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Via email: james.brownell@waterboards.ca.gov

Mr. James Brownell
Central Valley Regional Water Quality Control Board
11020 Sun Center Drive #200
Rancho Cordova, CA 95670-6114

Re: Amendments to the San Joaquin River Basin Plan to Adopt
Salinity Water Quality Objectives for the Lower San Joaquin River

Dear Mr. Brownell:

The South Delta Water Agency objects to the draft Salinity Objectives being proposed for adoption on the Lower San Joaquin River as unsupported by the technical work underlying the basis for the Objectives. The proposed Salinity Objectives are not based on any technical investigations of leaching occurring in the subject area, but are based on assumed and agreed to "data" which may or may not be correct. The analysis done by staff and the Lower San Joaquin River Committee continue the faulty practices done by the State Water Resources Control Board in support of its efforts to relax southern Delta salinity standards in order to avoid the need to enforce water quality objectives.

SDWA has on numerous occasions presented the State Board with facts which not only disputes their salt and leaching analysis, but clearly shows such analysis is simply not scientifically sound. That analysis is based on Dr. Glenn Hoffman's previous work which is now known to be incorrect and unreliable as will be explained below. To be clear, this is not a disagreement between approaches or modeling or opinion. Dr. Hoffman's work done for the southern Delta salinity objectives is just plain wrong. By employing this incorrect approach and having failed to do any actual testing of leaching in the subject area, the staff and LSJR Committee have produced recommended salinity objectives that lack any scientific support.

By way of introduction, the issue is of course the protection of agricultural beneficial uses

along a portion of the San Joaquin River; a protection now nearly 20 years past due. Generally, salts (and boron) are the constituents in River water that can most affect agricultural plant growth and crop production. Even though other constituents can have effects on crops, the control of the salts will for the most part provide the necessary protection for agricultural dependant on River water supply.

According to plant and soil science, plant health and crop production are a function of the soil salinity. Measuring or maintaining short term soil salinity is practically impossible, and so the yearly (or seasonal) soil salinity is used to estimate whether or not a particular crop is being affected. Thus, each crop has a predetermined/calculated soil salinity "threshold." Once the soil salinity rises to/above that threshold, damage to the plant and also to crop production increases. Protection therefore is maintained by keeping the soil salinity below the threshold.

Salts affect plant water uptake by interfering with the osmotic process by which plants take water into their roots. To maintain acceptable levels of salt in the soil, enough water of a certain quality must pass through the soil in order to move salts out of the plant root zone. This process is called "leaching" and the "leaching fraction" is the number given to the percentage of water passing through the soil. Thus one can calculate the leaching fraction needed in order to pass the delivered salt (delivered in the applied irrigation water) through the soil so salt does not build up, and one can calculate the actual amount of leaching fraction occurring in any particular field.

The ability of water to pass through a soil is dependent on a number of factors, especially of course the permeability/porosity of the soil. Different soils have different permeabilities so leaching occurs at different rates in different places. For example a sandy soil may pass water more easily than does a clay soil. The problem is not simply solved applying more water to "push" the salts through the soil. This is because some roots are susceptible to rot and disease if they are wet too long. In other cases the management practices preclude longer or continuous irrigations. Alfalfa fields must "dry out" in between some irrigations in order for mowing, raking and baling to be done. This means that the grower cannot simply irrigate longer in order to accomplish adequate leaching.

With this background I will now explain the fundamental faults with the Hoffman approach. The following is taken from the SDWA comments to the SWRCB's Draft SED examining/justifying proposed relaxation of the southern Delta salinity standards. The reader should not assume these duplicated comments are not germane to the subject issue as the comments show that absent reliable data, the Hoffman approach is simply "guessing" and not a scientific examination.

<u>HOFFMAN REPORT</u>

The basis for the SWRCB's proposed changes to the southern Delta water quality objectives is the January 2010 report by Dr. Glenn Hoffman, Salt Tolerances of Crops in the Southern Sacramento-San Joaquin Delta ("Hoffman Report"). As related in the Hoffman Report, impacts to crops are estimated to occur when the EC of the soil reaches a threshold for any particular crop. In addition, individual applications of high saline water can also adversely affect plants and crops even when the soil EC threshold is not reached. The Hoffman Report uses no current data, relies on no actual sampling and testing of soils, and contains no actual

data on existing conditions in the southern Delta. Because of this, both Dr. Hoffman and the single peer reviewer of Dr. Hoffman's work state that additional sampling and testing were desirable.

