Section V: Water Accounting and Water Supply Reliability

A. Quantifying the Water Supplier's Water Supplies

1. Agricultural Water Supplier Water Quantities

Table 38 shows typical water diversions from the CA Aqueduct during the representative water year (2012) and years 2013-2015.

Table 38. 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		0	0	0	0	0	0	0	0	0	0		0	0
Pre-1914 Rights		0	0	0	0	0	0	0	0	0	0		0	0
SWP Contract supply	60,190													
Other Surface Water	12,632													
Banked Water recovery	7,929	0	0	0	0	0	0	0	0	0	0		0	0
Landowner Transfers & Exchanges	20,023													
Total Supply	100,774	0	0	0	0	0	0	0	0	0	0		0	0
Deliveries*		2,691	2,042	1,909	6,654	10,953	14,244	13,883	17,776	8,672	4,543	549	1,422	85,338
Carryover to 2013														15,436

Notes:
The District doesn't track monthly deliveries by individual water type. The Agency does.
*Includes 1,774 AF delivered to processors.
Carryover balance is water from 2012 stored in a SWP facility for use in 2013 and beyond.

Table 38-13. 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 Contract supply	32,410													
Other Surface Water	25,291													
Banked Water recovery	28,440													
Landowner Transfers & Exchanges	21,979													
Total Supply	108,120													
Deliveries		1,236	3,256	2,882	8,862	13,192	15,866	17,446	16,333	7,672	6,490	242	551	94,028
Carryover Balance														14,092

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

Table 38-14. 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 Contract supply	4,630													
Other Surface Water	35,231													
Banked Water recovery	49,839													
Landowner Transfers & Exchanges	8,174													
Total Supply	98,874													
Deliveries		912	3,400	1,607	5,219	10,847	13,408	16,049	16,430	7,460	3,201	131	248	78,912
Carryover Balance														19,962

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

Table 38-15. 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 Contract supply	*18,520*													
Other Surface Water	*19,726*													
Banked Water recovery	*42,000*													
Landowner Transfers & Exchanges	*6,709*													
Total Supply														
Deliveries		*885*	*2,787*	*3,623*	*6,297*	*11,283*	*14,282*	*17,520*	*13,539*					
Carryover Balance														

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

Table 39 summarizes groundwater pumped by BMWD from groundwater banking projects located outside the District's boundaries during the representative year when SWP allocations were normal.

Table 39. Groundwater Supplies Summary for 2012 (AF)

Month	Pumped by the Water Supplier			Pumped within Service Area by Customers			TOTAL
	Pioneer/BM combined	Basin 2	Basin 3	Basin 1	Basin 2	Basin 3	
January							
February							
March	2,809						2,809
April							
May							
June	5,120						5,120
July							
August							
September							
October							
November							
December							
TOTAL	7,929						7,929

2. Other Water Sources Quantities

Effective precipitation is accounted for as a water source within the cropped irrigated area (Table 40).

Table 40. Effective Precipitation Summary (AF)

Month	Representative 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	79	0.58	630	0.00	0	0.11		
February	0.19	431	0.16	347	0.09	186	0.11		
March	0.03	68	0.10	217	0.20	414	0.01		
April	2.12	4,810	0.00	0	0.02	41	0.16		
May	0.00	0	0.00	0	0.00	0	0.06		
June	0.00	0	0.00	0	0.02	41	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			
October	0.00	0	0.00	0	0.00	0			
November	0.14	318	0.58	1,259	0.00	0			
December	0.88	998	0.19	206	1.60	1,656			
Total	3.43	6,704	1.61	2,659	1.93	2,339			

B. Quantification of Water Uses

Table 41 shows the volume of water charged to BMWD's irrigation water customers in 2012 for delivery into the Service Area. The water charged is based on the field personnel water measurements to the customers. During 2012, the volume of water charged to the customers is within an estimated plus or minus 2% of the actual deliveries. The difference between the applied water versus the allocated water is the amount of water that was carried over for use the following year (Table 42).

Table 41. Applied Water (AF)

	Rep. Year 2012	2013	2014	2015		
Applied Water (from Table 22)	85,338	94,028	78,912	*84,200*		

Table 42 summarizes the crop water use within the BMWD service area in 2012-2015.

Table 42. Quantify Water Use (AF)						
Water Use	**Rep. Year 2012**					
		2013	**2014**	**2015**		
Crop Water Use (from Table 24)						
1. Crop Evapotranspiration	81,749	80,675	80,466			
2. Leaching	4,527	4,658	4,537			
3. Cultural practices	0	0	0			
Conveyance & Storage System						
4. Conveyance seepage*	758	835	701			
5. Conveyance evaporation*						
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	0	0	0			
10. Environmental use – Other	0	0	0			
11. Riparian vegetation	0	0	0			
12. Recreational use	0	0	0			
Municipal and Industrial						
13. Municipal (from Table 27)	0	0	0			
14. Industrial (from Table 27)	1,774	1,550	1,580			
Outside the District						
15. Transfers or Exchanges out of the service area (not included)	0	0	0			
Conjunctive Use						
16. Groundwater recharge (from Table 28)	0	0	0			
Other	0	0	0			
Subtotal	88,808	87,718	87,284			
Note: *Seepage and evaporation losses combined.						

