KERN DELTA WATER DISTRICT

Final

2020 Agricultural Water Management Plan (AWMP)

Kern Delta Water District

March 2021

TODD GROUNDWATER

KERN DELTA WATER DISTRICT

2020 Agricultural Water Management Plan

FINAL March 19, 2021

TODD GROUNDWATER

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List of Acronyms

AEWSD	Arvin-Edison Water Storage District
AF	acre-feet
AFY	acre-feet per year
Aqueduct	California Aqueduct
AWMP or Plan	Agricultural Water Management Plan
BVWSD	Buena Vista Water Storage District
C2VSim	California Central Valley Groundwater-Surface Water Simulation
Cal Water	California Water Service-Bakersfield District
CASGEM	California Statewide Groundwater Elevation Monitoring
cfs	cubic feet per second
CIMIS	California Irrigation Management Information System
City or COB	City of Bakersfield
CVP	Central Valley Project
DDW	California Water Resources Control Board Division of Drinking Water
District	Kern Delta Water District
DWR	California Department of Water Resources
ENCSD	East Niles Community Services District
ET	Evapotranspiration
Eto	Reference Evapotranspiration
EWMP	Efficient Water Management Practice
gpm	gallons per minute
Greenfield CWD	Greenfield County Water District
GSA	Groundwater Sustainability Agency
GWMP	Groundwater Management Plan
ID4	Improvement District No. 4 of the Kern County Water Agency
ILRP	Irrigated Lands Regulatory Program
ITRC	Irrigation Training and Research Center
KCWA	Kern County Water Agency
KDWD or District	Kern Delta Water District
KRGSA	Kern River Groundwater Sustainability Agency
Lamont PUD	Lamont Public Utility District
MCL	Maximum Contaminant Level
METRIC	Mapping evapotranspiration at high Resolution with Internalized Calibration
Metropolitan	Metropolitan Water District of Southern California
M&I	Municipal and Industrial
mg/L	milligrams per liter
NOAA	National Oceanographic and Atmospheric Administration
NORMWD	North of the River Municipal Water District
NWKRCD	North West Kern Resource Conservation District
OMWC	Oildale Mutual Water Company
ppt	parts per trillion

RWQCB	Regional Water Quality Control Board
SBVMWD	San Bernardino Valley Municipal Water District
SBX7-7	Steinberg Water Conservation Act of 2009
SCADA	Supervisory Control and Data Acquisition
SGMA	Sustainable Groundwater Management Act
SWP	State Water Project
TCP	1,2,3-Trichloropropane
TDS	Total Dissolved Solids
ug/L	micrograms per liter
UWMP	Urban Water Management Plan
WAP	Kern River Water Allocation Plan, Kern Delta Water District
WWTP	Wastewater Treatment Plant
WY	Water Year, October 1 through September 30

1 PLAN PREPARATION AND ADOPTION

The California Water Code requires that agricultural water suppliers providing water to 10,000 or more irrigated acres prepare and adopt an Agricultural Water Management Plan (AWMP) and submit that Plan to the California Department of Water Resources (DWR). The Plan is required to describe and evaluate water deliveries and uses, sources of supply, water quality, water delivery measurements, water rates and charges, water shortage allocation policies, drought management, and reasonable and practical efficient water management practices. Adoption of an AWMP and implementation of efficient water management practices (EWMPs) are required in order for the agricultural water supplier to be eligible for any State water loans or grants.

This Kern Delta Water District (KDWD or District) has over 85,000 irrigated acres and this AWMP has been prepared in accordance with the requirements of SBX7-7 (Water Conservation Act of 2009) and new legislation. It follows the recommendations in *A Guidebook to Assist Agricultural Water Suppliers to Prepare a 2020 Agricultural Water Management Plan* (Guidebook) prepared by DWR.

AWMPs are to be prepared every five years. KDWD last updated its AWMP in 2015 (AECOM, 2015). This 2020 AWMP updates information in the 2015 AWMP and includes additional content requirements pursuant to new legislation including AB 1668 (Water Management Planning) and California Water Code §10820 (AWMP). These include:

- An annual water budget with specific components on a water-year basis,
- Identification of water management objectives based on the water budget to improve system efficiency or to meet other water management objectives,
- Quantification of water use efficiency using methods identified in *A Proposed Methodology for Quantifying the Efficiency of Agricultural Water Use* (DWR, 2012),
- Drought Plan with actions for drought preparedness, and
- Demonstration of reduced reliance on the Delta.

The structure and many of the tables from the 2015 AWMP have been retained and updated, where appropriate, for consistency and comparison purposes. However, the water use, supply, and budget tables have been revised from representative years to a five-year period extending from Water Year[1] (WY) 2015 to WY 2019.

1.1 PREVIOUS WATER MANAGEMENT ACTIVITIES

KDWD actively manages a diverse portfolio of local surface water, imported water, and groundwater supplies. Its Water Allocation Plan (WAP) (Todd, 2011) was developed to optimize the use of Kern River water available to the District, provide operational flexibility, and maximize the beneficial use of its Kern River water rights. The District uses groundwater to supplement surface water supplies and rainfall. Its

[1] A Water Year (WY) is defined as October 1 through September 30. For example, WY 2015 extends from October 2014 through September 2015. The format of some of the DWR table headings has been retained in this report and Water Year 14/15 is the same as WY 2015.

Groundwater Management Plan (GWMP) (Todd, 2013) summarizes local groundwater management and monitoring activities for conjunctive use of groundwater and surface water.

As a member agency of the Kern River Groundwater Sustainability Agency[2] (KRGSA), the District also participated in preparation of a Groundwater Sustainability Plan (GSP), submitted to DWR in January 2020 in compliance with the Sustainable Groundwater Management Act (SGMA) (Todd, 2020b). The GSP provides for cooperative management of the shared groundwater resources in the KRGSA. The GSP Sustainability goal is to manage groundwater sustainably to support beneficial uses and to optimize conjunctive use of surface water, imported water, and groundwater. The District leads implementation of the GSP in the Agricultural Management Area (MA), which encompasses the KDWD Service Area. Annual reporting demonstrates the implementation of the GSP including monitoring and management in accordance with the plan. The GSP is re-evaluated every five years to determine if additional actions are needed to meet the sustainability goal. In addition to these activities, the District also implements best management practices to improve water use efficiency. These Efficient Water Management Practices (EWMPs) are described in Section 7.

1.2 COORDINATION ACTIVITIES

KDWD is located on the south side of metropolitan Bakersfield in Kern County (**Figure** 1), covering portions of both the City and unincorporated County land. The District actively coordinates with the City on management of its Kern River diversions and conveyance. The District coordinates with Kern County Water Agency (KCWA), which serves as the contracting entity with the DWR for the District's State Water Project (SWP) supply. The District also coordinates and collaborates regularly with others regarding local and regional water management. As a member agency of the KRGSA, KDWD coordinates with the City, ID4, and other GSA member agencies, to manage water supplies in the area to achieve groundwater sustainability. Additional coordination occurs with numerous other local agencies for groundwater banking programs, shared water conveyance facilities, local groundwater recharge, and water exchanges.

Table 1 summarizes the efforts KDWD has taken to involve appropriate agencies and the general public in the District's AWMP update process. The City, County, and interested Parties were notified that the AWMP would be revised. Notifications included location where the AWMP can be viewed, time and place of the public hearing, and contact information. Public notices were published before the public hearing in accordance with Government Code §6066. Copies of notifications and public notices are included in **Appendix B**.

A public hearing was held on March 16, 2021 for KDWD Board consideration of adoption of this Plan. A summary of notice is provided below.

- Notification was sent to City and County on intent to update KDWD AWMP on February 17, 2021,
- Notification was sent to Interested Parties (see **Table 1**) on intent to update KDWD AWMP on February 17, 2021,

[2] KRGSA member agencies are KDWD, City of Bakersfield, Kern County Water Agency (KCWA) Improvement District No. 4 (ID4), North of the River Municipal Water District/Oildale Mutual Water Company (NORMWD/OMWC), and East Niles Community Services District (ENCSD).

- Notice in local newspaper on March 2, 2021 and March 8, 2021 of Public Hearing to adopt the 2020 AWMP (per Gov. Code §6066),
- Posted Draft AWMP on District's website (www.kerndelta.org) and a hard copy was available at District offices on February 23, 2021, and
- Electronic version of the Draft Plan was submitted to entities that requested such drafts (see **Table 1)**.

Table 1. Summary of Coordination, Adoption, and Submittal Activities

Potential Interested Parties	Notified of AWMP	Notified of Public Meetings	Sent Copy or Notified of Adopted AWMP Availability
City of Bakersfield	2/17/2021	2/17/2021	Before April 15, 2021
Kern County	2/17/2021	2/17/2021	Before April 15, 2021
Kern River GSA	2/17/2021	2/17/2021	Before April 15, 2021
Kern Groundwater Authority GSA	2/17/2021	2/17/2021	Before April 15, 2021
Kern County Water Agency	2/17/2021	2/17/2021	Before April 15, 2021
Arvin-Edison Water Storage District	2/17/2021	2/17/2021	Before April 15, 2021
Wheeler Ridge-Maricopa Water Storage District	2/17/2021	2/17/2021	Before April 15, 2021
Henry Miller Water District	2/17/2021	2/17/2021	Before April 15, 2021
Lamont PUD	2/17/2021	2/17/2021	Before April 15, 2021
Greenfield CWD	2/17/2021	2/17/2021	Before April 15, 2021
California Water Service Company	2/17/2021	2/17/2021	Before April 15, 2021
DWR			Before April 15, 2021
Bakersfield Californian		3/2/21 and 3/8/21	
California State Library			Before April 15, 2021

1.3 AWMP ADOPTION, SUBMITTAL AND AVAILABILITY

The 2020 AWMPs must be adopted by April 1, 2021 and submitted to DWR within 30 days of adoption. The KDWD 2020 AWMP was adopted by the District Board at a public hearing conducted at a regular meeting of the Board of Directors on March 16, 2021.The Board unanimously voted to consider and incorporate comments received prior to and at the March 16 public hearing. A copy of the resolution adopting the AWMP is included in **Appendix C**.

The District posted a Final version of the 2020 AWMP on its website and made available to the appropriate entities per California Water Code §10843 (see **Table 1**) no later than April 15, 2021, which is within 30 days of adoption by the District.

1.4 AWMP IMPLEMENTATION SCHEDULE

Following adoption, the 2020 AWMP will be in effect for five years; the next AWMP update will occur in early 2026. The 2020 AWMP provides details on its EWMPs along with an implementation schedule in Section 7 of this Plan.

1.5 AWMP CHECKLIST

Appendix A contains a multipage checklist provided in the Draft AWMP Guidebook developed from the California Water Code requirements for plan content and plan preparation and adaption. Completion of this table supports preparation of the AWMP and provides DWR and the public with the AWMP sections where required elements can be found.

2 DESCRIPTION OF KDWD AND SERVICE AREA

2.1 BACKGROUND AND PHYSICAL CHARACTERISTICS

For more than 130 years, canal systems located within the KDWD boundary have delivered water to support the agricultural economy on District lands south of the Kern River. These systems were first developed as separate canal companies, each with its own Kern River water right and defined service area and were later consolidated. KDWD was formed in 1965 to provide a public entity that secures and manages a diverse portfolio of water supplies conjunctively to benefit water users and to preserve the service areas' existing water rights to the Kern River. Facilities and Kern River water rights were subsequently acquired by the District in 1976.

The District's contract with KCWA for SWP water was executed in 1972. In addition to its Kern River and SWP supplies, the District has made occasional purchases of water from the Central Valley Project (CVP) through deliveries to the Kern River or the Arvin Edison Water Storage District's Intake Canal from the Friant-Kern Canal. Irrigation deliveries to lands within the District are also made with wastewater plant treated effluent, although not through District facilities. Irrigation demands in excess of the District surface water supplies are met through groundwater pumping.

2.1.1 Size and Location of Service Area

KDWD is located in the southern portion of the San Joaquin Valley south of the Kern River. It lies within the Kern County Groundwater Subbasin (5-22.14) as defined by DWR (**Figure 1**). **Figure 2** shows water districts in the vicinity of KDWD and **Figure 3** shows municipal water suppliers that overlap or adjacent to KDWD. The KDWD boundary covers approximately 129,000 acres, about 100,000 of which are irrigated agriculture. Of that amount, about 90,000 acres are planted and close to 10,000 acres are fallowed each year. Municipal and industrial (M&I) development in the District is estimated to cover approximately 15,000 acres. The District's water supply sources, size and formation date are summarized in **Table 2**. The District does not expect changes to the size of its service area.

Table 2. Water Supplier Information

Description	Summary
Date of District Formation[1]	December 1965
Source of Water	
Local Surface Water (Kern River)	✓
Local Groundwater	✓
Recycled Water	✓
Wholesaler	
USBR CVP water (when available)	✓
SWP	✓
Service Area Gross Acreage	128,960
Service Area Developed as Irrigated Agricultural Acreage	107,600
Service Area Irrigated Acreage (2019)	89,727

1. Kern River water rights date back to the late 1800's.

Approximately 89,210 of the District's acres are within the utility service areas of five canal systems (Kern Island, Buena Vista, Stine, Farmers, and Eastside) and about 35,620 acres are classified as non-utility areas. The remaining lands are major rights of way for State and County roads and canals. The District and canal service area boundaries are shown on **Figure 4**. As indicated on the map, the canal service area boundaries extend outside District boundaries.

2.1.2 Water Management Facilities

The District's water management facilities including canals, laterals, groundwater recharge basins, and District owned wells are shown on **Figure 4**. Brief descriptions of the facilities are included below.

Water Conveyance and Delivery System

The District's gravity water conveyance and delivery system consists primarily of unlined canals and laterals located within the utility service areas. Short reaches of canals and laterals within the urban area have been lined with concrete or enclosed in pipes. The total length of canals and laterals is approximately 142 miles (see **Table 3**). Most of the District canals remain unlined to preserve the groundwater benefits associated with operational recharge. The District does not operate any agricultural drains.

The District's main canals, from west to east, are the Buena Vista Canal, Stine Canal, Farmers Canal, Kern Island Canal (including the main canal and the Central Branch), and the Eastside Canal. These canals are connected to regional facilities operated by others (the Kern River Canal, Carrier Canal, and the Arvin-Edison Intake Canal), which allow the various surface water supplies to be diverted into the District.

Table 3. Water Conveyance and Delivery System

Conveyance System	Number of Miles
Unlined Canal	127
Lined Canal	4
Pipelines	11
Drains	0
Total	**142**

Groundwater Recharge Basins

The District operates groundwater banking facilities for use by the District as well as banking partners, including Metropolitan Water District of Southern California (Metropolitan) and San Bernardino Valley Municipal Water District (SBVMWD). KDWD facilities include close to 1,000 acres of existing recharge basins (see **Figure 4** and **Table 4**). KDWD is looking to expand their recharge capacities in the future by approximately 400 acres. The Metropolitan banking agreement allows the agencies to store up to 50,000 acre-feet per year (AFY) beneath KDWD with a maximum storage amount of 250,000 acre-feet (AF). The SBVMWD agreement allows for a one-time delivery of 30,000 AF with a maximum recovery of 5,000 AFY (about 6,300 AF remains in the account). An 11 percent conveyance loss is retained by KDWD in both agreements. Since the program began in 2003, KDWD has stored approximately 308,800 AF for return to banking partners.

Return of banked water to KDWD banking partners occurs through exchange of surface supplies or direct conveyance to the California Aqueduct (Aqueduct). These return or exchange amounts are not included in the tables in this AWMP since the return is through surface water (Kern River or SWP) before the surface water supply enters the District.

Table 4. Groundwater Recharge Basins

Recharge Basin	Service Area	Size (acres)	Average Infiltration Rate (feet/day)	Average Annual Recharge Capacity (AF)
Current Recharge Capacities[1]				
Buena Vista	Buena Vista	227	0.43	34,000
Pit	Stine	70	0.2	5,000
Stine	Stine	39	0.45	6,500
Romero	Farmers	165	0.45	28,000
Stonefield	Stine	79	0.45	13,000
Kern Island	Kern Island	179	0.45	26,000
Howard Frick	Eastside	70	0.3	8,500
Branch 1[2]	Kern Island	72	To be determined	To be determined
Sunset[3]	Eastside	75	To be determined	To be determined
Total		**976**	**-**	**121,000**

1. From KDWD

2. Recharge has only occurred in the Branch 1 basins in 2018

3. Sunset Recharge Basins is a new joint project with Arvin Edison Water Storage District. The total size of the basins will be 150 acres with 75 acres available for KDWD use.

Isabella Reservoir Rights

The District has storage rights in the Isabella Reservoir. The storage rights vary from month to month based on a rule curve. The maximum storage limits and the end of year carryover limits for each service area are shown in **Table 5**. KDWD can also use a portion of Buena Vista Water Storage District's (BVWSD) storage space per the terms of the SWP exchange agreement with BVWSD (maximum carryover of 6,000 AF).

Table 5. KDWD Isabella Reservoir Storage Rights

Service Area	Maximum Storage (AF)	Carryover (AF)
Kern Island	18,000	2,500
Buena Vista	11,000	1,500
Stine	9,000	1,500
Farmers	6,000	1,500
Total	**44,000**	**7,000**

District Owned Wells

KDWD owns 18 wells for recovering banked groundwater as a part of its banking program with Metropolitan. The wells are located adjacent to recharge basins in the Kern Island and Buena Vista service areas and near the Arvin-Edison Canal (operated by the Arvin-Edison Water Storage District (AEWSD)) in the northern portion of the District. Individual well capacities range from about 1,800 gallons per minute (gpm) to 4,500 gpm. The total annual recovery capacity of the wells is estimated to be 94,000 AFY.

These wells are used almost exclusively for the banking program. Return of banked water to KDWD banking partners occurs through exchange of surface supplies or direct conveyance to the Aqueduct. Currently, Kern River water supply is delivered to the ID4 treatment plant and ID4 delivers a like amount to the California Aqueduct for delivery to District banking partners. The District then pumps a like amount from its wells and delivers that water to its growers in-lieu of surface water supplies.

Tailwater/Spill Recovery Systems

The District does not operate any tailwater/spill recovery systems, however individual growers may operate their own systems; this water is not allowed back into District canals or facilities.

2.1.3 Service Area Terrain and Soils

KDWD is near the southern end of the San Joaquin Valley, with the Sierra Nevada Mountains to the east, the Tehachapi Mountains to the south, and the Temblor Range to the west. Elevations in the District slope gently from a maximum elevation of approximately 415 feet in the northeast to a minimum of 285 feet in the southwest. The topography allows for gravity operation of the District's canals and laterals. The District has allowed storm water drainage facilities operated by the City of Bakersfield and County of Kern to connect to the District's canal facilities in a number of locations. It is estimated that the quantity of storm water entering the District's canal facilities averages about 800 AFY.

The depositional history of the Kern River has influenced the shallow subsurface sediments and soil profile beneath the District. The terminus of the Kern River was historically at large inland lakes. The ancestral Kern River flowed from east to west across the valley and then turned north toward the Tulare Lake Bed approximately 40 miles away. During flood stage in the main east-west channel, flow spilled to

the south through KDWD and into Kern Lake, in the southern region of the District, and Buena Vista Lake, west of the District. These two now-dry lakebeds received thick deposits of fine-grained sediments as flood flows diminished and dropped their bed load. Since the regulation of River flows with the construction of Isabella Dam in the early 1950s, the lakebeds no longer receive flood waters and have been converted to agriculture.

These depositional patterns have resulted in thick sequences of coarse-grain sediments (sand) in the northern and central portions of the District and fine-grained deposits (silt and clay) in the paleo-lakebeds in the south, as indicated on the soil texture map on **Figure 5**. This soil texture map is from the Soil Survey Geographic (NRCS, 2018) database for Kern County, developed by the U.S. Department of Agriculture, Natural Resources Conservation Service. Soil textures are color-coded and listed in the legend by decreasing grain size (texture). Loamy sands, sandy loams, and fine sandy loams, shown by shades of yellow and light orange, are the dominant soil textures in the area. Loams to clay, shown in dark orange, green, brown, and dark red, are the primary soil textures along the southern boundary of KDWD. An additional north-south band of fine grain textures is present in the eastern portion of KDWD.

Figure 5 also illustrates the canals and recharge basins in the District. The recharge basins are operated by KDWD and are located primarily in areas of coarse-grained, permeable soils (loamy sands to fine sandy loams).

2.1.4 Climate

The climate of the area is characterized by hot, dry summers and cool, moist winters. The mean annual temperature is 65° F and summer highs frequently exceed 100° F. On average, about 70 percent of the precipitation occurs in December through March. **Table 6** provides average monthly climate information. The long-term average precipitation at the Bakersfield Field Meadows Airport station (located north of KDWD) is approximately 6 inches per year (NOAA, 2019). Annual precipitation – displayed by Water Year[3] (WY) – is shown on **Figure 6**, covering a 54-year period from WY 1966 – WY 2019. As shown on the figure, annual precipitation is highly variable, ranging from 2.26 inches in WY 2008 to 14.99 inches in WY 1998. Average annual precipitation during the period is 6.13 inches. **Figure 6** shows that the wettest water years are associated with precipitation totals above 10 inches per year; using this definition, wet years occurred in WYs 1978, 1983, 1995, 1998, and 2011. The driest water years, with precipitation less than 4 inches per year, occurred in WYs 1970, 1972, 1984, 1990, 2002, 2007-2008, 2013-2014, and 2018.

Evapotranspiration (ET) is the process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants. The area is characterized by relatively high rates of ET. Reference evapotranspiration[4] (ETo) averages about 66 inches per year (**Table 6**). Monthly averages range from an ETo of 1.8 inches in December to 9.39 inches in June (CIMIS, 2021). These rates indicate that much of the local precipitation would be evaporated (or transpired by local vegetation), with relatively small amounts contributing to deep percolation and recharge. However, most of the precipitation and runoff in the area is actively managed to maximize recharge. The City of Bakersfield, which overlaps a portion of the KDWD, maintains almost 400 small stormwater retention facilities (referred to as sumps) that are all open-bottomed and are managed for recharge of

[3] A Water Year (WY) is defined as October 1 through September 30.

[4] Reference evapotranspiration (ETo) refers to ET from a hypothetical reference surface, such as grass, which would potentially occur if unlimited amounts of water were available. It is used to estimate the evaporative demand of the atmosphere independent of crop type.

urban runoff (Carollo Engineers, 2015). Collectively, these small basins cover more than 500 acres, and are sited throughout the entire Metropolitan Bakersfield area. Almost all of these facilities reside on relatively permeable soils and underlying sediments and capture about 16,000 AFY of stormwater runoff, on average. Additional recharge of precipitation is accomplished by diversion and management of runoff into unlined canals and larger recharge/banking facilities.

Table 6. Average Monthly Climate Information

Month	Average Precipitation[1] inches	Average Reference Evapotranspiration (Et_o)[2] inches	Average Minimum Temperature[3] °F	Average Maximum Temperature[3] °F
January	1.05	2.63	38.5	57.4
February	1.11	2.74	42.1	63.6
March	1.11	4.84	45.4	69.0
April	0.67	6.18	49.7	75.7
May	0.23	8.41	56.6	84.2
June	0.07	9.39	63.3	92.1
July	0.01	8.99	69.2	98.6
August	0.03	8.52	67.7	96.7
September	0.10	6.27	63.1	91.0
October	0.29	4.36	54.0	80.5
November	0.59	2.54	44.1	67.3
December	0.86	1.80	38.5	57.8
Annual Total or Average	**6.10**	**66.67**	**52.7**	**77.8**

1. Precipitation at Bakersfield WSO ARPT station #40442, 1938-2020 (WRCC, 2021)
2. Eto at Arvin-Edison Station #125 from 3/22/1995 to present (CIMIS, 2021)
3. Temperature at Bakersfield WSO ARPT station #40442, 10/01/1937 to 06/09/2016 (WRCC, 2021).

2.2 OPERATIONAL INFORMATION

2.2.1 Operating Rules and Regulations

The District last updated its "Rules and Regulations for the Sale and Distribution of Water" on April 21, 2015 (**Appendix D**). These rules require at least 24-hour notice for requested water delivery or shutoff. A grace period for water overruns of up to four hours is included. Information on the operation of the District's delivery system and lead times is presented in **Table 7**.

