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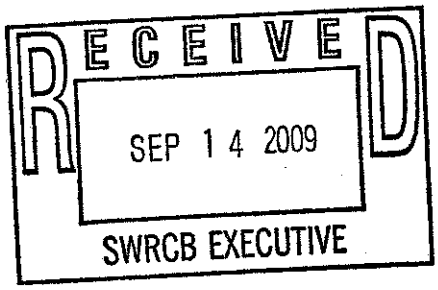
September 14, 2009



Via E-Mail commentletters@waterboards.ca.gov

State Water Resources Control Board
Division of Water Rights
P. O. Box 2000
Sacramento, CA 95812-2000

Re: Crop Salt Tolerance Study Report Comments

Dear Sir/Madam:

The following are the comments of the South Delta Water Agency to Dr. Glenn Hoffman's draft report of July 14, 2009 entitled *Salt Tolerance of Crops in the Sacramento-San Joaquin Delta.* This Report was prepared at the request of the State Water Resources Control Board as part of its review of certain water quality objectives, including the objectives to protect agricultural beneficial uses in the southern Delta.

Generally, the draft Report is a very good start to the process as it includes a comprehensive review of the current state of knowledge and a good evaluation of the various models being, or proposed for use. However, the draft Report is too narrowly focused and needs further work before it can be used a basis for reviewing or supporting changes to the current water quality objectives. These comments will include a discussion of the issues and facts which we believe are not adequately covered in the draft Report, and then specific comments to various sections in it.

Discussion of Inadequately Covered Issues and Conditions

The draft Report narrowly focuses on the salt tolerance of beans as the mechanism by which all southern Delta agriculture will be protected. Such a focus is not warranted due to the specifics of the southern Delta. The beginning point for any evaluation is to determine what is the end goal. Although the draft Report states that it seeks to review the data on impacts to crop productivity from the use of saline water, section 1.3 ends by noting it will "recommend a salinity guideline that could provide full protection of the most salt sensitive crop." The latter does not necessarily equate to the former if other factors affect crop salt tolerance or if the protection of the "most salt sensitive" crop differs significantly from the protections of other crops under varying conditions.

The salinity standard should protect all important South Delta crops, including different varieties of beans, alfalfa, first year asparagus, and tree crops. Each of these has a different planting season, different growing season, different root depth, different consumptive water needs and salt tolerance. Additionally, each crop has a different commercially practical percolative capability to convey applied water through the root zone to achieve adequate leaching fractions. They also have different surface soil temperature needed for germination, and a different range of plant sensitivity to salinity of soil moisture at different stages of growth, etc. The applied water quantity and salinity and timing for each crop must, therefore, first be determined. Only then can it be determined whether the same salinity standard can protect full yield of more than one crop at all times of the year. Experience shows that the needs of different crops will dictate the appropriate salinity standard at different times of the year. One cannot just consider beans which grow from May to September with a shallow root zone, without regard to other crops that have deep root zones and different rates of percolation, and must be irrigated at other times of the year.

Through no fault of Dr. Hoffman, the process that led to the draft Report seems to have been designed to determine the highest in-channel water salinity that would not destroy South Delta agriculture. The draft Report seems to assume that farmers can operate in accordance with an academic determination of what is feasible in field operation. It assumes that farmers need no margin in the salinity standard to allow for uncertainty in the report's analyses, or for problems which are largely ignored in the draft Report. These problems include;

1) The achievable leach fraction through and out of the root zone in alfalfa and tree crops depends on the percolative capacity throughout the deep root zone, and on the soaking time which is both available and non-damaging to the crop.

2) The existence of stagnant channel reaches whenever the flow into South Delta channels is less than consumptive use of water in the South Delta. No standard can be met in

stagnant reaches, and current monitoring points are not located to detect stagnant channel reaches.

3) The lack of adequate allowance for the fact that seedlings and young crop plants are more salt sensitive than established plants, and that it is typically very difficult to maintain soil moisture of low salinity the seedling root zone.

4) Allowance for the assumption that farmers should accept a reduced percentage of seedling emergence caused by soil moisture salinity. The report makes no analysis of possible abnormal distribution and/or reduced vigor of seedlings that then do emerge. There should be some allowance for the uncertainty this imposes on ultimate crop yield. The issue of the salt effects on emergence and seedling stage should be considered on the ultimate yield reduction, since that is a reality in the field.

Alfalfa not only has a large acreage, but is very important to supply San Joaquin County's many dairies. An examination of the specifics for alfalfa is instructive. Included herewith are three documents supporting the following discussion. They are entitled (I) *Typical Harvest and Irrigation Schedule for Alfalfa During June, July and August*, by Alex Hildebrand (ii) *Impact of San Joaquin River Quality on Crop Yields in the South Delta*, by Dr. Gerald Orlob, and (iii) *Outline of Testimony of Alexander Hildebrand on South Delta Agriculture* also by Mr. Hildebrand.

The Orlob paper includes a review of the data which shows that soils in the southern Delta have a wide range of permeability from rapid (>6 inches per hour) to slow (<0.2 inches per hour). The data shows that approximately 40% of the lands in the area are classified as "slow" permeability. This means that when water is applied, it soaks into and through the soil at a very slow rate; <0.2 inches per hour. Such extremely slow rates hamper the ability to achieve the leaching fractions discussed and assumed in the draft Report.

As set forth in the *Schedule* and in Mr. Hildebrand's draft testimony, the agricultural practices for alfalfa, when combined with the significant variations in soil permeability (both in the area and within individual fields) result in there sometimes being only enough "soaking" time during irrigation to satisfy the consumptive needs of the crop, with no effective leach occurring. Additional irrigation to achieve leaching is not commonly possible in these tight soils as the prolonged presence of the water can and does result in serious damage to the plant roots (such as anoxia and Phytopthera root rot). Hence, the local conditions simply preclude the ability to move enough water through the soils to leach the salts in the soils. To offset this, the salinity of the applied water must therefore be lowered so that the salinity of the soil moisture in the root zone does not rise above the threshold for full crop yield.

The draft Report assumes that a certain quality of water will move through the soil, and that there is sufficient time for it to do so. Since these assumptions are incorrect, the conclusions regarding what water quality is protective of agricultural uses is also incorrect.

A review of Dr. Orlob's paper and Mr. Hildebrand's writings shows that the leaching fraction in this instance is somewhere from 4-10%; well below the 20-25% assumed in the draft Report. In fact, Mr. Hildebrand's own experience using tensiometers on his fields indicates that sometimes no leach fraction is attained at all during summer months. We believe that all of this information has been previously provided to the SWRCB staff and/or Dr. Hoffman. If additional copies are needed, they can be easily provided.

A second issue complicating the ability to leach salts is the local ground water problem where the groundwater rises into the root zone. Although the draft report discusses ground water levels, the discussion does not appear to be completely accurate. The draft Report notes (on pages 46-47) that ground water levels are in most places 3-4 feet or more below the surface. The draft Report incorrectly discusses how crops may be able to use this shallow ground water, and also incorrectly discusses how the most salt-sensitive crops are shallow rooted, and thus not generally affected by the ground water. These are major errors.

In fact, ground water levels vary greatly depending on distance to the neighboring channels, and the relationship to sea level and tidal flows. In portions of the south Delta (northern and northwestern) the land is at and below sea level. Hence, without any ongoing drainage system at work, the ground water will rise to at or above the land surface. In addition, the shallow ground water is also of poor quality, being very saline; many times the current standards. Finally, there is a direct hydrologic connection between the waters in the neighboring channels and the ground water. This means that as the tides ebb and flow, the ground water rises and falls.

The result of these conditions is that salts which need to be leached from the root zone are constantly pushed up and down, in and immediately below the root zone. Here the salts collect and are repeatedly reintroduced into the very zone which needs to be flushed. Although there do not appear to be any published papers on this situation, discussions with area farmers are illustrative and uncontradicted. As the tide comes in, the shallow, poor ground water rises into the zone which needs to be leached of salts. The farmers regularly deal with salts being pushed up into or through the root zone where they are either flushed out with winter irrigation (when and if possible), or pushed away from the shallow roots of row crops through specific changes in irrigation practices. This situation certainly needs further study, but it is clear that "normal" irrigation practices will not result in the leaching of the salts. This problem is prevalent on Union Island, Fabian Tract, and Roberts Island. SDWA can coordinate meetings with Dr. Hoffman and

farmers with experience in these matters. We have already provided a written discussion of this authored by Mr. Hildebrand.

Important to this process is an acknowledgment of the historic water quality of the San Joaquin River. Per the1980 Report of the Effects of the CVP on the Delta, pre-export project water quality in the San Joaquin River (before it entered the Delta) was always substantially better than the current standard. We are including the appropriate excerpts from that report. This information addresses the potential argument that area farming simply cannot be reasonably protected due to local circumstances. To the contrary, farming flourish for 100 years before the operation of the CVP, and now the SWP, severely impacted River water quality.

The issue of the standard applying throughout the channels, and not just at the current measuring locations is stipulated by the SWRCB and highlighted from the testimony of Chip Salmon (attached hereto), a local farmer.[1] A portion of the fields he manages/farms are irrigated with water from the east end of Grant Line Canal, which is a dead end channel. This channel does not have any net flow, but rather is filled (and to some degree) flushed through tidal action. Even with subsurface tile drainage and up to date practices, Mr. Salmon has and continues to suffer from crop damage to his grapes, walnuts, and of course beans. These permanent and deep rooted crops use significantly more water over a longer growing season than the bean season on which the draft Report focused, and thus indicate that an examination of other times of the year, and other achievable leaching fractions is required.

Mr. Salmon's testimony shows that very significant salt damage results from use of water with a quality in the range of the 700's to 900's EC. Grapes, and especially walnuts are deep rooted, permanent crops. It is clear that adequate leaching of salts from the root zone is not regularly possible using water quality above the current standard. At the very least, additional study is needed to determine the specifics of why these crops are not protected by applied water salinities of 700-900 EC. SDWA can coordinate a meeting with Dr. Hoffman and Mr. Salmon.

With regard to the needs of seedlings, the draft Report discusses and appears to adopt an acceptable percentage of seedling loss (10%; see section 3.2.2). It is not clear why such a significant loss would be the threshold, and further explanation is necessary. The draft Report does not examine effects on ultimate crop yields, which would seem to be a more appropriate yardstick. The draft Report indicates that many local crops at emergence and early growth stages need salinities below the current standard and recommends further study. However, the data

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[1] Attached hereto is additional testimony including Alex Hildebrand's in a recent CDO hearing. We are also including the transcripts of the direct and cross-examination of Mr. Salmon and Mr. Hildebrand.

clearly indicates that the current standard is insufficient. This conclusion is not adequately high lighted.

Comments to Specific Sections of the draft Report.

1.3 Should add "adequate achievable leaching fraction" as an objective.

2.2.2 SAR of 2.4 but the Na to Ca is in excess of 3:1 indicating an infiltration problem in FAO 29 Rev 1. Page 60. 3.2/0.94=3.4

2.3.1 The values listed in Table 2.1 are for surface soils, not the limiting layer in the root zone. Should not the lowest permeability in the profile be used, especially for deep-rooted crops like alfalfa or trees?

3.1.2 Beans should not be the only crop taken into consideration when setting a standard which seeks to protect agriculture in general.

3.5 With regard to effective rainfall, the soil is not always devoid of vegetation during the winter or off season. Weeds increase the water loss to the atmosphere. Alfalfa and cover crops in orchards certainly have an ET during winter.

3.5.2 Table 3.6 deals with average rainfall. We suggest a comparison of the available data for Stockton, Modesto and Tracy for events, weekly and monthly totals be compared to the Table. The draft Report later mentions data from "Tracy-Carbona" area. Why is this data not used here or at least compared to the Table?

3.8.1 The report assumes that excess water is applied in some areas and provides runoff and deep percolation. This is not always the case; sometimes portions of the field are under irrigated. Most fields are disced after harvest and have no surface runoff.

3.8.2 The draft Report should better describe how it is believed that irrigation efficiencies can impact development of standards. Does this variable require more study?

3.10.2 Were some of these experiments conducted in climate controlled greenhouses? If so, how does this affect use of the data?

3.12.2 The ground water wells cited do not include areas with the shallowest ground water, and many are in areas which do not use channel water. [DMC water from exports is mostly composed of the fresher cross-Delta flows from the Sacramento River, with only a portion being from the San Joaquin River after it passes through the southern Delta.

Hence DMC quality is virtually always of better quality than that in the southern Delta channels.] As stated above, many ground water areas are subject to regular and significant fluctuations due to the tidal effects. These effects in some areas hold the salts in the soils and frustrate leaching and flushing. CDWA previously provided a DWR study indicating that the area acts as a salt reservoir during the growing season. These salts are trapped between and in the root zone and the shallow ground water.

If a study with 9 wells was deemed insufficient to draw generalizations, why was the 10 well study more reliable?

3.13.1 The draft Report discusses salts dissolved from the soils and added in fertilizers. Are not most "original" or natural salts in the soils long ago removed from 100+ years of irrigation? Are there any studies which indicate or quantify the amounts of salts added by fertilizers as compared to the salt load introduced by export operations?

3.13.2 Given the lack of confidence in the *Chilcott, Montoya, and Meyer* data, can South Delta leaching fractions be estimated with any degree of confidence? The *Chilcott* data (Table 3.18) appears to come mostly from wells in areas which receive DMC water, and which are not dependent on in-channel quality. In addition, they are mostly in the area with the lowest ground water, and thus not subject to the problem of tidal influenced ground water fluctuations. Hence, this data cannot be used to calculate leaching fractions for the pertinent areas of the southern Delta.

It is doubtful that the *Montoya* report of 2007 can be used for any purposes associated with Dr. Hoffman's review. The report is an attempt to identify the "sources" of salts in the southern Delta channels, but makes no mention or analysis of the salt loads or concentrations entering the system from the San Joaquin River. It attempts to identify agricultural discharges as "sources" of salt load and concentration, when in fact virtually all of the salt originated from the activities of the CVP in upstream areas.

More importantly, the report is a synthesis of old information and is not current or reliable. It estimates agricultural drainage from the area based on 50 year old data, not using current DWR modeling of the amounts. Even that old data is based on limited power data and cannot be seriously considered accurate for any purposes. With regard to the salinity data, the report relies exclusively on a Central Valley Regional Water Quality Control Board study during 1986-87. Most of the data is from an 18 month period, with minimums, maximums and median numbers given for EC. There is no explanation of associated irrigation, drainage, rainfall or other conditions which would indicate whether the numbers given are typical or representative of general conditions in the area. Without confirming, it appears that the period of data covers the time frame between a wet year

and the beginning of the 6 year drought. Important for our purposes, the draft Report of Dr. Hoffman uses these numbers to calculate an average drainage EC, and from that, average leach fractions. This data cannot be used for such purposes as it does not show the quality of water which has leached a field. In addition, drainage water quality is extremely dependent on location, source of applied water, and ground water depth. Some of the areas/drains cited would include none of the water which percolates down to the ground water. This of course would mean the drainage water is mostly excess applied water, and again would not allow one to calculate a leaching fraction. Without specific diversion/drainage/ground water data, leaching information simply cannot be calculated.

The draft Report mentions leaching fractions from 0.05 to 0.10, to 0.15 or greater. However, the Report then uses the higher end of the ranges in later calculations of needed water quality.

Modeling

The modeling analysis suggests that further workshops are necessary before considering the use of the dynamic models over the static ones. It is important to note that input for any of these models is the key. For example, the *Letey* model predicted that the standards could be raised to 1000 EC. However, that prediction was based on achieving a leach fraction well above those referenced immediately above, or suggested by the discussions above.

We hope this information and our offer to coordinate further meeting between Dr. Hoffman and local farmers will result in a more comprehensive evaluation of what is needed to protect southern Delta agriculture. The draft Report, and ultimately any decision regarding the SWRCB's review of standards must recognize that the existing conditions in the area simply do not allow adequate leaching of soils containing the introduced salts when the applied water has an EC above the current standard of 700 EC. Please feel free to contact us regarding the scheduling of additional meetings.

Very truly yours,

JOHN HERRICK

TYPICAL HARVEST AND IRRIGATION SCHEDULE FOR ALFALFA DURING JUNE, JULY, AND AUGUST

Day

1 The day after a cutting is baled and hauled off the field, it is irrigated. The soaking time on each portion of the field is about six hours. (The roots are damaged by loss of aeration if soaking time is extended.)

