SAN LUIS WATER DISTRICT

2011/12 Water Management Plan

(2011 Criteria)

Final Draft Approved USBR – December 19, 2012
Board Resolution Adopted January 2013

DATE SIGNED: 12-24-2012

Prepared by:

Provost and Pritchard Consulting Group
2505 Alluvial Ave.
Clovis, CA 93611-9166
(559) 326-1100

December 19, 2012

To All Interested Parties:

This Water Management Plan (WMP) has been prepared in conformance with requirements of the United States Bureau of Reclamation.

Unless otherwise noted, this plan is organized around the water year (March 1 through the last day of the following February) and not the calendar year. Data used in this WMP is from water year 2010 (March, 1 2010 to February 28, 2011) because water year 2011/12 was an abnormally wet year and is not representative of typical conditions in San Luis Water District.

The San Luis Water District Board of Directors promotes efficient use of water supplies and the free exchange of best practices, technologies and information. Please contact District staff with questions, comments or recommendations.

Sincerely,

Martin R. McIntyre
General Manager

Table of Contents

Page

Section I: Description of the District 1
A. History 1
B. Location and Facilities 6
C. Topography and Soils 7
D. Climate 9
E. Natural and Cultural Resources 9
F. Operating Rules and Regulations 10
G. Water Measurement, Pricing, and Billing 11
H. Water Shortage Allocation Policies 15
I. Evaluate Policies of Regulatory Agencies Affecting the Contractor and Identify Policies that Inhibit Good Water Management. 16
Section II: Inventory of Water Resources 17
A. Surface Water Supply 17
B. Groundwater Supply 17
Note: Only a small portion of these basins underlie SLWD 17
C. Other Water Supplies 18
D. Source Water Quality Monitoring Practices 19
E. Water Uses within the District 21
F. Outflow from the District (Agricultural only) 24
G. Water Accounting (Inventory) 27
Section III: Best Management Practices (BMPs) for Agricultural Contractors 28
A. Critical Agricultural BMPs 28
B. Exemptible BMPs for Agricultural Contractors 34
C. Provide a 3-Year Budget for Implementing BMPs 42
Section IV: Best Management Practices for Urban Contractors 44
Section V: District Water Inventory Tables 45

Attachments

1 - Information Required of Districts Located in a Drainage Problem Area
2- Samples of District Notices and Educational Materials Made Available to Growers

Appendix

A - Abbreviations
B - District Location Map, Facilities Map and Soils Information
C - Water Service Contracts
D - San Luis Water District Rules and Regulations
E - District Water Rates and Assessments
F - District Sample Water Bill, Annual Water Application, and Water Transfer Form
G - District Water Inventory Tables
H - Groundwater Management Plan
I - 2010 Consumer Confidence Report
J - 2010 Water Transfers
K - Crop Water Needs Analysis

L - Westside Regional Drainage Plan
M - Water Quality Monitoring Plan for the Delta Mendota Canal
N - Sample Water Quality Results from Wells Pumping into the Delta Mendota Canal
O - Board Resolution Approving Water Management Plan

Section I: Description of the District

District Name: San Luis Water District

Contact Name: Martin McIntyre

Title: General Manager

Telephone: 209-826-4043

E-mail: mcintyre.martin@gmail.com

A. History

San Luis Water District (SLWD or District) is located on the western side of the San Joaquin Valley near Los Banos (see **Appendix B**). The earliest agricultural ventures in the area now included in SLWD took place prior to 1900 and consisted of the growing of small grain. Irrigation by private parties started in the late 1920's through the use of shallow wells. The availability of groundwater was limited and the quality was relatively poor.

In the early 1950's the Delta-Mendota Canal (DMC), a major feature of the Central Valley Project (CVP), was constructed by the Bureau of Reclamation. During and after construction of the DMC, major development of farmland occurred on the western side of the San Joaquin Valley and led to the formation of SLWD and other water districts in the area.

SLWD was formed on January 23, 1951. The original size of SLWD was 50,576 gross acres (approximately 79 square miles). As a result of several inclusions and exclusions, the current gross acreage of SLWD is 64,502.

Historic population data for SLWD is not available. The current population within SLWD is approximately 700. The great majority of this population resides in and around the community of Santa Nella, which is located in the extreme northern portion of SLWD. In response to development interest, Merced County has approved several community specific plans in the vicinity including Fox Hills, Santa Nella and Villages at Laguna San Luis. While these community plans could ultimately result in substantial M&I growth, sharp market declines and diminished south of Delta water supply reliability have deferred if not diminished the potential for such development. Most of SLWD area is and will remain rural farmland with very few residents.

Irrigated acreage data is available beginning 1960. Over the years, there has been a large shift in crop types from row crops to permanent crops (trees and vines).

Negotiations between SLWD and the Bureau for a water service contract began on January 24, 1951 when the District formally applied to the Bureau for CVP water. Pending completion of the long-term contract, SLWD began receiving water from the DMC in May of 1952 under temporary contracts with the Bureau. Improvement District No. 1 (ID 1) was formed in 1958 and currently consists of approximately 19,790 acres. A distribution system for ID 1 was completed in 1959. SLWD entered into a long-term contract with the Bureau on February 25, 1959 for a firm water supply of 93,300 acre-feet. Temporary annual contracts were executed between 1964 and 1974 to provide for the delivery of M&I water from the DMC.

The San Luis Unit of the CVP was constructed during the 1960's. SLWD began receiving agricultural and M&I service from the San Luis Canal (SLC) in September of 1967 through annual temporary contracts with the Bureau. Included as part of the construction of the San Luis Unit were nine CVP pumping facilities to provide water service to SLWD lands that are upslope of the SLC. Improvement District No. 2 (ID 2) and Improvement District No. 3 (ID 3), currently consisting of 5,640 and 10,690 acres, respectively, were formed in 1972 and receive service from the above-mentioned pumping facilities. On June 18, 1974 the Bureau and SLWD entered into a new long-term water service contract that provided for both agricultural and M&I service from either the DMC or SLC and increased SLWD's firm water supply to 128,000 acre-feet. This contract does not identify specific quantities of agricultural versus M&I water nor does it identify specific quantities to be delivered from the DMC versus the SLC. SLWD also entered into a contract with the Bureau at this same time for a Public Law 130 construction loan to build distribution facilities for ID 2 and ID 3. These facilities were constructed during 1975 and 1976. Water deliveries to ID 2 and ID 3 began in January and March of 1977, respectively.

SLWD's water service contract was amended in December of 1975, as a result of excluding land from the District, to reduce the contract quantity by 2,920 acre-feet. SLWD's current contract quantity is 125,080 acre-feet.

Appendix C details SLWD's various water service contracts with the Bureau for project water. Contracts for non-project water, such as survival water contracts executed in 1977 and Warren Act contracts, are not included in **Appendix C**.

The Bureau contract is SLWD's only long-term water supply. SLWD does not own any groundwater wells and has no other long-term contracts for surface or groundwater supplies. Approximately 6,000 acres within SLWD overlie usable groundwater supplies. The quality of the groundwater is poor, averaging in excess of 1,000 parts per million of total dissolved solids. Some of this acreage is served exclusively by wells, while in other cases the wells are used to supplement project water supplies. All wells in this area are privately owned and operated. SLWD does not have specific pumping information regarding these wells, but it is estimated that approximately 10,000 acre-feet of groundwater are pumped annually.

Recent Endangered Species Act impacts have sharply constrained Delta pumping and reduced water supplies from the District's long term CVP contract. Modeling indicates that these changes will reduce CVP allocations to SLWD from a historic average of 81,000 acre-feet to about 50,000 acre-feet or less. Supplemental water transfers have always been used extensively by SLWD, however the projected decreases in average CVP allocations will result in expensive supplemental water becoming the largest share of SLWD's water portfolio.

Virtually all of the transfers into SLWD are for a single year only and cannot be relied upon as a long-term supply. **Appendix J** lists all transfers into and out of SLWD for water year 2010 (March 1, 2010-February 28, 2011). The District has an extensive internal water transfer program for landowners and water users to better manage their water supplies to meet their needs.

Increasing water costs have caused significant changes in SLWD cropping patterns. Higher value permanent crops, such as orchards and vineyards have replaced row crops. Every indication is that the conversion away from row crops and towards orchards and vineyards will continue. **Table 5** in **Appendix G** illustrates the fact that over 70% of the irrigated land in SLWD was planted to permanent crops in 2010. Due to the increasing cost of supplemental water supply, additional land will likely be converted from row crops to higher value trees and vines over the next 5 years. The major limiting factors to continued conversion are water supply and water supply reliability. The current unreliable nature of SLWD's water supply also acts as a detriment to continued conversion. There is an understandable reluctance by landowners to make the significant capital investments associated with an orchard or vineyard when the water supply is so uncertain and the long-term historic trend is a reduction in water supply reliability.

Irrigation methods have also changed over time. There has been a significant conversion to drip and micro irrigation systems over the last 15 years that has paralleled the above-mentioned crop conversion. In 2010/2011, drip or micro irrigation systems were used in over 80% of irrigated acreage in the District. SLWD anticipates furhter increases of this percentage over time.

The conversion from agriculture to M&I usage will continue to occur in the northern portion of the District, primarily within ID 3. Approximately 10,000 acres have been identified as potential development locations and are in some stage of the planning process with Merced County and SLWD. As with the conversion from row crops to permanent plantings, water supply and water supply reliability are two major factors that must be considered by potential developers. SLWD has adopted policies to insure that M&I development does not jeopardize other water users within the District. SLWD requires that a sufficient quantity of a dependable, long-term water supply be secured prior to the issuance of any "will serve" letter.

1. *Date district formed: 1/23/1951* *Date of first Reclamation contract*: 1952 (temporary contract)

Original size (acres): *50,576* *Current year (water year)*: *2010**

**Data used in this WMP is from water year 2010/11since water year 2011/12 was an abnormally wet year and is not representative of typical conditions in San Luis Water District.*

2. *Current size, population, and irrigated acres*

	Year: 2010
Size (acres)	64,502
Population served (urban connections)	700 +/-
Irrigated acres	30,954

3. *Water supplies delivered in water year 2010/11*

Water Source	*AF*
Federal urban water (Tbl 1)	809
Federal agricultural water (Tbl 1)	20,788
State water (Tbl 1)	0
Other Wholesaler (define) (Tbl 1)	0
Local surface water (Tbl 1)	0
Upslope drain water (Tbl 1)	0
District groundwater (Tbl 2)	0
Banked water (Tbl 1)	0
Transferred water (Tbl 1)	58,849
Recycled water (Tbl 3)	0
Other (define) (Tbl 1)	0
Total	80,446

4. *Annual entitlement under each right and/or contract*

	AF	*Source*	*Contract #*	*Availability period(s)*
Reclamation Urban AF/Y				
Reclamation Agriculture AF/Y	125,080	DMC/SLC	14-06-200-7773A	Ag and M&I supply, when contract water is available

5. *Anticipated land-use changes. For Ag contractors, also include changes in irrigated acres.*

Currently the SLWD has one residential development (59 homes) within its boundaries. Some other developments have been proposed for the area, but their timeline is unknown. Several solar projects are being considered by various developers but timelines and outcomes are unknown at this time.

6. Cropping patterns (Agricultural only)

List of current crops (crops with 5% or less of total acreage) can be combined in the 'Other' category.

Original Plan (1999)		*Previous Plan (2004)*		*Current Plan (2010 Data)*	
Crop Name	*Acres*	*Crop Name*	*Acres*	*Crop Name*	*Acres*
Alfalfa	2,176	Almonds	14,837	Almonds (3 yr)	2,408
Almonds	9,204	Cotton	10,058	Almonds (mat.)	16,449
Beans	2,312	Melons	3,195	Cotton	2,525
Cotton	11,518	Tomatoes	3,631	Oats	2,011
Melons	4,858			Tomatoes	2,802
Tomatoes	4,104			Wheat	4,324
Other (<5%)	8,760	*Other (<5%)*	6,566	*Other (<5%)*	4,990
Total	42,932	*Total*	38,287	*Total*	35,509

7. Major irrigation methods (by acreage) (Agricultural only)

Original Plan (1999)		*Previous Plan (2004)*		*Current Plan (2010 Data)*	
Irrigation Method	*Acres*	*Irrigation Method*	*Acres*	*Irrigation Method*	*Acres*
Surface	16,326	Graded surface ¼ mile	2,739	Flood/Furrow	4005
Sprinkler	15,267	Sprinkler, hand move	18,168	Sprinkler	1929
Drip & Micro	9,584	Trickle, surface/spray	17,380	Drip & Micro	25019
Total		*Total*		*Total*	30,954

Note: The difference between total acreage in Tables 6 and 7 is acreage that is dry farmed.

B. Location and Facilities

See **Appendix B** for maps containing the following: incoming flow locations, turnouts (internal flow), and outflow (spill) points, conveyance system, storage facilities, operational loss recovery system, District wells and lift pumps, water quality monitoring locations, and groundwater facilities.

1. Incoming flow locations and measurement methods (Active Only)

Location Name	*Physical Location*	*Type of Measurement Device*	*Accuracy*
Delta Mendota Canal	25 Turnouts	Propeller Meter	6%+/-
San Luis Canal	12 Turnouts	Venturi	6%+/-
San Luis Canal	26 Turnouts (Direct Service)	Propeller	6%+/-

2. Current year Agricultural Conveyance System

Miles Unlined - Canal	*Miles Lined - Canal*	*Miles Piped*	*Miles - Other*
3.2	14.3	52	0

The unlined canal section has been evaluated for lining but is not a good candidate due to its location in a floodzone. During floods the canal frequently fills with water and silt. SLWD uses high density polyethylene for canal liners, and this material can be easily damaged during de-silting operations. As a result, SLWD has no current plans to line the 3.2 miles of un-lined canal.

3. Current year Urban Distribution System

Miles AC Pipe	*Miles Steel Pipe*	*Miles Cast Iron Pipe*	*Miles - PVCPVC*
None	None	None	1.2

4. Storage facilities (tanks, reservoirs, regulating reservoirs)

Name	*Type*	*Capacity (AF)*	*Distribution or Spill*
Treated Water Tank	Bolted Steel	122,000 gal	None

5. Description of the agricultural spill recovery system and outflow points.

SLWD has 8 small reservoirs used to capture operated spills for pumping the water back into the delivery system. With the installation of automatic gate controllers and other canal improvements, operational spills are rare and of very limited volume.

6. Agricultural delivery system operation (check all that apply)

Scheduled	*Rotation*	*Other (describe)*
100%		

7. Restrictions on water source(s)

Source	*Restriction*	*Cause of Restriction*	*Effect on Operations*
Federal CVP supply from the San Luis Canal and Delta-Mendota Canal	Contract limitations for CVP water supply (water shortage provisions of water service contract)	Water supply limitations, application of the Endangered Species Act, and Delta water quality requirements	Variable water supply

8. Proposed changes or additions to facilities and operations for the next 5 years

No changes or additions to the District's facilities are proposed in the next 5 years (2013-2017). The District is fully developed and has a mature water conservation program. SLWD will enhance its meter calibration program such that all meters are calibrated at least once every 5 years. Such calibration will be in compliance with all applicable State and Federal requirements, records of which will be maintained for inspection. If contract calibration services are not cost effective, the District will likely construct a flow lab and calibration facility.

C. Topography and Soils

1. Topography of the District and its impact on water operations and management

In general, SLWD's terrain slopes from west to east. Interstate 5 is the approximate dividing line between the hilly terrain to the west and the relatively level land to the east. Elevations within SLWD vary from 150 to 700 feet above sea level.

The hilly terrain in the western portion of SLWD prevents the use of surface irrigation methods. Virtually the entire acreage of IDs 2 and 3 is irrigated with sprinkler or drip/micro irrigation systems.

Approximately 5,200 acres within SLWD have poor drainage. Drainage from this area is managed by a combination of public and private entities. Drainage from the majority

Soil Problem	*Estimated Acres*	*Effect on Water Operations and Management*
Salinity	None	
High water table	None	
High or low infiltration rates	None	
Poor Drainage	5,200	*Managed by others (see Section*

of this land (3,752 acres) is managed by Charleston Drainage District (CDD). CDD collects and returns most of the drainage to reuse areas within CDD. Pacheco Water District (PacWD) manages the drainage from another 792 acres. Drainage from the remaining 650 acres is managed privately. The location of the drainage areas in relation to the rest of SLWD is shown on the vicinity map in **Appendix B**

The entire drainage area has a drainage outlet to the San Joaquin River through participation in the Grassland Basin Drainers (GBD), a group of water and drainage districts that are using the San Luis Drain to re-route drainage flows around Grassland Water District and state and federal wildlife refuges. Stringent performance requirements have been imposed upon this project by a Use Agreement between the Bureau and the GBD and also by a waste discharge permit issued by the Regional Water Quality Control Board. Significant measures have been taken within the drainage area to increase water efficiency and decrease drainage discharges in order to meet the drainage load targets.

The Bureau has performed an Irrigation Suitability/Land Classification analysis for SLWD. Of the acres within SLWD eligible to receive a water allocation, approximately 5,915 were identified as Class 1 soils, 25,677 as Class 2, 24,041 as either Class 3 or 4, and 1,897 as Class 6. The 231 acres of land included into SLWD in 2002 have not been classified.

2. District soil association map (Agricultural only)

See **Appendix B** for a table listing the soil units in SLWD.

3. Agricultural limitations resulting from soil problems (Agricultural only)

		2.F)

None

D. Climate

1. General climate of the district service area

	Jan	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Annual*
Avg Precip.	1.90	1.68	1.41	0.71	0.35	0.06	0.02	0.02	0.18	0.48	0.97	1.44	9.21
Avg Temp.	45.7	51.0	55.5	60.5	67.2	73.3	78.4	77.2	73.2	64.7	53.8	46.0	62.2
Max. Temp.	75	79	89	98	106	114	116	114	111	102	87	75	97
Min. Temp	14	20	24	30	35	39	45	46	38	28	24	14	30
ETo	0.87	1.67	3.40	5.54	7.29	8.21	8.62	7.44	5.52	3.77	1.82	0.93	55.08

Weather station ID: Western Regional Climate Center, Station 045118: Los Banos

Data period: Year 1988 to 2010 (Eto only) , 1906 to 2010 (all other data)

ET Station ID: CIMIS No. 56 – Los Banos

Average annual frost-free days: 300

Average wide velocity: NW 6.5 mph

2. Impact of microclimates on water management within the service area

During much of the irrigation season, the northern reaches of the District (ID 3) are prone to high winds generated over Pacheco Pass. Sprinkler irrigation is generally not practical in this area due to wind disruption of the sprinkler head pattern.

E. Natural and Cultural Resources

1. Natural resource areas within the service area

Name	*Estimated Acres*	*Description*
NONE	NONE	NONE

2. Description of district management of these resources in the past or present

NA

3. Recreational and/or cultural resources areas within the service area

Name	*Estimated Acres*	*Description*
NONE	NONE	NONE

F. Operating Rules and Regulations

1. Operating rules and regulations
A copy of the SLWD's Rules and Regulations is contained in **Appendix D**. The Rules and Regulations were updated nine times since 2005, and were last updated in October 2009.

2. Water allocation policy (Agricultural only)

See Rule No. 6 of the district's Rules and Regulations (**Appendix D**).

Rule No. 6 provides information regarding water allocations. SLWD annually allocates the available Bureau supply on a pro-rata acreage basis to all eligible parcels that have requested water for that particular year.

The allocation process for any extra water purchased by SLWD is determined annually. Under severe water shortages, extra water has generally been made available on a pro-rata acreage basis, while under above-normal water conditions extra water has generally been sold on a first-come-first-served basis.

3. Official and actual lead times necessary for water orders and shut-off (Agricultural only)

SLWD requires 24-hour notice for any change in a water delivery (i.e. order, adjustment, or cancellation). The 24-hour requirement is a result of SLWD's need to provide 24-hour notice of water deliveries to the DWR and the SL&DMWA. However, SLWD often accepts water delivery changes from water users on less than 24-hour notice as long as the changes will not adversely impact operations of the DMC or SLC.

4. Policies regarding return flows (surface and subsurface drainage from farms) and outflow (Agricultural only)

Rule No. 4 (**Appendix D**) requires landowners to construct and maintain adequate drainage facilities so that adjacent or lower lying lands are not harmed by runoff and to insure that water is being beneficially used. As a result of the high cost of SLWD water and the limited supply available, all irrigation runoff (tail water) is kept on-farm. Discharge of tail water is prohibited by Rule No. 4. The majority of land within SLWD does not have a drainage outlet. A small area of SLWD, consisting of approximately 5,200 acres has a drainage outlet to the San Joaquin River through participation in the GBD's use of the San Luis Drain. Since the GBDs do not allow tail water to be discharged into the drainage system, all tail water is recycled on farm. Most of the subsurface drain water is either recycled on-farm or by the GBDs in order to meet the discharge requirement associated with use of the Drain.

5. Policies on water transfers by the District and its customers

Rule No. 7 (**Appendix D**) addresses water transfers. SLWD encourages and supports water transfers. However since SLWD is chronically short water supply, growers may only transfer water out to lands they own in other CVP districts. A guiding principle for transfers out of the District is that such transfers not create an adverse impact on SLWD landowners and/or water users. In addition, the District has an extensive internal water transfer program.

G. Water Measurement, Pricing, and Billing

1. Agricultural Customers

Refer to BMP A.1. Information on water measurement for agricultural contractors is completed under BMP A.1 on page 28.

2. Urban Customers

a. *Total number of metered connections 163*

b. *Total number of connections not billed by quantity* 0

c. *Percentage of water that was measured at delivery point* 100%

d. *Percentage of delivered water that was billed by quantity* *100%*

e. *Measurement device table*

Meter Size and Type	*Number*	*Accuracy[1] (+/-percentage)*	*Reading Frequency (Days)*	*Calibration Frequency (Months)*	*Maintenance Frequency (Months)*
5/8-3/4" nutating Disc	118[2]	+/- 5.5%	monthly	60	as needed
1" nutating Disc	4	+/- 5.5%	monthly	60	as needed

1" Propeller	7		monthly	60	as needed
1 ½" nutating Disc	2	+/- 5.5%	monthly	60	as needed
2" nutating Disc	3	+/- 5.5%	monthly	60	as needed
2" propeller	17	+/- 5.5%	monthly	60	as needed
3" propeller	2	+/- 5.5%	monthly	60	as needed
4" propeller	4	+/- 5.5%	monthly	60	as needed
6" propeller	2	+/- 5.5%	monthly	60	as needed
8" propeller	1	+/- 5.5%	monthly	60	as needed
10" propeller	2	+/- 5.5%	monthly	60	as needed
Venturi[3]	1	+/- 6%	twice week	annually	as needed
Total Meters	163	+/- 5.5%	monthly		annually
Total Customers	104				

Notes

(1) Historically the District has calibrated meters only on an "as needed" basis and has not maintained calibration records. During the 2012-2017 Plan period, the District will implement a comprehensive program to test and calibrate all meters at least once every five years. All District meters will have been calibrated by the end of 2016. It is anticipated that this program will be initiated prior to 2014. The District is currently comparing the costs and benefits between contracting out the calibration and constructing a certified test station in the District. Based on initial cost quotes contract services will run $400 per meter

(2) Includes two meters each for 59 customers, one for treated water and one for non-treated irrigation water

(3) Wholesale turn out delivers water to Santa Nella County Water District. Meter is owned, maintained and calibrated by DWR.

Wholesale M&I water is delivered from a metered turnout on the SLC to Santa Nella County Water District (SNCWD). DWR owns, maintains and calibrates the master meter at the turnout. SNCWD operates and maintains its own treatment plant and distribution system. SNCWD delivers approximately 550 acre-feet to 560 service connections. SLWD does not have specific information regarding the number of maintenance, calibration, and frequency of meter reading for the SNCWD system.

All M&I water delivered directly to the customer by the district is metered and the water use is billed on a monthly basis. All new developments are required to install meters on all connections (treated and untreated water). All meters purchased and installed have an initial factory calibrated accuracy of +/- 2%.

3. Agricultural and Urban Rates

a. Current year agricultural and /or urban water charges - including rate structures and billing frequency

See **Appendix E** for detailed information on water rates and fees.

b. Annual charges collected from agricultural customers

FIXED CHARGES			
Assessment Code	Acres	Rate	Total
AS0029 - 1993 Revenue Bond - Debt Service - ID 2	5852.03	$19.61	$114,758.31
AS0030 - 1993 Revenue Bond - Debt Service - ID 3	11222.15	$15.00	$168,332.25
AS0031 - Shop Loan - ID 1	19702.10	$0.60	$11,821.26
AS0032 - Standby Charge - Per Acre	57592.65	$4.70	$270,685.46
AS0033 - Standby Charge - Per Parcel	500.00	$4.70	$2,350.00
AS0049 - 1996 COP - ID1 - Debt Service	19702.10	$9.86	$194,262.71
AS0050 - 1996 COP - ID1 - Rebate	19702.10	-$9.86	-$194,262.71
AS0051 - 1996 COP - ID2 - Debt Service (Lining)	5852.03	$5.59	$32,712.85
AS0052 - 1996 COP - ID2 - Rebate (Lining)	5852.03	-$1.29	-$7,549.12
AS0053 - 1996 COP - ID2 - Debt Service (Capacity)	5408.74	$17.05	$92,219.02
AS0054 - 1996 COP - ID2 - Rebate (Capacity)	5408.74	-$3.66	-$19,795.99
AS0435 - I.D. No. 3 O&M Standby Charge	11222.15	$20.00	$224,443.00
AS0540 - 1993 Revenue Bond - Rebate - ID 2	5852.03	-$0.27	-$1,580.05
AS0541 - 1993 Revenue Bond - Rebate - ID 3	11222.15	-$0.29	-$3,254.42
			$885,142.56

*Assessments summarized in 3b. above do not provide for any water deliveries. With the exception of the $4.70 Standby charge and the $20 O&M charge for I.D. 3, all water delivery charges are quantity based and determined exclusively by metered usage.

Volumetric charges			
Charges ($ unit)	**Charge units ($/AF), ($/HCF), etc.**	**Units billed during year**	**$ Collected ($ times units)**
(Ag) $59.18-$388 Average $178 AF	$/acre-foot	79,637 AF	$ 14,231,501
(Untreated M&I) $86.57-140.48 Average= $126*	$/acre-foot	785AF	$ 98,875
(Treated M&I) $2,643 AF	$/acre-foot	24 AF	$ 64,696

*Average water costs for M&I supplies are lower than for ag. CVP M&I capital obligations have been retired and ag supplies include more expensive supplemental sources. Due to the M&I reliability preference, the great majority of M&I supply is derived from the District's long term CVP contract.

Subsequent to 2009 implementation of Biologic Opinions for Delta Smelt and salmonids, associated Delta pumping constraints reduced average SLWD CVP allocations to 35-40%. The difference between CVP allocations and demand must be satisfied by costly supplemental water. Prices for supplemental water are market driven and vary dramatically by source and water year type. In Water Year 2010/11 the District was allocated a total of 57,021 AF from its CVP contract, while total water demand was 80,446 AF.

c. Describe the contractor's record management system

SLWD has a sophisticated data management system for water usage information and accounts. The water supply shortages that began occurring in 1990 resulted in SLWD having to implement and modify policies affecting both water and financial operations. For example, prior to water shortages, SLWD's primary water function was to meter deliveries to all water users and to bill accordingly. Water shortages forced SLWD to formally allocate the limited supply. In addition, shortages resulted in significantly more water transfers and introduced many additional types or categories of water, each with unique associated costs.

SLWD collaborated with others in developing a custom PC based data management system. In general, the District wanted the software to manage all water transactions (allocations, orders, transfers, deliveries, etc.) and most financial transactions (billings, cash receipts, and accounts receivable). A separate accounting program would be used to handle general ledger, accounts payable, and payroll transactions. The districts also desired features to facilitate the management of parcel, name, field, and turnout information. This custom software was named STORM and is now in use by numerous districts.

All SLWD water information such as turnout deliveries, allocations, transfers, etc. is managed with STORM. This data is available to growers in a variety of formats. Data regarding water usage and remaining water quantities is routinely distributed on a monthly basis and is also made available upon request. STORM can accommodate the tracking of water usage data to the field level if field information is supplied when water is ordered.

Water delivery data for turnouts and SLWD pumping plants on the DMC and SLC since 1958 is available. Water delivery information from SLWD turnouts since 1977 is available. This data has been computerized and is available upon the request of a landowner or water user.

Water charges for both agricultural and M&I customers are almost exclusively based on usage (water-based) charges. All parcels are assessed a standby charge ($4.70 acre) to cover a portion of SLWD's administrative costs. Water charges in SLWD average over $175 per acre-foot. With the exception of the $4.70 stand-by charge the balance of water costs are usage based. One minor exception of note is Improvement District 3, where deliveries are too small (only 2,381 acre-feet in 2010/11) to cover O&M revenue requirements. Parcels within the Improvement Districts are assessed one or more additional charges to repay capital costs associated with their respective water distribution systems. All assessments and standby charges are paid in two equal installments due January 1 and September 1 of each year.

The Bureau's cost of the allocated supply plus the SL&DMWA's costs for operating and maintaining the federal delivery system is billed to landowners. A water application and a deposit billing are sent to landowners annually. The water application allows landowners to purchase none, a portion, or the entire amount of water available for that particular year. Failure to return a completed water application and to pay the deposit by March 1, results in the loss of a water allocation for that year. The final water billing detailing the exact quantity allocated to each parcel, the associated cost, the deposit payment made, and the remaining quantity owed is sent in June and is due July 1.

Water usage charges are billed on a monthly basis and include SLWD administrative charges, the Bureau's Restoration Fund charge, O&M charges associated with Improvement District or M&I development distribution systems, and other miscellaneous charges. Billings are generally generated by the tenth of the month following usage and become delinquent the tenth of the second month following usage. A uniform rate structure is used for water usage charges. STORM allows a tremendous amount of flexibility in assigning water rates for water usage billings. Water rates can be assigned to water categories, turnouts, fields, water users, or to any combination of these variables. Over 13,000 water rate assignments have been entered and are analyzed as part of each water usage billing. The STORM billing process uses a linear optimization algorithm to calculate the lowest possible cost for each water user. This process involves analyzing the actual location and quantity of water usage, the type and quantity of water supply available to a given water user, and the above-mentioned water rate possibilities. This sophisticated billing process has allowed SLWD to handle the billing

complexities associated with multiple types of water and multiple water rates while at the same time simplifying the billing process for water users through the assurance that the bill generated represents the least possible cost. Water rate information is provided in **Appendix E**.

The Rules and Regulations in **Appendix D** contain additional information regarding charges and billing procedures. Rule No. 8 of Article I addresses water allocation, water delivery, and standby and assessment charges. Paragraph III of Article II specifically addresses billing and collection procedures for domestic water and/or sewer service.

See **Appendix F** for a sample water bill, which are sent to growers monthly. The bill clearly shows how much water was used and that it is billed on a volumetric basis. SLWD can provide extra copies of the bills for the past several years upon grower request.

H. Water Shortage Allocation Policies

1. Current year water shortage policies or shortage response plan - specifying how reduced water supplies are allocated

The available Bureau supply is allocated on a pro-rata acreage basis to all eligible parcels whose owners have requested an allocation for that particular year. SLWD's water service contract requires that all agricultural water that is converted to M&I use be treated as an agricultural supply in the event of a water shortage. Consequently, all parcels within SLWD are generally treated equally for allocation purposes (Rule No. 6, **Appendix D**). The one exception to this is the Bureau's practice during recent water shortage years of allocating SLWD a quantity of M&I water based on "historical" M&I usage prior to 1990. When this has occurred, SLWD has generally maintained this same distinction when allocating water to property. No preference is given based on the type of crop being grown.

SLWD could not survive without the importation of supplemental supplies. Historically those supplies augmented the District's CVP allocations. In recent years, that trend has been reversed and the majority of the District's supplies are imported from sources other than its long term CVP contract. Both the District and individual growers must aggressively pursue other water supplies to avoid loss of permanent crops.
Additional information on water allocation procedures is included in Rule No. 6 of the Rules and Regulations (**Appendix D**).

2. Current year policies that address wasteful use of water and enforcement methods

The General Manager has the authority to immediately terminate water deliveries to any water user that is wasting water (See Rule No. 4 in **Appendix D**). The limited quantity of extremely expensive water available to SLWD water users has virtually eliminated wasteful use and the need to exercise this authority.

I. Evaluate Policies of Regulatory Agencies Affecting the Contractor and Identify Policies that Inhibit Good Water Management.

The criteria and policies governing the Bay-Delta have restricted water deliveries to SLWD. Both the quantity and reliability of water deliveries to the District have been seriously eroded. These policies need to be revised, or the water supply augmented, if SLWD is ever to receive a reliable water supply again.

Section II: Inventory of Water Resources

A. Surface Water Supply

SLWD's only long-term source of water is Contract No. 14-06-200-7773A with the Bureau for 125,080 acre-feet/year. This supply equates to a maximum supply of 2.1 acre-feet per acre to those parcels within SLWD eligible to receive an allocation. SLWD does not have a contract for SWP water nor does it have any other source of local surface supply.

1. Surface water supplies in acre feet, imported and originating within the service area, by month (Table 1)

See Water Inventory Tables, Table 1, **Appendix G**.

2. Amount of water delivered to the District by each of the District sources for the last 10 years

See Water Inventory Tables, Table 8 (**Appendix G**)

B. Groundwater Supply

1. Groundwater extracted by the district and delivered, by month (Table 2)

None by SLWD. See Table 2 in **Appendix G** and Section 2.B.5 below.

2. Groundwater basin(s) that underlies the service area

Name	*Size (Square Miles)*	*Usable Capacity (AF)*	*Safe Yield (AF/Y)*
Delta Mendota	187.5	Unknown	115,000+ historic
Los Banos Creek Valley Sub Area	7.5	Unknown	10,000-15,000 Estimated

Note: Only a small portion of these basins underlie SLWD

3. Map of District-operated wells and managed groundwater recharge areas
The District does not own any wells. The District does not manage the limited groundwater within their service area (see **Appendix B**).

4. Description of conjunctive use of surface and groundwater
(Please review Guidebook definition of conjunctive use)

None by SLWD.

5. Groundwater Management Plan

SLWD and seven other federal contractors in the same geographic area cooperated in the development of a Groundwater Management Plan (Southern DMC Service Area) in compliance with the Groundwater Management Act, Assembly Bill 3030. SLWD formally adopted the Plan in November of 1996, a copy of which is included in **Appendix H**. The Groundwater Management Plan is currently being updated to satisfy new standards established by the State of California.

The Delta-Mendota sub-basin of the San Joaquin Basin underlies a portion of SLWD. The San Joaquin Basin is a 13,500 square-mile basin with a storage capacity of 570,000,000 acre-feet and a usable capacity of 80,000,000 acre-feet (DWR Bulletins 118-75 and 118-80).

SLWD does not own or operate any ground water wells. There are approximately 22 private agricultural wells located several miles south of Los Banos that provide all or a portion of the water supply to approximately 6,000 acres within the District Service Area (DSA). There are no agricultural wells within the three improvement districts. SLWD estimates that landowner wells within the DSA pump approximately 10,000 acre-feet annually.

The horizontal groundwater flow direction in the semi-confined zones is northeast, towards the San Joaquin River from the Coast Ranges, typically causing subsurface outflow from the area. In the confined zone beneath the Corcoran Clay, water tends to move southwesterly.

SLWD has participated with the SL&DMWA and other neighboring districts in the approval and implementation of annual programs to allow individual landowners to pump groundwater into the DMC for credit.

6. Groundwater Banking Plan

SLWD does not have a groundwater recharge or banking project of its own. SLWD has stored water in the Kern Water Bank in the past.

C. Other Water Supplies

1. "Other" water used as part of the water supply – Describe supply

SLWD has no other long-term supplies of either surface or ground water. Due to ESA driven water allocation reductions and drought, SLWD routinely purchases supplemental water on the open market. Most such purchases are for one year, however a few supplemental water sources are based on five year agreements.

The only other source of water for SLWD is precipitation. SLWD has assumed that effective precipitation is one-half of total precipitation.

D. Source Water Quality Monitoring Practices

1. Potable Water Quality (Urban only)
SLWD is not currently considered an Urban contractor due to the small quantity of urban water it supplies, but it does operates a water treatment facility supplying treated water to 59 homes and 5 commercial customers. A copy of the district's latest Consumer Confidence Report is included as **Appendix I**.

2. Agricultural water quality concerns: *Yes* _____ *No* ____X____
(If yes, describe)

SLWD does not independently monitor surface water quality in the DMC or SLC. Water quality in these canals is monitored by the SL&DMWA and the DWR and is available to SLWD upon request. Agricultural and M&I use is not limited by the quality in either of these canals.

3. Description of the agricultural water quality testing program and the role of each participant, including the District, in the program

DWR routinely monitors water quality in the San Luis Canal at numerous points for TDS, EC, salinity, chlorides and numerous other constituents. The SLDMWA monitors water quality in the DMC at numerous locations, routinely testing TDS, EC, salinity, selenium boron, arsenic and mercury. See **Appendix M** for a comprehensive description of the monitoring plan.

All groundwater wells participating the DMC pump-in program are analyzed at least once every three years for agricultural constituents. Well upstream of check 13 are tested for the full suite of Title 22 Drinking Water standards. **See Appendix M** for more information. The District contracts with certified labs to collect and analyze samples.

The District is a member of the West Side San Joaquin River Watershed Coalition pursuant to the Regional Board's Irrigated Lands Program. Water quality samples are occasionally taken at four sample points in the District. EC and toxicity analysis is initially performed. If laboratory flora or fauna response indicates toxicity, samples are further analyzed for pesticides and herbicides. Flows at the Districts sampling points occur infrequently and only during substantial local storm events. No flows occurred in water year 2010/11.

4. *Current water quality monitoring programs for surface water by source (Agricultural only)*

DWR routinely monitors water quality in the San Luis Canal at numerous points for TDS, EC, salinity, chlorides and numerous other constituents. The SLDMWA monitors water quality in the DMC at numerous locations, routinely testing TDS, EC, salinity, selenium boron, arsenic, mercury and other constituents. **See Appendix M** *Sample: DMC Water Quality Monitoring Results*

5. *Current water quality monitoring programs for groundwater by source (Agricultural only)* See **Appendix N** for sample laboratory reports from wells participating in the DMC Groundwater Pump-in program.

E. Water Uses within the District

1. Agricultural

See Water Inventory Tables, Table 5 - Crop Water Needs

2. Types of irrigation systems used for each crop in current year

Crop name	*Total Acres[1]*	*Level Basin - acres*	*Furrow acres*	*Sprinkler acres*	*Low Volume acres*	*Multiple methods acres*
Alfalfa	*1018.71*	*430.30*	*0*	*588.41*	*0*	*0*
Almonds	*18,849.22*	*0*	*2*	*0*	*18,847.22*	*0*
Apples	*1*	*0*	*0*	*0*	*1*	*0*
Apricots	*301.7*	*0*	*187*	*18.9*	*95.8*	*0*
Asparagus	*116*	*0*	*0*	*0*	*116*	*0*
Barley	*59.3*	*0*	*0*	*59.3*	*0*	*0*
Beans	*166.48*	*0*	*100.51*	*0*	*65.97*	*0*
Cherries	*214.17*	*0*	*0*	*0*	*214.17*	*0*
Citrus	*93.82*	*0*	*0*	*0*	*93.82*	*0*
Corn	*651*	*0*	*615*	*36*	*0*	*0*
Cotton	*2524.57*	*0*	*1541.57*	*393*	*590*	*0*
Flowers	*58*	*0*	*0*	*58*	*0*	*0*
Garlic	*166*	*0*	*0*	*166*	*0*	*0*
Grapes	*225*	*0*	*0*	*0*	*225*	*0*
Melons	*666.28*	*0*	*240.28*	*0*	*426*	*0*
Oats	*437*	*0*	*75.8*	*361.2*	*0*	*0*
Olives	*3*	*0*	*0*	*0*	*3*	*0*
Ornamental	*51*	*0*	*0*	*20*	*31*	*0*
Pasture	*6.7*	*0*	*0*	*6.7*	*0*	*0*
Peaches	*1*	*0*	*0*	*0*	*1*	*0*
Pistachios	*711.73*	*0*	*0*	*0*	*711.73*	*0*
Pluots	*25*	*0*	*25*	*0*	*0*	*0*
Pomegranates	*28.5*	*0*	*0*	*10*	*18.5*	*0*
Prunes	*204.5*	*0*	*59.8*	*0*	*144.70*	*0*
Safflower	*20*	*0*	*0*	*0*	*20*	*0*
Tomatoes	*2802.37*	*0*	*0*	*0*	*2802.37*	*0*
Walnuts	*124*	*0*	*0*	*0*	*124*	*0*
Wheat	*1426.10*	*0*	*727.60*	*211.70*	*486.80*	*0*
Total	*30952*	*0*	*4004.86*	*1929.21*	*25,018.08*	*0*

Note: Most wheat and oats are dry farmed in SLWD. We have listed only that acreage which reported some irrigation. In some cases such irrigation may be only a single application.

3. *Urban use by customer type in current year*

Customer Type	*Number of Connections*	*Year 2010 Use (AF)*
Single-family	59	50
Multi-family		
Commercial	13	83
Industrial	1	8
Institutional	2	48
Landscape Irrigation		
Wholesale	1	420
Recycled		
Rural Residential	20	59
Golf Course	1	131
Stock Water	7	10
Total	104	809

The vast majority of SLWD's M&I usage is wholesale service to SNCWD.

4. Urban Wastewater Collection/Treatment Systems serving the service area

Treatment Plant	*Treatment Level (1, 2, 3)*	*AF*	*Disposal to / uses*
San Luis Hills/Plaza	3 (Tertiary)	30	Landscaping, spray field & fire control
	Total	30	
Total discharged to ocean and/or saline sink		0	

SLWD owns and operates a 75,000 gallon per day tertiary treatment wastewater facility (**Table 9** - SLWD). This facility has been operational since 1994 and is designed to serve approximately 59 homes and 5 commercial businesses (San Luis Hills/Plaza). The treated effluent is stored on site in a lined pond. A minimal amount is used for landscape irrigation associated with the commercial users, and the balance is discharged as necessary to a designated spray field. Water in the lined storage pond can be used for fire control.

5. Groundwater recharge in current year (Table 6)

Recharge Area	*Method of Recharge*	*AF*	*Method of Retrieval*
None		0	
	Total	0	

Geologic conditions preclude intentional groundwater recharge in most of SLWD. There is no managed groundwater recharge occurring within SLWD. Minimal deep percolation infiltrates to a usable groundwater source and is considered incidental groundwater recharge, while the remainder infiltrates to a saline sink or an areas that have no usable groundwater.

*6a. Transfers and exchanges **into** the service area in current year – (Table 1)*

From Whom	*To Whom*	*AF*	*Use*
See **Appendix J***			
	Total		

*Due to the large number of transfers in 2010, they are listed in a separate table.

In nearly all year types, SLWD must transfer into the District additional supplies to meet water needs. Over the past 20 years increasingly diminished CVP water allocations has exacerbated water supply shortfall.

The number of 'internal' transfers is dependent upon the Bureau allocation and the SLWD allocation policy. Another key factor affecting the number of internal transfers is SLWD's allocation policy. For a number of years, SLWD allocated water directly to water users (i.e. lessees or landowners farming their own property). Beginning in 1993, SLWD decided to allocate water to landowners. Each landowner was then responsible for transferring some or all of the allocation to the actual water user on his/her property. This change was made to insure that landowners had complete control of the water allocation associated with their property. This policy change greatly increased the number of internal transfers.

Given the chronic shortfall of CVP allocations transfers out of the District are generally limited in number and quantity. Grower transfers out of the District are prohibited except for a grower transferring to lands they hold in other districts. In addition, the District has adopted policies further limiting transfers out of the District during low allocation years.

*6b. Transfers and exchanges **out** of the service area in current year – (Table 6)*

From Whom	*To Whom*	*AF*	*Use*
See **Appendix J***			
	Total		

Due to the large number of transfers in 2010, they are listed in a separate table.

7. Wheeling, or other transactions in and out of the District boundaries – (Table 6)

SLWD has an annual wheeling arrangement with Central California Irrigation District (CCID) and the Bureau for approximately 400 acre-feet of water. Approximately 150 acres in the DSA near the northern boundary of SLWD do not have a distribution system from the DMC or the SLC. Since this property is located adjacent to CCID's Outside Canal, arrangements have been made for CCID to wheel a portion of SLWD's federal water supply to this property.

From Whom	*To Whom*	*AF*	*Use*
CCID	SLWD	219	Irrigation
	Total		

SLWD does not have any other major wheeling agreements.

SLWD participates in the "Water Reallocation Agreement Among the United States, Santa Clara Valley Water District, and the San Luis & Delta-Mendota Water Authority", executed in April of 1997. The main purpose of the agreement is to encourage Santa Clara Valley Water District (SCVWD) to maximize the use of SWP and local water supplies and to minimize the use of CVP supplies, thereby making more CVP supplies available to other contractors with the SL&DMWA. Prior to this agreement, SCVWD had been reluctant to minimize the use of CVP supplies since the Bureau's M&I allocation formula was based, in part, on historical usage. The agreement calls for certain districts within the SL&DMWA to provide the difference between 75% of SCVWD's contractual supply and 75% of SCVWD's historical usage in those water short years when the Bureau's M&I allocation process would be applicable. In return for this increased level of certainty, SCVWD agreed to provide 100,000 acre-feet of water, within a 10-year period, to those districts providing the increased certainty. SLWD is one of the districts providing the increased certainty. This agreement runs through 2023. SCVWD has delivered their 100,000 acre-foot obligation. Signatories to this agreement, including SLWD, have specific reciprocal obligations if in the future certain M&I shortage conditions occur.

8. Other uses of water

Other Uses	*AF*
NONE	

F. Outflow from the District (Agricultural only)

Aside from runoff generated only in substantial storm events, no water flows out of the District except limited subsurface drainage from the drainage management area. These drainage flows are measured and managed by Charleston Drainage District (CDD).

In calendar year 2010, CDD collected a total of 1,804 AF of drain water. Of that amount 1,633 AF was recycled and blended to irrigate crops, while 171 AF left the District and was delivered to the SJRIP area or discharged to the San Joaquin River. The drain water is mingled with other drainage flows and there is no way to breakout reused drainage verses drainage that is discharged. A total of 14,529 acre-feet were discharged through the Grassland Bypass Project from the entire Grassland

Drainage Area (including CDD) in 2010. The current reuse capacity of the SJRIP is approximately 20,000 acre feet per year.

The SLWD drainage area (approximately 5,200 acres) is part of a 97,000-acre regional drainage entity known as the Grassland Basin Drainers (GBD). The GBD are formed together through an Activity Agreement under the umbrella of the SL&DMWA. The GBD have entered into an agreement with the Bureau for use of a portion (28 miles) of the San Luis Drain to discharge subsurface drainage from these lands to the San Joaquin River.

These subsurface drainage waters are high in salinity, boron and selenium. The subsurface drain water was historically discharged northerly into Grassland Water District and beneficially used for wetland purposes. In 1983 selenium was discovered to be detrimental to waterfowl in the wetlands areas. In order for the Grassland Drainers to continue to be able to discharge drain water to the San Joaquin River, an alternative management program was required.

In 1996 the Grassland Bypass Project was implemented to manage these subsurface drainage waters as they flow through the wetlands. This resulted in the use agreement for the San Luis Drain. The use agreement includes strict limits on how much drainage water (selenium and salt load) can be discharged to the San Joaquin River which subsequently were adopted by the Regional Water Quality Control Board into waste discharge requirements. The GBD have implemented a multi-phased management program to control drainage discharges.

The GBD have implemented policies to reduce and control drainage including limitation of tail water, selenium load allocation, a tradable selenium loads policy, and a monitoring program. Lands within SLWD have installed improved on-farm water application equipment through State Revolving Fund (SRF) loans and have also installed a drain water recycling system in order to limit drainage discharge and conserve water supplies.

Further information on regional drainage issues can be found in the Westside Regional Drainage Plan in **Appendix L**. Additional information regarding long-term management within the Grassland Drainage Area can be found in the “Long-Term Drainage Management Plan for the Grassland Drainage Area”, dated September 30, 1998 and as updated July 1, 1999. In addition, an annual report is prepared for the Grassland Bypass Project. Copies of these documents are available upon request.

1. Surface and subsurface drain/outflow (Calendar Year 2010)

Outflow point	*Location description*	*AF*	*Type of measurement*	*Accuracy (%)*	*% of total outflow*	*Acres drained*
SLWD Drainage Area	See Appendix B	171	Propeller Meters	+/-6%	100%	5,194

Outflow point	*Where the outflow goes (drain, river or other location)*	*Type Reuse (if known)*
SLWD Drainage Area	Used on the San Joaquin River Improvement Project (SJRIP)	Irrigation

Drainwater leaving the District is either reused on the SJRIP or discharged through the Grassland Bypass Project to the San Luis Drain. All drain water is measured by propeller meter at three pump stations. The drain water is mingled with other drainage flows and there is no way to breakout reused drainage verses drainage that is discharged. A total of 14,529 acre feet were discharged through the Grassland Bypass Project from the entire Grassland Drainage Area (including CDD) in 2010. The current reuse capacity of the SJRIP is approximately 20,000 acre feet per year.

Beginning in 2007, CDD began implementing an aggressive recycling program that recirculates the majority of the produced drain water back into the irrigation system to reduce the overall drainage production.

Additional details on the regional drainage plan are provided in **Appendix L**.

2. Description of the Outflow (surface and subsurface) water quality testing program and the role of each participant in the program

The District does not test the quality of outflow water. However, the Grassland Bypass Project does test water quality for subsurface drainage.

3. Outflow (surface drainage & spill) Quality Testing Program

Analyses Performed	*Frequency*	*Concentration Range*	*Average*	*Reuse Limitation?*
Selenium	bi-weekly	0.03 mg/L to 0.13 mg/L	.07 mg/L	selected crops/blending
Boron	Bi-weekly	3.0 mg/L to 8.5 mg/L	4.9 mg/L	selected crops/blending
		3000 µs/cm to	~4300 µs/cm	selected

		6600 µs/cm		crops/blending

Water quality analyses are typically performed bi-weekly, as grab samples at the discharge point. EC reading are taken daily, Monday through Friday (holidays excepted).

Laboratory analyses are performed for selenium and boron. Field measurements for EC are performed using a calibrated field EC meter. Concentrations vary widely throughout the month and year. Approximate ranges by constituent are summarized above.

4. *Provide a brief discussion of the District's involvement in Central Valley Regional Water Quality Control Board programs or requirements for remediating or monitoring any contaminants that would significantly degrade water quality in the receiving surface waters.*

Districts included in the drainage problem area, as identified in "A Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley (September 1990)," should also complete Water Inventory Table 7 and Addendum C (include in plan as Attachment J)

The District is not responsible for groundwater remediation or contaminant plume management, and therefore they are not involved directly in any Central Valley Regional Water Quality Control Board programs. Those responsibilities are assigned to other agencies such as cities, counties, the USEPA or California Department of Toxic Substances Control. SLWD tries to stay informed of contaminant plumes and their management and remediation within District boundaries. SLWD also takes practical measures to prevent groundwater quality degradation.

The District conforms to requirements of the Regional Board's Irrigated Lands Regulatory program by way of its membership in West Side Water Quality Coalition, support for which is funded by an assessment voluntarily imposed on of each irrigated acre in the District. The District promotes the application of best management practices to improve the quality of run-off during major storm events.

G. Water Accounting (Inventory)

Go To Chapter 5 for Agricultural Water Inventory Tables and Instructions.

Section III: Best Management Practices (BMPs) for Agricultural Contractors

A. Critical Agricultural BMPs

1. Measure the volume of water delivered by the district to each turnout with devices that are operated and maintained to a reasonable degree of accuracy, under most conditions, to +/- 6%

a. Number of active delivery points (turnouts and connections) 212[3]

b. Number of delivery points serving more than one farm 14

c. Number of measured delivery points (meters and measurement devices) 228

d. Percentage of delivered water that was measured at a delivery point

100%

e. Total number of delivery points not billed by quantity *0*

f. Delivery point measurement device table

Measurement Type	*Number*	*Accuracy (+/- %)*	*Reading Frequency (Days)*	*Calibration Frequency (Months)*	*Maintenance Frequency (Months)*
Orifices					
Propeller meter	228[1]	+/-6%	See Below	60	annually
Weirs				60	
Flumes				60	
Venturi	7[2]	+/- 6%		60	
Metered gates				60	
Acoustic doppler				60	
Other (define)				60	
Total	235				

1.Includes 53 meters maintained and calibrated by SLDMWA and DWR
2.Owned, maintained and calibrated by DWR
3 Excludes inactive services which have been blind flanged

One hundred percent (100%) of the water deliveries within SLWD are metered. Deliveries through turnouts serving the DSA and through SLWD turnouts are metered with volumetric propeller meters. All pumping plants are equipped with venturi-type differential pressure flow meters. Meters on the DMC and SLC are maintained and calibrated by the SL&DMWA and the DWR, respectively. The meters for turnouts on SLWD's distribution system are maintained and calibrated by SLWD. Every SLWD meter is inspected and maintained annually. Historically calibration has been performed when determined necessary by SLWD or when requested by a water user. All meters purchased by SLWD are accurate to within two percent.

Meter readers routinely time the flow in District meters to confirm totalizer accuracy. The District has historically performed formal calibration tests of meters only on an "as needed" basis, only when discrepancies are noted. SLWD has not historically maintained calibration records for each meter. SLWD plans to enhance its meter calibration program such that all meters will be calibrated at least once every 5 years. Such calibration will be performed in compliance with all applicable requirements, records of which will be maintained for inspection. It is anticipated that this program will be initiated prior to 2014.

The SL&DMWA and DWR read meters weekly to semi-weekly. SLWD meters within IDs 1 and 2 are read daily, and ID 3 meters are read weekly.

There are approximately 125 water users within SLWD. Fourteen metered turnouts serve more than one customer. At these fourteen locations, in addition to the master meter, additional in-line propeller meters have been installed on each point of use. These sub-meters are on located on private property, are owned and maintained by the water users and are used to allocate by user the total amount measured at each master meter. At all times the amount of water allocated to the sub meters equals the total recorded on the District's meter.

The San Luis and Delta Mendota Water Authority calibrate 27 meters on the DMC, pursuant to a maintenance and measurement program approved by USBR. DWR reads, maintains and calibrates 33 meters on the San Luis Canal.

2. Designate a water conservation coordinator to develop and implement the Plan and develop progress reports

Name: Martin McIntyre *Title:* District Manager

Address: PO Box 2135, Los Banos, CA 93635

Telephone: (209) 826-4043 *E-mail:* mcintyre.martin@gmail.com

Martin McIntyre, the District Manager, is the designated Conservation Coordinator. He coordinated all District activities and goals discussed in the Water Management Plan and communicated with the USBR. Specifically, the Conservation Coordinator assisted with planning new facilities, attending regular Board meetings, and implementing Best Management Practices. All these tasks further the goals and objectives in the USBR Best Management Practices Guidelines. Martin McIntyre is currently designated to continue his role as the Conservation Coordinator. His responsibilities will include management and on-going evaluation of BMPs, identifying new water conservation and water management programs, maintaining records on BMPs including water supply statistics and expenditures, and preparing annual and five-year updates to the Water Management Plan.

3. *Provide or support the availability of water management services to water users*
   See Attachment 2, Notices of District Education Programs and Services Available to Customers.

The District maintains an extensive library of educational materials available upon request. Brochures and other literature are also made available for general distribution to interested parties.

The District holds a minimum of two workshops per year which all landowners and growers are strongly encouraged to attend. Participants are informed of evolving water management services and practices. Subjects typically include good water management practices and BMPs for nutrient, pesticide and herbicide management.

During the past five years, the District has not consistently maintained records of distributed information. During the term of this 2012 WMP the District will enhance this effort.

a. On-Farm Evaluations

1) On farm irrigation and drainage system evaluations using a mobile lab type assessment during the past five yeas:

	Total in district	*# surveyed last year*	*# surveyed in current year*	*# projected for next year*	*# projected 2nd yr in future*
Irrigated acres					
Number of farms	0	0	0	0	0

Mobile Lab services were first made available to SLWD customers in 1986. Since then they have been offered through several funding sources including SLWD, Los Banos Resource Conservation District, San Joaquin Valley Drainage Program, USDA Agricultural Research Service Water Management Unit, SL&DMWA, USBR and the Irrigation Training and Research Center at California Polytechnic University, San Luis Obispo. No agencies or organizations are offering free or subsidized evaluations. During the past five years, no on-farm evaluations have been offered by SLWD. However SLWD continues to encourage the use of on-farm irrigation evaluations.

Given rapidly increased water costs and diminished supplies, SLWD growers have become keenly aware of the need for on farm efficiency. Given the soaring cost of water and limited availability' many if not most growers rely on irrigation consultants or trained farm staff for on-farm evaluations. SLWD will commence annual surveys of on farm evaluations included, who and how they are being performed. The District will

promote and/or sponsor mobile lab services to the extent appropriate given survey results. Growers will be notified of such services by e mail, phone and newsletter.

2) Timely field and crop-specific water delivery information to the water user

All SLWD delivery points are metered and totalized allowing customers to read meters serving their property as frequently as desired. The District also provides customers with documented monthly water use statements detailing water use by turnout within ten (10) days after the end of the month following delivery. SLWD routinely provides reports detailing all activity on a customer's water account (allocations, transfers, usage, etc.) along with actual deliveries through each turnout. The delivery report will also include deliveries to each field if a customer has chosen to supply field information. These reports are mailed to all customers at least monthly, and are provided at any time upon request by phone, e mail or fax.

b. Real-time and normal irrigation scheduling and crop ET information

Due to the high cost of water, most growers are keenly aware that irrigation efficiency is critical. In SLWD most growers employ irrigation consultants or have on staff experts. A spot phone survey revealed that daily and weekly ET data and is typically accessed from CIMIS, Westlands Water District web site and daily reports broadcast on KMJ radio.

Ground truthing by soil probing and crop observation is also critical to optimizing irrigation schedules and crop coefficients. Soil moisture data is collected by hand boring, soil probe and increasingly by permanent probes which transmit real time soil moisture data. Private systems installed by larger growers in San Luis Water District have telemetered weather stations transmitting real time ET and other data from their dedicated weather stations. Several companies provide such instrumentation and routinely market such products to SLWD growers.

Although it is believed that growers throughout SLWD are aware of how to access this information, the District will periodically remind customers by e mail, newsletter and at grower workshops.

c. Surface, ground, and drainage water quantity and quality data provided to water users

SLWD does not independently monitor surface, ground or drainage water quality. Water quality data for the DMC and the SLC, which are the sole sources of SLWD's water supply, are available from the Bureau, DWR, and/or the SL&DMWA upon

request. SLWD has informed customers of the availability of this information, and will continue to do so in the future by way of e mail and newsletter.

As mentioned previously in this Plan, SLWD does not own or operate any ground water wells. Private wells are used as a sole or supplemental source in only a small portion of SLWD. In those years where certain wells are allowed to discharge into the DMC, the SL&DMWA conducts a thorough monitoring and management program regarding water quality.

An extensive drain water quantity and quality monitoring program is conducted within the drainage area as part of the Grasslands Bypass Project (**Attachment 1)**.

d. Agricultural water management educational programs and materials for farmers, staff, and the public

In the past, the Irrigation Technology Research Center (ITRC) at California Polytechnic State University at San Luis Obispo (Cal Poly) has offered several services that could benefit SLWD. Similar programs may be available from the Center for Irrigation Technology at CSU Fresno (CIT). In 2012, SLWD will contact ITRC about the availability of these programs.

SLWD is a member of the West Side Water Quality Coalition (West Side Coalition) pursuant to the Irrigated Lands Program. In conjunction with the Coaltion for Urban/Rural Environmental Stewardship the District sponsored a grower workshop on BMPs for protecting water supplies from pesticide/herbicide contamination.
During the term of this Water Management Plan, the District will sponsor workshops and educational materials summarized below:

Program	*Co-Funders (If Any)*	*Yearly Targets*
Distribution of Educational Materials Focused on Water Quality Protection and Irrigation Efficiency	Unknown	4 Distributions to all growers
Workshops BMPs for Pesticide/Herbicide Management	Unknown	2 per year with minimum of 20 participants
Irrigation Efficiency Workshops	Unknown	2 per year with minimum of 20 participants

See Attachment 2 for samples of provided materials and notices

e. Other

None

4. Pricing structure - based at least in part on quantity delivered

SLWD's water pricing structure is based almost entirely on volumetric delivery charges. With the exception of a $4.70 per acre standby charge, all of the District's water charges (which exceed an average of $175 per acre-foot) are quantity based. All water related costs are collected based on the volume of water delivered (see **Appendix G**). The District pricing structure also includes several incentive pricing policies that are discussed in Section 3.B.4 – Incentive Pricing. Refer to **Appendix E** for tables showing the District's water rates.

5. Evaluate and improve efficiencies of district pumps

At least once every 2 years, District staff compares pump output against rated and historic capacity. Underperforming pumps are refurbished. The Center for Irrigation Technology located at California State University, Fresno anticipates an expanded program of pump efficiency evaluations will be available in the coming two years. It is anticipated that the program will be funded by Pacific Gas and Electric. Currently this program is available only for well pumps. The District is eager to engage these services to evaluate overall pumping plant efficiencies.

	Total in district	*# surveyed last year*	*# surveyed in current year*	*# projected for next year*
Wells	0			
Lift pumps	60	35	25	30

B. Exemptible BMPs for Agricultural Contractors

(See Planner, Chapter 2, Addendum B for examples of exemptible conditions)

1. Facilitate alternative land use

Drainage Characteristic	*Acreage*	*Potential Alternate Uses*
High water table (<5 feet)	0	None identified by SLWD
Poor drainage	5,200	Solar Development, Dry Land Farming, Habitat
Groundwater Selenium concentration > 50 ppb		To be determined by Charleston Drainage District, See Attachment 1
Lower productivity	15,000-18,000	Dry-land farming, urban development, energy projects, grazing and/or habitat

A generalized description of the Districts 64,502 acres can be *approximated* as follows:

Ownership	**Acreage**	**Uses**
Private	31,000	irrigated agriculture
Private	4,000	Intermittent dry farming
Private	23,535	frequently fallowed, grazing, habitat, roads, easements, future M&I
Private	450	M&I, Rural Residential
USA	5,347	CVP project facilities, habitat, parks
State	170	habitat, highway corridors

Approximately 15,000-18,000 acres of the District is generally lower producing due to soil type and/or micro climate. Over time, it has been increasingly difficult for these lands to support the relentlessly increasing cost of water and production. They will likely remain permanently fallowed and their water supply transferred to more productive lands. Additional lands are periodically fallowed due to increasingly frequent water supply shortages. In low allocation years, many row crops are abandoned and water supplies moved to permanent crops.

The District exercised a “Multi-Year” Lease Program, where-by landowners transfer their water rights to the District for either three or five years in return for an annual payment of $40 per acre. The result was a guaranteed annual income per acre to participating landowners, regardless of the Bureau allocation, without the obligation to pay for their water allocation. In turn this water is made available to higher value crops. This program continued through the 2010 and is likely to continue into the future. The requirements of the program are explained in Rule No. 7 in the Rule and Regulations (**Appendix D**).

Less than 50% of the District is currently irrigated. Due to reduced water supply allocations and the shift towards higher valued permanent crops some lands will no longer be used for farming purposes. While some landowners are currently fallowing

land on an annual basis to use the water allocation on permanent crops, very little water has been permanently stripped from farmland for these other uses. The SLWD Board of Directors has developed policies and procedures to facilitate and manage this shift in land and water use (See Rule No. 7.D. in **Appendix D**).

The Record of Decision for USBR's San Luis Drainage Feature Re-evaluation, identifies land retirement as a suitable alternative to the provision of drainage service. Out of the 5,200 acres in SLWD determined to be "drainage impaired", the District has secured a permanent, recorded, non-irrigation covenant from a landowner who has proposed the development of a solar energy project on these lands. The remaining 4,200 acres of SLWD lands with a subsurface drainage problem will be retired, converted to alternative land uses, or provided drainage service . See **Attachment 1** for details.

2. Facilitate use of available recycled urban wastewater

Sources of Recycled Urban Waste Water	*AF/Y Available*	*AF/Y Currently Used in District*
San Luis Hills/Plaza Treatment Facility (2010)	28	4*

**Treated water in the lined reservoir is used for fire control, and landscape irrigation as needed*

The only available source of recycled water is from SLWD's wastewater treatment facility. As mentioned previously in this Plan, only a minor amount of development is served by this facility, and the annual production of treated wastewater is only 28 acre-feet (2010). A portion of this total is required to remain in a lined reservoir for fire suppression purposes, and as much as possible is used for landscape needs associated with the businesses served by the facility. Any remaining amount is discharged to a designated spray field. No other uses are cost effective. No crop irrigation occurs within two miles of the treatment facility.

The District may eventually have a significant amount of treated wastewater available for recycling or reuse. This will occur if several planned developments in the District are constructed. Plans for the use of this water are currently being reviewed and developed. It appears that the wastewater may be recycled for use on nearby farms. The timeline for completion of these developments is unknown, but will likely be delayed until the real estate market rebounds and south of Delta water supply reliability is restored.

3. Facilitate the financing of capital improvements for on-farm irrigation systems

Program	*Description*
State Revolving Fund Loan Program	Loans to growers

Currently, SLWD administers a State Revolving Fund loan program to assist local growers with irrigation efficiency enhancements. SLWD believes that all growers are currently aware of the program. SLWD will continue to promote the State Revolving Fund loan program and on-farm irrigation improvements through bill inserts and other media.

In 2013, SLWD will research opportunities with the Agricultural Water Enhancement Program (AWEP) for funding on-farm improvements for SLWD growers. The Agricultural Water Enhancement Program (AWEP) is a voluntary conservation initiative that provides financial and technical assistance to agricultural producers to implement agricultural water enhancement activities on agricultural land for the purposes of conserving surface and ground water and improving water quality. AWEP is funded by the Natural Resources Conservation Service (NRCS).

The SLWD will also remain cognizant of other funding opportunities for on-farm irrigation systems and will notify growers via bill inserts.

4. *Incentive pricing*
Describe incentive rate structure and purpose.

Structure of incentive pricing	**Related goal**
Formal District Clearing House For Internal Water Trades	Encourages more efficient water use at the farm level
Bilateral Farm Trades	Encourages more efficient water use at the farm level
High unit water cost	Encourages more efficient water use at the farm level

The Bureau's Incentive Pricing handbook, dated June 1998, identified six examples of programs that meet the requirement of the incentive pricing BMP. SLWD has implemented three of these examples to encourage more efficient water use at the farm level. Following is a description of each of these programs:

<u>Formal District Clearing House For Internal Water Trades</u> – As previously explained, internal water transfers are used extensively by water users within SLWD. All internal transfers are administered by the District. The District maintains a specific water account for each water user that details the various categories of water available to the user and the transactions specific to each category (i.e. allocations, usage, transfer in or

out, etc.). Written transfer agreements are required to transfer water from one user to another. Any financial arrangements between the buyer and seller are handled outside of the District transfer process. Water users are provided summaries, at least monthly, that detail all transactions, including transfers, to their water account.

In addition to internal transfers, SLWD allows landowners the opportunity to transfer some or all of their allocated supply to the District (Multi-Year Lease Program) in return for financial compensation. This water is then combined with other water acquired by the District and sold to water users within the District that request additional water supplies.

Bilateral Farm Trades – Because SLWD is chronically short water supply growers may only transfer water out of the District if they are transferring to land they own or lease in another district. Such transfers require the water user to execute a written transfer agreement with the District and the District to execute a formal transfer agreement, requiring Bureau approval, with the receiving district. SLWD does not charge any type of transfer fee but does collect district administrative and O&M charges that would have been applicable had the transferred water been delivered within the District.

High Volumetric Pricing – In order to qualify as an acceptable program, the Bureau's Incentive Pricing handbook requires that the district's water supply is less than ET and the average on-farm efficiency is greater than 80% or that the district's volumetric rates are higher than $75 per acre-foot. The first of these conditions is met. Section 2 of this Plan documented the water supplies available to the District and the ET of the various crops grown within the District. SLWD's water supply is clearly less than ET, especially since the implementation of Endangered Species Act driven pumping constraints in the Delta. Current long-term average supply is estimated to be 35-45% for federal contractors south of the Delta. Most importantly, the District's volumetric rates average over $175 per acre-foot, providing a costly but very effective incentive to conserve.

5. a) Line or pipe ditches and canals

SLWD's current distribution system consists of 52 miles of pipelines, 14.3 miles of lined canals, and 3.2 miles of unlined canals. Consequently, over 95% of the District's water delivery system is either pipeline or lined canal.

In 2009, SLWD applied for and received a CALFED Water Use Efficiency Grant to install HDPE lining in 3.2 miles of unlined canal. The District ultimately decided not to accept the grant because this section of canal is prone to periodic over-topping during major storm events. It was determined to be impractical to clean HDPE lined canals.

Canal/Lateral (Reach)	*Type of Improvement*	*Number of Miles in Reach*	*Estimated Seepage (AF/Y)*	*Accomplished/ Planned Date*
NONE				

b) Construct/line regulatory reservoirs

Reservoir Name	*Location*	*Describe improved operational flexibility and AF savings*
No additional regulation reservoirs are needed or planned		

6. Increase flexibility in water ordering by, and delivery to, water users

Copies of a sample water bill, annual water application, and water transfer form are included in **Appendix F.**

SLWD requires 24-hour notice for any change in a water delivery (i.e. order, adjustment, or cancellation). The 24-hour requirement is a result of SLWD's need to provide 24-hour notice of water deliveries to the DWR and the SL&DMWA. SLWD often accepts water delivery changes from water users on less than 24-hour notice as long as the changes will not adversely impact operations of the DMC or SLC.

7. Construct and operate District spill and tailwater recovery systems

Terminal reservoirs are located at the end of the Relift and Third Lift Canals, and each has pump-back facilities to return any operational spills to the canal. Due to the installation of flow control gates on the Relift Canal, virtually no water spills into the reservoir located at the end of this canal. This reservoir is only used for emergency spill situations. Improvements have also been made to the Third Lift Canal. As a result, virtually no water spills into the reservoir located at the end of this canal. If spills occur, the water is pumped back into the canal for delivery.

No operational spills occur from the pipeline distribution systems within SLWD.

Distribution System Lateral	*Annual Spill (AF/Y)*	*Quantity Recovered and reused (AF/Y)*
SLWD has 8 spill recovery reservoirs. These are rarely used due to automation improvements made to the irrigation system. Any water spilled, is returned to the irrigation system.	0	
Total	0	

In theory, irrigation water could flow into Little Panoche Creek or Los Banos Creek. However, SLWD's Rule No. 18 (**Appendix D)** prohibits the discharge of tail water into district facilities. All tail water must be kept on-farm. (Note: Rule 18 was modified in 2005 to specifically prohibit any discharge of water to other lands or natural stream channels.)

Acres where tail water does drain into distribution system: None

Annual tail water collected (AF/Y): None

Acres where tail water is currently lost: None

Estimated potential additional tail water recovery (AF/Y): None
(Measure within 3 years.)

Drainage System Lateral	*Annual Drainage Outflow (AF/Y)*	*Quantity Recovered and reused (AF/Y)*
Total	171	.153*

*Estimated quantity reused by the San Joaquin River Improvement Project as discussed in Section F

8. *Plan to measure outflow.*
No water is known to flow out of the district except for approximately 171 AF of drain water (2010) monitored and measured at three locations by Charleston Drainage District. Rule 18 of the District Rules and Regulations prohibits the discharge of such water from landowner's parcels. The California Regional Water Quality Control Board Irrigated Lands Monitoring Program monitors water quality of storm water run-off at four locations. Storm water flow is intermittent, occurring only during major local storm events.

Total # of outflow (surface) locations/points 0
Total # of outflow (subsurface) locations/points 3
Total # of measured outflow points 3
Percentage of total outflow (volume) measured during report year 100%

Identify locations, prioritize, determine best measurement method/cost, submit funding proposal

Location & Priority	*Estimated cost (in $1,000s)*				
	Year 1	*Year 2*	*Year 3*	*Year 4*	*Year 5*
None	0	0	0	0	0

9. Optimize conjunctive use of surface and groundwater

Describe the potential for increasing conjunctive use of surface and groundwater.

In recent years, SLWD has had limited water supplies due to Delta pumping restrictions, and therefore has had little to no water that could be stored in a groundwater bank. Therefore, SLWD does not own or participate in groundwater recharge or banking projects. Groundwater resources and banking opportunities are extremely limited within the District's boundaries. The District has investigated the feasibility of banking water outside the District. Return water costs in excess of $400 an acre foot and limited return capacity in very dry years has so far rendered such programs infeasible.

The District is collaborating with several other Districts to enhance groundwater recharge in the Los Banos Creek drainage area. Planning and environmental work is under way.

SLWD has participated with the SL&DMWA and other neighboring districts in the approval and implementation of annual programs to allow individual landowners to pump groundwater into the DMC for credit.

One District Landowner, Meyers Family Farms, has developed private groundwater banking facilities located outside SLWD. A primary purpose of the facilities is to provide a more secure water supply for the individual's orchards located within SLWD. The District assists by facilitating the water exchange with USBR so banked water can be returned to the District.

10. Automate distribution and/or drainage system structures
Identify locations where automation would increase delivery flexibility and reduce spill and losses. Describe program to achieve these benefits and estimate the annual water savings.

The entire SLWD irrigation system is automated. No additional improvements are planned or needed at this time.

11. Facilitate or promote water customer pump testing and evaluation
See Attachment 2, Notices of District Education Programs and Services Available to Customers

Benefits from pump efficiency testing include identifying older, inefficient wells that need repair or replacing, and identifying the most efficient wells to use first during groundwater pumping. This can ultimately lead to energy and cost savings.

In the past pump efficiency testing was performed by the SL&DMWA, but this program is no longer active. Pacific Gas & Electric currently offers well pump testing. The program is administered through CSU Fresno. The program offers $200 for testing each deep wells (> 50 horsepower). This would cover part of the cost for a pump test.

SLWD will promote this program through e mails, verbal communication and bill inserts. The bill inserts will also promote the overall benefits of pump testing.

12. *Mapping*

The District has GIS maps of their distribution system and drainage system. Soils data is available from NRCS soils maps. The District does not own any wells and therefore does not maintain maps of groundwater information. The District also has no natural or cultural resources. **Appendix B** includes copies of location and facility maps. Future work will be limited to updating maps with new information.

GIS maps	*Estimated cost (in $1,000s)*				
	2012	**2013**	**2014**	**2015**	**2016**
Layer 1 – Distribution system	0.2	2.5	0.5	0.5	2.5
Layer 2 – Drainage system					
Suggested layers:					
Layer 3 – Groundwater information					
Layer 4 – Soils map					
Layer 5 – Natural & cultural resources					
Layer 6 – Problem areas					

C. Provide a 3-Year Budget for Implementing BMPs

1. Amount actually spent during current year.

SLWD does not track costs specifically related to water management for the BMPs. The costs below are estimates. Enhancement of the District's meter calibration program is estimated to cost $30,000-$40,000 per year.

