Trent W. Orr, State Bar No. 77656
Michelle Ghafar, State Bar No. 315842
EARTHJUSTICE
50 California Street, Suite 500
San Francisco, CA 94111
torr@earthjustice.org
mghafar@earthjustice.org
Tel: (415) 217-2000
Fax: (415) 217-2040

Attorneys for Protestant Restore the Delta

BEFORE THE

CALIFORNIA STATE WATER RESOURCES CONTROL BOARD

HEARING IN THE MATTER OF CALIFORNIA DEPARTMENT OF WATER RESOURCES AND UNITED STATES BUREAU OF RECLAMATION REQUEST FOR A CHANGE IN POINT OF DIVERSION FOR CALIFORNIA WATERFIX	**TESTIMONY OF TIM STROSHANE**

I, Tim Stroshane, policy analyst with Restore the Delta (RTD), do hereby declare:

INTRODUCTION

1. I am self-employed working as a consulting Policy Analyst with Restore the Delta. My qualifications are declared in Exhibit RTD-1, with one update: In 2016, University of Nevada Press published my book, *Drought, Water Law, and the Origins of California's Central Valley Project,* an account of how water rights figured into the design of key parts of the state's largest public water system.

2. I further declare that I provided research and drafting assistance to Restore the Delta witness Barbara Barrigan-Parrilla for her testimony and presentations.

SUMMARY

3. In this testimony, I present and discuss evidence addressing the following issue prompts for the evidentiary hearing. These issue prompts were first stated in the State Water Resources Control Board's (SWRCB) hearing notice for this Change Petition, and restated in a recent Hearing Officers' ruling:

> *3. Will the changes proposed in the Petition unreasonably affect fish and wildlife or recreational uses of water, or other public trust resources?*
>
> > *a. Will the proposed changes in points of diversion alter water flows in a manner that unreasonably affects fish, wildlife, or recreational uses of water?*
> >
> > *b. Will the proposed changes in points of diversion alter water quality in a manner that unreasonably affects fish, wildlife, or recreational uses of water?*
> >
> > *c. If so, what specific conditions, if any, should the State Water Board include in any approval of the Petition to avoid unreasonable effects to fish, wildlife, or recreational uses?*
> >
> > *d. What Delta flow criteria are appropriate and should be included in any approval of the petition, taking into consideration the 2010 Delta flow criteria, competing beneficial uses of water, and the relative responsibility of the Projects and other water right holders for meeting water quality objectives?*
>
> *4. Are the proposed changes requested in the Petition in the public interest? If so, what specific conditions, if any, should be included in any approval of the Petition to ensure that the changes are in the public interest?*

5. Should the Final Environmental Impact Report be entered into the administrative record for the Petition?

(Notice of Petition and Hearing, October 30, 2015, p. 12; Hearing Officers' Ruling, August 31, 2017, pp. 12-13.)

4. My testimony provides answers to Questions 3a and 3b first by briefly surveying how and when Petition Facilities (defined herein as California WaterFix) are expected to alter flows and water quality in the Delta. As an additional flow matter, I summarize the current role of water transfers and indicate the degree to which Petition Facilities would increase flows of water transfer activity once constructed.

5. Also, in addressing these questions, my testimony will address impacts of nonnative invasive clams, particularly *Potamocorbula amurensis* (*P. amurensis*), which prodigiously bioaccumulate selenium, for the Bay-Delta Estuary.. Northern San Francisco Bay, including the western Delta, has been found by the San Francisco Regional Water Quality Control Board to be impaired for selenium, a known contaminant at higher concentrations. The major source of selenium to the Bay-Delta estuary is now agricultural drainage from the San Joaquin River to the Delta. (SWRCB-45, p. 53, Table 9 [November 18, 2015, report].) It is my testimony that changes in flow and water quality resulting from Petition Facilities' operations would likely increase the abundance of this clam species, which is toxic to various fish and waterfowl that prey on clams in the Delta's benthic food web. Unless SWRCB either denies the Change Petition, or conditions approval of permits on the Petition Facilities so as to prevent increased selenium loading to the Delta, many species, including sturgeon and diving ducks would be adversely affected by consuming this clam. Petition Facilities' operations, which would increase selenium loads in the Delta, and at the same time increase the population of *P. amurensis*, threaten to further impair recognized, designated beneficial uses in the Bay-Delta estuary, including COMM (Commercial and Sport Fishing), EST (Estuarine Habitat), WILD (Wildlife Habitat), and RARE (Rare, Threatened, or Endangered Species). (SWRCB-27, p. 9; SWRCB-45, p. 6, Table 2.)

6. In continuing to answer Questions 3a and 3b, it is my testimony that of Petition Facilities' changes to Delta flows and water quality would have potential unreasonable and adverse effects on aquatic habitat of giant garter snake in the Bay-Delta Estuary. The giant garter snake is listed as a threatened species under the federal Endangered Species Act (ESA), making it a "RARE" beneficial use that warrants explicit recognition and protection by SWRCB in this Proceeding. In addition, its habitat supports the WILD beneficial use because the giant garter snake relies heavily on fresh water sloughs, creeks, irrigation ditches, and other water bodies that commonly occur in the Delta. (SWRCB-27, p. 9.)

7. It is my testimony in answer to Questions 3c and 3d that Restore the Delta opposes this project and continues to recommend that SWRCB deny the Change Petition for California WaterFix. We recognize that SWRCB may approve the project, however, and request that SWRCB condition project construction and operations based on evidence and recommendations provided herein. Our inclusion of recommended permit conditions does not in any way alter our position that the best outcome is for SWRCB to deny this Change Petition.

8. To answer Question 3c, it is my testimony that there are potential unreasonable and adverse effects of Petition Facilities' changes in flow and water quality on the factors that contribute to impairment of Delta waters by selenium. It is also my testimony that further loss of giant garter snake habitat would be an unreasonable and adverse effect of changes to flow and water quality by Petition Facilities' operations. Barbara Barrigan-Parrilla's Part 1B testimony concerning harmful algal blooms documented potential public health and environmental justice effects of construction and operation of Petition Facilities, and the permit conditions we propose herein would help avoid or mitigate the factors that lead to harmful algal blooms.

9. My testimony also addresses Question 3d of the hearing notice prompts. Water Code section 85086(c)(2) requires SWRCB to develop "appropriate Delta flow criteria" for conditions to any permits issued for Petition Facilities. Hearing Officers have asked for testimony considering the relevance and potential contribution of the 2010 Delta Flow Criteria developed by SWRCB as permit conditions applied to Petition Facilities.

10. Finally, to address Question 4, whether approval of the Change Petition would be in the public interest, it is my testimony and understanding that the public interest is defined through water policy and law and environmental justice and project financing concerns. In her testimony and exhibits, Restore the Delta witness Barbara Barrigan-Parrilla supplies evidence that the public interest is not served by Petition Facilities due to environmental justice and financing concerns. It is my testimony in addressing Question 4 that Petition Facilities fail to reduce reliance on the Delta for California's future water needs, despite state Water Code section 85021's requirement of such a reduction, and that the Change Petition is therefore contrary to law and to the public interest as defined by the Legislature in section 85021.

11. Finally, in addressing Question 4, the evidence and testimony I provide supports SWRCB findings for denial of the Change Petition on grounds that the rights it would confer to both Petitioners would result in continuation and expansion of an unreasonable use of water—irrigation of lands with serious drainage problems in the San Luis Unit of the Central Valley Project (CVP). It is also my testimony that the Change Petition and its Petition Facilities would allow an unreasonable method of water diversion that would further deteriorate flow and water quality conditions in the Delta. This would harm public trust resources and the beneficial uses they provide via interactions of selenium loading with bioaccumulative nonnative invasive clams like *P. amurensis.* Flow and water quality conditions caused by Petition Facilities would also harm the public health of Delta environmental justice and recreational communities. Under Water Code section 100 and California Constitution Article X, Section 2, approval of the Change Petition would be unlawful and should be denied by SWRCB.

12. Granting the Change Petition and allowing the Petition Facilities to operate would be an unreasonable method of diversion of water in causing further reduction of giant garter snake habitat by increasing water residence time in the Delta, and through increased water transfer activity, additional loss of the snake's habitat in the Sacramento Valley.

13. Granting the Change Petition and allowing Petition Facilities to operate would be an unreasonable method of diversion of water because of expected harmful effects of its fish screens, and its approach and sweeping velocities on young resident and migratory fish in the

Sacramento River channel at north Delta intake sites. Further, the increased frequency of significant reverse flow events have a high potential to entrain young resident and migratory fish upstream toward Petition Facilities' intakes.

14. Granting the Change Petition and allowing Petition Facilities to operate would be an unreasonable method of diversion of water because of its effects on the City of Stockton's Delta Water Diversion on Empire Tract, removing fresh water from Delta channels that otherwise would provide that water to Stockton, and would increase Stockton's water treatment costs due to degraded water quality from increases in salinity and other constituents. In consequence, Stockton's residential, business, and industrial customers would experience increased costs for treatment as water rate increases to pay for additional treatment. As we documented in our Part 1B testimony by Restore the Delta witness Barbara Barrigan-Parrilla, many Stockton residents already face water rate increases, and such an outcome of approving the Change Petition and constructing and operating Petition Facilities would impose an undue burden on low-income Stockton residents. This disproportionate environmental justice impact again demonstrates that Petition Facilities' operation would be an unreasonable method of diversion.

OPERATION OF PETITION FACILITIES WOULD INCREASE SAN JOAQUIN RIVER FLOW AS A WATER SOURCE IN THE DELTA, WOULD DEGRADE WATER QUALITY, AND WOULD INCREASE CAPACITY FOR CROSS-DELTA WATER TRANSFERS.

15. Generally, SWRCB acknowledges that water quality of the lower San Joaquin River (SJR) "has decreased markedly in recent decades and has generally coincided with SJR flow reductions, population growth, and expanded agricultural production. There are numerous water quality constituents in the SJR basin which can negatively impact fish and wildlife beneficial uses including: dissolved oxygen, salinity and boron, nutrients, trace metals, and pesticides [citations]." (RTD-104, p. 3-52- to 3-53, Section 3.7.6.) Parts of the San Joaquin Valley are also naturally contaminated with salts, selenium, total dissolved solids, and high levels of other toxic elements like boron, arsenic, and molybdenum. (RTD-171, Figures 5, and 8 through 12.)

16. In my Part 1B testimony for Restore the Delta, I described, using source water fingerprinting model results (from SWRCB 3 and SWRCB-4), how operations of Petition Facilities would increase the presence of Sacramento River water diverted from the North Delta intakes in water pumped at the State Water Project's (SWP) Banks and CVP's Jones pumping plants. This would reduce San Joaquin River as a source of water at Banks and, especially, at Jones pumping plants. Simultaneously, Petition Facilities would increase the presence in much of the rest of the Delta's channels of flows from the San Joaquin River. (RTD-10rev2, pp. 7-8, ¶23 through ¶25; RTD-130, pp. 60-61.) More recent source water fingerprinting model results for both Sacramento and San Joaquin Rivers in the Delta generally confirm these same effects on source waters in various Delta channel locations from operation of Petition Facilities. (SWRCB-102, pp. 8D-315 to 8D-360; summarized in RTD-156.)

17. It is my understanding that residence time of water is an estimate of the length of time that the same water molecules remain in a water body before flow, evaporation, or plant evapotranspiration removes them from that water body. In my Part 1B testimony, I summarized increases in water residence times for five Delta subregions using DSM-2 particle tracking studies. (RTD-10rev2, pp. 37-38, ¶114-115; SWRCB-102, p. 8-198, Table 8-60a; RTD-158, p. 59; RTD-130, p. 73; SWRCB-5, p. 5C.5.4-84, Table 5C.5.4-14.) It is my further understanding that residence time is critical because the longer water containing contaminants or other chemical stressors remains in the same general place, the greater potential there is for physical and hydrodynamic processes to facilitate toxic interactions of those contaminants with organisms in that water.

18. It is also my understanding that increased residence time of water can alter water quality by increasing water temperature, facilitating partitioning and bioavailability of selenium from the water column (allowing selenium to enter benthic food webs), and risking harmful algal blooms that can release cyanotoxins into Delta waters. Beneficial uses that can be impaired from such alterations include water contact recreation; native fish that feed on shellfish and other benthic invertebrates bioaccumulating selenium and other toxins; and commercial, recreational,

and tribal and subsistence fishing and hunting uses, especially those that involve fish and wildlife predator species such as sturgeon and a number of diving ducks.

19. Under current hydrologic regimes, residence times of water in the south Delta and the North Bay can last from 16 days to three months during low flow, depending on levels of through-Delta discharge and mixing activity. In Suisun Bay, they may range from half a day in high flow to 35 days in low flow conditions. (RTD-159, p. 17.) Removal of Sacramento River flows from the north Delta will result in less overall fresh water reaching western and central Delta channels, including through Georgiana Slough or via Delta Cross Channel.

20. In addition to these flow and water quality effects, it is my understanding that, based on evidence I present herein, Petition Facilities' operations would include conveyance of cross-Delta water transfers. Cross-Delta water transfers already occur through use of existing SWP and CVP facilities in the Delta. (SWRCB-4, Appendix 1E, p. 1E-1:33-38.) Water transfers are defined as follows:

> Water transfers involve a change in the place of water use, from the water's historic point of diversion and use, to a new location either within or outside the watershed of origin. Water may be transferred from one user to another for a variety of purposes, including agricultural, municipal and industrial uses. It may also be transferred for environmental purposes such as in-stream flow augmentation and wildlife refuges. Water transfers and exchanges can be temporary—either short-term (up to 1 year) or long-term (more than one year but not permanent) or permanent.

(SWRCB-4, Appendix 1E, p. 1E-1:13-18.)

21. Cross-Delta water transfers (water transfers) are regulated by type of transfer (e.g., reservoir deregulation, groundwater substitution, crop idling, crop shifting, water conservation); by D-1641; by the 2008 delta smelt biological opinion from the U.S. Fish and Wildlife Service (FWS); by the 2009 salmonid biological opinion from the National Marine Fisheries Service (NMFS); and various provisions of the California Water Code. (*Id.*, pp. 1E-2 to 1E-13.) The delta smelt biological opinion limits water transfers to the period July 1 through September 30 as a "window" during which delta smelt are not usually present at the south Delta export pumps.

22. Petitioners state that the maximum daily pumping rate is 6,680 cfs (cubic feet per second) over a three-day average (6,993 cfs as a one-day average) under a combination of a specific U.S. Army Corps of Engineers operating permit (SWRCB-98), D-1641, and the biological opinions. Under the Corps' permit, Petitioners state that Banks pumping plant in the SWP:

> can export an additional 500 cfs between July 1 and September 30, which can be used for the purpose of replacing Project export pumping foregone for the benefit of Delta fish species, making the summer limit effectively 7,180 cfs. The 500 cfs has been used to move a portion of the water provided under the Lower Yuba River Accord…in most years.

(*Id*., p. 1E-12:34:38.)

23. Petitioners have operated water purchase programs, the Environmental Water Account, and Yuba River Accord Transfers for many years now. (*Id.*, pp. 1E-13 to 1E-15.) Between 2008 and 2012, current facilities conveyed over 700 thousand acre-feet (TAF) for the Lower Yuba River Accord program. (SWRCB-4, Appendix 5C, p. 5C-13, Table 5C.-4.) Between 2001 and 2007, the Environmental Water Account Program saw 1,351 TAF of sales and exchange activity. (*Id.*, p. 5C-10, Table 5C-3.) Overall, statewide cross-Delta water transfers totaled 25,842 TAF between 1982 and 2011, of which 15,351 TAF were for short-term flows. (*Id.*, pp. 5C-4 to 5C-5, Table 5C-2.)

24. Water transfers may be "wheeled" at times when one project's pumping capacity is insufficient. "Wheeling" water occurs when one project's water—for example, deliveries to be made by CVP—is actually pumped from the Delta by the Banks pumping plant, then later exchanged through the Intertie back to the Delta-Mendota Canal or credited back to the CVP via storage accounting at San Luis Reservoir (where Petitioners jointly store water south of the Delta).

25. Petition Facilities would increase the capacity for and occurrence of cross-Delta water transfers, continuing, rather than reducing, reliance on the Delta for California's future water supply needs. They would also provide a longer window of time than is currently allowed

during which transfers could occur under current biological opinion and water quality restrictions. (SWRCB-3, p. 4.3.1- 9:19-23.) Petitioners' environmental documents also state:

> As a result of avoiding those restrictions, transfer water could be moved at any time of the year that capacity exists in the combined cross-Delta channels, the new cross-Delta facility, and the export pumps, depending on operational and regulatory constraints, including criteria guiding the operation of water conveyance facilities under Alternative 4A.

(*Id.*, p. 4.3.1-9:23-26.) Identical language is provided for the Petition Facilities' other two RDEIR/SDEIS alternatives. (*Id.*, p. 4.4.1-9:12-19; p. 4.5.1-9:12-19.)