10 About ten days after the start of the first irrigation, the field is dry enough to irrigate again.

22 About 12 days after the second irrigation is completed, the field is dry enough to mow. Mowing, curing, raking, baling, and hauling takes about seven days.

29 In about 29 days, the harvest cycle is complete.

This schedule allows no extra time for days when there is inadequate dew for baling, or for delays in scheduling labor and irrigation pumps that are also needed for other crops.

Each summer harvest cycle yields about 1 1/3 tons of hay.

In order to produce 1 1/3 tons of hay in 29 days, the alfalfa must consume about 7.2 inches of water over the crop area plus another 15 percent for leaching salt and a little more for surface evaporation. This water must percolate into the root zone in about 12 hours of soaking time, or about 2/3 inches per hour.

Testimony in 1991 showed that bout 40 percent of South Delta soils have permeabilities that will percolate from less than 0.06 inches per hour to 0.2 inches per hour in the absence of near surface soil compaction by harvest procedures. In a new planting of alfalfa, a permeability of 2/3 inches per hour is therefore needed.

IMPACT OF SAN JOAQUIN RIVER QUALITY ON CROP YIELDS IN THE SOUTH DELTA

G. T. Orlob

INTRODUCTION

The agricultural productivity of lands within the South Delta Water Agency is dependent upon both the quantity of water that enters the Delta at Vernalis and its quality. It is also determined in part by the nature of soils, i.e. their permeabilities and leaching requirements to avoid excessive accumulation of salinity during the growing season. In general, fine textured soils such as those that comprise the major part of South Delta lands have lower permeabilities, and thus require higher quality of applied water to assure optimal crop growth without loss of yield.

To demonstrate the nature and dependence of agricultural productivity in the South Delta on San Joaquin River quality, it is necessary to consider the following factors:

1. Soil characteristics, i.e. permeabilities and field leaching fractions, and variability of these over the lands of the South Delta,

2. Crop yields in relation to water quality, soil characteristics, and crop type,

3. Quality of water available in South Delta channels during the growing season, and

4. Cropping pattern and crop value for the South Delta.

Attachment "I"

Combining these factors in a quantitative framework results in estimates of the sensitivity of the South Delta area to water quality at Vernalis.

SOIL CHARACTERISTICS

Soils of the South Delta, identified in the most recent soil survey of the area, have been organized into five groups according to field permeabilities. These are depicted on the general soil map for the South Delta area (SDWA Exhibit 106), and for a smaller representative area in the vicinity of Old River between the San Joaquin River and Salmon Slough (SDWA Exhibit 107). Characteristics of these soil groups, which are considered indicative of *between-field* variability in the South Delta, are given in Table 1.

Table 1. Soil Groups in the South Delta

Group	Map Color Code	Percent of area	Permeability description in/hr
A	brown	40	slow < 0.2
B	blue	34	mod. slow 0.2 - 0.6
C	yellow	17	moderate 0.6 - 2
D	green	6	mod. rapid 2 - 6
E	red	3	rapid > 6

Leaching characteristics of South Delta soils were derived from the 1976 South Delta Salinity Status Study (SDWA Exhibit 104), using observed EC_es and applied water EC_ws for 51 sites at 10 different locations. Leaching fractions (LF) were calculated for both spring and fall EC_e profiles at all sites (102 determinations) according to the relation

$$LF = \frac{EC_w}{2(EC_e)_d} \quad (1)$$

where

EC_w = electrical conductivity of applied water, mmhos/cm (dS/m)

$(EC_e)_d$ = electrical conductivity of soil solution extract at drainage horizon (assumed to be the maximum in the EC_e profiles) mmhos/cm (dS/m)

Mean leaching fractions ($\overline{LF}$) and standard deviations from the mean (σ) were determined for each location (up to 15 observations in some cases). It was found that σ ranged widely, from about 25 to 65 percent of $\overline{LF}$. An average of about one-third, i.e. $\sigma = \overline{LF}/3$, was adopted as representative of *in-field* variation in leaching during the growing season.

Soil permeabilities and leaching fractions were related to one another by identifying specific locations (Salinity Study, SDWA Exhibit 104) with permeability groups (Soil Permeability Map, SDWA Exhibit 106). Calculated LFs were plotted against permeabilities as shown in Figure 1. While some scatter is apparent, owing largely to in-field variation, there appears to be a fairly consistent relationship between permeability and leaching fraction.

In subsequent calculations, values of $\overline{LF}$ and standard deviations of the distributions shown in Figure 1 are identified with the various soils as they are actually classified for the South Delta (SDWA Exhibit 106). These values for the moderate to slow permeability soils are:

Group	$\overline{LF}$	σ
A	0.053	0.0177
B	0.093	0.0310
C	0.188	0.0627

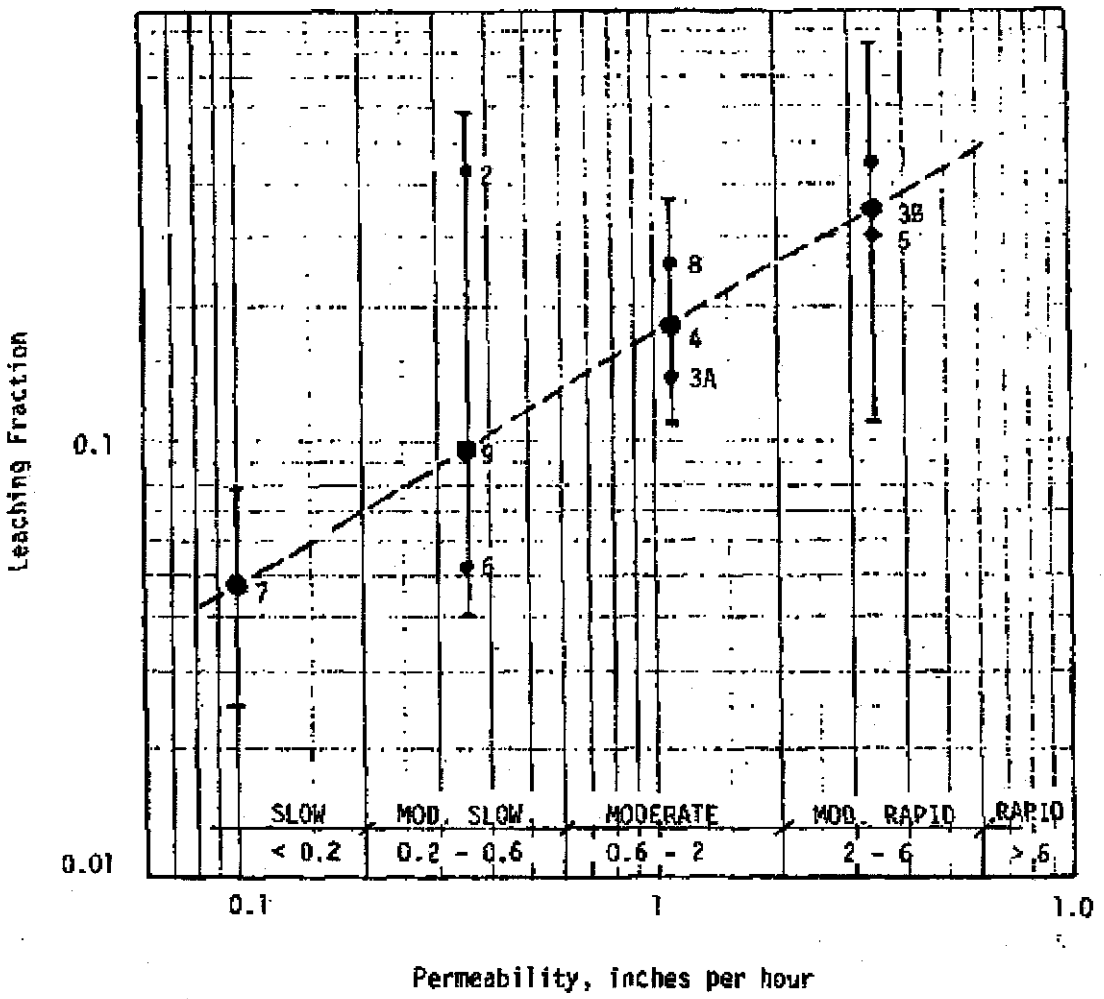

Figure 1. RELATIONSHIP BETWEEN LEACHING FRACTION AND FIELD PERMEABILITY, SOUTH DELTA SOILS

CROP YIELD VS WATER QUALITY

The relationship between yield decrement, leaching fraction, and applied water quality is given by

$$\Delta Y = S(EC_w \{ \frac{1 + LF}{5LF}) - B) \quad (2)$$

where

ΔY = yield decrement, percent

S = unit decrement, percent/mmho/cm

B = threshold EC_e, mmhos/cm

and other terms are as previously defined. Values of S and B for various crops are found in FAO Irrigation and Drainage Paper 29 as revised (SDWA Exhibit 105) and were supplemented by the Water Quality Advisory Panel for the South Delta Salinity Status Study (SDWA Exhibit 103).

The yield decrement for a field with variable LF is determined by combining equation (2) with the probability density function for LF and integrating from 0 to LF_c, a fraction above which no decrement in yield occurs.

$$\Delta Y = \int_0^{LF_c} S [EC_w \{\frac{1 + LF}{5 LF}\} - B] \frac{exp}{\sigma\sqrt{2\Pi}} \left(- \frac{1}{2} \frac{(LF-\overline{LF})^2}{\sigma^2} \right) dLF \quad (3)$$

where all terms are as previously defined.

A yield decrement--quality relationship for a particular soil, e.g. Group A, is obtained by carrying out the integration of equation (3) over the range of EC_w that is of interest. In the case of the South Delta, this was 0.7 to 1.3 mmhos/cm, corresponding to a range of TDS of roughly 450 to 825 mg/L. The properties of the soil are given by $\overline{LF}$ and σ and the susceptibility of the crop by S and B. Representative yield decrement--quality relationships used in this study are summarized for the six most sensitive crops and the three soil groups in Table 2.

Table 2. Yield Decrement at Function of Water Quality, Soil Type, and Crop

EC_w, dS/m	Yield Decrement, Δy, percent					
	Beans	Corn	Alfalfa	Tomatoes	Fruit & Nuts	Grapes
	Soil Group A, $\overline{LF}$ = 0.053, σ = 0.0177					
0.4	39	4	-	-	10	3
0.7	42	18	9	8	34	16
1.0	68	34	19	21	61	29
	Soil Group B, $\overline{LF}$ = 0.093, σ = 0.0310					
0.4	6	-	-	-	2	-
0.7	18	4	2	2	10	4
1.0	33	12	6	4	24	12
	Soil Group C, $\overline{LF}$ = 0.188, σ = 0.0627					
0.4	-	-	-	-	-	-
0.7	3	1	-	-	2	-
1.0	9	2	1	1	4	2

REVENUE LOSS DUE TO QUALITY DEGRADATION

The dollar value of potential crop losses for a given water quality and soil is estimated from the known acreage of specific crops, the market value per acre, and the decrement calculated by equation (3), and is given by

$$C_T = \frac{1}{100} \sum_{i=1}^{n} \sum_{j=1}^{m} A_{ij}\, c_{ij} \Delta Y_{ij} \qquad (4)$$

where

C_T = total potential loss, $
A = area, acres
c = value of crop, $/acre
ΔY = yield decrement, percent
i = crop, 1 to n
j = soil group, 1 to m

A representative cropping pattern for the South Delta Water Agency, i.e. values of A_{ij}, is derived from a survey of the San Joaquin County Agricultural Department for the period 1971-1975. Typical unit values of crops, i.e. values of c_{ij}, were derived from the 1980 San Joaquin Agricultural Report. These data are summarized in Table 3.

Table 3. Cropping Pattern for the South Delta Water Agency

Crop	Percent of total area	Area acres	Crop Value $/acre[1]
Beans	8	9,840	656
Corn	9	11,070	563
Alfalfa	26	31,980	732
Tomatoes	14	17,220	2110
Fruit and Nuts	5	6,150	2154[2]
Grapes	0.8	1,000	1358
Grains	16	19,680	426
Asparagus	7	8,610	1434
Sugar beets	10	12,300	1235
Other	4.2	5,150	-
Total	100	123,000	

Source: San Joaquin County Agricultural Department survey data within the SDWA for the 1971-75 period

[1]1980 values

[2]average of peaches and walnuts

CASE STUDY EXAMPLE

To illustrate the application of the procedure for estimation of potential crop losses due to water quality degradation, two scenarios are considered.

1. Actual conditions of water quality prevailing in the South Delta during 1976, and

2. 1976 conditions modified by the assumption of New Melones Project operation to maintain 500 mg/L TDS at Vernalis.

The procedure entails the following steps:

a. Simulation of hydrodynamics and water quality for the South Delta for the agricultural season, using the mathematical models of the estuarial system (SDWA Exhibit 82),

b. Estimation of the average quality of water supplied to each of 10 subareas of the South Delta, as identified in Figure 2,

c. Calculation of the yield decrement ΔY expected for each soil type (3), crop (6), and subarea(10) by application of Equation 3.

d. Summation of incremental costs due to loss of yield, by application of Equation 4.

e. Comparison of cost differences attributed to water quality control by New Melones.

Results of water quality simulations are presented in Figures 3 and 4. Conditions shown are for mid-July, considered to be representative of the quality of water available at the peak of the irrigation season. From the results of the two simulations, the average quality of water available to the 10 subareas may be estimated as that of the most accessible channel serving the area. These are summarized in Table 4.

Yield decrements were estimated from the relationships summarized in Table 2. These were then weighted by subarea and soil group in relation to the entire SDWA area, and summed to obtain the aggregate decrement for each crop type. These were then applied to the total value of the crop to obtain the decrement in revenue. Table 5 summarizes the calculations.

