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

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11
12
13 HEARING IN THE MATTER OF
14 CALIFORNIA DEPARTMENT OF WATER
15 RESOURCES AND UNITED STATES
16 BUREAU OF RECLAMATION REQUEST
FOR A CHANGE IN POINT OF DIVERSION
FOR CALIFORNIA WATERFIX

TESTIMONY OF MICHAEL MACHADO

1 I, Michael Machado, a board member with Restore the Delta, do hereby declare:

2 INTRODUCTION

3 1. I earned a bachelor's degree in economics from Stanford University and a master's
4 degree in agricultural economics from the University of California, Davis. For many years, I have
5 owned and operated P & M Farms, a diversified Central Valley family farming corporation based in
6 Linden (San Joaquin County), which has been in my family for three generations spanning over 100
7 years. Our farm possesses riparian pre-1914, and post-1914 water rights. In 1988 I attended Harvard
8 Agribusiness School in London, England. I subsequently served three terms in the California State
9 Assembly between 1994 and 2000 representing the 17th district, and two terms in the California State
10 Senate between 2001 and 2008 representing the 5th district. From 2010 to 2013, I served as executive
11 director of the Delta Protection Commission (DPC), where among my duties I implemented
12 direction from the Delta Legislative Package of 2009 for the commission to prepare and implement a
13 Delta Economic Sustainability Plan (DESP). (Public Resources Code [PRC] Section 29759.)

14 SUMMARY

15 2. I address the following issue prompts for Part 1 of the evidentiary hearing from the
16 Notice of Petition and Public Hearing, dated October 30, 2015, concerning the petition to change
17 points of diversion and rediversion concerning the California WaterFix project:

- 18 a. Will the proposed changes cause injury to any municipal, industrial or agricultural
19 uses of water, including associated legal users of water?
20 b. Will the proposed changes in points of diversion alter water flows in a manner
21 that causes injury to municipal, industrial, or agricultural uses of water?
22 c. Will the proposed changes in points of diversion alter water quality in a manner
23 that causes injury to municipal, industrial, or agricultural uses of water?

24 3. The 2011 DESP studied impacts of salinity changes that would result from flow and
25 water quality alterations that were known in broad terms at the time the Plan was prepared. My
26 testimony will summarize the study methodology and describe its results.

1 RELATIONSHIP OF THE DESP TO THE CHANGE PETITION

2 4. Nearly all water right holders in the Delta are either farmers irrigating crops or
3 owners of recreation and tourism enterprises, diverting and using water from Delta channels to
4 benefit their businesses. Water flow and quality alterations are expected from the Petition facilities.
5 My testimony summarizes how the DESP examined the economic impact of changes to salinity in
6 the Delta and what impacts would be expected from such changes. Its findings are relevant to
7 SWRCB's evaluation of the Petition. Injury is measurable at a broad scale through economic
8 analysis of the biophysical changes wrought by changes in flow and salinity conditions. These
9 conditions feedback through economic and irrigation decisions that farmers must make at the field
10 level. Every irrigation season, they decide whether and how much to use irrigation water from Delta
11 channels on their crops.

12 5. The Delta Protection Commission retained Dr. Jeffrey Michael, an economist with
13 the University of the Pacific's Eberhardt School of Business, to prepare the DESP. Among the
14 DESP's goals, the plan was to model effects on Delta agriculture of water policy proposals affecting
15 salinity.

16 AGRICULTURAL ECONOMIC BACKGROUND OF THE DELTA

17 6. This section of my testimony summarizes the geography of Delta agriculture.

18 7. Close to eighty (80) percent of all Delta farmland is categorized as prime farmland
19 according to California Farmland Mapping and Monitoring Program. (RTD-301, p. 107, and
20 Figure 20, p. 112) In 2010, total cropped acreage covered 423,727 acres, not including 38,000 acres
21 of grazing land. The top five Delta crops in terms of acreage in 2010 were corn, alfalfa, processing
22 tomatoes, wheat, and wine grapes. The top five crops in 2010 in terms of value were processing
23 tomatoes, wine grapes, corn, alfalfa, and asparagus. Total direct crop value in 2010 came to \$702
24 million, with truck and vineyard crops combining for 59 percent of this value. The highest per-acre
25 crop values come from truck crops mainly in the south Delta and from deciduous crops in the north
26 Delta. Animal production in the Delta came to about \$93 million in 2010. (RTD-301, p. 107.)