Year 2013 or Year 1

BMP #		BMP Name	Actual Expenditure (not including staff time)	Staff Hours
A	1	Measurement	$30,000	100
	2	Conservation staff	$0	40
	3	On-farm evaluation /water delivery info	$1,000	25
		Irrigation Scheduling	$500	20
		Water quality	$2,500	10
		Agricultural Education Program	$2,500	20
	4	Quantity pricing	$0	20
	5	Contractor's pumps	$10,000	40
B	1	Alternative land use	$0	20
	2	Urban recycled water use	$0	40
	3	Financing of on-farm improvements	$0	50
	4	Incentive pricing	$0	40
	5	Line or pipe canals/install reservoirs	$0	60
	6	Increase delivery flexibility	$0	20
	7	District spill/tailwater recovery systems	$0	10
	8	Measure outflow	$0	0
	9	Optimize conjunctive use	$0	0
	10	Automate canal structures	$0	20
	11	Customer pump testing	$500	25
	12	Mapping	$2,500	40
		Total	$49,500	600

Hours and costs are estimated.

2. Projected budget summary for the next year.

Year 2014 or Year 2

BMP #		BMP Name	Budgeted Expenditure (not including staff time)	Staff Hours
A	1	Measurement	$30,000	80
	2	Conservation staff	$0	40
	3	On-farm evaluation /water delivery info	$1,000	25
		Irrigation Scheduling	$500	20
		Water quality	$2,500	10
		Agricultural Education Program	$2,500	20
	4	Quantity pricing	$0	20
	5	Contractor's pumps	$10,000	40

B	*1*	*Alternative land use*	$0	20
	2	*Urban recycled water use*	$0	40
	3	*Financing of on-farm improvements*	$0	50
	4	*Incentive pricing*	$0	40
	5	*Line or pipe canals/install reservoirs*	$0	60
	6	*Increase delivery flexibility*	$0	20
	7	*District spill/tailwater recovery systems*	$0	10
	8	*Measure outflow*	*$0*	*0*
	9	*Optimize conjunctive use*	$0	0
	10	*Automate canal structures*	$0	20
	11	*Customer pump testing*	$500	25
	12	*Mapping*	$500	*20*
		Total	$47,500	540

Hours and costs are estimated.

3. Projected budget summary for 3rd year.

Year 2015 or Year 3

BMP #		*BMP Name*	*Budgeted Expenditure (not including staff time)*	*Staff Hours*
A	*1*	*Measurement*	*$30,000*	*80*
	2	*Conservation staff*	*$0*	*40*
	3	*On-farm evaluation /water delivery info*	*$1,000*	*25*
		Irrigation Scheduling	*$500*	*20*
		Water quality	*$2,500*	*10*
		Agricultural Education Program	*$2,500*	*20*
	4	*Quantity pricing*	*$0*	*20*
	5	*Contractor's pumps*	*$10,000*	*40*
B	*1*	*Alternative land use*	$0	20
	2	*Urban recycled water use*	$0	40
	3	*Financing of on-farm improvements*	$0	50
	4	*Incentive pricing*	$0	40
	5	*Line or pipe canals/install reservoirs*	$0	60
	6	*Increase delivery flexibility*	$0	20
	7	*District spill/tailwater recovery systems*	$0	10
	8	*Measure outflow*	*$0*	*0*
	9	*Optimize conjunctive use*	$0	0
	10	*Automate canal structures*	$0	20
	11	*Customer pump testing*	$500	25
	12	*Mapping*	$500	*20*
		Total	$47,500	560

Hours and costs are estimated.

Section IV: Best Management Practices for Urban Contractors

At this time, SLWD does not have 3,000 or more urban connections and therefore is not an Urban Contractor. When and if SLWD is considered an Urban Contractor, the Urban BMPs will be considered and, where appropriate, implemented.

Section V: District Water Inventory Tables

The District Water Inventory Tables are included in **Appendix G**.

SAN LUIS WATER DISTRICT

WATER MANAGEMENT PLAN (2011)

APPENDIX A

ABBREVIATIONS

Appendix A - Abbreviations

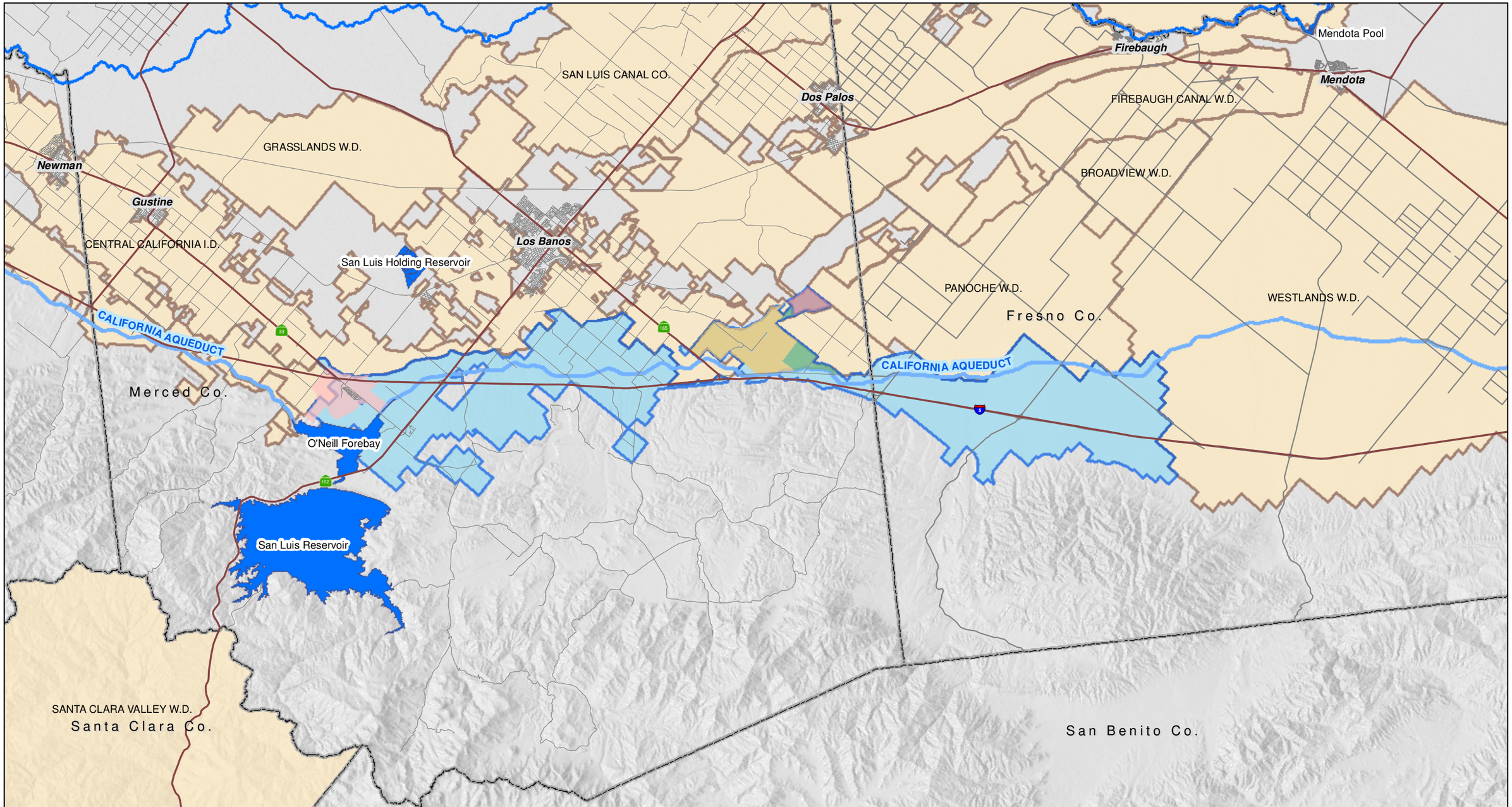
Abbreviation	Description
ac-ft	acre-feet
APS	Advanced Professional Services
BMP	Best Management Practice
Bureau	U.S. Bureau of Reclamation
CCID	Central California Irrigation District
CDD	Charleston Drainage District
cfs	cubic feet per second
CIMIS	California Irrigation Management Information System
CPUSLO	California Polytechnic University, San Luis Obispo
CVP	Central Valley Project
DMC	Delta-Mendota Canal
DSA	Direct Service Area
DWR	California Department Of Water Resources
ET	evapotranspiration
FDR	Bureau crop category
GBD	Grassland Basin Drainers
gpd	gallons per day
hp	horsepower
ID	Improvement District
in	inches
ITRC	Irrigation Training & Research Center
M&I	municipal and industrial
O&M	operations and maintenance
PP	pumping plant
PacWD	Pacheco Water District
PanWD	Panoche Water District
SCVWD	Santa Clara Valley Water District
SL&DMWA	San Luis & Delta-Mendota Water Authority
SLC	San Luis Canal
SLWD	San Luis Water District
SNCWD	Santa Nella County Water District
SRF	State Revolving Fund

SAN LUIS WATER DISTRICT

WATER MANAGEMENT PLAN (2011)

APPENDIX B

DISTRICT LOCATION MAP, FACILITIES MAP AND SOILS INFORMATION



0 1 2 3 4 Miles

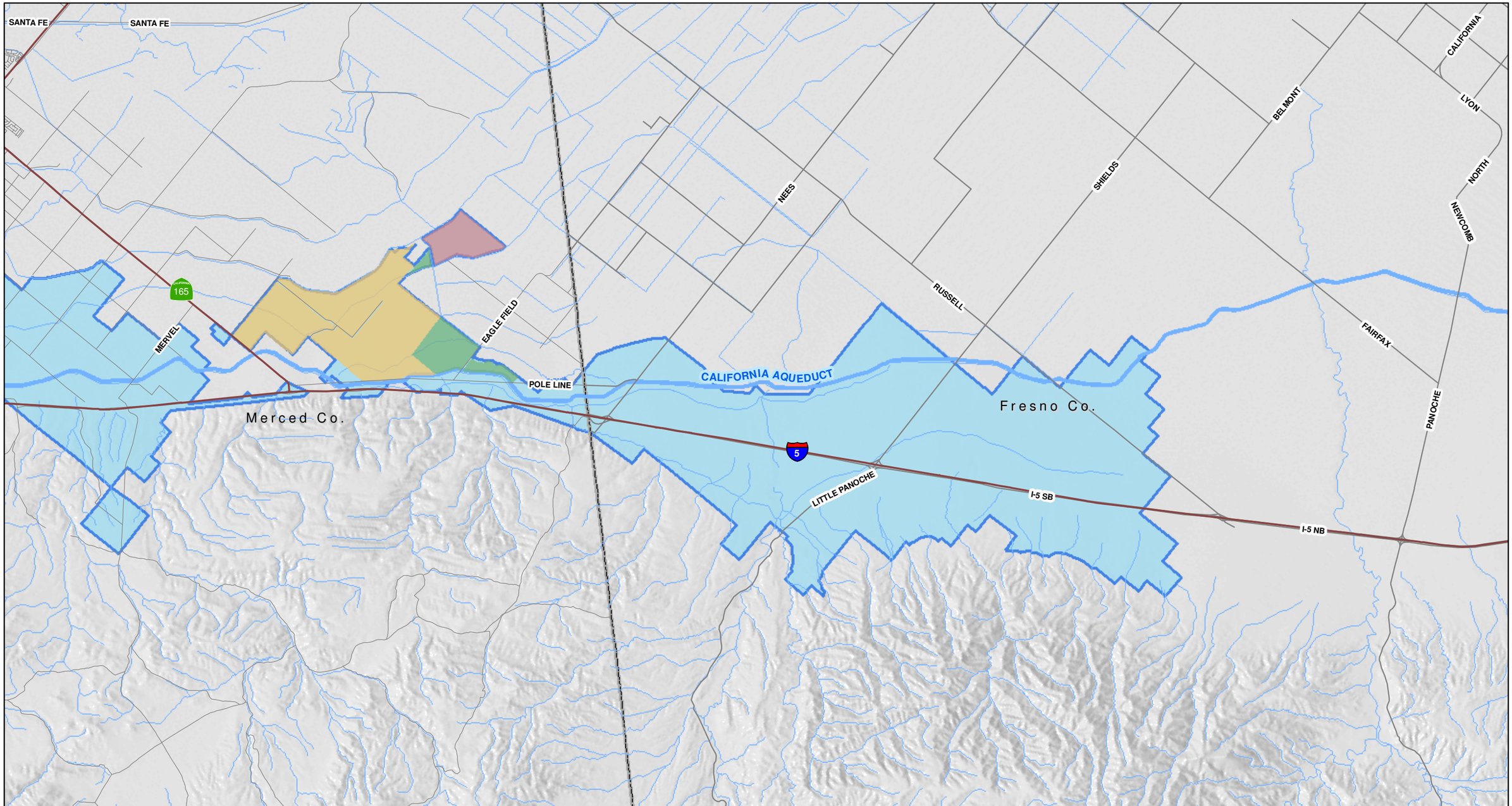
EST. 1968
PROVOST & PRITCHARD
CONSULTING GROUP
An Employee Owned Company
286 W. Cromwell Ave.
Fresno, CA 93711-6162
(559) 449-2700

Legend

- San Luis Water District
- Federal Water Districts
- Santa Nella County Water District
- County Line
- Drained Through Charleston DD
- Drained Through Pacheco WD
- Drained Privately

San Luis Water District

Vicinity Map



0 1 2 Miles

EST. 1968
PROVOST & PRITCHARD
CONSULTING GROUP
An Employee Owned Company

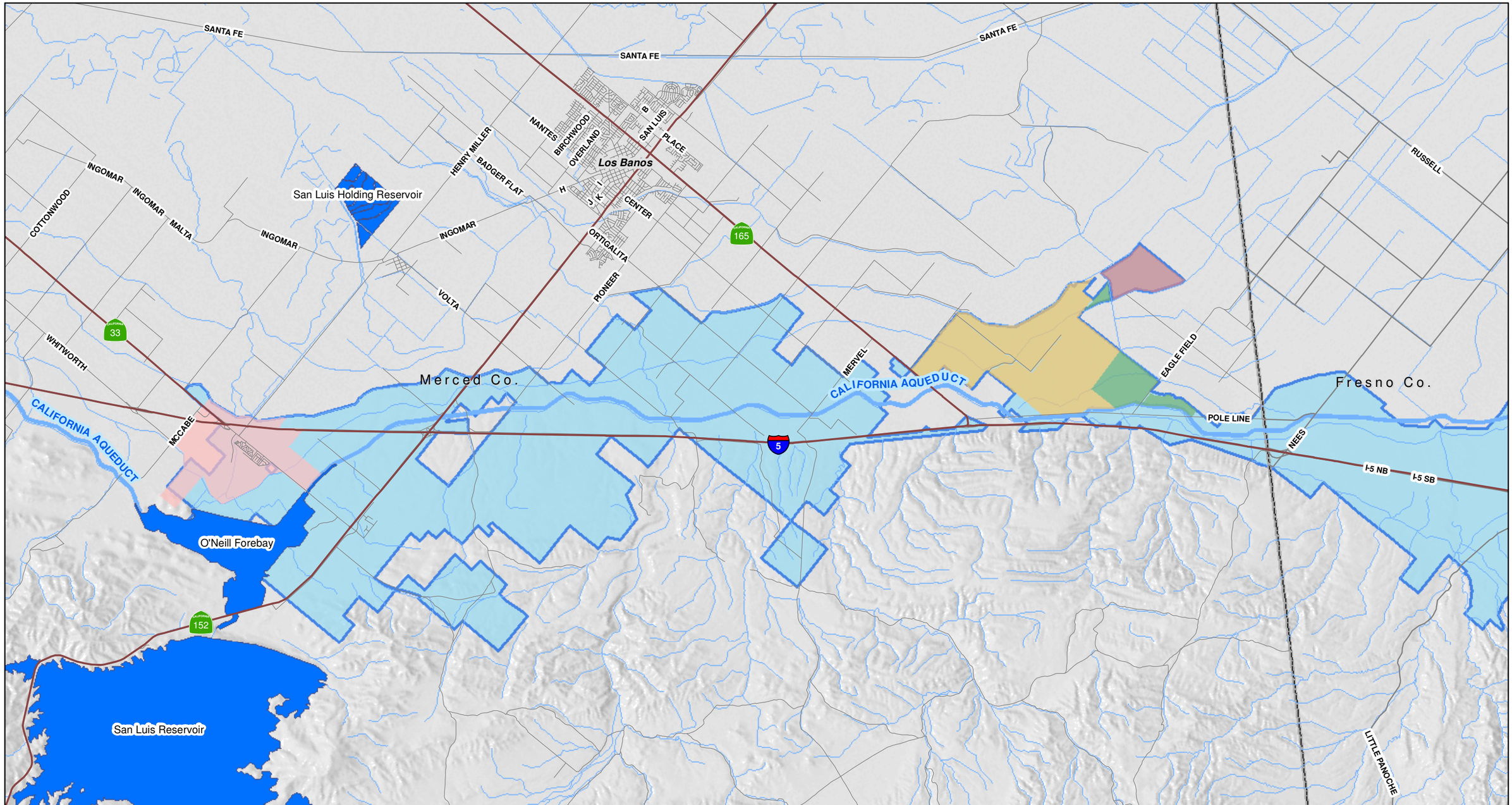
286 W. Cromwell Ave.
Fresno, CA 93711-6162
(559) 449-2700

Legend

- San Luis Water District
- Santa Nella County Water District
- County Line
- Drained Through Charleston DD
- Drained Through Pacheco WD
- Drained Privately

San Luis Water District

Location Map



0 1 2 Miles

EST. 1968
PROVOST & PRITCHARD
CONSULTING GROUP
An Employee Owned Company

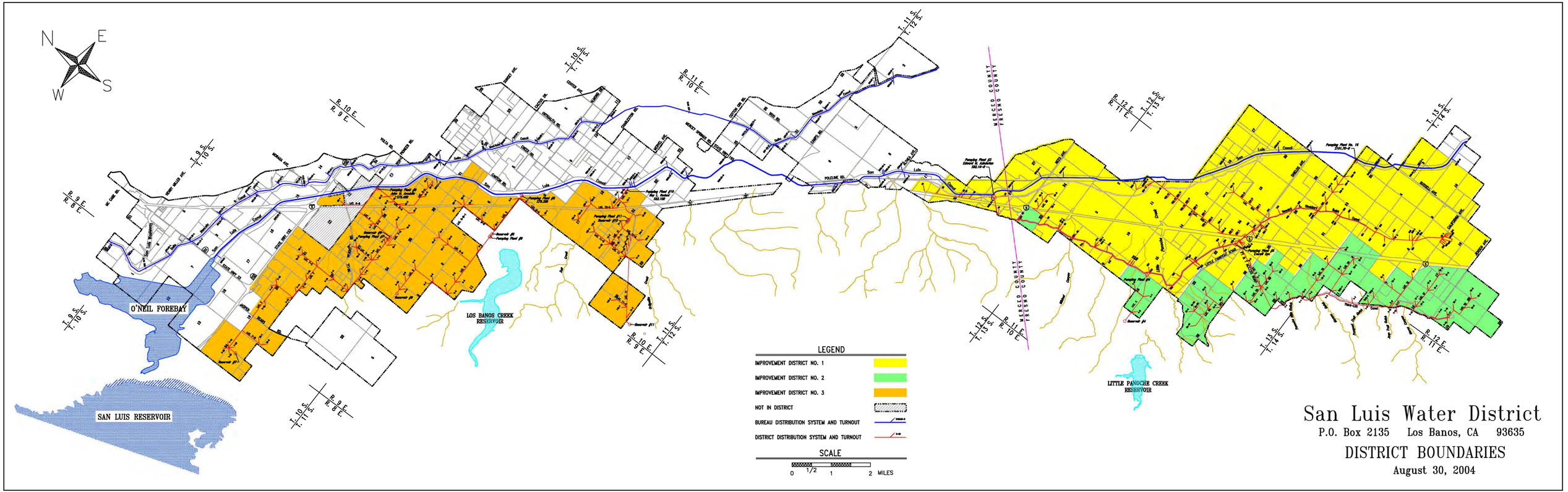
286 W. Cromwell Ave.
Fresno, CA 93711-6162
(559) 449-2700

Legend

- San Luis Water District
- Santa Nella County Water District
- County Line
- Drained Through Charleston DD
- Drained Through Pacheco WD
- Drained Privately

San Luis Water District

Location Map


N
E
S
W
O'NEIL FOREBAY
SAN LUIS RESERVOIR
LOS BANOS CREEK RESERVOIR
LITTLE PANOCHE CREEK RESERVOIR
MERCED COUNTY
FRESNO COUNTY
LEGEND
IMPROVEMENT DISTRICT NO. 1
IMPROVEMENT DISTRICT NO. 2
IMPROVEMENT DISTRICT NO. 3
NOT IN DISTRICT
BUREAU DISTRIBUTION SYSTEM AND TURNOUT
DISTRICT DISTRIBUTION SYSTEM AND TURNOUT
SCALE
0 1/2 1 2 MILES
San Luis Water District
P.O. Box 2135 Los Banos, CA 93635
DISTRICT BOUNDARIES
August 30, 2004

Soils Information

County	Map Unit	Description	Est. Acres
Fresno	107	Anela very gravelly sandy loam, 0-2% slopes	10
Fresno	285	Tranquility-Tranquillity, wet, complex, saline-sodic, 0-1% slopes	228
Fresno	352	Not available	8
Fresno	405	Polvadero-Guijarral complex, 5-15% slopes	28
Fresno	438	Panoche loam, 2-5% slopes	3,304
Fresno	442	Panoche clay loam, 0-2% slopes	2,740
Fresno	445	Excelsior sandy loam, 0-2% slopes	24
Fresno	447	Excelsior sandy loam, sandy substratum, 0-2% slopes	136
Fresno	452	Milham sandy loam, 2-5% slopes	1,344
Fresno	453	Milham sandy loam, 5-9% slopes	66
Fresno	459	Ciervo clay, 0-2% slopes	4,260
Fresno	466	Paver clay loam, 0-2% slopes	3,384
Fresno	474	Westhaven loam, 0-2% slopes	32
Fresno	479	Cerini clay loam, 0-2% slopes	4,700
Fresno	481	Cerini clay loam, 2-5% slopes	2,430
Fresno	588	Mugatu fine sandy loam, 5-30 % slopes	4
Fresno	590	Cerini-Anela-Fluvaquents, saline sodic association, 0-5% slopes	24
Fresno	723	Exclose-Wisflat-Grazer association, 15-65% slopes	76
Fresno	741	Anela-Vernalis association, 0-5% slopes	10
Fresno	851	Los Banos clay loam, 0-2% slopes	1,046
Fresno	853	Los Banos-Pleito complex, 2-8% slopes	2,844
Fresno	855	Pleito gravelly clay loam, 15-30% slopes	142
Fresno	863	Vernalis loam, 0-2% slopes	10
Fresno	950	Pits, gravel	46
Fresno	959	Not available	104
Fresno	960	Excelsior, sandy substratum-Westhaven assoc., flooded, 0-2% slopes	24
Merced	102	Akad-Conosta association, 30-50% slopes	16
Merced	106	Anela gravelly loam, 0-2% slopes	372
Merced	107	Anela very gravelly sandy loam, 2-8% slopes	24
Merced	108	Anela very gravelly sandy loam, 8-15% slopes	12
Merced	109	Apollo clay loam, 2-8% slopes	2,984
Merced	110	Apollo clay loam, 8-15% slopes	1,058
Merced	111	Apollo clay loam, 15-30% slopes	534
Merced	116	Arbuckle Variant sandy loam	98
Merced	117	Arburua loam, 2-8% slopes	372
Merced	118	Arburua loam, 8-15% slopes	100
Merced	119	Arburua loam, 15-30% slopes	314
Merced	120	Arburua loam, 30-50% slopes	4
Merced	123	Ayar clay, 5-8% slopes	72
Merced	124	Ayar clay, 8-15% slopes	50
Merced	125	Ayar clay, 15-30% slopes	12
Merced	126	Ayar clay, 30-50% slopes	138
Merced	128	Ayar-Arburua complex, 15-30% slopes	196
Merced	131	Ballvar loam, 2-8% slopes	614
Merced	133	Bapos sandy clay loam, 0-2% slopes	1,144
Merced	145	Capay clay	234

County	Map Unit	Description	Est. Acres
Merced	147	Carranza gravelly clay loam, 2-8% slopes	56
Merced	148	Carranza-Woo complex, 0-2% slopes	1,488
Merced	149	Chaqua loam, 2-8% slopes	210
Merced	150	Chateau clay, partially drained	124
Merced	151	Chateau clay, ponded	46
Merced	156	Conosta clay loam, 8-15% slopes	284
Merced	161	Damluis clay loam, 0-2% slopes	1,602
Merced	162	Damluis clay loam, 2-8% slopes	2,790
Merced	163	Damluis gravelly clay loam, 0-2% slopes	68
Merced	165	Damluis gravelly clay loam, 8-15% slopes	166
Merced	166	Damluis Variant clay loam	624
Merced	167	Deldota clay, partially drained	1,726
Merced	169	Dosamigos clay, partially drained	1,220
Merced	200	Kesterson loam, ponded	30
Merced	206	Los Banos clay loam, 0-2% slopes	140
Merced	207	Los Banos clay loam, 2-8% slopes	3,528
Merced	208	Los Banos clay loam, 8-15% slopes	570
Merced	209	Los Banos-Pleito clay loams, 2-8% slopes	324
Merced	220	Mollic Xerofluvents, channeled	200
Merced	221	Oneil silt loam, 8-15% slopes	140
Merced	222	Oneil silt loam, 15-30% slopes	768
Merced	223	Oneil silt loam, 30-50% slopes	784
Merced	225	Oquin fine sandy loam, 15-30% slopes	74
Merced	229	Paver clay loam, 0-2% slopes	990
Merced	230	Paver clay loam, 2-5% slopes	384
Merced	238	Pits	332
Merced	239	Pleito gravelly clay loam, 8-15% slopes	408
Merced	240	Pleito gravelly clay loam, 15-30% slopes	214
Merced	249	San Timoteo sandy loam, 2-8% slopes	12
Merced	250	San Timoteo-Wisflat sandy loams complex, 8-15% slopes	96
Merced	251	San Timoteo-Wisflat sandy loams complex, 15-30% slopes	22
Merced	253	Stanislaus clay loam	900
Merced	263	Vernalis loam, 2-5% slopes	2
Merced	271	Wisflat-Rock outcrop-Arburua complex, 30-50% slopes	70
Merced	272	Wisflat-Rock outcrop-Arburua complex, 50-75% slopes	20
Merced	273	Wisflat-Rock outcrop-Oneil complex, 30-50% slopes	118
Merced	276	Woo sandy clay loam, 0-2% slopes	558
Merced	277	Woo clay loam, 0-2% slopes	3,274
Merced	278	Woo clay loam, 2-5% slopes	138
Merced	280	Woo clay, 0-2% slopes	2,796
Merced	281	Woo-Anela-Urban land complex, 0-2% slopes	214
Merced	284	Xerofluvents, extremely gravelly	700
Merced	286	Yokut loam	4

SAN LUIS WATER DISTRICT

WATER MANAGEMENT PLAN (2011)

APPENDIX C

WATER SERVICE CONTRACTS

Water Service Contracts With Bureau

Year	Contract No.	Term (years)	Quantity (ac-ft)	Canal	Water Type	Notes
1974	14-06-200-7567A	1	Up To 5,000	SLC	Agricultural and M&I	
1974	14-06-200-7773A	34	128,000	Both	Agricultural and M&I	
1975	14-06-200-7773A					1
1975	14-06-200-7773A		-2,920			2
1986	14-06-200-7773A					3
1997	14-06-200-7773A-BA					4

Notes

1 Letter agreement modifying the long-term contract by deleting language in Article 22 regarding the sale of excess land

2 Letter agreement modifying the long-term contract by reducing the contractual water quantity by 2,920 acre-feet as a result of excluding land

3 Amendatory contract modifying Article 1 of the long-term contract by changing the definition of "year"

4 Binding agreement regarding early renewal of the long-term contract as provided for in Section 3404(c)(3) of the CVPIA

SAN LUIS WATER DISTRICT

WATER MANAGEMENT PLAN (2011)

APPENDIX D

SAN LUIS WATER DISTRICT RULES AND REGULATIONS

AMENDED AND RESTATED RULES AND REGULATIONS GOVERNING THE USE AND DISTRIBUTION OF WATER IN THE SAN LUIS WATER DISTRICT AND RATES AND TOLLS AND CHARGES FOR THE USE THEREOF.

Table of Contents

Article I

Rule Number ..... Page

1. Control Of Works 1
2. Installation Of Gates 1
3. Use Of Facilities 1
4. Private Ditches And Pipelines 1
5. Distribution Of Water 2
6. Water Allocations 2
7. Water Transfers 3
8. Description Of Charges And Billing Procedures 6
9. Water Orders 7
10. Rescheduling Water 8
11. Supplemental Water 9
12. Over-Usage of Water 11
13. Access to Land and Ditches 14
14. Compliance With Rules 14
15. Non-Liability of District 14
16. Extra Work Performed by the District 14
17. Changes in Rules and Regulations 15
18. Prohibition of Discharges 15
19. Handling of Disputes 15
20. Equitable Relief 15
21. Encroachments 16
22. Unauthorized Installation 16
23. Personal Liability 16

Article II

1. General Rules for Operation of Domestic Water and/or Domestic Sewer Systems 17
   - A. Notice of Content of Rules 17
   - B. Collateral But Binding Documents 17
   - C. Extra-Jurisdictional Services 18
   - D. Establishing Enterprise Accounts 18
   - E. Authority of General Manager 18
2. General Conditions for Delivery of Domestic Water 18
   - A. General Conditions 18
   - B. Raw Untreated Water 19
3. Procedures for Billing and Collection for Domestic Water and/or Domestic Sewer Services 20

These rules and regulations are adopted pursuant to Section 35423 of the Water Code of the State of California to effect orderly, efficient and equitable distribution and use of water. All rules and regulations heretofore adopted are hereby repealed and superseded by these rules and regulations.

It is not the intent in formulating rules and regulations governing the distribution and use of water to arbitrarily impose unreasonable restrictions on water users. One purpose of the rules and regulations is to permit the water to be handled in an orderly way so that water users can be served with some regularity and receive equal treatment in that regard. No rules and regulations can be enforced without the cooperation of the water users. We therefore request your cooperation in this, to the end that water users may receive equal treatment in the matter of water service. The benefits the landowners and water users derive from the District will be measured by the extent to which they cooperate to make it a success. It is the express intent of the District to apply these rules and regulations uniformly throughout the District.

Rule No. 1 - Control Of Works

The maintenance and operation of canals and works of the District or any Improvement District within the District shall be under the exclusive management and control of the General Manager appointed by the Board of Directors. No other person except District employees designated by him for the purpose shall have any right to interfere with said canals and works in any manner, except in the case of an order from the Board of Directors.

Rule No. 2 - Installation Of Gates

No gate, takeout, siphon or other structures or device shall be installed or placed in any canal, ditch or conduit belonging to the District except in the pursuance of plans adopting or orders made by the Board of Directors, nor shall any person divert or take water from any canal, ditch or conduit belonging to the District or under its control, or make any opening therein, or change, molest, disturb or interfere with any gate, takeout or other structure or device in any such canal, ditch or conduit without permission of the System Operator in charge thereof or the General Manager.

Rule No. 3 - Use Of Facilities

Water users shall not permit their livestock to feed or trespass upon the rights-of-way of the District owned canals or ditches, except with specific permission of the General Manager. In cases where it is necessary to cross the rights-of-ways, permission to use the rights-of-way for that purpose must be obtained from the General Manager in advance. Any damage done to canal or ditch banks by water users in using them for a roadway, whether moving livestock, farming equipment for other vehicles, shall be the responsibility of those making such use of the property. If it is found necessary for the District to repair such damage, those responsible therefore shall pay all costs of such repairs.

Rule No. 4 - Private Ditches And Pipelines

All private ditches and pipelines shall be maintained and kept clean by the users thereof at no cost to the District and shall be of sufficient size to carry the irrigation head ordered. In case any ditch or pipeline is found not to be in accordance with this rule, the water shall not be turned into it until this rule is complied with.

Where private ditches or pipelines must be constructed or enlarged to carry water from existing District canals to land to be served, the landowner or user requesting water must provide the right-of-way and

construct or enlarge at no cost to the District a service ditch or pipeline from said land to a District canal designated by the General Manager.

Landowners shall construct and maintain adequate drainage facilities so that adjacent or lower lying lands will not be damaged and no irrigator shall be delivered, in the opinion of the General Manager, a greater amount of water than can economically and beneficially be used without waste and with due regard to the needs of other irrigators.

No landowner shall construct or permit the use of any private facility which provides District water for domestic uses, including without limitation drinking or cooking, without the express prior written consent of the District and compliance with all applicable laws. If the District learns that a landowner has constructed or permitted the use of a private facility which provides District water for domestic uses, the District may immediately terminate any or all water service to such landowner.

The District shall have control of all diversion gates and weirs in private ditches and pipelines to such an extent as may be necessary to enforce the delivery or non-delivery of water in accordance with these rules and regulations, but the District shall not thereby assume or incur any liability for the maintenance or repair of such gates and weirs. Only District employees or persons delegated by them shall have authority to open such diversion gates and they shall have full authority to close such gates as soon as the proper amount of water for each irrigation has been discharged. The District is empowered to place its own locks on such gates, if, in the opinion of the General Manager, it is advisable to do so. If such gates are equipped with locks, the General Manager shall be provided with a key to such locks and, if he is not, then the District may take such action as necessary with regard to the lock in order to make or prevent the delivery.

Rule No. 5 - Distribution Of Water

In accordance with the water service contract with the United States Bureau of Reclamation, irrigation water can only be delivered to non-excess lands, lands subject to a recordable contract, or lands that are otherwise eligible to receive irrigation water under Federal Reclamation law. Irrigation water will not be allocated to ineligible land.

Rule No. 6 - Water Allocations

Under the terms and provisions of the Water Service Contract between the San Luis Water District and the United States of America, dated June 18, 1974, and as amended by letter agreement on January 13, 1976, the District has an entitlement for an annual supply of 125,080 acre-feet of Central Valley Project water. This supply is dependent upon the delivery of such water by the Bureau of Reclamation to the District, and is subject to shortages imposed by the Bureau of Reclamation.

The Bureau shall notify the District each year concerning the total amount of the District's contractual firm supply available. The Bureau may specify a quantity for agricultural use and a quantity for M&I use.

The Board of Directors shall determine on an annual basis the quantity of water to be set aside from the Bureau allocation for distribution system losses. The water set aside shall be maintained in a separate account under the District's name. Improvement Districts shall purchase water from this account for losses incurred by their distribution systems. In the event system losses exceed the quantity of water set aside, the set aside water shall be apportioned among Improvement Districts on a pro-rata basis based on distribution system losses. Each Improvement District will be responsible for purchasing other water to

make up any difference between actual losses and their portion of the water set aside by the Board of Directors.

The District will allocate the remaining Bureau allocation to eligible parcels on a pro-rata acreage basis. The remaining Bureau allocation may be divided into specific quantities of agricultural and M&I water and eligible parcels may be designated to receive either agricultural or M&I allocation. A parcel is eligible if it is subject to the District's Standby Charge, if the Water Deposit Billing has been paid, and if the landowner has filed a Water Application with the District. The Board of Directors shall annually approve the Water Application form and the District will mail such form with the Water Deposit Billing. The Board of Directors shall also annually fix the charge per acre for the Water Deposit Billing. If necessary, the Board of Directors shall specify the quantities of agricultural and M&I water and establish the criteria for designating eligible parcels as either agricultural or M&I.

Once allocated, water shall remain with the landowner (as shown on the last equalized assessment roll or a subsequent purchaser whom the District reasonably believes to be the current owner of the land) at the time the allocation is made, or the recipient of a transfer from such landowner made pursuant to Rule 7, signed by such landowner and received by the District. In the event that a lease is terminated or ownership changes hands during a water year but after the allocation has been made, the new tenant or the person claiming to be the new owner shall have no claim to water previously allocated to such property for that water year unless a transfer has been completed pursuant to Rule 7, signed by the landowner at the time of the allocation and received by the District.

When through lack of water, lack of canal capacity or for any other reason it is not possible for the District to deliver all or any portion of the full supply of water allocated pursuant to the procedures set forth in this Rule No. 6, such supply as can be delivered will be equitably prorated until such time as a delivery of a full supply can be made.

Rule No. 7 – Water Transfers

Other than water transfers to which the District, itself, is a party, no water may be transferred into, within or out of this District except as set forth in this Rule. For the purposes of interpreting this Rule, all water is either Allocated, Individually Acquired or Supplemental Water and all water transfers are either Annual, Permanent or Multi-year Transfers.

A. **Definitions**:

The following definitions shall apply to this Rule:

1. Annual Transfer: An Annual Transfer is for the period of one water year or less.

2. Permanent Transfer: A Permanent Transfer is for an indefinite duration or in perpetuity.

3. Multi-year Transfer: A Multi-year Transfer is for a period of more than one water year but for less than the duration of a Permanent Transfer.

4. Allocated Water: Water allocated by the District as a result of the District's water supply contract with the Bureau of Reclamation.

5. Individually Acquired Water: Water directly attributable to a specific water user acquired from some source outside of the District. Water transferred to the District for a particular water user or water which is pumped into the Delta-Mendota Canal or the San Luis Canal for the credit of an individual water user are examples of Individually Acquired Water.

6. Supplemental Water: Water acquired by the District and made available to water users within the District.

B. **Collection Of Charges On Transferred Water:**
Water transferred into the District will not be added to a water user's account until all costs associated with that water owed to the District, exclusive of the Water Delivery Charges, are paid in full. Neither Allocated, Individually Acquired nor Supplemental Water may be transferred either within or out of the District so long as any charges attributable to the water are delinquent. Charges on water transferred within or outside the District will be established annually as part of the District's budgeting process and may be modified during the course of the water year by Board action.

C. **Consent Required For And Prohibited Transfers:**

1. Supplemental Water: No transfer of Supplemental Water is allowed other than transfers within the District, which are allowed only with the General Manager's consent.

2. Annual Transfers: All annual transfers of either Allocated Water or Individually Acquired Water, into, within or out of the District require the General Manager's consent. A landowner may transfer their Allocated Water to lands they hold in another District. Sale or transfer of Allocated Water by a landowner to parties outside the District is prohibited.

3. Permanent Transfers: All permanent transfers of either Allocated Water or Individually Acquired Water into, within or out of the District are allowed only with the consent of the Board of Directors.

4. Multi-year Transfers: The Multi-year Transfer of Allocated Water within the District is not allowed. The Multi-year Transfer of Individually Acquired Water either into, within or out of the District and the Multi-year Transfer of Allocated Water out of the District is allowed only with the consent of the Board of Directors.

D. **Permanent Transfers of Allocated Water Within The District:**
Permanent Transfers of Allocated Water must be (i) to a parcel within the District, or to the District itself, and (ii) must be performed in a manner consistent with Sections D and E of this Rule 7, and (iii) must include all, and not a portion of, the Allocated Water to which the transferor's parcel is entitled. Permanent Transfers of Allocated Water within the District to an individual or entity, other than the District itself, are not allowed. The District's General Manager, before recommending to the Board of Directors that it approve a Permanent Transfer of Allocated Water from one property in the District to another property in the District, shall make a good faith effort to assure himself that the consent of everyone who

has an interest in the water allocation has been obtained. This shall be accomplished in the following manner:

1. The individual who requests the transfer from property which he purports to own shall provide the District with a title report from a reputable title company showing all parties with a recorded interest in that real property. He shall then provide the District with a written consent to the transfer signed by each person with a recorded interest in the property.

2. The individual who requests a transfer from property shall provide the District with appropriate documentation to establish that he has the authority to obligate the water allocation from the record owner of the property.

   a. If the property is owned by a number of individuals, (either a tenancy in common or joint tenancy), then those who have not signed the water transfer agreement shall have signed a power of attorney or similar document authorizing a representative to sign on their behalf and that representative shall have signed a Water Transfer Agreement in a form acceptable to the District.

   b. If the property is owned by a corporation, limited or general partnership, limited liability company or trust then the same documentation which would be required under state law to cast the vote of the owner for that property in a district election shall be provided to show that a particular individual has the authority to act on behalf of the property and that individual shall have signed a Water Transfer Agreement in a form acceptable to the District.

   c. The term "owned" in the preceding two paragraphs shall also apply to any ownership interest including an equitable ownership such as a deed of trust, mortgage or other voluntary lien. The written consent of all such owners of recorded equitable interests is also required before such a permanent transfer is approved.

3. The parties requesting the transfer of water from property which they purport to own or have authority over, shall also agree to indemnify, defend and hold the District harmless in the event of a claim by any party who has a recorded interest in the real property which arises out of the transfer of the water. A clause signed by the owner or representative of the owner of the land from which the water is being transferred in the District's Agreement to Transfer Water Allocation to this effect shall be considered sufficient to meet this requirement.

E. **Permanent Transfers Of Allocated Water To The District:**
A water allocation may be permanently transferred (i) to the District, or to one or more parcels owned by the District, for the purpose of relieving the transferring parcel of the obligation of the District's standby charge or (ii) to the District for the purpose of transferring the sole management and control over such allocation to the District on terms and conditions approved by the Board at the time of such transfer.

1. A transfer that the Board determines at the time it accepts the transfer is for the purpose of relieving the obligation of the District's standby charge shall relieve the land of the transferor of any obligation to pay standby charges to the District but not of any obligation to pay fees or charges imposed by an Improvement District, including but not limited to Improvement District standby charges, if any. The Board of Directors of the District will consider accepting the transfer of such a water allocation if and only if adequate provisions are made by the transferring owner for the payment or other satisfaction of all charges associated with the water, (other than standby charges payable to the District,) including but not limited to Improvement District charges, if any.

2. The Board of the District may, in its sole discretion, consider accepting a transfer of a water allocation for the purpose of transferring management and control over the water allocation upon application from a landowner. Any such water allocation managed by the District shall be administered by the District separate and apart from any other water allocations pursuant to the District's applicable policy and in accordance with the applicable agreement between the District and the transferring landowner, which agreement shall include such terms and conditions as the Board in its sole discretion determines to be appropriate at the time of the transfer. The District is not prohibited from selling water derived from the transferred allocation to purchasers inside or outside of the District at rates determined by the Board in its sole discretion.

Rule No. 8 - Description Of Charges And Billing Procedures

Charges will be classified as either Water Allocation Charges, Water Delivery Charges, or Standby And Assessment Charges.

A. A Water Allocation Deposit Billing will be sent to landowners specifying eligible parcels subject to the District's Standby Charge, the deposit price per acre for each parcel, and the date by which payment must be made. Failure to make payment by the specified date will result in the loss of a water allocation for that year but will not affect future years' allocations.

The Water Allocation Billing(s) will be sent to landowners who have submitted a valid Water Application, paid their Water Allocation Deposit, and met all other legal requirements the District's Board has imposed for this purpose, in a timely manner. The Water Allocation Billing shall identify the parcels subject to the District's Standby Charge, the quantity of water allocated to each parcel, the per acre-foot water rate applicable to each parcel, and a subtotal of the cost per parcel less any offsetting applicable credit including the Water Allocation Deposit previously paid. The resulting balance due must be paid by the due date indicated on the Allocation Billing; otherwise, water service to the delinquent parcel(s) will be suspended until full payment of the outstanding balance, including a 5% penalty on the outstanding amount, is received. Additionally any unpaid balance will accrue interest at a rate of 1.5% per month.

The Board of Directors shall, at least annually, establish the amount of the Water Allocation Deposit and the Water Allocation Charge. In determining these amounts, the Board shall consider the schedule of rates established by the Bureau of Reclamation for both the Delta-Mendota Canal and the San Luis Canal.

B. Water Delivery Charges are charges which become due when the water is transferred to Another district or is otherwise delivered. They will be billed on a monthly basis to a water user, beginning as soon as possible after the end of the month in which the delivery is made. If they are not paid they become delinquent on the 10th of the month following billing. Interest on the unpaid balance will accrue at a rate of 1.5% per month beginning the tenth of the month following billing. Water service will be suspended for any water user that has delinquent Water Delivery Charges.

The Board of Directors shall annually establish Water Delivery Charges.

Water users that have filed bankruptcy with the District will be required to pay Water Delivery Charges prior to the delivery of water.

All unpaid Water Delivery Charges are a lien on the land upon which the water was used. Amounts which are unpaid prior to the completion of the next assessment role, together with the penalty and/or interest, as applicable, will be added to and become a part of the annual assessment levied against the land. Water service to said land and the applicable water user shall be discontinued until the same inclusive of penalties and interest shall be paid in full.

C. Standby charges and assessments are due and payable on April 1st of each year and will be billed in a timely manner by the District before that date, and may be paid in two equal installments, the first of which shall be delinquent if not paid on or before September 1, and the second installment shall be delinquent if not paid on or before January 1, of each year. Upon delinquency, a penalty of 5 percent of such charges shall be added thereto. Water service on lands upon which standby charges or assessments are delinquent as of January 2, of each year, shall be discontinued until the same inclusive of all penalties shall be paid in full.

D. All unpaid Water Allocation Charges are a lien on the land to which the water was allocated. Amounts which are unpaid prior to the completion of the next assessment roll, together with penalty and/or interest, as applicable, will be added to and become a part of the annual assessment levied against the land. Water service to said land shall be discontinued until the same inclusive of penalties and interest shall be paid in full.

E. Water users or lands with unresolved delinquent charges shall not be eligible for any service or program administered by the District including but not limited to water transfers, water deliveries, water rescheduling, loans and grants, until all delinquencies, inclusive of penalties, are paid in full

Rule No. 9 - Water Orders

The District office must be notified of any change in water delivery by 10:00 a.m. of any working day preceding such change. However, the District reserves the right to reject or modify a water order if, in the opinion of the General Manager, such water order would create an undue hardship on District operations.

Rule No. 10 - Rescheduling Water

The Bureau will determine on an annual basis if rescheduling will be allowed. If so, the Bureau will determine general conditions for rescheduling such as eligible water, the rescheduling period, cost, and losses.

The District will schedule water prior to March 1 so as to maximize the amount of eligible water. The District will schedule water during the rescheduling period so as to maximize usage of rescheduled water.

The District will not reschedule water from a previous year. Water from the current year will be rescheduled upon receipt of a written request from a water user. The District will annually establish the form of the written request and determine the date by which such requests must be received. If allowed by the Bureau, water that is not rescheduled will be returned for credit.

Rescheduled water from another district will be allowed to be transferred in during the rescheduling period. Transfers in of other types of water will not be allowed during the rescheduling period unless all rescheduled water and transfers in of rescheduled water have been scheduled as delivered.

If the amount of eligible water delivered to the District during the rescheduling period equals or exceeds the amount of rescheduled water plus transfers in, all rescheduled water will be protected and water users will have the entire water year to use their rescheduled water.

If the amount of eligible water delivered to the District during the rescheduling period is less than the amount of rescheduled water plus transfers in, then a portion of the rescheduled water will be lost. The following is an example of the process that will be used to determine how this loss will be allocated among water users:

A. The District will calculate the following for each water user during the rescheduling period:

   Usage + transfers of rescheduled water to another water user or district - rescheduled water - transfers of rescheduled water from another water user or district

B. A water user will not lose any water if the result of this calculation positive.

C. The sum of all positive balances plus water losses within the District during the rescheduling period will be used first to protect general district water supplies.

D. Any remaining quantity will be allocated on a pro-rata basis among all water users with a negative balance.

E. Any water user that has a remaining negative balance will lose a like quantity of water.

Water users losing water will still be responsible for payment of all rescheduling or transfer costs associated with the lost water.

Following are definitions for the terms used in Rule No. 10:

Eligible water - water that is eligible for rescheduling as defined by the Bureau

Remaining water - unused water at the end of a water year

Reschedule - the process of transferring eligible water from one water year into the next

Rescheduled water - eligible water desired to be rescheduled minus losses as determined by the Bureau

Rescheduling period - the period during which rescheduled water may be used as defined by the Bureau

Schedule - the process of identifying for the Bureau the types and quantities of water delivered during a given period

RULE NO. 11 – SUPPLEMENTAL WATER

The District may, at the discretion of the Board and depending upon availability and price, acquire water in addition to the normal allocation from the Bureau. If the District does secure such an additional supply it will be equitably distributed based on the principals set forth in this Rule No. 11. Such water is referred to hereinafter, (and elsewhere in these Rules,) as "Supplemental Water"

A. **Application for Supplemental Water** – In order to avoid situation in which the District acquires water in addition to the normal allocation from the Bureau, which the water users in the District did not utilize (and for which the District is required to pay), the District will provide such water pursuant to the following requirements:

1. Content of Form – At least annually, the Board shall adopt a form Application for Supplemental Water. This form is not to be confused with the Water Application form described in Rule No. 6, which is mailed with the Water Deposit Billing and which is for use in the annual allocation of the District's water supplied by the Bureau of Reclamation. The Application for Supplemental Water shall set forth the quantity of Supplemental Water desired by the applicant, the maximum price per acre-foot the applicant is willing to pay and the parcel/s of land the applicant pledges as payment surety. At a minimum, the pledge shall include all lands to which the Supplemental Water will be applied or other lands and/or deposit adequate to provide payment surety.

2. Eligibility – Any landowner or tenant can apply for a supply of Supplemental Water. In order for an application to be considered for any particular allocation, the applicant must be otherwise eligible to receive water from the District, including but not limited to having no delinquent accounts with the District. An Application for Supplemental Water will not be placed on file unless it is fully completed, signed by the applicant, and accompanied by the required deposit. All completed forms on file with the District shall be considered public records as shall any revisions and/or modifications thereof.

3. Deposit – At the time each year that the Board adopts the form Application for Supplemental Water, the Board will determine the initial amount of a deposit per acre-foot that must accompany each application. The amount of the deposit may be changed by the Board during the course of the year depending upon the price of the water available to the District. If the General Manager, in his sole discretion, determines that an applicant cannot pledge adequate land to provide payment surety, the General Manager may require a larger deposit, up to and including the full amount of the purchase price.

4. Withdrawal – At any time during the course of the year any applicant may, upon written request, withdraw an application. Withdrawal of an application is without prejudice as to filing a new application for Supplemental Water during that same year.

5. Revision – At any time during the course of the year any applicant may, upon written request, revise a previously submitted application. A revision that increases the requested quantity will require an additional deposit. The deposit associated with any decreased quantity may be returned to the applicant at the end of the water year subject to the provisions of A.6 below. Revisions will become effective upon receipt by the District of a fully completed Application for Supplemental Water and, if necessary, payment of an additional deposit. No revision of an Application for Supplemental Water shall affect any previous allocations of Supplemental Water made prior to the effective date of the revision.

6. Refund of Deposit – In the event an applicant requests withdrawal of an application pursuant to A.4 above, or a decreased request pursuant to A.5 above, the deposit associated with that request will be refunded at the end of the water year, or can be applied to a subsequent Supplemental Water request provided one or more of the following conditions has been satisfied:

   a. Supplemental Water has not been acquired by the District for the water year in which the application was filed.
   b. Unfilled requests for Supplemental Water exceed the total amount of the Withdrawal or Revision requested by the applicant.
   c. One or more eligible water users submit a written application to replace the position and obligations of the user requesting Withdrawal or Revision of the original Supplemental Water application.

   Unless one or more of the preceding conditions have been satisfied, the application cannot be Withdrawn or Revised nor will any portion of the deposit be refunded. In such cases, the applicant will be charged the full cost of Supplemental Water.

B. **Allocation of Supplemental Water** – At least once each year, the Board will determine the quantity of Supplemental Water available and the price of this water. The District will allocate the Supplemental Water based on the information contained on the Applications for Supplemental Water. In the event Supplemental Water acquired by the District is less than the total requested, the available Supplemental Water shall be proportionately

allocated based on the amounts requested by each applicant. Different allocations of Supplemental Water may take place during the year and each such allocation may have a different price.

C. **Payment for Supplemental Water** – Supplemental Water will not be allocated to an applicant's account until the District has been paid the difference between the total cost of the Supplemental Water supply allocated to them and the deposit associated with the quantity of water allocated for that particular allocation. If not paid by the due date, (1) the Supplemental Water allocation will be lost, (2) the application will be considered invalid, (3) the applicant's account will be considered delinquent pursuant to Section 8 of these Rules and Regulations, and (4) in the event the District is unable to re-market the water allocated to the applicant for at least the same price applicant agreed to pay, then the applicant will be responsible for the difference between the price he/she agreed to pay and the cost of the re-marketed water. The Supplemental Water which is made available due to the applicant's failure to pay the invoice in a timely manner, shall be offered on a pro-rata basis to the other applicants who shared in the original allocation of that water for the same price as it was originally offered. All unpaid Supplemental Water allocation charges are a lien on the land pledged as payment surety and shall be treated as unpaid Water Allocation Charges pursuant to Section 8. D. of these Rules and Regulations.

D. **Surplus Supplemental Water** – If Supplemental Water is available and the demand from all applicants willing to pay the price of the available Supplemental Water has been met, then the Supplemental Water will be sold on a first-come-first-serve basis at a price established by the Board.

E. **Establishment of an Incidental Supplemental Pool** – Annually the General Manger shall establish an Incidental Pool of Supplemental Water not to exceed 50 acre ft at any one time. Such water shall be used to service small unanticipated demands such as those that might occur for construction water, stock water, accidental excess usage or other such unanticipated events. All allocations from the Incidental Pool shall be at the discretion of the General Manager. Such allocations shall not exceed 5 acre ft each and shall be charged at the highest Supplemental Water rate the District has charged during the previous twelve months. The Incidental Pool shall not be used to cover routine demands that should have been anticipated prior to Water Supply Allocation or the Supplemental Water Application.

Rule No. 12 – Over-Usage of Water

All water delivered by the District is measured by meters, which are available to the user of that water to read. All water users are sent monthly statements of how much water they are entitled to use, which has not yet been consumed. It is the responsibility of the water user to use no more than the water to which he is entitled. In the event that a water user uses more water than the water to which he is legally entitled, the water user is guilty of "over-usage" and shall be subject to the terms of this rule:

A. **Over-Usage Penalty**

1. Application With or Without Criminal Penalties - In the event that the over-usage constitutes a crime under state or federal law, the District reserves the right to report the commission of that crime to the appropriate law enforcement

authorities and to bring charges against the over user. It is the intent of the District's Board of Directors that the penalty provisions of set forth in this Rule shall apply regardless of whether the over-user is charged with or convicted of a crime as a consequence of the over-usage.

2. Initial Determination of Over Usage - As soon as the District is aware that over-usage has occurred, the District shall inform the water user. The water user shall have until the posting of the Water Usage billings to correct the over-usage by increasing the water in the account in question to a level which is equal to or greater than the total amount of water used, (including the over-usage water), in order to avoid the imposition of a penalty. If the over-usage water has not been replaced by the date of the posting of the Water Usage billing which includes the over-usage, then the water user is subject to the penalty set forth in this Rule.

3. Cumulative Monthly Penalty - An over-usage penalty in the form of a rate per acre-foot of over-usage water shall be established at least annually by the Board of Directors. The penalty shall be applied to all over-usage water each month thereafter until either the end of the water year or the complete replacement of the over-usage water, whichever occurs first. The maximum over-usage penalty which may be accumulated in any given year will be $200 per acre foot.

4. Annual Accounting - District will annually determine if there is an over-usage penalty which has not been paid. To the extent that such an unpaid penalty appears on an account at the time of the annual accounting, it shall be added to any unpaid water bills for the purpose of levying a lien against the real property in question.

B. **Replacement and Recapture of Over-Used Water** - Regardless of whether a penalty is imposed or collected, the over-user is responsible for the replacement of the water which was over-used.

1. Sale of Supplemental Water - To the extent that Supplemental Water supplies are available to replace the over-used water, the District may, at the District's option, declare that the over-user has involuntarily purchased so much of the Supplemental Water as is available, at the price for Supplemental Water previously established by the Board of Directors of the District, up to the full amount of the over-usage. This involuntary sale of Supplemental Water to over-users is final and will not be reversed at a later date, even if a water user with over-usage finds another water supply at a less expensive price.

2. Voluntary Replacement Before End of Water Year - To the extent that Supplemental Water is not available to replace the over-used water, the over-user may acquire water at any time prior to the end of the Water Year and transfer it to the account upon which the over-usage appears and thereby end his status as an over-user.

3. Recapture - If over-usage still exists at the end of a water year, then the District may subtract the over-usage from the next water year's allocation in a manner consistent with this Rule. If any recapture occurs, the Water Allocation Deposit

and the Water Allocation Billing charges on the recaptured water must be paid at the same time and in the same manner as if the recaptured water was being used in the year of recapture. Over-used water will be recaptured by debiting accounts in the following priority:

a. To the extent that this recapture can be accomplished by debiting the account of the water user who caused the over-usage, then the District will do so.

b. If the water user who caused the over-usage will not receive an allocation in an amount which is sufficient to allow for the full recapture of the over-used water, then any un-recaptured portion of the over-used water will be recaptured by debiting the account of the land which was the subject of the over-usage.

c. If the over-usage exceeds the total subsequent year's allocation as to all such accounts, then each subsequent year's water allocations shall be debited using the above-mentioned priority until the entire amount of over-usage is recaptured.

C. **Termination of Deliveries** - The district is under no obligation to deliver water if the water user is out of water or is other wise not entitled to the delivery of any water from the District. In order to minimize or avoid over-usage, the District's policy is to terminate deliveries in such a case until a new water supply is acquired. However, there may be circumstances under which the District is unable to terminate water deliveries due to the physical facilities by which the water user takes deliveries of water. In such circumstances, particularly if water deliveries cannot be curtailed to the water user in question without curtailing deliveries to another water user who is not out of water, the District will not terminate water deliveries to the water user who is out of water. In all situations in which the water user is out of water and where the physical facilities allow it, the District will terminate deliveries.

D. **Grievance Procedure** - The grievance procedure developed by the General Manager in compliance with the provisions of Article II of the District Rules, Section III, E, shall be applicable to all staff determinations made pursuant to this Rule 12. The District's initial notice to the water user of the over-usage shall include notification of the availability of this procedure. If a grievance is filed by a water user who has been notified that he is in an over-usage situation within three business days of his initial notification from the District of claimed over-usage, then all collection procedures will be held in abeyance until his grievance process has been completed. However, in the event that the grievance process eventually confirms any over-usage, the penalty shall be calculated retroactive to the date of initial posting of the bill, as if the grievance had not been filed. If the water user is out of water, then even the filing of a timely grievance will not serve to delay the District's suspension of further water deliveries.

E. **Exception or Suspension of Enforcement** - The Board of Directors of the District, on its own motion, may make an exception to this rule or suspend the enforcement of this rule for a given class or category of water users if the Board determines either that the enforcement of this rule as against that class or category of water user would be unfair, or

constitute an undue hardship or not be in the best interests of the District as a whole. In such an event, all water users who are in the category or class so benefited shall be informed of the terms of the exception or suspension of enforcement and shall be treated equally.

Rule No. 13 - Access to Land and Ditches

The authorized System Operators and other agents of the District shall have access at all times to all lands irrigated from the canal system and to all canals, laterals and ditches, for the purpose of inspection, examination, measurements, surveys or other necessary purposes of the District, with the right of installation, maintenance, control and regulation of all meters or other measuring devices, gates, turnout, or other structures necessary or proper for the measurement and distribution of water.

Said District assumes no liability for damages to persons of property occasioned through defective ditches, pipelines, laterals, meters or measuring devices.

Rule No. 14 - Compliance With Rules

Refusal to comply with each and all of these rules and regulations or any violation of any of the foregoing rules and regulations or any interference with the proper discharge of the duties of any person employed by the District shall be considered sufficient cause for shutting off the water, and water will not again be furnished until the opinion of the Board of Directors full compliance had been made with all requirements herein set forth.

Rule No. 15 - Non-Liability Of District

The District will not be liable for any damage of any kind of nature resulting directly or indirectly form any private ditch or pipeline or the water flowing therein or for negligent, wasteful or other use or handling of water by the users thereof. The district's responsibility shall absolutely cease when the water leaves the canal or a pipeline of the District. The District is not liable for shortages of water either temporary or permanent or for failure to deliver such water nor for interruptions in the delivery of water. The water user, and not the District, is responsible for installing protective devices to protect his private pump or other facilities from damage due to high water pressure and low water pressure which may occur from time to time in the District's water system.

Each property owner shall be responsible to the District for all damage to District property caused by his own negligent or careless acts or the negligent or careless acts of any agent, tenant, employee of the property owner. The cost of all such damage to the District shall be billed to the landowner.

Rule No. 16 - Extra Work Performed By The District

From time to time the District may agree, subject to the availability of District employees and equipment, to perform additional work on or for the benefit of property within the District. The District may require a deposit for any such work. Any such work performed by the District or by one of its employees on behalf or the District, shall be billed to the landowner or water user and shall accrue interest at the rate of 1.5% per month if unpaid 30 days after billing. The District is under no obligation to agree to perform any such work for anyone, but if the District should undertake such work then the District shall perform it in a workmanlike manner and shall complete the job to which it has committed.

All unpaid charges for such work are a lien on the land upon which the work was performed. Amounts, which are unpaid prior to the completion of the next assessment role, together with the penalty and/or interest, as applicable, will be added to and become a part of the annual assessment levied against the land. Water service to said land and, if applicable, to the water user requesting such work, shall be discontinued until the same inclusive of penalties and interest shall be paid in full.

Rule No. 17 - Changes in Rules and Regulations

The Board of Directors reserves the right to change these rules and regulations by majority action of the Board at any regular or special meeting, by adopting an appropriate resolution and spreading such resolution on the minutes of the District, a public record. Publication and dissemination of such changes by the printing of revised rules and regulations will be limited to economically feasible intervals as determined by the Board.

There shall be maintained at the office of the District, however, a loose-leaf master copy of these rules and regulations including all changes made by the Board of Directors, which copy will be open to inspection at any time during office hours of the District.

Rule No. 18 - Prohibiting Discharges

No District landowner or water user shall take any action (i) that would degrade the quality of water in the District's distribution system or in any creek, stream or watercourse within the District's boundaries, (ii) that would adversely affect any District owned, operated or controlled facilities, or (iii) that would result in the violation of any applicable legal requirement. Without limiting the foregoing, the no District landowner or water user shall allow or cause any tail water, runoff, spill water, backwash, other irrigation water silt, algae, chemicals or any other materials to (i) leave that landowner's or water user's property (ii) to enter into any District owned, operated or controlled facilities, or (iii) to enter into any creek, stream or other watercourse within the District's boundaries.

At the expense of the offending landowner or water user, the District will immediately remove upon discovery any facility that results, or could result, in a violation of this Rule No. 18. In addition, District water service to any landowner or water user violating this Rule No. 18 will immediately be discontinued without notice to the offending landowner or water user, and such water service will not be reinitiated until the offending landowner or water user has appeared before the District's board of directors and provided evidence satisfactory to the board of directors that continued violations of this Rule No. 18 will not occur. Any landowner or water user violating this Rule No. 18 will also be responsible for any increased costs incurred by the District as a result of that violation, including without limitation any increased monitoring or compliance costs incurred with connection with any discharge monitoring program undertaken by the District.

This Rule No. 18 will be strictly enforced, and waivers will not be allowed.

Rule No. 19 - Handling of Disputes

When a landowner or water user cannot resolve differences or controversies with the District's System Operator, System Supervisor or the Watermaster, they are to discuss the problem with the General Manager prior to asking the Board of Directors for a final determination. The Board of Directors reserves the authority to act as the final level of appeal on differences and controversies between landowners or water users and District employees.

Rule No. 20 - Equitable Relief

The Board of Directors will strictly enforce these Rules and Regulations in order to ensure consistency and equitable treatment of all District landowners and water users. However, the Board recognizes that unique circumstances may arise from time to time that dictate relief from the strict enforcement hereof. The Board therefore reserves the right to consider such circumstances and grant equitable relief when the Board finds it to be appropriate. Such relief shall only be granted by a unanimous vote of the Board in extraordinary circumstances upon a demonstration of substantial justification for that relief by the party seeking it. Generally, such relief will only be considered if the relevant circumstances are outside of the control of the party requesting relief. Similarly, relief will not be considered or granted if the circumstances giving rise to the request for relief are the result of the actions or negligence of the requesting party.

Rule No. 21 - Encroachments

No trees, vines, shrubs, corrals, fences, buildings, bridges, or any other type of encroachment (either surface or subsurface) shall be planted or placed in, on, over or across any District canal, ditch, conduit or the right-of-way therefore except pursuant to specific written authority of the District's General Manager. Any such encroachment of an unusual or extraordinary nature shall be approved by the Board of Directors. Any unauthorized encroachment may be removed by the District at the expense of the encroacher.

Rule No. 22 - Unauthorized Installation

No delivery gate, pipe, siphon, meter, or any other structure or device shall be installed or placed in any canal, ditch or conduit owned by the District without express written permission and must be in strict compliance with plans and specifications approved by the General Manager or his designated representative. Any such structure or device installed on a District canal, ditch or conduit without approval may be removed by the District at the expense of the owner or other party installing it.

Rule No. 23 - Personal Liability

Any person entering upon District property or District right-of-way does so at his own risk and assumes all risks associated therewith, and by such action accepts the responsibility for any damage to District or private property resulting there from.

RULES AND REGULATIONS OF SAN LUIS WATER DISTRICT CONCERNING BILLING AND COLLECTION FOR DOMESTIC WATER SERVICE AND DOMESTIC SEWER SERVICE

1. General Rules for Operation of Domestic Water and/or Domestic Sewer Systems

A. **Notice of Content of Rules**: The customer for domestic water service and/or domestic sewer services will be provided either with a copy of these rules and regulations or given notice of their existence and an opportunity to obtain a copy and, in either event, will sign an acknowledgment of such notice before domestic services are actually commenced.

B. **Collateral But Binding Documents**:

1. If, at any time, providing services to the domestic water and/or domestic sewer customer should in any way jeopardize the District's position with the Bureau of Reclamation or put the District at risk for being in violation of either a contractual agreement with the Bureau or a Bureau regulation or written policy, then the District may terminate domestic services to the customer if, in the opinion of a majority of the District's Board, such termination is necessary to correct the District's position with the Bureau.

2. If, at any time, providing services to a customer will result in the existence of a "public water system" for purposes of the federal Safe Drinking Water Act without the express prior consent of the District, the District may decline to provide or terminate such service if, in the opinion of a majority of the District's Board, the creation of such a "public water system is not in the best interests of the District. Unless expressly designated as potable domestic water, all water delivered by the district is non-potable and not to be used for domestic purposes. The use of District water for domestic uses without the prior knowledge and consent of the District is prohibited. Any violation by a customer of such prohibition may result in termination of water service, and will result in the District billing that customer for the District's costs (including without limitation actual and consequential damages) resulting from such violation.

3. If, at any time, providing services to the customer should in any way jeopardize the District's sewer discharge permit as to the sewer treatment plant servicing the customer's property or put the District at risk for being in violation of either the discharge permit or any regulations or written policy of either the Regional Water Quality Control Board, the State Water Quality Control Board, Merced County Department of Health or the State Department of Health, then the District may terminate domestic services to the customer if, in the opinion of a majority of the District's Board, such termination is necessary to correct the District's position with the respective regulatory agency.

4. The Board shall adopt by motion and shall, from time to time, amend by motion a list of substances which shall not be disposed of through the District's domestic sewer systems. The list may vary depending on which treatment plant accepts the sewage from the affected property. A single violation of this policy by a customer may result in termination of all domestic sewer services to that customer and repeated violations shall result in termination of all domestic sewer or both domestic water and domestic sewer services to that customer. Any

violation by a customer will result in the District billing that customer for the District's consequential damages. A charge that a customer has violated this Rule shall provide the customer with a right to pursue the grievance procedure described below but should such procedure either not be initiated or not pursued in a timely manner or exhausted, the District may add the bill for the District's consequential damages to the bill for sewer services and may impose any such unpaid bill as a lien against the real property which was the location of the violation.

C. **Extra-Jurisdictional Services**: The District will not provide domestic water or domestic sewer services outside of its jurisdictional boundaries as a general rule and shall never be compelled to do so. The District shall never provide Project Water, as defined in the District's contract with the Bureau of Reclamation, outside of the Contractor's Service Area, as defined by the District's contract with the Bureau of Reclamation, without the prior consent of the Bureau of Reclamation.

D. **Establishing Enterprise Accounts**: The domestic water enterprise and the domestic sewer enterprise shall each be treated as an enterprise account which is separate and apart from the agricultural water enterprise of the District, in accordance with the principals set forth in the Revenue Bond Act, (Government Code 54300, et seq.). Charges for domestic water and for sewer services, as well as penalties and interest rates for late payment and other events of default and re-connection charges, shall be determined from time to time, (but shall be considered at least annually,) by the Board of the District adopting by resolution a Schedule of Rates which sets the rates for services based on the cost to the District, including administrative overhead and establishes penalties, interest and re-connection charges. The cost of administration may be funded out of a general fund from which each of the enterprises purchase administrative services or it may be operated from one or the other enterprise accounts with the other enterprise accounts purchasing administrative services from that enterprise, or it may be shown as a cost item in each enterprise, depending upon the budget adopted each year by the Board.

E. **Authority of General Manager**: The water system and sewer system of the District are under the exclusive management and control of the Board of Directors of the District through its authorized agents and no other persons shall have any right to interfere with said system and works in any manner. The General Manager is the authorized agent for the Board for all matters. He may delegate his authority in this regard, from time to time, to authorized assistants and the Board may, from time to time, designate other authorized agents as well as the General Manager, should the need arise. The General Manager, or his authorized assistants shall have the right to go upon the property of landowners to check conditions and capacity of private ditches, pipelines, meters, septic systems and other water and/or sewer facilities or to maintain and/or replace existing District property and/or to read District meters.

2. General Conditions for Delivery of Domestic Water

A. **General Conditions:**

1. The provisions of this Article II, Chapter II, shall be inapplicable to the sale of raw, untreated water by the District to any other public agency which is also a water purveyor. Any of the provisions of Article II, Chapter III, hereof may also

be superseded by specific provisions of a written agreement between the District and another public agency which is also a water purveyor which is approved and signed by the Boards of each of the public agencies involved. The exceptions provided by this Rule shall be applicable to and include the Santa Nella County Water District.

2. All installation costs for any domestic water delivery services and/or domestic sewer services allowed by the District shall be paid by the owner of the land to which services are to be provided. All plans for providing a new domestic water and/or domestic sewer service to a customer shall be approved by the District Engineer and any cost of supervision of the installation of necessary facilities shall be paid by the customer.

3. There shall be no cross connections between domestic water systems owned or operated and maintained by the District and any privately owned wells or pipelines except by permit issued by the county health department, a copy of which is provided to the District. No landowner shall construct or permit the use of any private facility which provides District water for domestic uses, including without limitation drinking or cooking, without the express prior written consent of the District and compliance with all applicable laws. If the District learns that a landowner has constructed or permitted the use of a private facility which provides District water for domestic uses, the District may immediately terminate any or all water service to such landowner. All properties provided domestic water service by the District shall have back flow devices installed and in good working order, as is required by the California Code of Regulations and any applicable health and/or building code requirements. Whether the back flow prevention devices are owned by the customer or owned by the District, the District shall have the power to have such devices tested and, if necessary, repaired, at the customer's expense.

4. All domestic water provided to a customer, whether as raw water or as treated water, shall be metered as the water leaves the District's water delivery system and enters the privately owned water delivery system. All properties provided domestic water by the District shall have water meters installed and in good working order as a condition precedent to receiving District domestic water. Whether the water meters are owned by the customer or owned by the District or owned by the Bureau, the District shall have the power to have such devices tested and, if necessary, repaired, at the customers' expense.

B. **Raw Untreated Water:**

1. Any water, whether treated or untreated, delivered by the District for other than agricultural purposes, and any water delivered by the District to owners of less than two acres of land shall be presumed to be purchased for domestic purposes.

2. Whenever raw, untreated water is to be sold for domestic purposes, water service will not be provided by the District until the installation has been approved by the county health department and the services will be discontinued at any time the county health department notifies the District that the user's equipment for filtering or treating said water is not operating properly. Similarly, whenever raw, untreated water is to be sold for domestic purposes, water service will not be

provided by the District if the provision of such service will result in the existence of a "public water system" for purposes of the federal Safe Drinking Water Act without the express prior consent of the District. It shall be the responsibility of the landowner to comply with all of the provisions of Title 17 of the California Code of Regulations and the Safe Drinking Water Act.

3. Procedures for Billing and Collection for Domestic Water and/or Domestic Sewer Services

A. All District customers for domestic water and/or domestic sewer services shall be billed on a monthly basis on a unified or single statement billing system. All payments for services provided shall be credited first to sewer and any other sums owed and lastly to domestic water. If payment in full is not made for services in a timely manner as set forth in these policies, then pursuant to the procedures set forth below, domestic water services will be terminated, and, if payment in full has not been made in an amount adequate to pay for domestic sewer services, those services shall also be terminated.

B. The District will mail or cause to be hand delivered a bill for domestic services to the customer once every month. The bill is due upon dispatch from the District.

1. If the customer has not paid the bill within nineteen (19) days after the bill was mailed or hand-delivered to the customer, then the District shall give the customer a written notice, which gives the customer notice that his services will be terminated if his bill is not brought current. This notice shall be dispatched to the customer in such a manner that the customer is given at least, ten (10) days actual notice prior to the termination of utility services for non-payment. If this notice is given by mail, the ten-day time period shall not begin until at least five days after this notice is deposited in the mail. The notice, however dispatched, shall contain at a minimum, the following information:

a. The name and address of the customer;

b. The amount of the delinquency;

c. The date by which payment or arrangement for payment must be made in order to avoid termination;

d. The procedure by which a customer may initiate a complaint or request an investigation concerning their account, assuming that information is not on the bill (see the consequences of a customer requesting an investigation or making a complaint set forth below);

e. The procedure by which a customer may request amortization of the unpaid charges, including the telephone number of a representative of the District who can provide additional information or institute arrangements for payment.

2. If the customer has still not paid his bill in full two days before the end of this initial notice time period, the District shall give the customer a second notice which is dispatched to the customer in such a manner that the customer is given

at least forty-eight (48) hours notice prior to any termination of service. This second notice shall, at a minimum, contain each of the following:

a. The name and address of the customer;

b. The amount of the delinquency;

c. The date by which payment or arrangement for payment must be made in order to avoid termination;

d. The telephone number of a representative of the District who can provide additional information or institute arrangements for payment.

3. Notwithstanding the nineteen (19) days and the ten (10) days actual notice requirements of subsection (a) above and notwithstanding the forth-eight (48) hours notice provisions of subsection (b) above, the District shall be deemed to have complied with these provisions if the District's General Manager promulgates a billing and collection schedule which is substantial compliance with the foregoing provisions and the District in fact complies with the billing and collection schedule so promulgated by the District's General Manager.