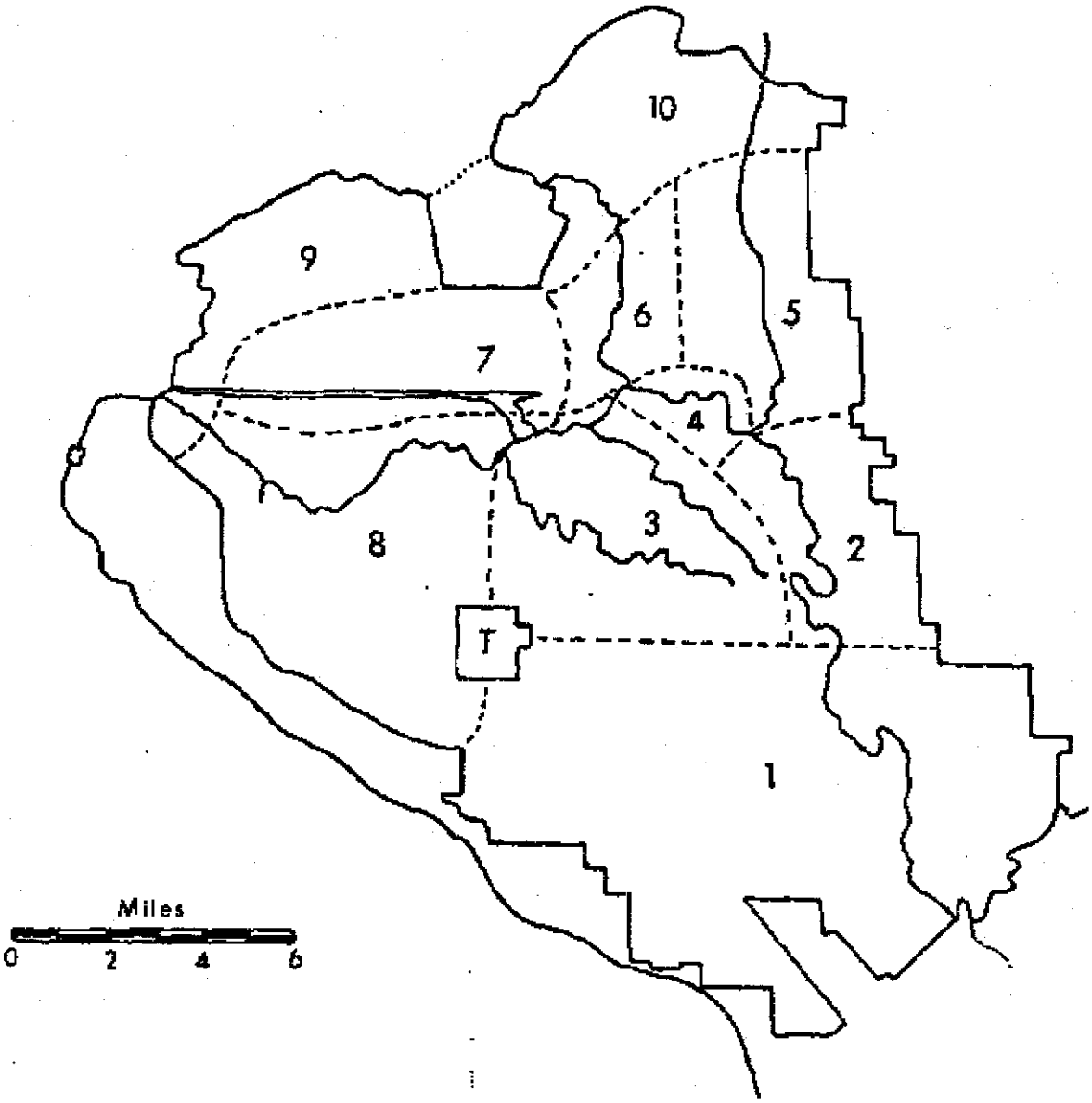

Figure 2. AGRICULTURAL SUBAREAS, SOUTH DELTA WATER AGENCY

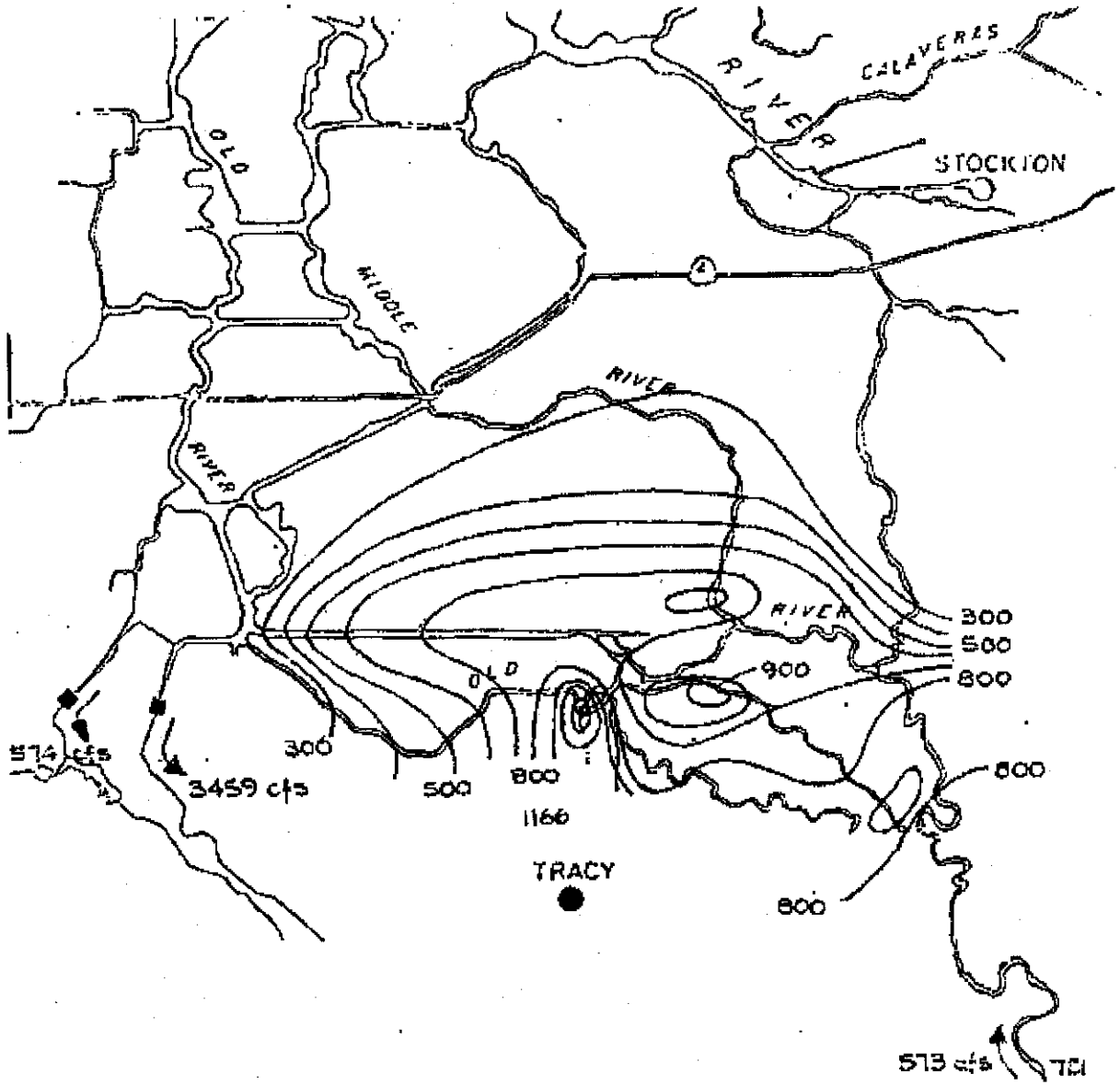

Figure 3. SIMULATED WATER QUALITY IN SOUTH DELTA CHANNELS, MID-JULY 1976, ACTUAL HYDROLOGY
(Contours are of equal TDS, mg/L)

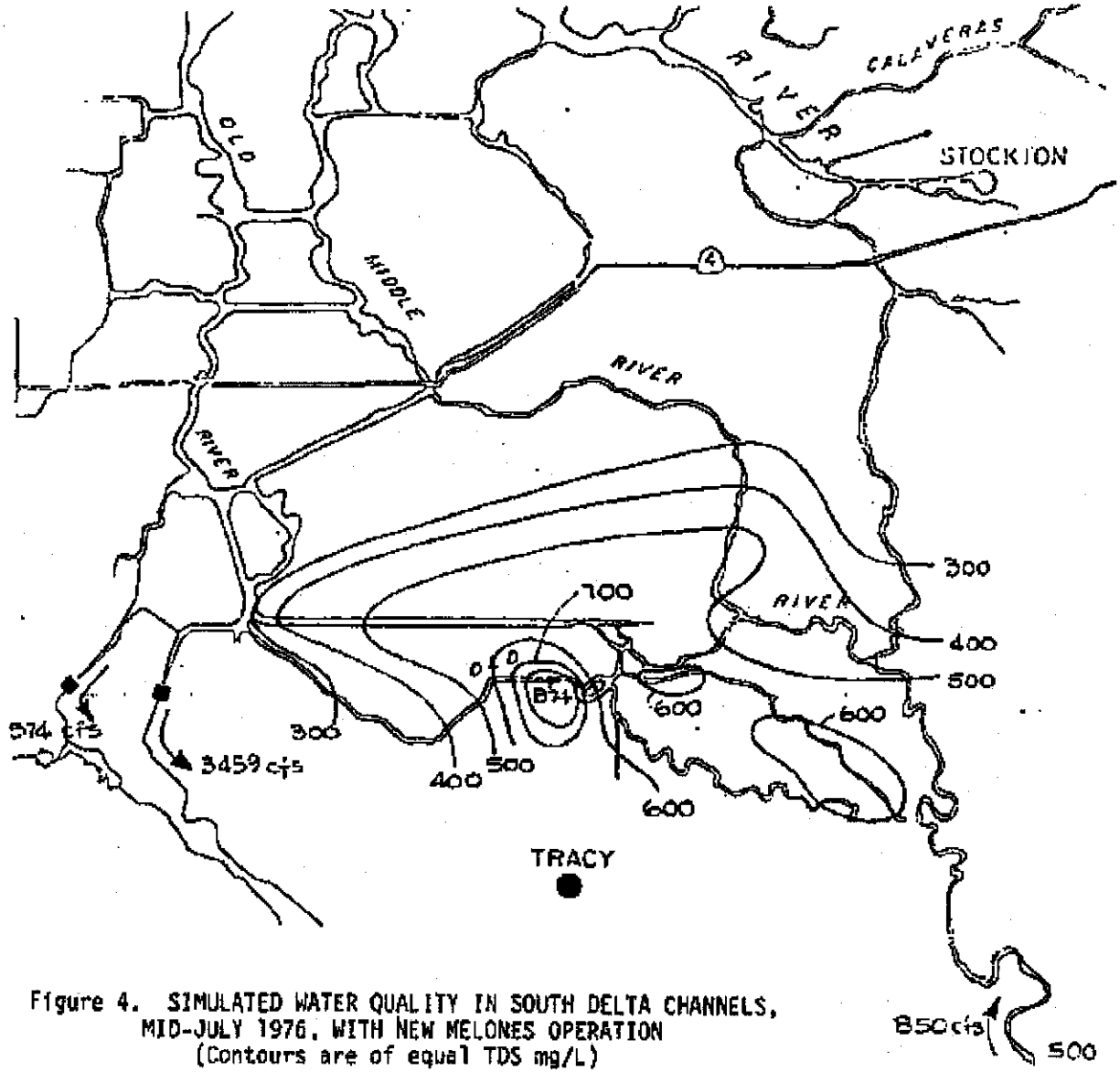

Figure 4. SIMULATED WATER QUALITY IN SOUTH DELTA CHANNELS, MID-JULY 1976, WITH NEW MELONES OPERATION
(Contours are of equal TDS mg/L)

Table 4. Comparison of Crop Loss for 1976 Conditions in South Delta With and Without New Melones Water Quality, Mid-July (Day 195)

Subarea	1976		1976 w/N.M.	
	TDS	EC*	TDS	EC*
1	753	1.19	496	0.77
2	812	1.28	492	0.76
3	777	1.22	559	0.87
4	675	1.06	487	0.77
5	244	0.36	264	0.40
6	684	1.07	486	0.75
7	710	1.12	521	0.81
8	673	1.06	575	0.90
9	227	0.34	226	0.34
10	297	0.45	282	0.43

* EC = (TDS - 18)/620, mmhos/cm

DISCUSSION

Results of this case study illustrate the potential impacts of water quality degradation on the agricultural productivity of lands within the South Delta Water Agency. These impacts are likely to be most severe in areas served by channels in which circulation is not sufficient for unidirectional transport of salt loads entering the Delta at Vernalis. Such was the case in 1976, the case investigated. It is noted that while the area is estimated to have suffered a substantial loss of productivity in this period--as much as 18 percent of the value of salt sensitive crops--this loss could be diminished by improving quality and flow at the upstream boundary at Vernalis. The apparent loss with New Melones operation, i.e. with a maximum TDS of 500 mg/L maintained by releases from the reservoir, would have been reduced by about one half, to roughly 10 percent of the total value of salt sensitive crops.

Table 5. Estimated Loss of Crop Revenue Due to Water Quality Degradation, Case Study: 1976 and 1976 With New Melones Operation

Crop	Area[1]	Unit Value[2]	Mkt.Value	Loss of Crop Revenue, 10^6 $			
				Actual 1976		1976 w/N.Melones	
				ΔY/100	ΔC	ΔY/100	ΔC
	acres	$/acre	10^6 $		$		$
Beans	9,840	656	6.46	0.408	2.62	0.331	2.14
Corn	11,070	563	6.23	0.201	1.25	0.105	0.65
Alfalfa	31,980	732	23.41	0.102	2.81	0.051	1.19
Tomatoes	17,220	2110	36.33	0.111	4.03	0.052	1.89
Fruit & Nuts	6,150	2154	13.25	0.359	4.76	0.199	2.64
Grapes	1,000	1358	1.36	0.169	0.23	0.093	0.13
TOTALS	72,260[3]		87.04		15.70		8.64

[1] 1971-75 average

[2] 1980 San Joaquin County Agriculture Department

[3] Does not include 50,740 acres of salt tolerant crops

It should be noted, however, that the presumption that the target quality could be assured by New Melones releases is conditioned by the availability of water in storage for quality control. In some years, the entire volume allocated for this purpose may be released before the critical period of crop growth, as early as mid-April in the case of 1987. With the expectation of increased yield of salinity from the San Joaquin Basin, it will be increasingly difficult to achieve quality control at Vernalis, and in the South Delta, under the present mode of operation and with the current limitations imposed on storage for water quality control.

Another important factor which is illuminated by this example is the increased sensitivity of crops to damage when they are grown in soils of only moderate permeability, less than necessary to achieve optimum leaching during irrigation. A high proportion of South Delta soils are of this type; more than a third are classified as having "slow" permeabilities, less than 0.2 inches per hour. These soils have inherently poor leaching characteristics, with leaching fractions averaging 10 percent or less. Moreover, the wide variability in permeabilities in South Delta soils, over the entire area and even within the same field, exacerbates the leaching problem. Significant fractions of an irrigated area may be comparatively less permeable than the average, requiring higher quality water to avoid potential crop damage due to salinization in sensitive zones.

In summary, soils of the South Delta are found to be more sensitive than normal because of their lower average permeabilities and natural heterogeneity. Crops normally grown in the area are impacted adversely when water quality is not sufficient to preclude buildup of salinity in the soil profile during the irrigation season. Obvious solutions to this problem lie in enhanced water quality in South Delta channels and reductions in the salt load carried into the estuary by the San Joaquin River.

OUTLINE OF TESTIMONY OF ALEXANDER HILDEBRAND
ON SOUTH DELTA AGRICULTURE

QUALIFICATIONS

My qualifications as an expert witness are set forth in SDWA Exhibit No. 1.

INTRODUCTION

Dr. Orlob has testified regarding the degradation of the South Delta's in-channel water supply that is caused by upstream development and by the operation of the export pumps.

My testimony will address the in-channel water supply needed for full crop yields, and the extent to which crop yields and crop versatility have been degraded by the degradation in the water supply which Dr. Orlob identified. I will then discuss proposals regarding water supply objectives for the South Delta.

You are already aware from evidence submitted of the effects of salts on plant performance by both osmotic and toxic ion effects, and also of the fact that there are threshold levels of soil-water salinity above which the growth of different varieties of established plants is reduced. You are also aware that the relationship between the soil-water salinity in the root zone of each plant and the salinity of irrigation water applied to that plant is a function of both the applied water salinity and the achieved leaching fraction.

There is little controversy over the maximum soil-water salinity which will permit a full yield of each variety of established crop plant, except that the figures should be

given as within a probability range rather than as fixed numbers. However, substantial uncertainties and limitations arise when one addresses the effect of salinity on germination and the survival and vigor of plant seedlings. There are also wide differences in different situations in the physical and economic feasibility of controlling the relationship between the applied water salinity and the soil-water salinity throughout commercial fields. Soils that are difficult for water to penetrate rapidly, or that vary from spot to spot within a field can cause non-uniform or inadequate soil leaching. Mr. Terry Prichard (see also FAO Report, SDWA Exhibit No. 105, page 4 and elsewhere) has discussed the importance of adequate leaching of salts; the limitations on commercially practicable leaching in some situations; and consequent limitations on the maximum applied water salinity which is compatible with adequate control of soil-water salinity. I shall discuss the nature and scope of these limitations as they occur in the South Delta. (Refer also to Preface of FAO report, SDWA Exhibit No. 105, 3rd paragraph; and page 6, 1st paragraph; and page 7, 2nd paragraph).

INFORMATION SPECIFIC TO SOUTH DELTA SOILS AND CROPS

First, let us examine the source and nature of the technical information which is needed in order to make a valid application in the South Delta of generalized data on applied water quality versus crop yield. You have heard a lot about peat soils, but ours are mineral soils. Some are

below sea level, but most are above summer mean levels.

In 1981 the SDWA, the Bureau, and the DWR jointly requested that a panel of three well-known soil and water consultants provide the best available information on the maximum salinity of soil-moisture that would permit full yields of various crop plants. (See SDWA Exhibit No. 103, Table 2). They were also asked (1) to indicate the loss of crop yield that would occur as a result of incrementally higher soil-water salinities with each crop variety; and further, (2) to indicate the irrigation water salinity required to provide a given soil-water salinity as a function of leach fraction; and, also, (3) to provide information on the soil varieties, the soil variability, and the soil permeabilities (i.e., percolative capacities) of South Delta soils, together with available data on measured leach ratios in commercial practice. The Report of these consultants is dated December 22, 1981, and is submitted as SDWA Exhibit No. 103. Table 5 and Figures 1 and 2 of the Report, show crop yield as a function of irrigation water salinity and leach fraction for each of eight different crops, all of which are grown in the South Delta. The consultants also cited, by reference (on page 4 and Table 3 of the Report) another study which measured actual leach fractions determined by field measurements of commercial practice in the South Delta, including the variations in leach fractions for different sites in each field. This study is submitted as SDWA Exhibit No. 104.

