District/Grower Survey; Cropping Patterns and Salinity in Reach 83 of the San Joaquin River; Merced River to Vernalis,

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Background

The Lower San Joaquin River (LSJR) Committee was established in 2010 as a subcommittee of the Central Valley Salinity Alternatives for Long-Term Sustainability (CV-SALTS) Initiative. The purpose of the LSJR Committee was to develop recommendations for updating water quality objectives for salts that protect the agricultural beneficial use along with an implementation plan to support the objectives through a Basin Plan Amendment for Reach 83, the San Joaquin River from the mouth of the Merced River to Vernalis. Members of the LSJR Committee are stakeholders in the Lower San Joaquin River watershed with an interest in the management of salt.

Reach 83 of the San Joaquin River receives water from 3 major tributaries, several creeks, tile drains, a wastewater treatment plant and irrigated cropland. Land upstream of the reach includes grasslands and agricultural operations that drain into the San Joaquin River. Concentrations of salts in the irrigation water depends on where the diversions are in relationship to the tributaries, creeks, tile drains and treatment plant.

The LSJR Committee further divided Reach 83 into sub-reaches: 8C from the Merced River Confluence to the Tuolumne River Confluence, sub-reach 8B from the Tuolumne River confluence to the Stanislaus River confluence, and sub-reach 8A from the Stanislaus River confluence to the bridge at Vernalis. Reach 83 starts in Merced County, flows through Stanislaus County and into San Joaquin County.

Methods

As part of the development of the Basin Plan Amendment and to gain a better understanding of the effects salinity has on cropping patterns, the LSJR Committee generated a survey to gather information from irrigation districts and growers that divert and use water from Reach 83. The purpose of the survey was to gain a better understanding of how agricultural practices were affected by the quality of irrigation water, especially related to concentrations of salts. Diverters and growers were asked how they used San Joaquin River water, for what crops, how the salinity affected various crops, and how the water users dealt with the various concentrations of salinity found throughout Reach 83 (see Appendix 1 for the full survey). Surveys were completed, in person, by Chester Anderson of the East and West Stanislaus Resource Conservation Districts.

An important factor in establishing salinity water quality objectives for agriculture is establishing the representative cropping system. To establish the cropping system, the LSJR Committee needed to know what agricultural parcels were irrigated with water from Reach 83 and what types of crops were grown

on those parcels. Given the capacity that the region has to grow a large number of crops and changes in consumer demands it is difficult to predict what the future crops are that will be grown on land irrigated by water from Reach 83. Therefore the LSJR Committee decide to use the current cropping system as the representative cropping pattern to be fed into a Hoffman analysis to determine a threshold salinity tolerance that is protective of 95% of the maximum relative yield in a 95th percentile precipitation year.

To identify operational diversions in Reach 83 the California Electronic Water Rights Information Management System Web Mapping Application (eWRIMS GIS database) maintained by the State Water Resources Control Board was referenced. Diversions in Reach 83 were further documented utilizing a survey completed in 1985 and 1986 and published as: Water Diversion and Discharge Points along the San Joaquin River: Mendota Pool Dam to Mossdale Bridge, Volume 2-B: Appendix B, 1989.

Results

According to the eWRIMS GIS database there were 2 large irrigation districts reporting greater than 150,000 acre feet per annum (AFA) diversion capacity in Reach 83: West Stanislaus and Patterson Irrigation Districts; four medium sized Districts of between 10,500-26,000 AFA: El Soylo Water District, James Coddington (who operates 4 individual diversions in the lower section of Reach 83), and Twin Oaks Water District. The rest of the diversions were less than 4,000 AFA and operated by individual growers. Each of the large and medium sized districts responded to the survey (Table 1).

The eWRIMS GIS database and the 1985-86 surveys provided latitude and longitude for each diversion and the eWRIMS GIS database provided the total number of acres irrigated by each diversion as estimated and reported by the owner/operator of each diversion. The exact location of each diversion was confirmed by overlaying and visually locating each diversion on Google Imagery. All except 2 diversions could be located on the imagery.