C. If rental property is provided domestic water service or domestic sewer service or both such domestic services it shall be provided such service in the name of the property owner only, and not in the name of the tenant who is not the owner. The District Manager may provide a system whereby, as a service to the owner, a copy of the bill is sent to both the owner and the tenant but this shall not relieve the owner of the duty to pay the bill nor any way compromise the District's ability to treat the owner only as the customer.

D. The General Manager shall develop a procedure for a customer to request the amortization of delinquent charges for domestic water and/or domestic water and sewer services.

1. This procedure shall not allow for the amortization for a period longer than six months without specific authorization by the Board.

2. This procedure must require a customer to need a credit test before the District extends credit to the customer in the form of an amortization agreement. The only exception to the credit test requirement is that the District shall offer an amortization agreement to a customer who is behind in their bill and provides both of the following:

a. The certification of a licensed physician that to terminate the customer's utility would be life threatening to the customer; and

b. The customer is financially unable to pay for the services within the normal time period and is willing to enter into an amortization agreement.

3. This procedure shall allow for termination of services with no more than a forty-eight hour notice should a customer, during the term of the amortization

agreement fail to both keep the current bill paid in full in a timely manner and make the payments on the back bill required by the amortization agreement.

E. The General Manager shall develop a procedure for a customer to pursue grievances with regard to disputed domestic water and/or sewer charges. The grievance procedure shall be separate and apart from and shall not satisfy requirements with regard to tort claims. The General Manager shall designate or ask the Board to designate a District employee to act as Review Manager for the purposes of this grievance process. This procedure shall, at a minimum, meet the requirements and parameters set forth herein.

1. Any customer who wishes to dispute a bill for domestic water or sewer services may file a grievance to seek review of that bill. The grievance procedure shall be designed to give the customer an opportunity for his grievance to be reviewed by the Review Manager, (who shall be an employee of the District other than the person who prepared the billing) and, if in the opinion of the Review Manager it is appropriate, then the Review Manager shall, after his review of the complaint, investigate the customer's complaint. In addition to reviewing the complaint, the Review Manager shall determine whether it is appropriate to offer the customer who filed the grievance an opportunity to enter into an amortization agreement with the District.

2. If such a grievance is filed in a timely manner, the customer may also request as a part of the review process, that District's procedure for termination of domestic water and/or sewer services due to the nonpayment of a bill, be suspended while the District considers the customer's grievance if the customer asserts that the bill is beyond his financial means to pay in full during the pendency of the grievance. Such a request may, in the appropriate case, be granted by the District's General Manager or the Review Manager. Filing of such a request will be considered to be timely if it is made, in writing at the District's office, either

   a. within five days of the customer receiving the bill he wishes to dispute, or

   b. within thirteen (13) days of the dispatch by the District of a 10-day notice on a bill which the customer wishes to dispute.

3. The grievance procedure shall provide a process by which any customer, whose complaint or request for an investigation has not been favorably decided by the Review Manger, has a right to appeal that adverse determination. This procedure may either provide for a direct appeal to the Board of Directors of the District or for an interim appeal to the General Manager, but the procedure shall ultimately allow for a review by the full Board of Directors.

4. If a request for suspension of the utility termination process was granted while the Review Manager considered the grievance, in the event of an adverse determination by the Review Manager, the utility termination procedure shall proceed, whether or not the customer requests a further review of his grievance by the District or by the District's Board of Directors.

4. WATER CONSERVATION ORDINANCE

A. **Application-** This Chapter 4 is applicable to all M&I customers of the District who receive their water directly from the District as a retail service. It does not apply to those customers within the District who obtain their water from another water purveyor, such as Santa Nella County Water District.

B. **Purpose-** To ensure that the District's M&I water supply is put to beneficial use, that waste and unreasonable use of water is prevented and to establish an incremental water conservation plan for implementation in the case of severe drought or other water shortage.

C. **Water Waste Prohibited-** The following uses of water are prohibited at all times:

i. Run Off- Use of water in a manner or to an extent that results in water running to waste down a sidewalk, gutter, storm drain, ditch or across adjacent property

ii. Plumbing Leaks- the escape of water through leaks, breaks or other malfunction in the water users plumbing, distribution or irrigation systems

iii. Use of Open Hose- Use of a hose for any wash down not equipped with an automatic shut off nozzle.

iv. Untended Hose- Irrigation of trees and shrubs with an untended hose

v. Fire Hydrant- the use of any fire hydrant for purposes other than fire suppression without the express approval of the District

D. **Alternate Watering Days** - Addresses ending in an even number may water landscaping only on Tuesdays, Thursdays and Saturdays. Addresses ending in an odd number may water landscaping only on Wednesdays, Fridays and Sundays.

E. **Penalties for Violation-** Penalties for violation of any water conservation rule as provided in this Article 4 are as follows:

i. First violation- warning

ii. Second violation- $25 fine

iii. Third violation- $50 fine

iv. Fourth and all subsequent violations- $100 each

All fines are payable with the next water bill.

F. **Water Shortage Stages-** In addition to the water conservation measures outlined in B and C of this Water Conservation Ordinance the following Rules and Regulations will apply:

1. **Stage I Conservation Measures-** Implemented when the District's CVP water supply allocation is 50% or below, and/or upon declaration of a Stage I shortage by the Board of Directors.

i. Washing exterior surfaces- the washing of sidewalks, fences, walls, driveways, buildings, tennis courts etc. is prohibited except where public health or safety would otherwise be compromised.

ii. Washing vehicles- the washing of cars, trucks, trailers, boats, machinery etc is prohibited except with a bucket and hose with automatic shut off nozzle or at commercial wash facilities.
iii. Water use shall be reduced by 25%

2. **Stage II Conservation Measures-** Implemented when the District's CVP water supply allocation is 25% or below, and/or upon declaration of a Stage II shortage by the Board of Directors.

i. Washing vehicles- the washing of cars, trucks, trailers, boats, machinery etc. is prohibited except at commercial wash facilities.
ii. Residential lawn watering is prohibited
iii. Refilling swimming pools except by water sources approved by the General Manager
iv. Irrigation of trees and shrubs is prohibited except by hand held hose equipped with an automatic shut off valve.
v. Irrigation of golf course fairways is prohibited
vi. Water use shall be reduced by 40%

3. **Other Water Conservation Measures-** In the case of severe water supply shortage or in circumstances not anticipated by this Chapter 4, the District may implement additional measures as necessary to satisfy the purposes of this Chapter.

G. **Exceptions, Waivers and Appeals-**

1. There shall be no exceptions to Section C of this Chapter 4.
2. The General Manager may grant a waiver from the alternate day watering provisions of Section D above for large landscapes such as parks and golf courses, where it can be demonstrated such alternate day watering limitation is not practical.
3. Establishing a new lawn- Except under Stage II Conservation below, the District may issue a temporary waiver of the alternate day watering schedule during the establishment of new lawns or groundcover.
4. The General Manager may issue a waiver under Stage I and II Conservation Measures, for M&I customers who have secured supplemental water supplies approved by the District.
5. Any District M&I customer may appeal the provisions of this Chapter to the General Manager.

SAN LUIS WATER DISTRICT
Rules and Regulations
Index

1.	Current Copy of the Rules and Regulations.	Revised January 29, 2008
2.	Resolution 95 Original Rules and Regulations.	Adopted February 14, 1961
3.	Resolution 92-632 Changing Delinquency Policy	Adopted November 17, 1992
4.	Resolution 96-706 Adding Article II, M & I Rules	Adopted January 23, 1996
5.	Resolution 96-714 Changing Article I, Misc Changes	Adopted March 19, 1996
6.	Resolution 96-726 Amending Rule 8(b)	Adopted September 24, 1996
7.	Resolution 97-732 Amending Rule 10	Adopted February 18, 1997
8.	Resolution 97-743 Amending Rule 7	Adopted June 17, 1997
9.	Resolution 97-748 Amending Rule 7	Adopted September 23, 1997
10.	Resolution 98-767 Amending Rule 8(a)	Adopted July 21, 1998
11.	Resolution 99-793 Amending Rule 8 (b & d) adding Rule 12	Adopted December 21, 1999
12.	Resolution 00-794 Amending Rule 8 and adding a new Rule 11	Adopted January 24, 2000
13.	Resolution 01-817 Amending Rule 11	Adopted January 16, 2001
14.	Resolution 02-838 Amending Rules & Regulations governing the use and distribution of water	Adopted February 26, 2002
15.	Resolution 02-839 Amending Rule 18	Adopted March 19, 2002
16.	Amendment of Rule 18 Prohibition of Discharges	Adopted August 23, 2005
17.	Resolution 06-910 Amending Rules 8 and 11	Adopted August 8, 2006
	Resolution 07-928 Amending Rule 7, and Rule 11	Adopted November 7, 2007
18.	Resolution 07-931 Amending Rule 7, Permanent Transfers of Water to District.	Adopted December 11, 2007
19.	Resolution 08-932 Amending Rule 11	Adopted January 29, 2008
20.	Resolution 08-942 Adding Article II, Chapter 4, Water Conservation Ordinance	Adopted June 24, 2008
21.	Resolution 08-944 Amending Rule 11	Adopted August 26, 2008
22.	Resolution 09-949 Amending Rule 7	Adopted February 24, 2009
23.	Resolution 09-968 Amending Rule 11	Adopted October 27, 2009

SAN LUIS WATER DISTRICT

WATER MANAGEMENT PLAN (2011)

APPENDIX E

DISTRICT WATER RATES AND ASSESSMENTS

SAN LUIS WATER DISTRICT
SUMMARY OF SUPPLEMENTAL/TRANSFER WATER RATES
2010 WATER YEAR

Description	Cost ($/ac-ft)				
	Direct Service DMC	Direct Service SLC	I.D. No. 1	I.D. No. 2	I.D. No. 3
Water Charges	$311.00	$311.00	$311.00	$311.00	$311.00
Authority Conveyance	$11.43	$38.99	$40.71	$40.71	$40.71
Administrative Charge	$11.00	$11.00	$11.00	$11.00	$11.00
O&M Charge			$13.00	$25.00	
Depreciation Charge			$1.00	$1.00	$1.00
1996 COP Charge			$3.90		
Trinity PUD					
	$333.43	$360.99	$380.61	$388.71	$363.71

*Rate Depends on if delivery is above or below Dos Amigos 231.00%

SAN LUIS WATER DISTRICT
SUMMARY OF AGRICULTURAL WATER RATES
2010 WATER YEAR

Description	Cost ($/ac-ft)				
	Direct Service DMC	Direct Service SLC	I.D. No. 1	I.D. No. 2	I.D. No. 3
Water Charges					
Bureau Water Cost	$41.50	$92.60	$92.60	$92.60	$92.60
Bureau Restoration Charge	$9.25	$9.25	$9.25	$9.25	$9.25
CA SWRCB Permit Fees	$0.00	$0.00	$0.00	$0.00	$0.00
Administrative Charge	$11.00	$11.00	$11.00	$11.00	$11.00
O&M Charge			$13.00	$25.00	
Depreciation Charge			$1.00	$1.00	$1.00
1996 COP Charge			$3.90		
Trinity PUD	$0.11	$0.11	$0.11	$0.11	$0.11
Total Proposed Budget FY 2011	$61.86	$112.96	$130.86	$138.96	$113.96
Total Adopted Budget 2010	**$59.07**	**$100.07**	**$119.58**	**$126.07**	**$101.07**
% Increase Proposed Budget	4.72%	12.88%	9.43%	10.22%	12.75%

This is a summary of rates for water allocated by the District. Other water (DMC well water, transfers in, etc.) may have different and/or additional rates.

SAN LUIS WATER DISTRICT
SUMMARY OF M&I (UNTREATED) WATER RATES
2010 WATER YEAR

Description	Cost ($/ac-ft)				
	Direct Service DMC	Direct Service SLC	I.D. No. 1	I.D. No. 2	I.D. No. 3
Water Charges					
Bureau Water Cost	$26.50	$49.60	$49.60	$49.60	$49.60
Bureau Restoration Charge	$18.25	$18.25	$18.25	$18.25	$18.25
CA SWRCB Permit Fees	$0.00	$0.00	$0.00	$0.00	$0.00
Administrative Charge	$40.00	$40.00	$40.00	$40.00	$40.00
O&M Charge			$13.00	$25.00	$0.00
Depreciation Charge			$1.00	$1.00	$1.00
1996 COP Charge			$3.90		
Trinity PUD	$0.11	$0.11	$0.11	$0.11	$0.11
Total Proposed Budget FY 2011	$84.86	$107.96	$125.86	$133.96	$108.96
Total Adopted Budget 2010	**$86.57**	**$104.82**	**$124.33**	**$130.82**	**$105.82**
% Increase Proposed Budget	-1.98%	3.00%	1.23%	2.40%	2.97%

This is a summary of rates for untreated M&I water. Treated M&I water may have different and/or additional rates.

SAN LUIS HILLS
SUMMARY OF UNTREATED M&I WATER RATES
2010 WATER YEAR

Item	Description	Cost ($/100 cf)	Cost ($/ac-ft)
	Water Charges		
1	Bureau Water Cost	$0.114	$49.60
2	CA SWRCB Permit Fees	$0.000	$0.00
3	Bureau Restoration Charge	$0.042	$18.25
4	Administration	$0.092	$40.00
5	Standby Charge	$0.009	$4.10
6	I.D. No. 3 O&M	$0.040	$17.46
7	I.D. No. 3 Assessments	$0.030	$13.09
8	Depreciation Charge	$0.002	$1.00
9	Trinity PUD	$0.000	$0.11
	Total Proposed Budget FY 2011	$0.329	$143.616
	Total Adopted Budget 2010	**$0.322**	
	% Increase Proposed Budget	2.17%	

Detailed Description:

1 U.S. Bureau of Reclamation M&I water rate for the San Luis Canal
2 California State Water Resources Control Board permit fees
3 U.S. Bureau of Reclamation Restoration Fund Charge for M&I water
4 District Administriation for raw (untreated) M&I Water
5 District Standby Charge
6 Improvement District No. 3 Operations and Maintenance Charge
7 Improvement District No. 3 Debt Service Charge
8 Improvement District Depreciation Charge for equipment and vehicle
9 Trinity Public Utility District Energy Fees

SAN LUIS HILLS
SUMMARY OF TREATED M&I WATER RATES
2010 WATER YEAR

Item	Description	Cost ($/100 cf)	Cost ($/AF)
	TREATED WATER RATE COMPONENTS		
1	Bureau Water Cost	$0.114	$49.66
2	CA SWRCB Permit Fees	$0.000	$0.00
3	Bureau Restoration Charge	$0.042	$18.30
4	Administration	$0.146	$234.00
5	Standby Charge	$0.003	$4.10
6	I.D. No. 3 O&M	$0.040	$17.46
7	I.D. No. 3 Assessments	$0.030	$13.09
8	Depreciation Charge	$0.002	$1.00
9	Trinity PUD	$0.000	$0.11
10	Water Treatment O&M	$6.400	$2,787.84
	FY 2011 WATER RATE	**$6.777**	**$3,125.55**
	Adopted Budget M&I Water Rate FY 2010	**$5.671**	
	% Increase Proposed Budget	19.50%	

Item	Description	Cost ($/100 cf)	Cost ($/AF)
	WASTEWATER RATE COMPONENTS		
11	Administration	$0.391	$234.00
12	Standby Charge	$0.007	$4.10
13	Wastewater Treatment O&M	$19.600	$8,537.76
	FY 2011 WASTEWATER RATE	**$19.998**	**$8,775.86**
	Adopted Budget M&I Wastewater Rate FY 2010	**$17.898**	
	% Increase Proposed Budget	11.73%	

TOTAL PROPOSED FY 2011 TREATED M&I RATE	**$26.78**	**$11,901.41**
Total Adopted Budget M&I Rate FY 2010	**$23.57**	
% Total Treated M&I Rate Increase Proposed Budget	13.60%	

Detailed Description:

1 U.S. Bureau of Reclamation M&I water rate for the San Luis Canal
2 California State Water Resources Control Board permit fees
3 U.S. Bureau of Reclamation Restoration Fund Charge for M&I water
4 District Administriation (Water Treatment)
5 District Standby Charge
6 Improvement District No. 3 Operations and Maintenance Charge
7 Improvement District No. 3 Debt Service Charge
8 Improvement District Depreciation Charge for equipment and vehicle replacement
9 Trinity Public Utility Fees
10 San Luis Hills Community Public Water System Operations and Maintenance (includes power, chemicals, labor, capital improvements, etc.)
11 District Administriation (Waste Water)
12 District Standby Charge
13 San Luis Hills sewer collection and Wastewater Treatment Facility Operations and Maintenance (includes power, chemicals, labor, capital improvements, etc.)

SAN LUIS WATER DISTRICT
SUMMARY OF STANDBY AND ASSESSMENT CHARGES
2010 WATER YEAR

Description	Cost ($/acre)				
	Direct Service DMC	Direct Service SLC	I.D. No. 1	I.D. No. 2	I.D. No. 3
District Standby Charge	$4.70	$4.70	$4.70	$4.70	$4.70
1996 COP - Old Debt			$0.00		
1996 COP - Old Debt Rebate			$0.00		
1996 COP - New Debt			$9.86		
1996 COP - New Debt Rebate			($9.86)		
1996 COP - Canal Lining				$5.59	
1996 COP - Canal Lining Rebate				($1.29)	
1996 COP - Capacity*				$17.05	
1996 COP - Capacity Rebate*				($3.66)	
Shop Repayment			$0.60		
2004 Refunding of CA Loan Puchase Auth.				$19.61	$15.00
2004 Refunding of CA Loan Puchase Auth Rebate				($0.27)	($0.29)
2004 Third Lift Canal Automation					
Westside Watershed Coalition **	2.60	2.60	2.60	2.60	2.60
O&M Standby Charge					$20.00
Total Proposed Budget FY 2011	$7.30	$7.30	$7.90	$44.33	$42.01
Total Adopted Budget 2010	**$6.81**	**$6.81**	**$7.41**	**$70.99**	**$41.78**
% Increase/Decrease Proposed Budget	7.15%	7.15%	6.57%	-37.56%	0.54%

* This charge is only applicable to specific participating parcels.

** This charge is voluntary & only applicable to watershed coalition participant's acreage(includes Westside Coalitio annual dues, Regional Water Quality Management annual dues & recovers SLWD admin & mailing costs)

Special assessments for inclusions, distribution system loans, delinquent water charges, etc. are not included in this summary.

on

SAN LUIS WATER DISTRICT

WATER MANAGEMENT PLAN (2011)

APPENDIX F

DISTRICT SAMPLE WATER BILL, ANNUAL WATER APPLICATION, AND WATER TRANSFER FORM

San Luis Water District
P.O. Box 2135, Los Banos, CA 93635
Telephone: (209) 826-4043 Facsimile: (209) 826-0524

Financial Summary
March 11, 2009 - May 10, 2009

Account #:	
Opening Balance:	13,811.17
Payments:	(19,811.17)
Adjustments:	0.00
Charges:	14,933.84
Closing Balance:	8,933.84

Los Banos, CA 93635

Please Pay This Amount: $8,933.84

Remittance Stub: Please return with your payment.

San Luis Water District Account Statement

Financial Transactions -

4/2/09 2009 Supp. Water Deposit Pool 2 Invoice #62684 Due Date: 4/10/2009 $6,000.00

Invoice Detail	Billing Code	Qty	Unit	Rate	Amount
	Supplemental Water Deposit	300.00	acft	20.00	$6,000.00

4/8/09 Interest Due Date: 4/ 8/2009 $8.40

5/8/09 Interest Due Date: 5/ 8/2009 $16.05

5/10/09 March & April Billing Invoice #63226 Due Date: 6/10/2009 $8,909.39

Invoice Detail	Turnout	Water Category				Qty	Unit	Rate	Amount
	D88.65-RA	Transfers In				106.00	acft	19.12	$2,026.72
		Reading Date	Prior Reading	Final Reading	Adjust	Qty	Unit		
		4/30/2009	10,020.00	10,020.00	0,000.00	106.00	acft		
	S089.15-L	Rescheduled				56.00	acft	16.32	$913.92
	S089.15-L	Transfers In				125.00	acft	47.75	$5,968.75
		Reading Date	Prior Reading	Final Reading	Adjust	Qty	Unit		
		4/30/2009	333.00	499.00	0.00	181.00	acft		

3/13/09 Payment #37309 ($5,677.12)
3/23/09 Payment #37344 ($6,000.00)
4/14/09 Payment #37408 ($8,134.05)

Water Transactions -

Category		Date	Transaction		Quantity	
Number	Description		Number	Description	Ac-Ft	Cc-Ft
WC0005	Transfers In	04/04/09	17760	CCID Well Transfer March	164	0
		05/07/09	17863	Transfer To	-30	0
		05/08/09	17865	CCID Well Transfer April	354	0
		05/10/09	17899	March & April Usage	-231	0
					257	0
WC0006	Rescheduled	03/01/09	17438	2008 Rescheduled into 2009	50	0
		03/19/09	17572	2008 Rescheduled into 2009 10% balance	6	0
		05/10/09	17899	March & April Usage	-56	0
					0	0
					257	0

* Accounts with a negative water balance are subject to a $20/Af per month penalty.
** Water allocated to this account is for agricultural purposes only. Usage for any domestic purpose is a violation of federal law and the District's Rules & Regulations.
*** Payments must be recieved on or before the due date. Postmark dates will not be excepted.

SAN LUIS WATER DISTRICT
ANNUAL WATER APPLICATION
2009 WATER YEAR

Los Banos, CA 93635
Account #

I hereby apply to San Luis Water District for: (please check only 1 box)

- ☐ All
- ☐ An amount not to exceed _____ acre-feet
- ☐ None (***Crop information is still mandatory***)

of my pro-rata share of the District's 2009 water supply, as allocated by the Bureau of Reclamation, for the parcels owned by the above-named entity. The 2009 water year begins on March 1, 2009 and ends on February 28, 2010.

I am aware that the District has adopted Bylaws, Rules and Regulations, and Policies governing various aspects of the District's relationship with its landowners and water users, and that such Bylaws, Rules and Regulations, and Policies may be amended or supplemented from time to time by the District's Board of Directors. I am familiar with the District's Bylaws, Rules and Regulations, and Policies in effect as of the date of this application, and will diligently review all future amendments and supplements thereto. At all times, and as a condition to the continued availability of water to me from the District, I agree to be bound by and comply with all of the District's Bylaws, Rules and Regulations, and Policies as they may be amended or supplemented from time to time.

I recognize that an allocation of District water in any given water-year is contingent upon the availability of said water to the District, submission of an executed Water Application, and full payment of the Water Allocation Deposit Charges by the close of business on March 1, 2009. Failure to meet these conditions will result in the loss of my 2009 Water Allocation.

I acknowledge that the delivery of water to my property is dependent upon several additional requirements. These include, but are not limited to, the submission of all essential certification and/or reporting forms under the Reclamation Reform Act of 1982 (RRA), compliance with all applicable laws, timely payment for all Water Allocation and Delivery Charges whether the water has been transferred to a third party or not. I understand that any unpaid charges for water or water service will be added to the assessment roll and will become a lien on my property.

I accept that I am ultimately responsible for all water delivered to my property and recognize that usage for domestic purposes or outside of the District's boundary is expressly prohibited and grounds for immediate suspension of service. I understand that all water provided to me by the District will be untreated, and that use for human consumption or other domestic purposes could result in illness. I agree to respond to District requests for information regarding water usage, including but not limited to, the Annual Crop & Irrigation Survey. The Annual Crop & Irrigation Survey is mandatory whether I am engaged in agricultural endeavors or not. I understand that any over-usage associated with the delivery of water to my property may ultimately be taken from future water allocations to my property or cause a like quantity of water to be involuntarily sold to me under Section B of District Rule 12 at a price determined by the Board of Directors.

I represent that I have the legal right to make this Application and I will indemnify and hold the District harmless from anyone who holds an interest in the above listed account who claims I acted without due authority.

Failure to submit a signed 2009 Water Application, Crop & Irrigation Survey, or payment for the Water Allocation Deposit billing by 5:00 p.m. March 1, 2009 will result in a 5% deposit penalty if the late application or deposit is accepted by the Board in its sole discretion. Failure to submit all of the above by March 10, 2009 will result in a 10% deposit penalty if the late application or deposit is accepted by the Board in its sole discretion. All late applications and deposits remain subject to Board approval.

_____ _____

Name Date

San Luis Water District
Water Transfer Agreement
2009 Water Year

This Agreement authorizes San Luis Water District to execute the following transfer in the 2009 water year:

❑ Please transfer _____ ac-ft of Category _____ water to the individual/entity identified below.

❑ Please transfer ALL of my 2009 Water Allocation(s) to the individual/entity identified below. I am aware that in checking this box, 100% of the water allocated to my account in this water-year, whether paid for or not, will be automatically transferred to this single account. I agree to remain fully and ultimately responsible for payment of any and all charges, delinquencies, penalties, and/or interest accrued on my account as a result of this decision.

From: Account # _____ Name (Print)_____

To: Account # _____ Name (Print)_____

I am aware that the District has adopted Bylaws, Rules & Regulations, and Policies governing various aspects of the District's relationship with its landowners and water users, and that the District's Board of Directors may amend such Bylaws, Rules & Regulations, and Policies from time to time. I am familiar with the District's Bylaws, Rules & Regulations, and Policies in effect as of the date of this application, and will diligently review all future amendments thereof. At all times, and as a condition to the continued availability of water to me from the District, I agree to be bound by and comply with all of the District's Bylaws, Rules & Regulations, and Policies as they may be amended in from time to time.

I acknowledge that the delivery of water is dependent upon the availability of said water to the District. I represent that I have the legal right to make this transfer and I will indemnify and hold the District harmless from anyone who holds an interest in the above listed account who claims I acted without proper authority.

_____ _____

Transferor Signature Date

_____ _____

Transferee Signature Date

SLWD Transfer No: _____ SLWD Fax Number: (209) 826-0524

SAN LUIS WATER DISTRICT

WATER MANAGEMENT PLAN (2011)

APPENDIX G

DISTRICT WATER INVENTORY TABLES

Year of Data 2010/11 WY **Enter data year here**

Table 1

Surface Water Supply Delivered in 2010/11

2010/11 WY Month	**Federal Ag Water** (acre-feet)	**Federal non-Ag Water.** (acre-feet)	**State Water** (acre-feet)	**Local Water (define)** (acre-feet)	**Other Water** (acre-feet)	**Transfers into District** (acre-feet)	**Upslope Drain** (acre-feet)	**Total** (acre-feet)
Method	M3	M3				M3		M3
March	992	41	0	0	0	3,812	0	4,845
April	3	39	0	0	0	5,075	0	5,117
May	930	74	0	0	0	9,589	0	10,593
June	10,007	93	0	0	0	3,508	0	13,608
July	2,942	118	0	0	0	12,772	0	15,832
August	80	108	0	0	0	9,880	0	10,068
September	414	103	0	0	0	3,735	0	4,252
October	543	73	0	0	0	4,601	0	5,217
November	1,388	43	0	0	0	1,795	0	3,226
December	0	32	0	0	0	105	0	137
January	745	41	0	0	0	319	0	1,105
February	2,744	44	0	0	0	3,658	0	6,446
TOTAL	20,788	809	0	0	0	58,849	0	80,446

Table 2

Ground Water Supply

2010/11 WY Month	Groundwater (acre-feet)	Urban Groundwater (acre-feet)	Agric Groundwater *(acre-feet)
Method			
March	0	0	0
April	0	0	0
May	0	0	2,000
June	0	0	2,000
July	0	0	2,000
August	0	0	2,000
September	0	0	2,000
October	0	0	0
November	0	0	0
December	0	0	0
January	0	0	0
February	0	0	0
TOTAL	0	0	10,000

*Private Groundwater is Estimated

Table 3

Total Water Supply Delivered

2010/11 WY Month	Surface Water Total (acre-feet)	Groundwater (acre-feet)	M&I Wastewater (acre-feet)	District Water (acre-feet)
Method				
March	4,845	0	0	4,845
April	5,117	0	0	5,117
May	10,593	0	0	10,593
June	13,608	0	0	13,608
July	15,832	0	0	15,832
August	10,068	0	0	10,068
September	4,252	0	0	4,252
October	5,217	0	0	5,217
November	3,226	0	0	3,226
December	137	0	0	137
January	1,105	0	0	1,105
February	6,446	0	0	6,446
TOTAL	80,446	0	0	80,446

*Recycled M&I Wastewater is treated urban wastewater that is used for agriculture.

2010/11 WY Precipitation Worksheet					2010/11 WY Evaporation Worksheet				
	inches precip	ft precip	acres	AF/Year		inches evap	ft evap	acres	AF/YEAR
Jan	1.90	0.16	106.06	16.79	Jan	0.87	0.07	106.06	7.69
Feb	1.68	0.14	106.06	14.85	Feb	1.67	0.14	106.06	14.76
Mar	1.41	0.12	106.06	12.46	Mar	3.4	0.28	106.06	30.05
Apr	0.71	0.06	106.06	6.28	Apr	5.54	0.46	106.06	48.96
May	0.35	0.03	106.06	3.09	May	7.29	0.61	106.06	64.43
Jun	0.06	0.01	106.06	0.53	Jun	8.21	0.68	106.06	72.56
Jul	0.02	0.00	106.06	0.18	Jul	8.62	0.72	106.06	76.19
Aug	0.02	0.00	106.06	0.18	Aug	7.44	0.62	106.06	65.76
Sept	0.18	0.02	106.06	1.59	Sept	5.52	0.46	106.06	48.79
Oct	0.48	0.04	106.06	4.24	Oct	3.77	0.31	106.06	33.32
Nov	0.97	0.08	106.06	8.57	Nov	1.82	0.15	106.06	16.09
Dec	1.44	0.12	0.00	0.00	Dec	0.93	0.08	0.00	0.00
TOTAL	**9.22**	**0.77**		**68.76**	**TOTAL**	**55.08**	**4.59**		**478.60**

Table 4

Agricultural Distribution System

2010/11 WY Canal, Pipeline, Lateral, Reservoir	Length (feet)	Width (feet)	Surface Area (square feet)	Precipitatio (acre-feet)	Evaporation (acre-feet)	Spillage (acre-feet)	Seepage (acre-feet)	Total (acre-feet)
Lined Canals	75,504	50	3,775,200	56.2	391.1	0	0	(335)
Unlined Canals	16,896	50	844,800	12.6	87.5	0	776	(851)
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
TOTAL				68.8	478.6	0	776	(1,186)

Urban Distribution System

2010/11 WY Area or Line	Length (feet)	Leaks (acre-feet)	Breaks (acre-feet)	Flushing/Fire (acre-feet)	Total (acre-feet)
San Luis Hills Subdivision Potabl	1.2 miles	0	0	0	0
San Luis Hills Non Potable	1.2 miles	0	0	0	0
San Luis Hills Reclaimed	1.2 miles	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
TOTAL	0	0	0	0	0

Notes: No known leaks or breaks. Any flushing is nominal and less than 1 acre-foot

Table 5

Crop Water Needs- Irrigated Acreage Only

2010/11 WY Crop Name	Area (crop acres)	Crop ET (AF/Ac)	Requirement (AF/Ac)	Cultural Practices (AF/Ac)	Precipitation (AF/Ac)	Appl. Crop Water Use (acre-feet)
Alfalfa	1,019	4.46	0.18	0.00	0.37	4,350
Almonds (1 yr.)	80	0.91	0.06	0.00	0.37	48
Almonds (3 yr.)	2,408	3.21	0.20	0.00	0.37	7,322
Almonds (mature)	16,359	3.37	0.24	0.00	0.37	53,003
Beans (dry)	166	1.96	0.10	0.00	0.37	281
Corn (field)	728	2.30	0.14	0.00	0.37	1,507
Cotton	2,525	2.61	0.23	0.00	0.37	6,236
Dec. Orchards (1 yr.)	59	2.22	0.20	0.00	0.37	121
Dec. Orchards (mat.)	840	3.36	0.30	0.00	0.37	2,764
Oats	437	1.71	0.15	0.00	0.37	651
Melons	666	1.23	0.06	0.00	0.37	613
Misc. Truck Crops	286	1.96	0.14	0.00	0.37	495
Nursery	109	1.76	0.09	0.00	0.37	161
Sub. Orchards (mat.)	97	3.79	0.27	0.00	0.37	358
Tomatoes	2,802	1.89	0.13	0.00	0.37	4,624
Vineyard (1 yr.)		0.62	0.03	0.00	0.37	0
Vineyard (mature)	225	2.29	0.09	0.00	0.37	452
Wheat	1,426	1.85	0.19	0.00	0.37	2,381
Irrigated Pasture	7	4.50	0.00	0.00	0.37	28
Pistachios	712	3.37	0.00	0.00	0.37	2,135
Crop Acres	30,952					87,530

Total Irrig. Acres 30,952 (If this number is larger than your known total, it may be due to double cropping)

Note: Most oats and wheat in District are dry farmed. The oat and wheat acreage listed in Table 5 received at least one irrigation

Table 6

2010/11 District Water Inventory

Water Supply		Table 3		80,446
Environmental Consumptive Use	(Distribution, Drain, etc.)		minus	0
Groundwater recharge	intentional - ponds, injection		minus	0
Seepage		Table 4	minus	776
Evaporation - Precipitation		Table 4	minus	410
Spillage		Table 4	minus	0
Leaks, Breaks, Flushing / Fire		Table 4	minus	0
Transfers out of District			minus	0
Water Available for sale to customers				79,260
Actual Agricultural Water Sales	2010/11 WY	From District Sales Records		79,637
Private Groundwater		Table 2	plus	10,000
Crop Water Needs		Table 5	minus	87,530
Drainwater outflow	(tail and tile not recycled)		minus	171
Percolation from Agricultural Land		(calculated)		1,936
M&I Actual Water Sales	2010/11 WY	From District Records		809
Inside Use		Feb urban use x 12		540
Landscape / Outside Use		(calculated)		269
Unaccounted for Water		(calculated)		(1,186)

Note: Agricultural Water Sales exclude water sales carried over to water year 2011/12

Table 7

Influence on Groundwater and Saline Sink

2010/11 WY

Agric Land Deep Perc + Seepage + Recharge - Groundwater Pumping = District Influence	947
Estimated actual change in ground water storage, including natural recharge)	0
Irrigated Acres (from Table 5)	30,952
Irrigated acres over a perched water table	5,200
Irrigated acres draining to a saline sink	0
Portion of percolation from agri seeping to a perched water table	325
Portion of percolation from agri seeping to a saline sink	0
Portion of On-Farm Drain water flowing to a perched water table/saline sink	0
Portion of Dist. Sys. seep/leaks/spills to perched water table/saline sink	0
Total (AF) flowing to a perched water table and saline sink	325

Table 8

Annual Water Quantities Delivered Under Each Right or Contract

Year	Federal Ag Water (acre-feet)	Federal non-Ag Water. (acre-feet)	State Water (acre-feet)	Local Water (define) (acre-feet)	Other Water (acre-feet)	Transfers into District (acre-feet)	Upslope Drain (acre-feet)	Total (acre-feet)
2000	61,115	572	0	0	0	0	0	61,687
2001	60,092	707	0	0	0	0	0	60,799
2002	71,280	715	0	0	0	0	0	71,995
2003	70,824	803	0	0	0	0	0	71,627
2004	88,943	1,059	0	0	0	0	0	90,002
2005/06 WY	77,558	896	0	0	0	18,425	0	96,879
2006/07 WY	84,125	1,634	0	0	0	9,363	0	95,122
2007/08 WY	52,963	1,219	0	0	0	32,139	0	86,321
2008/09 WY	26,131	1,238	0	0	0	47,623	0	74,992
2009/10 WY	30,817	477	0	0	0	39,151	0	70,445
2010/11 WY	20,788	809	0	0	0	58,849	0	80,446
Total	644,636	10,129	0	0	0	205,550	0	860,315
Average	58,603	921	0	0	0	18,686	0	78,210

Method Definitions:

M1	Measured summation from calibrated measuring devices, accurate to within +/- 6 percent.
M2	Measured summation from calibrated measuring devices.
M3	Measured summation from measuring devices.
C1	Calculated (more than summation) using information from calibrated devices (such as the difference between measurements upstream and down stream of diversion).
C2	Calculated using information from measuring devices.
C3	Calculated using estimates from pump run-times and pump efficiency.
E1	Estimated using measured information from similar conditions.
E2	Estimated using historical information.
E3	Estimated using observation.
O1	Other (attach a note with descriptions of other methods used).

SAN LUIS WATER DISTRICT

WATER MANAGEMENT PLAN (2011)

APPENDIX H

GROUNDWATER MANAGEMENT PLAN

GROUNDWATER MANAGEMENT PLAN FOR THE SOUTHERN AGENCIES IN THE DELTA-MENDOTA CANAL SERVICE AREA

Prepared For:

SAN LUIS & DELTA-MENDOTA
WATER AUTHORITY
Post Office Box 2157
Los Banos, California 93635

Prepared By:

STODDARD & ASSOCIATES
CIVIL ENGINEERS
1120 West I Street, Suite C
Los Banos, California 93635

OCTOBER 1996

AB 3030	Groundwater Management Act, Assembly Bill 3030
'MIS	California Irrigation Management System
CU	Crop Water Use
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
DMC	Delta-Mendota Canal
DOHS	Department of Health Services
DTSC	Department of Toxic Substances Control
DWR	Department of Water Resources
E_P	Effective Precipitation
EPA	U.S. Environmental Protection Agency
ET_c	Evapotranspiration of an Individual Crop
ET_o	Monthly Reference Evapotranspiration
GMA	Groundwater Management Area
GMP	Groundwater Management Plan
HSA	Hydrologic Study Area
$_c$	Monthly Crop Coefficient
mg/L	Milligrams Per Liter
RWQCB	Regional Water Quality Control Board
SLDMWA	San Luis & Delta-Mendota Water Authority
SWRCB	State Water Resources Control Board
TDS	Total Dissolved Solids
µg/L	Micrograms Per Liter
USBR	U.S. Bureau of Reclamation
USGS	U.S. Geological Survey
WPP	Wellhead Protection Program

TABLE OF CONTENTS

I. INTRODUCTION 1

II. GROUNDWATER MANAGEMENT AREA 5

III. HYDROGEOLOGIC CHARACTERISTICS OF THE GMA 6

IV. CURRENT GROUNDWATER MANAGEMENT ACTIVITIES 8

V. GMA WATER QUALITY 11

VI. POTENTIAL GROUNDWATER RESOURCE PROBLEM AREAS 13

A. GROUNDWATER EXPORT 13

B. SHALLOW WATER TABLE MANAGEMENT 14

VII. GMA WATER BALANCE 16

Water Supply Components 16

1. Surface Water Supply 16
2. Effective Precipitation 17
3. Seepage Losses From Canals And Creeks 18
4. Subsurface Inflow 19

Water Demand Components 19

1. Annual Crop Consumptive Use 19
2. Incidental Water Use 20
3. Groundwater Pumping Into The DMC 21
4. Return Flow 21
5. Subsurface Outflow 22

Change in Groundwater Storage 22

VIII. GMA WATER BALANCE SUMMARY SHEETS 24

X. ESTIMATES OF BASIN-WIDE GROUNDWATER PUMPING AND SUSTAINABLE YIELD 26

X. ELEMENTS OF THE GROUNDWATER MANAGEMENT PLAN 28

A. THE CONTROL OF SALINE WATER INTRUSION 28

B. IDENTIFICATION AND MANAGEMENT OF WELLHEAD PROTECTION AREAS AND RECHARGE AREAS. 30

C. REGULATING CONTAMINANTS MIGRATION IN GROUNDWATER 32

D. THE ADMINISTRATION OF WELL ABANDONMENT AND WELL DESTRUCTION PROGRAM 33

E. MITIGATION OF GROUNDWATER OVERDRAFT 33

F. REPLENISHMENT OF GROUNDWATER EXTRACTED BY WATER PRODUCERS 35

G. MONITORING OF GROUNDWATER LEVELS AND STORAGE 35

H. FACILITATING CONJUNCTIVE USE OPERATIONS 36

I. WELL CONSTRUCTION 39

J. CONSTRUCTION AND OPERATION OF GROUNDWATER MANAGEMENT FACILITIES 40

K. RELATIONSHIPS WITH STATE AND FEDERAL REGULATING AGENCIES 41

L. REVIEW OF LAND USE PLANS TO ASSESS RISK OF GROUNDWATER CONTAMINATION 41

XI. IMPLEMENTATION OF THE GROUNDWATER MANAGEMENT PLAN 42

REFERENCES

TABLES:

1.	Surface Water Supply	17
2.	Effective Precipitation	18
3.	Seepage Losses of Canals and Creeks	19
4.	Crop Water Demand	20
5.	Incidental Water Demand	21
6.	Groundwater Pumping into the DMC	21
7.	Return Flow Trends	22
8.	Change in Groundwater Storage Using Specific Yield Method	23
9.	GMA Water Resources Balance	24
10.	Estimates of Basin-Wide Annual Groundwater Pumping	26

FIGURES:

1. Hydrologic Study Areas, California (from Hauge 1992)
2. Groundwater Basins, San Joaquin Hydrologic Study Area, California (from DWR, 1980)
3. Boundary of the Groundwater Management Area
4. Unconfined Groundwater Levels (feet), Spring 1986
5. Unconfined Groundwater Levels (feet), Spring 1990
6. Unconfined Groundwater Levels (feet), Spring 1994
7. Unconfined Groundwater Level Change (feet), 1986-1990

8. Unconfined Groundwater Level Change (feet), 1990-1993

9. Unconfined Groundwater Level Change (feet), 1993-1994

10. Annual Water Resource Balance - Full Surface Water Supply

11. Annual Water Resource Balance - Restricted Surface Water Supply

DEFINITIONS

GROUNDWATER MANAGEMENT PLAN FOR THE SOUTHERN AGENCIES IN THE DELTA-MENDOTA CANAL SERVICE AREA

I. INTRODUCTION

The Groundwater Management Act, Assembly Bill 3030 (AB 3030), signed into law in 1992, establishes provisions to allow local water agencies to develop and implement groundwater management plans (GMP). The act applies to the groundwater basins identified in the Department of Water Resources (DWR) Bulletin 118-80. The water conservation guidelines prepared by the U.S. Bureau of Reclamation (USBR) to meet the requirements of the Central Valley Project Improvement Act (CVPIA) mandate that the federal water contractors prepare GMPs in accordance with AB 3030 or similar authority. There are twelve elements listed in Section 10753.7 of AB 3030 that may be included in the GMP. These twelve elements form a basic list of data collection and actions that may be undertaken under the act.

The water needed for agricultural production and municipal and industrial uses in the Groundwater Management Area (GMA) is obtained from three sources. The first source is imported surface water diverted from the Delta-Mendota and San Luis Canals under the Central Valley Project (CVP). The second source is groundwater that is used primarily for industrial purposes, for rural domestic needs, and for agricultural production when the surface water supplies are either not available or are insufficient to meet the crop demand. The third source is non-CVP water transferred into the basin, such as that which had been available through the State Water Bank.

Much of the land in the GMA was initially developed for agriculture based on pumped groundwater. Contracts for surface water supplies from the CVP became available during the 1950's and were for quantities of water "supplemental" to

existing groundwater. Over time, irrigators in the GMA came to rely entirely on these supplemental surface water supplies. During recent drought conditions, the CVP surface water supply was reduced by approximately 60 percent of what was being delivered prior to 1989. The reduction of the imported surface water supply prompted many water users to depend more heavily on groundwater. The increased groundwater pumping resulted in the lowering of groundwater levels, which focused attention on the potential impacts of the increased pumping and the interrelationship between surface water and groundwater.

This GMP is a part of the ongoing efforts by the San Luis & Delta-Mendota Water Authority (SLDMWA) and the participating districts to manage the limited groundwater resources within the subbasin. There are three aspects of groundwater management that will be especially important in the GMA: protecting and making available the groundwater resource for water users in the GMA that rely on the groundwater resource as part of their water supply; determining whether or not groundwater can be exported on a sustained basis for use outside the subbasin to meet demands of other water supply-limited areas in California and, if so, the quantity limits or other conditions that must be met to avoid adverse impacts; and determining the feasibility of groundwater pumping to manage the shallow groundwater table. Within the GMA groundwater is used by direct application, by pumping into district water conveyance facilities, and by pumping into the Delta-Mendota Canal (DMC) for conveyance and storage. Heavy pumping during drought periods can result in water quality degradation of the receiving waters and land subsidence. An important aspect of this GMP will be gaining a better understanding of the aquifers and development of operating parameters to protect against adverse impacts.

The districts within the GMA have engaged in and will continue to reserve operational flexibility to engage in transfers of water supply to any qualified purchasers of water in circumstances where shortages of water cause the potential for hardship in other areas of the region or state which have access to federal water project facilities and where the districts have a surplus of water supply conserved by programs benefiting their landowners and water users. Prior to undertaking any

program, the districts will evaluate any adverse economic or environmental impact of water transfer program, which may include but not be limited to management and determination of groundwater storage capacity and use of such capacity in a conjunctive manner with surface water supplies, in order to assist other areas in need of water in addition to landowners within the districts and to the benefit of the districts and its landowners, as long as such programs do not:

1. Exceed the safe annual yield of the aquifer;

2. Result in conditions of overdraft or otherwise fail to comply with provisions of California Water Code Section 1745.10; and,

3. Result in uncompensated adverse impacts upon landowners affected by the program.

Another important aspect of the GMP will be analyzing the feasibility of groundwater pumping from the upper (unconfined) zone as a strategy for management of shallow groundwater tables, a major problem in much of the GMA. Studies by the U.S. Geological Survey (USGS) concluded that increased pumping of groundwater from both the confined and semiconfined zones, together with reduced deep percolation, is an effective strategy for management of the water table and reducing drain flow. The San Joaquin Valley Drainage Program (SJVDP) also identified groundwater pumping from the upper (unconfined) zone as a strategy for management of shallow groundwater tables. However, the USGS found that the effectiveness of groundwater pumping was constrained by the poor quality groundwater in the unconfined zone and the potential for aquifer compaction (subsidence) in the confined zone. The SJVDP did not analyze the feasibility of pumping to manage the water table, but did conclude that pumping would have to be surplus to need by as much as ten-fold to maintain target water levels. Factors that will need to be examined for the feasibility of this strategy include constraints on out-of-basin disposal of saline water, crop water quality requirements, and potential compaction problems.

Implementation of this GMP will provide the means for collection of the necessary groundwater monitoring data and the assessment of pumping impacts such

that sustained use of groundwater can be optimized and benefits of shallow oundwater management can be achieved without adverse impacts. Optimizing groundwater use is the basic goal of groundwater management. Proper management of groundwater requires knowledge of the availability, distribution, depletion, and replenishment of the groundwater resource. Without such knowledge, the effect of past activities and predictions of effects of future activities on the groundwater basin cannot be adequately evaluated.

This report documents the characteristics of the groundwater basin, summarizes the existing groundwater management activities in the GMA, identifies potential groundwater problem areas, develops the relative elements of the GMP, and provides recommendations for the plan implementation.

The DWR, in cooperation with the State Water Resources Control Board (SWRCB) and the USGS, identified ten hydrologic study areas (HSA's) in California (DWR, 1980). The HSA's were defined on the basis of geological and hydrological conditions with consideration of political boundary lines, whenever practical (Figure 1). The San Joaquin and Tulare Lake HSA's were further divided into separate subbasins largely based on political considerations for groundwater management purposes (Figure 2).

The area included in this GMP is the southwestern portion of the Delta-Mendota basin of the San Joaquin HSA (Figure 2) and covers portions of Merced and Fresno Counties. The northern boundary of the groundwater management area is generally along the DMC, and the southeastern boundary is the northwestern boundary of the Westlands Water District. The GMA is bounded by the Coast Ranges on the southwest. Merced County has no plans of preparing a groundwater management plan for the county; rather, they will rely on the local water and irrigation districts in the county to provide the local management of groundwater. Fresno County is in the process of preparing a policy level AB 3030 plan, which will specify broad based goals under each plan element and will stress cooperation with district plans.

The GMA includes the following water districts: Broadview, Eagle Field, Mercy Springs, Oro Loma, Pacheco, Panoche, San Luis and Widren. Water is used for agricultural production, with a minor amount used for incidental municipal and industrial use. The GMA is a portion of the Central and Southern Subbasins defined in Stoddard & Associates (1996a) and encompasses approximately 120,000 acres.

The aquifers of the GMA consist of unconsolidated sediments derived primarily from the Coast Ranges. The area is underlain by the Pleistocene Corcoran Clay Member of the Tulare Formation, which is a lacustrine deposit that divides the aquifer system vertically into an upper semiconfined zone and a lower confined zone (Davis and DeWiest, 1966). The unconsolidated sediments taper towards the Coast Ranges and the Corcoran Clay crops out sporadically on the west margin of the valley.

In the semiconfined zone, the sediments consist of beds, lenses, and tongues of clay, sand, and gravel, and form most of the sedimentary material deposited west of the San Joaquin River (Hotchkiss, 1972). Although there are no distinct continuous aquifers or aquitards within the alluvium, the term "semiconfined" is used to emphasize the cumulative effect of the vertically distributed fine-grained materials. The confined zone underlies the confining Corcoran Clay stratum and is similar to the semiconfined zone in texture and composition. It extends downward from the base of the Corcoran Clay to the base of fresh water mapped by Page (1971).

The elevation to which water rises in a well that taps a semiconfined zone is the water table. The elevation of the water table represented by the static groundwater levels in wells completed to shallower depths may not be the same as the static levels in deeper wells. This is due to numerous fine-grained beds of variable thickness that exist in the semiconfined zone, as discussed above. These fine-grained sediments restrict the vertical movement of water. The elevation to which water rises in a well that taps a confined aquifer is its potentiometric surface. The potentiometric surface in a confined aquifer is an imaginary surface representing the confined aquifer pressure.

The horizontal groundwater flow direction in the semiconfined zone is northeast, towards the San Joaquin River from the Coast Ranges, typically causing subsurface outflow across the defined GMA boundary. In the confined zone beneath the Corcoran Clay, water tends to move southwesterly into the GMA.

Historically, irrigation of lands in the GMA accounts for most of the recharge to the semiconfined zone through seepage losses occurring in irrigation water conveyance channels and by deep percolation of applied water. Other sources of recharge include seepage from canals and creeks. Occasional recharge may enter the GMA from the Coast Ranges to the west, but is not well quantified. Recharge to the lower confined zone occurs primarily from leakance from the unconfined zone through the Corcoran Clay and a variable amount of inflow from the east. Groundwater pumping from below the Corcoran Clay increases the leakance through the clay layer and subsurface inflow. Groundwater pumping in the northern and southern portions of the GMA occurs primarily from above the Corcoran Clay. In the central portion of the GMA, pumping is primarily from below the Corcoran Clay.

IV. CURRENT GROUNDWATER MANAGEMENT ACTIVITIES

During recent years, there have been several groundwater management activities in the GMA undertaken by various agencies and individuals to protect the groundwater resources. These activities include a detailed hydrologic study conducted by the SLDMWA, a plan for management of deep well pumping into the DMC, and the water conservation plans and practices adopted by various member agencies.

The SLDMWA has completed a detailed hydrologic analysis to study the water supply conditions and impacts due to changes in the water supply (Stoddard & Associates, 1996a and 1996b). Over the 1986 through 1993 study period, surface water supplies were near normal from 1986 through 1989, and then were drastically decreased by reductions in CVP water allocations from 1990 to 1992. The reduction in supply prompted corresponding increases in groundwater pumping. The DMC was used to convey groundwater and numerous wells were constructed, concentrated in various areas along the canal. The study area covered most of the service area of the DMC. The hydrologic analysis was divided into two phases. The objectives of Phase 1 were: 1) determine the annual water supply and demand components and the change in groundwater storage; 2) assess the impact of reduction in CVP water supply on the hydrologic basin; and, 3) demonstrate the relative influence of various components of water supply and demand on the basin water balance. The objectives of Phase 2 of the study were: 1) develop groundwater models of identified areas of concern; 2) simulate groundwater flow patterns caused by multiple wells pumping into the DMC; and, 3) identify the potential impacts of the resulting cones of depression.

An extension of the hydrologic study was the development of a plan to manage the deep well pumping into the DMC. The hydrologic study and experiences of the pumping that occurred in 1994 made it evident that management of groundwater conditions is necessary to preclude any adverse impacts on the aquifer. Based upon the locations and depths of wells, five management areas south of Check 13 at the DMC and one management area north of Check 13 were established. Details of the study can be found in Stoddard & Associates (1996c).

A predictive model was also developed to estimate potential water development from the wells located south of Check 13. The purpose of the model was to predict deep well groundwater pumping into the DMC with varying mean monthly DMC background salinity, boron and selenium, and allocate pumping periods to individual wells based on well water quality (Stoddard & Associates, 1995).

Individual water districts in the GMA have also been putting effort into increasing water use efficiency to preserve their water resources. All the districts in the GMA have completed water conservation plans pursuant to the CVPIA. In these plans, water conservation practices have been identified to maximize beneficial use of the water supply. Practices include better irrigation management, physical improvements, and institutional adjustments. Irrigation management practices include on-farm water management and district water accounting, use of efficient irrigation methods, and on-farm irrigation system evaluations. Physical improvements include lining of canals, replacement of unlined ditches with pipeline conveyance systems, and improvement of on-farm irrigation technology. Institutional adjustments include improvements in communication and cooperative work among districts, water users, and state and federal agencies, and facilitating the financing of on-farm capital improvements. Other practices that have been instituted by the districts include installation of flow measuring devices, modification of distribution facilities to increase the flexibility of water deliveries, and changes in the water fee structure to provide incentive for more efficient use of water.

Water conservation measures that improve irrigation efficiency reduce the amount of water percolated beyond the root zone. The reduction of deep percolation is very beneficial in the GMA due to the poorly drained soils and the poor quality of the underlying groundwater. As noted, simulation of water table response to management alternatives by the USGS has shown that reduction in recharge coupled with groundwater pumping is an effective strategy for water table control. The water conservation plans have helped the districts identify the opportunities for better irrigation water utilization. The drainers have hired a Regional Drainage Coordinator who has been working with the districts to prepare

and implement drain water management plans and develop programs to meet 'scharge requirements. Programs being considered for farm-level source control include: tiered water pricing, revised on-farm tailwater policy, and farm-level water allotments. These programs will promote on-farm water conservation and, ultimately, will reduce deep percolation. This GMP will fill in the gap to provide for total water resources management in the GMA.

V. GMA Water Quality

Groundwater in the GMA occurs in two zones: the upper semiconfined zone and the lower confined zone separated by the Corcoran Clay. Chemical analysis of groundwater in the wells along the DMC has been submitted to the SLDMWA annually by the well owners since 1991. The wells tap both the semiconfined and confined zones in a narrow band along the DMC. The chemical analyses indicate that groundwater quality in both zones is highly variable and is affected by different irrigation and natural sources of recharge, and the geochemical nature of the sediments. The distribution of various constituents in the two zones shows little similarity.

The 1994 DMC water quality analyses indicate that in the semiconfined zone of the northern part of the GMA, total dissolved solids (TDS) concentrations range from 560 to 1,300 mg/L, boron concentrations range from 0.5 to 2.1 mg/L, sulfate concentrations range from 65 to 230 mg/L, and the selenium concentrations were below the detection limit of 1 µg/L. In the semiconfined zone of the southern part of the GMA, the concentrations of these constituents are relatively high. TDS concentrations range between 1,200 and 1,800 mg/L, boron concentrations range between 1.1 and 3.1 mg/L, sulfate concentrations range between 460 and 1,200 mg/L, and selenium concentrations range from less than detectable to 5 µg/L.

In the confined zone of the central part of the GMA, TDS concentrations range between 1,000 and 1,800 mg/L, boron concentrations range from 1.9 to 3.85 mg/L, sulfate concentrations range from 470 to 720 mg/L, and selenium concentrations range from less than detectable to 6 µg/L. Groundwater quality data in both the semiconfined zone and the confined zone in the GMA are sparse; therefore, a definitive groundwater quality picture of the portions of the GMA away from the DMC is lacking. Groundwater quality of the semiconfined and the confined zones in these areas can be expected to vary from the concentration ranges given above, due to variation in geochemical nature of sediments and different agricultural practices. The lack of current groundwater quality information available

in the GMA demonstrates the need to establish a groundwater quality monitoring ogram in the GMA.

VI. POTENTIAL GROUNDWATER RESOURCE PROBLEM AREAS

This section documents potential groundwater resource problems in the GMA identified by member agencies. The initial groundwater management activities should be prioritized and directed towards addressing problem areas before any impacts to the groundwater basin occur.

A. GROUNDWATER EXPORT

Drought conditions and restrictions on Delta export pumping have reduced the imported surface water supply to the San Joaquin Valley. Various arrangements for transfers of water supplies have evolved to match the limited water supply to water demand. Some of these transfers involve pumping of groundwater into the DMC for conveyance and use in other areas. The water has been conveyed through the federal CVP facilities under the authority of Warren Act Contracts issued between the USBR and various water districts for conveyance of non-project water on a year-to-year basis.

The major concerns that arose from the increase in groundwater pumping are land subsidence and degradation of the water quality in the DMC. The concentrated pumping, especially from the confined zone, causes deep cones of depression to form. As the pressure in the aquifer decreases, its ability to support the overburden also decreases and compaction of the aquifer results. The western San Joaquin Valley is known to be an area very susceptible to aquifer compaction. Both the Central California Irrigation District and the DWR have reported accelerated subsidence coinciding with the reduction in imported water supplies and the increase in regional groundwater pumping, including the pumping under Warren Act Contracts.

The groundwater pumped into the DMC, being of significantly poorer quality than the water in the DMC, reduces the quality of water in the DMC. Degradation occurs primarily due to increases in salinity (TDS) and boron. Increases must be limited so that the canal water quality does not limit

beneficial use either by significantly affecting crops, soil salinity levels, or drainage requirements. The management plan for the DMC groundwater pumping was prepared to address these issues and develop management strategies to avoid significant adverse impacts (Stoddard & Associates, 1996c).

B. SHALLOW WATER TABLE MANAGEMENT

Shallow groundwater levels in much of the GMA require the installation of subsurface drainage systems to collect the shallow groundwater, so the water table does not extend into crop root zones. Historically, the drainage water was moved through the grasslands to the San Joaquin River. Since September 23, 1966, the drainage water has discharged to the San Joaquin River via the San Luis Drain and Mud Slough. The drainage water contains salts and minerals, such as selenium, that can degrade the quality of the water in the river.

To remove the drain water from the water supply channels to bypass the wetlands, the draining entities under the SLDMWA proposed using the San Luis Drain to convey the drainage water from a point near the southerly tip of the Grassland Water District, Milepost 105.72 on the San Luis Drain. The drainage water is conveyed approximately 28 miles in the drain to the northern terminus at Milepost 78.65. At this point, the drainage water is to be discharged an additional 6 miles to the San Joaquin River. An agreement for use of the drain was executed between the USBR and the SLDMWA on November 3, 1995. The term of the agreement is for a maximum of 5 years and is designed to terminate in 2 years (after the date that the drain is first used), if commitments specified in the "*Finding of No Significant Impact*" are not met. The Basin Plan Amendments adopted by the RWQCB call for issuance of Waste Discharge Permits, including monthly selenium load limits that will significantly limit drain water discharge. Continuance of the discharge is predicated on reduction in drainage flows through reduction in deep percolation and lowering of water table elevations.

Shallow groundwater management is a priority within the GMA. Opportunities to pump groundwater for shallow groundwater management purposes must be investigated. The effectiveness and feasibility of such a strategy may be negated by limited disposal capability, configurations of irrigation water conveyance systems relative to well locations, and maintenance of acceptable irrigation water quality.

VII. GMA WATER BALANCE

This section estimates the components of inflow and outflow to understand the relative influence of the components of water supply and water demand on the change in groundwater storage. Storage changes are calculated by actual changes in the water table fluctuations that occurred over the study period.

Elements of water supply include water imported through canals, diversions from rivers and creeks, effective precipitation, seepage water from canals and creeks flowing through the GMA, and subsurface water moving into the GMA. Elements of water demand include crop consumptive use, urban water use, surface and subsurface outflow, and water exported out of the GMA.

The difference between the sum of the elements of water supply and the sum of the elements of water demand should equal the change in groundwater storage. Most of the supply and demand components cannot be or have not been measured; thus, the magnitude of the various components are best estimates using standard procedures. Since the assessment of groundwater storage change is on a spring to spring basis, the changes in soil moisture are assumed negligible.

In the following paragraphs, the various components of inflow and outflow are discussed and quantified for certain intervals of the study period. The selected intervals are 1986-1989, 1990-1992, and 1993-1994. By examining various intervals, the relationship of the components in the water resource balance are better understood.

- **Water Supply Components**

1. <u>SURFACE WATER SUPPLY</u>

The two sources of surface water supply in the GMA are the imported supply delivered via the DMC or San Luis Canal and local surface water supply or inflow. A district's water supply is augmented from time to time by transfers of project and non-project water into the district. The supplies may be diminished at other times by drought and by transfers of water from the

district. Since the water supplies vary and demands change depending on local climatic conditions, cropping patterns, etc., these transfers are necessary to balance water supplies with water demands among various districts from year to year.

Surface water supply data for the participating districts were either provided by the district's staff or were obtained from the water utilization reports of the districts. Table 1 presents the GMA water supply trends established from the data.

Table 1

Surface Water Supply Ac. Ft./Yr.			
Interval	Imported Water Supply	Other Surface Sources	Total Surface Supply
1986-1989	270,000	10,000	280,000
1990-1992	119,000	12,000	131,000
1993	130,000	4,000	134,000
1994	196,000	6,000	202,000

2. EFFECTIVE PRECIPITATION

Effective precipitation (E_P) is defined as the amount of rain that is either stored in the soil to be used by crops or contributes to groundwater recharge. E_P is equal to total rainfall less evaporation from the soil surface. For this mass balance calculation, E_P is calculated at 60% of the total annual rainfall (DWR, 1989). This procedure may slightly over-estimate the amount of rainfall that is effective. The soil has to be ready to adsorb the moisture for leaching and/or hold the moisture in the root zone for plant utilization. Due to the arid conditions within the basin, the amount of precipitation that actually recharges the basin is small.

Monthly rainfall records for the California Irrigation Management Information System (CIMIS) Station No. 10, Mendota Dam site, were obtained from the CIMIS data base in Sacramento. The estimated annual E_P in the GMA is given in Table 2.

Table 2

Effective Precipitation Ac. Ft./Yr.	
1986-1989	38,000
1990-1992	26,000
1993	49,000
1994	27,000

3. SEEPAGE LOSSES FROM CANALS AND CREEKS

Two major canals, the DMC and the San Luis Canal, extend through the GMA. Even though these canals are concrete lined, there is some seepage where the concrete lining is cracked, which contributes to recharge of the semiconfined aquifer. The recharge due to these canals was estimated based on estimated unit seepage rates (DWR, 1991), wetted perimeter (DWR, 1991 and USBR, 1950), number of operating days (DWR, 1991), and the length of the canals extending through the basin.

There are three westside creeks that flow into the GMA: Los Banos Creek, Little Panoche Creek, and Ortigalita Creek. Of these, only Los Banos Creek maintains a channel to the San Joaquin River and contributes significant flow the basin. Flow of Los Banos Creek has been regulated by the Los Banos Detention Dam since 1966. Annual releases in Los Banos Creek were obtained from the DWR, Los Banos. The seepage losses from the creek were calculated as 60% of the annual flows (Hotchkiss and Balding, 1971). The remaining creeks flow very intermittently and contribute very little water to the system. These creeks are not gauged, so flow records are unavailable. Seepage losses from these creeks into the GMA are estimated at 500 acre feet during normal years. Losses for the other years were estimated from the annual flow variations measured in Los Banos Creek. Seepage losses are a

very minor portion of basin inflow. Estimates of the total seepage loss from canals and creeks are given in Table 3.

Table 3

Seepage Losses of Canals and Creeks Ac. Ft./Yr.	
1986-1989	8,000
1990-1992	5,000
1993	16,000
1994	6,000

4. SUBSURFACE INFLOW

Subsurface inflow across the boundaries of the GMA is the amount of water moving laterally into the basin. Review of regional groundwater flow patterns (Figures 4, 5, and 6) show the unconfined groundwater gradient sloping from southwest to northeast. For the purposes of this water balance, subsurface inflow is assumed to be zero due to the southwest to northeast gradient and the lack of a significant source of water west of the GMA.

Subsurface inflow may occur across the other boundaries in the deeper zones (zones that are below the Corcoran Clay layer and zones immediately above the layer), induced mainly by deep well pumping inside the boundary of the GMA. The amount of subsurface inflow induced by the pumping is shown as a negative of the subsurface outflow in Table 9.

- **Water Demand Components**

1. ANNUAL CROP CONSUMPTIVE USE

The annual crop water use (CU) of an individual crop in acre feet is estimated by multiplying the annual evapotranspiration of an individual crop in feet (Et_c) by the irrigated acreage of that crop. The annual ET_c for each crop or group of crops was obtained by summarizing the product of monthly

reference evapotranspiration (ET_o) reported by CIMIS and the monthly crop coefficient (K_c) values. The total annual consumptive use for each district is the sum of the annual CU for each crop.

In this study, ET_o values were obtained from the CIMIS weather data base in Sacramento for Station No. 40, Mendota Dam site. Missing monthly ET_o data for the stations were estimated (U.C., 1992). Monthly K_c's were taken from various sources including DWR published values (DWR, 1975) and Jensen, et al. (1990). The same monthly K_c values were used for all the districts in the GMA, assuming that any variability in monthly K_c values has negligible significance on the overall crop water use.

District cropping patterns were taken from "Crop Production and Water Utilization Reports" over the 1986 to 1994 period. These are the reports filed annually with the USBR by each district. In order to standardize the reporting of crop information, some of the crops were grouped together. The representative crop demands over the chosen time intervals are given in Table 4.

Table 4

Crop Water Demand Ac. Ft./Yr.	
1986-1989	274,000
1990-1992	223,000
1993	245,000
1994	289,000

2. INCIDENTAL WATER USE

Incidental water use is the quantity of water consumed annually for industrial and domestic use within the GMA. The GMA land use is primarily agricultural; therefore the incidental water use is very small. The annual incidental water use was obtained from various districts in the GMA. Table 5 sets forth the incidental water use trends over the study period.

Table 5

Incidental Water Demand Ac. Ft./Yr.	
1986-1989	1,000
1990-1992	1,000
1993	1,000
1994	1,000

3. GROUNDWATER PUMPING INTO THE DMC

Groundwater pumped into the DMC is used both inside and outside of the GMA. In the GMA water balance, the water pumped into the DMC is considered as basin outflow. The portion of this water that is delivered back into the GMA is included in the CVP water delivery quantities; thus only the net export is a component of outflow. Table 6 presents the trends of groundwater pumping into the DMC over the study period.

Table 6

Groundwater Pumping into the DMC Ac. Ft./Yr.	
1986-1989	0
1990-1992	21,000
1993	27,000
1994	32,000

4. RETURN FLOW

Return flow is surface flow from the basin consisting of farm tailwater, district operational spill, and subsurface drainage water. Data on return flow volumes are sparse. The volume of return flow was either provided by districts or was calculated based on 10% of the surface supply. The return flows given in Table 7 are the best estimates of the trends in return flows over the study period.

Table 7

Return Flow Trends Ac. Ft./Yr.	
1986-1989	46,000
1990-1992	20,000
1993	24,000
1994	28,000

5. SUBSURFACE OUTFLOW

Subsurface outflow may occur laterally along the eastern boundary of the GMA. The lateral subsurface outflow is proportional to the horizontal hydraulic gradient, permeability of the porous media and the cross-sectional area of the flow path.

Subsurface outflow is the least accurate term in the water balance calculation. Hotchkiss and Balding (1971) estimate subsurface outflow in the Tracy-Dos Palos area at 240,000 acre feet per year. It appears from their information that, under full water supply conditions, subsurface outflow from the GMA is on the order of 50,000 acre feet per year.

- **Change in Groundwater Storage**

The specific yield method was used to compute storage changes over the study period. It is based on the principle that changes in groundwater storage are reflected by fluctuation in the level of the groundwater table. The data required to calculate changes in groundwater storage (acre feet) by this method are changes in groundwater levels (feet), specific yield of the geological formation (unitless fraction), and the area over which the change in groundwater levels applies (acres). The groundwater level measurements used in this study were annual spring water level measurement in unconfined wells.

The unconfined well data from 1986 through 1994 were obtained from the DWR and the USBR.

Water surface contour maps and volume calculations were made using a computer program that produces grid-based contouring, volume computations, and graphical output. The gridding method, known as Kriging, was used to interpolate between data points. Volumes were calculated using the trapezoidal rule and multiplying by the average specific yield of the aquifer determined from DWR data on estimated specific yields developed for each quarter township.

Maps indicating lines of equal elevation of water in wells for the springs of 1986, 1990, and 1993 are given in Figures 4 through 6. Maps delineating lines of equal change of water level in wells from 1986 to 1990, from 1990 to 1993, and from 1993 to 1994 are given in Figures 7 through 9, respectively.

Average water level changes and changes in groundwater storage in the GMA for the study period are given in Table 8. The results indicate that during the 1986-1990 and 1993-1994 study intervals, water levels rose in the basin. But from 1990-1993, water levels declined throughout the study area.

Table 8

Change In Groundwater Storage Using Specific Yield Method				
Study Interval	Average Change In Water Level (feet)	Change In Storage (ac-feet)	Average Storage Change/Yr	Cumulative Change In Storage (ac-feet)
1986-1990	+1.2	+16,000	+4,000	+16,000
1990-1993	-6.3	-83,000	-28,000	-67,000
1993-1994	+2.2	+29,000	+29,000	-38,000

Note: (-ve) indicates decrease and (+ve) indicates increase.

The average change in storage over the 8-year study period is -5,000 acre feet. Recognizing that rainfall over the study period was significantly less than average, the GMA was in near hydrologic balance for the period.

Having quantified the trends of the various inflow and outflow components of the water resource balance and estimated the change in storage based on changes in groundwater levels, the water resources balance over the various study intervals was developed.

For the first three intervals, all of the components less subsurface outflow were used to calculate the amount of subsurface outflow needed to complete the water resources balance. For the 1994 balance, water level data necessary to compute the change in storage was not available, so the subsurface outflow during 1994 could not be calculated. The GMA water resources balance for various intervals is presented in Table 9.

Table 9

GMA Water Resources Balance
Units of Acre Feet Per Year

Inflow Components				
Study Interval	Surface Water	Precip.	Seepage	Total Inflow
1986-90	280,000	38,000	8,000	326,000
1990-93	131,000	26,000	5,000	162,000
1993	134,000	49,000	16,000	199,000
1994	202,000	27,000	6,000	235,000

Outflow Components						
Study Interval	Crop Demand	Urban Demand	DMC Pumping	Return Flow	Subsurface Outflow	Total Outflow
1986-90	274,000	1,000	0	46,000	1,000	322,000
1990-93	223,000	1,000	21,000	20,000	-75,000	190,000
1993	245,000	1,000	27,000	24,000	-127,000	170,000
1994	289,000	1,000	32,000	28,000	ND 1/	ND

1/ Data not available.

Change In Storage (Inflow - Outflow)	
Study Interval	Net Change
1986-90	+4,000
1990-93	-28,000
1993-94	+29,000
1994	ND

The following observations can be drawn from the water resources balance.

1. As a result of the drought impact that began in 1990, surface water supply to the basin dropped approximately 150,000 acre feet.

2. While 1993 was a relatively wet year, low CVP supplies in 1993 meant continuance of the drought conditions into and through 1994.

3. Subsurface outflow computed from the other water balance components indicates a reversal in the subsurface outflow gradient due to the increased pumping in the GMA. This trend appears reasonable due to the increased pumping activity after 1989.

4. Comparison of the water balance components of the GMA to those of the Southern Subbasin in Stoddard (1996a) supports the finding of subsurface inflows from the east.

5. Under projected future average CVP water supply conditions (calculated based on 60% of the contract supply), the total surface water supply of the GMA will be 170,000 acre feet per year, which is insufficient to meet the average annual crop demand of 250,000 to 290,000 acre feet per year.

6. Under reduced CVP water supply conditions, growers will likely depend upon groundwater pumping to meet the demand, resulting in inducement of subsurface inflow. The estimated amount of subsurface inflow required under the reduced CVP supply will be in the range of 50,000 to 65,000 acre feet per year.

7. Further evaluation over a longer hydrologic period is needed to confirm the above observations.

Figures 10 and 11 graphically depict the components of water supply before and after the drop in surface supply.

IX. ESTIMATES OF BASIN-WIDE GROUNDWATER PUMPING AND BASIN SUSTAINABLE YIELD

The water resources balance can be utilized to develop estimates of groundwater pumping that occurred in the GMA and the average sustainable yield of the groundwater basin. The amount of groundwater pumping is estimated by two methods. The first method involves estimating the applied water requirement and subtracting the amount of surface water that has been supplied. The second method utilizes the components of inflow and outflow to the aquifer to estimate net aquifer recharge, which subtracted from the change in storage presents an estimate of water extracted from the aquifer. A certain percentage of groundwater pumped returns as groundwater recharge. This component of recharge cannot be quantified and is assumed zero; therefore the amount of pumping estimated by the second method will likely be somewhat less than that which actually occurred.

Table 10 presents the estimates of basin-wide groundwater pumping utilizing these two methods. These estimates indicate that pumping was on the order of 10,000 acre feet per year prior to the drop off in surface water supply. The pumping increased after the decrease in supply and was on the order of 180,000 to 200,000 acre feet per year. Comparing these pumping amounts with the corresponding surface supplies suggests that under an average of 60% CVP water supply conditions, average groundwater pumping would be around 165,000 acre feet, assuming that current cropping patterns are maintained.

Table 10

Estimates of Basin-Wide Annual Groundwater Pumping

Period	Applied Water Method 1/	Recharge Less Change In Storage Method 2/
Full CVP Supply 1986 - 1989	113,000	111,000
Restricted CVP Supply 1990 - 1992	197,000	164,000
1993-94	193,000	177,000

Table 10 *(Continued)*

Estimates of Basin-Wide Annual Groundwater Pumping

1/ $\text{Pumping} = \left(\frac{CU - E_P}{.6}\right) - SW$

2/ $\text{Pumping} = \left(SW + E_P - CL\right)\left(1 - IE\right) + CL + CCL - \Delta S - SO$

Where

CU	=	Crop Consumptive Use
E_P	=	Effective Precipitation
IE	=	Irrigation Efficiency
CL	=	Conveyance Losses (Seepage)
CCL	=	Seepage From Canals and Creeks
SO	=	Subsurface Outflow
SW	=	Surface Water
ΔS	=	Change in Storage

Sustainable yield is defined as the estimated pumping adjusted by the change in storage. By this formula, the sustainable yield of the basin prior to the water supply reduction is estimated at approximately 115,000 acre feet. During the drought period, sustainable yield increased to about 155,000 acre feet. The water resources balance suggests that the lowering of groundwater levels, due to the groundwater withdrawals, induces the subsurface inflow into the GMA and, therefore, increases the GMA sustainable yield.