They further cited a similar study in the Imperial Valley which they felt added credence to the values in the South Delta study. (Page 4 and Table 4 in SDWA Exhibit No. 103). SDWA Exhibit No. 104 also references Irrigation and Drainage Paper #29, Food and Agriculture Organization, United Nations, 1976. That reference also contains salinity tolerance data and soil-water versus applied water salinity relationships. The 1985 revision of that Paper is presented as SDWA Exhibit No. 105.

The soil types and permeabilities of South Delta soils are shown on the soil map that was submitted by the consultants along with the Consultants' Report and which was derived from a Soil Conservation Service survey (SDWA Exhibit No. 106). SDWA Exhibit No. 107 illustrates the variability of soils in a portion of SDWA as shown on that soil map. Note that there is a 100 fold variation in permeability, much of which can occur in a single field.

Typical ranges of leach fraction within commercial fields are shown in the South Delta Salinity Status Study (SDWA Exhibit No. 104), which was referenced in the Consultants' Report (SDWA Exhibit No. 103) and summarized on Table 3 of that Report. These leach fractions can be correlated with the soil types and permeabilities at the test fields as shown on the consultants' map. This correlation indicates the South Delta acreage for which the soils at each test field are approximately representative and the achievable leach fraction for that soil

type. There were 51 measurement sites in ten fields. From SDWA Exhibit No. 104, a rough estimate of the variation in leach fraction over a typical field may be derived.

The San Joaquin County Agricultural Commissioner supplied crop acreages, crop yields, and on-farm unit crop values for each of the major crops grown in the South Delta in 1981. This material is submitted as SDWA Exhibit No. 108.

I will expand on the relevance of some of this data before we proceed to the use of this information to estimate crop yield losses versus South Delta in-channel water quality.

PERCOLATION TIME LIMITATIONS

The reason why soils with low permeability require better water for full crop yield can be illustrated by considering the crop alfalfa, which has been the crop with the largest acreage and the second largest value in the South Delta. It is grown largely in support of the County's large dairy industry.

Table 1 in the Consultants' Report, (SDWA Exhibit No. 103), shows that alfalfa consumptively uses about 41 inches of applied water depth per year. Page 8 of that Exhibit shows that 40% of the South Delta's soils have percolation rates of less than 0.2 inches of water per hour. Furthermore, the operations of mowing, baling, and bale hauling compact the near surface soil and further reduce percolation rates. With 0.15 inches per hour of water percolation, the time required to percolate 41 inches of water is 273 hours even with a uniform distribution of applied water (i.e. 41 inches ÷ .15 inches per hour = 273 hrs.).

No salt flushing can take place unless that time is exceeded.

With six hay harvests per year, the time required to mow, cure, and bale the hay makes it very difficult to get more than two irrigations per cutting, or twelve irrigations during the crop season. More than one extra irrigation in the fall is risky on tight soils because of the possibility of an early rain after a late fall irrigation which could drown or water damage the crop. On the other hand, if the winter turns out to be dry, most of the 41 inches has to be percolated by irrigation. This then requires about 21 hours of soaking time per irrigation in a dry year with no effective rainfall (273 hours ÷ 13 irrigations) or 17 hours in a normal year (with 8.4" effective rainfall- per SDWA Exhibit No. 103, Table 1) before any leaching takes place. This soaking time is long enough to cause serious water damage to the alfalfa plants on a tight soil. This is why the 0.04 leach fraction shown on Table 3 of the Report is a plausible leach fraction for alfalfa on the tight soils. Figures 1 and 2 of the Report show that alfalfa crop loss occurs in this case with water salinities over 275 or 325 mg/L TDS depending on rainfall. Table 5 shows a 480 ppm TDS requirement for full yield with a .07 leach fraction in a dry year.

My own measurements with tensiometers in one of my fields demonstrated that it was difficult to get any leach fraction in the low permeability areas when growing alfalfa.

It is somewhat more feasible to get a larger leach fraction with an annual crop having a shallower root system and

less surface soil compaction and an opportunity for leaching between crops. However, a 0.11 leach fraction is needed for full yield with beans with a 400 mg/L TDS water supply, as shown in Figure 1 in SDWA Exhibit No. 103. Even on those soils where a 0.15 leach fraction can be obtained, the irrigation water quality requirement for beans is 520 TDS in a dry year or 580 TDS in a year with "normal effective rainfall" (Table 5 of SDWA Exhibit No. 103).

A table on page 17 of the March-April 1987 issue of "California Agriculture", (SDWA Exhibit No. 109) indicates that salinities of less than 450 mg/L TDS are needed for unrestricted use, but even this is qualified (page 16) for tight soils. The FAO report (SDWA Exhibit No. 105, p. 8, Table 1) also lists a requirement of less than 450 mg/L TDS for unrestricted use, but this assumes a 15% leach, and clay-loam permeability or better and good drainage capability (page 9).

IRRIGATION MANAGEMENT AND SOIL VARIABILITY

South Delta farmers have compelling incentives to achieve leach fractions that are adequate for full crop yields, as is the case with farmers elsewhere, and they do not have the disincentive of high water costs. It is, therefore, reasonable to conclude that when South Delta farmers have leach fractions that are inadequate for the poor quality of available water, that inadequacy is typically due to the problems discussed above which limit soaking time on tight soils. Ponding for winter leach is not feasible where the land is not flat or where the water drains through permeable areas without leaching areas with very

low permeability.

There are several reasons why no general assessment of farm management can be made in the South Delta on the basis of either excess or inadequate water application. Many South Delta fields have highly variable permeability (see SDWA Exhibit No. 107). The more permeable portions of a field, therefore, often have to be over-irrigated in order to strive for an adequate leach fraction in less permeable areas. Where permeability is variable, this leads to high <u>average</u> leach fractions. Furthermore, in dry and below normal years there is now no way to know how saline the channel water will get as the irrigation season progresses because there are no enforced water quality standards sufficient to protect most southern Delta areas. It is, therefore, prudent to irrigate heavily, where crop limitations permit, in order to keep soil salinity low early in the season. The fields with high permeability are typically located where excess subsurface drainage seeps back into the channel from which it was diverted, and can, therefore, be recaptured at little cost. Furthermore, excess drainage from South Delta soil does not significantly affect channel salt loads. There is, consequently, much less incentive to avoid excess field-average drainage as contrasted to other farm regions where water costs are high, and where drainage causes increased salt loads in the river or groundwater, or where seepage may be lost from the water supply system.

However, excess drainage does involve increased pumping costs and leads to high water tables in some locations. Where a high field-average leach is needed to achieve an adequate leach in tight areas, the overall excess drainage can become substantial, whereas in more uniformly tight fields there is insufficient drainage. Any increase in channel water salinity necessitates increased leaching. (SDWA Exhibit No. 105, page 4, paragraph 1)

The use of sprinklers, where feasible, can partially offset the in-field water distribution problem. However, the irregular shapes of fields along the channels do not lend themselves to self-propelled sprinklers, and even at best, sprinklers involve substantial energy, capital, and labor costs which should not be imposed on South Delta farmers so that upstream users can benefit by degrading the water supply. No significant saving in consumptive water use would result from the use of more expensive water application systems.

With appropriate allowance for the nature of our constraints, irrigation management in the Southern Delta compares favorably to other areas in California. Cropping patterns require cultural operations which do not provide an adequate opportunity on South Delta soils to attain the leach fractions required to prevent yield reductions when high quality water is not available. A major factor limiting production on these types of slowly permeable soils is the inability to prevent disease organisms from reducing crop plant survival when irrigation water is kept

on the ground long enough to obtain large leach fractions. High quality water minimizes this problem.

CROP VERSATILITY

An important economic asset for an agricultural region is the capability of growing many varieties of crops and of changing crops to meet changing market demands. The South Delta has this capability when it can count on good quality water.

For example, large acreages of many varieties of dry beans were once grown in the South Delta. However, beans are very salt sensitive. As the water quality became unreliable and the demand for corn grew, most of this bean acreage converted to corn. Now, corn is in oversupply and other crops, including beans, should displace corn. In my own case, I am growing beans this year on land that was in corn last year. This is made possible by the interim USBR-SDWA agreement on San Joaquin River flow and quality maintenance for 1987. Some of my neighbors are growing onions, which are also very salt sensitive.

Our assessment of crop loss due to increases in salinity does not attempt to quantify and include the financial impact of lost crop versatility, but that loss is serious.

SEEDLING SURVIVAL

Another important loss which we have been unable to quantify is the loss in seedling survival and seedling vigor caused by increased salinity. A critical stage of crop growth

is the seedling stage. Seedlings are generally more salt sensitive than established plants. Even some salt tolerant plants like barley have salt sensitive seedlings (See U. C. "California Agriculture", October 1984, page 9). (SDWA Exhibit No. 110)

The seedling root zone is very shallow. It is, therefore, fairly well leached by rain in a normal winter, but this is not the case in a dry year. Furthermore, the seedling zone tends to dry out after the seed is planted. As it dries, the soil-water salinity increases. (See also FAO report, SDWA Exhibit No. 105, page 43, paragraph 4; and page 44). Our mineral soils cannot retain the high volumes of soil-water that are retained by peat soils. If moisture is restored with sprinklers, crusting occurs. If it is restored from furrow irrigation there is, at best, some concentration of salt from the applied water. Either method also increases costs and can cause seedling damage from excess moisture. These are problems that occur and increase with higher salinity of applied water.

High salinity can also retard seed germination and, thereby, give more time for loss of moisture by evaporation from the soil. If the loss is too great, it can stop the germination. Slow germination also gives more time for salt tolerant weed growth to crowd the seedlings and deprive them of moisture and nutrients; and more time for pest problems, such as cut worms on corn seedlings. (Refer also to FAO Report, SDWA Exhibit No. 105, page 39, last paragraph).

The "Report on the Salt Tolerance of Corn in the Delta" by the U.S. Salinity Laboratory, et al, was based on peat lands. It, therefore, has limited applicability in the South Delta. It did, however, include germination and seedling tests which illustrate the fact that germination can be delayed by high salinity and that the seedlings are substantially more salt sensitive than established plants.

In dry years the problem of seedling survival and vigor has sometimes been substantial in the South Delta. Three slides of 1976 photographs show examples of this damage.
(SDWA Exhibits No. 111, 112, 113)

WATER LEVELS AND PUMP DRAFT

A third loss which is difficult to quantify is the loss which has occurred in some channels because of inadequate water depth for pump draft. Dr. Orlob has discussed the physical extent of this problem as it is caused by export pump drawdown. The impact on agricultural operations includes increased costs for pump maintenance, energy, and labor, and more important, the crop losses due to inability to irrigate in a timely fashion. The drawdown affects Old and Middle River channels in the South Delta. It also affects the adequacy of pump draft in the San Joaquin channel between Vernalis and Paradise Cut when it is combined with very low San Joaquin River flows at Vernalis. These pump draft problems are expected to be reduced this year by the terms of the interim agreements among SDWA, USBR, and DWR. However, the permanent corrective measures which we will outline are essential.

CROP LOSSES BY SALINITY IMPACTS ON ESTABLISHED CROP PLANTS

We will now proceed with Dr. Orlob's presentation of the calculation of crop yield losses as a function of the salinity of applied water on established crop plants in the South Delta. I remind you that these calculated losses do not include the other serious losses previously discussed which are difficult to quantify.

The methodology for this calculation of crop yield loss is provided by the expert consultants' and the FAO reports which we have cited. The data comes from the data sources I have cited and from the in-channel water salinity information previously presented by Dr. Orlob. We are not introducing any new concepts. We are merely applying accepted principles to a specific situation which differs from the more ideal situations covered by familiar tables of the tolerance of crops to applied water quality. In other words, we are accounting for the caveats usually mentioned in fine print under such tables and which are discussed in the FAO report, SDWA Exhibit No. 105,particularly the qualifications on page 9 which apply to the Table 1 Guidelines.

After Dr. Orlob's presentation, (SDWA Exhibit No. 114), I will discuss our conclusions on reasonable levels of protection for agricultural uses in the South Delta, and on the objectives and monitoring which will be needed.

WATER QUALITY NEEDS AND OBJECTIVES

It is evident from our previous testimony that optimum crop yields in the South Delta would require at least:

a) Adequate pump draft in all channels at all times, and

b) 400 ppm TDS or better throughout all channels at all times, or a 400 ppm TDS seasonal average with somewhat better quality through June and somewhat poorer quality after July.

Dr. Orlob's testimony has shown that prior to upstream development and export pumping there was adequate pump draft at all times in all SDWA channels. This would still be the case if upstream development were now eliminated except for rare late season occasions when the flow at Vernalis might be inadequate for pump draft at some points between Vernalis and Paradise Cut. However, the occasional inadequacy in that reach would even in that event not then occur if the reduced flows, previously caused by upstream development, had not permitted a large accumulation of silt since the 1930's. This siltation has raised the bottom of the channel substantially and it is now above low tide level (SDWA No. 4, 2nd page of Fig. VII-1).

Dr. Orlob has also shown that prior to upstream development, water quality throughout SDWA channels was always fully adequate to meet water quality needs. Water quality during the early irrigation season was always so good that even an occasional increase in late summer salinity was

not serious (except in a few channels that experienced Bay water intrusion in September of 1931). This was because the residual soil-water salinity in mid-summer was sufficiently low after using high quality early season water so that it could tolerate some salt buildup when more saline late summer water was applied. Furthermore, crop plants in late summer were then at their least salt sensitive stage of growth. The FAO report, SDWA 105, page 25, discusses the importance of good water quality early in the irrigation season.

Adequate pump draft is essential. It can be maintained by adequate flow maintenance at Vernalis combined with either adequate export pumping restraint during extreme tides, or by channel water level control devices such as those under study by SDWA, USBR, and DWR.

It is not feasible to maintain a uniform water quality throughout South Delta channels, and it would be impractical to restore the very high quality of San Joaquin River water that existed most of the time in the absence of upstream development. However, the South Delta must be protected from the substantially increased river salt load caused by upstream development. This protection can only be accomplished by providing a net daily unidirectional flushing flow within SDWA through each reach of: Old River, Grant Line Canal, Middle River, and the two reaches of the San Joaquin River (Vernalis to Old River and Old River to Stockton).

The net daily flushing flow would eliminate stagnation in South Delta channel reaches and should be sufficient in quantity to avoid any significant accumulation of the increased incoming river salt load in any South Delta channel reach.

There is very little chance that the increase in river salt load during low flows can be eliminated, and certainly not in the near future. Furthermore, a development such as the Mid-Valley Canal would further increase the salt load due to importation of salt to the east side of the watershed. The Vernalis flow must, therefore, be adequate to supply the net agricultural diversions and other channel depletions from all those channels which receive Vernalis flow, plus enough net flushing flow to maintain adequate quality throughout those channels. The Vernalis flow that is required can be reduced by using seasonally functional tide-gated barriers in Middle and Old Rivers. The design of these barriers, in conjunction with control of the Clifton Court intake schedule, should be such as to provide an adequate net daily unidirectional reverse or upstream flow by tidal cycling of Central Delta water into those two channels.

The other internal channels which would still be fed from Vernalis would rarely have water of as good quality as would be the case in the absence of upstream development. They should, therefore, be protected from salinity higher

than we now propose and which might otherwise occur on rare occasions, i.e., the range of fluctuation in water quality in internal channels can be narrowed somewhat and the mean seasonal salinity thereby adequately protected.

It should be noted that extra Vernalis flows can be provided by New Melones Reservoir releases with no loss of CVP project yield, particularly if New Melones is operated to serve eastern San Joaquin County on a conjunctive use basis. Increased releases from New Melones to Vernalis over those previously committed would only be required in about 25 to 30% of the water years unless there are further increases in salt load or in upstream diversions. At those times when flow restoration is needed at Vernalis, the deliveries to eastern San Joaquin County could be substantially reduced while some users returned to wells or to water stored locally from extra New Melones deliveries. These deliveries to storage could be made available, in large part, by increased direct diversions in wetter years. Similar releases from other upstream projects or limitations in upstream diversion schedules should also be considered.

The proposed level of water quality and water level protection could be required and monitored at designated internal channel points. Or, subsequently, if Middle and Old River flow and level control barriers were installed, the standards could stipulate minimum water levels and an adequate salinity control at Vernalis and at each other

point of water inflow, and a corresponding minimum inflow quantity at each point of inflow such that the level of protection of internal channels would be shown by model analyses to be the same as with the un-barriered requirements. This subsequent method can not be defined in detail until the location and design of flow and level control barriers is determined and a Clifton Court intake schedule established.

