Section IV: Description of Quantity and Quality of the Water Resources of the Agricultural Water Supplier

A. Water Supply Quantity

1. Surface Water Supply

Under its enabling legislation, KCWA was granted the primary power to acquire and contract water supplies, control storm water, reclaim water, reclaim land, and protect groundwater quality in Kern County. The Agency is a State Water Contractor and obtains water from the SWP for delivery to its 13 member agencies (a.k.a., Member Units). BMWD is a Member Unit of the KCWA. SWP deliveries for KCWA were initiated in 1968 with a "build up" schedule that allowed for increasing amounts of "firm water" each year, and decreasing amounts of "surplus water" until the maximum "firm water" Table A amount was achieved in 1990. BMWD's original 1967 Table A water supply contract with KCWA provided for an annual contract of 105,100 Acre-Feet (AF) of water. In 1970, BMWD purchased an additional perpetual annual Table A water supply contract of 50,000 AF raising the annual Table A water supply contract to 155,100 AF. Since then, BMWD has transferred a total of 62,500 AF of Table A contract water to other agencies. BMWD chose to transfer a portion of their Table A contract to reduce their SWP costs for a SWP contract supply that exceeded demand in BMWD. BMWD's annual Table A contract water presently stands at 92,600 AF (water supply). The current water demands are approximately 88,000 AF per year.

BMWD also has the ability to purchase water through various State and locally operated pools several of which serve as important supplies for groundwater recharge. The availability of these supplies, however, has become scarcer over time.

Table 29. Surface Water Supplies (AF)

Source	Diversion Restriction	Rep. Year 2012						Anticipated Changes
			2013	2014	2015			
Pre-1914 water rights	NA	0	0	0				
SWP Article 21	Delta/BiOps	0	0	0				
SWP water contract	Delta/BiOps	60,190	32,410	4,630	*18,520*			
Other imported surface water	Delta/BiOps	12,632	25,291	35,231	*19,726*			
Banked water recovery	NA	7,929	28,440	49,839	*42,000*			
Landowner Transfers	NA	0	2,500	0	*1,100*			
Transfers /Exchanges*	NA	20,023	19,479	8,174	*5,709*			
Total		100,774	108,120	98,874				

Notes:
BiOps = Smelt and Salmon Biological Opinions
*These are net ins after transfers outs are accounted for.

Table 30. Restrictions on Water Sources

Source	Restrictions*	Name of Agency Imposing Restrictions	Operational Constraints
SWP	Delta Diversions	NMFS and SWRCB	ESA and Water Quality

Notes:
*ESA = Endangered Species Act protection measures
*NMFS = National Marine Fisheries Service
*SWRCB = Sate Water Resources Control Board
*Water Quality = restrictions relate to maintenance of Delta salinity standards.

2. Groundwater Supply

A few private groundwater wells have historically supplied limited amounts of water for blending with SWP water, usually during shortage years. No records are available of the quantity of water pumped, as these were private wells. The District does participate in the Berrenda Mesa and Pioneer groundwater banking projects to supplement dry-year water supplies. Annually, the maximum amount BMWD can recover from both banking projects is 43,500 AF. Currently, they have banked a total of 105,000 AF in these projects. Both banking projects are operated and maintained by KCWA.

Individual landowners participate in other groundwater banking projects which allows them to deliver a significant amount of banked groundwater for and on their behalf.

Deep percolation amounts are unknown in BMWD. Estimates of District wide deep percolation from water balance calculations included later show negative deep percolation (obviously in error due either to widespread deficit irrigation and/or inaccurate crop coefficient factors). Deep percolation estimates from USDA soil moisture monitoring demonstration projects in the District show very low percent of applied water.

