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On behalf of South Delta Water Agency,
Central Delta Water Agency, Lafayette Ranch,
Heritage Lands, Mark Bachetti Farms
and Rudy Mussi Investments L.P.

STATE OF CALIFORNIA

STATE WATER RESOURCES CONTROL BOARD

Hearing in the Matter of California Department of Water Resources and United States Department of the Interior, Bureau of Reclamation Request for a Change in Point of Diversion for California Water Fix	**SUR REBUTTAL TESTIMONY OF TERRY PRICHARD** **Sur Rebuttal: Protestants South Delta Water Agency, Central Delta Water Agency, Lafayette Ranch, Heritage Lands, Mark Bachetti Farms And Rudy Mussi Investments L.P.**

I, Terry Pritchard, do hereby declare:

Having previously appeared in these hearings as an expert witness on behalf of South Delta Water Agency, Central Delta Water Agency, Lafayette Ranch, Heritage Lands, Mark Bachetti Farms and Rudy Mussi Investments L.P. ("SDWA Parties"), my Statement of Qualifications has been admitted into evidence as SDWA 91. I hereby submit this testimony in support of SDWA Parties sur-rebuttal case in response to the rebuttal testimony of Dr. Kimmelshue and Dr. Thornberg.

1. Dr. Kimmelshue's rebuttal testimony attempted to respond to by my case-in-chief testimony and well as that of Dr. Leinfelder-Miles. One of Dr. Kimmelshue's criticisms of Dr. Leinfelder-Miles's leaching study was that he could not determine if the salinity of the soil was the result of only the salts in the applied water, or also from those contained in the ground water in the area or some other source (DWR 85, page 14, lines 16-22). This perceived lack of data lead Dr. Kimmelshue to conclude the leaching fractions calculated by Dr. Leinfelder-Miles were inaccurate. In support of his conclusions, Dr. Kimmelshue references the Hoffman Report (DWR 580) which calculated much higher leaching fractions.

Dr. Kimmelshue was apparently unfamiliar with the Hoffman Report (DWR 580) and gave it credence even though it suffered from a more egregious error than that he accused Dr. Leinfelder-Miles of doing. In the Hoffman Report (DWR 580), Dr. Hoffman clearly used an assumed applied water EC (DWR 580, see page 53). Using an assumed applied water quality instead of the actual EC of the applied water necessarily means that his calculations for leaching fractions are at best a guess and only reliable IF actual applied water quality reflects the quality assumed. Dr. Hoffman could have easily located data on the water quality in the channels from which diversion occurred but did not.

However, the greater error done by Dr. Hoffman, and the one which Dr. Kimmelshue accused Dr. Leinfelder-Miles of doing is using incorrect drainage EC. Dr. Hoffman used tile drainage data (from many years ago) as the EC effluent data for the EC drainage water, or "salt out" part of his calculation (DWR 580, page 55). This approach might be useful if the tile drainage water was only the excess applied water or drainage water from the field. That is to

say in order to measure how much salt passed through the root zone (i.e. leached through the root zone) a drain intercepting this excess water might give one the needed information. However, the tile drain data used by Dr. Hoffman came from drains that are 8-9 feet deep and mostly intercepting ground water of unknown origins (personal communication with Jack Alvarez, Director of West Side Irrigation District). The degree to which any of these drains are collecting excess applied water is unknown. The sworn testimony from Jack Alvarez, a farmer in the area of those tile drains confirms those drains mostly collect the poor quality ground water in the area and not excess applied water to any great degree in this declaration submitted in the Bay-Delta process.

Obviously then, if Dr. Hoffman used an assumed applied water EC and the incorrectly used tile drain water as the indicator of the drainage water EC his leaching fractions are simply an exercise in math and bear no relationship to what actually occurred on the lands from which his data was derived or on Southern Delta lands in general. Dr. Leinfelder-Miles in her sur-rebuttal testimony is addressing the issue of whether her data was affected by poor ground water. It is clear however that Dr. Kimmelshue's reliance on the Hoffman Report (DWR 580) as an indication that the Leinfelder-Miles leaching fractions are incorrect is unsupportable. Dr. Hoffman's leaching fraction calculations cannot be used as a scientific basis for determining leaching fractions in the southern Delta. His data is simply wrong and unusable.