26. Petitioners' California WaterFix Final EIR/EIS similarly states:

> Due to the location of the new north Delta facilities, some of the restrictions relating to export of transfer water, including those related to Delta reverse flows or south Delta water levels and potential fisheries impacts (the basis for the current July through September transfer window) would not apply to the new facilities. Thus, transfer water could potentially be moved at any time of the year that capacity exists in the new cross-Delta facility and the export pumps, depending on operational and regulatory constraints. If the new north Delta facilities are not restricted to the current July through September transfer export window, crop idling or crop shifting-based transfers may become a more viable source of transfer water for much of the Sacramento Valley.

(SWRCB-102, p. 30-108:3-11.)

27. BDCP's purpose and need includes increasing the supply reliability of cross-Delta water transfers (i.e., from north of Delta to south of Delta locations) in drier and drought years. This is not disclosed in the Purpose and Need Statement of Chapter 2 in the EIR/EIS, nor in the Change Petition nor its addendum, where an electronic search for "water transfer" found no results for either document. (SWRCB-1; SWRCB-2.) The underlying purpose and need of BDCP and its North Delta Intake diversions is more fully disclosed in modeling results of EIR/EIS Chapter 5, Water Supply, and in accompanying analysis of water transfers in that chapter and related appendices.

28. With Petition Facilities in place, "wheeling" would originate further north along the Sacramento River at the North Delta Intakes, where export water quality would be better. BDCP Chapter 7, Implementation Structure, of the Bay Delta Conservation Plan stated that "Reclamation will likely enter into an agreement with DWR to 'wheel' CVP water through a new conveyance facility." (SWRCB-5, p. 7-10:11-12.)

29. It is my understanding that Petition Facilities would increase overall capacity in wet or above normal years of contractual deliveries relative to current conditions and relative to the No Action Alternative (the future condition without Petition Facilities in place). In drier years, Petitioners expect there would be extra capacity in North Delta Intakes and Tunnels. (SWRCB-4, Chapter 5, p. 5-29:1-2; Appendix 5D, p. 5D-1:28-31, p. 5D-2:18-23, p. 5D-3:29-33.) In drier years, "contractual" supplies may be much less available. Consequently, contractors would still have what Petitioners refer to as "supplemental demand" for water. Analysis provided in Appendix 5D specifically assumes that "supplemental demand" for water transfers is triggered when SWP allocations go below 50 percent of Table A SWP contract amounts, and below 40 percent of total CVP total contract amounts. This assumption was based on observed correlations of contract allocations for SWP and CVP with water transfer activity:

> Comparing the years when cross-Delta transfer activity picks up with allocations, and considering Delta export constraints on transfers, SWP demand for cross-Delta transfers increases noticeably at allocations below 50 percent and CVP demand for cross-Delta transfers increases below 40 percent.

(SWRCB-4, Appendix 5D, p. 5D-3:29-33 and 5D-6:25-40 through 5D-8:1-11 .)

30. According to the *State Water Project Atlas*, additional pumping capacity is also available at SWP's Banks Pumping Plant in the Delta. "During [Banks'] construction (1963-1969) seven pumps were installed. In 1986, four more were added to divert and pump more water during the wet months to fill offstream storage reservoirs and groundwater basins south of the Delta to improve water supply reliability." (RTD-115, p. 80.) These additional pumps can facilitate more water transfer capacity in the SWP.

31. According to the *Atlas*, the four newer pumps have a combined capacity to pump 4,268 cfs. (*Id.*, p. 80, [indicating four pumps with 1,067 cfs pumping capacity each].) This capacity nearly matches that of the CVP's Jones Pumping Plant owned by Petitioner Bureau of Reclamation, which has a pumping capacity of about 4,600 cfs. At that pumping rate, the four extra pumps alone would provide a pumped export capacity of nearly 780,000 acre-feet during a three-month irrigating season by themselves.

32. Currently, the "Four Pumps Agreement" between Petitioner DWR and the California Department of Fish and Wildlife (CDFW) idles these four Banks Pumping Plant units so that SWP complies with both fishery mitigations for DFW and navigability limits under US Army Corps of Engineers Public Notice 5820A (from October 1981). (SWRCB-98.) This Agreement states that Notice 5820A "limits exports to the amount of water that can be diverted by the existing [seven] pumps, except during winter months when additional amounts can be diverted during high San Joaquin River flow periods." (RTD-1016, p. 4, Recital E.)

33. The EIR/EIS provides a "spreadsheet model" analysis in Appendix 5D identifying two potential water market volumes in periods of "supplemental demand," one of up to 600,000 acre-feet, and the other of up to 1 million acre-feet, each for single-year time spans. (SWRCB-4, Appendix 5D, p. 5D-8 to 5D-16.)

34. The BDCP EIR/EIS states that:

> Alternative 4 provides a separate cross-Delta facility with additional capacity to move transfer water from areas upstream of the Delta to export service areas and provides a longer transfer window than allowed under current regulatory constraints. In addition, the facility provides conveyance that would not be restricted by Delta reverse flow concerns or south Delta water level concerns. As a result of avoiding those restrictions, transfer water could be moved at any time of the year that capacity exists in the combined cross-Delta channels, the new cross-Delta facility and the export pumps, depending on operational regulatory constraints including BDCP permit terms discussed in Alternative 1A.

(*Id.*, p. 5-108:32-39.) The same is true of Alternative 4A (Petition Facilities), which replaced Alternative 4 as Petitioners' preferred alternative. The California Environmental Quality Act (CEQA) conclusion of the Recirculated Draft EIR/Supplemental Draft EIS on California WaterFix (CWF) states:

> Alternative 4A would increase water transfer demand compared to existing conditions. Alternative 4A would increase conveyance capacity, enabling additional cross-Delta water transfers that could lead to increases in Delta exports when compared to existing conditions.

(SWRCB-3, Section 4.3.1, p. 4.3.1-9:34-36.)

THE SAN FRANCISCO REGIONAL WATER QUALITY CONTROL BOARD (SFRWQCB) HAS DECLARED THE NORTHERN SAN FRANCISCO BAY, INCLUDING SUISUN BAY TO THE WESTERN DELTA, AS IMPAIRED FOR SELENIUM, AND CONSIDERS THAT CHANGES TO DELTA FLOW REGIMES WITH CALIFORNIA WATERFIX COULD LEAD TO GREATER SELENIUM LOADING AND BIOACCUMULATION IN IMPAIRED AREAS.

35. It is my testimony that operation of Petition Facilities would alter flows and degrade water quality resulting in unreasonable selenium contamination of beneficial uses estuarine habitat (EST), rare, threatened, or endangered species (RARE), wildlife habitat (WILD), commercial and sport fishing (COMM), and water contact recreation (REC-1). (SWRCB-27, pp, 8-9.)

36. Northern San Francisco Bay is presently impaired for selenium. The basis for impairment initially rested on bioaccumulation of selenium that triggered health advisories to local hunters cautioning against consumption of diving ducks, and elevated selenium concentrations exceeded levels associated with potential reproductive impacts to fish elsewhere. (SWRCB-45, p. 3 [November 18, 2015, report].) With the subsequent arrival to San Francisco Bay all the way to Suisun Bay in 1986 of a nonnative, invasive Asian clam, *P. amurensis*, even greater concern has emerged about selenium. (*Id.*) The SFRWQCB stated in its 2015 selenium total maximum daily load (TMDL) report:

> The introduction of the Asian clam (*Corbula amurensis*)[1] into the Bay in 1986 has exacerbated the bioaccumulation of selenium in benthic fish. This non-native clam is a prodigious filter-feeder, and, by consuming large quantities of selenium-laden particles, this exotic species provides a pathway for biotransformation of a considerable mass of selenium from the benthic food web to diving ducks and large fishes such as white sturgeon. The estimated selenium concentrations found in sturgeon's muscle sporadically exceed the draft United States Environmental Protection Agency…limit of 11.3 µg/g proposed for freshwater fish [citation]. Increased levels of selenium in the Bay-Delta have been suggested as a possible contributing factor to the observed decline of some key species (e.g., white sturgeon, Sacramento splittail, and diving ducks), and therefore these species are the main focus of the analyses in this report.

(*Id.*)

[1] The scientific name for this nonnative invasive clam appears in various studies as either "*Potamcorbula*" *or* "*Corbula.*" In either usage, it is the same species. Except where quoted in context as here, my testimony applies "*Potamocorbula*" or "*P. amurensis*"to identify this clam.

Selenium toxicity, sources, and partitioning

37. It is my understanding that selenium is necessary to the health of most vertebrate species, including humans, in small doses. For example, adequate amounts of selenium are found in a well-balanced human diet. But at just slightly elevated levels, selenium becomes poisonous. As ingested concentrations rise, selenium can cause embryonic defects, reproductive problems, and death in vertebrate animals. (RTD-178.)

38. It is my understanding that selenium can readily substitute for sulfur in salts (such as selenates for sulfates) in certain amino acids, the building blocks of proteins. (E.g., seleno-cysteine and seleno-methionine; *id*., p. 554-555; RTD-159, p. 40.) Selenium's ability to substitute chemically for sulfur clears pathways to toxicity, increased gene mutation, and ecological damage. (RTD-178.)

39. At higher tissue concentrations, proteins in predator species may be altered by excessive exposure to selenium, leading to sterility and suppression of the immune system "at critical development stages when rapid cell reproduction and morphogenic movement are occurring." (*Id.*, p. 555.) Changes in the structure of many antibodies (such as from substitution of selenium for sulfur atoms) can compromise the organism's immune defenses, making it more susceptible to disease. (*Id*.)

40. The western San Joaquin Valley and its Coast Range foothills have naturally high levels of selenium in the rocks and soils. (RTD-169; RTD-170.) Three areas of the western San Joaquin Valley have the highest soil selenium concentrations:

- The alluvial fans near Panoche and Cantua creeks in the central western valley (near Gustine and Firebaugh);
- An area west of the town of Lost Hills; and
- The Buena Vista Lake Bed Area, west of Bakersfield.

(RTD-170, p. 8, Figure 2.)

41. Irrigation has played a key role in physical processes mobilizing selenium to the San Joaquin River, thence to the Delta:

> Prior to about 1940, groundwater moved toward valley stream channels, and much of the valley was a discharge area. By 1970, pumping for agriculture and other uses had drawn groundwater reservoirs down hundreds of feet. Importation of irrigation water (from rivers or from the [CVP]) together with continued overuse of groundwater means the Central Valley is now primarily a groundwater recharge area, and most groundwater discharge is a result of pumping rather than natural seepage. As a result, salts and selenium accrete in Central Valley soils, poisoning agricultural runoff water.

(RTD-165, p. 43.)

42. Because of the extent of the geologic formations and rocks containing selenium in the western San Joaquin Valley, it is important to recognize that at time scales relevant to society, "there are, for all practical purposes, unlimited reservoirs of selenium and salt stored within the aquifers and soils of the valley and upslope in the Coast Ranges." (RTD-172, p. 2) The selenium reservoir will be with Californians for a very long time to come—by one estimate, 304 to 2,828 years. (RTD-159, Appendix A, p. 111, Table 5.)

43. The National Research Council's 2012 report on Bay-Delta sustainable water management recognized this selenium reservoir as well, stating in part:

> A very large reservoir of selenium exists in the soils of the western San Joaquin Valley associated with the salts that accumulated there during decades of irrigation [citation]. Irrigation drainage, contaminated by selenium from those soils, is also accumulating in western San Joaquin Valley groundwaters. The problem is exacerbated by the recycling of the San Joaquin River when water is exported from the delta. While control of selenium releases has improved, how long those controls will be effective is not clear because of the selenium reservoir in groundwater.
>
> ...Other aspects of water management also could affect selenium contamination. For example, infrastructure changes in the delta such as construction of an isolated facility could result in the export of more Sacramento River water to the south, which would allow more selenium-rich San Joaquin River water to enter the bay. The solutions to selenium contamination must be found within the Central Valley and the risks from selenium to the bay are an important consideration in any infrastructure changes that affect how San Joaquin River water gets to the bay.

(RTD-168, p. 94.)

The invasive clam, Potamocorbula amurensis.

44. It is my understanding that the 1986 arrival of *Potamocorbula amurensis* (hereafter *P. amurensis*) has had a remarkable impact on the food webs and ecology of the San Francisco Bay and Delta. *P. amurensis* is a formidable clam. In Asian coastal Pacific waters, it

ranges from latitude 53 degrees north to about 22 degrees north, from cold temperate waters off Korea, Russia, and Japan to tropical waters off southern China. (RTD-173, p. 88.) *P. amurensis* adults tolerate salinity ranges of 2 to 30 parts per thousand. (SWRCB-5, Appendix 5.F, pp. 5.F-112 to 5.F-114.) It issues fertilized gametes in the early fall that are planktonic in open waters for up to three weeks. (RTD-174; SWRCB-5, *id*.)

45. Ranging in size up to about 25 mm (about 1 inch) in length, this clam overnight nearly replaced an established clam community in the Bay and Delta, including *Macoma balthica* and *Mya arenaria* (which dominated in Suisun Bay by the end of the 1976-1977 drought) and other species, some of which were themselves introduced to the estuary as early as the 1870s. (RTD-166, pp. 13-14; RTD-167, pp. 98-99.) Immediately prior to *P. amurensis*'s discovery in Suisun Bay in October 1986, a dry period benthic clam community led by *Macoma* and *Mya* was likely eliminated by high suspended sediment loads, scouring, and transport of bottom sediments from an extreme flood in February 1986.

> Thus, in mid-1986 when [*P. amurensis*] was introduced, presumably via ship ballast water [citation], the Suisun Bay region was inhabited by a depauperate benthic community. It is possible, therefore, that this species was initially successful because it exploited a naturally disturbed, sparsely occupied habitat rather than interjecting itself among and displacing existing species. If this is true. *P. amurensis* was acting, at least initially, as a colonizer rather than an invader [citation].

(RTD-167, p. 100; SWRCB-5, Appendix 5.F, p. 5.F-109.)

46. It is my understanding that in recent years, ecologists studying San Francisco Bay and Delta ecosystems may refer to invasive species like *P. amurensis* as "stressors"; that is, such species "stress" native or long-established Bay and Delta species by creating stiff competition for niches, consumption of food resources, and energy—the bases for reproductive advantage in ecology.[2] *P. amurensis* has had two important "stressor" roles: First, its consumption of plankton outcompetes native open water larval fish. Second, its physiology takes up bioavailable selenium and eliminates it only very slowly. The clam's shallow burial in sediments makes it easy prey,

[2] For example, the Bay Delta Conservation Plan (BDCP), Appendix 5.F, included among biotic stressors on covered fish invasive vegetation, invasive mollusks (*P. amurensis* and *C. fluminea*), and *Microcystis*, a key cyanobacterium causing harmful algal blooms. (SWRCB-5.)

and its predators bioaccumulate the selenium it contains into their tissues. Both of these stressor impacts are directly related to flow and water quality changes that would result from operation of Petition Facilities.

***P. amurensis* grazing activity and its significance**

47. First, *P. amurensis*'s voracious feeding habits in shallow subtidal to open water have reduced planktonic food resources in the vicinity of the Bay-Delta's low salinity zone (LSZ), making it a suspect responsible for declines in planktonic food availability for listed native fish like larval stage delta smelt and longfin smelt. (RTD-183; RTD-184; RTD-185; RTD-186; RTD-193, p. 4.) Its voraciousness and great fecundity generate highly dense colonies in much of Suisun Bay near the LSZ. (RTD-174, p. 1.)

48. The Bay Delta Conservation Plan (BDCP) described physiological tolerances for *P. amurensis*, including a side-by-side comparison with *Corbicula fluminea* (*C. fluminea*), a fresher-water invasive clam that also resides upstream in the Delta. *P. amurensis* tolerates saltier waters than *C. fluminea*, a similar range of temperatures, and hypoxic (i.e., low oxygen) conditions. (SWRCB-5, Appendix 5.F, p. 5.F-113, Table 5.F.7-1.) Salinities fluctuate in the Bay Delta Estuary, and *P. amurensis*'s larvae tolerate a wide salinity range. (*Id*., p. 5.F-112:36-38.) One study found that 2-hour-old embryos can tolerate salinities from 10 to 30 practical salinity units (psu) and by 24 hours they can tolerate the same salinities as can adult *P. amurensis*. (RTD-187, p. 377, 385.)

49. Analysis of California Department of Water Resources (DWR) benthic monitoring data from the Bay-Delta Estuary showed that benthic assemblage composition varied with salinity and hydrology (but was not associated with different substrate types). (RTD-188, p. 13 [Figure 8], p. 17 [Figure 9, showing lower benthic abundance after 1986], and p. 19; SWRCB-5, Appendix 5.F, p. 5.F-112.)

50. The Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) conceptual model for Delta aquatic food webs indicates that salinity's importance to such clams is high, its predictability as an abiotic factor in their abundance and life history is moderately

high, and scientists' understanding of these relationships is also moderately high. (RTD-189, Section 2.11.) It further notes that "[b]road shifts in salinity effectively determine the complementary ranges of these two bivalves, with [*P. amurensis*] residing primarily in marine to brackish water and [*C. fluminea*] in fresh water." (*Id.*)

51. It is my understanding that an ecological problem posed by these two nonnative clam species is that they graze the same relatively shallow open water column as larval delta smelt and longfin smelt. (*Id.*; RTD-188, comparing Figures 8 and 9 for comparative bivalve abundance for these two species in Grizzly Bay and Lower Sacramento River assemblages.) At typical North Bay densities, *P. amurensis* tends to occupy benthic sediments in Delta and Suisun Bay waters downstream of X2's position in fresher water areas where it can filter phytoplankton from the entire water column more than once per day in open water Delta channels and almost "13 times per day over shallow areas." *P. amurensis*'s filtration rate enables its consumption to exceed the phytoplankton growth rate in the Delta. (SWRCB-5, Appendix 5.F, p. 5.F-110:7-13; see also RTD-177.) *C. fluminea,* which tends to occupy benthic sediments in Delta and Suisun Bay waters upstream of X2's position[3], is considered to be less efficient than *P. amurensis* at filtering out shallow water bodies like Franks Tract. But *C. fluminea* can still "filter out the entire water column in less than a day." (SWRCB-5, Appendix 5.F, p. 5.F-111:18-25.)