KDWD water supply consists of groundwater (including banked surface water), Kern River water, and SWP water. The text below provides information on the operation and regulations of these water supplies. Additional information regarding the management of District supplies during drought is included in its Drought Plan in **Appendix E**.

Table 7. Supplier Delivery System and Actual Lead Times

Supplier Delivery System		
Type	**Check if Used**	**Percent of System**
Arranged Demand	✔ (24-hr notice)	100 Percent
Rotation	✔	Only during shortages
Actual Lead Times		
Operations	**Hours/Days**	
Water Orders	24 hours / 1 day	
Water Shut-Off	24 hours / 1 Day	
Grace Period (Water Shut-Off)	4 Hours	

Kern River Water
Kern River Utility Water may be prorated during times of shortage based on: (1) anticipated total deliverable water to specific areas within the District Service Areas, (2) total acres within those Areas, (3) acres owned or operated by each customer within those Areas, and (4) any other equitable factors deemed necessary and appropriate by the District (KDWD 2015 Rules and Regulations). During periods of severe water shortage, the District may deliver Utility Water on a rotational basis. The rotation may cause growers to go several days or weeks between deliveries.

The District's WAP (Todd, 2011) prioritizes Kern River water use as follows:

1. Irrigation deliveries within each Service Area
2. Irrigation deliveries within the District
3. Municipal and industrial use
4. In-District groundwater recharge
5. Pioneer Project groundwater recharge
6. Other uses (including meeting additional surface demands, groundwater recharge, and transfers to out-of-district agencies).

Imported SWP Water
Allocation of the District's SWP supplies is governed by Resolution No. 2009-05 and the "2nd Amendment to the 1974 Plan for Water Allocation and Procedure for Setting State Water Tolls" according to the following process:

1. The Board of Directors shall have the option to sell up to 2,000 acre-feet/year of Kern Delta's State Water Project (SWP) contractual water supply out-of-district but within Kern County.
2. The annual SWP contractual water supply, less any water sold out-of-district pursuant to Paragraph 1, shall be allocated as follows:

a) 12,500/30,000 to Eastside Utility lands and Eastside Area Non-Utility lands capable of receiving service from the Eastside Canal or the Central Branch of the Kern Island Canal.
b) 17,500/30,000 to Stine, Farmers, and Buena Vista Utility lands and Non-Utility lands lying west of the Kern Island Central Canal that are capable of receiving service.

3. Specific allocations to individual service areas shall be determined based on the following guidelines:
   a) 20% of the amounts allocated to the Eastside and Westside Areas shall be reserved to cover operational recharge within the District's canals. The remaining 80% of the Eastside and Westside Area supplies shall be allocated to individual District consumers.
   b) Water will be allocated to Eastside Area consumers (utility and non-utility) on an equal acre-foot per acre basis.
   c) The Westside Area supply shall be allocated to Stine, Farmers, and Buena Vista Utility consumers and Westside Non-Utility consumers, i.e., located west of Highway 99, capable of receiving service in amounts such that the total water deliveries to each area (based on projected long term average Utility Water deliveries and available SWP supply for that year) shall be equal in terms of acre-feet per acre.

Groundwater
Landowners in the District pump groundwater to cover shortages in surface water supplies. The District may shut off deliveries or refuse to make deliveries if private facilities are not reasonably maintained.

The District's conjunctive use program operations have been developed to maximize its surface water supplies in order to maintain sustainable groundwater quality and quantity and preserve groundwater supplies for drought conditions. In its GWMP, the District identifies its Groundwater Basin Management Measures to protect and sustain its groundwater and surface water supplies.

Table 8 summarizes the general basis for the District's Water Allocation Policy.

Table 8. Water Allocation Policy Basis

Basis of Water Allocation	*(Check if applicable)*			Allocation	
	Flow	Volume	Seasonal Allocations	Normal Year	Percent of Water Deliveries (%)
Area within the service area		✔		✔	100
Amount of land owned		✔		✔	100
Seepage Losses		✔		✔	20[1]
Other (Out-of-District)		✔		✔	2,000 AF max[2]

1. Percentage of SWP supply reserved to cover canal operational recharge.
2. Option to sell up to 2,000 AFY of SWP supply out-of-District within Kern County

2.2.2 Water Delivery Measurements/Calculations

Water delivery measurements are made as described in the KDWD Water Deliveries Report, July 2017 (included as **Appendix E**). KDWD utilizes two types of measurement devices: overpour weirs and meters (manual and automated). The measurement devices are read and reported daily by District staff.

Weirs used by the District for water measurement are constructed and maintained to conform to the requirements of fixed-blade, thin-walled rectangular weirs, as defined in the "Water Measurement Manual" published by the United States Department of the Interior, Bureau of Reclamation, in order to provide accurate measurements. The method of measurement has also been standardized by the District to eliminate potential sources of error. Measurements are taken at a distance between four and six times the head above the weir at approximately the center of the canal's flow path.

Waterman Type C-10 canal gates are a primary source of measurement and are used throughout the District at both major diversions and at individual farmer turnouts and delivery points. Farmer turnouts have pipe risers or stilling wells installed behind the headwall. Water delivery measurements at these locations are based on differential head readings, gate opening height, and gate size. Propeller meters are used in pipelines flowing full.

The District periodically reviews the condition of its measurement devices as a part of its routine maintenance program. **Table 9** provides information on the frequency of calibration and maintenance of the District's measurement devices along with typical levels of accuracy. SCADA measurement devices are being installed at the headworks of main canals; Kern Delta is considering an expansion of these devices into District service areas. SCADA (Supervisory Control and Data Acquisition) is a computer system for gathering and analyzing real time data at remote sites.

Table 9. Water Delivery Measurements

Measurement Device	Frequency of Calibration (Months)	Frequency of Maintenance (Months)	Estimated Level of Accuracy (%)
Orifices (meter gates)	As needed	As needed	+/- 5 to 10%
Propeller Meters	Per Mfr. Rec.	Per Mfr. Rec.	+/- 2%
Weirs	As needed	As needed	+/- 5 to 10%

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2.2.3 Water Rate Schedules and Billing

KDWD charges a combination of annual assessments on a per acre basis and a water rate per acre foot of deliveries. The assessment charges vary based on District Service Area and development type. Water rates are different for Utility Water and SWP supplies. Rates for SWP supplies also vary by District Service Area. Water rates are billed monthly per the District's Rules and Regulations (**Appendix D**). The water rates are uniform and do not vary with the quantity of water used.

The District's assessment charges and water rates for 2020 and 2021 are summarized in **Table 10**.

Table 10. 2020 Water Rate Basis

Water Charge Basis	Check if Used	Percent of Water Deliveries (%)	Description
Volume of Water Delivered	✓	100	Rates vary based upon water type and District Service Area. See below:
		Service Area	**Rate (per acre-feet)**
		KDWD Utility Water	$24.00/ac ft
		Eastside SWP Water	$103.47/ac ft
		Kern Island East of 99 SWP Water	$81.56/ac ft
		Kern Island West of HWY 99 SWP Water	$79.94/ac ft
		Stine and Farmers SWP Water	$75.35/ac ft
		Buena Vista SWP Water	$76.70/ac ft
Land Assessment	✓	100	Rates vary based upon District Service Area and development type. See below:
		Service Area	**Rate (per acre)**
		Annual Assessment Admin. Charge	$4.34
		Eastside Assessment Charge	$2.97
		Farmers Assessment Charge	$4.67
		Stine Assessment Charge	$5.48
		Buena Vista Assessment Charge	$5.21
		Kern Island Assessment Charge	$2.21
		South Fork Assessment Charge	$0.85
		City Sewer Plant Assessment Charge	$0.85
		Remaining Irrigated Land Assessment Charge	$6.31
		Undeveloped Lands Assessment Charge	$0.85
		Commercial / Residential Assessment Charge	$6.31
Equalization (Standby)	✓	100	Rates vary based upon District Service Area. See below:
		Service Area	**Rate (per acre)**
		Eastside Equalization Charge	$7.31
		Buena Vista Equalization Charge	$9.55
		Kern Island Equalization Charge	$6.55

2.2.4 Water Shortage Allocation Policies and Drought Plan

The District's Drought Plan is included as **Appendix E**. The Drought Plan includes the District's water shortage allocation policies, information on drought vulnerability, and drought responses. The foundation of KDWD's Drought Plan consists of optimizing conjunctive management, groundwater banking, and best use of additional source water (such as recycled water) as available. In brief, District landowners are incentivized to rely on surface water resources when available to preserve groundwater resources for use in drought conditions. Groundwater banking consists of numerous strategies including intentional recharge along unlined canals, in-District banking for out-of-basin participants, and out-of-District banking for both recovery and overdraft protection. In addition, the District incorporates out-of-basin storage in Isabella Reservoir. Finally, the District is active in optimization of all local water sources

obtained through cooperative transfers, exchanges, and agreements with other water districts and even shared recharge facilities. Additional details of these policies and strategies of the Drought Plan are provided in **Appendix E**.

3 DESCRIPTION OF QUANTITY OF WATER USES

Water use within the KDWD service area varies from year to year and is dependent upon precipitation, cropping patterns, fallowed acreage, and available surface water supplies. This section describes water uses during the previous five water years (WY 2015 to WY 2019).

3.1 BASIS FOR REPORTING WATER QUANTITIES

Analysis of water uses during the previous five water years is required for the annual budget (Section 5). This time period, extending from WY 2015 through WY 2019, was also selected to be representative of District water uses. It represents current uses of water on District land and includes both dry and wet years. Normal, wet, and dry conditions are determined by Kern River Indices which compare annual year river flows to long term average flows by calendar year (**Figure 7**) and by rainfall which is summarized by water year on **Figure 6**. Although Kern River indices are based on calendar year, they provide an indication of the amount of Kern River water available to the District in any given water year. Over the WY 2015-WY 2019 time period, rainfall averaged 6.17 inches per year and between calendar years 2015 and 2019, the average of the Kern River Indices was 109 percent. The year types are described below for the WY 2015 through WY 2019 time period. The water use information in this section is provided on a water year basis for the overall water budget unless indicated otherwise.

- WY 2015 was a dry year with the Kern River Index at 13 percent and rainfall at 5.33 inches.
- WY 2016 was a dry year with the Kern River Index at 48 percent and rainfall at 5.43 inches.
- WY 2017 was a wet year with the Kern River Index at 261 percent and rainfall at 8.34 inches.
- WY 2018 was a dry year with the Kern River Index at 48 percent and rainfall at 3.95 inches.
- WY 2019 was a wet year with the Kern River Index at 175 percent and rainfall at 7.82 inches.

3.2 AGRICULTURAL WATER USE

Annual agricultural water use by source within the District is shown in **Table 11** for WY 2015 – WY 2019. Sources of water include SWP water, Kern River water, recycled water, and groundwater.

SWP and Kern River water delivery and use information are from the Kern River Hydrographic Annual Reports published by City of Bakersfield Water Resources Department (COB, 2014-2020). In-lieu deliveries of surface water through the Metropolitan Water District of Southern California (Metropolitan) banking program provide customers with surface water in-lieu of pumping groundwater.

Treated effluent from the City of Bakersfield's Wastewater Treatment Plants #2 and #3 is used for irrigation on land within KDWD. The amount of treated effluent used ranged between 4,000 and 5,000 AFY. Effective precipitation is the amount of precipitation that is used by the crops and satisfies a portion of the applied water demand. These values are estimated from an integrated surface water-groundwater model referred to as C2VSimFG-Kern, which was developed to support the Subbasin GSP process and was updated for the Kern County Subbasin GSP Annual Report (Todd, 2020a).

The Kern County Subbasin GSP model was developed from the C2VSim Fine Grid Public Beta model released by DWR. This Central Valley regional model includes historical input data for WY 1922-2015, including crop type based on DWR and Kern County crop maps. The C2VSimFG-Kern model incorporated Subbasin-specific data and information into the regional model to provide a Kern County Subbasin-

specific local model. Although the model contains more detailed information that can support local water budgets, the recent updates supported the regional Annual Report and did not account for all land use conditions associated with agricultural conditions in the District. For this reason, only the effective precipitation estimates were used from the numerical model update in this AWMP water budgets. In the future, it is anticipated that future model updates could potentially support subsequent AWMP reports.

Groundwater pumping from private wells was estimated based on crop irrigation requirements minus available water. Estimation of annual crop irrigation requirements are discussed below. Available water includes surface water deliveries, recycled water, and groundwater pumped from District wells. After subtraction of water available for crop irrigation, all remaining crop irrigation requirements were assumed to be satisfied through private well groundwater pumping for agricultural irrigation.

Table 11. Annual Agricultural Water Use (AF)

Source	Water Year 2015	Water Year 2016	Water Year 2017	Water Year 2018	Water Year 2019
Agricultural Water Supplier Delivered					
Surface Water (SWP)[1]	100	11,430	4,229	12,957	13,605
Surface Water (Kern River)[2]	68,158	85,092	123,348	105,038	124,040
Surface Water (Lower Kern River)[2]	0	0	4,781	0	1,438
Surface Water (In-lieu Deliveries)[3]	0	0	12,216	3,291	9,401
Reclaimed Water[4]					
City of Bakersfield WWTP #2	1,169	1,195	1,195	1,195	1,195
City of Bakersfield WWTP #3	3,678	3,465	2,773	2,773	2,773
Other Water Supplies Used					
Groundwater-District Wells[5]	33,527	23,500	278	1,218	0
Effective Precipitation[6]	28,474	37,211	41,175	27,968	46,740
Groundwater-Private Wells[7]	166,237	161,951	126,632	174,294	154,520
Total	**301,344**	**323,845**	**316,628**	**328,735**	**353,712**

1. Based on the Kern River Annual Hydrographic Reports (COB, 2014-2020)
2. Based on the Kern River Annual Hydrographic Reports - deliveries to KDWD service areas (COB, 2014-2020)
3. Includes in-lieu deliveries from the Metropolitan Banking Program
4. Estimated average treated effluent deliveries to lands within KDWD
COB #2 SW irrigation in KDWD based on METRIC ET demands of area (WY17-WY19 assumes no change from WY16)
COB #3 SW irrigation in KDWD based on measured deliveries demands of area (WY18-WY19 assumes no change from WY17)
5. Pumping from District owned groundwater wells is used to return banked water to out of District banking partners through surface water exchanges
6. Based on numerical modeling developed for the KRGSA GSP (Todd, 2020b) and Kern Annual Report (Todd, 2020a)
7. Private Groundwater pumping is total crop water needs from Tables 12-16 minus surface water supply minus groundwater from District wells minus effective precipitation.

Agricultural acreages and cropping patterns were estimated for each of the preceding five years for parcels across the District. Crop type, associated acreage, and crop ET data are tabulated in **Tables 12**

through **16** for 2015 through 2019, respectively. Also included on each table are the estimated applied irrigation water demands for each crop type. Data are presented on a calendar year basis to align with the available data sources. **Figure 8** illustrates the 2016 cropping patterns across KDWD as presented in the KRGSA GSP (Todd, 2020b).

Crops and associated acreages are compiled from the Kern County Agricultural Commissioner and downloaded in Geographic Information Software (GIS) format (Kern County, 2021). ET data are developed from a Microsoft Excel application developed by DWR and referred to as the Consumptive Use Program PLUS (CUP+) (2011). This program provides a method for estimating crop ET and required amounts of applied water. For KDWD, estimates of applied water demands are based on an average irrigation efficiency of 80 percent – an estimate consistent with recent surface water-groundwater modeling. This irrigation efficiency indicates that about 20 percent of the surface water deliveries for agricultural irrigation infiltrate surficial soils past the root zone and percolate to the water table, providing groundwater recharge (Todd, 2020b). Total crop water needs are calculated based on net irrigated acreage (assumed to be 95 percent of total acreage to account for non-cropped portions of parcels) multiplied by the applied water demand for each crop.

The amount of the applied water demand that was provided by groundwater pumping was estimated using the reported amounts of surface water supply. Specifically, private irrigation pumping was estimated by subtracting the KDWD surface water supply and effective precipitation from the total crop water needs.

Table 12. Agricultural Crop Data for 2015

Crop	Total Acreage[2]	Crop ET[3] (AF/Ac)	Applied Water Demand (AF/Ac)[4]	Total Crop Water Needs (AF)[5]
Almonds & Pistachios	12,502	3.60	4.5	53,450
Carrot/Cabbage	2,604	1.29	1.6	3,992
Citrus & Subtropical	0	4.94	6.2	0
Corn	5,620	2.14	2.7	14,312
Cotton	4,576	2.34	2.9	12,695
Cucurbits	311	1.34	1.7	495
Dry Beans	35	1.41	1.8	58
Grain	18,032	2.12	2.6	45,309
Onions & Garlic	1,253	3.62	4.5	5,389
Other Deciduous	28	3.45	4.3	115
Other Field	6,778	2.93	3.7	23,621
Other Truck	5,042	2.88	3.6	17,223
Pasture/Alfalfa	17,026	4.49	5.6	90,790
Potatoes	1,494	2.35	2.9	4,163
Tomato-Fresh	1,913	2.32	2.9	5,280
Turf	154	3.85	4.8	703
Vineyards	5,882	2.71	3.4	18,901
Total[1]	**83,249**	**-**	**-**	**296,497**

1. Based on calendar year 2015
2. Based on Kern County Ag Commissioner Maps (Kern County, 2021)
3. Crop ET from DWR CUP+ in acre-foot per acre (DWR, 2011)
4. Based on irrigation efficiency of 80%
5. Assumes 95% of area to account for non-cropped portions of the parcel.

Table 13. Agricultural Crop Data for 2016

Crop	Total Acreage	Crop ET[2] (AF/Ac)	Applied Water Demand (AF/Ac)[3]	Total Crop Water Needs (AF)[4]
Almonds & Pistachios	18,761	3.71	4.6	82,592
Carrot/Cabbage	3,800	1.27	1.6	5,747
Citrus & Subtropical	25	5.07	6.3	150
Corn	5,455	2.27	2.8	14,672
Cotton	7,059	2.46	3.1	20,629
Cucurbits	262	1.34	1.7	416
Dry Beans	0	1.48	1.9	0
Grain	15,074	2.11	2.6	37,758
Onions & Garlic	1,133	3.72	4.6	5,001
Other Deciduous	24	3.59	4.5	100
Other Field	4,855	3.06	3.8	17,666
Other Truck	5,848	2.94	3.7	20,401
Pasture	15,655	4.61	5.8	85,666
Potatoes	1,312	2.46	3.1	3,828
Tomato-Fresh	1,700	2.44	3.0	4,918
Turf	154	3.95	4.9	722
Vineyards	5,663	2.81	3.5	18,918
Total	**86,778**	**-**	**-**	**319,184**

1. Based on calendar year 2016
2. Based on Kern County Ag Commissioner Maps (Kern County, 2021)
3. Crop ET from DWR CUP+ in acre-foot per acre (DWR, 2011)
4. Based on irrigation efficiency of 80%
5. Assumes 95% of area to account for non-cropped portions of the parcel.

Table 14. Agricultural Crop Data for 2017

Crop	Total Acreage	Crop ET[2] (AF/Ac)	Applied Water Demand (AF/Ac)[3]	Total Crop Water Needs (AF)[4]
Almonds & Pistachios	20,982	3.67	4.6	91,420
Carrot/Cabbage	5,690	1.21	1.5	8,182
Citrus & Subtropical	296	5.04	6.3	1,774
Corn	4,414	2.24	2.8	11,726
Cotton	5,906	2.44	3.1	17,113
Cucurbits	257	1.33	1.7	406
Dry Beans	829	1.44	1.8	1,422
Grain	18,497	2.08	2.6	45,758
Onions & Garlic	1,844	3.68	4.6	8,059
Other Deciduous	22	3.58	4.5	93
Other Field	1,921	3.06	3.8	6,970
Other Truck	5,803	2.92	3.7	20,151
Pasture	11,854	4.59	5.7	64,542
Potatoes	2,342	2.46	3.1	6,848
Tomato-Fresh	1,413	2.44	3.0	4,087
Turf	154	3.93	4.9	718
Vineyards	5,594	2.80	3.5	18,609
Total	**87,818**	**-**	**-**	**307,878**

1. Based on calendar year 2017
2. Based on Kern County Ag Commissioner Maps (Kern County, 2021)
3. Crop ET from DWR CUP+ in acre-foot per acre (DWR, 2011)
4. Based on irrigation efficiency of 80%
5. Assumes 95% of area to account for non-cropped portions of the parcel.

Table 15. Agricultural Crop Data for 2018

Crop	Total Acreage	Crop ET[2] (AF/Ac)	Applied Water Demand (AF/Ac)[3]	Total Crop Water Needs (AF)[4]
Almonds & Pistachios	24,207	3.78	4.7	108,600
Carrot/Cabbage	3,648	1.26	1.6	5,468
Citrus & Subtropical	469	5.22	6.5	2,905
Corn	5,219	2.34	2.9	14,509
Cotton	5,585	2.55	3.2	16,928
Cucurbits	292	1.35	1.7	467
Dry Beans	320	1.53	1.9	582
Grain	16,331	2.13	2.7	41,251
Onions & Garlic	1,005	3.78	4.7	4,513
Other Deciduous	5	3.73	4.7	22
Other Field	1,809	3.19	4.0	6,849
Other Truck	6,787	2.98	3.7	24,036
Pasture	12,490	4.74	5.9	70,369
Potatoes	2,274	2.53	3.2	6,839
Tomato-Fresh	732	2.52	3.1	2,189
Turf	154	4.07	5.1	744
Vineyards	5,345	2.91	3.6	18,496
Total	**86,673**	**-**	**-**	**324,767**

1. Based on calendar year 2018
2. Based on Kern County Ag Commissioner Maps (Kern County, 2021)
3. Crop ET from DWR CUP+ in acre-foot per acre (DWR, 2011)
4. Based on irrigation efficiency of 80%
5. Assumes 95% of area to account for non-cropped portions of the parcel.

Table 16. Agricultural Crop Data for 2019

Simple Crop Categorized	Total Acreage	Crop ET[2] (AF/Ac)	Applied Water Demand (AF/Ac)[3]	Total Crop Water Needs (AF)[4]
Almonds & Pistachios[6]	24,207	3.87	4.8	111,236
Carrot/Cabbage	4,219	1.30	1.6	6,510
Citrus & Subtropical	614	5.42	6.8	3,947
Corn	6,851	2.40	3.0	19,527
Cotton	3,893	2.63	3.3	12,136
Cucurbits	660	1.35	1.7	1,059
Dry Beans	41	1.60	2.0	78
Grain	15,931	2.20	2.8	41,705
Onions & Garlic	1,021	3.87	4.8	4,693
Other Deciduous	193	3.83	4.8	879
Other Field[6]	1,809	3.29	4.1	7,070
Other Truck	7,334	3.06	3.8	26,627
Pasture	14,340	4.92	6.1	83,702
Potatoes	1,903	2.53	3.2	5,709
Tomato-Fresh	935	2.56	3.2	2,841
Turf	154	4.22	5.3	771
Vineyards	5,623	2.97	3.7	19,815
Total	**89,727**	**-**	**-**	**348,306**

1. Based on calendar year 2019
2. Based on Kern County Ag Commissioner Maps (Kern County, 2021)
3. Crop ET from DWR CUP+ in acre-foot per acre (DWR, 2011)
4. Based on irrigation efficiency of 80%
5. Assumes 95% of area to account for non-cropped portions of the parcel
6. Anomalies in Almonds & Pistachios and Other Field acreages so used 2018 values.

As discussed above, the total crop water needs estimated in **Tables 12** through **16** include an irrigation efficiency of 80 percent. The actual crop consumptive use (Crop ET) is less than the applied water demand because it does not include excess irrigation water that returns to groundwater. The crop consumptive use and the applied water demands from **Tables 12** through **16** for WY 2015 – WY 2019 are summarized in **Table 17**. Note that the crop consumptive use values are 80 percent of the applied water demands.