I will also note that the locations of the tile drains referenced by Dr. Hoffman are virtually all located in the very southern or southwestern areas of the southern Delta. Those areas have much deeper ground water tables, do not for the most part receive water for the areas of poor quality in the southern Delta channels and do not experience salt impacts to the degree other areas do. In sum, not only did Dr. Hoffman use incorrect data, he also focused on areas which are less prone to salt damage.

2. As previously recognized in cross-examination and redirect, my calculations of crop yield reductions were incorrect due to my mistaken use of the ECw instead of the ECe (adjacent columns in FAO 29) that results in 0% Yield of each crop to calculate the rate of yield decline per unit of EC or the b value in the equation b = 100/(ECe 0 – ECe 100). The b

value is used to determine the relative yield via the equasion Yield relative = 100-b(ECe-a).The net effect was a correct determination of when yields begin to decline at a specific irrigation EC and leaching fraction , but overestimated the rate of yield decline after the threshold. In Dr. Kimmelshue's rebuttal testimony he attempted to produce the "correct" yield reduction calculations but also made an error by using the wrong yield reduction numbers (EC 100 rather than the b value) in two of his three charts in Table 1 on page 30 of his rebuttal testimony. The result was to under estimate the yield reduction per unit soil salinity. Obviously we each made simple mistakes which I am now correcting. Below is an updated Figure 4 from my testimony (page 11).

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Leaching Fraction			% Reduction in Yield at LF and Eci					
5%								
		Ave Soil						
	ECi	Ece	Bean	Corn	Alfalfa	Tomato	Almond	Grape
	0.2	0.65	0.00	0.00	0.00	0.00	0.00	0.00
	0.3	0.97	0.00	0.00	0.00	0.00	0.00	0.00
	0.4	1.3	5.66	0.00	0.00	0.00	0.00	0.00
	0.5	1.62	11.70	0.00	0.00	0.00	2.26	1.14
	0.6	1.95	17.92	3.01	0.00	0.00	8.49	4.29
	0.7	2.27	23.96	6.87	1.93	0.00	14.53	7.33
	0.8	2.6	30.19	10.84	4.29	0.95	20.75	10.48
	0.9	2.92	36.23	14.70	6.57	4.00	26.79	13.52
	1	3.25	42.45	18.67	8.93	7.14	33.02	16.67

Leaching Fracion								
10%								
			% Reduction in Yield at LF and Eci					
		Ave Soil						
	ECi	Ece	Bean	Corn	Alfalfa	Tomato	Almond	Grape
	0.2	0.41	0.00	0.00	0.00	0.00	0.00	0.00
	0.3	0.62	0.00	0.00	0.00	0.00	0.00	0.00
	0.4	0.82	0.00	0.00	0.00	0.00	0.00	0.00
	0.5	1.03	0.57	0.00	0.00	0.00	0.00	0.00
	0.6	1.23	4.34	0.00	0.00	0.00	0.00	0.00
	0.7	1.44	8.30	0.00	0.00	0.00	0.00	0.00
	0.8	1.64	12.08	0.00	0.00	0.00	2.64	1.33
	0.9	1.85	16.04	1.81	0.00	0.00	6.60	3.33
	1	2.05	19.81	4.22	0.36	0.00	10.38	5.24

Leaching Fracion								
15%								
			% Reduction in Yield at LF and Eci					
		Ave Soil						
	ECi	Ece	Bean	Corn	Alfalfa	Tomato	Almond	Grape
	0.2	0.32	0.00	0.00	0.00	0.00	0.00	0.00
	0.3	0.48	0.00	0.00	0.00	0.00	0.00	0.00
	0.4	0.64	0.00	0.00	0.00	0.00	0.00	0.00
	0.5	0.8	0.00	0.00	0.00	0.00	0.00	0.00
	0.6	0.95	0.00	0.00	0.00	0.00	0.00	0.00
	0.7	1.11	2.08	0.00	0.00	0.00	0.00	0.00
	0.8	1.27	5.09	0.00	0.00	0.00	0.00	0.00
	0.9	1.43	8.11	0.00	0.00	0.00	0.00	0.00
	1	1.59	11.13	0.00	0.00	0.00	1.70	0.86

The above data corrects both my error and that of Dr. Kimmelshue. Since the numbers are different, I think it helpful to explain them once again. Under the 5% leaching fraction scenario (and recall that the Dr. Leinfelder-Mile's study found some leaching fractions below 5%), we exceed the crop salt tolerance threshold at applied water EC of 0.4, for bean, 0.6 for corn, 0.7 for alfalfa, 0.8 for Tomato, 0.5 for almond, and 0.5 for grape. It is important to note that the point at which the decreased yields occurs does not change from the original incorrect calculations, rather the rate at which crop yields decrease is slightly less. The underlying point being that damages to crop yields occur when the EC of the applied water (the water taken from southern Delta channels) increases. Dr. Kimmleshue is incorrect when he dismisses such damages.

