7.7 Water Balance

7.7.1 Overview

This section describes the various uses of water within WCWD between 1999 and 2019, followed by detailed water balances for key accounting centers within the district. Water balances are presented for the distribution and drainage system (i.e. canals and drains), farmed lands, and the district as a whole. The water balances quantify all substantial inflows to and outflows from the WCWD service area on an irrigation season (April – September) and water year basis (October – September). The period from 1999 to 2019 has been chosen because it depicts recent water management conditions. Key drivers of water management variability across years include precipitation timing and amounts, crop idling for water transfers, and surface water reductions. Surface water reductions only occurred in one year, 2015, during the period from 1999 to 2019. Conditions in curtailed years are discussed in greater detail in the Drought Management Plan, included as Attachment 7.10.5 of this AWMP.

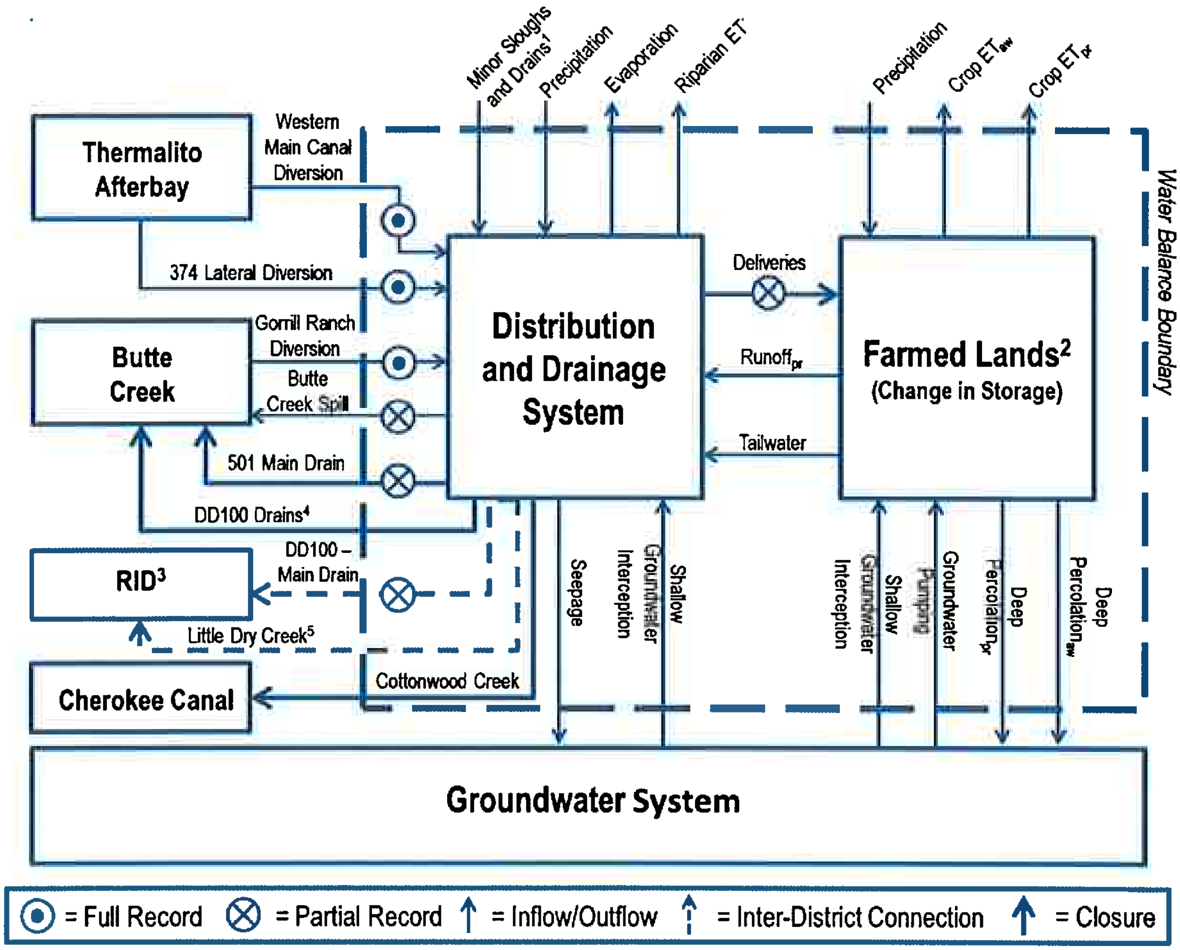
Historical estimates of water use may differ slightly from those presented in WCWD's 2015 AWMP as a result of refinements to the analyses used to develop the estimates, but fall within the range of uncertainty presented in Table 7.4 and do not affect conclusions regarding water management conditions within WCWD.

The remainder of this section includes the following subsections:

- Analytical Approach – Description of mass balance approach for water balance analysis, methodologies for estimation of individual flow paths, and uncertainty in flow path estimates;
- Water Uses – Description of water use for agricultural, environmental and recreational, municipal and industrial, groundwater recharge, and transfer and exchange purposes;
- Drainage – Description of drainage occurring within and flowing from the district; and
- Water Accounting (Water Balance Summary) – Summary of monthly and annual inflows to and outflows from the district, including a discussion of existing water management and performance.

7.7.2 Analytical Approach

The WCWD water balance includes separate accounting centers for the distribution and drainage system and the farmed lands within the service area. A total of 25 individual flow paths are estimated. A schematic of the water balance structure is provided in Figure 7.3. The schematic identifies sources and destinations of water, accounting centers, and individual flow paths by which water enters and leaves the system.



1. Minor sloughs and drains include Campbell Slough, Little Butte Creek, Durham Slough, Hamlin Slough, the Little Dry Creek Diversion, and other tributaries and drains.
2. Farmed Lands includes portions of Upper Butte Basin Wildlife Area and North Central Valley Wildlife Management Area.
3. RID is Richvale Irrigation District.
4. DD100 Drains to Butte Creek also includes Hamlin Slough, Little Butte Creek, Campbell Slough, and private drains.
5. Little Dry Creek to RID also includes DD100 and DD200 Drains and private drains

Figure 7.3. Water Balance Structure.

Mass Balance

In general, flow paths are quantified on a monthly basis. For each accounting center, water volumes associated with certain flow paths are estimated independently based on measured data or calculated estimates, and the remaining flow is then calculated based on the principal of conservation of mass (Equation 7.1), which states that the difference between total inflows to and total outflows from an accounting center for a given period of time is equivalent to the change in stored water within that accounting center. For the distribution and drainage system, the change in storage is assumed to be zero on a monthly basis. For the farmed lands, the monthly change in storage varies, reflecting changes in the volume of water ponded in rice and managed wetlands areas as well as changes in soil moisture stored in the root zone. Over the course of a year the change in storage across all farmed lands is expected to be near zero.

$$Inflows - Outflows = Change\ in\ Storage\ (monthly\ time\ step) \quad [7.1]$$

The flow path that is calculated based on Equation 7.1 is referred to as the "closure term" because the mass balance equation is solved for or "closed" on the unknown quantity. The closure term is selected based on consideration of the availability of data or other information to support an independent estimate as well as the volume of water representing the flow path relative to the size of other flow paths. Generally speaking, the largest, most uncertain flow path is selected as the closure term.

Flow Path Estimation and Uncertainty

Individual flow paths were estimated based on direct measurements or based on calculations using measurements and other available data. As described previously, those flow paths not estimated independently were calculated as the closure term of each accounting center.

The analysis results for each flow path are reported with a high level of precision (nearest whole acre-foot) that implies a higher degree of accuracy than is actually justified. The estimated percent uncertainty (approximately equivalent to a 95 percent confidence interval) in each measured or calculated flow path has been estimated as part of the water balance analysis. Based on the relative magnitude of each flow path, the resulting uncertainty in each closure term can be estimated by assuming that errors in estimates are random (Clemmens and Burt 1997). Errors in estimates for individual flow paths may cancel each other out to some degree, but the combined error due to uncertainty in the various estimated flow paths is ultimately expressed in the closure term.

For the distribution and drainage system accounting center, aggregated surface outflows were calculated as the closure term, based on the assumption that the change in storage over time is zero. Total outflows were distributed across each individual outflow waterway (i.e. creeks and drains) based on available outflow measurements and estimated drainage areas tributary to each outflow location. Aggregated surface outflows were selected as the closure term because of the combination of the lack of available outflow data, generally large magnitude, and relative uncertainty of the flow path.

For the farmed lands accounting center, deliveries were calculated as the closure term. Deliveries were selected as the closure term because historical measurements were not readily available for the full period of analysis and they represent the largest inflow into the farmed lands accounting center. Deliveries calculated via closure include deliveries by WCWD from canals and laterals, as well as any district or private reuse of water or unaccounted groundwater pumping.

Table 7.4 lists each flow path included in the water balance indicating which accounting center(s) it belongs to; whether it is an inflow or an outflow; whether it was measured or calculated; the supporting information and assumptions used to determine it; the estimated uncertainty, expressed as a percent; and average values for the period of analysis. Results for both the full water year and for the primary irrigation season (April to September) are provided. As indicated, estimated uncertainties vary from 5% to 100% of the average volume for the irrigation season, with uncertainties generally being less for measured flow paths and greater for calculated flow paths.

The estimated uncertainty of each closure term is also shown. As indicated, the estimated uncertainty in aggregated surface outflows is 31% for the water year as a whole and 46% for the irrigation season. The estimated uncertainty in deliveries is 15% for the water year as a whole and 12% for the irrigation season. The uncertainty in deliveries decreases for the irrigation season due to the lack of precipitation from winter storms.

7.7.3 Water Use

The district supplies agricultural irrigation water and also provides water for environmental use to provide wildlife habitat within and outside its service area. These water uses are described in greater detail in the remainder of this section.

Agricultural

Agricultural irrigation is by far the dominant water use in WCWD. Between 1999 and 2019, there were an average of 49,600 cropped acres within the district's service area, with an average of 4,800 additional acres of fallow or idle land.

Table 7.5 and Figure 7.4 present estimated irrigable acreages for this period. As indicated, the main crop in the district is rice, which was grown on an average of 46,600 acres between 1999 and 2019, representing 94% of the total cropped area, or 86% of the irrigable area. Orchards account for an average of 1,800 acres or 4% of the cropped area. Other crops such as grain, hay, and pasture account for an average of 1,200 acres or 3% of the cropped area. The acreage of other crops has decreased over time.

Crop acreage decreased in 2001, 2003, 2008, 2009, 2010, 2012, 2014, and 2018 as a result of crop idling-based water transfers. Cropped acreage within these years averaged 46,900 acres, with an average of 51,400 acres in years in which cropland was not idled for transfer.

Table 7.4. Water Balance Flow Paths, Supporting Data, and Estimated Uncertainty.

Accounting Center	Flow Path Type	Flow Path	Source	Supporting Data	Water Year (Oct. - Sept.)		Irrigation Season (Apr. - Sept.)	
					Average Volume (af)	Estimated Uncertainty	Average Volume (af)	Estimated Uncertainty
District Distribution and Drainage System	Inflow	Western Main Canal Diversion	Measurement	USGS Measurement Gage 11406880	297,146	5%	216,614	5%
		374 Lateral Diversion	Measurement	USGS Measurement Gage 11406900	3,787	5%	3,006	5%
		Gorrill Ranch Diversion	Calculation	WCWD operational data (1999-2012 Diversion Record)	5,907	10%	5,905	10%
		Minor Sloughs and Drains	Calculation	Estimated as zero	0	100%	0	100%
		Precipitation	Calculation	Quality-controlled precipitation from CIMIS, estimated canal surface area	418	15%	59	15%
		Shallow Groundwater Interception	Calculation	Estimated as closure of regional water balance. Distributed within region based on area, drain miles, and average depth to groundwater.	20,010	70%	20,391	70%
		Runoff of Precipitation	Calculation	IDC analysis, NRCS soils characteristics, CIMIS precipitation data	53,571	25%	5,674	25%
		Tailwater	Calculation	Estimated as 20% percent of Deliveries	83,308	30%	66,685	30%
	Outflow	**Deliveries (to Private Ditches and Farmed Lands)**	**Closure (Private Ditches and Farmed Lands)**	**Closure term of Private Ditches and Farmed Lands Water Balance**	**270,454**	**15%**	**216,422**	**12%**
		Evaporation	Calculation	CIMIS reference ET, estimated evaporation coefficient, estimated wetted surface area	955	15%	793	15%
		Riparian ET	Calculation	CIMIS reference ET, estimated crop coefficient based on 2009 SEBAL analysis, estimated riparian area	208	15%	159	15%
		Seepage	Calculation	NRCS soils data, published seepage rates by soil type, estimated wetted area, estimated wetted duration	10,210	35%	6,065	35%
		Butte Creek Spill	**Closure (District Distribution and Drainage System)**	**Difference between total inflows and measured/estimated outflows for District Distribution and Drainage System accounting center, distributed according to drainage area and available data, MBK 2003 Tailwater Study and Davids Engineering Boundary Outflow Monitoring from 2016 through 2019.**	**13,386**	**31%**	**6,967**	**43%**
		501 Main Drain			**12,315**		**6,410**	
		DD100 Drains			**10,939**		**5,694**	
		DD100 - Main Drain			**10,939**		**5,694**	
		Little Dry Creek			**24,796**		**12,906**	
		Cottonwood Creek			**9,116**		**4,745**	
		Subsurface Outflow to Butte Creek			**100,828**		**52,479**	
Private Ditches and Farmed Lands	Inflow	Precipitation	Calculation	Quality-controlled precipitation from CIMIS station, reported cropped area	107,501	15%	15,298	15%
		Deliveries	**Closure (Private Ditches and Farmed Lands)**	**Difference between measured/estimated inflows and total outflows for Privated Ditches and Farmed Lands accounting center, including estimated Tailwater as percentage of Deliveries**	**270,454**	**15%**	**216,422**	**12%**
		Shallow Groundwater Interception	Calculation	Estimated as closure of regional water balance. Distributed within region based on area, drain miles, and average depth to groundwater.	6,670	70%	6,797	70%
		Groundwater Pumping	Calculation	Estimated pumping based on estimated groundwater acres and associated applied water estimated from IDC.	9,237	25%	7,317	25%
	Outflow	Tailwater	Calculation	Estimated as 20% percent of Deliveries	83,308	30%	66,685	30%
		Crop ET of Applied Water	Calculation	CIMIS reference ET; estimated crop coefficients based on SEBAL 2009 analysis; crop acreages from WCWD records, DWR land use surveys, and agricultural commissioner crop reports; Integrated Water Flow Model Demand Calculator (IDC) analysis to divide total ET into applied water and precipitation components	170,113	10%	133,795	10%
		Crop ET of Precipitation	Calculation		39,877	10%	25,960	10%

Table 7.5. Crop and Idle Acres, 1999-2019.

