Water Management Plan

(5 Year Update)

Prepared By
PANOCHE WATER DISTRICT
52027 West Althea Avenue Firebaugh, California 93622

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Section 1: Description of the District

District Name: Panoche Water District

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A. History

1.*Date district formed:* 2/17/1954 *Date of first Reclamation contract*: 8-16-1955

Original size (acres): 38,000 *Current year (last complete calendar year)*: 2012

2. Current size, population, and irrigated acres

	(enter data year)
Size (acres)	38,000
Population served	None
Irrigated acres	37,436

3. Water supplies received in current year

Water Source	*2012*
Federal urban water (Tbl 1)	
Federal agricultural water (Tbl 1)	46,827 acre feet
State water (Tbl 1)	
Other Wholesaler (define) (Tbl 1)	
Local surface water (Tbl 1)	
CCID	1,083 acre feet
District ground water (Tbl 2)	
Banked water (Tbl 1)	
Transferred water (Tbl 6)	19,009 acre feet
Recycled water (Tbl 3)	
Other (define) (Tbl 1)	
Total	47,910

4. Annual entitlement under each right and/or contract

	AF	*Source*	*Contract #*	*Availability period(s)*
Reclamation Agriculture	94,000	USBR		South of Delta Allocation

5. Anticipated land-use changes

None anticipated within next 5 years.

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 (2001)		*Previous Plan (2006)*		*Current Plan*	
Crop Name	*Acres*	*Crop Name*	*Acres*	*Crop Name*	*Acres*
Melons	1,250	Melons	4,452	Melons	1,976
Tomatoes	3,190	Tomatoes	4,469	Tomatoes	7,593
Cotton	11,106	Cotton	16,848	Cotton	4,203
Wheat	1,635	Alfalfa	3,078	Grapes	3,582
Alfalfa	2,903	Other (<5%)	7,002	Almonds	3,286
Other (<5%)	3,466			Pistachios	4,057
				Wheat	3,265
				Other (<5%)	9,474
Total	23,546	*Total*	35,849	*Total*	37,436

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

Original Plan		*Previous Plan (2006)*		*Current Plan*	
Irrigation Method	*Acres*	*Irrigation Method*	*Acres*	*Irrigation Method*	*Acres*
Surface	32,000	Drip	17,631	Drip	27,628
Sprinkler	5,600	Furrow	9,542	Furrow	4,858
		Sprinkler	10,000	Sprinkler	4,950
Total	37,600	*Total*	37,173	*Total*	37,436

(See Planner, Chapter 2, Appendix A for list of irrigation system types)

B. Location and Facilities

See **Figure 1** for points of delivery, turnouts (internal flow), and outflow (spill) points, measurement locations, conveyance system, storage facilities, operational loss recovery system, wells, and water quality monitoring locations

1. Incoming flow locations and measurement methods

Location Name	*Physical Location*	*Type of Measurement Device*	*Accuracy*
Delta-Mendota Canal MP 93.25-R		Propeller Meter	+/-2%
Delta-Mendota Canal MP 96.70-R		Propeller Meter	+/-2%
San Luis Canal MP 89.68-L		Propeller Meter	+/-2%
San Luis Canal MP 96.15-L		Propeller Meter	+/-2%
San Luis Canal MP 96.8-L		Propeller Meter	+/-2%
San Luis Canal MP 97.51-L		Propeller Meter	+/-1%
San Luis Canal MP 100.48-L		Propeller Meter	+/-2%
San Luis Canal MP 102.64-L		Propeller Meter	+/-2%

2. 2012 Agricultural Conveyance System

Miles Unlined - Canal	*Miles Lined - Canal*	*Miles Piped*	*Miles - Other*
14.05	23.25	7.6	0

3. 2012 Urban Distribution System- **No Urban System**

Miles AC Pipe	*Miles Steel Pipe*	*Miles Cast Iron Pipe*	*Miles - Other*

4. Storage facilities (tanks, reservoirs, regulating reservoirs) **No Storage Facility**

Name	*Type*	*Capacity (AF)*	*Distribution or Spill*

5. List of Storage facilities

No Storage Facility

6. Description of the agricultural spill recovery system

The Districts delivery system was configured such that no operational spills left the District boundaries. Operational spills from one lateral were picked up into an adjacent lateral, where they were delivered to the farm turnouts. As more drip irrigation systems have been installed, water demand variability has increased on some of the districts laterals. This has resulted in some flooding in certain areas. To minimize the occurrence of flooding, some spill water is currently discharge into the drainage system. A portion of the drainage water is blended with fresh water and recirculated within the District to augment the water supply and reduce the drainage water discharge.

The District has adopted a policy that requires each individual landowner to regulate and manage tailwater. The District does not accept tailwater in the drainage system or the irrigation water distribution system. This policy has led to each landowner improving management of irrigation water to curtail generation of tailwater and/or install tailwater recovery systems.

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

On-demand	*Scheduled*	*Rotation*	*Other (describe)*
	Applicable		

8. Restrictions on water source(s)

Source	*Restriction*	*Cause of Restriction*	*Effect on Operations*
Federal Water	RRA Requirements	USBR Operations	Reduces water use efficiency
Federal Water	Reduce CVP allocations	Drought/CVP Delta Diversion Limits	Supply uncertainly
Federal Water	24 hour lead time for water orders	SLC/DMC Operations	Reduces delivery flexibility

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

In order to reduce seepage, the District plans to improve some of the canals/laterals.

Lateral 2 Spill Recovery System: The objective is to capture operation spill water from Laterals 11E, 5, 3, and 2 before it gets into the drainage system. This project will remove about 2,000 AF of water from the drainage system and the recovered water will be returned to the District's irrigation system for use.

As the use of micro-irrigation within the District increases, modifications to the distribution system may have to be made to efficiently meet irrigation water demands.

C. Topography and Soils

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

The topography in the District varies from moderately sloping to mild sloping lands. Lands in the extreme portions of the District range in slope from 30 to 40 feet per mile. The mild sloping land is located in the northern and eastern portions of the District with slopes ranging from 8 to 20 feet per mile.

Over time, much of the land in the District has been mechanically leveled to decrease field slope and provide more uniform slopes resulting in improved irrigation uniformity and efficiency. Where the field slopes are excessive due to topography, sprinklers or drip systems are used for irrigation.

On lands where surface irrigation tail water cannot be minimized due to the terrain or irrigation method, land owner return systems are used. Return systems are put in place to captures tail water and reuse by the land owner. The terrain within the District has not posed a significant problem that cannot be overcome with the selection of the appropriate irrigation technology and irrigation management.

2. District soil association map (Agricultural only)

See Figure 2

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

Soil Problem	Est. acres	Effect on water operations and management
Poorly drained	22,000 [11]	Tile drainage systems have been installed in most poorly drained areas.
Sandy Soils	3,400	Infiltration rates are high. Delivery laterals that traverse it may need concrete lining.
Selenium	22,000 [11]	Ability to discharge the water is limited, therefore increasing recycling.
Boron	22,000 [11]	Limits reuse of subsurface water
Salinity	22,000 [11]	Limits reuse of subsurface water

[11] Total tiled acreage in the District.

D. Climate

2. General climate of the district service area

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Avg Precip.	1.40	1.44	0.85	0.58	0.21	0.02	0	.01	.05	0.45	0.63	0.82	6.45
Avg Temp.	45.9	50.5	55.2	59.3	66.9	72.8	76.7	74.6	70.7	61.6	52.1	45.3	61.0
Max. Temp.	55.0	60.9	67.0	72.1	81.1	88.3	93.2	91.4	86.7	76.1	64.3	55.9	74.3
Min. Temp	37.8	40.8	42.8	45.6	51.2	56.2	60.2	58.8	55.34	48.0	40.6	36.0	47.8
ETo	1.16	1.96	4.08	5.60	7.680	8.53	8.44	7.37	5.72	3.94	2.02	1.25	4.81

Weather station ID Panoche #124 *Data period: Year* 1/1/1998 *to Year* 12/31/2012

Average wind velocity 5.0 *Average annual frost-free days:* 300

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

No microclimates exist in the District.

E. Natural and Cultural Resources

4. Natural resource areas within the service area

Name	*Estimated Acres*	*Description*
NONE		

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

No past or present management.

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

Name	*Estimated Acres*	*Description*
NONE		

F. Operating Rules and Regulations

1. Operating rules and regulations

The water delivery rules are attached as Appendix A Panoche tail water policy

2. Water allocation policy (Agricultural only)

The District allocates its water supply to the water users on a pro-rata basis depending on the acreage farmed within the District. Water users are required to file a water application with the District at the beginning of the water year stating their desire to take all or a portion of their allocated water for the upcoming year. (A copy of a water application is attached in Appendix C.) If a user does not want any or a portion of their allocation, that amount of water is reallocated to all other water users.

3. Official and actual lead times necessary for water orders and shut-off (Agricultural only)
The District requires a 24-hour notification of all water orders. The District normally allows variable shut-off times to avoid wasteful use of water.

4. Policies regarding return flows (surface and subsurface drainage from farms) and outflow
The District, which is a part of Panache Drainage District (PDD), requires that all tailwater be retained on farm and be managed by each water user. Discharge of tailwater into PDD system is prohibited. See Appendix A, Resolution No. 499-98.

The District manages drainage so that its drainage reduction goal is attained. The drainage water is recycled into the delivery system to achieve blended water quality of an average of no more than 700 mg/I Total Dissolved Solids (TDS) and 0.7 mg/I Boron.

Subsurface drain water is captured, stored, recirculated and used within the District, or discharged into the PDD system. Ultimately, PDD discharges drainage water into the San Luis Drain under a Waste Discharge Permit for the Grassland Bypass Project issued to the SLDMWA and Reclamation. The current permit expires on 12/31/19. See Appendix B.

5. Policies on water transfers by the district and its customers
The District allows individual transfers of water between individual water users within the District as well as transfers to other CVP contractors. Any transfer costs, including USBR water costs and District administrative, operation, and maintenance costs, are the responsibility of the transferor. See Appendix A.

G. Water Measurement, Pricing, and Billing

1. *Agricultural Customers*

a. Number of farms **61**

b. Number of delivery points (turnouts and connections) **218**

c. Number of delivery points serving more than one farm **0**

d. Number of measured delivery points (meters and measurement devices) **218**

e. Percentage of delivered water that was measured at a delivery point **100%**

f. Delivery point measurement device table (Agricultural only)

Measurement Type	*Number*	*Accuracy (+/- %)*	*Reading Frequency (Days)*	*Calibration Frequency (Months)*	*Maintenance Frequency (Months)*
Orifices					
Propeller meter	218	+/- 2%	Daily	Yearly, All Meters	12
Weirs					
Flumes					
Venturi					
Metered gates					
Total	218	+/- 2%	Daily	Yearly, All	12

2. *Urban Customers*

a. Total number of connections N/A

Total number of metered connections 0

b. Total number of connections not billed by quantity ____________

percentage of water that was measured at delivery point _

percentage of delivered water that was billed by quantity _

Measurement device table

Meter Size and Type	*umber*	*Accuracy (+/-percentage)*	*Reading Frequency (Days)*	*Calibration Frequency (Months)*	*Maintenance Frequency (Months)*
5/8-3/4"					
1"					
1 ½"					
2"					
3"					
4"					
6"					
8"					
10"					
Compound					
Turbo					
Other (define)					
Total					

3. *Agriculture and Urban Customers*

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

See attached document in Exhibit 3: Water Rates. Copies of typical water bills and a drainage bill are attached in Exhibit 4 Annual charges collected from customers.

The annual District USBR water allocation is prorated to each water user based on the water user's acreage in the District. The charges for allocation water are paid by the water user in two equal installments, due in March and June each year for the water year beginning in March. As water is used by the farmer, the District charges an operation and maintenance fee based on the volume of water used, which is billed monthly.

The District has in place a tiered water pricing system to promote water conservation. There are a pre-irrigation tier and seasonal tiers. The pre-irrigation tier is set at 9 inches of applied water. The grower is charged twice the rate for water used over the tier. Season tiers are established based on the District's cost of the water.

The seasonal tiers are applied to all water delivered above the CVP water allocation. Since the allocation rarely meets the District's delivery requirement these tiers are applied to the majority of growers in most years. This practice promotes water conservation and reduces the water supply augmentation requirements.

Fixed Charges			
Charges ($ unit)	*Charge units ($/acre), ($/customer) etc.*	*Units billed during year (acres, customer) etc.*	*$ collected ($ times units)*
$30.00[I]	37,815.90	37,815.90 Acres	$1,134477.00
$7.75[II]	38,129.30	38,129.30 Acres	$295,502.07
$10.00[III]	3,714.20	3,714.20 Acres	$37,142.00

[I] Drainage service fee- Tiled land [II] Drain water recirculation & recovery project. [iII] Drainage Service Fee-Non Tiled Land

Volumetric charges			
Charges ($ unit)	*Charge units ($/AF), ($/HCF), etc.*	*Units billed during year (AF, HCF) etc.*	*$ collected ($ times units)*
103.00[I]	46,538	46,538 AF	$4,793,414
194.00[II]	26,564	26,564 AF	$5,153,416

[I] USBR Water Allocation (Tier 1) [II] Supplemental Water (Tier 2).

b. Water-use data accounting procedures

The District utilizes the water resource management software called STORM. This software has the capability of managing all water transactions including allocations, orders, transfers, deliveries, etc., and most financial transactions including billing, cash receipts, and accounts receivable. Other key features the software offers are parcel management (section, township, range, acres etc.), name management (landowners or leasing information), and field management (crop, irrigation method, land classification, etc). All water records are kept on computer backup files stored in a secured vault. Water records on file for each landowner cover a period of eight years. See Exhibit 5

H. Water Shortage Allocation Policies

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

See Appendix A, Amendment of Rules and regulations, Rule 8.

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

The District has a policy that all tailwater is to be retained on farm by the individual water users. This policy does not allow for the dumping of tailwater in the District's drainage or distribution system and prohibits wasting of water. When a water user exhausts the allocated water, unless other water is purchased or transferred to the District, there is no additional District water allocated to the account. Evident wasting of water is reported by District personnel to the District Water Department, and the water user is contacted and remedial measures are taken. Waste of water is ill afforded due to the limited water supply and the cost of the supply. See Appendix A .Resolution No 499-98

Section 2: Inventory of Water Resources

A. Surface Water Supply

1. *Acre-foot amounts of surface water delivered to the water purveyor by each of the purveyor's sources*

   See Water Inventory Tables 1

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

   See Table 8

B. Ground Water Supply

1. Acre-foot amounts of ground water pumped and delivered by the district

In 2012 groundwater deliveries were 2,073 acre feet. Groundwater quality within the District is poor and it is not a preferred water source. Groundwater is used only when surface supplies are insufficient.

2. Ground water basin(s) that underlies the service area

Name	*Size (Square Miles)*	*Usable Capacity (AF)*	*Safe Yield (AF/Y)*
San Joaquin Basin-DAU 216	13,500	80,000,000	60% -est.

3. Map of district-operated wells and managed ground water recharge areas

The District owns and operates one well. No recharge areas exist in the District. **Exhibit 2,**Figure 1.

4. Description of conjunctive use of surface and ground water

None. Groundwater within the District is of poor quality and used only when surface supplies are insufficient.

5. Ground Water Management Plan

Panoche Water District is an agency in the Southern Delta-Mendota Canal service area. San Luis Delta-Mendota Water Authority adopted an AB 3030 Groundwater Management Plan on November 1994 and the District is a participating agency with that plan. See document attached in Exhibit 6.

6. Ground Water Banking Plan

The District does not participate in a ground-water banking plan.

C.Other Water Supplies

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

See Exhibit 1, Table 1.

D.Source Water Quality Monitoring Practices

1. Potable Water Quality (Urban only) *N/A*

2. Agricultural water quality concerns: *Yes* ___X___ *No* ________

(If yes, describe)

Salinity or total dissolved solids (TDS) of the water delivered to the users is the primary concern. TDS of irrigation water (measured by EC) delivered to the laterals is checked twice a day after blending of fresh water and drainage water, when the amount of drain water recirculated changes. The District maintains the TDS of the blended supply below 800 mg/L. Water quality data are furnished to the water users upon request. Data on the amount of water delivered to each field is also available in the District office and is checked daily by many of the water users.

Annual water quality report is attached in Exhibit 7.