It must be recognized that these conclusions are based on the available data utilized to construct the water resources balance and does not rely on any actual pumping data or verification of the amounts of subsurface outflow. The pumping estimates appear high, especially for the full CVP water supply period. This may be due to a combination of use of higher than actual crop consumptive use values and cropped acreage, and lower than actual irrigation efficiency and surface water diversion amounts. Further evaluation would be necessary to substantiate the findings.

Section 10753.7 of AB 3030 provides a listing of twelve elements or components that may be included in a groundwater management plan. The following paragraphs discuss how each of the elements relate to groundwater conditions in the GMA and what policies or actions may be appropriate by the participating districts for protecting the sustainability of the groundwater, in terms of both quantity and quality.

A. THE CONTROL OF SALINE WATER INTRUSION

Good quality groundwater can be permanently degraded if poorer quality groundwater migrates into aquifer zones containing better quality water. Such degradation has the potential to render the groundwater unsuitable for some uses, particularly domestic water use. In the GMA, saline water intrusion does not occur from an ocean or saltwater body; instead, it results from naturally occurring salts present in the soil, from salts imported with surface water, and from other activities on the land surface.

When water is applied for irrigation purposes, plants consume the water for plant growth leaving the salts in the soil profile. Water is applied to crops in amounts in excess of the crop consumptive use requirement, so there is sufficient water that will move downward and carry these salts beyond the crop root zone. This water carries with it not only the salts imported with the water supply, but also naturally occurring salts that are dissolved from the soil particles as the water moves downward. Without a means to remove the accumulated salts, the salts remain in the basin and ultimately increase the salinity of the groundwater. Chemical fertilizers used in agricultural production and percolation of effluent from waste treatment facilities also contribute salts to the groundwater basin.

Due to the nature of the processes, shallower groundwater is the first to degrade and a vertical water quality gradient is established, with the poorer quality water in the upper zones and the better quality water in the deeper zones. In the GMA, the best quality water occurs in the deeper unconfined zones or in the confined zone below the Corcoran Clay. The depth to the

base of the fresh water zone, defined as a total dissolved solids level of 2,000 mg/L is estimated to be about 1,000 feet below ground level.

While these are regional trends, variations in soil conditions, soil types, geologic structure, irrigation practices, and irrigation water quality have resulted in zones of differing water quality throughout the GMA. It is expected that there are areas where the shallow groundwater is quite poor and overlies very good quality groundwater, areas where the quality of upper and lower zones are of similar quality, and adjacent areas where the quality of water differs. In any of these situations where poor quality water is adjacent to high quality water, reversing the hydraulic gradient or steepening of the hydraulic gradient may cause the poor quality groundwater to migrate and degrade the better quality groundwater.

It is recognized that there is slow groundwater quality degradation occurring due to the regional downward movement of surface salts. The downward migration is accelerated due to increased groundwater pumping. During the 1976-1977 and 1986-1992 drought periods there was substantial increases in groundwater pumping that probably accelerated water quality degradation.

Due to the imported surface water supply and the marginal quality of the groundwater, agricultural users utilize groundwater only as a supplemental supply, drawing on it during times of drought and using it in combination by blending or in rotation with surface water for crop irrigation. Rural residents also rely on groundwater for their domestic water supply source. These residents are scattered throughout the GMA.

To maximize the sustainability of the groundwater basin, knowledge of the various water quality zones and groundwater flow patterns is necessary. Once this information is gained, groundwater management techniques can be evaluated to protect zones of high water quality so that the beneficial uses are protected. Typically, such a program would include the following elements:

1. Establish a network of monitoring wells completed to various depths in the semiconfined zone and the confined zone.

2. Wells should be monitored annually for salinity, nitrates, selenium, boron, and other constituents which may be of concern.

3. Identify areas where water quality monitoring and groundwater flow patterns suggest a high probability of water quality degradation.

4. Identify zones of marginal quality water that can be used in conjunction with surface water to increase water supply to reduce migration of saline water and lower groundwater levels.

5. Identify water management measures that may be employed to minimize the degradation.

6. Cooperate in programs aimed at providing a means to export salts out of the GMA via some type of drainage program to increase the longevity of the groundwater basin.

B. IDENTIFICATION AND MANAGEMENT OF WELLHEAD PROTECTION AREAS AND RECHARGE AREAS

The Federal Wellhead Protection Program (WPP) established by Section 1428 of the Safe Drinking Water Act Amendments of 1986 is designed to protect groundwater resources of public drinking water from contamination, to minimize the need for costly treatment to meet drinking water standards. A Wellhead Protection Area, as defined by the 1986 Amendments, is *"the surface and subsurface area surrounding a water well or well field supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water or well field."* Under the act, states are required to develop a U.S. Environmental Protection Agency (EPA) approved WPP. To date, California has no formal state-mandated program, but instead relies on local agencies to plan and implement programs under AB 3030. In California, a public water system is defined as any system that serves 15 or more connections or 25 or more persons for

greater than 60 days each year. Large farm housing complexes and the Oro Loma School fall under this category. A comprehensive WPP for Merced County has been prepared under the County Department of Public Health, Division of Environmental Health.

In the GMA, the primary source of recharge is from percolation of excess irrigation water. Incidental sources include seepage losses from canals and ditches and from the westside streams that flow intermittently during the rainfall season. Protection of recharge areas is realized by protecting groundwater from contamination from surface sources, which can either occur through percolation of contaminants to the groundwater table or, more directly, via wells that have been improperly constructed or developed.

Regulation of waste disposal is a function of the State of California, administered by the RWQCB or the Department of Toxic Substances Control (DTSC)). The participating districts will rely on continued regulation by the state; however, the participating districts will provide assistance to the RWQCB and DTSC by identifying areas that are the most susceptible to groundwater contamination.

To protect recharge areas, the participating districts should review applications for Waste Discharge Permits within and adjoining their boundaries that have the potential to degrade groundwater. Such waste disposal systems include disposal of dairy wastes, disposal of industrial wastes, sewage treatment plant effluent disposal, septic tanks, and solid waste disposal. Environmental documents for such facilities and Tentative Waste Discharge Permits issued by the RWQCB should be closely reviewed such that appropriate monitoring and mitigation measures are developed to preclude the possibility of migration of pollutants from the disposal sites. Participating districts should be on the lookout for existing and proposed land use activities that have the potential to degrade groundwater, so that appropriate action can be taken.

In development of a WPP the following elements must be included:

1. Locate the public water supply wells and identify the aquifer zones tapped by each well.

2. From the groundwater level monitoring plan (Element G), determine groundwater flow directions in the vicinity of each public water supply well.

3. Assist in the development of site specific well construction and abandonment programs to minimize contamination migration (Elements D & I).

4. Define capture zones for all public water supply wells and identify potential pollution sources within each capture zone.

5. Coordinate with appropriate state and local agencies in the regulation and permitting of activities that may pose a contamination threat to groundwater within public water supply well capture zones.

C. REGULATING CONTAMINANTS MIGRATION IN GROUNDWATER

Contaminants in this section are those that result from improper application, storage or disposal of petroleum products, solvents, pesticides, fertilizers and other chemicals used by industry, and are distinguished from the salinity degradation that is addressed in Element A. The participating districts' role in protecting groundwater from contamination by point sources will be supporting the RWQCB, which holds the primary responsibility for enforcing water quality regulations, and the respective counties who oversee soil and groundwater cleanup activities from leaking underground storage tanks and other point source contamination. The participating districts will assist in understanding the hydrogeology of the GMA, the vertical and lateral groundwater flow directions, and groundwater quality based on their groundwater monitoring activities. The participating districts shall make the appropriate regulating agency aware of changes in groundwater quality, which may indicate that point source contamination is occurring.

D. THE ADMINISTRATION OF WELL ABANDONMENT AND WELL DESTRUCTION PROGRAM

State regulations require that wells that are no longer useful or abandoned be properly destroyed so that they do not act as conduits for mixing of groundwater of differing quality. Non-pumped wells are a much greater threat than pumped wells, since pumping normally quickly removes contaminants that may have migrated during idle periods. In gravel packed wells, the gravel pack as well as the casing itself can act as a conduit for mixing and potential contamination.

Permits are required from the applicable county or city for abandonment of wells within their jurisdiction. For public water supply wells, additional requirements may be prescribed by the State Department of Health Services (DOHS). Permit fees are normally required. The participating districts will rely on continued administration of the well abandonment and destruction program by the permitting agencies.

The participating districts' role in well abandonment and destruction will be to provide the counties with the available groundwater data, assist in identifying locations of operating and abandoned wells, and advising well owners of why proper well destruction is important for protection of water quality.

E. MITIGATION OF GROUNDWATER OVERDRAFT

According to the DWR definition, overdraft occurs when continuation of present water management practices would probably result in significant adverse overdraft related impact upon environmental, social, or economic conditions at a local, regional, or state level. Long-term depletion of storage can cause several problems, including land subsidence, degradation of groundwater quality, and increased pumping costs. Overdraft is distinguished from aquifer dewatering, which may be beneficial in some areas of the GMA subject to shallow groundwater conditions, since simulations of groundwater

pumping have shown it to be effective in managing shallow groundwater. Some portions of the GMA may experience overdraft, while other portions have drainage conditions where aquifer dewatering may be beneficial.

Based on the basin's water balance calculations for the GMA over the 1986 through 1993 period summarized in Section VIII, it is estimated that the total surface water required to meet the water demand in the subbasin is approximately 326,000 acre feet. The imported surface water supply is the primary surface water source serving the GMA. There is also a very small amount available as local surface water supply. When CVP water supplies drop below 326,000 acre feet, groundwater pumping supplements the surface supply. This groundwater pumping induces subsurface inflow from the adjoining subbasin. If water supplies drop to levels where the basin inflow cannot be sustained, overdraft or aquifer dewatering will result.

Under full CVP water supply conditions in the GMA and assuming no significant change in demand, the basin is not in a condition of overdraft. Under the future projection of an average of 60% of CVP supply, groundwater pumping is estimated to approach 165,000 acre feet per year, and overdraft may occur depending on the sustainability of subsurface inflow on the order of 60,000 acre feet per year. Through planned water resource management, surface and water supply deficits should be offset by optimizing groundwater pumping to maximize groundwater tables and to minimize overdraft.

The prerequisite to implementation of an overdraft mitigation program is to monitor groundwater levels (Element G). Monitoring of groundwater levels and water quality is necessary to identify areas of overdraft and to determine the effects of groundwater pumping. Monitoring will allow the overdraft to be quantified, which is needed to evaluate means to control the overdraft. Curtailing overdraft usually requires increase or redistribution of basin water supplies or reducing the amount of pumping. If pumping is taking place to purposely dewater an aquifer, the monitoring is needed to evaluate the effectiveness of the program.

Once groundwater trends are known and overdraft identified, a responsive overdraft mitigation program can be developed around the following components:

1. Quantify the average annual overdraft.

2. Determine the potential for significant adverse impact due to the overdraft.

3. Formulate a plan to mitigate the impact and a strategy for plan implementation.

F. REPLENISHMENT OF GROUNDWATER EXTRACTED BY WATER PRODUCERS

The hydrologic balance suggests that lowering the groundwater levels increases sustainable yield, since subsurface inflow is induced by pumping in the confined zone which counteracts the water extracted. More data and analysis is needed to confirm this finding and to determine the level of pumping that can be sustained without overdraft. Due to the aquifer and water quality characteristics and the limited water supply, artificial recharge is not practical in the GMA.

G. MONITORING OF GROUNDWATER LEVELS AND STORAGE

The purposes of a groundwater level monitoring program are to identify areas of overdraft and provide information that will allow computation of changes in groundwater storage to determine net recharge or depletion. Groundwater level monitoring is essential to understand the impact on aquifer storage due to changes in basin inflow and outflow components and in pumping activities. Mapping of groundwater levels depicts the direction of groundwater movement and the hydraulic gradient necessary for quantifying groundwater flow and verifying estimates of subsurface outflow. Monitoring and mapping should be done independently in the unconfined and confined zones.

Participating districts will cooperatively develop a comprehensive groundwater level monitoring plan for the GMA, so that there is a coordinated effort of data acquisition and compilation. An adequate monitoring well network must include representative wells that tap particular aquifer zones in the GMA. Basic elements of the plan would include:

1. Determine the network of monitoring wells to be included in the program to monitor water level changes in the different aquifer zones.

2. Compile the necessary data on the monitoring wells (e.g., location, depth, driller's logs, E-logs, casing elevation, ground surface elevation).

3. Establish the frequency of the water level monitoring.

4. Inventory active wells and determine annual pumping amounts.

5. Develop a standardized data collection method.

6. Tabulation of data and groundwater mapping.

7. Interpretation and dissemination of results.

H. FACILITATING CONJUNCTIVE USE OPERATIONS

Conjunctive use of groundwater and surface water typically occurs when the surface water supply varies from year to year and there is useable groundwater and groundwater storage available. In years when the surface supply is greater than the water demand, water in excess of the crop demand is brought into the basin and recharged, either directly by operation of recharge facilities or indirectly by over-irrigation to increase percolation.

Conjunctive use in the traditional sense is not a viable water resource management strategy within the GMA. This is due to the fact that artificial

recharge is not practiced in the GMA, due to the aquifer and water quality characteristics and the limited water supply. Groundwater underlying most of the GMA is of marginal to poor quality for agricultural use due to high levels of salinity and boron. Aquifer characteristics are such that there is an absence of available storage capacity in the aquifer system. As discussed in Section VI, management of the shallow groundwater is necessary to maintain shallow groundwater levels below root zones to prevent crop damage. Pumping of groundwater for shallow groundwater management purposes must be investigated.

The water resources balance in the GMA suggests that with the anticipated reductions in CVP water supply delivery and absent the availability of other surface supplies, the average groundwater extractions will be in the 165,000 acre feet range.

In the case of this GMA, the conjunctive use plan must include management and redistribution of surface water supply to avoid conditions of localized overdraft, along with shallow water table groundwater management, as pumping of groundwater must continue to the foreseeable future to meet basin water demand.

Supplemental groundwater use occurs through direct application of water on the overlying land, pumping into district distribution systems to augment district supply, and pumping into the DMC for conveyance and storage in federal facilities under Warren Act Contracts. As described in Section VI, this pumping resulted in adverse impacts of land subsidence and DMC water quality degradation. As a result, the USBR determined, as of May 29, 1996, that a thorough environmental assessment, performed under the National Environmental Protection Act, would be necessary before pumping into the DMC could continue. The USBR recommended that the environmental assessment be prepared to address a long-term program for

conveying groundwater in the DMC, rather than trying to address pumping programs on an annual basis.

The environmental assessment must include evaluation of a no action alternative to discuss use of groundwater directly on adjacent fields and use of other surface water supplies available through transfers, in order to demonstrate that pumping of groundwater into the DMC is an economical and sensible source of supplemental water. The program must also consider the SLDMWA's basic goal of maximizing the availability of water to their member agencies and the varied need for groundwater among the districts participating in the GMP. A priority in implementation of the AB 3030 plan will be further refinement of the management of pumping groundwater into the DMC, so that an environmental assessment can be prepared that will contain necessary monitoring and mitigation measures to avoid significant adverse impact. A necessary element will be defining the quantities of groundwater to be pumped under different levels of surface water supply availability, which is necessary to evaluate impacts over the long term as required by the USBR. The current guidelines for management of pumping of groundwater into the DMC should be modified to address pumping over the long term. The environmental assessment, including mitigation measures and descriptions of the monitoring program must be prepared and shall be released for public review and comment.

Most, if not all, of the controversial aspects of the project, primarily concerns about DMC water quality degradation and subsidence, must be resolved before the USBR will be comfortable in making a finding of no significant impact and signing long-term Warren Act Contracts for the participating districts. The districts have been working closely with the Exchange Contractors, who are the recipients of the groundwater pumped into the DMC, and with the Central California Irrigation District to address subsidence of their Outside Canal in the vicinity of the concentrated deep well pumping. Securing long-term Warren Act Contracts for pumping

groundwater into the DMC will be a high priority groundwater management activity.

To be able to make good water management decisions on the use of groundwater to supplement the surface water supply, the dynamics of the groundwater basin must be better understood. This knowledge will be gained through the monitoring programs defined in Elements A and G, which will be used to assess the effect of water management efforts and design programs to optimize basin yield.

There is, nonetheless, a need to monitor aquifer responses to groundwater pumping, as is currently being done by the SLDMWA along the DMC, to avoid adverse impacts due to pumping. As localized overdraft has occurred, the supply is replaced by groundwater inflow primarily from below the Corcoran Clay. Replacement water could also come from occasional transfers of additional surface water supplies into the GMA to balance the long-term supply with demand, resulting in "in lieu" recharge of the aquifer. Because of the area's susceptibility to subsidence, frequent transfer is preferred to heavy pumping and depletion, and pumping should in zones which effect a beneficial water table response.

I. WELL CONSTRUCTION

Improperly constructed wells can establish pathways for pollutants to enter from surface drainage and can cause mixing of water between aquifers of differing quality. Sections 13700 through 13806 of the California Water Code require proper construction of wells. Standards of well construction are specified in DWR Bulletins 74-81 and 74-90.

The counties within the GMA have the fiduciary responsibility to enforce well construction standards. A well construction permit is required to drill a new well or to modify an existing well. Well Driller's Reports must be

filed with the DWR and the respective counties. Merced and Fresno Counties, encompassing the G.M.A. have adopted the DWR standards.

Because of their responsibility to enforce standards for construction and abandonment of wells and for issuance of drinking water permits for small water systems, the environmental health divisions of the respective counties maintain records on wells and groundwater quality. The records maintained by the various counties should be supplemented with data on water levels and groundwater quality collected by the participating districts to identify locations susceptible to intermixing of aquifer zones of varying water quality. The information would be used to establish specifications for well construction and destruction to optimize well water quality and minimize mixing of water between zones of varying water quality.

Better understanding of the subsurface geology and water quality is needed to define the confining beds between aquifer zones. Site specific hydrogeologic investigations may be needed to support well designs and should be submitted with the proposed well designs to obtain the well drilling permit.

It is proposed that authority over well construction remain with the respective counties and cities. The participating districts should request that the counties supply them with copies of well permits, logs, and studies to assist in their groundwater management activities.

J. CONSTRUCTION AND OPERATION OF GROUNDWATER MANAGEMENT FACILITIES

Groundwater management plans can include projects that protect the quality of groundwater and assure that the quantity of groundwater in storage is managed to meet long-term demand. The facilities that can aid in efficient management of groundwater resources include groundwater contamination clean-up projects and groundwater extraction projects for water table control. As knowledge is gained through implementation of the GMP elements, specific projects may be identified and evaluated. It is premature to list potential projects at this time.

K. RELATIONSHIPS WITH STATE AND FEDERAL REGULATING AGENCIES

Establishing effective working relationships with the various state agencies (DWR, SWRCB, DOHS, RWQCB, and DTSC) and federal agencies (USBR, USGS, and EPA) is important for water resources management to be efficient and effective. The participating districts value the information and guidance provided by these agencies and should collaborate with the appropriate state and federal agencies in well data collection, studies and findings, and in establishing effective data exchange and communication strategies.

L. REVIEW OF LAND USE PLANS TO ASSESS RISK OF GROUNDWATER CONTAMINATION

Land use planning is used by counties and cities for regulation of land uses within their jurisdiction to create a quality of life and to achieve compatibility between man's activities and the environment. It is a very effective method to mitigate impacts of changes in land use on groundwater quantity and quality. Current land use in the GMA is agricultural, with some agricultural related industry. Other land uses may be proposed that would have the potential to impact groundwater quality. The participating district should review proposed land use changes within their jurisdiction to determine if the potential for contamination exists and consult with the appropriate state or federal agency to provide groundwater data and request appropriate mitigation measures to avoid impacts to water quality.

Groundwater management plan implementation entails development of programs through cooperative efforts of the districts involved in the groundwater management plan. Implementation of some aspects of the plan may require considerable expenditures and formulas must be developed to allocate costs among the districts participating in the plan. Implementation of regional groundwater management plans are ultimately less costly than implementation of plans by individual agencies, but the implementation strategy is complicated since participating districts have varied reliance on the groundwater resource. The priorities for implementation of the various elements of the groundwater management plan will vary from district to district. The potential benefits of regional planning within a common groundwater basin or subbasin far outweigh the difficulties of plan implementation. The joining together of districts increases the opportunities for water resource management.

All participating districts are federal water service contract holders, with the CVP water supply their primary source of surface water. In quantifying the water supply needs of these districts, the USBR considered the groundwater unusable or of very limited availability due to generally poor quality.

With the restriction of moving water south of the Delta, it is forecast that the average CVP water delivery will be 60% of the contract amounts. This reduction in surface water supply has forced the water users to pump groundwater in most years to meet the water demand. As pointed out in the opening discussion in this report, implementation of the GMA will provide the necessary groundwater monitoring and assessments of pumping impacts to optimize groundwater pumping in the GMA.

With consideration given to the reliance upon groundwater by the participating districts and the varying importance of the groundwater management elements, the recommended implementation strategy is as follows:

1. After public review and consideration of comments received, the final plan is adopted by each participating district.

2. The SLDMWA will coordinate plan implementation among the participating districts.

3. A plan implementation committee made up of representatives of each participating district will meet periodically to guide and coordinate activities. This committee may be combined with the existing Steering Committee, which oversees the activities of the SLDMWA associated with pumping of wells into the DMC. The first work of the committee will be to develop rules and regulations pursuant to Water Code Section 10753.8 to be adopted by each district.

4. With consideration given to the identified problem areas, the committee shall establish a priority list for management actions. For example, a determination will be made on how groundwater levels and water quality information will be collected, who is responsible for collecting the information, and how the information will be compiled and analyzed.

5. Management activity groups will be formed of those participating districts interested in implementing certain elements of the groundwater management plan to identify specific management actions, develop budgets, apportion costs, and conduct environmental review of proposed projects.

6. An annual summary would be prepared to describe the management activity that has taken place for each plan element and used to keep participating districts and the SLDMWA abreast of the groups' activities.

This implementation strategy is expected to be refined as necessary by the management committee.

Stoddard and Associates. 1995. *"Prediction of 1995 Deep Well Pumping Into the Delta-Mendota Canal Downstream of Check 13."* Report submitted to San Luis & Delta-Mendota Water Authority, Los Banos, California.

Stoddard and Associates. 1996a. *"Delta-Mendota Canal Groundwater Pumping Analysis - Sustainable Yield Calculations."* Report submitted to San Luis & Delta-Mendota Water Authority, Los Banos, California.

Stoddard & Associates. 1996b. *"Numerical Simulation of Groundwater Flow Conditions in the DMC Management Areas."* Report submitted to San Luis & Delta-Mendota Water Authority, Los Banos, California.

Stoddard & Associates. 1996c. *"Guidelines for Management of Deep Well Pumping Into the Delta-Mendota Canal."* Report submitted to San Luis & Delta-Mendota Water Authority, Los Banos, California.

U. C. 1992. *"Determining Daily Reference Evapotranspiration* (ETo)*."* Cooperative Extension University of California, Division of Agriculture and Natural Resource, Leaflet No. 21426.

USBR. 1950. *"Geology of Part of the Delta-Mendota Canal Near Tracy, California."* U.S. Department of Interior, Bureau of Reclamation, Special Report No. 2.

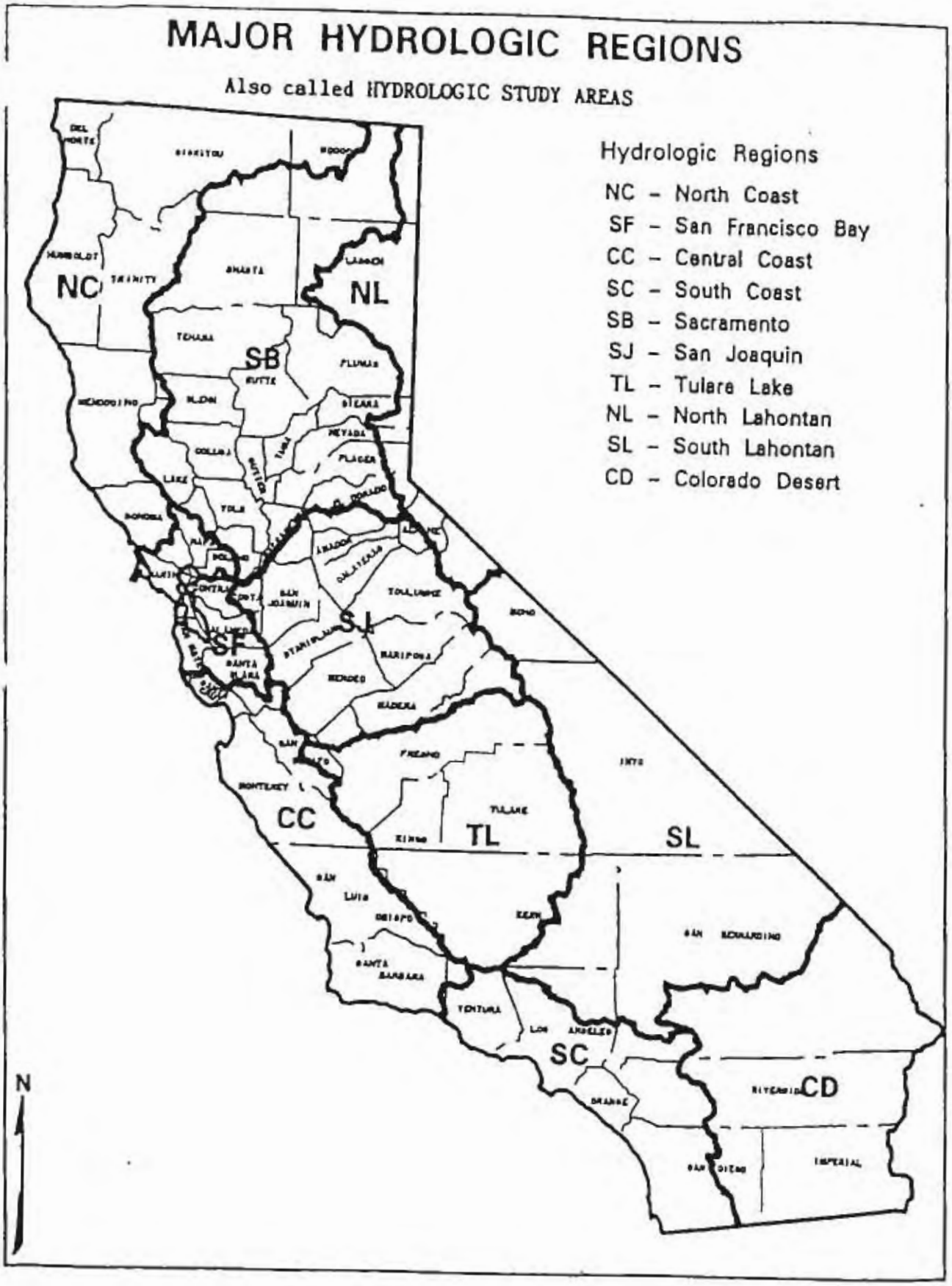


Figure 1. Hydrologic Study Areas, California (from Hauge, 1992)

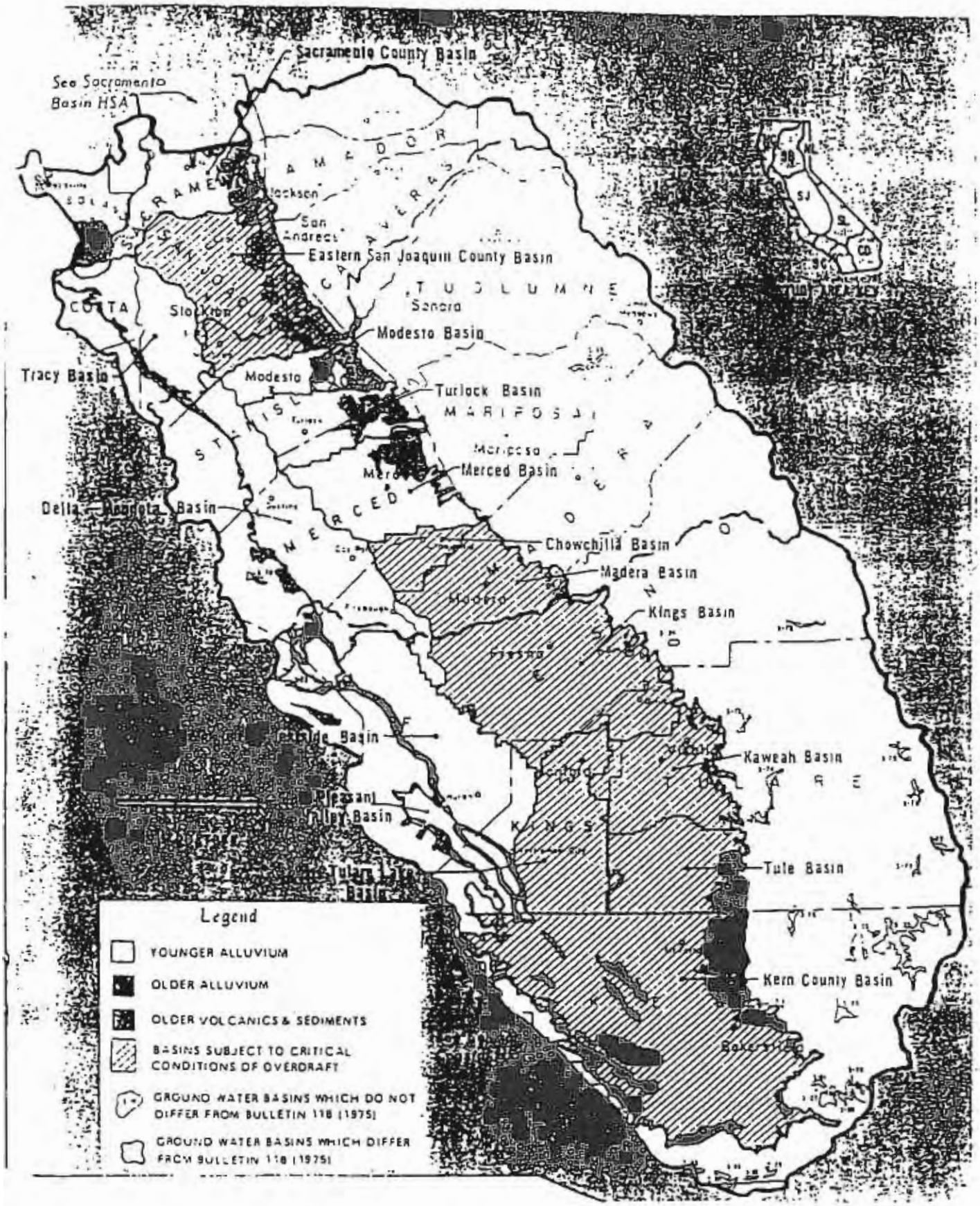


Figure 2 Groundwater Basins, San Joaquin Hydrologic Study Area, California (from DWR, 1980)

GROUNDWATER MANAGEMENT AREA

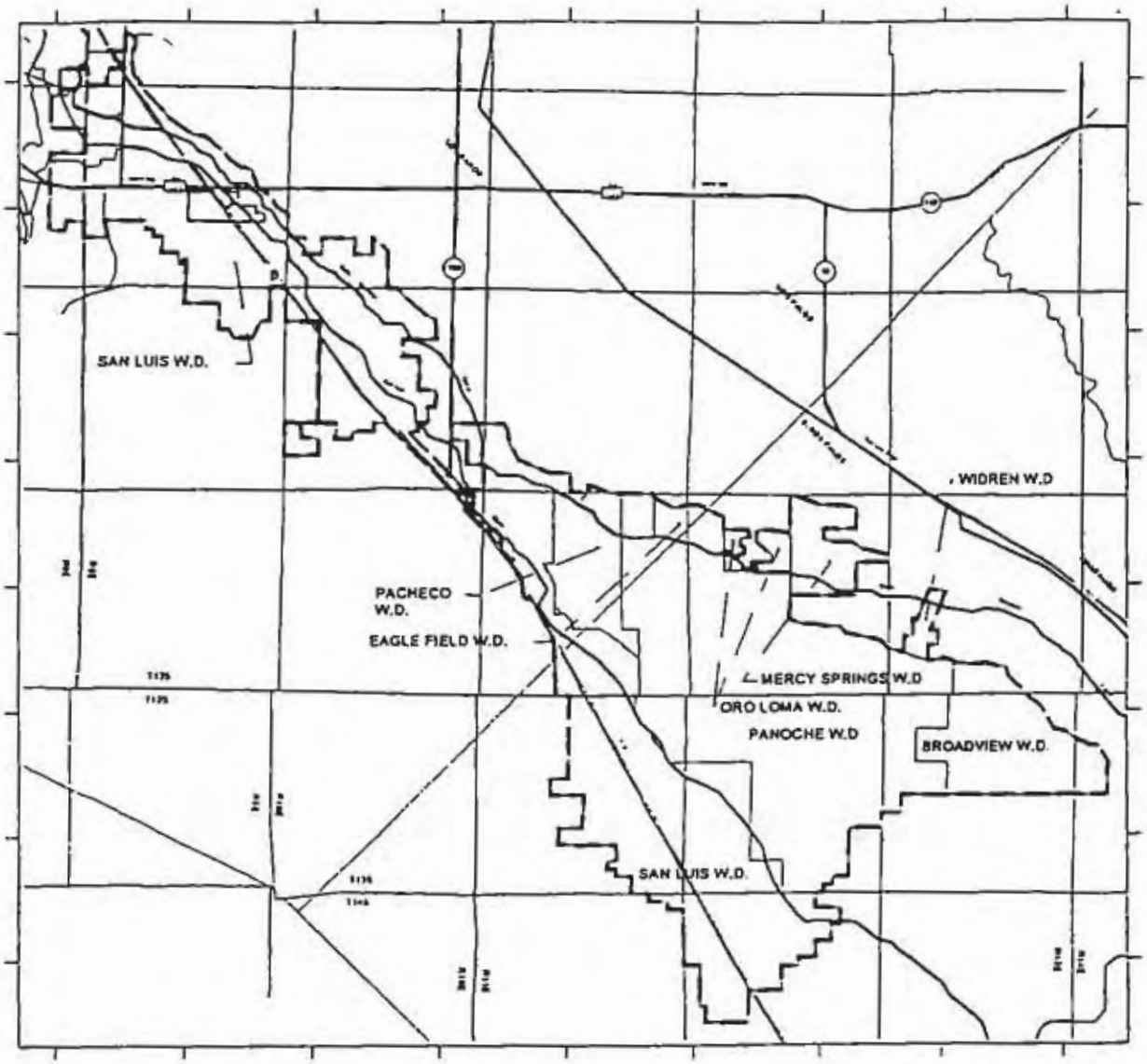


Figure 3. Boundary of the Groundwater Management Area.

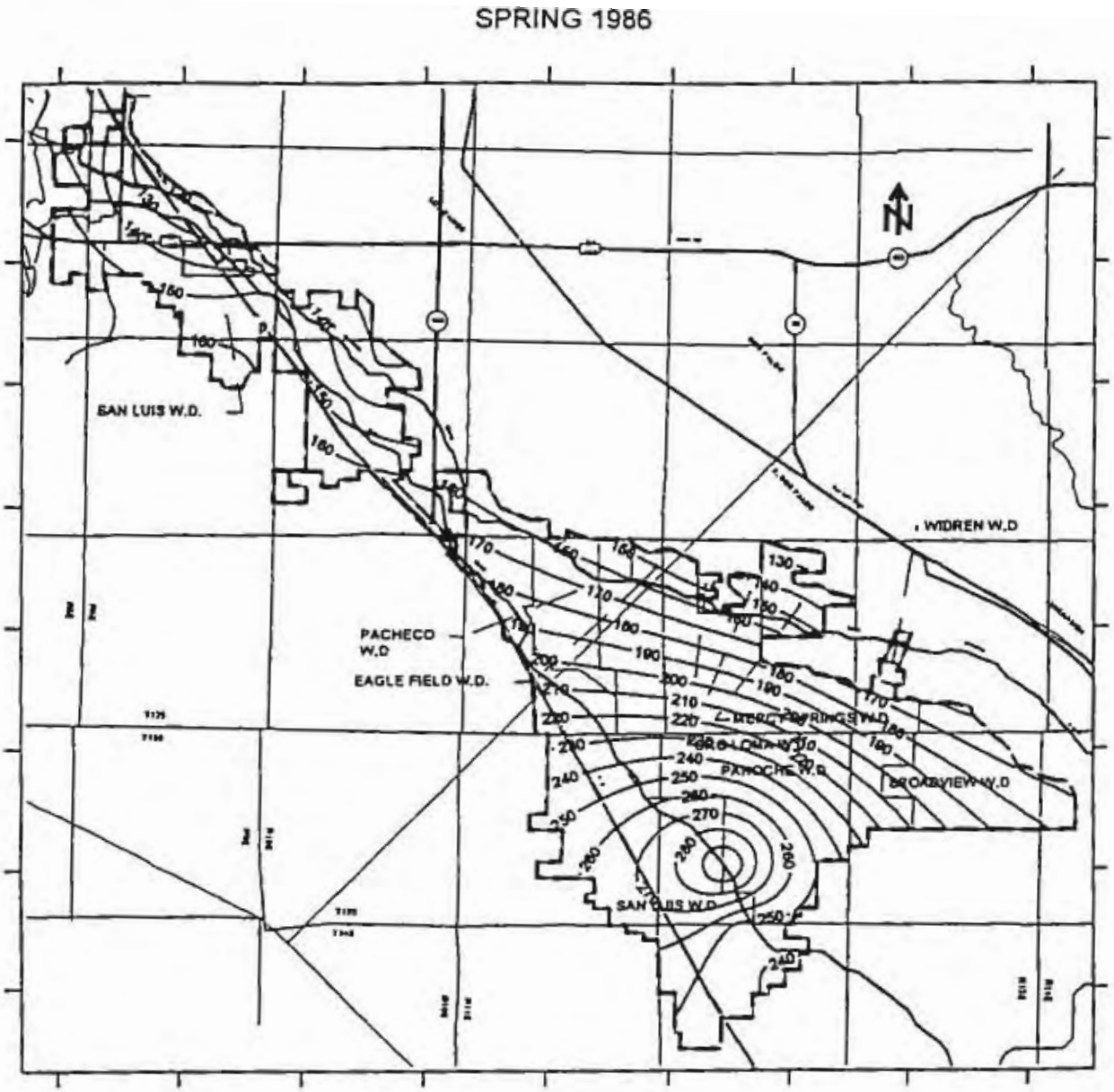


Figure 4. Unconfined Groundwater Levels (feet), Spring 1986.

SPRING 1990

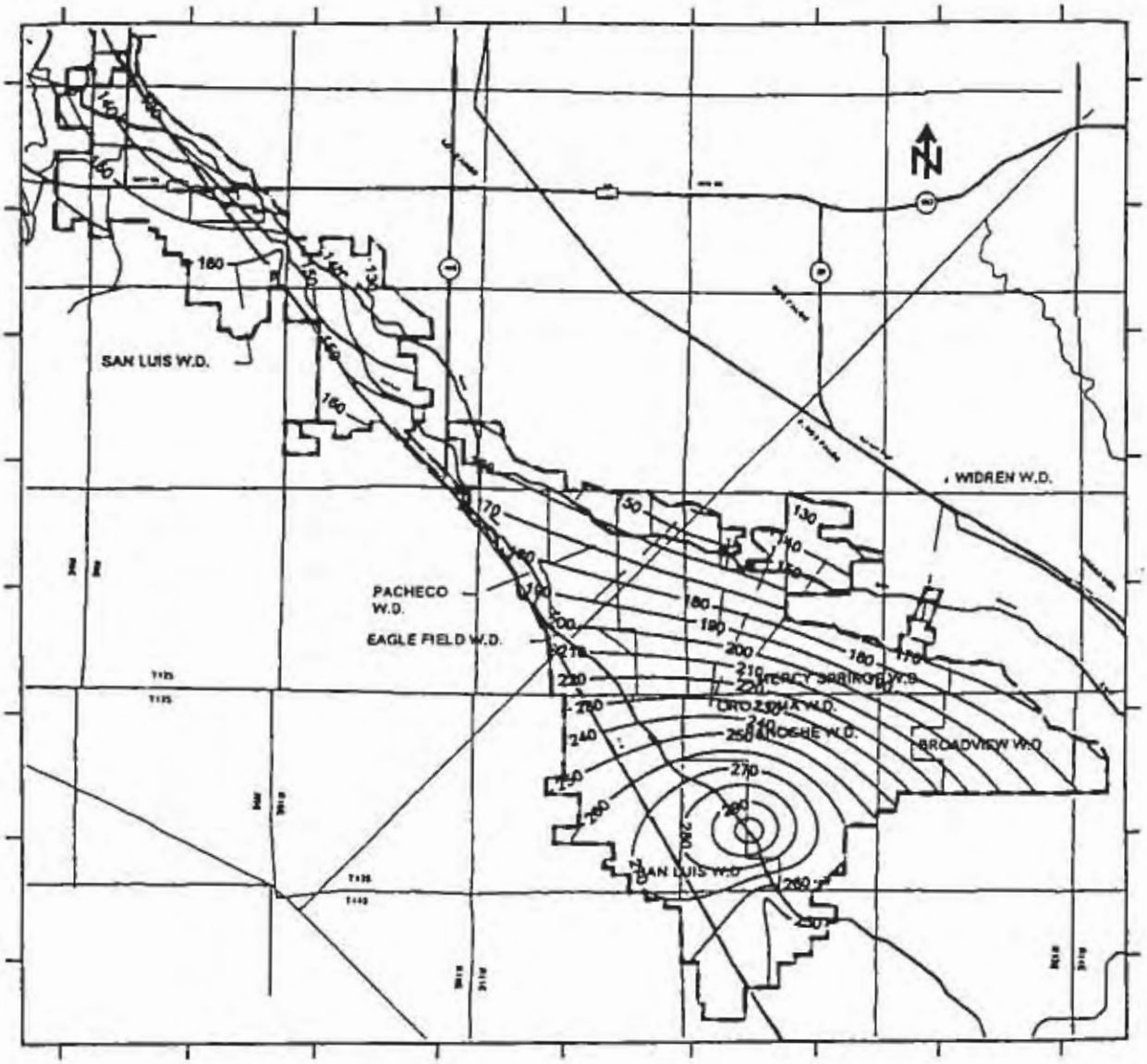


Figure 5. Unconfined Groundwater Levels (feet), Spring 1990.

SPRING 1994

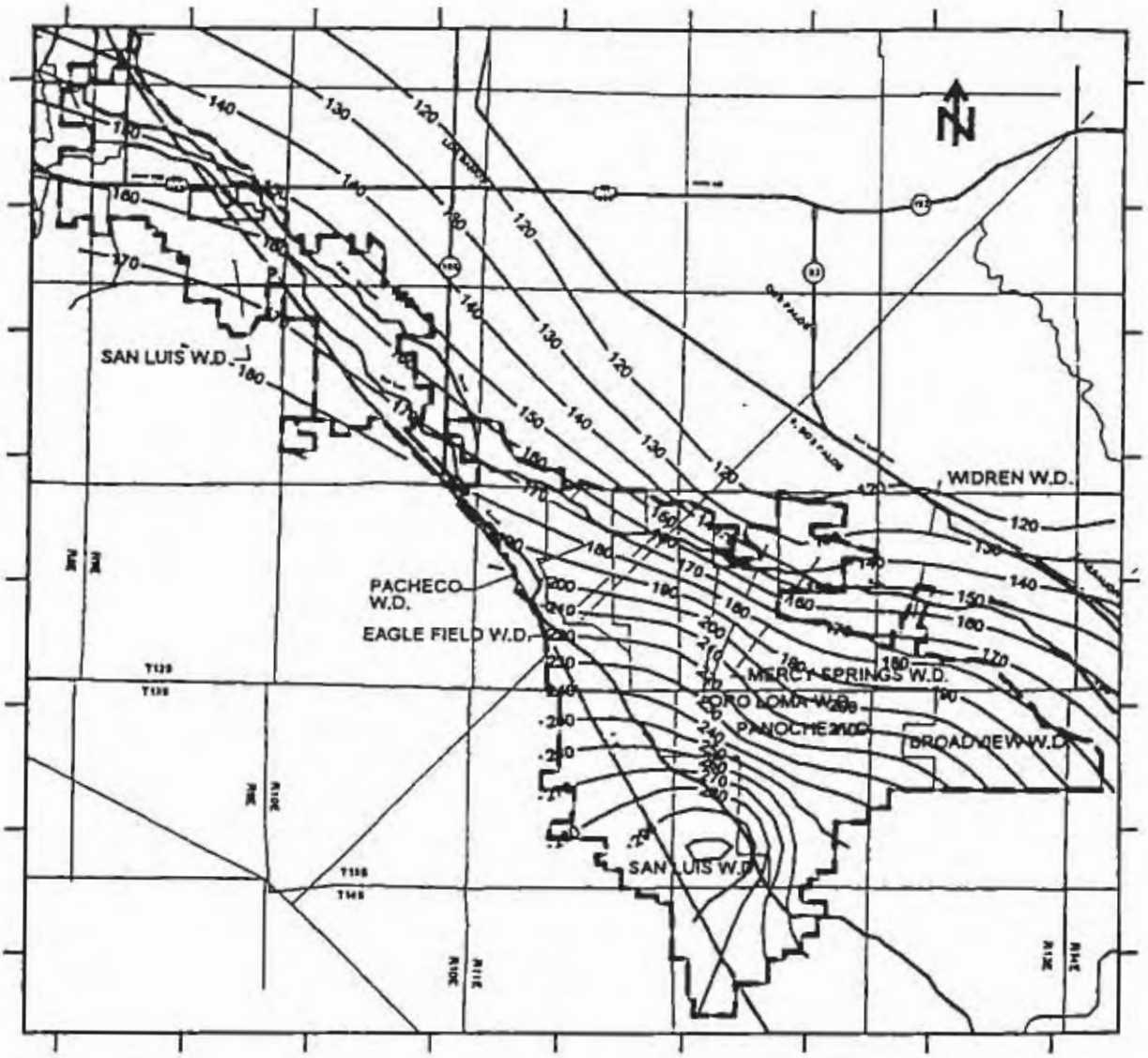


Figure 6. Unconfined Groundwater Levels (feet), Spring 1994.

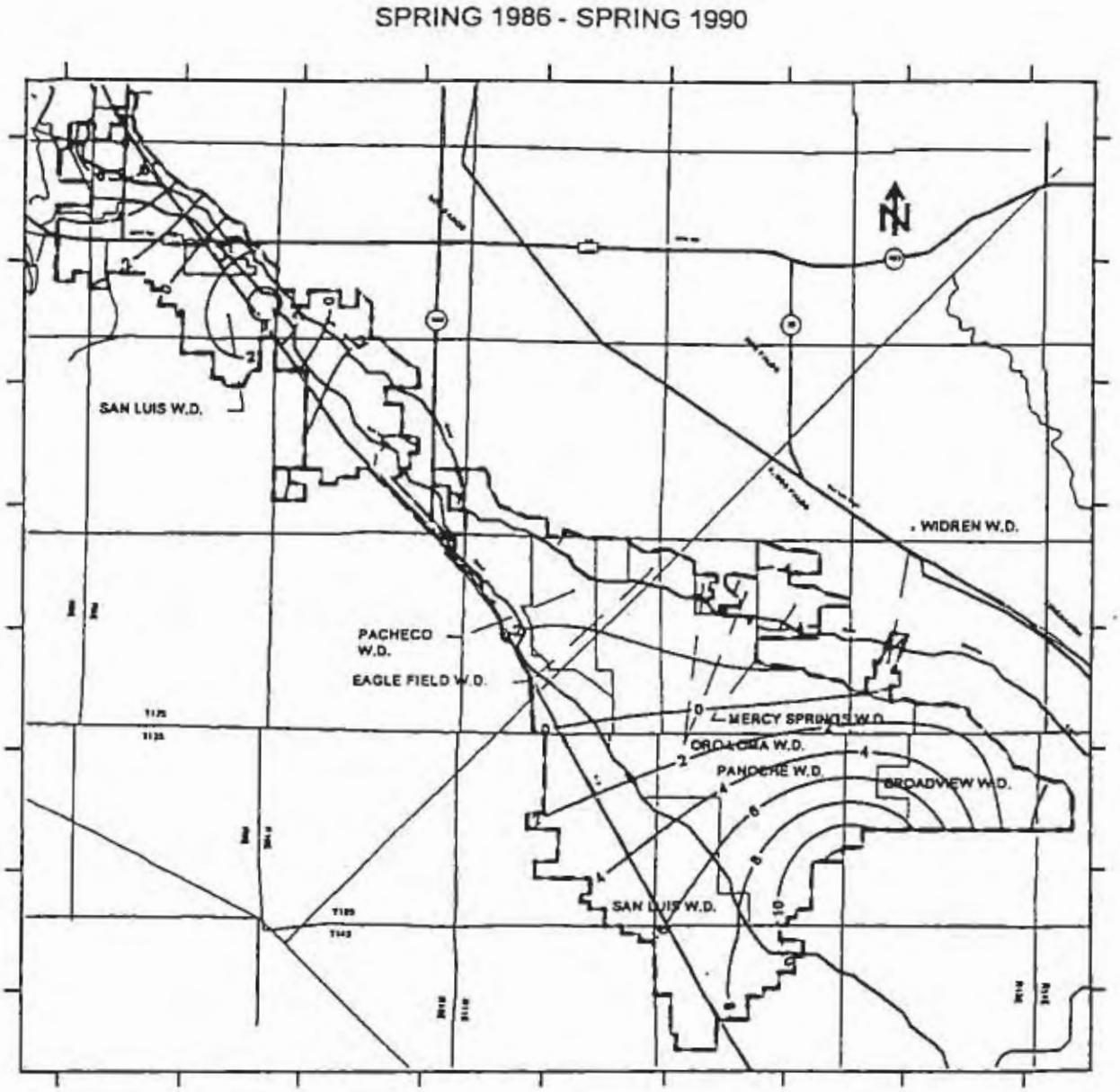


Figure 7. Unconfined Groundwater Level Change (feet), 1986 -1990.

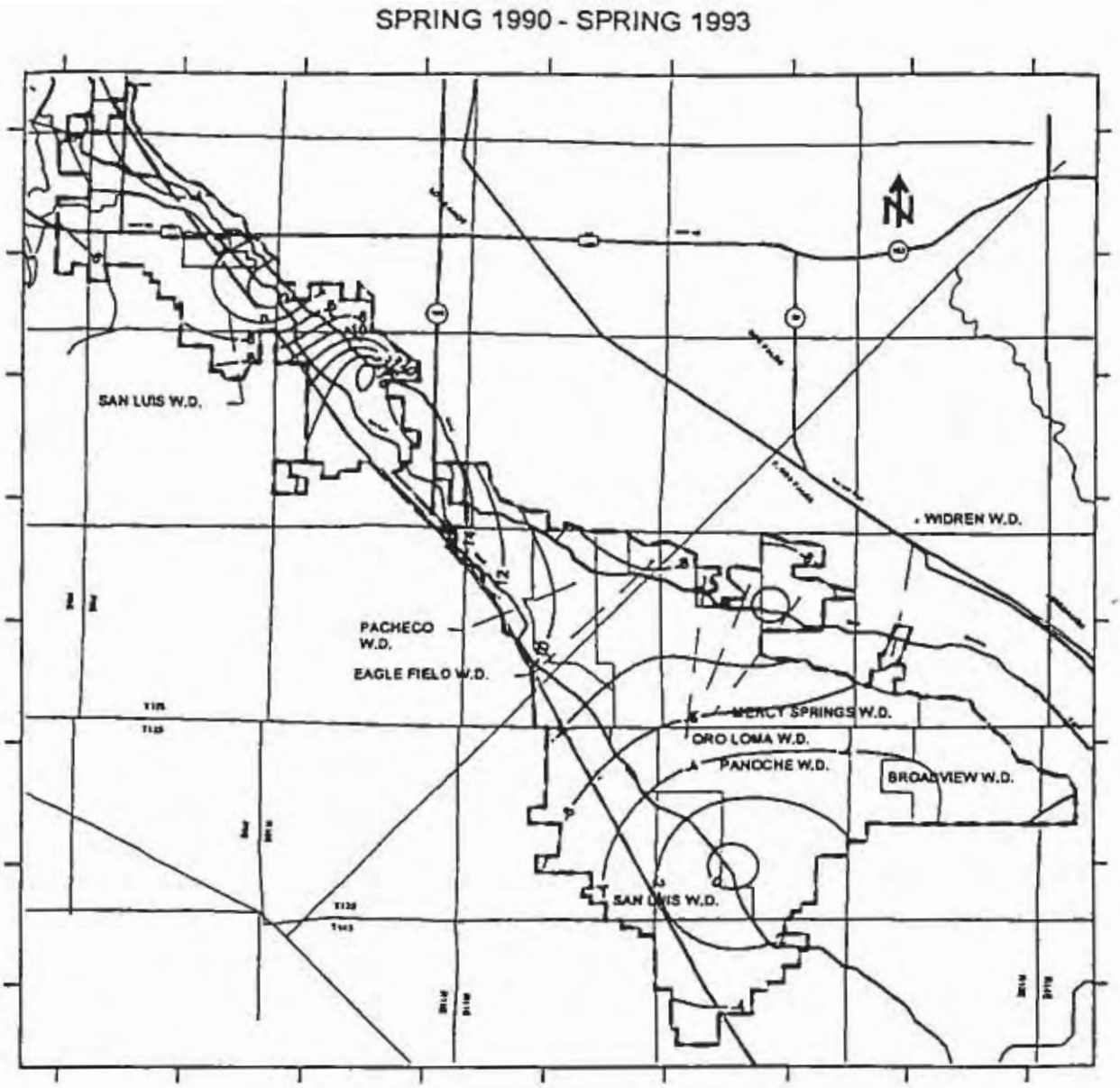


Figure 8. Unconfined Groundwater Level Change (feet), 1990 -1993.

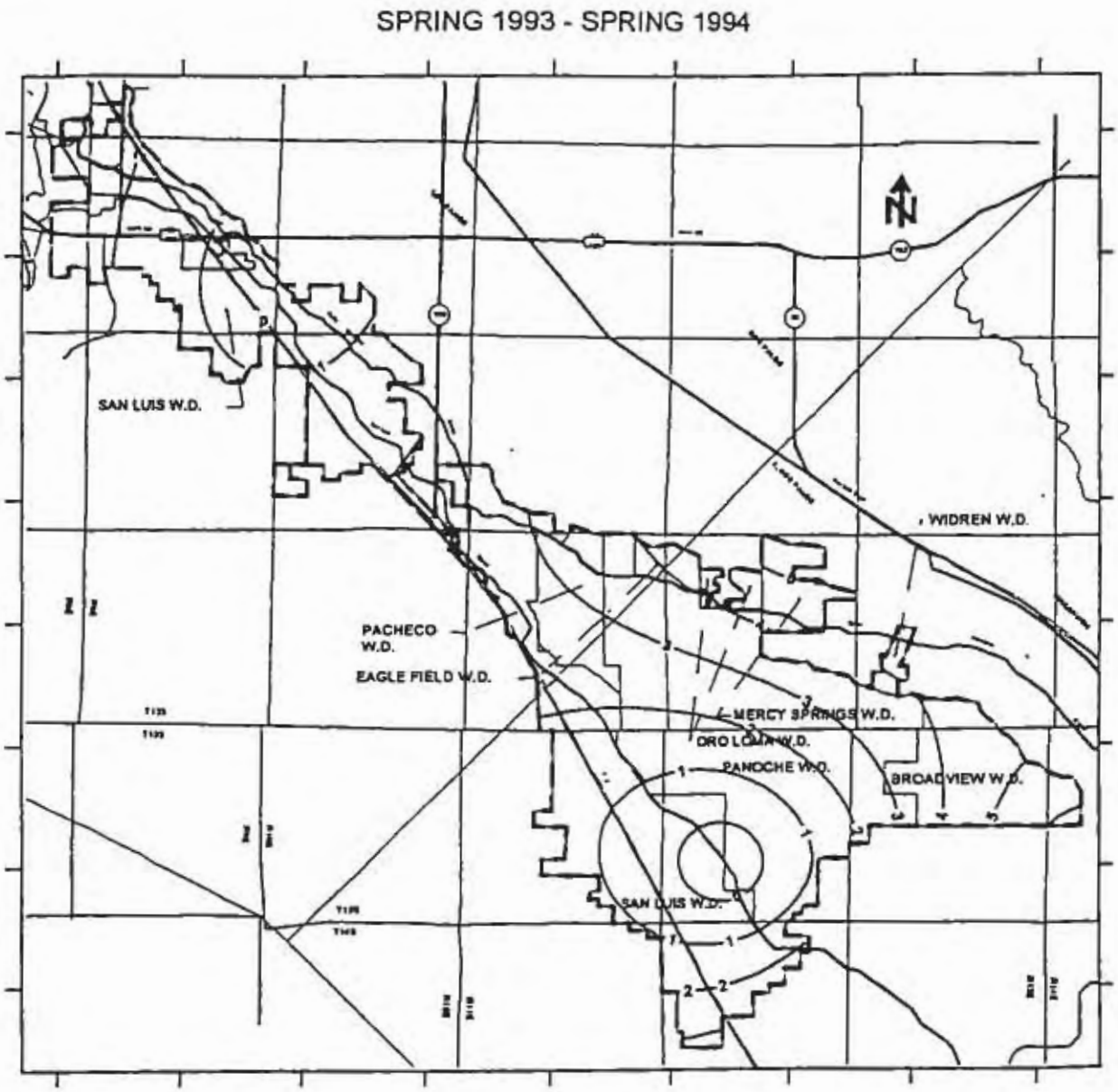
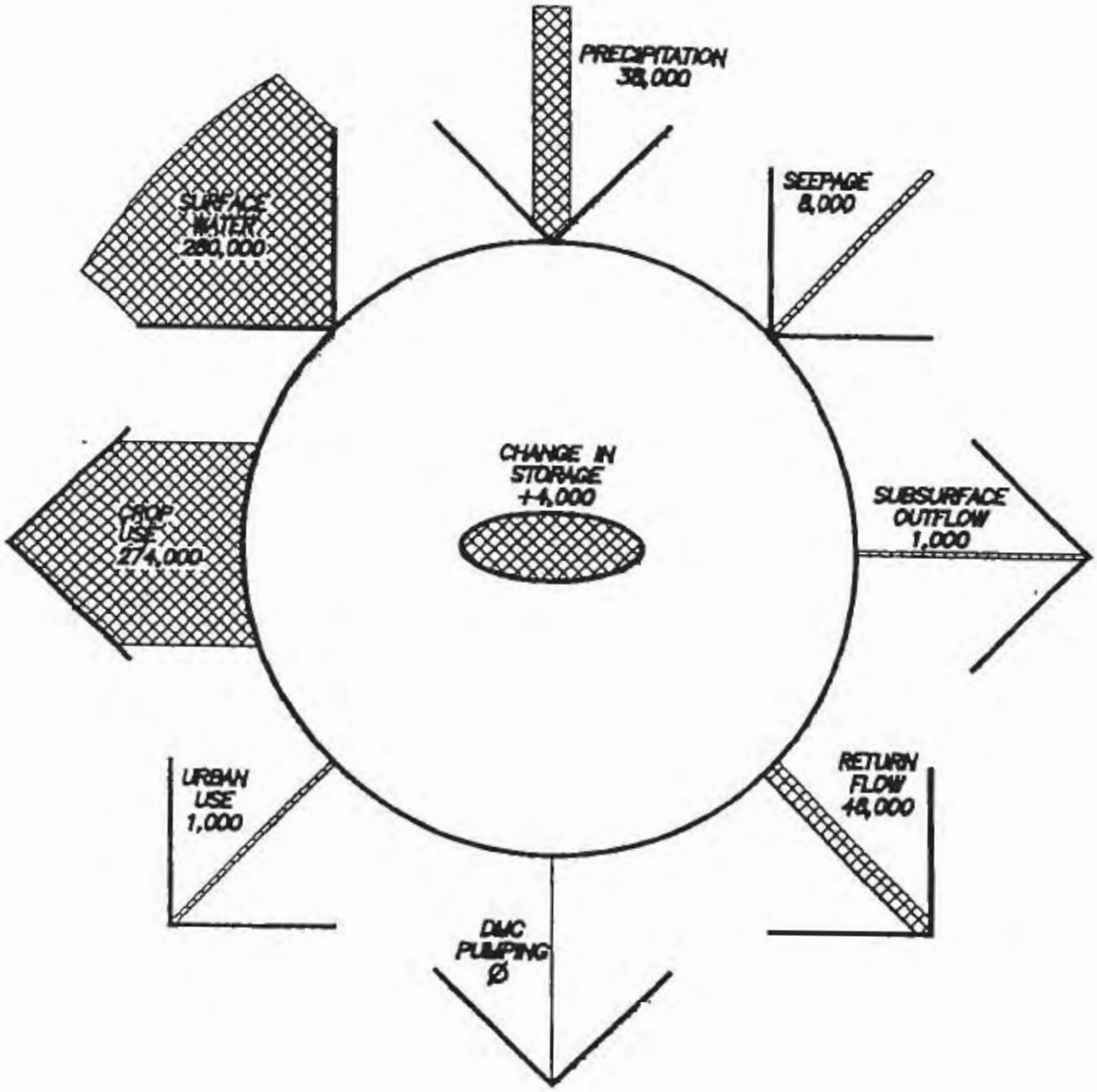


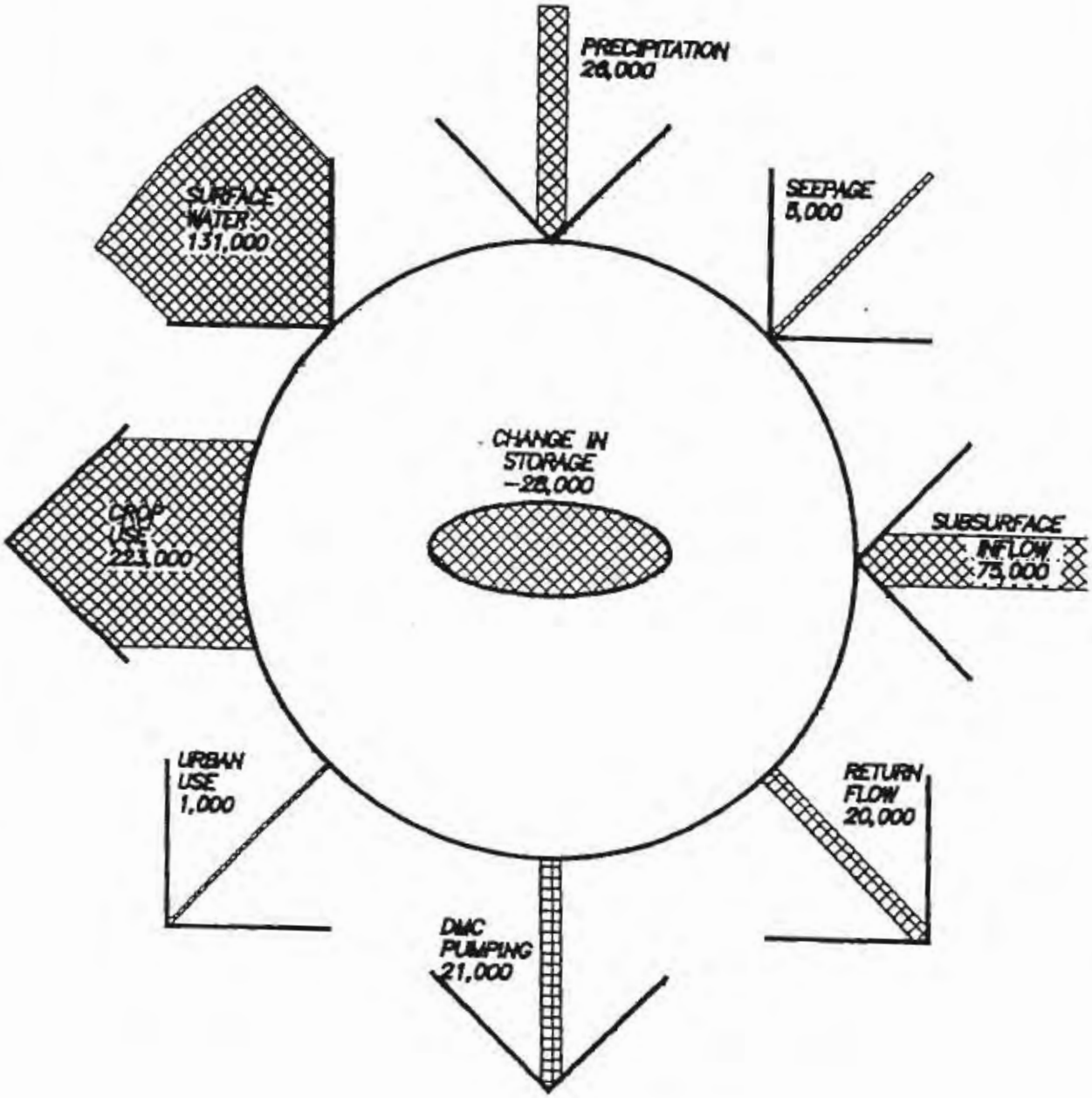
Figure 9. Unconfined Groundwater Level Change (feet), 1993 -1994.



ANNUAL WATER RESOURCE BALANCE

FULL SURFACE WATER SUPPLY

(UNITS OF ACRE FEET)



ANNUAL WATER RESOURCE BALANCE

RESTRICTED SURFACE WATER SUPPLY

(UNITS OF ACRE FEET)

SAN LUIS WATER DISTRICT

WATER MANAGEMENT PLAN (2011)

APPENDIX I

2010 CONSUMER CONFIDENCE REPORT

2011 Consumer Confidence Report

Water System Name: **San Luis Hills - San Luis Water District** **R**eport Date: June 24, 2012

We test the drinking water quality for many constituents as required by State and Federal Regulations. This report shows the results of our monitoring for the period of January 1 2011 – December 31, 2011.

Este informe contiene información muy importante sobre su agua beber. Tradúzcalo ó hable con alguien que lo entienda bien.

Type of water sources in use:

The only source of water is the San Luis Canal (California Aqueduct), which delivers surface water exported from the San Francisco Bay-Delta.

Name & location of source:

The San Luis Canal (California Aqueduct) raw water enters the District's distribution system from the Canal at milepost 75.49-R near Pioneer Road. The water is treated at the San Luis Truck Plaza Water Treatment Facility. The facility utilizes a conventional treatment process, which includes flash mixing and chemical coagulation, flocculation, sedimentation, filtration and chlorination.

Drinking Water Source Assessment information:

The California Department of Public Health will be performing a drinking water source assessment. The results of this program will be provided upon completion. A previous assessment titled "Sanitary Survey Update Report 1996" was prepared by the Department of Water Resources, Division of Local Assistance, Water Quality Assessment Branch.

Time and place of regularly scheduled board meetings for public participation:

The Board of Directors meets regularly at 1:30 PM on the last Tuesday of every month. Meetings are held at the District's office at 1015 Sixth Street in Los Banos, California.

For more information contact Mike Zuspan, Treatment Supervisor Phone: (209) 826-4043

TERMS USED IN THIS REPORT*:*

Maximum Contaminant Level (MCL): The highest level of a contaminant that is allowed in drinking water. Primary MCLs are set as close to the PHGs (or MCLGs) as is economically and technologically feasible.Secondary MCLs are set to protect the odor, taste, and appearance of drinking water.

Primary Drinking Water Standards (PDWS): MCLs and MRDL's for contaminants that affect health along with their monitoring and reporting requirements, and water treatment requirements.

Secondary Drinking Water Standards (SDWS): MCLs for contaminants that affect taste, odor, or appearance of the drinking water. Contaminants with SDWSs do not affect the health at the MCL levels.

ND: not detectable at testing limit
ppm: parts per million or milligrams per liter (mg/L)
ppb: parts per billion or micrograms per liter (ug/L)
ppt: parts per trillion or nanograms per liter (ng/L)
ppq: parts per quadrillion or nanograms per liter (pg/L)
pCi/L: picocuries per liter (a measure of radiation)

Public Health Goal (PHG): The level of a contaminant in drinking water below which there is no known or expected risk to health. PHGs are set by the California Environmental Protection Agency.

Maximum Contaminant Level Goal (MCLG): The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs are set by the U.S. Environmental Protection Agency (USEPA).

Maximum Residual Disinfectant Level (MRDL):
The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.

Maximum Residual Disinfectant Level Goal (MRDLG): The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.

Treatment Technique (TT): A required process intended to reduce the level of a contaminant in drinking water.

Regulatory action Level (AL): The concentration of a contaminant which, if exceeded, triggers treatment or other requirements which a water system must follow.

Variances and Exemptions: Department permission to exceed an MCL or not comply with a treatment technique under certain conditions.

The sources of drinking water (both tap water and bottled water) include rivers, lakes, streams, ponds, reservoirs, springs and wells. As water travels over the surface of the land or through the ground, it dissolves naturally-occurring minerals and, in some cases, radioactive material, and can pick up substances resulting from the presence of animals or from human activity.

Contaminants that may be present in source water include:

- *Microbial contaminants*, such as viruses and bacteria, that may come from sewage treatment plants, septic systems, agricultural livestock operations, and wildlife.
- *Inorganic contaminants*, such as salts and metals, that can be naturally-occurring or result from urban storm water runoff, industrial or domestic wastewater discharges, oil and gas production, mining, or farming.
- *Pesticides and herbicides*, which may come from a variety of sources such as agriculture, urban storm water runoff, and residential uses.
- *Organic chemical contaminants*, including synthetic and volatile organic chemicals, that are byproducts of industrial processes and petroleum, production, and can also come from gas stations, urban storm water runoff, and septic systems.
- *Radioactive contaminants*, which can be naturally-occurring or be the result of oil and gas production and mining activities.

In order to ensure that tap water is safe to drink, USEPA and the state Department of Health Services (Department) prescribe regulations that limit the amount of certain contaminants in water provided by public water systems. Department regulations also establish limits for contaminants in bottled water that must provide the same protection for public health.

Tables 1, 2, 3, 4, 5, 7 and 8 list all of the drinking contaminants that were detected during the most recent sampling for the constituent. The presence of these contaminants in the water does not necessarily indicate that the water poses a health risk. The Department allows us to monitor for certain contaminants less than once per year because the concentrations of these contaminants do not change frequently. Some of the data, through representative of the water quality, are more than one year old.

TABLE 1 – SAMPLING RESULTS SHOWING THE DETECTION OF COLIFORM BACTERIA

Microbiological Contaminants (complete if bacteria detected)	**Highest No. of detections**	**No. of Months In violation**	**MCL**	**MCLG**	**Typical Source of Bacteria**
Total Coliform Bacteria	(In a mo) 0	0	More than 1 sample in a month with a detection.	0	Naturally present in the environment
Fecal Coliform or E. coli	(In the year) 0	0	A routine sample and a repeat sample detect total coliform and either sample also detects fecal coliform or E. coli	0	Human and animal fecal waste

TABLE 2 – SAMPLING RESULTS SHOWING THE DETECTION OF LEAD AND COPPER

Lead and Copper (complete if lead or copper detected in the last sample set)	**No. of samples collected**	**90th percentile level detected**	**No. Sites exceeding AL**	**AL**	**MCLG**	**Typical Source of Contaminant**
Lead (ppb)	5	0.007(ppm)	0	15	2	Internal corrosion of household water plumbing systems; discharges from industrial manufacturers; erosion of natural deposits.
Copper (ppm)	5	0.183(ppm)	0	1.3	0.17	Internal corrosion of household water plumbing systems; erosion of natural deposits; leaching from wood preservatives.

TABLE 3 – SAMPLING RESULTS FOR SODIUM AND HARDNESS

Chemical or Constituent (and reporting units)	**Sample Date**	**Level Detected**	**Range of Detections**	**MCL**	**PHG (MCLG)**	**Typical Source of Contaminant**
Sodium (ppm)	08/11/11	27.0	N/A	None	None	Salt present in the water and is generally naturally occurring
Hardness (ppm)	08/11/11	157.5	N/A	None	None	Sum of polyvalent cations present in the water, generally magnesium and calcium and are usually naturally occurring

TABLE 4 – DETECTION OF CONTAMINANTS WITH A PRIMARY DRINKING WATER STANDARD						
Chemical or Constituent (and reporting units)	**Sample Date**	**Level Detected**	**Range of Detections**	**MCL**	**PHG (MCLG)**	**Typical Source Of Contaminant**
Aluminum	08/11/11	<50.0 ppb	N/A	1000 ppb	0.6 PHG N/A (MCLG)	Erosion of natural deposits; residual from some surface water treatment processes
Antimony	08/11/11	<6.0 ppb	N/A	6.0 ppb	20 PHG N/A (MCLG)	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder.
Arsenic	08/11/11	<2.0 ppb	N/A	10 ppb	0.004	Erosion of natural deposits; runoff from orchards; glass and electronics production wastes.
Asbestos	08/14/08	<0.20 MFL	N/A	7-MFL	N/A PHG 7 (MCLG)	Internal corrosion of asbestos cement water mains; erosion of natural deposits.
Barium	08/11/11	<100.0 ppb	N/A	1000 ppb	N/A PHG 2.0 (MCLG)	Discharge of oil drilling wastes and from metal refineries; erosion of natural deposits.
Beryllium	08/11/11	<1.0 ppb	N/A	4.0 ppb	N/A PHG 1.0 (MCLG)	Discharge from metal refineries; coal-burning factories, and electrical, aerospace, and defense industries.
Cadmium	08/11/11	<1.0 ppb	N/A	5.0 ppb	.04 PHG N/A (MCLG)	Internal corrosion of galvanized pipes; erosion of natural deposits; discharge from electroplating and industrial chemical factories and metal refineries; runoff from waste batteries and paints.
Chromium	08/11/11	<10. ppb	N/A	50.0 ppb	N/A PHG 100.0 (MCLG)	Discharge from steel and pulp mills and chrome plating; erosion of natural deposits.
Fluoride	08/11/11	<0.1 ppm	N/A	2.0 ppm	1.0 PHG N/A (MCLG)	Erosion of natural deposits; water additive, which promotes strong teeth; discharge from fertilizer and aluminum factories.