52. It is my further understanding that the invasive clams' relative abundances and location are affected by changes in flow and water quality that affect their respective locations and abundances. BDCP applies this understanding to whether Fall X2 flows are provided as part of Conservation Measure 1 mitigations (the precursor to Petition Facilities):

> If Fall X2 [that is, higher fall Delta outflow to move X2 downstream in autumn months] is implemented...no change in suitable habitat for [*P. amurensis*] from water operations would occur. However, if Fall X2 is not implemented, X2 would occur more easterly than under [the Existing Conditions Scenario with Fall X2 implemented under the Delta smelt biological opinion], and therefore the suitable habitat for [*P. amurensis*] would be expanded in wet and above normal water years. Likewise, increased tidal habitat from restoration of tidal natural

[3] "X2 is defined as the horizontal distance in kilometers up the axis of the estuary from the Golden Gate Bridge to where the tidally averaged near-bottom salinity is 2 practical salinity units (psu). [citation] The position of X2 roughly equates to the center of the low salinity zone…." (SWRCB-25, p. 29.)

> communities (CM4) may facilitate recruitment and expansion of [*P. amurensis*] if located in areas with salinity greater than 2 ppt. If this occurs, the foodweb benefits described [elsewhere in BDCP] may be reduced.

(SWRCB-5, Appendix 5.F, p. 5F-v:26-42.)

> [Also] if Fall X2 is not implemented, operations would comply with...Water Right Decision 1641 (D-1641) Delta outflow requirements. In that situation, outflow in wet and above normal years would be similar to [the Existing Conditions Scenario without Fall X2] in which X2 is more east than under [the Existing Conditions Scenario with Fall X2]. This situation may allow for [*P. amurensis*] to recruit farther into the Central Delta, and conversely, reduce habitat for [*C. fluminea*], which requires more freshwater conditions (<2 ppt). These invasive clams have the potential to reduce food production and export from Restoration Opportunity Areas (ROAs).

(*Id.*, Appendix 5.F, p. 5F-vi:1-14.)

53. BDCP sums up interrelationships of the *P. amurensis* and *C. fluminea* and their physical habitat tolerances this way:

> Thus, a long period of high flows may lead to increases in [*C. fluminea*] but limit [*P. amurensis*] juvenile success and increase adult mortality because of prolonged exposure to low salinities. However, if an extended period of high flows is followed by a dry year, higher than normal numbers of juvenile [*P. amurensis*] may be seen the following year as X2 moves upstream [citation].

(*Id.*, Appendix 5.F, p. 5.F-114:38-42; RTD-189, Section 2.11.)

54. It is my understanding that the analysis in BDCP of the potential efficacy of BDCP restoration efforts depended on understanding both invasive clams' tolerances of different flow and water quality regimes in the Bay-Delta Estuary. It has been shown already that, even factoring out climate change effects on flow and water quality, Petition Facilities' operations have the potential to reduce Delta outflows, increase residence times of water, and cause X2 (the zone in the Delta where salinity averages 2 psu) to migrate further east and upstream in the decades ahead. (RTD-149; RTD-150; RTD-130, p. 81, Figure 19.) As X2 moves east, planktonic food production in the LSZ would be fully consumed by *P. amurensis* (which would also spread eastward into the Delta, particularly in drier, lower-flow years), turning the western Delta and Suisun into a zone of high nonnative invasive clam production at the cost of reduced plankton abundance. (RTD-180, p. 19; see also RTD-179, pp. 78-79, 82.)

55. As I stated earlier, *P. amurensis* is a formidable clam. Scientists developed a conceptual model for *P. amurensis* that states that prolonged high outflow events are required to reduce *P. amurensis*'s estuary-wide population over an extended period of time or even to shift the east edge of its range westward. (RTD-190, p. 21, p. 39, Figure 4.) It regularly produces larval, pelagic offspring twice a year, which can float upstream with tidal incursions and survive where their salinity ranges permit. (*Id.*, p. 40, Figure 5.) The DRERIP Conceptual Model for *P. amurensis* states:

> Increased outflow periods would need to be maintained for this to be a long term solution, as depauperate periods such as was seen in 2006 can be followed by an increase in the population size of [*P. amurensis*] during subsequent years with normal salinity distributions. Therefore, sustained reduction in grazing would require the water for controlled floods most if not all years.

(*Id.*, p. 21.)

56. BDCP concluded that its activities would result in moderate positive change to zooplankton abundance for larval longfin smelt, and low positive change to zooplankton abundance for juvenile longfin smelt, with low certainty for both. (SWRCB-5, Chapter 5, p. 5.5.2-13: 39-46, and p. 5.5.2-14: 1-4.) Filling the gap in knowledge represented by such low levels of certainty was deferred into the BDCP adaptive management program and, with the curtailment of BDCP in 2015, perhaps to the California WaterFix adaptive management program.

***P. amurensis* selenium bioaccumulation**

57. Selenium dissolved in water is the predominant form (ranging from 80 to 93 percent) of total selenium loading in the Bay Delta, but it represents only a small proportion of organismic exposures. (SWRCB-45, p. 81; RTD-159, p. 38.) Selenium can undergo "partitioning" reactions in a slowing water column through many types of interaction with phytoplankton, algae, and organic particles in suspension. (SWRCB-45, p. 81-83.) The rate and degree of partitioning determine whether and how much selenium remains dissolved or enters what chemists refer to as its "particulate phase." (RTD-159, p. 41; RTD-162.) This is the phase wherein selenium becomes bioavailable and may be taken up by aquatic organisms.

58. It is my understanding that increased residence time and increased SJR flows into the Delta due to north Delta diversions by Petition Facilities could also slow flow velocities because of decreased flows of Sacramento River water into the rest of the Delta. (RTD-163, p. 53.) Currently, SJR flows are mostly diverted at the south Delta CVP and SWP export pumps. (SWRCB-45, p. 94, 116; RTD-163, p. 53.) Along with two adopted TMDL regulations for the Grasslands Marsh area and the Lower San Joaquin River by the Central Valley Regional Water Quality Control Board, this presently helps limit selenium exposures in the Delta and Bay sourced from SJR flows. (RTD-191; RTD-192.)

59. Calm waters of marshes, wetlands, and estuaries facilitate selenium partitioning. Presser and Luoma catalog a range of hydrologic environments and how they influence selenium's partitioning behavior. (RTD-160, p. 692, Table 2, and 703, Figure 6**;** summarized in RTD-161, p. 26, Table 7.) This partitioning is expressed in modeling efforts as a "selenium partitioning factor," which varies with different aquatic environments and hydrologic conditions. (RTD-164, showing a variety of Bay-Delta Estuary K_d values in Supplemental Tables 8 through 10, 14 through 19.) Once selenium is consumed by prey organisms, predators can then bioaccumulate selenium depending on how much these prey are part of predator diets in higher trophic levels of Bay-Delta Estuary food webs. (RTD-159, pp. 41-94; RTD-160, pp. 689-705; RTD-163, pp. 21-24.)

60. As mentioned above, *P. amurensis*'s other "stressor" impact is to take bioavailable selenium into its tissues with high efficiency, and its metabolic elimination of selenium is slow. Consequently, *P. amurensis* specimens subject to high exposures of particulate selenium in their planktonic diet (such as through phytoplankton) will bioaccumulate large concentrations of selenium in their biomass. Seasonal variability in selenium contamination is important since measured selenium tissue concentrations were found to be highest in the fall, when Petition Facilities diversions may be highest with respect to Sacramento River inflows. (RTD-175, p. 62; RTD-176, p. 4525)

61. It is my understanding that *C. fluminea* prefers fresher water and so is found in some central and south Delta channels and upstream into lower San Joaquin River tributaries. (RTD-151.)

62. In one selenium ecological risk assessment, the best predictor of fish selenium concentrations derived from water column selenium concentrations is provided by a logarithmic function that lags fish tissue samples 1 to 7 months after the water column concentration is measured. (Correlation coefficient [R^2] equals 0.76; RTD-194, p. E.2-10.) The same assessment also found that selenium levels in aquatic invertebrates in these wetlands (including crayfish) "are broadly correlated with selenium concentrations in water." The correlation was strongest (R^2 equals 0.68; *id*.) when invertebrate selenium tissue concentrations were lagged 30 to 60 days after measurement of the water column selenium concentration. (*Id.*) It takes just a few weeks for selenium in the water column to become bioavailable through partitioning and deposition in sediments. It is my understanding that this is why residence time of selenium in the water body is so important to its fate and to selenium's toxicity in aquatic food webs.

63. It is my understanding that the Grassland Bypass Project has resulted in decreasing selenium loading to the surface channels of the Grassland marshes upstream of the Delta because this Project diverts selenium-laden agricultural drainage around the marshes before discharging this drainage into Mud Slough (north) downstream of the marshes but several miles upstream of its confluence with the San Joaquin River. This has resulted in improvements to protecting the beneficial uses within the Grassland marshes. (SWRCB-45.)

64. Mud Slough (north) on the west side, the lower San Joaquin River, and Suisun Bay are hydrologically connected, though at present much of San Joaquin River flows and their selenium loads are exported at Jones and Banks pumping plants. Rising selenium levels threaten various vertebrate species, including salmon, white sturgeon, green sturgeon, and migratory birds that feed on benthic organisms like clams and worms burrowing through sediments where selenium collects. (RTD-164, p. 10.) Selenium concentrations in subsurface drain water in the central area of the San Joaquin River Basin (which includes tile drains in the vicinity of Mud Slough) exceed U.S. Environmental Protection Agency (EPA) aquatic selenium criterion for

rivers and streams by 8 to 29 times (depending on whether the arithmetic or geometric mean is compared); by 21 to 73 times the aquatic criterion for wetlands in California, and by 84 to 292 times, the level recommended as non-toxic in animal tissues by the US Geological Survey in recent research. (RTD-181, p. 27, Table 13; RTD-182.) This is the reservoir of selenium toxicity draining from the central area's agricultural return flow drainage water potentially reaching the SJR, and thence to the Delta.

65. Because of findings that both *P. amurensis* and *C. fluminea* can bioaccumulate selenium significantly, benthic food predator fish like green sturgeon and predator birds like greater and lesser scaup and surf and black scoters are at risk of elevated selenium exposure and contamination given selenium loading forecasted projections. (RTD-159, p. 93, Table 33; RTD-160; RTD-164.) Both green and white sturgeon are migratory fish, while scaups and scoters are migratory estuary-based water birds that dive to prey on clams and other bottom-dwelling organisms.

Restore the Delta recommends denial of the Change Petition, but offers permit conditions for Petitioners' water rights permits.

66. The San Francisco Bay Regional Water Quality Control Board (Region 2) approved a TMDL regulation for selenium in November 2015. (SWRCB-45.) The TMDL for selenium is set at 5,300 kilograms of Total Selenium per year (kg/year), which also represents the existing selenium load to the Bay. Selenium load allocations within the TMDL for petroleum refineries, municipal and industrial sources, local tributaries, and atmospheric deposition account for only about 23 percent of total selenium loading to North San Francisco Bay (which includes the western Delta and Suisun Bay). (SWRCB-45, p., 105, Table 24.) The remaining 4,070 kg/year of selenium loading comes from Central Valley sources, of which over 80 percent is dissolved selenium and about 770 kg/year is in particulate form. The Region 2 TMDL does not directly disclose loading from the Sacramento and San Joaquin rivers separately, but it acknowledges that, "[w]hile concentrations of selenium in Sacramento are the lowest in the region, the San Joaquin River concentrations are up to an order of magnitude higher." (*Id.*, p. 114.) One research paper found the average concentration of total dissolved selenium was 0.91 ±

0.27 nano-moles (nmol) per liter in the Sacramento River at Freeport, 8.6 ± 2.5 nmol per liter in the San Joaquin River at Vernalis, and negligible in in-Delta agricultural return water. (RTD-157, p. 4, Table 1.)

67. The Region 2 TMDL further acknowledges that selenium loads from the San Joaquin River to the North Bay may change "if there are increases in the flow of San Joaquin River water to restore beneficial uses and maintain fish populations." (SWRCB-45, p. 116.) The Region 2 TMDL adds that "if there is no continued reduction of San Joaquin River flow due to the State Water Project operations and other upstream diversions, the loads from San Joaquin River may increase." (*Id.*, p. 94.) Currently, as mentioned earlier, the San Joaquin River's selenium loads are "partially reduced because of diversions of San Joaquin River water" by the Banks and Jones pumping plants before they reach the Northern San Francisco Bay Estuary. (*Id*.)

68. It is my testimony that Restore the Delta recommends denial of the Change Petition by the SWRCB. In the event that the SWRCB chooses instead to approve the Change Petition, we request that the Board consider the following permit conditions relating to potential for increased selenium contamination with operation of Petition Facilities.

69. Extensive, permanent monitoring for selenium loading and concentrations should be included in Change Petition permit conditions. These conditions should include:

- Bird egg monitoring, analysis, evaluation, and quarterly reporting to SWRCB and interested parties.
- Sturgeon muscle plug sampling, analysis, evaluation, and quarterly reporting to SWRCB and interested parties.
- Fin ray sampling from sturgeon and other North San Francisco Bay fish, with analysis, evaluation, and quarterly reporting to SWRCB and interested parties. (SWRCB-45, pp. 117-118.)
- In the event that Sacramento River flows decrease with Petition Facilities' operations relative to San Joaquin River source water entering and flowing through Delta channels, prohibit as an unreasonable use of water application of Sacramento River Basin irrigation supplies on SWP and CVP service area lands high in soil selenium and experiencing high water tables and return flows to the San Joaquin River with significant selenium concentrations. Restore the Delta recognizes it is not possible to assess this presently, but permit conditions for the Change Petition should include a program to identify likely flow thresholds for Sacramento and San Joaquin River inflow and San Francisco Bay tidal exchange, using ecosystem risk methodologies for Delta channels to identify potential flow and export conditions when risks from

selenium contamination to Delta ecosystems rise in a hydraulic regime involving Petition Facilities' operations.

- Selenium goes unmentioned in Petition Facilities-related descriptions of the Change Petition's adaptive management framework. (SWRCB-104, Appendix 3.H; SWRCB-106, Appendix A.2.) This omission is unacceptable to Restore the Delta. It is my testimony that SWRCB should further condition the Change Petition to include in its adaptive management research scope and framework a module or element that addresses key research, monitoring, analysis, and evaluation questions concerning selenium in San Joaquin River source water to the Delta as well as its flow timing, magnitude and volume; distribution; partitioning and bioavailability; and pathways into Delta and North San Francisco Bay food webs.

REDUCTION OF FLOW, INCREASED RESIDENCE TIME OF WATER, AND DEGRADED WATER QUALITY BY PETITION FACILITIES, AS WELL AS INCREASED WATER TRANSFERS WILL CAUSE UNREASONABLE ADVERSE EFFECTS TO GIANT GARTER SNAKE HABITAT IN THE DELTA.

70. It is my understanding that the giant garter snake (GGS, *Thamnophis gigas*) is listed as a threatened species under both the federal Endangered Species Act (ESA) and California Endangered Species Act. (CESA). (RTD-196, p. 54060; RTD-197, PDF pages 19-20.) Its threatened status is due primarily to loss, degradation, and fragmentation of wetland habitat due to conversion of wetlands throughout the Central Valley to agricultural and urban and industrial development. (RTD-197, PDF page 19.) Biologists estimate that 90 to 95 percent of its suitable habitat has been lost. (*Id.*; SWRCB-5, p. 2A.28-9; RTD-198, p. iii.) The BDCP includes among GGS stressors habitat loss and fragmentation, predation, selenium contamination, and impaired water quality. (SWRCB-5, p. 2A.28-10.)

71. GGS uses habitat in the Delta. Historically, GGS inhabited fresh water marshes, streams, and wetlands throughout the Sacramento and San Joaquin Valleys in central California. (RTD-198, p. iii.) The U.S. Fish and Wildlife Service (USFWS) currently recognizes nine (9) populations in its recently approved recovery plan, though when it was first listed as threatened in 1993, the agency recognized 13 populations. (RTD-196, p. 54054, column 2.) The reduction in recognized populations resulted from extirpation of two populations, while genetic research indicated it was appropriate to group together some of the populations. (RTD-198, pp. I-10 to I-11, Table 4.)