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

Current water quality monitoring programs for surface water (water monitored daily by Panoche Water District)

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

Analyses Performed	*Frequency*	*Concentration Range*	*Average*
TDS	Daily	200 to 800 mg/l	650
Alkalinity (mg/I)	Monthly	45-92	66.4
Bicarbonate (mg/I)	Monthly	39-83	61.7
Boron (mg/I)	Monthly	ND-2.0	0.4
Calcium (mg/I)	Monthly	13-120	30
Carbonate (mg/I)	Monthly	ND-35	4.8
Chloride (mg/I)	Monthly	31-190	65.6
Conductivity (µmho/cm)	Monthly	270-1500	533
Hydroxide (mg/l)	Monthly	ND	ND
Magnesium (mg/l)	Monthly	6.4-29	12.3
Nitrate (mg/I)	Monthly	1-30	8.1
Percent Sodium(%)	Monthly	44-55	49.5
pH	Monthly	7.6-9.6	8.3
Potassium (mg/I)	Monthly	ND-2.5	1.4
Selenium (µg/l)	Monthly	ND-16	4.4
Sodium (mg/l)	Monthly	23-190	59.6
Sulfate (mg/I)	Monthly	19-390	95.5

Current water quality monitoring programs for groundwater by source (Agricultural only)

Analyses Performed	*Frequency*	*Concentration Range*	*Average*
TDS	Yearly	1400-2200	1800
Alkalinity (mg/I)	Yearly	150-250	150
Bicarbonate (mg/l)	Yearly	150-300	150
Boron (mg/I)	Yearly	ND-3.0	2.4
Calcium (mg/I)	Yearly	60-75	64
Carbonate (mg/I)	Yearly	ND	ND
Chloride (mg/I)	Yearly	200-300	200
Conductivity (µmho/cm)	Yearly	2200-3600	2940
Hydroxide (mg/l)	Yearly	ND	ND
Magnesium (mg/l)	Yearly	30-50	39
Nitrate (mg/I)	Yearly	1-30	9.5
Percent Sodium(%)	Yearly	60-80	69
pH	Yearly	7.6-9.6	8.1
Potassium (mg/I)	Yearly	2-8	4.7
Selenium (µg/l)	Yearly	ND-20	11
Sodium (mg/l)	Yearly	320-370	340
Sulfate (mg/I)	Yearly	550-650	580

E. Water Uses within the District

1. *Agricultural*

See Table 5

Types of irrigation systems used for each crop in current year

Crop name	*Total Acres*	*Level Basin - acres*	*Furrow - acres*	*Sprinkler - acres*	*Low Volume - acres*	*Multiple methods -acres*
Grapes	3,582				3,582	
Tomatoes	7,593				7,593	
Cotton	4,203		500		3,703	
Pistachios	4,057				4,057	
Almonds	3,285				3,285	
Wheat	3,265			3,265		

3. *Urban use by customer type in current year.* N/A

Customer Type	*Number of Connections*	*AF*
Single-family		
Multi-family		
Commercial		
Industrial		
Institutional		
Landscape irrigation		
Wholesale		
Recycled		
Other (specify)		
Other (specify)		
Other (specify)		
Unaccounted for		
Total		

4. *Urban Wastewater Collection/Treatment Systems serving the service area – N/A*

Treatment Plant	*Treatment Level (1, 2, 3)*	*AF*	*Disposal to / uses*
N/A			

5. *Ground water recharge/management in current year (Table 6)*

Recharge Area	*Method of Recharge*	*AF*	*Method of Retrieval*

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

From Whom	*To Whom*	*AF*	*Use*
PWD	WWD	1030	Agriculture
PWD	SLWD	2000	Agriculture
PWD	WWD	500	Agriculture
PWD	WWD	600	Agriculture
PWD	WWD	500	Agriculture
PWD	WWD	100	Agriculture
PWD	WWD	250	Agriculture
PWD	SLWD	400	Agriculture
PWD	WWD	400	Agriculture

PWD	WWD	100	Agriculture
PWD	OLWD	200	Agriculture
PWD	WWD	238	Agriculture
PWD	WWD	400	Agriculture
PWD	PAC	100	Agriculture
PWD	WWD	1500	Agriculture
PWD	SLWD	200	Agriculture
PWD	MSWD	132	Agriculture
PWD	WWD	1000	Agriculture
PWD	WWD	250	Agriculture
PWD	SLWD	150	Agriculture
PWD	WWD	140	Agriculture
PWD	SLWD	185	Agriculture
PWD	SLWD	24	Agriculture
PWD	WWD	2500	Agriculture
PWD	SLWD	5	Agriculture
PWD	WWD	50	Agriculture
PWD	SLWD	50	Agriculture
PWD	WWD	130	Agriculture
PWD	SLWD	110	Agriculture
PWD	WWD	100	Agriculture
PWD	WWD	1300	Agriculture
PWD	SLWD	465	Agriculture
PWD	WWD	3500	Agriculture
PWD	MSWD	400	Agriculture
WSID	PWD	1000	Agriculture
PAC	PWD	32	Agriculture
WSID	PWD	573	Agriculture
PAC	PWD	380	Agriculture
DPWD	PWD	671	Agriculture
PAC	PWD	35	Agriculture

7. *Trades, wheeling, wet/dry year exchanges, banking or other transactions in current year* N/A
8. *Other uses of water in current year* **N/A**

F. Outflow from the District (Agricultural only)

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),"

See Facilities Map, Exhibit 2, Figure 1

Surface and subsurface drain/outflow in current year

Outflow point	*Location description*	*AF*	*Type of measurement*	*Accuracy (%)*	*% of total outflow*	*Acres drained*
	Subsurface flows	**10,497**	**Datalogger**	**+/- 2%**	**100%**	**97,000**

Outflow point	*Where the outflow goes (drain, river or other location)*	*Type Reuse (if known)*
	San Joaquin River Quality Improvement Project	**Reuse – Irrigation of Salt Tolerant Crops**
	Grassland Bypass Project – Discharge to the San Luis Drain	**Discharge**

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

PDD monitors the drainage water coming into its system and the discharge at PE-14. Subsurface drainage inflows are continually monitored by a flow meter installed on each tile sump. The District compares the measured tile sump volumes with target sump volumes in order to meet the District's Total Maximum Monthly Load (TMML) allocation for selenium discharged to the San Joaquin River. The quality of the water' discharged by each sump is monitored three times a year (In April, July and October) by measurements of EC, selenium, and boron.

Drainage leaving the District at PE-14 is monitored by storing stage data supplied by an encoder mounted at the measuring weir, as well as using a staff gauge. An EC/temperature probe stores daily data on the same data logger. An auto sampler is programmed to take samples every 2 hours, and then the composite sample for the week is sent to a certified testing lab where it is analyzed for boron, selenium, and EC. Sampling at the PE-14 site is conducted in cooperation with the SLDMWA and the Grassland Bypass Project.

2. *flow (surface drainage & spill) Quality Testing Program*

Analyses Performed	*Frequency*	*Concentration Range*	*Average*	*Reuse limitation?*
EC	Weekly	4,000-6,000 µmho/cm	5,200 umho/cm	Unsuitable for all crops
Selenium	Weekly	50-200 ug/L	94 ug/L	NONE
Boron	Weekly	4-8 ug/L	5.9ug/L	Unsuitable for all crops

3. *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.*

Panoche Water District is located within the Grassland Drainage Area, which is a 100,000 acre region that is regulated by a Total Maximum Monthly Load (TMML) program for selenium discharge through the Grassland Bypass Project and includes an extensive monitoring program. Regulation and enforcement of that TMML is performed by the Central Valley Regional Water Quality Control Board. As a stakeholder participant in that program, the District has implemented a number of actions to minimize its drainage discharges, including:

- No tailwater discharge policy. The District aggressively enforces a district-wide prohibition of surface irrigation runoff (tailwater). Al growers are required eliminate or recirculate their surface runoff.
- Recirculation of subsurface drain water. To the extent possible, the District recirculates subsurface drain water back into the irrigation system, reducing the volume of drainage that leaves the District.
- Encouragement of high-efficiency irrigation systems. High-efficiency irrigation methods (such as subsurface drip and micro-sprinklers) reduce deep percolation which reduces the volume of subsurface drain water. When possible, the District offers low-interest loans to growers to facilitate their installation.
-

- Implementation of the Westside Regional Drainage Plan. The Westside Regional
-
- Drainage Plan was developed by the districts within the Grassland Drainage Area and other stakeholders to provide an ultimate solution to subsurface drainage discharges from the region. Panoche Water District is participating in the implementation of that plan.

G. Water Accounting (Inventory)

1. *Water Supplies Quantified*

    a. *Surface water supplies, imported and originating within the service area, by month (Table 1)*
    b. *Ground water extracted by the district, by month (Table 2)*
    c. *Effective precipitation by crop (Table 5)*
    d. *Estimated annual ground water extracted by non-district parties (Table 2)*
    e. *Recycled urban wastewater, by month (Table 3)* N/A
    f. *Other supplies, by month (Table 1)*

2. *Water Used Quantified*

    a. *Agricultural conveyance losses, including seepage, evaporation, and operational spills in canal systems (Table 4) or*
    Urban leaks, breaks and flushing/fire uses in piped systems (Table 4)
    b. *Consumptive use by riparian vegetation or environmental use (Table 6)* N/A
    c. *Applied irrigation water - crop ET, water used for leaching/cultural practices (e.g., frost protection, soil reclamation, etc.) (Table 5)*
    d. *Urban water use (Table 6)*
    e. *Ground water recharge (Table 6)* N/A
    f. *Water exchanges and transfers and out-of-district banking* N/A
    g. *Estimated deep percolation within the service area (Table 6)*
    h. *Flows to perched water table or saline sink (Table 7)*
    i. *Outflow water leaving the district (Table 6)*

3. *Overall Water Inventory*
a. *Table 6*

H. Assess Quantifiable Objectives:

Identify the Quantifiable Objectives that apply to the District (Planner, chapter 10) and provide a short narrative describing past, present and future plans that address the CALFED Water Use Efficiency Program goals identified for the District.

QO #	*QO Description*	*Past, Present & Future Plans*
106	Decrease flows to Salt Sinks to increase water supplies for beneficial uses.	PWD encourages growers to modernize their irrigation systems to increase efficiency and reduce deep percolation. PWD is pursuing funding to install lining in canals, laterals and regulating reservoirs.
109	Provide Long-term diversion flexibility to increase the water supply for beneficial uses.	PWD encourages growers to modernize their irrigation systems to increase efficiency and has provided funding assistance to this end. PWD is also pursuing funding to upgrade water delivery infrastructure to reduce seepage losses and increase system reliability.

93	Reduce Group A Pesticides to enhance and maintain beneficial uses of water.	Growers within PWD no longer use Group A Pesticides.
95,96,98	Reduce native constituents to enhance and maintain beneficial uses of water.	PWD has participated in the Grassland Bypass Project since its inception to manage and reduce discharges of subsurface drain water. Through a combination of irrigation system and distribution facilities improvements, drainage reuse, and ultimately treatment, PWD expects to eventually eliminate drainage discharges from the district.
97,99, 100,101	Reduce Pesticides to enhance and maintain beneficial uses of water.	Growers within PWD follow appropriate management practices to minimize drift and discharge pesticides. PWD has also
		implemented a "no tailwater" policy, which prohibits growers from discharging tailwater and prevents pesticides from leaving the district through surface runoff.
102,103, 104	Reduce salinity to enhance and maintain beneficial uses of water.	PWD encourages growers to modernize their irrigation systems to increase efficiency and reduce deep percolation and the subsequent production of saline drainwater. PWD has provided funding assistance to growers for irrigation systems improvements. PWD is pursuing funding to install lining in canals, laterals and regulating reservoirs. Additionally, PWD participates in the Grassland Bypass Project to manage and reduce discharges of subsurface drain water. Through a combination of irrigation system and distribution facilities improvements, drainage reuse, and ultimately treatment, PWD expects to eventually eliminate drainage discharges from the district.

Section 3: 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%*

Number of turnouts that are unmeasured or do not meet the standards listed above: 0

ımber of measurement devices installed last year: 3

Number of measurement devices installed this year: 1

Number of measurement devices to be installed next year: 0

Types of Measurement Devices Being Installed	*Accuracy*	*Total Installed During Current Year*
Propeller (NS-OF 32)	+/- 2%	1

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

Name: Juan Cadena *Title:* Drainage Coordinator

Address: 52027 W. Althea Ave, Firebaugh, CA. 93622

Telephone: (209) 364-6136 *E-mail:* jcadena@panochewd.org

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

a. On-Farm Evaluations

1) On farm irrigation and drainage system evaluations using a mobile lab type assessment

	Total in district	*# surveyed last year*	*# surveyed in current year*	*# projected for next year*	*# projected 2nd yr in future*
Irrigated acres	37,163				
Number of farms	61	0	0	10	10

The District will send a notice at the beginning of the irrigation season included with their monthly billing.

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

The District understands the importance of crop-specific and field-specific water use data; however, water delivered to the growers is recorded at the grower turnout, which usually serves multiple fields and crops. Therefore, it is not possible to account for the water deliveries by crop and field. The grower manages the water deliveries to their fields but does not report these data to the District.

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

The District provides weather station data and promotes the use of CIMIS data. The District informs the grower's via U.S. mail and email, about the availability of the data in the District office. The District also promotes the use of Westlands Water District (WWD) website for irrigation scheduling and WWD web link **(https://cs.westlandswater.org/resources/wtrcon/guide/tfoawx.htm)**

See attached document in Exhibit 9.

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

Electrical conductivity (EC) of the water in the delivery system is checked twice daily during the irrigation season when recirculating drainage water, and the results are furnished upon request to the water users. Data on the amount of water delivered to each field is also available in the District office and is checked daily by many of the water users. Subsurface drainage flow is measured with propeller meters on each pump discharge and tabulated monthly. EC, selenium, and boron concentrations of each tile sump as well as the District's discharge point are checked monthly. In the fall of 1996, the District became a participating agency in the Grassland Bypass Project, which routed it's drainage, along with that of seven other district, to the San Luis Drain and ultimately the San Joaquin River. This discharge is subject to comprehensive water quality and biological monitoring and must comply with waste discharge requirements regulated by the Central Valley Regional Water Quality Control Board. The District continues its extensive drain water quality-monitoring program. All drainage sumps are analyzed for electrical conductivity, boron, and selenium three times

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

See attached document in Exhibit 10.

District Water Conservation Library. The District maintains a library of literature regarding crop water use, irrigation management practices, and basic irrigation science acquired through public sources such as the UC Extension Service. This literature is available in the District office to be reviewed by water users.

Irrigation Seminars and Short Course. The District notifies its water users of seminars and workshops sponsored by various public agencies, such as Cal- Poly/SLO Irrigation Training and Research Center. The objective of the seminars and short-courses is to inform water users of current research or methods of improved irrigation and drainage reduction techniques. Notifications to water users take place at least two times per year.

District-Sponsored Seminars. As an ongoing water conservation activity, the District's Water Conservation coordinator meets with growers one-on-one or in small groups to discuss irrigation management principles either in classroom or field situations. This allows focused attention to specific management methods and questions.

Grassland Area Farmers Meeting. As the need to minimize and regulate subsurface drainage becomes paramount, it is crucial to keep the landowners, water user's staff, and the public informed of the current circumstances including any changes in policy. The District strongly promotes attending any of the public meetings pertaining to drainage.

Employee Training. Employees attend training and seminars on various topics, such as pumps, and basic pipeline hydraulics classes. The objected is to help the water user with on farm situations regarding pumps and pipeline hydraulics upon request.

The focus for the future is to involve more irrigation foreman and field workers in the educational opportunities.

4. Pricing structure - based at least in part on quantity delivered
Describe the quantity-based water pricing structure, the cost per acre-foot, and when it became effective.

The District charges for the measured volume of water delivered to each water user under a tiered pricing system. This provides an incentive for increased irrigation efficiency, thus decreasing subsurface drainage volumes.
(Copies typical water bills are attached in Exhibit 4.)

5. *Evaluate and describe the need for changes in policies of the institutions to which the district is subject*

   Reclamation's annual CVP allocations are announced too late in the year for growers to effectively plan and optimize their water use. CVP water allocations need to be announced no later than January 31st of each year.

6. *Evaluate and improve efficiencies of district pumps*

Describe the program to evaluate and improve the efficiencies of the contractor's pumps.

The District has an extensive pump-testing program for District pumping facilities. Each pump is evaluated every year, with inefficient pumps being replaced or repaired.

B. Exemptible BMPs for Agricultural Contractors

1. *Facilitate alternative land use*

The District provides for alternate use of land for management of subsurface drainage water through their participation in the SJRIP. In this project, lands have been purchased and converted from traditional agriculture to irrigation of salt tolerant crops with subsurface drainage water. This program has resulted in a substantial reduction in drainage water discharge to the San Joaquin River improving the water quality in the river.

2. *Facilitate use of available recycled urban wastewater that otherwise would not be used beneficially, meets all health and safety criteria, and does not cause harm to crops or soils*

Sources of Recycled Urban Waste Water	*AF/Y Available*	*AF/Y Currently Used in District*
No Urban waste water available.		

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

Funding source Programs	*How provide assistance*
Low interest loans, grants	DWR, USBR, SWRCB, SRF

The District has pursued low interest loans made available through the State of California State Revolving Fund (SRF) and Agricultural Drainage Loan Program (ADLP). These programs provide low interest loans to the District which, in turn, are provided to land owners for irrigation system improvements. Growers have improved irrigation methods on 1663 acres. Additionally, the District can help growers apply for funding through other assistance programs such as the NRCS EQIP program. The District is still pursuing low interest loans, and grants.

4. *Incentive pricing*

The District utilizes a tiered block pricing system consisting of both a pre-irrigation tier and a seasonal tier. See Section 1.G for description of pricing. This system is an incentive for increased on-farm water use efficiency, reducing deep percolation and the consequential drainage component that must be managed by the District.

5. *a) Line or pipe ditches and canals*

Canal/Lateral (Reach)	*Type of Improvement*	*Number of Miles in Reach*	*Estimated Seepage (AF/Y)*	*Accomplished/ Planned Date*
Contour	Lining	1.25	0	3/2012

b) Construct regulatory reservoirs

Reservoir Name	*Annual Spill in Section (AF/Y)*	*Estimated Spill Recovery (AF/Y)*	*Accomplished/ Planned Date*
Lateral 2 Spill Recover System	2,000	2,000	3/2014

*Spill was going into the Drainage System and recirculated by our Recirculation Plant for Ag deliveries.

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

The District continues to operate within the constraints of its existing water distribution system to maximize flexibility in water deliveries. As listed in 7, below our constructed, water delivery flexibility will improve.

7. *Construct and operate district spill and tailwater recovery systems*

The District has been able to operate without operational spills by putting some reliance on the tailwater collection and return systems utilized by the growers. Excess water in the system would be delivered to the field and would become a component of tailwater to be stored and reapplied by the grower. With the conversion of irrigation methods from furrow to drip, tailwater systems are being abandoned and are no longer available to manage operational spills. As a result, the District is taking various steps to modify its system to capture and reuse the newly created operational spill water. The projects identified in the Phase I Master Plan, as a result, have changed priority and the design concepts have been modified to lessen the incremental cost of plan implementation.

The District has not been able to obtain funds for the Herndon Avenue Lateral (HAL) project and needs to move forward with the spill recovery project using Lateral 2. The concept plan for the HAL will be modified at the time the District needs to increase delivery capacity and flexibility to accommodate drip irrigation systems.

The plan now includes the following elements listed by priority:

I. Lateral 1 improvement, to reduce seepage and operational spill.

2. Lateral 2 Spill Recovery System, which will provide the spill recovery function rather than the proposed HAL.

3. Reconfiguring new spill recovery systems for Lateral 3, Lateral 5, and the 11E extension, to connect to the Lateral 2 Spill Recovery System. The spill recovery system covering the southeast portion of the District, initially planned to be function of the HAL, will now be accommodated by the Lateral 2 Spill Recovery System. Lateral 11E Spill was already constructed to convey spill from Lateral 11 E to Lateral 3.

8.*Plan to measure outflow.*

The District operates the distribution system with no out flow.

Total # of outflow (surface) locations/points **0**

Total # of outflow (subsurface) locations/points **0**

Total # of measured outflow points **0**

Percentage of total outflow (volume) measured during report year **0**

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

Location & Priority	*Estimated cost (in $1,000s)*				
	2009	*2010*	*2011*	*2012*	*2013*

9. Optimize conjunctive use of surface and ground water

Groundwater is not a preferred source of water and is used only when surface supplies are insufficient. The District does not have a conjunctive use policy.

10. Automate canal structures

The District's conveyance system captures and returns operational spill. Automation of canal structures would provide limited benefit.

11. Facilitate or promote water customer pump testing and evaluation

The water conservation coordinator meets and advises farmers of the benefits of maintaining high pumping efficiency and of the available pump testing service (SLDMWA Pump Evaluation Program).

See Exhibit 8, Notices of District Education Programs and Services Available to Customers

The water conservation coordinator meets with growers and advises them of:

1) The benefits of keeping pump efficiency high;
2) The SLDMWA pump evaluation program;
3) The program is currently at no customer cost

12. Mapping

The District has evaluated GIS software along with other mapping software and has determined that, because of the size of the District, the cost of the software, and the staff training required to effectively use it, implementation of a GIS program is not an appropriate use of District resources. The District uses Auto Cad to develop the distribution and drainage systems. The District is satisfied with the Auto Cad program.

