STATE WATER RESOURCES CONTROL BOARD

Public Hearing on the Adequacy of the Substitute Environmental Document
March 20/21, 2013

San Joaquin River Flows and Southern Delta Water Quality

SOUTH DELTA WATER AGENCY

John Herrick, Esq.

SDWA OPPOSES THE PROPOSED RELAXATION OF THE FOUR SOUTHERN DETLA SALINITY STANDARDS

… because the conclusions in the Hoffman Report are not supported any, much less substantial evidence.

WATER QUALITY OBJECTIVES FOR AGRICULTURAL BENEFICIAL USES IN THE SOUTHERN DELTA

CURRENT

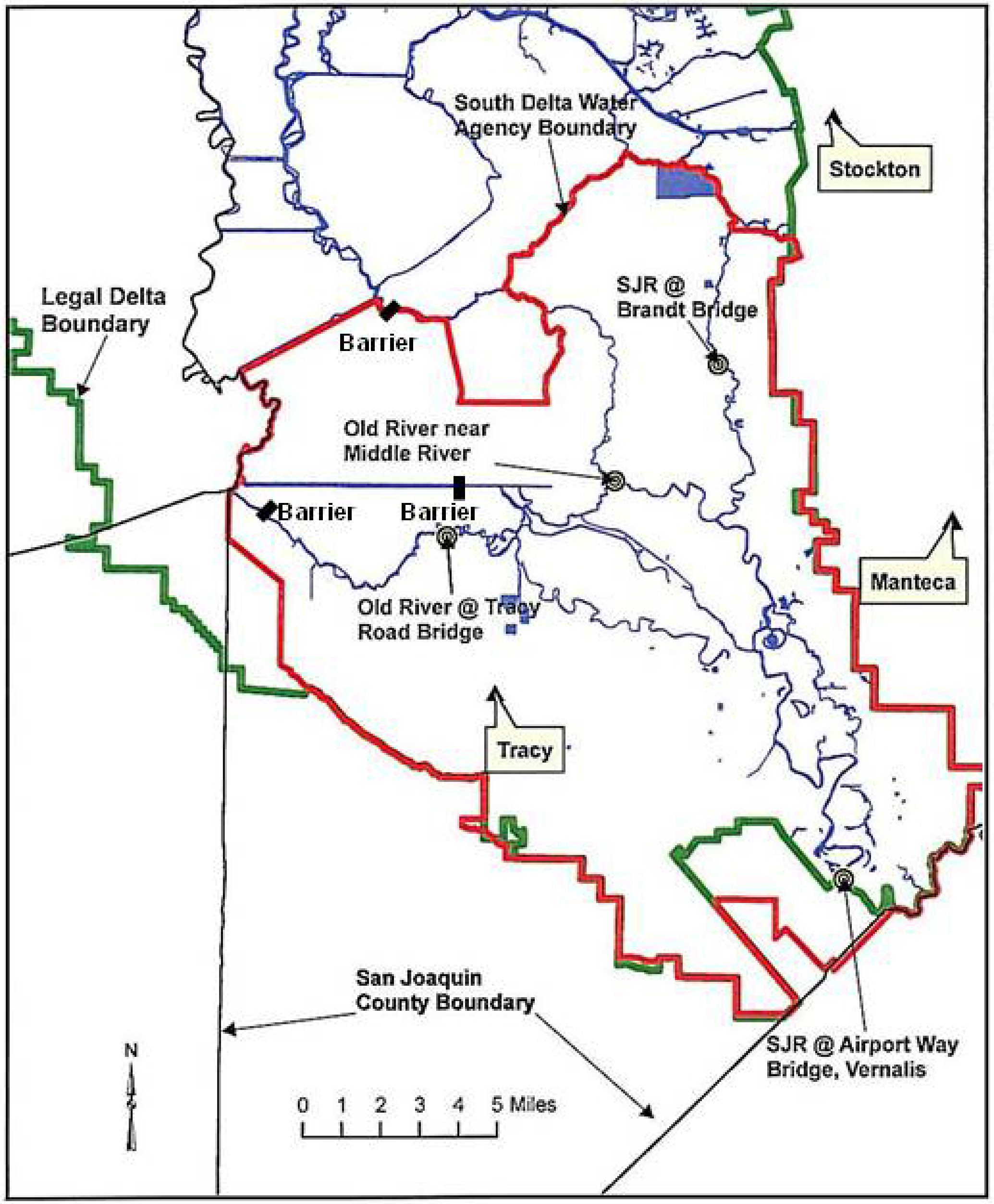
0.7 EC April – August
1.0 EC September - March

PROPOSED

1.0 EC all year

Standards apply throughout the channels but are measured at four locations: Vernalis, Brandt Bridge, Old River at Middle River, and Old River at Tracy Blvd. Bridge

Figure 1.1. Map of southern Delta showing boundary of the South Delta Water Agency and salinity compliance stations.



Recent Violations:

State of California - Department of Water Resources - Division of Operations & Maintenance - Operations Control Office

Delta Water Quality Conditions

South Delta Stations

Date	Vernalis		Brandt Bridge		Old River Near Tracy		Old River Near Middle River	
	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg
12/31/2012	0.49	0.67	0.44	0.66	0.58	0.89	0.45	0.71
01/01/2013	0.57	0.67	0.49	0.66	0.64	0.88	0.52	0.71
01/02/2013	0.62	0.67	0.58	0.65	0.71	0.88	0.59	0.70
01/03/2013	0.68	0.67	0.63	0.65	0.85	0.88	0.65	0.70
01/04/2013	0.72	0.67	0.68	0.65	0.95	0.89	0.72	0.71
01/05/2013	0.74	0.68	0.73	0.65	1.08	0.90	0.75	0.71
01/06/2013	0.74	0.68	0.76	0.66	1.12	0.90	0.78	0.71
01/07/2013	0.68	0.68	0.80	0.66	1.10	0.91	0.79	0.72
01/08/2013	0.66	0.68	0.80	0.66	1.01	0.92	0.73	0.72
01/09/2013	0.65	0.67	0.75	0.67	0.99	0.92	0.73	0.71
01/10/2013	0.70	0.67	0.75	0.67	0.93	0.92	0.71	0.71
01/11/2013	0.73	0.67	0.70	0.67	0.89	0.92	0.68	0.71
01/12/2013	0.80	0.67	0.70	0.67	0.91	0.92	0.75	0.71
01/13/2013	0.85	0.67	0.75	0.67	0.93	0.92	0.81	0.70
01/14/2013	0.89	0.67	0.83	0.68	1.03	0.92	0.86	0.71
01/15/2013	0.90	0.68	0.87	0.68	1.12	0.93	0.90	0.71
01/16/2013	0.92	0.68	0.92	0.69	1.12	0.93	0.93	0.71
01/17/2013	0.93	0.68	0.94	0.70	1.21	0.94	0.94	0.71
01/18/2013	0.95	0.69	0.95	0.71	1.27	0.94	0.95	0.71
01/19/2013	0.96	0.69	0.96	0.72	1.35	0.95	0.98	0.72
01/20/2013	0.96	0.69	0.98	0.72	1.32	0.96	0.97	0.72
01/21/2013	0.97	0.70	0.99	0.73	1.23	0.96	0.97	0.72
01/22/2013	0.95	0.70	1.01	0.73	1.25	0.97	1.00	0.73
01/23/2013	0.95	0.71	1.01	0.74	1.19	0.97	1.00	0.73
01/24/2013	0.94	0.73	1.02	0.74	1.16	0.98	1.00	0.74
01/25/2013	0.96	0.75	1.01	0.76	1.18	0.99	1.00	0.76
01/26/2013	0.96	0.77	1.00	0.78	1.20	1.00	1.01	0.78
01/27/2013	0.98	0.79	1.00	0.80	1.17	1.02	1.02	0.80
01/28/2013	0.99	0.81	1.01	0.82	1.16	1.04	1.03	0.82
01/29/2013	1.00	0.83	1.01	0.84	1.18	1.06	1.04	0.84