Monitoring points and control standards are proposed in SDWA Exhibit No. 115 for the case with no flow and level control facilities. SDWA Exhibit No. 116 illustrates the approach to possible monitoring and control standards with barriers in Middle and Old Rivers at specified locations and with specified functional designs.

TESTIMONY OF ALEX HILDEBRAND
HEARING ON PROPOSED CEASE AND DESIST ORDER TO DWR AND USBR

My name is Alex Hildebrand. I was a Director of the South Delta Water Agency (SDWA) for 30 years and am currently the engineer for that Agency. A copy of the Agency's boundaries is provided as Attachment "A." I have testified many times before this Board as well as other regulatory and legislative bodies and was qualified as an expert witness with regard to the water quality and flow issues affecting the South Delta.

A copy of my current statement of qualifications is attached hereto as Attachment "B." Briefly, I have a B.S. in physics with minors in chemistry and engineering, and worked for Chevron until I retired in engineering and technical capacities including Assistant Chief Engineer of the Richmond Refinery and Director of the La Habra Research Laboratory. Since that time I have farmed approximately 150 acres on the San Joaquin River about 12 miles by river downstream of Vernalis in the South Delta. For the past 30 years, I have been intimately involved in the discussions, negotiations, regulatory proceedings and litigation to protect its diverters from the adverse effects of SWP and CVP and to insure the area has an adequate supply of good quality water.

My testimony for this proceeding is divided into four parts following a discussion of background. The first part deals with how the DWR and USBR can meet current salinity standards while using temporary rock barriers. It has been argued that the 0.7 EC requirement in internal channels cannot be reasonably met even after implementation of the SDIP and that it is therefore unreasonable to require it now. That assertion is incorrect. The second deals with the numerous interrelated benefits which result from compliance with permit conditions. The third part explains how I and others are personally affected. And the last part addresses the reconsideration of the Water Quality Response Plan.

I. Background

1) Regulatory Background

As set forth in the 1991 and 1995 Water Quality Control Plans, the two San Joaquin River standards (at Brandt Bridge and Vernalis) were to be implemented promptly. The two Old River standards (Old River near Middle River and Old River at Tracy Road Bridge) were to be implemented no later than December 31, 1997 (see Attachment "C"). The 1995 Plan therefore recognized that the San Joaquin River standards would be addressed with good quality flows on the River, while the Old River standards required other actions such as barriers which could not be immediately implemented.

In D-1641, the Board acknowledged that, "Construction of permanent barriers alone is not expected to result in attainment of the water quality objectives." The Board went on to note that the "objectives can be met consistently only by providing more dilution or by treatment." (See Attachment "D" D-1641 at page 88.)

Hence, in 2000, this Board recognized that permanent barrier installation and operation ***and*** other actions, including additional dilution flows, were necessary to meet the standards.

Since 1995 at the earliest, and 2000 at the latest, DWR and USBR have known that in order to meet the 0.7/1.0EC standards, they had to undertake actions ***in addition to the proposed barrier program.*** To my knowledge, DWR and USBR have undertaken no actions other than the barrier program.

As I understand the issues before the Board in this proceeding, the questions are first, whether a Cease and Desist Order should issue, and second, if so, what terms should be in such an order.

The answer to the first question is certainly "yes." Since DWR and USBR do not believe their current operations, including temporary barriers, will result in compliance with their permit terms, especially at the three interior South Delta stations, they should be ordered to comply. There appears to be no logical or practical reason for not requiring compliance with existing Water Quality Objectives and permit terms. This is especially true given that the Board determined over five years ago in D-1641 that compliance would indeed require additional dilution flows (or treatment). The fact that DWR and USBR knew the permanent operable barriers would not be built in the short term and did not undertake the necessary and anticipated other actions to secure and provide additional flows or treatment does not change the need for the objectives or the benefits therefrom.

I note that HR 2828 requires the USBR to develop a plan by the end of this year under which it will meet its water quality obligations on the San Joaquin River (see Attachment "E"). Since the Congress believes the Bureau should meet the objectives, one would think the SWRCB would too.

2) <u>Historical Background</u>

The changes in San Joaquin River flows and water quality pre-CVP and post CVP are set forth in the June 1980 Report entitled "*Effects of the CVP Upon the Southern Delta Water Supply Sacramento - San Joaquin River Delta, California.*" This Report and numerous other studies and investigations (including D-1641) have identified the operation of the CVP as the principle cause of the salinity problem in the lower San Joaquin River and Delta. However, the SWP's effects on flows in Delta channels and its

joint efforts with the CVP in supplying export water to the San Joaquin Valley are significant contributory causes.

As a consequence of this problem, the SWRCB slowly adopted and even more slowly implemented water quality objectives to protect agricultural beneficial uses. Currently, only dilution water is used to meet the Vernalis standard. The delay in implementing the other three standards has allowed DWR and USBR to avoid taking other actions. [Although temporary barriers do trap some good quality export water which improves water quality in portions of Middle River and Tracy Old River compliance stations, the net flow is back (downstream) over the barriers and the water quality does not approach the 0.7 EC standard.

The dilution water needed to comply with the current Vernalis salinity objectives is required because the westside wetlands and farm lands receive Delta Mendota Canal (DMC) water which contains a large salt load. That salt load is then concentrated by crop and wetland evaporation. Most of the salt then drains to the river where it must be diluted.

II. Compliance with the 0.7/1.0EC internal South Delta salinity standard with Temporary barriers

The subject Water Quality Objectives can be met and the in-channel water supply in internal South Delta channels can be maintained at 0.7 EC from April through August with very little water cost to the CVP and SWP. This is the case both before and after permanent barriers are installed and other concurrent measures are provided. While using temporary barriers the following salinity control measures and others should be utilized.

1) Dilution Needs.

A) As water passes Vernalis, it slowly degrades due to evaporation, consumptive uses and urban discharges. This degradation is reflected in field data which DWR has collected and which is set forth in Attachment "F." The increase in salinity during low flows can be .1 EC or more from Vernalis to Brandt Bridge. The amount of dilution water needed to offset this rise in salinity at Brandt Bridge or elsewhere depends on the quality of the dilution water and the amount of the flow from Vernalis to Brandt Bridge. Dilution provided upstream of Vernalis can be used to lower salinity below 0.7 EC at Vernalis so that it will not rise above 0.7 EC at downstream locations. Dilution with Middle River water can be used to restore salinity to 0.7 EC at the point of dilution. To offset a 0.1 EC rise in salinity would take about 250 cfs of 0.4 EC dilution water when the Vernalis base flow is 1000 cfs. The 0.4 EC is representative of DMC water quality. If the dilution flow was provided from one of the tributaries, less of that better quality

water would be required.

2) Dilution Opportunities.

A) New Melones is currently the only reservoir used by the USBR to meet the Vernalis standard. Whatever additional measures are undertaken to meet the downstream South Delta standards, the New Melones releases that would be required in the absence of these measures to meet the Vernalis standard will continue to be required at least in the short term. Additional releases could also be made from this source to contribute to meeting the other South Delta standards. This year as of June, the Bureau has allocated 180,000 acre-feet of New Melones storage for water quality purposes, but has used none of this amount (see Attachment "G;" personal communication with USBR staff). Obviously, in the short term, water is available from New Melones.

B) Additional water from the tributaries to the San Joaquin River could be purchased for release during the April through August time frame. In the recent past, hundreds of thousands of acre-feet have been purchased from the tributaries for a variety of reasons. As stated above, it would take less of this high quality water to provide the needed dilution than is the case when DMC water is used.

C) Upstream exchanges could also be coordinated to provide dilution flows. Given the various connections of the SWP and CVP distribution systems, exchanges between water users could be made to provide additional flows on the San Joaquin River. For example, this year excess and flood flows from Friant were diverted at the Mendota Pool for delivery to Westlands Water District and others. Some of that water could have been allowed to flow downstream in exchange for other DMC, California Aqueduct, or San Luis Reservoir supplies.

D) Water can also be recirculated through the DMC using one of its wasteways to deliver the flows to the San Joaquin River. The Bureau conducted such a recirculation pilot project in 2004 using DMC water released from the Newman Wasteway. The releases during that project had a significant impact on San Joaquin River quality. (See Attachment "H"). The 250 CFS recirculation release from the Newman Wasteway decreased the EC in the River from 1,200 to 900 (or 1.2 to 0.9 using the same parameters as the 0.7 standard) at the Patterson Measurement Station and from 700 to 600 (or 0.7 to 0.6) at the Vernalis Station. [The differing changes are due to the differing amounts of flow in the River at the two locations.] I also note that D-1641 specifically required the Bureau to investigate the use of such recirculation to assist in meeting water quality standards. I believe the Bureau has failed to meet the deadlines required by D-1641.

E) Transfers for EWA or other purposes can be coordinated such that the transfer water could be released during the April - August time frame. The transfer water

would provide dilution but would not be lost as San Joaquin River and South Delta diversion needs do not change with flow fluctuations.

F) As the Board knows, CVP permits in addition to New Melones are burdened with the requirement of meeting the salinity objectives. Hence, releases from Friant, Shasta, Folsom, or San Luis could be used to supplement San Joaquin River flows. For example, the high flows this year from Friant re-charged (to some degree) the groundwater in the area at and above Gravelly Ford on the San Joaquin. The Bureau missed a perfect opportunity to test how much water would be lost from additional summer releases once that groundwater had been re-charged.

G) Temporary barrier operations result in net downstream flow back over the Middle River and Grant Line Canal barriers. Improved San Joaquin River water quality will also improve the Middle River and Grant Line quality. If this does not result in compliance at the Middle River and Old River Stations, other actions can be undertaken. The Middle River rock barrier can be improved to capture and retain more high tide water, and low lift pumps can be added at the barrier to increase the flow of high quality water up through Middle River and into Old River. This will maintain high quality water in Middle River, and the flow continuing into Old River will blend with the water flowing into the head of Old River. This will further reduce the salinity of the Old River water which is also reduced by the measures discussed above.

3) Recovery of Dilution Flows.

A) Any additional dilution flows added to the San Joaquin River are available for export as they pass through the South Delta. If the water cannot be currently pumped as additional exports, DWR and USBR could coordinate exchanges so that the water is pumped for such things as EWA purposes using the additional 500 CSF export authorization of the SWP or exchanged to replace or substitute for a transfer being accomplished under JPOD operations. Even if none of these authorizations were available, DWR and USBR could petition the Board for short term authorization to allow them to pump these additional dilution flows. One would assume the Board would look favorably upon such a request given that its underlying purpose is to meet existing Water Quality Objectives. Approval of such petition would be similar to D-1641's "no net loss" principle regarding fishery releases. In sum, all additional dilution flows would enter the South Delta and be available for export at the SWP and/or the CVP pumps. The losses should only be minimal. For example, the recirculation pilot program estimated the losses at less than 10%. I recall that carriage water losses for the DWR Dry Year Purchase Program were less than 5% in 2004.

It is important to note that the water deliveries of the CVP to its westside service area of the San Joaquin Valley, as assisted by the SWP, are the cause of the River's

salinity problems. As I understand it, other parties are asserting that the CVP and SWP should not be required to meet the standards if it adversely affects their deliveries or costs. It would be illogical and unfair to allow the continued delivery of the water which causes the salt problem, and yet not require that some of that delivered water be used to mitigate the salt problem.

III. Benefits Resulting From Compliance With The Salinity Objectives

I will now give an overview of the benefits from meeting the Water Quality Objectives which also addresses the question of whether a Cease and Desist Order should issue.

A) As the Board knows, the 0.7/1.0 EC standards were developed to protect agricultural beneficial uses. The voluminous studies, investigations, and testimony previously used by the Board in setting these standards was referenced in SDWA's presentation at the Periodic Review process workshops. Generally, EC's above 0.7 have an incremental adverse effect on crop production, which translates into a monetary damage to farmers.

B) To get a broad estimate of the damage that occurs as the EC of the water rises, I refer the Board to the previously submitted report of Dr. G. T. Orlob attached hereto as Attachment "I," and entitled "Impacts of San Joaquin River Quality On Crop Yields In The South Delta." Therein, Mr. Orlob calculated the crop damage in dollars between actual crop yields and the yields which would result if a standard of 500 TDS had been met. Using 1976 figures and dollars, the crop loss for the South Delta area was (15.70 - 8.64) $7.06 million. In 2005 dollars, it is approximately $24 million (using a CPI calculation at http://woodrow.mpls.frb.fed.us/research/data/us/calc/). This gives the Board a good idea of the scope of the crop damage if the EC downstream of Vernalis were allowed to exceed the current standard during the April through August time frame. The specific impacts on diverters is exemplified by the testimony of the other SDWA and CDWA witnesses.

C) We also know that virtually all of the San Joaquin River water ends up at the State and Federal pumps (see Testimony of Thomas Zuckerman, Exhibit No. CDWA-10). This is due to the fact that even with temporary barriers, the net flow is downstream over the Grant Line and Middle River barriers, and, that the water which continues down the mainstem of the River also mostly ends up at the pumps. Hence, the quality of export water is partially dependent on the quality of the San Joaquin River. Improving the River water quality in order to meet the standards will benefit export interests, especially municipal water users. Although I do not have the calculations, I understand that the Bureau has done investigations which determined the benefit to municipal water treatment plants resulting from improvements and source water quality.

D) The Board is also well aware of the dissolved oxygen (DO) problem in both the mainstem of the River, specifically in the Stockton Deep Water Ship Channel, and also generally throughout the South Delta. Two Basin Plan Objectives for DO apply to these waters. Additional good quality water added to the system for purpose of meeting the salinity standards will also help improve DO levels both because of the quality of the flows, and the additional flow/circulation they will provide.

E) The additional flows would also provide benefits to the various fisheries. We know that out-migrating salmon smolts are traveling through the system even after the spring pulse flow has ended. These fish would be helped by the higher flows. Other species, such as steelhead and smelt may also be benefitted by the higher flows. Use of the additional flows for dilution would provide an opportunity for the fishery agencies to examine the effects.

IV. Effects On Farming Operations

As I referenced above, I am a farmer on the San Joaquin River. I divert under both appropriative rights (see Attachment "J") and under my riparian rights (my chain of title documents are being introduced by a CDWA witness as Exhibit No. CDWA-6). I have personally experienced the adverse impacts of the SWP and CVP, and other upstream projects. I have had reduced crop yields due to high salinity of the River water. I have been unable to divert from the River due to decreased upstream flows and the destruction of the high tide which previously extend to the portion of the River I abut. Requiring the DWR and USBR to meet the previously established Water Quality Objectives which are contained in their permits would not only protect me, but also numerous other beneficial users of water. Farmers further downstream have experienced more loss due to salinity because salinity rises above the Vernalis standard as water flows downstream as previously discussed.

Finally, for clarification, the draft Cease and Desist Order states the temporary barriers are installed to mitigate the adverse effects of the HOR fish barrier. This is misleading. Although the federal funding for the temporary barriers was previously linked in CVPIA to the funding for the HOR fish barrier as mitigation of that barrier, that does not accurately describe why the other three tidal barriers are installed. It is my understanding that DWR now shoulders all of the costs of the temporary barrier program, though there may be some arrangement whereby USBR will pay its share in some other way. The temporary tidal barriers are installed to partially mitigate the adverse effects on water levels, quality, and quantity resulting from the operations of the CVP and SWP. At this date, the SWRCB should not be trying to avoid describing the true state of affairs in the South Delta. There is no disagreement that the projects lower water levels, decrease flows, reverse channel flows, cause stagnant zones and worsen water quality. The temporary tidal barriers are one of the preliminary steps in correcting these problems.

V. Water Quality Response Plan

Finally, I will address this Board's reconsideration of the Chief of the Division of Water Rights approval of the current Water Quality Response Plan for Joint Point of Diversion. In approving the current Response Plan, the Division Chief waived compliance with the currently existing Water Quality Objectives for Agricultural Beneficial Uses at the Brandt Bridge, Old River near Middle River and Old River at Tracy Road (sic) Bridge. This would appear to be not only beyond the Division Chief's authority and contrary to D-1641, but also directly contrary to the purpose of the Water Quality Response Plan.

D-1641 requires as a condition to JPOD that the DWR and USBR "develop a response plan to ensure that the water quality in the southern and central Delta will not be significantly degraded through operations of the Joint Point of diversion to the injury of water users in the southern and central Delta" (see for example page 150-151 of D-1641). Approval of the plan was to come from the Division Chief.