Table 17. Crop Consumptive Use and Applied Water Demands

	Water Year 2015	Water Year 2016	Water Year 2017	Water Year 2018	Water Year 2019
Crop Consumptive Use[1]	237,197	255,348	246,303	259,813	278,645
Applied Water Demand[2]	296,497	319,184	307,878	324,767	348,306

1. Crop consumptive use is derived from Tables 12-16 and does not include the additional 20% water required to account for irrigation efficiencies
2. Applied water demands are from Tables 12-16

Table 18 summarizes the irrigated acreages and the total irrigable area within the District for WY 2015 – WY 2019. The Kern County Agricultural Commissioner data are used for permits for agricultural use on a parcel basis. The data often indicates parcels with multiple crops. Multiple-cropping occurs on about 5 to 9 percent of the total acres.

Table 18. Irrigated Acreages and Multiple Cropping

	Water Year 2015	Water Year 2016	Water Year 2017	Water Year 2018	Water Year 2019
District Irrigable Acres[1]	88,188	89,977	91,194	90,243	94,042
Total Irrigated Acres[2]	83,249	86,778	87,818	86,673	89,727

1. Based on Kern County Ag Commissioner Maps (Kern County, 2021). Includes idle acreage
2. Based on Kern County Ag Commissioner Maps (Kern County, 2021)

3.3 ENVIRONMENTAL WATER USE

In an agreement with DWR, KDWD has dedicated approximately 10 acres of wetland/willow bosque within the area of the Buena Vista Recharge Basins. This area will have varying water levels based on the natural hydrologic cycles and recharge basin operations. In dry years, the District will dedicate up to 30 AFY of intermittent flows to maintain a functioning wetland environment. This water usage is small relative to other water use and has not been included in this Plan at this time.

3.4 RECREATIONAL WATER USE

There are no recreational uses that are supported by the District's surface water supplies. There are several privately owned small artificial lakes that rely on pumped groundwater. Recreational lake use was quantified for the KRGSA GSP (Todd, 2020b) water budgets and water use was estimated at 54 AFY

to 68 AFY. This water usage is small relative to other groundwater pumping and has not been included in this Plan.

3.5 MUNICIPAL AND INDUSTRIAL USE

The District does not supply water directly for municipal or industrial (M&I) water uses but it recharges water for the City of Bakersfield (City or COB), California Water Service-Bakersfield District (Cal Water), Greenfield County Water District (Greenfield CWD), and Lamont Public Utility District (Lamont PUD) through a sale of canal operational recharge. Urban areas that serve M&I water supply have expanded into KDWD over time (mostly from the north) and currently cover more than 15,000 acres within KDWD boundaries. Urban areas within or adjacent to KDWD include a portion of the City of Bakersfield, the communities of Greenfield, Lamont and Weedpatch, and other unincorporated areas and communities such as the small urban area of Pumpkin Center. Service areas of the City overlap District areas while the KDWD boundary circumnavigates around some of the smaller communities (e.g., Greenfield and Lamont). Some private domestic wells also pump within District boundaries, but net consumption of this water is judged small compared to agricultural and municipal consumption; it has not been estimated for this Plan.

Table 19 summarizes production from municipal wells that supply the City of Bakersfield. Groundwater production from municipal wells that supply the communities of Lamont and Greenfield are also included.

Table 19. Municipal/Industrial Groundwater Pumping (AF)

Municipal / Industrial Entity	Water Year 2015	Water Year 2016	Water Year 2017	Water Year 2018	Water Year 2019
City of Bakersfield[1]	3,710	3,537	5,349	7,633	2,030
Lamont Public Utility District	3,305	3,245	3,424	3,619	3,637
Greenfield County Water District	2,153	2,075	2,334	2,427	2,435
Total	**9,168**	**8,858**	**11,107**	**13,678**	**8,102**

From Kern Annual Reports (Todd, 2020a)
1. Production from City of Bakersfield Domestic Water System wells within KDWD and Cal Water well #202 which is in KDWD.

3.6 GROUNDWATER RECHARGE USE

The District recharges surplus SWP and Kern River water for groundwater replenishment and conjunctive management. Recharge occurs through District-constructed recharge basins as well as operational recharge from unlined canals. KDWD also operates groundwater banking facilities for out-of-district banking partners including Metropolitan and SBVMWD. Recharge basins and canal locations are shown on **Figure 4**. Return of banked water to KDWD banking partners occurs primarily through exchange of surface supplies. **Table 20** presents a summary of the District's groundwater recharge for WY 2015 - WY 2019. It also includes estimates of deep percolation for irrigation return flows.

Table 20. Groundwater Recharge (AF)

Location/Groundwater Basin	Water Year 2015	Water Year 2016	Water Year 2017	Water Year 2018	Water Year 2019
District Recharge Basins (for KDWD)[1]	0	0	30,900	4,887	9,321
District Recharge Basins (for others)[2]	0	0	21,790	10,263	38,697
District Canal Operational Recharge[3]	35,241	55,202	72,306	70,367	64,854
Deep Percolation (from irrigation)[4]	64,146	68,497	70,325	68,922	75,068
Total	**99,387**	**123,699**	**195,321**	**154,439**	**187,940**

1. Source: KDWD. Includes Grower Recharge program (5,155 AF in WY 2017)
2. Source: KDWD. Includes direct recharge and conveyance recharge
3. Canal Operational Recharge from Kern River Reports (COB, 2014-2019)
4. Deep percolation of irrigation return flows from Table 32

3.7 OTHER WATER USE

No other transfers or exchanges have occurred in WY 2015 - WY 2019. The District has entered into various other operational exchanges that help to maximize the efficient use of its water supplies. For example, the District's SWP contract deliveries are made through an exchange with BVWSD where KDWD's SWP supplies are delivered to BVWSD in exchange for BVWSD's Kern River supplies. These exchange deliveries are discussed in Section 4.1.

4 DESCRIPTION OF QUANTITY AND QUALITY OF WATER RESOURCES

Water supply for the KDWD includes groundwater, Kern River surface water, banked water, imported water (SWP), and recycled water. A summary of these water sources and associated uses are provided below.

4.1 WATER SUPPLY QUANTITY

4.1.1 Surface Water Supply

Kern River Water

The Kern River originates northeast of Bakersfield in the Inyo and Sequoia National Forests and the Sequoia National Park at the base of Mt. Whitney. For more than 150 years, the Kern River has provided most of the natural surface water supply to the Kern County Subbasin, including water for agricultural irrigation, drinking water, groundwater banking and replenishment, and other uses. The Kern River channel enters the Subbasin from the northeast, north of the KDWD service area, and traverses southwest to the stream gage shown as Second Point on **Figure 1**.

Flows in the River consist of regulated and managed releases from Lake Isabella, approximately 25 miles upstream of the First Point stream gage shown on **Figure 1**. Isabella Dam and Lake Isabella were constructed by the U.S. Army Corp of Engineers in 1953 to address downstream flooding. Since that time, Isabella Dam has been operated for flood control, hydroelectric power, water supply, and conservation storage. KDWD has out-of-District storage space in Lake Isabella (see Section 2.1.2 and **Table 5**).

Distribution of water within the First Point service area of the Kern River was adjudicated in the 1900 Shaw Decree. Over the years, Kern River water has been apportioned based on entitlements determined through canal company consolidations, water rights transfers and acquisitions, court decisions, and agreements. In 1888, two permanent stream gage stations, First Point and Second Point, were established to measure flow in the Kern River on a real-time basis (**Figure 1**). The First Point daily discharge is used to allocate water among various Kern River interests, referred to as First Point diverters, Second Point diverters, and Lower River diverters. The Second Point of measurement is approximately 20 miles downstream and is used to check upstream water use (and entitlements) with diversion rights on the Lower River. KDWD, City of Bakersfield, and North Kern Water Storage District are First Point water diverters. The City monitors, manages, and records flows and diversions in the River on behalf of the Kern River Watermaster for all water users.

Flows in the Kern River are highly variable, subject to both flooding and drought. To provide a means of comparison between current flows and long-term average flow conditions, an annual river index is calculated and included in annual Kern River Hydrographic Reports. An index of 100 percent is representative of the long-term average flow in the River. The annual indices between 1995 and 2019 are provided on **Figure 7**. During that time, the annual Kern River Index ranged from 13 percent (2015) to 261 percent (2017). KDWD's Kern River diversion rights (for the former Kern Island, Buena Vista, Stine, Farmers, and Eastside canal companies) were acquired from the City in 1976. Diversions are based on the river stage and the priority of each water right as summarized in **Table 21**. Current Kern River supplies have been reduced as a result of litigation that placed caps on the District's entitlement for various rights in certain months. The District estimates that its average long-term Kern River water

supply will be about 202,000 AFY (Todd, 2011). Restrictions on the District's Kern River entitlement supply are summarized in **Table 22**.

Table 21. KDWD Kern River Water Rights

Service Area	Right (cfs)	River Stage (cfs)	Diversion Priority	Appropriation Date
Kern Island	300	0-300	1	12/1/1869
	56	3,106-3,162	26	
Buena Vista	80	330-410	4	7/19/1870
	90	2,416-2,526	22	
Stine	150	550-700	7	12/12/1872
Farmers	150	730-880	9	4/28/1873
Eastside	83/300th of Kern Island (March 15-August 15)			6/30/1921

Table 22. Kern River Entitlement Caps from Court Decisions

Service Area	January (AF)	August (AF)	September (AF)	October (AF)	November (AF)	December (AF)
Kern Island	8,493	-	-	6,989	3,375	2,050
Buena Vista	347	-	-	-	236	191
Stine	-	-	583	1,380	22	12
Farmers	-	610	268	-	-	207

Imported Water

In 1972, KDWD contracted with KCWA to receive 30,000 AFY of SWP water imported into the county via the California Aqueduct. KDWD's SWP contract included a buildup schedule that reached the maximum amount in 1990, consisting of 25,500 AF of firm supply and 4,500 AF of unregulated surplus supply to be delivered during four winter months on an as-available basis. In 1994, the surplus water was eliminated as part of the Monterey Agreement, revising the District's SWP maximum amount to 25,500 AFY. The SWP water supply is used to reduce the area's groundwater overdraft and provide supplemental surface water deliveries to various portions of the District.

In the absence of a readily-available means to convey SWP water into the District, KDWD executed exchange agreements with BVWSD to allow BVWSD access to KDWD's SWP allotment for an equal amount of BVWSD water supply on the Kern River. This arrangement allowed KDWD to divert its SWP allotment from the Kern River using existing facilities while BVWSD accessed the SWP water directly from the California Aqueduct, which is adjacent to its service area.

Court imposed pumping restrictions on the deliveries of SWP water south of the Sacramento-San Joaquin River Delta have resulted in reductions in the District's SWP supplies. Since the early 1990s, the availability of SWP water has declined. Over the last 20 years, the District's full allotment of SWP water was available during only one year.

Purchases of water from the CVP (Section 215 floodwater), SWP Article 21, lower Kern River rights, and other sources are made when available and advantageous to the District. The District has also received water supplies from Metropolitan and SBVMWD as a part of its groundwater banking programs.

A summary of the District's surface water supplies for WY 2015-WY 2019 is shown in **Table 23**.

Table 23. Surface Water Supplies (AF)

Source	Water Year 2015	Water Year 2016	Water Year 2017	Water Year 2018	Water Year 2019
Kern River[1]	68,158	85,092	123,348	105,038	124,040
SWP Contract[2]	100	11,430	4,229	12,957	13,605
Lower River Purchase[2]	0	0	4,781	0	1,438
District Recharge[3]	0	0	113,192	75,549	73,852
Metropolitan In Lieu[4]	0	0	12,216	3,291	9,401
Metropolitan Recharge[5]	0	0	21,790	10,263	38,697
SBVMWD Recharge[5]	0	0	0	0	0
Total	**68,258**	**96,522**	**279,556**	**207,098**	**261,033**

1. Based on the Kern River Annual Reports - deliveries to KDWD service areas (COB, 2014-2020)
2. Based on the Kern River Annual Reports (COB, 2014-2020)
3. The District recharges surplus SWP and Kern River water
4. In-lieu deliveries from the Metropolitan Recharge Program
5. Surface water brought into the District for recharge for Metropolitan Water District and San Bernardino Valley Municipal Water District. Recharge values from Table 20.

4.1.2 Groundwater Supply

Groundwater is an important source of agricultural, domestic, and municipal supply in the District, which is managed conjunctively with numerous surface water supplies. The Kern County Subbasin (5-22.14, **Figure 1**) is the largest in the state, covering approximately 2,834 square miles (1,813,630 acres) and containing more than 40,000,000 AF of groundwater in storage (Todd, 2020b).

The location of District wells and groundwater recharge areas are shown on **Figure 4** and described in Section 2.12. Groundwater recharge operations are summarized in **Table 20** in Section 3.6. Estimated groundwater pumping within the District for WY 2015-WY 2019 is shown in **Table 24**.

Table 24. Groundwater Supplies (AF)

Source	Water Year 2015	Water Year 2016	Water Year 2017	Water Year 2018	Water Year 2019
District Well Pumping[1]	33,527	23,500	278	1,218	0
Municipal Pumping[2]	9,168	8,858	11,107	13,678	8,102
Private Well Pumping[1]	166,237	161,951	126,632	174,294	154,520
Total	**208,932**	**194,309**	**138,017**	**189,191**	**162,622**

1. From Table 11. Pumping from District owned groundwater wells is used to return banked water to out of District banking partners through surface water exchanges
2. From Table 19

4.1.3 Other Water Supplies

Recycled water
Treated effluent from the City of Bakersfield's Wastewater Treatment Plants (WWTP) #2 and #3 is used for irrigation on land within KDWD. The amount of applied treated effluent ranged between 4,000 and 5,000 AFY between WY 2015 and WY 2019 (**Table 25**). Recycled water from WWTP #2 is primarily delivered to nearby lands south of the plant between the Kern Island Central Canal and the Eastside Canal. Some recycled water from WWTP #3 is also delivered west of the Buena Vista Service area for a farm owned and operated by the City of Los Angeles called Green Acres; a portion of this farm lies within KDWD boundaries.

Table 25. Recycled Water Supplies (AF)

Source	Water Year 2015	Water Year 2016	Water Year 2017	Water Year 2018	Water Year 2019
City of Bakersfield WWTP #2[1]	1,169	1,195	1,195	1,195	1,195
City of Bakersfield WWTP #3[1]	3,678	3,465	2,773	2,773	2,773
Total	**4,847**	**4,660**	**3,968**	**3,968**	**3,968**

1. From Table 11. Estimated average treated effluent deliveries to lands within KDWD

Drainage
KDWD does not operate drainage facilities. Landowners, especially in areas of perched water, may operate tile drains and reuse drainage flows for irrigation, but these amounts are unknown and considered a relatively minor component of the water balance.

4.2 WATER SUPPLY QUALITY

KDWD water supply is generally of excellent quality. The sections below provide information on Kern River, SWP, groundwater, and recycled water quality.

4.2.1 Surface Water Quality

Kern River water is the primary source of surface water in KDWD and is of excellent quality. Total dissolved solids (TDS) represents the total concentration of anions and cations in water and is used as an indicator of mineralization, salt content, and overall water quality. From 1995 to 2007, TDS concentrations of the Kern River have ranged from 28 milligrams per liter (mg/L) to 215 mg/L with an average of 97 mg/L (Todd, 2020b). TDS in SWP water imported into Kern County has averaged about 245 mg/L between WY 1995 – WY 2014 with slightly lower averages in wet years and higher averages in dry years. During the drought conditions of WY 2015 – WY 2016, the average monthly TDS in SWP water increased slightly to about 301 mg/L.

ID4 reports on the quality of surface water from the Kern River, Friant-Kern, and SWP through the Aqueduct in their annual Report on Water Conditions. Kern River and California Aqueduct (SWP) water quality data from the 2019 Report on Water Conditions for select parameters are presented in **Table 26**. Although the water quality listed in **Table 26** is reported by KCWA, sources are the same as those used by KDWD, and water quality is expected to be similar. As indicated in the table, TDS concentrations were 95 mg/L in Kern River water and 191 mg/L in SWP water.

Table 26. Water Quality, 2019

Source Water Quality, 2019[1]				
Parameter	**Units**	**Kern River Water Quality**	**SWP Water Quality**	**Groundwater Quality**
Total Dissolved Solids (TDS)	mg/L	95	191	200
Calcium	mg/L	12.0	14.0	26.8
Boron	mg/L	ND	0.11	0.14
Arsenic	mg/L	0.003	ND	ND
Magnesium	mg/L	2.18	7.49	4.47
Potassium	mg/L	1.83	2.44	1.78
Sodium	mg/L	9.28	31.3	28.8
Chloride	mg/L	3.81	43.2	41.0
Sulfate	mg/L	8.70	27.4	25.0
Nitrate (as N)	mg/L	ND	0.24	0.75

1. Kern County Water Agency Improvement District No. 4 (ID4), 2020, Report on Water Conditions 2019.

4.2.2 Groundwater Quality

The water quality of KDWD groundwater is similar to local surface water with relatively low TDS levels resulting, in part, from decades of actively managed recharge of both local and imported surface water supplies in the area.

Total Dissolved Solids

TDS concentrations in the Kern County Subbasin average between 400 and 450 mg/L but can range up to 5,000 mg/L in the western Subbasin (Todd, 2020b). TDS concentrations in groundwater in the KRGSA, which included KDWD, are shown on **Figure 9**. Concentrations of TDS are lowest (less than 500 mg/L) in the vicinity of the Kern River and south of the Kern River extending through most of the KDWD service area. TDS concentrations are higher (above 1,000 and 1,500 mg/L), along the southern rim and extending northward in the southeastern KDWD. In general, elevated TDS concentrations occur within and near the area where perched water has been observed (**Figure 9**) and may indicate concentrations of salts in the clay soils where surface water does not readily infiltrate into the subsurface.
Select groundwater quality parameters for 2019 as reported by ID4 is included in **Table 26**. The ID4 groundwater supply is similar to groundwater quality within the northern portion of KDWD because of like influences from Kern River recharge.

KDWD has collected local water quality samples with a focus on agricultural supply as summarized in its GWMP and shown in **Table 27**. As shown in the table, TDS concentrations are generally consistent with the sources and data discussed above. In general, sodium and boron concentrations are not sufficiently high throughout the District to negatively impact irrigation water quality. Nitrate detections in District samples have been below the MCL; additional data for nitrate concentrations in groundwater are discussed below.

KDWD has also granted permission to the Kern River Watershed Coalition Authority to collect annual water quality samples from four KDWD wells as a part of the Groundwater Quality Trend Monitoring Program.

Table 27. Groundwater Quality

General Groundwater Quality[1]		
Parameter	**Units**	**Range**
TDS	mg/L	200-500[2]
Sodium	mg/L	13-154
Boron	mg/L	<0.6
NO_3	mg/L	<0.4 – 26

1. From Groundwater Management Plan (Todd, 2013)
2. General range of average values

Nitrate

Sources of nitrate in groundwater include excess application of nitrogen fertilizer in irrigated areas, feedlot and dairy drainage, leaching from septic systems, wastewater percolation, industrial wastewater, aerospace activities, and food processing wastes. Some nitrate is also believed to be from natural sources and predates irrigation and farming. Maximum concentrations of nitrate (as NO^3) in the KRGSA, including KDWD, from WY 1995 through WY 2014 are shown on **Figure 10**. Also included on the

figure for reference are areas of irrigated agriculture, dairies, and wastewater treatment plants. Nitrate concentrations are illustrated as yellow circles (below its primary California maximum contaminant level (MCL) of 45 mg/L), orange circles (between 45 and 90 mg/L) and dark red circles (greater than 90 mg/L). As shown on the figure, most nitrate concentrations are below the MCL throughout the KRGSA and KDWD. Multiple localized areas have at least one detection that has exceeded the MCL. Most of the elevated detections in the KDWD area are in agricultural areas with some detections near a dairy or a wastewater treatment facility. In addition, the detections are in rural areas where domestic septic systems may also be a contributing factor.

Pesticides

Pesticide impacts to groundwater can result from over-application in agricultural areas, landscaping/lawn and garden areas, and along roads and railways for weed control. Although pesticides are typically soluble in water, these compounds can be highly sorptive to soils, which may impede migration to underlying groundwater.

Pesticide data in the KRGSA and KDWD are displayed on **Figure 11**. Concentrations are shown as yellow circles for samples where no pesticides were detected and orange circles for samples that detected one or more pesticides. As shown on the figure, most wells did not detect any pesticides in groundwater. One or more pesticides were detected at various locations both inside and outside of current agricultural areas. As noted on **Figure 11**, none of the detections exceeded the respective MCL.

Constituents of Concern

In addition to the salts, nutrients, and pesticides discussed above, the KRGSA GSP identified two additional constituents of concern, 1,2,3-Trichloropropane (TCP) and arsenic, as a potential threat to drinking water supplies in the KRGSA. Neither of these constituents adversely impact crops and are not a concern for agricultural irrigation water.

TCP. 1,2,3-Trichloropropane (TCP) is a man-made chlorinated hydrocarbon that occurs as an intermediate in chemical manufacturing. TCP has been found throughout the Central Valley of California as a result of its inclusion in soil fumigants used in agriculture to control nematodes. Although TCP was banned from pesticides in the 1990s, its widespread occurrence in Kern County groundwater has been documented in agricultural areas. In 2017 the California Water Resources Control Board Division of Drinking Water (DDW) adopted an MCL of 0.005 micrograms per liter (ug/L) (5 parts per trillion, ppt) for TCP. TCP sampling data are compiled on **Figure 12**. Data are color-coded to reflect the maximum concentration detected at any given well. Green and yellow dots represent wells where TCP was either not detected or it was detected at concentrations below the 0.005 ug/L MCL. Red and purple dots represent wells with maximum detections up to twice the MCL and more than twice the MCL, respectively. The DDW is overseeing additional sampling requirements and compiling data for analysis. As indicated on the map, most of the TCP data generated to date have occurred in the metropolitan Bakersfield municipal wellfields in the northern KRGSA area and extending into the northern portion of KDWD. TCP treatment facilities have been installed on many impacted municipal wells as shown by the black diamonds on **Figure 12**.

Arsenic. Arsenic is a naturally-occurring trace element in the rocks, soils, and groundwater of the Kern County Subbasin. In general, elevated arsenic concentrations are correlated to deeper groundwater where the dissolved oxygen content is low, and pH is high. The California MCL for arsenic is 0.010 mg/L (10 ug/L). Arsenic concentrations are a constituent of concern primarily in the northern KRGSA where municipal wellfields have been impacted with elevated concentrations have impacted drinking water supplies as water levels have declined during the recent drought. Concentrations of arsenic in the northern KRGSA (including the northern portion of KDWD) are shown on **Figure 13**. Concentrations are

color-coded with green and yellow dots indicative of wells that have either not detected arsenic or detected it at lower levels only (below the MCL). Red dots and purple dots indicate wells that have detected arsenic at levels up to twice the MCL (20 ug/L) and above, respectively. Arsenic treatment facilities have been installed on wells as shown by the black diamonds.

Data on **Figure 13** indicate primary areas of elevated arsenic concentrations including a cluster of wells southeast of the intersection of Highways 58 and 99 and additional wells to the northwest, north of the Kern River and in the groundwater banking areas. For the wells in the southeastern portion of the map, most of the elevated arsenic concentrations occurred in the 1990s (see dates included on **Figure 13**). This occurrence may be attributable more to older laboratory methods for analysis of arsenic than actual elevated concentrations. Concentrations after about 2009 are generally below the MCL in almost all of these wells and most data do not support increasing trends. However, water supply wells farther south, owned by Greenfield County Water District GSA, have detected arsenic in past samples and two wells have been equipped with arsenic treatment (see southern-most wells on **Figure 13**, east of Highway 99). An additional municipal well in the area west of Highway 99 is also being treated for arsenic. In general, arsenic concentrations are lower west of Highway 99 and south of the Kern River.

4.2.3 Other Water Quality

Recycled water

Wastewater treated effluent from the City of Bakersfield's Wastewater Treatment Plants #2 and #3 is used for irrigation in the KDWD. Treated effluent quality is monitored and reported to the Regional Water Quality Control Board (RWQCB). Recycled water quality data from the Waste Discharge Requirements permit (WDR) is listed in **Table 28**.