Electrical Conductivity (EC) units: milliSiemens per Centimeter
md : mean daily
NR : No Record
NC : Average not computed due to insufficient data
BR : Below Rating
e : estimated value

State of California - Department of Water Resources - Division of Operations & Maintenance - Operations Control Office

Delta Water Quality Conditions

South Delta Stations

Date	Vernalis		Brandt Bridge		Old River Near Tracy		Old River Near Middle River	
	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg	md EC	30 day avg
01/23/2013	0.95	0.71	1.01	0.74	1.19	0.97	1.00	0.73
01/24/2013	0.94	0.73	1.02	0.74	1.16	0.98	1.00	0.74
01/25/2013	0.96	0.75	1.01	0.76	1.18	0.99	1.00	0.76
01/26/2013	0.96	0.77	1.00	0.78	1.20	1.00	1.01	0.78
01/27/2013	0.98	0.79	1.00	0.80	1.17	1.02	1.02	0.80
01/28/2013	0.99	0.81	1.01	0.82	1.16	1.04	1.03	0.82
01/29/2013	1.00	0.83	1.01	0.84	1.18	1.06	1.04	0.84
01/30/2013	0.99	0.85	1.02	0.85	1.19	1.08	1.06	0.86
01/31/2013	1.01	0.86	1.04	0.87	1.25	1.10	1.03	0.88
02/01/2013	0.85	0.87	1.03	0.89	1.26	1.12	1.03	0.89
02/02/2013	0.82	0.87	1.04	0.90	1.26	1.13	0.90	0.90
02/03/2013	0.81	0.88	0.93	0.91	1.23	1.14	0.83	0.91
02/04/2013	0.81	0.88	0.84	0.91	1.15	1.15	0.82	0.91
02/05/2013	0.81	0.88	0.82	0.92	1.09	1.14	0.82	0.91
02/06/2013	0.78	0.88	0.82	0.92	1.06	1.14	0.81	0.91
02/07/2013	0.75	0.89	0.81	0.92	1.08	1.15	0.79	0.91
02/08/2013	0.70	0.89	0.80	0.92	1.04	1.15	0.76	0.91
02/09/2013	0.69	0.89	0.74	0.92	0.94	1.15	0.68	0.91
02/10/2013	0.68	0.89	0.67	0.92	0.87	1.15	0.65	0.91
02/11/2013	0.68	0.88	0.66	0.92	0.87	1.15	0.64	0.91
02/12/2013	0.66	0.87	0.64	0.91	0.88	1.14	0.63	0.90
02/13/2013	0.65	0.87	0.63	0.91	0.90	1.14	0.61	0.89
02/14/2013	0.65	0.86	0.62	0.90	0.90	1.13	0.61	0.88
02/15/2013	0.66	0.85	0.61	0.89	0.88	1.12	0.60	0.87
02/16/2013	0.64	0.84	0.61	0.88	0.82	1.11	0.61	0.86
02/17/2013	0.61	0.83	0.61	0.86	0.81	1.10	0.59	0.85
02/18/2013	0.62	0.82	0.60	0.85	0.75	1.08	0.58	0.84
02/19/2013	0.60	0.81	0.59	0.84	0.73	1.06	0.59	0.82
02/20/2013	0.57	0.79	0.59	0.83	0.72	1.04	0.57	0.81
02/21/2013	0.58	0.78	0.57	0.81	0.70	1.02	0.55	0.80

Electrical Conductivity (EC) units: milliSiemens per Centimeter
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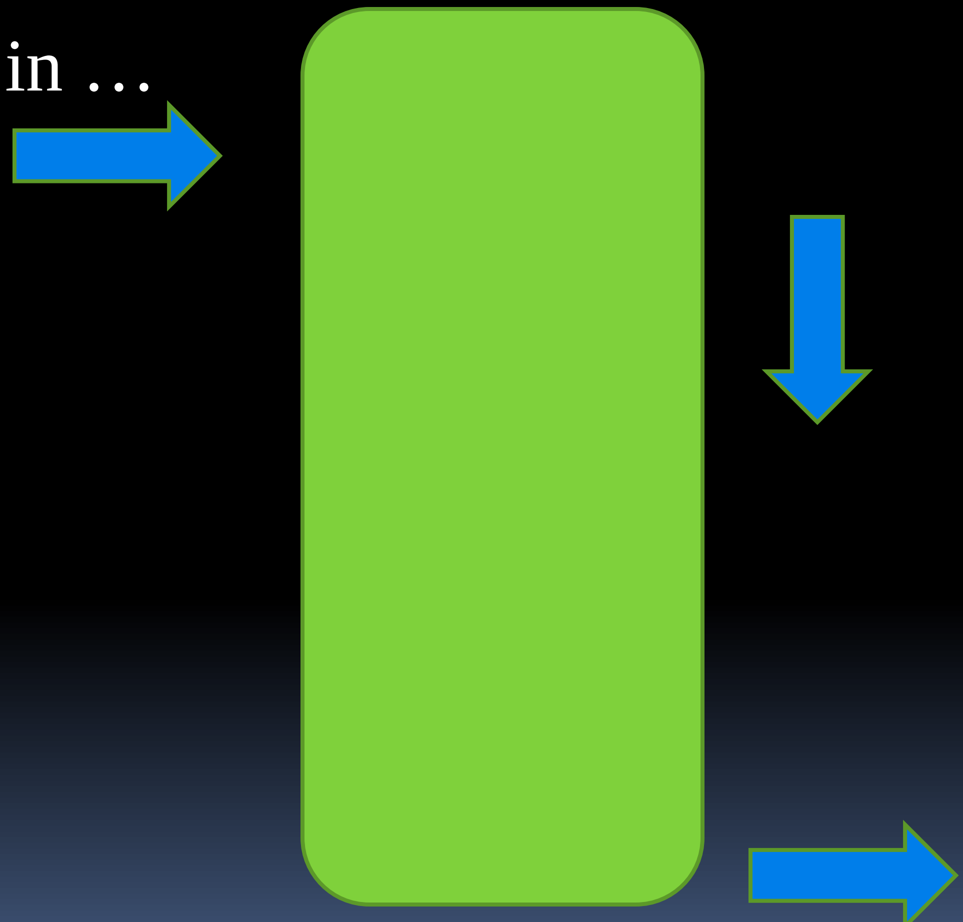
The Proposed changes suggest that the southern Delta will be protected even if the salinity standards are relaxed. This conclusion is based upon Dr. Glenn Hoffman’s report that calculates a range of leaching fractions for the area. From the leaching fractions he calculated, Dr. Hoffman concluded a worse water quality would adequately protect southern Delta agricultural beneficial uses.

