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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	**REBUTTAL TESTIMONY OF MICHELLE LEINFELDER-MILES** **Joint Rebuttal: Local Agencies of the North Delta, Delta Watershed Landowner Coalition, Bogle Vineyards, Diablo Vineyards, Stillwater Orchards, and Islands, Inc.**

I, Michelle Leinfelder-Miles, do hereby declare:

I. INTRODUCTION

I am the Delta Crops Resource Management Advisor with the University of California Cooperative Extension, based in San Joaquin County. I have five years of experience working in this capacity and fourteen total years of research experience in agricultural cropping systems, which includes work in grains and forages, vegetable crops, and tree and vine fruit crops. I received my B.S. in Crop Science and Management from UC Davis (2001), my M.S. in Horticulture from Cornell University (2005), and my Ph.D. in Horticulture from Cornell University (2010). As the Delta Crops Resource Management Advisor, I conduct an applied science, multidisciplinary research and outreach program on agricultural production and resource stewardship. My research projects center on row crops and the management of water and soil resources in those agricultural systems. I conduct research projects in cooperation with Delta growers, on their farms, in order to gain an understanding of how scientific principles apply in the field. A description of my research projects is included in my statement of qualifications (II-12). My outreach program is directed toward agricultural producers, allied industry representatives, and natural resource managers. I conduct instructional meetings and demonstration field meetings where I communicate research results from my own program and those of my UC colleagues to the agricultural community. These are the major roles of a UC Cooperative Extension farm advisor—to conduct applied research and to extend the findings of research to the local community.

II. EVALUATING SALINITY IN DELTA AGRICULTURAL SYSTEMS

I have dedicated considerable time to assessing soil salinity conditions in the Delta because salinity has the potential to impact crop productivity and soil resource management. I have led several field projects over the last few years where we have monitored irrigation water salinity and investigated soil salinity in the north and south Delta under various cropping and irrigation regimes. These projects were developed with the source of irrigation water, soil series, crop, and irrigation system in mind, in order to understand baseline conditions at various locations throughout the Delta and, in the case of the alfalfa project, how the irrigation water salinity and soil salinity changed over time.

In a scenario where asked to evaluate how water salinity may impact soil salinity and crop yield, I would identify sampling locations with the following criteria in mind:

- Water quality. I would select sampling locations where water salinity ranges from low to high and/or has daily or seasonal fluctuations. I have used information from the California Data Exchange Center[1] to assist in cursory selection, but I also value land owners' understanding for water quality and how it can vary across different points of diversion on the same farm. My procedures would then involve monitoring water quality over the course of the irrigation season, preferably taking water samples as it is applied to fields, or at least taking samples at points of diversion onto Delta islands of interest. Documents submitted by protestants, and other available information, demonstrate the locations of water diversions and water uses that could potentially be injured by the Project as petitioned, including LAND-62, Exhibit C [Water Rights within LAND Area]; LAND-5 and LAND-75 [Bogle water rights protest to Petition, Exhibits A and B], LAND-6 and LAND-76 [Diablo water rights protest to Petition, Exhibits A and B], LAND-7 and LAND-77 [Elliot/Stillwater water rights protest to Petition, Exhibits A and B][2], and II-38 [Ryer Island diversions]; see also SWRCB-2, DWR and Reclamation's September 11, 2015 Joint Change Petition Addendum and Errata, Attachment C [list of all diversions within Project area].
- Soil series. I would sample fields with soil series that are representative of large areas of the Delta. This information is available from the Natural Resources Conservation Service SSURGO database, accessible from the CA Soil Resource interface.[3]

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[1] Available at http://cdec.water.ca.gov/.

[2] These exhibits include reliable listings and/or maps with an accurate and undisputed description of the water rights associated with these protestants.

[3] Available at: http://casoilresource.lawr.ucdavis.edu/drupal/node/902.

- Cropping patterns and crop salinity tolerance. Crop acreage is available from the offices of the county Agricultural Commissioners and can be parsed out for the Delta region. I would use established salinity thresholds (II-15; Ayers and Westcot, 1985) to determine what crops are most sensitive to salinity. I would then concentrate my sampling efforts on crops that are sensitive or moderately sensitive to salinity, widely planted in the Delta, and/or high value.
- Irrigation method. My previous testimony (II-13) and an updated project report, which is identified as exhibit LAND-79 [Leinfelder-Miles (2016)] describe how sampling methods should vary based on drip, sprinkler, and flood irrigation programs. The methods capture how soil salinity varies with how water is applied to the field.

I would follow previously described procedures for monitoring applied water salinity, soil salinity, groundwater depth and salinity, and crop yield, as described for border check flood irrigated alfalfa fields, a drip irrigated vineyard, and a sprinkler irrigated pear orchard (II-13, II-14, and LAND-79 [Leinfelder-Miles, 2016].)