GIS maps	*Estimated cost (in $1,000s)*				
	2009	*2010*	*2011*	*2012*	*2013*
Layer 1 – Distribution system	**$0**	**$0**	**$0**	**$0**	**$0**
Layer 2 – Drainage system	**$0**	**$0**	**$0**	**$0**	**$0**
Suggested layers:					
Layer 3 – Ground water information	**$0**	**$0**	**$0**	**$0**	**$0**
Layer 4 – Soils map	**$0**	**$0**	**$0**	**$0**	**$0**
Layer 5 – Natural & cultural resources	**$0**	**$0**	**$0**	**$0**	**$0**
Layer 6 – Problem areas	**$0**	**$0**	**$0**	**$0**	**$0**

1. Provide a 3-Year Budget for Implementing BMPs

2. *Amount actually spent during current year.*

3.

BMP #		*BMP Name*	*Actual Expenditure (not including staff time)*	*Staff Hours*
A	*1*	*Measurement*	$1200	160
	2	*Conservation staff*	$0	20
	3	*On-farm evaluation /water delivery info*	$0	8
		Irrigation Scheduling	$150	8
		Water quality	$74,505	80
		Agricultural Education Program	$150	8
	4	*Quantity pricing*	$0	0
	5	*Policy changes*	$0	0

	6	*Contractor’s pumps*	$90,651.58	160
B	1	*Alternative land use*	$0	0
	2	*Urban recycled water use*	$0	0
		(continued)		0
	3	*Financing of on-farm improvements*	$0	0
	4	*Incentive pricing*	$0	0
	5	*Line or pipe canals/install reservoirs*	$350,415	90
	6	*Increase delivery flexibility*	$0	0
	7	*District spill/tailwater recovery systems*	$0	0
	8	*Measure outflow*	$0	0
	9	*Optimize conjunctive use*	$0	0
	10	*Automate canal structures*	$0	0
	11	*Customer pump testing*	$0	0
	12	*Mapping*	$2,000	*160*
		Total	$517,073	694

2. *Projected budget summary for the next year.*

BMP #		*BMP Name*	*Budgeted Expenditure (not including staff time)*	*Staff Hours*
A	1	*Measurement*	$600	80
	2	*Conservation staff*	$0	10
	3	*On-farm evaluations/water delivery info*	$300	16
		Irrigation Scheduling	$0	10
		Water quality	$73,000	8
		Agricultural Education Program	$600	20
	4	*Quantity pricing*	$0	0
	5	*Policy changes*	$0	0
	6	*Contractor‟s pumps*	$15,000	40
B	1	*Alternative land use*	$0	0
	2	*Urban recycled water use*	$0	0
	3	*Financing of on-farm improvements*	$0	0
	4	*Incentive pricing*	$0	0
	5	*Line or pipe canals/install reservoirs*	$25,000	0
	6	*Increase delivery flexibility*	$25,000	0
	7	*District spill/tailwater recovery systems*	$25,000	0
	8	*Measure outflow*	$0	0
	9	*Optimize conjunctive use*	$0	0
	10	*Automate canal structures*	$0	0
	11	*Customer pump testing*	$3,000	0
	12	*Mapping*	$500	30
		Total	$168,000	214

3. Projected budget summary for 3rd year.

BMP #		BMP Name	Budgeted Expenditure (not including staff time)	Staff Hours
A	1	Measurement	$600	80
	2	Conservation staff	$0	10
	3	On-farm evaluations/water delivery info	$300	16
	4	Irrigation Scheduling	$0	10
	5.	Water quality	$72,000	8
	6.	Agricultural Education Program	$600	20
	7.	Quantity pricing	$0	0
	8.	Policy changes	$0	0
	9.	Contractor's pumps	$15,000	40
		Total	$93,900	184

	BMP #	BMP Name	Budgeted Expenditure (not including staff time)	Staff Hours
B	1	Alternative land use	$0	0
	2	Urban recycled water use	$0	0
	3	Financing of on-farm improvements	$0	0
	4	Incentive pricing	$0	0
	5	Line or pipe canals/install reservoirs	$0	0
	6	Increase delivery flexibility	$20,000	0
	7	District spill/tailwater recovery systems	$0	0
	8	Measure outflow	$0	0
	9	Optimize conjunctive use	$0	0
	10	Automate canal structures	$0	0
	11	Customer pump testing	$3000	0
	12	Mapping	$500	30
		Total	$23,500	30

APPENDIX A

PANOCHE WATER DISTRICT

RESOLUTION NO. 499-98

RESOLUTION APPROVING GRASSLAND BASIN DRAINAGE STEERING COMMITTEE RULE ENFORCING SELENIUM LOAD TARGETS AND TAILWATER RESTRICTIONS

WHEREAS, the Board of Directors of the Panoche Water District (the "Board" and the District," respectively) has considered that certain Grassland Basin Drainage Steering Committee Rule Enforcing Selenium Load Targets and Tailwater Restrictions (the "Enforcement Rule"), a copy of which is attached hereto as Exhibit "A," and by this reference is incorporated herein;

WHEREAS, lands within the District and to which the District provides irrigation water are included within the Panoche Drainage District, an active participant in the Grassland Bypass Project; and

WHEREAS, the defining documents for the Grassland Bypass Project describe monthly and annual selenium loan targets that must be achieved to allow continuance of the Project for its full term and establish Drainage Incentive Fees to be paid in the event such load targets are exceeded; and

WHEREAS, the Enforcement Rule allocates responsibility for meeting selenium load targets and for paying incentive fees to each participating District based on such District's assigned selenium load allocation; and

WHEREAS, the Enforcement Rule prohibits discharge of surface runoff (tailwater) after September 30, 1998, because such runoff adds sediment to the Grassland Bypass Channel and the San Luis Drain, and increases the total volume of drainwater which must be managed; and

WHEREAS, it is in the best interest of the District and with respect to the public affairs thereof to accept the Enforcement Rule as a mechanism for promoting drainage management and for protecting the benefits of the Grassland Bypass Project both within the District and on a regional basis.

NOW, THEREFORE, BE IT RESOLVED:

Section 1: The matters stated in the Recitals above and in the documents described therein are true and correct, and the Board so finds and determines.

<u>Section 2</u>: The Board hereby approves the Grassland Basin Drainage Steering Committee Enforcement Rule, agrees to cooperate with the Grassland Basin Drainage Steering Committee and the Regional Drainage Coordinator thereof in order to achieve implementation of the Enforcement Rule.

<u>Section 3</u>: The Board hereby authorizes the District Manager to take all actions authorized by existing district policies and/or rules and by California law, to implement the Grassland Basin Drainage Steering Committee Enforcement Rule, and to encourage compliance with that Enforcement Rule as expediently as possible.

PASSED, APPROVED AND ADOPTED this 10th day of March, 1998.

ED KODA, Vice President

[Seal]
Attest:

MICHAEL STEARNS, Secretary

* * * * *

I hereby certify that the foregoing Resolution is a true and correct copy of a Resolution duly passed and adopted by the Board of Directors of PANOCHE WATER DISTRICT at a regular meeting of the Board of Directors duly called and held at the offices of the District on the 10th day of March, 1998.

MICHAEL STEARNS, Secretary

GRASSLAND BASIN DRAINAGE STEERING COMMITTEE
RULE ENFORCING SELENIUM LOAD TARGETS
AND TAILWATER RESTRICTIONS

STATEMENT OF PURPOSE

1. To establish the selenium load allocation ("SLA") for each Member/Participating Party ("Member" or "Members") and to assign responsibility to each Member to meet its assigned SLA;

2. To authorize the Regional Drainage Coordinator to restrict the discharge from any Member that fails to meet its SLA when such discharge threatens to result in an exceedence of the Regional selenium load limits and to authorize the Steering Committee to determine appropriate sanctions, if any, when any Member exceeds its assigned SLA.

3. To establish the manner by which Drainage Incentive Fees imposed under the Agreement for Use of the San Luis Drain Between the Bureau of Reclamation and the San Luis & Delta-Mendota Water Authority (the "Use Agreement") will be allocated to Members.

4. To require the separation of tail water from discharges into the Grassland Bypass.

1. SELENIUM LOAD ALLOCATIONS

1.a. Exhibit "A" attached hereto and by reference incorporated into this Rule sets forth by Member the Monthly and Annual SLA's which must be met by such Member in order to assure non-exceedence of the pounds of selenium allowed to be discharged from the region pursuant to the terms of the Use Agreement. The SLA's have been calculated based upon the proportionate tiled acreage, total acreage, and loads historically discharged from the area served by each such Member.[1]

1.b. Each Member is responsible for meeting such Member's Use Agreement Monthly and Annual SLA's.

---

[1] Monthly SLA's are calculated based on the Use Agreement Monthly Load Values proportioned to each Member. (Annualized monthly SLA's have been calculated in the past for reference, which are smaller than the Use Agreement monthly SLA's and when totaled equal the annual SLA. These annualized monthly SLA's may continue to be utilized for reference purposes but are not incorporated into the operation of this policy.)

1.d. Except as authorized below, no Member is authorized to discharge into the Grassland Bypass drainage water that contains selenium in excess of its Use Agreement Monthly or Annual SLA, and the Regional Drainage Coordinator is authorized to order a Member Party to cease discharging into the Grassland Bypass Project in the event current estimates of selenium discharges indicate that the Member will exceed or has exceeded its Use Agreement Monthly or Annual SLA.

1.d.1 So long as the regional Use Agreement Monthly or annual load targets set forth in Exhibit "A" are not exceeded, discharges may continue from a Member that is estimated to exceed its SLA.

1.d.2 The Steering Committee shall review any exceedence of Use Agreement Monthly or Annual SLA's for a Member on a case-by-case basis and is authorized to determine appropriate sanctions, if any. Sanctions may include further discharge restrictions or fines. In determining whether sanctions are appropriate, the Steering Committee shall consider relevant factors, including but not limited to, whether or not a) the Member is taking all reasonable steps to avoid the exceedence, and b) the monthly or annual load target for the region described in the Use Agreement has been or will be exceeded due to the Member's discharge.

INCENTIVE FEES LEVIED UNDER THE USE AGREEMENT

2.a. Monthly Use Agreement Incentive Fees. Incentive Fees levied by the Oversight Committee established under the Use Agreement for exceedence at Site B of the regional monthly selenium loads ("Monthly Use Agreement Incentive Fees") will be paid by those Members, if any, which exceeded their Use Agreement Monthly SLA's established under Exhibit "A" for such month. The share to be paid by each Member that has exceeded its Use Agreement Monthly SLA will be the percentage of the Use Agreement Monthly Exceedence Incentive Fee calculated by dividing such member's Use Agreement Monthly SLA exceedence (in pounds) by the total of all Members Use Agreement Monthly SLA exceedences (in pounds) for such month.

2.b. Use Agreement Annual Incentive Fees. Incentive Fees levied by the Oversight Committee established under the Use Agreement for exceedence at Site B of the regional annual selenium loads set in the Use Agreement will be paid by those Members~~/Participating Parties~~, if any, which exceeded their Annual SLA's established under Exhibit "A". The share to be paid by each Member that has exceeded its Annual SLA will be the percentage of the Use Agreement Annual Exceedence Incentive Fee calculated by dividing such member's Annual SLA exceedence (in pounds) by the total of all Members Annual SLA exceedences (in pounds).

2.c. Use Agreement Incentive Fees Resulting from Extraordinary Storm Events There are impacts on selenium loads from extraordinary (1 in 10 year or greater) storm events. These include storm discharges from Coast-range streams and increased discharges due to excessive local rainfall. Exceedences caused by these events will be determined as closely as possible by the Drainage Coordinator. The share to be paid by each Member for Monthly or Annual Use Agreement Incentive Fees attributable to these exceedences will be the same percentage each Member is assigned for payment of costs in Budget Category 3A.

3. TAILWATER (Rev. 2/19/98)

No Member is authorized to discharge tailwater from irrigation into the Grassland Bypass after September 30, 1998. Each Member will provide the Drainage Coordinator with a schedule and proposed actions indicating how tailwater removal will be accomplished.

4. GENERAL

The Regional Drainage Coordinator shall provide this rule and sample Resolution Adopting the Rule to the governing bodies of Members/Participating Parties for adoption. Upon request from any such governing body, the Regional Drainage Coordinator and/or subcommittee appointed by the Steering Committee will also assist in presenting this rule to non-member agencies immediately upslope to the Grassland Basin Drainage Area, including but not limited to San Luis Water District, Central California Irrigation District and Westlands Water District.

EXHIBIT A

Us eement Monthly Selenium Load Allocation, By Member, fo ber 1997 through September 1998, In Pounds
Pro ons of the Total Load Target are shown below each name, in italic

Month	All Members	Panoche	Firebaugh	Broadvie	Pacheco	Charlesto	Camp-13	Widren	Sloan (Pacheco)	Other
		48.1%	*19.2%*	*12.8%*	*7.7%*	*4.7%*	*3.5%*	*0.5%*	*1.0%*	*2.5%*
Oct	348	167	67	45	27	16	12	2	3	9
Nov	348	167	67	45	27	16	12	2	3	9
Dec	389	187	75	50	30	18	14	2	4	10
Jan	533	256	102	68	41	25	19	3	5	13
Feb	866	417	166	111	67	41	30	4	9	22
Mar	1066	513	205	136	82	50	37	5	11	27
April	799	384	153	102	62	38	28	4	8	20
May	666	320	128	85	51	31	23	3	7	17
June	599	288	115	77	46	28	21	3	6	15
July	599	288	115	77	46	28	21	3	6	15
Aug	533	256	102	68	41	25	19	3	6	15
Sept	350	168	67	45	27	16	12	2	5	13
									4	9
Total	7096	3413	1362	908	546	334	248	35	71	177

Use Agreement Annual Selenium Load Allocation, By Member, for October 1997 through September 1998, In Pounds

	All Members	Panoche	Firebaugh	Broadvie	Pacheco	Charlesto	Camp-13	Widren	Sloan (Pacheco)	Other
	6660	3203	1279	852	513	313	233	33	67	166

PANOCHE WATER DISTRICT

RESOLUTION NO. 475-97

RESOLUTION DESCRIBING ACTIONS TO REDUCE SUBSURFACE DRAINAGE

WHEREAS, the lands within the Panoche Water District comprise a portion of the Panoche Drainage District, which is a member of the Grassland Basin Drainage Activity Agreement; and

WHEREAS, the lands within the Panoche Water District comprise a portion of the Panoche Drainage District, which is an active participant in the Grassland Bypass Project, with six other irrigation and drainage districts; and

WHEREAS, that Project is described in a Finding of No Significant Impact, a Supplemental Environmental Assessment, a Use Agreement for the San Luis Drain, and a Consensus Letter to the Regional Board; and

WHEREAS, the defining documents for the Grassland Bypass Project describe monthly and annual selenium load targets that must be achieved to avoid financial penalties; and

WHEREAS, an exceedance of the annual selenium loan target by more than 20% might result in termination of the Use Agreement for the San Luis Drain; and

WHEREAS, the selenium load targets have now been incorporated into the Regional Water Quality Control Board's ("RWQCB's") Basin Plan Amendment for this region; and

WHEREAS, the RWQCB has commenced proceedings to adopt a Basin Plan Amendment setting revised water quality standards for salinity; and

WHEREAS, the RWQCB's Basin Plan includes the following statement: "The Regional Board will request that the State Water Board use its water rights authority to preclude the supplying of water to specific lands, if water quality objectives are not met by the specified compliance dates and Regional Board remedies fail standards to achieve compliance;" and

WHEREAS, successful achievement of the monthly and annual selenium load targets requires that all farmers implement the best available irrigation methods to eliminate surface runoff and minimize deep percolation; and

WHEREAS, surface runoff (tailwater) is not desirable in District drainage facilities because it adds sediment to the Grassland Bypass Channel and the San Luis Drain, and increases the total volume of drainwater which must be managed; and

WHEREAS, the District's long-term interests include maintaining its drainage water outlet to the San Joaquin River.

NOW, THEREFORE, BE IT RESOLVED that the Board of Directors of the Panoche Water District hereby authorize the District Manager to implement the following policies and programs:

Section 1: A prohibition on surface runoff in District drainage facilities.

Section 2: A requirement that all farmers use the best available irrigation methods to minimize deep percolation and eliminate surface runoff.

Section 3: An aggressive sump management program in which the District Manager, staff, and farmers will manually control the operation of drainage system sumps to minimize the volume of subsurface drain water discharged into regional drainage facilities.

Section 4: An aggressive drainage water recycling program, in which the District Manager and Staff will recycle as much drainage water as possible, to minimize the volume of subsurface drain water discharged into regional drainage facilities.

FURTHERMORE, BE IT RESOLVED that the Board of Directors of the Panoche Water District authorize the District Manager to take of the following actions, in addition to all other actions authorized by existing district policies and/or rules, to implement the policies and programs listed above, and to encourage compliance with those policies as expediently as possible:

Suspend water deliveries to fields on which farmers are using irrigation methods that are not consistent with the District's subsurface drainage reduction goals, or which are discharging tailwater into District facilities.

PASSED, APPROVED AND ADOPTED this 22nd day of May, 1997.

MIKE LINNEMAN, PRESIDENT
PANOCHE WATER DISTRICT

[Seal]

Attest:

MICHAEL STEARNS, SECRETARY

* * * * *

I hereby certify that the foregoing is a true and correct copy of a resolution duly adopted by PANOCHE WATER DISTRICT, a California drainage district, at an adjourned regular meeting of the Board of Directors thereof duly called and held at the office of the district on the 22nd day of May, 1997.

MICHAEL STEARNS, SECRETARY
PANOCHE WATER DISTRICT

PANOCHE DRAINAGE DISTRICT

RESOLUTION NO. 345-97

RESOLUTION APPROVING AND ADOPTING PANOCHE WATER DISTRICT POLICY ESTABLISHING MANDATORY INTERIM DRAINAGE REDUCTION PROGRAM

WHEREAS, the Board of Directors of the Panoche Drainage District (the "Board" and the "District," respectively), has considered that certain Resolution Adopting Panoche Water District Policy Establishing Mandatory Interim Drainage Reduction Program, adopted by Panoche Water District on June 12, 1997, a copy of which is attached hereto as Exhibit "A" and incorporated herein; and

WHEREAS, all the lands encompassed within the Panoche Water District boundaries also lie within the boundaries of the District, and the District owns and operates the drainage facilities serving such lands; and

WHEREAS, it is in the best interest and with respect to the public affairs of the District to cooperate with the Panoche Water District in the implementation and enforcement of the drainage reduction goals of Panoche Water District, which are essential to meeting selenium load targets for lands within the Panoche Water District that are participating through this District in the Grassland Bypass Project.