LEACHING REQUIREMENT/LEACHING FRACTION

By definition, leaching requirement (LR) is the fraction of total water applied that must drain below the root zone to restrict salinity to a specified level according to the level of tolerance of the crop.

IN THE LAB:

EC Water in …



EC Water out …

IN THE REAL WORLD:

Applied water EC varies;

Soil already contains salts;

Difficult to measure amount of water applied;

Impossible to measure amount of water passing through root zone;

Difficult to measure surface runoff;

Difficult to measure subsurface conditions;

Etc ….

HOW TO DETERMINE LEACHING IN THE FIELD:

1. Measure beginning soil salinity

2. Measure applied water EC

3. Measure end soil salinity

SDWA and local U.C. Davis Ag Cooperative Extension are undertaking just such a study.

LAB: SALT *IN* MINUS SALT *OUT* EQUALS SALT LEFT IN ROOT ZONE.

FIELD: SALT AT END EQUALS BEGINNING SALT PLUS APPLIED SALT WHICH WAS NOT LEACHED.

WHAT DID DR. HOFFMAN DO?

Calculated leaching fraction from *applied water* EC and *drain water* EC.

EC of Applied Water:

ASSUMED!

EC of Tile or Surface Drain Water:

SOURCE of WATER?

Paine Slough. The average electrical conductivity of the 26 outlets was 1.5 dS/m. If the salinity of the applied water was 0.7 dS/m then the leaching fraction would be 0.7/1.5 = 0.47. This is a very high leaching fraction and based on these data one would surmise that the irrigation efficiency, on average, is low and/or a great deal of low salinity water was entering the drains without passing through the crop root zone. If the main drains were open surface drains then it is possible that much of the discharge from these drains was irrigation return flow rather than subsurface drainage.

Table 3.10. Electrical conductivity (EC) and calculated leaching fraction (L), assuming EC of applied water is 0.7 dS/m for subsurface tile drains during 1986 and 1987. (Chilcott et al., 1988.).

Drain Location	No. of Samples	EC (dS/m)	L assuming EC_i=0.5 dS/m	L assuming EC_i=0.7 dS/m
3, Grant Line Rd. Sump	3	2.7	0.19	.26
4, Bethany / Lammers	3	2.1	0.24	.33
5, Patterson Pass Rd.	6	2.5	0.20	.28
6, Moitose	3	1.6	0.31	.44
7, Krohn Rd.	4	2.1	0.24	.33
8, Pimentel	2	2.2	0.23	.32
9, Lammers / Corral Hollow	4	4.4	0.11	.16
11, Delta Ave.	6	2.4	0.21	.29
13, Costa Brothers East	2	4.1	0.12	.17
14, Costa Brothers West	4	3.6	0.14	.19
15, Castro	3	2.4	0.21	.29
16, Earp	4	2.8	0.18	.25
17, Freeman	4	3.9	0.13	.18
18, Costa	5	3.4	0.15	.21
19, Moitoso and Castro	4	2.0	0.25	.35
24, Corral Hollow / Bethany	5	6.2	0.08	.11
26, Chrisman Rd.	3	2.0	0.25	.35
36, Kelso Rd. / Byron Hwy.	6	2.4	0.21	.29
37, Spirow Nicholaw	4	3.1	0.16	.23
38, JM Laurence Jr. East	4	3.5	0.14	.20
39, JM Laurence Jr. West	4	2.4	0.21	.29
40, Sequeira	3	3.6	0.14	.19
41, Reeve Rd.	3	3.8	0.13	.18
44, Larch Rd.	4	2.8	0.18	.25
Number of Drains Sampled: 24				
	Average:	3.0	0.18	0.23
	Median:	2.8	0.18	0.25
	Minimum:	1.6	0.08	0.11
	Maximum:	6.2	0.31	0.44

An example of the average leaching fraction for a large area is the New Jerusalem Drainage District. The location of the 12,300 acre District is shown in Figure 3.19. The soils drained are clay and clay loam. The electrical conductivity and the calculated leaching fraction assuming an EC_i of 0.7 dS/m are summarized in Table 3.11. From 1 to 13 samples were analyzed annually from 1977 to 2005. The average EC of the drainage water was 2.6 dS/m with the minimum annual value being 2.4 dS/m and the maximum being 3.2 dS/m. If the EC of the applied water is taken as 0.7 dS/m, the average annual leaching fraction is 0.27 with the minimum and maximum being 0.22 and 0.29, respectively. The measurements over the 17 years of measurements are relatively stable.

Table 3.11. Electrical conductivity (EC) and calculated leaching fraction (L) for applied water of 0.7 dS/m for the New Jerusalem Drainage District (Belden et al., 1989 and D. Westcot, personal communication, 2009)

Year Sampled	No. of Samples	EC of Effluent (dS/m)	L w/ ECi = 0.7 dS/m
1977	1	2.6	0.27
1978	1	3.2	0.22
1979	1	3.0	0.23
1980	1	2.6	0.27
1982	5	2.5	0.28
1983	11	3.0	0.23
1984	13	2.6	0.27
1985	11	2.5	0.28
1986	5	2.5	0.28
1987	2	2.4	0.29
1988	4	2.5	0.28
2000	3	2.4	0.29
2001	12	2.5	0.28
2002	13	2.4	0.29
2003	9	2.4	0.29
2004	6	2.4	0.29
2005	11	2.4	0.29
Number of Years Sampled: 17			
Number of Samples: 109			
	Average:	2.6	0.27
	Median:	2.5	0.28
	Minimum:	2.4	0.22
	Maximum:	3.2	0.29

Another drainage system monitored from 1982 until 1987 is the Tracy Boulevard Tile Drain Sump. This system is labeled in Figure 3.19. As shown in Figure 3.12, the 44 samples taken over the 6-year period had an average EC of 3.4 dS/m with minimum and maximum annual values of 3.1 and 3.6 dS/m. Again, if the EC of the applied water is taken as 0.7 dS/m, the leaching fraction averaged 0.21.