There are two ways to determine if salts are building up in the root zone of agricultural crops. One is to actually ***measure*** *the salts in the soil and the other is to* ***calculate*** *the soil salt and how it might be changing. The calculation method attempts to determine the leaching fraction of a particular area. The "leaching fraction" is the amount of additional applied water (of a certain quality) above the amount needed/used by the plant and which passes through (out of) the root zone. Leaching fractions are normally expressed as a percentage. This amount or percentage of "extra" water is the means by which salts move out of the root zone.*

In order to calculate leaching fractions for the southern Delta, Dr. Hoffman used a specified water quality for the applied water and 1986, 1987 and 1989 data from the sampling of tile drains (see Table 3.10 of Hoffman Report). In nonscientific language, Dr. Hoffman used applied water EC as the "salt in" to the soil, and tile drainage EC as the "salt out" of the soil.[1]

Dr. Hoffman assumed the applied water quality was 0.7 dS/m EC (to be consistent herein I will convert from the dS/m scale to the mS/m scale, in this instance converting 0.7 to 700). There is no basis for such an assumption. Data from DWR indicates that the EC at the three interior southern Delta compliance locations is regularly above the 700 EC levels in summer months (see for example attached DWR Water Quality Data). Dr. Hoffman made no attempt to determine what the range of EC's were in any particular year or in any year types. Neither did Dr. Hoffman or SWRCB staff seek data from individual farmers who regularly take EC measurements. Attached hereto is a declaration I prepared and signed giving one example of such local testing. In June of 2015 I sampled the supply water from the southeastern end of Tom Paine slough as 2,200 EC. Thus, when Dr. Hoffman assumed the "salt in" as being 700 EC he was not using actual or accurate data; he was simply guessing.

For the "salt out" inputs, Dr. Hoffman used the tile drain data referenced above. However, to be useful, the tile drain water (which was originally sampled and the EC thereof measured), would have to be the excess applied water which passed through the root zone which transported the applied salts through the soil. Instead, those tile drains (described in pages 51-53 of the Hoffman Report) contain mostly shallow ground water and not excess applied water. The ground water in that area is very saline (see attached Statement of Jack Alvarez). Thus, Dr. Hoffman's data for how much salt is being passed through the soil profile is simply not that.

Therefore, Dr. Hoffman used the incorrect salt in data (understating applied salt) and incorrect salt out data (overstating salts leached from the soil). The results therefore may indeed be calculation outputs or modeling results, but they bear no relationship to what was/is happening to salt levels in southern Delta agricultural soils. Not only can one ***not*** *calculate an accurate leaching fraction by using incorrect and irrelevant data, but one also cannot thereafter estimate what quality of water is necessary to protect agricultural beneficial uses. Once the*

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[1] Dr. Hoffman also references some other drainage and tile drainage data but again never confirms if the water in that drainage was from poor quality ground water, excess applied water, or some combination thereof.

initial, incorrect data was used, Dr. Hoffman's entire effort and certainly his results are merely some hypothetical math exercise and useless in evaluating southern Delta salinity issues.

The only effort made to address this fundamental fault in the work was when Dr. Hoffman added another, lower leaching fraction (15%) to his work; and still concluded that the objectives could be relaxed. Of course such a "correction" does not cure the underlying problem unless this new leaching fraction he later inserted was indeed an accurate representation of leaching fractions for southern Delta soils. As one might assume, it was not as will be explained below.

The Hoffman Report suffers from other inaccuracies and misconceptions which also preclude its use to justify a relaxation of water quality standards. Water and the dissolved salts in it must pass through the soil in order to leach salts from the soil (or prevent their buildup). However, as previously presented to SWRCB staff and Dr. Hoffman, the permeabilities/percolation rates of southern Delta soils inhibit, if not actually prevent the water from moving fast enough to accomplish any leaching (see attached Water Quality Considerations for the South Delta Water Agency, Hoffman, Prichard and Meyer). Also attached hereto is the Outline of Testimony of Alexander Hildebrand on South Delta Agriculture by Alex Hildebrand explaining this problem with many southern Delta soils. Mr. Hildebrand relates how slow percolation rates can prevent a farmer from applying the necessary additional water to leach the soil because the field must be allowed to dry out before the next irrigation is necessary. Because of this, the farmer ends up adding more and more salt over the season and the crop suffers.