NOW, THEREFORE, BE IT RESOLVED, AS FOLLOWS:

Section 1. The facts stated in the recitals above are true and correct, and the Board so finds and determines.

Section 2. The Board hereby approves the Panoche Water District Policy Establishing Interim Drainage Reduction Program attached hereto as Exhibit "A", and adopts said Policy with regard to drainage facilities of the District within the Panoche Water District, effective immediately.

Section 3. The District Manager, and such staff as are directed by the District Manager, is hereby authorized to take any and all actions necessary to enforce the District policy and the drainage terms of the Panoche Water District Mandatory Interim Drainage Program Agreements described therein, including without limitation the authority to grant waiver from sump management recirculation and drainage reduction goals for specific sumps upon a showing to the Manager's satisfaction that alternate measures are being implemented by the landowner/water user whose fields drain into the sump for which the waiver is granted.

Section 4. This Resolution is intended to supplement and augment the policies of the Board adopted in Resolution 342-97.

Section 5. This policy shall take effect immediately.

PASSED, APPROVED AND ADOPTED this 12th day of June, 1997, by the following vote:

AYES: MIKE LINNEMAN, ED KODA, MICHAEL
STEARNS, SUE REDFERN, JOHN BENNETT

NOES: NONE

ABSENT: NONE

MIKE LINNEMAN, President

Attest:

MICHAEL STEARNS, Secretary

* * * * *

I hereby certify that the foregoing is a true and correct copy of a resolution adopted at an special meeting of the Board of Directors of the Panoche Drainage District, duly called and held at the offices of the District on June 12, 1997.

MICHAEL STEARNS, Secretary

PANOCHE DRAINAGE DISTRICT

RESOLUTION NO. 342-97

RESOLUTION DESCRIBING ACTIONS TO REDUCE SUBSURFACE DRAINAGE

WHEREAS, the Panoche Drainage District is a member of the Grassland Basin Drainage Activity Agreement; and

WHEREAS, the Panoche Drainage District is an active participant in the Grassland Bypass Project, with six other irrigation and drainage districts; and

WHEREAS, that Project is described in a Finding of No Significant Impact, a Supplemental Environmental Assessment, a Use Agreement for the San Luis Drain, and a Consensus Letter to the Regional Board; and

WHEREAS, the defining documents for the Grassland Bypass Project describe monthly and annual selenium load targets that must be achieved to avoid financial penalties; and

WHEREAS, an exceedance of the annual selenium loan target by more than 20% might result in termination of the Use Agreement for the San Luis Drain; and

WHEREAS, the selenium load targets have now been incorporated into the Regional Water Quality Control Board's ("RWQCB's") Basin Plan Amendment for this region; and

WHEREAS, the RWQCB has commenced proceedings to adopt a Basin Plan Amendment setting revised water quality standards for salinity; and

WHEREAS, the RWQCB's Basin Plan includes the following statement: "The Regional Board will request that the State Water Board use its water rights authority to preclude the supplying of water to specific lands, if water quality objectives are not met by the specified compliance dates and Regional Board remedies fail to achieve compliance;" and

WHEREAS, successful achievement of the monthly and annual selenium load targets requires that all farmers implement the best available irrigation methods to eliminate surface runoff and minimize deep percolation; and

WHEREAS, surface runoff (tailwater) is not desirable in District drainage facilities because it adds sediment to the Grassland Bypass Channel and the San Luis Drain, and increases the total volume of drainwater which must be managed; and

WHEREAS, the District's long-term interests include maintaining its drainage water outlet to the San Joaquin River.

NOW, THEREFORE, BE IT RESOLVED that the Board of Directors of the Panoche Drainage District hereby authorize the District Manager to implement the following policies and programs:

<u>Section 1</u>: A prohibition on surface runoff in District drainage facilities.

<u>Section 2</u>: A requirement that all farmers use the best available irrigation methods to minimize deep percolation and eliminate surface runoff.

<u>Section 3</u>: An aggressive sump management program in which the District Manager, staff, and farmers will manually control the operation of drainage system sumps to minimize the volume of subsurface drain water discharged into regional drainage facilities.

<u>Section 4</u>: An aggressive drainage water recycling program, in which the District Manager and Staff will recycle as much drainage water as possible, to minimize the volume of subsurface drain water discharged into regional drainage facilities.

FURTHERMORE, BE IT RESOLVED that the Board of Directors of the Panoche Drainage District authorize the District Manager to take of the following actions, in addition to all other actions authorized by existing district policies and/or rules, to implement the policies and programs listed above, and to encourage compliance with those policies as expediently as possible:

Suspend water deliveries to fields on which farmers are using irrigation methods that are not consistent with the District's subsurface drainage reduction goals, or which are discharging tailwater into District facilities.

PASSED, APPROVED AND ADOPTED this 22nd day of May, 1997.

MIKE LINNEMAN, PRESIDENT
PANOCHE DRAINAGE DISTRICT

[Seal]

Attest:

MICHAEL STEARNS, SECRETARY

* * * * *

I hereby certify that the foregoing is a true and correct copy of a resolution duly adopted by PANOCHE DRAINAGE DISTRICT, a California drainage district, at an adjourned regular meeting of the Board of Directors thereof duly called and held at the office of the district on the 22nd day of May, 1997.

MICHAEL STEARNS, SECRETARY
PANOCHE DRAINAGE DISTRICT

Surface Water Transfer Policy
For Supplies Allocated Under District Contract

Whereas, it is the Districts intent to serve and protect the agricultural water supply interest of its landowners, and

Whereas, it is the districts responsibility to use all proper methods to accomplish the most reasonable and beneficial use of its contractual surface water supplies, and

Whereas, the district desires to manage water transfers so that there are no unreasonable impact on the water supplies, operation, and financial condition of the District, or on its water users within the Districts service area, and

Whereas, the Districts allocates its Bureau-allotted contractual surface water supplies to eligible District lands on an equal-share-per-irrigable acre basis, and

Whereas, each water user is best able to determine where use of these allocated surface water supplies are most beneficial to his/her operation, and

Whereas, it is the intent of the District to prevent profiteering on contractual surface water supplies and

Whereas, it is the intent of the District to develop additional supplies for the benefit of its in-District water users, and

Whereas, Water Code Section 382 provides that the District may transfer water that is surplus to the in-District needs of the water user of the District and/or water that is voluntarily foregone for in-District use during the period of the transfer by a water user of the District;

Therefore, the Board of Directors has adopted the following policy statements with regard to intra- and inter-District transfer of allocated surface water supplies during the current water year:

- All unused and/or unsubscribed contract water allocations revert to the District for remarketing as Additional Supplies for the primary benefit of its in-District water users.

- The District will allow transfer of Bureau-allocated contract water supply between parcels of land within the District where the supply has been allocated to lands that are within the same landholding.

- "Landholding" shall mean eligible irrigable land that is owed and/or operated under a lease by and individual of legal entity or another legal entity that includes that same individual or legal entity.

- If the allocation is 35% or above the District will allow transfer of Bureau-allocated contract water supply between parcel of land in the District and parcels of land in other CVP-contracted districts where the supply is associated with land that are within the same Landholding, provided further that the Landholder is a current user of water in the District and the land is owned or leased.

- All transfers must take place during the water year in which the water was allocated. Transfer of water rescheduled into a subsequent water year are subject to the terms of the Bureau of Reclamations current Rescheduling Guidelines.

- The transferring landholder/Water User will pay the current District cost plus all Operation & Maintenance rates for transferred supplies, less any rate components that the District is not required to pay on transferred supplies, plus any incremental chargers assessed by the Bureau of Reclamation for use of additional facilities to effectuate the transfer.

- In any year when Additional Supplies are insufficient to meet all in-District demand, available Additional Supplies will be pro-rated and allocated to those who have requested Additional Supplies based on each Landholder's total irrigable District acreage, less any acreage from which Bureau-allocated supplies have been transferred outside of the district.

- Additional Supplies and developed water allocated to a District Landholder are for in-District use and may not be transferred out of the District.

- During years when District CVP contract allocation is 35% or less, transfers out will not be permitted without the express approval of the Board of Directors. Such transfers will be strongly discouraged and not approval without a finding of substantial hardship or other extenuation circumstances.

AMENDMENT
OF
RULES AND REGULATIONS
OF
PANOCHE WATER DISTRICT

Resolution No. 287-86

Pursuant to the By-Laws of the district, Rule 12 of the Rules and Regulations of the district, and such other enactments of the district and the legislature as may be applicable thereto,

BE IT RESOLVED, that the Rules and Regulations governing the operation of district facilities and sale of water of the PANOCHE WATER DISTRICT adopted September 14, 1976, are hereby amended by repeal of said Rules in their entirety and by substitution of the new Rules and Regulations governing operations of district facilities and sale of water, including the form of application, attached hereto as EXHIBIT NO. 1;

BE IT FURTHER RESOLVED that the attached Rules and Regulations, including the form of application, attached hereto as EXHIBIT NO. 1 are hereby approved, passed and adopted as the Rules and Regulations and the form of application of said District.

PASSED AND ADOPTED at a regular meeting of the Board of Directors of PANOCHE WATER DISTRICT on January 20, 1986, by the following vote:

AYES:	MIKE LINNEMAN	ED KODA
	JOHN E. WILLIAMS	F. E. REDFERN
NOES:	NONE	
ABSENT:	JAMES HAMMONDS	

ATTEST:

Secretary, PANOCHE WATER DISTRICT

AFTER RECORDING RETURN TO:

ENT

SAE

Linneman, Burgess, Telles, Van Atta & Vierra
Attorneys at Law
P. O. Box 156
Dos Palos, CA 93620

86017313

RECORDED IN OFFICIAL RECORDS OF
FRESNO, COUNTY, CALIFORNIA
AT .... MIN. PAST 2 ....M
FEB 14 1986
FRESNO COUNTY, CALIFORNIA
GALEN LARSON, County Recorder
BY DEPUTY RECORDER
FEE
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PANOCHE WATER DISTRICT

RULES AND REGULATIONS GOVERNING OPERATIONS OF DISTRICT FACILITIES AND SALE OF WATER

RULE 1. CONTROL OF SYSTEM.

Subject to the direction and control of the Board of Directors, the maintenance and operation of the canals, outlets, headworks, pumping facilities and other physical properties shall be under the exclusive supervision of the Manager of the District appointed by the Board of Directors, and no other person, except his authorized fellow employees, shall have any right or authority to interfere or tamper with said canals, outlets, headworks or any of the physical properties of the District, or with the service or maintenance thereof. Any person tampering with or in any manner damaging or injuring any such properties or facilities of the District will be fully responsible for any such damage or injury, in addition to any other legal remedies which may be available to the District.

RULE 2. INSTALLATION OF GATES, PUMPS AND STRUCTURES.

No pumps, gates, platforms, takeout siphons or other structures or devices shall be placed in any canal, ditch or conduit of the District, except pursuant to plans adopted by the Board of Directors or pursuant to an order issued by said Board. No person shall divert or take water from any canal, ditch or conduit belonging to the District or under its control, or make any opening therein or tamper with, change, molest, disturb or in any manner interfere with any gate, takeout or other structure, facility or device in any such canal, ditch or conduit, except under the direction and authority of the Manager or the Board of Directors of the District. In the event of any violation of the foregoing provision by a water user of the District, such gate or outlet may be padlocked, and further water service to such

3987 Linneman, Burgess, Telles, (et al) at 9:30 Am
Recorded by
On FEB. 25. 1986 VOL 2526 PAGE 415
Official Records Of Merced County, Calif.
LeRoy G. Gilsdorf, Recorder

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user may be denied upon such terms and for such period of time as the Board of Directors may determine.

RULE 3. PRIVATE DITCHES.

(a) All private ditches shall be cleaned and maintained by the user thereof without expense to the District, and such ditches shall be of sufficient size to carry the maximum quantity of water ordered by the owner thereof. No privately owned ditches shall be constructed upon or be permitted to impinge upon any right-of-way belonging to the District without the District's consent in writing.

(b) Where ditches must be constructed or enlarged in order to carry water from existing District laterals to the land to be served, the landowner or user requesting water for such land must provide the right-of-way and construct or enlarge such connecting ditch from said land to a District lateral designated by the District, all without cost to the District.

(c) Delivery by the District will be made at such turnout on the system as the water user may designate, provided there are sufficient facilities and sufficient water available for such delivery at the point so suggested.

RULE 4. MEASURING DEVICES.

In the event any turnout shall not have a proper measuring device, or in case of a disagreement in water measurements, the District shall install a meter or other measuring device, and thereafter such equipment shall be maintained at the expense of the District.

RULE 5. APPLICATIONS FOR WATER; PAYMENT FOR WATER PURCHASED AND FOR ELECTRIC CURRENT AND OTHER EXPENSES.

(a) For the purpose of these regulations and the application herein referred to, all water acquired by the District shall be divided into two (2) classes as follows:

1. CLASS I WATER is defined as all water acquired by the District pursuant to the Water Service Contract between

the District and the U. S. of America, dated August 30, 1974.

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2. CLASS II WATER shall include all water which may be acquired or made available to the District from any other source, including water recirculated by the District, pumped from the underground or acquired from other districts.

(b) The District hereby adopts the form of Application for Water, marked Exhibit "A", attached hereto, and hereby approves and adopts all the terms and provisions thereof as part and parcel of these Rules and Regulations.

(c) On or before January 20th of each year, each landowner and water user desiring water for the ensuing water year, shall file at the District's office application for water on the aforesaid form to be approved by the District. Payment for water shall be made in accordance with the terms of the aforesaid application. The first installment shall accompany the application and shall equal one-half (1/2) of the cost of all water being ordered thereunder, together with an added sum per acre foot to be set each year by the Board of Directors, which added sum shall be deposited in the revolving fund; the second installments shall contain identical amounts and shall be paid to the District not later than June 15th of each year, or at such earlier date as the District may require.

(d) All obligations incurred hereunder for irrigation water, or which is incidental thereto or to the delivery thereof, shall constitute a debt owed by the landowner to the District, and shall be secured by a lien against the land upon which such water is used.

In the event any owner of land within the District shall lease all or a portion of such land, such lessee shall be jointly and severally liable with the landowner for all obligations incurred in connection with water used upon said premises, and the District will, upon request by the landowner, mail copies of all billings for water and incidental charges to such lessee, but such action shall not in any manner release the landowner from the obligation to pay for such water in the event the lessee fails so to do.

(e) Monthly billings shall be mailed to water users in the District for overhead, electricity and such other incidental expenses as shall be involved in the purchase, sale and disposition of irrigation water in the District. Such billings shall become delinquent fifteen (15) days after the date of mailing, and if not paid within said time, a notice of delinquency shall be mailed to the landowner. If payment is not received on or before the 5th day after the mailing of such delinquent notice, the District may close and lock such water user's gate, and thereafter all delivery of water shall be withheld until such delinquent obligations have been paid in full. Further, in case of such default, all payments for such items shall be made in advance for the remainder of said crop year, upon an estimated monthly basis.

(f) In the event any water user shall order more Class I water, as that term is defined herein, than he shall use for any calendar year, he shall be required to pay for the amount ordered, unless the District is able to dispose of said water to other parties.

(g) No irrigation water shall be used upon any land within the District unless such land is entitled to receive irrigation water under the contract between the United States and Panoche Water District providing for water service.

RULE 6. FAILURE TO APPLY FOR WATER ENTITLEMENT.

In the event any landowner or prospective water user within the District shall fail to apply for his full entitlement of Class I water, or other water service, or shall fail to deposit the sum of money required to accompany such application as herein and in said application provided, he shall thereupon waive his right to receive such full entitlement, and such water not so ordered shall become Class II Water and shall be distributed in accordance with the provisions hereof.

RULE 6A.

OBLIGATION OF PAYMENT FOR PRO RATA SHARE OF THE DISTRICT CLASS I WATER SUPPLY

(a) All landowners or water users of irrigation water within the district shall be liable for the payment to the district, as herein specified, for all sums of money necessary for the purchase and delivery of 2.483 acre feet of water per acre on all elgible land, or such different quantity per acre as the Board of Directors shall from time to time fix and determine, whether or not such water is actually used.

(b) "Eligible Land" as used herein is intended to include all land within the district entitled to receive irrigation water pursuant to the provision of the existing contract between the PANOCHE WATER DISTRICT and the United States of America dated August 30, 1974, and the liability provided for herein shall include in addition to such owner, any lessee, contractor or other user of irrigation water furnished by the district on the eligible lands of such owner.

(c) The charge herein provided for shall be paid in accordance with the provisions of Rule 5 hereof.

(d) Overhead, electricity, and incidental charges on 2.483 acre feet of water per acre on all eligible land within the district, or such quantity per acre as the Board shall from year to year fix and determine, shall be billed and paid in accordance with the Rules and Regulations of PANOCHE WATER DISTRICT adopted by the district on January 20, 1986, and any amendments thereto.

(e) In the event any landowner or prospective water user within the district shall apply for less than 2.483 acre feet of water per acre on all eligible land owned or operated within the district, PANOCHE WATER DISTRICT shall take all reasonable steps to resell the difference between 2.483 acre feet of water per acre on all such eligible land and the amount for which the landowner or user has applied, and shall apply the proceeds of such resold water pro-rata throughout the district to the credit those landowners or users who apply for and use less than the specified amount. In the event PANOCHE WATER DISTRICT shall not sell such unused amounts, each landowner or user shall remain liable nonetheless for payment for the amount specified hereunder, up to the full 2.483 acre foot per acre amount."

RULE 7. DRAIN WATER.

No landowner within the District shall at any time discharge drainage water into any of the District's canals or conduits without permission of the Board of Directors or the Manager.

All reasonable steps shall be taken to eliminate waste of water in the District.

RULE 8. SHORTAGE OF WATER OR PUMPING CAPACITY.

In the event it shall at any time be impossible for the District to deliver the full supply of water required by the water users, whether because of a shortage of water, lack of ditch capacity or pumping capacity, or any other reason, such supply as shall be available and subject to delivery will be prorated on an acreage basis to such acreage as is eligible to receive such water until such time as delivery of a full supply can be made.

RULE 9. DISTRICT NOT LIABLE FOR DAMAGES.

Neither the District, the Board of Directors, its officers, agents or employees, shall be liable for any loss or damage which may occur as a result of terminating or shutting off service in accordance with the provisions hereof, nor for taking any other action provided for by the By-Laws or by these Rules and Regulations.

RULE 10. ENFORCEMENT OF RULES AND REGULATIONS.

(a) Refusal or failure to comply with the foregoing Rules and Regulations, or any breach or violation of any thereof, or any interference with the proper discharge of the duties of any person employed by the District shall be sufficient cause for shutting off the water of any such offending person; and in such event, water will not again be furnished until, in the opinion of the Board of Directors, full compliance has been made with all such requirements, and assurance has been given of future compliance with these Rules and Regulations.