27 8. The DESP mapped the agricultural crop pattern of the Legal Delta based on publicly
28 available 2009 crop data. Appendix G of the DESP defines the broad crop categories used in its

1 economic analysis of agriculture. (RTD-301, Appendix G, p. G-5) Field and grain crops were
2 concentrated along the corridors of the Cache Slough complex, Ryer Island, the lower Sacramento
3 River south of Isleton, the vicinity of Georgiana Slough and the Mokelumne River, the mainstem
4 San Joaquin River, and the Old and Middle River corridors. These crops also occur in small pockets
5 from the northern end of the Delta along the Sacramento Deep Water Ship Channel to the southern
6 end in the corridors of Victoria and Grant Line canals almost to Vernalis. (RTD-301, p. 113,
7 Figure 21.)

8 9. Deciduous and vineyard crops were concentrated in the north Delta from north of
9 Clarksburg along the Sacramento River, past Walnut Grove to nearly Isleton. These crops occur
10 along Elk, Sutter, and Steamboat Sloughs, as well as occurring on the east side of the Sacramento
11 River from south of Hood to areas just east of Walnut Grove. A few parcels of vineyard and
12 deciduous crops dot agricultural lands southwest of Stockton. (RTD-301, *Id.*)

13 10. Truck crops are varied and numerous, and include such crops as artichoke, asparagus,
14 lima beans, tomatoes, peppers, celery, cucumber, eggplant, berries, beets, sweet corn, garlic and
15 herbs, turnips, melons, lettuce and chard, onion, carrots, peas, potatoes, and squashes. (RTD-305,
16 Appendix G, p. G-5, Table G-3.) Truck crops were concentrated in the south Delta, with pockets
17 along Steamboat Slough, Georgiana Slough, Terminous, Bouldin, McDonald, and King Islands,
18 Rindge Tract, Victoria, Union, and Roberts Islands, and along Fabian Tract. (RTD-301, p. 113,
19 Figure 21.)

20 11. Pasture lands for animal grazing typified western Delta islands (for example,
21 Bradford, Jersey, and Holland tracts, as well as in the northern lands north and west of the Cache
22 Slough complex and in the southwestern vicinity of Clifton Court Forebay. (RTD-301, *Id.*)
23 Delta agricultural revenues came to \$702.4 million based on 2009 acreage, according to the DESP.
24 (RTD-301, p. 114, Table 9.) The spatial distribution of crop revenues per acre was mapped in the
25 DESP. Higher revenue-per-acre fields (those with \$801 per acre and above) are found throughout the
26 legal Delta, but are concentrated along the mainstem Sacramento River from Freeport to Isleton, as
27 well as in eastern Delta lands from north and east of Walnut Grove to Stockton. Such higher revenue
28 fields are also interspersed throughout the south Delta where truck crops are grown. Lower revenue-

1 per-acre fields (generally coinciding with field, grain, and pasture crops) are found along the
2 Sacramento Deep Water Ship Channel and the Cache Slough complex (interspersed with higher
3 revenue-per-acre vineyards), as well as on Staten Island between the Mokelumne River and
4 Georgiana Slough; Bouldin, Venice and King Islands; and Empire and Rindge Tracts. Much of the
5 south Delta area also shows many lower revenue-per-acre field and grain crops among the higher
6 revenue truck crops. This crop pattern in the south Delta reflects in part the contingency of salinity
7 conditions in south Delta river, slough, and canal channels. Neither truck nor field crops entail
8 permanent investments the way deciduous and vineyard crops do, and switching between such crops
9 can provide south Delta farmers with some revenue stability while controlling for other input costs
10 of planting and cultivating. By contrast, in the north Delta, prevailing salinity conditions in the
11 recent past are generally fresher than in the south, allowing north Delta farmers to invest in higher
12 revenue-per-acre permanent crops like deciduous and vineyard crops, especially along the
13 Sacramento River and Elk, Sutter, and Steamboat Slough areas. (RTD-301, Figure 22.)