Table 3.12. Electrical conductivity (EC) and calculated leaching fraction (L) for an applied water of 0.7 dS/m for the Tracy Boulevard Tile Drain Sump (Belden et al., 1989).

Year Sampled	No. of Samples	EC of Effluent (dS/m)	L w/ ECi = 0.7 dS/m
1982	3	3.5	0.20
1983	10	3.6	0.19
1984	10	3.4	0.21
1985	12	3.4	0.21
1986	7	3.1	0.23
1987	2	3.1	0.23
Number of Years Sampled: 6			
Number of Samples: 44			
	Average:	3.4	0.21
	Median:	3.4	0.21
	Minimum:	3.1	0.19
	Maximum:	3.6	0.23

The other source of information located for the South Delta is the study by Meyer and colleagues (1976). They measured soil salinity at nine locations in April or May, 1976 and again in August or September, 1976. The locations represented a variety of crops, soil types, and irrigation water sources. They estimated the leaching fraction based upon the irrigation water quality in 1976 and the maximum soil salinity in the lower reaches of the crop root zone. Of the nine locations studied, five had leaching fractions of 0.25 or greater. At three locations the leaching fraction was estimated at 0.15 or greater; one location had an apparent leaching fraction of less than 0.10. The highest soil salinities and lowest apparent leaching fractions occurred at locations where water quality was the best in this study, seasonal average of about 0.7 dS/m. High leaching and low salt accumulations were found at the locations where more saline irrigation water was available, 1.1 dS/m or more.

Hoffman didn’t know:

The amount of salts in the soil at the beginning;

The amount of salt applied;

The amount of water or salt that passed through the root zone;

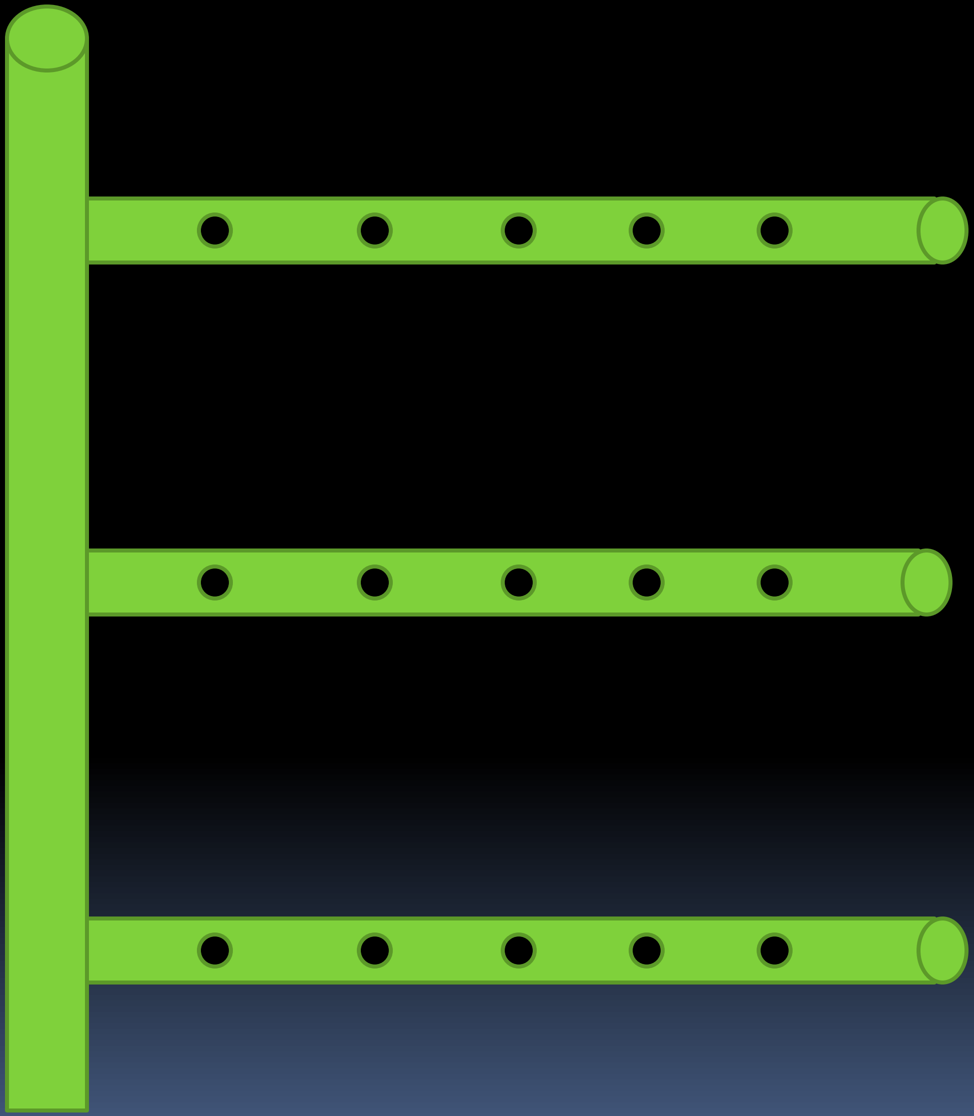
The amount of salts that left the root zone;

The amount ground water/salts in the drainage;

The amount of salt remaining in the root zone ;

All OF WHICH PREVENTS THE HIM FROM CALCULATING THE LEACHING FRACTION

REPRESENTATION OF TILE DRAINAGE SYSTEM



Tile drains remove
GROUND WATER!

By adding drain tile, the water table is effectively lowered, and plants can properly develop their roots. The lack of water saturation allows oxygen to exist in the soil around the roots. Drain tile prevents the roots from being under the water table during wet periods that could cause excessive plant stress. By removing excessive water, crops use water they have more effectively. Wikipedia

