Section V: Water Accounting and Water Supply Reliability

A. Quantifying the Water Supplier's Water Supplies

1. Agricultural Water Supplier Water Quantities

Table 46 illustrate the District's water. The District routinely transfers and/or exchanges water to and from various entities as part of its normal operations.

Table 46. Surface and Other Water Supplies for 2012 (AF)

Source	2012 Supply	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
CVP Class 1 Contracts														
Pre-1914 Rights														
SWP water contract	77,422													77,422
Other Surface Water	19,510													19,510
Banked water recovery	4,510													4,510
Landowner Transfers	3,700													3,700
Recycled Water														
Other														
Total Supply	105,142													105,142
Monthly Deliveries		1,235	1,627	1,855	6,378	11,173	14,453	18,461	17,807	8,975	4,230	575	1,849	88,617
Carryover balance														16,525

Notes:
The District doesn't track monthly deliveries by individual water type. The Agency does.
Carryover balance is water from 2012 stored in a SWP facility for use in 2013 and beyond.

Table 46-13. Surface and Other Water Supplies for 2013 (AF)

Source	2013 Supply	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
CVP Class 1 Contracts	0													
Pre-1914 Rights	0													
SWP water contract	41,686													
Other Surface Water	44,643													
Banked water recovery	5,492													
Landowner Transfers	23,056													
Recycled Water	0													
Other	0													
Total Supply	114,879													
Monthly Deliveries		409	1,695	2,702	7,413	10,928	17,068	19,782	16,480	11,266	6,345	574	168	94,829
Carryover Balance														20,050

Notes:
The District doesn't track monthly deliveries by individual water type. The Kern County Water Agency does.

Table 46-14. Surface and Other Water Supplies for 2014 (AF)

Source	2014 Supply	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
CVP Class 1 Contracts	0													
Pre-1914 Rights	0													
SWP water contract	5,955													
Other Surface Water	53,588													
Banked water recovery	17,874													
Landowner Transfers	27,849													
Recycled Water	0													
Other	0													
Total Supply	105,266													
Monthly Deliveries		547	1,487	2,022	5,112	9,510	14,395	17,835	16,317	9,400	3,401	209	71	80,307
Carryover Balance														24,959

Notes:
The District doesn't track monthly deliveries by individual water type. The Kern County Water Agency does.

Table 46-15. Surface and Other Water Supplies for 2015 (AF)

Source	2015 Supply	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
CVP Class 1 Contracts														
Pre-1914 Rights														
SWP water contract	*23,822*													
Other Surface Water	*32,117*													
Banked water recovery	*11,103*													
Landowner Transfers	*24,199*													
Recycled Water														
Other														
Total Supply														
Monthly Deliveries		*512*	*2,184*	*3,279*	*7,464*	*11,737*	*14,494*	*17,026*	*14,887*					
Carryover Balance														

Notes:
The District doesn't track monthly deliveries by individual water type. The Kern County Water Agency does.

Table 47 does not apply as the District does not have groundwater supplies.

Table 47. Groundwater Supplies Summary for 2012 (AF)

Month	Pumped by the Water Supplier			Pumped within Service Area by Customers			TOTAL
	Basin 1	Basin 2	Basin 3	Basin 1	Basin 2	Basin 3	
January							
February							
March							
April							
May							
June							
July							
August							
September							
October							
November							
December							
TOTAL	0	0	0				

2. Other Water Sources Quantities

Effective precipitation is accounted for as a water source within the cropped irrigated area (Table 48).

Table 48. Effective Precipitation Summary (AF)

Month	Rep. Year 2012		2013		2014		2015		Average
	Gross (in)	Effective (AF)*	Gross (in)	Effective (AF)*	Gross (in)	Effective (AF)*	Gross (in)	Effective (AF)*	
January	0.07	93	0.58	766	0.00	0	0.11		
February	0.19	505	0.16	423	0.09	228	0.11		
March	0.03	80	0.10	264	0.20	507	0.01		
April	2.12	5,638	0.00	0	0.02	51	0.16		
May	0.00	0	0.00	0	0.00	0	0.06		
June	0.00	0	0.00	0	0.02	51	0.03		
July	0.00	0	0.00	0	0.00	0	1.39		
August	0.00	0	0.00	0	0.00	0	0.00		
September	0.00	0	0.00	0	0.00	0	0.09		
October	0.00	0	0.00	0	0.00	0	0.73		
November	0.14	372	0.58	1,533	0.00	0			
December	0.88	1,170	0.19	251	1.60	2,029			
Total	3.43	7,859	1.61	3,238	1.93	2,866			

Note:
*Assumes an effectiveness coefficient of 50% for the months of December and January and 100% for the remaining months. Volumes in AF result from multiplying the effective precipitation depth in a given year and the irrigated acreage (Table 27).