14 12. The importance and impact of Delta agriculture goes beyond the local economy. The
15 DESP states that “the four most significant crops in the Delta—alfalfa, corn, processing tomatoes,
16 and wine grapes—are supporting a significant value-added chain in the region and state.” (RTD-301,
17 p. 117.) Linkages between the Delta’s key crops and other economic sectors from animal production
18 to the food processing of tomato canning and wine production are accounted for in the DESP to
19 arrive at the Delta’s wider economic impact.

20 13. Delta agriculture’s direct economic effects (not including food processing effects) on
21 the five Delta counties in 2009 included 4,132 jobs, \$146.7 million in labor income, \$361.7 million
22 in total value added, and about \$816 million in total output in the Delta region. The total effect of
23 Delta agriculture, including its indirect and induced effects, includes 9,600 jobs and \$1.4 billion in
24 total output. (RTD-301, p. 120, Table 13.) The Delta’s impact on California (not including effects on
25 food processing) represented 12,900 jobs and total output of \$1.64 billion in 2009. (RTD-301, p.
26 120, Table 14.)

27 14. When the Delta’s linkages include the food processing sector of the region’s five
28 counties and California were factored in, Delta agriculture’s regional impact supports nearly 13,200

1 jobs, \$594 million in labor income, over \$1 billion in value added to products, and total output in the
2 region of \$2.65 billion. (RTD-301, p. 121, Table 15.) This represents about \$200,859 of total output
3 per Delta farm job in the Delta region.

4 15. Its linkages into California's economy mean that Delta agriculture supports over
5 25,000 jobs statewide, \$1.25 billion in labor income (nearly \$50,000 on average per job that year),
6 \$2.1 billion in value added to the state's products, and in all, total output contributed to the state's
7 economy of \$5.4 billion. (RTD-301, p. 121, Table 16.) Such indirect and induced output and jobs
8 employ workers as varied as machinists repairing and making agricultural equipment and vehicles,
9 seasonally-hired food processing workers in plants throughout the Delta region, and truck drivers
10 hauling raw crops and finished products to market.

11 METHOD OF MODELING CROP PATTERNS IN THE DELTA

12 16. Farmers choose to plant crops (or not) based on a number of factors. These can
13 include: anticipated market demand for the crop, access to transportation routes for efficient delivery
14 to market, soil conditions, underlying land value, potential for conversion of their land to urban or
15 other use than agriculture, irrigation water availability, and irrigation water quality. The geographic
16 pattern of crops in the Legal Delta in 2010 reflects many of these factors. The DESP reported that
17 Delta farmers monitor salinity levels closely in their current operations and that some already incur
18 costs in chemicals and drainage systems to deal with current levels of salinity. (RTD-301, p. 127.)

19 17. Dr. Michael employed in the DESP a multinomial logit (MNL) model to estimate
20 farmers' crop choice at the field level in the Delta. He described in the DESP how such a model, and
21 related models, has wide usage in professional economic analysis. One of the model's developers,
22 economist Daniel McFadden at the University of California, Berkeley, was awarded the Nobel Prize
23 for these methods in 2000. Dr. Michael notes that MNL model methods have been used previously
24 to study irrigation technology choices and crop management practices. He applied an MNL approach
25 to Delta crop patterns in relation to urbanization potential as a method to estimate or predict future
26 Delta crop patterns given regional urbanization pressure on the Delta land market. The model
27 predicted that urbanization will reduce agricultural production in the Delta due to the loss of 26,625
28 acres of land to urban uses. (RTD-301, p. 123, Table 17.) Some farm land where probability of

1 urbanization was considered high or very high were confined to the western and southeastern
2 peripheries of the Legal Delta, including Bethel Island, Bishop and Shima tracts, Stewart Tract, an
3 area due west of French Camp and Lathrop, and around the northern periphery of the city of Tracy.
4 A few parcels in the north Delta were also identified to have very high probability of urbanizing, but
5 are small in size, and dispersed from each other. (RTD-301, p. 124, Figure 23.)