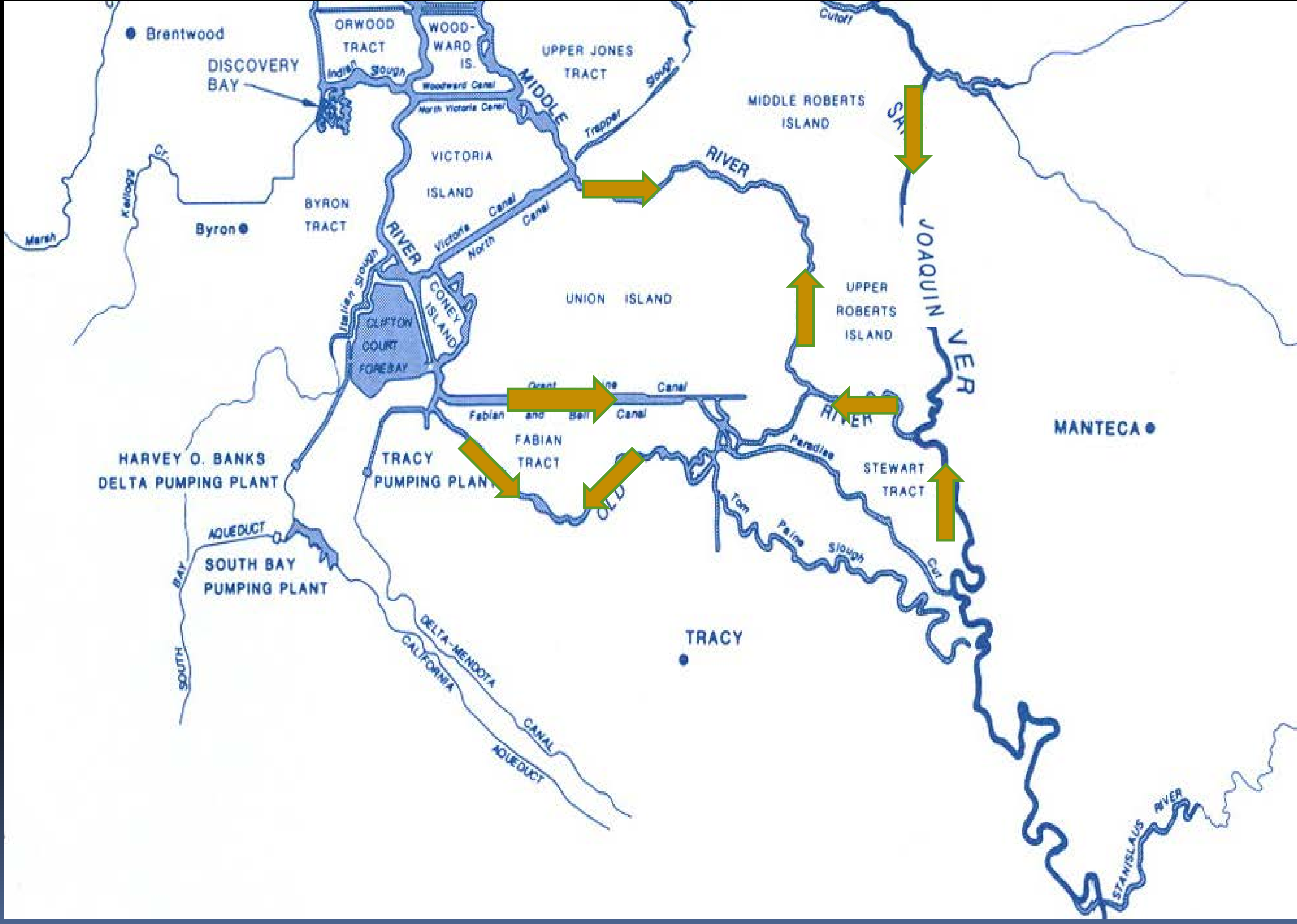
Per New Jerusalem District manager, the District’s tile drains contain mainly ground water!

Supply Water Quality Varies in the South Delta.

Good quality in the cross-Delta flow to the export pumps;

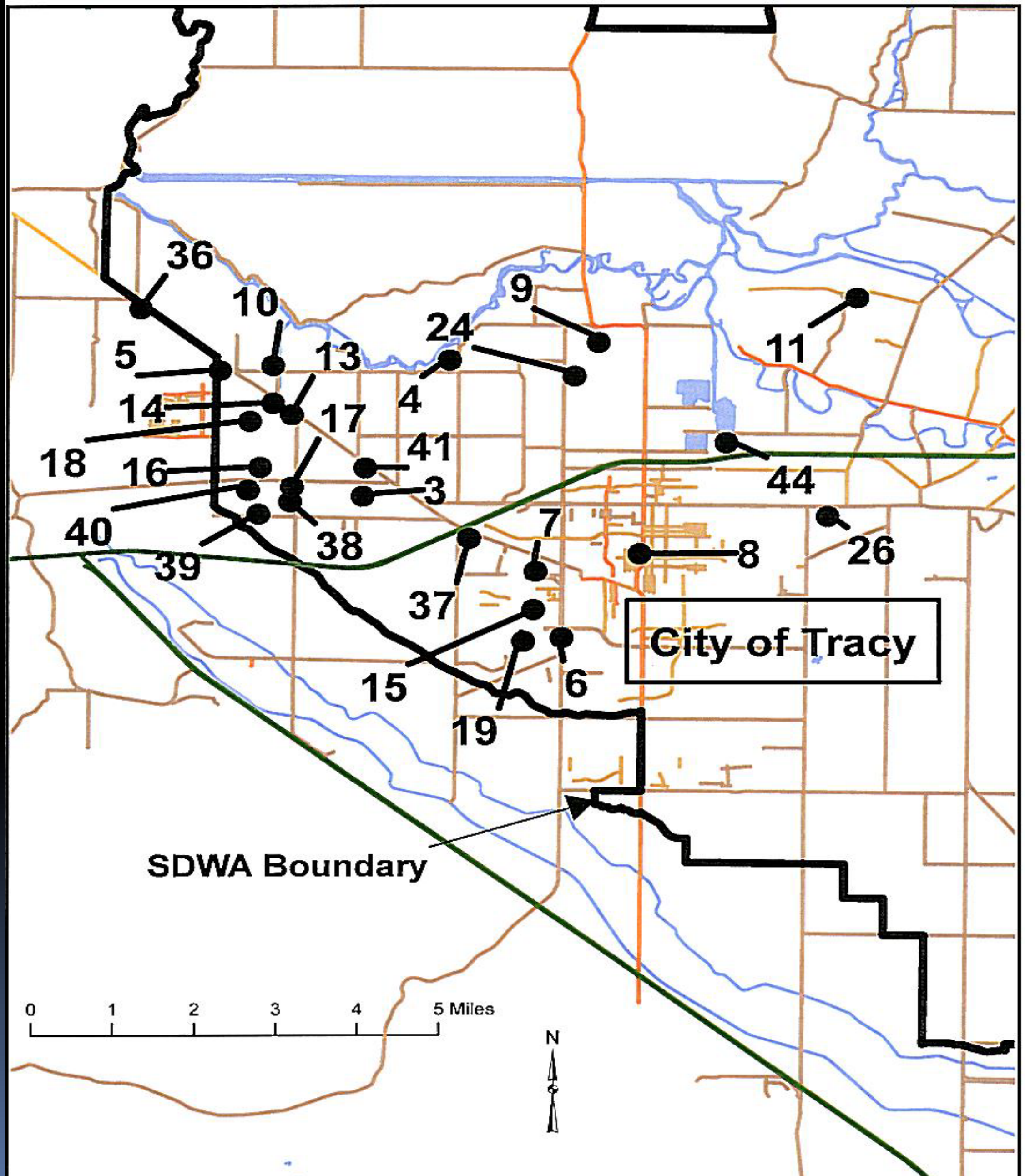
Medium water quality where channels have net flow; and