TABLE 4 – DETECTION OF CONTAMINANTS WITH A PRIMARY DRINKING WATER STANDARD

Chemical or Constituent (and reporting units)	**Sample Date**	**Level Detected**	**Range of Detections**	**MCL**	**PHG (MCLG)**	**Typical Source Of Contaminant**
Mercury	08/11/11	<1.0 ppb	N/A	2.0 ppb	1.2 PHG N/A (MCLG)	Erosion of natural deposits; discharge from refineries and factories; runoff from landfills; runoff from cropland.
Nickel	08/11/11	<10.0 ppb	N/A	100.0 ppb	12.0 PHG N/A (MCL	Erosion of natural deposits; discharge from metal factories.
Nitrite (as nitrogen,N)	08/11/11	<400 ppb	N/A	1000 ppb	1.0 PHG N/A (MCLG)	Runoff and leaching from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits.
Nitrate (as nitrate,NO3)	08/11/11	<2.0 ppm	N/A	45.0 ppm	45.0 PHG N/A (MCLG)	Runoff and leaching from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits.
Selenium	08/11/11	<5.0 ppb	N/A	50.0 ppb	N/A PHG 30.0 (MCLG)	Discharge from petroleum, glass and metal refineries; erosion of natural deposits; discharge from mines and chemical manufacturers; runoff from livestock lots (feed additive).
Thallium	08/11/11	<1.0 ppb	N/A	2.0 ppb	0.1 PHG N/A (MCLG)	Leaching from ore-processing sites' discharge from electronics, glass and drug factories.
Gross Alpha	06/25/09 09/10/09 12/15/09 03/22/10	6.2 pCi/l <3.0 <3.0 3.10	2.25 pCi/l	15.0 pCi/l	N/A PHG 0 (MCLG)	Erosion of natural deposits.

TABLE 5 – DETECTION OF CONTAMINANTS WITH A SECONDARY DRINKING WATER STANDARD

Chemical or Constituent (and reporting units)	**Sample Date**	**Level Detected**	**Range of Detection**	**MCL**	**PHG (MCLG)**	**Typical Source of Contaminant**
Aluminum	08/11/11	<50.0 ppb	N/A	200 ppb	N/A	Erosion of natural deposits; residual from some surface water treatment processes.
Color	08/11/11	15.0 units	N/A	15 units	N/A	Naturally-occurring organic materials
Copper	08/11/11	<50.0 ppb	N/A	1000 ppb	N/A	Internal corrosion of household plumbing systems; erosion of natural deposits; leaching from wood preservatives.
Foaming Agents (MBAS)	08/11/11	<0.02 ppm	N/A	0.5 ppm	N/A	Municipal and industrial waste discharges.
PH	08/11/11	6.9	N/A	6.5 – 8.5	N/A	Leaching from natural deposits.
Silver	08/11/11	<10.0 ppb	N/A	100.0 ppb	N/A	Industrial discharges
Turbidity	08/11/11	2.8 units	N/A	5.0 units	N/A	Soil Runoff
Zinc	08/11/11	<50.0 ppb	N/A	5000 ppb	N/A	Runoff/leaching from natural deposits; industrial wastes.
Total Dissolved Solids (TDS)	08/11/11	141.0 ppm	N/A	1000.0 ppm	N/A	Runoff/leaching from natural deposits.
Specific Conductance	08/11/11	293.0 micromhos	N/A	1600.0 micromhos	N/A	Substances that form ions when in water; seawater influence
Sulfate	08/11/11	38.1 ppm	N/A	500.0 ppm	N/A	Runoff/leaching from natural deposits; industrial wastes.
Chloride	08/11/11	45.4 ppm	N/A	500.0 ppm	N/A	Runoff/leaching from natural deposits; seawater influence
Iron	08/11/11	<100.0 ppb	N/A	300.0 ppb	N/A	Leaching from natural deposits; industrial wastes.
Manganese	08/11/11	<20.0 ppb	N/A	50.0 ppb	N/A	Leaching from natural deposits

TABLE 6 - DETECTION OF UNREGULATED CONTAMINANTS				
Chemical or Constituent	**Sample Date**	**Level Detected**	**Action Level**	**Health effects Language**

- *Any Violation of a MCL, MRDI, or TT is asterisked. Additional information regarding the violations is provided later in this report.*

Additional General Information On Drinking Water

All drinking water, including bottle water, may reasonably be expected to contain at least small amounts of some contaminants. The presence of contaminants does not necessary indicate that the water poses a health risk. More information about contaminants and potential health effects can be obtained by calling the USEPA's Safe Drinking Water Hotline (1-800-426-4791).

Some people may be more vulnerable to contaminants in drinking water than the general population. Immuno-compromised persons such as persons with cancer undergoing chemotherapy, persons who have undergone organ transplants, people with HIV/AIDS or other immune system disorders, some elderly, and infants can be particularly at risk from infections. These people should seek advice about drinking water from their health care providers. USEPA/Centers for Disease Control (CDC) guidelines on appropriate means to lessen the risk of infections by *Cryptosporidium* and other microbial contaminants are available from the Safe Drinking Water Hotline (1-800-426-4791).

If present, elevated levels of lead can cause serious health problems, especially for pregnant women and young children. Lead in drinking water is primarily from materials and components associated with service lines and home plumbing. San Luis Water District is responsible for providing high quality drinking water, but cannot control the variety of materials used in plumbing components. When your water has been sitting for several hours, you can minimize the potential for lead exposure by flashing your tap for 30 seconds to 2 minutes before using water for drinking or cooking. If you are concerned about lead in your water, you may wish to have your water tested. Information on lead in drinking water, testing methods, and steps you can take to minimize exposure is available from Safe Drinking Water Hotline or at http://www.epa.gov/safewater/lead.

Summary Information for Violation of a MCL, MRDL, AL, TT, or Monitoring and Reporting Requirement

VIOLATION OF A MCL, MRDL, AL, TT, OR MONITORING AND REPORTING REQUIREMENT				
Violation	**Explanation**	**Duration**	**Actions Taken to Correct the Violation**	**Health Effects Language**

For Water Systems Providing Ground Water as a Source of Drinking Water

TABLE 7 – SAMPLING RESULTS SHOWING FECAL INDICATOR-POSITIVE GROUND WATER SOURCE SAMPLES					
Microbiological Contaminants (complete if fecal-indicator detected)	**Total No. of Detections**	**Sample Dates**	**MCL [MRDL]**	**PHG (MCLG) [MRDLG[**	**Typical Source of Contaminant**
E. coli	0		0	(0)	Human and animal fecal waste
Enterococci	0		TT	n/a	Human and animal fecal waste
Coliphage	0		TT	n/a	Human and animal fecal waste

Summary Information for Fecal Indicator-Positive Ground Water Source Samples, Uncorrected Significant Deficiencies or Ground Water TT

SPECIAL NOTICE OF FECAL INDICATOR-POSITIVE GROUND WATER SOURCE SAMPLE

SPECIAL NOTICE FOR UNCORRECTED SIGNIFICANT DEFICIENCIES

VIOLATION OF GROUND WATER TT				
TT Violation	**Explanation**	**Duration**	**Actions Taken to Correct the Violation**	**Health Effects Language**

For Systems Providing Surface Water as a Source of Drinking Water

TABLE 8 – SAMPLING RESULTS SHOWING TREATMENT OF SURFACE WATER SOURCES	
Treatment Technique[a] (Type of approved filtration technology used)	Conventional Filtration and Treatment: A process which includes flash mixing and chemical coagulation, flocculation, sedimentation, filtration and chlorination.
Turbidity Performance Standards[b] (that must be met through the water treatment process)	Turbidity of the filtered water must; 1 – Be less than or equal to ≤1.0 NTU in 95% of measurements in a month. 2 – Not exceed 0.3 NTU for more than eight consecutive hours. 3 – Not exceed 2.0 NTU at any time.
Lowest monthly percentage of samples that met Turbidity Performance Standard No. 1.	100%
Highest single turbidity measurement during the year.	0.260 NTU
The number of violations of any surface water treatment requirements.	1.

(a) A required process intended to reduce the level of a contaminant in drinking water.
(b) Turbidity (measured in NTU) is a measurement of the cloudiness of water and is a good indicator of water quality and filtration performance. Turbidity results which meet performance standards are considered to be in compliance with filtration requirements.

* *Any violation of a TT is marked with an asterisk. Additional information regarding the violation is provided below.*

Summary Information for Violation of a Surface Water TT

VIOLATION OF A SURFACE WATER TT				
TT Violation	**Explanation**	**Duration**	**Actions Taken to Correct the Violation**	**Health Effects Language**
Noncompliance of Disinfection By Product Precursor Treatment Technique Requirements	Failure to achieve acceptable levels of TOC removal.	4th Quarter of 2011	The District is testing different treatment techniques to optimize TOC reduction.	Total organic carbon (TOC) has no health effects. However, total organic carbon provides a medium for the formation of disinfection byproducts. These byproducts include trihalomethanes (THMs) and Haloacetic acids (HAAs). Drinking water containing these byproducts in excess of the MCL may lead to adverse health effects, liver or kidney problems, or nervous system effects, and may lead to an increased risk of cancer.

Summary Information for Operating Under a Variance or Exemption

SAN LUIS WATER DISTRICT

WATER MANAGEMENT PLAN (2011)

APPENDIX J

2010 WATER TRANSFERS

SAN LUIS WATER DISTRICT
2010 WATER TRANSFERS

TRANSFERS IN			
From	**To**	**acre-feet**	**Notes**
Banta Carbona	SLWD	1,500	
Del Puerto	SLWD	200	
Delano-Earlimart	SLWD	595	
Exchange Contractors	SLWD	3,455	
Exeter ID	SLWD	150	
Firebaugh Canal WD	SLWD	1,093	
Fresno ID	SLWD	599	
James ID	SLWD	2,000	
Kern-Tulare	SLWD	5,330	
Laguna WD	SLWD	320	
Madera ID	SLWD	1,485	
Pacheco	SLWD	1,575	
Pacheco	SLWD	90	
Panoche	SLWD	3,550	
Porterville ID	SLWD	239	
Santa Clara	SLWD	8,885	
Saucelito ID	SLWD	262	
Shafter-Wasco ID	SLWD	316	
Tranquillity	SLWD	3,367	
Tri-Valley	SLWD	514	
Warren Act Contract 10-WC-20-4031		4,986	
Warren Act Contract 10-WC-20-4032		2,078	
Warren Act Contract 09-WC-20-3930		1,864	
Warren Act Contract 09-WC-20-3929		3,671	
Warren Act Contract 09-WC-20-3964		1,571	
2009 Rescheduled Transfer In Water		9,154	
	Total	**58,849**	

TRANSFERS OUT			
From	**To**	**acre-feet**	
SLWD	Metropolitan WD	30,000	Water at risk of spill in San Luis Reservoir. Exchanged with MWD for return in following year
SLWD	Mercy Springs WD	445	Growers Transfering to self in another district
SLWD	Panoche	200	Growers Transfering to self in another district
SLWD	Westlands	895	Growers Transfering to self in another district
	Total	**31,540**	

SAN LUIS WATER DISTRICT

WATER MANAGEMENT PLAN (2011)

APPENDIX K

CROP WATER NEEDS ANALYSIS

SAN LUIS WATER DISTRICT

CROP WATER NEEDS ANALYSIS

1989 & 1998

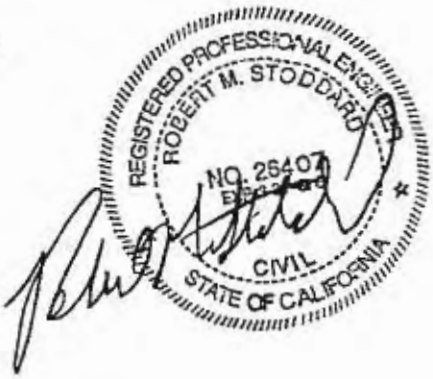
Prepared For:

SAN LUIS WATER DISTRICT

P.O. Box 2135
Los Banos, California 93635

Prepared By:

STODDARD & ASSOCIATES
CIVIL ENGINEERS
1120 West I Street, Suite C
Los Banos, California 93635



SEPTEMBER 1999

TABLE OF CONTENTS

I.	INTRODUCTION		1
II.	WATER DEMAND COMPONENTS		2
	A.	Cropping Patterns	2
	B.	Reference Evapotranspiration Values	2
	C.	Crop Coefficients	3
	D.	Crop Evapotranspiration	3
	E.	Annual Crop Consumptive Use	4
	F.	Effective Precipitation	4
	G.	Leaching Requirements	5
	H.	Cultural Practices	6
	I.	Crop Water Needs	6
III.	WATER NEEDS SUMMARY		7
	REFERENCES		

APPENDIX A

Crop Water Needs Summaries

APPENDIX B

List of Crop Categories

APPENDIX C

Reference Evapotranspiration and Precipitation Data

APPENDIX D

Crop Coefficients and Supporting Documentation

APPENDIX E

Monthly Crop Evapotranspiration Data

APPENDIX F

Yearly Crop Evapotranspiration Data

ADMINISTRATIVE DRAFT

SAN LUIS WATER DISTRICT

CROP WATER NEEDS ANALYSIS

1989 & 1998

I. INTRODUCTION

A. The purpose of this study was to quantify the crop water needs for the San Luis Water District (the District) for the years of 1989 and 1998.

B. This report summarizes the methods used to quantify the components of crop water demand. A summary of the demand for each year, calculated on a crop year (October of the previous year through September of that year), water year (March of that year through February of the following year), and calendar year (January through December), can be found in Appendix A.

C. The study area was divided into two sub-basins, including the Northern and Southern Sub-basins. These sub-basins were selected with consideration given to district location relative to availability of daily evapotranspiration data.

II. WATER DEMAND COMPONENTS

A. CROPPING PATTERNS

1. Crop Categories

In order to standardize the reporting of acreage, the U.S. Bureau of Reclamation's crop reporting methodology was used. A final list of twenty-two crop categories or FDR's (Columns A and B, Appendix A)

was derived from consolidating a larger list of approximately eighty-six categories. Crops included in each final category have similar leaching requirements and consumptive use requirements. A complete list of the crop categories can be found in Appendix B.

2. 1989 and 1998 Irrigated Acreage Data

Irrigated acreage data were gathered directly from the District for each of the subject years (Column D, Appendix A).

B. REFERENCE EVAPOTRANSPIRATION VALUES

1. Reference evapotranspiration (ETo) is used to estimate the evapotranspiration of a reference crop. It supplies information about the water lost from the soil surface (evaporation) and the amount of water used by plants (transpiration) for grass which is well watered, closely clipped, actively growing, and completely shading the soil.

2. In this study, 1989 and 1998 ETo values were obtained from the California Irrigation Management Information System (CIMIS) database in Sacramento. Daily ETo data were downloaded and totaled monthly from October of the previous year through February of the following year. Any missing daily ETo data were estimated by taking the average of the adjacent days.

3. 1989 and 1998 ETo Data

Three representative CIMIS weather stations were chosen in order to gather daily ETo data for each of the two sub-basins.

1989

- Northern Sub-Basin: Station #56 (Los Banos)
- Southern Sub-Basin: Station #40 (Mendota Dam)

1998

- Northern Sub-Basin: Station #56 (Los Banos)
- Southern Sub-Basin: Station #105 (Tranquillity)

The monthly data from the Northern and Southern Sub-Basis were then averaged to obtain representative monthly ETo values for the District, which were the ETo values used for the remainder of the computations. A summary of the ETo data for each year can be found in Appendix C.

C. CROP COEFFICIENTS

The crop coefficient (Kc) is a dimensionless number that is multiplied by the monthly ETo value to arrive at the crop evapotranspiration (ETc) estimate. Average monthly crop coefficients were derived from various sources including California State Water Resources Control Board Report 84-1 (Pettygrove et al., 1984), Jensen, et al. (1990), Cal Poly (1994), and UC Leaflet 21428, (1989). The same monthly Kc values were applied to both sub-basins and both years, assuming that the variability in Kc values due to change in geographical locations has negligible significance on the overall water demand calculation. A table summarizing monthly Kc's used in this study and explanations on the derivation of each can be found in Appendix D.

D. CROP EVAPOTRANSPIRATION

The monthly ETc for each of the twenty-two crop categories was derived by calculating the product of the monthly ETo and Kc values (Appendix E). The annual ETc was then tabulated by summing the monthly ETc values. This data

was compiled on a crop year, water year, and calendar year basis. Summary tables of the estimated yearly ETc values for 1989 and 1998 can be found in Appendix F, and can also be found in Column E, Appendix A.

E. ANNUAL CROP CONSUMPTIVE USE

The annual crop consumptive use (CU) is the volume of water required by the crop during the growing season for full potential under the given growing environment. The annual CU in acre-feet of an individual crop is calculated by multiplying the ETc of the crop by the irrigated acreage and converting from acre-inches to acre-feet (Column F, Appendix A).

F. EFFECTIVE PRECIPITATION

1. Effective precipitation (Ep) is defined as the amount of rainfall that infiltrates into the ground and is used by crops, or aids in the leaching of salts from the crop root zone. There are numerous approaches used in estimating Ep. In this study, the California DWR methodology (DWR, 1989) of estimating Ep at 50% of the total annual rainfall was utilized (Appendix C & Column G, Appendix A). This procedure may slightly over-estimate the amount of rainfall that is effective. The amount of total rainfall that actually infiltrates into the soil will vary widely depending upon geography, soil, and surface conditions.

2. In this study, 1989 and 1998 precipitation values were obtained from the CIMIS database in Sacramento. Daily precipitation data were downloaded and totaled monthly for October of the previous year through February of the following year for both sub-basins. The average of the Northern and Southern Sub-basins was used for the District precipitation values. A summary of the precipitation data by month and by sub-basin for each year

can be found in Appendix C. The CIMIS stations used to gather the ETo data were also used to gather precipitation data.

3. The volume of effective precipitation by crop was calculated for the District by multiplying the Ep by the irrigated acreage and converting from acre-inches to acre-feet (Column H, Appendix A).

G. LEACHING REQUIREMENTS

1. The leaching requirement (LR) is the amount of water applied to maintain viable irrigated agriculture. This water requirement is in excess of crop consumptive use and is necessary to maintain soil salinity at acceptable levels. The LR depends on the salinity of the irrigation water (ECw) and the salt tolerance of the crop. If leaching is inadequate, salt can accumulate within the root zone. The only means of controlling root zone salinity is to ensure a net downward flow of water through the crop root zone.

2. In this study, irrigation water quality most representative of the average water quality of the delivered water (Appendix A) was obtained from the District and the California Data Exchange Center's (CDEC) web site, sponsored by the California Department of Water Resources.

3. Threshold values of soil salinity (ECe) for the various crop categories were obtained from Tanji (1990) and Ayers (1977) (Column C, Appendix A).

4. The additional water required for leaching, (expressed as a portion of the infiltrated water), of individual crops was calculated using the following equation. (Schwab et al, 1993)

$$LR = ECw/[5(ECe) - ECw]$$

where: ECw and ECe are in dS/m

The LR was then multiplied by the ETc to arrive at the depth of water (Column I, Appendix A) required for sufficient leaching for each crop. The LR depth was then multiplied by the irrigated acreage and converted from acre-inches to acre-feet, which resulted in the volume of water required for leaching (Column J, Appendix A).

H. CULTURAL PRACTICES

1. A cultural practice is the amount of additional water required by crops, in excess of crop consumptive use and leaching requirements. Cultural practices are crop specific practices or practices inherent to a location as a result of a pre-existing condition. Such practices may include frost protection for subtropical orchards, pre-harvest irrigation for garlic, seed germination for tomatoes, or control of certain pests.

2. Records of water deliveries for cultural practice needs were requested from the District for 1989 and 1998. In both years, these volumes were reported as zero (Column K and L, Appendix A).

I. CROP WATER NEEDS

1. The total crop water (CW) need in inches for each crop (Column M, Appendix A) was calculated as the summation of the ETc, the LR, and the CP, less the Ep. This depth was multiplied by the irrigated acreage and converted from acre-inches to acre-feet to arrive at the volume of water needed to sustain each crop (Column N, Appendix A).

III. WATER NEEDS SUMMARY

A. The total crop water demand for 1989, with slightly below average rainfall, ranged from 115,484 AF for the crop year versus 119,707 AF for the calendar year. This disparity of 4,223 AF can be accounted for by the slight variation in ETo and Ep data by month.

B. The crop water needs analysis for 1998 (the record wettest year), yielded a larger range of demand, ranging from 66,821 AF in the crop year to 83,700 AF in the water year. This 16,879 AF difference mainly stems from the diversity in monthly precipitation data. Approximately 19 inches of precipitation was recorded for the crop year and only 11 inches for the water year. A significant amount of rainfall was recorded in February of 1998, and thus was not included in the water year precipitation total. Therefore, the water year Ep was notably lower than the crop year, yielding a higher crop water demand.

C. This analysis delineates the importance of the type of year (relative to rainfall) and its impact on the crop water needs. The 42,000 AF decrease in crop water demand from 1989 to 1998 results fairly proportionately from the increased Ep and the decreased ETo data. Also, note this large variability exists despite the substantial increase in irrigated and deciduous acres from 1989.

Ayers, Robert S. 1977. *"Quality of Water for Irrigation."* Journal of Irrigation and Drainage Division, American Society of Civil Engineers Proc. Paper 13010, Vol. 103; No. 1R2: 135-154.

Cal Poly. 1994. *"Grassland Basin Irrigation and Drainage Study."* Irrigation Training and Research Center, California Polytechnic State University, San Luis Obispo, California, Volume 1 – Final Report.

DWR. 1989. *"Effective Precipitation: A Field Study to Assess Consumptive Use of Winter Rains by Spring and Summer Crops."* Department of Water Resources, California.

Jensen, M. E., R. D. Burman and R. G. Allen. 1990. *"Evapotranspiration and Irrigation Water Requirements."* American Society of Civil Engineers Manual and Reports on Engineering Practice, No. 70: 127.

Pettygrove, G.S. and T. Asano (ed.). 1984. *"Irrigation with Reclaimed Municipal Wastewater – A Guidance Manual."* Report No. 84-1 wr, California State Water Resources Control Board, Sacramento.

Schwab, Glenn, O., Delmar D. Fangmeier, William J. Elliot and Richard K. Frevert. 1993. *"Soil and Water Conservation Engineering."* John Wiley & Sons, Inc., Fourth Edition.

Stoddard & Associates. 1994. *"Water Needs Analysis for the Delta-Mendota Canal Service Area Water Contractors Undergoing Contract Renewal."* Report submitted to San Luis & Delta-Mendota Water Authority, Los Banos, California.

Tanji, K. K. 1990. *"Agricultural Salinity Assessment and Management."* American Society of Civil Engineers Manuals and Reports on Engineering Practice, No. 71: 270-286.

U. C. 1989. *"Using Reference Evapotranspiration (ETo) and Crop Coefficients to Estimate Crop Evapotranspiration (ETc) for Trees and Vines."* Cooperative Extension University of California, Division of Agriculture and Natural Resource, Leaflet No. 21428.

CROP WATER NEEDS SUMMARIES

9/24/99

SAN LUIS WATER DISTRICT

CROP YEAR 1999

SUPPLY WATER QUALITY	SOURCE %	SOURCE ECw,dS/m
DMC	21	0.62
SLC	71	0.33
SJR	0	
WELLS	8	0.90
TOTAL	100	
WEIGHTED ECw		0.44

A	B	C	D	E	F	G	H	I	J	K	L	M	N
FDR #	CROP	ECe dS/m	AREA ACRES	CROP CON. USE INCHES	CROP CON. USE AC.FT.	EFF. PRECIPITATION INCHES	EFF. PRECIPITATION AC.FT.	LEACHING REQM'T INCHES	LEACHING REQM'T AC.FT.	CULTURAL PRACT. INCHES	CULTURAL PRACT. AC.FT.	CROP WATER INCHES	CROP WATER AC.FT.
1	ALFALFA	2.0	6,001	52.36	26,167	3.43	1,717	2.39	1,195	0.00	0	51.32	25,665
2	ALMONDS												
	YEAR 1	1.5	250	11.29	235	3.43	72	0.70	15	0.00	0	8.56	178
	YEAR 2	1.5	80	27.60	184	3.43	23	1.71	11	0.00	0	25.88	173
	YEAR 3	1.5	100	38.48	321	3.43	29	2.38	20	0.00	0	37.42	312
	MATURE	1.5	1,989	41.82	6,932	3.43	569	2.58	428	0.00	0	40.98	6,792
3	BARLEY	8.0	802	17.84	1,192	3.43	229	0.20	13	0.00	0	14.60	976
4	BEANS(DRY)	1.0	2,782	22.97	5,286	3.43	790	2.20	508	0.00	0	21.73	5,002
5	CORN(FIELD)	1.7	713	30.78	1,829	3.43	204	1.67	99	0.00	0	29.01	1,724
6	COTTON	7.7	17,382	33.57	48,619	3.43	4,972	0.38	558	0.00	0	30.52	44,205
7	DECIDUOUS ORCHARDS												
	YEAR 1	1.5	126	11.71	123	3.43	36	0.72	8	0.00	0	9.00	94
	YEAR 2	1.5	158	28.61	377	3.43	45	1.77	23	0.00	0	26.95	355
	YEAR 3	1.5	0	39.69	0	3.43	0	2.46	0	0.00	0	36.92	0
	MATURE	1.5	1,847	43.35	6,673	3.43	528	2.68	412	0.00	0	42.60	6,557
8	GRAIN SORGHUM(MILO)	4.0	0	20.34	0	3.43	0	0.45	0	0.00	0	17.36	0
9	GRAINS	7.0	74	19.63	121	3.43	21	0.25	2	0.00	0	16.44	101
10	MELONS	2.2	6,590	19.23	10,559	3.43	1,885	0.79	436	0.00	0	16.59	9,111
11	MISC. TRUCK FIELD CROPS(HIGH)	2.0	0	37.89	0	3.43	0	1.73	0	0.00	0	36.19	0
12	MISC. TRUCK FIELD CROPS(LOW)	1.7	0	16.00	0	3.43	0	0.87	0	0.00	0	13.44	0
13	MISC. TRUCK FIELD CROPS(MED)	1.5	899	26.95	2,019	3.43	257	1.87	125	0.00	0	25.18	1,886
14	NURSERY/LETTUCE	1.3	0	8.00	0	3.43	0	0.58	0	0.00	0	5.14	0
15	PASTURE(IMPROVED)	2.8	136	52.16	591	3.43	39	1.68	18	0.00	0	50.40	571
16	POTATOES	1.8	0	23.63	0	3.43	0	1.38	0	0.00	0	21.57	0
17	RICE	2.8	0	49.97	0	3.43	0	1.81	0	0.00	0	48.14	0
18	SUBTROPICAL ORCHARDS												
	YEAR 1	1.7	43	10.39	37	3.43	12	0.56	2	0.00	0	7.52	27
	YEAR 2	1.7	0	25.41	0	3.43	0	1.38	0	0.00	0	23.35	0
	YEAR 3	1.7	145	35.41	428	3.43	41	1.92	23	0.00	0	33.90	410
	MATURE	1.7	411	38.49	1,318	3.43	118	2.08	71	0.00	0	37.15	1,272
19	SUGAR BEETS	7.0	654	40.38	2,200	3.43	187	0.51	28	0.00	0	37.44	2,040
20	TOMATOES	2.5	1,927	31.12	4,997	3.43	551	1.13	181	0.00	0	26.81	4,626
21	VINEYARD												
	YEAR 1	1.5	0	8.09	0	3.43	0	0.50	0	0.00	0	5.16	0
	YEAR 2	1.5	0	19.79	0	3.43	0	1.22	0	0.00	0	17.56	0
	YEAR 3	1.5	0	27.58	0	3.43	0	1.70	0	0.00	0	25.85	0
	MATURE	1.5	1,205	29.98	3,011	3.43	345	1.85	186	0.00	0	28.40	2,852
22	WHEAT	6.0	470	17.34	679	3.43	134	0.26	10	0.00	0	14.16	555
	TOTALS		44,764		123,918		12,804		4,371		0		115,484

9/24/99

SAN LUIS WATER DISTRICT

WATER YEAR 1999

SUPPLY WATER QUALITY	SOURCE %	SOURCE ECw,dS/m
DMC	20	0.62
SLC	72	0.33
SJR	0	
WELLS	8	0.90
TOTAL	100	
WEIGHTED ECw		0.43

A	B	C	D	E	F	G	H	I	J	K	L	M	N
FDR #	CROP	ECe dS/m	AREA ACRES	CROP CON. USE INCHES	CROP CON. USE AC.FT.	EFF. PRECIPITATION INCHES	EFF. PRECIPITATION AC.FT.	LEACHING REQM'T INCHES	LEACHING REQM'T AC.FT.	CULTURAL PRACT. INCHES	CULTURAL PRACT. AC.FT.	CROP WATER INCHES	CROP WATER AC.FT.
1	ALFALFA	2.0	6,001	53.05	26,529	3.25	1,627	2.40	1,202	0.00	0	52.20	26,105
2	ALMONDS												
	YEAR 1	1.5	250	11.36	237	3.25	68	0.70	15	0.00	0	8.81	183
	YEAR 2	1.5	80	27.77	185	3.25	22	1.70	11	0.00	0	26.22	175
	YEAR 3	1.5	100	38.71	323	3.25	27	2.38	20	0.00	0	37.63	315
	MATURE	1.5	1,989	42.08	6,974	3.25	539	2.58	428	0.00	0	41.41	6,863
3	BARLEY	8.0	802	17.77	1,188	3.25	217	0.19	13	0.00	0	14.71	983
4	BEANS(DRY)	1.0	2,762	22.97	5,286	3.25	749	2.18	502	0.00	0	21.90	5,040
5	CORN(FIELD)	1.7	713	30.78	1,829	3.25	193	1.65	98	0.00	0	29.18	1,734
6	COTTON	7.7	17,382	33.62	48,701	3.25	4,711	0.38	555	0.00	0	30.75	44,545
7	DECIDUOUS ORCHARDS												
	YEAR 1	1.5	126	11.85	124	3.25	34	0.73	8	0.00	0	9.32	98
	YEAR 2	1.5	158	28.97	381	3.25	43	1.78	23	0.00	0	27.49	362
	YEAR 3	1.5	0	40.38	0	3.25	0	2.48	0	0.00	0	39.60	0
	MATURE	1.5	1,847	43.89	6,755	3.25	501	2.69	415	0.00	0	43.33	6,669
8	GRAIN SORGHUM(MILO)	4.0	0	20.56	0	3.25	0	0.46	0	0.00	0	17.76	0
9	GRAINS	7.0	74	19.56	121	3.25	20	0.25	2	0.00	0	16.55	102
10	MELONS	2.2	6,590	19.23	10,559	3.25	1,788	0.79	433	0.00	0	16.76	8,206
11	MISC. TRUCK FIELD CROPS(HIGH)	2.0	0	36.24	0	3.25	0	1.73	0	0.00	0	36.72	0
12	MISC. TRUCK FIELD CROPS(LOW)	1.7	0	16.01	0	3.25	0	0.66	0	0.00	0	13.62	0
13	MISC. TRUCK FIELD CROPS(MED)	1.5	699	27.13	2,032	3.25	244	1.66	125	0.00	0	25.54	1,913
14	NURSERY/LETTUCE	1.3	0	8.01	0	3.25	0	0.57	0	0.00	0	5.33	0
15	PASTURE(IMPROVED)	2.8	138	52.85	599	3.25	37	1.69	19	0.00	0	51.28	581
16	POTATOES	1.6	0	23.63	0	3.25	0	1.35	0	0.00	0	21.74	0
17	RICE	2.8	0	50.04	0	3.25	0	1.60	0	0.00	0	48.39	0
18	SUBTROPICAL ORCHARDS												
	YEAR 1	1.7	43	10.47	38	3.25	12	0.56	2	0.00	0	7.78	28
	YEAR 2	1.7	0	25.58	0	3.25	0	1.38	0	0.00	0	23.70	0
	YEAR 3	1.7	145	35.66	431	3.25	39	1.92	23	0.00	0	34.32	415
	MATURE	1.7	411	38.76	1,328	3.25	111	2.08	71	0.00	0	37.59	1,288
19	SUGAR BEETS	7.0	654	40.36	2,200	3.25	177	0.51	28	0.00	0	37.61	2,050
20	TOMATOES	2.5	1,927	31.12	4,997	3.25	522	1.12	180	0.00	0	28.98	4,654
21	VINEYARD												
	YEAR 1	1.5	0	6.17	0	3.25	0	0.50	0	0.00	0	5.42	0
	YEAR 2	1.5	0	19.68	0	3.25	0	1.23	0	0.00	0	17.98	0
	YEAR 3	1.5	0	27.85	0	3.25	0	1.71	0	0.00	0	26.31	0
	MATURE	1.5	1,205	30.28	3,040	3.25	327	1.86	187	0.00	0	28.68	2,900
22	WHEAT	6.0	470	17.29	677	3.25	127	0.25	10	0.00	0	14.29	560
	TOTALS		44,764		124,534		12,133		4,368		0		116,769

9/24/99

SAN LUIS WATER DISTRICT

CALENDAR YEAR 1999

SUPPLY WATER QUALITY	SOURCE %	SOURCE ECw,dS/m
DMC	20	0.62
SLC	72	0.33
SJR	0	
WELLS	8	0.90
TOTAL	100	
WEIGHTED ECw		0.43

A	B	C	D	E	F	G	H	I	J	K	L	M	N
FDR #	CROP	ECe dS/m	AREA ACRES	CROP CON. USE INCHES	CROP CON. USE AC.FT.	EFF. PRECIPITATION INCHES	EFF. PRECIPITATION AC.FT.	LEACHING REQM'T INCHES	LEACHING REQM'T AC.FT.	CULTURAL PRACT. INCHES	CULTURAL PRACT. AC.FT.	CROP WATER INCHES	CROP WATER AC.FT.
1	ALFALFA	2.0	6,001	53.20	26,602	2.49	1,245	2.41	1,206	0.00	0	53.12	26,562
2	ALMONDS												
	YEAR 1	1.5	250	11.36	237	2.49	52	0.70	15	0.00	0	9.57	199
	YEAR 2	1.5	80	27.77	185	2.49	17	1.70	11	0.00	0	26.98	180
	YEAR 3	1.5	100	38.71	323	2.49	21	2.38	20	0.00	0	38.60	322
	MATURE	1.5	1,989	42.08	6,974	2.49	413	2.58	428	0.00	0	42.17	6,989
3	BARLEY	8.0	802	17.89	1,196	2.49	166	0.20	13	0.00	0	15.60	1,042
4	BEANS(DRY)	1.0	2,762	22.97	5,288	2.49	573	2.18	502	0.00	0	22.68	5,215
5	CORN(FIELD)	1.7	713	30.78	1,829	2.49	148	1.65	86	0.00	0	29.95	1,779
6	COTTON	7.7	17,382	33.62	48,701	2.49	3,607	0.38	555	0.00	0	31.51	45,649
7	DECIDUOUS ORCHARDS												
	YEAR 1	1.5	126	11.85	124	2.49	26	0.73	8	0.00	0	10.09	106
	YEAR 2	1.5	158	28.97	381	2.49	33	1.78	23	0.00	0	28.25	372
	YEAR 3	1.5	0	40.38	0	2.49	0	2.48	0	0.00	0	40.37	0
	MATURE	1.5	1,847	43.89	6,755	2.49	383	2.69	415	0.00	0	44.09	6,767
8	GRAIN SORGHUM(MILO)	4.0	0	20.56	0	2.49	0	0.46	0	0.00	0	18.52	0
9	GRAINS	7.0	74	19.65	121	2.49	15	0.25	2	0.00	0	17.40	107
10	MELONS	2.2	6,590	18.23	10,559	2.49	1,367	0.79	433	0.00	0	17.53	9,625
11	MISC. TRUCK FIELD CROPS(HIGH)	2.0	0	38.33	0	2.49	0	1.74	0	0.00	0	37.57	0
12	MISC. TRUCK FIELD CROPS(LOW)	1.7	0	18.00	0	2.49	0	0.86	0	0.00	0	14.37	0
13	MISC. TRUCK FIELD CROPS(MED)	1.5	899	27.16	2,035	2.49	187	1.67	125	0.00	0	26.34	1,973
14	NURSERY/LETTUCE	1.3	0	8.00	0	2.49	0	0.57	0	0.00	0	6.08	0
15	PASTURE(IMPROVED)	2.8	136	53.06	601	2.49	28	1.70	19	0.00	0	52.27	592
16	POTATOES	1.6	0	23.63	0	2.49	0	1.35	0	0.00	0	22.50	0
17	RICE	2.8	0	50.04	0	2.49	0	1.60	0	0.00	0	49.15	0
18	SUBTROPICAL ORCHARDS												
	YEAR 1	1.7	43	10.47	38	2.49	9	0.56	2	0.00	0	8.54	31
	YEAR 2	1.7	0	25.58	0	2.49	0	1.38	0	0.00	0	24.47	0
	YEAR 3	1.7	145	35.86	431	2.49	30	1.92	23	0.00	0	35.09	424
	MATURE	1.7	411	38.78	1,328	2.49	85	2.08	71	0.00	0	38.35	1,314
19	SUGAR BEETS	7.0	654	40.36	2,200	2.49	138	0.51	28	0.00	0	38.38	2,091
20	TOMATOES	2.5	1,927	31.12	4,997	2.49	400	1.12	180	0.00	0	29.74	4,778
21	VINEYARD												
	YEAR 1	1.5	0	8.17	0	2.49	0	0.50	0	0.00	0	6.18	0
	YEAR 2	1.5	0	19.98	0	2.49	0	1.23	0	0.00	0	18.72	0
	YEAR 3	1.5	0	27.85	0	2.49	0	1.71	0	0.00	0	27.07	0
	MATURE	1.5	1,205	30.28	3,040	2.49	250	1.86	187	0.00	0	29.64	2,977
22	WHEAT	8.0	470	17.38	681	2.49	98	0.25	10	0.00	0	15.14	593
	TOTALS		44,764		124,624		9,289		4,372		0		119,707

9/24/99

SAN LUIS WATER DISTRICT

CROP YEAR 1996

SUPPLY WATER QUALITY	SOURCE %	SOURCE ECw,dS/m	
DMC	17	0.30	
SLC	83	0.30	* quality assumed
SJR			
WELLS			
TOTAL	100		
WEIGHTED ECw		0.30	

A	B	C	D	E	F	G	H	I	J	K	L	M	N
FDR #	CROP	ECe dS/m	AREA ACRES	CROP CON. USE INCHES	CROP CON. USE AC.FT.	EFF. PRECIPITATION INCHES	EFF. PRECIPITATION AC.FT.	LEACHING REQM'T INCHES	LEACHING REQM'T AC.FT.	CULTURAL PRACT. INCHES	CULTURAL PRACT. AC.FT.	CROP WATER INCHES	CROP WATER AC.FT.
1	ALFALFA	2.0	2,165	46.23	8,341	9.61	1,734	1.43	258	0.00	0	36.05	6,866
2	ALMONDS												
	YEAR 1	1.5	1,761	10.14	1,489	9.61	1,410	0.42	62	0.00	0	0.96	141
	YEAR 2	1.5	2,377	24.80	4,912	9.61	1,904	1.03	205	0.00	0	16.22	3,213
	YEAR 3	1.5	747	34.57	2,152	9.61	598	1.44	90	0.00	0	26.40	1,643
	MATURE	1.5	2,911	37.57	9,115	9.61	2,331	1.57	380	0.00	0	29.53	7,163
3	BARLEY	8.0	721	12.98	780	9.61	577	0.10	6	0.00	0	3.47	209
4	BEANS(DRY)	1.0	2,048	19.73	3,367	9.61	1,640	1.26	215	0.00	0	11.38	1,942
5	CORN(FIELD)	1.7	655	28.05	1,531	9.61	525	1.03	56	0.00	0	19.47	1,063
6	COTTON	7.7	13,508	31.16	35,072	9.61	10,818	0.24	275	0.00	0	21.79	24,529
7	DECIDUOUS ORCHARDS												
	YEAR 1	1.5	156	10.71	139	9.61	125	0.45	6	0.00	0	1.55	20
	YEAR 2	1.5	40	26.18	87	9.61	32	1.09	4	0.00	0	17.66	59
	YEAR 3	1.5	65	36.49	198	9.61	52	1.52	8	0.00	0	26.40	154
	MATURE	1.5	1,472	39.66	4,865	9.61	1,179	1.65	203	0.00	0	31.71	3,889
8	GRAIN SORGHUM(MILO)	4.0	210	20.50	359	9.61	168	0.31	5	0.00	0	11.20	196
9	GRAINS	7.0	1,253	14.39	1,502	9.61	1,003	0.12	13	0.00	0	4.90	512
10	MELONS	2.2	4,923	15.90	6,523	9.61	3,943	0.45	183	0.00	0	6.74	2,763
11	MISC. TRUCK FIELD CROPS(HIGH)	2.0	100	32.78	273	9.61	80	1.01	8	0.00	0	24.18	202
12	MISC. TRUCK FIELD CROPS(LOW)	1.7	805	12.12	813	9.61	645	0.44	30	0.00	0	2.95	198
13	MISC. TRUCK FIELD CROPS(MED)	1.5	1,104	22.45	2,065	9.61	884	0.94	86	0.00	0	13.77	1,267
14	NURSERY/LETTUCE	1.3	126	6.08	64	9.61	101	0.29	3	0.00	0	-3.26	-34
15	PASTURE(IMPROVED)	2.8	39	45.59	148	9.61	31	1.00	3	0.00	0	36.98	120
16	POTATOES	1.8	0	18.46	0	9.61	0	0.72	0	0.00	0	9.57	0
17	RICE	2.8	0	44.24	0	9.61	0	0.97	0	0.00	0	35.59	0
18	SUBTROPICAL ORCHARDS												
	YEAR 1	1.7	0	9.33	0	9.61	0	0.34	0	0.00	0	0.06	0
	YEAR 2	1.7	0	22.80	0	9.61	0	0.83	0	0.00	0	14.02	0
	YEAR 3	1.7	7	31.78	19	9.61	6	1.16	1	0.00	0	23.33	14
	MATURE	1.7	1,157	34.54	3,330	9.61	927	1.26	122	0.00	0	26.19	2,525
19	SUGAR BEETS	7.0	610	36.19	1,840	9.61	489	0.31	16	0.00	0	26.89	1,367
20	TOMATOES	2.5	2,252	28.03	5,260	9.61	1,803	0.69	129	0.00	0	19.11	3,586
21	VINEYARD												
	YEAR 1	1.5	156	7.60	100	9.61	127	0.32	4	0.00	0	0.00	0
	YEAR 2	1.5	0	18.59	0	9.61	0	0.77	0	0.00	0	9.75	0
	YEAR 3	1.5	0	25.91	0	9.61	0	1.08	0	0.00	0	17.38	0
	MATURE	1.5	1,060	26.16	2,488	9.61	849	1.17	104	0.00	0	19.73	1,743
22	WHEAT	8.0	5,494	12.70	5,814	9.61	4,400	0.13	59	0.00	0	3.22	1,473
	TOTALS		47,924		102,845		38,379		2,533		0		66,821

9/24/99

SAN LUIS WATER DISTRICT

WATER YEAR 1996

SUPPLY WATER QUALITY	SOURCE %	SOURCE ECw,dS/m	
DMC	18	0.30	
SLC	82	0.30	* quality assumed
SJR			
WELLS			
TOTAL	100		
WEIGHTED ECw		0.30	

A	B	C	D	E	F	G	H	I	J	K	L	M	N
FDR #	CROP	ECe dS/m	AREA ACRES	CROP CON. USE INCHES	CROP CON. USE AC.FT.	EFF. PRECIPITATION INCHES	EFF. PRECIPITATION AC.FT.	LEACHING REQM'T INCHES	LEACHING REQM'T AC.FT.	CULTURAL PRACT. INCHES	CULTURAL PRACT. AC.FT.	CROP WATER INCHES	CROP WATER AC.FT.
1	ALFALFA	2.0	2,165	46.18	8,331	5.33	962	1.43	258	0.00	0	42.28	7,627
2	ALMONDS												
	YEAR 1	1.5	1,761	10.03	1,472	5.33	782	0.42	61	0.00	0	5.12	751
	YEAR 2	1.5	2,377	24.51	4,856	5.33	1,056	1.02	202	0.00	0	20.20	4,002
	YEAR 3	1.5	747	34.17	2,127	5.33	332	1.42	89	0.00	0	30.26	1,884
	MATURE	1.5	2,911	37.14	9,010	5.33	1,293	1.55	375	0.00	0	33.38	8,092
3	BARLEY	8.0	721	13.49	811	5.33	320	0.10	6	0.00	0	8.26	497
4	BEANS(DRY)	1.0	2,048	19.73	3,367	5.33	910	1.26	215	0.00	0	15.66	2,672
5	CORN(FIELD)	1.7	655	26.05	1,531	5.33	291	1.03	56	0.00	0	23.75	1,296
6	COTTON	7.7	13,508	31.06	34,962	5.33	6,000	0.24	275	0.00	0	25.97	29,236
7	DECIDUOUS ORCHARDS												
	YEAR 1	1.5	156	10.57	137	5.33	69	0.44	6	0.00	0	5.68	74
	YEAR 2	1.5	40	25.83	86	5.33	18	1.08	4	0.00	0	21.58	72
	YEAR 3	1.5	65	38.01	195	5.33	29	1.50	8	0.00	0	32.18	174
	MATURE	1.5	1,472	39.14	4,802	5.33	654	1.63	200	0.00	0	35.44	4,348
8	GRAIN SORGHUM(MILO)	4.0	210	20.13	352	5.33	93	0.31	5	0.00	0	15.11	264
9	GRAINS	7.0	1,253	14.89	1,555	5.33	557	0.13	13	0.00	0	9.69	1,012
10	MELONS	2.2	4,823	15.90	6,523	5.33	2,187	0.45	183	0.00	0	11.02	4,519
11	MISC. TRUCK FIELD CROPS(HIGH)	2.0	100	32.68	272	5.33	44	1.01	8	0.00	0	26.36	236
12	MISC. TRUCK FIELD CROPS(LOW)	1.7	805	12.23	821	5.33	358	0.45	30	0.00	0	7.35	493
13	MISC. TRUCK FIELD CROPS(MED)	1.5	1,104	22.46	2,068	5.33	490	0.94	86	0.00	0	16.06	1,662
14	NURSERY/LETTUCE	1.3	126	8.12	64	5.33	56	0.30	3	0.00	0	1.08	11
15	PASTURE(IMPROVED)	2.8	39	45.72	149	5.33	17	1.00	3	0.00	0	41.39	135
16	POTATOES	1.8	0	18.46	0	5.33	0	0.72	0	0.00	0	13.85	0
17	RICE	2.8	0	44.11	0	5.33	0	0.97	0	0.00	0	39.75	0
18	SUBTROPICAL ORCHARDS												
	YEAR 1	1.7	0	9.20	0	5.33	0	0.34	0	0.00	0	4.21	0
	YEAR 2	1.7	0	22.49	0	5.33	0	0.82	0	0.00	0	17.99	0
	YEAR 3	1.7	7	31.35	18	5.33	3	1.15	1	0.00	0	27.17	16
	MATURE	1.7	1,157	34.08	3,266	5.33	514	1.25	120	0.00	0	30.00	2,892
19	SUGAR BEETS	7.0	610	36.19	1,840	5.33	271	0.31	16	0.00	0	31.17	1,584
20	TOMATOES	2.5	2,252	28.03	5,260	5.33	1,000	0.69	129	0.00	0	23.39	4,369
21	VINEYARD												
	YEAR 1	1.5	158	7.51	99	5.33	70	0.31	4	0.00	0	2.49	33
	YEAR 2	1.5	0	18.35	0	5.33	0	0.78	0	0.00	0	13.78	0
	YEAR 3	1.5	0	25.56	0	5.33	0	1.07	0	0.00	0	21.31	0
	MATURE	1.5	1,060	27.80	2,456	5.33	471	1.16	102	0.00	0	23.63	2,087
22	WHEAT	6.0	5,494	13.15	6,019	5.33	2,440	0.13	61	0.00	0	7.95	3,640
	TOTALS		47,924		102,465		21,286		2,520		0		83,700

9/24/99

SAN LUIS WATER DISTRICT

CALENDAR YEAR 1996

SUPPLY WATER QUALITY	SOURCE %	SOURCE ECw,dS/m	
DMC	17	0.30	
SLC	83	0.30	* quality assumed
SJR			
WELLS			
TOTAL	100		
WEIGHTED ECw		0.30	

A	B	C	D	E	F	G	H	I	J	K	L	M	N
FDR #	CROP	ECe dS/m	AREA ACRES	CROP CON. USE INCHES	CROP CON. USE AC FT.	EFF. PRECIPITATION INCHES	EFF. PRECIPITATION AC FT.	LEACHING REQM'T INCHES	LEACHING REQM'T AC FT.	CULTURAL PRACT. INCHES	CULTURAL PRACT. AC.FT.	CROP WATER INCHES	CROP WATER AC FT.
1	ALFALFA	2.0	2,185	45.89	8,280	8.29	1,496	1.42	256	0.00	0	39.02	7,040
2	ALMONDS												
	YEAR 1	1.5	1,761	10.03	1,472	8.29	1,217	0.42	61	0.00	0	2.16	316
	YEAR 2	1.5	2,377	24.51	4,856	8.29	1,842	1.02	202	0.00	0	17.24	3,416
	YEAR 3	1.5	747	34.17	2,127	8.29	516	1.42	89	0.00	0	27.30	1,700
	MATURE	1.5	2,811	37.14	8,010	8.29	2,011	1.55	375	0.00	0	30.40	7,374
3	BARLEY	8.0	721	13.05	784	8.29	498	0.10	6	0.00	0	4.85	292
4	BEANS(DRY)	1.0	2,048	19.73	3,387	8.29	1,415	1.26	215	0.00	0	12.70	2,167
5	CORN(FIELD)	1.7	655	28.05	1,531	8.29	452	1.03	56	0.00	0	20.79	1,135
6	COTTON	7.7	13,508	31.06	34,962	8.29	9,332	0.24	275	0.00	0	23.01	25,904
7	DECIDUOUS ORCHARDS												
	YEAR 1	1.5	156	10.57	137	8.29	108	0.44	8	0.00	0	2.72	35
	YEAR 2	1.5	40	25.83	88	8.29	28	1.08	4	0.00	0	18.62	62
	YEAR 3	1.5	65	36.01	195	8.29	45	1.50	8	0.00	0	29.22	158
	MATURE	1.5	1,472	39.14	4,602	8.29	1,017	1.63	200	0.00	0	32.48	3,985
8	GRAIN SORGHUM(MILO)	4.0	210	20.13	352	8.29	145	0.31	5	0.00	0	12.15	213
9	GRAINS	7.0	1,253	14.47	1,511	8.29	866	0.13	13	0.00	0	6.31	659
10	MELONS	2.2	4,923	15.90	6,523	8.29	3,401	0.45	183	0.00	0	8.08	3,305
11	MISC. TRUCK FIELD CROPS(HIGH)	2.0	100	32.48	271	8.29	69	1.00	8	0.00	0	25.20	210
12	MISC. TRUCK FIELD CROPS(LOW)	1.7	805	12.12	813	8.29	556	0.44	30	0.00	0	4.27	287
13	MISC. TRUCK FIELD CROPS(MED)	1.5	1,104	22.30	2,052	8.29	763	0.93	85	0.00	0	14.94	1,374
14	NURSERY/LETTUCE	1.3	126	6.08	64	8.29	87	0.29	3	0.00	0	0.00	0
15	PASTURE(IMPROVED)	2.8	39	45.32	147	8.29	27	0.99	3	0.00	0	38.03	124
16	POTATOES	1.8	0	18.46	0	8.29	0	0.72	0	0.00	0	10.89	0
17	RICE	2.8	0	44.11	0	8.29	0	0.97	0	0.00	0	36.79	0
18	SUBTROPICAL ORCHARDS												
	YEAR 1	1.7	0	9.20	0	8.29	0	0.34	0	0.00	0	1.25	0
	YEAR 2	1.7	0	22.49	0	8.29	0	0.82	0	0.00	0	15.03	0
	YEAR 3	1.7	7	31.35	18	8.29	5	1.15	1	0.00	0	24.21	14
	MATURE	1.7	1,157	34.08	3,286	8.29	799	1.25	120	0.00	0	27.04	2,607
19	SUGAR BEETS	7.0	810	36.19	1,840	8.29	421	0.31	16	0.00	0	28.21	1,434
20	TOMATOES	2.5	2,252	28.03	5,260	8.29	1,556	0.69	129	0.00	0	20.43	3,834
21	VINEYARD												
	YEAR 1	1.5	158	7.51	99	8.29	109	0.31	4	0.00	0	0.00	0
	YEAR 2	1.5	0	18.35	0	8.29	0	0.76	0	0.00	0	10.82	0
	YEAR 3	1.5	0	25.58	0	8.29	0	1.07	0	0.00	0	18.35	0
	MATURE	1.5	1,060	27.80	2,456	8.29	732	1.16	102	0.00	0	20.67	1,826
22	WHEAT	6.0	5,484	12.76	5,844	8.29	3,795	0.13	59	0.00	0	4.80	2,108
	TOTALS		47,824		102,143		33,107		2,516		0		71,577

LIST OF CROP CATEGORIES

CATEGORY

ID	Name	Group Name	FDR Number
61	Alfalfa Hay	Alfalfa	1
87	Peppermint	Alfalfa	1
88	Spearmint	Alfalfa	1
181	Almonds	Almonds	2
51	Barley	Barley	3
81	Beans, dry and edible	Beans (Dry)	4
90	Soybeans	Beans (Dry)	4
52	Corn	Corn (Field)	5
66	Silage or Ensilage	Corn (Field)	5
70	Other Forage	Corn (Field)	5
82	Cotton, lint (Upland)	Cotton	6
83	Cotton, seed (Upland)	Cotton	6
84	Cotton, lint (American-Pima)	Cotton	6
85	Cotton, seed (American-Pima)	Cotton	6
161	Apples	Deciduous Orchard	7
162	Apricots	Deciduous Orchard	7
164	Cherries	Deciduous Orchard	7
178	Other fruits	Deciduous Orchard	7
182	Pecans	Deciduous Orchard	7
183	Walnuts	Deciduous Orchard	7
184	Pistachios	Deciduous Orchard	7
185	Other nuts	Deciduous Orchard	7
68	Sorghum	Grain Sorghum (Milo)	8
53	Oats	Grains	9
58	Other Cereals	Grains	9
62	Other Hay	Grains	9
111	Cucumbers	Melons	10
114	Cantalope, etc.	Melons	10
115	Honey Ball, Honeydew, etc.	Melons	10
116	Watermelon	Melons	10
124	Squash	Melons	10
101	Asparagus	Misc. Truck/Field Crops (High)	11
141	Alfalfa seed	Misc. Truck/Field Crops (High)	11
142	Clover seed (all kinds)	Misc. Truck/Field Crops (High)	11
144	Grass seed (all kinds)	Misc. Truck/Field Crops (High)	11
104	Broccoli	Misc. Truck/Field Crops (Low)	12
105	Cabbage	Misc. Truck/Field Crops (Low)	12
107	Cauliflower	Misc. Truck/Field Crops (Low)	12
112	Greens (kale, etc.)	Misc. Truck/Field Crops (Low)	12
118	Onions, green	Misc. Truck/Field Crops (Low)	12
119	Peas, green (processing)	Misc. Truck/Field Crops (Low)	12
120	Peas, green (fresh market)	Misc. Truck/Field Crops (Low)	12
126	Tomatoes (fresh market)	Misc. Truck/Field Crops (Low)	12
127	Other vegetables	Misc. Truck/Field Crops (Low)	12
145	Lettuce seed	Misc. Truck/Field Crops (Low)	12
146	Onion seed	Misc. Truck/Field Crops (Low)	12
147	Pea seed	Misc. Truck/Field Crops (Low)	12
150	Other seed	Misc. Truck/Field Crops (Low)	12

CATEGORY

ID	NAME	GROUP NAME	FDR #
88	Hops	Misc. Truck/Field Crops (Med)	13
91	Other field crops	Misc. Truck/Field Crops (Med)	13
02	Beans (processing)	Misc. Truck/Field Crops (Med)	13
03	Beans (fresh market)	Misc. Truck/Field Crops (Med)	13
106	Carrots	Misc. Truck/Field Crops (Med)	13
108	Celery	Misc. Truck/Field Crops (Med)	13
109	Corn, sweet (processing)	Misc. Truck/Field Crops (Med)	13
110	Corn, sweet (fresh market)	Misc. Truck/Field Crops (Med)	13
117	Onions, dry	Misc. Truck/Field Crops (Med)	13
121	Peppers (all kinds)	Misc. Truck/Field Crops (Med)	13
143	Corn seed	Misc. Truck/Field Crops (Med)	13
177	Strawberries	Misc. Truck/Field Crops (Med)	13
113	Lettuce	Nursery/Lettuce	14
137	Nursery	Nursery/Lettuce	14
63	Irrigated Pasture	Pasture (Improved)	15
122	Potatoes, early	Potatoes	16
123	Potatoes, late	Potatoes	16
148	Potatoe seed (all kinds)	Potatoes	16
54	Rice	Rice	17
165	Grapefruit	Subtropical Orchard	18
166	Lemons and Limes	Subtropical Orchard	18
167	Oranges and Tangerines	Subtropical Orchard	18
168	Dates	Subtropical Orchard	18
173	Olives	Subtropical Orchard	18
174	Peaches	Subtropical Orchard	18
175	Pears	Subtropical Orchard	18
176	Prunes and Plums	Subtropical Orchard	18
89	Sugar Beets	Sugar Beets	19
149	Sugar beet seed	Sugar Beets	19
126	Tomatoes (canning)	Tomatoes	20
163	Berries (all kinds)	Vineyard	21
169	Grapes, table	Vineyard	21
170	Grapes, wine	Vineyard	21
171	Grapes, raisin	Vineyard	21
172	Grapes, other	Vineyard	21
57	Wheat	Wheat	22
11	Harvested cropland and pasture	N/A	
12	Cropland not harvested	N/A	
13	Acres irrigated	N/A	
14	Fallow or idle	N/A	
15	Total area in irrig. rotation	N/A	
16	Dry cropped, idle, fallow or grazed	N/A	
17	Farmsteads, roads, ditches, drains	N/A	
18	Total area not in irrig. rotation	N/A	
19	Urban and suburban area	N/A	
20	Total irrigable area for service	N/A	
21	Total irrigable area not for service	N/A	
22	Total irrigable area	N/A	
23	Class 6 - Temporarily irrigated	N/A	

REFERENCE EVAPOTRANSPIRATION AND PRECIPITATION DATA

9/24/99

SAN LUIS WATER DISTRICT - NORTHERN SUB-BASIN

	MONTH	LOS BANOS 1989 ETo (IN)	LOS BANOS 1989 PRECIP (IN)	LOS BANOS 1998 ETo (IN)	LOS BANOS 1998 PRECIP (IN)
	OCTOBER	3.83	0.24	3.94	0.00
	NOVEMBER	1.41	1.10	1.41	2.74
	DECEMBER	1.04	1.62	0.86	2.13
	JANUARY	1.64	0.55	0.65	0.44
	FEBRUARY	2.33	1.18	1.25	11.42
	MARCH	4.33	0.83	2.92	2.58
	APRIL	5.54	0.32	4.61	0.72
	MAY	7.66	0.00	5.75	3.07
	JUNE	8.71	0.00	7.36	0.35
	JULY	9.36	0.00	8.47	0.00
	AUGUST	8.14	0.08	7.66	0.00
	SEPTEMBER	5.40	1.10	5.22	0.00
	OCTOBER	3.74	0.63	3.39	0.87
	NOVEMBER	2.01	0.28	1.38	0.88
	DECEMBER	0.96	0.08	1.04	0.68
	JANUARY	1.09	1.86	0.68	2.27
	FEBRUARY	2.12	1.23	1.52	1.83
Crop Year	Total	59.39	7.02	50.10	23.45
	50%		3.51		11.73
Water Year	Total	59.06	6.41	50.00	13.25
	50%		3.21		6.63
Calendar Year	Total	59.82	5.05	49.70	21.01
	50%		2.53		10.51

9/24/99

SAN LUIS WATER DISTRICT - SOUTHERN SUB-BASIN

		MENDOTA DAM		TRANQUILITY	
		1989		1998	
	MONTH	ETo (IN)	PRECIP (IN)	ETo (IN)	PRECIP (IN)
	OCTOBER	3.30	0.00	4.53	0.05
	NOVEMBER	1.59	0.67	1.62	2.65
	DECEMBER	0.94	2.13	0.86	1.43
	JANUARY	1.49	0.29	0.67	1.61
	FEBRUARY	1.70	1.15	1.17	4.04
	MARCH	3.83	0.89	2.80	1.85
	APRIL	5.75	0.13	4.89	0.95
	MAY	7.86	0.09	5.52	2.19
	JUNE	8.58	0.00	7.27	0.10
	JULY	8.95	0.00	8.57	0.00
	AUGUST	7.40	0.00	7.96	0.00
	SEPTEMBER	5.12	1.36	5.36	0.12
	OCTOBER	4.10	0.68	3.86	0.26
	NOVEMBER	2.18	0.32	1.71	0.66
	DECEMBER	1.13	0.00	1.24	0.37
	JANUARY	1.38	2.37	0.79	1.05
	FEBRUARY	2.10	0.76	1.62	0.51
Crop Year	Total	56.51	6.71	51.22	14.99
	50%		3.36		7.50
Water Year	Total	58.38	6.60	51.59	8.06
	50%		3.30		4.03
Calendar Year	Total	58.09	4.91	51.02	12.15
	50%		2.46		6.08

9/23/99

SAN LUIS WATER DISTRICT

		LB/MENDOTA 1989		LB/TRANQUILITY 1998	
	MONTH	ETo (IN)	PRECIP (IN)	ETo (IN)	PRECIP (IN)
	OCTOBER	3.57	0.12	4.24	0.03
	NOVEMBER	1.50	0.89	1.52	2.70
	DECEMBER	0.99	1.88	0.86	1.78
	JANUARY	1.57	0.42	0.66	1.03
	FEBRUARY	2.02	1.17	1.21	7.73
	MARCH	4.08	0.86	2.86	2.22
	APRIL	5.65	0.23	4.75	0.84
	MAY	7.76	0.05	5.64	2.63
	JUNE	8.65	0.00	7.32	0.23
	JULY	9.16	0.00	8.52	0.00
	AUGUST	7.77	0.04	7.81	0.00
	SEPTEMBER	5.26	1.23	5.29	0.06
	OCTOBER	3.92	0.66	3.63	0.57
	NOVEMBER	2.10	0.30	1.55	0.77
	DECEMBER	1.05	0.04	1.14	0.53
	JANUARY	1.24	2.12	0.74	1.66
	FEBRUARY	2.11	1.00	1.57	1.17
Crop Year	Total	57.95	6.87	50.66	19.22
	50%		3.43		9.61
Water Year	Total	58.72	6.51	50.80	10.66
	50%		3.25		5.33
Calendar Year	Total	58.96	4.98	50.36	16.58
	50%		2.49		8.29

CROP COEFFICIENTS AND SUPPORTING DOCUMENTATION

9/23/99

MONTHLY CROP Kc VALUES

FDR #	CROP	OCT	NOV	DEC	JAN	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT
1	ALFALFA	0.91	0.79	0.68	0.63	0.66	0.87	0.91	0.91	0.92	0.94	0.97	0.87
2	ALMONDS												
	1 YEAR	0.19	0.00	0.00	0.00	0.00	0.16	0.19	0.22	0.23	0.23	0.23	0.22
	2 YEAR	0.47	0.00	0.00	0.00	0.00	0.38	0.46	0.54	0.57	0.57	0.57	0.55
	3 YEAR	0.65	0.00	0.00	0.00	0.00	0.53	0.64	0.75	0.80	0.80	0.80	0.76
	MATURE	0.71	0.00	0.00	0.00	0.00	0.58	0.70	0.82	0.87	0.87	0.87	0.83
3	BARLEY	0.00	0.07	0.21	0.68	1.10	1.17	0.86	0.45	0.13	0.00	0.00	0.00
4	BEANS(DRY)	0.00	0.00	0.00	0.00	0.00	0.02	0.07	0.53	1.13	0.83	0.13	0.00
5	CORN(FIELD)	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.35	0.91	1.14	0.98	0.29
6	COTTON	0.16	0.00	0.00	0.00	0.00	0.00	0.10	0.37	0.74	1.14	1.13	0.75
7	DECIDUOUS ORCHARDS												
	1 YEAR	0.23	0.10	0.00	0.00	0.00	0.08	0.18	0.21	0.23	0.26	0.26	0.26
	2 YEAR	0.57	0.25	0.00	0.00	0.00	0.18	0.43	0.51	0.57	0.63	0.63	0.63
	3 YEAR	0.80	0.35	0.00	0.00	0.00	0.26	0.60	0.72	0.80	0.88	0.88	0.88
	MATURE	0.87	0.38	0.00	0.00	0.00	0.28	0.65	0.78	0.87	0.96	0.96	0.96
8	GRAIN SORGHUM(MILO)	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.36	1.13	1.05
9	GRAINS	0.00	0.00	0.31	0.57	1.05	1.19	1.15	0.64	0.00	0.00	0.00	0.00
10	MELONS	0.00	0.00	0.00	0.00	0.00	0.07	0.24	0.67	1.02	0.39	0.00	0.00
11	MISC. TRUCK FIELD CROPS(HIGH)	0.66	0.30	0.35	0.40	0.47	0.74	0.97	0.97	0.66	0.19	0.66	0.87
12	MISC. TRUCK FIELD CROPS(LOW)	0.00	0.00	0.00	0.06	0.30	0.59	1.02	0.92	0.00	0.00	0.00	0.00
13	MISC. TRUCK FIELD CROPS(MED)	0.33	0.15	0.18	0.23	0.39	0.67	1.00	0.85	0.33	0.10	0.33	0.44
14	NURSERY/LETTUCE	0.00	0.00	0.00	0.03	0.15	0.30	0.51	0.46	0.00	0.00	0.00	0.00
15	PASTURE(IMPROVED)	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
16	POTATOES	0.00	0.00	0.00	0.00	0.00	0.66	1.08	1.20	0.64	0.00	0.00	0.00
17	RICE	0.20	0.00	0.00	0.00	0.00	0.10	1.00	1.15	1.27	1.23	1.15	0.59
18	SUBTROPICAL ORCHARDS												
	1 YEAR	0.20	0.00	0.00	0.00	0.00	0.15	0.18	0.21	0.22	0.22	0.22	0.16
	2 YEAR	0.50	0.00	0.00	0.00	0.00	0.36	0.45	0.51	0.53	0.53	0.53	0.38
	3 YEAR	0.69	0.00	0.00	0.00	0.00	0.51	0.63	0.71	0.75	0.75	0.75	0.53
	MATURE	0.75	0.00	0.00	0.00	0.00	0.55	0.68	0.77	0.81	0.81	0.81	0.58
19	SUGAR BEETS	0.00	0.00	0.00	0.00	0.00	0.08	0.28	0.75	1.16	1.18	1.16	0.53
20	TOMATOES	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.42	0.94	1.18	0.96	0.00
21	VINEYARD												
	1 YEAR	0.16	0.04	0.00	0.00	0.00	0.00	0.02	0.10	0.19	0.23	0.23	0.22
	2 YEAR	0.40	0.09	0.00	0.00	0.00	0.00	0.05	0.24	0.46	0.55	0.55	0.53
	3 YEAR	0.55	0.13	0.00	0.00	0.00	0.00	0.06	0.33	0.63	0.77	0.77	0.75
	MATURE	0.60	0.14	0.00	0.00	0.00	0.00	0.07	0.36	0.69	0.84	0.84	0.81
22	WHEAT	0.00	0.04	0.23	0.54	0.95	1.17	1.04	0.47	0.00	0.00	0.00	0.00

9/24/99

EXPLANATION OF THE DERIVATION OF CROP COEFFICIENT (Kc) VALUES

FRD	CROP GROUP NAME	EXPLANATION OF DERIVATION
1	ALFALFA	Average of A and C
2	ALMONDS	
	YEAR 1	27% OF THE MATURE Kc VALUE (AS PER FIGURE 3, REFERENCE D)
	YEAR 2	66% OF THE MATURE Kc VALUE (AS PER FIGURE 3, REFERENCE D)
	YEAR 3	92% OF THE MATURE Kc VALUE (AS PER FIGURE 3, REFERENCE D)
	MATURE	D (assumed initial growth date of 3/1)
3	BARLEY	C (average of fall and winter)
4	BEANS(DRY)	Average of A and B
5	CORN(FIELD)	Average of A and B
6	COTTON	Average of A and B
7	DECIDUOUS ORCHARDS	
	YEAR 1	27% OF THE MATURE Kc VALUE (AS PER FIGURE 3, REFERENCE D)
	YEAR 2	66% OF THE MATURE Kc VALUE (AS PER FIGURE 3, REFERENCE D)
	YEAR 3	92% OF THE MATURE Kc VALUE (AS PER FIGURE 3, REFERENCE D)
	MATURE	B (assumed clean cultivated)
8	GRAIN SORGHUM(MILO)	B
9	GRAINS	B
10	MELONS	Average of A and B
11	MISC. TRUCK FIELD CROPS(HIGH)	A (Assumed an established crop for the previous year and following year, estimated values for August through January)
12	MISC. TRUCK FIELD CROPS(LOW)	A (vegetables)
13	MISC. TRUCK FIELD CROPS(MED)	A (average of FDR 11 and 12)
14	NURSERY/LETTUCE	A (Assumed 0.5 * Kc's(vegetables))
15	PASTURE(IMPROVED)	A
16	POTATOES	C
17	RICE	Average of A and C
18	SUBTROPICAL ORCHARDS	
	YEAR 1	27% OF THE MATURE Kc VALUE (AS PER FIGURE 3, REFERENCE D)
	YEAR 2	66% OF THE MATURE Kc VALUE (AS PER FIGURE 3, REFERENCE D)
	YEAR 3	92% OF THE MATURE Kc VALUE (AS PER FIGURE 3, REFERENCE D)
	MATURE	Average of A and C
19	SUGAR BEETS	B
20	TOMATOES	B
21	VINEYARD	
	YEAR 1	27% OF THE MATURE Kc VALUE (AS PER FIGURE 3, REFERENCE D)
	YEAR 2	66% OF THE MATURE Kc VALUE (AS PER FIGURE 3, REFERENCE D)
	YEAR 3	92% OF THE MATURE Kc VALUE (AS PER FIGURE 3, REFERENCE D)
	MATURE	B
22	WHEAT	A

LEGEND OF REFERENCES USED

A= Cal Poly, 1994, 100% Kc values
B= Jensen, et al., 1990, Table 6.10
C= California State Water Resources Control Board, Report 84-1, Table 5-12
D= University of California, Leaflet 21428

Table 5-12. Recommended monthly crop coefficients, k_c for principal crops grown in California, as adapted from Table 5 of DWR Bull. 113-3 [7][a]. Values of k_c for relating to ET_o were derived by dividing DWR's monthly k_p data for the month and crop of interest, by the k_p for pasture for the same month. Example: Cantaloupes in June; k_c = 0.86/0.78 = 1.10.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Field Crops												
Alfalfa (hay)	1.00	1.00	0.92	0.91	0.91	0.94	0.97	1.03	1.04	1.03	1.00	1.00
Barley (fall)	0.94	1.28	1.08	0.65	0.26	-	-	-	-	-	0.14	0.43
Barley (winter)	0.42	0.91	1.25	1.06	0.64	0.26	-	-	-	-	-	-
Beans (dry)	-	-	-	-	-	-	0.54	1.09	0.56	-	-	-
Cantaloupes	-	-	-	0.19	0.41	1.10	0.17	-	-	-	-	-
Corn (field)	-	-	-	-	0.15	0.62	1.20	1.08	0.65	-	-	-
Cotton (solid)	-	-	-	-	0.13	0.69	1.31	1.29	1.13	0.65	-	-
Cotton (2 x 1)	-	-	-	-	0.13	0.63	1.17	1.36	1.13	1.01	-	-
Cotton (2 x 2)	-	-	-	-	0.13	0.47	1.13	1.18	1.08	0.55	-	-
Cotton (2 x 2)[b]	-	-	-	-	0.13	0.19	0.87	1.13	0.81	0.35	-	-
Grain sorghum	-	-	-	-	0.13	0.32	1.15	1.05	0.52	-	-	-
Pasture (improved)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Rice	-	-	-	1.04[c]	1.15	1.28	1.28	1.28	1.17	0.40	-	-
Sugar beets (annual)	-	-	-	0.20[d]	0.50	1.00	1.18	1.03	1.04	0.79	0.55	-
Sugar beets (overwintered)	1.00	1.00	1.00	0.49	0.20[d]	0.50	1.00	1.18	1.04	1.07	1.00	1.00
Tomatoes (Machine harvested)	-	-	-	0.29	0.77	1.13	1.06	0.79	-	-	-	-
Trees and Vines												
Deciduous orchard[e]	-	-	0.59	0.71	0.83	0.90	0.96	0.96	0.91	0.80	-	-
Subtropical orchard[f]	-	-	0.59	0.58	0.64	0.64	0.64	0.64	0.58	0.60	-	-
Vineyard (table grapes)	-	-	-	0.16	0.58	0.77	0.85	0.83	0.71	0.40	-	-
Vineyard (vine grapes)[f]	-	-	-	0.16	0.58	0.71	0.64	0.45	0.26	0.07	-	-
Truck Crops												
Potatoes (Spring crop)	-	-	0.66	1.08	1.20	0.64	-	-	-	-	-	-
Tomatoes (hand-picked)	-	-	0.29	0.78	1.13	1.13	0.96	0.64	0.39	-	-	-

a. Relate mainly to Central Valley (California) growing seasons. Modifications may be needed for use in areas or situations with different planting dates.

b. For extremely fine textured (clay) soils.

c. Planted or harvested at mid-month. ET_o for partial month should be used with ratio.

d. Adjusted upward from original values which appeared to be unreasonable.

e. Deciduous trees except almonds (Presumably clean cultivated orchards). Coefficients should likely be 10-25% lower for almonds during the last one-third of the season if cultural practices involve no post-harvest irrigations.

f. No ET data available (in 1974). Original k_p ratios reported were estimated from PET data modified to reflect prevalent irrigation and cultural practices.