Table 31. Groundwater Basins

Basin Name	Size (Sq. Mi.)	Usable Capacity (AF)	Safe Yield (AF/Yr)
BMWD portion of Kern sub-basin of Tulare Lake basin	87	Unknown and limited	Unknown and limited

Note:
Area of main Tulare Lake Hydrologic Region: 5,149,000 acres = 8,045 sq. mi.
Area of Kern County sub-basin: 1,950,000 acres = 3,047 sq. mi. (37.9% of Tulare Lake Hydrologic Region)
Area of BMWD: 55,440 acres = 87 sq. mi. (2.8% of Kern County Sub-basin)

Table 32. Groundwater Management Plan

Written By	None in BMWD
Year	Not Applicable
Is Appendix Attached?	No

Table 33. Groundwater Supplies (AF)

Groundwater Basin	Diversion Restriction	Rep. Year 2012	Planning Cycle					Anticipated Changes
			2013	2014	2015			
Water Supplier Direct Pumping	None	0	0	0	0			None
Private Pumping*	None	0	0	0	0			None
Transfers /Exchanges	None	0	0	0	0			None
TOTAL		0	0	0	0			

Notes:
*The district does not monitor pumping from private wells in the district.

3. Other Water Supplies

BMWD has no other water supplies besides those described before.

4. Drainage from the Water Supplier's Service Area

The land serviced by BMWD does not have a subsurface drainage water problem. There are no on-farm subsurface tile drains (Table 34).

On-farm tail water (surface) drainage within the District's service is also minimal due to the use of pressurized irrigation systems (Table 34). In the cases where on-farm tailwater is generated, the water users typically contain it within the property, as stated in the District's Operating Rules and Regulations.

Table 34. Drainage Discharge (AF)

Surface/ Subsurface Drainage Path	Rep. Year 2012						End Use	Inside/ Outside Service Area
		2013	2014	2015				
Surface drainage	0	0	0					
Subsurface drainage	0	0	0					
Total	0	0	0					

B. Water Supply Quality

1. Surface Water Supply

There have been no water quality problems that limit the use of the SWP water within the District. The District does not monitor the surface water quality since all of the water delivered by the District is from the SWP and other agencies are already analyzing this water. The DWR has an on-going monitoring program where the quality of the SWP water is monitored on a monthly basis. The water is sampled at several locations along the Aqueduct and analyzed for electrical conductivity, standard minerals, selected trace elements and chemical residue. Table 3-3 presents historical water quality data for the months of January and June for the years 2010 through 2015. The water quality data shown in Table 35 was collected by DWR at Check 21 in the Aqueduct near Kettleman City, just upstream of the District.