6 18. While taking account of potential farmland conversions to urban use, the DESP states
7 that urbanization pressure can also offer opportunities for agricultural entrepreneurs, particularly for
8 vineyard, fresh vegetables, and nursery products, as well as agri-tourism at the urban fringe. (RTD-
9 301, pp. 122-126.) Dr. Michael's use of MNL model methodology found that urbanization and the
10 increased income it can bring to the region can stimulate planting and cultivation of high value crops
11 in the Delta's future. With such stimulus from regional urbanization, there would be an estimated
12 \$111 million increase in total agricultural revenue, assuming current crop acreage and average crop
13 class revenue from 2009 prices (which were already \$702 million in 2009). But accounting for urban
14 pressure, the model predicted a decrease of \$43 million in direct Delta crop values relative to the
15 "baseline" model scenario in which no lands converted to urban uses. Future net crop revenue
16 growth factoring in urbanization was estimated at a net positive \$68 million. (RTD-301, p. 125,
17 Table 19.)

18 IMPACTS OF SALINITY CHANGES IN THE SOUTH DELTA

19 19. Turning to salinity impacts, the DESP reported that the MNL model found salinity to
20 have a statistically significant impact on crop choice in the Delta. (RTD-301, p. 130.) Dr. Michael's
21 modeling effort used salinity data from over 50 sites in the Delta region, and focused on salinity
22 effects during the irrigation season of May through August, when sensitive crops are most
23 vulnerable to salinity changes in irrigation supplies. Salinity values were mapped to each individual
24 crop field by using averaged salinity measurements across all measurement stations within a three-
25 mile radius of each crop field. If there were no measurement stations within that radius, then the
26 nearest station's measurements were used for that crop field. Salinity data were obtained from the
27 Interagency Ecological Program and the California Data Exchange Center. (RTD-301, pp. 129-130,
28 including Figure 24; RTD-305, Appendix G, pp. G-6 to G-9.)

1 20. The DESP summarized nine years of salinity conditions in Delta waters by Bay Delta
2 Conservation Plan (BDCP) conservation zone. (RTD-305, Appendix G, p. G-6.) Conditions are
3 generally fresher in the north Delta, with higher average electrical conductivities in the south Delta.
4 Averaging the data for the irrigation season has unfortunately masked spikes in the salinity data that
5 may occur during years when the average is considerably lower. The data set also contained salinity
6 conditions for six dry years out of nine. On average, the south Delta experiences significantly higher
7 salinity levels and more variability than do north Delta channels. This is due in part to significant
8 ambient differences in water quality, presence of reverse flows along Old and Middle rivers due to
9 State Water Project pumped diversions, and flow conditions on the Sacramento and San Joaquin
10 Rivers, as well as to climatic and hydrologic conditions. (RTD-301, p. 130.)

11 21. The DESP also provided background analysis of salinity issues as known in 2011. On
12 one hand, Phase 1 of SWRCB's Bay-Delta Estuary WQCP was proposing to increase salinity
13 objectives at interior south Delta channel monitoring locations from 700 to 1000 $\mu\text{S/liter EC}^1$ (at San
14 Joaquin River at Brandt Bridge, Old River at Middle River, and Old River at Tracy Boulevard
15 Bridge) as well as San Joaquin River at Vernalis during the irrigation season (April through
16 August).² This Phase 1 proposal by SWRCB would increase salinity objectives, and likely salinity
17 concentrations, in south Delta channels by as much as 40 to 42 percent. (RTD-301, p. 126.)
18 On the other hand was a conceptual proposal from the BDCP for isolated conveyance around or
19 under the Delta. (RTD-301, *Id.*) At the time the DESP was completed and adopted, neither the
20 tunnels facilities of the BDCP (announced by the state in 2012) nor California WaterFix (announced
21 in 2015) had yet been formally proposed. Consequently, the DESP considered an "isolated
22 conveyance" proposal which, like the Petition facilities, was described as dual conveyance.