72. GGS is dormant in winter, often brumating (i.e., reptilian hibernating) from late October through early March in abandoned muskrat, crayfish, or ground squirrel burrows with sunny south- or west-facing aspects that are usually well above high water lines to avoid flood waters. (RTD-199, p. 6.) When active during spring, summer, and warm early fall months, GGS prefers aquatic habitat with a mud bottom, especially marshes and sloughs (there are many of the latter in the Delta). In these locations it prefers vegetation such as tules and cattails that provide cover, with broken tules providing basking sites that also allow ready escape from predators into water below. GGS prefers slow moving water and "is notably absent from large rivers or bodies of water with little vegetation." (*Id.*, pp. 5-6.)

73. With the loss of native wetland and marsh habitat, it is my understanding GGS has made do in the extensive rice fields of the Sacramento Valley and where rice is cultivated elsewhere in the Central Valley, including Yolo Bypass. In these areas, GGS occupies the inter-webbed irrigation and drainage ditches and canals, where it hunts tadpoles of frogs and toads, and small fish, including introduced species like common carp, western mosquitofish, and all life stages of American bullfrogs. (RTD-196, p. 54054.) The USFWS Recovery Plan states that GGS individuals capture all their food from water. (RTD-198, p. I-6.) Biologists believe that in nocturnal hunting, GGS may use its sense of touch to locate small fish. (RTD-199, p. 11.) They also acknowledged that, "[m]any questions remain regarding the innate prey preferences and prey selection of [GGS], particularly given the highly altered prey communities on which they now depend." (*Id*.) GGS is preyed on by a number of native mammals and birds, including raccoons, striped skunks, otters, hawks, great egrets, American bitterns, and great blue herons. (RTD-198, p. I-6; RTD-199, p. 11.) The introduced American bullfrog is believed to prey on GGS neonates (young snakes) and consequently "likely take a large toll" on GGS, taking an estimated 22 percent of annual GGS production. (RTD-199, p. 12.) GGS defends itself through stealth and by taking refuge in burrows and decaying piles of vegetation and can drop into water as a predator approaches within 15 feet. It can also thrash, excrete musk, feces, and uric acid, and inflict bites on its attackers as defense tactics. (*Id.*)

74. The 2017 Recovery Plan for GGS by USFWS states that the list of threats to GGS changed since its original listing in 1993. (RTD-198-p., I-11; RTD-1000, "Five-Factor Analysis," pp. 17-42.) The current list of threats includes habitat loss and fragmentation due to urbanization and changes in levels and methods of rice production, but USFWS also identifies additional threats as including changes in water availability; levee and canal maintenance (due to removal of vegetative cover); water management and water deliveries that do not account for GGS; water transfers (resulting in cropland idling or shifting, reservoir releases, or groundwater substitution); the species' small populations; and invasive aquatic species. (RTD-198, p. I-12.) GGS was recommended for continued threatened status in USFWS's 2012 5-year review due to continuing loss and fragmentation of habitat from urbanization and loss of rice production. This habitat condition contributes to GGS populations' isolation from one another and from suitable habitat in the Central Valley, such as occurs in the Delta, which may or may not be occupied by GGS. Such habitat fragmentation means the species lacks safe corridors by which to reach and use suitable habitat within its range. (RTD-199, p. 6.) A habitat conceptual model found that habitat quality plays a central role in the population ecology of GGS, affecting growth, survival, and fecundity indirectly through its influence on prey availability. (*Id.*, p. 24.) Habitat quality is itself "strongly and directly affected by other variables," including water and refuge availability and emergent vegetation (up to a point when over-dense vegetation hampers GGS mobility). (*Id*.) On the other hand, floating vegetation, submerged vegetation, linear waterways, and scouring floods are seen in the conceptual model as having negative effects for GGS habitat quality. (*Id*.)

75. On May 7, 2015, an individual GGS was sighted on Bradford Island by Anna Swenson and Karen Smith Cunningham, close to the north anchorage of the False River barrier that Petitioner DWR was installing to regulate tidal flow into the western Delta during the last drought. (RTD-1001.) As stated by Barbara Barrigan-Parrilla to the SWRCB at its May 20, 2015, public workshop on drought emergency measures, Ms. Swenson and Ms. Smith Cunningham reported the sighting of the GGS to the California Department of Fish and Wildlife on May 8,

2015, but did not hear back from the agency. (RTD-1002, slides 5 through 8; RTD-1003, Part 6, video minutes 22:26 to 30:17.)

76. It is my understanding that, for biologists studying GGS, much remains unknown about the species due to its sparse population, low detection probabilities, relatively short period of annual activity, stealthy behavior, and preference for vegetative or aquatic cover. (RTD-199, pp. 4 [regarding low detection probabilities], 7 [regarding habitat selection], 11 [regarding prey selection among native versus introduced prey species], 13 [regarding GGS demographic rates, survival of subadult and male GGS too small for radio telemetry tracking, and survival rates of neonate GGS individuals].)

77. The primary strategy of the 2017 GGS Recovery Plan is to protect existing occupied habitat, identifying and protecting areas for habitat restoration, enhancement, or creation, including corridors between habitat locations that provide connectivity that GGS individuals could colonize. It also calls for maintaining and protecting existing populations. (RTD-198, p. II-1.) It further states that "an essential part of the management of habitat for giant garter snakes is to ensure that sufficient clean water is available to provide adequate aquatic habitat during the summer active season." (*Id*.) The 2017 GGS Recovery Plan states that further research is needed:

> on the ecology, behavior and life history of the giant garter snake…to further define specific recovery tasks, management needs and goals, help assess threats and determine best methods to eliminate or ameliorate the threats, and to analyze aspects of population viability.

(*Id*.)

78. It is my understanding that selenium contamination and impaired water quality have been identified as threats to GGS and contribute to its decline, in addition to habitat loss and fragmentation. (RTD-1000, p. 37.) High levels of selenium contamination have been documented in biota from at least six major canals and water courses in the Grassland Ecological Area of the western San Joaquin Valley where GGS has historically lived. (*Id*.) The USFWS acknowledges that knowledge of how and whether selenium contamination affects GGS is uncertain. (RTD-1000, p. 38.) Studies of similar aquatic snakes found that they accumulate

selenium from ingesting seleniferous prey and the resulting contamination can result in maternal transfer of potentially toxic quantities of selenium to offspring and in higher rates of metabolic activity than snakes from uncontaminated sites. (RTD-1000, pp. 38-39.) USFWS also states that, "various selenium and mercury interactions (additive, synergistic, and antagonistic) are known to occur in many organisms including humans" and noted that the potential for such complex interactions to occur in GGS and its habitat in the Grassland Ecological Area is of concern and warrants study. (*Id.*)

79. USFWS also found that toxic levels of environmental contaminants such as sodium sulfate, mercury, pesticides, and herbicides may reduce populations of aquatic prey—the small tadpoles of frogs and toads and small fish—upon which GGS relies for food. (RTD-1000, p. 39.)

80. It is my testimony that Restore the Delta is concerned that increased contributions of selenium loading with increased source waters from the San Joaquin River, as I discussed herein earlier, could increase potential selenium uptake in GGS individuals through as yet unknown food web pathways. It is my understanding from researching GGS for this testimony that more scientific research is needed in this area.

81. It is also my testimony that harmful algal blooms are anticipated to increase with both climate change and reduced through-flow of water in the Delta during summer months. Petition Facilities would also reduce Delta flows, particularly along the Sacramento River and associated sloughs in the north Delta. Algal blooms tend to form in slow-moving bodies of water where irradiance increases water temperatures. They also can form in the presence of abundant nutrients like nitrogen and phosphorus. It is my testimony that with increased water residence time in various parts of the Delta where suitable GGS habitat exists—the small sloughs and/or marshes where slow-moving water persists—may also be water bodies and locations where harmful algal blooms can occur over the summer. Harmful algal blooms can contain the cyanobacterium *Microcystis*, which manufactures a powerful neurotoxin, microcystin. When ingested by fish or other animals, severe illness and death can ensue; microcystin could result in illness and death of GGS individuals that reside in the Delta. (RTD-236; RTD-237.)

82. As stated herein, GGS relies to a great extent on fresh water marsh and riceland habitat in the Delta and elsewhere in the Central Valley. The California Department of Fish and Game (CDFG) Quantitative Biological Objectives Report (DFG QBO Report) stated as one of its biological goals to contribute to the recovery of GGS. (RTD-1005, p. 18.) The report further recommended protection of existing populations and habitat of GGS within the Delta, and that suitable habitat areas adjacent to known populations should be restored, enhanced, and managed to encourage natural expansion of GGS. (*Id.*, p. 99.)

83. Restore the Delta continues to recommend denial of the Change Petition. But in the event that the SWRCB approves the Change Petition, and in so doing indirectly authorizes increased water transfer activity, we recommend conditions be placed on the Petitioners' permits that help implement GGS protection in the Legal Delta through the 2017 GGS Recovery Plan. (RTD-198.) This would mean requiring funding, expertise, and land purchases by Petitioners reflecting "block pairings" of habitat favored by GGS as described in the 2017 GGS Recovery Plan. (*Id.*, p. II-15.) Those block pairings attempt to take advantage of adjacency of perennial wetland habitat and contiguous active rice lands, and to create wildlife corridors between blocks. (Id.) Petitioners' commitments should be applied in the portions of the Yolo Basin, Cosumnes-Mokelumne Basin, and Delta Basin recovery units identified in the 2017 GGS Recovery Plan that overlap with the Legal Delta. (*Id.*, pp. II-8 through II-11, Figures 8, 9, and 10.) Opportunities for habitat connectivity and suitability exist and should include Stone Lakes National Wildlife Refuge and other publicly owned lands throughout the Legal Delta. (*Id.*, pp. II-16 through II-18.)

84. Change Petition permit conditions must also require Petitioners to improve water quality in habitat suitable for GGS but affected by poor water quality conditions by determining which water bodies are impaired and are occupied by GGS in the Delta, and ensure summer water is available for wetland habitats used by GGS. (*Id.*, p. III-2 to III-3.)

85. Change Petition permit conditions must also require Petitioners to include in their adaptive management, monitoring, and research program scopes the requirement to monitor population and habitat to assess success or failure of management activities and habitat protection efforts (including reintroduction of GGS within suitable Delta habitat); to conduct

surveys and research to identify areas requiring protection and management using habitat suitability analysis appropriate for GGS; and to conduct research focused on the management needs of GGS and on identifying and removing specific threats to GGS within the Delta. (*Id.*, pp. III-3 through III-6.)

86. The 2017 GGS Recovery Plan identifies a cost range for plan implementation of between $17.3 million to over $116 million "plus additional costs to be determined." (*Id.*, p. iv.) Change Petition permit conditions must require Petitioners to provide their fair share of Recovery Plan costs (including costs remaining to be identified by plan implementation). Additional costs for which Petitioners should be responsible should include purchase of land or easements in GGS core areas and corridors linking such areas; restoration costs; and development and implementation of deliberately experimental adaptive management plans as outlined in the 2017 GGS Recovery Plan. Petitioners should also be required to be active partners in the overall conservation and recovery of GGS. (*Id.*, p. iv.)

Fish screens proposed to mitigate unavoidable impacts to listed fish species have high uncertainty of success.

87. In this section of my testimony I contend that the fish screens proposed for north Delta diversion points would not function as claimed. In so contending, I do not represent myself as an expert on fish screen criteria, engineering, design, construction, operation, monitoring, or evaluation. Nonetheless, within my expertise as an interdisciplinary researcher and urban and environmental planner, I have reviewed technical and environmental documentation and offer evidence and testimony to this effect based on my review.

88. Key to the talking points and mitigation approach of Petition Facilities for addressing direct, in-river impacts of the three north Delta intakes between Courtland and Clarksburg along the lower Sacramento River is the placement and operation of fish screens before the aperture of each intake structure. California WaterFix (i.e., Petition Facilities') promotional descriptions and illustrations acknowledge risks of both flow velocities and predation of covered (and listed) fish as they pass screens of the Petition Facilities' north Delta intakes. (RTD-1025, p. 3, "1. North Delta Diversions.") The illustration of fish screens in this

exhibit is not to scale and is therefore misleading because juvenile salmonids (4 to 8 inches) and small delta and longfin smelt (2 to 4 inches) would be tiny compared with fish screens at least 10 to 20 feet high and thousands of feet long.

89. Neither scaled illustrations nor engineered drawings of north Delta intake fish screens are provided in the Draft EIR/EIS or the RDEIR/SDEIS. The RDEIR/SDEIS describes water conveyance from the north Delta to the south Delta through the Tunnels Project. "Water would be diverted from the Sacramento River through three fish-screened intakes on the east bank of the Sacramento River between Clarksburg and Courtland." (SWRCB-3, Section 3, "Conveyance Facility Modifications to Alternative 4," p. 3-2.) For the new sub-alternatives, the RDEIR/SDEIS states: "...implementing a dual conveyance system would align water operations to better reflect natural seasonal flow patterns by creating new water diversions in the north Delta equipped with state-of-the-art fish screens, thus reducing reliance on south Delta exports." (SWRCB-3, Section 4.1, p. 4.1-1 to 4.1-2.)

90. The 2011 *BDCP Fish Facilities Technical Team Technical Memorandum* observed that, "[t]here is a high level of uncertainty as to the type and magnitude of impacts that these new diversions will have on covered fish species that occur within the proposed diversion reach." (DWR-219, p. 33.) The proposed screens are experimental and have never been employed anywhere else. Their size (multiple, very large, and in close proximity), type (on-bank flat plate), and tidally influenced location make it almost impossible to conform to existing screening criteria. (*Id.*, pp. 22, 33.) Even with a required variance from existing DFW and NMFS fish screening criteria, enormous uncertainties would remain, which is why the technical team suggested phased construction to see if the first one works before constructing the rest. (*Id*., pp. 35, 36.) Part of the problem is that delta smelt can be present at the diversion points during the months of February through June, and no screens can prevent entrainment of larval delta smelt, longfin smelt, Sacramento splittail, and smaller lamprey ammocoetes and adults. (SWRCB-5, pp. 5.B-viii to 5.B-ix, Table 5.B.0-2.)

91. Fish screen descriptions indicate they would exclude fish greater than 20 millimeters (mm) in length (nearly one inch) from being scooped up by diversions, but there is

no mention in any of the intake descriptions of BDCP, the Draft EIR/EIS or the RDEIR/SDEIS what happens to fish, larvae and eggs that are 20 mm in size or smaller.

92. The fish screens are assumed to be in place as part of applying north Delta bypass flows in Tunnels Project operational criteria for each of Alternatives 4A (the preferred alternative), 2D, and 5A:

> The objectives of the north Delta diversion bypass flow criteria include regulation of flows to 1) maintain fish screen sweeping velocities; 2) reduce upstream transport from downstream channels in the channels downstream of the intakes [that is, reduce "reverse flows" in the lower Sacramento and its various distributaries]; 3) support salmonid and pelagic fish transport and migration to regions of suitable habitat; 4) reduce losses to predation downstream of the diversions; and 5) maintain or improve rearing habitat conditions in the north Delta.

(SWRCB-3, Section 4.1, p. 4.1-11.)

93. CDFW and NMFS put forward design criteria for fish screens. (RTD-1021; RTD-1022.) Two vectors of flow shape their criteria: approach and sweeping velocity. RTD-1023 compares these agencies' fish screen design criteria with BDCP/Tunnels Project approach to fish screen design criteria. (RTD-1023.)

94. Petitioner DWR's *Conceptual Engineering Report* (*CER*) summarizes current Petition Facilities' fish screens. (DWR-212.) Proposed fish screens for the north Delta intakes are intended to be "self-cleaning." According to the *CER*, they will consist of gear motors with variable speed control; one cleaning system per screen bay group. The capacity of a screen-bay group is 500 cfs, so there are six such screen bay groups per 3000 cfs intake. Therefore there will be six motorized cleaning systems per intake. Each cleaning system will traverse its screen bay at a rate of 0.5 to 2 feet per second (120 feet per minute or 1.4 miles per hour). Each cleaning cycle is estimated to take 5 minutes, maximum. (*Id.*, pp. 6-4 through 6-6, Table 6-2.)

95. Debris removal and "biofouling" can create difficulties for the fish screens, however. "Cleaning frequency depends on the debris load," states the *CER*. Daily checks of intake screen clean functionality must be performed. (*Id*. p. 6-17.) Biofouling has troubling aspects as well, according to the *CER*:

> Biofouling, the accumulation of algae, freshwater sponge, Asian clams, mussels, and other biological organisms, can occlude the screens and jeopardize function. A key design provision for intake facilities is that all mechanical elements can be moved to the top surface for inspection, cleaning, and repairs. The intake facilities have top-side gantry crane systems for removal and insertion of screen panels, tuning baffle assemblies, and bulkheads.
>
> All panels will require removal for pressure washing. Additionally, screen bay groups will require dewatering for inspection and assessment of biofoul growth rates.
>
> With the invasion of Quagga and Zebra mussels into inland waters, screen and bay washing will increase. Coatings and other deterrents will be more thoroughly investigated during preliminary and final design.

(*Id*.) The *CER* anticipates that a

> log boom system will be aligned within the river alongside the intake structure to protect the fish screens and their cleaning systems from damage by large floating debris. Spare parts for vulnerable portions of the intake structure should be available to minimize downtime should repairs be needed. With the majority of working components being submerged and with security provisions in place, vandalism damage is not expected to be significant.

(*Id*., p. 6-18.)