The purpose of the plan is to ensure that the incremental affects on water quality resulting from JPOD do not injure other users. Inexplicably, the Division Chief decided that while she was protecting the Delta users from the incremental effects of JPOD on water quality, she would relax the existing Water Quality Objectives. In other words, she allowed a greater impact to water quality than she was protecting through the plan.

This bizarre decision by the Division Chief cannot stand and should be forthwith revoked. No further evidence is necessary to undo such an act which is not only beyond her authority but directly contrary to the explicit and implicit purposes of the Water Quality Response Plan. This Board will consider changes to the 1995 Water Quality Control Plan through the Periodic Review process and perhaps through the process resulting from DWR and USBR's Petition to delay implementation of their permit terms. The Response Plan process did not give any party notice that such a significant change was pending and so it would be unfair and wrong to allow it. Similarly, we belief a change in the standards would require new environmental evaluation.

SDWA requests that the Water Quality Response Plan not include the Division Chief's wrongful waiver of existing standards.

TESTIMONY OF WILLIAM "CHIP" SALMON

My name is William Salmon. I reside at 7749 West Undine Road, Stockton, California. For the past five years I have been the manager of ABF Services, Inc. ("ABF") and I also own and lease other property in the South Delta which I farm separately.

As manager of ABF, I farm a piece of property at the east end of Grant Line Canal as indicated on Attachment "A." It is my understanding this property is riparian to both Grant Line Canal and Middle River. The crops on this property have included walnuts, grapes, beans, alfalfa, tomatoes and other row crops.

In the last few years, I have noticed an increasing and substantial damage to the crops resulting from salinity. This problem has been verified by representatives of the Ag Extension Service and by a laboratory analysis done by my fertilizer representative at John Taylor Fertilizer. Attachment "B" is a copy of the tissue analysis of the walnuts. It indicates acute chloride toxicity.

Attachments "C" and "D" are certain water quality sampling data from DWR for Middle River and Grant Line Canal, the two places from which I diverted water for this property. The Middle River data for 2002 shows EC levels in the 700 and 800 range for most of the year, especially in summer. The Grant Line Canal data (measured at Doughty Cut) shows EC in August was generally above 800 and sometimes 900. For the summer months in general, the level was most always above 700, though of course there were fluctuations. The EC objective at Vernalis for agriculture during the summer months is 700.

I have also attached some pictures as Attachment "E" which show some of the salt damage to the crops. Copies are difficult to view, but they do show the burned margins of the leaves and arrested growth associated with the salt damage.

The data for the damages in 2002 are as follows. The 105 acres of walnuts had a decrease in yield form 254,580 tons in 1999 to 105,380 in 2002 for the Payne variety and 85,420 tons in 1999 to 33,440 tons for the Westside variety. There was obvious leaf burn and stunted growth on the walnuts from the salts. Although the orchard would have to have been removed eventually due to a virus, it still should have had many more years of production left. However, I had to remove the orchard in 2002 because of the decrease in yield at a cost of $450 - $550 per acre which included tree removal, root removal and associated labor.

SDWA-3

The grapes are 47 acres of the Chardonnay variety. The sugar levels necessary to allow harvest for the contract I have were never reached, the grapes actually began to turn into raisins and the vines to defoliate. Although I did harvest some of them for juice, basically the entire crop was lost.

Beans were planted on 68 acres. The stunted growth of the plants was very obvious and the crop yield was one-half of other fields using the same seed and cultural practices. This acreage yielded 10 sacks per acre while the others were 20.

Although I have not calculated the current year's problems, the Chardonnay grapes are again stressed and will have a decreased yield and the young walnut tress I have planted which include the varieties of Tulare and Chandler are suffering from chloride stress.

To address this problem over the years I have applied soil amendments such as gypsum and have flooded the fields in winter to attempt to flush out the salts. However, the soil ph in combination with the salty water binds the chlorides and prevents leaching. The walnuts and grapes acreage are installed with tile drainage, but even that aid to drainage was inadequate.

If the water quality in the interior South Delta channels, including the Middle River near Old River compliance location was maintained at the 700 EC standard (April through August), the salt problems I am experiencing would certainly decrease and result in a direct economic benefit to ABF and associated parties. It is my personal belief that the State Water Resources Control Board should require DWR and USBR to comply with their respective permit conditions and meet the South Delta Water Quality Objectives.

PUBLIC HEARING

STATE OF CALIFORNIA

WATER RESOURCES CONTROL BOARD

DIVISION OF WATER RIGHTS

JOE SERNA JR., CALEPA HEADQUARTERS BUILDING

1001 I STREET

COASTAL HEARING ROOM

SACRAMENTO, CALIFORNIA

MONDAY, NOVEMBER 7, 2005

9:00 A.M.

JAMES F. PETERS, CSR, RPR
CERTIFIED SHORTHAND REPORTER
LICENSE NUMBER 10063

PETERS SHORTHAND REPORTING CORPORATION (916) 362-2345

APPEARANCES CONTINUED

ALSO PRESENT

Mr. Dante John Nomellini, Central Delta Water Agency

Mr. Dan Odenweller, California Sportfishing Protection Alliance

Mr. Tim O'Laughlin, San Joaquin River Group Authority

Mr. Terry Prichard, South Delta Water Agency

Mr. Jerry Robinson, South Delta Water Agency

Mr. Jon Rubin, San Luis and Delta Mendota Water Authority

Mr. Clifford Schulz, State Water Contractors

Dr. Sean Snaith, South Delta Water Agency

Ms. Jeanne Zolezzi, Stockton Eastern Water District

DIRECT EXAMINATION OF THE

SOUTH DELTA WATER AGENCY PANEL

BY MR. JOHN HERRICK, ESQ. representing the South Delta Water Agency:

MR. HILDEBRAND: Good morning, Madam Chairperson.

CHAIRPERSON DODUC: Welcome.

MR. HILDEBRAND: Before I begin on my testimony, I'd just like to call your attention to the fact that I've been a farmer for more than 40 years. But prior to that, I was the director of a major oil field research laboratory, which did research that was relevant to what we're discussing here and that will provide me with expertise when I do the rebuttal testimony later in the proceeding here.

The purpose of my direct testimony is to demonstrate that contrary to allegations by other parties failure to enforce the 0.7 EC standard would cause substantial damage and that the DWR and USBR can comply with the .7 standards without resorting to any measures that are beyond their control and without any reasonable -- unreasonable water costs.

And this is true not only with the temporary barriers but later on with the permanent barriers. It's even easier to do it then, quite a bit easier.

My testimony, first, reviews the regulatory

background that led to the Board's adoption of the .7 EC standard. I was an active participant in all of those reference proceedings. I won't dwell on that, because counsel has already covered that pretty well.

The issues before this proceeding are whether a Cease and Desist Order should be issued and whether its provisions should result in prompt compliance with the .7 EC requirement. The answer to both questions should clearly be yes. The DWR and USBR show no signs of having considered how they could comply with the .7 EC requirement, and have apparently made no plans to do so.

My testimony next explains and gives references to show that the CVP is the principal cause of the salinity problem in the south Delta. And my testimony explains why this is the case. The references show that prior to the CVP, the salinity in the south Delta channels was consistently lower than the current .7 EC requirement, except in September of 1931 after most crops had been harvested. Even then the hire salinity came from the Bay and only under portions of south Delta channels.

My testimony then discusses the fact that dilutions water will be needed to meet the .7 EC requirement until west side drainage from the CVP service area is kept out of the river. That should be done.

My testimony goes on to list 7 measures which

could be combined in various ways at various times to meet the .7 EC requirement, even while using temporary barriers.

None of these measures are beyond USBR and DWR control, and none would involve an unreasonable use of water. For example, recirculation of the Delta-Mendota Canal water, such as was done in August of last year, can provide .7 EC water at Brandt Bridge and in Old River at the Head of Middle River in July, August and September. Those are 2 of the 3 compliance points we've discussed.

If the salinity in Old River at Tracy Boulevard would then still exceed .7 EC, the Middle River barrier can be redesigned and provided with a fish-friendly low-lift pump to force high quality water up through Middle River and into Old River. That would enable compliance with all 3 of the internal periods.

Now, in other months than June -- than July August, and September fishery considerations make preclude the recycling of DMC water. But there are various potentials however to purchase tributary water or to make exchanges such as the release of water from westside storage or from -- when there are concurrent deliveries to storage, they could instead be put in the river. And in any other case, that water then can be replaced during July, August and September when recirculation can take

place.

My testimony goes on to discuss the other benefits that can result from recovery of these dilution flows. It also calls attention to the benefit to export water quality that results from meeting the .7 EC requirement. The measures needed to provide .7 EC will also substantially contribute toward maintaining adequate dissolved oxygen for fish in the Stockton ship channel, and will assist in outmigrating Salmon smolts that migrate after May 15th.

The testimony also discusses the substantial agricultural loss that will occur if the .7 EC requirement is not enforced. We will rebut testimony during -- disputing this loss which is being submitted by other parties. Those parties all receive irrigation supplies incidentally with salinities substantially lower than .7 -- the .7 that they don't want us to have.

Another issue in this proceeding is the water quality was response plan. In improving the current response, the Division Chief waived compliance with the water quality objectives for agricultural beneficial uses. This is contrary to D-1641 and contrary to the purpose of the response plan.

In summary, the USBR and DWR have known for at least 5 years that they would have an obligation to

provide .7 EC water in south Delta channels this year, but they apparently did not even consider how they could do so. The CVP is primarily responsible for increasing the pre-CVP in-channel salinity, which was appreciably lower than .7 EC. The .7 EC requirement can be met even while using temporary barriers by combining a whole list of measures in various ways at various times.

None of these measures are beyond USBR and DWR control. You've heard a lot about how maybe the violations occurred due to reasons beyond their control. That is just plain not the case, and none involves substantial water costs. Enforcing the .7 EC requirement will involve measures that benefit fishery and export water quality.

Failure to enforce .7 EC would be damaging to south Delta agriculture. Allegations by other parties that .7 EC is not needed for crop yields are based on flawed testimony that south Delta will rebut.

When the Division Chief waived compliance with the existing water quality objectives she violated both D-1641 and the purpose of the water quality response plan.

For all these reasons there should be a Cease and Desist Order which enforces prompt compliance with the .7 objective at all monitoring points.

Thank you.

MR. HERRICK: Madam Chairman, Mr. Hildebrand, is south Delta Water Agency Exhibit Number 2 a true and correct copy of your testimony summarized here today?

MR. HILDEBRAND: That is correct.

Q And that exhibit includes Attachments A through J; is that correct?

A That's correct.

Q And exhibit South Delta Water Agency 2 Attachment B is your statement of qualifications; is that correct?

A That's correct. And that's what I expanded on briefly for the benefit of the chairman.

MR. HERRICK: Thank you. I'll now move to our next witness, Terry Prichard.

If you will please summarize your testimony, sir.

MR. PRICHARD: Good morning Madam Chair. My name is Terry Prichard. I'm a water management specialist in the Department of Land, Air and Water Resources at UC Davis. I've worked on water and salinity issues for many years. I was asked to comment on the necessity and the underlying reasons for the 0.7 and 1.0 EC standards depending upon the time of season.

In setting the water quality objectives for the southern Delta, an array of crops were originally used. We hear in these hearings a lot about beans, but the crops represented were both annual crops and perennial crops.

are not within the control of the DWR and USBR?
Q No, I meant the opposite. Actually, I meant that because you have stated that those are actions that could help achieve compliance. If noncompliance occurred, should the Board take those actions into consideration as to whether they were taken, and if that would be a basis for finding an enforcement action is necessary?
A Well, I haven't assumed that the Board would dictate to the projects which of those options they utilize and in what combination and in what times, but I think it's clear that it is possible to meet the .7 without measures that are beyond the control. And therefore, the Cease and Desist Order should merely state that you must comply.
Q Thank you. So you described several actions that the Bureau and DWR could take, as I just mentioned. One of them is a release of water from New Melones in 2005, you mentioned in your written testimony that the Bureau failed to make any releases in 2005 to help meet water quality in the south Delta. Are you aware of any need to make releases for water quality in the south Delta in 2005?
A If I implied that it was -- the need was in any particular year, I didn't mean to do so. Whenever it is needed, the Bureau has an obligation to make releases from New Melones sufficient to meet the Vernalis standard.
And sure once when we get a high flow year like

this, it doesn't happen to be necessary. But the Bureau has a practice of saying that they're allocating a certain amount of water for water quality, even in the years when they know they won't need it, and then somehow implying some credit for that in the years when they do need it. It's a rather peculiar system.

Q Well, in 2006 if the Bureau had water available in New Melones, would you support a finding that that water should be used for meeting water quality objectives on the south Delta?

A Yes.

Q So if that water is available and you say it should be, could -- is there a reason to find that there is a threat of noncompliance at this time?

A Yes, because the amount of water they allocate from New Melones isn't always allocated. They have not met it in the past. Numerous occasions they have not complied with the standard. And even if they do, it doesn't meet the standard further downstream.

Q Well, Mr. Hildebrand, we're talking about the standard in the southern Delta at 3 compliance locations which only began April 2005 at .7. So --

A Yes, but I think you just referred to 2006 and they will apply in 2006.

Q Yes, that's my point, is that's where the enforcement

team has said that there is to be a threat of noncompliance that we're addressing at this hearing is whether or not there is sufficient evidence to support a threat of noncompliance. And I'm trying to determine based on your testimony if the Board could consider the current water quality conditions to help them understand whether the enforcement team is correct in bringing this action at this time.

So that's all I'm relating it to, not past standards that the Bureau may not have met related to Vernalis, which I think you're referring to. I'm only talking about the standards of this hearing. And they only became effective April 2005.

So my question now is, given that, this is the direction I'm asking you in this question is, given that you've described several actions that the Bureau and DWR could take to meet compliance with the objectives, do you think these actions support a determination by the Board that a threat of noncompliance as described by the enforcement team is not supported?

A The DWR and the Bureau have shown no indication that they intend to do those things that I've listed that are feasible. And therefore, if we have a dry year next year, there's definitely a threat of noncompliance.

Q Well, what do you base the -- you're stating that DWR

and the Bureau have made indications that there is no intent to comply with their water right permit conditions, what is the basis for that?

A Well, I think there are several bases. For one thing I've seen letters from the DWR and the Bureau saying that they might not be able to meet the standard next year. That seems to me to be a threat of noncompliance.

Q What was the purpose of that letter?

CHAIRPERSON DODUC: All right. I think we've been here before.

MS. CROTHERS: I don't think he's ever answered this question.

CHAIRPERSON DODUC: Well, I think he's tried. And he's based it on evidence and discussions that have already taken place and questions that have already been asked by other witness, especially the prosecution team. If you're stepping into the area of whether or not the prosecution team can propose a Cease and Desist Order for a potential violation, again, that's a legal matter that we're not going to be discussing here in this hearing.

I suggest you move on to your next line of questioning.

MS. CROTHERS: Okay. Well, these questions are going to whether there are facts in the record to support the threat or likelihood of noncompliance. Mr. Hildebrand

has given us several facts that would suggest that that's not supported. So I'm trying to understand what the basis of his conclusion is that there is a threat.

CHAIRPERSON DODUC: And I believe he's answered your question.

MS. CROTHERS: Okay. Thank you.

You also have said that DWR has not taken any actions to support -- any actions to improve the water quality conditions in the San Joaquin River to help meet these objectives. Are you aware of the substantial funds and actions that DWR has administered and supported in the San Joaquin River Drainage Program?

MR. HILDEBRAND: I'm aware of what's been done, but it's, at this point, not adequate to resolve the problem. It's true that if the various parties involved were to stop the drainage into the river from those lands, including wildlife refuges that receive Delta-Mendota Canal water, and hence receive that salt load, if they would keep that salt load out of the river -- it's a none indigenous salt load -- then we would go back largely to the situation we had, pre CVP, when we had no salinity problem. But while there's talk of doing, it's a long way from having happened. It's not anything that's going to avoid violation in the next few years.

Q But you would agree that there are -- have been

actions taken by DWR to reduce the salinity into the south Delta based on the San Joaquin River Drainage Management Program?

A Say that last again, based on what?

Q Well, I am just trying to clarify your position that DWR has taken no actions to help improve water quality conditions in the San Joaquin -- south Delta. And I am trying to clarify that that -- I think you have said it, but I wasn't quite clear of your answer, that there have been actions by DWR to improve the water quality in the south Delta?