Year	Crop Acreage by Type					
	Rice	Orchards	Other	Idle	Total Cropped	Total with Idle
1999	48,344	1,472	2,972	2,763	52,787	55,551
2000	49,241	1,574	2,501	2,068	53,316	55,383
2001	42,256	1,784	3,223	7,257	47,263	54,519
2002	49,026	1,653	2,540	1,402	53,218	54,620
2003	42,845	1,680	1,639	8,895	46,164	55,060
2004	49,006	1,681	962	3,414	51,648	55,062
2005	48,692	1,634	1,290	2,768	51,616	54,384
2006	50,250	1,706	848	2,052	52,803	54,855
2007	50,515	1,727	927	1,462	53,169	54,631
2008	47,039	1,679	886	5,441	49,603	55,045
2009	50,078	1,667	897	2,242	52,642	54,884
2010	44,791	1,701	911	7,768	47,403	55,170
2011	51,524	1,724	1,066	237	54,314	54,552
2012	44,012	1,700	1,137	8,218	46,849	55,066
2013	51,969	1,650	1,030	29	54,648	54,676
2014	40,782	1,792	802	10,953	43,376	54,329
2015	44,198	2,125	675	5,464	46,998	52,462
2016	49,011	2,275	404	1,458	51,690	53,148
2017	40,894	2,275	404	9,575	43,572	53,148
2018	38,893	2,275	404	11,576	41,572	53,148
2019	45,203	2,275	404	5,267	47,881	53,148
Average	**46,598**	**1,812**	**1,234**	**4,777**	**49,644**	**54,421**

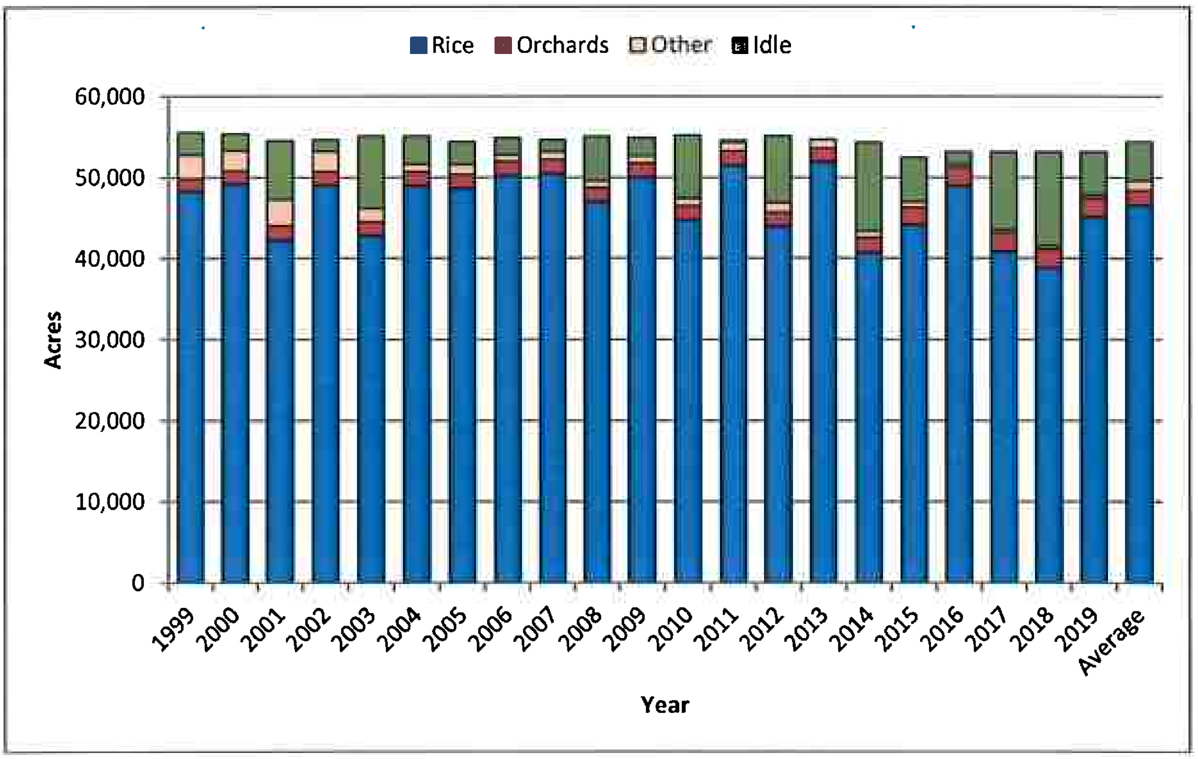


Figure 7.4. Crop and Idle Acres, 1999-2019[5].

Crop evapotranspiration (ET) was estimated using a crop coefficient approach, whereby estimated crop- and time-specific water use coefficients were multiplied by reference ET (ET_o) to calculate the total consumptive use of water for the farmed lands over time. Crop coefficients specific to the Sacramento Valley were developed based on actual ET estimates from a remote sensing analysis using the Surface Energy Balance Algorithm for Land (SEBAL). The analysis used ground and satellite data to compute actual ET from March to September for individual 30-meter satellite pixels within Glenn and Colusa counties in 2009. Spatially distributed cropping data from DWR land use surveys for Glenn and Colusa counties for 2009 were combined with quality-controlled reference evapotranspiration (ET_o) from CIMIS to calculate crop coefficients representing actual ET over the course of the growing season[6]. A map showing March to September ET estimates for WCWD from SEBAL for 2009 is provided in Figure 7.5.

[5] Total acres vary somewhat from year to year reflecting estimated changes in total irrigable acres resulting from rural development and changes in areas of native vegetation.
[6] Ideally, the crop coefficient analysis would have included portions of Butte, Sutter, and Yuba counties within the Feather River region; however, DWR land use surveys were not available for 2009 for these counties. Crop coefficients developed for Glenn and Colusa counties are considered reasonably representative for the region as a whole.

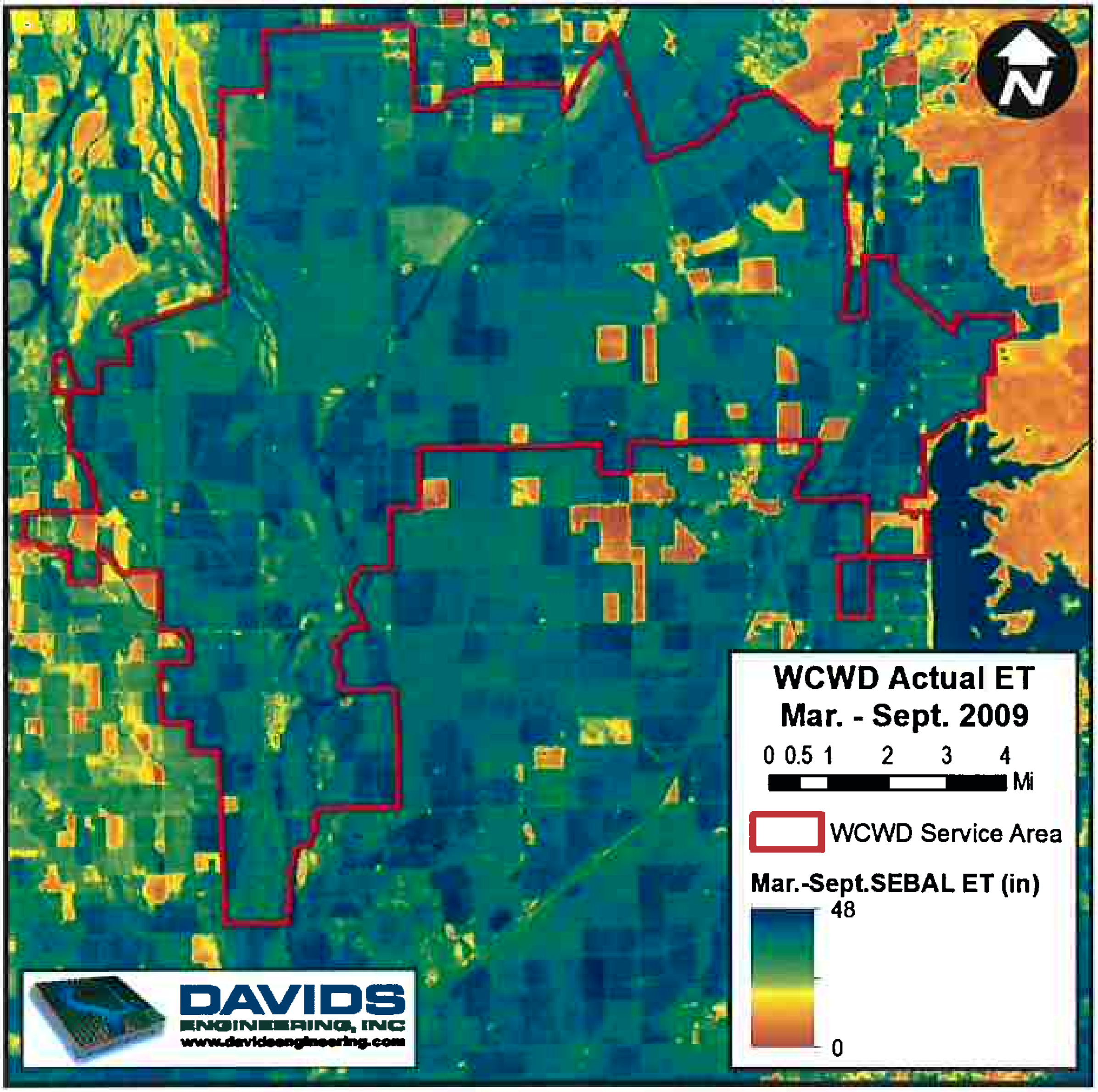


Figure 7.5. March to September 2009 SEBAL Actual ET.

A root zone water balance simulation was developed for each crop using the Integrated Water Flow Model (IWFM) Demand Calculator (IDC) Version 4.0 developed by DWR to estimate the portions of total ET derived from applied water (ET_{aw}) and from precipitation (ET_{pr}). ET values for each crop, expressed in units of acre-feet per acre were multiplied by the corresponding acreage in each year to compute total water volumes consumed for agricultural purposes.

For rice, the IDC model simulates ponding during the growing season and during the decomposition period in the fall and winter. As a result, precipitation occurring when ponds are full runs off of the fields and is not available to contribute to crop ET. Precipitation stored in the soil during the winter is available for extraction. For non-ponded crops, runoff and infiltration of precipitation are modeled for individual precipitation events. Precipitation entering the soil may be stored and available to support crop ET, or it may leave the root zone as deep percolation. One result of the differences in irrigation and cultural practices between rice and non-ponded crops is that ET_{pr} is significantly less for rice. Additional detail describing rice water management is provided in Volume I, Section 2.

Starting in 2015, water budget results presented in this AWMP are based on the Butte Basin Groundwater Model (BBGM) developed to support recent, local water management activities, including SGMA. The BBGM was developed using the latest available datasets including land use, precipitation, and actual evapotranspiration. Results from the BBGM for each land use category, expressed in units of acre-feet per acre, were multiplied by the corresponding acreage within the District's service area and incorporated into the District's water balance. Further information on the BBGM is available through Butte County's Department of Water and Resource Conservation.

The monthly consumptive use of water in WCWD ranges from approximately 1.2 inches of total ET in December and January to approximately 8.1 inches in June and July. A majority of ET is derived from applied water, and ET_{aw} ranges from approximately 0.9 inches in December and January to approximately 7.3 inches in July for the irrigable area. The average monthly consumptive use of water is presented in Figure 7.6.

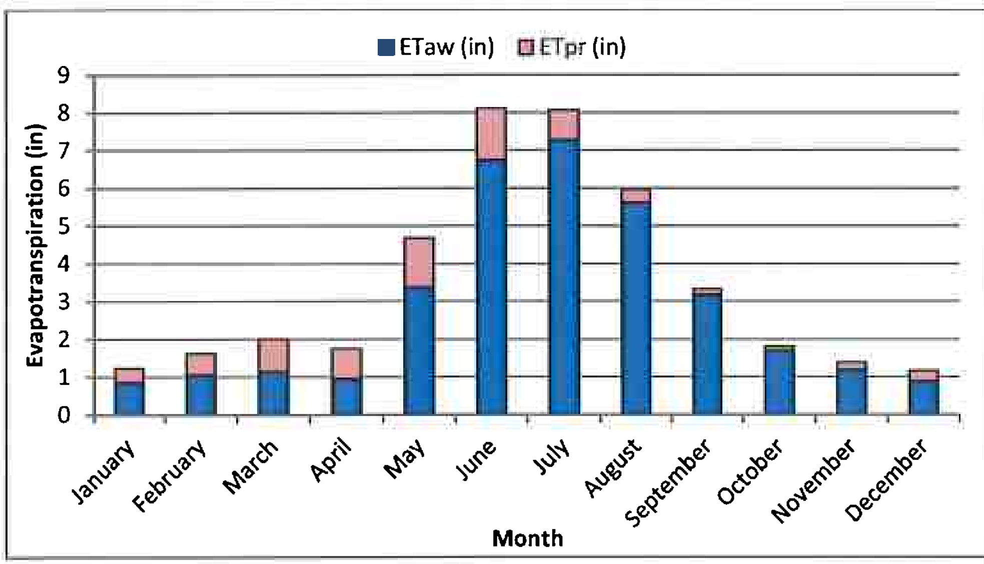


Figure 7.6. Average Monthly Consumptive Use of Water.

As indicated in Table 7.6, the annual consumptive use of water by crops in WCWD ranges from approximately 45 inches of total crop ET for rice to approximately 33 inches for other crops. ET_{aw} ranges from approximately 23 inches to 38 inches. For rice, approximately 39 inches of the 45 inches of total ET are derived from applied irrigation water. On average, approximately 34 inches of 41 inches of total ET are derived from applied irrigation water district-wide.

Table 7.6. Average Acreages and Annual Evapotranspiration Rates by Crop.

Crop	Average Acres	Average Evapotranspiration (in)		
		ET_c	ET_{aw}	ET_{pr}
Rice	46,598	45.1	38.4	6.8
Orchard	1,812	37.8	25.3	12.5
Other	1,234	33.1	23.4	9.7
Idle	4,777	11.4	1.1	10.3
Totals	**54,421**	**41.1**	**33.9**	**7.2**

ET_c and ET_{aw} vary from year to year due to differences in atmospheric water demand (ET_o) and differences in the timing and amount of precipitation available to support crop growth and offset crop irrigation requirements. Total annual ET varied between approximately 171,000 af and 248,000 af during the 1999 to 2019 period, with an average annual volume of 210,000 af. On average, approximately 170,000 af of ET were derived from applied irrigation water (81% of total ET) and 40,000 af of ET were derived from precipitation (19% of total ET).

Other uses of applied water include winter deliveries for habitat and rice straw decomposition (discussed in the following section). Due to the low salinity of surface water diverted from the Feather River, the required leaching fraction is assumed to be negligible for the crops grown in the District. Additionally, water applied for frost protection is also assumed to be negligible, based on the growing season and typical frost protection requirements of crops grown in WCWD (see Section 7.7.7).

Environmental and Recreational

Wetland and riparian habitat in WCWD comprise approximately 6,500 acres or 10% of lands within the district and include portions of the CDFW Upper Butte Basin Wildlife Area and the USFWS North Central Valley Wildlife Management Area. WCWD also provides water for habitat to a portion of the Llano Seco Unit of the Sacramento National Wildlife Refuge and to several private duck clubs both inside and outside of its boundary.

In addition to managed habitat, a majority of the rice fields in WCWD are currently flooded in the winter following harvest to aid in rice straw decomposition and to create winter habitat for migratory birds along the Pacific Flyway and other species. Use of water during the winter for rice decomposition and waterfowl habitat increased substantially between 1992 and 2001, largely driven by the phasing out of burning of rice straw as a result of the Connelly-Areias-Chandler Rice Straw Burning Reduction Act of 1991 and has remained relatively steady since around 2000.

Estimated deliveries for managed wildlife habitat and rice straw decomposition within WCWD are provided in Table 7.7. These estimates are based on estimated deliveries from the water balance closure for the October to March period. Deliveries are typically near zero between February and March. In addition to deliveries for managed wetlands within WCWD, water is released to Butte Creek for use by duck clubs downstream of the District boundaries based on a 1922 agreement. These releases have been on the order of 15,000 to 30,000 af in recent years and were over 36,000 af in 2014.

Table 7.7. Estimated Winter Applied Water for Managed Habitat, Rice Straw Decomposition, and Butte Sink Duck Clubs.

Water Year	Applied Water (af)[1]	Butte Sink Duck Clubs (af)[2]	Total Winter Use (af)
1999	41,811	13,100	54,911
2000	54,503	22,840	77,343
2001	54,233	10,550	64,783
2002	58,444	18,100	76,544
2003	60,519	18,220	78,739
2004	52,254	11,350	63,604
2005	56,732	6,550	63,282
2006	52,196	11,850	64,046
2007	68,137	12,900	81,037
2008	61,674	13,000	74,674
2009	58,210	10,100	68,310
2010	52,981	13,850	66,831
2011	41,166	15,700	56,866
2012	55,204	26,000	81,204
2013	50,574	21,300	71,874
2014	74,028	36,450	110,478
2015	79,830	15,750	83,259
2016	33,197	22,350	33,968
2017	36,831	10,500	26,976
2018	54,438	12,100	44,898
2019	37,706	13,000	33,563
Average	**54,032**	**15,979**	**65,581**

1. Estimated based on water balance analysis. Includes metered deliveries plus reuse.

2. Based on recorded releases by WCWD to meet downstream demands. May differ from water balance estimates of total surface outflows.

The water supplied during the winter period provides critical habitat to support migratory waterfowl and shorebirds while also creating recreational opportunities. Aside from this, there are no recreational water uses within the district.