Table 28. Recycled Water Quality

Constituent	Units	COB WWTP #2 Effluent[1]	COB WWTP #3 Effluent[2]
Chloride	mg/L	78	75
Sodium	mg/L	83	83
EC	umhos/cm	750	798
TDS	mg/L	413	446
Nitrate as Nitrogen	mg/L	6.0	0.46
Total Nitrogen	mg/L	-	27
Arsenic	ug/L	2.0	1.38
Lead	ug/L	1.62	-
Copper	ug/L	20	-
Iron	ug/L	-	0.16
Manganese	ug/L	-	0.01

1. From RWQCB-Central Valley Region Waste Discharge Requirements for City of Bakersfield Wastewater Treatment Plant #2 Order No. R5-2009-0122

2. From RWQCB-Central Valley Region Waste Discharge Requirements for City of Bakersfield Wastewater Treatment Plant #3 Order No. R5-2009-0087

Drainage
The District does not operate any drains and does not monitor water quality of privately operated drain water facilities.

4.2.4 Source Water Quality Monitoring

The City of Bakersfield monitors Kern River water quality at various locations along the Carrier and River Canals. Some data are compiled and included in the annual Hydrographic Reports developed for the Kern River. Additional monitoring occurs in compliance with the City and County Stormwater Permit, which includes a monitoring and reporting program approved by the Central Valley Water Board. The objectives of the monitoring are to assess the chemical, physical, and biological impacts of urban runoff on receiving waters, including the Kern River.

ID4 monitors the quality of its water sources (Kern River, SWP, and groundwater) and includes this information in its annual Report on Water Conditions.

Groundwater quality is also sampled in compliance with the State Water Board Long-Term Irrigated Lands Regulatory Program (ILRP). This program provides for waste discharge requirements from irrigated lands through surface water and groundwater monitoring. Owners or operators of irrigated lands may comply with the program either as individuals or through coalition groups. In the KDWD area, the Kern River Watershed Coalition Authority was formed to combine resources in order to monitor, review, analyze, and reduce the cost of compliance in the Kern River sub-watershed. The latest monitoring plan is detailed in the KRWCA's Groundwater Trend Monitoring Work Plan – Phase II Monitoring Network Addendum 2.0. There are four secondary wells (not yet being monitored) and five supplementary wells (monitored by local public water systems and reported to KRWCA) located in the KRGSA GSP area including several wells owned by KDWD. Selected wells in the ILRP monitoring program will be analyzed annually for nitrate concentrations; TDS will be analyzed on a five-year interval. In addition, the ILRP provides best-management practices (BMPs) for control of nitrate and TDS including BMPs for fertilizer application to control and manage nitrogen.

5 WATER BUDGET

This section summarizes the District water use and supply for the WY 2015 – WY 2019 time period. This water budget provides an overall picture of water use within the District and the ability of the available supplies to meet these water demands. A discussion of water management objectives follows the water budget section, and at the end of the section, the efficiency of agricultural water use is quantified.

5.1 QUANTIFYING KDWD'S WATER SUPPLIES

Water supplies available to KDWD include Kern River water, SWP water, recycled water, groundwater, recharged water, and effective precipitation. The District recharges additional Kern River and SWP water when available in its basins and canals. These water supply sources are discussed in Section 4 and **Table 29** tabulates water source quantities for WY 2015 – WY 2019.

Table 29. Water Supply Quantities (AF)

Source	Water Year 2015	Water Year 2016	Water Year 2017	Water Year 2018	Water Year 2019
Kern River[1]	68,158	85,092	123,348	105,038	124,040
SWP Contract[2]	100	11,430	4,229	12,957	13,605
WWTP Treated Effluent[3]	4,847	4,660	3,968	3,968	3,968
Banking Programs					
Water Banked for KDWD[4]	0	0	30,900	4,887	9,321
Water Banked for Others[5]	0	0	21,790	10,263	38,697
Operational Recharge[6]	35,241	55,202	72,306	70,367	64,854
Lower River Purchase[2]	0	0	4,781	0	1,438
Effective Precipitation[7]	28,474	37,211	41,175	27,968	46,740
District Well Pumping[8]	33,527	23,500	278	1,218	0
Private Pumping (Ag)[9]	166,237	161,951	126,632	174,294	154,520
Municipal and Industrial Pumping[10]	9,168	8,858	11,107	13,678	8,102
Total	**336,585**	**379,047**	**429,408**	**410,961**	**457,183**

1. From Table 23. Based on the Kern River Annual Reports - deliveries to KDWD service areas (COB, 2014-2020)
2. From Table 23. Based on the Kern River Annual Reports (COB, 2014-2020)
3. From Table 25. Estimated average treated effluent deliveries to lands within KDWD
COB #2 SW irrigation in KDWD based on METRIC ET demands of area (WY17-WY19 assumes no change from WY16)
COB #3 SW irrigation in KDWD based on measured deliveries demands of area (WY18-WY19 assumes no change from WY17)
4. From Table 20. Includes Grower Recharge program (5,155 AF in WY 2017)
5. From Table 20. Includes direct recharge and conveyance recharge for others
6. From Table 20.

7. From Table 11. Based on numerical modeling developed for the KRGSA GSP (Todd, 2020b) and Kern County Subbasin Annual Report (Todd, 2020a)
8. From Table 24. Pumping from District owned groundwater wells
9. From Table 24. Private Groundwater pumping is total crop water needs from Table 18 minus surface water supply minus groundwater from District wells minus effective precipitation.
10. From Table 19

5.1.1 Other Water Sources Quantities

The District does not operate any surface or subsurface drains nor are there flows to saline sinks. There are flows to perched water that may be recoverable, but this small amount of water has not been quantified.

5.2 Quantification of Water Uses

Water use within the District is summarized in **Table 30**. It includes crop consumption, water that was recharged via District basins or canals (operational recharge), and water pumped for M&I use be wells owned by the City of Bakersfield, Cal Water, Lamont PUD, and Greenfield CWD. Section 3 provides additional details on these water uses.

Table 30. Quantify Water Use (AF)

Water Use	Water Year 2015	Water Year 2016	Water Year 2017	Water Year 2018	Water Year 2019
Crop Consumptive Use[1]	237,197	255,348	246,303	259,813	278,645
Operational Recharge[2]	35,241	55,202	72,306	70,367	64,854
Environmental Use	0	0	0	0	0
Municipal/Industrial[3]	9,168	8,858	11,107	13,678	8,102
Transfers or Exchanges[4]	0	0	0	0	0
Groundwater Recharge[5]	0	0	52,690	15,150	48,018
Total	**281,606**	**319,408**	**382,406**	**359,009**	**399,619**

1. From Table 17
2. From Table 20
3. From Table 19
4. Banking program return is not included here since returns are made by exchange of surface supplies not delivered to the District and not included in Table 29
5. From Table 20. Includes recharge for KDWD and for others

5.3 Annual Water Budget

Water budget inflows are summarized in **Table 31**. Inflows include all the water delivered to agricultural customers. It does not include groundwater recharge since the recharge components would be considered both an inflow (surface water into the District) and an outflow (recharged to the groundwater basin). In addition, M&I pumping is also not included in the inflow and outflow tables since it would also be considered an inflow (pumping within District) and an outflow (delivery for M&I use).

Table 31. Water Budget Inflows (AF)

Inflow Component	AWMP Location for Supporting Calculations	How Quantified?	Uncertainty	How Quantified?	Water Year 2015	Water Year 2016	Water Year 2017	Water Year 2018	Water Year 2019
Effective Precipitation[1]	Section 3.2	Modeled	+/- 10%	Estimated	28,474	37,211	41,175	27,968	46,740
Water Supplier surface water diversions[1]	Sections 3.2, 4.1.1	Measured	+/- 5 to 10%	Estimated	68,258	96,522	144,574	121,286	148,484
Water supplier groundwater pumping[1]	Sections 3.2, 4.1.2	Measured	+/- 2%	Estimated	33,527	23,500	278	1,218	0
Private groundwater pumping[1]	Section 3.2	Estimated	+/- 20%	Estimated	166,237	161,951	126,632	174,294	154,520
WWTP irrigation[1]	Sections 3.2, 4.1.3	Measured	+/- 5 to 10%	Estimated	4,847	4,660	3,968	3,968	3,968
Total					**301,344**	**323,845**	**316,628**	**328,735**	**353,712**

1. From Table 11. Pumping from District owned groundwater wells is used to return banked water to out of District banking partners through surface water exchanges

Outflows are shown on **Table 32** and include crop consumptive use and deep percolation of applied water. There are no quantified surface water outflows. The deep percolation term was calculated and is the difference between total inflows used for agriculture (**Table 31**) minus crop consumptive use and is a balancing term for the water budget. The magnitudes of deep percolation values for 2015 to 2019 are similar to the values generated with the model update (Todd, 2020a).

Table 32. Water Budget Outflows (AF)

Outflow Component	AWMP Location for Supporting Calculations	How Quantified?	Uncertainty	How Quantified?	Water Year 2015	Water Year 2016	Water Year 2017	Water Year 2018	Water Year 2019
Crop Consumptive Use[1]	Section 3.2	Calculated and Estimated	+/- 20%	Estimated	237,197	255,348	246,303	259,813	278,645
Surface Outflows	NA	NA	NA	NA	0	0	0	0	0
Deep Percolations[2]	Section 3.6	Estimated	+/- 20%	Estimated	64,146	68,497	70,325	68,922	75,068
Total					**301,344**	**323,845**	**316,628**	**328,735**	**353,712**

1. From Table 17
2. Difference between total inflows used for agriculture (Table 31) minus crop consumptive use

5.4 IDENTIFY WATER MANAGEMENT OBJECTIVES

KDWD has developed water management objectives (WMOs) to improve long-term planning and resiliency, adapt to climate change, and improve regional self-reliance. These WMOs are listed and discussed below.

- Encourage more efficient water use at the farm level
- Optimize conjunctive management of imported SWP water and local Kern River water with groundwater resources through direct use and groundwater banking and recovery

- Implement Kern River Groundwater Sustainability Agency projects and management actions applicable to KDWD
- Operate within the established KRGSA GSP sustainable management criteria.

Encourage More Efficient Water Use at the Farm Level

Efficient water use by landowners can reduce water demands if growers are made aware of more efficient practices and if these practices are cost effective. The District encourages more efficient water use at the farm level in many ways and will continue to do so as technology and new methods or options becomes available. The District measures all water delivered to customers and water pricing is generally based on quantity delivered. The customers can use this as a benchmark to track reduced water use and save money. The District contributes to the North West Kern Resource Conservation District (NWKRCD) which provides technical assistance to landowners to allow them to make the best use of their land and irrigation water. Landowners can receive technical assistance regarding improvements to on-farm irrigation systems through the NWKRCD. The District provides information on NWKRCD's Mobile Lab on its website (https://www.kerndelta.org/irrigationmobilelab), and landowners are encouraged to take advantage of the NWKRCD services.

Optimize Conjunctive Management of Imported SWP Water and Local Kern River Water with Groundwater Resources Through Direct Use and Groundwater Banking and Recovery

Conjunctive use of water in the Kern County Subbasin is a key component of sustainable water supplies. KDWD is optimizing conjunctive management, groundwater banking, and best use of additional source water (such as recycled water), as available. Groundwater banking consists of numerous strategies including intentional recharge along unlined canals, in-District banking for out-of-basin participants, and out-of-District banking for both recovery and overdraft protection. In addition, the District incorporates out-of-basin storage in Isabella Reservoir to maximize use of its surface water rights. Finally, the District is active in optimization of all local water sources obtained through cooperative transfers, exchanges, and agreements with other water districts and even shared recharge facilities.

Implement Kern River Groundwater Sustainability Agency Projects and Management Actions Applicable to KDWD

The KRSGA GSP (Todd, 2020b) identified projects and management actions to achieve groundwater sustainability. Key ones applicable to KDWD include its Water Allocation Plan (WAP) (Todd, 2011). The WAP was developed to optimize the use of Kern River water available to the District, provide operational flexibility, and maximize the beneficial use of its Kern River water rights. It prioritizes Kern River water use as follows:

1. Irrigation deliveries within each Service Area
2. Irrigation deliveries within the District
3. Municipal and industrial use
4. In-District groundwater recharge
5. Pioneer Project groundwater recharge
6. Other uses (including meeting additional surface demands, groundwater recharge, and transfers to out-of-district agencies).

Another project is the increase in use of recycled water within the KDWD area. The City will increase recycled water use inside of the KRGSA from its WWTP No. 3 in 2026 when a contract for use outside of the KRGSA expires (about 72 percent is currently used outside of the KRGSA).

Annual KRGSA GSP reports will document the status of these projects and identify additional ones if needed.

Operate Within the Established KRGSA GSP Sustainable Management Criteria
The KRGSA GSP identified sustainable management criteria for applicable sustainability indicators under SGMA (chronic lowering of water levels, reduction of groundwater in storage, degraded water quality, inelastic land subsidence, and depletion of interconnected surface water[5]). Each sustainability indicator relevant to the KRGSA is related to water levels; accordingly, water levels are used as a proxy for setting the sustainable management criteria, including minimum thresholds (MTs) and measurable objectives (MOs), for all of the indicators.

A monitoring network was designed to support the KRGSA GSP Sustainability Goal by providing the ability to detect undesirable results. The GSP Sustainability Goal is to manage groundwater sustainably to support beneficial uses and to optimize conjunctive use of surface water, imported water, and groundwater. The District leads implementation of the GSP in the Agricultural Management Area (MA), which encompasses the KDWD Service Area. Annual reporting demonstrates the implementation of the GSP including monitoring and management in accordance with the GSP. The GSP is re-evaluated every five years to determine if additional actions are needed to meet the sustainability goal.

The District is actively implementing each of these four WMOs. Additional information on implementation of the EWMPs is provided in Section 7.

5.5 QUANTIFY THE EFFICIENCY OF AGRICULTURAL WATER USE

For the AWMP, suppliers are to quantity the efficiency of agricultural water use within its service area using one or more of the four provided water use efficiency quantification methods developed by DWR and documented in A Proposed Methodology for Quantifying the Efficiency of Agricultural Water Use (DWR, 2012). The method chosen must account for all of the applicable water uses:

Method 1: Crop Water Use
Method 2: Agronomic Water Use
Method 3: Environmental Water Use
Method 4: Recoverable Flows

Method 1 (Crop Water Use) and Method 4 (Recoverable Flows) are applicable to KDWD and are provided below. KDWD has little agronomic or environmental water use within its service area.

Method 1: Crop Consumptive Use Fraction
The Method 1 calculation quantifies the efficiency of applied irrigation water consumed directly for crop growth. The crop consumptive use fraction (CCUF) for WY 2015- WY 2019 are shown in **Table 33**. The CCUFs are all around 80 percent, which is the irrigation efficiency assumed for irrigation of crops with KDWD.

Method 4: Water Management Fraction
Method 4 documents the amount of water that is recoverable for reuse. For KDWD, this includes deep percolation of irrigation water, operational recharge, and groundwater recharge. The water

[5] A sixth sustainability indicator for seawater intrusion is not applicable to conditions in the Kern County Subbasin.

management fraction (WMF) for WY 2015- WY 2019 are shown in **Table 34**. The recoverable flows values include groundwater recharge for the District, 11 percent of the groundwater recharge conducted for others, operational recharge, and deep percolation of irrigation return flows. An 11 percent conveyance loss is retained by KDWD in its banking agreements with others. The WMFs are all over 1, indicative of the positive water management, primarily as a result of the intentional groundwater recharge that occurs within KDWD.

Table 33. Crop Consumptive Use Fraction

Water Year	Evapotranspiration of Applied Water (ETAW)[1] (Acre-feet/Year)	Applied Water (AW)[1] (Acre-feet/Year)	Crop Consumptive Use Fraction (No units)
WY 2015	237,197	296,497	0.80
WY 2016	255,348	319,184	0.80
WY 2017	246,303	307,878	0.80
WY 2018	259,813	324,767	0.80
WY 2019	278,645	348,306	0.80

1. From Table 17

Table 34. Water Management Fraction

Water Year	Evapotranspiration of Applied Water (ETAW)[1] (Acre-Feet per Year)	Recoverable Flows (RF)[2] (Acre-Feet per Year)	Applied Water (AW)[1] (Acre-Feet per Year(	Water Management Fraction (No units)
WY 2015	237,197	99,387	296,497	1.14
WY 2016	255,348	123,699	319,184	1.19
WY 2017	246,303	195,321	307,878	1.43
WY 2018	259,813	154,439	324,767	1.28
WY 2019	278,645	187,940	348,306	1.34

1. From Table 17

2. From Table 20. Includes groundwater recharge for District, others, canal seepage and deep percolation of irrigation return flows

6 CLIMATE CHANGE

Climate change factors that have the potential to affect the District and its water supplies include:

- Changes in water demand
- Decreased water supply
- Extreme weather events.

Climate change impacts were modeled for the KRGSA GSP (Todd, 2020b) and are described in this section. The District encompasses the southern half of the KRGSA GSP area as shown on **Figure 1**.

The 2030 Climate Change Conditions: represented by reductions in water supply and increases in water demand using DWR climate change factors and guidance. For the KRGSA, further reductions in SWP water availability provided by KCWA/DWR (2070 climate change tables) for ID4 and KDWD were incorporated. Increases in urban demand were estimated using the same methodology as applied in baseline conditions (see description above). Agricultural demand was increased by an average of about four percent based on decreases in effective precipitation and higher estimates of potential ET as provided by DWR. DWR climate change guidance also includes a change in the timing of Kern River flows, with more winter/early spring flows and less summer flows. However, the total volume of the Kern River does not change significantly.

2070 Climate Change Conditions: represented by further reductions to the 2030 Climate Change conditions for water supply and additional increases in water demand using DWR climate change factors and guidance. For the KRGSA, reductions in SWP amounts for ID4 and KDWD were incorporated from KCWA/DWR 2070 SWP availability data. Increases in urban demand were estimated using the same methodology as applied in baseline conditions. Increases in agricultural demand of approximately seven percent were based on DWR guidance for 2070 conditions of precipitation and potential ET.

As shown in **Table 35**, SWP water availability is projected to decline under baseline and both climate change conditions. Agricultural demand increases under climate change conditions as a result of higher potential evaporation and lower precipitation (i.e., hotter and drier conditions). Urban demand is projected to increase based on an increase in population and changes in per capita water demand, as documented in the individual Urban Water Management Plans (UWMPs) of the primary water purveyors. A decline in urban demand from baseline to 2030 conditions is due to a decrease in per capita water demand for future conditions as indicated in the UWMPs.

Kern River supply is not included in **Table 35** because it is not associated with a significant future deficit. Although there are projected changes in the monthly timing and flows for the Kern River under both 2030 and 2070 Climate Change conditions, the total average annual flows in the River are not expected to decline significantly.

Table 35. Projected Climate Change Impacts on Water Supply

Water Budget Component	Historical Average Annual Amounts (AFY)	Baseline Conditions (AFY)	2030 Climate Change Conditions (AFY)	2070 Climate Change Conditions (AFY)
SWP[1] – ID4	74,035	52,758	51,182	48,759
SWP - KDWD	18,655	15,765	15,294	14,537
TOTAL SWP	92,690	68,523	66,476	63,296
Net decrease in SWP from historical:		**24,167**	**26,214**	**29,394**
Agriculture Demand	261,019	261,019	271,460	281,460
Urban Demand[2]	167,970	182,290	178,115	254,117
TOTAL DEMAND	428,989	443,309	449,575	535,577
Net increase in demand from historical:		**14,320**	**20,586**	**106,588**
Potential Future Water Budget Deficits[3]:		-38,487	-46,800	-135,982
Deficit from Historical Water Budget[4]:		-29,153	-29,153	-29,153
Combined Future Water Budget Deficits:		**-67,640**	**-75,953**	**-165,135**

Reference: Table 4-14 from KRGSA GSP (Todd, 2020b)

[1] Table A Allocation and Article 21 water

[2] Baseline Conditions urban demand from WY 2013. Urban demand for 2030 based on area-weighted population growth (average 1.1% annually) and per capita water demand estimates from UWMPs (average 248 gpcd). Population growth rates for the County (0.8% annually) used for years 2040 through 2070.

[3] Sum of net decrease in SWP and net increase in demand from data in upper table.

[4] Remaining average annual deficits from adjusted checkbook method of the historical water budget.

KDWD's Drought Plan (**Appendix E**) consists of optimizing conjunctive management, groundwater banking, and best use of additional source water (such as recycled water) as available. In brief, District landowners are incentivized to rely on surface water resources when available to preserve groundwater resources for use in drought conditions. Groundwater banking consists of numerous strategies including intentional recharge along unlined canals, in-District banking for out-of-basin participants, and out-of-District banking for both recovery and overdraft protection. In addition, the District incorporates out-of-basin storage in Isabella Reservoir. Finally, the District is active in optimization of all local water sources obtained through cooperative transfers, exchanges, and agreements with other water districts and even shared recharge facilities. Incorporations of these policies and strategies as components of the Drought Plan are summarized in the sections below.

The potential decreases in supply and increases in demand in **Table 35** were used to develop appropriate projects and management actions that target a sustainable water budget as part of the KRGSA GSP (Todd, 2020b).

7 WATER USE EFFICIENCY INFORMATION

7.1 EFFICIENT WATER MANAGEMENT PRACTICES IMPLEMENTATION AND REPORTING

EWMPs are best management practices implemented to improve water use efficiency. The California Water Code mandates that AWMPs address a specific list of 16 EWMPs: 2 critical and 14 conditional. These EWMPs are summarized in **Table 36**. Twelve of the 16 EWMPs have been fully or partially implemented. EWMPs that have not been implemented are listed in **Table 37**. EWMPs only need to be implemented if they are locally cost-effective and technically feasible. Three of the 14 conditional EWMPs have not been implemented; all three are not locally cost-effective and one is not technically feasible.

Table 36. EWMPs Implemented or Planned

Report of EWMPs Implemented/Planned (Water Code §10608.48(d), §10608.48 (e), and §10826 (e))		
EWMP No.	**Description of EWMP Implemented**	**Description of EWMPs Planned**
Critical EWMPs		
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) (10608.48(b)).*	All deliveries to District customers are measured using either metered or gated turnouts (see Sections 2.2.2 and Appendix E).
2	*Adopt a pricing structure for water customers based at least in part on quantity delivered (10608.48(b)).*	Water pricing is based on the volume of water delivered (see Section 2.2.3 and Appendix E).
Conditionally Required EWMPs (locally cost-effective and technically feasible EWMPs)		
1	*Facilitate alternative land use for lands with exceptionally high water duties or whose irrigation contributes to significant problems, including drainage.*	The District contributes to the North West Kern Resource Conservation District (NWKRCD) which provides technical assistance to landowners to allow them to make the best use of their land and irrigation water. Landowners are encouraged to take advantage of the NWKRCD services.
2	*Facilitation of use of available recycled water that otherwise would not be used beneficially, meets health and safety criteria, and does not harm crops or soils. The use of recycled urban wastewater can be an important element in overall water management.*	Recycled urban wastewater is currently used for agricultural irrigation within the District.
3	*Facilitate the financing of capital improvements for on-farm irrigation systems.*	Landowners are able to receive technical assistance regarding improvements to on- farm irrigation systems through the NWKRCD.
4	*Implement an incentive pricing system that promotes one of the following goals (A) more efficient water use at the farm level such that it reduces waste, (B) conjunctive use of groundwater, (C) Appropriate use of groundwater recharge, (D) Reduction in problem drainage (E) Improved management of environmental resources (F) Effective management of all water sources throughout*	The KDWD has established a pricing structure for surface water that is tied directly to the quantity of surface water used. This promotes the efficient use of water supplies since customers have to pay for all water deliveries. SWP supplies are priced so that those supplies will be utilized in-lieu of groundwater pumping.