To identify exactly which parcels were irrigated by a particular diversion, shape-files from the California Department of Water Resources (DWR) Land Use Survey were overlaid on the diversion map. The DWR Land Use Surveys focused on mapping agricultural land and identifying which crops were grown on each parcel. The shape-files provided crop type, parcel acreage and parcel location. Parcel information was related to County Assessor maps. The DWR Land Use Surveys were completed in 2004 for Stanislaus County, 1996 for San Joaquin County, and 2002 for Merced County

To associate a particular parcel with a particular diversion, it was assumed that the parcels closest to or adjacent to a diversion were the parcels most likely irrigated by that diversion and that the parcel acreage that summed closest to the total number of acres listed in the eWRIMS GIS database were assumed to be the parcels irrigated by that diversion. For example, if 107 acres was listed as being irrigated by a particular diversion in the eWRIMS GIS database and 3 adjacent parcels summed to the closest number to 107 acres out of several combinations of adjacent parcels, it was assumed that those 3 parcels were irrigated by that diversion.

Recognizing that there has been significant changes in cropping systems over the last 18 years, crop types for parcels were further updated with field visits, interviewing diverters, obtaining crop data collected by the larger Irrigation Districts and interviewing agronomists and experts familiar with cropping systems, especially related to parcels owned and operated by dairy operations.

There were 36 operational diversions identified in Reach 83, servicing a total of 55,037 acres, each diversion servicing between 3 and 25,000 acres (Table 1). Of the 36 diversions, Coddington held 4 diversion points and Herger held 2 diversion points. Reclamation District 2064 held 2 diversions points below the Stanislaus River that overlapped in service area with 2 adjacent diversions and therefore were not included in the cropping systems table. The eWRIMS GIS database listed the City of Modesto as holding a diversion. However, this diversion is currently not active and lists 0 acres as being irrigated. The eWRIMS GIS database listed two diversions as belonging to White Lake Mutual Water Company but these are now owned by the San Joaquin River National Wildlife Refuge and are currently not operated. Reclamation District 2099 was listed in the 1989 Diversion Report as owning and operating a diversion point but this diversion was not listed in the eWRIMS GIS database and was no longer in place or operational. All other diversion points listed in the 1989 diversion survey were still in place but, according to the eWRIMS GIS database, several were now owned by different entities. Diversions owned and operated by River Partners service acreage that is currently farmed, primarily in dairy crops, but plans for this acreage were to convert all of it into native vegetation. River Partners also owns and operates the Nutcher diversion with plans to convert the farmed acreage to native vegetation and, therefore, native vegetation was listed for the parcels being served by these 3 diversions in the cropping systems table (Table 1).

The largest discrepancies between irrigated acreage in the eWRIMS GIS database and irrigated acreage as identified in crop reports or parcel identifications using DWR Land Use Survey information belonged to the larger Water Districts: West Stanislaus Irrigation District, Patterson Irrigation District, and Twin Oaks Irrigation District (Table 1). Those District's provided the LSJR Committee with their 2013 crop reports and these reports were used in developing the cropping patterns table for Reach 83. The next largest discrepancy was 174 acres for the Brocchini Trust diversion that could not be identified using the DWR Land Use Surveys or County Parcel information. Therefore, only 137 acres were reported in the Cropping Systems Table. All other discrepancies were less than 55 acres, some being acreage that could not be located or some being acreage that came out as over estimates of acreage being reported/irrigated or simply from inaccuracies in the parcel information available or reported for the eWRIMS GIS database.

Table 1. Cropping Patterns for Parcels Irrigated by water from San Joaquin River Reach 83.

Diversion Name	Bernardo	Del Terra Farms	RJM Vineyards LLC	Robert Albert Brocchini Trust	Gallo	Jim Coddington (4 diverions)	El Solyo	Mapes	West Stanisaus	River Partners	River Partners	Nutcher	Machado	Dykzeul	Co. of Stanilaus	Harry H Baker Jr. Trust	Houk	Herger	Herger	Patterson	Azevedo	Patterson Crops Project	Twin Oaks	Mendonca	Mederios	Heiny	Manuli Trust	Moonshine Dairy	Souza & Sons	Borba	Stevinson Corp.	TOTALS
Sub Reach (as defined by LSJR Committee)	8 A	8 A	8 A	8 A	8 B	8 B	8 B	8 B	8 C	8 C	8 C	8 C	8 C	8 C	8 C	8 C	8 C	8 C	8 C	8 C	8 C	8 C	8 C	8 C	8 C	8 C	8 C	8 C	8 C	8 C	8 C	
Report Date (eWRIMS GIS database)	2010	2012	2012	2012	2010	2012-2013	2012	2010	2013	2012	2012	2012	2012	2012	2013	2012	2012	2012	2012	2011	2013	2013	2013	2011	2013	2012	2013	2012	2010	2012	2012	
Application Id (eWRIMS GIS database)	S007681	S019136	S018394	A009834	S014002	SO21735, SO16965, SO16949, A001195	A001476	S014001	A001987	S017388	S017293	S018230	S020595	S016820	A016669	A016662	A013552	A013553	A004507	S009320	S005279	S022125	A004237	S007393	S020850	A006467	A013555	A006393	S005469	S020429	S021829	
Acre Feet Water Diverted (as reported in eWRIMS GIS database)	213	839	702	1128	6	54	19281	2509	63166	619	2701	169	577	5000	0	230	617	419	1294	37982	286	880	8869	0	1507	105	5	400	1242	2992	1886	