ASCE Manuals and Reports on Engineering Practice No. 70

Evapotranspiration and Irrigation Water Requirements

Edited by
M.E. Jensen, R.D. Burman, and R.G. Allen

A manual prepared by the
Committee on Irrigation Water Requirements of the
Irrigation and Drainage Division of the
American Society of Civil Engineers

Contributors

R.G. Allen
R.H. Cuenca
M.E. Jensen
W.O. Pruitt
R.K. Blatchley
J.M. Erpenbeck
E.L. Johns
J.F. Stone
R.D. Burman
R.W. Hill
P.R. Nixon
J.L. Wright*
*Nonmember Advisor

Published by the
American Society of Civil Engineers
345 East 47th Street
New York, New York 10017-2398

TABLE 6.10. Example Mean Crop Coefficients Related to E_{to}[1] Suggested for Crops Grown in the San Joaquin Valley (adapted from Pruitt et al., 1987a)

Date	Citrus (clean cultivate)	Table grapes	Deciduous orchard (clean cultivate)	Deciduous orchard with cover crop	Beans (dry)	Corn (grain)	Milo	Small grains	Cotton	Sugar beets	Tomato	Onions	Onions	Melons
Jan 1–15	0.83							0.46					0.70	
16–31	0.82							0.67					0.90	
Feb 1–14	0.81							0.95					1.05	
15–28	0.80							1.15					1.10	
Mar 1–15	0.74							1.18				0.32	1.12	
16–31	0.73		0.56	0.96				1.20		0.16		0.34	1.15	0.18
Apr 1–15	0.72		0.62	1.01				1.20		0.22	0.26	0.40	1.15	0.23
16–30	0.72	0.14	0.68	1.06		0.19		1.10	0.17	0.33	0.26	0.55	1.15	0.36
May 1–15	0.72	0.21	0.74	1.10	0.14	0.24		0.81	0.21	0.53	0.31	0.85	1.15	0.72
16–31	0.72	0.50	0.81	1.14	0.40	0.44		0.47	0.29	0.97	0.47	1.06	1.15	1.10
Jun 1–15	0.67	0.64	0.86	1.17	1.10	0.72			0.59	1.14	0.78	1.13	1.14	1.10
16–30	0.67	0.74	0.88	1.19	1.14	1.15	0.14		0.94	1.17	1.10	1.15	1.06	1.10
Jul 1–15	0.67	0.82	0.95	1.21	1.14	1.18	0.21		1.23	1.18	1.19	1.13	0.92	0.96
16–31	0.67	0.85	0.96	1.21	1.01	1.18	0.50		1.25	1.17	1.17	1.04	0.74	0.21
Aug 1–15	0.67	0.85	0.96	1.22	0.52	1.13	1.12		1.25	1.17	1.04	0.91		
16–31	0.67	0.83	0.96	1.21		0.91	1.14		1.22	1.14	0.87	0.74		
Sept 1–15	0.67	0.83	0.96	1.19		0.59	1.10		1.08	1.06				
16–30	0.68	0.78	0.95	1.18			1.00		0.81					
Oct 1–15	0.74	0.67	0.89	1.16			0.80		0.54					
16–31	0.75	0.52	0.84	1.15			0.40							
Nov 1–15	0.76	0.27	0.76	1.11										
16–30	0.77													
Dec 1–15	0.79							0.28						
16–31	0.80							0.34						

[1] Crop coefficients are related to E_{to} defined as cool-season grass E_t. A constant of $K_c = 1.0$ can be assumed for a well-managed pasture with rotation grazing. A $K_c = 0.95$ to 1.0 is recommended as an average between-cutting value for alfalfa for all but winter months.

PROCEDURE

A single spreadsheet was developed for the entire study area using the ETc approach. The spreadsheet is available in PC-Compatible format or Macintosh format. The entire spreadsheet in its original format is included in **Appendix D.**

STEP 1: Crop Coefficients

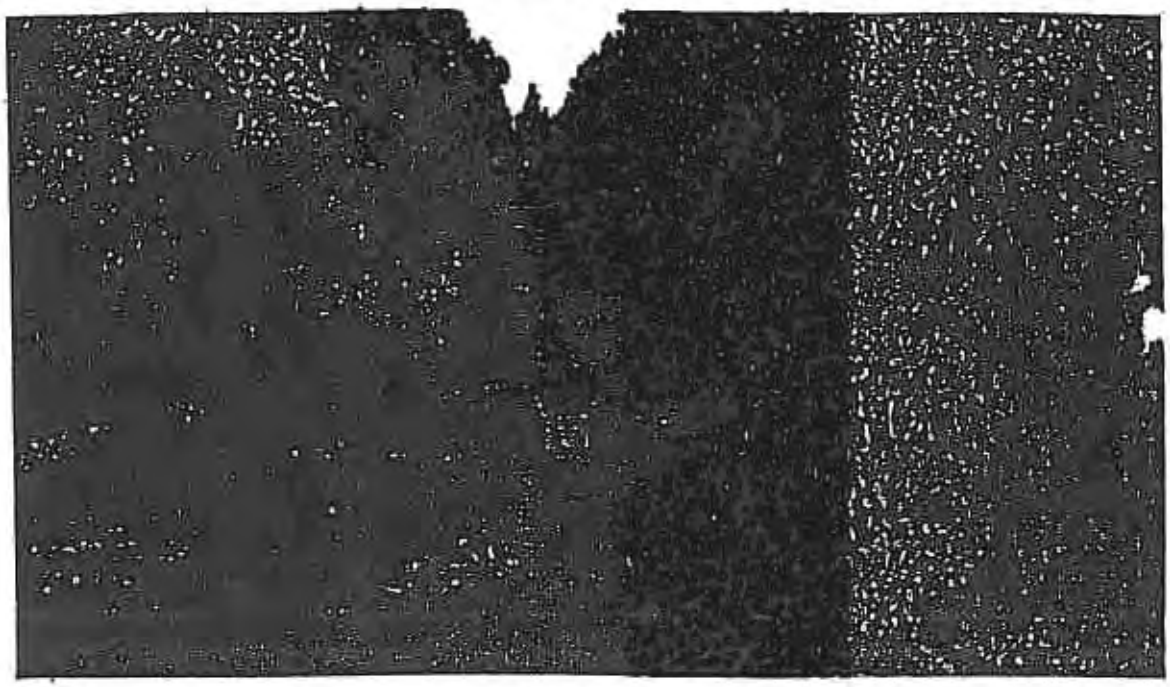
Determination of the crop coefficients.

The crop coefficient is a dimensionless number (usually between 0.0 and 1.2) that is multiplied by the reference evapotranspiration (ETo) value to arrive at a crop evapotranspiration (ETc) estimate. Average crop coefficients were determined from various sources including DWR published values, the University of California Cooperative Extension, locally developed Kc's and Kc's reported from Westlands Water District. The daily values used for each of the crops in this report are included in **Appendix B.** The following table are the monthly Kc's used in this report.

Table 10
Monthly Crop Kc Values

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
Fallow	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Misc.	0.00	0.00	0.00	0.06	0.30	0.59	1.02	0.92	0.00	0.00	0.00	0.00
Cotton	0.05	0.00	0.00	0.00	0.00	0.00	0.10	0.23	0.70	1.03	1.02	0.56
Alfalfa	0.79	0.57	0.36	0.25	0.32	0.82	0.90	0.90	0.90	0.90	0.90	0.90
Wheat	0.00	0.04	0.23	0.54	0.95	1.17	1.04	0.47	0.00	0.00	0.00	0.00
Melons	0.00	0.00	0.00	0.00	0.00	0.04	0.18	0.43	0.94	0.18	0.00	0.00
Process Tom.	0.00	0.00	0.00	0.00	0.00	0.05	0.24	0.40	0.90	1.10	0.85	0.00
Sugar Beets	1.10	1.10	1.10	1.10	1.04	0.44	0.00	0.13	0.38	0.96	1.10	1.10
Barley	0.00	0.03	0.23	0.53	0.93	1.15	0.98	0.30	0.00	0.00	0.00	0.00
Beans	0.00	0.00	0.00	0.00	0.00	0.03	0.14	0.78	1.14	0.56	0.00	0.00
Seed Alf.	0.00	0.03	0.20	0.24	0.47	0.74	0.97	0.97	0.66	0.19	0.00	0.00
Rice	0.00	0.00	0.00	0.00	0.00	0.19	0.95	1.14	1.25	1.17	1.02	0.00
Corn	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.36	0.88	1.10	0.93	0.27
Vegetable	0.00	0.00	0.00	0.06	0.30	0.59	1.02	0.92	0.00	0.00	0.00	0.00
Pasture	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Stonefruit	0.89	0.00	0.00	0.00	0.00	0.50	0.78	0.89	0.98	0.98	0.98	0.97
Walnut/Apple	0.42	0.06	0.00	0.00	0.00	0.54	0.84	0.95	1.06	1.14	1.09	0.77
Sorghum	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.16	0.51	1.04	0.93	0.59

Using Reference Evapotranspiration (ETo) and Crop Coefficients to Estimate Crop Evapotranspiration (ETc) for Trees and Vines



Introduction

Reference evapotranspiration (ETo) information is now available in many agricultural areas of California through the California Irrigation Management Information System (CIMIS). Direct access to real-time (daily) weather and ETo information through a computer dialup service can be obtained by writing:

California Department of Water Resources
Office of Water Conservation
P.O. Box 942836
Sacramento, CA 94236-0001

These daily real-time ETo estimates are used by growers to determine a refined irrigation schedule that can optimize profits relative to the use of water.

Historical average or "normal" ETo values are useful in determining an average or normal irrigation schedule for your crop that will give good results in most years. Daily normal ETo for many locations within California can be determined using the method and average monthly ETo accumulations given in Determining Daily Reference Evapotranspiration, UC Leaflet 21426.

Cooperative Extension University of California
Division of Agriculture and Natural Resources
Leaflet 21428

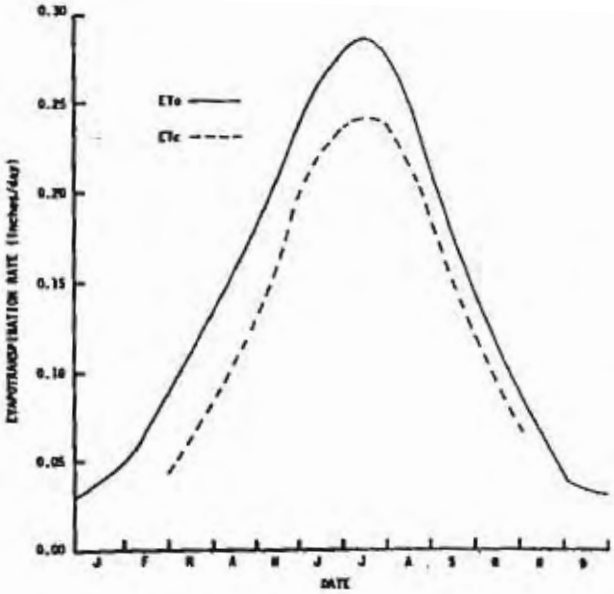


Fig. 1. Normal reference evapotranspiration (ETo) and crop evapotranspiration (ETc) for almonds with no cover crop grown near Bakersfield, California.

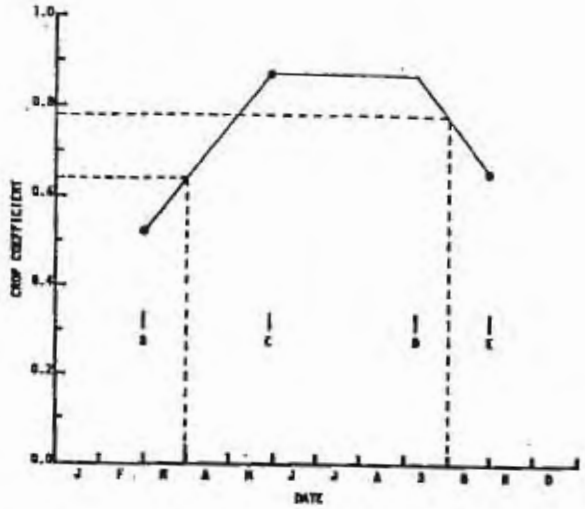


Fig. 2. Crop coefficient (Kc) curve for almonds grown with no cover crop in the San Joaquin Valley with leafout (date B) on March 1, 60 percent ground shading (date C) on May 28, and leafdrop (date E) on October 31.

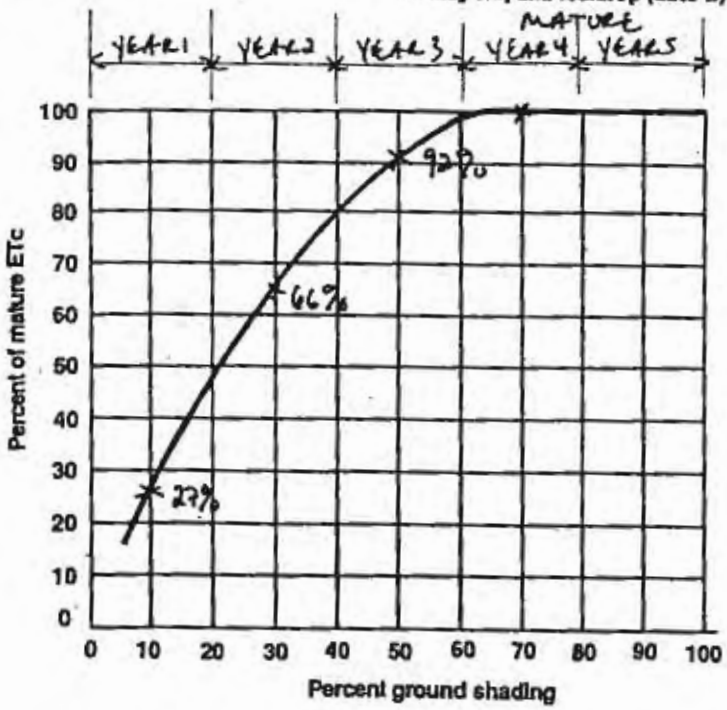


Fig. 3. Relationship between the percent ground area shaded by tree canopy in midsummer and ETc of drip-irrigated young trees as a percent of ETc of mature orchards (estimated from figure 8 in UC Leaflet 21259).

Table 1. Tree and vine coefficients[a] for date B (Kc1), date C (Kc2), and date E (Kc3) with approximate growth dates. Crop coefficients given for deciduous trees are for no cover crop. See the footnotes to correct Kc values for cover crops. Choose the crop coefficients and growth dates corresponding most closely to leafout date (B) for your crop to obtain a first estimate of the Kc values and dates to use for calculating ETc.

Region	Crop	Crop Coefficient			Growth dates			Code[b]
		Kc1	Kc2	Kc3	B	C	E	
Imperial Valley	Citrus	0.56	0.56	0.56	01/01	05/01	12/31	375
	Deciduous orchard	0.55	0.95	0.70	02/28	06/24	10/31	186
	Guayule	0.28	0.72	0.50	01/01	07/24	12/31	166
Central Valley	Deciduous[c] orchard	0.50	0.91	0.48	02/12	05/30	11/03	175
		0.55	0.92	0.52	02/26	06/24	11/10	174
		0.52	0.87	0.65	03/01	05/28	10/31	178
		0.50	0.86	0.75	03/16	06/09	11/15	180
	Deciduous[d] orchard	0.50	1.01	0.53	02/12	05/30	11/03	175
		0.55	1.02	0.57	02/26	06/24	11/10	174
		0.52	0.93	0.88	04/15	06/10	11/10	190
		0.52	0.97	0.85	03/01	05/28	10/31	178
		0.50	0.96	0.80	03/16	06/09	11/15	180
		0.50	0.85	0.80	04/01	06/02	11/30	190
	Grapes	0.35	0.81	0.27	03/12	05/30	09/22	172
		0.25	0.80	0.27	03/26	05/25	10/06	171
		0.27	0.82	0.32	04/30	07/06	11/10	169
		0.06	0.78	0.20	03/01	05/10	09/30	173
		0.07	0.80	0.30	03/16	05/30	10/15	164
		0.07	0.76	0.12	04/16	06/24	11/15	175
	Kiwifruit	0.31	1.05	1.05	04/15	06/01	10/31	175
	Citrus	0.65	0.65	0.65	01/01	05/01	12/31	375
	Olives	0.58	0.80	0.80	03/31	06/19	10/31	175
	Pistachio	0.04	1.12	0.33	03/31	06/04	08/07	161
Statewide	Evergreen shrubbery	1.15	1.15	1.15	01/01	05/01	12/31	375
	trees	1.20	1.20	1.20	01/01	05/01	12/31	375

[a]Crop coefficients were estimated from Pereres, et al. (1981), Doorenbos and Pruitt (1977), Letey and Vaux (1984), CDWR (1986), Goldhamer, et al. (1985), Pruitt and Snyder (1984), and Buchner, Shaw and Schulbach (1985).

[b]The first digit of the code identifies the crop type (1 = deciduous; 3 = constant year-round Kc). For deciduous crops, the last two digits are the percentage of the season from leafout (date B) to date D when the Kc begins to decline due to aging. When the crop type is equal to 3, the Kc values do not decline and the last two digits of the code set equal to 99.

[c]Includes peaches, apricots, pears, plums, almonds and pecans without a cover crop. Add 0.30 to Kc1, 0.25 to Kc2, and 0.20 to Kc3 for orchards with an active cover crop.

[d]Includes apples, cherries, and walnuts without a cover crop. Add 0.40 to Kc1, 0.30 to Kc2, and 0.30 to Kc3 for orchards with an active cover crop.

4/99

DS

PIVOT DATE D= 191

B1(SLOPE FROM B TO C) 0.0040
B2(SLOPE FROM D TO E) -0.0041

TAL DAYS	B TO C	CTO D	D TO E	DATE	PIVOT KC	KC	MONTHLY WEIGHTED KC
1	1			1-Mar	0.52	0.5200	
2	2			2-Mar		0.5240	
3	3			3-Mar		0.5280	
4	4			4-Mar		0.5319	
5	5			5-Mar		0.5359	
6	6			6-Mar		0.5399	
7	7			7-Mar		0.5439	
8	8			8-Mar		0.5478	
9	9			9-Mar		0.5518	
10	10			10-Mar		0.5558	
11	11			11-Mar		0.5598	
12	12			12-Mar		0.5638	
13	13			13-Mar		0.5677	
14	14			14-Mar		0.5717	
15	15			15-Mar		0.5757	
16	16			16-Mar		0.5797	
17	17			17-Mar		0.5836	
18	18			18-Mar		0.5876	
19	19			19-Mar		0.5916	
20	20			20-Mar		0.5956	
21	21			21-Mar		0.5995	
22	22			22-Mar		0.6035	
23	23			23-Mar		0.6075	
24	24			24-Mar		0.6115	
25	25			25-Mar		0.6155	
26	26			26-Mar		0.6194	
27	27			27-Mar		0.6234	
28	28			28-Mar		0.6274	
29	29			29-Mar		0.6314	
30	30			30-Mar		0.6353	
31	31			31-Mar		0.6393	0.58
32	32			1-Apr		0.6433	
33	33			2-Apr		0.6473	
34	34			3-Apr		0.6513	
35	35			4-Apr		0.6552	
36	36			5-Apr		0.6592	
37	37			6-Apr		0.6632	
38	38			7-Apr		0.6672	
39	39			8-Apr		0.6711	
40	40			9-Apr		0.6751	
41	41			10-Apr		0.6791	
42	42			11-Apr		0.6831	
43	43			12-Apr		0.6870	
44	44			13-Apr		0.6910	
45	45			14-Apr		0.6950	
46	46			15-Apr		0.6990	
47	47			16-Apr		0.7030	
48	48			17-Apr		0.7069	
49	49			18-Apr		0.7109	
50	50			19-Apr		0.7149	
51	51			20-Apr		0.7189	
52	52			21-Apr		0.7228	
53	53			22-Apr		0.7268	
54	54			23-Apr		0.7308	
55	55			24-Apr		0.7348	
56	56			25-Apr		0.7388	

57	57		26-Apr		0.7427	
58	58		27-Apr		0.7467	
	59		28-Apr		0.7507	
	60		29-Apr		0.7547	
61	61		30-Apr		0.7586	0.70
62	62		1-May		0.7626	
63	63		2-May		0.7666	
64	64		3-May		0.7706	
65	65		4-May		0.7745	
66	66		5-May		0.7785	
67	67		6-May		0.7825	
68	68		7-May		0.7865	
69	69		8-May		0.7905	
70	70		9-May		0.7944	
71	71		10-May		0.7984	
72	72		11-May		0.8024	
73	73		12-May		0.8064	
74	74		13-May		0.8103	
75	75		14-May		0.8143	
76	76		15-May		0.8183	
77	77		16-May		0.8223	
78	78		17-May		0.8263	
79	79		18-May		0.8302	
80	80		19-May		0.8342	
81	81		20-May		0.8382	
82	82		21-May		0.8422	
83	83		22-May		0.8461	
84	84		23-May		0.8501	
85	85		24-May		0.8541	
86	86		25-May		0.8581	
87	87		26-May		0.8620	
88	88		27-May		0.8660	
89	89	1	28-May	0.87	0.8700	
90		2	29-May		0.8700	
91		3	30-May		0.8700	
92		4	31-May		0.8700	0.82
93		5	1-Jun		0.8700	
94		6	2-Jun		0.8700	
95		7	3-Jun		0.8700	
96		8	4-Jun		0.8700	
97		9	5-Jun		0.8700	
98		10	6-Jun		0.8700	
99		11	7-Jun		0.8700	
100		12	8-Jun		0.8700	
101		13	9-Jun		0.8700	
102		14	10-Jun		0.8700	
103		15	11-Jun		0.8700	
104		16	12-Jun		0.8700	
105		17	13-Jun		0.8700	
106		18	14-Jun		0.8700	
107		19	15-Jun		0.8700	
108		20	16-Jun		0.8700	
109		21	17-Jun		0.8700	
110		22	18-Jun		0.8700	
111		23	19-Jun		0.8700	
112		24	20-Jun		0.8700	
113		25	21-Jun		0.8700	
114		26	22-Jun		0.8700	
115		27	23-Jun		0.8700	
116		28	24-Jun		0.8700	
117		29	25-Jun		0.8700	
118		30	26-Jun		0.8700	
119		31	27-Jun		0.8700	

120	32	28-Jun	0.8700	
121	33	29-Jun	0.8700	
122	34	30-Jun	0.8700	0.87
123	35	1-Jul	0.8700	
124	36	2-Jul	0.8700	
125	37	3-Jul	0.8700	
126	38	4-Jul	0.8700	
127	39	5-Jul	0.8700	
128	40	6-Jul	0.8700	
129	41	7-Jul	0.8700	
130	42	8-Jul	0.8700	
131	43	9-Jul	0.8700	
132	44	10-Jul	0.8700	
133	45	11-Jul	0.8700	
134	46	12-Jul	0.8700	
135	47	13-Jul	0.8700	
136	48	14-Jul	0.8700	
137	49	15-Jul	0.8700	
138	50	16-Jul	0.8700	
139	51	17-Jul	0.8700	
140	52	18-Jul	0.8700	
141	53	19-Jul	0.8700	
142	54	20-Jul	0.8700	
143	55	21-Jul	0.8700	
144	56	22-Jul	0.8700	
145	57	23-Jul	0.8700	
146	58	24-Jul	0.8700	
147	59	25-Jul	0.8700	
148	60	26-Jul	0.8700	
149	61	27-Jul	0.8700	
150	62	28-Jul	0.8700	
151	63	29-Jul	0.8700	
152	64	30-Jul	0.8700	
153	65	31-Jul	0.8700	0.87
154	66	1-Aug	0.8700	
155	67	2-Aug	0.8700	
156	68	3-Aug	0.8700	
157	69	4-Aug	0.8700	
158	70	5-Aug	0.8700	
159	71	6-Aug	0.8700	
160	72	7-Aug	0.8700	
161	73	8-Aug	0.8700	
162	74	9-Aug	0.8700	
163	75	10-Aug	0.8700	
164	76	11-Aug	0.8700	
165	77	12-Aug	0.8700	
166	78	13-Aug	0.8700	
167	79	14-Aug	0.8700	
168	80	15-Aug	0.8700	
169	81	16-Aug	0.8700	
170	82	17-Aug	0.8700	
171	83	18-Aug	0.8700	
172	84	19-Aug	0.8700	
173	85	20-Aug	0.8700	
174	86	21-Aug	0.8700	
175	87	22-Aug	0.8700	
176	88	23-Aug	0.8700	
177	89	24-Aug	0.8700	
178	90	25-Aug	0.8700	
179	91	26-Aug	0.8700	
180	92	27-Aug	0.8700	
181	93	28-Aug	0.8700	
182	94	29-Aug	0.8700	

183	95		30-Aug		0.8700	
184	96		31-Aug		0.8700	0.87
185	97		1-Sep		0.8700	
186	98		2-Sep		0.8700	
187	99		3-Sep		0.8700	
188	100		4-Sep		0.8700	
189	101		5-Sep		0.8700	
190	102		6-Sep		0.8700	
191	103	1	7-Sep	0.87	0.8700	
192		2	8-Sep		0.8659	
193		3	9-Sep		0.8619	
194		4	10-Sep		0.8578	
195		5	11-Sep		0.8537	
196		6	12-Sep		0.8496	
197		7	13-Sep		0.8456	
198		8	14-Sep		0.8415	
199		9	15-Sep		0.8374	
200		10	16-Sep		0.8333	
201		11	17-Sep		0.8293	
202		12	18-Sep		0.8252	
203		13	19-Sep		0.8211	
204		14	20-Sep		0.8170	
205		15	21-Sep		0.8130	
206		16	22-Sep		0.8089	
207		17	23-Sep		0.8048	
208		18	24-Sep		0.8007	
209		19	25-Sep		0.7967	
210		20	26-Sep		0.7926	
211		21	27-Sep		0.7885	
212		22	28-Sep		0.7844	
213		23	29-Sep		0.7804	
214		24	30-Sep		0.7763	0.83
215		25	1-Oct		0.7722	
216		26	2-Oct		0.7681	
217		27	3-Oct		0.7641	
218		28	4-Oct		0.7600	
219		29	5-Oct		0.7559	
220		30	6-Oct		0.7519	
221		31	7-Oct		0.7478	
222		32	8-Oct		0.7437	
223		33	9-Oct		0.7396	
224		34	10-Oct		0.7356	
225		35	11-Oct		0.7315	
226		36	12-Oct		0.7274	
227		37	13-Oct		0.7233	
228		38	14-Oct		0.7193	
229		39	15-Oct		0.7152	
230		40	16-Oct		0.7111	
231		41	17-Oct		0.7070	
232		42	18-Oct		0.7030	
233		43	19-Oct		0.6989	
234		44	20-Oct		0.6948	
235		45	21-Oct		0.6907	
236		46	22-Oct		0.6867	
237		47	23-Oct		0.6826	
238		48	24-Oct		0.6785	
239		49	25-Oct		0.6744	
240		50	26-Oct		0.6704	
241		51	27-Oct		0.6663	
242		52	28-Oct		0.6622	
243		53	29-Oct		0.6581	
244		54	30-Oct		0.6541	
245		55	31-Oct	0.65	0.6500	0.71

MONTHLY CROP EVAPOTRANSIRATION DATA

9/23/99

San Luis Water District
Crop Consumptive Use - Alfalfa (FDR #1)

Month	Kc	1989 ETo (in)	1989 ETc (in)	1998 ETo (in)	1998 ETc (in)
October	0.91	3.57	3.24	4.24	3.85
November	0.79	1.50	1.19	1.52	1.20
December	0.68	0.99	0.67	0.86	0.58
January	0.63	1.57	0.99	0.66	0.42
February	0.66	2.02	1.33	1.21	0.80
March	0.87	4.08	3.55	2.86	2.49
April	0.91	5.65	5.14	4.75	4.32
May	0.91	7.76	7.06	5.64	5.13
June	0.92	8.65	7.95	7.32	6.73
July	0.94	9.16	8.61	8.52	8.01
August	0.97	7.77	7.54	7.81	7.58
September	0.97	5.26	5.10	5.29	5.13
October	0.91	3.92	3.57	3.63	3.30
November	0.79	2.10	1.66	1.55	1.22
December	0.68	1.05	0.71	1.14	0.78
January	0.63	1.24	0.78	0.74	0.46
February	0.66	2.11	1.39	1.57	1.04
Crop Year Total		57.95	52.36	50.68	46.23
Water Year Total		58.72	53.05	50.80	46.18
Calendar Year Total		58.96	53.20	50.36	45.89

9/23/99

San Luis Water District
Crop Consumptive Use - Almonds (FDR #2)

Month	Kc				1989					1998				
					ETo	ETc (in)				ETo	ETc (in)			
	Year 1	Year 2	Year 3	Mature	(in)	Year 1	Year 2	Year 3	Mature	(in)	Year 1	Year 2	Year 3	Mature
October	0.19	0.47	0.65	0.71	3.57	0.68	1.67	2.33	2.53	4.24	0.81	1.98	2.77	3.01
November	0.00	0.00	0.00	0.00	1.50	0.00	0.00	0.00	0.00	1.52	0.00	0.00	0.00	0.00
December	0.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.00	0.88	0.00	0.00	0.00	0.00
January	0.00	0.00	0.00	0.00	1.57	0.00	0.00	0.00		0.66	0.00	0.00	0.00	0.00
February	0.00	0.00	0.00	0.00	2.02	0.00	0.00	0.00	0.00	1.21	0.00	0.00	0.00	0.00
March	0.16	0.38	0.53	0.58	4.08	0.64	1.56	2.18	2.37	2.86	0.45	1.09	1.53	1.66
April	0.19	0.46	0.64	0.70	5.65	1.07	2.61	3.64	3.95	4.75	0.90	2.19	3.06	3.33
May	0.22	0.54	0.75	0.82	7.76	1.72	4.20	5.85	6.36	5.84	1.25	3.05	4.25	4.62
June	0.23	0.57	0.80	0.87	8.65	2.03	4.96	6.92	7.52	7.32	1.72	4.20	5.85	6.36
July	0.23	0.57	0.80	0.87	9.16	2.15	5.26	7.33	7.96	8.52	2.00	4.89	6.82	7.41
August	0.23	0.57	0.80	0.87	7.77	1.83	4.46	6.22	6.76	7.81	1.83	4.46	6.25	6.79
September	0.22	0.55	0.76	0.83	5.26	1.18	2.68	4.02	4.37	5.29	1.19	2.90	4.04	4.39
October	0.19	0.47	0.65	0.71	3.92	0.75	1.84	2.56	2.78	3.63	0.69	1.70	2.37	2.57
November	0.00	0.00	0.00	0.00	2.10	0.00	0.00	0.00	0.00	1.55	0.00	0.00	0.00	0.00
December	0.00	0.00	0.00	0.00	1.05	0.00	0.00	0.00	0.00	1.14	0.00	0.00	0.00	0.00
January	0.00	0.00	0.00	0.00	1.24	0.00	0.00	0.00	0.00	0.74	0.00	0.00	0.00	0.00
February	0.00	0.00	0.00	0.00	2.11	0.00	0.00	0.00	0.00	1.57	0.00	0.00	0.00	0.00
Crop Year Total					57.95	11.29	27.60	38.48	41.82	50.66	10.14	24.80	34.57	37.57
Water Year Total					58.72	11.36	27.77	38.71	42.08	50.80	10.03	24.51	34.17	37.14
Calendar Year Total					58.96	11.36	27.77	38.71	42.08	50.36	10.03	24.51	34.17	37.14

9/23/99

San Luis Water District
Crop Consumptive Use - Barley (FDR #3)

Month	Kc	1989 ETo (in)	1989 ETc (in)	1998 ETo (in)	1998 ETc (in)
October	0.00	3.57	0.00	4.24	0.00
November	0.07	1.50	0.11	1.52	0.11
December	0.21	0.99	0.21	0.86	0.18
January	0.68	1.57	1.06	0.66	0.45
February	1.10	2.02	2.22	1.21	1.33
March	1.17	4.08	4.77	2.86	3.35
April	0.86	5.65	4.85	4.75	4.09
May	0.45	7.76	3.49	5.64	2.54
June	0.13	8.65	1.12	7.32	0.95
July	0.00	9.16	0.00	8.52	0.00
August	0.00	7.77	0.00	7.81	0.00
September	0.00	5.26	0.00	5.29	0.00
October	0.00	3.92	0.00	3.63	0.00
November	0.07	2.10	0.15	1.55	0.11
December	0.21	1.05	0.22	1.14	0.24
January	0.68	1.24	0.84	0.74	0.50
February	1.10	2.11	2.32	1.57	1.73
Crop Year Total		57.95	17.84	50.66	12.98
Water Year Total		58.72	17.77	50.80	13.49
Calendar Year Total		58.96	17.89	50.36	13.05

9/23/99

San Luis Water District
Crop Consumptive Use - Beans (dry) (FDR #4)

Month	Kc	1999 ETo (in)	1999 ETc (in)	1998 ETo (in)	1998 ETc (in)
October	0.00	3.57	0.00	4.24	0.00
November	0.00	1.50	0.00	1.52	0.00
December	0.00	0.99	0.00	0.86	0.00
January	0.00	1.57	0.00	0.66	0.00
February	0.00	2.02	0.00	1.21	0.00
March	0.02	4.08	0.08	2.86	0.06
April	0.07	5.85	0.40	4.75	0.33
May	0.53	7.76	4.11	5.64	2.99
June	1.13	8.65	9.77	7.32	8.27
July	0.83	9.16	7.60	8.52	7.07
August	0.13	7.77	1.01	7.81	1.02
September	0.00	5.26	0.00	5.29	0.00
October	0.00	3.92	0.00	3.63	0.00
November	0.00	2.10	0.00	1.55	0.00
December	0.00	1.05	0.00	1.14	0.00
January	0.00	1.24	0.00	0.74	0.00
February	0.00	2.11	0.00	1.57	0.00
Crop Year Total		57.95	22.97	50.66	19.73
Water Year Total		58.72	22.97	50.80	19.73
Calendar Year Total		58.96	22.97	50.36	19.73

9/23/99

San Luis Water District
Crop Consumptive Use - Corn (field) (FDR #5)

Month	Kc	1989 ETo (in)	1989 ETc (in)	1998 ETo (in)	1998 ETc (in)
October	0.00	3.57	0.00	4.24	0.00
November	0.00	1.50	0.00	1.52	0.00
December	0.00	0.99	0.00	0.86	0.00
January	0.00	1.57	0.00	0.66	0.00
February	0.00	2.02	0.00	1.21	0.00
March	0.00	4.08	0.00	2.86	0.00
April	0.11	5.65	0.62	4.75	0.52
May	0.35	7.76	2.72	5.64	1.97
June	0.91	8.65	7.87	7.32	6.66
July	1.14	9.16	10.44	8.52	9.71
August	0.98	7.77	7.61	7.81	7.65
September	0.29	5.26	1.53	5.29	1.53
October	0.00	3.92	0.00	3.63	0.00
November	0.00	2.10	0.00	1.55	0.00
December	0.00	1.05	0.00	1.14	0.00
January	0.00	1.24	0.00	0.74	0.00
February	0.00	2.11	0.00	1.57	0.00
Crop Year Total		57.95	30.78	50.66	28.05
Water Year Total		58.72	30.78	50.80	28.05
Calendar Year Total		58.96	30.78	50.36	28.05

9/23/99

San Luis Water District
Crop Consumptive Use - Cotton (FDR #6)

Month	Kc	1989 ETo (in)	1989 ETc (in)	1998 ETo (in)	1998 ETc (in)
October	0.16	3.57	0.57	4.24	0.68
November	0.00	1.50	0.00	1.52	0.00
December	0.00	0.99	0.00	0.86	0.00
January	0.00	1.57	0.00	0.66	0.00
February	0.00	2.02	0.00	1.21	0.00
March	0.00	4.08	0.00	2.86	0.00
April	0.10	5.65	0.56	4.75	0.48
May	0.37	7.76	2.87	5.64	2.08
June	0.74	8.65	6.40	7.32	5.41
July	1.14	9.16	10.44	8.52	9.71
August	1.13	7.77	8.78	7.81	8.83
September	0.75	5.26	3.95	5.29	3.97
October	0.16	3.92	0.63	3.63	0.58
November	0.00	2.10	0.00	1.55	0.00
December	0.00	1.05	0.00	1.14	0.00
January	0.00	1.24	0.00	0.74	0.00
February	0.00	2.11	0.00	1.57	0.00
Crop Year Total		57.95	33.57	50.66	31.16
Water Year Total		58.72	33.62	50.60	31.06
Calendar Year Total		58.96	33.62	50.36	31.06

9/23/99

San Luis Water District
Crop Consumptive Use - Deciduous Orchard (FDR #7)

Month	Kc				1989					1998				
					ETo	ETc (in)				ETo	ETc (in)			
	Year 1	Year 2	Year 3	Mature	(in)	Year 1	Year 2	Year 3	Mature	(in)	Year 1	Year 2	Year 3	Mature
October	0.23	0.57	0.80	0.87	3.57	0.84	2.05	2.85	3.10	4.24	0.99	2.43	3.39	3.68
November	0.10	0.25	0.35	0.38	1.50	0.15	0.38	0.52	0.57	1.52	0.16	0.38	0.53	0.58
December	0.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.00	0.88	0.00	0.00	0.00	0.00
January	0.00	0.00	0.00	0.00	1.57	0.00	0.00	0.00	0.00	0.66	0.00	0.00	0.00	0.00
February	0.00	0.00	0.00	0.00	2.02	0.00	0.00	0.00	0.00	1.21	0.00	0.00	0.00	0.00
March	0.08	0.18	0.26	0.28	4.08	0.31	0.75	1.05	1.14	2.88	0.22	0.53	0.74	0.80
April	0.18	0.43	0.60	0.65	5.65	0.99	2.42	3.38	3.67	4.75	0.83	2.04	2.84	3.09
May	0.21	0.51	0.72	0.78	7.76	1.63	3.99	5.57	6.05	5.84	1.19	2.90	4.04	4.40
June	0.23	0.57	0.80	0.87	8.65	2.03	4.96	6.92	7.52	7.32	1.72	4.20	5.85	6.36
July	0.28	0.63	0.88	0.96	9.16	2.37	5.80	8.09	8.79	8.52	2.21	5.40	7.52	8.18
August	0.26	0.63	0.88	0.96	7.77	2.01	4.92	6.86	7.46	7.81	2.02	4.95	6.90	7.50
September	0.26	0.63	0.88	0.96	5.26	1.36	3.33	4.65	5.05	5.29	1.37	3.35	4.67	5.08
October	0.23	0.57	0.80	0.87	3.92	0.92	2.25	3.14	3.41	3.63	0.85	2.08	2.90	3.15
November	0.10	0.25	0.35	0.38	2.10	0.21	0.53	0.73	0.80	1.55	0.16	0.39	0.54	0.59
December	0.00	0.00	0.00	0.00	1.05	0.00	0.00	0.00	0.00	1.14	0.00	0.00	0.00	0.00
January	0.00	0.00	0.00	0.00	1.24	0.00	0.00	0.00	0.00	0.74	0.00	0.00	0.00	0.00
February	0.00	0.00	0.00	0.00	2.11	0.00	0.00	0.00	0.00	1.57	0.00	0.00	0.00	0.00
Crop Year Total					57.95	11.71	28.61	39.89	43.35	50.66	10.71	26.18	36.49	39.66
Water Year Total					58.72	11.85	28.97	40.38	43.89	50.80	10.57	25.83	36.01	39.14
Calendar Year Total					58.96	11.85	28.97	40.38	43.89	50.38	10.57	25.83	36.01	39.14

9/23/99

San Luis Water District
Crop Consumptive Use - Grain Sorghum (Milo) (FDR #8)

Month	Kc	1989 ETo (in)	1989 ETc (in)	1998 ETo (in)	1998 ETc (in)
October	0.60	3.57	2.14	4.24	2.54
November	0.00	1.50	0.00	1.52	0.00
December	0.00	0.99	0.00	0.86	0.00
January	0.00	1.57	0.00	0.66	0.00
February	0.00	2.02	0.00	1.21	0.00
March	0.00	4.08	0.00	2.86	0.00
April	0.00	5.65	0.00	4.75	0.00
May	0.00	7.76	0.00	5.64	0.00
June	0.07	8.65	0.61	7.32	0.51
July	0.36	9.16	3.30	8.52	3.07
August	1.13	7.77	8.78	7.81	8.83
September	1.05	5.26	5.52	5.29	5.55
October	0.60	3.92	2.35	3.63	2.18
November	0.00	2.10	0.00	1.55	0.00
December	0.00	1.05	0.00	1.14	0.00
January	0.00	1.24	0.00	0.74	0.00
February	0.00	2.11	0.00	1.57	0.00
Crop Year Total		57.95	20.34	50.66	20.50
Water Year Total		58.72	20.56	50.80	20.13
Calendar Year Total		58.96	20.56	50.36	20.13

9/23/99

San Luis Water District
Crop Consumptive Use - Grains (FDR #9)

Month	Kc	1989 ETo (in)	1989 ETc (in)	1998 ETo (in)	1998 ETc (in)
October	0.00	3.57	0.00	4.24	0.00
November	0.00	1.50	0.00	1.52	0.00
December	0.31	0.99	0.31	0.86	0.27
January	0.57	1.57	0.89	0.66	0.38
February	1.05	2.02	2.12	1.21	1.27
March	1.19	4.08	4.86	2.86	3.40
April	1.15	5.65	6.49	4.75	5.46
May	0.64	7.76	4.97	5.64	3.61
June	0.00	8.65	0.00	7.32	0.00
July	0.00	9.16	0.00	8.52	0.00
August	0.00	7.77	0.00	7.81	0.00
September	0.00	5.28	0.00	5.29	0.00
October	0.00	3.92	0.00	3.63	0.00
November	0.00	2.10	0.00	1.55	0.00
December	0.31	1.05	0.32	1.14	0.35
January	0.57	1.24	0.70	0.74	0.42
February	1.05	2.11	2.22	1.57	1.65
Crop Year Total		57.95	19.63	50.66	14.39
Water Year Total		58.72	19.56	50.80	14.89
Calendar Year Total		58.96	19.65	50.36	14.47

9/23/99

San Luis Water District
Crop Consumptive Use - Melons (FDR#10)

Month	Kc	1989 ETo (in)	1989 ETc (in)	1998 ETo (in)	1998 ETc (in)
October	0.00	3.57	0.00	4.24	0.00
November	0.00	1.50	0.00	1.52	0.00
December	0.00	0.99	0.00	0.86	0.00
January	0.00	1.57	0.00	0.66	0.00
February	0.00	2.02	0.00	1.21	0.00
March	0.07	4.08	0.29	2.86	0.20
April	0.24	5.65	1.35	4.75	1.14
May	0.67	7.76	5.20	5.64	3.78
June	1.02	8.65	8.82	7.32	7.46
July	0.39	9.16	3.57	8.52	3.32
August	0.00	7.77	0.00	7.81	0.00
September	0.00	5.26	0.00	5.29	0.00
October	0.00	3.92	0.00	3.63	0.00
November	0.00	2.10	0.00	1.55	0.00
December	0.00	1.05	0.00	1.14	0.00
January	0.00	1.24	0.00	0.74	0.00
February	0.00	2.11	0.00	1.57	0.00
Crop Year Total		57.95	19.23	50.66	15.90
Water Year Total		58.72	19.23	50.80	15.90
Calendar Year Total		58.96	19.23	50.36	15.90

9/23/99

San Luis Water District
Crop Consumptive Use - Misc. Truck/Field Crops (High) (FDR#11)

Month	Kc	1989 ETo (in)	1989 ETc (in)	1998 ETo (in)	1998 ETc (in)
October	0.66	3.57	2.35	4.24	2.80
November	0.30	1.50	0.45	1.52	0.45
December	0.35	0.99	0.35	0.86	0.30
January	0.40	1.57	0.63	0.66	0.26
February	0.47	2.02	0.95	1.21	0.57
March	0.74	4.08	3.02	2.86	2.12
April	0.97	5.65	5.48	4.75	4.61
May	0.97	7.76	7.53	5.64	5.47
June	0.66	8.65	5.71	7.32	4.83
July	0.19	9.16	1.74	8.52	1.62
August	0.66	7.77	5.13	7.81	5.15
September	0.87	5.26	4.58	5.29	4.60
October	0.66	3.92	2.59	3.63	2.39
November	0.30	2.10	0.63	1.55	0.46
December	0.35	1.05	0.37	1.14	0.40
January	0.40	1.24	0.49	0.74	0.29
February	0.47	2.11	0.99	1.57	0.74
Crop Year Total		57.95	37.69	50.66	32.78
Water Year Total		58.72	38.24	50.80	32.68
Calendar Year Total		58.96	38.33	50.36	32.48

9/23/99

San Luis Water District
Crop Consumptive Use - Misc. Truck/Field Crops (Low) (FDR#12)

Month	Kc	1989 ETo (in)	1989 ETc (in)	1998 ETo (in)	1998 ETc (in)
October	0.00	3.57	0.00	4.24	0.00
November	0.00	1.50	0.00	1.52	0.00
December	0.00	0.99	0.00	0.86	0.00
January	0.06	1.57	0.09	0.68	0.04
February	0.30	2.02	0.60	1.21	0.36
March	0.59	4.08	2.41	2.86	1.69
April	1.02	5.65	5.76	4.75	4.85
May	0.92	7.76	7.14	5.64	5.18
June	0.00	8.65	0.00	7.32	0.00
July	0.00	9.16	0.00	8.52	0.00
August	0.00	7.77	0.00	7.81	0.00
September	0.00	5.26	0.00	5.29	0.00
October	0.00	3.92	0.00	3.63	0.00
November	0.00	2.10	0.00	1.55	0.00
December	0.00	1.05	0.00	1.14	0.00
January	0.06	1.24	0.07	0.74	0.04
February	0.30	2.11	0.63	1.57	0.47
Crop Year Total		57.95	16.00	50.66	12.12
Water Year Total		58.72	16.01	50.80	12.23
Calendar Year Total		58.96	16.00	50.36	12.12

9/23/99

San Luis Water District
Crop Consumptive Use - Misc. Truck/Field Crops (Med) (FDR#13)

Month	Kc	1989 ETo (in)	1989 ETc (in)	1998 ETo (in)	1998 ETc (in)
October	0.33	3.57	1.18	4.24	1.40
November	0.15	1.50	0.23	1.52	0.23
December	0.18	0.99	0.17	0.86	0.15
January	0.23	1.57	0.36	0.66	0.15
February	0.39	2.02	0.78	1.21	0.47
March	0.67	4.08	2.71	2.86	1.90
April	1.00	5.65	5.62	4.75	4.73
May	0.95	7.76	7.33	5.64	5.33
June	0.33	8.65	2.85	7.32	2.41
July	0.10	9.16	0.87	8.52	0.81
August	0.33	7.77	2.56	7.81	2.58
September	0.44	5.26	2.29	5.29	2.30
October	0.33	3.92	1.29	3.63	1.20
November	0.15	2.10	0.31	1.55	0.23
December	0.18	1.05	0.18	1.14	0.20
January	0.23	1.24	0.28	0.74	0.17
February	0.39	2.11	0.81	1.57	0.60
Crop Year Total		57.95	26.95	50.66	22.45
Water Year Total		58.72	27.13	50.80	22.46
Calendar Year Total		58.96	27.16	50.36	22.30

9/23/99

San Luis Water District
Crop Consumptive Use - Nursery/Lettuce (FDR#14)

Month	Kc	1989 ETo (in)	1989 ETc (in)	1998 ETo (in)	1998 ETc (in)
October	0.00	3.57	0.00	4.24	0.00
November	0.00	1.50	0.00	1.52	0.00
December	0.00	0.99	0.00	0.86	0.00
January	0.03	1.57	0.05	0.66	0.02
February	0.15	2.02	0.30	1.21	0.18
March	0.30	4.08	1.20	2.86	0.84
April	0.51	5.65	2.88	4.75	2.42
May	0.46	7.76	3.57	5.64	2.59
June	0.00	8.65	0.00	7.32	0.00
July	0.00	9.16	0.00	8.52	0.00
August	0.00	7.77	0.00	7.81	0.00
September	0.00	5.26	0.00	5.29	0.00
October	0.00	3.92	0.00	3.63	0.00
November	0.00	2.10	0.00	1.55	0.00
December	0.00	1.05	0.00	1.14	0.00
January	0.03	1.24	0.04	0.74	0.02
February	0.15	2.11	0.32	1.57	0.24
Crop Year Total		57.95	8.00	50.66	6.06
Water Year Total		58.72	8.01	50.60	6.12
Calendar Year Total		58.96	8.00	50.36	6.06

9/23/99

San Luis Water District
Crop Consumptive Use - Pasture (Improved) (FDR #16)

Month	Kc	1989 ETo (in)	1989 ETc (in)	1998 ETo (in)	1998 ETc (in)
October	0.90	3.57	3.21	4.24	3.81
November	0.90	1.50	1.35	1.52	1.36
December	0.90	0.99	0.89	0.86	0.77
January	0.90	1.57	1.41	0.66	0.59
February	0.90	2.02	1.81	1.21	1.09
March	0.90	4.08	3.67	2.86	2.57
April	0.90	5.65	5.08	4.75	4.28
May	0.90	7.76	6.98	5.64	5.07
June	0.90	8.65	7.78	7.32	6.58
July	0.90	9.16	8.24	8.52	7.67
August	0.90	7.77	6.99	7.81	7.03
September	0.90	5.26	4.73	5.29	4.76
October	0.90	3.92	3.53	3.63	3.26
November	0.90	2.10	1.89	1.55	1.39
December	0.90	1.05	0.94	1.14	1.03
January	0.90	1.24	1.11	0.74	0.66
February	0.90	2.11	1.90	1.57	1.41
Crop Year Total		57.95	52.16	50.66	45.59
Water Year Total		58.72	52.85	50.80	45.72
Calendar Year Total		58.96	53.06	50.36	45.32

9/23/99

San Luis Water District
Crop Consumptive Use - Potatoes (FDR #16)

Month	Kc	1989 ETo (in)	1989 ETc (in)	1998 ETo (in)	1998 ETc (in)
October	0.00	3.57	0.00	4.24	0.00
November	0.00	1.50	0.00	1.52	0.00
December	0.00	0.99	0.00	0.86	0.00
January	0.00	1.57	0.00	0.66	0.00
February	0.00	2.02	0.00	1.21	0.00
March	0.66	4.08	2.69	2.86	1.89
April	1.08	5.65	6.10	4.75	5.13
May	1.20	7.76	9.31	5.64	6.76
June	0.64	8.65	5.53	7.32	4.68
July	0.00	9.16	0.00	8.52	0.00
August	0.00	7.77	0.00	7.81	0.00
September	0.00	5.26	0.00	5.29	0.00
October	0.00	3.92	0.00	3.63	0.00
November	0.00	2.10	0.00	1.55	0.00
December	0.00	1.05	0.00	1.14	0.00
January	0.00	1.24	0.00	0.74	0.00
February	0.00	2.11	0.00	1.57	0.00
Crop Year Total		57.95	23.63	50.66	18.46
Water Year Total		58.72	23.63	50.80	18.46
Calendar Year Total		58.96	23.63	50.36	18.46

9/23/99

San Luis Water District
Crop Consumptive Use - Rice (FDR #17)

Month	Kc	1989 ETo (in)	1989 ETc (in)	1998 ETo (in)	1998 ETc (in)
October	0.20	3.57	0.71	4.24	0.85
November	0.00	1.50	0.00	1.52	0.00
December	0.00	0.99	0.00	0.88	0.00
January	0.00	1.57	0.00	0.66	0.00
February	0.00	2.02	0.00	1.21	0.00
March	0.10	4.08	0.41	2.86	0.29
April	1.00	5.65	5.65	4.75	4.75
May	1.15	7.76	8.92	5.64	6.48
June	1.27	8.65	10.98	7.32	9.29
July	1.23	9.16	11.26	8.52	10.48
August	1.15	7.77	8.94	7.81	8.98
September	0.59	5.26	3.10	5.29	3.12
October	0.20	3.92	0.78	3.63	0.73
November	0.00	2.10	0.00	1.55	0.00
December	0.00	1.05	0.00	1.14	0.00
January	0.00	1.24	0.00	0.74	0.00
February	0.00	2.11	0.00	1.57	0.00
Crop Year Total		57.95	49.97	50.66	44.24
Water Year Total		58.72	50.04	50.80	44.11
Calendar Year Total		58.96	50.04	50.36	44.11

9/23/99

San Luis Water District
Crop Consumptive Use - Subtropical Orchard (FDR #18)

Month	Kc				1989					1996				
					ETo	ETc (in)				ETo	ETc (in)			
	Year 1	Year 2	Year 3	Mature	(in)	Year 1	Year 2	Year 3	Mature	(in)	Year 1	Year 2	Year 3	Mature
October	0.20	0.50	0.69	0.75	3.57	0.72	1.76	2.46	2.67	4.24	0.86	2.10	2.92	3.18
November	0.00	0.00	0.00	0.00	1.50	0.00	0.00	0.00	0.00	1.52	0.00	0.00	0.00	0.00
December	0.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.00	0.88	0.00	0.00	0.00	0.00
January	0.00	0.00	0.00	0.00	1.57	0.00	0.00	0.00	0.00	0.66	0.00	0.00	0.00	0.00
February	0.00	0.00	0.00	0.00	2.02	0.00	0.00	0.00	0.00	1.21	0.00	0.00	0.00	0.00
March	0.15	0.36	0.51	0.55	4.08	0.61	1.48	2.06	2.24	2.86	0.42	1.04	1.45	1.57
April	0.18	0.45	0.63	0.68	5.65	1.04	2.53	3.53	3.84	4.75	0.87	2.13	2.97	3.23
May	0.21	0.51	0.71	0.77	7.76	1.61	3.94	5.50	5.98	5.64	1.17	2.86	3.99	4.34
June	0.22	0.53	0.75	0.81	8.65	1.89	4.62	6.44	7.00	7.32	1.60	3.91	5.45	5.93
July	0.22	0.53	0.75	0.81	9.16	2.00	4.89	6.82	7.42	8.52	1.86	4.55	6.35	6.90
August	0.22	0.53	0.75	0.81	7.77	1.70	4.15	5.79	6.29	7.81	1.71	4.18	5.82	6.33
September	0.16	0.36	0.53	0.58	5.26	0.82	2.01	2.81	3.05	5.29	0.83	2.03	2.82	3.07
October	0.20	0.50	0.69	0.75	3.92	0.79	1.94	2.70	2.94	3.63	0.73	1.79	2.50	2.72
November	0.00	0.00	0.00	0.00	2.10	0.00	0.00	0.00	0.00	1.55	0.00	0.00	0.00	0.00
December	0.00	0.00	0.00	0.00	1.05	0.00	0.00	0.00	0.00	1.14	0.00	0.00	0.00	0.00
January	0.00	0.00	0.00	0.00	1.24	0.00	0.00	0.00	0.00	0.74	0.00	0.00	0.00	0.00
February	0.00	0.00	0.00	0.00	2.11	0.00	0.00	0.00	0.00	1.57	0.00	0.00	0.00	0.00
Crop Year Total					57.95	10.39	25.41	35.41	38.49	50.66	9.33	22.80	31.76	34.54
Water Year Total					58.72	10.47	25.58	35.66	38.76	50.80	9.20	22.49	31.35	34.06
Calendar Year Total					58.96	10.47	25.58	35.66	38.76	50.36	9.20	22.49	31.35	34.08

9/23/99

San Luis Water District
Crop Consumptive Use - Sugar Beets (FDR #19)

Month	Kc	1989 ETo (in)	1989 ETc (in)	1998 ETo (in)	1998 ETc (in)
October	0.00	3.57	0.00	4.24	0.00
November	0.00	1.50	0.00	1.52	0.00
December	0.00	0.99	0.00	0.86	0.00
January	0.00	1.57	0.00	0.66	0.00
February	0.00	2.02	0.00	1.21	0.00
March	0.08	4.08	0.33	2.86	0.23
April	0.28	5.65	1.58	4.75	1.33
May	0.75	7.76	5.82	5.64	4.23
June	1.16	8.65	10.03	7.32	8.49
July	1.16	9.16	10.80	8.52	10.05
August	1.16	7.77	9.01	7.81	9.06
September	0.53	5.26	2.79	5.29	2.80
October	0.00	3.92	0.00	3.63	0.00
November	0.00	2.10	0.00	1.55	0.00
December	0.00	1.05	0.00	1.14	0.00
January	0.00	1.24	0.00	0.74	0.00
February	0.00	2.11	0.00	1.57	0.00
Crop Year Total		57.95	40.36	50.66	36.19
Water Year Total		58.72	40.36	50.80	36.19
Calendar Year Total		58.96	40.36	50.36	36.19

9/23/99

San Luis Water District
Crop Consumptive Use - Tomatoes (FDR #20)

Month	Kc	1989 ETo (in)	1989 ETc (in)	1998 ETo (in)	1998 ETc (in)
October	0.00	3.57	0.00	4.24	0.00
November	0.00	1.50	0.00	1.52	0.00
December	0.00	0.99	0.00	0.86	0.00
January	0.00	1.57	0.00	0.66	0.00
February	0.00	2.02	0.00	1.21	0.00
March	0.00	4.08	0.00	2.86	0.00
April	0.26	5.65	1.47	4.75	1.24
May	0.42	7.76	3.26	5.64	2.37
June	0.94	8.65	8.13	7.32	6.88
July	1.18	9.16	10.80	8.52	10.05
August	0.96	7.77	7.46	7.81	7.50
September	0.00	5.26	0.00	5.29	0.00
October	0.00	3.92	0.00	3.63	0.00
November	0.00	2.10	0.00	1.55	0.00
December	0.00	1.05	0.00	1.14	0.00
January	0.00	1.24	0.00	0.74	0.00
February	0.00	2.11	0.00	1.57	0.00
Crop Year Total		57.95	31.12	50.66	28.03
Water Year Total		58.72	31.12	50.80	28.03
Calendar Year Total		58.96	31.12	50.36	28.03

9/24/99

San Luis Water District
Crop Consumptive Use - Vineyard (FDR# 21)

Month	Kc				1989					1998				
					ETo	ETc (in)				ETo	ETc (in)			
	Year 1	Year 2	Year 3	Mature	(in)	Year 1	Year 2	Year 3	Mature	(in)	Year 1	Year 2	Year 3	Mature
October	0.16	0.40	0.55	0.60	3.57	0.58	1.41	1.97	2.14	4.24	0.69	1.68	2.34	2.54
November	0.04	0.09	0.13	0.14	1.50	0.06	0.14	0.19	0.21	1.52	0.06	0.14	0.20	0.21
December	0.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.00	0.86	0.00	0.00	0.00	0.00
January	0.00	0.00	0.00	0.00	1.57	0.00	0.00	0.00	0.00	0.86	0.00	0.00	0.00	0.00
February	0.00	0.00	0.00	0.00	2.02	0.00	0.00	0.00	0.00	1.21	0.00	0.00	0.00	0.00
March	0.00	0.00	0.00	0.00	4.08	0.00	0.00	0.00	0.00	2.86	0.00	0.00	0.00	0.00
April	0.02	0.05	0.06	0.07	5.65	0.11	0.28	0.36	0.40	4.75	0.09	0.22	0.31	0.33
May	0.10	0.24	0.33	0.36	7.76	0.75	1.84	2.57	2.79	5.64	0.55	1.34	1.87	2.03
June	0.19	0.46	0.63	0.69	8.65	1.61	3.94	5.49	5.97	7.32	1.38	3.33	4.64	5.05
July	0.23	0.55	0.77	0.84	9.16	2.08	5.08	7.07	7.69	8.52	1.93	4.72	6.58	7.16
August	0.23	0.55	0.77	0.84	7.77	1.78	4.31	6.00	6.53	7.81	1.77	4.33	6.04	6.56
September	0.22	0.53	0.75	0.81	5.26	1.15	2.81	3.92	4.26	5.29	1.16	2.83	3.94	4.28
October	0.16	0.40	0.55	0.60	3.92	0.64	1.55	2.16	2.35	3.63	0.59	1.44	2.00	2.18
November	0.04	0.09	0.13	0.14	2.10	0.08	0.19	0.27	0.29	1.55	0.06	0.14	0.20	0.22
December	0.00	0.00	0.00	0.00	1.05	0.00	0.00	0.00	0.00	1.14	0.00	0.00	0.00	0.00
January	0.00	0.00	0.00	0.00	1.24	0.00	0.00	0.00	0.00	0.74	0.00	0.00	0.00	0.00
February	0.00	0.00	0.00	0.00	2.11	0.00	0.00	0.00	0.00	1.57	0.00	0.00	0.00	0.00
Crop Year Total					57.95	8.09	19.79	27.58	29.98	50.66	7.60	18.59	25.91	28.16
Water Year Total					58.72	8.17	19.98	27.85	30.28	50.80	7.51	18.35	25.58	27.80
Calendar Year Total					58.96	8.17	19.98	27.85	30.28	50.36	7.51	18.35	25.58	27.80

9/23/99

San Luis Water District
Crop Consumptive Use - Wheat (FDR# 22)

Month	Kc	1989 ETo (in)	1989 ETc (in)	1998 ETo (in)	1998 ETc (in)
October	0.00	3.57	0.00	4.24	0.00
November	0.04	1.50	0.06	1.52	0.06
December	0.23	0.99	0.23	0.86	0.20
January	0.54	1.57	0.85	0.66	0.36
February	0.95	2.02	1.91	1.21	1.15
March	1.17	4.08	4.77	2.86	3.35
April	1.04	5.65	5.87	4.75	4.94
May	0.47	7.76	3.65	5.64	2.65
June	0.00	8.65	0.00	7.32	0.00
July	0.00	9.16	0.00	8.52	0.00
August	0.00	7.77	0.00	7.81	0.00
September	0.00	5.26	0.00	5.29	0.00
October	0.00	3.92	0.00	3.63	0.00
November	0.04	2.10	0.08	1.55	0.06
December	0.23	1.05	0.24	1.14	0.26
January	0.54	1.24	0.67	0.74	0.40
February	0.95	2.11	2.00	1.57	1.49
Crop Year Total		57.95	17.34	50.66	12.70
Water Year Total		58.72	17.29	50.80	13.15
Calendar Year Total		58.96	17.38	50.36	12.76

YEARLY CROP EVAPOTRANSPIRATION DATA

9/23/99 **SAN LUIS WATER DISTRICT**
1989 - CROP CONSUMPTIVE USE, ETc (IN)

FDR #	CROP	CROP YEAR	WATER YEAR	CALENDAR YEAR
1	ALFALFA	52.36	53.05	53.20
2	ALMONDS			
	YEAR 1	11.29	11.36	11.36
	YEAR 2	27.60	27.77	27.77
	YEAR 3	38.48	38.71	38.71
	MATURE	41.82	42.08	42.08
3	BARLEY	17.84	17.77	17.89
4	BEANS(DRY)	22.97	22.97	22.97
5	CORN(FIELD)	30.78	30.78	30.78
6	COTTON	33.57	33.62	33.62
7	DECIDUOUS ORCHARDS			
	YEAR 1	11.71	11.85	11.85
	YEAR 2	28.61	28.97	28.97
	YEAR 3	39.89	40.38	40.38
	MATURE	43.35	43.89	43.89
8	GRAIN SORGHUM(MILO)	20.34	20.56	20.56
9	GRAINS	19.63	19.56	19.65
10	MELONS	19.23	19.23	19.23
11	MISC. TRUCK FIELD CROPS(HIGH)	37.89	38.24	38.33
12	MISC. TRUCK FIELD CROPS(LOW)	16.00	16.01	16.00
13	MISC. TRUCK FIELD CROPS(MED)	26.95	27.13	27.16
14	NURSERY/LETTUCE	8.00	8.01	8.00
15	PASTURE(IMPROVED)	52.16	52.85	53.06
16	POTATOES	23.63	23.63	23.63
17	RICE	49.97	50.04	50.04
18	SUBTROPICAL ORCHARDS			
	YEAR 1	10.39	10.47	10.47
	YEAR 2	25.41	25.58	25.58
	YEAR 3	35.41	35.66	35.66
	MATURE	38.49	38.76	38.76
19	SUGAR BEETS	40.36	40.36	40.36
20	TOMATOES	31.12	31.12	31.12
21	VINEYARD			
	YEAR 1	8.09	8.17	8.17
	YEAR 2	19.79	19.98	19.98
	YEAR 3	27.58	27.85	27.85
	MATURE	29.98	30.28	30.28
22	WHEAT	17.34	17.29	17.38
	TOTAL	958.04	963.95	964.72

9/24/99 **SAN LUIS WATER DISTRICT**
1998 - CROP CONSUMPTIVE USE , ETc (IN)

FDR #	CROP	CROP YEAR	WATER YEAR	CALENDAR YEAR
1	ALFALFA	46.23	46.18	45.89
2	ALMONDS			
	YEAR 1	10.14	10.03	10.03
	YEAR 2	24.80	24.51	24.51
	YEAR 3	34.57	34.17	34.17
	MATURE	37.57	37.14	37.14
3	BARLEY	12.98	13.49	13.05
4	BEANS(DRY)	19.73	19.73	19.73
5	CORN(FIELD)	28.05	28.05	28.05
6	COTTON	31.16	31.06	31.06
7	DECIDUOUS ORCHARDS			
	YEAR 1	10.71	10.57	10.57
	YEAR 2	26.18	25.83	25.83
	YEAR 3	36.49	36.01	36.01
	MATURE	39.66	39.14	39.14
8	GRAIN SORGHUM(MILO)	20.50	20.13	20.13
9	GRAINS	14.39	14.89	14.47
10	MELONS	15.90	15.90	15.90
11	MISC. TRUCK FIELD CROPS(HIGH)	32.78	32.68	32.48
12	MISC. TRUCK FIELD CROPS(LOW)	12.12	12.23	12.12
13	MISC. TRUCK FIELD CROPS(MED)	22.45	22.46	22.30
14	NURSERY/LETTUCE	6.06	6.12	6.06
15	PASTURE(IMPROVED)	45.59	45.72	45.32
16	POTATOES	18.46	18.46	18.46
17	RICE	44.24	44.11	44.11
18	SUBTROPICAL ORCHARDS			
	YEAR 1	9.33	9.20	9.20
	YEAR 2	22.80	22.49	22.49
	YEAR 3	31.78	31.35	31.35
	MATURE	34.54	34.08	34.08
19	SUGAR BEETS	36.19	36.19	36.19
20	TOMATOES	28.03	28.03	28.03
21	VINEYARD			
	YEAR 1	7.60	7.51	7.51
	YEAR 2	18.59	18.35	18.35
	YEAR 3	25.91	25.58	25.58
	MATURE	28.16	27.80	27.80
22	WHEAT	12.70	13.15	12.76
	TOTAL	846.38	842.35	839.90

SAN LUIS WATER DISTRICT

WATER MANAGEMENT PLAN (2011)

APPENDIX L

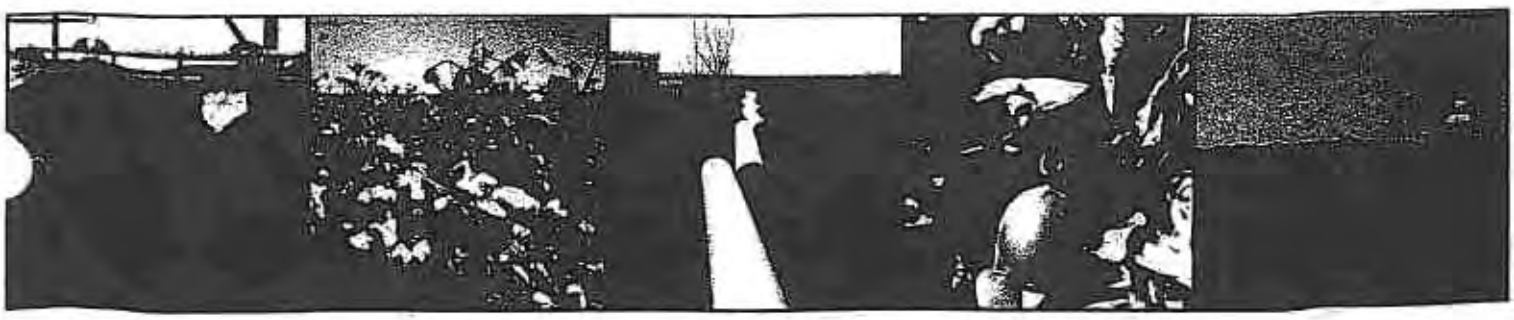
WESTSIDE REGIONAL DRAINAGE PLAN

Westside Regional Drainage Plan

May 2003

Prepared By:

San Joaquin River Exchange Contractors Water Authority
Broadview Water District
Panoche Water District
Westlands Water District



Westside Regional Drainage Plan — AN OVERVIEW

Background:

The U. S. Bureau of Reclamation recently completed a San Luis Drain Feature Re-Evaluation Plan Formulation Report for the area located in the western San Joaquin Valley. The area consists of Westlands, Broadview, Panoche, Firebaugh, and Pacheco water districts and portions of San Luis Water District and Central California Irrigation District.

Long-established drainage practices for farmers in the north portion of the drainage service area are at immediate risk. Impending discharge standards will cut off vital drainage to the San Joaquin River by 2009. The Westside Regional Drainage Plan (Plan) is developed by the stakeholders and is designed primarily to quick-start identified drainage elements in time to meet standards. The initial projects in the Plan are the first steps needed for implementation of the USBR's San Luis Drain Feature Re-Evaluation Plan Formulation Report.

Plan Elements:

- The Plan identifies scientifically sound projects, develops an aggressive implementation plan, curtails discharge to the San Joaquin River in accordance with regulatory constraints.
- Accelerates Plan schedule by using existing adopted environmental documentation. The schedule provides for immediate drainage service implementation.
- Is fully supported by the local stakeholders including Westlands, Panoche and Broadview water districts, Central California Irrigation District, Firebaugh Canal Water District, and the San Joaquin River Exchange Contractors Water Authority.
- The local stakeholders are dedicated to working cooperatively with the USBR to achieve immediate implementation.
- Is consistent with the USBR's San Luis Drain Feature Re-Evaluation Plan Formulation Report. The main difference is the accelerated schedule for the provision of drainage.
- A key element is adaptive management combining investigation, construction of proven drainage components, and operational experience to perfect the final drainage strategy.
- The chief components include land retirement, groundwater management, source control, regional re-use, treatment, and salt disposal.

Table of Contents

Table of Contents 2
Executive Summary 3
Background 5
Current Drainage Management Activities 6
- Grassland Drainage Area 6
  - Grassland Bypass Project 7
  - San Joaquin River Water Quality Improvement Project 8
- Groundwater Management Pilot Project 8
- Westlands Drainage Area 9

Key Management Practices 10
- Land Retirement 10
- Potential Uses of Retired Land within Westlands 11
  - Regional Drainage Reuse and Treatment 12
  - I-5 Business Corridor 12
  - Panoche/Silver Creek Detention Basin 13
  - Arroyo Pasajero Flood Control Project 13
  - Surface Water Storage 13
  - Dry Land Farming, Hunting Opportunities 14
  - Wildlife Corridor 14
  - Upland Habitat Development 14

Groundwater Management 14
- Source Control 16
- Regional Drainage Reuse 17
- Drain Water Treatment 18
- Salt Disposal 18

Adaptive Management Approach 20
Phase I Drainage Plan from 2003 to 2009 - Figure 1 21
Phase II Drainage Plan - Figure 2 22
- All Sub-areas 22

Bibliography / References 23

Executive Summary

Drainage on the westside of the San Joaquin Valley has been studied for decades. Enormous investments of time and money have been spent developing theoretical drainage reduction strategies. Although many strategies are known to be effective, few projects have been implemented. For over 50 years, both State and Federal planners have recognized the need for a special drainage plan for the region. However, little has been done to actually implement such a plan.

Drainage for farmers in and adjacent to the Central Valley Project's San Luis Unit service area is at a crisis point. Present regulatory requirements for discharge from these lands to the San Joaquin River are nearly impossible to meet. Impending discharge standards will cut off current vital drainage to the San Joaquin River by 2009.

The Westside Regional Drainage Plan (Plan) is intended to: 1) identify scientifically sound projects proven to be effective by the government, local agencies and private consultants; 2) develop an aggressive implementation plan initially utilizing existing projects documented to be environmentally sound; and 3) curtail discharges to the San Joaquin River in accordance with impending regulatory constraints while maintaining the ability to farm.

Local stakeholders have formulated this Plan by integrating all consistent elements developed by government, local agencies, and private partnerships. Local stakeholders are dedicated to working cooperatively with the U.S. Bureau of Reclamation (USBR) to achieve immediate implementation.

The Plan focuses on regional drainage projects implemented on a short timeline. The initial projects of this Plan are the first steps needed for any of the Drainage Service Alternatives identified by USBR in their San Luis Drain Feature Re-Evaluation (Re-Evaluation) Plan Formulation Report, December 2002. Once these regional projects are in place, final disposal projects will be implemented. We concur with USBR that in-valley disposal appears to be the preferred alternative when considering cost, time to implement, implementation complexity, and environmental concerns. The Drainage Service Area is presented on Exhibit A. Identically to the Re-Evaluation, components include drain water reduction measures, irrigation drainage management, drainage collection, and drainage reuse. The Plan coordinates all strategies to meet regulatory requirements on time, to protect the environment and to sustain agriculture.

Adaptive management and implementation of drainage projects are essential. An educated landowners' group, working cooperatively with Federal, State and local agencies, and environmental interests, is the key for successful management. Local knowledge and cooperation, together with the resources of the State and Federal governments will ensure viable projects.

Drainage on the westside must be addressed on a regional basis. However, local districts and entities within each sub-area have specific needs and resources. The Plan for each sub-area must allow for implementation of the most efficient and effective specific drainage management while integrating these practices into one comprehensive program. Drainage cannot be effectively managed without equitably addressing each sub-area.

The Plan's key management components are: (1) Land Retirement, (2) Groundwater Management, (3) Source Control, (4) Regional Reuse Projects, (5) Drain Water Treatment, and (6) Salt Disposal. Each sub-area will implement a different suite of management practices that will be coordinated to alleviate drainage impacts throughout the region. By implementing management practices in the most effective areas, past, present and future drainage impacts will be mitigated.

Executive Summary Continued

As this coordinated drainage program is implemented, stakeholders will evaluate the long-term sustainability of the complete solution. The first phase of the Plan will be to implement the projects consistent with any ultimate disposal option. We concur with USBR that the preferred alternative is in-Valley treatment and disposal.

The implementation schedule for Phase I projects provides the time needed to perfect and implement the in-Valley option. If treatment proves ineffective, then the Plan provides the necessary immediate drainage relief and time to implement other disposal alternatives.

USBR has analyzed the proposed plan to retire up to 200,000 acres of land within the Westlands Water District. The San Luis Drain Feature Re-Evaluation identifies the remaining quality and quantity of drain water disposal required. The Re-Evaluation recalculates the costs of collection, conveyance, reuse, treatment and disposal. The cost savings to provide drainage by retiring 200,000 acres is on average 33% less expensive than without land retirement.

Background

The United States understood the need for drainage service for the San Luis Unit even before its initial authorization. The San Luis Drain was originally designed to transport drainage flows to the Sacramento-San Joaquin Delta for disposal to the ocean. The upper reaches of the San Luis Drain and Kesterson Regulating Reservoir were constructed, but due to political and environmental concerns, construction was never completed to the Delta. The drain was ordered closed during the mid-1980s creating the drainage dilemma we face today. In order to develop a long-term plan to provide drainage service to the westside, the State and Federal governments initiated the interagency San Joaquin Valley Drainage Program.

In 1990, the San Joaquin Valley Drainage Program published A Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley, Final Report of the San Joaquin Valley Drainage Program (The "Rainbow Report"). The Rainbow Report outlined a management plan that included all of the key management practices contained in this Plan. In January 2000, the San Joaquin Valley Drainage Implementation Program issued a report titled Final Report, Evaluation of the 1990 Drainage Management Plan for the Westside San Joaquin Valley, California (2000 SJVDIP Report). The 2000 SJVDIP Report also identified the key management practices included in this Regional Drainage Plan. Currently, USBR has just completed the San Luis Drainage Feature Re-Evaluation to once again identify alternatives to provide drainage service to the Westside of the San Joaquin Valley. The key components of the USBR's current Re-evaluation effort are included in this Plan. The main difference between the USBR's efforts and this Plan are the inclusion of an adaptive management approach, shorter implementation timeline, and reduced cost of design, construction, and operation.