Report of EWMPs Implemented/Planned
(Water Code §10608.48(d), §10608.48 (e), and §10826 (e))

EWMP No.	Description of EWMP Implemented	Description of EWMPs Planned
	the year by adjusting seasonal pricing structures based on current conditions.	
5	*Expand line or pipe distribution systems, construct regulatory reservoirs to increase distribution system flexibility and capacity, decrease maintenance, and reduce seepage.*	Most of the District's irrigation deliveries are supplied through unlined canals and ditches which allow for groundwater recharge through operational recharge. The District considers this a benefit and does not have plans to expand canal lining or pipelining. Some reaches of the canals and ditches have been lined or pipelined as urban development has encroached into the District service area.
6	*Increase flexibility in water ordering by, and delivered to, water customers within operational limits.*	The District has increased its flexibility in water ordering and deliveries through the supplies and facilities available from its groundwater banking programs, including groundwater recharge basins and District owned wells.
7	*Construct and operate supplier spill and tail-water systems.*	The District does not operate spill and tail- water systems. Due to water quality concerns, landowner spill and tail-water is not allowed in the KDWD delivery system.
8	*Increase planned conjunctive use of surface water and groundwater within the supplier service area.*	The District has increased its conjunctive use activities through the implementation of its groundwater banking and surface water exchange programs. The District has extended canals to serve additional customers.
9	*Automate canal control devices.*	While the KDWD has automated many of its metering devices, the KDWD does not have any automated canal control devices.
10	*Facilitate or promote customer pump testing and evaluation.*	The District encourages the use of PG&E or pump companies for customer well pump testing and evaluations.
11	*Designate a water conservation coordinator who will develop and implement the water management plan and prepare progress reports.*	The District plans to designate a staff member to serve as the Water Conservation Coordinator.
12	*Provide for the availability of water management services to water users. These services may include, but are not limited to, all of the following: A. On-farm irrigation and drainage system evaluations, B. Normal year and real-time irrigation scheduling and crop evapotranspiration information, C. Surface water, groundwater, and drainage water quantity and quality data, D. Agricultural water management educational programs and materials for farmers, staff, and the public.*	These services are available to KDWD customers through the District and the agencies that it supports. The NWKRCD provides on-farm evaluations, irrigation scheduling information is available through the California Irrigation Management System (CIMIS), and the KCWA provides water management educational programs and materials. Surface and groundwater quality data is available from the District, the KCWA and the California DWR. The District encourages the use of these services.
13	*Evaluate the policies of agencies that provide the supplier with water to identify the potential for institutional change to allow more flexible water deliveries and storage.*	The District works with the KCWA, Friant Water Users, and Kern River interests to execute water exchanges that allow for more flexible water deliveries and storage.
14	*Evaluate and improve the efficiencies of the supplier's pumps.*	The KDWD routinely evaluates the condition and efficiency of its existing pumps as a part of its on-going maintenance program.

Table 37. Non-Implemented EWMPs

Non-Implemented EWMP Documentation (Water Code §10608.48(d), §10608.48 (e), and §10826 (e))				
EWMP No.	**Description**	***(check one or both)***		**Justification/Documentation***
		Technically Infeasible	**Not Locally Cost-Effective**	
5	Expand lining or pipelining		X	Unlined canals provide groundwater recharge benefits to the District service area that would be lost by canal lining or pipelining. Lining the 127 miles of the District's unlined canals would not be cost effective. Short sections of canals have been lined or pipelined as a part of urban development projects. This practice will continue where it is feasible with the District's operations.
7	Supplier spill and tail-water systems	X	X	Tail-water systems are operated by individual customers. The District does not want potentially poor quality water to enter its canals and create water quality issues for its customers.
9	Automate canal controls		X	It is not believed that installation of automatic canal controls would result in significant water savings. Due to the length of canals and the size of the District's service area, implementation of an automated canal control system would not be cost effective at this time.

Estimates of water use efficiency improvements that have occurred since the 2015 AWMP and estimates of water use efficiency improvements estimated to occur 5 and 10 years in the future are listed in **Table 38**.

Table 38. EWMPs Efficiency Improvements

Report of EWMPs Efficiency Improvements (Water Code §10608.48(d), §10608.48 (e), and §10826 (e))		
EWMP No.	**Estimate of Water Use Efficiency Improvements That Occurred Since Last Report** ***(Quantitative or Descriptive)***	**Estimated Water Use Efficiency Improvements 5 and 10 years in future** ***(Quantitative or Descriptive)***
Critical		
1 -Water Measurement	No change since last AWMP	Moderate
2 - Volume-Based Pricing	Slight	Slight

Report of EWMPs Efficiency Improvements
(Water Code §10608.48(d), §10608.48 (e), and §10826 (e))

EWMP No.	Estimate of Water Use Efficiency Improvements That Occurred Since Last Report *(Quantitative or Descriptive)*	Estimated Water Use Efficiency Improvements 5 and 10 years in future *(Quantitative or Descriptive)*
Conditional		
1 – Alternate Land Use	Slight Conversion of agricultural land to urban	Moderate Conversion of agricultural land to urban
2 – Recycled Water Use	Slight	Slight
3 – On-Farm Irrigation Capital Improvements	No change since last AWMP	Moderate
4 – Incentive Pricing Structure	Slight	Slight
5 – Infrastructure Improvements	No change since last AWMP	None
6 – Order/Delivery Flexibility	Moderate WAP allocation of Kern River supplies	Moderate KRGSP implementation measures
7 – Supplier Spill and Tailwater Systems	Not applicable. No change since last AWMP	None. Not applicable
8 – Conjunctive Use	Moderate Groundwater banking, WAP, purchase Pioneer Project water	Moderate KRGSP implementation measures, purchase Pioneer Project water when available, banking expansion
9 – Automated Canal Controls	No change since last AWMP	SCADA measurement devices at headworks of canals, District will consider expanding into service areas
10 – Customer Pump Test/Eval.	Slight	Slight
11 – Water Conservation Coordinator	Slight	Slight
12 – Water Management Services to Customers	Slight	Slight
13 – Identify Institutional Changes	Moderate Implementation of WAP	Moderate KRGSP implementation measures
14 – Supplier Pump Improved Efficiency	Slight	Slight

7.2 EWMP IMPLEMENTATION SCHEDULE

The schedule to implement EWMPs appears in **Table 39**.

Table 39. Schedule to Implement EWMPs

Schedule to Implement EWMPs ((Water Code §10608.56 (d))			
EWMP No.	**Implementation Schedule**	**Finance Plan**	**Budget Allotment**
Critical			
1 – Water Measurement	Implemented	Annual District Budget	Staff time
2 - Volume-Based Pricing	Implemented	Annual District Budget	Staff time
Conditional			
1 – Alternate Land Use	Implemented	Annual District Budget	$4,000
2 – Recycled Water Use	Implemented	Annual District Budget	Staff time
3 – On-Farm Irrigation Capital Improvements	Partially Implemented	Annual District Budget	Part of NWKRCD contributions (see EWMP #1)
4 – Incentive Pricing Structure	Implemented	Annual District Budget	Staff time
5 – Infrastructure Improvements	Partially Implemented	Annual District Budget	Staff time
6 – Order/Delivery Flexibility	Implemented	Annual District Budget	Staff time
7 – Supplier Spill and Tailwater Systems	Not Implemented	NA	NA
8 – Conjunctive Use	Implemented	Annual District Budget	Staff time, capital for land purchases
9 – Automated Canal Controls	Not Implemented	NA	NA
10 – Customer Pump Test/Eval.	Implemented	Annual District Budget	Staff time
11 – Water Conservation Coordinator	Planned Implantation	Annual District Budget	Staff time
12 – Water Management Services to Customers	Implemented	Annual District Budget	Staff time

Schedule to Implement EWMPs ((Water Code §10608.56 (d))			
EWMP No.	**Implementation Schedule**	**Finance Plan**	**Budget Allotment**
13 – Identify Institutional Changes	Implemented	Annual District Budget	Staff time
14 – Supplier Pump Improved Efficiency	Implemented	Annual District Budget	Staff time

8 SUPPORTING DOCUMENTATION

8.1 AGRICULTURAL WATER MEASUREMENT REGULATION DOCUMENTATION

Agricultural water suppliers are to follow critical efficient management practices identified in California Water Code §597. These include that the water delivered to customers be measured with a sufficient accuracy to comply with subdivision (a) of §531.10 and to adopt a pricing structure for water customers based at least in part on quantity delivered. Agricultural water suppliers are to submit an annual report to DWR that summarizes aggregated farm-gate delivery data, on a monthly or bimonthly basis, using best professional practices. The District's water measurement methods and quality control procedures are described in its Water Deliveries Report, 2017, in **Appendix E**. Its pricing structure (**Table 10**) includes rates based on water delivered.

The District assesses the condition and performance of the measurement devices as a part of its on-going maintenance program. The District follows the flow meter testing and calibration program procedures outlined in the SBX7-7 Compliance for Agricultural Irrigation Districts prepared by the Irrigation Training and Research Center (ITRC, 2012).

KDWD measures almost all of its delivered water at the delivery point or farm-gate of single customers but there are a couple of exceptions where the District measures an overpour upstream of a turnout (at the weir). In these cases, measurements are taken at the overpour (not far upstream from the customer gate) because this measurement was determined to be more reliable than the turnout measurement. In a few cases, the canal system ends in a grower's reservoir where there is no gate, so the overpour is measured at the reservoir.

There are a few farm-gate deliveries that cannot be measured at the gate itself. This is due to the gate being submerged on both ends thus nullifying the procedures outlined in the SBX7-7 compliance procedures and the US Bureau of Reclamation's handbooks. These gates are measured just upstream in the canal using a standard sharp crested weir overpour procedure.

8.2 DELTA PLAN CONSISTENCY

An agricultural water supplier that anticipates participating in or receiving water from a proposed project that involves transferring water through, exporting water from, or using water in the Sacramento-San Joaquin Delta (Delta) should consider providing information in their 2015 and 2020 AWMPs that can then be used in the covered action process to demonstrate consistency with the Delta Plan policy WR P1, *Reduce Reliance on the Delta Through Improved Regional Water Self-Reliance* (California Water Code, Title 23, § 5003). KDWD receives SWP water and has included this section in the AWMP to qualitatively demonstrate reduced reliance on Delta water.

KDWD has used an historical average of 18,655 AFY of SWP water. For the KRGSA GSP (Todd, 2020b), KDWD's baseline use of SWP water was 15,765 AFY. Future use projections were reduced to 15,294 AFY by 2030 and 14,537 AFY by 2070. These projections were developed to simulate potential climate change impacts (**Table 35**). A comparison of historic, baseline and projected SWP water use is provided in **Table 40**.

Table 40. Historical, Baseline and Project SWP Water Use

Use of State Water Project Water Supplies				
	Historical Average Annual Amount	KRGSA GSP Baseline Amount	2030 Climate Change Conditions	2070 Climate Change Conditions
Average Annual Supplies[1] (acre-feet)	18,655	15,765	15,294	14,537
Percent of Historical Average Supplies	-	85%	82%	78%
Percent Reduction in Supplies	-	15%	18%	22%

1. From Table 35

SWP water is only about 5 percent of the District's water supply sources. This is based on an estimated average annual supply of 320,000 AFY (**Table 31**: Kern River, SWP, recycled water, groundwater) and a SWP supply of 15,765 AFY.

As stated in multiple sections of this AWMP, KDWD is optimizing conjunctive management, groundwater banking, and best use of additional source water (such as recycled water) as available. Groundwater banking consists of numerous strategies including intentional recharge along unlined canals, in-District banking for out-of-basin participants, and out-of-District banking for both recovery and overdraft protection. In addition, the District incorporates out-of-basin storage in Isabella Reservoir. Finally, the District is active in optimization of all local water sources obtained through cooperative transfers, exchanges, and agreements with other water districts and even shared recharge facilities.

Several factors enhance KDWD's resilience to reduced reductions in supplies. Most notable are the conjunctive management programs including conveyance, distribution, recharge and use in the KDWD and surrounding area. Examples of local conjunctive use include (but are not limited to) the following:

- Storage space in Isabella Reservoir is managed for Kern River water and, by exchange, imported SWP water.
- Recycled water is used for recharge and irrigation.
- Kern River water is intentionally discharged to unlined canals to promote surface water operational recharge and groundwater recharge.
- Recharge basins and banking programs in the area and managed recharge in the Kern River Channel.
- Water banking programs are active with participation by local agencies and out-of-basin agencies.

The District is a participant in ongoing, planned, and future programs to strengthen and diversify its water sources and provide flexibility in years with limited water supply. This diversification of water sources (Kern River, SWP, groundwater, recycled water) coupled with conjunctive use (intentional canal recharge, in-district banking programs, and out-of-district/in-basin banking programs) provides the

District with extensive operational flexibility. This flexibility results in optimizing use of available water supplies, especially during drought times.

The District's WAP (Todd, 2011) allows for optimization of the District's surface water allowing more groundwater supplies to be available throughout the District during periods when surface water supplies are limited. The District has historically and will continue to purchase excess water in Pioneer Storage Project, just northwest of the KDWD, for overdraft protection. Because water recharged for this purpose will not be recovered, it provides both groundwater replenishment and a rise in groundwater levels in northwestern KDWD. Also, growers in KDWD use recycled water (obtained from the City of Bakersfield) for irrigation, which decreases local reliance on groundwater resources and provides an alternative agricultural water source even in drought conditions.

The KRGSA GSP (Todd, 2020b) identified projects and management actions to achieve groundwater sustainability that will also result in reduced reliance on Delta supplies because groundwater can be used during times of limited surface water supply. By using all of its Kern River entitlement (less obligations) conjunctively with imported water and recycled water supplies, the KRGSA is implementing six Phase One projects that collectively provide:

- Increases in recharge and banking to offset potential future deficits and avoid overdraft
- Decreases in municipal and agricultural pumping
- Optimal conjunctive management of surface water and groundwater resources
- Improvements in drinking water quality for disadvantaged communities
- Mitigation for the potential of land subsidence in disadvantaged communities.

Three water supply projects have been identified to meet potential future deficits in the historical and projected water budgets, thereby reducing the potential for future overdraft conditions while providing adequate supply to support projected demands. One project provides for demand reduction with increased urbanization of former agricultural lands. Two water quality projects provide improvements to drinking water quality for disadvantaged communities (DACs) in the KRGSA. A summary of the six Phase One water supply projects is provided in **Table 41**. Additional details and status of these projects and additional future projects can be found in the KRGSA GSP annual reports.

Incorporation of these policies and strategies will assist with the reduction in reliance on Delta water.

Table 41. Phase One Project Summary for KRGSA GSP

Project	Description	New KRGSA Water Supply
Water Allocation Plan	KDWD plans to use its full Kern River entitlement as prioritized in its Water Allocation Plan (WAP) for the Agricultural MA. The WAP total average supply has been corrected for planned sales to NKWSD.	20,797 AFY
Kern River Optimized Conjunctive Use	The City plans to use its full Kern River entitlement, less current obligations, to mitigate undesirable results for water levels and water quality in the Urban MA.	89,619 AFY
Expand Recycled Water Use in the KRGSA	The City will increase recycled water use inside of the KRGSA from its WWTP No. 3 in 2026 when a contract for use outside of the KRGSA expires (about 72% is currently used outside of the KRGSA).	11,556 to 13,407 AFY
Conversion of Agricultural Lands to Urban Use	Approximately 10,000 acres of current KRGSA agricultural lands is expected to be urbanized; this future urban demand is already included in the projected water budget, so 100% of this agricultural water use represents a demand reduction.	27,000 AFY
ENCSD North Weedpatch Highway Water System Consolidation	Up to six small water systems in the northeast KRGSA will be consolidated into the ENCSD system for benefits to drinking water quality, including to disadvantaged communities (DACs).	No new supply; improved water quality to DACs
Possible Water Exchange	KRGSA member agencies can perform exchanges of surface water and groundwater for benefits to water quality, including to DACs	No new supply; improved water quality to DACs

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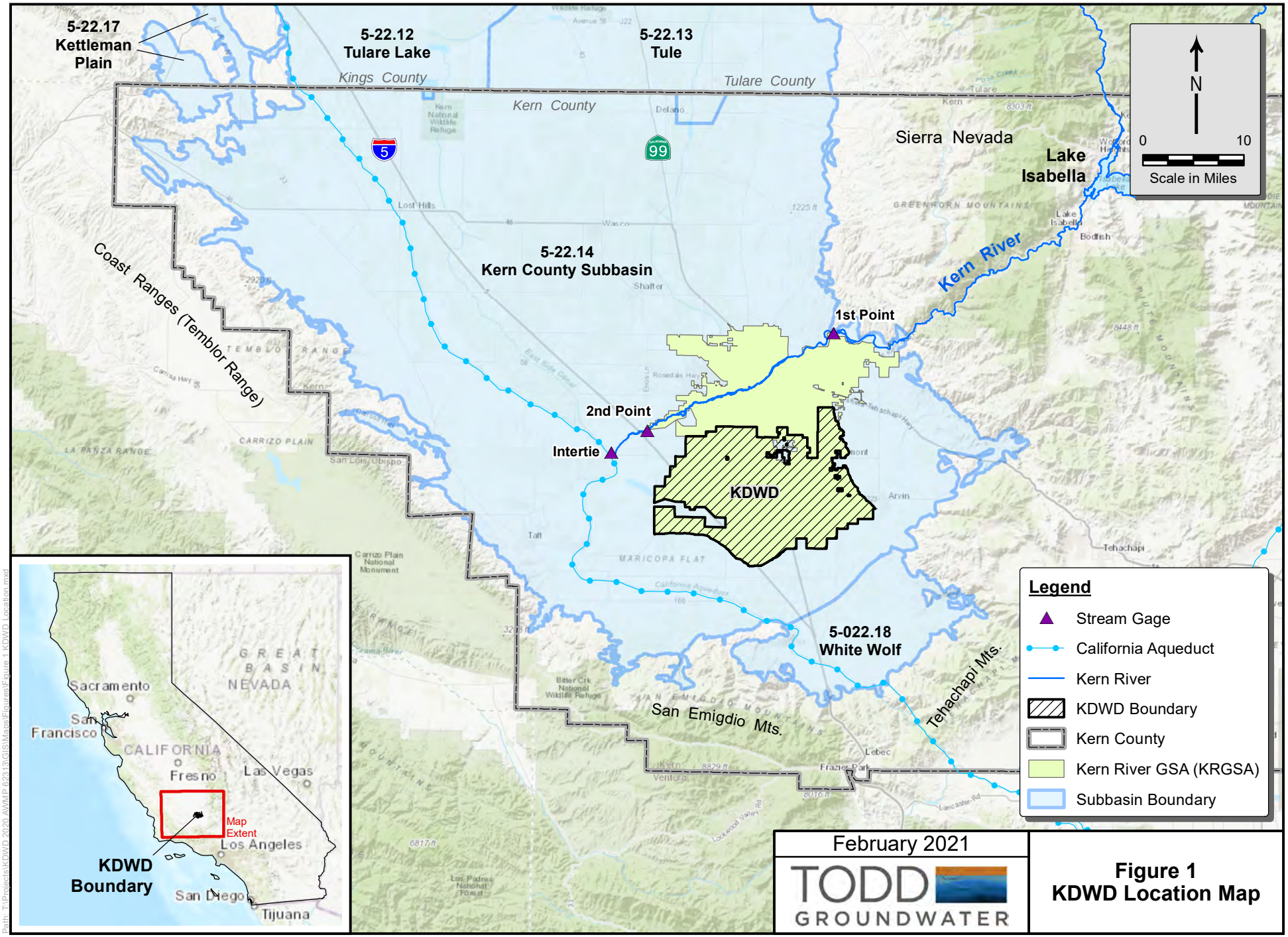
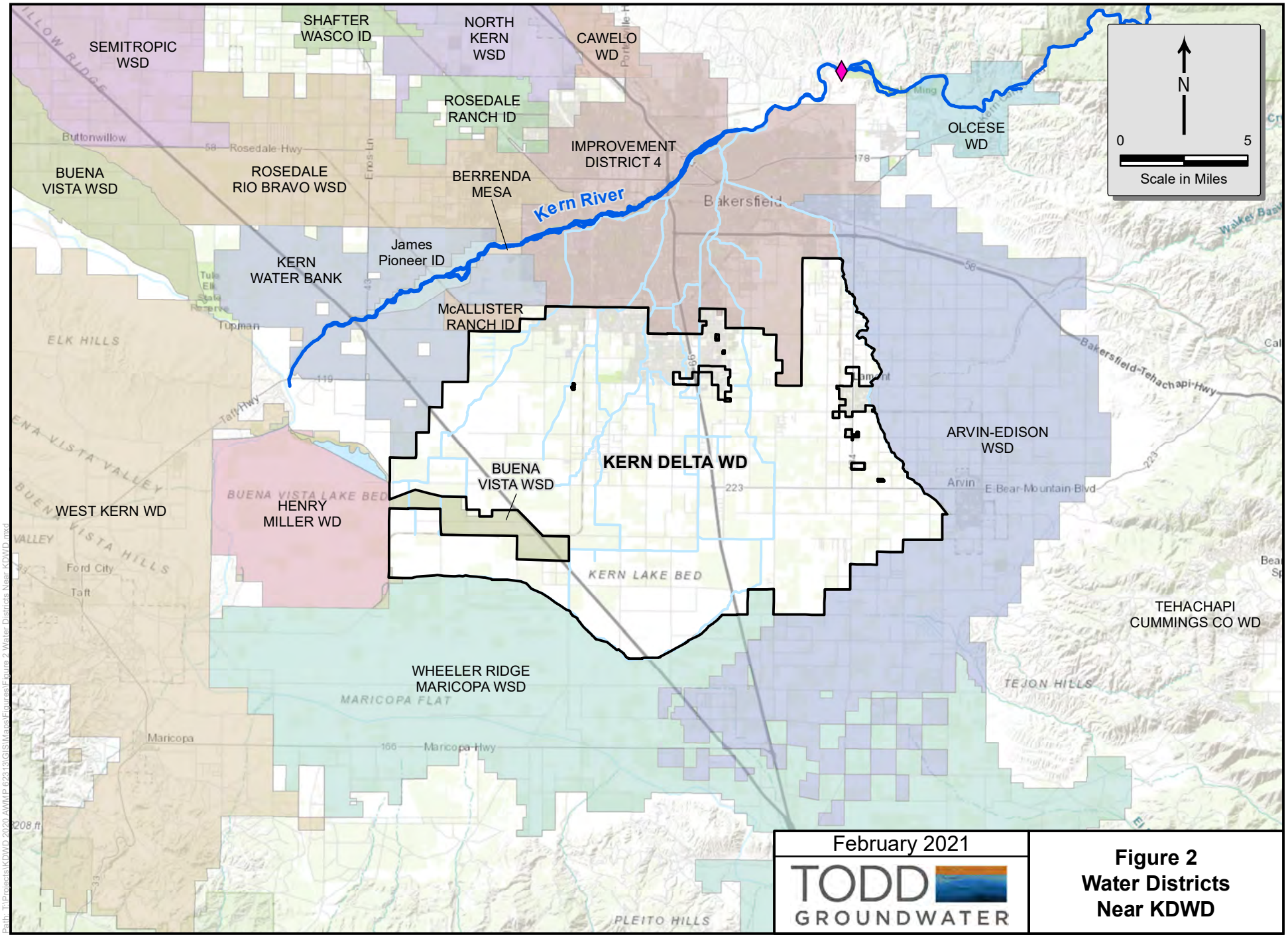
FIGURES


5-22.17
Kettleman
Plain
5-22.12
Tulare Lake
5-22.13
Tule
Kings County
Kern County
Tulare County
Sierra Nevada
Lake
Isabella
N
0
10
Scale in Miles
5-22.14
Kern County Subbasin
Coast Ranges (Temblor Range)
Kern River
1st Point
2nd Point
Intertie
KDWD
5-022.18
White Wolf
San Emigdio Mts.
Tehachapi Mts.
Legend
Stream Gage
California Aqueduct
Kern River
KDWD Boundary
Kern County
Kern River GSA (KRGSA)
Subbasin Boundary
GREAT BASIN
NEVADA
Sacramento
San Francisco
CALIFORNIA
Fresno
Las Vegas
Los Angeles
San Diego
Tijuana
Map Extent
KDWD Boundary
February 2021
TODD GROUNDWATER
Figure 1
KDWD Location Map