In addition to use of water within the district to provide winter habitat, surface outflows flow to Butte Creek, providing important flows to support migration of salmon and steelhead and other downstream uses of water for wildlife habitat, such as diversions by Sutter National Wildlife Refuge in the Sutter Bypass to support seasonal wetlands. Outflows from the WCWD service area are discussed in greater detail in the drainage and water accounting sections.

Municipal and Industrial

WCWD does not provide any municipal or industrial water.

Groundwater Recharge

Groundwater recharge that occurs within the district's service area consists of seepage from canals as well as deep percolation of precipitation and applied irrigation water. Distributed recharge through seepage and deep percolation provides a means to replenish the groundwater system to the benefit of WCWD water users, the community of Nelson, other individuals within WCWD, and surrounding areas overlying the Butte groundwater subbasin and Sacramento Valley groundwater basin.

Estimates of recharge were developed as part of the water balance analysis. Specifically, canal seepage estimates were calculated based on estimated soil hydraulic characteristics along with estimated canal wetted perimeters, overall lengths, and wetting frequency. Deep percolation of applied irrigation water and precipitation were calculated based on estimated applied irrigation water amounts over time as influenced by ET_o, precipitation, crop, and soil type, and simulated by the IDC model described previously.

Estimated annual seepage and deep percolation volumes for water years 1999 to 2019 are provided in Table 7.8, along with total recharge expressed as a volume and as a depth of water for each year.

Table 7.8. Total Groundwater Recharge, 1999-2019.

Water Year	Canal Seepage (af)	Deep Percolation of Applied Water (af)	Deep Percolation of Precipitation (af)	Total Recharge	
				af	af/ac
1999	10,877	36,879	10,190	57,947	1.1
2000	10,877	39,586	9,824	60,288	1.1
2001	10,877	36,875	7,774	55,527	1.2
2002	9,811	41,762	11,399	62,972	1.2
2003	10,877	35,554	11,538	57,969	1.3
2004	10,877	37,936	10,100	58,913	1.1
2005	10,877	39,338	12,286	62,501	1.2
2006	9,811	41,487	16,275	67,573	1.3
2007	10,877	40,454	3,272	54,604	1.0
2008	10,877	39,123	6,854	56,855	1.1
2009	10,877	39,141	4,799	54,817	1.0
2010	9,811	35,325	11,396	56,532	1.2
2011	9,811	39,857	17,542	67,210	1.2
2012	9,811	32,163	8,922	50,895	1.1
2013	10,877	38,714	5,999	55,590	1.0
2014	10,877	34,545	2,283	47,705	1.1
2015	9,242	33,849	6,410	49,501	1.1
2016	8,176	39,455	10,026	57,657	1.1
2017	8,887	38,682	15,882	63,451	1.5
2018	9,704	32,866	6,062	48,632	1.2
2019	9,704	39,910	13,580	63,194	1.3
Average	**10,210**	**37,786**	**9,639**	**57,635**	**1.2**

Total recharge between 1999 and 2019 ranged from approximately 48,000 af to 68,000 af per year, or from 1.0 af to 1.5 af per acre per year. On average between 1999 and 2019, total recharge was estimated to be approximately 58,000 af per year (1.2 af/ac), with approximately 18% of recharge originating from canal seepage, 66% from deep percolation of applied water, and 17% from deep percolation of precipitation.

Groundwater level monitoring data and field observations suggest that the shallow groundwater system and regional aquifer are coupled within portions of WCWD's service area at certain times and that an unsaturated aquifer zone may thus not be present to receive recharge. Depth to water in residential and irrigation wells is commonly less than five feet, and drains flow even when irrigation is not occurring. These conditions likely result from limited groundwater pumping in the area along with sustained use of surface water for irrigation over past decades. As a result, it is likely that a substantial portion of the water percolating into the soil from ponded fields and seeping from canals is unable to flow downward but rather flows horizontally to where it is intercepted by non-ponded vegetation or by drains, providing base flow. Shallow groundwater interception is shown conceptually in Figure 7.7 and discussed in a regional context in Volume I of this AWMP.

Even in areas where an unsaturated zone is present, water infiltrating into the soil in ponded fields may encounter impermeable layers caused by plow pan or natural soil features and flow laterally to adjacent lands or provide base flow for drains. Additional information is needed to distinguish shallow groundwater interception in areas where the shallow and regional groundwater systems are coupled from areas with perched shallow groundwater.

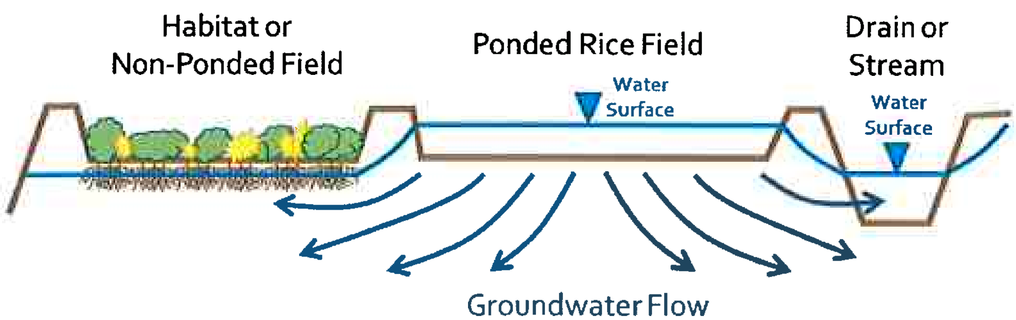


Figure 7.7. Conceptualization of Shallow Groundwater Interception in Rice Growing Areas.

Groundwater recharge net of well pumping and shallow groundwater interception represents the net amount of water contributing to groundwater storage from irrigation and precipitation processes in WCWD. Net recharge was calculated by subtracting estimated pumping volumes from total recharge volumes. As described above, shallow groundwater interception occurs when drains, creeks, or other waterways intercept or "gain" water from the shallow groundwater system, which may be perched or connected to the regional aquifer. Additionally, shallow groundwater can be intercepted and consumed by natural or other non-ponded vegetation. Net annual recharge estimates for 1999 to 2019 are provided in Table 7.9.

Table 7.9. Net Groundwater Recharge, 1999-2019.

Water Year	Total Recharge (af)	Groundwater Pumping (af)	Shallow Groundwater Interception (af)	Net Recharge	
				af	af/ac
1999	57,947	7,897	26,679	23,370	0.4
2000	60,288	8,180	26,679	25,428	0.5
2001	55,527	7,759	26,679	21,089	0.4
2002	62,972	8,516	26,679	27,777	0.5
2003	57,969	6,795	26,679	24,495	0.5
2004	58,913	7,613	26,679	24,621	0.5
2005	62,501	8,086	26,679	27,736	0.5
2006	67,573	7,194	26,679	33,700	0.6
2007	54,604	9,924	26,679	18,000	0.3
2008	56,855	8,840	26,679	21,336	0.4
2009	54,817	8,370	26,679	19,768	0.4
2010	56,532	6,590	26,679	23,263	0.5
2011	67,210	6,818	26,679	33,713	0.6
2012	50,895	7,484	26,679	16,732	0.4
2013	55,590	9,409	26,679	19,502	0.4
2014	47,705	8,004	26,679	13,021	0.3
2015	49,501	33,333	26,679	-10,511	-0.2
2016	57,657	13,498	26,679	17,480	0.3
2017	63,451	6,441	26,679	30,330	0.7
2018	48,632	6,339	26,679	15,614	0.4
2019	63,194	6,880	26,679	29,634	0.6
Average	**57,635**	**9,237**	**26,679**	**21,719**	**0.5**

Net recharge varied from approximately -11,000 af to 34,000 af per year between 1999 and 2019, or -0.2 af to 0.7 af per acre per year. On average between 1999 and 2019, net recharge was estimated to be approximately 22,000 af per year (0.5 af/ac-year). The only year in which net recharge was negative during this period was 2015.

Transfers and Exchanges

The district participated in seven voluntary water transfers between in 1999 and 2019. All transfers were crop idling-based. Participating landowners idled land within the district and transferred the surface water that would have been consumed in lieu of the transfer. The quantity of water transferred was based on DWR estimates of the annual evapotranspiration of applied water for rice (3.3 af/ac). Estimates of idled acres and the amount of water transferred each year are provided in Table 7.10.

Table 7.10. Crop Idling Water Transfer Volumes, 1999-2019.

Year	Idle Acreage	Transfer Volume (af)
2001	5,077	16,754
2003	6,060	19,998
2008	4,517	14,906
2009	1,844	6,085
2010	7,444	24,565
2012	8,193	27,037
2014	10,740	35,442
2018	10,344	34,135

Other Water Uses

Other incidental uses of water within WCWD may include watering of roads for dust abatement or agricultural spraying. The volume of water used for such purposes is small relative to other uses and, thus, not itemized, but is accounted for in the water budget as part of the volume of deliveries to farmed lands.

7.7.4 Drainage

Surface Outflows

Surface drains within WCWD convey runoff of precipitation, surface inflows from upgradient lands, runoff of irrigation water (tailwater), and provide shallow groundwater relief by capturing canal seepage and intercepting shallow groundwater. Surface drains are also an important source of water for crop season irrigation and winter flooding in certain areas. All water leaving the district as surface outflow is available for downstream agricultural and environmental uses. Annual surface outflows are summarized in Table 7.11. Surface outflows during the irrigation season are approximately half of annual values.

Water year boundary outflows ranged from approximately 137,000 af to 252,000 af between 1999 and 2019 with an average of 182,000 af. Based primarily on estimated tributary areas above each outflow location, total boundary outflows were divided among the primary outflows.

Table 7.11. Estimated Surface Outflow Volumes, 1999-2019.

Water Year	Butte Creek Spill (af)	501 Main Drain (af)	DD100 Drains (af)	DD100-Main Drain (af)	Little Dry Creek (af)	Cotton wood Creek (af)	Subsurface Outflow to Butte Creek (af)	Total Boundary Outflows (af)
1999	11,680	10,746	9,545	9,545	21,636	7,954	87,982	159,090
2000	14,653	13,481	11,975	11,975	27,143	9,979	110,374	199,580
2001	11,837	10,890	9,673	9,673	21,926	8,061	89,158	161,217
2002	12,109	11,140	9,896	9,896	22,431	8,246	91,211	164,929
2003	11,932	10,978	9,751	9,751	22,103	8,126	89,880	162,523
2004	16,347	15,039	13,359	13,359	30,281	11,132	123,132	222,649
2005	12,224	11,247	9,990	9,990	22,644	8,325	92,080	166,500
2006	15,466	14,229	12,639	12,639	28,649	10,533	116,499	210,655
2007	10,264	9,443	8,388	8,388	19,013	6,990	77,313	139,799
2008	12,701	11,685	10,379	10,379	23,527	8,649	95,669	172,989
2009	12,595	11,587	10,292	10,292	23,330	8,577	94,868	171,541
2010	15,021	13,819	12,275	12,275	27,825	10,230	113,145	204,591
2011	16,235	14,937	13,268	13,268	30,074	11,056	122,292	221,130
2012	13,074	12,028	10,684	10,684	24,217	8,903	98,475	178,064
2013	10,560	9,715	8,630	8,630	19,561	7,191	79,541	143,827
2014	10,976	10,098	8,969	8,969	20,331	7,474	82,673	149,490
2015	10,056	9,251	8,218	8,218	18,627	6,848	75,743	136,960
2016	13,199	12,143	10,786	10,786	24,449	8,988	99,417	179,767
2017	18,467	16,990	15,092	15,092	34,208	12,576	139,102	251,526
2018	14,161	13,028	11,572	11,572	26,231	9,643	106,663	192,870
2019	17,548	16,144	14,340	14,340	32,505	11,950	132,178	239,005
Average	**13,386**	**12,315**	**10,939**	**10,939**	**24,796**	**9,116**	**100,828**	**182,319**

Tailwater

The farmed lands water balance includes an estimate of the volume of tailwater entering the distribution and drainage system that is available for reuse. A portion of this volume is reused within the district and is included in the estimated deliveries; the remainder is available for reuse by downgradient water users in RID, along Butte Creek, in the Butte Sink, in the Sutter Bypass, etc. Table 7.12 presents the estimated annual tailwater volumes between water years 1999 and 2019.

Tailwater entering the distribution and drainage system between 1999 and 2019 ranged from approximately 66,000 af to 100,000 af per year. The average tailwater volume for this period was approximately 83,000 af per year.

Reuse

WCWD recovers operational spillage and tailwater via gravity at two locations in the distribution system. First, the Fenn drain conveys upstream operational spillage and tailwater to the Main Canal upstream of the "reservoir" at Little Butte Creek. Second, the control structure on the 501 Main Drain allows the upstream water level to be raised so that water can be delivered from the drain to Howard Slough for downstream use via the Howard Slough headgates.

Table 7.12. Estimated Tailwater Volumes, 1999-2019.

Water Year	Tailwater (af)
1999	81,768
2000	87,675
2001	84,224
2002	90,484
2003	77,752
2004	79,130
2005	82,165
2006	80,066
2007	100,487
2008	92,192
2009	89,055
2010	75,077
2011	74,028
2012	76,202
2013	91,699
2014	81,005
2015	66,472
2016	84,337
2017	85,258
2018	96,714
2019	73,672
Average	**83,308**

Based on comparison of WCWD total measured deliveries for 2008 through 2012 to deliveries calculated from the water balance analysis, which include district and private reuse, it is estimated that approximately 18 percent of the calculated deliveries represent reuse, or approximately 50,000 af annually. It is assumed that approximately one third of the total reuse results from recapture of spillage and tailwater by the district, with the remaining two thirds resulting from recapture by individual water users. Reuse by WCWD and individual water users reduces diversion requirements from the afterbay and results in district-scale water use efficiency that would otherwise not be attained. Implications of reuse at the district and regional scales are further discussed in the following section.

7.7.5 Water Accounting (Summary of Water Balance Results)

The WCWD water balance structure was shown previously in Figure 7.3. The water balance was prepared for the distribution and drainage system and for farmed lands. Additionally, the water balance can be summarized for the WCWD service area as a whole ("Water Balance Boundary" shown in Figure 7.3). An accounting center representing the groundwater system is also included in Figure 7.3 to account for exchanges between the root zone and the underlying groundwater system; however, a complete balance for the underlying aquifer has not been developed because not all inflows and outflows into the groundwater system (such as horizontal boundary flows) have been estimated.

As depicted in Figure 7.3 and discussed previously, interconnection exists between the accounting centers due to recapture and reuse of water by both WCWD and by individual water users. Specifically, surface runoff of applied water (tailwater) flows back into the distribution and drainage system. Within the drainage system, reuse of tailwater, operational spillage, or water from other sources is practiced by the district and by individual water users. This water recovery and reuse results in higher levels of aggregate performance than would otherwise occur.

The water balance results are presented on a water year basis for 1999 through 2019. Underlying the annual time step is a more detailed water balance in which all flow paths are estimated on a monthly basis.

District-Wide and Individual Accounting Center Water Balance Results

A district-wide water balance combining individual inflows and outflows into general categories is shown in Figure 7.8 for the water year and for the April to September primary irrigation season. In each figure, average volumes are presented for each inflow and outflow category, as well as average volumes expressed in acre-feet per acre. Average monthly inflows to and outflows from WCWD are further summarized in Figures 7.9 and 7.10, respectively.

Detailed annual water balance results for the distribution and drainage system are summarized in Table 7.13. Detailed annual water balance results for the farmed lands are summarized in Table 7.14. In each table, performance indicators discussed in the following section are provided.

