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BEFORE THE

CALIFORNIA STATE WATER RESOURCES CONTROL BOARD

HEARING IN THE MATTER OF CALIFORNIA DEPARTMENT OF WATER RESOURCES AND UNITED STATES BUREAU OF RECLAMATION REQUEST FOR A CHANGE IN POINT OF DIVERSION FOR CALIFORNIA WATER FIX	**SUR-REBUTTAL TESTIMONY OF JOEL KIMMELSHUE**

I Joel Kimmelshue do hereby declare:

I. INTRODUCTION

My name is Joel Kimmelshue and I am a Certified Professional Soil Scientist (license #18204) with the Soil Science Society of America. A true and correct copy of my Statement of Qualifications is attached as Exhibit DWR-25. A brief summary of relevant experience was summarized previously in my rebuttal testimony, Exhibit DWR-85.

This sur-rebuttal testimony focuses on two main documents and inconsistencies, lack of scientific rigor and errors in those documents:

1. Verbal testimony provided by Dr. Leinfelder-Miles on Friday, May 19, 2017 – (Testimony Vol. 46)
2. Written testimony provided by Dr. Leinfelder-Miles (LAND-79), which includes new updates to the same previous summary report.

This written sur-rebuttal testimony directly responds to that testimony and report, and states concerns with those methodologies and conclusions. The testimony and report provided by witness Dr. Leinfelder-Miles, in relation to other, more comprehensive studies, and my professional experience pose unclear, unsubstantiated, and in some cases inaccurate results.

In order to address these concerns, this written surrebuttal testimony will discuss common major technical themes including:

- Threshold soil salinity levels and tolerances of modern and improved alfalfa varieties.
- Importance of identifying and understanding surrounding environmental impacts to site and sampling locations.
- Establishment of "baseline" conditions to compare changes in salinity.
- The rigors of information required in a research manuscript suitable for publication in a peer reviewed journal.

II. SUMMARY OF TESTIMONY

Below is a summary of the key issues with the Leinfelder-Miles testimonies, analyses, and supporting materials of (Testimony Vol. 46 and Land 79).

My conclusions are that Dr. Leinfelder-Miles:

- does not adequately recognize the newly developed dormant alfalfa varieties and the associated increase in salinity thresholds over the 32 years since the 1985 Ayers and Westcot reference threshold of 2.0 dS/m;
- does not adequately provide exact field and within-field sampling locations for the alfalfa study to assess precise environmental and management practices that can significantly influence salinity management even though GPS locations were allegedly taken;

- provides confusing and misleading information related to the definition of the base of the root zone; and,
- introduces and report update (LAND-79), containing new approaches/concepts that potentially conflict with her earlier methods but do not rectify misinterpretations of her work.

III SUBSTANTIVE SURREBUTTAL

Salinity Thresholds and Varieties

In the testimony (Vol. 46, p.29:7-10) from Dr. Leinfelder-Miles it is stated that, "My projects were developed in order to understand baseline salinity conditions and how irrigation water salinity and soil salinity change over time." This statement is concerning for two reasons. First, studies developed to establish baseline conditions need to take place in varying hydrologic year types, such as dry, wet, and average conditions to establish a reliable baseline in which to compare future results. The 2014-2016 alfalfa study performed was not, in any way, conducted during a time in which a representative baseline condition could be established. Instead it was conducted in a time that would be considered an extreme dry condition. Secondly, as Dr. Leinfelder Miles expresses later in her testimony (Vol. 46, p.60:6-7), she expects to include more data in the report for hopeful future publication. Some of these data include precipitation records, which should have been included previously.

It is also stated that "my alfalfa project was not a study of crop salinity tolerance. (Vol. 46, p.29:12-13). This statement may in fact be true, however multiple times (LAND-79; Vol. 46, p33:6-9) and in previous testimony Dr. Leinfielder-Miles states and relies on an alfalfa salinity threshold of 2.0 dS/m to draw significant conclusions. It is stated during this testimony that she expects yield decline to occur at any soil salinity over 2.0 dS/m. This is again stated in LAND-79, p.3, "Beyond an average root zone soil salinity threshold (ECet)

of 2.0 dS/m and an average applied water salinity threshold of 1.3 dS/m, alfalfa yield reductions are expected (Ayers and Westcot, 1985)."