96. No estimate is provided in the CER for how often and how long individual screens must be hoisted from the river for cleaning. Such maintenance would force temporary shutdown of at least that portion of the screened intake. This could cause either loss of screening capability while diversions continued, or interrupt diversions while the screens were cleaned. In either case, it imposes risks to fish or to water diversions.

97. Petitioners allege that benefits of fish screens would offset significant impacts to listed fish species and non-covered fish species that would be expected to encounter the north Delta intakes and their screened entrances. The alleged mitigation begins with the Tunnels Project's approach to adaptive management:

> Specifically, collaborative science and adaptive management will, as appropriate, develop and use new information and insight gained during the course of project construction and operation to inform and improve: . . . the design of fish facilities including the intake fish screens.

(SWRCB-3, Section 4.1.2.4, *Collaborative Science and Adaptive Management Program*, p. 4.1-18, lines 28-31; see also Section 4.1.3.1, p. 4.1-29 for Alternative 2D and Section 4.1.4.1, p. 4.1-36 for Alternative 5A.)

98. This statement demonstrates no confirmed, certain, nor effective mitigation to protect fish in the design of intake fish screens. Petitioners wish to build the intakes with screens, then improve the screens via adaptive management. However, "as appropriate" is not a definite course of action; it means "whatever we think is best for the project."

> The collaborative science process will also inform the design and construction of the fish screens on the new intakes. This requires active study to maximize water supply, ensure flexibility in their design and operation, and minimize effects to covered species.

(*Id.*, p. 4.1-20, lines 4-6.)

99. The collaborative science process assumes north Delta intakes with fish screens are built first, then studied. It is not a mitigation program because it allows the fish screens to go forward with no demonstration that impacts to fish would be avoided, minimized, or mitigated. It employs adaptive management in the service of building and operating massive intake structures in the presence of listed fish species and asking California and decision makers to trust Petitioners to solve problems of proper water flow vector velocities and routinized screen cleaning and maintenance, while ignoring consideration of whether the project achieves the Delta Reform Act's coequal goals and reduced Delta reliance policy and complies with the state's reasonable use and public trust doctrines.

100. This "wild card" application of adaptive management to fish screen deployment is applied throughout the Petitioners' treatment of impacts to Delta smelt, longfin smelt, winter-run Chinook salmon, spring-run Chinook salmon, and Central Valley steelhead. The "wild card" fish screens are also applied to non-listed native and non-native species that would also be vulnerable to impingement, entrainment, injury, and death from the north Delta intakes. For winter-run Chinook salmon:

> State-of-the art [footnote] fish screens operated with an adaptive management plan would be expected to eliminate entrainment and impingement risk for juvenile winter-run Chinook salmon.
>
> [Footnote] The fish screens would be state of the art by incorporating the best available technology and operating to fishery agency standards of protection for fishes.

(*Id.*, Section 4.3.7, p. 4.3.7-48, lines 13-15.)

101. Petitioners acknowledge:

> For the purposes of this EIR/EIS, it is assumed that the fish screens would be designed to meet delta smelt criteria, which requires 5 square feet per cfs [cubic feet per second or 5 feet per second]. The fish screen sizes, like the individual intake sizes, would vary depending on intake location and would range from 10 to 22 feet in height and from 915 to 1,935 feet in length. It is anticipated that the screen cleaning system would include several traveling brush cleaning systems installed on the waterside of the intake. As an alternative to the fixed screen panel and brushing system, a traveling screen system with a screen belt and stationary brush/water jet system could be used.

(SWRCB-4, p. 3-87, lines 16-22.)

102. These passages indicate, despite their technological and scientific optimism, that the screens are unproven, experimental, and very much a work in progress.

103. Petitioners conclude that "[p]otential entrainment and impingement risks at the proposed north Delta facilities would be limited because it is outside the main range of delta smelt....The intakes would be screened and would exclude delta smelt of around 22 mm and larger." (SWRCB-3, p. 4.3.7-24, lines 4-7.) This conclusion is speculative. As with last year's Draft EIR/EIS, BDCP did not model and disclose results estimating entrainment and impingement risks for delta smelt at the north Delta intakes to buttress this claim. Table 11-4A-1 presents modeling results of "proportional entrainment . . . of Delta Smelt at SWP/CVP South Delta Facilities for Alternative 4A. . . ." No other such table is presented for entrainment risk at north Delta intakes. This is also true of Alternatives 2D and 5A. (*Id*., Section 4.4.7, Table 11-2D-1, p. 4.4.7-3, and Section 4.5.7, Table 11-5A-1, p. 4.5.7-4.)

104. In comments to the Delta Stewardship Council, the Delta Independent Science Board stated:

> It is unclear how (and how well) the fish screens would work. The description of fish screens indicates that fish >20 mm are excluded, but what about fish and larvae that are <20 mm, as well as eggs?...some fish screens appear to have been installed, but data on their effects are not given. Despite the lack of specific data on how well screens function, the conclusion that there will be no significant impact is stated as certain [citation].
>
> Here, as in many other places, measures are assumed to function as planned, with no evidence to support the assumptions. The level of certainty seems optimistic, and it is unclear whether there are any contingency plans in case things don't work out as planned. This problem persists from the Previous Draft.

(RTD-1024, p. 17.)

105. Assuming delta smelt-friendly design parameters does not mean those parameters are known or have been incorporated into a specific design that would perform as assumed. This passage does not explain where the delta smelt fish screen criterion comes from. Nor is it consistent with NMFS or CDFW criteria. (RTD-1021; RTD-1022; RTD-1023.) North Delta intake fish screen designs likely do not comply with CDFW and NMFS criteria error relative to fish designs. North Delta bypass flow operational criteria may not be sufficiently protective, even just as modeling assumptions.

106. Fish screens "do affect or impact river flow," states the DWR engineering solutions report drafted for compliance with the 2009 NMFS salmonid biological opinion.

> A large amount of system structure would be placed into the water, thus potentially affecting local and regional hydraulic patterns. Another disadvantage...is the potential for debris accumulation. Debris may obstruct or damage parts of the screen, which potentially could lead to minimizing the effectiveness of the system. Therefore, CDFW and NMFS screening criteria may not always be met. Debris issues would require constant monitoring and maintenance to assure that the system is working properly.

(RTD-1020, pp. 2-31 to 2-32.) The study adds:

- Boat navigation may also be affected. Some type of boat lock may be necessary to accommodate recreational boat passage.
- In waterways where there are dynamic hydraulics such as reversing flow, there would be potential for fish impingement.

(*Id*.)

107. DWR's study rejected fish screen technology for natural diversion situations where a portion of the Sacramento River split off at either Georgiana Slough or Three Mile Slough, stating:

> The use of fish screens as a deterrence option was evaluated and discussed for each site. Typically, maximum flow diversions are used to size fish screens and meet CDFW and NMFS screening requirements. Given the range of high maximum flows over the Delta daily tidal cycles at the five sites, fish screens would be unreasonably large to meet these requirements. Average flow diversions were also used but resulted in screen sizes that were still large and exceptionally long. These results were presented to the TWG at its January 28, 2014 meeting (see Appendix A). The TWG decided to remove fish screens from further consideration based on the required large structure sizes and concerns over the ability to meet CDFW and NMFS screening criteria.

(RTD-1020, p. 4-1.) Fish screen options were considered at sites just a few miles downstream of the North Delta intakes and were rejected for natural diversions from the Sacramento River. Yet they are deemed acceptable or even necessary for the north Delta intakes associated with Petition Facilities and described by Petitioner DWR as "state-of-the-art." (RTD-1025, p. 3, inset 1.)

108. As X2 migrates upstream, estuarine habitat grows smaller and migrates eastward, and the delta smelt's favored shallow open water habitat grows smaller and migrates eastward (upstream) as well. By the time north Delta intakes with fish screens would be completed and begin operation, and under changing climatic conditions, X2 and delta smelt could frequent this reach more than anticipated presently, assuming they survive that long. Nonetheless, Petitioners conclude: "Predation loss at the north Delta intakes may occur but would be limited because few delta smelt are anticipated to occur that far upstream." This conclusion ignores BDCP modeling results concerning upstream migration of X2 (the estuarine habitat indicator that is a key component of Delta smelt habitat index measurement) due to Tunnels Project operations. (RTD-158, p. 65 and Figure 7.)

Predator Hotspots

109. BDCP stated the conceptual framework of fish predation this way:

> The likelihood of a predation event is a function of three factors: rates of encounter between predator and prey; a decision by the predator to attack the prey; and capture or feeding efficiency of the predator(s). Encounter frequencies between predators and covered fish are related to their overlap in habitat use spatially and temporally, the vulnerability of prey, which is typically linked to environmental conditions like river flows and turbidity…, and their abundance relative to alternative prey[.]

(SWRCB-5, p. 3.4-299, lines 4-9.)

110. "Predation hotspots" were mapped in BDCP, but no definition of predation hotspot was given. (*Id.*, Figure 3.4-32, "Predation Hotspots in the Plan Area.") They appear to have recognizable characteristics: most, if not all, are associated with artificial (human-built) in-channel hydraulic structures like temporary rock barriers, failed levees, submerged bridge abutments, and Jones Pumping Plant. They also include artificial open water areas like Clifton Court Forebay and Franks Tract where open waters lack refuge for prey fish, and prey visibility

is high due to relatively shallow conditions. Predators have also learned to wait patiently for deliveries of salvaged fish from Banks and Jones pumping plants at regular locations along the lower Sacramento River. "Total consumption rates," states BDCP, "relate to predator number, predator size, water temperature, prey density, and sometimes prey vulnerability (i.e., microhabitat use of predator and prey and whether the prey has a refuge at low density)." (*Id.*, p. 3.4-299, lines 12-14.) Currently known predation hotspots are listed and briefly described (*Id.*, p. 3.4-299:15-39, and p. 3.4-300:1-11.) Salvage release sites are areas where microhabitat use coincides with predator frequency.

111. Petitioners acknowledge that both the north Delta water diversion facilities and nonphysical fish barriers are expected to create new predation hotspots. (*Id.*, p. 3.4-300:12.)

112. The baseline of predation in the lower Sacramento River between Clarksburg and Courtland for each of the listed fish species is unknown and not disclosed in the RDEIR/SDEIS for its three sub-alternatives. Predation losses for winter-run Chinook salmon at the north Delta intakes are acknowledged by the RDEIR/SDEIS:

> Potential predation effects at the north Delta intakes for juvenile salmonids remaining in the Sacramento River (as opposed to entering the Yolo Bypass) could occur if predatory fish aggregated along the screens as has been observed at other long screens in the Central Valley [citation]. Baseline levels of predation are uncertain, however.

(SWRCB-3, p. 4.3.7-65:36-39.)

113. The RDEIR/SDEIS indicated methodological problems with another fish predation study at the GCID fish screen in the Sacramento River near Hamilton City. (SWRCB-3, footnote 5, p. 4.3.7-66.)

APPROPRIATE FLOW CRITERIA MUST BE DERIVED FROM CALIFORNIA'S WATER POLICY FRAMEWORK (ESPECIALLY THE DELTA REFORM ACT OF 2009 AND PUBLIC TRUST DOCTRINE), WATER AVAILABILITY ANALYSIS, AND APPLICATION OF WATER RIGHTS LAW TO THE CHANGE PETITION AND PETITION FACILITIES.

114. It is my testimony that SWRCB must address two issues with "appropriate Delta flow criteria." First, Petitioners requested on September 8, 2017, that SWRCB apply the provisions of Water Rights Decision 1641 as permit conditions. SWRCB's own flow criteria and

scientific basis reports show why this should not be done. Second, the Legislature's plain language in Water Code section 85086(c)(2) is contrary to the Petition Facilities described in the Change Petition, and SWRCB needs to determine how the language should read.

115. It continues to be my testimony for Restore the Delta that the Change Petition should be denied; if the Petition Facilities it contains continue forward, the content of the Change Petition should be refiled with SWRCB as a new water right application.

116. It is my testimony that "appropriate flow criteria" for permit conditions on Petition Facilities must be derived from California's water policy framework. This framework expresses policies that apply statewide to all water users, should SWRCB approve either a Change Petition or new water right application. (Water Code sections 85021, 85023, 85031, 85054, 13000 *et seq*.; Fish and Game Code sections 5937, 5946, 6902(a); Central Valley Project Improvement Act, Pub. L. No. 102-575, sections 3401 *et seq*., 106 Stat. 4600 (1992); Federal Water Pollution Control Act, as amended through Pub.L. 111-378 (2011), 33 U.S.C. sections 1251 *et seq.*) Taken as a whole, these statewide water policies provide state agencies with authority to regulate, establish, implement, construct, and operate a range of solutions to California's water problems, including approval, denial, and conditioning of water rights change petitions.

117. It is my understanding from such policies that the "longstanding constitutional principle of reasonable use and the public trust doctrine shall be the foundation of state water management policy and are particularly important and applicable to the Delta." (Water Code section 85023.) California is to reduce reliance on the Delta in meeting California's future water supply needs by "investing in improved regional supplies, conservation, and water use efficiency." (Water Code section 85021.) Such regional self-reliance shall be improved through investment in "water use efficiency, water recycling, advanced water technologies, local and regional water supply projects, and improved regional coordination of local and regional water supply efforts." (Water Code section 85021.)

118. This statewide framework also expresses "coequal goals" that are defined as "providing a more reliable water supply for California and protecting, restoring, and enhancing

the Delta ecosystem. The coequal goals shall be achieved in a manner that protects and enhances the unique cultural, recreational, natural resource, and agricultural values of the Delta as an evolving place." (Water Code section 85054.)

119. The Legislature also stated its intent that state agencies "determine instream flow needs of the Delta" for making planning decisions and achieving Delta Plan objectives. (Water Code section 85086, subd. (b).) It required SWRCB to develop in a strictly informational proceeding flow criteria that would protect Delta public trust resources. (Water Code section 85086, subd. (c)(1).) The Legislature further required that the Board consider these latter flow criteria in developing "appropriate Delta flow criteria" for the Petition Facilities and Petitioners' water rights permits when the time came:

> [A] *change* in the point of diversion of the State Water Project or the federal Central Valley Project *from* the southern Delta *to* a point on the Sacramento River shall include *appropriate* Delta flow criteria and shall be informed by the analysis conducted pursuant to this section.

(Water Code section 85086, subd. (c)(2); emphases added.)

120. The "section" in question, in my reading of this passage, is the entirety of Water Code section 85086; the meaning of the above-quoted passage must be interpreted at least in light of all portions of this section, as well as the larger statewide water policy framework.

SWRCB's own flow criteria and scientific basis report show why D-1641 should not be applied unchanged to Petitioners' water rights permits conditions.

121. Petitioners stated two requests to Hearing Officers in a letter dated September 8, 2017, concerning permit conditions for Petition Facilities to date:

> Petitioners propose that the California WaterFix be conditioned upon the terms contained in Water Rights Decision 1641 ("D-1641"). Modeling assumptions demonstrate it is possible to meet existing regulatory requirements inclusive of D-1641 and the 2008/2009 Biological Opinions. For purposes of this hearing, these modeling assumptions are not proposed as conditions but are presented in order to demonstrate compliance with the existing Water Quality Control Plan, which sets forth the thresholds for protecting beneficial uses.

(Petitioners' Letter to Chair Felicia Marcus and Board Member Tam Doduc regarding August 31, 2017 Ruling Regarding Scheduling of Part 2 and Other Procedural Matters, September 8, 2017, p. 1.)

122. Petitioners state that "modeling assumptions demonstrate it is possible to meet existing regulatory requirements" and that "these modeling assumptions . . . are presented in order to demonstrate compliance" with the Bay-Delta Plan, "which sets forth the thresholds for protecting beneficial uses" in the Bay-Delta Estuary. (*Id*.; DWR-116; DWR-515, Table 1.)

123. Petitioners' second request was that the Hearing Officers "incorporate the adaptive management process into the water rights permits," and that they are "not proposing as conditions the operational criteria contained within the Biological Opinions and 2081(b) Incidental Take Permit" for Petition Facilities in the Change Petition. (Petitioners' Letter to Chair Felicia Marcus and Board Member Tam Doduc regarding August 31, 2017 Ruling Regarding Scheduling of Part 2 and Other Procedural Matters, September 8, 2017, p. 2.) Petitioners request this because, first, the Change Petition includes an adaptive management process; and second, Petitioners wrote that they:

> presented the boundary analysis of B1 to B2 in order to demonstrate no impact to legal users of water within the range of foreseeable outcomes of the adaptive management process. Through the adaptive management process, that was made a requirement of the Biological Opinions and 2081(b) Incidental Take Permit for the California WaterFix, new information can be assessed and, if appropriate, incorporated into the ESA/CESA permits.

(*Id*.)

124. It is my understanding that existing terms of D-1641 contain neither operational criteria nor water quality or flow objectives for diversion rates applicable to Petition Facilities' north Delta intakes, nor does D-1641 contain bypass flow objectives in the Sacramento River for waters in the vicinity of these same intakes.

125. Since there are presently no permanent operable gates at the head of Old River, the terms of D-1641 also contain no criteria or objectives for the operation of such gates, nor for the waters in the vicinity of such gates.