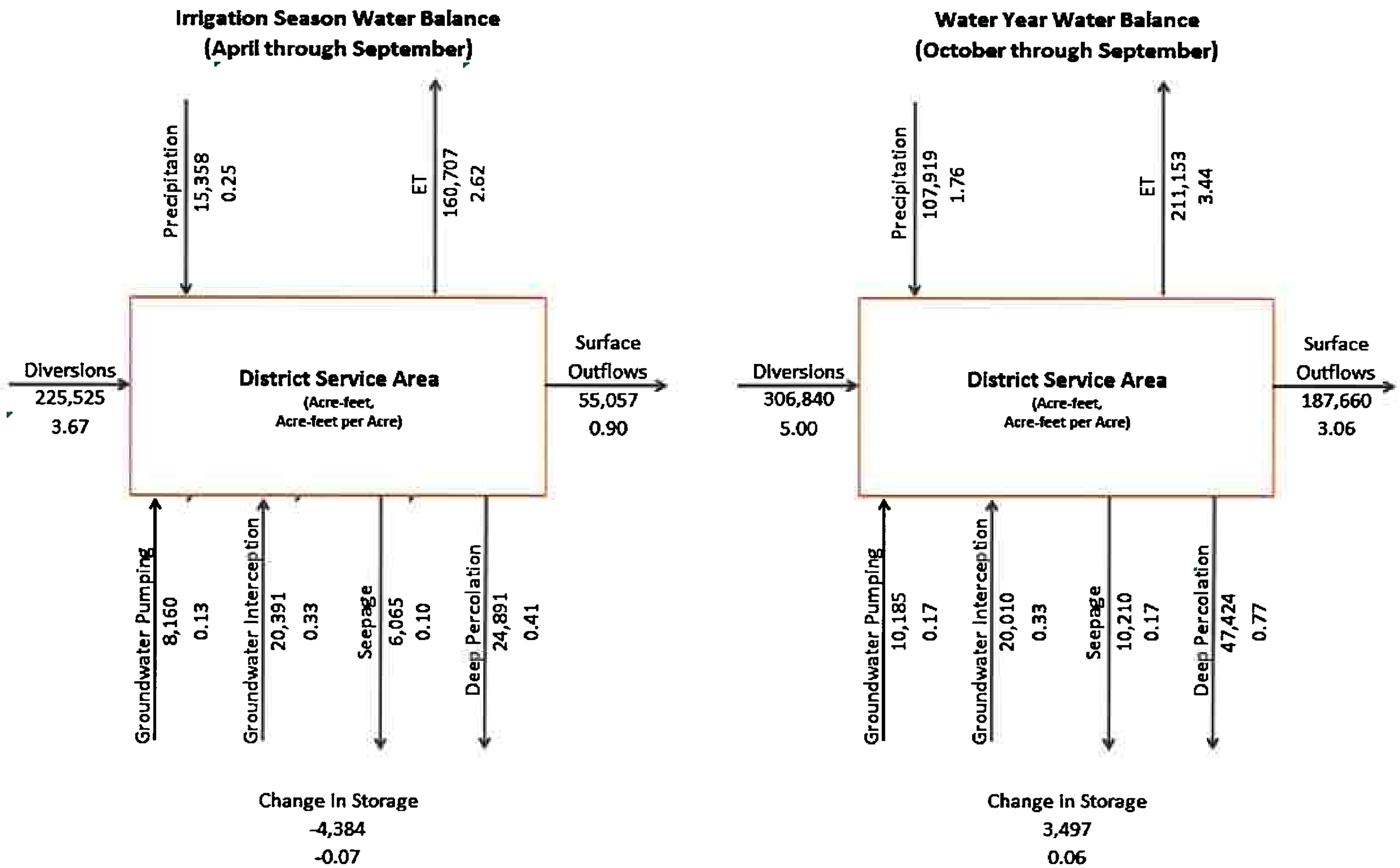


Figure 7.8. Average District Water Balance, 1999-2019.

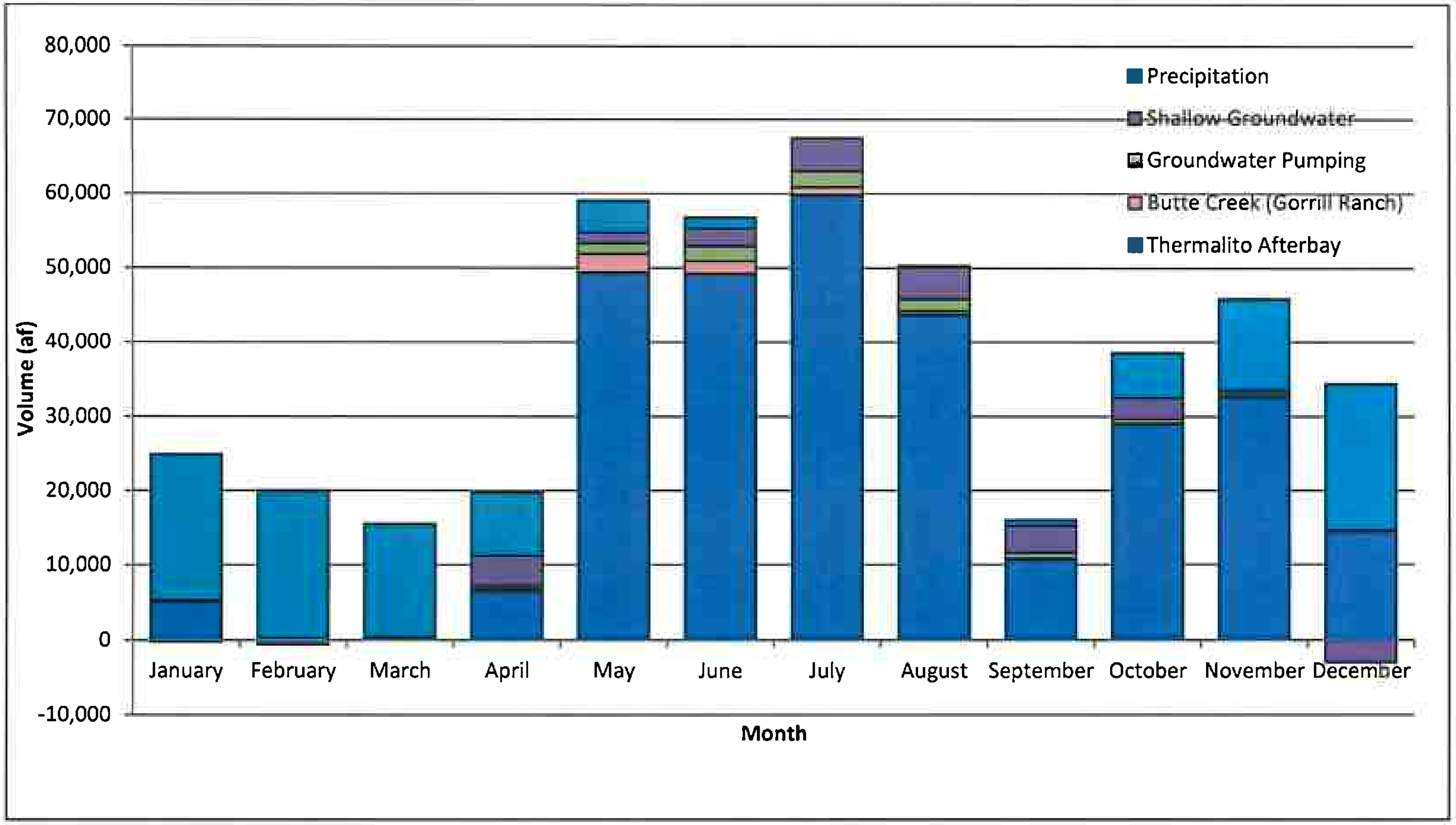


Figure 7.9. Average Monthly Inflows, 1999-2019.

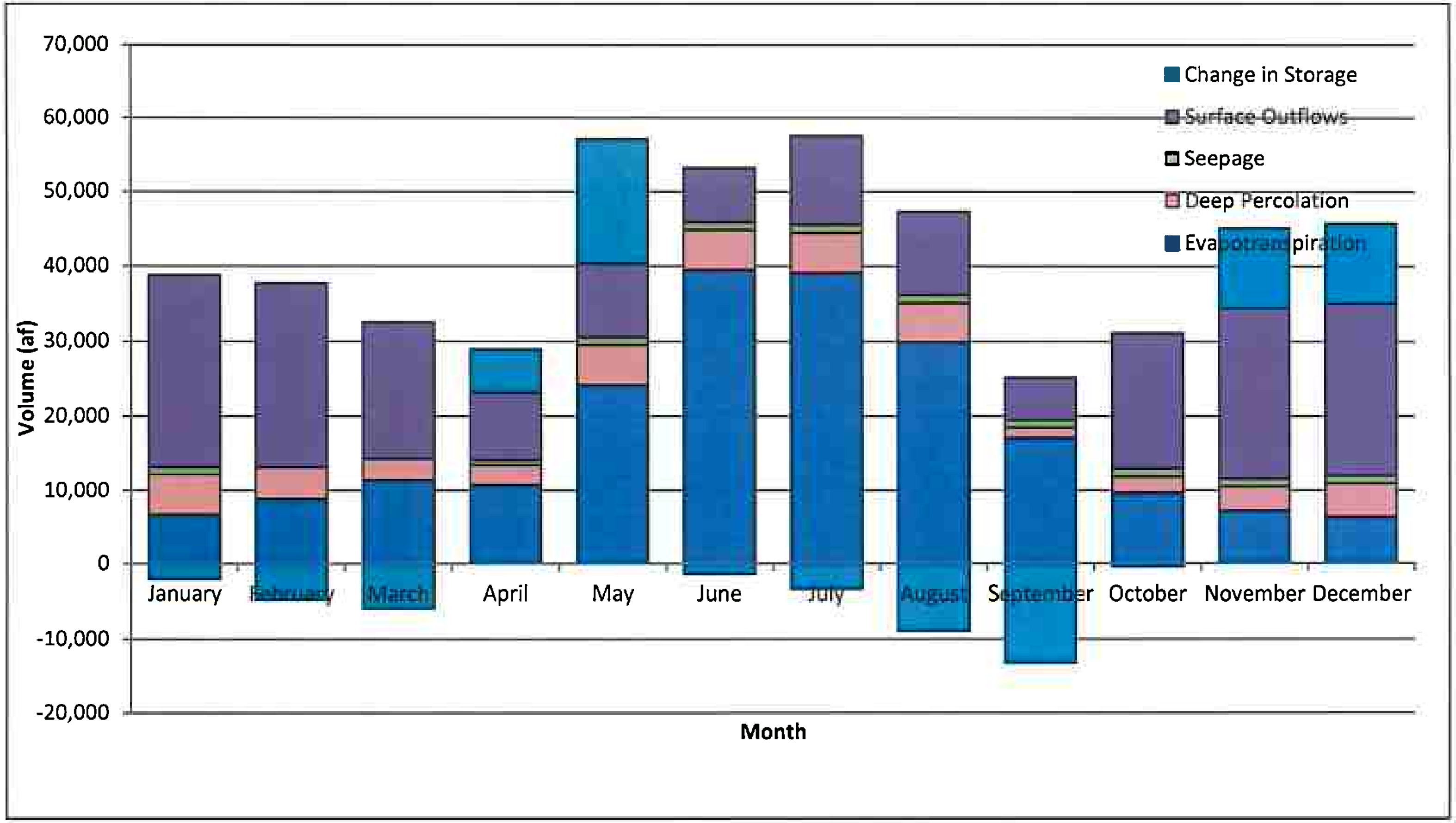


Figure 7.10. Average Monthly Outflows and Change in Storage, 1999-2019.

Table 7.13. Distribution and Drainage System Annual Water Balance Results, 1999-2019.

Water Year	Inflows (af)								Outflows (af)					Performance Indicators	
	Western Main Canal Diversion	374 Lateral Diversion	Gorrill Ranch Diversion	Precipitation	Shallow Groundwater Interception	Minor Sloughs and Drains	Runoff	Tailwater	Deliveries	Seepage	Riparian ET	Evaporation	Boundary Outflows	Delivery Fraction	Water Management Fraction
1999	289,095	4,332	13,463	350	20,010	0	34,678	81,768	272,561	10,877	205	963	**159,090**	0.89	0.998
2000	321,352	4,050	9,197	459	20,010	0	61,189	87,675	292,251	10,877	213	1,011	**199,580**	0.87	0.998
2001	298,505	4,304	7,567	358	20,010	0	39,131	84,224	280,748	10,877	218	1,038	**161,217**	0.90	0.998
2002	300,986	4,515	6,526	425	20,010	0	54,552	90,484	301,614	9,811	218	925	**164,929**	0.97	0.998
2003	257,119	4,076	8,965	501	20,010	0	65,337	77,752	259,173	10,877	200	986	**162,523**	0.96	0.998
2004	325,402	4,325	9,658	409	20,010	0	59,574	79,130	263,768	10,877	196	1,018	**222,649**	0.78	0.998
2005	280,303	3,901	7,482	492	20,010	0	58,026	82,165	273,882	10,877	202	918	**166,500**	0.94	0.998
2006	291,042	3,939	8,240	597	20,010	0	84,532	80,066	266,886	9,811	193	881	**210,655**	0.88	0.998
2007	332,607	4,113	4,370	257	20,010	0	25,024	100,487	334,955	10,877	231	1,004	**139,799**	0.98	0.998
2008	330,411	3,289	5,295	326	20,010	0	40,869	92,192	307,305	10,877	226	992	**172,989**	0.91	0.998
2009	325,619	3,101	5,981	320	20,010	0	36,319	89,055	296,849	10,877	210	927	**171,541**	0.89	0.998
2010	309,798	4,091	6,357	449	20,010	0	49,914	75,077	250,255	9,811	195	842	**204,591**	0.78	0.998
2011	289,878	3,795	10,289	609	20,010	0	80,050	74,028	246,759	9,811	189	770	**221,130**	0.81	0.998
2012	306,572	2,924	5,403	361	20,010	0	31,501	76,202	254,008	9,811	211	880	**178,064**	0.81	0.998
2013	320,442	3,799	2,289	269	20,010	0	23,112	91,699	305,664	10,877	215	1,035	**143,827**	0.94	0.998
2014	315,985	3,236	650	158	20,010	0	10,609	81,005	270,016	10,877	220	1,050	**149,490**	0.84	0.998
2015	247,415	2,654	0	267	20,010	0	32,134	66,472	221,573	9,242	201	975	**136,960**	0.89	0.997
2016	279,154	3,711	2,176	432	20,010	0	62,843	84,337	263,554	8,176	210	957	**179,767**	0.92	0.998
2017	259,765	3,413	4,729	712	20,010	0	118,001	85,258	230,351	8,887	197	926	**251,526**	0.86	0.998
2018	280,596	3,600	3,233	352	20,010	0	41,048	96,714	241,785	9,704	208	985	**192,870**	0.84	0.998
2019	278,025	4,360	2,176	671	20,010	0	116,543	73,672	245,573	9,704	204	971	**239,005**	0.86	0.998
Minimum	247,415	2,654	0	158	20,010	0	10,609	66,472	221,573	8,176	189	770	**136,960**	0.78	0.997
Maximum	332,607	4,515	13,463	712	20,010	0	118,001	100,487	334,955	10,877	231	1,050	**251,526**	0.98	0.998
Average	297,146	3,787	5,907	418	20,010	0	53,571	83,308	270,454	10,210	208	955	**182,319**	0.88	0.998

Table 7.14. Farmed Lands Annual Water Balance Results, 1999-2019.