It was also stated by her at the hearing that "there is no current research looking at – at that salt tolerance threshold. There is no current research that would change that salt tolerance threshold." (Vol. 46, p.43:11-14.)

In multiple personal conversations with alfalfa breeders, seed dealers and researchers (e.g. Joe Machado and Peter Reisen, 2017 – America's Alfalfa and Forage Genetics – the largest alfalfa breeders in the world), it was clear that since the value of 2.0 dS/m (Ayers and Westcot, 1985) was developed 32 years ago, in fact, significant research has taken place specifically over the past 10 years to develop dormant varieties of alfalfa that in some cases do not see yield declines beginning until soil salinities of 6.0-6.5 dS/m. These varieties (including dormant variety categories of 5-7 that are currently grown in the Delta) will be commercially available beginning in 2018, do not cost any more than current varieties, and produce equal or better yields. These researchers work collaboratively with researchers from research institutions in many of the western states, including actively with the University of California.

According to LAND-79, Table 3, average root zone salinity down the soil profile (ECe, dS/m) for seven sites across 2013-2015, and with simply a change to alfalfa varieties only 2 of the 7 sites would potentially result in a reduction in yield if the threshold soil salinity were 6.5 dS/m, rather than 5 out of 7 for the assumed, and dated threshold of 2.0 dS/m. That being said, and even with improved threshold suitability, the application of the results in Table 3 cannot be definitively relied upon until specific site locations are provided as to each of the 7 sites and their surrounding hydrologic environment (i.e. proximity to saline shallow groundwater originating from surrounding waterways, etc).

Dr. Leinfelder-Miles also states that, "… alfalfa is not rotated on a yearly basis, so even if we were to learn that there are alfalfa varieties that are more salt-tolerant, it's not a decision that a grower can make quickly without losing the invest that the grower has

already put into the alfalfa crop." (Vol. 46, p.41:18-23.) Because dormant varieties will be on the market that have a soil salinity thresholds of up to 6.5 dS/m, the four year planting decision timespan is more than enough when compared to the ten year construction timeframe of the CA WaterFix for a grower to make these informed decisions, should there in fact be any increase in soil salinity associated with the WaterFix and assuming the disputed 5% leaching fraction is correct in the first place.

Dr. Leinfelder-Miles makes a statement that says, "...the choice of what to grow is an economic decision that takes many factors into account, and plant breeding is not a substitute for soil salinity management." (Vol. 46, p.34:5-8:12.) In fact, plant breeding exists to provide more tolerant (e.g. drought, salinity, sodicity, etc) plant species to overcome existing environmental conditions. It is very likely that alfalfa growers in the south Delta will be very interested in the new, more saline-tolerant alfalfa varieties that will be available in the marketplace in 2018, because it will add that additional level of safety in a naturally occurring saline environment.

Dr. Leinfelder-Miles indicates that "You are adding salts immediately with the irrigation water and so, yes, it would have an immediate effect on soil salinity." (Vol. 46, p.56:8-10.) This statement is misleading. The resultant salinity of the soil profile is a result of the long-term equilibrium established as a result of the salinity added via irrigation water (and precipitation as well) to the surface of the soil (Ayers, et al, 2012; Ayers and Westcot, 1985). A new salinity equilibrium will be reached in the soil profile with introduction of a new water quality. Variations in applied water quality impacts to this soil salinity equilibrium, however, are far from "immediate" and usually take months to achieve if not longer. This is why it is more realistic to see seasonal fluctuations in soil salinity as longer-term dry and wet periods occur. This is also why dedicated leaching events only occur periodically, usually annually or even less frequent depending on rainfall.