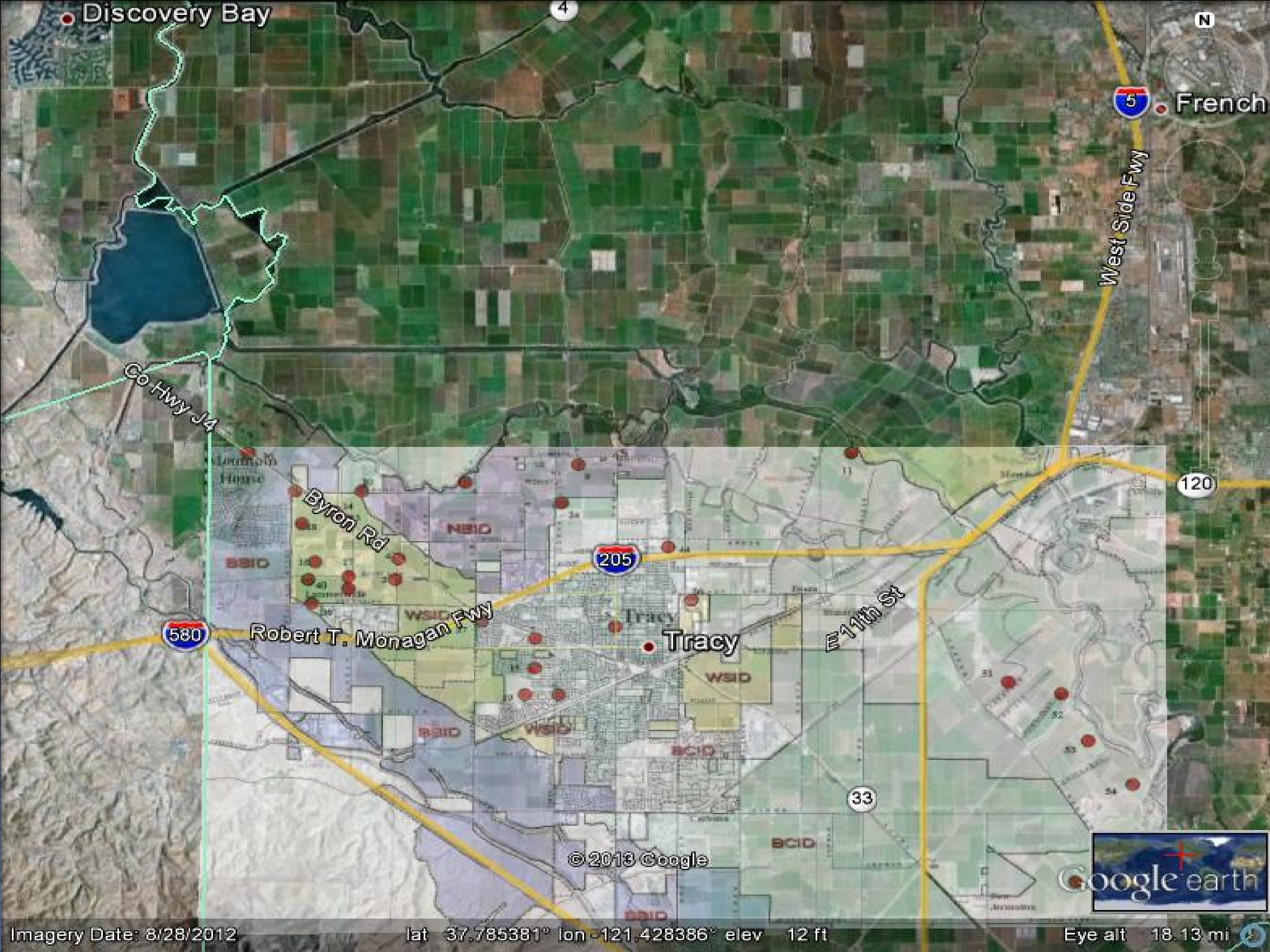
Poor water quality where null zones collect and concentrate salts.



Brentwood
DISCOVERY BAY
ORWOOD TRACT
WOOD-WARD IS.
Indian Slough
Woodward Canal
North Victoria Canal
MIDDLE
UPPER JONES TRACT
Trapper Slough
Cutoff
MIDDLE ROBERTS ISLAND
VICTORIA ISLAND
RIVER
Kellogg Cr.
Marsh
Byron
BYRON TRACT
Victoria Canal
North Canal
RIVER
Italian Slough
CLIFTON COURT FOREBAY
CONEY ISLAND
UNION ISLAND
UPPER ROBERTS ISLAND
JOAQUIN
VER
Grant Line Canal
Fabian and Bell Canal
RIVER
FABIAN TRACT
MANTECA
HARVEY O. BANKS DELTA PUMPING PLANT
TRACY PUMPING PLANT
OLD
Paradise
STEWART TRACT
Tom Paine Slough
Cut
AQUEDUCT
SOUTH BAY PUMPING PLANT
SOUTH BAY
DELTA-MENDOTA CANAL
CALIFORNIA AQUEDUCT
TRACY
STANISLAUS RIVER

Figure 3.18. Location of subsurface tile drains sampled on the west side of the SDWA (Chilcott, et al., 1988).




Discovery Bay
4
5
French
West Side Fwy
Co Hwy J4
Byron Rd
NSID
BBID
WSID
205
120
580
Robert T. Monagan Fwy
Tracy
E 11th St
WSID
BBID
WSID
BCID
33
BCID
BBID
© 2013 Google
Google earth
Imagery Date: 8/28/2012
lat 37.785381° lon -121.428386° elev 12 ft
Eye alt 18.13 mi