For applied water salinity, I emphasize the importance of sampling water as it was being applied to the field and from as many irrigations as possible during the growing season (generally April-October) in order to characterize the salinity of the water available to the crop. In contrast, the Petitioners failed to consider injuries that the Petition may cause to individual water rights. In testimony and cross examination, a DWR witness stated that she relied on regulatory Water Quality Control Plan compliance requirements rather than individual diversions in evaluations of how the Project could injure water users. (DWR-53, Testimony of Maureen Sergent, pp. 4:9-16, 13:7-20; see also September 23, 2016, Meserve Cross Examination of Maureen Sergent, p. 36:7-25; September 23, 2016, Meserve Cross Examination of Maureen Sergent, pp. 41:4-42:1 ["Let's note that to everyone. They did not investigate individual diversions."].)

The salinity of water in surface waterways is not an accurate representation of what the crop takes up. Additionally, monthly averages of salinity in surface waterways do not accurately represent what the crop takes up. Monthly averages of surface waterway salinity should not be used as a substitute for the seasonal average applied water salinity to a field.

Irrigation water salinity influences soil salinity because irrigation water carries salts, and when it is applied to fields, salts are added to the soil. Salts accumulate in the soil at higher concentrations than they existed in the irrigation water because evaporation and plant uptake extract water from the soil leaving the salts behind. Salts may accumulate disproportionately in the soil profile depending on soil properties, irrigation systems, groundwater depth, or other reasons. For these reasons, soil sampling procedures must be thorough enough to understand salt distribution with soil depth and across variations in the field based on soil, cropping pattern, and/or irrigation program. This could represent a two-dimensional grid pattern, as described for a drip irrigated vineyard; random sampling across an area but at specific depth increments, as described for a sprinkler irrigated pear orchard; or in field sections (e.g., top, middle, and bottom), as described for border check flood irrigated alfalfa fields. It would also be important to measure groundwater depth and salinity to better understand how groundwater may be influencing soil salinity.

III. CHARACTERIZING SALINITY INJURIES TO DELTA AGRICULTURAL SYSTEMS AS A RESULT OF INCREASES IN SURFACE WATER SALINITY

Increases in applied water salinity may injure Delta agricultural systems by degrading soil conditions or decreasing yield. Unleached salts have the potential to injure current crops and future cropping. Fluctuating groundwater depth, crop rotations and associated tillage, and changes in irrigation regimes are all reasons that unleached salts can be redistributed in the rooting zone and injure future cropping—either by reducing cropping choices or by reducing yields. In evaluating yield impacts, I would measure yields at the field because county Agricultural Commissioner reports will tally crop yields for the entire county, and those yields may not accurately reflect crop yields for the Delta.

It can be difficult to establish statistical relationships between water quality, soil salinity, and crop yields using surveying procedures, but soil salinity thresholds have been established for various crops (II-15, Ayers and Westcot, 1985), which relate soil salinity to yield potential.

We can plot these values for salinity and yield potential to understand how salinity may reduce yields. This is presented for alfalfa and grapes in Figures 1-2, attached hereto as Exhibit A. For alfalfa, we would not expect yield to be impacted until soil salinity (ECe) reaches the threshold 2.0 dS/m. Beyond this level, we would expect to see a roughly 7% decline in yield potential with each 1 dS/m increase in ECe. For grapes, the ECe threshold is 1.5 dS/m. Beyond this level, we would expect to see a roughly 9.5% decline in yield potential with each 1 dS/m increase in ECe. While absolute tolerances may vary depending on climate, soil conditions, and cultural practices, these numbers serve as a guide for understanding how soil salinity impacts crop yields.

In cross examination, a DWR witness stated that a change in water quality that is less than 5% is not an impact. (August 25, 2016 John Herrick Cross Examination of Parviz Nader-Tehrani, pp. 11:21-12:8.) This is a hasty and unfounded assumption. First, based on crop salinity tolerances (II-15, Ayers and Westcot, 1985), even a small change in water salinity could reduce yield if that change resulted in an increase in soil salinity that exceeded the crop tolerance threshold. Nevertheless, if a grower must change practices to adapt to increases in water salinity in order to prevent reaching the soil salinity threshold, then another potential injury is the cost associated with these changes in practices (e.g., soil amendments, applying more water, changing crops). For example in previous testimony (II-13 and II-14), I illustrated how salinity is distributed in a Ryer Island vineyard and how average root zone salinity has reached a level that has the potential to impact yield. A small increase in applied water salinity could injure yields and soil quality through evapoconcentration of salts. A change in practices, such as applying more water, could negatively impact fruit quality by reducing the soluble solids of the grapes.

I have heard the argument that growers should grow salt-tolerant crops or plant varieties with higher salt tolerance in response to higher salinity conditions, but my response is that the choice of what crop to grow is an economic decision that takes many factors into account, and plant breeding is not a substitute for soil salinity management. For all of these reasons, it is my opinion that it is inaccurate to conclude that injury would not result to Delta agricultural water uses and users from changes in water quality that Petitioners may characterize as small.