Field Locations are not Provided in the Rebuttal Testimony, but are Necessary for Meaningful Conclusions

Dr. Leinfelder-Miles indicates that it is her intent to have this alfalfa study summary further reviewed, add more information (e.g. precipitation), and publish in a refereed scientific journal. (Vol. 46, p.59:24-25; p.60;1-3.) In the development of any research article destined for publication in a peer reviewed document, it will be necessary to account for as many variables as possible to determine their impact and hopefully isolate the impacting variable(s) on the changes in soil salinity. Currently, in the updated report (LAND-79) it is partially speculated that irrigation water quality may result in increased soil salinity. The report does not provide any location of any of the sampled fields and therefore is incomplete. This is critical to understand the proximity to saline waterways and the potential source of salt in the root zone. The report does not indicate the existence or absence of a sub-surface or surface drainage system, or the management of that system. No mention of alfalfa varieties is included, nor does Dr. Leinfelder-Miles indicate that she knows the varieties used by the growers other than they are dormant varieties. (Vol. 46, p.42:10-12.) The report also does not provide a summary of the grower's irrigation management efforts, nor any mention of salinity management efforts in the past. There are other items the report is lacking that will be required by reviewers prior to submittal and approval by any peer-reviewed scientific journal. Therefore, if it is the intention for this report to be submitted in a peer reviewed manner (Vol. 46, p.57-58), the summary document should be considered incomplete at this stage and thus, the conclusions should be interpreted with caution and could be interpreted differently with the addition of additional necessary and available data..

For example, Dr. Leinfelder-Miles indicated that she had GPS points for the alfalfa sites in the three year study. (Vol. 46, p.66:7-11.) It was also indicated that these locations were not included in the summary report. Because this information exists, for the conclusions of the study to be considered credible, locations must be referenced in the summary report to aid the reader in orienting to the surrounding environment including

water ways, water supply routes, soil types, drainage systems, etc. etc. The fact that these locations were not provided only makes interpretation of the results that much more difficult for the end reader.

In a recent addition to the updated summary report (LAND-79), the author indicates that, "Because this project was not a replicated experiment with imposed treatments, but rather involved surveying current conditions, other sources of variability that affect yield … could not be statistically controlled." This not only holds true for a comparison to yield, but also a comparison to estimated leaching fractions, soil salinity variability, and other variables. Therefore, because of these limitations, the results of the report cannot be statistically validated and should be viewed with caution. There is no way to ascertain whether results were statistically significant or not.

Fundamental Differences in Root Zone Base Determination

In response to questions posed the witness defined the calculation of the leaching fraction as defined in Ayers and Westcot, 1985 as "… the salinity of the water applied to the soil … and the soil water at the base of the root zone." (Vol. 46, p.46-47.) Follow up questioning asked, "Did you use the Ayers and Westcot approach in determining your leaching fraction?" in which the witness answered "yes." In Ayers and Westcot, 1985, the base of the root zone is clearly defined as "below the root zone" or "below the rooting depth." Dr. Leinfelder-Miles states that, "… the base of the root zone is the area of soil where the soil salinity is highest. And previous research has shown that crop roots do not grow into that zone." It is assumed that Dr. Leinfelder-Miles is referring to a research article newly introduced in the project report update (LAND-79) from Bali, et al, 2001. The author indicates that, "The 30-cm increment with the highest ECe in the fall was considered the bottom of the root zone for the Lf calculation and represents the salt concentration of deep percolation water from the bottom of the bottom of the root zone. This is supported by Bali, et al. (2001), who found that most alfalfa roots are growing in soil layers above the highest

soil salinity." At this point, Dr. Leinfelder-Miles is discussing two different definitions as to the bottom of the root zone. These different definitions, when used in calculating leaching fractions, will result in different estimates of those leaching fractions. It is evident from this discussion, and introduction of a differing approach from Ayers and Westcot, 1985, that the calculation of leaching fractions in high water table soils is not straight-forward due to confounding issues previously mentioned (DWR-85).

Not only does the Bali definition of the base of the root zone completely differ from that of Ayers and Westcot, 1985, but it also assumes that no roots will grow past a zone of elevated salinity in the root zone. Whether a root grows past a zone of increased salinity in the root zone (or not) is entirely dependent on the concentration of salinity in that zone. In some cases the soil salinity will be low enough whereby it does not restrict root growth. In other cases it may. Both conditions exist in these alfalfa fields in the Delta and the results from Dr. Leinfelder-Miles study show that with varying soil profile salinity levels in the 7 sites. Therefore, it is confusing that Dr. Leinfelder-Miles says she uses the Ayers and Westcot formula for calculating leaching fractions, however alternatively defines the root zone depth such that it results in an artificially low value in the end. As was stated in DWR-85, the methods used (and therefore associated results) are incorrect for high water table soils with salts at the bottom of the root zone originating from sources other than that applied to the surface through irrigation water.