Though perhaps not a controlling fact, Dr. Hoffman's familiarity with the underlying issues associated with farming perhaps helps explain why his work is not reliable. At a workshop early in this process, Mr. Hildebrand explained publically to Dr. Hoffman that he was not considering real-life problems in his analysis. Mr. Hildebrand explained how the management practices for alfalfa included mowing, raking and baling upwards of 8 times a season and how this regular vehicle traffic over the fields further compact the soils and exacerbates the low permeability problems. Dr. Hoffman's now semi-infamous reply was that he "could not help it if farmers had bad management practices." Of course such a comment lays bare the technical shortcomings of the process and also how difficult it is to get "experts" to change their mind even in light of irrefutable evidence. Alfalfa cannot be farmed without vehicle traffic for mowing, raking and baling.

This example also recommends a change to the entire process. Since the first agricultural objectives were developed for the Delta, the SWRCB and most interested parties have focused on measuring impacts to "salt-sensitive" crops. Thus the current SED as well as the many prior efforts all look to how applied water quality might affect beans, a salt sensitive crop. This perhaps makes sense in the lab where plant scientists pour water into containers of sand to see how much water passes through the soil and the degree to which salt may accumulate in the soil. However, the real world is something different altogether.

The degree to which any plant may be sensitive to salt may not be the most important concern in developing a water quality objective. If the soils do not allow adequate leaching, then the salt delivered via the applied water never gets fully flushed out of the root zone and eventually that plant's particular threshold is reached and the crop suffers. Of course for any particular crop the time it takes to reach the threshold may differ, but the issue is not so much

how sensitive the plant is, its whether or not salts are being flushed out of the soil. Dr. Hoffman's fundamental error was thinking that he could calculate the leaching fractions of the soil and that his calculations need not be ground-truthed. One cannot know if a soil is allowing enough water to pass through to allow leaching without measuring what is actually going on in that particular area. Modeling leaching is at best a guess, and in this case a very bad one.

Lastly with regard to the Hoffman Report it must be noted that in his attempts to use tile drain data, Dr. Hoffman failed to investigate (or understand) the many differences in the southern Delta. The southern Delta has land that is 20 feet above sea level and land that is 5 feet below sea level. Some of the lands get water from near Vernalis which is generally kept at or below the objective; some get water from interior areas that are stagnant and higher in salinity (than the water at Vernalis), some get export quality water either from the cross Delta flow or directly from the CVP's Delta Mendota Canal; and everything in between. Many areas have shallow ground water of very poor quality and the plants roots are in contact with that poor quality water. In some areas the tides directly affect ground water levels and thus twice daily raise the poor quality ground water up and down, in and out of the root zone. This inhibits if not prevents salts from permanently passing through the root zone. A myriad of differences determines the ability or success at leaching.

Though some of these peculiarities were mentioned by Dr. Hoffman, none were actually taken into account in his work. For example, the notion that tile drains in the southeastern portion of the area are typical of drainage in other southern Delta areas is false on its face. Those drains are in soils and area that have little in common with other areas. Thus even if the tile drain data were accurate representations of water that only passed through the soil (and it is irrefutably it was not) it would still not be reflective of drainage from other areas or indicate how much salts passes through other root zones. In this same vein, Dr. Hoffman did not determine if the supply water for the lands served by the tile drains was from the Delta channels or from the DMC. Such lack of "ground-truthing" cannot support changes to water quality objectives.

As we see, the Hoffman Report simply cannot support changes to water quality objectives. The only evidence bearing on the issue of "what quality of water is necessary to reasonably protect agricultural beneficial uses" was in fact produced by the SDWA.

LEINFELDER-MILES REPORT

In response to Dr. Hoffman's inaccurate Report and to the SWRCB staff's unwillingness to recognize the deficiencies therein, SDWA, in conjunction with grant funds from UC Davis retained Michele Leinfelder Miles to conduct a study. The study is entitled Leaching Fractions Achieved in South Delta Soils Under Alfalfa Culture Project, Report Updated December 2016 and is attached hereto. Ms. Leinfelder-Miles is the Delta Resource Management Advisor with the University of California Cooperative Extension, based in San Joaquin County. For the investigation seven locations were selected throughout the southern Delta to get a sampling of different soil types and different water qualities. The basic design of the study was to sample and measure the soil salinity in the root zone at the beginning of the irrigation season, sample the applied water used for each irrigation and measure its salinity, and then sample and measure the soil salinity at the end of the season. In this manner, the study would determine the amounts

of salts applied and how much of those did or did not remain in the root zone (were or were not leached out).