The adaptive management component of this Plan will allow the local interests to work with the USBR and other State and Federal agencies to adapt to practical experience gained through the continued implementation of on-the-ground projects. The local interests understand from experience with operating drainage projects that a successful effort must adapt to new information gained through constant evaluation of in-progress projects. The short implementation timeline of this Plan is essential in order to provide meaningful drainage service to the region. The regulatory constraints being imposed by various State and Federal agencies do not allow the region to wait while the USBR completes its study and begins design of a drainage alternative; drainage service is needed immediately. The Grassland Drainage Area must reduce its selenium discharges by 42% within the next three years and 55% percent within the next six years to meet regulatory requirements. Additional water quality regulations are being imposed on the region that further necessitates immediate action.

These regulatory constraints on drainage discharges further exacerbate the impacts to local growers. Shallow groundwater levels continue to rise causing serious impacts to crop production. Groundwater levels must be managed in order to prevent further hardships to family farmers and crop productivity. Large-scale drainage projects are needed immediately to provide meaningful relief from drainage-related impacts.

Current Drainage Management Activities

Significant drainage control efforts are ongoing within the Drainage Service Area. (See Exhibit B.) The efforts have been implemented to respond to the specific needs of the different sub-areas. The Drainage Service Area has been subdivided into five sub-areas; 1) the San Luis Unit Sub-area; 2) the Exchange Contractors Sub-area 3) the Northern Westlands Sub-area, 4) the Central Westlands Sub-area, and; 5) the Southern Westlands Sub-area.

Drainage Service Area:

Five sub-areas:

- San Luis Unit Sub-area
- Exchange Contractors Sub-area
- Northern Westlands Sub-area
- Central Westlands Sub-area
- Southern Westlands Sub-area

Grassland Drainage Area

The Grassland Drainage Area is comprised of the San Luis Unit and Exchange Contractors sub-areas. The Grassland Drainage Area formed a regional drainage entity in March 1996 under the umbrella of the San Luis and Delta-Mendota Water Authority to implement the Grassland Bypass Project. Participants include the Broadview Water District, Charleston Drainage District, Firebaugh Canal Water District, Pacheco Water District, Panoche Drainage District, Widren Water District, and the Camp 13 Drainage District, located in part of Central California Irrigation District. The area comprises approximately 97,000 gross acres of irrigated farmland on the westside of the San Joaquin Valley. The area is highly productive, producing an estimated $113 million annually in agricultural crop market value, with an additional estimated $126 million generated for the local and regional economies, for a total estimated annual economic value of $239 million.

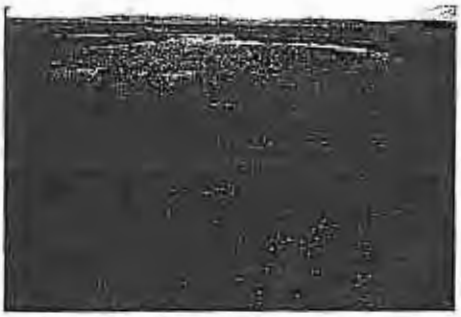


Photo Credit: Gary Zahm, USFWS

The Grassland Drainage Area farmers have implemented several activities aimed at reducing discharge of subsurface drainage waters to the San Joaquin River. These activities include the Grassland Bypass Project, the San Joaquin River Water Quality Improvement Project, formation of a regional drainage entity, distribution of newsletters and other farmer-oriented education series, development of a monitoring program, use of State Revolving Fund loans for improved irrigation systems, development and implementation of drainage recycling systems to mix subsurface drainage water with irrigation supplies under strict limits, tiered water pricing and tradable loads programs.

Grassland Drainage Area

Current Drainage Management Activities Continued

Grassland Bypass Project

The entities within the Grassland Drainage Area have implemented the Grassland Bypass Project, an innovative program designed to improve water quality in drainage channels now used to deliver water to wetland areas. Prior to the project, subsurface drainage water was conveyed through these channels to the San Joaquin River and limited their availability to deliver habitat supplies. The Project consolidates subsurface drainage flows regionally and utilizes a portion of the federal San Luis Drain to convey the flows around the habitat areas to the San Joaquin River downstream of the Merced River confluence.

Negotiations between the San Luis and Delta-Mendota Water Authority and the USBR to utilize a portion of the San Luis Drain for the Project commenced in 1988. Stakeholders included in the process were the U.S. Environmental Protection Agency, U.S. Fish & Wildlife Service, California Department of Fish and Game, the Central Valley Regional Water Quality Control Board, Environmental Defense, Contra Costa County, and Contra Costa Water District.

In late 1995, environmental documentation for the first five years of the project was completed and an agreement was signed. Discharge through the project began in September 1996. In September 2001, the agreement was extended for another 8 years and 3 months through December 2009. An Environmental Impact Report/Environmental Impact Statement (EIR/EIS) was completed. On September 7, 2001, the Central Valley Regional Water Quality Control Board issued new Waste Discharge Requirements for the project. In addition, a Biological Assessment/Biological Opinion was completed as well as Total Maximum Monthly Load (TMML) reports submitted to the Regional Board and EPA. The agreement requires continued reductions in selenium discharge until ultimately TMML limits are achieved in 2005 for above-normal and wet years, and continued progress is made to meet water quality objectives in 2010 for below-normal, dry and critically dry years.

The benefits of the Grassland Bypass Project are well documented. In water year (WY) 2001, drainage volume was reduced by 47%, selenium load was reduced 56%, salt load reduced 28% and boron load reduced 41% compared to the pre-project conditions in WY 1996. In WY 1996, prior to the Grassland Bypass Project, the mean selenium concentration in Salt Slough at Lander Avenue was 16 parts per billion (ppb). Since October 1996, the 2 ppb water quality objective for Salt Slough has been met in all months except in February 1998 when uncontrollable flood flows were mixed with subsurface drainage water and could not be contained within the Grassland Bypass Project (that month the selenium concentration in Salt Slough was 4 ppb). In WY 1996, the mean selenium concentration at Camp 13 Ditch was 55.9 parts per billion (ppb). In WY 1997, the first year of operation of the Grassland Bypass Project, the mean selenium concentration at Camp 13 Ditch was 2.6 ppb. This value was slightly above the wetland selenium objective of 2 ppb. In April 1998, specific actions were taken to eliminate any possible subsurface drainage discharges from the Grassland Drainage Area into the Camp 13 Slough and other discharge points. Since that time, there have been no discharges from the Grassland Drainage Area into wetland channels.

Grassland Bypass Project

- Consolidates regional subsurface flows
- Utilizes San Luis Drain to convey water around habitat areas for strategic SJR discharge
- Meets waste discharge requirement
- Meets Selenium TMDLs

- 2001 results:
  - Water volume down 47%
  - Selenium load down 56%
  - Salt load down 28%
  - Boron load down 41%

Current Drainage Management Activities Continued

San Joaquin River Water Quality Improvement Project

The San Joaquin River Water Quality Improvement Project (SJRIP) is a major project undertaken by Grassland Drainage Area entities. The project, covered under the 2001 EIR/EIS, used Proposition 13 funds to purchase and improve 4,000 acres of land within the Grassland Drainage Area for the purpose of drainage water treatment and disposal. The initial Phase I projects of the SJRIP were implemented in the winter of 2001 with the planting of salt tolerant crops and construction of distribution facilities, which allowed for 1,821 acres to be irrigated with drainage water and/or blended water.

Photo Credit: Gary Zahm, USFWS

As a result, 1,025 pounds of selenium, 14,500 tons of salt, and 62,000 pounds of boron were retained and not discharged to the Grassland Bypass Project and to the San Joaquin River. The SJRIP project is the key component for the Grassland Drainage Area as a whole to meet future selenium load limits.

This project will ultimately allow for planting and irrigation of the entire 4,000 acres with drainage water. Future phases call for acquisition of additional acreage, installation of subsurface drainage systems and implementation of treatment and salt disposal components.

A component of this future phase, the Grassland Integrated Drainage Management Project, is being implemented with Proposition 13 funds. Subsurface drains are being installed in 550 acres within the SJRIP area and irrigation systems improvements are underway so drainage water can be applied to this land and associated crops.

San Joaquin River Water Quality Improvement Project

SJR Water Quality Improvement Project:

- Salt tolerant crops are irrigated with drainage water
- Improve acres in Grassland Drainage Area
- Projects key component to help meet load discharge
- Drainage water treatment and disposal

Groundwater Management Pilot Project

In 2002, the San Joaquin River Exchange Contractors Water Authority (Exchange Contractors) in cooperation with the USBR implemented a pilot project to study the feasibility of using groundwater pumping to mitigate drainage impacts. The project involves pumping two wells above the Corcoran Clay but below the shallow groundwater. Although this water supply does contain elevated levels of salt, it contains no selenium.

This water supply is diverted into a surface supply canal and put to beneficial use on surrounding lands and refuges. In addition to the water supply being made available, the project also included monitoring of the shallow groundwater levels and discharges of nearby tile sumps. The 2002 project has demonstrated significant lowering of the crop root zone water levels by pumping groundwater from within the sierran sands located above the Corcoran Clay but below shallow selenium laden groundwater. It has long been identified that the sierran sands reduce selenium and can eliminate the constituent from groundwater discharges. This pilot project also showed reductions in nearby tile sump outputs.

The pilot project indicates that expansion of the groundwater management program is a viable component of the long-term drainage plan. Additionally, extensive modeling has demonstrated significant drain water source reduction benefits

Current Drainage Management Activities Continued

from groundwater pumping. Figure 1 (See Page 21) presents the modeled estimations of drainage discharge from the Exchange Contractors sub-area assuming several land retirement and pumping combination alternatives. The modeling results show that a carefully crafted and implemented groundwater management program alone can result in significant source reduction.

Groundwater Management Pilot Project:

- Using groundwater pumping to mitigate impacts
- Reduced crop root zone water levels
- Pumped zones are above Corcoran Clay, below shallow groundwater

Westlands Drainage Area

Westlands Water District (Westlands) includes more than 560,000 irrigated acres of diversified crops on some of the most productive soil in the world. Large portions of the westside of the San Joaquin Valley are affected by salinity and drainage problems. This affected area includes approximately 200,000 acres of farmland within Westlands. The U.S. government has long been aware of these problems, and congressional authorization of the facilities to deliver Central Valley Project (CVP) water to Westlands mandated drainage service as part of this project. Accordingly, provisions for drainage service were expressly included in Westlands water service contract with the USBR.

Construction of drainage facilities began in 1968. By 1975, concerns over costs and possible environmental issues led to a suspension in construction. Increased environmental concerns led to the closure of existing drainage facilities in 1986, and Westlands and other districts served by the San Luis Unit of the CVP have been without drainage service since that time.

In 1999, Westlands initiated a process to purchase approximately 14,000 acres of land with shallow groundwater problems and within the area identified by the USBR as needing drainage service.

In addition, 1,443 acres have been retired under the USBR's Land Retirement Demonstration Project. As the land was purchased, the water supply that was historically applied to that land was reallocated to the remaining lands in the District. The District developed an agricultural lease program for these lands, which allows lessees to dry land farm and maintain it according to District specifications. The USBR has been using its land for habitat restoration.

In 2002, Westlands approved an agreement to settle that portion of *Sagouspe, et al., v. Westlands Water District*, et al., concerning how the District will allocate Central Valley Project water to the Area I Lands and Area II Lands after December 31, 2007, or after a long-term renewal contract, which is currently being negotiated with the USBR, is executed and becomes effective. The agreement is the product of lengthy negotiations between Area I and Area II representatives. Under the settlement agreement, the District will acquire additional lands and the water appurtenant to those lands will be allocated as provided in the settlement agreement.

The proposed plan shows acquisition of 100,175 irrigable acres through the issuance of debt. This total includes the 13,978 acres previously taken out of agricultural production and lands to be acquired through the settlement of other litigation. These lands will be temporarily fallowed and managed by the District.

Westlands Drainage Area:

- No natural drainage
- No drainage service since 1986
- District land buy-out program
- Proposed plan shows acquisition of 100,175

Key Management Practices

This Regional Drainage Plan proposes the expansion of the current drainage management practices into a comprehensive sustainable drainage program. In order to implement a sustainable drainage program, all management practices must be integrated to provide long-term salt balance in the region. While the goal of salt balance is the same for each sub-area, the most efficient suite of management practices designed to achieve salt balance may vary among sub-areas. Therefore, each sub-area will emphasize different management practices in their drainage program.

With the goal of maintaining a salt balance in the region, the management plan will implement on-the-ground management practices on an increasingly larger scale. As practices are shown to be effective they will be expanded. The process will build upon past research and evolve into a fully developed integrated in-Valley drainage control effort. The districts will implement drainage control efforts appropriate for their specific needs. The implementation of the district efforts will be coordinated with input from USBR and will be integrated into one comprehensive program.

The key management practices are: (1) Land Retirement (2) Groundwater Management (3) Source Control (4) Regional Reuse Projects (5) Drain Water Treatment (6) Salt Disposal. These components are described in more detail below.

Photo Credit: Central California Irrigation District

Key Management Practices for a Sustainable Drainage Program:

- Land Retirement
- Groundwater Management
- Source Control
- Regional Reuse Projects
- Drainage Water Treatment
- Salt Disposal

Land Retirement

Land retirement is a key component of the Plan. By retiring drainage impacted land on a voluntary basis the need for future drainage service on these lands will be reduced. The retired lands will no longer be irrigated with surface supplies, which will reduce the impacts of deep percolation from these lands. To the extent possible, groundwater pumping will continue throughout the areas where land retirement occurs. Modeling shows a significant drain water source reduction from such a combination.

The land will become available for other uses such as regional drainage reuse projects, commercial and industrial use, flood control, surface water storage where appropriate, and wildlife habitat. Each project will be strategically located to maximize the benefits to the region. For example, drainage reuse projects will be located to maximize their ability to mitigate past drainage impacts and eliminate future regional impacts from land that remains in production. Each land use choice will be coordinated into an overall program designed to maintain a viable environment and economy.

The land retirement component of the Plan will be to buy land from willing sellers in areas currently impacted by shallow groundwater. The water supply from this land will remain with the region so long as appropriate drainage mitigation programs are effectively implemented consistent with this Plan. Specific measurable criteria will be developed to document that the drainage management measures are effective at mitigating past, present, and future drainage impacts resulting from irrigation within the region.

Key Management Practices Continued

Westlands Water District Land Retirement Plan

As previously indicated, each area will place different emphasis on each management practice. Westlands Water District plans significant land retirement within their area. At the present time, the general outline of the Westlands Water District land retirement plan is as follows:

- Up to 200,000 acres of drainage-impacted land will be purchased from individual landowners, permanently removing the land from irrigated agricultural production. Title to these lands would be retained by Westlands and/or a nonprofit entity, and put to beneficial uses such as wildlife habitat, dry land farming, or related economic development activities. Westlands would manage the retired lands in ways compatible with continuing agriculture on the remaining farmlands.
- The plan must provide balanced benefits for all affected parties.
- The plan must provide farmers a fair and reasonable price for their land, with values determined as if those lands had drainage services provided.
- The program must be voluntary, involving only willing sellers.
- No harm or loss of water should occur to any other CVP water user.
- Third-party impacts must be identified and addressed.

Land Retirement:

- Key component of regional plan
- Voluntary basis
- WWD Retirement Plan
  - Drainage-impacted lands
  - No harm to CVP users
  - Third-party impacts addressed
- Retired land uses:
  - Drainage Reuse Treatment facility
  - Commercial/Industrial
  - Flood control
  - Surface water storage
  - Wildlife habitat
  - Dry land farming
  - Land holding

Potential Uses of Retired Land within Westlands

Westlands has begun a preliminary investigation into the potential alternative uses of the retired land, with the objective of administering those lands to achieve broader benefits for the District and region. This land will become available for other uses such as regional drainage reuse projects, commercial and industrial use, flood control, surface water storage where appropriate, and wildlife habitat. Each project will be strategically located to maximize the benefits to the region.

For example, drainage reuse projects will be located to maximize their ability to mitigate past drainage impacts and eliminate future regional impacts from land that remains in production. Each land use choice will be coordinated into an overall program designed to maintain a viable environment and economy. Title to these lands would be retained by Westlands and/or a nonprofit entity.

Key Management Practices Continued

To date, the following potential uses for the land have been considered:

- Regional Drainage Reuse and Treatment / Disposal
- Highway 180 Business Corridor
- Panoche/Silver Creek Detention Basin
- Arroyo Pasajero Flood Control Project
- Surface Water Storage (where appropriate)
- Dry Land Farming, Hunting Opportunities
- Wildlife Corridor
- Upland Habitat Development

Regional Drainage Reuse and Treatment

Westlands anticipates that lands adjacent to the retired area will still need drainage service with a focus on treatment and reuse. Retired lands can be used as regional reuse projects to provide drainage for lands remaining in production and to mitigate for past drainage impacts. The facilities would be designed and operated similar to the project identified in the USBR's Plan Formulation Report of the San Luis Drainage. The beneficiaries of this project would include: Westlands, landowners who need drainage service, and the USBR since it will be relieved from providing drainage service at a significant cost to the US.

Highway 180 Business Corridor

This project allows land along the proposed Highway 180 alignment to be used for commercial and industrial activities. Land could be made available to local communities impacted by land retirement and land fallowed as a result of decreased water supplies resulting from the implementation of CVP Improvement Act. Beneficiaries from this project would include the City of Mendota, County of Fresno, and Westlands.

Panoche/Silver Creek Detention Basin

This project consists of constructing a detention basin to collect and attenuate flood flows from Panoche/Silver Creek and discharge a constant flow to the Fresno Slough. Historically, flows from Panoche Silver Creek have flowed out from the channel and down to the City of Mendota flooding parts of the city, depositing silt on county and state roadways, and damaging adjacent crop land. Westlands expects this activity will also be administered by the Panoche Silver Creek Coordinated Resource Management and Planning Program. The beneficiaries would include the City of Mendota, County of Fresno, CALTRANS, landowners, and the U.S. Army Corps of Engineers.

Key Management Practices Continued

Arroyo Pasajero Flood Control Project

Retired lands could be used to construct a detention basin to collect and attenuate flood flows from the Arroyo Pasajero. The Corp of Engineers completed a report to construct a 50,000 acre-foot reservoir to attenuate the flows from the creek; however, the cost-benefit ratio did not support construction of the project. As an alternative, DWR is investigating a proposal to divert Arroyo Pasajero flows into the California Aqueduct, transport them downstream, and then divert the waters into the Tulare Lake Bed. As an alternative, which is less expensive and easier to implement, Westlands is proposing to divert the Arroyo Pasajero flows onto land retired in the District. The beneficiaries of this project would be the City of Huron, County of Fresno, CALTRANS, U.S. Army Corps of Engineers, California Department of Water Resources, State Water Contractors, and the CVP contractors.

Surface Water Storage

The project consists of constructing a series of storage basins on eight sections (5,120 acres) adjacent to Westlands Laterals 6 and 7 within Township 15 South and Range 15 East. The Project will have an estimated 40,000 to 50,000 acre-feet of storage for rescheduled water, surplus water, and water from other sources including refuges, San Joaquin River flood flows, and other CVP contractors. In addition to the storage benefit, the project will be near the Mendota Wildlife Area and will provide habitat for migratory birds, and with this benefit, other partners could be willing to contribute to the project. This project will be designed to prevent impacts to shallow groundwater due to seepage.

Dry Land Farming, Hunting Opportunities

Currently, Westlands is leasing out land acquired by the District for lessees to farm. Since these lands do not have a CVP allocation, dry land farming is the best alternative. Typically, lessees will plant a winter or spring grain on the land, which will be harvested or used for livestock grazing. Retired lands can be dry land farmed with grains and other crops to provide food and habitat for wildlife. Beneficiaries include Westlands, wildlife, and the local economy.

Key Management Practices Continued

Wildlife Corridor

Westlands has been meeting with the USBR, California Department of Fish and Game, and U.S. Fish and Wildlife Service to discuss restoring acquired and retired land for wildlife purposes. Both wildlife agencies are interested in restoring an east-west and north-south corridor to allow species to migrate to different lands and different areas of the District.

In addition to using dedicated retired lands for a wildlife corridor, Westlands would also work with landowners with permanent crops, which could also be used for a corridor. Beneficiaries of this project include the California Department of Fish and Game, U.S. Fish and Wildlife Service, and Valley species.

Upland Habitat Development

Similar to the Wildlife Corridor Project, Westlands has been meeting with the USBR, California Department of Fish and Game, and U.S. Fish and Wildlife Service to discuss restoring acquired and retired land for upland habitat purposes. Retired lands can be restored to upland habitat similar to the USBR demonstration project for animal and plant species. Beneficiaries include the USBR, the California Department of Fish and Game, U.S. Fish and Wildlife Service, and Valley species.

Photo Credit:
Gary Zahm, USFWS

Groundwater Management

Groundwater management will be used to meet several goals of the drainage management program. These goals include: 1) limiting the advance of sub-surface drainage; 2) maintaining groundwater below the crop root levels; 3) mitigating the impacts from the lack of historical drainage service; 4) providing necessary interim drainage management until disposal options are developed; and 5) developing an additional water supply for beneficial uses, such as Level 2 refuge supplies during the life of the project.

Studies conducted by the Federal government and others have identified that groundwater management is a suitable strategy to provide drainage within the region. The studies conclude that extraction of groundwater above the Corcoran Clay will lower groundwater levels and reduce drainage water production. Also using a groundwater flow model, specifically designed for the region (Belitz) the U.S. Geological Survey estimated the beneficial effects from pumping on levels and flows.

Key Management Practices Continued

The Belitz model demonstrates significant drain water source reduction benefits from groundwater pumping. Figure 1 (see page 21) presents the modeled estimations of drainage discharge reduction from the Exchange Contractors sub-area. The modeling indicates that groundwater management is a key component of any drainage program.

Groundwater pumping also is needed to manage the advance of poor quality groundwater northeasterly towards the City of Firebaugh and the San Joaquin River. The San Joaquin River Exchange Contractors Water Authority AB3030 groundwater monitoring effort has documented this advance and concluded that groundwater pumping is needed to manage the advance.

In addition, groundwater pumping is needed in order to extract the accumulated drainage water from the shallow groundwater. The accumulation is from the many years of irrigation of crop lands without the ability to drain. The resulting imbalance in the water budget within the region has caused the shallow water table to rise. Surface water has been applied at rates that exceed the carrying capacity of the groundwater system resulting in increase groundwater storage in shallow zones. A groundwater pumping program would be designed to extract the accumulation to pre-CVP levels.

The Groundwater Management Plan will develop a usable water supply during the life of the project. It has been shown that water from well below the root zone and above the Corcoran Clay, while generally high in salinity, does not contain selenium. This selenium-free water can be used to augment water supplies for regional re-use projects, wildlife habitat and traditional farming without creating potential problems associated with selenium-laden water.

A Groundwater Management Program is currently in the early stages of deployment through a set of studies and pilot projects focused on immediate drainage relief. Program progress is managed through a monitoring analysis and refinement system designed to maximize benefits and direct project component development. It is expected that the program will include the following steps:

1. Identify the acceptable water quality standards for the various water supply needs in the area. As an example, the Grassland Drainage Area (GDA) 4,000-acre experimental salt removal project has an additional need for water supply in the 2,500 parts per million (ppm) total dissolved solids (tds) range. Additionally, an investigation is being conducted to determine whether a portion of the well water could be blended with better quality Delta-Mendota Canal water and used within the Grassland Water District. On the basis of the required standards, identify potential production areas with acceptable groundwater quality through evaluation of existing data, pilot project data, and additional samples to be collected for this purpose. The results will provide preliminary groundwater volumes and production area estimates for the future pumping strategy.

2. Modify, update and develop analytical tools. The U.S. Geological Survey groundwater-flow model is the primary tool to analyze the proposed pumping strategy. Necessary updates include: a) extension of model boundaries to include all of the area; b) reevaluation of boundary conditions for potential impacts on the pumping assessment and modification as necessary; c) representation of drainage systems in greater detail; d) revise model time-steps to provide seasonal information, review and revise hydraulic conductivity data; and e) revise sub-area boundaries. Portions of these work tasks are currently being accomplished and are in various stages of completion.

3. Utilize analytical tools to identify preferred production areas and develop a preliminary pumping strategy. The groundwater-flow model and an optimization program will be used to estimate the mixture of pumping volumes to optimize water quality. The groundwater-flow model will be utilized to determine pumping amounts and locations to minimize drainage water production, possible subsidence effects, and maximize management of poor groundwater migration. Solute transport modeling updated using recent pilot project data will be used to calculate the expected operation life of the pumping strategy.

Key Management Practices Continued

4. Design and implementation of further field-scale pilot projects to evaluate the pumping in areas most likely to result in successful drainage and/or water level reductions and yield good quality water. Collect water level, drainage and pumping data. Measurement of pumping volumes will be critical for effective evaluation of the project. Implementation of initial field-scale pilot projects is currently under way with results from the monitoring indicating good results towards successful drainage management.

5. Incorporate pilot projects results into the model and reevaluate pumping using the new information. Integrate pumping into the overall drainage management strategy.

6. Conduct necessary environmental and additional legal analysis.

7. Fully integrate pumping into the overall drainage management strategy; install necessary wells and integrate these existing wells into the water supply system.

Groundwater Management:

- Develop new water supply
- Maintain groundwater below crop root zone
- Mitigate lack of drainage service
- Necessary interim management
- Limit advance of subsurface drainage

Source Control

Source control is the first line of defense in the battle to control subsurface drainage. Farmers in the region have implemented various irrigation improvements by taking advantage of funding through the State Revolving Fund (SRF) and other sources to improve irrigation practices. These practices include conversion to ¼-mile furrows, sprinkler systems and drip irrigation systems. Experimentation has also proceeded with timing of pre-irrigation and shallow drainage management to reduce deep percolation. These practices and new improvements will continue to be implemented to further reduce the production of subsurface drainage water that has to be managed by other means. It is assumed funding will be utilized through various sources including SRF loans or other loan/grant sources.

Photo Credit: Central California Irrigation District

In addition to on-farm measures, such as improved irrigation practices, there are regional source control measures that likely would be implemented on a regional level by districts or other regional entities. These would include lining of surface water delivery canals to reduce seepage losses that contribute to subsurface drainage and implementation of uses of drainage water for displacement projects, such as replacing fresh water dust control with permanent systems or water trucks using drainage water.

Source Control (drainage volume reduction):

- Reduce drainage volume through improved irrigation on farm
- Regional efforts to reduce drainage
- Reduce seepage loss in canals
- Use drainage water for dust management

Key Management Practices Continued

Regional Drainage Reuse

Reuse is the application of subsurface drainage water (either directly or slightly diluted) to salt tolerant crops. The purpose is to reduce the volume of the subsurface drainage water for ease in treatment.

Reuse is different from recycling in that recycled water is minimized for maximum yield on salt sensitive crops. Reuse is maximized for drainage quantity reduction. Crops used for reuse would include salt tolerant alfalfa, pasture or halophytes.

These crops would not necessarily be grown for returns on yield but for drainage volume reduction. Lands used for reuse would have to be managed to maintain adequate salt levels in the fields for the crops grown. This would likely entail installing of subsurface drains under the reuse fields so an adequate leaching fraction can be maintained. It is assumed that approximately 4 acre-feet per acre could be applied on the reuse crops with leaching fraction of about 27% or 1 acre-foot per acre. So there is a 73% reduction in volume through the reuse projects. The reuse projects are essential to any long-term drainage plan.

These projects will be modeled after the San Joaquin River Water Quality Improvement Project (SJRIP) that has already been partially implemented within the Grassland Drainage Area. Within Westlands Water District, portions of the land purchased under the land retirement program that are best suited to mitigate past and future drainage impacts will be used to implement these regional reuse projects. The land will be used to grow salt tolerant crops as a means to utilize water collected by shallow agricultural tile sumps as well as water generated by shallow well pumping described above in the groundwater management section. These projects will reuse drainage water in order to reduce the volume of and increase the efficiency of treatment. These types of projects have been proven effective and will be integrated into the entire regional approach to maximize drainage water use and minimize drainage impacts.

Specific locations will be selected to implement large-scale reuse projects to mitigate regional drainage impacts. These sites will be selected based upon the ease of delivering drainage flows to the area, the regional benefits from intercepting drainage flows on the property, and the availability of the property. Preliminary investigations indicate that, in addition to retired lands within Westlands, portions of Broadview Water District and areas on the northern edge of the Grassland Drainage Area are potential candidates for regional reuse projects.

These projects will reuse drainage water in order to minimize flows for more efficient treatment. Drainage water will be applied to salt tolerant crops such as pasture and alfalfa. These crops will be marketed when possible to reduce costs of the project. While the crops will be marketed the primary factor in planting decisions will be drainage reduction not crop production. The agricultural activity will also provide jobs in the region and help maintain retired ground to avoid impacts to surrounding farmland. Subsurface tile lines will be installed on the reuse projects to collect water that percolates from the irrigation. This water will be reused, treated or placed in evaporation ponds.

Regional Drainage Reuse:

- Reuse subsurface water on salt tolerant crops
- Maximized for drainage volume reduction
- Crops grown mostly for drainage, not commercial purposes

Key Management Practices Continued

Drainage Water Treatment

Drainage water treatment is another essential component of a regional drainage solution. Drainage water collected from the regional drainage projects described above will require treatment to further reduce its volume, remove salt and allow for more cost-effective disposal of the residue.

This treatment will consist of reverse osmosis and other membrane systems, chemical reduction systems as well as flow-through wetland systems. Pilot projects exist for all of these treatment systems. The region will expand these pilot programs to find the most effective system to treat the drainage water.

It is anticipated that irrigation efficiency, source control, groundwater management and regional reuse projects can reduce the amount of drainage water by 82%. However, to eliminate discharge to the San Joaquin River the remaining water needs to be managed. Pilot treatment plants are being implemented within the Grassland Drainage Area. These investigations include membrane treatment for removal of salt, selenium, and boron as well as flow-through selenium removal systems. The membrane systems for pretreatment and salt removal are showing water recovery of up to 92% and salt removal of up to 98%. The system also is showing promise on accomplishing this with reduced power requirements. These pilot projects will continue for the next five years. Selenium treatment systems are showing a high percentage of selenium removal. Investigations are continuing on the removal of selenium through cropping in reuse areas.

The products of these treatment systems will be improved quality water and concentrated brine. The water will be made available to augment regional water supplies. Some of this water may be of such high quality to be used for municipal and industrial supplies. This water will be marketed to help offset the costs of the treatment process. After treatment the resulting brine solution must be disposed of or utilized.

Drainage Water Treatment:

- Treatment to reduce volume, remove salts, allow for cost-effective disposal.
- Reverse Osmosis membrane systems.
- Pretreatment and salt removal shows water recovery at 92%, salt removal at 98%.

Salt Disposal

Salt disposal is the final stage of the drainage solution. Initially, the brine solution could be stored in waste containment facilities, including evaporation ponds, built on retired land. Ultimately, it may be possible to market some of this product for uses ranging from construction materials to dying textiles. An aggressive investigation into potential markets for reclaimed salts should be implemented. If successful, this investigation could result in the most economical and environmentally favored alternative for salt disposal. If a viable market for reclaimed salt is not developed then, as an alternative, salts could be collected in waste containment facilities and stored indefinitely. Evaporation ponds and solar evaporators will be used to concentrate the

Key Management Practices Continued

brine into sludge or dry crystals for ultimate utilization and disposal. Final disposal also could be into permitted disposal sites. Recent legislation has acknowledged the need for on-site disposal of salt.

While the need for ultimate salt disposal is obvious, the best method for this disposal is unclear. Any final salt disposal option must be economically viable and environmentally sound. In an effort to find the best disposal option, the parties will explore a wide variety of disposal methods. The ultimate disposal option will be selected based upon economic, environmental and practical considerations. Determination of the best disposal method will require significant efforts by all parties, but these efforts will result in a comprehensive drainage program.

Salt Disposal:

- Preferred alternative in current analysis
- Final stage of drainage solution
- Possible market for salt product
- Permitted disposal site

Adaptive Management Approach

This Plan will utilize adaptive management to find the most effective and efficient drainage solutions. Districts in the region will coordinate their activities with input from USBR. Each of the districts will participate in a group to manage the regional activities and document the program's progress. The members will work with the USBR, and other State and Federal agencies to ensure the most effective program possible. This Plan establishes a three-phased approach to establishing drainage service. The phased approach will allow the districts to modify their activities according to the most recent developments in drainage control.

The group will analyze specific management efforts and refine them as needed to meet the goal of sustaining agriculture while addressing regulatory issues. When particular practices are shown to be viable they will be expanded. When the analysis indicates that other practices are deficient they will be refined or abandoned. This process will serve as a practical test of the drainage reduction concepts developed over the last several decades.

Each of the districts supporting this approach has specific resources and expertise that can be used to find long-term in-Valley solutions. If after the region has made a focused effort to reduce drainage impacts through in-Valley solutions and these practices do not prove to be the total drainage solution, then an out-of-Valley solution can be more thoroughly explored. The projects, expertise and knowledge the region develops through this process will greatly benefit regional drainage control in both the short- and long-term.

Adaptive Management Approach:

- To find and perfect most effective and efficient solutions
- Each district coordinate with USBR
- Three phased approach allows for modifications and flexibility
- Reacts to changes and advancements made in drainage management

Phase I Drainage Plan from 2003 to 2009

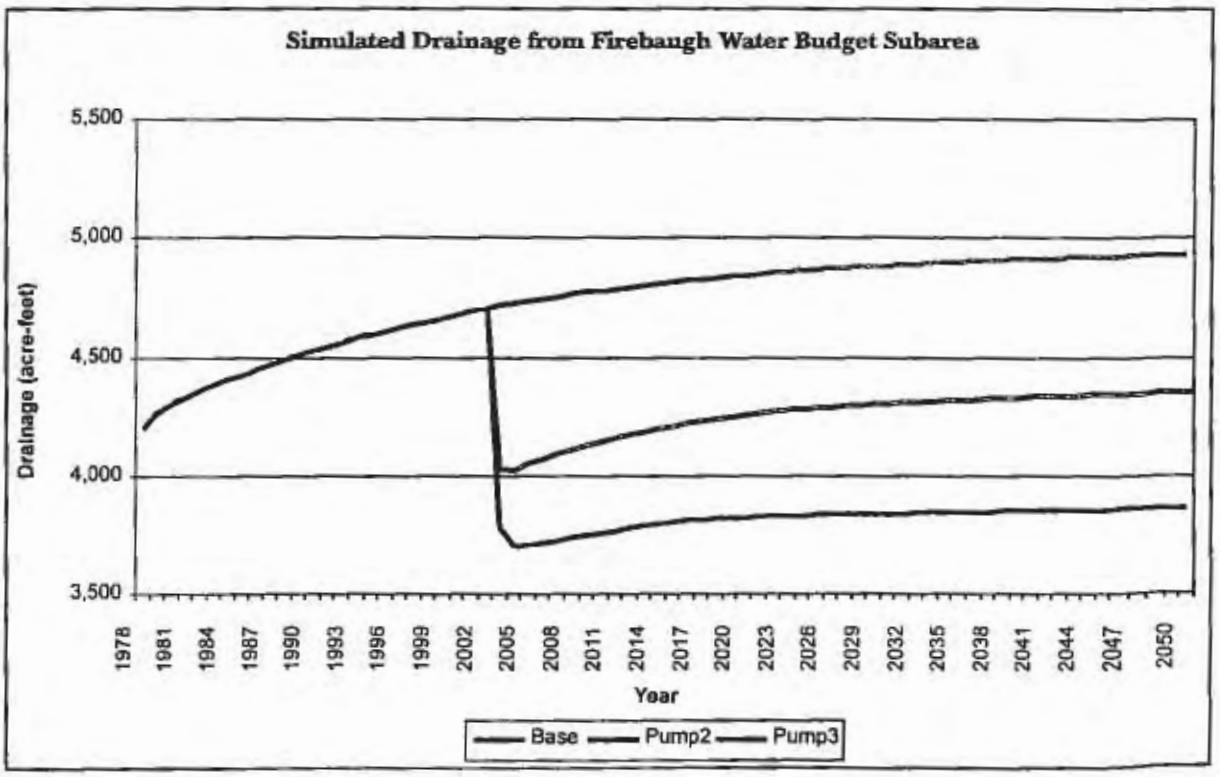
The region will implement the drainage management projects, which are generally located on Exhibit C.

Figure 2 presents the proposed timeline and cost estimates for implementation for Phase I.

All Sub-areas

- Adaptive management of SJRIP and Groundwater Management Programs.
- Expand and develop reuse areas.
- Continue implementation of proven treatment programs,
- Implement other viable land use options evaluated in Phase I,
- Finalize in-Valley treatment and disposal, or select and implement other disposal alternative,
- Implement salt disposal program,
- Evaluate success of the Drainage Management Program,

Figure 1



Base	Continue existing conditions.
Pump 2	Retire , 25,000 AF/yr pumpage from beneath Firebaugh Subarea (95% above corcoran).
Pump 3	Retire , 50,000 AF/yr pumpage from beneath Firebaugh, Broadview, Panoche, and WWD.

Firebaugh subarea includes CCID and FCWD.

Phase II
Drainage Plan

Figure 2

Westside Regional Drainage Plan
Project Funding and Implementation for Phase I

Year	Item	Estimated Cost	Sub-Area	Comment
2003	Land Retirement Monitoring	$200,000	3	Calfed & Local
	Groundwater Management	$900,000	1,2,3	5 wells Total - 4500af Water Supply & Calfed
	SJRIP Phase I Completion	$2,000,000	1,2	SJRIP, USBR Plan, Prop 50, Prop13 and Local
		$3,100,000		
2004	Land Retirement	$100,000,000	3,4,5	"Up to" amount based on Implementation
	Groundwater Management	$600,000	1,2,3	8 Wells Total - 6500 af Water Supply & Calfed
	GW Conveyance Legal & Engineering	$3,000,000	1,2,3	Long Term Water Supply
	SJRIP Phase I Completion	$3,000,000	1,2	SJRIP, USBR Plan, Prop 50, Prop13 and Local
	Treatment Legal & Engineering	$2,000,000	1,2,3	USBR Plan
		$108,600,000		
2005	Land Retirement	$100,000,000	3	"Up to" amount based on Implementation
	Groundwater Management	700,000	1,2,3	11 Wells Total - 9500af Water Supply
	GW Conveyance Construction	$10,000,000	1,2,3	Long Term Water Supply
	SJRIP Plumbing	$950,000	1,2	SJRIP & USBR Plan
	SJRIP Phase 2 Expansion	$8,100,000	1,2	SJRIP & USBR Plan
	SJRIP Phase 2 Development	$2,300,000	1,2	SJRIP & USBR Plan
	Treatment Legal & Engineering	$2,000,000	1,2,3	SJRIP & USBR Plan
		$124,050,000		
2006	Land Retirement	$100,000,000	3,4,5	"Up to" amount based on Implementation
	Groundwater Management	$800,000	1,2,3	14 Total Wells - 12500af Water Supply
	GW Conveyance Construction	$10,000,000	1,2,3	Long Term Water Supply
	SJRIP Phase 2 Development	$5,000,000	1,2	SJRIP & USBR Plan
	SJRIP Phase 3 Expansion	$5,000,000	1,2	SJRIP & USBR Plan
	Treatment Legal & Engineering	$4,000,000	1,2,3	SJRIP & USBR Plan
		$124,800,000		
2007	Land Retirement	$100,000,000	3,4,5	"Up to" amount based on Implementation
	Groundwater Management	$850,000	1,2,3	17 Total Wells - 15500af Water Supply
	SJRIP Phase 3 Expansion	$7,100,000	1,2	SJRIP & USBR Plan
	SJRIP Phase 3 Development	$7,300,000	1,2	SJRIP & USBR Plan
	Treatment Construction	$21,000,000	1,2	SJRIP & USBR Plan
		$136,250,000		
2008	Land Retirement	$100,000,000	3,4,5	"Up to" amount based on Implementation
	Groundwater Management	$1,000,000	1,2,3	20 Total Wells - 19500af Water Supply
	Treatment Construction	$21,000,000	1,2	USBR Plan
		$122,000,000		

NOTE: The Land Retirement includes development of the key management practices such as regional reuse and treatment, dry land farming, etc.

Sub Area
1 San Luis Unit Sub-Area
2 Exchange Contractors Sub-Area
3 Northern Westlands Sub-Area
4 Central Westlands Sub-Area
5 Southern Westlands Sub-Area

Bibliography / References
Westside Drainage Plan

- Central Valley Basin, A Compressive Department Report on the Development of the Water and Related Resources of the Central Valley Basin, and Comments from the State of California and Federal Agencies – U. S. Department of the Interior Bureau of Reclamation – August 1949

- San Luis Unit – Central Valley Project – California – Special Report on Drainage and Water Service Draft Supplement to Final Environmental Statement – USBR – September 1984

- Central Valley Project Water Development – Raymond W. Gaines - 1986

- Detailed Options Descriptions – San Luis Unit Drainage Program, U.S. Department of the Interior, Bureau of Reclamation Mid-Pacific Region – Prepared by Davids Engineering – August 17, 1990

- Plan Formulation Appendix – San Luis Unit Drainage Program – Prepared for U.S. Department of the Interior, Bureau of Reclamation Mid-Pacific Region – Prepared by CH2MHILL Sacramento, California in association with U.S. Department of the Interior, Bureau of Reclamation Denver office – December 1991

- Westlands Sub-area Report – Prepared for the San Joaquin Valley Drainage Implementation Program – Westlands Water District – October 1998

- Task 1 – Drainage Reuse – Final Report February 1999 – Drainage Reuse Technical Committee – The San Joaquin Valley Drainage Implementation Program and The University of California Salinity/Drainage Program

- Task 3 – Land Retirement – Final Report February 1999 – Land Retirement Technical Committee – The San Joaquin Valley Drainage Implementation Program and The University of California Salinity/Drainage Program

- Task 5 – Source Reduction – Final Report February 1999 – Source Reduction Technical Committee – The San Joaquin Valley Drainage Implementation Program and The University of California Salinity/Drainage Program

- Task 6 – Groundwater Management – Final Report – April 1999 – Groundwater Management Technical Committee – The San Joaquin Valley Drainage Implementation Program and The University of California Salinity/Drainage Program

- Final Report – Evaluation of the 1990 Drainage Management Plan For the Westside San Joaquin Valley, California – Submitted to the Management Group of the San Joaquin Valley Drainage Implementation Program – January 2000 – Prepared by SJVDIP and The University of California Ad Hoc Coordination Committee

- The San Joaquin Valley Implementation Program reports can be found at the following web site: http://wwwdpla.water.ca.gov/agriculture/drainage/implementation/hq/sjvlib.htm

- Grassland Bypass Project, Final EIS/EIR, prepared by URS for the USBR and San Luis & Delta Mendota Water Authority, May 25, 2001

- The Rainbow Report - A Management Plan for Agricultural Subsurface Drainage And Related Problems on the Westside San Joaquin Valley, September, 1990

- San Luis Drainage Feature Re-Evaluation Plan Formulation Report. Prepared by the U. S. Department of the Interior Bureau of Reclamation, Sacramento California, December 2002

DRAINAGE SERVICE AREA

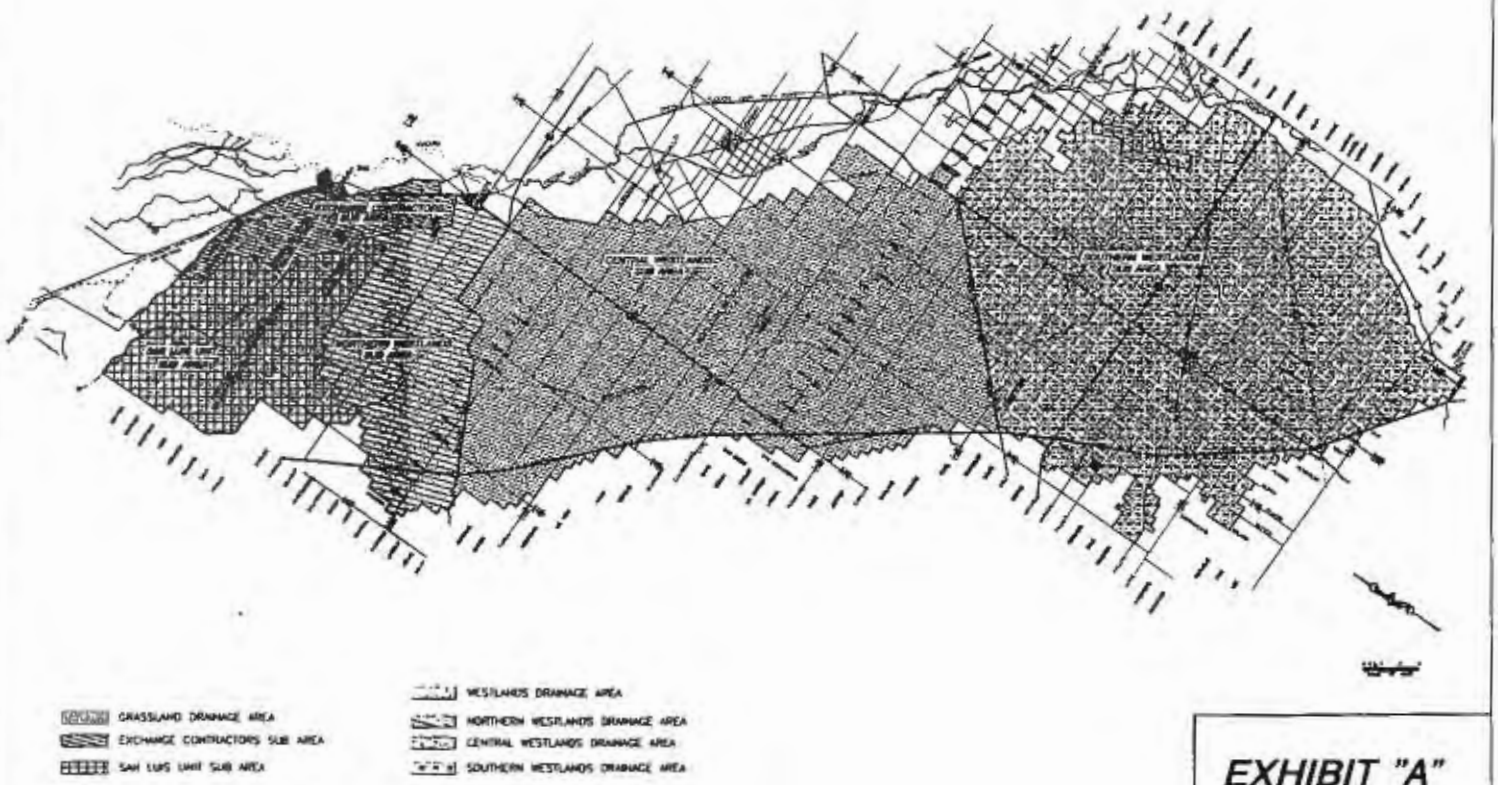
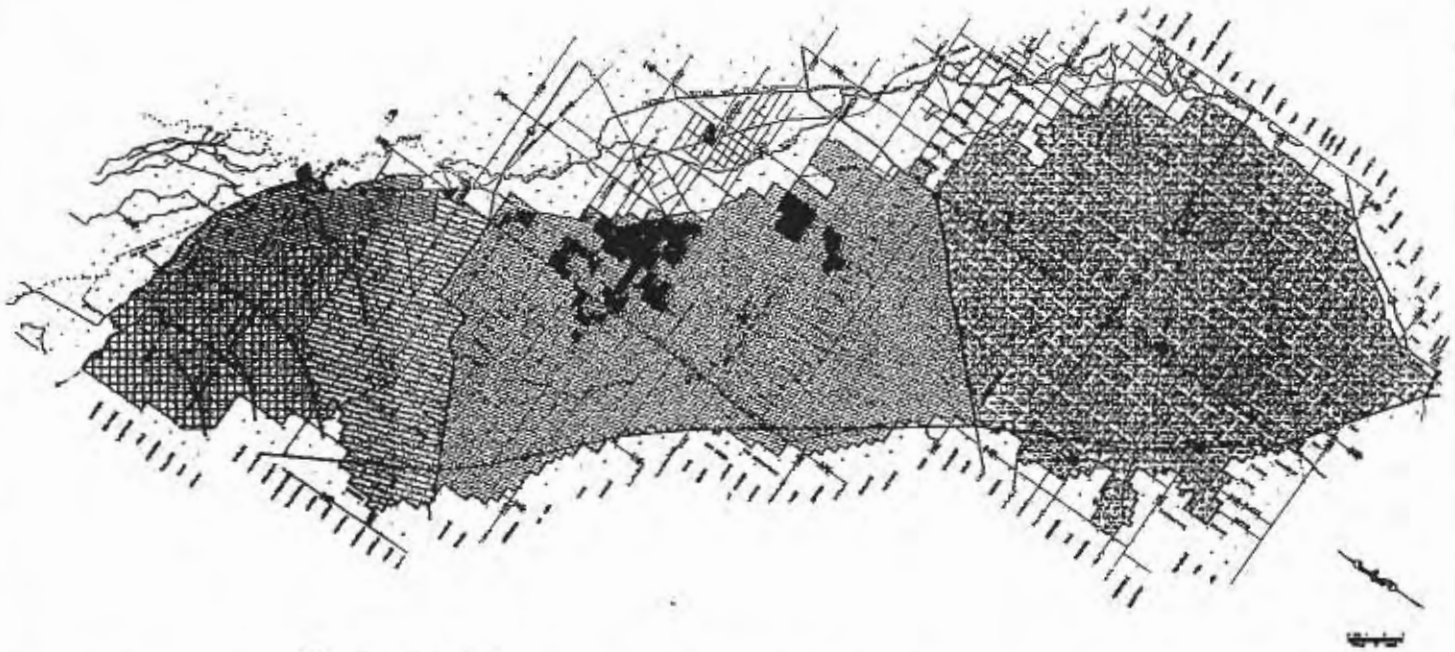


EXHIBIT "A"

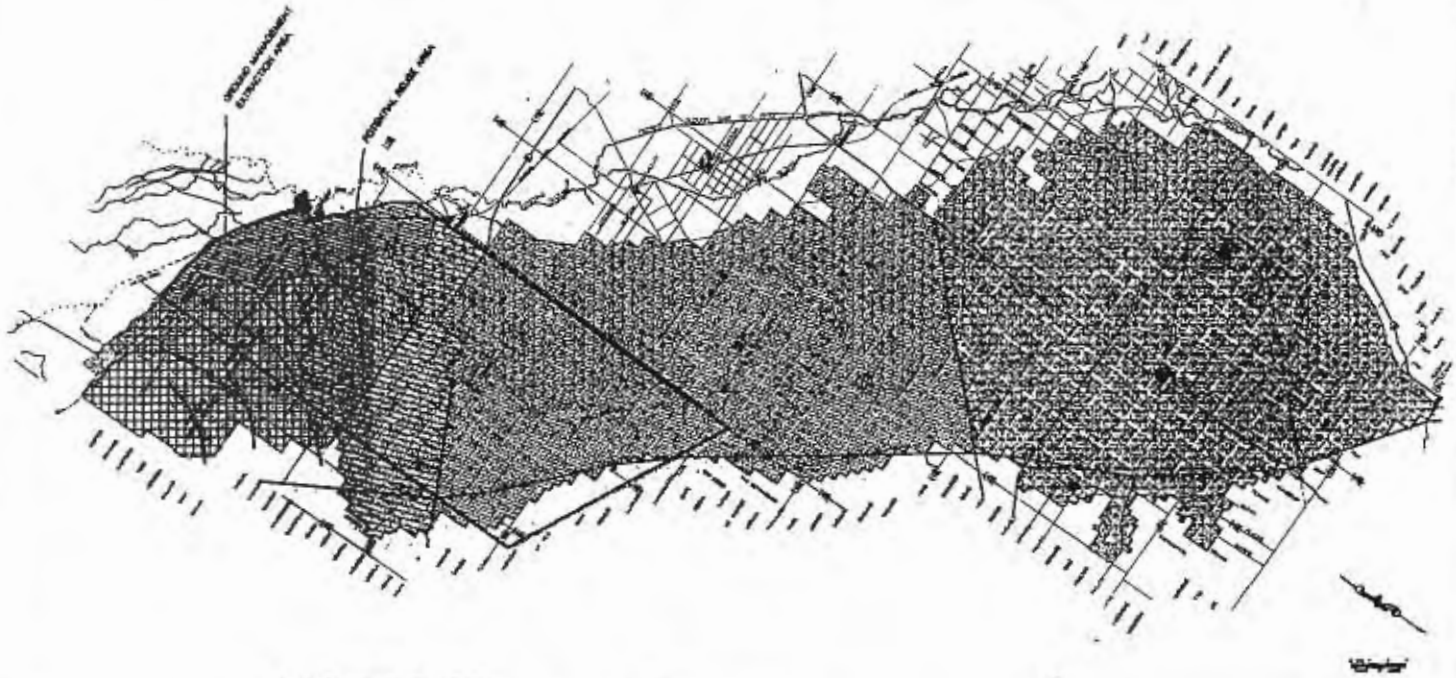
LOCATION OF CURRENT DRAINAGE MANAGEMENT ACTIVITIES



GRASSLAND DRAINAGE AREA
EXCHANGE CONTRACTORS SUB AREA
SAN LUIS UNIT SUB AREA
WESTLANDS DRAINAGE AREA
NORTHERN WESTLANDS DRAINAGE AREA
CENTRAL WESTLANDS DRAINAGE AREA
SOUTHERN WESTLANDS DRAINAGE AREA
GROUNDWATER MANAGEMENT PILOT WELLS
RECENTLY RETIRED LANDS
EXISTING SAN JOAQUIN RIVER WATER QUALITY IMPROVEMENT PROJECT
RECENTLY INSTALLED MULTI-COMPLETION MONITORING WELLS

EXHIBIT "B"

DRAINAGE MANAGEMENT PLAN (PHASE I)



GRASSLAND DRAINAGE AREA
EXCHANGE CONTRACTORS SUB AREA
SAN LUIS UNIT SUB AREA
WESTLANDS DRAINAGE AREA
NORTHERN WESTLANDS DRAINAGE AREA
CENTRAL WESTLANDS DRAINAGE AREA
SOUTHERN WESTLANDS DRAINAGE AREA
EXPANDED REUSE AREA
GROUND MANAGEMENT EXTRACTION AREA
POTENTIAL REUSE AREA

EXHIBIT "C"

C:\ACADV\OSCAR\MAPS\DRAINAGE\DRAINAGE MANAGEMENT PLAN (PHASE I) 8-9 Model, 05/13/2 1:10:56 AM

SAN LUIS WATER DISTRICT

WATER MANAGEMENT PLAN (2011)

APPENDIX M

WATER QUALITY MONITORING PLAN FOR DELTA MENDOTA CANAL

RECLAMATION

Managing Water in the West

2012 Delta-Mendota Canal Pump-in Program Water Quality Monitoring Plan

U.S. Department of the Interior
Bureau of Reclamation
Mid-Pacific Region
South-Central California Area Office

Revised: 06 Feb 2012

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

List of Abbreviations and Acronyms

Authority	San Luis and Delta-Mendota Water Authority
ºC	degrees Celsius
DMC	Delta-Mendota Canal
DMC Headworks	DMC Milepost 2.5, Jones Pumping Plant
DMC Check 13	DMC Milepost 70, O'Neill Forebay
DMC Check 20	DMC Milepost 111, near Firebaugh
DMC Check 21	DMC Milepost 116, terminus at Mendota Pool
COC	chain of custody
CVP	Central Valley Project
DFG	California Department of Fish and Game
EC	electrical conductivity, µS/cm
Exchange Contractors	San Joaquin River Exchange Contractors Water Authority
ºF	degrees Fahrenheit
mg/L	milligrams per liter, equivalent to parts per million
QA	Quality Assurance
QC	Quality Control
QCO	Quality Control Officer
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
Regional Board	California EPA, Central Valley Regional Water Quality Board
TDS	Total dissolved solids, mg/L
USGS	U.S. Geological Survey
µg/L	micrograms per liter, equivalent to parts per billion
µS/cm	microSiemens per cm, salinity in water

2012 Delta-Mendota Canal Pump-in Program Water Quality Monitoring Plan

Introduction

The overall supply of Central Valley Project (CVP) water has been reduced by drought and restrictions on pumping from the Sacramento-San Joaquin Delta. Under the Warren Act of 1911, Reclamation may execute temporary contracts to convey non-project water in excess capacity in federal irrigation canals. In 2012, Reclamation proposes to execute temporary contracts with water districts to convey groundwater in the Delta-Mendota Canal (DMC) subject to the monitoring and reporting requirements outlined in this document.

Estimated 2012 Warren Act Contract Quantities

District	Acre-feet
Banta Carbona ID	5,000
Del Puerto WD	10,000
West Stanislaus ID	3,000
San Luis WD	10,000
Panoche WD	10,000
Pacheco WD	6,000
Mercy Springs WD	6,000
Total	50,000

This document describes the plan for measuring the changes in the quality of water in the DMC caused by the conveyance of groundwater during 2012, plus changes in groundwater elevation to estimate subsidence. Various agencies will use these data to determine the water quality conditions in the DMC, Mendota Pool, and wetlands water supply channels, and physical condition of local groundwater resources.

This document has been prepared by the U.S. Department of the Interior, Bureau of Reclamation (Reclamation), in cooperation with the San Luis & Delta-Mendota Water Authority (Authority), and the San Joaquin River Exchange Contractors Water Authority (Exchange Contractors), with assistance from staff of Banta Carbona Irrigation District, Del Puerto Water District, San Luis Water District, and Panoche Water District.
This monitoring plan will be conducted by staff of Reclamation, the Authority, and Water Districts and will complement independent monitoring by other Federal, State, and private agencies.

Several sampling techniques will be used to collect samples of water, including real-time, grab, and composite. The techniques used at each location are summarized in Section 3.

Continuous measurement of specific conductance (salinity) will be recorded at four stations in the canal using sondes connected to digital data loggers. The data will be averaged every 15 minutes, sent via satellite to the California Data Exchange Center where it will be posted in the Internet as preliminary data:

http://cdec.water.ca.gov/queryDaily.html

Central Valley Operations Office will post the daily average salinity measurements on its website:

http://www.usbr.gov/mp/cvo/wqrpt.html

The real-time data will be collected by Reclamation and used in a mass balance to calculate and predict water quality conditions along the DMC. The calculated results will be reported to various agencies, and compared with independent field measurements collected by the Reclamation, the Exchange Contractors, US Geological Survey, and California EPA Central Valley Regional Water Quality Control Board (Regional Board).

Based on available funding, Reclamation will operate autosamplers at four locations along the DMC and Mendota Pool that will collect daily composite samples for measurement of selenium and salinity.

Reclamation and the Regional Board will collect grab samples from various locations in the watershed to measure selenium and many other parameters.

Reclamation will use these data to assess changes in water quality and groundwater conditions caused by the 2012 DMC Pump-in Program, and will implement the terms and conditions of the 2012 Warren Act Contracts, exchange agreements, and the 2012 Letter from the Exchange Contractors to Reclamation (Appendix 1).

Background

The Delta Division of the federal Central Valley Project (CVP) delivers water to almost a million acres of farmland in the San Joaquin Valley of California. The CVP is also the sole source of clean water for state and federal wildlife refuges and many private wetlands in Fresno, Merced, San Joaquin, and Stanislaus Counties.

The source of water for the Division is delta of the Sacramento and San Joaquin Rivers. This water is suitable in quality for irrigation and wetlands. The region is regularly affected by droughts that reduce the supply of water. Environmental regulations also restrict the operation of the Jones Pumping Plant to divert water from the Delta. The salinity of water in the Delta is highly variable due to the influence of tides and outflow of river water.

The Delta-Mendota Canal (DMC) carries CVP water to farms, communities, and wetlands between Tracy and Mendota. The 116 mile canal is operated and maintained by the San Luis and Delta-Mendota Water Authority (Authority) under contract with

Reclamation. Inflows of tailwater and subsurface water add contaminants to the DMC. The conveyance of groundwater may further degrade the quality of water in the canal.

The districts and refuges in the Delta Division use groundwater to supplement their contractual supply from the CVP. Three Delta Division districts also have riparian rights to water in the San Joaquin River. These other supplies of groundwater and riparian water are called "Non-Project Water" because they have not been appropriated by the United States for the purposes of the CVP.

The Warren Act of 1911([1]) authorizes Reclamation to execute temporary contracts to impound, store, and carry water in federal irrigation canals when excess capacity is available. Such contracts will be negotiated by Reclamation with Delta Division water districts to allow the introduction of non-project water into the DMC to supplement the supply of CVP water to help farmers deliver enough water to irrigate and sustain valuable permanent crops like grapes, citrus, and deciduous fruit, and to sustain the local multi-billion dollar farming economy.

The quality of local groundwater is variable and must be measured to confirm that there will be no harm to downstream water users when the non-project water is pumped into the DMC. Reclamation has developed a set of standards for the acceptance of non-project water in the DMC based on the requirements of downstream water users.

In 2012, environmental regulations and climate change continue to reduce the supply of surface water for the Central Valley Project. Water managers now must depend on groundwater to supplement surface water for irrigation. However, continuous pumping of groundwater can quickly reduce local aquifers and can cause irreversible damage to facilities through subsidence.

Reclamation will require information about each source of groundwater and more monitoring of the aquifer to measure overdraft, prevent subsidence, and determine the feasibility of continuing this program in the future. Staff from the Authority and water districts will be required to take regular measurements of depth to groundwater, pump rates, and in-stream salinity measurements.

This Monitoring Plan will ensure that monitoring data will measure any changes in the quality of CVP water in the DMC and Mendota Pool, and assess impacts on local aquifers.

Monitoring Mission and Goals

The mission of this monitoring program is to produce physical measurements that will determine the changes in the quality of the water in canal caused by the conveyance of groundwater during 2012. The data will be used to implement the terms of the 2012 Warren Act Contracts and exchange agreements, and to ensure that the quality of CVP water is commensurate with the needs and expectations of water users.

[1] Act of February 21, 1911, ch. 141, 36 Stat. 925

The monitoring program will also deal with changes to groundwater resources to identify and prevent long-term problems to local aquifers and facilities.

Program Goals

The general goals of monitoring are:

- Evaluate the quality of water in each well, and

- Confirm that the blend of CVP water and groundwater is suitable for domestic, agricultural, and wetlands uses.

- Provide reliable data for regulation of the 2012 DMC Pump-in Program to prevent contamination problems

- Provide measurements of groundwater dynamics (depth, recharge) to identify overdraft and subsidence

Study Area

The Study Area for this program encompasses the Delta-Mendota Canal from Tracy to Mendota, and the Mendota Pool. The canal is divided into two reaches in relation to the O'Neill Forebay and the connection to the State Water Project.

Water Quality Standards

Non-project water must meet the standards listed in Tables 6 and 7. The lists have been developed by Reclamation to measure constituents of concern that would affect downstream water users. In particular, the concentration of selenium in any pump-in water shall not exceed 2 µg/L, the limit for the Grasslands wetlands water supply channels specified in the 1998 Basin Plan.[2] The salinity of each source of pump-in water shall not exceed 1500 mg/L TDS. The other constituents are mainly agricultural chemicals listed in the California Drinking Water Standards (Title 22)[3].

---

[2] California Regional Water Quality Control Board, Central Valley Region, Fourth Edition of the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins. http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/sacsjr.pdf

[3] California Code of regulations, Title 22. The Domestic Water Quality and Monitoring Regulations specified by the State of California Health and Safety Code (Sections 4010 4037), and Administrative Code (Sections 64401 et seq.), as amended. http://www.cdph.ca.gov/certlic/drinkingwater/Documents/Lawbook/dwregulations-06-24-2010.pdf

Water Quality Monitoring Plan

In-stream Monitoring

The quality of water in the DMC will be measured at the locations listed in Tables 1, 2, and 3.

Reclamation will operate and maintain the real-time stations listed in Table 1. Based on available funding, Reclamation will continue to collect water samples at the sites listed in Table 2 under the DMC Water Quality Monitoring Program. Reclamation will be responsible for the costs of sampling and analysis of water sampled from the DMC under this monitoring program.

Table 3 is a list of places along the canal near clusters of wells that could pump into the canal under this program. If the real-time monitoring is not sufficient to identify in-stream changes in quality caused by the addition of groundwater, Reclamation may require weekly measurements at the checks listed in Table 3 to determine local effects from groups of wells. For example, if the quantity of CVP water in the canal is limited, Reclamation will require detailed monitoring to identify the individual and cumulative changes in water quality caused by the addition of groundwater.

Table 1. Real-Time Monitoring Stations

Location	Operating Agency	Parameters	Frequency	Remarks
DMC Headworks Milepost 3.5	CVO	EC	Real-time	CDEC Site: DMC
DMC Check 13 Milepost 70	CVO	EC	Real-time	CDEC site : ONI
DMC Check 20 Milepost 111	CVO	EC	Real-time	CDEC site : DM2
DMC Check 21 Milepost 116.5	CVO	EC	Real-time	CDEC site : DM3

Key: CDEC: California Data Exchange Center CVO: Central Valley Operations Office

Table 2. Water Quality Monitoring Stations

Location	Operating Agency	Parameters	Frequency	Remarks
DMC Headworks Milepost 3.46	Reclamation	EC, selenium	Daily composite	Autosampler
DMC at McCabe Rd Milepost 68	Reclamation	Various	Monthly	Grab sample
DMC Check 13 Milepost 70	Reclamation	EC, selenium	Daily composite	Autosampler
DMC at Russell Ave Milepost 97.7	Reclamation	EC, selenium, boron, mercury	Monthly	Grab sample
DMC at Telles Farm Bridge Milepost 100	Reclamation	EC, selenium	Monthly	Grabs sampler
DMC at Washoe Ave Milepost 110.1	Reclamation	EC, selenium, boron, mercury	Monthly	Grab sample
DMC Check 21 Milepost 116.5	Reclamation	EC, selenium	Daily composite	Autosampler
CCID Main Canal at Bass Ave	Reclamation	EC, selenium	Daily composite	Autosampler

Key: Reclamation: MP-157 Environmental Monitoring Branch

Note: Frequency may be reduced at Headworks and Check 13 in 2012.

Table 3. In-Stream Monitoring Stations (Optional)

Location	Responsible Agency	Parameters	Frequency	Remarks
DMC Check 2 Milepost 16.2	SLDMWA	EC	Weekly	Field measurement
DMC Check 3 Milepost 20.6	SLDMWA	EC	Weekly	Field measurement
DMC Check 6 Milepost 34.4	SLDMWA	EC	Weekly	Field measurement
DMC Check 7 Milepost 38.7	SLDMWA	EC	Weekly	Field measurement
DMC Check 9 Milepost 48.6	SLDMWA	EC	Weekly	Field measurement
DMC Check 12 Milepost 64.0	SLDMWA	EC	Weekly	Field measurement
DMC Check 16 Milepost 85.1	SLDMWA	EC	Weekly	Field measurement
DMC at Telles Bridge Milepost 100.9	SLDMWA	EC	Weekly	Field measurement

Key: SLDMWA: San Luis and Delta-Mendota Water Authority

Wellhead Monitoring

Initial Analysis

All districts participating in the 2012 DMC Pump-in Program must provide the following information about each well to Reclamation prior to pumping groundwater into the DMC:

- the location of each well, pumping rate, and point of discharge into the DMC;
- complete water quality analyses (Table 5 or 6)[4]
- the depth to groundwater in every well before pumping into the DMC commences.

Though most of the wells are privately owned, the Districts must provide access to each well for Reclamation and Authority staff.

All water samples must be sampled and preserved according to established protocols in correct containers. Analyses should be conducted by laboratories that have been approved by Reclamation, listed in Table 7. Each sample of well water must be sampled and analyzed at the expense of the well owner. Reclamation staff will review the analytical results and notify the District which wells may pump into the DMC in 2012.

Compliance Monitoring

Daily Salinity

Mean daily salinity of water in the DMC will be assessed with the sensors along the canal that report real-time data to CDEC, listed in Table 1. Reclamation and the Authority will monitor daily changes in salinity along the canal.

Weekly Monitoring

Reclamation may require weekly measurements of salinity along the DMC if the real-time sensors are not sufficient to identify changes. If necessary, Reclamation will direct the Authority to measure the EC of water in the canal at the places listed in Table 3. These sites are located downstream from clusters of wells that could pump into the DMC. In addition, Reclamation may also direct Authority staff to measure the EC of the water in each active well

The weekly volume of groundwater pumped into the DMC from each well will be measured by the Authority and sent to Reclamation at the end of each week.

Selenium Monitoring

Reclamation will continue to measure selenium in the canal and Mendota Pool with autosamplers listed in Table 2. Reclamation may collect random samples of water from

[4] Note: Laboratory analyses of water in each well may be measured within three years

various active wells; the cost of these selenium tests will be borne by Reclamation. Based on available funds, Reclamation may also measure boron in the canal and wells.

Depth to Groundwater

The Authority will to measure the depth to groundwater in each active well quarterly. Table 8 is a summary of measurements collected by the Authority since May 1995. The current depth to groundwater in each well will be compared to the depths listed in Table 8. If the current depth exceeds the maximum depth observed in Table 8, then Reclamation will advise the District to stop pumping from that well until the depth of water in the well recovers to an agreed depth, such as the median observed depth.

Data Compilation and Review

All compliance monitoring data collected by the Authority (i.e., flow/ EC/depth of groundwater in each active well, flow/EC in the DMC) will be entered into worksheets and presented each week to Reclamation via e-mail. Reclamation will review the data to identify changes in the quality of water in the canal and in individual wells, and potential changes in the local aquifer that could lead to overdraft or subsidence.

Water Quality Monitoring Parameters and Data Management

The following sections describe the parameters for real-time and laboratory measurement of water quality, as well as methods for quality control, data management, and data reporting.

Real-Time Water Quality Monitoring Parameter

Reclamation and the Central Valley Operations Office have sensors along the DMC that measure salinity and temperature of water. These continuous measurements are posted on the Internet in real-time.

Salinity

Salinity is a measure of dissolved solids in water. It is the sum weight of many different elements within a given volume of water, reported in milligrams per liter (mg/L) or parts per million (ppm). Salinity is an ecological factor of considerable importance, influencing the types of organisms that live in a body of water. Also, salinity influences the kinds of plants and fish that will grow in a water body. Salinity can be estimated by measuring the electrical conductivity (EC) of the water.

Central Valley Operations Office (CVO) uses this conversion factor for estimating Total Dissolved Solids (TDS) from EC:

$$\text{TDS (mg/L)} = \text{EC } (\mu\text{S/cm}) * 0.618 + 16$$

Sampling For Laboratory Analyses of Water Quality

The following sections describe constituents for laboratory analyses of water quality, as well as methods for water quality sampling and chain of custody documentation.

Constituents

Table 5 and 6 are lists of constituents to be measured at in each well that will pump into the DMC during 2012. Parameters include selenium, mercury, boron, nutrients, and other compounds that cannot be measured with field sensors. Table 7 is a list of laboratories whose sampling and analytical practices have been approved by Reclamation.

Sampling methods

Grab samples will be collected in a bucket or bottle from the point of discharge into the canal. Samples of canal water should be collected mid-stream from a bridge or check structure. Grab samples should be poured directly into sample bottles appropriate to the analyses. This technique is for samples collected weekly or less frequently. The analytical laboratory will specify the sample volume, type of bottle, need for preservative, and special handling requirements. Reclamation may train field staff on proper sample collection and handling.

Time composite samples will be collected from the DMC by Reclamation using an autosampler. Daily composite samples will consist of up to eight subsamples taken per day and mixed into one sample. Weekly composite samples will consist of seven daily subsamples mixed into one sample.

Chain of Custody documentation

Chain of custody (COC) forms will be used to document sample collection, shipping, storage, preservation, and analysis. All individuals transferring and receiving samples will sign, date, and record the time on the COC that the samples are transferred.

Laboratory COC procedures are described in each laboratory's Quality Assurance Program Manual. Laboratories must receive the COC documentation submitted with each batch of samples and sign, date, and record the time the samples are transferred. Laboratories will also note any sample discrepancies (e.g., labeling, breakage). After generating the laboratory data report for the client, samples will be stored for a minimum of 30 days in a secured area prior to disposal.

Chain of Custody documentation

Chain of custody (COC) forms will be used to document sample collection, shipping, Quality control (QC) is the overall system of technical activities that measure the attributes and performance of a process, item, or service against defined standards to verify that stated requirements are met.

Quality assurance (QA) is an integrated system of management activities involving, planning, implementation, documentation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the customer.

QA objectives will be used to validate the data for this project. The data will be accepted, rejected, or qualified based on how sample results compare to established acceptance criteria.

The precision, accuracy, and contamination criteria will be used by the QCO to validate the data for this project. The criteria will be applied to the blind external duplicate/split, blank, reference, or spiked samples submitted with the production samples to the analytical laboratories by the participating agencies to provide an independent assessment of precision, accuracy, and contamination.

Laboratories analyze their own QC samples with the client's samples. Laboratory QC samples, including laboratory fortified blanks, matrix spikes, duplicates, and method blanks, assess precision, accuracy, and contamination. Laboratory QC criteria are stated in the analytical methods or determined by each laboratory. Since internal control ranges are often updated in laboratories based on instrumentation, personnel, or other influences, it is the responsibility of the QCO to verify that these limits are well documented and appropriately updated during system audits. The preferred method of reporting the QC results is for the laboratory to provide a QC summary report with acceptance criteria for each QC parameter of interest.

For water samples, the QCO will use a statistical program to determine if current concentrations for parameters at given sites are consistent with the historical data at these sites. A result is determined to be a historical outlier if it is greater than 3 standard deviations from the average value for the site. The presence of an outlier could indicate an error in the analytical process or a significant change in the environment.

Samples must be prepared, extracted, and analyzed within the recommended holding time for the parameter. Data may be qualified if the sample was analyzed after the holding time expires.

Completeness refers to the percentage of project data that must be successfully collected, validated, and reported to proceed with its intended use in making decisions.

Constraints with regard to time, money, safety, and personnel were some of the factors in choosing the most representative sites for this project. Monitoring sites have been selected by considering the physical, chemical, and biological boundaries that define the system under study.

Sites also were selected to be as representative of the system as possible. However, Reclamation will continue to evaluate the choice of the sites with respect to their representativeness and will make appropriate recommendations to the Contracting Officer given a belief or finding of inadequacy.

Comparability between each agency's data is enhanced through the use of Standard Operating Procedures that detail methods of collection and analysis. Each agency has chosen the best available protocol for the sampling and analyses for which it is responsible based on the agency's own expertise. Audits performed by the QCO will

reinforce the methods and practices currently in place and serve to standardize techniques used by the agencies.