Applying the Bali method does not rectify the problems with the Leinfelder-Miles analysis because it assumes a root response to salinity that is not reflective of all areas in the south Delta. In other words, there are clearly areas where concentrations of soil salinity in the soil profile do not preclude rooting depth.

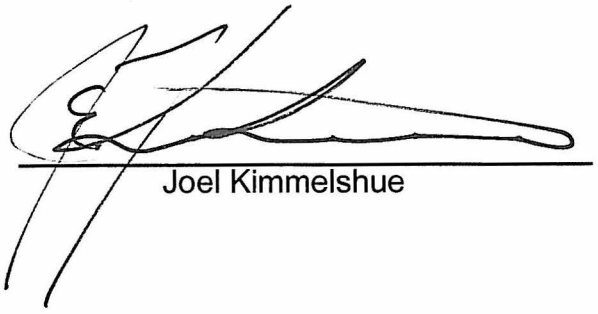
IV. CONCLUSION

Overall, the testimony was unclear as to why more information was not provided in the updated project report (LAND-79) when this information was taken in the field and could prove or disprove conclusions provided.

It is important to understand that the updated report provided by Dr. Leinfelder-Miles, although intended to be published in a peer-reviewed journal, has yet to be comprehensively peer-reviewed and is likely needing significant additional information and analysis to support existing conclusions definitively. The author opening admits the study was not replicated, rather involved a surveying approach that doesn't allow for statistical evaluation of significance of any intended measured variables. In addition it is unclear and confusing as to the approach used to determine the "bottom of the root zone" as two methods are now discussed that will undoubtedly result in differing results. Lastly, Dr. Leinfelder-Miles' reports require significant additional information and analysis to support the conclusions.

Overall, the reliance on a study and approach such as this for such a significant modification of Delta infrastructure is something that should be carefully scrutinized.

Executed on 9 day of June, 2017 in Sacramento, California.



Joel Kimmelshue

BIBLIOGRAPHY

Ayars, J.E., Corwin, D.L., and G.J. Hoffman. 2012. Leaching and root zone salinity control. In: W.W. Wallender and K.K. Tanji (eds.) ASCE Manual and Reports on Engineering Practice No. 71 Agricultural Salinity Assessment and Management (2nd Edition). ASCE, Reston, VA. Chapter 12 pp: 371-403. https://www.researchgate.net/profile/Dennis_Corwin/publication/262373274_Leaching_and_Rootzone_Salinity_Control/links/00b495376675b8d56b000000.pdf.

Ayers, R.S. and D.W. Westcot. 1985. Water quality for agriculture. FAO Irrigation and Drainage Paper 29.

Hoffman, G.J. 2010. Salt tolerance of crops in the southern Sacramento-San Joaquin Delta. Jan. 5, 2010. http://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/bay_delta_plan/water_quality_control_planning/docs/final_study_report.pdf

Leinfelder-Miles, M. 2015. Leaching fractions achieved in South Delta soils under alfalfa culture. 2015 San Francisco Estuary Conference, Poster Abstracts. p. 39. http://www.sfestuary.org/wp-content/uploads/2015/09/Poster-Abstracts-Final-Full-083115.pdf

Leinfelder-Miles, M. 2015. Leaching fractions achieved in south Delta soils under alfalfa culture. http://ucanr.edu/sites/2015jointsiconference/files/221268.pdf.

Leinfelder-Miles, M. Jan. 8, 2016. Salinity management in alfalfa fields. SJC and Delta field crops meeting. UCANR. http://ucanr.edu/sites/deltacrops/files/229234.pdf

Leinfelder-Miles, M. Oct. 25, 2016. Drought, Delta agriculture, and managing salinity. Drought and the Delta briefing. UCANR. http://www.watereducation.org/sites/main/files/file-attachments/michelle_leinfelder-miles_presentation.pdf.

Machado, Joe. 2017. Personal Communication. Research and Sales. Forage Genetics – America's Alfalfa.

Reisen, Peter. 2017. Personal Communication. Lead alfalfa breeding researcher. Forage Genetics – America's Alfalfa.