Oats	Grain and/or Sudan Grass**	Wheat	Walnuts	Corn*	Tomatoes	Alfalfa	Almonds	Crop Class Name	Source of Information for cropping patterns
-	-	-	-	84	64	33	-	Crop Acreage	Shapefiles/Grnd Truth
-	-	-	-	-	142	142	-		Shapefiles/Grnd Truth
-	-	-	-	-	-	-	-		Shapefiles/Grnd Truth
-	129	-	-	-	-	8	-		Shapefiles
-	-	-	-	45	-	-	-		Shapefiles
-	-	-	-	800	-	800	14		Interviewee
			945		378	378	1891		Interviewee
-	-	-	-	-	-	-	-		Shapefiles/Grnd Truth
419	-	824	1,349	1,482	5,592	1,999	9,575		Crop Report
-	-	-	-	-	-	-	-		Water Rights
-	-	-	-	-	-	-	-		Water Rights/Inte-viewiee
-	-	-	-	-	-	-	-		Water Rights
-	221	-	-	15	-	-	-		Shapefiles/Grnd Truth
-	293	-	-	-	11	206	-		Water Rights/Interviewiee
-	-	-	-	-	-	-	-		Shapefiles
-	-	-	-	-	-	-	-		Water Rights
-	-	-	-	-	-	-	-		Water Rights
-	-	-	-	-	-	-	-		Water Rights
-	-	-	-	-	433	77	-		Shapefiles/Grnd Truth
1,286	127	1,277	1,096	2,574	1,062	3,837	2,018		Crop Report
-	-	-	-	-	-	69	-		Shapefiles/Grnd Truth
-	116	-	-	-	-	54	-		Shapefiles/Grnd Truth
40	-	671	-	360	62	1,454	-		Interviewee
-	188	-	-	8	-	-	-		Shapefiles/Grnd Truth
-	168	-	-	-	-	131	-		Shapefiles/Grnd Truth
-	-	-	-	22	-	19	-		Shapefiles/Grnd Truth
-	-	-	-	-	-	89	-		Shapefiles/Grnd Truth
-	-	-	-	-	-	185	-		Shapefiles/Grnd Truth
-	192	-	-	-	-	86	-		Shapefiles/Grnd Truth
-	598	-	-	-	-	-	-		Shapefiles/Grnd Truth/Interveiwee
-	87	-	-	-	-	100	-		Shapefiles/Grnd Truth
1,745	2,119	2,772	3,390	5,389	7,744	9,666	13,498		

Peppers	Turf	Cauliflower	Apples	Peaches	Cherries	Parsley	Other, Seed	Melons	Mixed Pasture (alfalfa and grass)	Apricots	Native Vegetation	Grapes	Beans
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	700	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	20	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
													189
-	-	-	-	-	-	-	-	-	394	-	-	-	-
-	-	-	61	176	89	164	436	431	20	708	-	695	989
-	-	-	-	-	-	-	-	-	-	-	169	-	-
-	-	-	-	-	-	-	-	-	-	-	609	-	-
-	-	-	-	-	-	-	-	-	-	-	340	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	40	-	-
-	-	-	-	-	-	-	-	-	-	-	117	-	-
-	-	-	-	-	-	-	-	-	-	-	84	-	-
-	-	-	-	-	-	-	-	27	-	-	-	59	127
20	22	-	20	37	147	95	20	172	494	534	-	21	222
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	121	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	77	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	22	77	81	213	236	259	456	751	928	1,242	1,359	1,475	1,527