Chain of Custody documentation

Chain of custody (COC) forms will be used to document sample collection, shipping, Real-Time Data – Raw data from field sensors, must be identified as preliminary, subject to change

Provisional Data - Data that have been reviewed by the collecting agency but may be changed pending re-analyses or statistical review

Laboratory Data – Data produced by the laboratory following laboratory QA/QC protocols

Chain of Custody documentation

Chain of custody (COC) forms will be used to document sample collection, shipping, In-stream data will be collected by Reclamation. Routine measurements of flow, EC, and depth of groundwater in each well will be collected by the Authority and sent to Reclamation each week.

Reclamation will compile these data in a water balance model developed by Reclamation, the Authority, and Exchange Contractors to predict the change in salinity in the canal with the addition of groundwater.

Real-time data will be used to monitor day-to-day patterns and assess actual conditions. The real-time data will be posted in regular e-mail messages to the districts and Authority. Reclamation will compile all flow, water quality, and groundwater data into a final report for future reference.

Chain of Custody documentation

Chain of custody (COC) forms will be used to document sample collection, shipping, and handling.

Water Quality Requirements

Each week, Reclamation staff will use the real-time salinity measurements (Table 1) and optional weekly in-stream measurements (Table 3) to monitor and determine the changes in salinity in the DMC, and determine if the groundwater pump-ins have caused these changes. Reclamation staff will compile other water quality data collected for this program and by others do evaluate changes in the canal.

Reclamation and the Authority will allow groundwater to be pumped into the DMC if such water does not cause the concentration of important constituents in the canal to exceed certain thresholds listed in Tables 4a and 4b. The 2012 Exchange Contractors letter will have further conditions for the lower portion of the canal.

Table 4a. Maximum Allowable Concentration of Seven Constituents in the Upper DMC (between Jones Pumping Plant and Check 13)

Constituent	Monitoring Location	Maximum concentration in the DMC
Arsenic	McCabe Road	10 µg/L
Boron	McCabe Road	0.7 mg/L
Nitrates as N	McCabe Road	45 mg/L
Selenium	Check 13	2 µg/L
Specific conductance (EC)	Check 13	1,200 µS/cm
Sulfates	McCabe Road	250 mg/L
Total Dissolved Solids*	Check 13	800 mg/L

*Calculation: TDS (mg/L) = EC (µS/cm) x 0.618 + 16

Reclamation will direct the Districts to stop pumping groundwater into the upper DMC if the concentration of any of these constituents in the canal exceed the maximum allowable concentrations listed in Table 4a.

Table 4b. Maximum Allowable Concentration of Three Constituents in the Lower DMC

Constituent	Monitoring Location	Maximum concentration in the DMC
Selenium	Check 21	2 µg/L
Daily Change in TDS	Checks 13 – 20	Less than 30 mg/L
Total Dissolved Solids*	Check 20	450 mg/L

Reclamation will direct the Districts to stop pumping groundwater into the lower DMC if any of the parameters listed in Table 4b are exceeded.

Reclamation will continue to monitor the effects of the six sumps near Firebaugh that pump subsurface groundwater into the canal. Note: the sumps are located downstream of the proposed wells listed in Table 8.

Reclamation reserves the right to modify this monitoring program at any time to change.

Revised: 06 Feb 2012 SCC-107

Table 5. Water Quality Standards for Acceptance of Groundwater into the Upper Delta-Mendota Canal Jones Pumping Plant to Check 13 (O'Neill Forebay)

Constituent	Units	Maximum Contaminant Level		Detection Limit for Reporting		CAS Registry Number	Recommended Analytical Method
Primary							
Aluminum	mg/L	1	(1)	0.05	(2)	7429-90-5	EPA 200.7
Antimony	mg/L	0.006	(1)	0.006	(2)	7440-36-0	EPA 200.8
Arsenic	mg/L	0.01	(1)	0.002	(2)	7440-38-2	EPA 200.8
Barium	mg/L	1	(1)	0.1	(2)	7440-39-3	EPA 200.7
Beryllium	mg/L	0.004	(1)	0.001	(2)	7440-41-7	EPA 200.7
Boron	mg/L	0.7	(16)			7440-42-8	EPA 200.7
Cadmium	mg/L	0.005	(1)	0.001	(2)	7440-43-9	EPA 200.7
Chromium	mg/L	0.05	(1)	0.01	(2)	7440-47-3	EPA 200.7
Lead	mg/L	0.015	(9)	0.005	(8)	7439-92-1	EPA 200.8
Mercury	mg/L	0.002	(1)	0.001	(2)	7439-97-6	EPA 245.1
Nickel	mg/L	0.1	(1)	0.01	(2)	7440-02-0	EPA 200.7
Nitrate (as NO3)	mg/L	45	(1)	2	(2)	7727-37-9	EPA 300.1
Nitrate + Nitrite (sum as nitrogen)	mg/L	10	(1)				EPA 353.2
Nitrite (as nitrogen)	mg/L	1	(1)	0.4	(2)	14797-65-0	EPA 300.1
Selenium	mg/L	0.002	(13)			7782-49-2	EPA 200.8
Thallium	mg/L	0.002	(1)	0.001	(2)	7440-28-0	EPA 200.8
Secondary							
Chloride	mg/L	250	(7)			16887-00-6	EPA 300.1
Copper	mg/L	1	(10)	0.05	(8)	7440-50-8	EPA 200.7
Iron	mg/L	0.3	(6)			7439-89-6	EPA 200.7
Manganese	mg/L	0.05	(6)			7439-96-5	EPA 200.7
Molybdenum	mg/L	0.01	(11)			7439-98-7	EPA 200.7
Silver	mg/L	0.1	(6)			7440-22-4	EPA 200.7
Sodium	mg/L	69	(15)			7440-23-5	EPA 200.7
Specific Conductance	µS/cm	2,200	(7)				SM 2510 B
Sulfate	mg/L	250	(7)			14808-79-8	EPA 300.1
Total Dissolved Solids	mg/L	1,500	(7)				SM 2540 C
Zinc	mg/L	5	(6)			7440-66-6	EPA 200.7
Radioactivity							
Gross Alpha	pCi/L	15	(3)	3	(3)		SM 7110C
Organic Chemicals							
Atrazine	µg/L	1	(4)	0.5	(5)	1912-24-9	EPA 508.1
Bentazon	µg/L	18	(4)	2	(5)	25057-89-0	EPA 515
Carbofuran	µg/L	18	(4)	5	(5)	1563-66-2	EPA 531.1-2
Chlordane	µg/L	0.1	(4)	0.1	(5)	57-74-9	EPA 505
Chlorpyrifos	µg/L	0.025	(14)			2921-88-2	EPA 8141
2,4-D	µg/L	70	(4)	10	(5)	94-75-7	EPA 515.1-4
Diazinon	µg/L	0.16	(14)			333-41-5	EPA 507
Dibromochloropane (DBCP)	µg/L	0.2	(4)	0.01	(5)	96-12-8	EPA 504.1
Endrin	µg/L	2	(4)	0.1	(5)	72-20-8	EPA 505
Ethylene Dibromide (EDB)	µg/L	0.05	(4)	0.02	(5)	206-93-4	EPA 504.1
Glyphosate	µg/L	700	(4)	25	(5)	1071-83-6	EPA 547
Heptachlor	µg/L	0.01	(4)	0.01	(5)	76-44-8	EPA 505
Heptachlor Epoxide	µg/L	0.01	(4)	0.01	(5)	1024-57-3	EPA 505
Lindane	µg/L	0.2	(4)	0.2	(5)	58-89-9	EPA 505
Methoxychlor	µg/L	30	(4)	10	(5)	72-43-5	EPA 505
Molinate	µg/L	20	(4)	2	(5)	2212-67-1	EPA 525.2
2, 4, 5-TP (Silvex)	µg/L	50	(4)	1	(5)	93-72-1	EPA 515.1-4
Simazine	µg/L	4	(4)	1	(5)	122-34-9	EPA 508.1
Thiobencarb	µg/L	70	(4)	1	(5)	28249-77-6	EPA 525.2
Toxaphene	µg/L	3	(4)	1	(5)	8001-35-2	EPA 505

Table 5. Water Quality Standards for Acceptance of Groundwater into the Upper Delta-Mendota Canal Jones Pumping Plant to Check 13 (O'Neill Forebay)

Sources:

Title 22. The Domestic Water Quality and Monitoring Regulations specified by the State of California Health and Safety Code (Sections 4010-4037), and Administrative Code (Sections 64401 et seq.), as amended.

(1) Title 22. Table 64431-A (mg/L)
(2) Title 22. Table 64432-A (mg/L)
(3) Title 22. Table 64442 (pCi/L)
(4) Title 22. Table 64444-A (mg/L)
(5) Title 22. Table 64445.1-A (mg/L)
(6) Title 22. Table 64449-A (mg/L)
(7) Title 22. Table 64449-B (mg/L)
(8) Title 22. Table 64678-A (mg/L)
(9) Title 22. Section 64678 (d)
(10) Title 22. Section 64678 (e)

California Drinking Water Regulations Sep 2011

http://www.cdph.ca.gov/certlic/drinkingwater/Documents/Lawbook/dwregulations-2011-09-22.pdf

California Regional Water Quality Control Board, Central Valley Region, Fourth Edition of the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins.

(13) Basin Plan, Table III-1 (ug/L) (selenium in Grasslands water supply channels)

(14) Basin Plan, Table III-2A (ug/L) (chlorpyrifos & diazinon in San Joaquin River from Mendota to Vernalis)

Sacramento & San Joaquin River Basin Plan 2009

http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/sacsjr.pdf

Ayers, R. S. and D. W. Westcot, *Water Quality for Agriculture* , Food and Agriculture Organization of the United Nations - Irrigation and Drainage Paper No. 29, Rev. 1, Rome (1985).

(15) Ayers, Table 1 (mg/L) (sodium)

(16) Ayers, Table 21 (mg/L) (boron)

Water Quality Standards for Agriculture 1985

http://www.fao.org/DOCREP/003/T0234E/T0234E00.HTM

revised: 10 Jan 2012 SCC-107

Table 6. Water Quality Standards for Acceptance of Groundwater into the lower Delta-Mendota Canal Check 13 (O'Neill Forebay) To Check 21 (Mendota Pool)

Constituent	Units	Maximum Contaminant Level		CAS Registry Number	Recommended Analytical Method
Bicarbonate	mg/L	61	(5)	71-52-3	SM 2320 A
Boron	mg/L	0.7	(3)	7440-42-8	EPA 200.7
Calcium	mg/L	80	(5)	7440-70-2	EPA 200.5
Chloride	mg/L	40	(5)	189689-94-9	EPA 300.1
Chlorpyrifos	µg/L	0.025	(2)	2921-88-2	EPA 8141
Chromium, total	µg/L	50	(1)	7440-47-3	EPA 200.7
Diazinon	µg/L	0.16	(2)	333-41-5	EPA 507
Hardness	mg/L				calculated
Magnesium	mg/L	16	(5)	7439-95-4	EPA 200.5
Mercury	µg/L	2	(1)	7439-97-6	EPA 245.1
Molybdenum	µg/L	10	(3)	7439-98-7	EPA 200.7
Nickel	µg/L	100	(1)	7440-02-0	EPA 200.7
Nitrate (as NO3)	mg/L	45	(1)	7727-37-9	EPA 300.1
Nitrite (as nitrogen)	mg/L	1	(1)	14797-65-0	EPA 300.1
pH	units	5.0 - 7.0	(5)		EPA 150.1
Potassium	mg/L	4.5	(5)	7440-09-7	EPA 200.5
SAR		<2	(5)		calculated
Selenium	µg/L	2	(2)	7782-49-2	EPA 200.8
Sodium	mg/L	69	(3)	7440-23-5	EPA 200.7
Specific Conductance	µS/cm	1,230	(4)		SM 2510 B
Sulfate	mg/L	250	(1)	14808-79-8	EPA 300.1
Total Dissolved Solids	mg/L	800	(4)		SM 2540 C

(1) Title 22. The Domestic Water Quality and Monitoring Regulations specified by the State of California Health and Safety Code (Sections 4010-4037), and Administrative Code (Sections 64401 et seq.), as amended.

(2) California Regional Water Quality Control Board, Central Valley Region, Fourth Edition of the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins. Table III-2A

(3) Ayers, R. S. and D. W. Westcot,*Water Quality for Agriculture* , Food and Agriculture Organization of the United Nations - Irrigation and Drainage Paper No. 29, Rev. 1, Rome (1985).

(4) Second Amended Contract for Exchange of Waters, No I1r-1144, Article 9. Quality of Substitute Water.

(5) Spectrum Analytic, Inc. Guide to Interpreting Irrigation Water Analysis. Washington C.H., Ohio
http://www.spectrumanalytic.com/support/library/rf/A_Guide_to_Interpreting_Irrigation_Water_Analysis.htm

revised 11/23/2009 SCC-107

RECLAMATION
Managing Water in the West

Table 7. Approved Laboratory List for the Mid-Pacific Region Environmental Monitoring Branch

APPL Laboratory	**Address**	908 North Temperance Avenue, Clovis, CA 93611
	Contact	Diane Anderson (Project Manager) or Cynthia Clark
	P/F	(559) 275-2175 / (559) 275-4422
	Email	danderson@applinc.com; cclark@applinc.com
	Methods	*Approved for inorganic and organic parameters in water and soil*
Basic Laboratory	**Address**	2218 Railroad Avenue Redding, CA 96001 USA
	Contact	Nathan Hawley, Melissa Hawley, Ricky Jensen
	P/F	(530) 243-7234 / (530) 243-7494
	Email	nhawley@basiclab.com (QAO), mhawley@basiclab.com (PM), sthomas@basiclab.com (quotes)
		poilar@basiclab.com (sample custody), khawley@basiclab.com (sample custody)
	CC Info	nhawley@basiclab.com, Jennifer Rawson (ext. 203 - invoices)
		Reanalysis requests need to always be addressed to Melissa Hawley and CC'd to Nathan Hawley
		Quotes address to Sabrina Thomas and cc Nathan Hawley
	Methods	*Approved for inorganic/organic parameters*
Block Environmental Services	**Address**	2451 Estand Way Pleasant Hill, CA 94523 USA
	Contact	David Block
	P/F	(925) 682-7200 / (925) 686-0399; (925) 382-9760 Cell
	Email	dblock@blockenviron.com
	Methods	*Approved for Toxicity Testing*
California Laboratory Services	**Address**	3249 Fitzgerald Road Rancho Cordova, CA 95742
	Contact	Scott Pieters
	P/F	(916) 638-7301 / (916) 638-4510
	Email	scottp@californialab.com (p.m.), janetm@californialab.com (QA)
	Methods	*Approved for inorganic, organic, and microbiological parameters.*
Caltest Analytical Laboratory	**Address**	1885 N. Kelly Rd. Napa, CA 94558
	Contact	Mike Hamilton
	P/F	(707) 258-4000/(707) 226-1001
	Email	Mike_Hamilton@caltestlabs.com; info@caltestlabs.com
	Methods	*Approved for inorganic parameters*
Dept. of Fish & Game - WPCL	**Address**	2005 Nimbus Road Rancho Cordova, CA 95670 USA
	Contact	David B. Crane - Laboratory Director Patty Bucknell - Inorganic Chemist
		Gail Chow - QA Manager + re-analysis requests (916) 358-2840
	P/F	(916) 358-2858 / (916) 985-4301, Sample Receiving: (916) 358-0319 Scott or Mary
	Email	dcrane@ospr.dfg.ca.gov; pbucknell@ospr.dfg.ca.gov; gcho@ospr.dfg.ca.gov
	Methods	*Approved only for metals analysis in tissue, organics pending*
Fruit Growers Laboratory	**Address**	853 Corporation Street Santa Paula, CA 93060 USA
	Contact	David Terz, QA Director
	P/F	(805) 392-2024 / (805) 525-4172
	Email	davidt@fglinc.com
	Methods	*Approved for all inorganic and organic parameters in drinking water and general physical analysis in soils.*

Table 7. Approved Laboratory List for the Mid-Pacific Region Environmental Monitoring Branch

Montgomery Watson/Harza Laboratories	**Address**	750 Royal Oaks Drive Ste. 100 Monrovia, CA 91016 USA
	Contact	Bradley Cahoon and Rita Reeves (Project Managers - Sacramento), Linda Geddes* (Project Manager - Monrovia) *Work with Linda after samples arrive at laboratory
	P/F	(916) 418-8358, (626) 386-1100, Linda - (626) 386-1163, Rita cell 916-996-5929
	Email	Bradley.Cahoon@us.mwhglobal.com, linda.geddes@mwhglobal.com
	CC Info	cc. Rita on all communications to Bradley.
	Methods	*Approved for all inorganic, organic, and radiochemistry parameters in drinking water*
Moore Twining Laboratories, Inc.	**Address**	2527 Fresno Street Fresno, CA 93721 USA
	Contact	Julio Morales (PM), Maria Manuel (QA Officer), Sample Control (Bottle Orders), Juli Adams (Lab Director); Lisa Montijo (Assistant PM)
	P/F	(559) 268-7021 / (559) 268-0740
	Email	juliom@mooretwining.com; mariam@mooretwining.com; julia@mooretwining.com; lisam@mooretwining.com
	Methods	*Approved for COD by SM5220D and general chemistry including boron analysis (not TOC)*
Olson Biochemistry Laboratories	**Address**	SDSU: Box 2170, ACS Rm. 133 Brookings, SD 57007 USA
	Contact	Nancy Thiex, Laboratory Director
	P/F	(605) 688-5466 / (605) 688-6295
	Email	Nancy.Thiex@sdstate.edu
	CC Info	For re-analysis: contact Zelda McGinnis-Schlobohm and Nancy Anderson
		Zelda.Schobohm@SDSTATE.EDU, Nancy.Anderson@SDSTATE.EDU
		For analysis questions only: just CC. Nancy Anderson
	Methods	*Approved for boron, selenium, and molybdenum analyses (except boron in soil; Olson does not have the capability)*
Sierra Foothill Laboratory, Inc.	**Address**	255 Scottsville Blvd, Jackson, CA 95642
	Contact	Sandy Nurse (Owner) or Dale Gimble (QA Officer)
	P/F	(209) 223-2800 / (209) 223-2747
	Email	sandy@sierrafoothilllab.com, CC: dale@sierrafoothilllab.com
	Methods	*Approved for all inorganic parameters, microbiological parameters, acute and chronic toxicity.*
TestAmerica	**Address**	880 Riverside Parkway West Sacramento, CA 95605 USA
	Contact	Linda Laver
	P/F	(916) 374-4362 / (916) 372-1059 fax
	Email	Linda.Laver@TestAmericaInc.com
	Methods	*Approved for all inorganic parameters and hazardous waste organics. Ag analysis in sediment, when known quantity is present, request 6010B*
Western Environmental Testing Laboratories	**Address**	475 East Greg Street # 119 Sparks, NV 89431 USA
	Contact	Erin Pfau (Client Services), Andy Smith (Lab Drctr)
	P/F	(775) 355-0202 / (775) 355-0817
	Email	erinp@wetlaboratory.com, andy@wetlaboratory.com
	Methods	*Approved for inorganic parameters (metals, general chemistry) and coliforms.*

revised: 2/14/2011

Table 8. Summary of Depth to Groundwater in Wells Beside the Delta-Mendota Canal (feet)
May 1995 - Dec 2011

DMC Milepost	Max	Min	Average	Median	Recent	Count
12.37L	327.8	164.2	230.7	226.0	240.0	53
12.69L	244.8	207.5	224.7	223.0	213.0	53
12.75R	295.0	212.0	249.6	253.0	253.0	52
13.31L	275.8	210.0	227.9	223.5	210.0	52
14.26R	268.5	225.0	239.2	238.0	227.0	52
15.11R	264.0	200.0	241.1	244.0	260.0	53
21.25L	156.0	106.0	122.0	116.0	132.0	51
21.86L	130.0	89.6	108.7	108.0	107.0	53
22.77R	170.0	39.2	134.8	135.0	135.0	53
23.41L	254.0	141.0	191.8	189.5	174.0	53
30.43R	169.8	121.8	145.0	145.8	143.0	53
30.43L	191.0	102.0	126.1	124.2	191.0	53
31.60L	277.0	110.1	213.8	231.8	133.0	53
33.71L	198.6	130.9	164.3	167.9	136.0	53
35.73R	287.0	146.8	165.2	160.6	181.0	53
36.01L	290.0	137.2	203.9	185.5	256.0	51
36.80L	204.0	111.0	154.4	153.0	153.0	52
37.10L	277.0	158.0	192.3	191.0	173.0	52
37.32L	200.0	150.8	165.3	161.7	164.0	52
37.58L	170.0	127.8	145.9	141.2	146.0	52
45.78R	121.0	83.0	99.7	97.1	102.0	52
48.97L	130.0	71.0	96.7	94.5	71.0	48
48.96LNEW	101.0	88.0	95.0	96.0	101.0	8
51.66L	141.2	86.4	107.9	106.0	92.0	52
58.28L	69.0	27.0	44.4	43.1	52.0	51
60.06R	95.0	37.6	67.0	67.2	73.0	51
66.71L	54.0	19.8	36.4	34.1	40.0	51
78.31L	49.3	21.9	29.3	27.9	28.0	60
79.13R	111.8	57.8	82.8	87.8	57.8	60
79.13L	87.8	63.3	72.2	68.8	87.8	8
79.60L	83.2	52.9	65.3	63.0	59.6	60
80.03L	80.0	16.0	35.8	35.5	37.4	60
80.03R	143.5	73.0	108.4	122.8	73.0	9
80.62R	100.2	47.8	61.9	59.8	57.0	60
80.62L	69.0	19.4	43.6	43.0	41.3	60
81.08-R	72.5	55.1	60.5	58.1	56.5	8
83.08-R	64.9	37.6	46.3	43.0	44.1	35
83.67-L	71.6	12.0	25.0	23.4	24.2	35
90.18R	201.3	103.9	138.5	132.4	129.8	60
90.19L1	218.5	98.9	145.3	137.4	145.5	60
90.19L2	190.0	72.0	131.7	124.5	118.8	60
90.39R	212.0	105.0	138.7	133.8	134.6	60

Table 8. Summary of Depth to Groundwater in Wells Beside the Delta-Mendota Canal (feet)
May 1995 - Dec 2011

DMC Milepost	Max	Min	Average	Median	Recent	Count
90.60L	192.0	28.7	136.5	132.0	131.5	60
90.61R	198.0	104.0	137.1	132.7	132.5	60
90.91L	285.9	93.2	143.8	136.1	127.1	60
91.15L	287.7	97.4	138.0	129.3	129.3	60
91.36L	217.0	11.3	103.0	118.9	11.3	60
91.57R	222.2	91.8	134.2	128.0	131.2	60
91.68R	219.6	99.2	142.1	138.9	167.5	60
91.77R	172.2	96.0	127.1	124.2	n/a	60
91.80L	195.2	93.1	133.8	126.5	130.0	60
92.00R	172.6	109.0	137.7	131.2	n/a	60
92.14L	215.1	98.8	143.5	138.7	140.8	60
92.20R	220.0	95.8	141.0	139.1	132.0	60
92.72L	218.3	100.2	146.2	134.5	133.4	60
93.20L	296.1	102.2	138.1	131.0	134.9	60
93.27R	228.4	115.0	157.7	150.5	158.0	59
93.27L	218.9	100.8	144.7	140.1	141.7	60
94.26L	228.1	99.7	142.4	133.2	168.9	60
95.62L	213.4	99.6	143.0	129.9	167.9	60
97.28L	138.8	34.0	67.8	52.6	128.3	60
98.74L	114.2	39.2	53.8	45.8	56.9	60
99.24L	158.3	31.5	60.7	51.5	93.6	60
99.82L	181.8	19.5	64.4	54.7	75.0	60
100.24L	136.6	28.1	58.1	49.8	66.2	60
100.65L	131.2	36.5	64.7	58.2	98.8	60
100.85L	98.3	39.0	57.2	55.0	67.6	59
101.27L	131.4	37.4	63.4	50.5	74.4	59
102.04R	130.0	38.0	62.1	51.5	61.5	59
106.20R	138.3	60.7	90.4	83.2	126.0	59
113.72L	29.2	13.2	21.6	21.6	n/a	59
115.32R	82.9	18.5	30.6	31.6	19.8	59
115.62L	42.0	12.2	25.6	24.4	17.6	58
115.84R	39.2	14.9	24.8	23.0	19.3	59
116.40L1	77.0	14.2	29.8	27.8	17.2	59
116.40L2	74.0	11.3	29.8	23.7	29.1	55

Source: San Luis & Delta-Mendota Water Authority

Appendix 1. 2012 Letter from Exchange Contractors

SAN JOAQUIN RIVER EXCHANGE CONTRACTORS WATER AUTHORITY
CCID • CCC
FCWD • SLCC

Consisting of 240,000 acres on the Westside of the San Joaquin Valley

JAMES E. O'BANION
Chairman

ROY CATANIA
Vice Chairman

STEVE CHEDESTER
Executive Director

LARRY FREEMAN
Water Resources Specialist

JOANN WHITE
Administrative Assistant

MINASIAN, SPRUANCE, MEITH, SOARES & SEXTON LLP
Legal Counsel

CENTRAL CALIFORNIA IRRIGATION DISTRICT

James E. O'Banion
President

Christopher White
General Manager

SAN LUIS CANAL COMPANY

James L. Nickel
President

Chase Hurley
General Manager

FIREBAUGH CANAL WATER DISTRICT

Mike Stearns
President

Jeff Bryant
General Manager

COLUMBIA CANAL COMPANY

Roy Catania
President

Randy Houk
General Manager

P.O. Box 2115
541 H Street
Los Banos, CA 93635
(209) 827-8616
Fax (209) 827-9703
e-mail: jtoscano@sjrecwa.net
Website: www.sjrecwa.net

February 3, 2012

VIA EMAIL & U.S. MAIL
Mr. Michael Jackson
U.S. Bureau of Reclamation
1243 N Street
Fresno, CA 93721-1813

Ms. Frances Mizuno
San Luis & Delta-Mendota Water Authority
Post Office Box 2157
Los Banos, CA 93635

RE: ***2012 DMC Pumping***

Dear Michael and Frances:

This letter is to confirm the San Joaquin River Exchange Contractors Water Authority's (Exchange Contractors) approval of your request to continue the DMC pumping program in 2012. As a result of subsidence effects being determined in 2008, this year's program must continue to include that no pumping will be allowed in Management Areas 2 and 3.

Additionally, the joint groundwater study between the Central California Irrigation District, the City of Los Banos and the United States Bureau of Reclamation was completed in the Los Banos aquifer subarea due to significant groundwater concerns in April 2010. The study and its recommendations are to be incorporated into the 2012 DMC pumping program.

The Exchange Contractors' Board approval for this pumping program is based upon the conditions set forth below:

1. Any well that is proposed to pump into the lower DMC must obtain a current water quality analysis. The analysis shall consist of Ag Suitability and selenium, plus any other constituents the U.S. Bureau of Reclamation (USBR) may require. (Wells may be pumped for 24

hours in order to get the initial sample for water quality testing.) These tests will be conducted on a monthly basis for the duration of the pumping period. From our perspective, pumping may begin once we have received copies of current lab test results for salinity and selenium, recognizing the other constituents may take longer to obtain the lab results.

2. Only wells that test at 1,500 ppm TDS or less at the well head will be allowed.

3. Only wells that test at 2 ppb selenium or less at the well head will be allowed.

4. The calculated degradation caused by the lower DMC wells shall not exceed 30 ppm. (The model developed by USBR during the 2008 and 2009 pumping program shall be used and USBR shall provide at least weekly updates of the reports to the Exchange Contractors.)

5. At any time, the wells in the lower DMC will be shut off if the measured water quality at Check 20 on the DMC exceeds 450 ppm TDS in a single day. The wells may resume pumping after the average water exceedence no longer exists for 3 days. Wells with water quality at the well head of 450 TDS or less would be allowed to continue to pump and would not be subject to this restriction.

6. Pumping in the Los Banos aquifer subarea shall only be credited for use in that local subarea (San Luis Water District) and is subject to the monitoring triggers established in the April 2010 joint report between the Central California Irrigation District, the City of Los Banos and the United States Bureau of Reclamation.

7. The water would be credited to the receiving district as a whole, not for specific growers.

8. The wells will only run through February 28, 2013.

If you agree with the program as outlined, and before any additional lower DMC pumping commences, we request that each of your agencies confirm in writing to the program described above. Please contact us if you have any questions regarding this matter.

Sincerely,

Steve Chedester

cc: San Joaquin River Exchange Contractors Board Members
Paul Minasian, Esq.

SAN LUIS WATER DISTRICT

WATER MANAGEMENT PLAN (2011)

APPENDIX N

SAMPLE WATER QUALITY RESULTS FROM WELLS PUMPING INTO THE DELTA MENDOTA CANAL

MOORE TWINING ASSOCIATES, INC.
California ELAP Certificate #1371

2527 Fresno Street
Fresno, CA 93721
(559) 268-7021 Phone
(559) 268-0740 Fax

San Luis Water District	Project: Analytical Services	
1015 6th Street	Project Number: Analytical Services	**Reported:**
Los Banos CA, 93635	Project Manager: Janet Gutierrez, Watermaster	04/22/08

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
Well Site, Gravel Pit Rd.	8D07026-01	Ground Water	04/07/08 11:00	04/07/08 17:20
Well Site, Gravel Pit Rd.	8D07026-02	Ground Water	04/08/08 11:30	04/07/08 17:20

MOORE TWINING ASSOCIATES, INC.
California ELAP Certificate #1371

2527 Fresno Street
Fresno, CA 93721
(559) 268-7021 Phone
(559) 268-0740 Fax

San Luis Water District	Project: Analytical Services	
1015 6th Street	Project Number: Analytical Services	Reported:
Los Banos CA, 93635	Project Manager: Janet Gutierrez, Watermaster	04/22/08

Well Site, Gravel Pit Rd.

8D07026-01 (Ground Water) Sampled:04/07/08 11:00

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes.
Semi-Volatile Organics									
1,2-Dibromo-3-chloropropane (DBCP)	ND	0.010	µg/L	1	T8D1101	04/11/08	04/11/08	EPA 504.1	
1,2,3-Trichloropropane (123TCP)	ND	0.0050	µg/L	1	T8D1101	04/11/08	04/11/08	EPA 504.1	
1,2-Dibromoethane (EDB)	ND	0.020	µg/L	1	T8D1101	04/11/08	04/11/08	EPA 504.1	
Alachlor	ND	1.0	µg/L	1	T8D1203	04/11/08	04/12/08	EPA 507	
Atrazine	ND	0.50	µg/L	1	T8D1203	04/11/08	04/12/08	EPA 507	
Bromacil	ND	10	µg/L	1	T8D1203	04/11/08	04/12/08	EPA 507	
Butachlor	ND	0.38	µg/L	1	T8D1203	04/11/08	04/12/08	EPA 507	
Diazinon	ND	0.25	µg/L	1	T8D1203	04/11/08	04/12/08	EPA 507	
Dimethoate	ND	10	µg/L	1	T8D1203	04/11/08	04/12/08	EPA 507	
EPTC	ND	2.0	µg/L	1	T8D1203	04/11/08	04/12/08	EPA 507	
Metolachlor	ND	1.0	µg/L	1	T8D1203	04/11/08	04/12/08	EPA 507	
Metribuzin	ND	2.0	µg/L	1	T8D1203	04/11/08	04/12/08	EPA 507	
Molinate	ND	2.0	µg/L	1	T8D1203	04/11/08	04/12/08	EPA 507	
Prometon	ND	0.050	µg/L	1	T8D1203	04/11/08	04/12/08	EPA 507	
Prometryn	ND	2.0	µg/L	1	T8D1203	04/11/08	04/12/08	EPA 507	
Propachlor	ND	0.050	µg/L	1	T8D1203	04/11/08	04/12/08	EPA 507	
Simazine	ND	1.0	µg/L	1	T8D1203	04/11/08	04/12/08	EPA 507	
Terbacil	ND	2.0	µg/L	1	T8D1203	04/11/08	04/12/08	EPA 507	
Thiobencarb	ND	1.0	µg/L	1	T8D1203	04/11/08	04/12/08	EPA 507	
Surrogate: 1,3-Dimethyl-2-nitrobenzene		*94.6 %*	*0-200*		*T8D1203*	*04/11/08*	*04/12/08*	*EPA 507*	
Aldrin	ND	0.075	µg/L	1	T8D1204	04/11/08	04/13/08	EPA 508	
Chlordane (tech)	ND	0.10	µg/L	1	T8D1204	04/11/08	04/13/08	EPA 508	
Chlorothalonil	ND	5.0	µg/L	1	T8D1204	04/11/08	04/13/08	EPA 508	
Dieldrin	ND	0.020	µg/L	1	T8D1204	04/11/08	04/13/08	EPA 508	
Endrin	ND	0.10	µg/L	1	T8D1204	04/11/08	04/13/08	EPA 508	
gamma-BHC (Lindane)	ND	0.20	µg/L	1	T8D1204	04/11/08	04/13/08	EPA 508	
Heptachlor	ND	0.010	µg/L	1	T8D1204	04/11/08	04/13/08	EPA 508	
Heptachlor epoxide	ND	0.010	µg/L	1	T8D1204	04/11/08	04/13/08	EPA 508	
Hexachlorobenzene	ND	0.50	µg/L	1	T8D1204	04/11/08	04/13/08	EPA 508	
Methoxychlor	ND	10	µg/L	1	T8D1204	04/11/08	04/13/08	EPA 508	
Polychlorinated biphenyls	ND	0.50	µg/L	1	T8D1204	04/11/08	04/13/08	EPA 508	
Propachlor	ND	0.50	µg/L	1	T8D1204	04/11/08	04/13/08	EPA 508	
Toxaphene	ND	1.0	µg/L	1	T8D1204	04/11/08	04/13/08	EPA 508	

MOORE TWINING ASSOCIATES, INC.
California ELAP Certificate #1371

2527 Fresno Street
Fresno, CA 93721
(559) 268-7021 Phone
(559) 268-0740 Fax

San Luis Water District 1015 6th Street Los Banos CA, 93635	Project: Analytical Services Project Number: Analytical Services Project Manager: Janet Gutierrez, Watermaster	**Reported:** 04/22/08

Well Site, Gravel Pit Rd.

8D07026-01 (Ground Water) Sampled:04/07/08 11:00

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes.
Semi-Volatile Organics									
Trifluralin	ND	0.50	µg/L	1	T8D1204	04/11/08	04/13/08	EPA 508	
Surrogate: PCNB		*98.2 %*	*0-200*		*T8D1204*	*04/11/08*	*04/13/08*	*EPA 508*	
2,4,5-TP (Silvex)	ND	1.0	µg/L	1	T8D1205	04/10/08	04/13/08	EPA 515.1	
2,4-D	ND	10	µg/L	1	T8D1205	04/10/08	04/13/08	EPA 515.1	
Bentazon	ND	2.0	µg/L	1	T8D1205	04/10/08	04/13/08	EPA 515.1	
Dalapon	ND	10	µg/L	1	T8D1205	04/10/08	04/13/08	EPA 515.1	
Dicamba	ND	1.5	µg/L	1	T8D1205	04/10/08	04/13/08	EPA 515.1	
Dichloroprop	ND	2.0	µg/L	1	T8D1205	04/10/08	04/13/08	EPA 515.1	
Dinoseb	ND	2.0	µg/L	1	T8D1205	04/10/08	04/13/08	EPA 515.1	
Pentachlorophenol	ND	0.20	µg/L	1	T8D1205	04/10/08	04/13/08	EPA 515.1	
Picloram	ND	1.0	µg/L	1	T8D1205	04/10/08	04/13/08	EPA 515.1	
Surrogate: 2,4-Dichlorophenylacetic acid		*96.7 %*	*58-130*		*T8D1205*	*04/10/08*	*04/13/08*	*EPA 515.1*	
3-Hydroxycarbofuran	ND	3.0	µg/L	1	T8D1001	04/10/08	04/14/08	EPA 531.1	
Aldicarb	ND	3.0	µg/L	1	T8D1001	04/10/08	04/14/08	EPA 531.1	
Aldicarb sulfone	ND	4.0	µg/L	1	T8D1001	04/10/08	04/14/08	EPA 531.1	
Aldicarb sulfoxide	ND	3.0	µg/L	1	T8D1001	04/10/08	04/14/08	EPA 531.1	
Carbaryl	ND	5.0	µg/L	1	T8D1001	04/10/08	04/14/08	EPA 531.1	
Carbofuran	ND	5.0	µg/L	1	T8D1001	04/10/08	04/14/08	EPA 531.1	
Methiocarb	ND	5.0	µg/L	1	T8D1001	04/10/08	04/14/08	EPA 531.1	
Methomyl	ND	2.0	µg/L	1	T8D1001	04/10/08	04/14/08	EPA 531.1	
Oxamyl	ND	20	µg/L	1	T8D1001	04/10/08	04/14/08	EPA 531.1	
Propoxur	ND	5.0	µg/L	1	T8D1001	04/10/08	04/14/08	EPA 531.1	
Glyphosate	ND	25	µg/L	1	T8D1802	04/18/08	04/18/08	EPA 547	
Atrazine	ND	0.50	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	
Azinphos-methyl	ND	25	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	
Trifluralin	ND	0.050	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	
Bolstar	ND	1.2	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	
Chlorpyrifos	ND	1.0	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	
Coumaphos	ND	5.0	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	
Demeton-o	ND	1.2	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	
Demeton-s	ND	1.2	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	
Diazinon	ND	0.25	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	
Dimethoate	ND	1.2	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	

MOORE TWINING ASSOCIATES, INC.
California ELAP Certificate #1371

2527 Fresno Street
Fresno, CA 93721
(559) 268-7021 Phone
(559) 268-0740 Fax

San Luis Water District	Project: Analytical Services	
1015 6th Street	Project Number: Analytical Services	**Reported:**
Los Banos CA, 93635	Project Manager: Janet Gutierrez, Watermaster	04/22/08

Well Site, Gravel Pit Rd.

8D07026-01 (Ground Water) Sampled:04/07/08 11:00

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes.
Semi-Volatile Organics									
Disulfoton	ND	0.50	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	
Ethion	ND	0.50	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	
Ethoprop	ND	0.50	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	
Fensulfothion	ND	2.5	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	
Fenthion	ND	1.2	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	
Malathion	ND	1.2	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	
Naled	ND	25	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	
Parathion-ethyl	ND	1.2	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	
Parathion-methyl	ND	2.5	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	
Phorate	ND	0.50	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	
Phosdrin	ND	2.5	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	
Ronnel	ND	2.5	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	
Simazine	ND	1.0	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	
Stirophos	ND	5.0	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	
Thionazin	ND	5.0	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	
Trichloronate	ND	1.2	µg/L	1	T8D1108	04/10/08	04/12/08	EPA 8141A	
Surrogate: Triphenyl phosphate		*78.0 %*	*70-140*		*T8D1108*	*04/10/08*	*04/12/08*	*EPA 8141A*	

MOORE TWINING ASSOCIATES, INC.
California ELAP Certificate #1371

2527 Fresno Street
Fresno, CA 93721
(559) 268-7021 Phone
(559) 268-0740 Fax

San Luis Water District	Project: Analytical Services	
1015 6th Street	Project Number: Analytical Services	**Reported:**
Los Banos CA, 93635	Project Manager: Janet Gutierrez, Watermaster	04/22/08

Well Site, Gravel Pit Rd.

8D07026-02 (Ground Water) Sampled:04/08/08 11:30

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes.
Inorganics									
Chloride	**67**	6.0	mg/L	3	T8D0902	04/09/08	04/09/08	EPA 300.0	
Specific Conductance (EC)	**1100**	1.0	µS/cm	1	T8D0912	04/09/08	04/09/08	EPA 120.1	
Nitrate as NO3	**31**	6.0	mg/L	3	T8D0902	04/09/08	04/09/08	EPA 300.0	
Sulfate as SO4	**200**	10	mg/L	5	T8D1002	04/10/08	04/10/08	EPA 300.0	
Total Dissolved Solids	**710**	13	mg/L	1.33	T8D1110	04/11/08	04/14/08	EPA 160.1	
Metals									
Aluminum	ND	4.0	µg/L	1	T8D1305	04/13/08	04/16/08	EPA 200.8	
Antimony	ND	1.0	µg/L	1	T8D1305	04/13/08	04/15/08	EPA 200.8	
Arsenic	ND	1.0	µg/L	1	T8D1305	04/13/08	04/15/08	EPA 200.8	
Barium	**50**	1.0	µg/L	1	T8D1305	04/13/08	04/15/08	EPA 200.8	
Beryllium	ND	1.0	µg/L	1	T8D1305	04/13/08	04/16/08	EPA 200.8	
Boron	**0.36**	0.050	mg/L	1	T8D1113	04/11/08	04/11/08	EPA 200.7	
Cadmium	ND	0.20	µg/L	1	T8D1305	04/13/08	04/15/08	EPA 200.8	
Chromium	**1.4**	1.0	µg/L	1	T8D1305	04/13/08	04/15/08	EPA 200.8	
Copper	ND	1.0	µg/L	1	T8D1305	04/13/08	04/15/08	EPA 200.8	
Iron	ND	20	µg/L	1	T8D1305	04/13/08	04/15/08	EPA 200.8	
Lead	ND	0.50	µg/L	1	T8D1305	04/13/08	04/15/08	EPA 200.8	
Manganese	**1.2**	1.0	µg/L	1	T8D1305	04/13/08	04/15/08	EPA 200.8	
Mercury	ND	0.10	µg/L	1	T8D1305	04/13/08	04/15/08	EPA 200.8	
Molybdenum	**1.5**	1.0	µg/L	1	T8D1305	04/13/08	04/15/08	EPA 200.8	
Nickel	**2.1**	1.0	µg/L	1	T8D1305	04/13/08	04/15/08	EPA 200.8	
Silver	ND	1.0	µg/L	1	T8D1305	04/13/08	04/15/08	EPA 200.8	
Sodium	**73**	1.0	mg/L	1	T8D1113	04/11/08	04/11/08	EPA 200.7	
Thallium	ND	1.0	µg/L	1	T8D1305	04/13/08	04/15/08	EPA 200.8	
Zinc	**6.6**	5.0	µg/L	1	T8D1305	04/13/08	04/15/08	EPA 200.8	

Notes and Definitions

TW	Tap water used for batch QC MS/MSD analyses.
ug/L	micrograms per liter (parts per billion concentration units)
mg/kg	milligrams per kilogram (parts per million concentration units)
mg/L	milligrams per Liter (parts per million concentration units)
ND	Analyte NOT DETECTED at or above the reporting limit
RPD	Relative Percent Difference

BSK Analytical Laboratories
Engineers & Laboratories

1414 Stanislaus Street
Fresno, California 93706
(559) 497-2888
Fax (559) 485-6935

Amended Page

Certificate of Analysis

NELAP Certificate #04227CA
ELAP Certificate #1180

Janet Gutierrez
San Luis Water District
PO Box 2135
Los Banos, CA 93635

BSK Submission #: 2008071140
BSK Sample ID #: 1009996

Report Issue Date: 08/12/2008

Project ID:
Project Desc:
Submission Comments:
Sample Type: Liquid
Sample Description: 79.13R
Sample Comments:

Date Sampled: 07/14/2008
Time Sampled: 1000
Date Received: 07/15/2008

Inorganics

Analyte	Method	Result	Units	PQL	Dilution	DLR	Prep Date/Time	Analysis Date/Time
Aggressive Index		**13**	-		1	N/A	07/30/08	07/30/08
Alkalinity (as CaCO3)	SM 2320 B	**180**	mg/L	3.0	1	3.0	07/15/08	07/15/08
Aluminum (Al)	EPA 200.7	**ND**	mg/L	0.050	1	0.050	07/16/08	07/22/08
Antimony (Sb)	EPA 200.8	**ND**	µg/L	2	1	2	07/16/08	07/24/08
Arsenic (As)	EPA 200.8	**6.6**	µg/L	2	1	2	07/16/08	07/24/08
Barium (Ba)	EPA 200.7	**0.20**	mg/L	0.050	1	0.050	07/16/08	07/22/08
Beryllium (Be)	EPA 200.8	**ND**	µg/L	1.0	1	1.0	07/16/08	07/24/08
Bicarbonate (as CaCO3)	SM 2320 B	**180**	mg/L	3.0	1	3.0	07/15/08	07/15/08
Boron (B)	EPA 200.7	**0.82**	mg/L	0.10	1	0.10	07/16/08	07/22/08
Cadmium (Cd)	EPA 200.8	**ND**	µg/L	1.0	1	1.0	07/16/08	07/24/08
Calcium (Ca)	EPA 200.7	**97**	mg/L	0.10	1	0.10	07/16/08	07/22/08
Carbonate (as CaCO3)	SM 2320 B	**ND**	mg/L	1.0	1	1.0	07/15/08	07/15/08
Chloride (Cl)	EPA 300.0	**270**	mg/L	1.0	3	3.0	07/15/08	07/15/08
Chromium - Total (Cr)	EPA 200.8	**ND**	µg/L	10	1	10	07/16/08	07/24/08
Conductivity - Specific (EC) @25°C	SM 2510 B	**1300**	µmho/cm	1.0	1	1.0	07/15/08	07/15/08
Copper (Cu)	EPA 200.7	**ND**	mg/L	0.050	1	0.050	07/16/08	07/22/08
Cyanide (CN)	SM 4500-CN-F	**ND**	µg/L	20	1	20	07/25/08	07/25/08
Fluoride	EPA 300.0	**0.24**	mg/L	0.10	1	0.10	07/18/08	07/18/08
Hardness (as CaCO3)	SM 2340 B	**450**	mg/L	1.0	1	1.0	07/30/08	07/30/08
Hydroxide (as CaCO3)	SM 2320 B	**ND**	mg/L	1.0	1	1.0	07/15/08	07/15/08
Iron (Fe)	EPA 200.7	**ND**	mg/L	0.050	1	0.050	07/16/08	07/22/08
Langelier Index (Saturation Index)	SM 2330 B	**1.1**	-	-	1	N/A	07/30/08	07/30/08
Lead (Pb)	EPA 200.8	**ND**	µg/L	5.0	1	5.0	07/16/08	07/24/08
Magnesium (Mg)	EPA 200.7	**51**	mg/L	0.10	1	0.10	07/16/08	07/22/08
Manganese (Mn)	EPA 200.7	**ND**	mg/L	0.010	1	0.010	07/16/08	07/22/08
MBAS, Calculated as LAS, mol wt 340	SM 5540 C	**ND**	mg/L	0.050	1	0.050	07/16/08 07:20	07/16/08 07:20
Mercury (Hg)	EPA 200.8	**ND**	µg/L	0.40	1	0.40	07/16/08	07/24/08
Nickel (Ni)	EPA 200.8	**ND**	µg/L	10	1	10	07/16/08	07/24/08
Nitrate (NO3)	EPA 300.0	**17**	mg/L	1.0	3	3.0	07/15/08 19:20	07/15/08 19:20
Nitrite (NO2-N)	EPA 300.0	**ND**	mg/L	0.050	3	0.15	07/15/08 19:20	07/15/08 19:20

mg/L: Milligrams/Liter (ppm)
mg/Kg: Milligrams/Kilogram (ppm)
µg/L: Micrograms/Liter (ppb)
µg/Kg: Micrograms/Kilogram (ppb)
%Rec: Percent Recovered (surrogates)

PQL: Practical Quantitation Limit
DLR: Detection Limit for Reporting : PQL x Dilution
ND: None Detected at DLR
pCi/L: Picocurie per Liter

H: Analyzed outside of hold time
P: Preliminary result
S: Suspect result. See Case Narrative for comments.
E: Analysis performed by External laboratory. See External Laboratory Report attachments.
MDC: Min Detectable Concentration

Report Authentication Code:

BSK Analytical Laboratories
Engineers & Laboratories

1414 Stanislaus Street
Fresno, California 93706
(559) 497-2888
Fax (559) 485-6935

Amended Page

Certificate of Analysis

NELAP Certificate #04227CA
ELAP Certificate #1180

Janet Gutierrez
San Luis Water District
PO Box 2135
Los Banos, CA 93635

BSK Submission #: 2008071140
BSK Sample ID #: 1009996

Report Issue Date: 08/12/2008

Project ID:
Project Desc:
Submission Comments:
Sample Type: Liquid
Sample Description: 79.13R
Sample Comments:

Date Sampled: 07/14/2008
Time Sampled: 1000
Date Received: 07/15/2008

Inorganics

Analyte	Method	Result	Units	PQL	Dilution	DLR	Prep Date/Time	Analysis Date/Time
Percent Sodium	EPA 200.7	**30**	%	-	1	N/A	08/07/08	08/07/08
pH at 22.72°C	SM 4500-H+ B	**8.1**	Std. Unit	-	1	N/A	07/15/08 19:33	07/15/08 19:33
Potassium (K)	EPA 200.7	**3.2**	mg/L	2	1	2.0	07/16/08	07/22/08
Selenium (Se) - Total	EPA 200.8	**11**	µg/L	2	1	2.0	07/16/08	07/25/08
Silver (Ag)	EPA 200.7	**ND**	mg/L	0.010	1	0.010	07/16/08	07/22/08
Sodium (Na)	EPA 200.7	**89**	mg/L	1.0	1	1.0	07/16/08	07/22/08
Sulfate (SO4)	EPA 300.0	**66**	mg/L	2	3	6.0	07/15/08	07/15/08
Thallium (Tl)	EPA 200.8	**ND**	µg/L	1.0	1	1.0	07/16/08	07/24/08
Total Dissolved Solids (TDS)	SM 2540 C	**760**	mg/L	5.0	1	5.0	07/15/08	07/17/08
Zinc (Zn)	EPA 200.7	**ND**	mg/L	0.050	1	0.050	07/16/08	07/22/08

mg/L: Milligrams/Liter (ppm)
mg/Kg: Milligrams/Kilogram (ppm)
µg/L: Micrograms/Liter (ppb)
µg/Kg: Micrograms/Kilogram (ppb)
%Rec: Percent Recovered (surrogates)

PQL: Practical Quantitation Limit
DLR: Detection Limit for Reporting : PQL x Dilution
ND: None Detected at DLR
pCi/L: Picocurie per Liter

H: Analyzed outside of hold time
P: Preliminary result
S: Suspect result. See Case Narrative for comments.
E: Analysis performed by External laboratory. See External Laboratory Report attachments.
MDC: Min Detectable Concentration

Report Authentication Code:

BSK Analytical Laboratories
Engineers & Laboratories

1414 [illegible] nislaus Street
Fresno, California 93706
(559) 497-2888
Fax (559) 485-6935

Certificate of Analysis

NELAP Certificate #04227CA
ELAP Certificate #1180

Janet Gutierrez
San Luis Water District
PO Box 2135
Los Banos, CA 93635

BSK Submission #: 2008071140
BSK Sample ID #: 1009996

Report Issue Date: 07/30/2008

Project ID:
Project Desc:
Submission Comments:
Sample Type: Liquid
Sample Description: 79.13R
Sample Comments:

Date Sampled: 07/14/2008
Time Sampled: 1000
Date Received: 07/15/2008

Inorganics

Analyte	Method	Result	Units	PQL	Dilution	DLR	Prep Date/Time	Analysis Date/Time
Aggressive Index		**13**	-		1	N/A	07/30/08	07/30/08
Alkalinity (as CaCO3)	SM 2320 B	**180**	mg/L	3.0	1	3.0	07/15/08	07/15/08
Aluminum (Al)	EPA 200.7	**ND**	mg/L	0.050	1	0.050	07/16/08	07/22/08
Antimony (Sb)	EPA 200.8	**ND**	µg/L	2	1	2	07/16/08	07/24/08
Arsenic (As)	EPA 200.8	**6.6**	µg/L	2	1	2	07/16/08	07/24/08
Barium (Ba)	EPA 200.7	**0.20**	mg/L	0.050	1	0.050	07/16/08	07/22/08
Beryllium (Be)	EPA 200.8	**ND**	µg/L	1.0	1	1.0	07/16/08	07/24/08
Bicarbonate (as CaCO3)	SM 2320 B	**180**	mg/L	3.0	1	3.0	07/15/08	07/15/08
Cadmium (Cd)	EPA 200.8	**ND**	µg/L	1.0	1	1.0	07/16/08	07/24/08
Calcium (Ca)	EPA 200.7	**97**	mg/L	0.10	1	0.10	07/16/08	07/22/08
Carbonate (as CaCO3)	SM 2320 B	**ND**	mg/L	1.0	1	1.0	07/15/08	07/15/08
Chloride (Cl)	EPA 300.0	**270**	mg/L	1.0	3	3.0	07/15/08	07/15/08
Chromium - Total (Cr)	EPA 200.8	**ND**	µg/L	10	1	10	07/16/08	07/24/08
Conductivity - Specific (EC) @25°C	SM 2510 B	**1300**	µmho/cm	1.0	1	1.0	07/15/08	07/15/08
Copper (Cu)	EPA 200.7	**ND**	mg/L	0.050	1	0.050	07/16/08	07/22/08
Cyanide (CN)	SM 4500-CN-F	**ND**	µg/L	20	1	20	07/25/08	07/25/08
Fluoride	EPA 300.0	**0.24**	mg/L	0.10	1	0.10	07/18/08	07/18/08
Hardness (as CaCO3)	SM 2340 B	**450**	mg/L	1.0	1	1.0	07/30/08	07/30/08
Hydroxide (as CaCO3)	SM 2320 B	**ND**	mg/L	1.0	1	1.0	07/15/08	07/15/08
Iron (Fe)	EPA 200.7	**ND**	mg/L	0.050	1	0.050	07/16/08	07/22/08
Langelier Index (Saturation Index)	SM 2330 B	**1.1**	-	-	1	N/A	07/30/08	07/30/08
Lead (Pb)	EPA 200.8	**ND**	µg/L	5.0	1	5.0	07/16/08	07/24/08
Magnesium (Mg)	EPA 200.7	**51**	mg/L	0.10	1	0.10	07/16/08	07/22/08
Manganese (Mn)	EPA 200.7	**ND**	mg/L	0.010	1	0.010	07/16/08	07/22/08
MBAS, Calculated as LAS, mol wt 340	SM 5540 C	**ND**	mg/L	0.050	1	0.050	07/16/08 07:20	07/16/08 07:20
Mercury (Hg)	EPA 200.8	**ND**	µg/L	0.40	1	0.40	07/16/08	07/24/08
Nickel (Ni)	EPA 200.8	**ND**	µg/L	10	1	10	07/16/08	07/24/08
Nitrate (NO3)	EPA 300.0	**17**	mg/L	1.0	3	3.0	07/15/08 19:20	07/15/08 19:20
Nitrite (NO2-N)	EPA 300.0	**ND**	mg/L	0.050	3	0.15	07/15/08 19:20	07/15/08 19:20
pH at 22.72°C	SM 4500-H+ B	**8.1**	Std. Unit	-	1	N/A	07/15/08 19:33	07/15/08 19:33

mg/L: Milligrams/Liter (ppm)
mg/Kg: Milligrams/Kilogram (ppm)
µg/L: Micrograms/Liter (ppb)
µg/Kg: Micrograms/Kilogram (ppb)
%Rec: Percent Recovered (surrogates)

PQL: Practical Quantitation Limit
DLR: Detection Limit for Reporting : PQL x Dilution
ND: None Detected at DLR
pCi/L: Picocurie per Liter

H: Analyzed outside of hold time
P: Preliminary result
S: Suspect result. See Case Narrative for comments.
E: Analysis performed by External laboratory. See External Laboratory Report attachments.
MDC: Min Detectable Concentration

Report Authentication Code:

BSK Analytical Laboratories
Engineers & Laboratories

1414 nislaus Street
Fresno, California 93706
(559) 497-2888
Fax (559) 485-6935

Certificate of Analysis

NELAP Certificate #04227CA
ELAP Certificate #1180

Janet Gutierrez
San Luis Water District
PO Box 2135
Los Banos, CA 93635

BSK Submission #: 2008071140
BSK Sample ID #: 1009996

Report Issue Date: 07/30/2008

Project ID:
Project Desc:
Submission Comments:
Sample Type: Liquid
Sample Description: 79.13R
Sample Comments:

Date Sampled: 07/14/2008
Time Sampled: 1000
Date Received: 07/15/2008

Inorganics

Analyte	Method	Result	Units	PQL	Dilution	DLR	Prep Date/Time	Analysis Date/Time
Potassium (K)	EPA 200.7	**3.2**	mg/L	2	1	2.0	07/16/08	07/22/08
Selenium (Se) - Total	EPA 200.8	**11**	µg/L	2	1	2.0	07/16/08	07/25/08
Silver (Ag)	EPA 200.7	**ND**	mg/L	0.010	1	0.010	07/16/08	07/22/08
Sodium (Na)	EPA 200.7	**89**	mg/L	1.0	1	1.0	07/16/08	07/22/08
Sulfate (SO4)	EPA 300.0	**66**	mg/L	2	3	6.0	07/15/08	07/15/08
Thallium (Tl)	EPA 200.8	**ND**	µg/L	1.0	1	1.0	07/16/08	07/24/08
Total Dissolved Solids (TDS)	SM 2540 C	**760**	mg/L	5.0	1	5.0	07/15/08	07/17/08
Zinc (Zn)	EPA 200.7	**ND**	mg/L	0.050	1	0.050	07/16/08	07/22/08

mg/L: Milligrams/Liter (ppm)
mg/Kg: Milligrams/Kilogram (ppm)
µg/L: Micrograms/Liter (ppb)
µg/Kg: Micrograms/Kilogram (ppb)
%Rec: Percent Recovered (surrogates)

PQL: Practical Quantitation Limit
DLR: Detection Limit for Reporting
: PQL x Dilution
ND: None Detected at DLR
pCi/L: Picocurie per Liter

H: Analyzed outside of hold time
P: Preliminary result
S: Suspect result. See Case Narrative for comments.
E: Analysis performed by External laboratory.
See External Laboratory Report attachments.
MDC: Min Detectable Concentration

Report Authentication Code:

BSK Analytical Laboratories
Engineers & Laboratories

1414 Stanislaus Street
Fresno, California 93706
(559) 497-2888
Fax (559) 485-6935

Amended Page

Certificate of Analysis

NELAP Certificate #04227CA
ELAP Certificate #1180

Janet Gutierrez
San Luis Water District
PO Box 2135
Los Banos, CA 93635

BSK Submission #: 2008071140
BSK Sample ID #: 1009997

Report Issue Date: 08/12/2008

Project ID:
Project Desc:
Submission Comments:
Sample Type: Liquid
Sample Description: 79.60L
Sample Comments:

Date Sampled: 07/14/2008
Time Sampled: 1009
Date Received: 07/15/2008

Inorganics

Analyte	Method	Result	Units	PQL	Dilution	DLR	Prep Date/Time	Analysis Date/Time
Aggressive Index		**13**	-		1	N/A	07/30/08	07/30/08
Alkalinity (as CaCO3)	SM 2320 B	**200**	mg/L	3.0	1	3.0	07/15/08	07/15/08
Aluminum (Al)	EPA 200.7	**ND**	mg/L	0.050	1	0.050	07/16/08	07/22/08
Antimony (Sb)	EPA 200.8	**ND**	µg/L	2	1	2	07/16/08	07/24/08
Arsenic (As)	EPA 200.8	**6.2**	µg/L	2	1	2	07/16/08	07/24/08
Barium (Ba)	EPA 200.7	**0.15**	mg/L	0.050	1	0.050	07/16/08	07/22/08
Beryllium (Be)	EPA 200.8	**ND**	µg/L	1.0	1	1.0	07/16/08	07/24/08
Bicarbonate (as CaCO3)	SM 2320 B	**200**	mg/L	3.0	1	3.0	07/15/08	07/15/08
Boron (B)	EPA 200.7	**0.64**	mg/L	0.10	1	0.10	07/16/08	07/22/08
Cadmium (Cd)	EPA 200.8	**ND**	µg/L	1.0	1	1.0	07/16/08	07/24/08
Calcium (Ca)	EPA 200.7	**84**	mg/L	0.10	1	0.10	07/16/08	07/22/08
Carbonate (as CaCO3)	SM 2320 B	**ND**	mg/L	1.0	1	1.0	07/15/08	07/15/08
Chloride (Cl)	EPA 300.0	**140**	mg/L	1.0	2	2.0	07/15/08	07/15/08
Chromium - Total (Cr)	EPA 200.8	**ND**	µg/L	10	1	10	07/16/08	07/24/08
Conductivity - Specific (EC) @25°C	SM 2510 B	**1000**	µmho/cm	1.0	1	1.0	07/15/08	07/15/08
Copper (Cu)	EPA 200.7	**ND**	mg/L	0.050	1	0.050	07/16/08	07/22/08
Cyanide (CN)	SM 4500-CN-F	**ND**	µg/L	20	1	20	07/25/08	07/25/08
Fluoride	EPA 300.0	**0.20**	mg/L	0.10	1	0.10	07/18/08	07/18/08
Hardness (as CaCO3)	SM 2340 B	**370**	mg/L	1.0	1	1.0	07/30/08	07/30/08
Hydroxide (as CaCO3)	SM 2320 B	**ND**	mg/L	1.0	1	1.0	07/15/08	07/15/08
Iron (Fe)	EPA 200.7	**ND**	mg/L	0.050	1	0.050	07/16/08	07/22/08
Langelier Index (Saturation Index)	SM 2330 B	**1.0**	-	-	1	N/A	07/30/08	07/30/08
Lead (Pb)	EPA 200.8	**ND**	µg/L	5.0	1	5.0	07/16/08	07/24/08
Magnesium (Mg)	EPA 200.7	**40**	mg/L	0.10	1	0.10	07/16/08	07/22/08
Manganese (Mn)	EPA 200.7	**ND**	mg/L	0.010	1	0.010	07/16/08	07/22/08
MBAS, Calculated as LAS, mol wt 340	SM 5540 C	**ND**	mg/L	0.050	1	0.050	07/16/08 07:20	07/16/08 07:20
Mercury (Hg)	EPA 200.8	**ND**	µg/L	0.40	1	0.40	07/16/08	07/24/08
Nickel (Ni)	EPA 200.8	**ND**	µg/L	10	1	10	07/16/08	07/24/08
Nitrate (NO3)	EPA 300.0	**34**	mg/L	1.0	2	2.0	07/15/08 19:29	07/15/08 19:29
Nitrite (NO2-N)	EPA 300.0	**ND**	mg/L	0.050	2	0.10	07/15/08 19:29	07/15/08 19:29

mg/L: Milligrams/Liter (ppm)
mg/Kg: Milligrams/Kilogram (ppm)
µg/L: Micrograms/Liter (ppb)
µg/Kg: Micrograms/Kilogram (ppb)
%Rec: Percent Recovered (surrogates)

PQL: Practical Quantitation Limit
DLR: Detection Limit for Reporting : PQL x Dilution
ND: None Detected at DLR
pCi/L: Picocurie per Liter

H: Analyzed outside of hold time
P: Preliminary result
S: Suspect result. See Case Narrative for comments.
E: Analysis performed by External laboratory. See External Laboratory Report attachments.
MDC: Min Detectable Concentration

Report Authentication Code:

BSK Analytical Laboratories
Engineers & Laboratories

1414 Stanislaus Street
Fresno, California 93706
(559) 497-2888
Fax (559) 485-6935

Amended Page

Certificate of Analysis

NELAP Certificate #04227CA
ELAP Certificate #1180

Janet Gutierrez
San Luis Water District
PO Box 2135
Los Banos, CA 93635

BSK Submission #: 2008071140
BSK Sample ID #: 1009997

Report Issue Date: 08/12/2008

Project ID:
Project Desc:
Submission Comments:
Sample Type: Liquid
Sample Description: 79.60L
Sample Comments:

Date Sampled: 07/14/2008
Time Sampled: 1009
Date Received: 07/15/2008

Inorganics

Analyte	Method	Result	Units	PQL	Dilution	DLR	Prep Date/Time	Analysis Date/Time
Percent Sodium	EPA 200.7	**29**	%	-	1	N/A	08/07/08	08/07/08
pH at 23.19°C	SM 4500-H+ B	**8.1**	Std. Unit	-	1	N/A	07/15/08 19:42	07/15/08 19:42
Potassium (K)	EPA 200.7	**3.0**	mg/L	2	1	2.0	07/16/08	07/22/08
Selenium (Se) - Total	EPA 200.8	**5.6**	µg/L	2	1	2.0	07/16/08	07/25/08
Silver (Ag)	EPA 200.7	**ND**	mg/L	0.010	1	0.010	07/16/08	07/22/08
Sodium (Na)	EPA 200.7	**72**	mg/L	1.0	1	1.0	07/16/08	07/22/08
Sulfate (SO4)	EPA 300.0	**73**	mg/L	2	2	4.0	07/15/08	07/15/08
Thallium (Tl)	EPA 200.8	**ND**	µg/L	1.0	1	1.0	07/16/08	07/24/08
Total Dissolved Solids (TDS)	SM 2540 C	**600**	mg/L	5.0	1	5.0	07/15/08	07/17/08
Zinc (Zn)	EPA 200.7	**ND**	mg/L	0.050	1	0.050	07/16/08	07/22/08

mg/L: Milligrams/Liter (ppm)
mg/Kg: Milligrams/Kilogram (ppm)
µg/L: Micrograms/Liter (ppb)
µg/Kg: Micrograms/Kilogram (ppb)
%Rec: Percent Recovered (surrogates)

PQL: Practical Quantitation Limit
DLR: Detection Limit for Reporting : PQL x Dilution
ND: None Detected at DLR
pCi/L: Picocurie per Liter

H: Analyzed outside of hold time
P: Preliminary result
S: Suspect result. See Case Narrative for comments.
E: Analysis performed by External laboratory. See External Laboratory Report attachments.
MDC: Min Detectable Concentration

Report Authentication Code:

BSK Analytical Laboratories
Engineers & Laboratories

1414 S. Minnislaus Street
Fresno, California 93706
(559) 497-2888
Fax (559) 485-6935

Certificate of Analysis

NELAP Certificate #04227CA
ELAP Certificate #1180

Janet Gutierrez
San Luis Water District
PO Box 2135
Los Banos, CA 93635

BSK Submission #: 2008071140
BSK Sample ID #: 1009997

Report Issue Date: 07/30/2008

Project ID: Project Desc:

Submission Comments:

Sample Type: Liquid
Sample Description: 79.60L
Sample Comments:

Date Sampled: 07/14/2008
Time Sampled: 1009
Date Received: 07/15/2008

Inorganics

Analyte	Method	Result	Units	PQL	Dilution	DLR	Prep Date/Time	Analysis Date/Time
Aggressive Index		**13**	-		1	N/A	07/30/08	07/30/08
Alkalinity (as CaCO3)	SM 2320 B	**200**	mg/L	3.0	1	3.0	07/15/08	07/15/08
Aluminum (Al)	EPA 200.7	**ND**	mg/L	0.050	1	0.050	07/16/08	07/22/08
Antimony (Sb)	EPA 200.8	**ND**	µg/L	2	1	2	07/16/08	07/24/08
Arsenic (As)	EPA 200.8	**6.2**	µg/L	2	1	2	07/16/08	07/24/08
Barium (Ba)	EPA 200.7	**0.15**	mg/L	0.050	1	0.050	07/16/08	07/22/08
Beryllium (Be)	EPA 200.8	**ND**	µg/L	1.0	1	1.0	07/16/08	07/24/08
Bicarbonate (as CaCO3)	SM 2320 B	**200**	mg/L	3.0	1	3.0	07/15/08	07/15/08
Cadmium (Cd)	EPA 200.8	**ND**	µg/L	1.0	1	1.0	07/16/08	07/24/08
Calcium (Ca)	EPA 200.7	**84**	mg/L	0.10	1	0.10	07/16/08	07/22/08
Carbonate (as CaCO3)	SM 2320 B	**ND**	mg/L	1.0	1	1.0	07/15/08	07/15/08
Chloride (Cl)	EPA 300.0	**140**	mg/L	1.0	2	2.0	07/15/08	07/15/08
Chromium - Total (Cr)	EPA 200.8	**ND**	µg/L	10	1	10	07/16/08	07/24/08
Conductivity - Specific (EC) @25°C	SM 2510 B	**1000**	µmho/cm	1.0	1	1.0	07/15/08	07/15/08
Copper (Cu)	EPA 200.7	**ND**	mg/L	0.050	1	0.050	07/16/08	07/22/08
Cyanide (CN)	SM 4500-CN-F	**ND**	µg/L	20	1	20	07/25/08	07/25/08
Fluoride	EPA 300.0	**0.20**	mg/L	0.10	1	0.10	07/18/08	07/18/08
Hardness (as CaCO3)	SM 2340 B	**370**	mg/L	1.0	1	1.0	07/30/08	07/30/08
Hydroxide (as CaCO3)	SM 2320 B	**ND**	mg/L	1.0	1	1.0	07/15/08	07/15/08
Iron (Fe)	EPA 200.7	**ND**	mg/L	0.050	1	0.050	07/16/08	07/22/08
Langelier Index (Saturation Index)	SM 2330 B	**1.0**	-	-	1	N/A	07/30/08	07/30/08
Lead (Pb)	EPA 200.8	**ND**	µg/L	5.0	1	5.0	07/16/08	07/24/08
Magnesium (Mg)	EPA 200.7	**40**	mg/L	0.10	1	0.10	07/16/08	07/22/08
Manganese (Mn)	EPA 200.7	**ND**	mg/L	0.010	1	0.010	07/16/08	07/22/08
MBAS, Calculated as LAS, mol wt 340	SM 5540 C	**ND**	mg/L	0.050	1	0.050	07/16/08 07:20	07/16/08 07:20
Mercury (Hg)	EPA 200.8	**ND**	µg/L	0.40	1	0.40	07/16/08	07/24/08
Nickel (Ni)	EPA 200.8	**ND**	µg/L	10	1	10	07/16/08	07/24/08
Nitrate (NO3)	EPA 300.0	**34**	mg/L	1.0	2	2.0	07/15/08 19:29	07/15/08 19:29
Nitrite (NO2-N)	EPA 300.0	**ND**	mg/L	0.050	2	0.10	07/15/08 19:29	07/15/08 19:29
pH at 23.19°C	SM 4500-H+ B	**8.1**	Std. Unit	-	1	N/A	07/15/08 19:42	07/15/08 19:42

mg/L: Milligrams/Liter (ppm)
mg/Kg: Milligrams/Kilogram (ppm)
µg/L: Micrograms/Liter (ppb)
µg/Kg: Micrograms/Kilogram (ppb)
%Rec: Percent Recovered (surrogates)

PQL: Practical Quantitation Limit
DLR: Detection Limit for Reporting : PQL x Dilution
ND: None Detected at DLR
pCi/L: Picocurie per Liter

H: Analyzed outside of hold time
P: Preliminary result
S: Suspect result. See Case Narrative for comments.
E: Analysis performed by External laboratory. See External Laboratory Report attachments.
MDC: Min Detectable Concentration

Report Authentication Code:

BSK Analytical Laboratories
Engineers & Laboratories

1414 S. Minnislaus Street
Fresno, California 93706
(559) 497-2888
Fax (559) 485-6935

Certificate of Analysis

NELAP Certificate #04227CA
ELAP Certificate #1180

Janet Gutierrez
San Luis Water District
PO Box 2135
Los Banos, CA 93635

BSK Submission #: 2008071140
BSK Sample ID #: 1009997

Report Issue Date: 07/30/2008

Project ID:
Project Desc:
Submission Comments:
Sample Type: Liquid
Sample Description: 79.60L
Sample Comments:

Date Sampled: 07/14/2008
Time Sampled: 1009
Date Received: 07/15/2008

Inorganics

Analyte	Method	Result	Units	PQL	Dilution	DLR	Prep Date/Time	Analysis Date/Time
Potassium (K)	EPA 200.7	**3.0**	mg/L	2	1	2.0	07/16/08	07/22/08
Selenium (Se) - Total	EPA 200.8	**5.6**	µg/L	2	1	2.0	07/16/08	07/25/08
Silver (Ag)	EPA 200.7	**ND**	mg/L	0.010	1	0.010	07/16/08	07/22/08
Sodium (Na)	EPA 200.7	**72**	mg/L	1.0	1	1.0	07/16/08	07/22/08
Sulfate (SO4)	EPA 300.0	**73**	mg/L	2	2	4.0	07/15/08	07/15/08
Thallium (Tl)	EPA 200.8	**ND**	µg/L	1.0	1	1.0	07/16/08	07/24/08
Total Dissolved Solids (TDS)	SM 2540 C	**600**	mg/L	5.0	1	5.0	07/15/08	07/17/08
Zinc (Zn)	EPA 200.7	**ND**	mg/L	0.050	1	0.050	07/16/08	07/22/08

mg/L: Milligrams/Liter (ppm)
mg/Kg: Milligrams/Kilogram (ppm)
µg/L: Micrograms/Liter (ppb)
µg/Kg: Micrograms/Kilogram (ppb)
%Rec: Percent Recovered (surrogates)

PQL: Practical Quantitation Limit
DLR: Detection Limit for Reporting : PQL x Dilution
ND: None Detected at DLR
pCi/L: Picocurie per Liter

H: Analyzed outside of hold time
P: Preliminary result
S: Suspect result. See Case Narrative for comments.
E: Analysis performed by External laboratory. See External Laboratory Report attachments.
MDC: Min Detectable Concentration

Report Authentication Code:

SAN LUIS WATER DISTRICT

WATER MANAGEMENT PLAN (2011)

APPENDIX O

BOARD RESOLUTION APPROVING WATER MANAGEMENT PLAN

RESOLUTION NO. 13-1021

OF THE BOARD OF DIRECTORS OF SAN LUIS WATER DISTRICT APPROVING THE DISTRICT'S UPDATED WATER MANAGEMENT PLAN

WHEREAS, Reclamation Law and the Central Valley Project Improvement Act require the District to prepare and implement a Water Management Plan (WMP) to be updated every five years; and

WHEREAS, District staff with the support of consulting services prepared a draft 2011/12 WMP five year update in compliance with 2011 Plan Criteria developed by the United States Bureau of Reclamation (USBR); and

WHEREAS, USBR has reviewed and approved the District's draft 2011/12 WMP attached hereto as Exhibit A; and

WHEREAS, the Board of Directors has reviewed the 2011/12 WMP and finds that it accurately describes the District's water management objectives and practices.

NOW, THEREFORE, BE IT RESOLVED by the Board of Directors of San Luis Water District as follows:

Section 1. Declaration of the Board. The facts stated in the recitals above are true and correct, and the Board so finds, determines and orders.

Section 2. Water Management Plan. The Board of Directors adopts and approves the 2011/12 WMP as presented.

Section 3. Further Actions. Subject to approval by USBR, the General Manager is hereby authorized to amend the WMP which may be deemed necessary or advisable in order to give effect to and comply with the intent of this Resolution and the WMP.

****

PASSED AND ADOPTED this 29th day of January, 2013.

Chris Hurd, President

Attest

Tom Teixeira, Secretary by Linda M. Bond, Assistant Secretary

****

I certify that the foregoing is a true and correct copy of a resolution duly adopted by San Luis Water District, a California Water District, at a regular meeting of the Board of Directors thereof duly called and held at 1015 Sixth Street, Los Banos, California on the 29th day of January, 2013.

Linda M. Bond, Assistant Secretary
San Luis Water District