Water Year	Inflows (af)				Outflows (af)						Change In Storage (af)	Performance Indicators		
	Deliveries	Precipitation	Shallow Groundwater Interception	Groundwater Pumping	Evapotranspiration of Applied Water	Evapotranspiration of Precipitation	Deep Percolation of Applied Water	Deep Percolation of Precipitation	Runoff of Precipitation	Tailwater		Deliveries (af/ac)	Surface Water Supply Fraction	Crop Consumptive Use Fraction
1999	272,561	89,625	6,670	7,897	174,788	44,417	36,879	10,190	34,678	81,768	-5,969	4.54	0.97	0.62
2000	292,251	117,770	6,670	8,180	186,442	41,658	39,586	9,824	61,189	87,675	-1,504	4.83	0.97	0.62
2001	280,748	91,445	6,670	7,759	177,693	40,247	36,875	7,774	39,131	84,224	678	5.12	0.97	0.62
2002	301,614	108,884	6,670	8,516	193,609	39,555	41,762	11,399	54,552	90,484	-5,676	4.98	0.97	0.62
2003	259,173	128,310	6,670	6,795	155,594	45,790	35,554	11,538	65,337	77,752	9,384	4.86	0.97	0.59
2004	263,768	104,745	6,670	7,613	175,397	32,474	37,936	10,100	59,574	79,130	-11,815	4.51	0.97	0.65
2005	273,882	126,103	6,670	8,086	166,980	47,272	39,338	12,286	58,026	82,165	8,675	4.68	0.97	0.59
2006	266,886	152,924	6,670	7,194	163,488	45,233	41,487	16,275	84,532	80,066	2,593	4.49	0.97	0.60
2007	334,955	65,618	6,670	9,924	214,396	34,051	40,454	3,272	25,024	100,487	-517	5.62	0.97	0.62
2008	307,305	83,278	6,670	8,840	197,828	34,521	39,123	6,854	40,869	92,192	-5,294	5.51	0.97	0.63
2009	296,849	81,788	6,670	8,370	189,401	34,893	39,141	4,799	36,319	89,055	69	5.07	0.97	0.62
2010	250,255	114,789	6,670	6,590	150,852	46,392	35,325	11,396	49,914	75,077	9,349	4.71	0.97	0.59
2011	246,759	156,015	6,670	6,818	157,211	51,076	39,857	17,542	80,050	74,028	-3,503	4.10	0.97	0.62
2012	254,008	92,494	6,670	7,484	161,902	49,346	32,163	8,922	31,501	76,202	620	4.84	0.97	0.62
2013	305,664	68,709	6,670	9,409	201,639	33,410	38,714	5,999	23,112	91,699	-4,121	5.06	0.97	0.64
2014	270,016	40,232	6,670	8,004	171,540	25,794	34,545	2,283	10,609	81,005	-855	5.49	0.97	0.62
2015	221,573	69,507	6,670	33,333	147,532	32,088	33,849	6,410	32,134	66,472	12,599	4.22	0.87	0.58
2016	263,554	116,031	6,670	13,498	164,761	39,729	39,455	10,026	62,843	84,337	-1,399	5.10	0.95	0.59
2017	230,351	187,255	6,670	6,441	138,034	43,245	38,682	15,882	118,001	85,258	-8,384	5.29	0.97	0.58
2018	241,785	86,903	6,670	6,339	135,847	34,835	32,866	6,062	41,048	96,714	-5,675	5.82	0.97	0.55
2019	245,573	175,090	6,670	6,880	147,449	41,383	39,910	13,580	116,543	73,672	1,677	5.13	0.97	0.58
Minimum	221,573	40,232	6,670	6,339	135,847	25,794	32,163	2,283	10,609	66,472	-11,815	4.10	0.87	0.55
Maximum	334,955	187,255	6,670	33,333	214,396	51,076	41,762	17,542	118,001	100,487	12,599	5.82	0.97	0.65
Average	270,454	107,501	6,670	9,237	170,113	39,877	37,786	9,639	53,571	83,308	-432	5.77	0.97	0.61

Characterization of Water Management and Performance

District

Monthly inflow and outflow patterns provide insight into water management at the district-scale, which is heavily influenced by water management for rice. The observed monthly patterns likely differ from individual fields, and reflect the full population of fields in the district.

Diversions begin in April or May and continue at relatively steady levels through August, decreasing in September as fields are drained for harvest. In October and November diversions again increase and continue through December to flood fields for rice straw decomposition and habitat. Diversions cease in January in preparation for the next year's crop.

Monthly ET generally follows the pattern of ET_o, increasing in the spring and summer as temperatures and available solar radiation increase and then decreasing in the winter. Actual ET rates are relatively similar to reference values due to the availability of adequate surface water supplies to support crop growth and relatively moist conditions throughout the growing season. Deep percolation and seepage are relatively constant over time due to the use of available surface water during the majority of the year, with deep percolation increasing somewhat in the winter as a result of precipitation and decreasing prior to planting and following harvest as a result of dry conditions. Surface outflows follow the general pattern of diversions, increasing during irrigation and winter flooding as a result of both irrigation and precipitation processes.

The monthly change in storage reflects rice growing and winter flooding as well, with water going into storage in April and May, remaining relatively constant in June and July, and coming out of storage as fields are drained in August and September. Storage then increases again October through December due to winter flooding and decreases in January through March in preparation for planting.

On a water year basis, substantial recharge of the groundwater system occurs as a result of the use of surface water within WCWD. It is estimated that approximately 21,000 af of groundwater recharge net of groundwater pumping and shallow groundwater interception occur annually within the district. Net recharge is somewhat limited due to shallow groundwater conditions in WCWD resulting in part from historical use of surface water and limited pumping. Approximately 27,000 af of shallow groundwater interception occurs annually. Groundwater interception supports the growth of native vegetation and provides base flow for streams and drains.

Comparing total inflows to WCWD to total outflows to meet consumptive irrigation demands plus recoverable flows available for use by others or the environment, a Water Management Fraction (WMF) may be calculated[7]. This indicator describes the amount of the total water supply not lost irrecoverably to evaporation from the canal and drain system (Equation 7.2).

[7] The WMF is based on methodologies to quantify the efficiency of agricultural water use developed by DWR (DWR 2012b) and has been broadened to include all beneficial ET as well as all water supplies.

$$Water\ Management\ Fraction = \frac{Evapotranspiration + Recoverable\ Flows}{Inflows} \quad [7.2]$$

Over the period from 1999 to 2019, the average WMF was 0.998, indicating that essentially all available water supply is used to meet irrigation demands or is recoverable for downstream surface water and groundwater uses.

Distribution and Drainage System

Inflows to the distribution and drainage system in the WCWD service area include diversions from the Thermalito Afterbay via the Western Main Canal and 374 Lateral; Gorrill Ranch diversions from Butte Creek; precipitation falling directly into canals and drains; runoff of precipitation from farmed lands; shallow groundwater interception; and tailwater inflows from farmed lands. Outflows include deliveries; surface outflows through the Butte Creek Spill, 501 Main Drain, DD100 drains, Little Dry Creek, and Cottonwood Creek; seepage; evaporation; and riparian ET.

The objective of WCWD operations is to meet the irrigation and environmental water demands of its customers. The water balance results indicate several characteristics of water management by WCWD and its customers. Comparing total deliveries to meet irrigation demand to diversions provides a measure of the effectiveness of system operation. A Delivery Fraction (DF), representing the ratio of deliveries to diversions may be calculated to provide an indicator of distribution and drainage system performance (Equation 7.3)[8].

$$Delivery\ Fraction = Deliveries/Diversions \quad [7.3]$$

The DF ranged from 0.78 to 0.98 between 1999 and 2019 with an overall average of 0.88. DF values increase as a result of limiting operational spillage and through recovery and reuse of available water in the system by WCWD and individual water users.

Farmed Lands

Inflows to the farmed lands include deliveries[9], groundwater pumping from private wells, and precipitation. Outflows include ET, tailwater, runoff of precipitation, and deep percolation. Additionally, as discussed previously, appreciable changes in stored water in the surface layer occur within the district as a result of rice production and winter flooding.

The objective of irrigation in WCWD is to meet crop and environmental water demands in the most effective and efficient manner practical. Like the distribution and drainage system water balance, the farmed lands water balance provides insight into water management by WCWD and growers.

[8] Although the surface water supply includes sources other than diversions (e.g., precipitation inflows), the DF is calculated to include only diversions as this is the portion of surface water supply directly managed by WCWD.

[9] As described previously, deliveries include direct deliveries by WCWD and reuse by WCWD and individual water users.

Comparing total surface water supply (other than precipitation falling on farmed lands) to total irrigation supply including groundwater pumping, a surface water supply fraction (SWSF) may be calculated as an indicator of the relative amount of the total irrigation supply derived from surface water (Equation 7.4).

$$Surface\ Water\ Supply\ Fraction = Deliveries\ /\ (Deliveries + Groundwater\ Pumping) \qquad [7.4]$$

The SWSF was approximately 0.97 between 1999 and 2019, demonstrating the reliability of and reliance on surface water supplies within WCWD. In the event of reduced surface water allocations due to surface water shortages, private groundwater pumping can be increased to some extent to minimize lost production, resulting in decreased SWSF for those years. The SWSF in 2015 was 0.87, and it is estimated that the SWSF in the shortage years of 1991 and 1992 was approximately 0.81; this indicates that surface water is the primary water source to meet demands even in years of reduced supply.

Comparing crop ET_{aw} to total irrigation supplies, a crop consumptive use fraction (CCUF) may be calculated as an indicator of the relative amount of applied irrigation water consumed to grow the crop (Equation 7.5) (DWR 2012b).

$$Crop\ Consumptive\ Use\ Fraction = Crop\ ET\ of\ Applied\ Water\ /\ (Deliveries + Groundwater\ Pumping) \qquad [7.5]$$

Between 1999 and 2019, the CCUF ranged from 0.55 to 0.65 with an overall average of 0.61. These CCUF values are calculated at the field scale and thus are not reflective of water reuse within the district. Based on estimated reuse of approximately 16,000 af of surface water by the district annually and 33,000 af of private reuse, the average CCUF at the district scale is estimated to be 0.73[10].

7.7.6 Water Management Objectives

Water management objectives (WMOs) vary depending on perspective. From a local, agricultural perspective, the objective of a water supplier is to provide water to customers for irrigation in a manner that supports optimal crop production. From a regional and statewide perspective, WMOs encompass broader goals to support long-term reliability of water supply, and to provide instream flows that benefit aquatic ecosystems.

WCWD's WMOs are to support the long term reliability, quality, and affordability of local surface water and groundwater supplies, and to provide the best service practical to the water users it supplies. WCWD is implementing a number of actions to support these WMOs, including:

- Implementation of a volumetric water rate to encourage on-farm water use efficiency
- Conjunctive management of surface water and groundwater to support the long-term reliability and quality of water supplies

[10] Estimated as annual ET_{aw}/(deliveries + groundwater pumping – district reuse*DF – other reuse).

- Implementing new technology to increase operational efficiency, including a:
    - Comprehensive water information system (WIS) that improves overall system management and incorporates tools for operational staff to support increased operational efficiency
    - FLOW Portal, an online platform that gives growers access to their delivery flow measurements in real-time in an effort to reduce farm tailwater

Section 7.9, "Efficient Water Management Practices and Water Use Efficiency," describes other actions that WCWD is doing, or planning to do in the coming years, to improve water system management, reduce water loss, and meet the District's management objectives.

The local, regional, and statewide WMOs that apply to the Feather River region as a whole are described in Volume I, Section 4.4 of this regional AWMP. Many WMOs are widely applicable due to the similarity in the nature of diversion agreements with the State among the primary water suppliers relying on the Feather River, and due to similarity in cropping and other factors that impact water uses and water system efficiency.

7.7.7 Water Use Efficiency

Water use efficiency is a core consideration in WCWD's operations. As stated above, WCWD's objectives are to support the long term reliability, quality, and affordability of local surface water and groundwater supplies, and to provide the best service practical to the water users it supplies. Efficient water use at all levels benefits this mission by conserving or utilizing water for maximal benefit to WCWD's customers, the environment, and downstream water users.

Key water use components and water use efficiency in WCWD are quantified in the sections below.

Water Use Efficiency Components

Four types of water use serve as the basis for water use efficiency calculations: crop water use, agronomic water use, environmental water use, and recoverable flows. These water use efficiency components are quantified in Table 7.15, and are described in the sections below.

<u>Crop Water Use</u>

Crop water use, or crop consumptive use, represents the portion of total applied water withdrawn by crops that is evaporated, transpired, incorporated into products or crops, or otherwise removed from the immediate water environment for consumptive use (ASCE, 2016).

In the water budget presented in this AWMP, crop water use of applied water is referred to as evapotranspiration of applied water (ET_{aw}). ET_{aw} is quantified as a portion of total crop ET using the IDC root zone water budget model, as described above in Section 7.7.3. Table 7.15 summarizes the ET_{aw} in WCWD in the last five water years (2015-2019). In addition to ET_{aw} from farmed lands, a small amount of riparian evapotranspiration is included (approximately 200 af per year).

Table 7.15. Water Use Efficiency Components.

Water Use Efficiency Component	Water Year Volume (Surface Water Allotment), af/year					
	2015 (Curtailed)	2016 (Full)	2017 (Full)	2018 (Full)	2019 (Full)	Average
Crop Consumptive Use (ET_{aw}, Riparian ET[1])	147,733	164,970	138,230	136,056	147,653	**146,928**
Agronomic Use[2]	67,509	11,618	16,476	32,798	20,563	**29,793**
Environmental Use[3]	15,750	22,350	10,500	12,100	13,000	**14,740**
Recoverable Flows of Total Water Supply						
Recoverable Surface Flows (Deliveries Less ET_{aw}[4], Boundary Outflows)	227,392	269,476	334,630	296,984	344,201	**294,537**
Other Recoverable Flows (Canal Seepage)	9,242	8,176	8,887	9,704	9,704	**9,143**
Total Recoverable Flows	236,634	277,651	343,517	306,689	353,905	**303,679**

[1] In additional to crop consumptive use, a small amount of water is consumptively used by riparian vegetation (approximately 200 af per year).
[2] Agronomic use for rice straw decomposition.
[3] Winter deliveries for managed wildlife habitat.
[4] Applied irrigation water is either consumptively used by crops as ET_{aw}, or available as recoverable flows to surface water (tailwater) or as recoverable flows to groundwater (deep percolation of applied water). As some water is reused internally within the WCWD canals to support deliveries, the total deliveries (less ET_{aw}) are summarized under recoverable surface flows.

Agronomic Water Use

Agronomic water use in WCWD represents the portion of total applied water that is directly used for crop cultivation practices, but that is not consumed by crops (i.e., excluding ET_{aw}). Sample agronomic water uses include water used for seedbed preparation, pest control, salt leaching, and climate control.

In WCWD, agronomic water use mainly includes winter deliveries for rice straw decomposition. A majority of the rice fields in WCWD are flooded following harvest to aid in rice straw decomposition. The volume of applied water that is used to support this agronomic purpose is estimated as the deliveries and reuse during the October to March period, calculated as the water balance closure in those months. Deliveries are typically near zero between February and March. These deliveries also help to create winter habitat for migratory birds and other species along the Pacific Flyway. The estimated agronomic water uses for rice straw decomposition are summarized in Table 7.15.

Surface water diverted from the Feather River is of very high quality, with low salinity and low TDS, resulting in generally low leaching requirements for the crops grown in the District. Considering the low salinity of surface water supplied by WCWD, the leaching that results from winter precipitation, and the crop-specific leaching requirements of crops found in the District's service area, it was assumed that no appreciable salt leaching is required in WCWD.

Likewise, agronomic water use for frost protection was assumed to be negligible. Rice is the predominant crop cultivated in WCWD. Freezing temperatures typically occur during the fall and winter decomposition period, outside the growing season, precluding the need for frost protection. Crops that may require frost protection are not cultivated across appreciable acreage in WCWD. Therefore, it was also assumed that no appreciable frost protection is required in WCWD.

Environmental Water Use

In WCWD, environmental water use includes winter deliveries that support wildlife habitat.

As described in Section 7.7.3, the WCWD service area includes approximately 6,500 acres of wetland and riparian habitat, including portions of the CDFW Upper Butte Basin Wildlife Area and the USFWS North Central Valley Wildlife Management Area. WCWD also provides water for habitat to a portion of the Llano Seco Unit of the Sacramento National Wildlife Refuge and to several private duck clubs both inside and outside of its boundary.

The estimated environmental water uses for managed wildlife habitat are summarized in Table 7.15. WCWD records the volume of water released to Butte Creek for use by duck clubs downstream of the District boundaries, based on a 1922 agreement.

Recoverable Flows

The portion of total water supply that is neither consumed by crops nor evaporated from the distribution system is recoverable for other beneficial uses within WCWD, downstream of WCWD, or from the groundwater basins underlying those areas.

Inflows to WCWD are either evaporated from the distribution and drainage system, consumptively used by crops as ET_{aw}, or are recoverable flows to surface water or to groundwater and, as such, available for later use. A significant volume of tailwater, runoff, and other supplies are reused within the WCWD canals to support deliveries. To account for these total recoverable supplies within WCWD, the total deliveries, not consumed as ET_{aw}, plus the total boundary outflows from WCWD are included as recoverable surface flows. Other recoverable flows include seepage from canals to the groundwater system. Table 7.15 summarizes the combined recoverable flows from WCWD.

Water Use Efficiency Fraction

The water use efficiency fraction most applicable to WCWD is the water management fraction (WMF). As depicted in Figure 7.3 and discussed previously, interconnection exists between the accounting centers due to recapture and reuse of water by both WCWD and by individual water users. The District also provides significant volumes of surface water to support environmental uses and other downstream users through deliveries, boundary outflows, and seepage. These outflows are available for beneficial use outside the District's service area. This total water recovery and reuse results in higher levels of aggregate performance than would otherwise occur.