(b) The foregoing Rules and Regulations are established and adopted pursuant to Section 35423 and Section 35424 of the Water Code of California and the By-Laws of the District. Any person violating any provision of said Rules and Regulations shall be guilty of a misdemeanor and upon conviction thereof shall be subject to all penalties now or hereafter provided by law and the By-Laws of the District.

(c) The remedies and penalties herein provided for violation of these Rules and Regulations shall be deemed to be cumulative, and the pursuit of one or more thereof shall not prohibit the Board in pursuing any or all other remedies which may be available to it upon such violation.

RULE 11. DEFINITION OF ACREAGE ENTITLED TO WATER.

(a) No acreage within the District shall be eligible to receive irrigation water unless it is non-excess land as provided for by the terms of the aforesaid Water Service Contract with the U. S. of America, or derives such eligibility by virtue of a valid recordable contract upon said land as provided for in the aforesaid Water Service Contract.

(b) The term "water" as used in these Rules and Regulations shall be deemed to include the term "water service" wherever the context permits.

RULE 12. AMENDMENTS.

These Rules and Regulations shall repeal and supersede the Rules and Regulations previously adopted by the District on September 14, 1976, and all subsequent amendments thereto.

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PANOCHE WATER DISTRICT
APPLICATION FOR WATER
CLASS I WATER

Dated:__________

The undersigned, (singular includes the plural) hereby applies for__________acre feet of Class I irrigation water (not to exceed 2 1/2 acre feet per acre) for use on the land hereinafter described during the year________, and hereby subscribes to and agrees to be bound by the By-Laws and Rules and Regulations of the District governing the purchase and use of such water and water service and the payment therefore; I acknowledge that I am liable for payment to the District of all sums necessary for the purchase and delivery of my pro-rata share per acre of the District Class I supply and I further acknowledge that the delivery thereof is dependent on the availability of said water to the District.

Said water is to be used for the irrigation of the following described land within the District, which I hereby certify contains____________acres of land, entitled to receive water service.

____
____
____
____

I estimate the monthly requirements as follows:

Jan._____acre feet	May_____acre feet	Sept._____acre feet
Feb._____acre feet	June____acre feet	Oct. _____acre feet
Mar._____acre feet	July____acre feet	Nov. _____acre feet
Apr._____acre feet	Aug.____acre feet	Dec. _____acre feet

I, or we, jointly and severally, agree to make payment for said water and water service as billed by the District, as follows: 1/2 thereof on the date hereof, and 1/2 upon or before June 15, 19____. If any action is brought to enforce any convenant or provision hereof, I agree to pay a reasonable attorneys fee unless I prevail in said action.

CLASS II WATER

I also hereby apply for__________acre feet of additional water at the rate of $____________per acre foot, with the understanding that it will be delivered only upon a pro-rata and an availability basis. A deposit in the full amount of the water so ordered accompanies this application and any unused balance of said deposit will be refunded to me, only in the event such water is not available.

NOTICE: NO APPLICATION WILL BE ACCEPTED AFTER JANUARY 20th OF ANY YEAR FOR THE NEXT ENSUING WATER YEAR, NOR WITHOUT PAYMENT AS ABOVE SPECIFIED.

____
____
____
____
Landowner Applicant
____
____
Tenant Applicant

____
____
Contract Applicant
____
____
Trustee Applicant
____
____
Other User

I hereby certify that the foregoing RULES AND REGULATIONS GOVERNING OPERATIONS OF DISTRICT FACILITIES AND SALE OF WATER were duly established and adopted by PANOCHE WATER DISTRICT at a special meeting of the Board of Directors thereof duly called and held on the 20th day of January, 1986.

DATED: January 20th, 1986.

F. E. Redfern
F. E. REDFERN, Secretary
PANOCHE WATER DISTRICT

ACKNOWLEDGMENT

NO 202

State of CALIFORNIA
County of MERCED
} ss.

On this the 21st day of January 19 86, before me,
MARILYN J. JONES,
the undersigned Notary Public, personally appeared
F. E. REDFERN,
☒ personally known to me
☐ proved to me on the basis of satisfactory evidence
to be the person(s) who executed the within instrument as Secretary of Panoche Water District or on behalf of the ~~corporation~~ district therein named, and acknowledged to me that the ~~corporation~~ district executed it.
WITNESS my hand and official seal.

OFFICIAL SEAL
MARILYN J. JONES
NOTARY PUBLIC - CALIFORNIA
MERCED COUNTY
My Comm. Expires Oct. 27, 1989

Marilyn J. Jones
Notary's Signature

20 122

NATIONAL NOTARY ASSOCIATION • 23012 Ventura Blvd. • P.O. Box 4625 • Woodland Hills, CA 91364

END OF DOCUMENT

10

LeRoy G. Gilsdorf, Recorder

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WATER CODE
SECTION 35450-35455

35450. A district may fix and change a date prior to which applications for water for the ensuing irrigation season are to be received for all crops, or for annual crops and new plantings, and may require a cash deposit to be made at the time of application for each acre for which application is made.

35451. The action of a district fixing or changing any date prior to which applications for water are to be received is ineffective until notice of the date is given by publication once a week for two successive weeks in a newspaper published in the office county. The date fixed is effective for each year thereafter unless changed by the board.

35452. The cash deposit shall, in the discretion of the board, be forfeited as to each acre not using the water applied for if the district has a sufficient supply of water available at the time the water is to be used.

35453. In the event of water shortage the district may, with respect to the shortage area, give preference to or serve only the land for which application was filed prior to the application date fixed and the land for which no application was required.

35454. If the available water is inadequate to serve all of the land as to which applications for water are filed pursuant to Section 35450, the district may require the owners of land which is proposed to be planted to annual crops or to new plantings to take a proportionate percentage reduction in the water they would normally use thereon and may require the owners of land which is planted to permanent crops to take a reasonable proportionate percentage reduction in the water they would normally use in an amount not exceeding the percentage reduction required of plantings to annual crops and new plantings.

The provisions of this section shall be effective only if more than one-half of the district's revenue for that year will be derived from charges made for the sale of water.

35454.5. In any year in which the board of a district not having meters or other volumetric measuring instruments or facilities to measure substantially all agricultural water to be delivered concludes the available water supply will be inadequate to serve all land entitled to service that will probably desire such service, the district may establish reasonable annual water requirements for growing each type of crop grown or likely to be grown in the district in that year; determine the maximum acreage of each crop that each holder of title to land, or his duly authorized agent or tenant, may irrigate with district water by dividing the quantity of water apportioned or apportionable to him by such reasonable annual water requirements so established by the district; limit the acreage of each crop that each such holder of title to land, or his duly authorized agent or tenant, may irrigate with district water to the maximum acreage or acreages so determined; and refuse to deliver water to, or assess penalities on, a holder of title to land, or his duly authorized agent or tenant, who uses district water on a greater acreage of such crops.

Nothing in this section shall prohibit or limit the application of the provisions of Section 35453 or 35454. This section provides a means of measuring the allocation of water to lands based on the type of crop grown and does not authorize a district to designate the crops to be grown on such land.

35455. Nothing in this article restricts or limits existing powers of a district to control and provide for distribution of water.

APPENDIX B

The Westside Regional Drainage Plan: An In-Valley Solution.

The Grassland Drainage Area (GDA) is a 97,400 acre agricultural region on the westerly side of the San Joaquin Valley. It is located about 8 miles south of Los Banos and is bounded on the west by Interstate 5, on the east by Highway 33, on the North by the CCID Main Canal, and by Westlands Water District on the South. The GDA includes seven districts (Broadview Water District, Camp 13 Drainage District, Charleston Drainage District, Firebaugh Canal Water District, Pacheco Water District, Panoche Drainage District, and Widren Water District) and approximately 7,500 acres of lands that are not incorporated into any district. 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 economic value of $239 Million.

Approximately 50% of the GDA includes subsurface drainage systems that remove saline drain water from the soil profile and discharge it to the San Joaquin River through the Grassland Bypass Project. However, impending water quality standards in the San Joaquin River and tributaries will soon eliminate this discharge as a means of disposing of agricultural drainage from this region. The Westside Regional Drainage Plan was developed in response to these upcoming requirements. The crux of this plan is to manage all drainage water internally so that no drainage leaves the boundaries of the GDA: Source control practices, such as irrigation improvements and groundwater management will reduce the volume of drainage produced. Reuse on the San Joaquin River Improvement Project (SJRIP) will utilize drainage water as an irrigation source for salt tolerant crops. The remaining drain water will be cleansed through a treatment process and reused as an irrigation source.

This phase of the Westside Plan proposes to expand the reuse area by purchasing additional acreage and developing that acreage for drainage reuse. Approximately 2,000 acres will be purchased and developed with funds through California Proposition 50 (Integrated Regional Water Management Program) and a funding agreement through the U.S. Bureau of Reclamation (Assistance Agreement 06FG202067). This appropriations request will be used for the purchase and development of an additional 1,000 acres.

Drainage Reuse: The San Joaquin River Improvement Project (SJRIP).

In June 1998, as part of Grassland Area Farmers' efforts to meet selenium load targets, Panoche Drainage District began applying drainage water to pasture and alfalfa fields. In January 2001, with $17,500,000 in funding from the State of California Proposition 13, the San Joaquin River Improvement Project (SJRIP), Phase I was implemented. Phase I of the SJRIP included the purchase of approximately 4,000 acres of farmland within the Grassland Drainage Area, some 1,800 acres of which was already planted with alfalfa, pasture, and asparagus. Throughout the irrigation season of 2001, drain water from the Grassland Drainage Area was used to irrigate these crops, displacing more than 2,800 acre feet.

Table 1 shows the volume of drain water and associated constituents reused on the PDD Drainage Reuse Project and SJRIP since 1998.

Table 1.

Water Year	Reused Drain Water	Displaced Selenium	Displaced Boron	Displaced Salt
	(acre feet)	(pounds)	(pounds)	(tons)
1998[¥]	1,211	329	NA	4,608
1999[¥]	2,612	321	NA	10,230
2000[¥]	2,020	423	NA	7,699
2001	2,850	1,025	61,847	14,491
2002	3,711	1,119	77,134	17,715
2003	5,376	1,626	141,299	27,728
2004	7,890	2,417	193,956	41,444
2005	8,143	2,150	210,627	40,492
2006	9,139	2,825	184,289	51,882

NA = Not Available

[¥] PDD drainage reuse project prior to SJRIP

As is evident from Table 1, the SJRIP reused more than 9,000 acre feet of subsurface drain water in 2006. Without this reuse project, that water, along with the associated salt, selenium, and boron, would have been discharged to the San Joaquin River. Currently, the SJRIP encompasses approximately 4,000 acres, of which about 3,800 acres are planted and only 1,300 acres are drained. For long term project operation, the full 4,000 acres of the SJRIP must be planted with salt tolerant crops and drained by subsurface drainage systems and an additional 2,000 to 4,000 acres of land must be added. For the next phase of the SJRIP expansion, the Grassland Area Farmers have identified approximately 3,000 acres for purchase and development for drainage reuse. In January 2007, the Westside Regional Drainage Plan was awarded a Grant through the Proposition 50 Integrated Regional Water Management Program that provided $14,698,000 in funds for the purchase and development of approximately 2,000 acres of reuse area and the completion of development of the existing SJRIP (this grant also provided funding for other parts of the Westside Regional Drainage Plan). This project will provided funding for the purchase and development of 1,000 acres of reuse area. This additional reuse area will provide sufficient reuse capacity to manage the subsurface drainage volume developed within the Grassland Drainage Area

APPENDIX C

PANOCHE WATER DISTRICT
WATER APPLICATION
2012 WATER YEAR

DATE: _____________

CVP CONTRACT WATER

The undersigned, (singular includes the plural) hereby subscribes to and agrees to be bound by the By-Laws and Rules and Regulations of the District governing the purchase and use of CVP Contract irrigation water, the receipt of District water service, and the payment to the District of all sums necessary for the purchase and delivery of my pro-rata share per acre of the District CVP Contract water supply; I further acknowledge that the delivery thereof is dependent on the availability of said water to the District. Said water is to be used to irrigate the land described in my *Bureau of Reclamation Certification or Reporting forms,* and I hereby agree to provide the District with such form.

I, or we, jointly and severally, agree to make payment for said water and water service as billed by the District as follows:

1. For CVP Contract Water:
   A. A partial payment, roughly one-half (1/2) of the total water allocation, through the Water Allocation Deposit Billing and the remainder through the Final Water Allocation Billing.
2. For District Water Service:
   A. Monthly O&M Billings based upon actual water deliveries through water user's assigned gates.

If the District has to enforce any covenant or provision hereof, I agree to pay the District's reasonable attorney's fee unless I prevail in said action.

NOTICE: NO 2014 YEAR WATER WILL BE DELIVERED UNTIL COMPLETE AND CORRECT CURRENT U.S.B.R REPORTING AND CERTIFICATION FORMS ARE FILED WITH THE DISTRICT. FAILURE TO PAY THE INITIAL WATER INVOICE FOR CONTRACT WATER AS BILLED WILL RESULT IN WAIVER OF YOUR CONTRACT ENTITLEMENT. REFUNDS FOR CONTRACT WATER PAYMENTS WILL BE MADE ONLY IF THE DISTRICT IS UNABLE TO DELIVER THE PURCHASED AMOUNT OR IF THE DISTRICT CAN RESELL ANY UNUSED WATER.

FARMING ENTITY NAME:

SIGNATURES:

______________________	______________________
LANDOWNER APPLICANT(S)	**LESSEE APPLICANT(S)**

EXHIBIT 1

2012

Table 1
Surface Water Supply

2012 Month	**Federal Ag Water** (acre-feet)	**Federal Non-Ag Water** (acre-feet)	**State Water** (acre-feet)	**CCID** (acre-feet)	**Other (undefine)** (acre-feet)	**Upslope Drain Water** (acre-feet)	**Total** (acre-feet)
METHOD	M1			M1	C2		
January	2,922			0	0		2,922
February	6,852			0	0		6,852
March	2,940			0	937		3,877
April	2,877			0	0		2,877
May	5,792			40	1,432		7,264
June	7,335			180	1,204		8,719
July	7,444			252	1,394		9,090
August	5,571			268	1,340		7,179
September	1,799			177	1,356		3,332
October	1,672			166	1,184		3,022
November	1,192			0	1,236		2,428
December	431			0	608		1,039
Total	46,827			1,083	10,691		58,601

Note: Quantity of transferred in water is included in Federal Ag. Water.

2012

Table 2
Ground Water Supply

2012 Month	**District Groundwater (acre-feet)**	**Private Groundwater *(acre-feet)**
January	0	0
February	0	0
March	0	395
April	0	0
May	0	0
June	0	685
July	0	599
August	0	394
September	0	0
October	0	0
November	0	0
December	0	0
Total	0	2,073

2012

Table 3

Total District Water Supply

Month	**Surface Water** (acre-feet)	**Groundwater** (acre-feet)	**Recycled Water** (acre-feet)	**Total Water Supply** (acre-feet)
METHOD	M1			
January	2,922	0	0	2,922
February	6,852	0	0	6,852
March	3,877	395	0	4,272
April	2,877	0	0	2,877
May	7,264	0	0	7,264
June	8,719	685	0	9,404
July	9,090	599	0	9,689
August	7,179	394	0	7,573
September	3,332	0	0	3,332
October	3,022	0	0	3,022
November	2,428	0	0	2,428
December	1,039	0	0	1,039
Total	58,601	2,073		60,674

Table 4
Distribution System

2012 Canal, lateral, reach, reservoir	Length/size (Feet or AF)	Surface Area (square feet)	Seepage acre-feet	Precipitation acre-feet	Evaporation acre-feet	Spillage acre-feet	Total acre-feet
Main Dist. Dith-Earth	36,900	10,164,000	1667	191	967	0	140
T-Canal	20,592	4,056,624	760	76	386	0	22
Contour Canal	22,440	4,420,680	670	83	420	0	57
10-W Canal	10,560	411,840	0	8	39	0	31
10-E-2 Canal	10,032	310,992	0	6	30	0	431
Russell Canal	9,504	370,656	0	7	35	0	38
Lateral 1	5,280	121,440	0	2	12	0	55
Lateral 2	26,400	1,663,200	26	31	158	0	14
Lateral 3	26,928	1,696,464	25	32	161	0	296
Lateral 5	7,920	316,800	0	6	30	0	415
Lateral 11-E	18,480	720,720	0	14	69	0	24
Total	195,036	24,253,416	3,148	456	2,307	0	1,523

Table 5
Surface Water Supply

2012

Crop	**Area** (acre-feet)	**Crop ET** (AF/Ac)	**Leaching Requirement** (AF/Ac)	**Cultural Practice** (AF/Ac)	**Effective Precipitation** (AF/Ac)	**Shallow Groundwater** (AF/Ac)	**Appl. Crop Water use** (acre-feet)
Melons	1,976	1.6	0.075	0.00	0.16	0.00	3,310
Tomatoes	7,593	2.10	0.140	0.00	0.16	0.00	17,008
Cotton	4,203	2.20	0.052	0.00	0.16	0.00	9,465
Grapes	3,582	2.17	0.340	0.00	0.16	0.00	8,991
Almonds	3,286	2.20	0.120	0.00	0.16	0.00	7,624
Wheat	3,265	1.10	0.029	0.00	0.16	0.00	3,686
Alfalfa	751	3.73	0.430	0.00	0.16	0.00	3,124
Pistachios	4,057	1.28	0.050	0.00	0.16	0.00	5,396
Others Hay	574	1.28	0.050	0.00	0.16	0.00	763
Others	8,149	1.87	0.140	0.00	0.16	0.00	12,206
							0
							0
Crop Acres	37,436						71,573

Table 6
System Water Budget

2012

Water Into Distribution			58,601
Riparian ET	(Distribution and Drain)	Minus	0
Groundwater Recharge	(Intentional, Ponds, Injection)	Minus	0
Seepage	Table 4	Minus	3,148
Evaporation	Table 4	Minus	2,307
Spillage	Table 4	Minus	0
Non-Ag Deliveries	Federal and Non-Federal	Minus	19,009
Theoretical Water Available for Sale to Ag Customers			
Compare the above Line with the next Line to Help find Omissions			34,137
2009 Actual Agriculture Water Sales		From District Sales Records	72,772
Private GroundWater	Table 2	Plus	2,073
Crop Water Needs	Table 5	Minus	71,573
Drain Water Outflow	(Tail & Tile Not Recycle)	Minus	
Ag tail Water Pumped back into Distribution System		Minus	
Percolation from Agricultural Land		(Calculated)	1,199