There is no water leaving the District (Table 43) and irrecoverable water losses (Table 44).

Table 43. Quantify Water Leaving the District (AF)						
	Rep. Year 2012	**2013**	**2014**	**2015**		
1. Surface drain water leaving the service area	0	0	0	0		
2. Subsurface drain water leaving the service area	0	0	0	0		
Subtotal	0	0	0	0		

Table 44. Irrecoverable Water Losses (Optional)* (AF)						
	Rep. Year 2012	**2013**	**2014**	**2015**		
Flows to saline sink	0	0	0	0		
Flows to perched water table	0	0	0	0		
Subtotal	0	0	0	0		

C. Overall Water Budget

Table 45 and Table 46, respectively indicate the representative year water supplies and water budget for the District.

Table 45. Quantify Water Supplies (AF)						
Water Supplies	**Rep. Year 2012**	**2013**	**2014**	**2015**		
1. Surface Water (summary total from Table 38)	85,338	94,028	78,912			
2. Groundwater (summary total from Table 39)	0	0	0			
3. Annual Effective Precipitation (summary total from Table 40)	6,704	2,659	2,339			
4. Water purchases	0	0	0			
Subtotal	92,042	96,687	81,251			

Table 46. Budget Summary (AF)						
Water Accounting	**Rep. Year 2012**					
		2013	**2014**	**2015**		
1. Subtotal of Water Supplies (Table 45)	92,042	96,687	81,251			
2. Subtotal of Water Uses (Table 42)	88,808	87,718	87,284			
3. Drain Water Leaving Service Area	0	0	0			
Excess Deep Percolation*	3,233	8,969	(6,033)			
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 46 for year 2012 suggests a Total Water Use Efficiency (TWUE) for the District of approximately 96% under the assumptions used in the calculations (see Table 23 for details). Excess deep percolation and TWUE values vary accordingly with the year type. Crop water use estimates may appear high. These results are due to uncertainties in the crop coefficient (might be high) values to estimate crop evapotranspiration and the salt tolerance threshold values to estimate the leaching requirement. These results though suggest that growers are very efficient with their 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 96% TWUE. At Table A allotments of 35% in 2013 and 5% in 2014, growers would have been forced to abandon (some 3,000 acres have been taken out of production since 2010) or to under-irrigate their remaining crop. Table 42 (Adjusted) and Table 46 (Adjusted) illustrate the possible effects of minor (2013) and more severe (2014) deficit irrigation factors to the overall TWUE.

Table 42 (Adjusted). Quantify Water Use (AF)						
Water Use	**Rep. Year 2012**	**2013**	**2014**	**2015**		
Crop Water Use (from Table 24)						
Deficit Irrigation Adjustment		95% of ETc	80% of ETc			
1. Crop Evapotranspiration	81,749	76,641	64,373			
2. Leaching	4,527	4,425	3,630			
3. Cultural practices	0	0	0			
Conveyance & Storage System						
4. Conveyance seepage*	758	835	701			
5. Conveyance evaporation*						
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	0	0	0			
10. Environmental use – Other	0	0	0			
11. Riparian vegetation	0	0	0			
12. Recreational use	0	0	0			
Municipal and Industrial						
13. Municipal (from Table 27)	0	0	0			
14. Industrial (from Table 27)	1,774	1,550	1,580			
Outside the District						
15. Transfers or Exchanges out of the service area (not included)	0	0	0			
Conjunctive Use						
16. Groundwater recharge (from Table 28)	0	0	0			
Other	0	0	0			
Subtotal	88,808	83,451	70,284			

Note:
*Seepage and evaporation losses combined.

Table 46 (Adjusted). Budget Summary (AF)						
Water Accounting	**Rep. Year 2012**	**2013**	**2014**	**2015**		
1. Subtotal of Water Supplies (Table 45)	92,042	96,687	81,251			
2. Subtotal of Water Uses (Table 42)	88,808	83,451	70,284			
3. Drain Water Leaving Service Area	0	0	0			
Excess Deep Percolation*	3,233	13,236	10,967			
Note: *Calculated from lines 2 and 3 subtracted from line 1						

D. Water Supply Reliability

BMWD's utilizes water from groundwater banking projects to supplement SWP supplies, primarily in years of SWP delivery deficiencies. Annually, the maximum amount BMWD can extract from both banking projects is 43,500 AF. Currently, they have banked a total of 100,000 AF in these projects. Additional surface storage would be one means to improve water reliability.

Another source of reliable water for certain landowners is through access to other groundwater banking projects located outside the District's boundaries.

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."

In addition to these potential reductions, the District's ability to deliver a reliable water supply to its landowners is further impacted by capacity issues on the Coastal Branch of the Aqueduct. Not only is DWR responsible for maintaining facilities, it is also responsible for controlling aquatic weed growth. Often during peak irrigation demand (May-September) the dense growth of aquatic weeds impacts DWR's ability to convey an adequate supply through the Coastal Branch. This forces the District to allocate capacity and reduce the amount of water available to landowners during the most critical growing period.