The water management fraction (WMF) can be calculated by comparing the consumptive use of applied water (ET_{aw}) and all recoverable flows in the WCWD service area to the total water supplies available within WCWD. The WMF is calculated on an annual basis at the water supplier scale according to Equation 7.2 (see Section 7.7.5), using the water volumes reported in Table 7.15.

Over the 2015 to 2019 period, the WMF averaged more than 0.99 (99 percent) (Table 7.16). This high WMF indicates that essentially all of WCWD's water supply is used to meet irrigation demands or is recoverable for beneficial use by down gradient surface water and groundwater users. The only water budget flow path that is not recoverable or consumed by crops in WCWD is evaporation from the distribution and drainage system.

Table 7.16. Water Management Fraction.

Year[1]	ET_{aw}[1] (af/year)	Recoverable Flows[2] (af/year)	Inflows[3] (af/year)	Water Management Fraction
2015	147,733	236,634	385,342	0.997
2016	164,970	277,651	443,579	0.998
2017	138,230	343,517	482,673	0.998
2018	136,056	306,689	443,730	0.998
2019	147,653	353,905	502,529	0.998
Average	146,928	303,679	451,571	0.998

[1] In additional to crop consumptive use on farmed lands, a small amount of water is consumptively used by riparian vegetation (approximately 200 af per year).

[2] Total recoverable flows summarized in Table 7.15.

[3] Total inflows to the WCWD distribution and drainage system, summarized in Table 7.13.

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7.8 Climate Change

Climate change has the potential to directly impact surface water resources in the Feather River region and to indirectly impact groundwater resources. Due to the similarity in the nature of diversion agreements with the State among the primary water suppliers relying on the Feather River and due to similarity in cropping, climate, soils, and other factors, potential effects of climate change, impacts on water management, and actions by individual suppliers or through regional coordination to help mitigate future impacts are described for the region as a whole in Volume I, Section 5 of this regional AWMP. In particular, the following are discussed:

- Potential effects of climate change within the region;
- Resulting potential impacts on water resources including water supply, water demand, water quality, and flood control;
- Ongoing and potential future actions to help mitigate future impacts; and
- Additional resources regarding water resources planning to address climate change.

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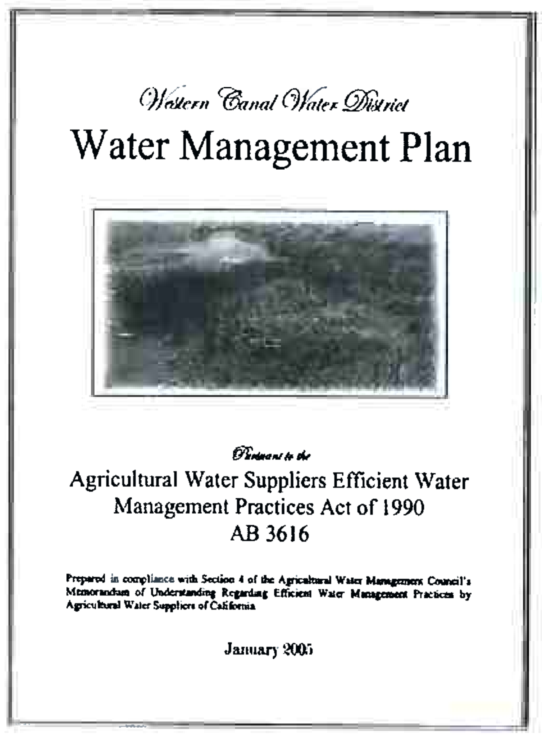
7.9 Efficient Water Management Practices and Water Use Efficiency

7.9.1 Efficient Water Management Practices

WCWD seeks to efficiently manage available water supplies to meet water management objectives, considering operational and financial constraints. WCWD implements technically feasible efficient water management practices (EWMPs) described in the California Water Code (CWC §10608.48) at locally cost-effective levels. Existing and planned water management activities related to each of the EWMPs are summarized in Table 7.17. Water use efficiency improvements achieved through these activities may include increased local, regional, and statewide water supplies and water supply reliability; increased local flexibility; increased in-stream flow; improved water quality; and improved energy efficiency.

Notable water management actions that WCWD has implemented include the following:

- Voluntary preparation and adoption of an AB3616 AWMP in 2005 as a member of the Agricultural Water Management Council (AWMC).
- Longstanding implementation of customer delivery measurement program and volumetric pricing structure, which encourages efficient on-farm water usage;
- Development and implementation of a water information system (WIS) to streamline operational and delivery measurement data collection and management;
- Implementation of FLOW Portal providing growers real-time access to delivery status and water use;
- Provision of flexible deliveries for the range of crops grown and irrigation methods employed;
- Support of on-farm physical and management improvements;
- Automation of control structures along the Western Main Canal, with further automation planned for the future;
- Recovery of drain water into the distribution system for reuse at two locations;
- Promotion of on-farm financing programs and water management services;
- Monitoring operational spillage at key sites in the distribution system multiple times daily;
- Monitoring drain outflows to improve understanding of District's water budget


Western Canal Water District
Water Management Plan

Pursuant to the
Agricultural Water Suppliers Efficient Water Management Practices Act of 1990
AB 3616

Prepared in compliance with Section 4 of the Agricultural Water Management Council's Memorandum of Understanding Regarding Efficient Water Management Practices by Agricultural Water Suppliers of California

January 2005

WCWD 2005 AWMP.

with planned improvements to provide real-time access to improve operations.

- Evaluation of water management opportunities through a rapid appraisal of opportunities to modernize facilities for water conservation and improved water management performed by the Irrigation Training and Research Center (ITRC) at Cal Poly San Luis Obispo (ITRC 2006);
- Evaluation of opportunities and associated cost to recover and reuse additional drain water through a study performed by MBK Engineers (MBK 2004);
- Evaluation of opportunities to further improve service through automation of control structures, drain water recovery, and flow measurement and telemetry in key locations; and
- Ongoing coordination with DWR operations and other water management entities to evaluate and improve policies to allow for more flexible deliveries and storage.

As part of this plan, reconnaissance level cost estimates have been prepared for potential future water management improvements identified during field inspections and consultations with WCWD staff. Additionally, potential benefits of the improvements have been estimated. These improvements could be implemented over time as determined to be locally cost effective. Alternatively, these projects could be implemented to meet regional and statewide water management objectives. The evaluation of potential water management improvements is included in Section 7.10.4.

Implementation of improvements must consider the nature of water management in the region, whereby water not consumed is available for reuse by downstream water users and the environment. At this time, there is no incentive for the district to implement projects that are not locally cost effective but would result in conserved water remaining in storage. To the extent that such water can be released to increase overall water supplies or to meet timing and water quality objectives, these benefits are realized regionally or statewide by other water users such as State Water Project contractors, providing no direct benefit to the district.

Table 7.17. EWMP Implementation Status.

Water Code Reference No.	EWMP	Implementation Status	Implemented Activities	Planned Activities
Critical (Mandatory) Efficient Water Management Practices				
10608.48.b(1)	Measure the volume of water delivered to customers with sufficient accuracy to comply with subdivision (a) of Section 531.10 and to implement paragraph (2).	Being Implemented	• WCWD has implemented a delivery measurement program with approximately 300 propeller meters that satisfies the requirements of CCR 23 §597. • WCWD invested in the development and implementation of a water information system (WIS) to streamline delivery and operational measurement data collection and management. It utilizes field computers to record measurement data and automatically transmit it to a custom database in the district office. The database is used to quality control, process, and store data from the measurement program so that it can be disseminated to district operators and customers in near real time.	• Continue implementation of delivery measurement program, including meter maintenance, testing and calibration, and replacement. • Continue use and enhancement of WIS.
10608.48.b(2)	Adopt a pricing structure for water customers based at least in part on quantity delivered.	Being Implemented	• WCWD's pricing is based directly on the quantity of water delivered; minimum charges apply. • WCWD's WIS will allow for automation of billing processes and support provision of real time information on water use and cost to customers. • Implemented automated billing system to interface with WIS.	• Continue to use pricing structure based on quantity of water delivered. • Continue using automated billing system to interface with WIS.
Additional (Conditional) Efficient Water Management Practices				
10608.48.c(1)	Facilitate alternative land use for lands with exceptionally high water duties or whose irrigation contributes to significant problems, including drainage.	Not Technically Feasible	Lands with exceptionally high water duties or whose irrigation contributes to significant problems are not found within the district. Furthermore, WCWD's rules and regulations prohibit wasteful use of water, preventing exceptional water duties or significant problems from occurring. Water applied but not consumed to produce crops provides beneficial groundwater recharge or is available for downstream uses.	
10608.48.c(2)	Facilitate use of available recycled water that otherwise would not be used beneficially, meets all health and safety criteria, and does not harm crops or soils	Not Technically Feasible	There is no available water from municipal or industrial uses within WCWD that meets all health and safety criteria.	
10608.48.c(3)	Facilitate financing of capital improvements for on-farm irrigation systems	Being Implemented	• The district provides at-cost labor and materials to assist landowners in improving on-farm irrigation systems. • WCWD promotes on-farm programs that finance improvements and promote the environment through NRCS, APEP, and others.	• Continue to provide at-cost labor and materials for on-farm improvements, as resources allow. • Continue to promote available on-farm financing and other programs.

Water Code Reference No.	EWMP	Implementation Status	Implemented Activities	Planned Activities
10608.48.c(4)	Implement an incentive pricing structure that promotes one or more of the following goals: (A) More efficient water use at farm level, (B) Conjunctive use of groundwater, (C) Appropriate increase of groundwater recharge, (D) Reduction in problem drainage, (E) Improved management of environmental resources, (F) Effective management of all water sources throughout the year by adjusting seasonal pricing structures based on current conditions.	Being Implemented	• WCWD's pricing structure promotes goal A by charging based on volume delivered, and WCWD promotes goal A by providing growers with real-time access to water delivery status and water use through the FLOW Portal. • The district's water rates promote goals B and C by encouraging the use of available surface water supplies, which provides beneficial groundwater recharge through deep percolation. Groundwater is then available in years of surface water shortage while maintaining long term sustainability of the groundwater system. • WCWD water rates promote goal E by providing a reliable, affordable source of water to maintain both public and private wetlands and aquatic habitat, including winter flooding of rice fields. Among other species, wetlands within the district provide habitat for the Giant Garter Snake, a federally threatened species.	• Continue to promote goals A, B, C, and E through current water rates and other water management activities.
10608.48.c(5)	Expand line or pipe distribution systems, and construct regulatory reservoirs to increase distribution system flexibility and capacity, decrease maintenance and reduce seepage	Not Locally Cost Effective	• A regulating reservoir would provide limited benefit, as the district is directly adjacent to Thermalito Afterbay and receives relatively steady deliveries from DWR, which limits the benefit a regulating reservoir could provide. Rather, WCWD is increasing flexibility through automation of primary control structures to provide increased flexibility in operating the distribution system. • Soil conditions in the district result in very low seepage rates that would not be substantially reduced through concrete lining and pipeline conversion of existing canals. Any seepage reduction would reduce beneficial groundwater recharge. As a result, lining and pipeline conversion are not locally cost effective.[11]	• None at this time.

[11] Comparison of metered diversions to metered deliveries made possible in 2015 through development and implementation of the WIS supports prior estimates of seepage that are less than 5%.

Water Code Reference No.	EWMP	Implementation Status	Implemented Activities	Planned Activities
10608.48.c(6)	Increase flexibility in water ordering by, and delivery to, water customers within operational limits	Being Implemented	• WCWD provides a high degree of flexibility to customers by providing orders typically within the day of the request, always within 24 hours. • The district delivery measurement program results in improved water ordering and delivery to meet customer demands. • WCWD has automated control structures along the Western Main Canal in order to reduce delivery variability. Most recently automated the Nelson Check structure during Winter 2015-2016. • WCWD evaluated opportunities to further improve service through increased automation and implementation of additional flow measurement and SCADA. • As part of the WIS, WCWD provides district operators and customers access to real-time measurement data through an online interface.	• Continue current practices to provide flexibility in ordering and delivery. • Explore options and proceed with automation, flow measurement, and SCADA improvements, contingent on availability of funding and project prioritization. Likely next major projects include the 634 and 1115 check structures. • Continue to provide landowners and growers with access to real-time delivery measurement data through an online interface.
10608.48.c(7)	Construct and operate supplier spill and tailwater recovery systems	Being Implemented	• Drain water recovery by gravity into the distribution system for reuse is currently accomplished in two locations by WCWD. • Evaluated drain water recovery at three additional locations. • Evaluated flow measurement and SCADA capabilities at five key tailwater outflow and drain water recovery sites. • Monitored drain outflow at four key locations: 501 Main Drain, Little Dry Creek, Butte Creek Spill, and Drain 100 during the last five irrigation seasons (2016-2020). • Operational spillage is currently monitored multiple times daily at key locations. • Reporting spill reduction for Nelson Check.	• Continue drain water recovery into the distribution system for reuse. • Explore options and proceed with automation, flow measurement, and SCADA improvements, contingent on availability of funding and project prioritization. • Continue to monitor drain outflows; awaiting decision from the USBR for potential cost-share to setup a District SCADA system and integrate boundary outflow sites.
10608.48.c(8)	Increase planned conjunctive use of surface water and groundwater within the supplier service area	Being Implemented	• An adequate amount of surface water is available for irrigation in most years. During shortage years, groundwater is used conjunctively with reduced surface water supplies to meet demand. • Shortage allocation policies are designed to facilitate the conjunctive use of groundwater in surface water shortage years. • WCWD works in coordination with Butte County, Glenn County, and DWR to monitor and report groundwater levels within its service area. • The district is actively involved in implementation of the Sustainable Groundwater Management Act (SGMA) and works collaboratively with the County, GSAs, and other interested parties to implement the Act.	• Continue usage of surface water when available and conjunctive use of surface water and groundwater during periods of shortage to meet demand. • Continue implementation of SGMA, including active participation in ongoing GSP development and exploring the option of increasing conjunctive use to increase water supply reliability.

Water Code Reference No.	EWMP	Implementation Status	Implemented Activities	Planned Activities
10608.48.c(9)	Automate canal control structures	Being Implemented	• WCWD has automated four control structures along the Western Main Canal. • WCWD has evaluated automation of additional canal control structures.	• Automation for the 634 and 1115 check structures is planned, dependent on funding. • Explore options and proceed with automation of canal control structures, contingent on availability of funding and project prioritization.
10608.48.c(10)	Facilitate or promote customer pump testing and evaluation	Being Implemented	• WCWD promotes available programs regarding pump testing and evaluation through communication with landowners and growers. • The district requires flowmeters on private wells that pump water into the distribution system during shortage years, supporting evaluation of pump performance. • WCWD provides at-cost meter repairs and installation, which facilitates evaluation of pump performance.	• Continue promoting customer pump testing and evaluation through available programs. • Continue to provide at-cost meter repairs and installation.
10608.48.c(11)	Designate a water conservation coordinator who will develop and implement the water management plan and prepare progress reports.	Being Implemented	• WCWD's Special Projects Manager serves as water conservation coordinator and is responsible for implementing AWMP.	• Special Projects Manager will continue to serve as water conservation coordinator.
10608.48.c(12)	Provide for the availability of water management services to water users.	Being Implemented	• WCWD communicates with landowners and growers regarding reports, regulations, drought information, and other water management topics of interest through letters, email, internet, social media, Northern California Water Association (NCWA) and other forms of communication. • The district promotes awareness of water management services such as CIMIS and federal conservation programs (e.g. EQIP). • WCWD provides at-cost labor and materials for on-farm improvements, subject to resource availability. • The district is developing a program to provide periodic electronic updates on water use to landowners and growers during the irrigation season. • As part of WIS development and implementation, WCWD provides customers with access to real-time delivery measurement data through an online interface (FLOW Portal).	• Continue communicating with landowners and growers regarding documents and regulations of interest to landowners and growers. • Continue promoting available water management services. • Continue to provide at-cost labor and materials for on-farm improvements. • Continue to provide landowners and growers with access to real-time delivery measurement data.