3. Though Dr. Jeff Michael is providing sur-rebuttal to the rebuttal testimony of Dr. Thornberg, I would like to comment on a portion of Dr. Thornburg's rebuttal testimony. Dr. Thornberg makes various conclusions about how increased salinity in the southern Delta channels could not be occurring because of the crop production (profits?) data for San Joaquin County. He concludes that since production in the County went up overall, then in-Delta productions could not have been affected by changes in EC of the applied water. This conclusion is not only logically incorrect, but demonstratively false.

Various areas of San Joaquin County have distinct conditions that are not duplicated in other areas. Soils differ (from very sandy soils to massive clay soils and everything in between), applied water quality differs, temperatures differ, pest problems differ, etc. In any particular year for example, the Linden area, in east San Joaquin County, might have a greater than average walnut crop while the walnut crop in some other area might be less than average. Thus, using county-wide data to draw conclusions about in-Delta crop yields is unscientific.

Similarly, we know that in-Delta farmers already experience salt damage problems or incur additional costs to mitigate elevated salinity levels in the applied water. Testimony in this hearing provided by SDWA et. al. farmer witnesses (SDWA 106, SDWA 111, and SDWA 121) clearly prove this point. Increasing Delta channel salinity is calculated to have an impact on in-Delta farmers, but would have no effect on Linden area farmers who do not (and cannot)

use Delta water. The conclusion that county-wide data can be used to determine changes in crop yields in one area which might experience elevated salinity levels defies logic. Crop production and yields might increase county-wide while the specific Delta crops might decrease. Dr. Thornburg's conclusions based on county-wide data are unreliable from a scientific and logical basis.

4. Dr. Kimmelshue makes the point in his rebuttal testimony (e.g page 27, lines 14-22, DWR-85) that I and Dr. Leinfelder-Miles are emphasizing study and modeling results which show adverse impacts while not taking into account times when there may be no expected impacts. This misses the point of the analyses being done by both Petitioners and Protestants.

It is my understanding that the purpose of these hearings is to determine if the proposed project will injure other legal users of water. To determine if such injury occurs, one must examine those conditions and circumstances under which injury might or is expected to occur. To also look at any potential benefit derived from the proposed project is not, to my knowledge, a criterion by which the SWRCB evaluates adverse impacts. If for example the project causes harm in one year but two years later somehow causes a benefit, the fact that there was a benefit does not in any manner "undo" the previous harm. If in this example a famer loses 10% of his crop due to the project, that crop and resulting income loss results in real, specific harm. It is not just that the farmer may have less net profit at the end of the season, but the loss of gross income might result in no net profit, or the inability to pay off ongoing or seasonal debts (many farmers get loans each year to fund their operations).

Thus, the notion of offsetting benefits with injury is in fact an attempt to average away impacts on third parties. Dr. Kimmelshue's suggestion that it is more appropriate to look at averages (as done in the Hoffman Report DWR 580) is unrealistic when applied to farmers who are supposed to be protected against injury when the SWRCB grants a permit for a change in the point of diversion.

5. Dr. Kimmelshue concludes that "crop production has not been impacted by current irrigation water salinity levels and will not be impacted by anticipated future salinity

levels." (DWR-85, page 10, lines 19-21) There are two errors contained in this conclusion. The first is that it ignores the testimony of other SDWA et. al. farmer witnesses (SDWA 106, SDWA 111, and SDWA 121) who were unanimous in stating that under the current conditions they were either experiencing crop damage due to salts or were undertaking taking additional management practices to prevent or lessen salt damage. There is no basis for reliance on the Hoffman Report's (DWR 580) calculated conclusions about no harm when people actually being harmed have presented testimony and evidence that they are indeed being harmed.