Difference	Acres irrigated as reported to Water Rights Division	** Double or tripled cropped with corn	* Double or triple cropped with grain and/or Sudan grass	TOTAL	**Pears**	**Pistachio**	**Pomegranate**	**Cactus**	**Basil**	**Pecans**	**Nursery**
1	180			181	-	-	-	-	-	-	-
(8)	292			284	-	-	-	-	-	-	-
20	680			700	-	-	-	-	-	-	-
(174)	311			137	-	-	-	-	-	-	-
(10)	75			65	-	-	-	-	-	-	-
24	1590			1,614	-	-	-	-	-	-	-
-	3,781			3,781							
(6)	400			394	-	-	-	-	-	-	-
3,343	21666			25,009	-	-	-	-	-	-	-
-	169			169	-	-	-	-	-	-	-
-	609			609	-	-	-	-	-	-	-
-	340			340	-	-	-	-	-	-	-
26	210			236	-	-	-	-	-	-	-
15	495			510	-	-	-	-	-	-	-
0	3			3	3	-	-	-	-	-	-
-	40			40	-	-	-	-	-	-	-
-	117			117	-	-	-	-	-	-	-
-	84			84	-	-	-	-	-	-	-
(10)	734			724	-	-	-	-	-	-	-
647	14,500			15,147	-	5	10	10	11	13	17
1	68			69	-	-	-	-	-	-	-
(27)	196			169	-	-	-	-	-	-	-
496	2,212			2,708	-	-	-	-	-	-	-
(55)	251			196	-	-	-	-	-	-	-
(1)	300			299	-	-	-	-	-	-	-
1	40			41	-	-	-	-	-	-	-
21	145			166	-	-	-	-	-	-	-
(15)	200			185	-	-	-	-	-	-	-
2	276			278	-	-	-	-	-	-	-
(2)	600			598	-	-	-	-	-	-	-
21	165			186	-	-	-	-	-	-	-
4,308	50,729			55,037	3	5	10	10	11	13	17

Crop survey data show that at least 28 crops/crop types were grown in 2013 by water diverted from Reach 83. Almonds, alfalfa, tomatoes and grain crops (corn, wheat, oats, and Sudan grass) related to diary operations encompass the majority of the irrigated acreage supplied by water from Reach 83 (Table 1). Most diversions in the upper 1/3 of the reach supply irrigation water for dairy operations. In the middle 1/3 of the reach, diversions supply water for alfalfa, corn almonds, wheat, melons, walnuts, and stone fruits. In the lower 1/3 of the reach, water irrigates almonds, tomatoes, alfalfa, corn and walnuts.

Summary of Responses to Surveys

Listed below are responses to survey questions and relevant side conversations from District representatives and growers that divert water from Reach 83 and deemed most important to the LSJR Committee's process (full survey and responses found by clicking here).

In average precipitation years salinity related water quality problems last from the middle of July until the 1st of October. In drought years salinity related water quality problems start showing up as early as June 1st and last until the end of October. VAMP flows were helpful in reducing concentrations of salt. Salts in the San Joaquin River (SJR) are now a bigger problem given that VAMP flows are no longer occurring.

Patterson and West Stanislaus Irrigation Districts use Delta Mendota Canal (DMC) water when they are short on water from the San Joaquin River. Due to the cost of DMC water (~ $45/af) compared to the cost of SJR water (~ $15/af) the Districts do not use DMC water for the luxury of reducing salinity concentrations. When DMC water was less expensive, Districts used DMC water more often for water quality purposes. Other districts and diverters in Reach 83 do not have access to DMC water. Other Districts and growers have access to ground water which in general has higher concentrations of salts and boron.

For growers receiving water from the West Stanislaus Irrigation District, the size of the salinity issue depends on how close to the river is the land that they are irrigating. WSID has 6 laterals between the Delta Mendota Canal and the river and for land that receives water from the bottom 3 laterals, which have a greater amount of San Joaquin River water and less DMC water, the grower surveyed will no longer plant permanent crops. The most valuable crop grown in the region is almonds and their life span may be cut by a third and annual production may be cut in half due to concentrations of salinity in the irrigation water.

For forage crops on irrigated land near the Merced River confluence, salinity concentrations in the SJR is a non-issue. Concentrations of salinity in the SJR for irrigated land near Vernalis (Maze Boulevard to the Stanislaus River) is a problem for all crops, including forage crops. Salinity reduces property values and substantially increases costs for this grower due to the need to purchase and apply sulfuric acid, gypsum, and leaching water to address salinity issues in irrigation water.

High flows create salinity problems on the Eastside of the SJR by bringing salts that have concentrated in the subsoil below the root zone to the surface, requiring substantial amounts of leaching to move the salts back below the root zone, especially behind Army Corps Levies that do not allow the land to drain after high flows.

A related problem to salinity is high pH values and increased buffering capacity. Nut trees do not grow and produce well with high pH water and acid does little to help when pH values are as higher than 8.5 in the SJR due to all the constituents in the water and their buffering capacity.