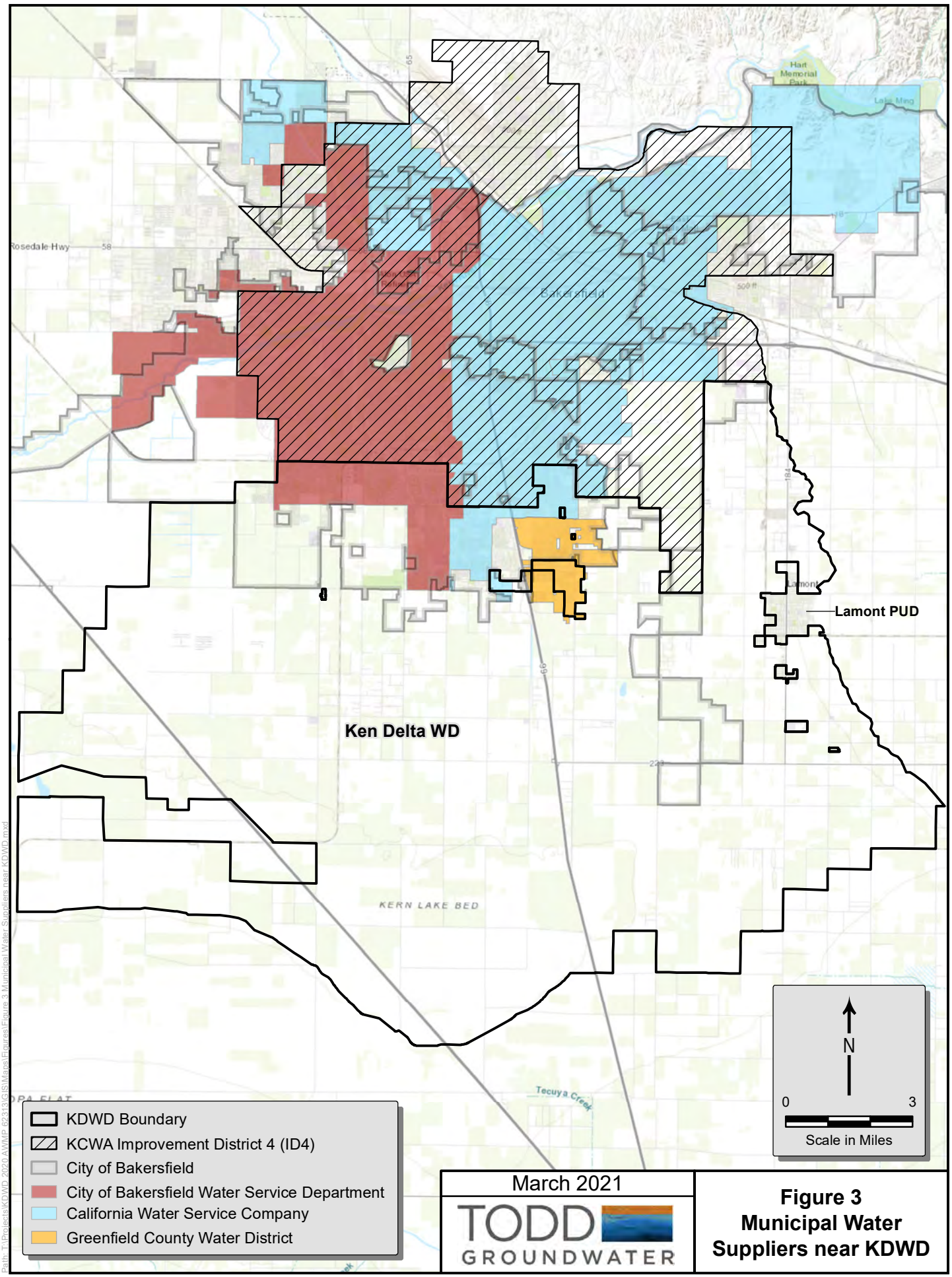


February 2021

TODD GROUNDWATER

Figure 2
Water Districts Near KDWD

Path: T:\Projects\KDWD 2020 AWMP 823.13\GIS\Maps\Figures\Figure 2 Water Districts Near KDWD.mxd

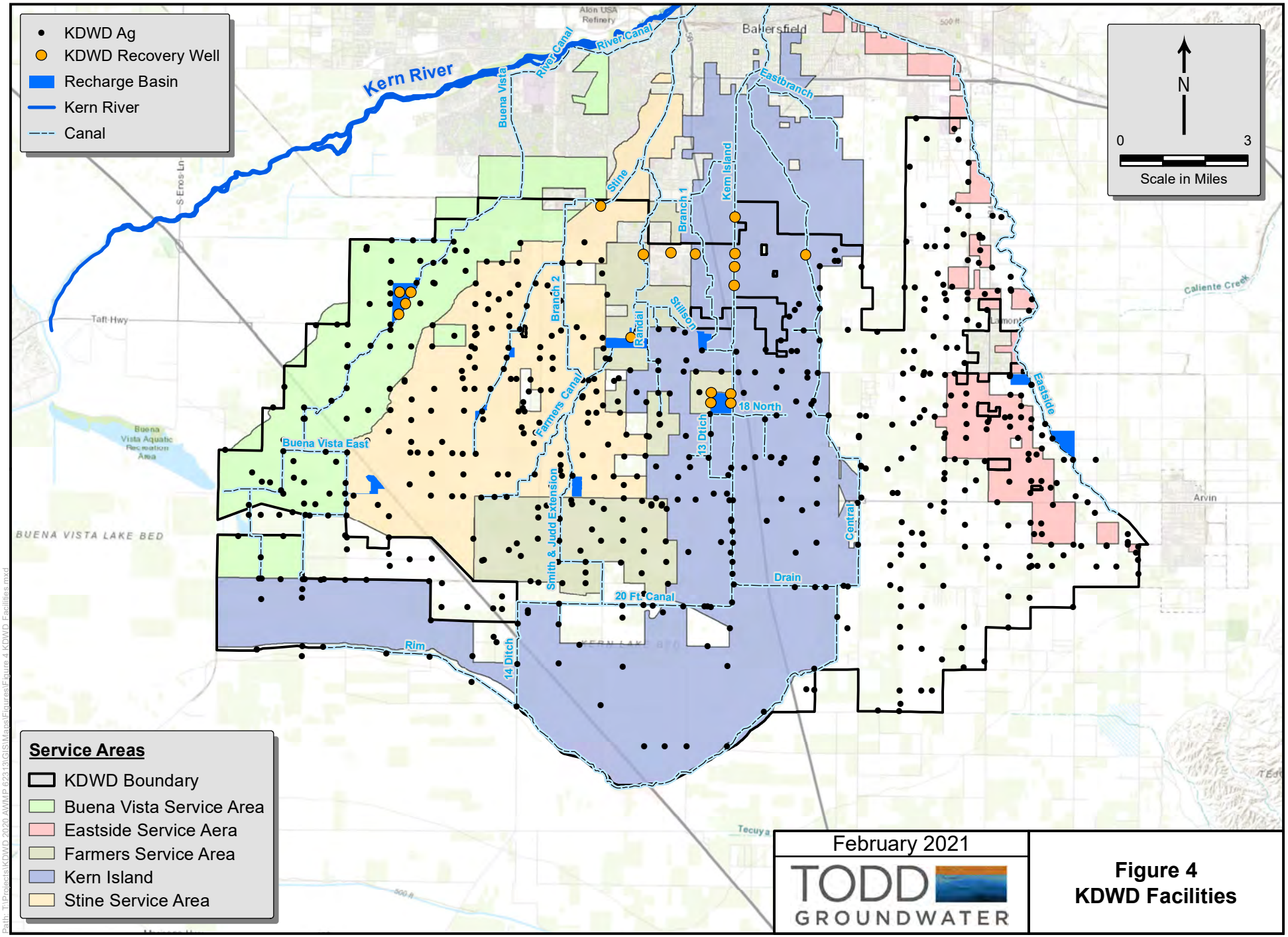


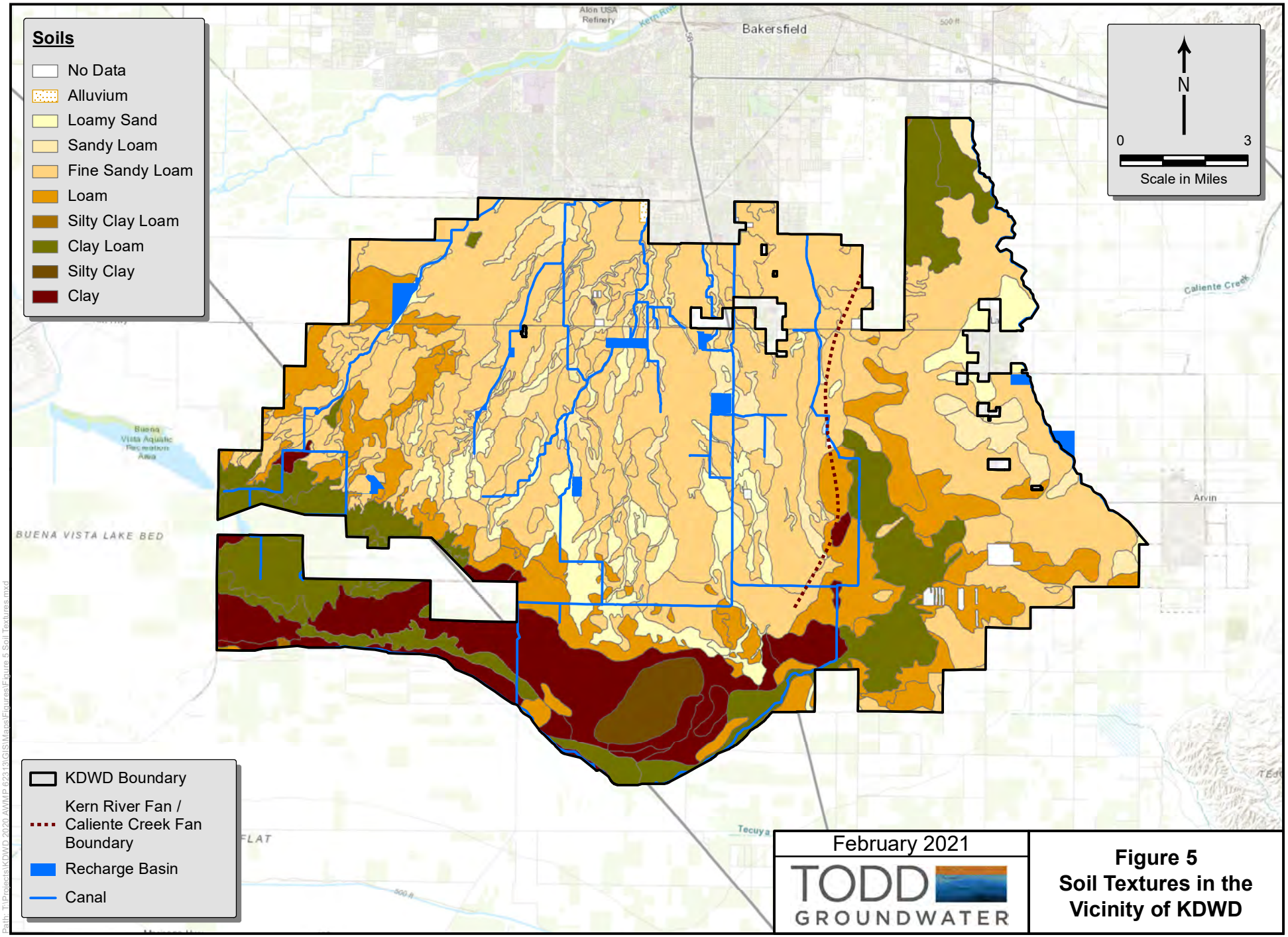
March 2021

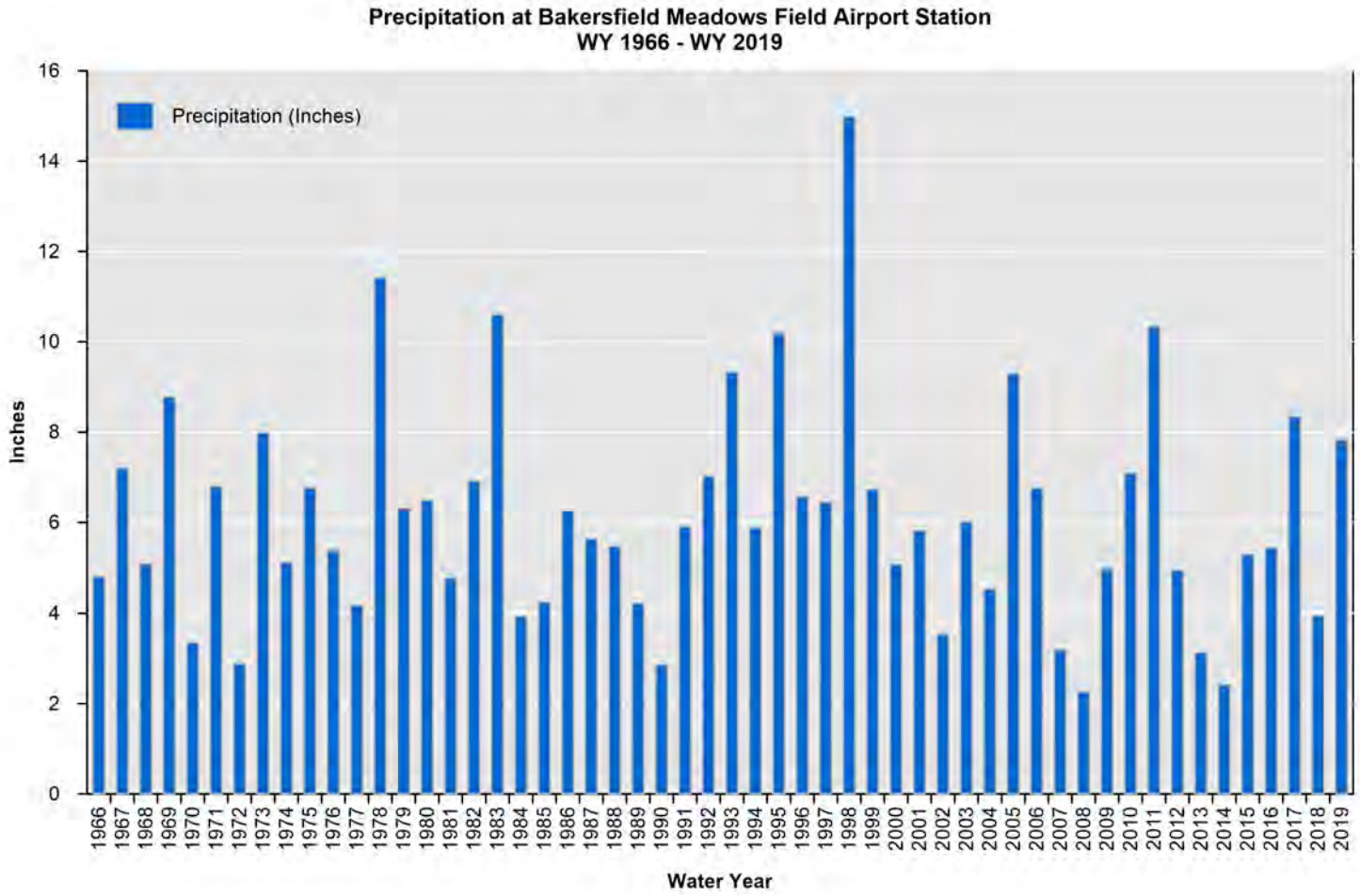
TODD GROUNDWATER

Figure 3
Municipal Water Suppliers near KDWD

Path: T:\Projects\KDWD 2020 AWMP 62313\GIS\Maps\Figures\Figure 3 Municipal Water Suppliers near KDWD.mxd


KDWD Ag
KDWD Recovery Well
Recharge Basin
Kern River
Canal
N
0
3
Scale in Miles
Kern River
Buena Vista
River Canal
Stine
Branch 1
Kern Island
Eastbranch
Branch 2
Rand
Stillwell
Farmers Canal
18 North
13 Ditch
Buena Vista East
Smith & Judd Extension
Central
Drain
20 Ft. Canal
Rim
14 Ditch
Eastside
Caliente Creek
Bakersfield
Arvin
Taft Hwy
BUENA VISTA LAKE BED
Service Areas
KDWD Boundary
Buena Vista Service Area
Eastside Service Aera
Farmers Service Area
Kern Island
Stine Service Area
February 2021
TODD GROUNDWATER
Figure 4
KDWD Facilities


Soils
No Data
Alluvium
Loamy Sand
Sandy Loam
Fine Sandy Loam
Loam
Silty Clay Loam
Clay Loam
Silty Clay
Clay
N
0
3
Scale in Miles
Bakersfield
Alon USA Refinery
Kern River
Caliente Creek
Buena Vista Aquatic Recreation Area
BUENA VISTA LAKE BED
Arvin
Tecuya
FLAT
KDWD Boundary
Kern River Fan / Caliente Creek Fan Boundary
Recharge Basin
Canal
February 2021
TODD GROUNDWATER
Figure 5
Soil Textures in the Vicinity of KDWD