A Well, not primarily by DWR, because the problem arises from the CVP primarily rather than DWR, but DWR wheels water for the CVP and so they become involved in it. But the cause of the problem is the drainage that is of nonindigenous salts that are imported into the valley by the Delta-Mendota Canal and delivered to ag lands and to wild life refuges, which consume water and then drain the salt into the river. Now, I don't know that the DWR has done anything particular about that.

MR. CROTHERS: These are some questions for Mr. Robinson. Mr. Robinson, you state that you're a -- that you have a farming operation on the Lafayette Ranch; is correct that correct?

MR. ROBINSON: Yes.

actions taken by DWR to reduce the salinity into the south Delta based on the San Joaquin River Drainage Management Program?

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A Well, not primarily by DWR, because the problem arises from the CVP primarily rather than DWR, but DWR wheels water for the CVP and so they become involved in it. But the cause of the problem is the drainage that is of nonindigenous salts that are imported into the valley by the Delta-Mendota Canal and delivered to ag lands and to wild life refuges, which consume water and then drain the salt into the river. Now, I don't know that the DWR has done anything particular about that.

MR. CROTHERS: These are some questions for Mr. Robinson. Mr. Robinson, you state that you're a -- that you have a farming operation on the Lafayette Ranch; is correct that correct?

MR. ROBINSON: Yes.

CROSS EXAMINATION OF

THE SOUTH DELTA WATER AGENCY PANEL

BY MS. TINA CANNON, STAFF COUNSEL, representing the California Department of Fish and Game:

MS. CANNON: Good afternoon Tina Cannon from the California Department of Fish and Game. I only have a couple of questions.

My question is for Mr. Alex Hildebrand regarding statements that are made in South Delta Water Agency Exhibit 2 Section 3(e), page 7. Mr. Hildebrand, in your statement you state that additional flow would provide benefit to various fisheries. Is this a generalized statement or is this a reference to recirculation?

MR. HILDEBRAND: It's generalized to the extent that it addresses the benefit to fishery of having a greater flow and most of these things that are referred to, the methods by which the .7 EC could be met also involved an increase in flow at Vernalis and on downstream.

The source of that flow is a separate question, but I made the point that the measures in order to deal with the salt load that comes out of the westside CVP service area at this time until they control it otherwise, you have to have more dilution. And the question is how you get that dilution and to what extent can you do it by

recirculating water rather than releasing new water. But in either event you increase the flow.

Now the ability to maintain the dissolved oxygen required for fishery, at any point in the south Delta requires there to be a net flow, so you don't have a stagnant area where you can't control either salinity or dissolved oxygen. And you had big fish kills. For example, when we didn't have a net flow in Old River, and there's a major problem for the migrant fish getting back and forth through the ship channel, because if the dissolved oxygen requirements for the ship channel are not being met most of the time or much of the time, I should say.

And if you do the -- use these methods of meeting the .7 that I referred to, you then do have a bigger flow both in Old River and also into the ship channel. And this should benefit the fishery from the standpoint of dissolved oxygen. But it also has a benefit that it's My understanding from testimony from Fish and Game in the past, that there are a good many Salmon smolts, for example, that come down before and after the pulse flow from April 15th to May 15th.

And if you don't have an adequate flow at Vernalis, and that flow essentially all goes in to Old River, it shoots those poor little Salmon smolts right

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And if you don't have an adequate flow at Vernalis, and that flow essentially all goes in to Old River, it shoots those poor little Salmon smolts right

over to the export pumps. And the contention is at least that that's not very good for the Salmon.

If, on the other hand, you have enough flow so that at least a substantial portion of the Vernalis flow goes on down to the central Delta rather than cutting through Old River and Grant Line and back to the federal pumps, then those smolts have a chance of getting out to the bay.

Q Mr. Hildebrand, are you aware of any specific study that's been done on the effect recirculation would have on the fishery?

A No, we've tried to get the fishery to propose the testing that might be done to assess that very question. At the time of this temporary thing in August of last year, the fish agencies indicated that, number 1, they didn't have time to think about how to test it, and, number 2, the impact of a flow of only 250 CFS would have on the hydraulics of the system were so small they didn't think they could detect it.

For the most part, the kinds of flows we're talking about for recirculation would be in the range of 250 to 500 or at most 1,000. So I've been in communication with the Bureau representative who handled that test last August to try to get the fish agencies to propose a new test next year, which would resolve that

issue.

But it's my understanding that so far he hasn't succeeded in getting much interest on the part of the fish agencies to do that. The 250 was sufficient. It was superimposed on the 1,000 CFS at Vernalis. So it went from 1,000 to 1,250. In doing that, if you maintain the same release from New Melones that you would have if you weren't recirculating, you then get a reduction in -- at the salinity in Vernalis of about .1, in other words from .7 down to .6, and you then have .7 at Brandt Bridge, because typically the degradation, increase in salinity getting from Vernalis to Brandt Bridge is only about one-tenth. It doesn't go all the way up to 1.0, except under extreme situations.

Now, sometimes it does rise more than one-tenth. But the more typical situation is if you have .6 at Vernalis, you will indeed have .7 at Brandt Bridge, and you will have increased the flow all the way down through the ship channel, which is a major problem for the fishery.

Q So if I heard you correctly, there was no fishery element in the Newman waste study?

A No, the fishery people were asked to provide that and they did not choose to do so.

Q If you provide added flow through recirculation, do

you increase pumping to recover the water?

A At the time you're recirculating, yes. The recirculating plans that have been studied the most and very much of it by my working with the metropolitan water district staff, is that it appears to be very little fishery potential impact in July, August and September and also that they have the capability physically of doing recirculation during that period.

Now, if you recirculate in June, there may be fishery issues. But you can do that by delayed recirculation. Suppose, for example, that in June you're delivering water to storage somewhere, the projects are, and suppose instead of delivering it to storage, you delivered into the river, and then you restore the storage that was there by loss, during June, July and -- or July, August and September. Then you get the increased flow in June without increasing theDelta pumping in June or you can take the borrow the water out of San Luis Dam, for example, and provide the increased flow in the river by that means at that point in time.

And then in June, July and August -- or July, August and September you have the physical capability of replenishing that supply in San Luis Dam. These are just examples. There are other things that can be done with water exchanges and other things. And my testimony gave a

list of possible things to consider. And what are the best things to consider in that particular point in time would be something for the -- to be determined by the projects. But they have the capability of doing it if they just would do it.

MS. CANNON: No further questions.

CHAIRPERSON DODUC: Thank you.

Contra Costa Water District?

Not here.

Merced Irrigation District San Luis Canal Company?

CROSS EXAMINATION OF

THE SOUTH DELTA WATER AGENCY PANEL

BY MR. ARTHUR GODWIN, ESQ., representing the Merced Irrigation District:

MR. GODWIN: Good morning. Arthur Godwin for Merced Irrigation District.

First of all, I have some questions for Mr. Hildebrand, and this is regarding his testimony. It's Attachment I, which I believe was South Delta Water Agency Exhibit 3.

MR. HILDEBRAND: Let me get that. Just a moment.

Q It's the Orlob report.

A I have the Orlob report before me now, what's the question?

referring to, you know, what is their objective function and how does the information change behavior. I'm not exactly sure who the people that you're referring to are, so I can't say exactly.

MR. MINASIAN: Okay. Well, let's turn to Dr. Hildebrand -- Mr. Hildebrand and Mr. Robinson for that information.

Alex, the typical the farmer within South Delta Water Agency is reliant upon a pump out of a slough or out of the river, is he not?

MR. HILDEBRAND: Typically, yes.

Q Does that farmer have available to him a hand-held EC meter to know what the water quality coming out of that pump is at any given point?

A Well, I do and many farmers do, but not necessarily, because it's not something the farmer can control. So he has to make do the best he can with whatever is there.

Q Let's take a typical farmer who has an alfalfa crop, and let's take a typical dry year. And how would we help that farmer reduce any harm that might occur from salinity in the water that he's pumping?

A Can I be a typical farmer?

Q Please.

A Okay. When I have had alfalfa, I've used Tensiometers to determine the salinity of the water penetration down

through the root zone. And I found that in the summer months the alfalfa transpires a great deal of water, because the amount of water that a crop plant has to transpire up through its roots and out through its leaves in order to grow a pound of crop biomass is a pretty fixed proposition.

Alfalfa generates an enormous biomass. That's why -- and it's a major input to the dairy industry, of which is a very large industry in San Joaquin county. The result is that you have to penetrate a lot of water into the root zone. Alfalfa, incidentally, is harvested once a month, so it's something you Might get to 6 or 8 harvests a year.

And so you have to penetrate each month into that root zone as much water as the crop needs to transpire and have maximum growth, plus enough to flush the salt that's always in the incoming water out the bottom.

Now, the more -- the higher the salinity of the water, within the ranges we're talking about here, the more leach you have to have, hence the more penetration you have to have.

Well, I found that in the summer months the ET of the crop was so great, that I couldn't get any leach at all, so that the salt coming in with the irrigation water in each irrigation was just accumulative salt in the root

zone.

Now, the theorists say oh, well all you've got to do is put on more water. But you can't do that. In the first place, when you grow alfalfa each month you have to mow it you, you have to cure it, you have to rake it, you have to bail it and you have to haul it off the field.

Q Right. And you're describing the timing problem.

A The timing problem. It turns out that you can only irrigate typically about twice a month, and you can't leave that water on too long when you do irrigate, because the alfalfa roots in their crowns are very susceptible to damage from the lack of aeration.

Q So let's imagine the farmer's problem. He's got to time the irrigation with his harvest, with his fertilization practices, with the weather, because if it's too hot, he'll scald it. And he's got to know what about the salt in the soil?

A Well, he needs to know -- he needs to attempt to get enough leach with whatever his incoming water salinity is so that he won't accumulate salt in the root zones.

Q And he if has a soil test at the beginning of the season, and midway in the season he knows what the salt level is in his soil, does he not?

A If it's worth his while to make that test. But basically after you do it a few years, you find out that

you know pretty well.
Q Okay. And he then has to make a decision, I'm going to turn on the pump or I'm going to delay turning on the pump. Now, is there a variance in salt in the water over time at various locations in south Delta?
A He can't make a decision to defer the irrigation or do it sooner because it has to fit into the slot of opportunity in his harvesting program.
Q But if he knew what the salinity was in his water and if he knew how it varied over time during a week, he could pick a better time to irrigate, could he not?
A My point he can't pick a better time, because the time is dictated by the harvest problem.
Q Is it not -- would you agree that generally farmers within South Delta Water Agency today, don't have the tools to predict whether there is any change, if there is any, in the salinity of the water at his pump, because they don't have the data?
A That's an exaggeration. Some of us do have EC gauges and we can check as often as we find it.
Q And what do you know about your particular location which happens to be pretty high up in the south Delta?
A I'm fairly close to Vernalis, so that when the Bureau chooses to meet the salinity at Vernalis, I'm in not too bad a shape, if they do that.

Q Let's take a farmer in south Delta who's located at one of these sloughs, his pump is off the river because he was protecting it from floods, and there are drains, there are farmers draining above him. Does he have the data available to him to know whether the water is good on Friday night when everybody goes home and not so good on Monday morning when they come back?

A If he's irrigating off the main stream, he will know what typically is the reduction in -- or the increase in salinity at the point where he's irrigating.

Q Would it be correct to say that South Delta Water Agency and its land owners currently don't have a method of monitoring when the drain pumps are turned on in areas that do influence the quality of the water being taken by an irrigator?

A Most farmers are in situations where they know whether the drain pumps are running or not.

Q But you agree that there's no data bank in which hand-held EC meters are transmitted to a central registry for drain water operations?

A I don't think that would do them any good.

Q Do you agree that there's no schedule for turning on drain water pumps in those situations where back-flow and tidal impact can bring it into a receiving -- excuse me, a location where irrigation pumps are extracting water?

A You're assuming again that the agricultural community has more control over the time of their pumping, whether it be onto the land or out of a slough than they actually can have in commercial practice.

Q So your opinion is the construct of South Delta Water Agency educating land owners accumulating data and transmitting the data to its irrigators and land owners is flawed. Why is it flawed?

A I didn't say it was flawed. I said they don't have the opportunity for the flexibility you're suggesting. Furthermore, if you're an experienced farmer, you can look at your crop and just tell by looking at it whether it's short of water or not. And it may be short of water because you didn't apply it soon enough or it may be short of water because the salts built up and the plant is unable then, through its osmotic root system, to take the water out.

Q If a farmer has accurate readings of soil salinity, and if he applies water earlier when its better quality, he can do something about the soil salinity when the water quality is worse, can't he?

A Again, you're assuming that he can apply it earlier. That isn't necessarily the case, typically not the case. He has a very defined opportunity to do that water application, and particularly in alfalfa, but this is

somewhat true in other cases.

Furthermore, you can't grow a crop unless you can get it through the seedling stage. And what all these academics overlook is that the seedlings are considerably more salt sensitive than the mature crop, which is all that was tested when they made these tables.

And furthermore, the moisture that's in the seeling root zone is close to the surface. Consequently, unless you're in the rainy season, which you aren't when you try to start a crop usually, the evaporation from the soil surface takes that rainwater away that came down before or even irrigation, if it was very long before, and takes the water molecules out and leaves the salt molecules behind, so that it's very difficult to avoid having a salinity in the seedling root zone which is damaging to the seedlings.

And if you've planted a crop, which I guess you haven't, you'll find out that you may plant beans, for example, and a third of the beans come up, because the conditions weren't suitable. It was too salty or it got dried out too much before you could get them planted or the soil -- the weather was such that it was too cold. Beans won't germinate when it's cold. Or you do get an abrupt rain shower, which creates a crust on the surface and the leaves -- the beans can't get up through it.

There are a whole lot of complexities to farming that don't seem to be apparent to nonfarmers.

Q Okay. Well, let's take those complexities and try to work with the $3.3 million that government alone would lose under Dr. Snaith's hypotheticals and study. And if I gave you $1.5 million of that, if the prosecution staff ordered that as a condition, how would you help that bean farmer make his decision about whether to plant at all in February?

A Well, it's a decision the farmer has to make. In a lot of years he'll decide he better not.

Q Okay. For one thing you'd have a soil test to see when the salt was that you were starting with, wouldn't you?

A No, no, because the seedlings zone for beans is near the surface. And if you make a salt test, when are you going to make it? Before you put the seeds in or after or when.

Q Well, let me give you a hypothetical. Let's assume that you did it before you made the choice of buying the seed transplants for the seed itself?

A You don't translate beans.

Q Okay. And let's assume for a moment that that decision is made in December, you don't know what kind of water year it is, do you?

A I wouldn't decide in December whether I'm going to plant beans in May. That's too far ahead.
Q Okay. And so by May you would know pretty much what the water conditions were going to be, wouldn't you?
A No, not at the time I would have to buy my seed and make my crop plan.
Q Well, if you knew when the wildlife refuges were going to release their water and their salt, and if you had a website and a model that showed what the operations of New Melones were likely to be, your farmer would be better educated as to how to prevent the harm, wouldn't he?
A I can predict better when the wildlife refuges are going to dump their salt in the river than they can what the Bureau is going to do at New Melones.
(Laughter.)
MR. MINASIAN: My point to you is if you had a million five to work with each year, could South Delta Water Agency get into a position where it could do the testing, give hand-held meters, set up the website, basically educate people so they would make better decisions?
MR. HILDEBRAND: Well, am I to assume that the Bureau is going to meet the standard at Vernalis or not?
Q Well, I assume that their website is going to tell you how the State and Bureau intend to operate the pumps and

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Q Well, I assume that their website is going to tell you how the State and Bureau intend to operate the pumps and

Vernalis are imperfect at this point in time?
A They certainly are.
Q And do you agree that if we had better data produced by the CVP and the State Water Project that harm could be prevented to your land owners in some circumstances?
A It would have to not just be better current data, but better predictability and we don't have that.
Q And I want to use a word with you, you used recirculation. There's a dispatchability to the recirculation, isn't there? You need to know when the water is coming, don't you?
A Well we know fair amount ahead of time, because it takes a couple 2, 3 days to get that thing started. So, yeah, if they're going to recirculate like August of last year, I knew when they were going to recirculate. In fact, they wouldn't have done it if I hadn't needled them. And then I knew when it was going to come, sure. And we got out there and we measured and knew exactly when it arrived, and we knew exactly what happened to the EC when it arrived and we knew what increase in water elevation we had. Because when we only have 1,000 CFS at Vernalis, it gets so shallow that sometimes I and my neighbors can't pump. It's too shall for our pumps to operate. You have to maintain an adequate volume of water, and we didn't have it. And when we got that 250 CFS come down, the

depth increased 6 inches and we were in good shape.