Water Code Reference No.	EWMP	Implementation Status	Implemented Activities	Planned Activities
10608.48.c(13)	Evaluate the policies of agencies that provide the supplier with water to identify the potential for institutional changes to allow more flexible water deliveries and storage.	Being Implemented	• Conducts ongoing interactions with DWR SWP operations (e.g. biweekly meetings during drought seasons and quarterly during non-drought years). • WCWD is a voluntary participant in ACWA, CFWC, NCWA, DWR ASC, and Butte and Glenn County Water Advisory Committees. • WCWD participated in the SVIRWMP and is a voluntary participant in the NSVIRWMP and the FRRAWMP. • WCWD participates in regional water management discussions between Feather River water suppliers and state and federal agencies. • The district is implementing the Sustainable Groundwater Management Act (SGMA) as a party to a Cooperation Agreement and by collaborating with other interested parties.	• Continue interactions with DWR SWP operations. • Continue to evaluate policies of agencies that provide WCWD with water. • Continue to participate in local, regional, and statewide water management groups and initiatives. • Continue to implement SGMA.
10608.48.c(14)	Evaluate and improve the efficiencies of the supplier's pumps.	Not Technically Feasible	WCWD does not own or operate any pumps.	

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7.9.2 Evaluation of Water Use Efficiency Improvements

CWC §10608.48(d) requires that AWMPs include:

> *... a report on which efficient water management practices have been implemented and are planned to be implemented, an estimate of the water use efficiency improvements that have occurred since the last report, and an estimate of the water use efficiency improvements estimated to occur five and 10 years in the future.*

A description of EWMPs that have been implemented by WCWD has been provided previously in Section 7.9.1. This section provides an evaluation of EWMP implementation and an estimate of water use efficiency (WUE) improvements that have occurred in the past and are expected to occur in the future.

The value of evaluating water use efficiency (WUE) improvements (and EWMP implementation in general) from WCWD's perspective is to identify what the benefits of EWMP implementation are and to identify those additional actions that hold the potential to support and advance the district's water management objectives. WCWD's water management objectives include the long term reliability, quality, and affordability of local surface water and groundwater supplies and providing the best service practical to water users it supplies. To that end, WCWD has taken action to develop and maintain reliable surface water and groundwater supplies, to prevent or reduce losses from the distribution system in order to increase operational efficiency, to promote the efficient use of water at the farm level, and to meet changing environmental and other demands that affect the flexibility with which the district can divert and deliver water. WCWD's water management activities are consistent with these objectives and have resulted in local and statewide benefits.

First and foremost among the issues that must be considered in any evaluation of the benefits of EWMP implementation and resulting WUE improvements is how water management actions affect the water balance (Davenport and Hagan, 1982; Keller, et al., 1996; Burt, et al., 2008; Clemmens, et al., 2008; Canessa, et al., 2011). Accordingly, any evaluation of EWMP implementation and WUE improvements for WCWD must consider how water balance changes relate to the district's water management objectives. For example, flows to deep percolation and seepage that could be considered losses in some settings are critical to maintain the long-term sustainability of the underlying groundwater basin. Reductions in these flows resulting from EWMP implementation could be considered WUE improvements at the farm or district scale, but have the consequential effect of diminishing recharge of the underlying groundwater system. Other flows that could be considered losses at the farm or district scale such as spillage and tailwater are also recoverable. For example, spillage from the WCWD distribution and drainage systems is available for beneficial use by downgradient water users. The only distribution and drainage system or on-farm losses that are not recoverable within the WCWD service area, the underlying groundwater basin, or the Feather River region as a whole are canal and drain water surface evaporation and evaporation from irrigation application. These components represent a small portion of WCWD's water supply (less than one percent as indicated in Table 3.13). An implication of this is that very little "new" water can be made available through water conservation in WCWD's service area to increase the

State's overall water supply; however, there may be opportunities to change the timing and amount of water used to meet local, regional, or statewide objectives, as discussed in Volume I, Section 3 of this AWMP.

An important step in evaluating EWMP implementation and water use efficiency improvements is a comprehensive, quantitative, multi-year water balance (see Section 3.7). The quantitative understanding of water use enables identification of targeted flow paths for WUE improvements, along with improved understanding of the beneficial impacts and consequential effects of EWMP implementation at varying spatial and temporal scales. The water balance enables evaluation of potential changes in water use amounts and timing for any given change in water management.

Even where comprehensive, multi-year water balances have been developed, evaluating water balance impacts and WUE improvements is not a trivial task. Issues of spatial and temporal scale and relatively small changes in flow paths resulting from many water management improvements (relative to day to day and year to year variation in water diversions and use) coupled with inaccuracies inherent in even the best water measurement complicate the evaluation of water balance impacts. The implications of recoverable and irrecoverable losses at varying scales complicate the evaluation of WUE improvements, and consequential, potentially unintended effects must be considered.

As part of assembling this AWMP, WCWD has identified the targeted flow paths associated with implementation of each EWMP, the water management benefits of each EWMP and the potential consequential effects of implementation. A brief discussion of the benefits associated with implementation of each EWMP is provided, along with a brief discussion of consequential effects that must be considered. A summary of targeted flow paths, impacts, and consequential effects associated with implementation of each EWMP by WCWD is provided in Table 7.18.

Table 7.18. Summary of Targeted Flow Paths, Impacts, and Consequential Effects Associated with EWMP Implementation.

Water Code Reference No.	EWMP	Implementation Status	Targeted Flow Path(s)	Benefits	Consequential Effects	Notes (See End of Table)
10608.48.b (1)	Measure the volume of water delivered to customers with sufficient accuracy.	Being Implemented	Deliveries, Spillage, Tailwater, Diversions, Drainage Outflows	Delivery measurement can encourage efficient on-farm water use, and has the potential to lead to reduced deliveries, dependent on pricing. Reduced deliveries result in reduced diversions, which result in corresponding reductions in spillage and drainage outflows. Available water not diverted remains in storage and can improve local supply reliability or could potentially be available for transfer. Additionally, water quality benefits may occur through reduced tailwater outflow.	Increased on-farm water use efficiency results in reduced tailwater available for reuse by downstream water users. For crops other than rice, increased on-farm efficiency results in reduced beneficial recharge to the groundwater system through deep percolation.	1
10608.48.b (2)	Adopt a pricing structure based at least in part on quantity delivered.	Being Implemented	Deliveries, Spillage, Tailwater, Diversions, Drainage Outflows	Volumetric pricing may result in increased efficiency of on-farm water use, which has the potential to lead to reduced deliveries. Reduced deliveries result in reduced diversions, which result in corresponding reductions in spillage and drainage outflows. Available water not diverted remains in storage and can improve local supply reliability or could potentially be available for transfer. Additionally, water quality benefits may occur through reduced tailwater outflow.	Increased on-farm water use efficiency results in reduced tailwater available for reuse by downstream water users. For crops other than rice, increased on-farm efficiency results in reduced beneficial recharge to the groundwater system through deep percolation.	1
10608.48.c (1)	Facilitate alternative land use for lands with exceptionally high water duties or whose irrigation contributes to significant problems, including drainage.	Not Technically Feasible	Not Applicable	Not Applicable	Not Applicable	2
10608.48.c (2)	Facilitate use of available recycled water that otherwise would not be used beneficially, meets all health and safety criteria, and does not harm crops or soils.	Not Technically Feasible	Not Applicable	Not Applicable	Not Applicable	2
10608.48.c (3)	Facilitate financing of capital improvements for on-farm irrigation systems.	Being Implemented	Deliveries, Spillage, Tailwater, Diversions, Groundwater Pumping, Drainage Outflows	Assisting in on-farm improvements through the provision of at-cost labor and materials can result in reduced deliveries due to increased delivery efficiency and/or reduced tailwater and, in some cases, deep percolation. Reduced deliveries result in reduced diversions, which result in corresponding reductions in spillage and drainage outflows. Available water not diverted remains in storage and can improve local supply reliability or could potentially be available for transfer. Additionally, water quality benefits may occur through reduced tailwater outflow.	Increased on-farm water use efficiency results in reduced tailwater available for reuse by downstream water users. For crops other than rice, increased on-farm efficiency results in reduced beneficial recharge to the groundwater system through deep percolation. Reduced operational spillage, tailwater, and drainage outflows result in reduced water available downstream for beneficial use for agriculture or the environment.	1

Water Code Reference No.	EWMP	Implementation Status	Targeted Flow Path(s)	Benefits	Consequential Effects	Notes (See End of Table)
10608.48.c (4)	Implement an incentive pricing structure that promotes one or more of the following goals: (A) More efficient water use at farm level, (B) Conjunctive use of groundwater, (C) Appropriate increase of groundwater recharge, (D) Reduction in problem drainage, (E) Improved management of environmental resources, (F) Effective management of all water sources throughout the year by adjusting seasonal pricing structures based on current conditions.	Being Implemented	Varies	Volumetric pricing promotes goal (A), resulting in on-farm benefits as described for the volumetric pricing EWMP (10608.48.b(2)). Provision of surface water at lower rates than the cost of groundwater pumping incentivizes goals (B) and (C) and improves the reliability of regional water supplies while maintaining and enhancing ecosystems. Provision of water at affordable rates incentivizes goal (E) by offering a reasonably priced, reliable source of water to maintain both public and private waterfowl habitat and wetlands, including winter flooding of rice fields.	Consequential effects of volumetric pricing are the same as described for the volumetric pricing EWMP (10608.48.b(2)).	1
10608.48.c (5)	Expand line or pipe distribution systems, and construct regulatory reservoirs to increase distribution system flexibility and capacity, decrease maintenance and reduce seepage.	Not Locally Cost Effective	Deliveries, Spillage, Tailwater, Deep Percolation, Seepage, Diversions, Drainage Outflows	Benefits of lining, pipeline, and regulating reservoirs are reductions in losses such as seepage, operational spillage, and drainage outflows. In addition, regulating reservoirs provide improved consistency in deliveries, potentially providing a modest reduction in on-farm deliveries due to reduced tailwater and, in some cases, deep percolation and tailwater. Due to the proximity of the district's system to Thermalito Afterbay and heavy soils, which limit seepage losses, these benefits do not outweigh the costs at this time. Water quality benefits may occur through reduced tailwater outflow.	Reduced seepage and deep percolation result in reduced beneficial recharge of the underlying groundwater system. Reduced operational spillage, tailwater, and drainage outflows result in reduced water available downstream for beneficial use for agriculture or the environment.	1
10608.48.c (6)	Increase flexibility in water ordering by, and delivery to, water customers within operational limits.	Being Implemented	Deliveries, Spillage, Tailwater, Deep Percolation, Diversions, Drainage Outflows	Flexible water ordering and deliveries result in reduced operational spillage, tailwater, and, in some cases, seepage and deep percolation. It can also result in a modest reduction in deliveries due to on-farm reductions in tailwater and deep percolation. System improvements result in greater operational efficiency and reductions in spillage. Additionally, water quality benefits may occur through reduced tailwater outflow. In aggregate, reduced losses (both on-farm and at the district level) can lead to reduced deliveries and reduced diversions. Available water not diverted remains in storage and can improve local supply reliability or could potentially be available for transfer.	Increased on-farm water use efficiency results in reduced tailwater available for reuse by downstream water users. For crops other than rice, increased on-farm efficiency results in reduced beneficial recharge to the groundwater system through deep percolation. Reduced operational spillage, tailwater, and drainage outflows result in reduced water available downstream for beneficial use for agriculture or the environment.	1
10608.48.c (7)	Construct and operate supplier spill and tailwater recovery systems.	Being Implemented	Deliveries, Spillage, Tailwater, Diversions, Drainage Outflows	Reuse of operational spillage and tailwater results in decreased required diversions. Available water not diverted remains in storage and can improve local supply reliability or could potentially be available for transfer. Additionally, water quality benefits may occur through reduced tailwater outflow.	Reduced operational spillage, tailwater, and drainage outflows result in reduced water available downstream for beneficial use for agriculture or the environment. Tailwater may be of diminished quality as compared to other available water supplies. Spillage and tailwater recovery using pumps requires the use of electricity or fuel as a component, increasing energy demand.	1

Water Code Reference No.	EWMP	Implementation Status	Targeted Flow Path(s)	Benefits	Consequential Effects	Notes (See End of Table)
10608.48.c (8)	Increase planned conjunctive use of surface water and groundwater within the supplier service area.	Being Implemented	Diversions, Deliveries, Deep Percolation, Groundwater Pumping	Conjunctive management provides multiple benefits: • Maintain local and statewide water supply reliability • Enhance aquatic and wetlands ecosystems • Reduce energy requirements for irrigation	Not Significant	1
10608.48.c (9)	Automate canal control structures.	Being Implemented	Deliveries, Spillage, Tailwater, Diversions, Drainage Outflows	Automation results in reduced operational spillage and reduced deliveries due to increased delivery efficiency, which reduces on-farm tailwater and, in some cases, deep percolation. Reduced deliveries result in reduced diversions, which results in corresponding reductions in spillage and drainage outflows. Available water not diverted remains in storage and can improve local supply reliability or could potentially be available for transfer. Additionally, water quality benefits may occur through reduced tailwater outflow.	Increased on-farm water use efficiency results in reduced tailwater available for reuse by downstream water users. For crops other than rice, increased on-farm efficiency results in reduced beneficial recharge to the groundwater system through deep percolation. Reduced operational spillage, tailwater, and drainage outflows result in reduced water available downstream for beneficial use for agriculture or the environment.	1
10608.48.c (10)	Facilitate or promote customer pump testing and evaluation.	Being Implemented	None	Improved pumping efficiency by WCWD's customers results in decreased energy demand and reduced pumping costs for customers. There are no direct benefits to WCWD.	Not Significant	
10608.48.c (11)	Designate a water conservation coordinator who will develop and implement the water management plan and prepare progress report.	Being Implemented	Varies	See Comment	See Comment	3
10608.48.c (12)	Provide for the availability of water management services to water users.	Being Implemented	Deliveries, Spillage, Tailwater, Diversions, Groundwater Pumping, Drainage Outflows	Promoting available water management services can increase efficiency of on-farm water use, which has the potential of leading to reduced deliveries. Reduced deliveries result in reduced diversions, which result in corresponding reductions in spillage and drainage outflows. Available water not diverted remains in storage and can improve local supply reliability or could potentially be available for transfer. Additionally, water quality benefits may occur through reduced tailwater outflow.	Increased on-farm water use efficiency results in reduced tailwater available for reuse by downstream water users. For crops other than rice, increased on-farm efficiency results in reduced beneficial recharge to the groundwater system through deep percolation. Reduced operational spillage, tailwater, and drainage outflows result in reduced water available downstream for beneficial use for agriculture or the environment.	1
10608.48.c (13)	Evaluate the policies of agencies that provide the supplier with water to identify the potential for institutional changes to allow more flexible water deliveries and storage.	Being Implemented	Diversions	Increased flexibility and storage for the surface water supply could result in reductions in losses to operational spillage, tailwater, and drainage outflows. Additionally, water quality benefits may occur through reduced tailwater outflow.	Reduced operational spillage, tailwater, and drainage outflows result in reduced water available downstream for beneficial use for agriculture or the environment.	1
10608.48.c (14)	Evaluate and improve the efficiencies of the supplier's pumps.	Not Technically Feasible	Not Applicable	Not Applicable	Not Applicable	4

Notes:
1. WCWD works to balance tradeoffs between incentivizing water conservation (both districtwide and on-farm) and maintaining long-term surface water and groundwater reliability.
2. Such conditions do not exist in WCWD. As a result, it is not technically feasible to implement this EWMP.
3. Implementation of the AWMP by WCWD's water conservation coordinator and other staff as appropriate is the mechanism by which all EWMPs are implemented and targeted benefits are realized.
4. WCWD does not own or operate any pumps.

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WUE definitions vary. For purposes of evaluating WUE improvements associated with EWMP implementation by WCWD, specific WUE improvement categories or objectives have been identified that correspond to each EWMP. Potential WUE improvements include reduction of irrecoverable losses, increased local supply and supply reliability, increased local flexibility, increased in-stream flow, improved water quality, and improved energy efficiency. Definitions for each of the WUE improvement categories have been developed and are provided in Table 7.19. Note that the WUE improvement categories are not mutually exclusive in many cases. For example, reductions in irrecoverable losses could be used to increase local supply. The applicability of each EWMP to each WUE improvement category based on WCWD's water management activities has been identified and is presented in Table 7.20.

Table 7.19. WUE Improvement Categories.