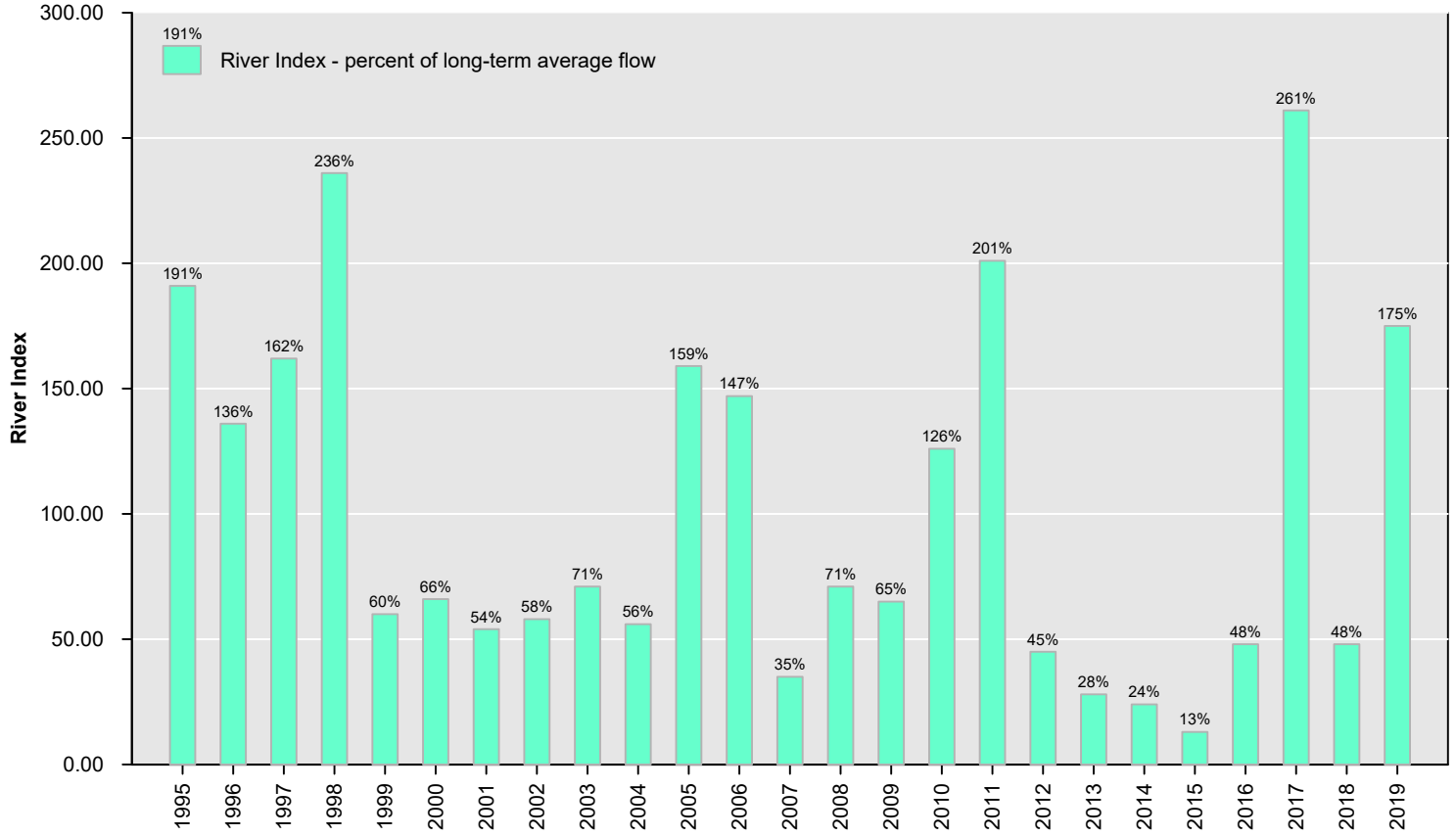


Source: NOAA, 2020

February 2021

TODD GROUNDWATER

Figure 6
Precipitation at Bakersfield Meadows Field Airport Station

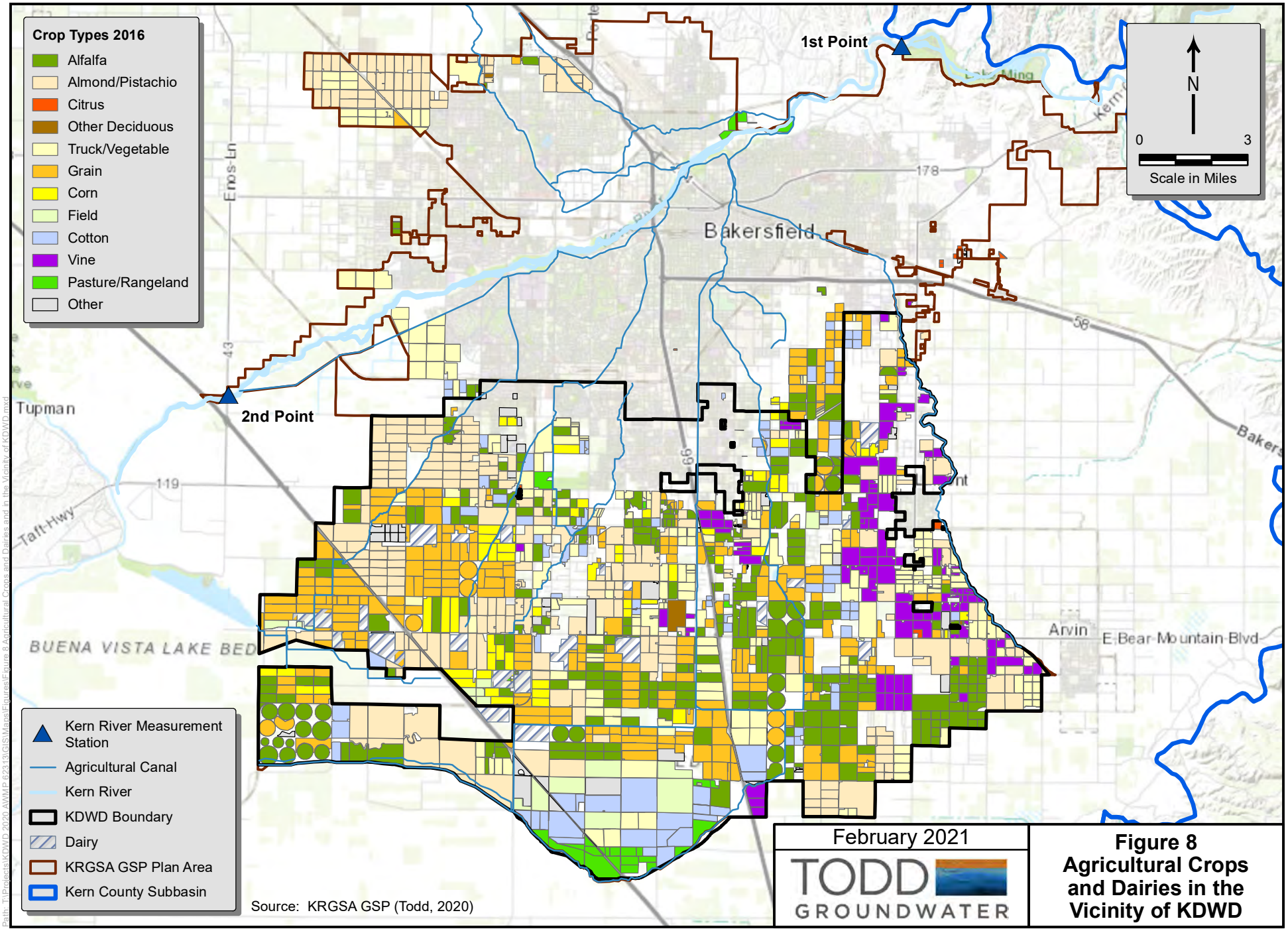


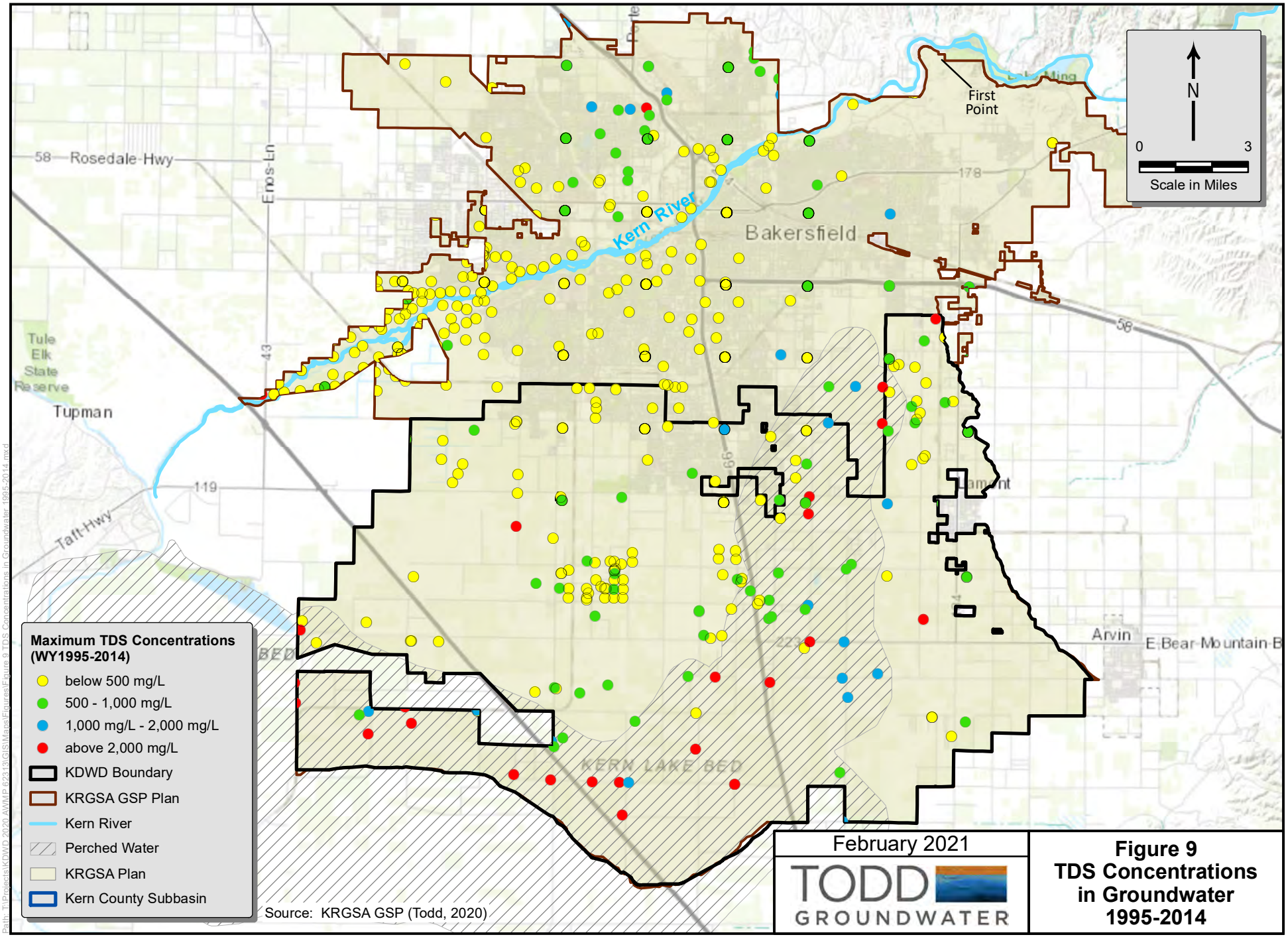
Data Sources:
Kern River Hydrographic Reports (COB 2019, 2020)

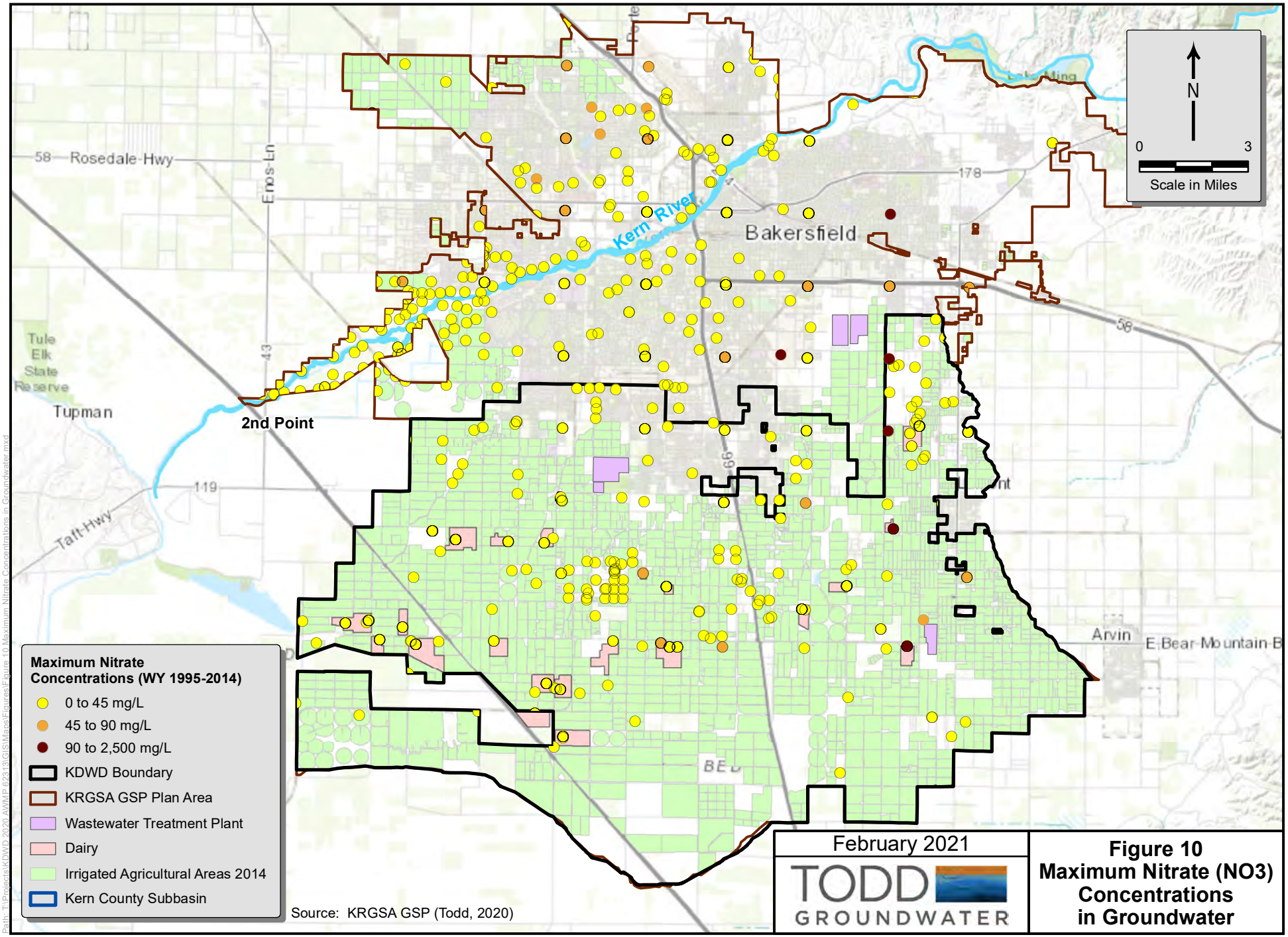
February 2021

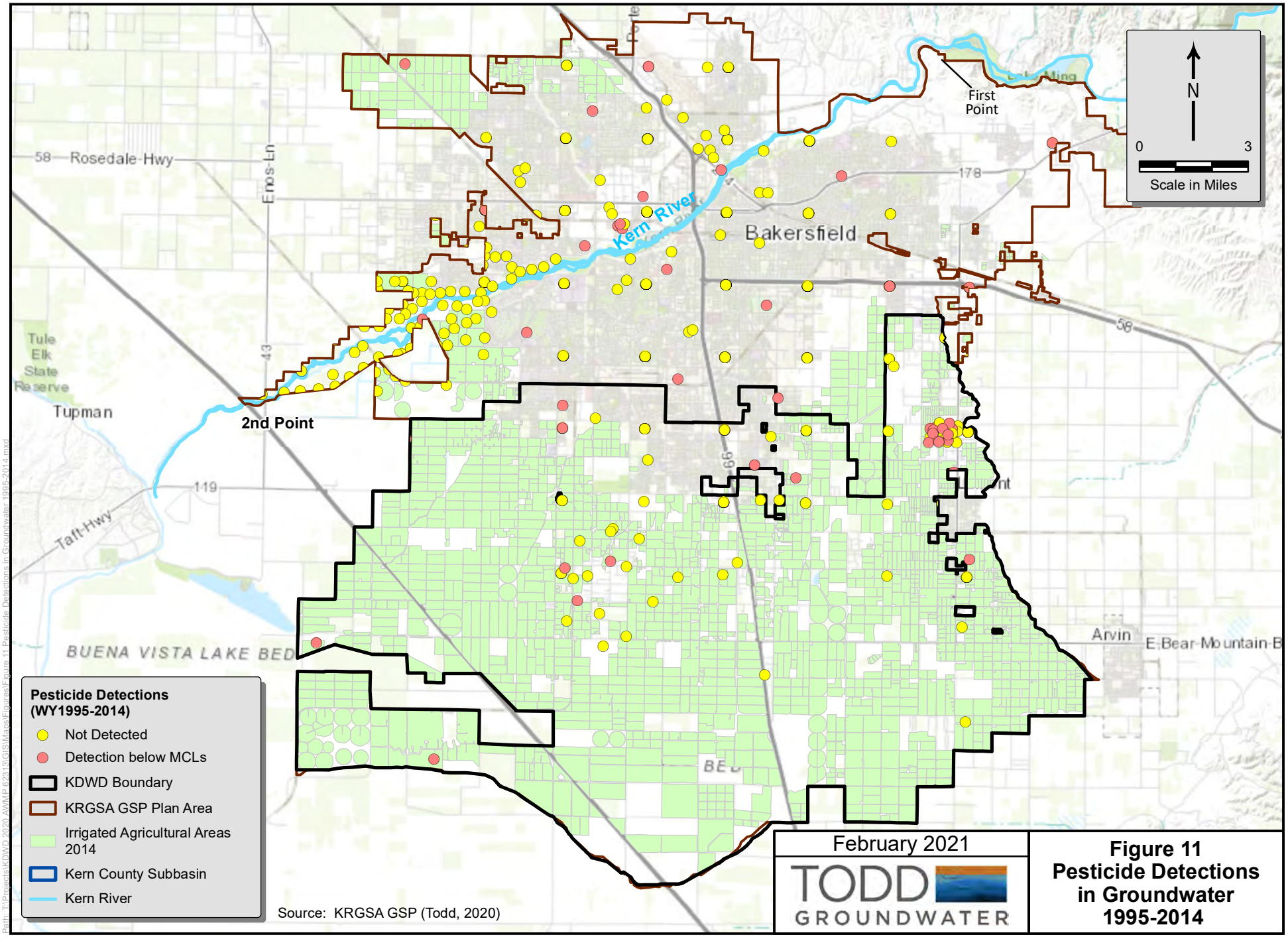
TODD GROUNDWATER

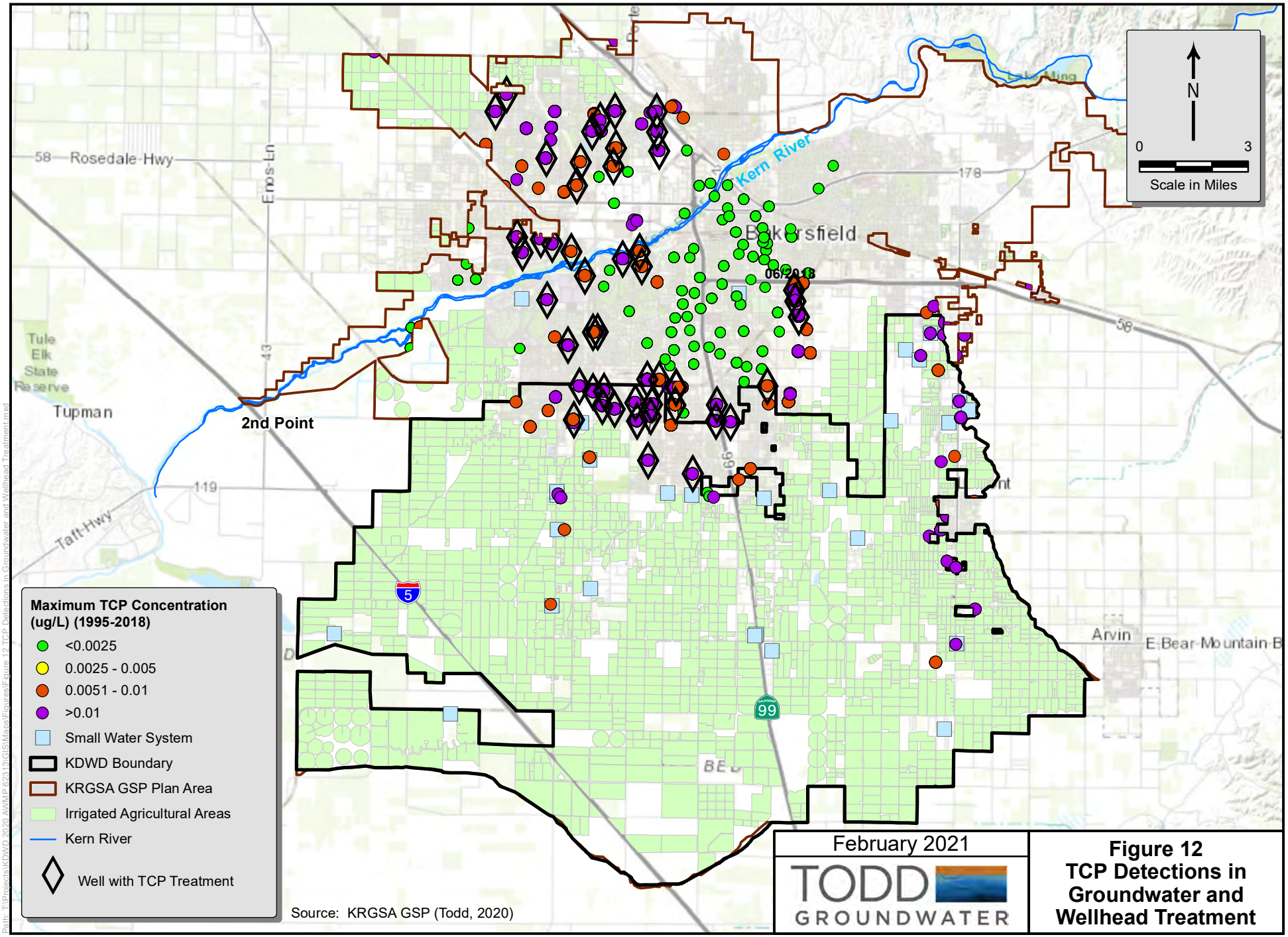
Figure 7
Kern River Indices
1995-2019

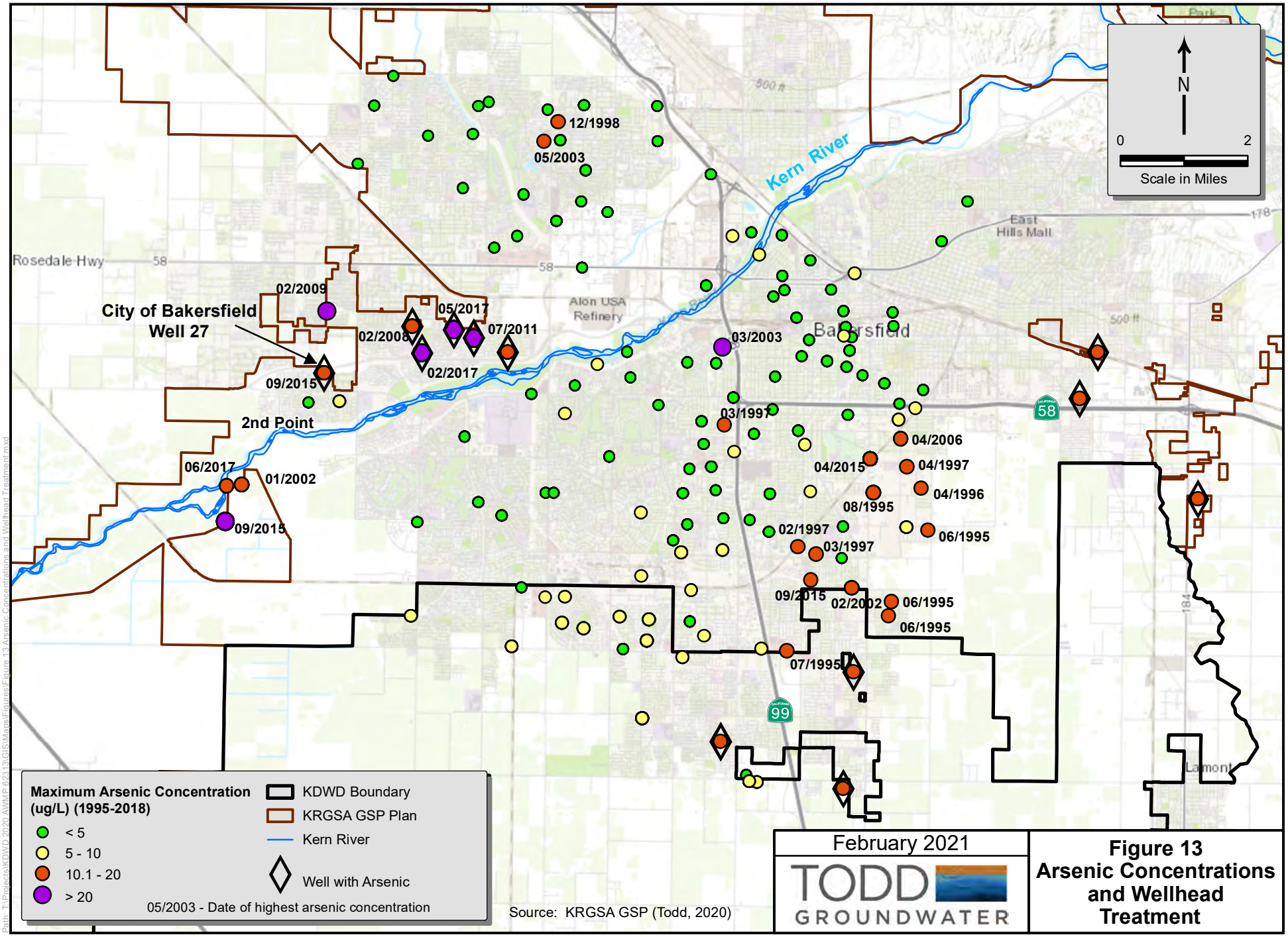

Crop Types 2016
Alfalfa
Almond/Pistachio
Citrus
Other Deciduous
Truck/Vegetable
Grain
Corn
Field
Cotton
Vine
Pasture/Rangeland
Other
1st Point
2nd Point
N
0
3
Scale in Miles
Bakersfield
Tupman
Taft Hwy
Arvin
E Bear Mountain Blvd
BUENA VISTA LAKE BED
Kern River Measurement Station
Agricultural Canal
Kern River
KDWD Boundary
Dairy
KRGSA GSP Plan Area
Kern County Subbasin
Source: KRGSA GSP (Todd, 2020)
February 2021
TODD GROUNDWATER
Figure 8
Agricultural Crops and Dairies in the Vicinity of KDWD


Maximum TDS Concentrations (WY1995-2014)
below 500 mg/L
500 - 1,000 mg/L
1,000 mg/L - 2,000 mg/L
above 2,000 mg/L
KDWD Boundary
KRGSA GSP Plan
Kern River
Perched Water
KRGSA Plan
Kern County Subbasin
Source: KRGSA GSP (Todd, 2020)
N
0
3
Scale in Miles
First Point
Bakersfield
Kern River
58 Rosedale Hwy
Enos Ln
Tule Elk State Reserve
Tupman
Taft Hwy
119
178
58
Arvin
E Bear Mountain B
KERN LAKE BED
February 2021
TODD GROUNDWATER
Figure 9
TDS Concentrations in Groundwater 1995-2014


N
0
3
Scale in Miles
Bakersfield
Kern River
58 Rosedale Hwy
Enos Ln
178
58
Tule Elk State Reserve
Tupman
2nd Point
43
119
Taft Hwy
99
Arvin
E Bear Mountain B
Maximum Nitrate Concentrations (WY 1995-2014)
0 to 45 mg/L
45 to 90 mg/L
90 to 2,500 mg/L
KDWD Boundary
KRGSA GSP Plan Area
Wastewater Treatment Plant
Dairy
Irrigated Agricultural Areas 2014
Kern County Subbasin
Source: KRGSA GSP (Todd, 2020)
February 2021
TODD GROUNDWATER
Figure 10
Maximum Nitrate (NO3) Concentrations in Groundwater


First Point
2nd Point
Kern River
Bakersfield
Rosedale Hwy
Enos Ln
Tupman
Tule Elk State Reserve
Taft Hwy
BUENA VISTA LAKE BED
Arvin
E Bear Mountain B
58
178
119
43
99
N
0
3
Scale in Miles
Pesticide Detections (WY1995-2014)
Not Detected
Detection below MCLs
KDWD Boundary
KRGSA GSP Plan Area
Irrigated Agricultural Areas 2014
Kern County Subbasin
Kern River
Source: KRGSA GSP (Todd, 2020)
February 2021
TODD GROUNDWATER
Figure 11
Pesticide Detections in Groundwater 1995-2014


Maximum TCP Concentration (ug/L) (1995-2018)
<0.0025
0.0025 - 0.005
0.0051 - 0.01
>0.01
Small Water System
KDWD Boundary
KRGSA GSP Plan Area
Irrigated Agricultural Areas
Kern River
Well with TCP Treatment
Source: KRGSA GSP (Todd, 2020)
N
0
3
Scale in Miles
Kern River
Bakersfield
2nd Point
Tupman
Tule Elk State Reserve
Rosedale Hwy
Taft Hwy
Arvin
E Bear Mountain B
06/2018
February 2021
TODD GROUNDWATER
Figure 12
TCP Detections in Groundwater and Wellhead Treatment


N
0
2
Scale in Miles
Kern River
Rosedale Hwy
58
Alon USA Refinery
East Hills Mall
Bakersfield
Lamont
99
City of Bakersfield Well 27
2nd Point
12/1998
05/2003
02/2009
05/2017
02/2008
07/2011
02/2017
09/2015
03/2003
03/1997
04/2006
04/2015
04/1997
04/1996
08/1995
02/1997
06/1995
03/1997
09/2015
02/2002
06/1995
06/1995
07/1995
06/2017
01/2002
09/2015
Maximum Arsenic Concentration (ug/L) (1995-2018)
< 5
5 - 10
10.1 - 20
> 20
KDWD Boundary
KRGSA GSP Plan
Kern River
Well with Arsenic
05/2003 - Date of highest arsenic concentration
Source: KRGSA GSP (Todd, 2020)
February 2021
TODD GROUNDWATER
Figure 13
Arsenic Concentrations and Wellhead Treatment