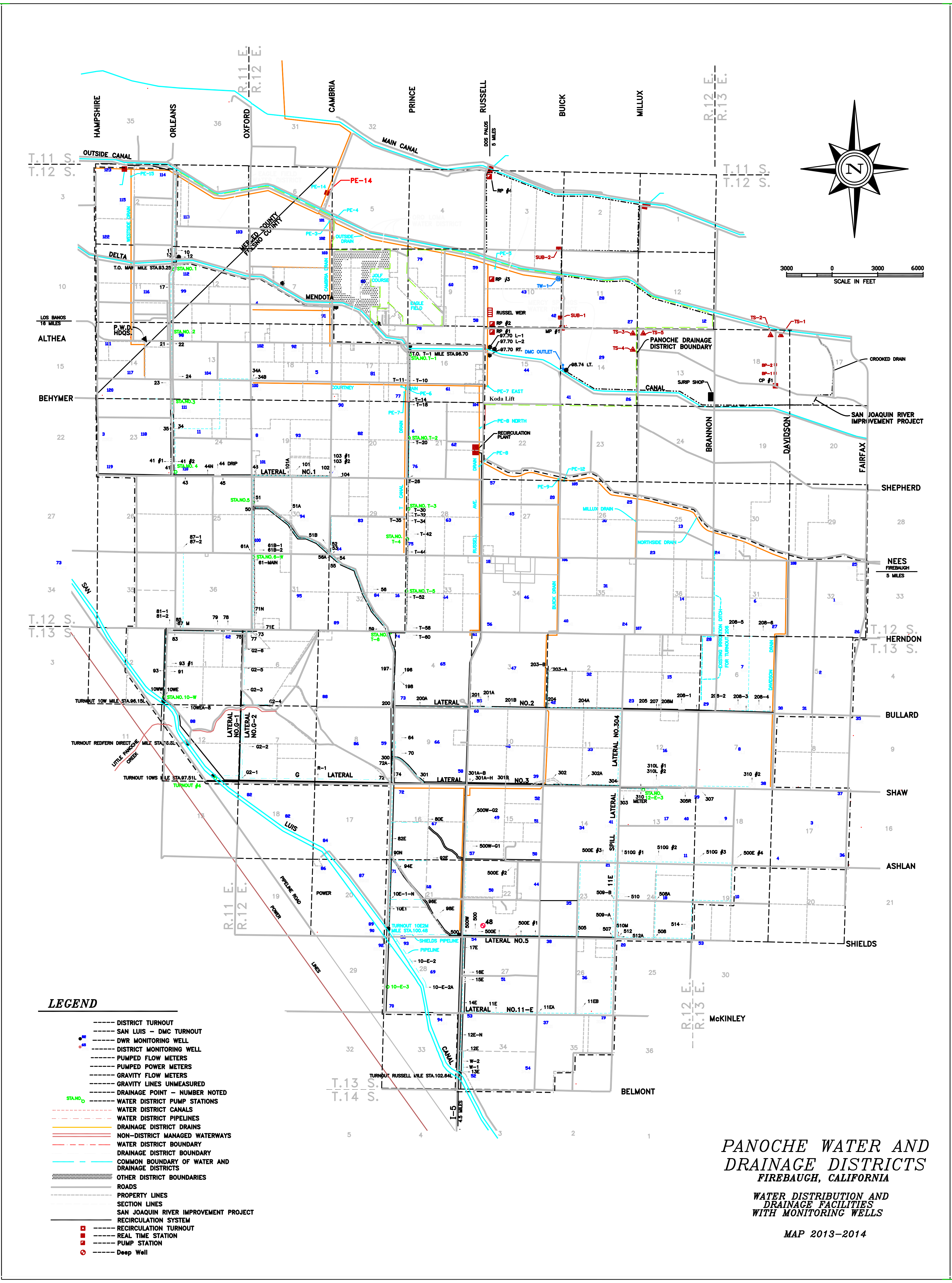
Table 7
Influence on Ground Water and Saline Sink

2012	Flows or Acres (AF or Ac)
Deep Percolation from fields+Seepage+Groundwater =Theoretical influence on ground water storage from district operations	2,944
Estimated actual change in ground water storage, accounting for subsurface conditions (estimated from water table and basin data)	0
Irrigated Acres (from Table 5)	37,436
Irrigated acres over a perched water table	22,000
irrigated acres draining to saline sink	0
Portion of percolation from ag flowing to a perched water table	705
Portion of percolation from ag flowing 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	705

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)	CCID (acre-feet)	Other (undefine) (acre-feet)	Total (acre-feet)
2003	61,444	0	0	952	4,920	67,316
2004	60,691	0	0	1,078	4,601	66,370
2005	58,220	0	0	0	3,936	62,156
2006	59,260	0	0	0	11,400	70,660
2007	48,102	0	0	985	4244	53,331
2008	33,405	0	0	2,285	2,187	37,877
2009	24,958	0	0	1,315	2,807	29,080
2010	43,613	0	0	0	0	43,613
2011	63,547	0	0	0	0	63,547
2012	40,014	0	0	1,083	0	41,097
Total	493,254	0	0	7,698	34,095	535,047
Average	49,325	0	0	770	3,410	53,505

EXHIBIT 2



PANOCHE WATER AND DRAINAGE DISTRICTS

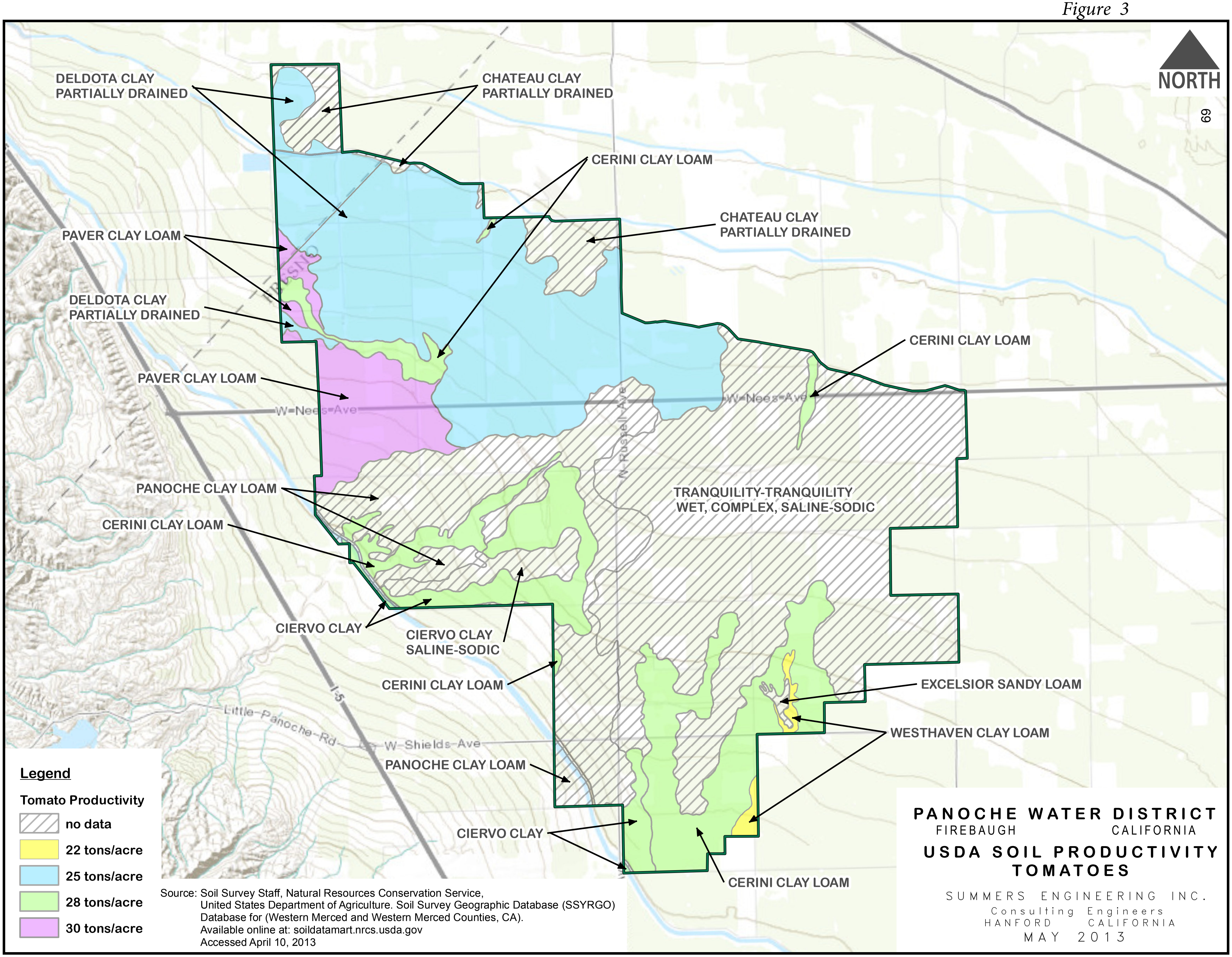
FIREBAUGH, CALIFORNIA

WATER DISTRIBUTION AND DRAINAGE FACILITIES WITH MONITORING WELLS

MAP 2013–2014

Figure 1

Figure 3



Source: Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Soil Survey Geographic Database (SSYRGO) Database for (Western Merced and Western Merced Counties, CA). Available online at: soildatamart.nrcs.usda.gov Accessed April 10, 2013

PANOCHE WATER DISTRICT
FIREBAUGH CALIFORNIA

USDA SOIL PRODUCTIVITY TOMATOES

SUMMERS ENGINEERING INC.
Consulting Engineers
HANFORD CALIFORNIA
MAY 2013

EXHIBIT 3

PANOCHE WATER DISTRICT

52027 WEST ALTHEA, FIREBAUGH, CA 93622 • TELEPHONE (209) 364-6136 • FAX (209) 364-6122

WATER RATES AND LAND ASSESSMENT CHARGES

WY 2012: MARCH 1, 2012 – FEBRUARY 28, 2013

2012 WATER SUPPLY

The Bureau of Reclamation has made a 40% allocation. The WY2012 USBR water allocation to all growers will be 1.08 AF/AC. In addition to the USBR supply, there is also an additional 0.72 AF/AC Supplemental Water Allocation available upon request.

WATER COST

A) USBR: Composed from the U.S.B.R. water rate, the USBR restoration rate, and the San Luis and Delta Mendota Water Authority self-funding rates. The water cost is assessed per the water user's allocation in two installments.

OPERATION AND MAINTENANCE

Panoche's cost to operate and maintain District facilities and the development, construction, and conveyance of additional supplies. The O&M is collected based on monthly usage.

RESTORATION

The U.S.B.R. restoration rate ($ 9.39) is melded into the USBR water rate. It will be collected as part of the water user's allocation.

U.S.B.R. HAMMER CLAUSE

The Board of Directors approved non-collection of the Hammer Clause ($ 14.08).

DELIVERED WATER RATES: ($/AF)

(Rates Subject to Change –Based on Decreased Water Supply, Water Availability, and Costs):

	USBR	SUPPLEMENTAL	USBR/SUPP'L MELDED COST (Including O&M)
WATER	$ 103.00	$ 194.00	
O&M AND CONSTRUCTION	$ 76.00	$ 76.00	
U.S.B.R. RESTORATION ($ 9.39)	na	na	$ 215.00
HAMMER CLAUSE ($ 14.08)	na	na	na
TOTAL	**$ 179.00**	**$ 270.00**	**$ 215.00**

DRAINWATER RECIRCULATION & RECOVERY PROJECT: $7.75 / AC

This is the cost to build the recirculation system located on Russell Ave. The project allows the District to help meet it's drainage reduction goals as part of the Grassland Bypass Project, while also creating an additional water supply to the District. The final loan payment on the project will be in WY 2018.

PANOCHE DRAINAGE DISTRICT - DRAINAGE SERVICE FEE: $30.00 / AC

The rate billed is approved annually by the Board of Directors. **The rate of $ 30.00 per acre was the rate approved for July 1, 2011 thru June 30, 2012.** The Drainage Service Fee is billed in two annual installments and is payable to the Panoche Drainage District.

EXHIBIT 4

PANOCHE WATER DISTRICT
WATER USAGE BILLING

MAY BILLING

June 25, 2013

Barcellos, Et Al
17599 S. Ward Road
Los Banos, CA 93635

Invoice # **31558**

Account # **66745**

Water Rate		Quantity (ac-ft)	Unit Cost	Cost
Description	Code			
PWD O&M 2 (WARREN ACT)	WR0021	235.00	$25.00	$5,875.00
SLDMWA 1 (WARREN ACT)	WR0023	235.00	$44.70	$10,504.50
USBR 2 (WARREN ACT)	WR0024	235.00	$33.28	$7,820.80
PWD O&M 11 (SUPPLEMENTAL)	WR0056	1.46	$85.00	$124.10
				$24,324.40

Due Date: July 10, 2013

If you have any questions regarding this invoice please call
Sandra Reyes at (209) 364-6136 for assistance.

PANOCHE WATER DISTRICT

WATER ALLOCATION - FIRST INSTALLMENT
2013-14 WATER YEAR

Barcellos, Et Al
17599 S. Ward Road

Los Banos, CA 93635

Invoice Date :	**05/06/13**
Invoice # :	**31348**
Account # :	**66745**

Assessor's Parcel Number	Acres	Deposit ($/acre)	Deposit ($/parcel)
004-120-09	18.66	$ 38.00	$709.08
004-120-17	368.19	$ 38.00	$13,991.22
004-130-13	40.00	$ 38.00	$1,520.00
004-130-14	14.14	$ 38.00	$537.32
004-130-21	77.42	$ 38.00	$2,941.96
004-140-17	80.00	$ 38.00	$3,040.00
004-140-19	40.00	$ 38.00	$1,520.00
004-140-20	20.00	$ 38.00	$760.00
004-150-17A	10.00	$ 38.00	$380.00
004-150-17B	10.00	$ 38.00	$380.00
004-150-18A	26.11	$ 38.00	$992.18
004-150-18B	26.11	$ 38.00	$992.18
004-160-01A	34.41	$ 38.00	$1,307.58
004-160-01B	34.41	$ 38.00	$1,307.58
TOTAL	799.45		$30,379.10

Due Date: **May 26, 2013**

If you have any questions regarding this invoice, please feel free to contact Sandra Reyes at (209) 364-6136 for assistance.

PANOCHE WATER DISTRICT
FINAL WATER ALLOCATION BILLING
2013-14 WATER YEAR

Invoice # **31820**

Barcellos, Et Al
17599 S. Ward Road
Los Banos, CA 93635

Bill Date **08/21/13**
Due Date **09/11/13**
Account # **66745**

Assessor's Parcel Number	Acres	Water Category	Allocation (ac-ft)	Rate ($/ac-ft)	Total Water Cost	Deposit Billed	Balance Due
004-120-09	18.66	WC0001	10.82	$ 131.00	$ 1,417.42	$ (709.08)	**$ 708.34**
004-120-17	368.19	WC0001	213.55	$ 131.00	$ 27,975.05	$ (13,991.22)	**$ 13,983.83**
004-130-13	40.00	WC0001	23.20	$ 131.00	$ 3,039.20	$ (1,520.00)	**$ 1,519.20**
004-130-14	14.14	WC0001	8.20	$ 131.00	$ 1,074.20	$ (537.32)	**$ 536.88**
004-130-21	77.42	WC0001	44.90	$ 131.00	$ 5,881.90	$ (2,941.96)	**$ 2,939.94**
004-140-17	80.00	WC0001	46.40	$ 131.00	$ 6,078.40	$ (3,040.00)	**$ 3,038.40**
004-140-19	40.00	WC0001	23.20	$ 131.00	$ 3,039.20	$ (1,520.00)	**$ 1,519.20**
004-140-20	20.00	WC0001	11.60	$ 131.00	$ 1,519.60	$ (760.00)	**$ 759.60**
004-150-17A	10.00	WC0001	5.80	$ 131.00	$ 759.80	$ (380.00)	**$ 379.80**
004-150-17B	10.00	WC0001	5.80	$ 131.00	$ 759.80	$ (380.00)	**$ 379.80**
004-150-18A	26.11	WC0001	15.14	$ 131.00	$ 1,983.34	$ (992.18)	**$ 991.16**
004-150-18B	26.11	WC0001	15.14	$ 131.00	$ 1,983.34	$ (992.18)	**$ 991.16**
004-160-01A	34.41	WC0001	19.96	$ 131.00	$ 2,614.76	$ (1,307.58)	**$ 1,307.18**
004-160-01B	34.41	WC0001	19.96	$ 131.00	$ 2,614.76	$ (1,307.58)	**$ 1,307.18**
	799.45		463.67		$ 60,740.77	$ (30,379.10)	**$ 30,361.67**

If you have any questions regarding this invoice, please feel free to contact Sandra Reyes at the District offfice.

EXHIBIT 5

Chapter 1 - Brief History of STORM

In order to use STORM, it is helpful to know how the program came to fruition. With the help of several water districts, STORM was designed with water districts specifically in mind.

STORM is a water resource management software designed to facilitate all aspects of water management and accounting. STORM was created to meet the specific needs of water and irrigation districts through a partnership between APS and several California water agencies. STORM is Windows based and Year 2000 compliant. APS has worked hard to make STORM flexible so that it will change and grow with you.

Product Inception

San Luis Water District ("SLWD"), consisting of approximately 55,000 acres, and Panoche Water District ("PWD"), consisting of approximately 38,000 acres, are located on the west side of the San Joaquin Valley. Both districts have water service contracts with the U.S. Bureau of Reclamation ("Bureau").

Shortages in the districts' water supply began occurring in 1990 as a result of drought conditions. The drought conditions were exacerbated during the next several years due to regulatory impacts associated with the federal Endangered Species Act, the federal Clean Water Act, the Central Valley Project Improvement Act, and other state and federal regulations.

Water shortages resulted in the districts having to implement and modify policies affecting both water and financial operations. For example, prior to water shortages, the districts' primary water function was to meter deliveries to water users and to bill accordingly. Water shortages forced the districts 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.

At this time, SLWD was using custom software for its water and financial transactions. However, this software needed significant modifications to accommodate the numerous additional water and financial features needed. In addition, the software was written for an IBM System 36 computer, and SLWD desired software that would operate under the Windows environment on a PC-based network. PWD was using an internally developed DOS-based database system on a stand-alone personal computer to manage many of its water and financial transactions. PWD desired professionally developed software and, like SLWD, wanted to move to a PC-based network.

Due to the similarities between SLWD and PWD, the districts decided in 1994 to jointly fund the development of custom software to meet their needs. In general, the districts 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. In addition, the districts also desired features to facilitate the management of parcel, name, field, and turnout information.

It was decided that SLWD would take the lead in developing, testing, and implementing the software. A description of the desired features and functions was developed and bids for programming were solicited. Advanced Professional Services ("APS") was hired in August of 1995 to begin development of the software. SLWD began using the developed software in March of 1996. The district's contract with APS was considered complete in December of 1997, and PWD began using the software in March of 1998. The districts sold the rights to the program to APS. APS named the software "STORM" and began marketing the product in 1998. STORM has continued to evolve and many additional features have been added to accommodate the needs of other districts that have purchased the product.