126. In addition, Petitioners' September 8th letter attachment of "modeling parameters" states that "operational criteria [for export to in-flow ratio] are the same as defined under D-1641, and applied as a maximum 3-day running average." Applying this export to in-

flow ratio excludes north Delta intake exports from the ratio and is justified by Petitioners as follows:

> The D-1641 ratio calculation was designed to protect fish from south Delta entrainment. For Alternative 4A [i.e., Petition Facilities] Reclamation and DWR propose that the north Delta diversion be excluded from the export/inflow ratio calculation. In other words, Sacramento River inflow is defined as flows downstream of the north Delta diversion and only south Delta exports are included for the export component of the criteria.

(*Id.*, PDF page 6.)

127. In the absence of other as-yet unformulated conditions to be placed on their water rights permits, Petitioners' proposals for permit conditions omit important aspects of Petition Facilities' operational activities from future permit conditions that are not otherwise foreseen by D-1641: among other things, these include timing, volume, and duration of north Delta intakes' diversions; operation of permanent operable gates on Old River; and the relationship of north Delta exports to inflow and the basis for their overall regulation of beneficial use protection throughout the Delta. Moreover, Petitioners' requests in the September 8, 2017 letter imply that SWRCB should delay decisions on these gaps in D-1641 water quality and flow regulation pending discovery of scientific and policy bases for them through the adaptive management process. Petitioners' reasoning appears to be that inclusion of the adaptive management process in water rights permits conditions, which Petitioners' request of SWRCB, would facilitate formulation of operational criteria as permit conditions. In other words, put off until later what SWRCB should logically and properly decide sooner.

128. Petitioners have consistently stated that the modeling assumptions they employ to demonstrate compliance with D-1641 are not the permit conditions they request and that they do not use models to operate the Petitioners' SWP and CVP facilities.(*Id.,* p. 1; Hearing Transcript [HT] 4, opening statement by Mark Cowin, Director of Petitioner DWR, p. 19:8-18; HT 4, opening statement by David Murillo, Regional Director of Petitioner Reclamation, p. 22:18-25, 23:1-2.) Models cannot accurately simulate real-time operations because they do not incorporate real-time management of salinity, precise weather forecasting and prediction, and the manner in which operators respond to day-to-day changes in conditions that can at times be volatile.

(DWR-61, p. 7:18-22; HT 9, p. 175:18-25 to p. 184:1-8.) Models are primarily useful in making comparisons between potential outcomes associated with Petition Facilities' operations rather than predictions of actual outcomes, in part through application of generalized or predefined "rules" to approximate regulatory requirements like D-1641. They are not able to adjust rules to respond to specific events that may have occurred historically or to exactly match actual operations in a specific month or year within the simulation period "since operational decisions are evolving and informed by numerous real-time operational considerations." (DWR-71, p. 3:6-16, p. 4:16-27.)

129. Petitioners' witness Jennifer Pierre testified that the project description for Petition Facilities had "three pieces: the physical components, the operational component, and the collaborative science" (adaptive management process). (HT 4, p. 87:24-25 to p. 88:1-6.) The operational component described in Ms. Pierre's formulation consists of "terms imposed through D-1641", "terms in BiOps and State CESA Permits", "new or additional added parameters" (e.g., north Delta bypass flows, Old and Middle River flows, Rio Vista minimum flow, spring Delta outflow, additional criteria for the Head of Old River gates), and "additional CWF components" that include real time operations and "collaborative science and adaptive management." (DWR-51, p. 12:17-27, 13: 1-17, 14:11-27, pp. 15-16, p. 17:1-3.) At present, only D-1641 and Biological Opinions from 2008 and 2009 are in effect. Other parameters listed in her testimony are not currently regulated. Ms. Pierre acknowledged under cross-examination that if assumptions made about project operations turn out to be inaccurate, that:

> it would depend on what the changes are. So it's possible that there's adjustments in the future and that it doesn't effect [*sic*] what the evaluation is currently saying. It's possible that there's changes in the future that could affect it. It's very speculative to understand that—what may change outside of the proposal that's here today.

(HT, p. 90:3-25 to 91:1-6.)

130. Several aspects of SWRCB's adopted 2010 Delta Flow Criteria Report (DFC Report) and other more recent SWRCB scientific reporting that must be explicitly considered by SWRCB in any order approving or denying the Change Petition. These include:

- Acknowledgement that recent Delta flows continue to be insufficient to support native Delta fishes for in their Delta habitats. (SWRCB-25, p. 2, 5.)
- That "in order to preserve the attributes of a natural variable system to which native fish species are adapted, many of the criteria developed" by SWRCB "are crafted as percentages of natural or unimpaired flows." These included 75 percent of unimpaired Delta outflow from January through June; 75 percent of unimpaired Sacramento River inflow from November through June; and 60 percent of unimpaired San Joaquin River inflow from February through June. (SWRCB-25, p. 5, and Tables 20 through 23, pp. 131-135.) SWRCB further stated that it intended these flow criteria to "reflect the general timing and magnitude of flows" while recognizing that historic flows "in the last 18 to 22 years" were generally much less than these criteria would establish. (*Id.*) SWRCB tempers its presentation of these criteria with a statement that "only the underlying principles for the numeric criteria and other measures are advanced as long term criteria," though SWRCB does not make clear exactly to which "principles" it refers. (SWRCB-25, p. 6.)
- That SWRCB specifically concurred with DFG's finding that:

> current science-based conceptual model which concludes that placement of X2 in Suisun Bay represents the best interaction of water quality and landscape for fisheries production given the current estuary geometry. [Citation.] Maintaining X2 at 75 km and 64 km corresponds to net Delta outflows of approximately 11,400 cfs and 29,200 cfs, respectively.

(*Id.*, pp. 86-87, Table 18, and p. 107.) The DFC Report further specifies these X2 criteria would apply from February through June. However, these flow criteria are not included in the DFC Report's summary of Category A determinations. (*Id.*, pp. 131-135, Tables 20 through 23.) It is my understanding that such estuarine protection criteria would address stressors involving the interaction of selenium contamination with highly selenium-bioaccumulative nonnative invasive benthic clams like *P. amurensis*, as discussed earlier herein, and it would further have recent scientific basis in the DRERIP Conceptual Model concerning *P. amurensis*. (RTD-190, p. 21.) Restore the Delta requests that SWRCB consider these criteria as among the appropriate Delta flow criteria it would apply to Change Petition permit conditions.

131. The DFC Report included other determinations that SWRCB should consider as it prepares appropriate Delta flow criteria and any potential related permit conditions for Petition Facilities' water rights permits regarding variability and the natural hydrograph, floodplain activation and other habitat improvements, water quality and contaminants, cold water pool management, and adaptive management. (SWRCB-25, pp. 5-6; p. 136, Table 25.)

132. Because the DFC Report flow criteria were informational, SWRCB stated at the time that they "do not consider any balancing of public trust resource protection with public interest needs for water" and that the criteria in the DFC Report are not intended "to supersede requirements for health and safety such as the need to manage water for flood control." (*Id.*, p. 4.) Restore the Delta recommends SWRCB complete a comprehensive, independent benefit-cost analysis, inclusive of nature's services maintained and foregone, to help determine appropriate Delta in-stream flow criteria as permit conditions for Petition Facilities.

133. In determining flow and related criteria in its 2010 DFC report, SWRCB separated Category A from Category B determinations on the basis that Category A determinations (such as its main Delta flow criteria based on unimpaired flow) were based on more robust science, while Category B determinations recognized "there is less scientific information to support specific numeric criteria, but there is enough information to support the conceptual need for flows." SWRCB stated further that "Category A and B criteria are both equally important for protection of the public trust resource, but there is more uncertainty about the appropriate volume of flow required to implement Category B criteria." (*Id.*, p. 98.)

134. Restore the Delta urges that DFC Report flow criteria and Category A and Category B determinations should inform SWRCB determinations for appropriate Delta flow criteria applied to Petition Facilities and their water rights permits. If Category B determinations remain as such, we request that SWRCB include Category B determinations from the DFC Report into the scope of Petition Facilities' adaptive management program included in water rights permit conditions.

135. In November 2010, the CDFG completed its DFG QBO report pursuant to the Delta Reform Act of 2009. (Water Code section 85084.5.) This report found in pertinent part that: (1) recent Delta flows are insufficient to support native Delta fishes in habitats that now exist in the Delta; (2) water flow stabilization harms native species and encourages non-native species; (3) for many species, abundance is related to water flow timing and quantity (or the placement of X2 [the SWRCB's current estuarine water quality objective]); (4) for many species, more water flow translates into greater species production or abundance; (5) species are adapted

to use Delta water resources during all seasons of the year, but particularly winter-spring seasons when they reproduce and/or out-migrate; (6) some invasive species negatively influence native species abundance, such as the "overbite clam" (*P. amurensis*) and aquatic plants, and "certain flows in and through the Delta may influence these undesirable species both positively and negatively." (RTD-1005, pp. 94-95.)

136. In early October 2017, SWRCB issued its Scientific Basis Report in Support of New and Modified Requirements for Inflows from the Sacramento River and Its Tributaries and Eastside Tributaries to the Delta, Delta Outflows, Cold Water Habitat, and Interior Delta Flows (SBR). This report states that "[i]t is widely recognized that the Bay-Delta ecosystem is in a state of crisis." (SWRCB-103, p. 1-4.) According to the SBR, this crisis has not abated despite high hopes for the 1995 Bay-Delta Water Quality Control Plan, which five years later was implemented by D-1641 five years later. The SBR acknowledges:

> Fish species have continued to experience precipitous declines since the last major [plan] update and implementation of the Bay-Delta Plan in 1995 that was intended to halt and reverse the aquatic species declines occurring at that time. In the early 2000s, scientists noted a steep and lasting decline in population abundance of several native estuarine fish species that has continued and worsened during the recent drought. Simultaneously, natural production of all runs of Central Valley salmon and steelhead remains near all-time low levels.

(*Id*., pp. 1-4 to 1-5.)

137. The SBR attributes these declines in part to changes in flow due to dams, and water diversions, and related operations. Upstream diversions and water exports in the Delta have reduced January to June outflows by an average of 56 percent and annual outflow by an annual average of 52 percent. In drier years, in some months, Delta outflows are reduced by more than 80 percent, and January to June outflows by more than 70 percent, while total annual average outflows are reduced by more than 65 percent. (*Id.*, p. 1-5.) Such percentages of water diverted from natural Delta outflows exceed scientifically-observed thresholds for estuarine water diversions' adverse effects on ecosystem structure and function. (*Id*., citing Richter et al 2011 and Rozengurt et al 1987.) The SBR acknowledges that "[n]ative fish and wildlife in the

Bay-Delta watershed have been significantly impacted by the reductions of flow, with many species currently on the verge of extinction." (*Id.*)

138. Currently, no comprehensive regulatory strategy addresses systematic protection of upstream inflows, ecosystem values like cold water and estuarine habitat, and Delta outflows as a whole. The SBR states:

> Many of these requirements are the sole responsibility of the Projects [i.e., the SWP and CVP] under the Bay-Delta Plan, as implemented through Revised Water Right Decision 16431 (D-1641), and two biological opinions (BiOps) addressing Delta smelt and salmonids and an incidental take permit addressing longfin smelt. The best available science, however, indicates that these requirements are insufficient to protect fish and wildlife. Further, these requirements address only portions of the watershed; there are a number of tributaries that do not have any requirements to protect fish and wildlife or that have requirements that are not integrated with other requirements, including the Bay-Delta Plan and CESA and ESA requirements.

(Id.)

139. SWRCB acknowledges the insufficiency of D-1641 to protect fish and estuarine beneficial uses. Based on this evidence, it is my testimony that D-1641 is inadequate and inappropriate as Delta flow criteria terms for Petition Facilities' water rights permits' conditions. Restore the Delta continues to recommend denial by SWRCB of the Change Petition. Similarly, inclusion in permit conditions of a vague and largely unformulated adaptive management process is presently insufficient for a project of the scale and duration of Petition Facilities. Given the possibility that SWRCB may approve water rights permits in some form for Petition Facilities, Restore the Delta's case in chief includes herein recommendations for scientific research to be undertaken as part of the adaptive management scope, as well as the X2-related estuarine determination on which SWRCB and DFW concurred in 2010.

SWRCB must rely on the plain language of Water Code section 85086(c)(2) and interpret it in light of the full section of the Delta Reform Act to which it refers.

140. The Legislature's plain language regarding the change in point of diversion from the southern Delta to a point on the Sacramento River in the north Delta literally means relocation of the points of diversion of Petitioners' existing projects.

141. The Legislature's plain language explicitly expresses a change in the point of diversion of the projects from south to north. In the absence of expressed Legislative intent otherwise, this appears to preclude dual conveyance without filing a new water rights application. The plain language does not presently state or mean that existing southern points of diversion (i.e., Banks and Jones pumping plants) would be kept while adding new points on the Sacramento River. For this reason, the Change Petition should be denied as contrary to state law.

THE PETITION'S PURPOSE IS CONTRARY TO STATEWIDE POLICY MANDATING REDUCED RELIANCE ON THE DELTA FOR CALIFORNIA'S FUTURE WATER NEEDS AND IS THEREFORE NOT IN THE PUBLIC INTEREST.

142. The Delta Reform Act of 2009 (Act) mandates that: "The policy of the State of California is to reduce reliance on the Delta in meeting California's future water supply needs through a statewide strategy of investing in improved regional supplies, conservation, and water use efficiency." (Water Code section 85021.) I present evidence that the purpose of the California WaterFix project is intended to maintain and likely increase exports of Delta water to meet California's future water needs, contrary to the Act. Evidence shows that Petition Facilities' increased conveyance capacity and north Delta diversions create expectations that project allocations and water transfers will be facilitated, continuing Petitioners' and water contractors' reliance on Delta exports for future imported water supply needs.

143. Petition Facilities' environmental documents provide no concrete analysis of their compliance with this section of the Act. For example, the BDCP contained no mention and therefore no policy analysis of whether the proposed Conservation Measure 1 facilities complied with Water Code section 85021. (SWRCB-5, search of "85021" yielded no results.) The BDCP Draft Environmental Impact Report/Statement mentions Water Code section 85021 and its statement of reduced Delta reliance, but provides no analysis of the proposed project's compliance with this provision. (SWRCB-4, Appendix 1C, p. 1C.3-18; Appendix 3A, p. 3A-20 to -22, p. 3A-68, and p. 3A-149, Table 3A-15; and Appendix 3D, pp. 3D-68 to 3D-69.) The California WaterFix Recirculated Draft Environmental Impact Report/Supplemental Draft Environmental Impact Statement similarly mentions Water Code section 85021 once but again

provides no analysis of the proposed project's compliance with this section of the Act. (SWRCB-4, Appendix 3D, p. 3D-57.)

144. Petitioners' master responses to comments in the California WaterFix Final Environmental Impact Report/Final Environmental Impact Statement state in Master Response 31:

> Under Section 85021, it is the obligation of each region that relies on water from the Delta watershed, not DWR or the Bureau of Reclamation, to determine the best ways to meet this goal by improving regional self-reliance. Neither DWR nor any of the public water agency proponents of the proposed project have the legal authority or duty to impose a statewide investment strategy on different regions of the state or individual water suppliers that depend on water from the Delta watershed. In addition, DWR lacks any legal authority or duty to make and implement localized decisions about water technology investments, to develop and impose investments for new water supply projects that serve particular geographic regions, or to mandate coordinated efforts among local and regional water suppliers.

(SWRCB-102, Volume II, p. 1-277:11-17.)

145. In Master Response 31, Petitioners reject their own responsibility for enforcing the Legislature's command in Water Code section 85021 to reduce reliance on the Delta for California's future water needs. Petitioner DWR is the state agency that owns and operates SWP, and administers contracts for water service from the Project serving northern and southern California regions reliant on the Delta. As a state agency, it is responsible for enforcing this command to reduce Delta reliance by aligning its water service contracts and allocations of SWP with Water Code Section 85021. Petitioner Bureau has similar capacity and responsibility with respect to its owning and operating CVP, and administering contracts for water service within that project's service area. Petitioner Reclamation also has a duty under the National Reclamation Act of 1902 to comply with the water laws of states in which the Bureau operates. This duty includes compliance with the Delta policies of the Delta Reform Act of 2009, including reducing Delta reliance.

146. Master Response 31 by Petitioners also fails to accurately represent the verbatim language of Water Code Section 85021. This section is silent on whether any water agency has specific obligations under the law to achieve reduced Delta reliance. Petitioner DWR construes

this to mean (in the above quote) that it and Petitioner Bureau have no responsibility for stimulating local and regional self-sufficiency in water supply separate from Delta reliance. Master Response 31 would let Petitioners continue to operate their projects without regard to the statutory command to reduce Delta reliance. A more logical and reasonable interpretation of 85021—consistent with this command—is that all state agencies should determine what authorities and funding they do have and apply them toward enforcing, encouraging, and assisting local and regional agencies with reducing their reliance on Delta imports. Petitioners' contracting authorities are sufficient to accomplish such changes under state and federal law.

147. A purpose of Petition Facilities—in either their BDCP or California WaterFix forms—is to maintain Delta exports while increasing water supply reliability of the state and federal water projects that export from the Delta. This purpose is, on its face, contrary to Water Code section 85021 of the Delta Reform Act, which commands that reliance on the Delta for California's future water needs must be reduced.