HISTORIC WATER QUALITY WAS VERY GOOD

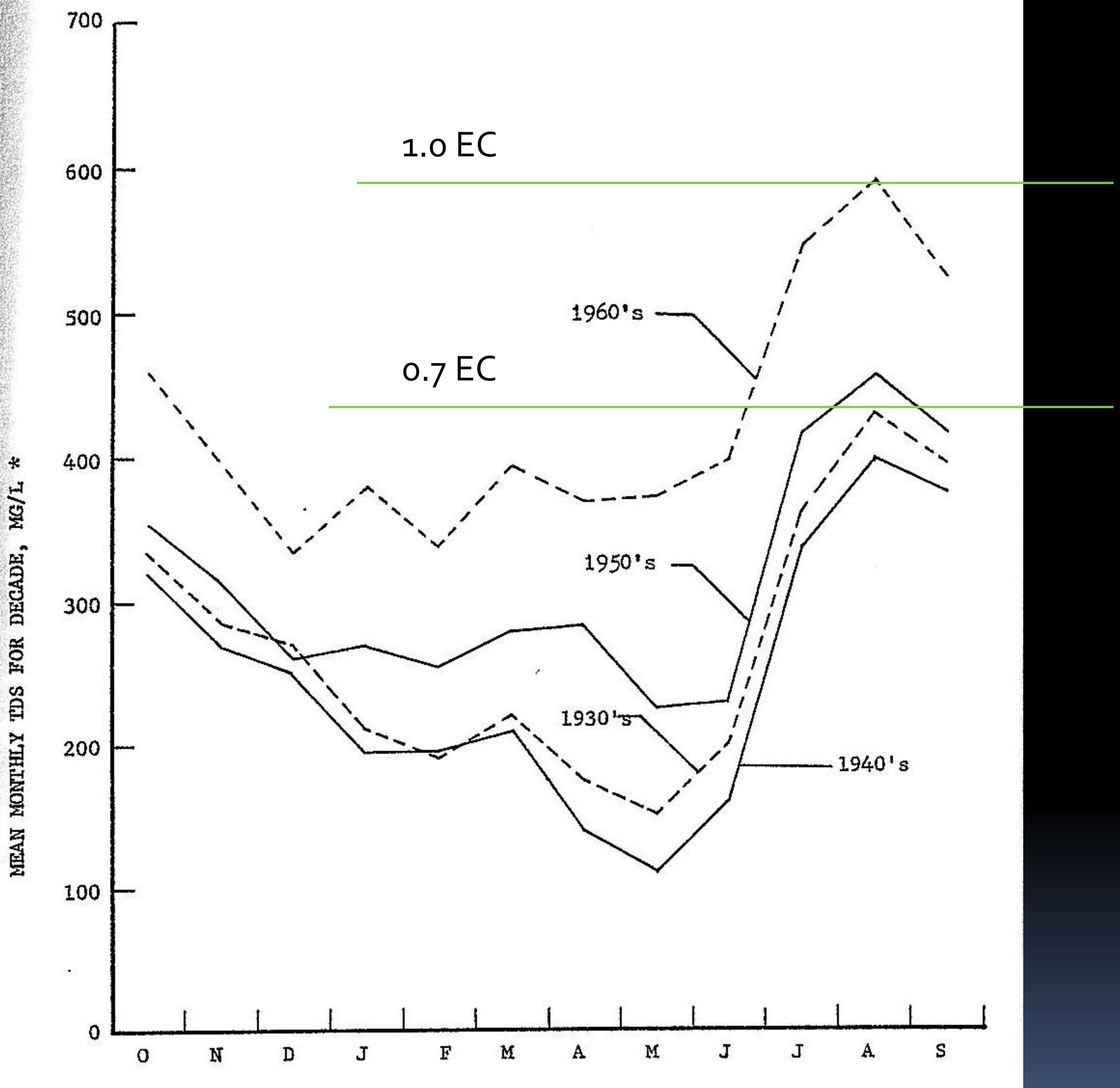


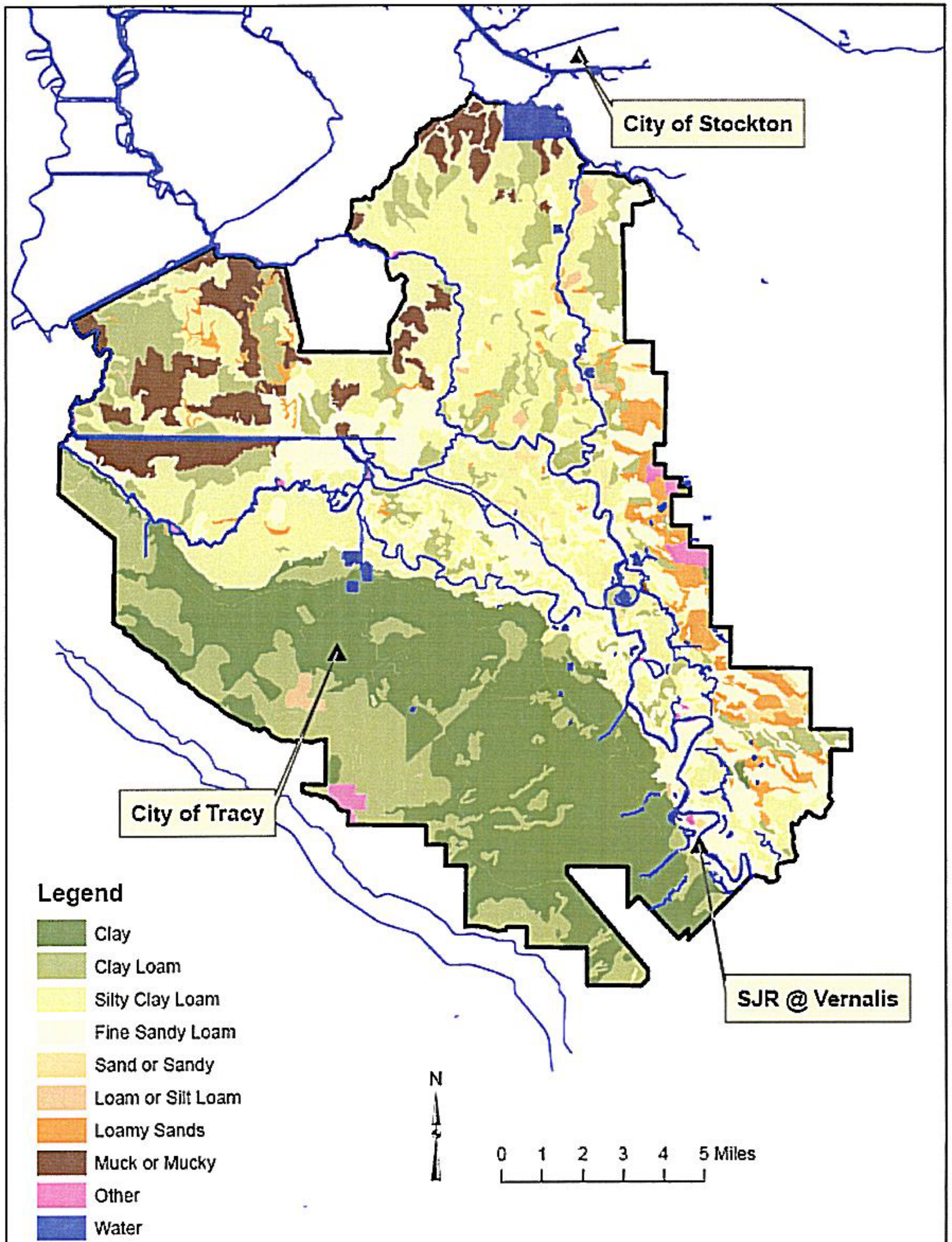
Figure VI-27 MEAN MONTHLY TDS AT VERNALIS BY DECADES 1930-1969

* Estimated by chloride load-flow regressions for 30's and 40's.

Report of the Effects of the CVP Upon the Southern Delta Water Supply Sacramento-San Joaquin River Delta, California, June 1980

VARYING SOIL TYPES IN THE SOUTH DELTA AFFECT ABILITY TO LEACH SALTS

Figure 2.4. Map of soil textures in the southern Delta using GIS data from the NRCS-SSURGO Database.