B. Quantification of Water Uses

Applied water (Table 49) is equivalent to agricultural water use (Table 24).

Table 49. Applied Water (AF)

	Rep. Year 2012	2013	2014	2015		
Applied Water (fromTable 46)	88,617	94,829	80,307			

The water use for each of the different concepts is described in Table 24. The different concepts are specified in the indicated tables.

Table 50. Quantify Water Use (AF)						
Water Use	**Rep. Year 2012**					
		2013	**2014**	**2015**		
Crop Water Use (from Table 26)						
1. Crop Evapotranspiration*	105,417	108,010	106,876			
2. Leaching*	4,959	5,173	5,172			
3. Cultural practices	0	0	0			
Conveyance & Storage System						
4. Conveyance seepage	236	253	214			
5. Conveyance evaporation	221	236	200			
6. Conveyance operational spills	0	0	0			
7. Reservoir evaporation	0	0	0			
8. Reservoir seepage	0	0	0			
Environmental Use (consumptive)						
9. Environmental use – wetlands (from Table 29)	0	0	0			
10. Environmental use – Other (from Table 29)	530	671	705			
11. Riparian vegetation (from Table 29)	0	0	0			
12. Recreational use (from Table 30)	0	0	0			
Municipal and Industrial						
13. Municipal (from Table 31)	0	0	0			
14. Industrial (from Table 31)	1,186	1,367	1,421			
Outside the District						
15. Transfers or Exchanges out of the service area (not included)	0	0	0			
Conjunctive Use						
16. Groundwater recharge (from Table 32)*	0	0	0			
Other (from Table 33)	0	0	0			
Subtotal	112,548	115,710	114,588			
Note: * Recharge outside District boundary is not accounted here.						

There is no water leaving the District (Table 51) and no irrecoverable water losses (Table 52).

Table 51. Quantify Water Leaving the District (AF)						
	Rep. Year 2012	**2013**	**2014**	**2015**		
1. Surface drain water leaving the service area	0	0	0			
2. Subsurface drain water leaving the service area	0	0	0			
Subtotal	0	0	0			

Table 52. Irrecoverable Water Losses (Optional) (AF)						
	Rep. Year 2012	**2013**	**2014**	**2015**		
Flows to saline sink	0	0	0			
Flows to perched water table	0	0	0			
Subtotal	0	0	0			

C. Overall Water Budget

Error! Reference source not found. and Table 54 summarize the water supplies and the water budget in the District.

Table 53. Quantify Water Supplies (AF)						
Water Supplies	**Rep. Year 2012**	**2013**	**2014**	**2015**		
1. Surface Water (summary total from Table 49)	88,618	94,829	80,307			
2. Groundwater (summary total from Table 47)	0	0	0			
3. Annual Effective Precipitation (summary total from Table 48)	7,859	3,238	2,866			
4. Water purchases	0	0	0			
Subtotal	96,477	98,067	83,173			

Table 54. Budget Summary (AF)						
Water Accounting	**Rep. Year 2012**	**2013**	**2014**	**2015**		
1. Subtotal of Water Supplies (Table 53)	96,477	98,067	83,173			
2. Subtotal of Water Uses (Table 50)	112,548	115,710	114,588			
3. Drain Water Leaving Service Area (Table 51)	0	0	0			
Excess Deep Percolation* (Deficit Irrigation)	(16,071)	(17,643)	(31,415)			
Note: *Calculated from lines 2 and 3 subtracted from line 1						

The District as a whole appears to be very efficient with its water supply. Data from Table 54 for year 2012 suggests a Total Water Use Efficiency (TWUE) for the District of approximately 117% under the assumptions used in the calculations (see Table 25 for details). Excess deep percolation and TWUE values vary accordingly with the year type. Crop water use estimates may be too high, particularly for pomegranates. These results are due to uncertainties in the crop coefficients (might be high) values to estimate crop evapotranspiration and the salt tolerance threshold values to estimate the leaching requirements. These results suggest that growers are performing deficit irrigation in response to a limited, unreliable, and expensive water supply. These results also collaborate mobile lab results which indicate distribution uniformities (DU) for District Water Users ranged between 91% and 97% from 2006 to 2012.

In addition, it is probable that the growers are deficit irrigating in response to multiple years of insufficient water supplies. In 2012, the Table A allotment of 50% yielded a corresponding 117% TWUE. At Table A allotments of 35% in 2013 and 5% in 2014, growers would have been forced to abandon (some 2,000 acres have been taken out of production since 2010) or to under-irrigate their remaining crop. Table 50 (Adjusted) and Table 54 (Adjusted) illustrate the possible effects of minor (2013) and more severe (2014) deficit irrigation factors to the overall TWUE.