Table 35. Surface Water Supply Quality

Selected Laboratory Results													
Station Name/NR	CALIFORNIA AQU NR KETTLEMAN CK-21 (KA017226)												
		Sample Date											
Parameter	Units	01/12/10	06/15/10	01/18/11	06/14/11	01/17/12	06/19/12	01/15/13	06/18/13	01/14/14	06/17/14	01/20/15	06/16/15
Alkalinity as CaCO3	mg/L	78	76	47	40	77	73	72	72	89	93	95	92
Aluminum	mg/L	N/A	N/A	N/A	.173,0.175*	0.077	0.092	0.124	0.048	r	r	0.015	r
Dissolved Ammonia	mg/L	0.04	0.01	0.05	<0.01	0.02	0.01	0.05	r	0.002	0.02	0.08	0.04
Dissolved Arsenic	mg/L	0.002	0.002	0.001	0.001	0.002	0.002	0.001	0.002	0.001	0.003	0.004	0.002
Arsenic	mg/L	N/A	N/A	N/A	0.001	0.002	0.002	0.002	0.002	0.002	0.003	0.004	0.003
Barium	mg/L	N/A	N/A	N/A	<0.05	0.039	0.033	0.033	0.037	0.031	0.026	0.045	0.039
Dissolved Beryllium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	r	r	r	r	r	r
Beryllium	mg/L	N/A	N/A	N/A	<0.001	<0.001	<0.001	r	r	r	r	r	r
Dissolved Boron	mg/L	0.2	0.2	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.2
Cadmium	mg/L	N/A	N/A	N/A	<0.001	<0.001	<0.001	r	r	r	r	r	r
Dissolved Calcium	mg/L	22	21	15	12	22	20	22	22	25	25	26	25
Dissolved Chloride	mg/L	75	70	28	24	109	62	74	76	107	110	116	109
Dissolved Chromium	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	r	r	r	r	r	r
Chromium	mg/L	N/A	N/A	N/A	0.001	0.003	0.001	r	r	r	r	r	r
Conductance (EC) µS/cm	µS/cm	496	449	259	223	630	426	474	469	624	648	671	645
Dissolved Copper	mg/L	0.002	0.002	0.008	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001
Copper	mg/L	N/A	N/A	N/A	0.002	0.002	0.001	0.002	0.002	0.001	0.002	0.002	0.002
Dissolved Hardness as CaCO3	mg/L	112	105	68	53	114	98	113	111	132	135	137	136
Dissolved Iron	mg/L	<0.005	<0.005	0.017	0.016	0.019	<0.005	0.034	r	0.005	r	r	r
Iron	mg/L	N/A	N/A	N/A	.389,0.395*	0.131	0.12	0.14	0.08	0.017	0.017	0.017	0.023
Kjeldahl Nitrogen as N	mg/L	0.4	0.4	0.6	0.4	0.4	0.3	0.5	0.5	0.4	0.5	0.5	0.5
Dissolved Lead	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	r	r	r	r	r	r
Lead	mg/L	N/A	N/A	N/A	<0.001	<0.001	<0.001	r	r	r	r	r	r
Dissolved Lithium	mg/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dissolved Magnesium	mg/L	14	13	8	6	15	12	14	14	17	18	18	18
Dissolved Manganese	mg/L	<0.005	<0.005	0.006	<0.005	<0.005	<0.005	r	0.005	r	0.005	0.01	r
Manganese	mg/L	N/A	N/A	N/A	0.049,0.05**	0.014	0.021	0.007	0.015	0.008	0.015	0.023	0.017
Dissolved Mercury	mg/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dissolved Molybdenum	mg/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dissolved Nickel	mg/L	0.001	0.001	0.002	<0.001	0.001	0.001	0.002	0.001	0.001	0.001	0.001	0.001
Nickel	mg/L	N/A	N/A	N/A	0.002	0.001	0.001	0.002	0.002	0.002	0.002	0.002	0.002
Dissolved Nitrate	mg/L	3.7	2.5	2.9	2.4	3.8	1.8	4.6	1.6	2.4	0.4	0.2	2
Dissolved Nitrate + Nitrite as N	mg/L	0.69	0.54	0.65	0.41	0.87	0.4	1	0.32	0.57	0.09	r	0.49
Dissolved Ortho-phosphate as P	mg/L	0.05	0.08	0.08	0.05	0.06	0.06	0.07	0.05	0.05	0.05	0.08	0.08
Phosphorus	mg/L	0.09	0.1	0.12	0.11	0.08	0.08	0.09	0.08	0.07	0.08	0.09	0.1
Dissolved Selenium	mg/L	0.001	0.001	0.001	<0.001	<0.001	0.001	r	r	0.001	0.001	0.001	0.001
Selenium	mg/L	N/A	N/A	N/A	<0.001	<0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.001
Silver	mg/L	N/A	N/A	N/A	<0.001	<0.001	<0.001	r	r	r	r	r	r
Dissolved Sodium	mg/L	52	50	24	21	68	46	56	54	76	80	79	71
Total Dissolved Solids	mg/L	275	274	151	124	347	236	270	261	345	367	370	357
Total Suspended Solids	mg/L	2	11	7	20	2	11	1	3	1	1	r	1
Volatile Suspended Solids	mg/L	1	<1	1	2	<1	3	r	1	1	r	r	r
Dissolved Strontium	mg/L	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dissolved Sulfate	mg/L	42	43	26	25	45	35	44	40	52	52	47	52
Dissolved Zinc	mg/L	<0.005	<0.005	0.005	<0.005	<0.005	<0.005	r`	r	r	r	r	r
Zinc	mg/L	N/A	N/A	N/A	<0.005	<0.005	<0.005	0.005	r	r	r	r	0.007
pH		8	8.2	7.6	7.7	7.8	8.1	7.6	7.8	8.6	8.7	8	8.2

http://www.water.ca.gov/waterdatalibrary/waterquality/station_county/select_station.cfm?URLStation=KA017226&source=map
mg/L = milligrams per liter
µS/cm = microSiemens per centimeter