STORMS initial feature set

With STORM, users are able to accomplish several different tasks within the same program. Essentially, the program comes in three sections. These sections are as follows:

- Water Management Transactions
- Land Management Transactions
- Financial Transactions
- Other Key Features

Following is brief introductions of what each of these sections contribute to STORM. SLWD and PWD are used as the examples but by no means are the standard for water districts. Since STORM is so flexible, many different water districts with many different needs can take full advantage of the many features within the STORM program. These features are explained further from within the rest of this manual.

Water Transactions

Water Orders - STORM tracks orders placed by growers based on district determined criteria such as account, turnout, field, date, time, desired flow rate, and irrigation method. A lockout feature is incorporated which prevents the placing of an order to a particular account, turnout, field, or entire portion of the district's delivery system. A user-defined message can be linked to each lockout to explain the reason for the lockout. The projected deliveries for any future date can be calculated using the available order information. PWD uses this feature to produce daily reports for the field employees that operate their water delivery system to inform them of which turnouts should be open and the desired flow rate. STORM allows, but does not require, order information to be the basis for water deliveries. This will allow STORM to accommodate districts with both open, closed and mixed distribution systems.

Water Deliveries -STORM includes a water delivery feature that allows the entry of meter readings and calculates the water delivery based on the most recent meter reading. This calculated delivery can be overridden in the event that there is a meter stoppage or problem. Water deliveries through a particular turnout are distributed to one or more water users. Water order information is available to assist in this distributed. STORM also accommodates the entry of delivery information based on measurement methods other than meters. The water delivery feature allows, but does not require, identification of the particular water category being delivered. Some districts identify the water category as part of the water usage billing process rather than as part of the water delivery process.

Source Deliveries/Orders – A water "source" is defined as any location where water is delivered to or through a district distribution facility. A classic example is a district pumping plant that takes water from a Bureau canal. STORM allows the actual quantity of water delivered through the source to be entered. Also, the quantity of water ordered by the district for each source can be entered. These functions allow the district to compare its orders against actual deliveries to determine the accuracy of its orders. In addition, actual source deliveries can be compared to the deliveries made to water users in order to determine the extent of water losses in the district's distribution system.

Transfers - Both SLWD and PWD handle a large number of water transfers, either among growers within the district or from and to other growers outside the district. STORM includes a water transaction feature that maintains the water balance for each specific category of water available for a particular account. Certain STORM functions, such as water allocations and water usage billings, automatically enter information into the water transaction table. Manual entries can be made to handle water transfers or any miscellaneous adjustments that are required.

Water Allocations - STORM is designed to allocate a particular category of water to either landowners or water users based on either field or parcel data and based on either total or irrigable acreage. The process allows water to be allocated to a specific group of fields or parcels based on code information that is linked to those fields or parcels. For example, SLWD receives both agricultural and municipal and industrial ("M&I) water from the Bureau. SLWD defines a separate water category for each of these water types since they have different Bureau costs. The process allows SLWD to allocate agricultural water to only those parcels that have been coded as agricultural. The process provides tremendous flexibility in allocating not only the districts' Bureau supply but also other types of available water that may be associated with only certain property.

Financial Transactions

Billing - There are four main types of billing: assessment(land based water usage, leases, loans), water, water usage, and miscellaneous. STORM allows billing codes to be defined for the various billing types. Specific debit and credit general ledger accounts are tied to each billing code. The particular unit cost for each code can be defined for a specific time period to accommodate rate changes over time. Assessment billing codes are linked to parcels and can be defined as a rate per parcel, per acre, or per $100 of assessed value. A billing code can be applied to only a portion of the acreage for a particular parcel. SLWD has instances where a certain assessment charge is only applicable to a portion of a parcel while other assessment charges are applicable to the entire acreage. The ability to define a particular acreage for each charge provides maximum flexibility to the assessment billing process. The assessment billing process can handle up to twelve installments and can assign invoice numbers to each parcel or to each landowner.

SLWD and PWD's water billing consists of the collection of the Bureau cost of water. Since the districts are required to pay for this water approximately two months in advance of delivery, the districts collect the Bureau water costs from customers in advance to prevent cash flow difficulties. The Bureau begins making water supply projections on February 15th of each year and updates these projections at least monthly thereafter until the water supply is finalized. The dynamics associated with water exports from the Delta delays the finalization of a water supply until as late as June in certain years. The changing water supply situation may also result in changes to the water rate. The problem of needing advance payment but not knowing the specific quantity and/or price of water until several months into the water year is addressed by both SLWD and PWD through the use of a Water Allocation Deposit Billing. This billing consists of a charge per acre for eligible property. SLWD sends this billing in January and makes it due by March 1, the beginning of the water year. Failure to pay by this date results in the loss of the water allocation for that year. A Water Allocation Billing is mailed later in the year after the actual water allocation and prices are known. This billing details the actual water allocation per parcel, the unit cost of the water, the total water cost per parcel, and the remaining water cost per parcel taking into account the Water Allocation Deposit Billing. The Water Allocation Billing for SLWD is due by July 1.

Both SLWD and PWD generate monthly water usage billings. SLWD has an extremely complicated pricing structure. SLWD has many different categories of water, each of which has one or more unique associated charges. In addition, a portion of SLWD is served by district-owned distribution facilities while the remainder is served from private distribution facilities connected directly to Bureau canals. SLWD has chosen to separate administrative costs from operation and maintenance costs associated with the district-owned distribution system. Administrative costs are allocated to all water users with SLWD, while operation and maintenance costs are allocated only to water users served from district distribution facilities. To further complicate matters, the portion of SLWD served from district distribution facilities is separated into three improvement districts, each of which has a unique operation and maintenance charge.

STORM was designed so that water rates could be linked to one or more of the following variables: water user, turnout, water category, field, and date range. This provides the flexibility to handle very complex billing needs. Links can be very general. For example, a particular water rate could be linked to a water category. The result would be that that rate would be charged whenever that water category is delivered, regardless of where or to whom the water was delivered. However, very specific and complex situations can also be handled. A rate could be established that would only be applicable when a particular water category is delivered to a particular field through a particular turnout during a specific time period. SLWD has approximately 40 different water rates. At this time, SLWD has linked these rates to only water categories, water turnouts, or a combination thereof. SLWD's complex rate and billing structure results in over 7,500 possible combinations of water rate, water category, and turnout.

For SLWD, the water usage billing is where the particular water category of delivered water is determined. The water delivery process only identifies the quantity of water delivered. The water usage billing process determines what category was delivered. This is accomplished by comparing the actual water delivered to a particular water user, to the types and quantities of water categories that are currently on that water user's account, and to the above-mentioned file containing possible water rate combinations. A linear optimization process is used to analyze this date and categorize the actual water delivered so that the resulting bill represents the least-cost billing for each different water user. This process has been very beneficial to SLWD water users. Prior to the implementation of STORM, SLWD water users needed to inform the district of the priority of water use for their various water categories. The complex rate structure made if very difficult for water users to determine how they wanted to prioritize their water categories. Being able to assure water users that a least-cost analysis is automatically being formed as part of the water usage billing has significantly reduced the amount of time spent by both water users and SLWD regarding the water usage process. STORM allows the optimization process to be over-ridden on either the district, water user, or field level by entering a specific priority of water category usage. STORM is also designed to handle all types of miscellaneous billing that may be needed. SLWD uses this feature to handle billing adjustments that may be required or to bill for things like specific equipment or labor expenses that are not addressed through the other types of billing.

STORM has functions to calculate penalty and/or interest charges on delinquent billings. Both simple and compound interest calculations can be handled.

Cash Receipts - STORM has a very efficient cash receipts function that allows a receipt to be allocated to a particular account, a particular billing associated with that account, or to a specific charge within a given billing.

Accounts Receivable - The billing and cash receipts functions result in the ability to monitor the accounts receivable status of landowners and water users. This information is referenced by other functions of STORM to provide warning messages if delinquencies exist. For example, the water order feature can be formatted to check for delinquent charges. SLWD has found this feature very helpful in implementing the district's policy that water will not be delivered to water users that have delinquent charges.

Other Key Features

There are several other key features of STORM that greatly enhance the ability to manage district operations. Following is a brief summary of some of these features.

Parcel Management - Information such as section, township, range, total acres, irrigable acres, county, assessed valuation, ownership and leasing information, turnouts water service is received from, and other information can be linked to parcels. Of particular benefit to SLWD is the parcel code feature. This consists of the ability to define any unique characteristic as a separate code and to link this code to any parcels that have that characteristic. SLWD has defined codes for things such as inclusion in an improvement district, whether or not a parcel is eligible to receive a water allocation, and whether a parcel receives agricultural or M&I service. Parcel codes allow detailed analysis of parcel information by allowing the grouping of related parcels through user-defined criteria. Parcel codes provide tremendous analysis opportunities that are limited only by the creativity of the user.

Name Management - In addition to standard information such as address and unlimited telephone numbers, this feature also provides a quick reference for other information associated with a particular name. Ownership and leasing information is readily available as are the turnouts that are available to that account and the current water order status of those turnouts. The easy access of this information has made district staff much more efficient in responding to customer inquiries. As with parcels, name codes can be defined to group various accounts that have a common characteristic. An added feature is the ability to use these name codes in combination with parcel codes and ownership and leasing information to generate mailing lists. There are many occasions where correspondence needs to be sent to only a particular group of customers. This feature makes it very easy to generate a mailing list, for example, for all water users within a particular improvement district.

Field Management - STORM allows water user-defined field information to be entered into the system. Field information includes data such as crop, irrigation method, acreage, land classification, etc. The ability to enter field information allows water orders and deliveries to be tracked to another level of detail. Both SLWD and PWD are in the process of transitioning to a situation where field information will be required from water users in order to place water orders. The use of this feature will allow SLWD and PWD to analyze water use efficiency on a field basis. Current plans are to add a tier feature to STORM that would allow the application of tiered water rates on a crop-specific basis. Again field codes can be defined as desired.

EXIHIBIT6

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

OCTOBER 1996

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

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DEFINITIONS

AB 3030	Groundwater Management Act, Assembly Bill 3030
CIMIS	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
K_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

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 a 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 groundwater 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.

II. GROUNDWATER MANAGEMENT AREA

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 of 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 discharge 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 program 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. SURFACE WATER SUPPLY

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. 40, 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 To 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.

VIII. GMA WATER BALANCE SUMMARY

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 110,000 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.

X. ELEMENTS OF THE GROUNDWATER MANAGEMENT PLAN

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 GMA, 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.

XI. IMPLEMENTATION OF THE GROUNDWATER MANAGEMENT PLAN

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.

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EXHIBIT 7

PANOCHE WATER DISTRICT
IRRIGATION WATER QUALITY

SLC RUSSELL TURNOUT	ALKALINITY CaCO3 mg/L	BICARBONATE CaCO3 mg/L	BORON B mg/L	CALCIUM Ca mg/L	CARBONATE CaCO3 mg/L	CHLORIDE Cl mg/L	CONDUCTIVITY EC umho/cm	TDS EC*0.7 PPM	HYDROXIDE CaCO3 mg/L	MAGNESIUM Mg mg/L	NITRATE NO3 mg/L	PERCENT SODIUM %	Ph STD	POTASSIUM K mg/L	SELENIUM Se. PPB	SODIUM Na mg/L	SULFATE SO4 mg/L
5/23/2005	81	81	0.20	22	ND	72	460	322	ND	13	3	50	8	3	ND	51	42
8/24/2005	70	70	0.10	16	ND	49	340	238	ND	9.5	2	51	8.1	2	ND	39	23
7/12/2006	57	57	0.14	14	ND	50	300	210	ND	8.1	8	50	8.1	2	ND	33	98
8/19/2006	57	57	0.11	15	ND	40	290	203	ND	9.2	2	47	8.2	2.1	ND	32	21
9/20/2006	71	67	ND	13	4.3	33	280	196	ND	7.6	2	44	8.6	ND	ND	23	19
2/21/2007	81	73	0.21	22	8	80	500	350	ND	14	4.3	51	8.5	3.2	ND	56	41
3/31/2007	76	76	0.18	19	ND	49	400	280	ND	11	3.2	47	8.1	2.4	ND	39	37
4/25/2007	77	72	0.18	19	5.3	60	420	294	ND	12	2.7	49	8.5	2.6	ND	45	34
5/23/2007	80	76	0.15	20	4.4	70	380	266	ND	12	2.1	52	8.4	2.9	2.5	51	34
6/20/2007	81	76	0.15	20	5.5	70	450	315	ND	12	1.8	52	8.4	2.9	ND	51	34
7/18/2007	64	64	0.11	14	ND	40	290	203	ND	8.8	1.8	49	8.3	ND	ND	31	20
8/20/2007	65	65	ND	14	ND	86	440	308	ND	11	1.3	58	8.1	2.9	ND	53	20
9/19/2007	71	63	0.13	17	8.4	120	590	413	ND	14	1.2	61	8.6	3.6	ND	75	27
1/31/2008	90	90	0.22	26	ND	110	670	469	ND	17	7	55	8.1	4.3	3.0	78	58
2/13/2008	82	82	0.22	27	ND	71	480	336	ND	16	8.3	46	8.1	4.3	ND	54	56
3/26/2008	83	77	0.26	26	6.4	81	510	357	ND	15	4.5	49	8.5	3.5	ND	59	50
4/16/2008	75	70	0.17	22	4.7	90	530	371	ND	14	3.4	53	8.5	3.5	ND	60	41
5/29/2008	78	78	0.17	22	ND	87	530	371	ND	14	3	54	8.2	3.3	ND	63	41
6/18/2008	79	79	0.19	22	ND	91	540	378	ND	14	3.1	54	8.3	3.4	ND	64	40
7/16/2008	75	75	0.15	18	ND	66	430	301	ND	12	2.5	52	8.3	2.9	ND	49	32
1/21/2009	94	94	0.23	29	ND	130	710	497	ND	19	6.2	54	8.1	4.1	ND	85	54
2/18/2009	92	88	0.24	28	3.2	130	710	497	ND	19	5.4	55	8.4	4.0	ND	86	61
3/19/2009	96	90	0.26	29	5.8	100	680	476	ND	18	5.7	52	8.5	3.6	ND	74	66
4/16/2009	89	89	0.22	24	ND	70	490	343	ND	14	3.4	47	8.3	2.9	ND	50	46
5/19/2009	93	85	0.19	23	7.8	95	580	406	ND	15	2.3	54	8.6	3.3	ND	66	50
6/8/2009	98	95	0.24	26	2.5	110	680	476	ND	17	3.6	54	8.4	3.8	ND	76	54
7/14/2009	73	73	0.11	14	ND	25	240	140	ND	8.4	ND	42	8.1	ND	ND	23	14
4/22/2010	96	84	0.27	26	12	67	570	399	ND	15	3.2	50	8.7	2.9	ND	59	53
11/11/2010	65	65	0.12	18	ND	73	488	342	ND	12	3.4	54	7.3	2.9	ND	54	23
3/16/2011	51	51	0.15	17	ND	36	334	234	ND	8.8	3.2	33	8.3	1.9	ND	33	39
6/15/2011	41	41	0.12	12	ND	22	228	160	ND	5.9	2.7	22	7.9	1.4	ND	22	25
8/19/2011	54	54	0.11	17	ND	37	281	197	ND	9.5	2.2	32	7.91	2.1	ND	32	21
9/21/2011	59	57	0.09	15.5	ND	20	219	127	ND	8.7	1.6	22	8.3	1.5	ND	22	15
10/19/2011	54	54	0.09	13.8	ND	20	226	131	ND	7.3	2.5	21	8.1	1.6	ND	21	16
4/8/2012	83	83	0.11	28.9	ND	74	497	285	ND	17	3.2	60	8.5	1.5	ND	60	49
5/17/2012	70	70	0.25	30.1	ND	62	430	255	ND	18.2	2.7	72	7.8	3.9	ND	72	41
6/13/2012	71.1	71.1	0.15	22.3	ND	60	469	328	ND	13.1	2.2	51	7.9	2.9	ND	51	33
7/25/2012	60.6	60.6	0.10	15.1	ND	49	322	225	ND	9.9	0.96	36	7.9	2.6	ND	36	21
8/29/2012	58.2	58.2	0.09	13.6	ND	61	358	251	ND	10.2	0.83	48	8.2	2.4	ND	48	17
9/24/2012	68.1	68.1	0.13	15.9	ND	111	518	363	ND	15.5	1.2	76	8.2	3.3	ND	76	28
3/14/2013	102	102	0.77	51.2	ND	126	881	616.7	ND	24.2	17.6	144	8.39	3.4	17	144	197

EXHIBIT 8

- 4 Main Education Messages
- MEC - Bringing Education to you
- Participate in Program
- Event Calendar
- Demonstration Facilities
- Written Material/Literature

[Click here to read about CI cy Program]

Pacific Gas and Electric Co the Advanced Pumping Efficiency Program (APEP) through 2014 using Public Purpose Programs Funds under the auspices of the California Public Utilities Commission.

Eligibility extends to all owners or users of a non-residential, PG&E electric or natural gas account that is primarily used for pumping water for the following: Production agriculture; landscape or turf irrigation; municipal purposes, including potable and tertiary-treated (reclaimed) water but excluding pumps used for industrial processes, raw sewage, or secondary-treated sewage.

Customers must pay the Public Purpose Programs Charge on their utility bill. Customers should call APEP for questions concerning program eligibility.
APEP has four program components:

1. Educational Seminars (free of charge)

2. Technical Assistance (free of charge but APEP does not provide site-specific engineering)

3. Subsidized Pump Efficiency Tests - APEP maintains a list of approved Participating Pump Test Companies. Subsidized tests are only available through them. The APEP subsidy may or may not pay for the entire cost of test. The pump operator may have to provide some of these costs. The pump test subsidy is now $200/test if the pump hasn't been tested in the last 4 year and $100/test if it hasn't been tested in the last 2 years. APEP will continue to provide only one subsidized test in any 2 year period (other restrictions may apply).

"IMPORTANT! Program eligibility and requirements have changed as of June 10, 2013.

1. To receive an incentive for a pump retrofit APEP requires pump efficiency tests both before and after the project. These tests cannot be more than 3 years apart.

2. An application package for the incentive must be complete within 2 years after the after-project pump efficiency test.

3. Only one incentive will be provided for any one pump in a six-year period.
Click here to read the entire revised Policies and Procedures."
This program effort will provide for:

- 2,700 subsidized pump efficiency tests per year. Click here to learn more about pump tests and how you could obtain one.
- Cash incentives for 300 pump retrofit projects per year. Click here to learn more about eligibility and how you can apply for a retrofit Incentive

Whats New?

- Home
- Site Map
- Español

Latest News & Events

- Fresno State CIT- APEP Pumps...
- Santa Maria- Fertigation Wor...
- Fresno State CIT- Groundwate...
- Fresno State CIT- Water Use...