23 22. In either case, however, broad salinity changes in the Delta would be similar. The
24 Phase 1 changes to the WQCP focus on increasing San Joaquin River inflow while simultaneously
25 relaxing salinity objectives for the River and its distributaries Old and Middle Rivers. In the case of

26 _____
27 ¹ The units of $\mu\text{S/liter EC}$ are translated as microSiemens per liter for electrical conductivity.

28 ² The rest of the year, SWRCB proposed increasing the salinity objective from 1000 to 1400 $\mu\text{S/liter EC}$ at these same monitoring stations during the rest of the year. This is not pertinent to the salinity impact analysis, however, which focuses on the May through August irrigation season.

1 isolated conveyance, fresh water from the Sacramento River would be subtracted during the
2 irrigation season upstream of the Delta Cross Channel near Walnut Grove. Its absence would be
3 filled by more flows from the San Joaquin River bypassing Banks and Jones pumping plants and
4 more tidal flows reaching other Delta channels from San Francisco Bay. (SWRCB-3, Appendix
5 B.4.2, pp. B-191 to B-256; RTD-130, pp. 60-61, Figure 5.) While salinity concentrations in north
6 Delta channels are also likely to increase as a result of isolated conveyance diversions, baseline
7 salinity levels were lower there. (RTD-301, Appendix G, page G-6.) The MNL model work done by
8 Dr. Michael focused on south Delta channels where existing salinity conditions were already higher.

9 23. The DESP focused on south Delta crop fields within BDCP conservation zones 6
10 through 9 since they contain south, west and central Delta channels directly affected by both San
11 Joaquin River and tidal flows. These zones were selected for use in establishing percentage increases
12 in salinity for fields in these zones. (RTD-301, p. 130, Figure 25.) The DESP acknowledges that
13 “salinity would not increase uniformly across the region, and future simulations of the model with
14 more spatially precise estimates of salinity changes could generate more accurate and detailed
15 results.” (RTD-301, p. 130.)

16 24. In addressing salinity changes, the MNL model predicted a large shift from high-
17 value truck and vineyard crops to lower-value grain and pasture crops should salinity levels rise in
18 the south Delta. (RTD-301, p. 131, Table 20, and p. 132.) These shifts would reflect choices by
19 south Delta farmers to plant more salt-tolerant crops as salinity conditions worsened under either or
20 both scenarios (that is, should isolated conveyance be operated and/or salinity objectives relaxed
21 significantly). The model does not estimate any potential impacts from yield declines as salinity
22 increases. (RTD-301, p. 132.)

23 25. The model estimated an 18 percent decrease in truck crop revenue for a 25 percent
24 rise in salinity, as well as a 33.4 percent decrease in truck crop revenue for a 50 percent rise in
25 salinity. Doubling salinity in the south Delta would result in an estimated 57.3 percent decrease in
26 truck crop revenue, and for a 200 percent increase in salinity, an 83 percent drop in estimated truck
27 crop revenue. Similar decreases were estimated by the model for south Delta deciduous and vineyard
28 crops. (RTD-301, p. 131, Table 20; RTD-304, p. 1.)

1 26. That analysis does not account for loss of 5,404 acres of agricultural land in the Delta
2 (1,495 acres temporarily and 3,909 acres permanently) due to construction and alignment of the
3 Tunnels project. (SWRCB-3, p. 4.3.10-1:22-26.) Relative to \$231 million in 2010 crop revenue in
4 the south Delta, a 25 percent increase in salinity on average would result in a \$24 million decrease in
5 crop value, as field, grain and pasture crop acreage were predicted by the model to increase at the
6 expense of deciduous, truck and vineyard crops, which are less salt-tolerant. (RTD-301, p. 131,
7 Table 20, columns c and h.) Agricultural land losses at an average crop revenue per acre of \$1,651
8 would result in about \$8.9 million losses annually.