VII. CONCLUSIONS

My experiences in monitoring soil and applied water salinity in Delta agricultural systems have elucidated the complexity of managing salinity in these systems. My understanding of salinity comes from sampling field conditions in the north and south Delta, with varying water quality, soil types, cropping systems, and irrigation regimes. An increase in water salinity has the potential to injure agricultural water users by decreasing yields or increasing soil salination. The Petitioners failed to characterize these injuries in their modeling of water quality, disregarded individual diversions/water users, and improperly assumed that small changes would not cause injury, without considering crop salinity tolerances and other site-specific considerations. For these reasons, the analysis presented by the Petitioners is inadequate to conclude no injury to Delta agricultural water users.

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 23rd day of March 2017, at Stockton, California.

Michelle Leinfelder-Miles

Michelle Leinfelder-Miles

REFERENCES

II-15, Ayers, R. S. and D. W. Westcot. 1985. Water Quality for Agriculture. FAO Irrigation and Drainage Paper 29 Rev. 1. FAO, United Nations, Rome. 174 p.

Leinfelder-Miles, M. 2016. Leaching fractions achieved in South Delta soils under alfalfa culture. Project Report Update December 2016. UC Cooperative Extension, San Joaquin County, Stockton, CA.

EXHIBIT A

EXHIBIT A – Yield potential as a function of soil salinity for alfalfa and grapes (From Ayers and Westcot, 1985).

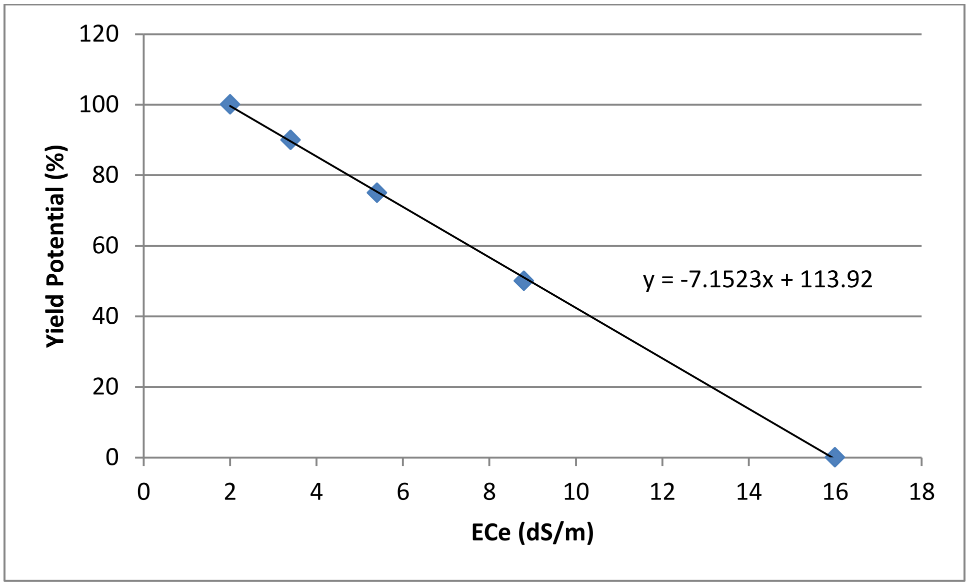

Figure 1. Yield potential of alfalfa as a function of soil salinity (ECe).

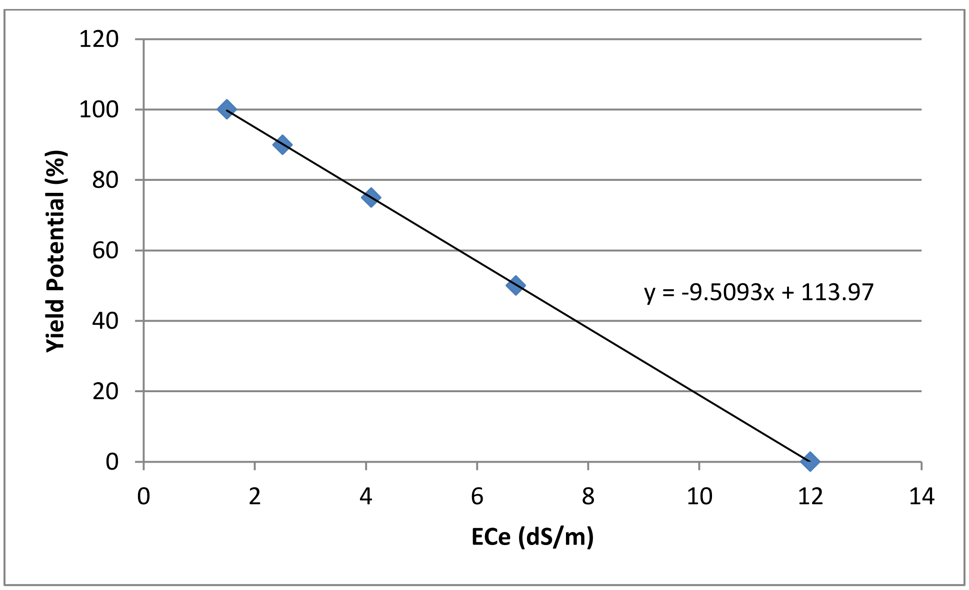

Figure 2. Yield potential of grapes as a function of soil salinity (ECe).