Table 50 (Adjusted). Quantify Water Use (AF)						
Water Use	**Rep. Year 2012**	**2013**	**2014**	**2015**		
Crop Water Use (from Table 26 w/deficit irrigation)						
Deficit Irrigation Adjustment		95% of ETc	80% of ETc			
1. Crop Evapotranspiration*	105,417	102,610	85,501			
2. Leaching*	4,959	4,914	4,138			
3. Cultural practices	0	0	0			
Conveyance & Storage System						
4. Conveyance seepage	236	253	214			
5. Conveyance evaporation	221	236	200			
6. Conveyance operational spills	0	0	0			
7. Reservoir evaporation	0	0	0			
8. Reservoir seepage	0	0	0			
Environmental Use (consumptive)						
9. Environmental use – wetlands (from Table 29)	0	0	0			
10. Environmental use – Other (from Table 29)	530	671	705			
11. Riparian vegetation (from Table 29)	0	0	0			
12. Recreational use (from Table 30)	0	0	0			
Municipal and Industrial						
13. Municipal (from Table 31)	0	0	0			
14. Industrial (from Table 31)	1,186	1,367	1,421			
Outside the District						
15. Transfers or Exchanges out of the service area (not included)	0	0	0			
Conjunctive Use						
16. Groundwater recharge (from Table 32)*	0	0	0			
Other (from Table 33)	0	0	0			
Subtotal	112,548	110,051	92,179			

Note:
* Recharge outside District boundary is not accounted here.

Table 54 (Adjusted). Budget Summary (AF)						
Water Accounting	**Rep. Year 2012**					
		2013	**2014**	**2015**		
1. Subtotal of Water Supplies (Table 53)	96,477	98,067	83,173			
2. Subtotal of Water Uses (Table 50)	112,548	110,051	92,179			
3. Drain Water Leaving Service Area (Table 51)	0	0	0			
Excess Deep Percolation* (Deficit Irrigation)	(16,071)	(12,984)	(9,006)			
Note: *Calculated from lines 2 and 3 subtracted from line 1						

D. Water Supply Reliability

The water supply reliability for the District is parallel to that of the SWP and is best described by DWR in the following excerpts from "The State Water Project Final Delivery Reliability Report 2011", dated June 2012.

"The 2011 Report shows that the SWP continues to be subject to reductions in deliveries similar to those contained in the State Water Project Delivery Reliability Report 2009 (2009 Report), caused by the operational restrictions of biological opinions (BOs) issued in December 2008 and June 2009 by the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) to govern SWP and Central Valley Project operations. Federal court decisions have remanded the BOs to USFWS and NMFS for further review and analysis. We expect that the current BOs will be replaced sometime in the future. The operational rules defined in the 2008 and 2009 BOs, however, continue to be legally required and are the rules used for the analyses supporting the 2011 Report."

Regulatory Restrictions on SWP Delta Exports

"*Multiple needs converge in the Delta: the need to protect a fragile ecosystem, to support Delta recreation and farming, and to provide water for agricultural and urban needs throughout much of California. Various regulatory requirements are placed on the SWP's Delta operations to protect special-status species such as delta smelt and spring- and winter-run Chinook salmon. As a result, as described below, restrictions on SWP operations imposed by State and federal agencies contribute substantially to the challenge of accurately determining the SWP's water delivery reliability in any given year."*

Biological Opinions on Effects of Coordinated SWP and CVP Operations

"*Several fish species listed under the federal Endangered Species Act (ESA) as endangered or threatened are found in the Delta. The continued viability of populations of these species in the Delta depends in part on Delta flow levels. For this reason, the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS)*

have issued several BOs since the 1990s on the effects of coordinated SWP/CVP operations on several species.

These BOs affect the SWP's water delivery reliability for two reasons. Most obviously, they include terms that specifically restrict SWP pumping levels in the Delta at certain times under certain conditions. In addition, the BOs' requirements are based on physical and biological phenomena that occur daily while DWR's water supply models are based on monthly data.

The first BOs on the effects of SWP (and CVP) operations were issued in February 1993 (NMFS BO on effects of project operations on winter-run Chinook salmon) and March 1995 (USFWS BO on project effects on delta smelt and splittail). Among other things, the BOs contained requirements for Delta inflow, Delta outflow, and reduced export pumping to meet specified incidental take limits. These fish protection requirements imposed substantial constraints on Delta water supply operations. Many were incorporated into the 1995 Water Quality Control Plan for the San Francisco Bay/Sacramento–San Joaquin Delta (1995 WQCP), as described in the "Water Quality Objectives" section later in this chapter.

The terms of the USFWS and NMFS BOs have become increasingly restrictive in recent years. In December 2008, USFWS issued a new BO covering effects of the SWP and CVP on delta smelt, and in June 2009, NMFS issued a BO covering effects on winter-run and spring-run Chinook salmon, steelhead, green sturgeon, and killer whales. These BOs replaced BOs issued earlier by the federal agencies.