Water Use Efficiency Improvement Category	Definition
Reduce Irrecoverable Losses	Reduce losses that cannot be recovered and used by the water supplier or downgradient users (e.g. evaporation and flows to salt sinks).
Increase Local Supply (and Supply Reliability)	Reduce losses and/or increase storage locally to increase supply available to meet demands, including both near-term (within an irrigation season) and long-term (over more than one year).
Increase Local Flexibility	Improve the supplier's ability to divert, pump, convey, control, and deliver available water supplies to meet customer demands.
Increase In-Stream Flow	Increase flow in natural waterways to benefit fisheries or meet other environmental objectives.
Improve Water Quality	Increase the quality of targeted water bodies (i.e. streams, lakes, or aquifers).
Improve Energy Efficiency	Increase the efficiency of water supplier or customer pumps.

In order to more explicitly report an estimate of WUE improvements and an estimate of WUE improvements expected to occur five and ten years in the future, WCWD has estimated the qualitative magnitude (expressed as None, Limited, Modest, or Substantial in order of increasing relative magnitude) for the targeted flow paths associated with each EWMP relative to the applicable WUE improvement categories identified in Table 7.19. Past WUE improvements are estimated relative to no historical implementation. WUE improvements relative to the time of the last plan are estimated in reference to 2015, the time of adoption of the district's prior AWMP. Future WUE improvements are estimated for five years in the future (2025) relative to 2020 and for ten years in the future (2030) relative to 2020. The result of this evaluation is provided in Table 7.21.

WCWD will continue to seek out and implement water management actions that meet its overall water management objectives and result in WUE improvements. The continuing review of water management within WCWD, coupled with exploration of innovative opportunities to improve water management will result in future management improvements by the district and resulting WUE improvements.

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Table 7.20. Applicability of EWMPs to WUE Improvement Categories.

Water Code Reference No.	EWMP	Implementation Status	Potential Water Use Efficiency Improvement Category: Reduce Irrecoverable Losses	Increase Local Supply	Increase Local Flexibility	Increase In-Stream Flow	Improve Water Quality	Improve Energy Efficiency[1]
10608.48.b (1)	Measure the volume of water delivered to customers with sufficient accuracy.	Being Implemented		□		□	□	□
10608.48.b (2)	Adopt a pricing structure based at least in part on quantity delivered.	Being Implemented		□		□	□	
10608.48.c (1)	Facilitate alternative land use for lands with exceptionally high water duties or whose irrigation contributes to significant problems, including drainage.	Not Technically Feasible	Not Applicable to WCWD					
10608.48.c (2)	Facilitate use of available recycled water that otherwise would not be used beneficially, meets all health and safety criteria, and does not harm crops or soils.	Not Technically Feasible	Not Applicable to WCWD					
10608.48.c (3)	Facilitate financing of capital improvements for on-farm irrigation systems.	Being Implemented		□		□	□	
10608.48.c (4)	Implement an incentive pricing structure that promotes one or more of the following goals: (A) More efficient water use at farm level, (B) Conjunctive use of groundwater, (C) Appropriate increase of groundwater recharge, (D) Reduction in problem drainage, (E) Improved management of environmental resources, (F) Effective management of all water sources throughout the year by adjusting seasonal pricing structures based on current conditions.	Being Implemented		□		□	□	
10608.48.c (5)	Expand line or pipe distribution systems, and construct regulatory reservoirs to increase distribution system flexibility and capacity, decrease maintenance and reduce seepage.	Not Locally Cost Effective		□	□	□	□	
10608.48.c (6)	Increase flexibility in water ordering by, and delivery to, water customers within operational limits.	Being Implemented		□	□	□	□	
10608.48.c (7)	Construct and operate supplier spill and tailwater recovery systems.	Being Implemented		□	□	□	□	
10608.48.c (8)	Increase planned conjunctive use of surface water and groundwater within the supplier service area.	Being Implemented		□				
10608.48.c (9)	Automate canal control structures.	Being Implemented		□	□	□	□	
10608.48.c (10)	Facilitate or promote customer pump testing and evaluation.	Being Implemented						□
10608.48.c (11)	Designate a water conservation coordinator who will develop and implement the water management plan and prepare progress report.	Being Implemented	The activities of the Water Conservation Coordinator and other WCWD staff to achieve WUE improvements through implementation of the AWMP are described individually by EWMP.					
10608.48.c (12)	Provide for the availability of water management services to water users.	Being Implemented		□		□	□	□
10608.48.c (13)	Evaluate the policies of agencies that provide the supplier with water to identify the potential for institutional changes to allow more flexible water deliveries and storage.	Being Implemented		□	□	□	□	
10608.48.c (14)	Evaluate and improve the efficiencies of the supplier's pumps.	Not Technically Feasible	Not Applicable to WCWD					

1. Includes reducing energy demands.

Table 7.21. Relative Magnitude of Past and Future WUE Improvements by EWMP.

Water Code Reference No.	EWMP	Implementation Status	Marginal WUE Improvement[1,2]			
			Past		Future	
			Relative to No Historical Implementation[3]	Since Last AWMP[4]	5 Years in Future[5]	10 Years in Future[5]
10608.48.b (1)	Measure the volume of water delivered to customers with sufficient accuracy.	Being Implemented	Modest	None	None	
10608.48.b (2)	Adopt a pricing structure based at least in part on quantity delivered.	Being Implemented	Modest	None	None	
10608.48.c (1)	Facilitate alternative land use for lands with exceptionally high water duties or whose irrigation contributes to significant problems, including drainage.	Not Technically Feasible	Not Applicable to WCWD			
10608.48.c (2)	Facilitate use of available recycled water that otherwise would not be used beneficially, meets all health and safety criteria, and does not harm crops or soils.	Not Technically Feasible	Not Applicable to WCWD			
10608.48.c (3)	Facilitate financing of capital improvements for on-farm irrigation systems.	Being Implemented	Modest	Limited	Limited	
10608.48.c (4)	Implement an incentive pricing structure that promotes one or more of the following goals: (A) More efficient water use at farm level, (B) Conjunctive use of groundwater, (C) Appropriate increase of groundwater recharge, (D) Reduction in problem drainage, (E) Improved management of environmental resources, (F) Effective management of all water sources throughout the year by adjusting seasonal pricing structures based on current conditions.	Being Implemented	Modest (Goals A, B, C & E)	None	None	
10608.48.c (5)	Expand line or pipe distribution systems, and construct regulatory reservoirs to increase distribution system flexibility and capacity, decrease maintenance and reduce seepage.	Not Locally Cost Effective	None (Flexibility Improvements Achieved through Canal Automation)			
10608.48.c (6)	Increase flexibility in water ordering by, and delivery to, water customers within operational limits.	Being Implemented	Substantial	Modest	Modest	Modest, Depending on Funding
10608.48.c (7)	Construct and operate supplier spill and tailwater recovery systems.	Being Implemented	Modest	None	Modest, Depending on Funding	
10608.48.c (8)	Increase planned conjunctive use of surface water and groundwater within the supplier service area.	Being Implemented	Substantial	Modest	Modest, Depending on Opportunities	
10608.48.c (9)	Automate canal control structures.	Being Implemented	Substantial	None	Modest	Modest, Depending on Funding
10608.48.c (10)	Facilitate or promote customer pump testing and evaluation.	Being Implemented	Limited	Limited	None	
10608.48.c (11)	Designate a water conservation coordinator who will develop and implement the water management plan and prepare progress report.	Being Implemented	The activities of the Water Conservation Coordinator and other WCWD staff to achieve WUE improvements through implementation of the EWMPs are described individually by EWMP.			
10608.48.c (12)	Provide for the availability of water management services to water users.	Being Implemented	Modest	Modest	None	
10608.48.c (13)	Evaluate the policies of agencies that provide the supplier with water to identify the potential for institutional changes to allow more flexible water deliveries and storage.	Being Implemented	Substantial	Modest	Modest, Depending on Outcomes	
10608.48.c (14)	Evaluate and improve the efficiencies of the supplier's pumps.	Not Technically Feasible	Not Applicable to WCWD			

1. As noted herein and throughout this analysis, reductions in losses that result in WUE improvements at the farm or district scale do not result in WUE improvements at regional scale, except in the case of evaporation reduction. All losses to seepage, spillage, tailwater, and deep percolation are recoverable within the WCWD service area or by downgradient water users.
2. Quantitative estimates of improvements are not available. Rather, qualitative estimates are provided as follows, in increasing relative magnitude: None, Limited, Modest, and Substantial.
3. WUE Improvements occurring in recent years relative to if they were not being implemented.
4. WUE Improvements occurring in recent years relative to the level of implementation at time of WCWD 2005 AWMP.
5. WUE Improvements expected in 2025 (five years in the future) and 2030 (ten years in the future), relative to level of implementation in recent years.

7.10 Attachments

This section includes the following attachments:

- 7.10.1 – Public Coordination and Adoption
- 7.10.2 – Bylaws
- 7.10.3 – Agricultural Water Measurement Compliance Documentation
- 7.10.4 – Potential Projects to Enhance Water Management Capabilities
- 7.10.5 – Drought Management Plan

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Chico Enterprise-Record
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2124135

WESTERN CANAL WATER DISTRICT
2003 NELSON ROAD
NELSON, CA 95958

IN THE SUPERIOR COURT OF THE STATE OF CALIFORNIA, IN AND FOR THE COUNTY OF BUTTE

In The Matter Of
Public Notice - Adoption of Agricultural Water Management Plan

AFFIDAVIT OF PUBLICATION

STATE OF CALIFORNIA
COUNTY OF BUTTE } SS.

The undersigned resident of the county of Butte, State of California, says:

That I am, and at all times herein mentioned was a citizen of the United States and not a party to nor interested in the above entitled matter; that I am the principal clerk of the printer and publisher of

The Chico Enterprise-Record
The Oroville Mercury-Register

That said newspaper is one of general circulation as defined by Section 6000 Government Code of the State of California, Case No. 26796 by the Superior Court of the State of California, in and for the County of Butte; that said newspaper at all times herein mentioned was printed and published daily in the City of Chico and County of Butte; that the notice of which the annexed is a true printed copy, was published in said newspaper on the following days:

04/06/2021, 04/13/2021

Dated April 28, 2021
at Chico, California

(Signature)

Legal No. **0006561800**

PROOF OF PUBLICATION

NOTICE OF CONSIDERATION OF ADOPTION OF AGRICULTURAL WATER MANAGEMENT PLAN.

Notice is hereby given that Western Canal Water District shall hold a public hearing to consider the adoption of the District's 2020 update to the applicable sections of the 2015 Feather River Regional Agricultural Water Management Plan (AWMP). The hearing shall be held on April 20, 2021 commencing at 10:00 am at 2003 Nelson Road, Nelson, CA. The AWMP proposed for adoption is publicly available at the District office located at 2003 Nelson Rd., Nelson, CA 95958 and available at http://westerncanal.com/feather-river-awmp-info. Please submit questions or comments concerning the proposed AWMP in writing to the District at P.O. Box 190, Richvale, CA 95974 prior to the hearing date.
4/06, 4/13/2021

EP7-31 27/16 1

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Western Canal Water District <info@westerncanal.com>

PUBLIC NOTICE: Draft Feather River Regional and Western Canal Water District Ag Water Management Plan

1 message

Western Canal Water District <info@westerncanal.com> Wed, Mar 17, 2021 at 3:13 PM
To: Anjanette Shadley <anjanette@westerncanal.com>
Bcc: BCWater <BCWater@buttecounty.net>, Valley Mirror <valleymirror@pulsarco.com>, Bridget Gibbons <bridget.gibbons@wildlife.ca.gov>, Lisa Hunter <LHunter@countyofglenn.net>, barbarav@aqualliance.net, mfahey@countyofcolusa.org, jimb@aqualliance.net, Todd Turley <tturley@ari-slc.com>, Susan Strachan <susanpstrachan@gmail.com>, tito.cervantes@water.ca.gov, Ted Trimble <ted@westerncanal.com>

Dear Interested Parties:

Please see notice of the Draft 2020 FRRAWMP and WCWD AWMP updates available on our website.

Please contact Anjanette Shadley, Assistant General Manager at the numbers below.

--

Western Canal Water District

P.O. Box 190 | Richvale, CA 95974-0190

P 530.342.5083 | F 530.342.8233

WESTERNCANAL.COM

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April 15, 2021

AGENDA

April 20, 2021
9:00 AM DISTRICT OFFICE

OPTIONAL CONFERENCE CALL LINE
(530) 207-0908

WESTERN CANAL WATER DISTRICT
BOARD OF DIRECTORS MEETING

1. CALL TO ORDER

2. PUBLIC COMMENTS……………………………………

3. Approval of the Minutes of the Regular Meeting 3/16/21
4. Financial Reports
5. Payment of the Bills
6. Manager Report
7. Attorney Report

- BUSINESS……………………………………………

8. **Public Hearing**: Receive Public Comment on Adoption of the Feather River Regional Agricultural Water Management Plan 2020 Update (10:00 AM)
9. Consideration of Resolution 2021-03 to Adopt the Feather River Regional Agricultural Water Management Plan 2020 Update
10. Consideration of Butte Local Agency Formation Commission Director Election Ballots
11. Consideration of Request for Contribution/Membership for the Water Education Foundation
12. Adoption of WCWD 2021 Final Water Supply Allocation
13. Discussion of Sustainable Groundwater Management Act (SGMA) Activities
14. CLOSED SESSION PER GOVERNMENT CODE 54956.9 - Conference with Legal Counsel – EXISTING LITIGATION (Paragraph (1) of subdivision (d): Bay-Delta proceedings, including the California WaterFix, the associated environmental document and change petition pending before the State Water Resources Control Board and the planned update to the Bay-Delta Water Quality Control Plan.

- REPORTS……………………………………………
15. President Johnson
16. Director Larrabee
17. Director Lundberg
18. Director Sheppard
19. Director Davis

20. Adjournment……………………………………………

P.O. BOX 190, RICHVALE, CA 95974 | (P) 530.342.5083 | (F) 530.342.8233 | INFO@WESTERNCANAL.COM

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April 15, 2021

AGENDA

April 20, 2021
9:00 AM DISTRICT OFFICE

OPTIONAL CONFERENCE CALL LINE
(530) 207-0908

WESTERN CANAL WATER DISTRICT
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- REPORTS……………………………………………………
15. President Johnson
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19. Director Davis

20. Adjournment…………………………………………………

P.O. BOX 190, RICHVALE, CA 95974 | (P) 530.342.5083 | (F) 530.342.8233 | INFO@WESTERNCANAL.COM

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RESOLUTION 2021-03

Resolution of the Board of Directors of Western Canal Water District to Adopt the Feather River Regional Agricultural Water Management Plan - 2020 Update

WHEREAS, the Board of Directors of Western Canal Water District ("Board") has caused the preparation of an Agricultural Water Management Plan 2020 Update pursuant to the Water Conservation Act of 2009, SBX7-7; and

WHEREAS, the Western Canal Water District Feather River Regional Agricultural Water Management Plan 2020 Update ("Plan") has been prepared and updated in compliance with Part 2.8 of Division 6 of the California Water Code; and

WHEREAS, in compliance with the requirements set forth in Section 10841 of the Water Code, the Board made the Plan available for public inspection, caused notice of the time and place of this hearing considering adoption of the Plan to be published in accordance with applicable statutory requirements, and such notice was published on or about April 6th, 2021 and on or about April 13th, 2021 in the Enterprise-Record; and

WHEREAS, pursuant to Section 10851 of the Water Code, the California Environmental Quality Act ("CEQA") does not apply to the preparation and adoption of the Plan.

NOW, THEREFORE, BE IT RESOLVED by the Board of Directors of Western Canal Water District that the Feather River Regional Agricultural Water Management Plan 2020 Update is hereby approved and adopted.

BE IT FURTHER RESOLVED that the Board is authorized to implement the adopted Plan in accordance with any schedules set forth therein, and to take all steps necessary to publish and submit the Plan in compliance with Part 2.8 of Division 6 of the California Water Code.

PASSED AND ADOPTED this 20th day of April, 2021 at Nelson, California, the following Directors voting thereon:

Ayes: Johnson, Larrabee, Lundberg, Sheppard, Davis
Noes: 0
Abstain: 0
Absent: 0

BY ________________
Greg Johnson, President of the Board

ATTEST: ________________
Ted Trimble, Secretary to the Board

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