The second error in Dr. Kimmelshue's conclusion is that Hoffman's Report (DWR 580) assumed a water quality of 0.7 EC. Once again the record in this case provides us with facts instead of Dr. Hoffman's assumptions. SDWA 18, SDWA 19, and SDWA 35 shows data of measured water quality in certain southern Delta locations. As can be clearly seen, the channel water is often worse than 0.7 EC during the irrigation season. The SWRCB is of course aware of this situation given the hundreds of exceedances of southern Delta salinity standards over the past decade. The point being that Dr. Hoffman's calculations are based on applied water EC of 0.7 while the actual quality is sometimes worse. Thus, one cannot rely on Dr. Hoffman's conclusions about existing or future harm (as Dr. Kimmelshue did) because the calculations are not connected to reality.

6. Dr. Kimmelshue criticizes my explanation of how model inputs can be modified to better reflect actual "in the field conditions" by comparing it to a later comment by me that differences between model runs should not be understood to indicate what conditions will actually result (DWR-85, page 27, lines 3-6). His criticism has no basis. My testimony included a reference as to how models can and are adjusted to better reflect actual conditions when one is trying to analyze some specific set of conditions. My later comment that model run differences should not be considered to reflect actual conditions is simply a truism regarding modeling and in no way contradicts my earlier observation about how modelers adjust inputs to get better outputs. Of course models (like the ones used to calculate soil salinities or leaching fractions) are only calculations which produce results from a set of inputs and cannot ever be thought as of iron-clad predictors of what happens in the real world.

However, we use models to try to understand how conditions might change because we simply cannot do multi-year studies for thousands of acres every time we want to analyze how some change of conditions might affect soil salinity, or crop production, etc.

The point is that although we use models to help us understand what might happen when certain conditions change they are not expected to be precisely accurate. In this case, Dr. Kimmelshue criticizes my descriptions of how models work and their reliability while at the same time choosing to rely on model runs (the Hoffman Report DWR 580) instead of relying on an actual study of the area. He can't have it both ways especially when an examination of the Hoffman Report (DWR 580) indicates it is undoubtedly unreliable.

7. Dr. Leinfelder-Miles is addressing numerous issues in her sur-rebuttal testimony including the reliability of her data and conclusion. I would like to comment on one of those issues also as it relates directly to my above comments. Dr. Kimmelshue believes it is more appropriate to rely on the Hoffman Report (DWR 580) calculations than to rely on the work by Dr. Leinfelder-Miles. It is true that Dr. Leinfelder-Miles study was done over a relatively short period of time and during dry conditions. However, that is no scientific basis for discounting the study and preferring calculations based upon faulty numbers. The Leinfelder-Miles alfalfa study is an accurate, sound and reliable study which showed how (then) existing conditions included very poor leaching of soils, the build-up of salts in the soil and the potential for decreases in crop production when certain local crop soil salinity thresholds are exceeded.

The data indicates that in certain areas salinity build-up in the soil is a real threat to crop production. The Leinfelder-Miles study is strong evidence that any adverse change in applied water salinity resulting from the proposed project will likely adversely affect southern Delta crop productions. When this evidence is compared to the lack of evidence provided by DWR on potential impacts to southern Delta farmers, it appears only one conclusion can be made. Dr. Kimmelshue's criticisms notwithstanding, that conclusion is that the Petitioners have not shown what will happen to southern Delta crop production if the project is undertaken and SDWA et. al. have shown the likelihood of damage.

8. Dr. Kimmelshue criticizes my assertion that on-site conditions can limit the ability of applied water to move through the soil profile and remove excess salts. He further states " if this were actually true, salinization of the ground would have already occurred and no agricultural production would be taking place." Therefore, the leaching fraction must be of some significance to continue to allow for crop production to continue to occur" (DWR-85, page 28, lines 1-11). These comments were made in reference to alfalfa culture and the leaching study conducted by Dr. Michele Leinfelder-Miles. The study clearly shows low leaching fractions exist in delta alfalfa culture. In making this statement, Dr. Kimmelshue obviously does not consider the long term effects of rotation to crops in which a higher leaching fractions can be achieved, rainfall variability or other grower practices that mitigate salt buildup.

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

Executed on the _9_ day of June 2017, at Stockton, California.

/s/

Terry L. Prichard