The data was collected in the years 2013 and 2014 and the results are in the attached study and were presented to the SWRCB orally at its December 2016 workshop/meeting held in Stockton California. The oral and written materials at that workshop/meeting are incorporated into these comments. In general, Ms. Leinfelder-Miles' study found that of the seven locations, ***five never achieved a leaching fraction greater than 8%*** *and of the 14 results (seven sites over two years)* ***half had leaching fractions at or less than 5% with results of 3% and 2% in certain cases.*** *Recall that Dr. Hoffman calculated leaching fractions for the southern Delta at 20% and above and then later added a 15% leaching fraction analysis after the initial criticisms to his work.*

The conclusions reached by Ms. Leinfelder-Miles were (i) salinity in the area is a problem because of the low permeability of the local soils, poor quality applied water and shallow groundwater, (ii) the data indicates that leaching fractions being achieved are very low such that salts are building up in the soils, potentially harming crops, and (iii) local conditions and best management practices constrain farmers ability to leach salts.

Thus one the one hand, the SWRCB has before it calculated leaching fractions by Dr. Hoffman which were arrived at using incorrect and irrelevant data. On the other hand the SWRCB has Ms. Leinfelder-Miles' study which actually determined leaching fractions based on specific, current data. That data shows very low leaching fractions and a buildup of salts in the soil. As stated above, the question before the SWRCB does not hinge on a choice between two sets of data or two opposing opinions. The only accurate, reasonable and reliable data that exists does not support a relaxation of the water quality objectives. To the contrary it suggests current standards are insufficient. That conclusion is perhaps premature in that we do not generally know if the current objectives are protective because DWR and USBR do not regularly meet the standards and the SWRCB does not enforce the standards. Regardless, there is no data supporting a relaxation of the water quality objectives for agricultural beneficial uses in the southern Delta.

It becomes clear from the above that although the Hoffman approach might be useful as an overview of how to calculate leaching fractions, in practice is does not predict actual leaching and cannot therefore be used as the basis for determining a salinity standard. Dr. Hoffman used faulty data because he did not conduct any studies nor find any studies showing what leaching fractions were occurring or what soil salinities were resulting from the application of the available water supply. When confronted with the inaccuracies of his results, Dr. Hoffman simply added a new, lower leaching fraction instead of taking note that the actual leaching fractions being achieved were sometimes 1/10th what he had calculated. The real data, from actual testing showed that salts were collecting in the soils. The calculated data indicated no such problem.

Thus we arrive at the proposed Water Quality Objectives being considered by the Regional Board. The staff and LSJR Committee conducted no sampling, no testing, and no field analysis at all. There is no data on existing soil salinities. There is no data on actual leaching fractions being achieved. There is no data on whether current conditions are increasing soil salinity. There is no data on how the proposed objective will affect soil salinity. There is no data

on whether current conditions are harming agriculture. The authors/proponents simply "decided" what inputs to use and then decided which leaching fraction to use. That may be fine as a thought experiment but is does not suffice as scientific analysis.

When the actual data was used to calculate southern Delta leaching fractions it was revealed that the outputs from the Hoffman work had no relation to reality. Given this "track record" of the approach, there is no basis for concluding its application in this instance is correct or reliable. It is worth noting that the LSJR Committe process has been ongoing for a number of years and that the two year southern Delta study conducted by Ms. Leinfelder-Miles cost somewhere around $40,000 in total. During the development of the subject Water Quality Objectives a similar study could have been conducted with virtually no impact on the overall funding/expenses of both the CV-SALTS and LSJR Committee. The reliance on the Hoffman approach instead of using actual scientific studies should give the Regional Board pause for thought. In today's environment, it all too easy to assume that a calculation or model will give reliable results.

The above indicates that there is no real technical support for the proposed salinity objectives. However, the proposed Basin Plan Amendment/Agricultural Water Quality Objectives suffer a number of other fatal flaws.

First, the analysis deals mainly if not almost exclusively with almonds and other crops which constitute the majority of crops currently farmed in the subject area. By limiting the analysis to these crops and ignoring crops with smaller acreage, the proposal pre-determines agricultural choices. During the development of the proposed changes to the southern Delta salinity standards, it was noted that beans, a salt sensitive crop, were no longer farmed as extensively as in the past. Thus it was argued that since it covered much less acreage, the standard need not be protective of that smaller crop. This is of course contrary to logic. Crop choices are a reflection of a number of things, especially changing market conditions. What is only minimally farmed now may change if prices increases for that crop or decrease for some other crop. By not protecting beans or some other crop, the Regional Board is in fact precluding farmers from begin able raise that crop given the poor water quality allowed by the new objectives.

Staff should be aware of the Delta Protection Commission's Economic Sustainability report issued a few years back. In that report, the DPC found that there was a direct relationship in the Delta between increasing applied water salinity and changes to less salt sensitive crops. Thus, not only does a lax salinity standard prevent a farmer from changing to some crops, it also forces him to move away from some crops.