Search our Knowledge Base for: ☐ GO! ›››

The Center for Irrigation Technology
California State University, Fresno
5370 North Chestnut Ave. - MS/OF 18
Fresno, CA. 93740-8021
(559) 278-8662
(800) 845-6038

- 10 educational seminars/year (refer to the events calendar to the right for notice of seminars coming to your area) - also, click here to view all of the APEP's educational materials. Click here to transfer to the WATERIGHT web site, a site dedicated to agricultural and turf water conservation.

PG&E offers many other energy efficiency programs in all markets, residential, commercial, industrial, and agricultural and for both retrofit and new-construction projects. Click here to learn more about these programs.

The Advanced Pumping Efficiency Program (APEP or the "Program") is a continuing effort by the Center for Irrigation Technology. It is intended as a multi-level program addressing the following important resource management problems in California:

- Energy Conservation
- Water Conservation
- Water Quality
- Air Quality

The twin goals of APEP are:

- Get highly efficient hardware in the field, including pumping plants, irrigation systems, and water distribution systems.
- Ensure that this hardware is managed correctly.

APEP has operated with funding from a variety of sources including the California Energy Commission, the California Public Utilities Commission, and the Federal Environmental Protection Agency. It works with agriculturalists and municipal and private water companies.

From 2001 through 2003 CIT implemented the Agricultural Peak Load Reduction Program on behalf of the California Energy Commission. This program provided the following to California during the "energy crisis":

- 9.3 megaWatts of reduced peak load (power use during the time period 12:00 noon through 6:00 PM in the summer months)
- 88.6 gigaWatt-hours conserved annually
- $7.4 million in distributed grants

From 2002 through 2012 CIT has operated APEP with funding from the CPUC and provided California water pumpers with:

- 1750 pump retrofit / repair rebates
- $6,900,000 in incentive rebates for those projects
- 108,000,000 kilowatt-hours saved annually as a result of those projects
- 373,000 therms saved annually as a result of those projects
- 27,600 subsidized pump efficiency tests
- $4,560,000 in pump test subsidies
- 180 educational seminars

Diesel Pumping Efficiency Program

In addition to the APEP activities funded by PG&E, CIT also implemented a pilot program in the area of diesel-powered pumping plants on behalf of the Federal EPA and the Valley CAN group. This effort resulted in 69 pump efficiency tests, 11 pump retrofit projects, and preparation of a diesel pump testers kit including computer software to database and perform calculations regarding the test, instructions for assembling equipment necessary to measure fuel flows, and guidance on performance in interpreting the test results. The background thesis paper regarding this effort can be read here.

Although the main objective of the diesel-oriented program is improving air quality through reductions in emissions from the diesel-powered pumping plants, we also emphasize sound water management.

See our Case Studies for examples of the kinds of savings California farmers have realized through CITs efforts. Please visit the Educational section of this site as all of our written materials can be downloaded.

IMPORTANT! Three important resources for those interested in the Diesel Pumping Efficiency Program, diesel-powered pumping plants, pump efficiency testing of diesel-powered pumps, and air quality in general are now available:

1. Click here to view the final report to the EPA for the pilot-level Diesel Pumping Efficiency Program.

2. Click here to view the Diesel Pump Tester's Resource Manual developed for the follow-on project funded by the Valley CAN group.

3. Click here to view the PowerPoint presentation summarizing the Diesel Pumping Efficiency Program. This file includes extensive notes for each slide. You may want to download the file (about 3.2 MB) and view with the notes visible.

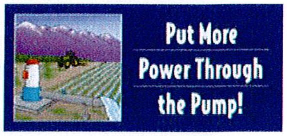
Design & Development by

Center for
Irrigation
Technology

Pacific Gas and
Electric Company®

Advanced Pumping Efficiency Program

Helping California...



Policies and Procedures Manual

What's Inside:

The information in this Policies and Procedures manual is current as of January 6, 2011. The Advanced Pumping Efficiency Program (APEP) may be modified or terminated at any time. Please contact the main APEP Program Office for up-to-date information, especially if you are applying for an incentive for a pump retrofit/replacement project. The APEP Program Office can be contacted by calling toll free, 1 (800) 845-6038. You may also log on to the APEP web site at www.pumpefficiency.org for more information and a knowledge-base for pumping efficiency.

APEP Development and Management by:

Center for Irrigation Technology - California State University, Fresno
5370 North Chestnut Avenue – M/S OF18
Fresno, CA 93740-8021
(559) 278-2066
Peter Canessa – Program Manager

Pacific Gas & Electric Company
P.O. Box 770000
San Francisco, CA 94177
Elisa Brossard
Senior Program Manager - Customer Energy Efficiency Programs

IMPORTANT!
California consumers are not obligated to purchase any full fee service or other service not funded by this program. This program is funded by California utility ratepayers under the auspices of the California Public Utilities Commission.

Los consumidores en California no estan obligados a comprar servicios completos o adicionales que no esten cubiertos bajo este programa. Este programa esta financiado por los usuarios de servicios públicos en California bajo la jurisdiccion de la Comisión de Servicios Públicos de California.

EXHIBIT 9

CIMIS (California Irrigation Management Information System)

Monthly Report

Rendered in ENGLISH Units.
January 1, 2012 - December 31, 2012
Printed on October 22, 2013
See the bottom of this report for a legend for all flag values.

San Joaquin Valley - Panoche - #124

Month Year	Tot ETo (in)	Tot Precip (in)	Avg Sol Rad (Ly/Day)	Avg Vap Pres (mBars)	Avg Max Air Tmp (F)	Avg Min Air Tmp (F)	Avg Air Tmp (F)	Avg Max Rel Hum (%)	Avg Min Rel Hum (%)	Avg Rel Hum (%)	Avg Dew Point (F)	Avg Wind Speed (mph)	Avg Soil Temp (F)
Jan 2012	1.98	0.33 K	240	7.3 K	60.4	33.9 K	46.5	84	47	66 K	35.4 K	3.7 K	46.5
Feb 2012	2.79	0.14	317	8.0	63.2	39.6	50.9	84	41	63	38.1	4.9 K	50.0
Mar 2012	3.95 K	1.34	401	8.7 K	66.5 K	42.8 K	54.4	83	39	59 K	39.9 K	5.2 K	55.5
Apr 2012	5.82	1.07	545	10.3 K	73.8 K	48.0 K	61.2	78	35	55 K	44.1 K	6.0 K	61.6
May 2012	8.93 K	0.01 K	689 K	9.0	84.2	52.1 K	69.2	66	21	38	41.5	7.1 K	65.8
Jun 2012	9.25	0.00 K	719	10.8 K	88.2 K	55.6 K	73.0	68	23	39 K	46.2 K	7.2 K	69.5
Jul 2012	8.59	0.00	670	14.1	92.5 K	58.6	75.7	80	28	47	53.7	5.4 K	74.0 L
Aug 2012	7.70	0.00	588	14.6	93.9	60.7	77.1	75	28	46	54.7	4.7 K	74.7 L
Sep 2012	5.89	0.00	494 K	12.7	91.0	56.8	73.6	76	25	45	50.7	4.0	69.3 K
Oct 2012	3.73 K	0.00	341	11.9 K	78.1	50.3 K	64.0 K	82 K	37 K	59 K	48.8 K	4.1 K	62.1 K
Nov 2012	1.89	0.53	233	10.7 K	66.9 K	42.3 K	54.2	90	53	73 K	45.6 K	3.5	54.8
Dec 2012	1.04	1.45	162 K	9.9 K	56.0	39.2 K	47.5	95	70	85 K	42.4 K	4.2 K	52.3 K
Totals/Avgs	61.56	4.87	450	10.7	76.2	48.3	62.3	80	37	56	45.1	5.0	61.4

M - All Daily Values Missing	K - One or More Daily Values Flagged
J - One or More Daily Values Missing	L - Missing and Flagged Daily Values

W/sq.m = Ly/day/2.065
inches * 25.4 = mm
C = 5/9 * (F - 32)
m/s = mph * 0.447
kPa = mBars * 0.1

Westlands Water District

Water Conservation Program - Irrigation Guide

Voice (559) 224-1523 FAX (559) 241-6277

Northern Zone 09/16/2013

Crop	Plant Date	--------Total--------- -Total To Date- Degree Days	Water Use	Season Avg. Use	---Past Daily Use--- Prior 14 Days 08/19-09/01	Prior 7 Days 09/02-09/08	Last 7 Days 09/09-09/15	Forecast Use 10 Days 09/16-09/25
Alfalfa Hay	01/01/13	0	41.4"	43.4"	0.31"	0.11"	0.18"	0.21"
Alfalfa Hay	01/01/13	0	41.3"	43.4"	0.31"	0.11"	0.18"	0.21"
Alfalfa Seed	11/15/12	0	32.1"	31.6"	0.03"	0.13"	0.18"	0.19"
Almond, Drip	02/15/13	0	36.3"	34.6"	0.14"	0.11"	0.09"	0.06"
Cotton, D	05/01/13	0	25.3"	23.3"	0.31"	0.26"	0.19"	0.15"
Grape, Drip	03/20/13	0	23.4"	22.9"	0.19"	0.19"	0.14"	0.08"
Olive	01/01/13	0	31.5"	32.6"	0.18"	0.18"	0.17"	0.14"
Orange	01/01/13	0	32.2"	33.1"	0.19"	0.18"	0.17"	0.14"
Pistachio	04/01/13	0	32.6"	32.5"	0.22"	0.20"	0.18"	0.14"
Current ETP					0.39"	0.38"	0.35"	0.27"
Long-Term Average ETP					0.33"	0.31"	0.30"	
Percent Variance from Average					18%	22%	16%	

Federal Storage Thousands of AF	San Luis 2013	2012	Shasta 2013	2012
July 04,2013	191	213	2,871	3,805
Aug. 01,2013	110	168	2,420	3,255
Sep. 15,2013	186	232	1,994	2,664
Capacity	966		4,552	

LEASE OF ACQUIRED LANDS

Agricultural Industries Inc. is resposible for Management of District owned lands. If you have questions, please contact Cork McIsaac, at

* * *

The application period for the District low interest lease-purchase program (EISIP)for improved irrigation equipment is open and will remain open continuously. Funds are available this year for all water users who would like to participate. For details, check the District web site, http://www.westlandswater.org. Go to Water Conservation, Cost-Sharing Programs and then EISIP or call Israel Sanchez at (559) 241-6237.

* * *

This Irrigation Guide, updated daily, is now available on the Internet. The District has a web site at http://www.westlandswater.org on the Internet. Go to the Water Conservation page and select the link to the daily Irrigation Guide.

* * *

EXHIBIT 10

Juan

From: Coral L. Norris <clnorris@calpoly.edu>
Sent: Monday, May 06, 2013 6:14 PM
To: clnorris@calpoly.edu
Subject: ITRC - Irrigation Training Workshops

The following classes are available for persons interested in irrigation courses through the Irrigation Training and Research Center (ITRC):

AG IRRIGATION SYSTEM EVALUATION – June 2013

(http://www.itrc.org/classes/iseclass.htm)

Online Portion: $250, plus $115 for required textbook

The online portion of ITRC's new hybrid online/hands-on course presents the theories and procedures of drip/micro irrigation system evaluations through videos, tutorials, and quizzes in conjunction with textbook and online reading material. Students can register at any time until two weeks prior to the first hands-on short course, and progress through the material at their own pace. Final exam required for Irrigation Association CEU credit.

Evaluation Class 1 – June 17-19, 2013 (Free - in conjunction with the online class)

This first 2 ½ day class combines classroom (50%) and outdoor laboratory (50%) activities. Efficiency definitions and evaluation techniques are emphasized, ranging from how to take a pressure measurement to what specific measurements are needed for evaluation of six distinct irrigation methods (furrow, border strip, hand move/side roll sprinkler, linear move sprinkler, undertree sprinkler, and drip/micro). These systems can be "tuned up" to conserve water and power, and to maintain adequate surface water and groundwater qualities. The techniques and programs covered are the standard used for DWR-funded evaluation projects throughout California.

Evaluation Class 2 – June 19-21, 2013 (Free - in conjunction with the online class)

This 2½-day class travels to the San Joaquin Valley and performs the entire evaluations on 2 fields. Emphasis is on performing the field evaluations for drip and microspray irrigation systems on trees/vines. This class allows for more extensive field training to help with the comprehension of the materials from Class 1.

DESIGNER/MANAGER SCHOOL OF IRRIGATION – July/August 2013

See the following link for pricing: http://www.itrc.org/classes/desmgr.htm

Basic Soil, Plant & Water Relationships – July 16, 2013
Irrigation Scheduling, Salinity & Drainage – July 17-18, 2013
Basic Pipeline Hydraulics I – July 22, 2013
Basic Pipeline Hydraulics II – July 23, 2013
Pumps I – July 24, 2013
Pumps II – July 25-26, 2013
Chemigation – July 25, 2013
Row Crop Drip Irrigation – July 29, 2013
Drip/Micro Irrigation Design – July 30-August 1, 2013
Landscape Sprinkler Design – July 30-31, 2013
Landscape Irrigation Auditor – August 1-2, 2013

To register for any ITRC classes, please visit http://www.itrc.org/classes.htm or call Coral Norris at (805) 756-2434.

IRRIGATION TRAINING AND RESEARCH CENTER
California Polytechnic State University
San Luis Obispo, CA 93407
Phone: (805) 756-2434
FAX: (805) 756-2433
www.itrc.org   Contact: Dr. Burt   cburt@calpoly.edu

Summer Irrigation Evaluation Program

Drip/Micro Irrigation Systems

Funded by the US Bureau of Reclamation, Water Conservation Office (Fresno)
Supported by local Irrigation/Water Districts

What the student team does:

- Spends about 1 day in the field taking measurements of pressures, flows, and make observations of the filtration, chemical injection, etc.
- Inputs data into the Cal Poly ITRC Irrigation Evaluation Programs, examines field data.
- Prints out the data, results, and recommendations
- Sets up an appointment with the farmer to review the information.

The type of information provided:

The Cal Poly ITRC Irrigation Evaluation Programs provide:

- The Distribution Uniformity (DU) of the irrigation system. **The DU is a measure of how evenly the irrigation water is applied to plants throughout a field.**
- The causes of non-uniformity. For example, the program will tell a farmer what percentage of the non-uniformity is due to plugging, what percentage is due to pressure differences, etc.
- Recommendations on how to improve that specific system's performance.

Who gets the information:

- The farmer
- The irrigation district (but without any farmer's name or address)
- The USBR (but without any farmer's name or address)
- Cal Poly ITRC

The obligation by the farmer:

- There is no fee; it is completely funded by the USBR
- The farmer must agree to have someone show the students the field, explain the layout, and start and stop the pump on the agreed-upon date and at the agreed-upon time.
- If the system is a subsurface drip system, the farmer must provide workers with shovels to uncover tape in 3 locations, about 30' per location.
- The farmer must be willing to take the time to sit down and go over the results (about 30 minutes).

Why participate?

- Irrigation systems cost money to operate, and their performance has a huge impact on yield and yield quality. Older systems need to be checked out just as automobiles do. Sometimes they need a tune-up; sometimes they don't. This evaluation lets a farmer know if a tune-up is needed, and what types of things can be done.
- On the average, we find that the DU of drip/micro systems is about 0.76 (out of a perfect 1.00), whereas reasonably attainable values are about 0.92 for drip/micro systems. If you can shift from a DU of 0.76 to a DU of about 0.92, the ratio of (maximum/minimum) water applied to different plants throughout a field will shift from about (2/1) to about (1.2/1).
- Farmers should expect a high DU from a new irrigation system. This program allows farmers to verify the quality of a new system that might have been recently purchased.

CAL POLY

Irrigation Training
& Research Center

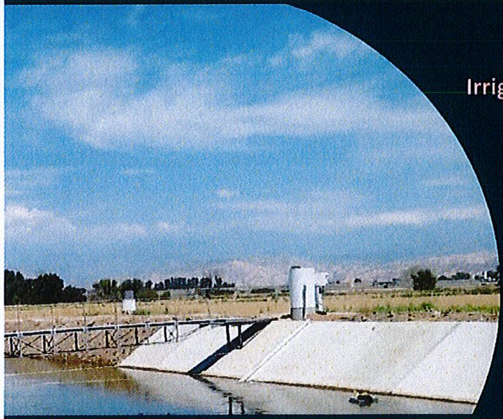
ITRC
moving water in new directions

ITRC HOME | WHO WE ARE | ITRC CLASSES | ON-CAMPUS FACILITIES | ONLINE REPORTS & PAPERS | EXAMPLE PROJECTS | ORDER BOOKS & EQUIPMENT | ONLINE DATABASES | HELPFUL LINKS

Irrigation Canal and Drain Flow Measurement Using Acoustic Doppler Velocity Meters (ADVMs)

Sponsored by: Environmental Protection Agency (EPA) and Fred and Ginny Hamisch

Registration Cost: $350
<<< Please call the ITRC front office at 805-756-2434 for waiting list information >>>



ONLINE PORTION

Irrigation Canal and Drain Flow Measurement - ADVMs

The web-based course material will be available to participants in early November and access is included with registration. Through various forms of multimedia (video, audio, discussion), participants will have online access to course content and the instructors. This portion of the course is designed to provide the participants with irrigation canal and drain flow measurement knowledge, which will be expanded on in the classroom and field portions. The online content will also be available to participants for approximately two weeks after the classroom portion of the short course.*

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CLASSROOM AND FIELD PORTION

Day 1: Acoustic Doppler Technology for Irrigation Canal Flow Measurement I

Background and Theory – Real-Time Flow Measurement

a) Introduction to Open Channel Flow Measurement
b) Introduction to Acoustic Doppler Velocity Meters
c) Velocity profiles in canals and drains
d) Velocity sampling
e) Need for calibration
f) Velocity indexing procedures
g) Installation
    i. When to use side-looking and up-looking devices
    ii. Channel modifications and algae prevention
    iii. Trash deflectors
h) Subcritical contraction design to eliminate the need for calibration
    i. Using the computers to design an example subcritical contraction

Day 2: Acoustic Doppler Technology for Irrigation Canal Flow Measurement II**

ADCP Boat Operation and ADVM Software and Setup

a) Introduction and Operation of the SonTek Acoustic Doppler Current Profiler boat (ADCP) and FlowTracker
    i. Principles
    ii. Operation of the SonTek RiverSurveyer M9 ADCP boat
    iii. Post processing data
b) Hands-on installation and setup of latest ADVM technology including side-lookers and up-looking devices.
    i. Using software
    ii. Setting some units in ITRC facilities
    iii. Data collection and post processing
c) Understanding purchasing options
    a. Cable lengths
    b. On-site displays
    c. Integration into SCADA systems
    d. Power requirements

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For questions regarding this web page, please contact the webmaster

Interactive Map of Cal Poly Campus
Map of ITRC (in building 08A)
Directions to Cal Poly
All materials on this website

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Contact Us!