The SWP water quality is generally very good for irrigation purposes, although even good quality water contains some salt. The evapotranspiration (ET) process returns water to the atmosphere but leaves the salts behind in the soil. To avoid damaging buildup of salt in the crop root zone, water in excess of the crops' ET is required. The amount of excess water needed, known as the leaching requirement, varies with the crop, soil, climate and quality of the applied water and is used as an indicator of the minimum amount of water needed to flush salts from the root zone.

2. Groundwater Supply

Groundwater aquifers in the BMWD area are considered to be unconfined or semi-confined. Shallow groundwater is naturally recharged by infiltration from runoff in intermittent stream channels and natural depressions which has a significant impact on quality. However, this is a minor, local effect that does not affect the deeper aquifer in

the Tulare/alluvium formation as significantly as recharge from the adjacent Temblor Range which is comprised of mainly of tilted and folded marine sediments. Groundwater quality in the deeper aquifer (Tulare Formation) beneath the District is by nature of poorer quality, because of its recharge source (Temblor Range). Because of its limited lateral and vertical extent, poor quality and relatively low permeability, neither the shallow nor deeper aquifers provide an adequate groundwater supply to irrigate lands extensively in the District.

Groundwater quality has not been monitored on a consistent basis in BMWD because historically this water has not been considered a reliable water supply. The limited data and historical use indicate that the groundwater is saline. Total dissolved solids (TDS) concentrations have ranged from 500 to over 6,000 mg/L. The groundwater quality of most wells in the District is not generally considered suitable for most agricultural applications unless it is blended with better quality water. By comparison, TDS concentrations in SWP water provided to BMWD generally ranges from 150 to 500 mg/L. In portions of BMWD, the groundwater also contains high boron and sulfate concentrations, which further reduces its suitability for agricultural purposes. Until recently, use of groundwater as a supplemental water supply was thought to be uneconomical. However, because recent reliability studies from DWR indicate reliable supplies on the SWP around 67% of Table A amounts, and given the tolerance of some crops, namely pistachios and some cotton varieties, to higher concentrations of salts, two landowners have blended a limited amount of groundwater with surface water to supplement their supplies. However, the viability of these sources as long-term supplies is still in question, as the quality has been declining.

BMWD does participate in groundwater banking projects outside of the District boundaries just southwest of the City of Bakersfield. Appendix 4 shows the location of the banking facilities location with respect to the District boundary. The Pioneer Project and Berrenda Mesa Project are discussed in the groundwater recharge section.

3. Other Water Supplies

BMWD relies on surface water only, and has no other water supplies.

4. Drainage from the Water Supplier's Service Area

BMWD has no drainage water and therefore there is no drainage reuse.

C. Water Quality Monitoring Practices

1. Source Water

BMWD's main water supply is the SWP. DWR maintains records of all water diversions, water quality, and storage operations related to the SWP. Operational reports are distributed weekly and monthly to the District and published annually in Bulletin 132. DWR maintains water quality standards for its downstream urban users (Metropolitan Water District of Southern California and Central Coast Water Authority). BMWD is located at the terminus of the Coastal Aqueduct and thus there are no potential

downstream agencies. TDS concentrations in the SWP water provided to BMWD generally ranges from 150 to 500 mg/L, suitable for agricultural use.

DWR maintains an automated sampling station at Check 21 (just upstream from the District turnouts) that records electrical conductivity, water temperature, and turbidity on a daily basis. In addition, grab samples are taken on monthly intervals. Table 37 summarizes sampled constituents and sampling frequency.