The USFWS BO includes additional requirements in all but 2 months of the year. The BO calls for "adaptively managed" (adjusted as necessary based on the results of monitoring) flow restrictions in the Delta intended to protect delta smelt at various life stages. USFWS determines the required target flow, with the reductions accomplished primarily by reducing SWP and CVP exports. Because this flow restriction is determined based on fish location and decisions by USFWS staff, predicting the flow restriction and corresponding effects on export pumping with any great certainty poses a challenge. The USFWS BO also includes an additional salinity requirement in the Delta for September and October in wet and above-normal water years, calling for increased releases from SWP and CVP reservoirs to reduce salinity. Among other provisions included in the NMFS BO, limits on total Delta exports have been established for the months of April and May. These limits are mandated for all but extremely wet years.

The 2008 and 2009 BOs were issued shortly before and shortly after the Governor proclaimed a statewide water shortage state of emergency in February 2009, amid the threat of a third consecutive dry year. NMFS calculated that implementing its BO would reduce SWP and CVP Delta exports by a combined 5% to 7%, but DWR's initial estimates showed an impact on exports closer to 10% in average years, combined with the effects of pumping restrictions imposed by BOs to protect delta smelt and other species. The 2008 USFWS and 2009 NMFS BOs have been subject to considerable litigation. Recent decisions by U.S. District Judge Oliver Wanger changed specific

operational rules for the fall/ winter of 2011–2012, and both the USFWS BO and NMFS BO have been remanded to the agencies for further review and analysis. However, the operational rules specified in the 2008 and 2009 BOs continue to be legally required and are the rules used in the analyses presented in Chapters 5, 6, and 7 of this report. Chapter 5 presents a comparison of monthly Delta exports as estimated for this 2011 Report with those estimated for the 2005 Report, illustrating how the 2008 and 2009 BOs have affected export levels from the Delta.

The California Department of Fish and Game (DFG) issued consistency determinations for both BOs under Section 2080.1 of the California Fish and Game Code. The consistency determinations stated that the USFWS BO and the NMFS BO would be consistent with the California Endangered Species Act (CESA). Thus, DFG allowed incidental take of species listed under both the federal ESA and CESA to occur during SWP and CVP operations without requiring DWR or the U.S. Bureau of Reclamation to obtain a separate State-issued permit.

Specific restrictions on Delta exports associated with the USFWS and NMFS BOs and their effects on SWP pumping levels are described further in Chapter 5, "SWP Delta Exports," of this report."

Water Quality Objectives

"*Because the Delta is an estuary, salinity is a particular concern. In the 1995 WQCP, the State Water Board set water quality objectives to protect beneficial uses of water in the Delta and Suisun Bay. The objectives must be met by the SWP (and federal CVP), as specified in the water right permits issued to DWR and the U.S. Bureau of Reclamation. Those objectives—minimum Delta outflows, limits on SWP and CVP Delta exports, and maximum allowable salinity levels— are enforced through the provisions of the State Water Board's Water Right Decision 1641 (D-1641), issued in December 1999 and updated in March 2000.*

DWR and Reclamation must monitor the effects of diversions and SWP and CVP operations to ensure compliance with existing water quality standards. Monitoring stations are shown in Figure 4-1.

Among the objectives established in the 1995 WQCP and D-1641 are the "X2" objectives. D-1641 mandates the X2 objectives so that the State Water Board can regulate the locations of the Delta estuary's salinity gradient during the months of February–June. X2 is the position in the Delta where the electrical conductivity (EC) level, or salinity, of Delta water is 2 parts per thousand. The location of X2 is used as a surrogate measure of Delta ecosystem health. For the X2 objective to be achieved, the X2 position must remain downstream of Collinsville in the Delta (shown in Figure 4-1) for the entire 5- month period, and downstream of other specific locations in the Delta on a certain number of days each month from February through June. This means that Delta outflow must be at certain specified levels at certain times—which can limit the amount of water the SWP may pump at those times at its Harvey O. Banks Pumping Plant in the Delta. Because of the relationship between seawater intrusion and interior-

Delta water quality, meeting the X2 objective also improves water quality at Delta drinking-water intakes; however, meeting the X2 objectives can require a relatively large volume of water for outflow during dry months that follow months with large storms.

The 1995 WQCP and D-1641 also established an export/inflow (E/I) ratio. The E/I ratio, presented in Table 3 of the 1995 WQCP (SWRCB 1995:18– 22), is designed to provide protection for the fish and wildlife beneficial uses in the Bay-Delta estuary (SWRCB 1995:15). The E/I ratio limits the fraction of Delta inflows that are exported. When other restrictions are not controlling, Delta exports are limited to 35% of total Delta inflow from February through June and 65% of inflow from July through January."