148. Petition Facilities' environmental documents state as among the project's purposes the intent to maintain present export levels into the future and even increase the reliability of delivery to contractors from those exports:

> Restore and protect the ability of the SWP [State Water Project] and CVP [Central Valley Project] to deliver up to full contract amounts, when hydrologic conditions result in the availability of sufficient water, consistent with the requirements of State and federal law and the terms and conditions of water delivery contracts and other existing applicable agreements.

(SWRCB-3, Chapter 2, p. 2-3:21-24 and p. 2-4:29-33; SWRCB-4, Chapter 1, p. 1-8:34-37 and p. 1-9:33-37.)

149. Petition Facilities' environmental documents disclose modeling results indicating that preferred scenarios will not result in significant change to long-term average SWP and CVP deliveries. Deliveries for Alternative 4, Scenarios H3 and H4 of Conservation Measure 1 would range between 4,019 TAF and 4,497 TAF, as compared with existing conditions of about 4,658 TAF, and no action alternative scenarios (future conditions without Petition Facilities) of between 4,043 to 4,305 TAF. (SWRCB-4, p. 7-53, Table 7-7; SWRCB-3, p. 4.3.3-7, Table

4.3.3-1.) Alternative 4A (Petition Facilities) is estimated to result in long-term average deliveries of between 4,273 to 4,776 TAF. This alternative's range of deliveries includes existing average deliveries and is higher than the range of deliveries anticipated for BDCP's Alternative 4 scenarios. (SWRCB-4, p. 7-53, Table 7-7; SWRCB-3, p. 4.3.3-7, Table 4.3.3-1.)

150. It is my understanding that an independent modeling report provided to various upstream and Delta water users by MBK Engineers and Daniel Steiner (MBK/Steiner) found that BDCP modeling results showed total exports increasing by 540 thousand acre-feet (TAF) over a No Action Alternative base of 4.73 million acre-feet (MAF) or about 5.27 MAF of total exports on average. (RTD-143, Attachment 1, p. 72.) This report acknowledged several necessary adjustments to operational assumptions to ensure that CalSIM II modeling results better represented how CVP and SWP systems would be operated with incorporation of Petition Facilities. These adjustments included changes approved by Petitioners for the 2013 baseline applied in the SWP Delivery Reliability Report and in this report. (*Id.*, Attachment 1, p. 44-45.) Other changes were made to establish a meaningful and reasonable "Future No Action Alternative" that included several additional revisions to CalSIM II assumptions in the 2013 baseline. (*Id.*, p. 45.) Changes were also made to North Delta Diversion Bypass Flow Criteria (*Id.*, p. 48) and to Delta Cross Channel Gate Reoperation in October. (*Id.*, p. 49.) These changes were intended to make CalSIM II modeling more closely approximate actual operations based on research by MBK/Steiner into known operator behavior. (*Id.*, p. 44.) The independent modeling results showed that combined exports would average 5.61 MAF annually for a "Future No Action" (FNA) alternative, indicating an increase in exports for Alternative 4 of about 750 TAF. (*Id.*, p. 72.) This represents an increase in exports with the Petition Facilities, with more apparently realistic operational assumptions built into their modeling, averaging about 200 TAF annually. (*Id.*) It does not represent reduced reliance on the Delta for California's future water needs.

151. An updated report accepted into evidence of this proceeding from Sacramento Valley Water Users uses many similar adjustments to Petition Facilities' operations in CalSIM II modeling. (SVWU-107.) On average, this report found that while there would be a 2.5 MAF

reduction in total South Delta diversions, there would still be a 491 TAF increase in total Delta exports, a 63 TAF increase in Jones Pumping Plant exports for the CVP, and a 428 TAF increase in Banks Pumping Plan exports for the SWP—all relative to the report's consistent adjustments of the No Action Alternative (NAA). Average Delta outflow would decrease by about 464 TAF compared with the NAA. (*Id.*, pp. 49-54, Figures 39, 41, 42, 43, and 46; SVWU-110, slides 36-38, 44-46, and 49-51.)

152. These statements by Petitioners make clear that increased conveyance capacity offered by Petition Facilities boosts not just contractual water supply reliability, but also market-based or "supplemental demand" supply reliability.

153. Petitioner DWR presented modeling scenario results for Petition Facilities in its draft "Water Available for Replenishment Report" issued in January 2017 that shows that Petition Facilities would increase SWP and CVP exports to south of Delta water contractors compared with "No Action." (RTD-1011, p. 56, Figure 11.) This contradicts other claims made by Petitioner DWR that Petition Facilities are intended strictly to maintain existing SWP and CVP export and delivery levels to their water contractors.

154. The Westlands Water District Board of Directors received a staff report for the meeting of September 19, 2017 that analyzed the merits of financial participation in Petition Facilities (under the project's public name "California WaterFix" [CWF]). The report stated that:

> …staff projects that the average combined exports of the SWP and CVP with the CWF will [ap]proximate Boundary 1 (5.6 — 5.8 MAF). Moreover, the increase in exports with the CWF, when compared to existing conditions, will be approximately 1 MAF in all years except Critical years, when the increase is projected to be approximately 400,000 AF. These projects are uncertain, however, because the ongoing re-initiation of consultation on long-term operations of the CVP and SWP may result in additional constraints on south Delta exports and the SWRCB may in the ongoing CWF water right proceedings impose outflow criteria that dramatically reduce the yield of CWF.

(RTD-1012, pp. 6-8.)

155. The Westlands staff report states that a reason to participate financially in Petition Facilities is that these Facilities would eliminate a "water loss of approximately 20—30%" to what is called carriage water—fresh water typically from the Sacramento River that

creates an hydraulic barrier against tidal salt water entering the western Delta as water passes from the Delta Cross Channel into the central Delta to the south Delta pumps. The significance of reducing carriage water losses would be to increase potential water transfer supplies crossing the Delta through Petition Facilities:

> The CWF would eliminate this loss, which would have a positive effect on the "through the meter cost" of transfer water from north-of-Delta agencies. In addition, the existence of the CWF would improve the opportunity to obtain transfer water from north-of-Delta sources and potentially expand the transfer window beyond the July through September period. The August 29, 2017 presentation by Terry Erlewine and Allison Febbo estimate that the mean increase in transfer capacity with CWF is approximately 915,000 acre-feet. In a dry year, the increase in transfer capacity with CWF would be approximately 1.135 MAF. The analysis presented by Mr. Erlewine and Ms. Febbo demonstrates that restored water supply and increased transfer capacity resulting from the CWF would aid Westlands' compliance with SGMA [Sustainable Groundwater Management Act].

(RTD-1012, pp. 9-10.)

156. On October 26, 2017, the California WaterFix Change Petition hearing service list received a letter from Thomas W. Birmingham, Westlands Water District general manager. The Westlands Board voted not to participate in the project "as presented", he stated, but "not based on any opposition to the project," and that "Westlands continues to support efforts to implement the California WaterFix." Mr. Birmingham explained that their decision was largely a reaction to Petitioner Reclamation's "participation approach" that simply recovered CVP contractors' costs without providing any up-front federal financing for the project—financing which, it is my understanding, involves taxpayer subsidies from across the United States. If CVP contractors like Westlands had to shoulder costs of "incremental water supply" produced by the project, it would be too expensive, resulting in Mr. Birmingham's estimate of "an average blended cost of $565 an acre-foot." Assuming cost allocation issues facing Westlands and perhaps other CVP contractors can be resolved, Mr. Birmingham expressed confidence that "Westlands will revisit its decision." He further stressed that "the decision to not participate was not based on the merits of the project." (RTD-1013 p. 1; emphases in original.)

157. It is my testimony that, despite the Westlands Board's action not to participate at this time, in financing Petition Facilities that same day, the Westlands Water District staff

analysis of and continued support for Petition Facilities' yield indicates expectation of increased exported water to south-of-Delta contractors—an expectation contrary to the State Legislature's command to reduce reliance on the Delta for California's future water needs.

158. A draft "Policy Regarding Administration of California WaterFix Yield within Kern County" was considered at Kern County Water Agency's (Kern County) Board Meeting on October 26, 2017. (RTD-1014.) It states that "[o]n November 14, 2013, the Kern County Water Agency hosted a policy meeting to review and discuss potential options for the administration of *additional State Water Project ("SWP") yield resulting from participation in California Water Fix ("WaterFix Yield*")." (*Id.*, p. 1; emphasis added.) The goals and objectives stated in the draft policy include: "Encourage Member Units to acquire WaterFix yield"; "Mitigate risk and expense associated with commitment to incremental WaterFix Yield through market opportunities"; "Maximize incremental WaterFix Yield for Kern County"; and "Preservation of the groundwater basin/no net increase in demand" in Kern County. (*Id.*) Water sales by Member Units are further contemplated: "A Member Unit may sell or assign all or a portion of its allocated share of WaterFix Yield subject to the following:…Assignments or sales may be negotiated between Member Units…" (*Id.*, p. 2, subd. 5.a.)

159. A report compiled by Kern County for its Board's decision-making about financial participation in Petition Facilities stated "Average Improvement in [SWP] Project Water Supply" would be 1.3 MAF per year. (RTD-1015, p. 71, Table 9.) Kern County's "overall share of California WaterFix" was projected to be 13.33 percent. (*Id*.) Expressed as water yield from Petition Facilities, this would be an average improvement in imported water supply of approximately 173 TAF per year. This average improvement represents a potential for increase, not reduction, of SWP deliveries to Kern County.

160. The draft policy also states that Member Units may sell to other SWP contractors within Kern County:

> In the event the Member Unit is unable to negotiate an assignment or sale with another Member Unit, the Member Unit may then negotiate with other entities within the State Water Project service area of the Kern County Water Agency and the terms and conditions of the assignment or sale, including price, shall be as agreed upon by the buyer and seller.

(RTD-1014, p. 2, subd. 6.d.)

161. The draft policy further states that Member Units may sell to other State Water Contractors as follows:

> In the event the Member Unit is unable to negotiate an assignment or sale with other entities within the State Water Project service area of the Kern County Water Agency, the Member Unit may then negotiate with other State Water Contractors and the terms and conditions of the assignment or sale, including price, shall be as agreed upon by the buyer and seller. However, such assignment or sale shall be subject to a first right of refusal by other Member Units and/or entities within the SWP service area of the Kern County Water Agency.

(*Id.*, pp. 2-3, subd. 6.e.)

162. It is my understanding that the Metropolitan Water District of Southern California (MWD) is a state water contractor with the largest Table A amount in its contract of any contractors within SWP. In one of its "white papers" issued this summer, MWD stated that Petition Facilities would improve SWP and CVP export water quality through the use of its "dual intake system" because Sacramento River water quality in the vicinity of north Delta intake sites "is generally lower in salinity, organic carbon, and nitrates as compared to the San Joaquin River and south Delta." (RTD-1007, p. 15.) The "white paper" claims that relative to the No Action Alternative, Petition Facilities' operations would reduce levels of salinity in export water by 18 to 22 percent; of total dissolved solids by 17 to 22 percent; of bromide by 31 to 43 percent; of organic carbon by 2 to 11 percent; and of nitrates by 5 to 27 percent. (*Id*.) Water quality is important to MWD for blending with poorer quality Colorado River Aqueduct supplies. According to MWD:

> To meet these blending goals, on average Metropolitan needs 950,000 acre-feet of SWP supplies. Without the water supply reliability improvements provided by the California WaterFix, Metropolitan will be less likely to meet this salinity goal.

(RTD-1009, p. 5.)

163. By managing "high flow events," states MWD, "an additional 1.2 MAF could have been diverted if California WaterFix had been operational in 2016." (RTD-1007, p. 13.) However, Mr. Leahigh's written testimony, however (upon which MWD relied for its above-

quoted statement), qualifies this modeling result for annual average yield from Petition Facilities, stating that:

> On average, the annual amount of water diverted and stored by the SWP/CVP, as a result of CWF with the Initial Operational Criteria indicates that the combined SWP/CVP average annual combined diversions may be the same as the no action alternative or may increase up to approximately 500 thousand acre-feet (TAF). Though just over 1.2 MAF of water could have been diverted and stored January through April 2016 with the project in place, the proposed operating rules for CWF would require reduced pumping during drier periods in order to protect the environment.

(DWR-61, p. 18:6-18, and p. 19:1-26; indented quote, p. 19:16-20.) MWD, however, omitted Mr. Leahigh's qualification of Petition Facilities yield, however, evidently preferring the larger estimate for early 2016, except to say that "the actual quantity that may be diverted under similar circumstances in the future could be less than predicted." (RTD-1007, p. 14.)

164. Like Westlands and Kern County, MWD informed its Board that Petition Facilities "would significantly increase the amount of available capacity to accommodate the movement of water transfers across the Delta and the SWP and CVP system." (RTD-1007, p. 14.) MWD stated that "[f]uture water transfers or particular quantities of transfers are not components of California WaterFix," because "any amounts and locations of future water transfers are speculative" and subject to "regulatory approvals and environmental review." Water Code section 1729 states, however, that "[a] proposed temporary change [of place of use to a water right for a water transfer] under this article shall be exempt from the requirements of" CEQA. "Even with these considerations," states the MWD operations white paper, "California WaterFix would provide much greater capability to manage transfers." (*Id*.)

165. It is my understanding that available unused capacity in any regional or local publicly owned water conveyance facilities, including in the California Aqueduct, must be made available for bona fide transfers, provided fair compensation is paid. (SWRCB-102, p. 1-342:9-11; Water Code section 1810.) Given this legal requirement in the California Water Code, increasing conveyance capacity for cross-Delta water transfers during droughts would make it easier for the state and federal government to facilitate water transfers in drier years. Thus, it

would be easier for south-of-Delta SWP and CVP water contractors to employ market forces to pay for and receive Sacramento Valley surface water and groundwater supplies for the benefit of south-of-Delta water contractors.

166. It is my testimony that the Change Petition creates expectations expressed in state and federal water contractor policy documents and staff analyses that additional yield above and beyond SWP contract Table A amounts would be forthcoming from Petition Facilities—expectations driving actions by these entities and Petitioners whose intended outcomes are contrary to the State Legislature's command to reduce reliance on the Delta. (Water Code section 85021.) MWD's Board voted to approve financial participation in the project on October 17, 2017. Kern County's Board voted to approve financial participation in the project on October 26, 2017.

167. In wet or above normal years, these expectations would be met through allocations to meet contractual demands via each project's normal allocation process. In drier years, as indicated by BDCP water transfer modeling assumptions described herein, expectations of these and other SWP contractors would be fulfilled via market-based transfers to meet their Table A contractual demands as much as possible.

168. Petition Facilities are intended to facilitate both more reliable contractual deliveries *and* a water transfer market that moves north-of-Delta willing sellers/senior water right holders' supplies through the Delta in exchange for monetary compensation. The only question in the long-term with a Petition Facilities in place (from the standpoint of objectives, purpose, and need) would be when and under what project allocation conditions water from north of the Delta moves—under contract terms, or under market-based transfer activity. In my opinion, based on this evidence, market-based water transfers are obscured in the Change Petition and Petition Facilities' environmental compliance documentation. They are an important part of Petitioners' and water contractors' efforts to maintain, not reduce, Delta reliance for California's future water needs. Petition Facilities (and the Change Petition containing them) therefore fail to comply with the Legislature's command that reduced Delta reliance for California's future water needs is statewide policy. (Water Code section 85021.)

169. It is my opinion, though I am not a lawyer, that the Legislature's command that it is the policy of California to reduce reliance on the Delta for the state's future water needs is entitled to deference by state agencies, including SWRCB. The foundation for my opinion in this matter is that in affairs of waters of the State of California, courts and state agencies like SWRCB have concurrent jurisdiction over claims made under Article X, Section 2 of the California Constitution. (RTD-1017, p. 7.) This subject was addressed by the California Office of the Attorney General to the Delta Vision Blue Ribbon Task Force in 2008:

> The Legislature has exercised the powers granted to it by the constitutional provision [Article X, Section 2]. For example, the Legislature has determined that it is the policy of the state to leave wild and scenic rivers in their free-flowing condition and that such use of the water is the "highest and most beneficial use and is a reasonable and beneficial use of water within the meaning of Section 2 of Article X of the California Constitution." (Pub. Resources Code, § 5093.50.) The Legislature has also enacted Fish and Game Code section 5937,…which requires dam owners to release water to keep fish below the dam in good condition, and section 5946, which requires the SWRCB to insert compliance with section 5937 in water rights permits and licenses in Inyo and Mono Counties. In *California Trout, Inc. v. State Water Resources Control Board* (1989) 207 Cal.App.3d 585, the court considered this law to be not only a specific expression of the public trust, but also a legislative determination that such use was reasonable. "We find no preclusion in article X, section 2 of legislative power to make rules concerning what uses of water are reasonable at least so long as those rules are not themselves unreasonable…." [citation] Where various policy views are held concerning the reasonableness of a use of water, the view enacted by the Legislature is entitled to deference by the courts.

(RTD-1017, p. 5.)

170. Given the concurrent jurisdiction of the courts and the board, the Legislature is owed deference from SWRCB in the matter of reduced Delta reliance for California's future water needs and based on evidence provided herein, Petitioners' Change Petition fails to defer to the clear determination of the Legislature on this matter.