But one of our problems is that the State Board has stipulated flows for fish but not for agriculture. And consequently much of the fish flow is derived by shifting the time of flow, so that instead of coming down the summer when we need it, it comes down in the spring and fall for fish. No w I'm not against fish, but if you're going to regulate the flow at Vernalis, you need to regulate it on a year-round basis or you're just robbing Pete to pay Paul.

CHAIRPERSON DODUC: I appreciate that, but that's again --

MR. MINASIAN: Mr. Robinson, can I take you for a moment. You've heard Mr. Hildebrand. You're a member of the Record of the South Delta Water Agency, are you not?

MR. ROBINSON: Yes.

Q If South Delta Water Agency took on an educational role with growers, took on a testing and a data collection role, could it improve the chances of reducing harm from higher salinity water?

A It probably could. But I think where you're going is we don't want to get paid for damage, we want water quality.

Q And water quality does differ on a temporal basis, that is at a point in time it may be better than it is at

PUBLIC HEARING

STATE OF CALIFORNIA

WATER RESOURCES CONTROL BOARD

DIVISION OF WATER RIGHTS

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SACRAMENTO, CALIFORNIA

THURSDAY, NOVEMBER 17, 2005

9:00 A.M.

JAMES F. PETERS, CSR, RPR
CERTIFIED SHORTHAND REPORTER
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question. And, again, what it was, is in essence you assumed that the salinity was a cause of -- or the salinity in the applied water was the cause of the reduction in yield?

A Based on the results in the Orlob report, yes, I did.

MR. RUBIN: Thank you.

Mr. Hildebrand, I have some questions for you and I believe the remaining questions are directed towards you. The purpose of your testimony is to describe how the use of rock barriers could achieve the south Delta objectives, that's one of the purposes; is that correct?

MR. HILDEBRAND: A purpose of my testimony was to show that even with the rock barriers rather than the permanent barriers, it was nevertheless feasible for the 2 projects to adopt measures that would meet the .7 EC without either adopting measures beyond their control or using an excessive amount of water.

Q In your testimony, which is South Delta Water Agency Exhibit 2, you appear to draw a distinction between the Vernalis objective and certain south Delta objectives; is that correct?

A I'm not sure what you mean by making a distinction.

Q I refer you to page 1 of South Delta Water Agency Exhibit 2, the last paragraph, you indicate that the 1995 water -- excuse me, "The 1995 plan therefore recognized

that the San Joaquin River standards would be addressed with good quality flows in the river while the Old River standards required other actions, such as barriers, which could not be implemented -- immediately implemented, excuse me"; is that correct?

A That was the assumption made by the Board at that time.

Q And the question that I asked is there was a distinction drawn between the Vernalis objective and certain south Delta objectives, correct?

A I guess in the sense that if you had almost 0 flow at Vernalis and you get distilled water at Vernalis, you would still have a problem downstream.

Q But according to your testimony, the 1995 plan or Decision 1641 sought to address the Vernalis standard with flow and the south Delta standards with, as you've characterized it, other actions?

A It meeting the south Delta standard, the internal standards, requires more than just maintaining an adequate minimum flow.

Q Thank you. I now turn to page 3 of your testimony, South Delta Water Agency Exhibit 2, under Section 2 Subparagraph 1A, appears on the bottom of that page, you indicate, "As water passes Vernalis, it slowly degrades..."; is that correct?

A That's correct.
Q And the factors that you have listed here that contribute to the degradation are evaporation, consumptive use and urban discharges; is that correct?
A That's correct.
Q Are ag discharges another factor that contributes to the degradation?
A The degradation caused by ag discharges is a result of the salinity that arrives at Vernalis. Pre CVP, when we didn't have a lot of salt coming down Vernalis, it didn't degrade much. If you were to illustrate with an extreme, suppose we were -- we had distilled water coming at Vernalis, so that the irrigators then downstream of Vernalis were irrigating with 0 EC water, then their discharge would also be practically 0.

As you decrease the flow and increase the salinity of that flow, those irrigators necessarily are pumping some of that nonindigenous salt onto their lands, their crops can take up the water and reject the salt which flows back into the river. In addition to that, we have sewage outflows from Manteca, and Lathrop and if they get a reverse flow that comes up from Stockton and also into Old River from Tracy.

So there are other things coming in that tend to degrade it. But I think we submitted some sheets that

showed that typically the degradation or the increase in salinity from Vernalis to either the Head of Old River or Brandt Bridge was of the order of one-tenth EC, so that if you had .6 EC at Vernalis instead of .7, you'd still have .7 downstream.

Q So if I understand your response correctly, what the farmers in the south Delta are dealing with is a water supply that has, as you've characterized it, nonindigenous salts --

A That's right.

Q -- that are brought onto the farm. And as a result of the farming practices, the salts are concentrated and it is reflected in the quality of water that's discharged?

A That's correct. As I explained during cross examination, this is true of any farmer. And your farmers do the same thing, they receive water. And the ones who receive water out of the Delta-Mendota Canal are receiving good quality water, but their plants take up the water through their roots and evaporate through their leaves. The salt is left behind and then drains into the river at a high concentration. So no farmer can function without having -- causing a concentration of the salt that he receives in his irrigation water. But there is very little salt added to the water in the south Delta channels by the farming operations in the south Delta. They merely

concentrate and have no choice but to concentrate.
Q In response to 2 questions I asked previously, you have recognized that there are factors that contribute to the degradation of water quality after water passes Vernalis including urban discharges; is that correct?
A That's correct.
Q And I believe you referenced certain urban discharges; is that correct?
A I mentioned them, yes.
Q And which urban discharges are those?
A Manteca, Lathrop, Tracy, and if we get a reverse flow, Stockton. A new town of Mountain House is going to discharge into Old River in the future. It doesn't do so yet.
Q Thank you. I know ask you to turn to page 2 of your testimony, South Delta Water Agency Exhibit 2. The third complete paragraph, which begins, "Since 1995..." Do you see that paragraph?
A Yes.
Q You indicate that DWR and the United States Bureau of Reclamation knew that they had to undertake actions in addition to the proposed barrier programs in order to meet the 0.7/1.0 EC standard; is that correct?
A That's correct.
Q And what documents do you rely on, if any, to support

that statement?

A Well, I rely on the fact that the EC standard was determined by the Board to become effective this year, and that obviously it was going to require actions in addition to the temporary barrier program in order to do that.

Q And I should have clarified this, but when you speak in terms of the 0.7/1.0 EC standard in this paragraph, you're speaking specifically of the south Delta standards that are a subject of this Cease and Desist Order here?

A Yeah, the 4 south Delta standards.

Q And I understand the mandate in the 1995 Water Quality Control Plan as well as the terms and conditions that are imposed on the Bureau of Reclamation and the Department of Water Resources permits and licenses. But again, is there a specific section of a document that indicates that DWR and the United States Bureau of Reclamation had to undertake actions in addition to the barrier program in order to meet the south Delta objectives?

A If you'll refer up to the first paragraph on page 2, it refers to the acknowledgement by the Board that construction of permanent barriers alone is not expected to result in a attainment of water quality objectives. Now, that statement would apply also to temporary barriers.

Q I recognize that statement and the quotation in your

testimony. What didn't appear in there for me is the either a recognition or a statement that the actions in addition to the barriers would have to be done by DWR or Reclamation. And that is why I asked the question to you if there is somewhere more specifically directing that obligation on DWR or Reclamation?

A Well, I think that's inherent in the fact that the permit terms require that this be done, to explore the exports.

Q Would you be surprised to learn that documents that support the statement that you quoted were made during the hearing that led to 1641 without reference to who had the obligation?

A I don't know that -- I don't think they were direct references to that, but the indirect reference is there because of the fact that the permits require it.

Q And in your preparation for today's hearing, have you reviewed the specific permit terms and conditions that address the south Delta objectives?

A I didn't go at this from the standpoint of a lawyer. I went at it from the standpoint of an expert on plants, soil science and farming. And the soil and plant science has not changed nor have the soil conditions in the south Delta changed since the time of those hearings.

Q Mr. Hildebrand, on page 4 of your testimony, you speak

of a tool of recirculation as one of the means you're proposing to help -- or a tool that could help achieve the south Delta objectives; is that correct?

A That's correct. That's been analyzed into a considerable degree by various parties, and primarily by my work with the metropolitan water district and their technical team.

Q And part of your conclusion, if I understand it correctly, as that being a viable tool is based on the ability that the impacts of recirculation to those in the CVP/SWP Export would be minimized; is that correct?

A And the technical analyses I refer to has been -- they examined it from the standpoint of being able to do that without an impact on the exports, and that's why the studies have been restricted primarily to July, August and September. But as I discussed in my, I guess it was, an answer to cross examination, there are other ways to do it at other times, given the capability of recouping water that you've borrowed, for example, out of San Luis or some place else during the, say, the month of June. And then you can replace it with the capability during July, August and September given the fact that as far as we've been able to find out, those are not sensitive times from a fisherey point of view.

Q That was some testimony that you provided that did

raise some additional questions. What you're proposing, if I understand it correctly, is a recirculation program that would move water through the State and/or federal pumps at a time earlier in the year, and that that lost water to the CVP/SWP contractors would be made up later in the year; is that correct?

A Either that way or the opposite where you borrow the water, say, out of San Luis and then make it up later in the year after the 1st of July.

Q Have you studied -- done any analysis on the ability to reoperate, in essence, the projects as you've contemplated?

A The studies were made in consultation with me, but not by me that made that determination.

Q Thank you.

Mr. Hildebrand, I gather from some of the hearings that I participated in and some of the meetings I've participated in with you, you are very familiar with the report that you cite on page 2 of your testimony, South Delta Water Agency Exhibit 2, which is a June 1980 report entitled, "Effects of the CVP upon the South Delta Water Supply..."?

A Yeah, I was one of the authors of that.

Q And on page 5 of your testimony, South Delta Water Agency Exhibit 2, you state that, "It is important to note

that the water deliveries of the CVP to the westside service area of the San Joaquin valley, as assisted by SWP are the cause of the river's salinity problems"; is that correct?

A Yes, I probably should have said the predominant cause.

Q And that was my question, there are other factors and the 1980 report recognizes that there are other factors that affect the water quality in the river, and I presume that's the San Joaquin River?

A Well, yeah. For example, there's a lot of water exported from the Tuolumne system to the Bay Area, and that decreases the flow further, in addition to the decreases caused by the CVP. This then reduces the amount of dilution available absent releases from New Melones.

Now, as the way this thing is set up, New Melones is supposed to maintain that regardless of those exports, but their interim operating plan doesn't always accomplish that, particularly in July and August.

Q On page 6 of your testimony, Mr. Hildebrand, you make a statement that "ECs above 0.7 have an incremental adverse effect on crop production"; is that correct?

A That's correct.

Q Have you conducted studies to support that conclusion?

A Yes.

Q And what studies are you referring to?
A Well, we can go back to the 1995 hearings, for example. And, at that time, we had the agricultural extension service come out and examine places of crop loss to determine that they were in deed caused by salinity. We also, as I mentioned earlier, took pictures of places where there was essentially no crop and the salt was visible on the surface. In general, it takes quite a bit of crop loss before you can visually to see it is distinguishing from detecting it in the yield of your crop.

This varies somewhat among different kinds of crops. For example, alfalfa if it has insufficient water, either because it couldn't percolate enough or because they got too salty for the osmotic root system to take it up, it just sort of stops growing. It doesn't die right away. And if you get water again, you can restore the growth process, but you've already lost that production. Some other crops will die more quickly when they have that problem.

Q Mr. Hildebrand, I apologize. Maybe I didn't ask my question clearly enough. Part of your answer to my question was that you relied upon information that was submitted during the hearings that led to D-1641; is that correct?

A In part, yes.
Q Is part of your conclusion based on the Orlob study?
A Well, I worked very closely with Orlob. And at the time of the study, yeah, he and I were in agreement.
Q And I'm not familiar with the reports that were presented during the proceedings that led to D-1641, can you explain some of those reports that you --
A I don't what you mean by explaining them.
Q Well, I'm trying to understand how you were able to draw the conclusion today in 2005 that ECs above 0.7 have an incremental adverse effect on crop production?
A Well, I explained under cross examination the problem I had with my own alfalfa crop, that I could not get a net fraction of purging the salt incline during the summer months, and that therefore the salt built up from irrigation to irrigation.

Now, if you start out -- if you're adding -- if you have a high -- low salinity water, you're not adding as much salt. It doesn't create the same degree of problems as if you do have that kind.

Q And have you done any soil testing on your farms?
A Yes.
Q And what type of soils do you have on your farm or does your farm comprise?
A Well, as is typical in the south Delta, an even one of

my fields I'll have several different soils types. And the question is I have to manage the field and to do the best I can on the average over the field. So that if I have an area that has fairly high permeability, it has to be over-irrigated in order to get enough water percolating in the other portions of the field.

But this becomes quite visible at times in the field. You can see where crop is flourishing and where it isn't. In general, the portions of the field that have higher permeability also have a lower soil water retention capacity, so that they can't go as long between irrigations, as the tighter soils can if you can percolate enough water into them.

Q And as part of your testing of your lands that comprise your farm, did you also test to determine where the groundwater levels were?

A In my case the groundwater level is essentially the same as the river water level, and that's 15 feet below my land.

Q And therefore based on your answers here, am I correct that your general conclusion that ECs above 0.7 have an incremental adverse effect on crop production may be correct, but that is dependent upon a number of other factors?

A It's dependent on how much leach fraction you need

with different water quality and irrigation water, whether you can irrigate often enough and long enough in each irrigation to achieve the leach fraction. But my soils are not atypical. There will be many other farmers who'd have similar situations.

Q And now I turn again to the Orlob, and I'll try not to ask questions that were already asked or that you've provided the information that I was speaking, but can you identify for me the year in which the report was prepared?

A Well, I don't know that I can remember just what happened in the '91 hearings versus the '95 hearings. I suspect that you're too young to remember that either.

CHAIRPERSON DODUC: I do remember the question being asked before though.

MR. RUBIN: But it was roughly a period, Mr. Hildebrand, of -- or it's likely a period in the eighties or early nineties or is that too much of a speculation for you?

MR. HILDEBRAND: Likely what?

Q The year in which the report was prepared?

A Well, the testimony before the Board, I believe, was in '91 and again in '95 if my memory is correct.

Q Okay. Thank you.

Mr. Hildebrand, do you recall the factors that were considered to demonstrate the nature and dependency

of agricultural productivity in the south Delta that were examined within that report?

A Would you repeat the question?

Q Sure. Well, I can direct you to it. It's on Attachment I of South Delta Water Agency Exhibit 2. I'm referring to the factors that are listed on page 1 of that attachment. I believe there are 4 factors that are listed there, which are characterized by Mr. Orlob as the factors that demonstrate the nature and dependency of agricultural productivity?

A I see what was said there. What's your question?

Q One of those factors is the soil characteristics; is that correct?

A That's correct.

Q And, as an example, permeability is provided; is that correct?

A That's correct.

Q And if I understand your testimony -- previous testimony, you've indicated similarly that permeability is a factor?

A That's correct, but it's not the only factor.

Q I understand. What factors affect permeability of soil?

A Well, when I was director of the research laboratory, we did quite a bit of research relative to the flow of

water in dissolved substances through soils. And we made quite a study of the microscopic composition of those soils. And we had to distinguish between porosity, which is the amount of fluid the soil can hold versus permeability, which is the rate at which water flows through it.

And what you find is that the pores in the soil are such that water tends to flow through the larger better connected pores and bypass the more poorly connected or smaller pores, some of which are actually blind alleys, you might say. The water never really flows through them.

So that when you flush a soil, it doesn't -- it's not like flushing the toilet. It doesn't take it all out in one sweep. What happens is that the water flushes those pores through which it flows, but then it doesn't flush these bypass areas.

Now over time, diffusion will cause the molecules -- the dissolved molecules of salt in those bypass pores to diffuse over into and equalize in concentration with the salt that's in the less pores. But this doesn't happen all of a sudden. This takes time.

So people who assume that when you irrigate you're taking all the salt out all in one irrigation, just don't understand the science involved.