Table 36. Water Quality Monitoring Practices

Water Source	Monitoring Location	Measurement/ Monitoring Method or Practice	Frequency
Surface water	DWR California Aqueduct (Kettleman City) Check 21 Station KA017226	See DWR standards	DWR standards
Groundwater	NA		
Subsurface drainage water	Pond influent sumps and pond itself	Grab sampling of drainwater at influent sumps and evaporation pond	Quarterly

Table 37. Water Quality Monitoring Programs for Surface/Sub-Surface Drainage

Constituent	Units	Standard
Total Alkalinity as CaCO3	mg/L	Std Method 2320 B
Total Aluminum	mg/L	EPA 200.8 (T)
Dissolved Ammonia as N	mg/L	EPA 350.1
Dissolved Arsenic	mg/L	EPA 200.8 (D)
Total Arsenic	mg/L	EPA 200.8 (T)
Total Barium	mg/L	EPA 200.8 (T)
Dissolved Beryllium	mg/L	EPA 200.8 (D)
Total Beryllium	mg/L	EPA 200.8 (T)
Dissolved Boron	mg/L	EPA 200.7 (D)
Total Cadmium	mg/L	EPA 200.8 (T)
Dissolved Calcium	mg/L	EPA 200.7 (D)
Dissolved Chloride	mg/L	EPA 300.0 28d Hold
Dissolved Chromium	mg/L	EPA 200.8 (D)
Total Chromium	mg/L	EPA 200.8 (T)
Conductance (EC)	µS/cm	Std Method 2510-B
Dissolved Copper	mg/L	EPA 200.8 (D)
Total Copper	mg/L	EPA 200.8 (T)
Dissolved Hardness as CaCO3	mg/L	Std Method 2340 B
Dissolved Iron	mg/L	EPA 200.8 (D)
Total Iron	mg/L	EPA 200.8 (T)
Total Kjeldahl Nitrogen as N	mg/L	EPA 351.2
Dissolved Lead	mg/L	EPA 200.8 (D)
Total Lead	mg/L	EPA 200.8 (T)
Dissolved Lithium	mg/L	EPA 200.8 (D)
Dissolved Magnesium	mg/L	EPA 200.7 (D)
Dissolved Manganese	mg/L	EPA 200.8 (D)
Total Manganese	mg/L	EPA 200.8 (T)
Dissolved Mercury	mg/L	EPA 200.8 (Hg Dissolved)
Dissolved Molybdenum	mg/L	EPA 200.8 (D)
Dissolved Nickel	mg/L	EPA 200.8 (D)
Total Nickel	mg/L	EPA 200.8 (T)
Dissolved Nitrate	mg/L	EPA 300.0 28d Hold
Dissolved Nitrate + Nitrite as N	mg/L	Std Method 4500-NO3-F (28Day)
Dissolved Ortho-phosphate as P	mg/L	EPA 365.1 (DWR Modified)
Total Phosphorus	mg/L	EPA 365.4
Dissolved Selenium	mg/L	EPA 200.8 (D)
Total Selenium	mg/L	EPA 200.8 (T)
Total Silver	mg/L	EPA 200.8 (T)
Dissolved Sodium	mg/L	EPA 200.7 (D)
Total Dissolved Solids	mg/L	Std Method 2540 C
Total Suspended Solids	mg/L	EPA 160.2
Volatile Suspended Solids	mg/L	EPA 160.4
Dissolved Strontium	mg/L	EPA 200.8 (D)
Dissolved Sulfate	mg/L	EPA 300.0 28d Hold
Dissolved Zinc	mg/L	EPA 200.8 (D)
Total Zinc	mg/L	EPA 200.8 (T)
pH	pH	Std Method 2320 B

Source of data:
http://www.water.ca.gov/waterdatalibrary/waterquality/station_county/select_station.cfm?URLStation=KA017226&source=map