THE PROPOSED CHANGE PETITION FACILITIES WOULD BE AN UNREASONABLE METHOD OF DIVERSION OF WATER AND THEIR APPROVAL WOULD THEREFORE NOT BE IN THE PUBLIC INTEREST AND SHOULD BE DENIED.

171. Petitioners, through their Change Petition for California WaterFix, propose to construct and operate an unreasonable method of diversion of state and federal water supplies from the San Francisco Bay-Delta Estuary along the lower Sacramento River, and to continue

operating unreasonable methods of diversion at existing Tracy Pumping Plant and Banks Pumping Plant facilities of CVP and SWP. The California Constitution, Article X, Section 2 requires that the manner and location of diverting water out of streams and rivers must always be reasonable. This passage commands that the conservation and use of waters must implement as many relevant beneficial uses as may be reasonable. An unreasonable method of water diversion may impair beneficial uses. Because California's water supplies are limited, "the public interest requires that there be the greatest number of beneficial uses which the supply can yield." (*Peabody v. City of Vallejo* (1935) 2 Cal.2d 351, 368.) Because there are many feasible alternatives to meeting California's future water needs—especially in light of the Legislature's command to reduce reliance on the Delta in meeting them—approval of the Change Petition and its Facilities would violate Article X, Section 2.

172. It is my testimony that reasons for denial of the Change Petition include:

1) Approval of the Change Petition is unreasonable because of Petitioners' lack of compliance with the scheme for acquiring and diligently exercising appropriative water rights permits. (RTD-10rev2, ¶ 17-28.)

2) Approval of the Change Petition is unreasonable because it is unreasonable for Petitioners to use a change petition for Petition Facilities that will have region-wide effects, including changes to the predominant source of water diverted, in violation of the principle that "a right cannot be so changed that it in essence constitutes a new right." (SWRCB Water Rights Order 2009-0061, p. 5; Cal. Code Regs., tit. 23, § 791, subd. (a).)

3) Approval of the Change Petition is unreasonable as a method of diversion because, given Petition Facilities' regional-scale effects, the Change Petition process does not call for analysis of whether and how much water is available for Petition Facilities to divert.

4) Approval of the Change Petition is unreasonable as a method of diversion because the processing of the Change Petition is contrary to law and good planning practice for determining beneficial uses to be protected and the water quality objectives and "appropriate Delta flow criteria" to accomplish that protection. In short, the proceeding at hand places setting of appropriate Delta flow criteria applicable to Petition Facilities prior to a watershed-wide planning process for determining tributary inflow requirements, cold water requirements, and Delta outflows to which Petition Facilities would otherwise have to conform. Plumbing should not come before planning.

5) Approval of the Change Petition is unreasonable as a method of diversion because the manner by which Petition Facilities would divert water would cause unavoidable negative impacts to Delta fish species, many of which are protected as rare, endangered, or threatened, because fish screens proposed to mitigate such impacts have high uncertainty of success, and because new water management structures among Petition Facilities would create more "predation hotspots."

6) Approval of the Change Petition is unreasonable as a method of diversion because the project's claimed purpose and need fail to reduce reliance on the Delta for California's future water needs, as commanded by the Legislature, as previously described herein.

7) Approval of the Change Petition is unreasonable as a method of diversion because it would increase the use of the imported supplies it creates for application to irrigate lands in the service area of the San Luis Unit of CVP that are either drainage-impaired, naturally contaminated with selenium, boron, arsenic and other toxic

stressors, or both. Drainage from these lands, while bypassing the historic and environmentally sensitive Grasslands Area, return with San Joaquin River runoff to the Delta and, in the presence of Petition Facilities' operations, would increase risks of benthic food web contamination and toxic tissue loading in listed fish species like green sturgeon, as previously described herein. Specifically, estuarine (EST) and wildlife (WILD) beneficial uses would be degraded or impaired as a result.

Approval of the Change Petition is unreasonable because of Petitioners' lack of compliance with the scheme for acquiring and diligently exercising appropriative water rights permits.

173. I testified and presented evidence accepted into the record in Part 1B that Petitioners improperly submitted a change petition implicitly contending that their existing permits are for projects not yet completed. It was my testimony in Part 1B that (1) the three new points of diversion (SWRCB-102, Volume 2 [Master Responses], p. 1-114:5-8) are not the same as the existing DWR water right permit that contains a single diversion at Hood, and (2) the single point of diversion at Hood for the Peripheral Canal proposal was rejected by the California electorate in 1982. As a consequence, the diversion point at Hood has not been diligently developed as required by California's prior appropriation doctrine. (3) Petitioners' existing water right permits are expired and should be licensed, since the rest of their CVP and SWP facilities in the water right permits are completed and putting water to beneficial use; (4) consequently, Petition Facilities' diversion points, if they are to comply with California's scheme for appropriate water rights acquisition, should be the subject of a new water right application with a priority date reflecting when this new application is eventually filed; and (5) finally, the nature of the diversion points for California WaterFix would take water out of Delta channels and isolate it from through-Delta flow, resulting in depletions in a different river source and location of the Delta than now occurs. This too is a distinct difference from the nature of the diversion originally included in the state water right permits and therefore requires a new application to appropriate.

174. Complicating SWRCB's consideration of this Change Petition is the fact that SWRCB has delayed decisions since 2009 on Petitioners' earlier Requests for Time Extensions

for their existing Delta-related water rights permits, as described in my Part 1B testimony for Restore the Delta. (RTD-10rev2; SWRCB exhibits 6 through 9 for Petitioner DWR's permits; SWRCB exhibits 10 through 19 for U.S. Department of the Interior's permits; RTD-118; RTD-121.) While Restore the Delta was not a protestant to Petitioners' requests for time extensions, I was retained by California Water Impact Network at the time and participated in correspondence with both SWRCB and Petitioners' representatives on the Network's behalf at that time. As a party to this proceeding, Restore the Delta briefly but firmly asserts that these existing permits have long been complete and that Petitioners and SWRCB should have processed licenses for CVP and SWP facilities as mandatory ministerial actions by SWRCB. (RTD-10rev2; *California Trout v. State Water Resources Control Board* (1989) 207 Cal.App.3d 585, 611.) However, delay by both Petitioners and SWRCB has led to cold storage of water rights by Petitioners, tolerated by SWRCB, and contrary to California's prior appropriation doctrine. (RTD-10rev2, pp. 13-19, ¶s 40 through 60.)

It is unreasonable for Petitioners to use a change petition for Petition Facilities that would have region-wide effects, including changes to the predominant source of water diverted, violating the principle that "a right cannot be so changed that it in essence constitutes a new right."

175. SWRCB has previously stated that criteria for initiating a new water right include primarily expanding an existing right by volume, increasing the season of diversion, and/or seeking a new source of water to satisfy the right. (Water Rights Order 2009-0061, pp. 5-6.)

176. Existing SWP and CVP pumping plants, operable gate facilities, and temporary rock barriers in the Delta have ecosystem-scale and region-wide effects reflecting manipulations in the estuary by SWP and CVP water management, according to researchers Nancy E. Monsen, James E. Cloern, and Jon R. Burau. ("researchers"; RTD-157.) These researchers found that under high export activity:

> Old and Middle Rivers become a freshwater corridor of Sacramento-derived water. On 6 October 2001, the Mildred Island region [a flooded island along the Middle River corridor] was dominated by Sacramento-derived water. However, San Joaquin source water dominated the region on 6 November, after a month of pump curtailment when the Sacramento freshwater corridor was constricted to Old River [to the west]. The San Joaquin source of water increased inside Mildred Island because the regional mass balance changed: less Sacramento-derived water

> entered from the north and more San Joaquin derived water exchanged with Mildred Island from the channel at its southeast corner.

(*Id.*, p. 4-5.)

177. Salinity also changed in response to pumping curtailment between Mildred Island and its surrounding channels, with salt exiting Mildred Island to be exported at the pumps during high export activity. When pumping subsided, the researchers observed in some periods that salt re-entered Mildred Island from the direction of the San Joaquin River. (*Id*.) They concluded from this example that "exports generate regional responses. Salinity in the central Delta changed almost instantaneously with changes in export diversions occurring 25 km [about 16 miles] away." (*Id*., p. 8.)

178. The researchers also investigated flow and salinity changes associated with Delta Cross Channel (DCC) gate operations. Located along the Sacramento River near Walnut Grove, DCC supplies SWP and CVP stored water to central Delta channels (including mixing with Mokelumne River distributaries via Snodgrass Slough) to a point where south Delta pumping action can pull the stored water in for export. When the gates are closed, such as on 26 November 2001 on which the researchers report, more Sacramento River water flows down the main stem from Walnut Grove toward Rio Vista and beyond and away from the central Delta. The researchers observed that, on one hand, "less fresh water was available in the central Delta to prevent salinity intrusion on the San Joaquin stem of the western Delta." (*Id*., p. 9.) On the other hand, "[s]alinity decreased at Emmaton on the Sacramento River, but tidally-averaged salinity increased almost immediately on the San Joaquin at Jersey Point and Dutch Slough. Salt intrusion into the San Joaquin progressed until export pumping was curtailed on 10 December" to avoid violating Contra Costa Water District's Rock Slough diversion water quality objective of 250 mg/L chlorine standard. (*Id*.) Export pumping curtailment enabled more fresh San Joaquin-derived water to repel intruding sea water and reduced salinities at both Jersey Point and Dutch Slough. In sum, the researchers found that "changes in DCC operations altered salinity across the central Delta including the large shallow habitat of Franks Tract." (*Id*., p. 10.) They concluded that this example:

> illustrates how a localized diversion in the north Delta can influence regional-scale water quality through its modification of the flow paths of Sacramento- and San Joaquin-derived river water….The Delta is subjected to multiple diversions and this example highlights the compounding effect of gate and export operations on salinity distributions.

(*Id*.)

179. These two examples illustrate the regional-scale effect of existing SWP system facilities in the Delta. My Part 1B testimony draws on Petitioners' environmental documentation to show the regional-scale effects on hydrodynamics and flow in and through the Delta, indicating that Petition Facilities will remove fresh water from the Sacramento River causing flow reductions evident for at least a stream-length of 21 miles; increased frequency of reverse flows or "upstream transport" at times of reduced Delta inflow; increased residence time of water; and altered water sources in various Delta locations. (RTD-10rev2, pp. 31-37, ¶ 95-112; p. 37, ¶ 113; p. 37-38, ¶ 114-115; p. 38, ¶ 116.) My testimony also stated that flow alterations would lead to water quality changes that would violate water quality objectives and degrade water quality in the Delta and which would adversely affect the City of Stockton's drinking water and groundwater supplies. (*Id.*, pp. 38-41, ¶ 117-124; pp. 41-47, ¶ 125-140; pp. 47-48, ¶ 141-142.)

180. The flow and water quality alterations I just summarized would be accomplished by removal of water from the lower Sacramento River in the north Delta by Petitioners' proposed intake facilities. (RTD-10rev2, p. 5:19-22.) No part of the proposed method of diversion is at present described or addressed by existing permits for the SWP and CVP. Nor are any facilities contained in the Petition authorized by state or federal legislation. (*Id*., p. 5:23-25.) Petition Facilities are not represented in any of the existing Petitioners' water rights permits. Consequently the Change Petition's requested rights for three new north Delta points of diversion represent a change in the essence of Petitioners' existing water rights and thus exceed any reasonable basis on which change petitions could be properly granted by SWRCB. The source of water for Petitioners' water rights would be fundamentally altered from its present mixed sources of San Joaquin and Sacramento River water to one that would become

predominantly sourced from Sacramento River water. The flow and water quality characteristics of the Delta estuary would be fundamentally changed by Petition Facilities' introduction of a method of diversion that removes Sacramento River water from downstream Delta channels into diversions connected to tunnels beneath the estuary for conveyance to Jones and Banks pumping plants. This change in the source of water for Petitioners' water rights permits is further confirmed by modeling results for Petition Facilities' north and south Delta exports comparing the No Action Alternative with Alternative 4A. North Delta exports increase from zero (0) TAF to 2,435 TAF in the long-term average; 0 TAF to 3,763 TAF for the wet year average; and 0 TAF to 1,082 TAF in the dry and critical year average. (SWRCB-102, Figures 5-51, 5-52, 5-53; see also Figures 5-65, 5-66, and 5-67.)

181. Herein I have also indicated that Petitioners and important CVP and SWP contractors have created and nurtured expectations that overall SWP and CVP exports would increase. Such expectations, while contrary to the Delta Reform Act as noted herein, are also evidence of expectations that water rights to divert and export from the Delta would be exceeded; in which case, the Petition Facilities should be processed as an initiation of a new water right. (RTD-10rev2.)

182. It is unreasonable for Petitioners to use a change petition for Petition Facilities that would have such region-wide deleterious and degrading effects on flow and water quality in the Estuary, including but not limited to changes in the predominant source of water currently diverted by removal of Sacramento River water from flow through other Delta channels. This would violate the principle in Title 23 of the California Code of Regulations that "a right cannot be so changed that it in essence constitutes a new right." (SWRCB Water Rights Order 2009-0061, p. 5; Cal. Code Regs., tit. 23, § 791, subd. (a).)

Petition Facilities are unreasonable as a method of diversion because the Change Petition process, including SWRCB's duty to impose appropriate Delta flow criteria on them, does not require analysis of whether and how much water is available for Petition Facilities to divert, given Petition Facilities' regional-scale effects.

183. It is my understanding that courts and state agencies addressing competing water rights claims of parties throughout a watershed should take into consideration all of the water

available and then determine, considering the entire supply, the needs of the parties, their methods of use, methods of diversion, and other necessary factors. (*Rancho Santa Margarita v. Vail* (1938) 11 Cal.2d 501, 558.) Indeed, California Constitution, Article X, Section 2's purpose is to ensure that the state's water resources will be available for the constantly changing needs of all of its people, according to the California Office of the Attorney General (citing case law). (RTD-1017, p. 4.) SWRCB is obligated under statutory and case law to set water quality standards, including "appropriate Delta flow criteria," to protect beneficial uses, even if it means that other water users would have to contribute to that protection. (RTD-1017, p. 10; RTD-1019, p. 2; *United States v. State Water Resources Control Board* (1986) 182 Cal.App.3d 82, 120.) SWRCB must consider all competing demands for water in determining a reasonable level of water quality protection. (RTD-1019, p. 4.)

184. SWRCB performs water availability analysis when considering new water rights applications. Because this proceeding goes forward considering a Change Petition for Petitioners' California WaterFix project, it appears that no SWRCB water availability analysis will be performed. However, SWRCB summarized Central Valley Bay-Delta watershed water rights for the Delta Vision Blue Ribbon Task Force (Task Force) in 2008, finding that as part of a water availability analysis, SWRCB:

> looks at both the demand characteristics associated with the proposed use and the likelihood that supply will be adequate to supply that demand. The State Water Board is required to maximize the beneficial use of water. Historically, the State Water Board has approved permits for agricultural projects if water is available in 50 percent of years, under the condition that water cannot be diverted in years in which there is insufficient supply to satisfy prior vested rights.

(RTD-1018, p. 3.)

185. Restore the Delta has included in its case in chief exhibit RTD-131, a water availability analysis of Sacramento and San Joaquin River watershed water rights for SWRCB's consideration here. This study's methodology incorporates SWRCB 2010 DFC Report public trust determinations for Delta inflow sources and estimates water availability for diversion under claimed water rights. In other words, it examines public trust beneficial uses together with claimed water rights. Petitioners' contractors include many agricultural water agencies south of

the Delta. As indicated herein, some agricultural water agencies actively entertain expectations of obtaining deliveries of irrigation water via Petition Facilities once constructed and in operation. I know of no analysis performed by SWRCB or any other party to this proceeding that examines whether water is actually available in 50 percent of years to satisfy either their expectations or their Table A contract amounts, or those of any other SWP contractors, or those of other non-propertied beneficial uses.

186. In summarizing case law concerning SWRCB's water quality planning role (which also includes "appropriate Delta flow criteria"), the California Office of the Attorney General informed the Task Force that SWRCB must establish water quality standards at the level needed to protect all beneficial uses in the Delta, not just those of water rights holders. (RTD-1019, p. 4.)

187. When it approved Water Rights Decision 1485 in 1978, SWRCB employed a "without project" level of protection: "[t]he objectives were designed to maintain the levels of water quality in the Delta which would theoretically exist if the [SWP and CVP] projects had never been constructed." (*Id*.) The California Third District Appellate Court found this in error. Conducting this proceeding as it has, SWRCB risks unreasonably setting appropriate Delta flow criteria for the Petition Facilities' permit conditions based on comparison of the No Action Alternative with Alternative 4A of Petition Facilities, which would be similar to committing its error of forty years ago. Such a process is contrary to SWRCB's role in setting "appropriate Delta flow criteria," required by the Legislature, where it must protect all beneficial users in the Delta.

188. Establishing appropriate Delta flow criteria for the Petition Facilities must be based on a reasonable water availability analysis that fulfills SWRCB's responsibilities under the Delta Reform Act, the Porter-Cologne Water Quality Control Act, and the California Constitution, Article X, Section 2.

Thank you for the opportunity to provide this testimony.

DATED: November 29, 2017

TIM STROSHANE