9 27. The 25 percent salinity increase scenario on average would cost Delta counties (not
10 including the food processing sector) an estimated \$32.8 million in lost crop revenue, 389 total Delta
11 region jobs, and over 519 jobs statewide. (RTD-304, p. 2.) A 50 percent increase in salinity on
12 average would cause crop losses valued at about \$54 million, loss of about 640 total jobs in Delta
13 counties, and 857 jobs statewide. (Id.) The method used to generate these job loss estimates excludes
14 impacts to the region's food processing sector, since food processors can take action to mitigate
15 losses of direct Delta inputs to their production. In addition, the shift to grain and field crops (which
16 are more salt-tolerant) results in production that is less labor-intensive (that is, these crops do not
17 create as many jobs per unit output) than orchard, vineyard, or truck crops.

18 28. Should salinity concentrations double (a 100 percent rise), the DESP estimates would
19 cost south Delta farmers nearly \$89 million, more than a one-third reduction in crop values and land
20 loss due to salinity impacts and tunnels construction and operation, exclusive of food processing.
21 (RTD-301, p. 131, columns e and j; RTD-304, p. 2.) This would trigger an estimated loss of 1,053
22 total jobs in Delta counties and about 1,406 jobs statewide. (Id.) Tripling salinity concentrations (a
23 200 percent increase), coupled with agricultural land losses, would shrink direct farm receipts in the
24 south Delta by nearly \$132 million. (RTD-301, p. 131, columns f and k.) This would trigger an
25 estimated loss of about 1,100 total jobs in Delta counties, and nearly 2,700 jobs statewide. (RTD-
26 304, p. 2.)

27 29. These estimates of crop revenue and job losses based on the DESP methodology
28 represent broadly the magnitude of economic injury to agricultural water rights holders, and the

1 larger impact on total jobs in the Delta region and California that would result from changes to flow
2 and water quality resulting from California WaterFix.

3 INDEPENDENT REVIEW OF THE DESP STUDY

4 30. The Delta Science Program of the Delta Stewardship Council was requested to
5 perform an independent review of the Delta Economic Sustainability Plan. (RTD-302.) The review
6 states that, based on the DESP’s analysis of “isolated conveyance” and flow and salinity impacts:

7 [A]n isolated conveyance to improve water-supply reliability could potentially impact
8 the sustainability of the Delta by increasing salinity and decreasing local water
9 availability because it will reduce through-flow of fresher Sacramento River water in
10 the Delta. Therefore, the costs required to mitigate salinity impacts, local water
11 supply impacts and catastrophic salt-water intrusion in the event of a large earthquake
12 are a relevant consideration in assessing isolated conveyance.

13 (RTD-302, p. 2, 7.)

14 31. The SWRCB has determined that “protection of agriculture in the southern Delta is in
15 the public interest” (SWRCB-21, p. 35, Section 6.3.4.2.4) and established interior south Delta
16 salinity objectives to protect these agricultural beneficial uses. (SWRCB-21, pp. 159-160.) The
17 Independent Review Panel noted that the existing water export system keeps salinity sufficiently low
18 in the southern and eastern Delta to facilitate agricultural production. (RTD-302, p. 10.) The Panel
19 further stated that the DESP “demonstrates the potential negative effects of increasing salinity levels
20 on agricultural yields in the southern Delta.” (RTD-302, p. 10.)

21 Although the Sustainability Plan does not document potential changes to salinity
22 levels arising from the operation of an isolated conveyance system, it is reasonable to
23 assume that diversion of up to 15,000 cfs of flow from the Sacramento River (North
24 Delta) and movement via pipelines to the Tracy pumping facilities, would alter Delta
25 through-flows. To the extent that these alterations in flows increase south Delta
26 salinity levels, the economic and ecosystem impacts of these alterations must be
27 recognized, and where appropriate, mitigated. **Given that water exporters will be
28 the primary beneficiaries of such a conveyance system, the DPC and the DSC
need to ensure that the sponsors of a conveyance system fully pay for any and all
Delta mitigation.**

(RTD-302, *Id.* Emphasis in original.)