Second, it is unclear where the notion that the Objective should protect/allow 95% crop yields instead of 100%. It is not clear what federal or state water quality laws are aimed at partial and not full protection. It appears the staff is hanging its collective hat on the notion that all one needs is "reasonable protection" under Porter-Cologne. Ignoring the fact that federal law has no such caveat, the word "reasonable" in that phrase refers to the ability to provide the needed level of water quality. It does not create an authorization to protect only a part of the beneficial use.

Along this same line, the Draft Basin Plan Amendment makes no analysis of how that 5% decrease in a crop translates into an effect on the farmer. If the profit margin for a farmer is

small, and/or it is only when he produces a certain amount per acre that he makes a profit, the automatic loss of 5% of his crop each year might be a controlling factor is his ability to survive. I find no analysis in the supporting documents to justify the decision to only prevent "most" of the harm to the beneficial use. Further, when the objective relaxes even more during dry times, the Regional Board is then forcing an even larger decrease in the farmers' economic viability.

This of course makes no sense. If the purpose of an objective is to protect a specified beneficial use but the objective predetermines a significant harm to the use, then the objective is not protective. It must be noted that the notion that any farmer would think that a water quality of 1,550 EC or 2,470 EC is acceptable is bordering on the ludicrous. One wonders what CVP contractors receiving DMC water would say if their supply was allowed to be this poor.

Which brings us to another shortcoming of the proposed Objectives. The proposal is that the 1,550 EC will relax to 2,470 EC (assuming EC meters can reliably be that accurate). There is no legal authority or plant science support for allowing a one-and-a-half times increase in salinity because of the water year type. The soil salinity thresholds for each crop do not suddenly change when less precipitation occurs. The relaxation to the grossly unsupportable 2,479 EC limit simply means that the beneficial use will not be protected during dry times. Worse still, it appears that a declared drought emergency will trigger the relaxation. We saw in the recent past that the Governor of California declared a drought emergency even when there was no drought, but rather based upon California's long term water crisis. Thus by the whim of one person agricultural diverters suddenly have no protection.

Fourth, the supporting documents appear to show that "full" protection would be provided by an Objective of 1,200 EC. It is not clear why full protection is somehow unreasonable, but it is clear that the justification for this choice is a result of USBR/CVP contractor input. The parties who pollute the River with salts have apparently decided that full protection is too much of a burden and so a lesser "protection" is all that will be condoned.

It is important to remember that the River's salt problem is a direct result of the CVP's import of upwards of 1 million tons of salt to the valley each year, much of which drains into the River via surface drainage and subsurface accretions. The starting point for considering a water quality objective should be to first force the party or parties that created a problem to fully mitigate their impacts. Thereafter, if some better quality is required then limitations or affirmative actions may be required of others. Until the USBR mitigates its impacts there should be no Basin Plan Amendment. Without the foreign CVP salts in the River (or the CVP caused decreases in River flows), all beneficial uses might be protected.

Lastly, it appears from the record and statements from LSJR Committee personnel that the relaxation to 2,470 EC was the result of some sort of "meeting of the minds." Of course that is not what constitutes sound Basin Plan policy, but it also appears that the "decision" was based on the question "would you rather have bad water quality or no water?" Such a choice is not part of sound Basin Plan development. It may or may not be the obligation of any party to insure water is in the River to protect beneficial uses. A party may or may not be legally entitled to divert the water in the River under varying circumstances. However, the protection of beneficial uses is not a function of USBR or CVP contractor willingness to make releases into the River. The responsible parties should mitigate their impacts, not begrudgingly agree to partial mitigate while threatening those who are each year adversely impacted by the ever-present CVP salt.

SDWA urges the Regional Board to not adopt the proposed Basin Plan Amendment/Agricultural Water Quality Objectives currently being considered. Instead, the Regional Board should immediately authorize a leaching study similar to the one done in the south Delta, and from that result determine what is necessary to protect agricultural beneficial uses along the River. During that time, the Regional Board in conjunction with the SWRCB should develop the appropriate enforcement action to require the USBR to mitigate its adverse effects to the River. The Regional Board is reminded that PL 361-108 (HR 2828) requires the USBR to develop and implement a program to meet all of its water quality obligations in a manner that decreases its use of New Melones. The regulators of water quality should not allow the USBR to avoid its federally mandated obligations.

Please feel free to contact me if you have any questions.

Very truly yours,

JOHN HERRICK