84 Soil Types in the Southern Delta

Percent of acreage	Type	Permeability in./hr
40%	Slow	<0.2
34%	Moderately slow	0.2 – 0.6
17%	Moderate	0.6 – 2.0
6%	Moderately rapid	2.0 – 6.0
3%	Rapid	>6.0

Water Quality Consideration for the South Delta Water Agency, Hoffman, Prichard, Meyer

SDWA explained to Dr. Hoffman that time restraints for such crops as alfalfa (irrigation, field dries out, cutting, mowing, raking, baling, next irrigation) exacerbated the farmers ability to leach salts from the soil, especially when the low permeability soils were involved.

There simply was not enough time to adequately leach.

DR. GLENN HOFFMAN:

"I can't help it if you have bad management practices."

Local Ground Water is of Very Poor Quality

Hoffman cites three studies regarding drainage and groundwater quality. Per those studies, local ground water ranges from:

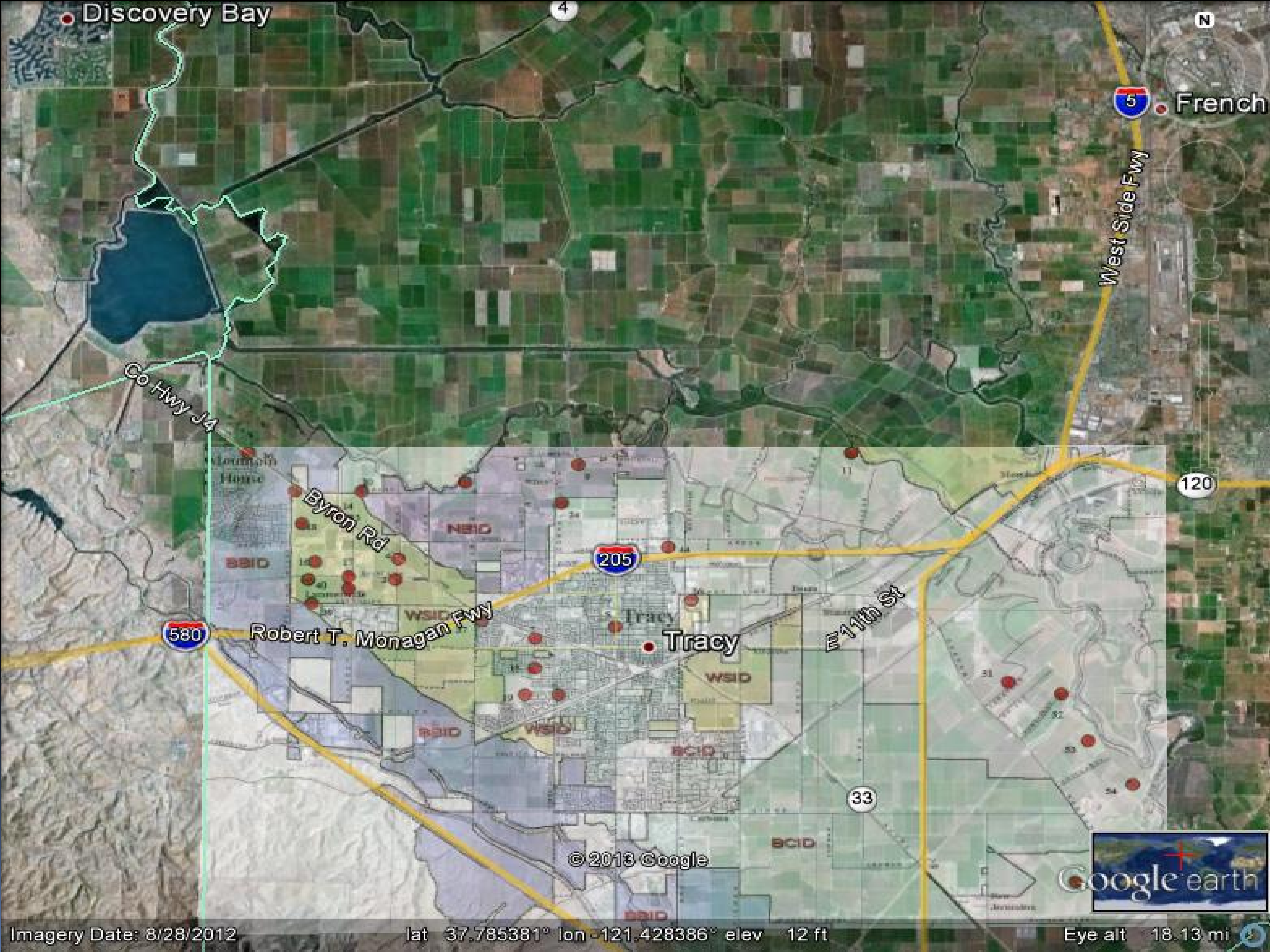
Belden, et.al.	410 – 9400 EC
Chilcott, et.al.	1900 – 4230

Montoya not included; data contains surface water drain data

Most of the Southern Delta ag land is between -5 and +10 feet compared to sea level. The shallow ground water in the area is directly linked to the channel water and thus rises and falls twice daily with the tides.

That shallow ground water contains the accumulation of 50+ years of CVP salts. Thus, when the tides rise and fall, the salty ground water rises and falls entering or approaching the root zone.

This means any salts which are leached do not go anywhere!



Discovery Bay
4
5
French
West Side Fwy
Co Hwy J4
Byron Rd
NSID
BBID
WSID
205
120
580
Robert T. Monagan Fwy
Tracy
E 11th St
WSID
BBID
WSID
BCID
33
BCID
BBID
© 2013 Google
Google earth
Imagery Date: 8/28/2012
lat 37.785381° lon -121.428386° elev 12 ft
Eye alt 18.13 mi

Site #	Feet Above Sea Level	Site #	Feet Above Sea Level
3	51	19	68
4	3	24	7
5	37	36	41
6	69	37	44
7	43	38	77
8	41	39	109
9	7	40	90
10	17	41	34
11	12	44	21
13	30	51	24
14	33	52	22
15	56	53	26
16	70	54	23
17	68	55	33
18	49	56	58

Per Google Earth

HOFFMAN REPORT ERRORS:

1. Used assumed applied water EC, and tile drain data from upland areas to calculate leaching fractions; ***wrong area***.

2. Soil permeability not adequately analyzed; ***inability to leach***.

3. Groundwater not adequately understood; ***tides push bad water up into root zone***.

4. Lack of practical knowledge; ***farming alfalfa is "bad management practice."***

OTHER ISSUES:

SALT

Beans, beans, beans …;
Modeling;
How did we get here;
Mitigation of project impacts;
No assimilative capacity;
Implementation plan problems;

River Flows

Zero–sum game;
Upstream obligations.