32. The Independent Review Panel’s charge from the Delta Science Program included
question 9, which asked: “Is the multinomial logit model a methodologically sound approach for
estimating the impacts of water policy proposals on Delta agriculture and/or on environmental

1 change, such as salinity, on crop choice and production?” The Panel affirmed that the MNL was a
2 sound approach:

3 We commend the authors for using this approach. A multinomial logit (MNL) is a
4 standard, recognized method in the extant literature for problems with discrete,
5 limited dependent variables. However, the authors’ discussion of key assumptions
6 and procedures is too brief. For example, in the main text, the authors suggest that the
7 MNL is a conditional MNL, where the conditional is on the current land use (pg 123).
8 More detail of this assumption and its impact would be helpful in the Appendix.

9 (RTD-302, p. 14.)

10 33. Dr. Michael and I responded by letter to Dr. Clifford N. Dahm, lead scientist of the
11 Delta Science Program, regarding the Independent Review Panel’s report in December 2011. The
12 Panel’s report identified six “limitations” of the DESP, but none of the Panel’s stated limitations
13 applied to the MNL modeling and the Plan’s analysis of salinity impacts of isolated conveyance on
14 crop choice in the Delta. Dr. Michael and I stated to Dr. Dahm that, “[t]he ESP shows that salinity
15 significantly impacts Delta agriculture even at recently observed levels of water quality. It is a myth
16 that Delta water quality standards can be weakened and an isolated conveyance introduced without
17 negative impacts on Delta agriculture.” (RTD-303, p. 2.)

18 SUMMARY OF DIRECT ANSWERS TO SWRCB PETITION PROMPTS

19 34. As I understand the matters I have addressed herein, I answer to the State Water
20 Board’s hearing prompts as follows:

21 35. *Will the proposed changes cause injury to any municipal, industrial or agricultural*
22 *uses of water, including associated legal users of water?* Yes, removal of fresh Sacramento River
23 water at new intakes in the north Delta can reasonably be expected to injure agricultural uses of
24 water in the Delta, including those diverting and using water directly from Delta channels to irrigate
25 crops.

26 36. *Will the proposed changes in points of diversion alter water flows in a manner that*
27 *causes injury to municipal, industrial, or agricultural uses of water?* Yes, new points of diversion
28 will alter water flows in a manner that causes injury to agricultural uses of water, particularly in the
south Delta. The Delta Economic Sustainability Plan analyzed impacts reflecting changes in salinity

1 to Delta farmers' crop choices based on a broad change in flows that would trigger salinity increases
2 of varying levels.

3 37. Will the proposed changes in points of diversion alter water quality in a manner that
4 causes injury to municipal, industrial, or agricultural uses of water? Yes, the new points of
5 diversion will alter water quality by increasing salinity generally in Delta channels in a manner that
6 will injure agricultural uses of water. The DESP analysis of salinity impacts estimates that for a 25
7 percent salinity increase, the loss of direct crop revenues would amount to nearly \$33 million a year,
8 about 166 direct Delta farm jobs, and about 389 total jobs in Delta counties. (RTD-304, p. 2.) For a
9 50 percent increase in salinity, crop revenue foregone was estimated to exceed \$54 million, about
10 274 direct Delta farm jobs, and about 640 total jobs to Delta counties. Doubling salinity levels in
11 Delta channels would result in nearly \$89 million in foregone crop revenues, about 450 direct Delta
12 farm jobs, and over 1,050 total jobs in Delta counties. Finally, tripling salinity in Delta channels (an
13 increase of 200 percent) would cause an estimated \$132 million in lost crop revenue, about 670
14 Delta farm jobs, and nearly 1,570 total jobs in Delta counties. (RTD-304, p. 2.)

15 38. Thank you for the opportunity to submit this testimony on the agricultural impacts of
16 flow and water quality alterations posed by this Petition for Change on California WaterFix.

17
18 Dated: August 29, 2016


Michael Machado