APPENDIX A

AWMP Checklist

Appendix A AWMP Checklist

AWMP Section	Guidebook Location	Description	Water Code Section (or as identified)
1	1.4	AWMP Required?	10820, 10608.12
1, 3.2	1.4	At least 25,000 irrigated acres	10853
Not applicable	1.4	10,000 to 25,000 acres and funding provided	10853
1.3	1.4	April 1, 2021 update	10820 (a)
1.3	1.4 A.2	**Added to the Water Code:** Added to the Water Code: AWMP submitted to DWR no later than 30 days after adoption; AWMP submitted electronically	**New to the Water Code:** 10820(a)(2)(B)
1	1.4 B	5-year cycle update	10820 (a)
Not applicable	1.4 B	New agricultural water supplier after December 31, 2012 - AWMP prepared and adopted within 1 year	10820 (b)
Not applicable	1.6, 5	USBR water management/conservation plan:	10828(a)
Not applicable	1.6, 5.1	Adopted and submitted to USBR within the previous four years, AND	10828(a)(1)
Not applicable	1.6, 5.1	The USBR has accepted the water management/conservation plan as adequate	10828(a)(2)
Not applicable	1.4 B	UWMP or participation in area wide, regional, watershed, or basin wide water management planning: does the plan meet requirements of SB X7-7 2.8	10829
1.1	3.1A	Description of previous water management activities	10826(d)
1.2, Table 1	3.1 B.1	Was each city or county within which supplier provides water supplies notified that the agricultural water supplier will be preparing or amending a plan?	10821(a)
1.2	3.2 B.2	Was the proposed plan available for public inspection prior to plan adoption?	10841
1.2.1, Appendix B	3.1 B.2	Publicly-owned supplier: Prior to the hearing, was the notice of the time and place of hearing published within the jurisdiction of the publicly owned agricultural water supplier in accordance with Government Code 6066?	10841
1.2	3.1 B.2	14 days notification for public hearing	GC 6066

AWMP Section	Guidebook Location	Description	Water Code Section (or as identified)
1.2, Appendix B	3.1 B.2	Two publications in newspaper within those 14 days	GC 6066
1.2, Appendix B	3.1 B.2	At least 5 days between publications? (not including publication date)	GC 6066
Not applicable	3.1 B.2	Privately-owned supplier: was equivalent notice within its service area and reasonably equivalent opportunity that would otherwise be afforded through a public hearing process provided?	10841
1.3	3.1 C.1	After hearing/equivalent notice, was the plan adopted as prepared or as modified during or after the hearing?	10841
1.2, Table 1	3.1 C.2	Was a copy of the AWMP, amendments, or changes, submitted to the entities below, no later than 30 days after the adoption?	10843(a)
1.2, Table 1	3.1 C.2	The department.	10843(b)(1)
1.2, Table 1	3.1 C.2	Any city, county, or city and county within which the agricultural water supplier provides water supplies.	10843(b)(2)
1.2, Table 1	3.1 C.2	Any groundwater management entity within which jurisdiction the agricultural water supplier extracts or provides water supplies.	10843(b)(3)
1.3	3.1 C.3	Adopted AWMP availability	10844
1.3	3.1 C.3	Was the AWMP available for public review on the agricultural water supplier's Internet Web site within 30 days of adoption?	10844(a)
1.2, 1.3, Table 1	3.1 C.3	If no Internet Web site, was an electronic copy of the AWMP submitted to DWR within 30 days of adoption?	10844(b)
1.5, 7.2	3.1 D.1	Implement the AWMP in accordance with the schedule set forth in its plan, as determined by the governing body of the agricultural water supplier.	10842
2	3.3	Description of the agricultural water supplier and service area including:	10826(a)
2.1.1	3.3 A.1	Size of the service area.	10826(a)(1)
2.1.1	3.3 A.2	Location of the service area and its water management facilities.	10826(a)(2)
2.1.3	3.3 A.3	Terrain and soils.	10826(a)(3)
2.1.4	3.3 A.4	Climate.	10826(a)(4)
2.2.1	3.3 B.1	Operating rules and regulations.	10826(a)(5)

AWMP Section	Guidebook Location	Description	Water Code Section (or as identified)
2.2.2	3.3 B.2	Water delivery measurements or calculations.	10826(a)(6)
2.2.3	3.3 B.3	Water rate schedules and billing.	10826(a)(7)
2.2.4, Appendix E	3.3 B.4	Water shortage allocation policies and detailed drought plan	10826(a)(8) 10826.2
3	3.4	Water uses within the service area, including all of the following:	10826(b)(5)
3.2	3.4 A	Agricultural.	10826(b)(5)(A)
3.3	3.4 B	Environmental.	10826(b)(5)(B)
3.4	3.4 C	Recreational.	10826(b)(5)(C)
3.5	3.4 D	Municipal and industrial.	10826(b)(5)(D)
3.6	3.4 E	Groundwater recharge, including estimated flows from deep percolation from irrigation and seepage	10826(b)(5)(E)
4	3.5 A	Description of the quantity of agricultural water supplier's supplies as:	10826(b)
4.1.1	3.5 A.1	Surface water supply.	10826(b)(1)
4.1.2	3.5 A.2	Groundwater supply.	10826(b)(2)
4.1.3	3.5 A.3	Other water supplies, including recycled water	10826(b)(3)
4.1.3	3.5 A.4	Drainage from the water supplier’s service area.	10826(b)(6)
4.2	3.5 B	Description of the quality of agricultural waters suppliers supplies as:	10826(b)
4.2.1	3.5 B.1	Surface water supply.	10826(b)(1)
4.2.2	3.5 B.2	Groundwater supply.	10826(b)(2)
4.2.3	3.5 B.3	Other water supplies.	10826(b)(3)
4.2.4	3.5 C	Source water quality monitoring practices.	10826(b)(4)
5.1, 5.2, 5.3	3.6	**Added to Water Code:** Annual water budget based on the quantification of all inflow and outflow components for the service area.	**Added to Water Code** 10826(c)
5.4	3.7 C	**Added to Water Code:** Identify water management objectives based on water budget to improve water system efficiency	**Added to Water Code** 10826(f)
5.4.1	3.8 D	**Added to Water Code** Quantify the efficiency of agricultural water use	**Added to Water Code** 10826(h)
6	3.9	Analysis of climate change effect on future water supplies analysis	10826(d)
7	4	Water use efficiency information required pursuant to § 10608.48.	10826(e)

AWMP Section	Guidebook Location	Description	Water Code Section (or as identified)
7	4.1	Implement efficient water management practices (EWMPs)	10608.48(a)
7.1, Table 36	4.1 A	Implement Critical EWMP: Measure the volume of water delivered to customers with sufficient accuracy to comply with subdivision (a) of §531.10 and to implement paragraph (2).	10608.48(b)
7.1, Table 36	4.1 A	Implement Critical EWMP: Adopt a pricing structure for water customers based at least in part on quantity delivered.	10608.48(b)
7.1, Table 36	4.1 B	Implement additional locally cost-effective and technically feasible EWMPs	10608.48(c)
7.1, Table 37	4.1 C	If applicable, document (in the report) the determination that EWMPs are not locally cost- effective or technically feasible	10608.48(d)
7.1, Table 36	4.1 C	Include a report on which EWMPs have been implemented and planned to be implemented	10608.48(d)
7.1, Table 38	4.1 C	Include (in the report) 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.	10608.48(d)
Not applicable	5	USBR water management/conservation plan may meet requirements for EWMPs	10608.48(f)
8.1	6 A	Lack of legal access certification (if water measuring not at farm gate or delivery point)	CCR§597.3(b)(2)(A)
8.1	6 B	Lack of technical feasibility (if water measuring not at farm gate or delivery point)	CCR§597.3(b)(1)(B), §597.3(b)(2)(B)
8.1	6 A, 6 B	Delivery apportioning methodology (if water measuring not at farm gate or delivery point)	CCR§597.3.b(2)(C),
8.1	6 C	Description of water measurement BPP	CCR §597.4(e)(2)
8.1	6 D	Conversion to measurement to volume	CCR §597.4(e)(3)
8.1	6 E	Existing water measurement device corrective action plan? (if applicable, including schedule, budget and finance plan)	CCR §597.4(e)(4))

APPENDIX B

Notification Documentation

February 17, 2021

Kern Delta Water District Agricultural Water Management Plan 2020
Notification of Draft AWMP for Review

In accordance with the California Water Code Section 10841, you are being notified that Kern Delta Water District is preparing a draft 2020 Agricultural Water Management Plan. A public hearing will be held in the afternoon of March 16, 2021 to consider and determine whether the District shall adopt an agricultural water management plan. The public hearing will be conducted virtually, and the meeting information is provided below.

> **Kern Delta Board Meeting and Public Hearing to Consider Adoption of 2020 AWMP**
> Tuesday, March 16, 2021 12:00 pm - 4:00 pm (PST)
>
> **Please join the meeting from your computer, tablet or smartphone.**
> https://global.gotomeeting.com/join/596355797
>
> **You can also dial in using your phone.**
> United States: +1 (872) 240-3412
>
> **Access Code:** 596-355-797
>
> New to GoToMeeting? Get the app now and be ready when your first meeting starts:
> https://global.gotomeeting.com/install/286997645

This information will also be in the agenda package for the March 16 meeting on the District's website: https://www.kerndelta.org/about-us/agenda-minutes.

The Draft 2020 Agricultural Water Management Plan can be viewed and downloaded from the District website: https://www.kerndelta.org. It will be posted by February 23. You are encouraged to provide written comments before the public hearing and can also provide comments at the public hearing. Written comments can be emailed to kwhite@toddgroundwater.com or jana@kerndelta.org or mailed to Kern Delta Water District, 501 Taft Hwy, Bakersfield, CA 93307. Comments receive before and at the public hearing will be considered.

Thank you.

Kate White, PE
Todd Groundwater
kwhite@toddgroundwater.com
510-747-6920 x107

From:	Kate White
Bcc:	Kate White; Jana Marquez; Steven Teglia; Mark Mulkay; Phyllis Stanin; Richard Iger; DevPln@ci.bakersfield.ca.us; Art Chianello; planning@kerncounty.com; ppoire@kerngwa.com; jmuhar@aewsd.org; info@kcwa.com; snicholas@wrmwsd.com; dsween@jgboswell.com; Scott Taylor; greenfieldcountywater@gmail.com; PlanningInfo@calwater.com; krgsa@kernrivergsa.org
Subject:	Kern Delta Water District Agricultural Water Management Plan 2020 - Notification of Draft AWMP for Review
Date:	Wednesday, February 17, 2021 1:00:00 PM
Attachments:	KDWD 2020 AWMP Notification 2-17-21.pdf

February 17, 2021

Kern Delta Water District Agricultural Water Management Plan 2020 Notification of Draft AWMP for Review

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Thank you.

Kate White, PE
Senior Civil Engineer

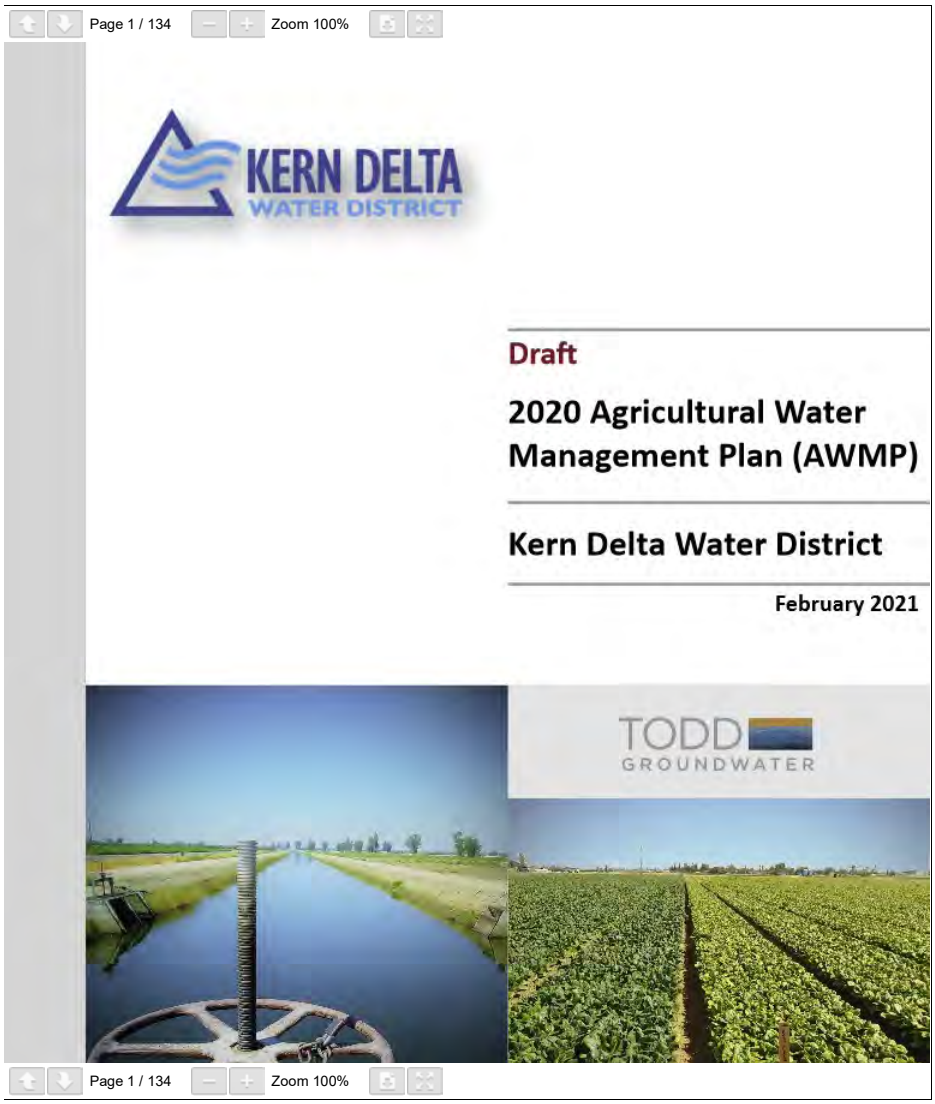
TODD GROUNDWATER

2490 Mariner Square Loop, Suite 215
Alameda, CA 94501
510.747.6920 x107
kwhite@toddgroundwater.com
www.toddgroundwater.com

KERN DELTA WATER DISTRICT

CONTACT US
661-834-4656

KDWD DRAFT 2020 AG WATER MANAGEMENT PLAN



If you have any questions regarding our services or any water concerns, please feel free to contact us today.

CONTACT

KERN DELTA WATER DISTRICT

Office Hours

Monday - Friday 7:30AM to 4:30PM

501 Taft Highway, Bakersfield, CA 93307 **Directions to District Office**

Main Office 661-834-4656

24-hr Dispatch 661-834-4653

Highway 99 to Eastbound Taft Highway South Union Avenue to Westbound Taft Highway

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Projects
Maintenance
Water Order Policy
Resources
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AGENDA & MINUTES

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MAR 1 1 2021

PROOF OF PUBLICATION

The BAKERSFIELD CALIFORNIAN
3700 PEGASUS DRIVE
BAKERSFIELD, CA 93308

KERN DELTA WATER DIST
501 TAFT HWY
BAKERSFIELD, CA 93307

Ad Number:	14766962	**PO #:**	KDWD
Edition:	CALC	**Run Times**	2
Class Code	Legal Notices		
Start Date	3/2/2021	**Stop Date**	3/8/2021
Billing Lines	25	**Inches**	150.98
Total Cost	$ 455.08	**Account**	1KDE05
Billing Address	KERN DELTA WATER DIST 501 TAFT HWY BAKERSFIELD,CA 93307		

--

STATE OF CALIFORNIA
COUNTY OF KERN

I AM A CITIZEN OF THE UNITED STATES AND A RESIDENT OF THE COUNTY AFORESAID: I AM OVER THE AGE OF EIGHTEEN YEARS, AND NOT A PARTY TO OR INTERESTED IN THE ABOVE ENTITLED MATTER. I AM THE ASSISTANT PRINCIPAL CLERK OF THE PRINTER OF THE BAKERSFIELD CALIFORNIAN, A NEWSPAPER OF GENERAL CIRCULATION, PRINTED AND PUBLISHED DAILY IN THE CITY OF BAKERSFIELD COUNTY OF KERN,

AND WHICH NEWSPAPER HAS BEEN ADJUDGED A NEWSPAPER OF GENERAL CIRCULATION BY THE SUPERIOR COURT OF THE COUNTY OF KERN, STATE OF CALIFORNIA, UNDER DATE OF FEBRUARY 5, 1952, CASE NUMBER 57610; THAT THE NOTICE, OF WHICH THE ANNEXED IS A PRINTED COPY, HAS BEEN PUBLISHED IN EACH REGULAR AND ENTIRE ISSUE OF SAID NEWSPAPER
AND NOT IN ANY SUPPLEMENT THEREOF ON THE FOLLOWING DATES, TO WIT: 3/2/21
3/8/21

ALL IN YEAR 2021

I CERTIFY (OR DECLARE) UNDER PENALTY OF PERJURY THAT THE FOREGOING IS TRUE AND CORRECT.

DATED AT BAKERSFIELD CALIFORNIA
3/8/21

Solicitor I.D.: 0

First Text
NOTICE OF PUBLIC HEARINGON THE PROPOSED

Ad Number 14766962

NOTICE OF PUBLIC HEARING
ON THE PROPOSED 2020
AGRICULTURAL WATER MANAGEMENT PLAN

NOTICE IS HEREBY GIVEN that Kern Delta Water District will hold a public hearing on Tuesday, March 16, 2021 12:00 pm - 4:00 pm (PST) to consider the adoption of the 2020 Agricultural Water Management Plan (AWMP). The public hearing will be conducted virtually, and the meeting information is provided below:

https://global.gotomeeting.com/join/596355797
You can also dial in using your phone.
United States: +1 (872) 240-3412
Access Code: 596-355-797

Copies of the AWMP can be viewed and downloaded from the District website: https://www.kerndelta.org. A hard copy is available for review at the District office located at 501 Taft Hwy Bakersfield, CA 93307.

You are encouraged to provide written comments before the public hearing. Written comments can be emailed to kwhite@toddgroundwater.com or jana@kerndelta.org or mailed to Kern Delta Water District, 501 Taft Hwy, Bakersfield, CA 93307. Comments will also be received at the public hearing.

March 2, 8, 2021
14766962

APPENDIX C

Resolution of Plan Adoption

RESOLUTION NO. 2021-04

A RESOLUTION OF THE BOARD OF DIRECTORS OF KERN DELTA WATER DISTRICT ADOPTING THE 2020 AGRICULTURAL WATER MANAGEMENT PLAN

WHEREAS, Kern Delta Water District ("District") is a California Water District formed pursuant to Division 13 of the California Water Code; and

WHEREAS, Part 2.8 (commencing with §10800) of Division 6 of the California Water Code, otherwise known as the Agricultural Water Management Planning Act, requires this District to prepare, adopt, and implement an agricultural Water Management Plan; and

WHEREAS, notice as required by Water Code §10821 has been provided to the City of Bakersfield and the County of Kem regarding the proposed adoption of an agricultural water management plan for the Kem Delta Water District; and

WHEREAS, notice of a public hearing to consider the adoption of the Agricultural Water Management Plan was published as required by Water Code §10841, and a public hearing was held pursuant thereto on March 16, 2021.

NOW THEREFORE, BE IT RESOLVED by this Board of Directors that:

1. The foregoing is true and correct.

2. The Board of Directors hereby adopts the 2020 Agricultural Water Management Plan in accordance with Part 2.8 of Division 6 of the California Water Code.

3. The Board of Directors hereby authorizes the General Manager to execute all documents and take any other action necessary or advisable to carry out the purpose of this resolution.

ALL THE FOREGOING being on motion of Director Mendonca, second by Director Kaiser and authorized by the following vote:

AYES: Antongiovanni, Collins, Kaiser, Mendonca, Palla, Spitzer, and Tillema.
NOES:
ABSTAIN:
ABSENT: Bidart, and Garone.

I HEREBY CERTIFY that the foregoing is a full, true, and correct copy of a resolution of the Board of Directors of Kern Delta Water District adopted at its meeting held on March 16, 2021.

DocuSigned by:
ECC3BE39CF14479...
RODNEY PALLA
President of the Board

DocuSigned by:
6F99D769390B495...
RICHARD TILLEMA
Secretary of the Board

APPENDIX D

KDWD Rules and Regulations

ADOPTED 1/19/2010
AMENDED 4/21/2015

KERN DELTA WATER DISTRICT

RULES AND REGULATIONS FOR THE SALE AND DISTRIBUTION OF WATER

These Rules and Regulations are established by the Board of Directors pursuant to California Water Code section 35423 which provides, in pertinent part, that the District may establish, print, and distribute equitable rules and regulations for the sale and distribution of water. The District Board may change these Rules and Regulations, without prior notice, at their sole discretion.

APPLICABILITY OF RULES

General: All water service and deliveries and other activities pertaining to the use of water provided by the District shall be subject to these Rules and Regulations of the District.

DISTRICT FACILITIES

District Facilities: The District facilities, including any and all diversion works, canals, ditches, headgates, weirs and any other property owned by the District shall be operated and maintained solely by the District or its authorized agent, permittee, or subcontractor. Such facilities shall be under the exclusive control of the Manager or those employees whom the Manager has designated with authority. The Manager is hereby authorized to do all acts necessary and proper to enforce these Rules and Regulations.

Private Facilities: The operation and maintenance of private ditches, laterals, or other waterworks which are not the property of the District shall be undertaken by the individual or group of individuals who own or use such facilities (community ditches). At all times such facilities must be kept in reasonable repair and reasonably free from weeds and/or other obstructions and must be of sufficient capacity to carry the amount of water which is to be delivered by the District. The District reserves the right to refuse water delivery in the case of a facility or community ditch that, in the sole discretion of the District, is deemed to be not

properly maintained.

Connections: All connections to District facilities shall be made in such a manner so as to prevent damage from occurring to the District's facilities, and so as to prevent water from customers' facilities from entering District facilities. Any connections to District facilities must be approved by the Manager of the District, or his designee. It is the responsibility of the customer to reach the District's canal right-of-way or easement with a suitable pipeline or ditch. In the event the customer is unable to obtain an appropriate easement for such pipeline, the District may, under terms and conditions acceptable to the District, assist in the acquisition of an appropriate easement. The District will install a turnout and pipe from the canal to the edge of the District's right-of-way or easement. For parcels of 40 acres or more, the District will pay for the aforementioned turnout and pipe at no cost to the customer. For parcels smaller than 40 acres, the customer or landowner will pay the fee.

Obstructions: No fences, gates, bridges, ditches, buildings, culverts, pipelines, roads, telephone poles, power poles, signs, vehicle parking, storage, any fertilizer tanks or tubs, trees, or any other obstructions shall be placed within, along, across, or upon any property or right-of-way of the District without the permission of the Manager and an encroachment permit from the District stating the conditions governing the obstruction. No fences, structures, rubbish, garbage or any other matter may be placed in, or allowed to be placed in or on any District canal or other District facility or property.

If any obstruction listed above, or any other similar obstruction necessitates maintenance or other remedial action being taken by the District, the customer, the landowner, or other responsible person shall, within ten (10) days of being notified of said expenses by mail, reimburse the District for any such cost of repairs or remedial actions.

APPLICATIONS FOR WATER

Applications: In order to obtain delivery of water, the owner of lands (or their agent) and the tenant or lessee of lands, (hereinafter referred to as "customer(s)") must complete, execute and file with the District, an application for water service which shall include the name and

addresses of the landowner and tenant or lessee, a description of the land to be irrigated, and any other information required by the District. If the owner of lands is not available or not willing to execute the application for any reason, a copy of an executed lease agreement and Vesting Deed, for said land, will take the place of the owner's execution and the tenant/lessee must also provide the District a letter allowing the District to lien the tenant's or lessee's land in the District if the tenant/lessee become delinquent in their payments to the District. Application forms shall be provided by the District. The District may fix the date prior to which applications for water for the ensuing irrigation season are to be received, and may require a cash deposit at the time of application for each acre for which application is made.

Land Transfers: When land is sold, a change of tenant occurs, or title is otherwise transferred to another party, the District shall be under no obligation to deliver water to such lands until a new application for water service is properly completed and filed with the District.

Authority of Applicant: District shall not be obligated to provide water service pursuant to any application for water service, or otherwise, unless and until District is provided, upon request, verification acceptable to the District that applicant has authority to bind the landowner and/or tenant for charges associated with water deliveries by District and for any other charges or expenses associated with these Rules and Regulations. Any such verification shall be in the form prescribed by District.

DELIVERY

Delivery Orders: All orders for water delivery or shutoffs must be placed by the customer, or his designee, either by telephone, or in writing no later than 10:30 a.m., and twenty four (24) hours prior to the requested delivery or shutoff. Shutoff orders not placed within the minimum 24 hour period will be charged for a full 24 hour day for "Off Without Notice". Delivery shall be made as requested by customer, provided that sufficient water is available to permit such delivery and provided that the capacity of the District's facilities has not previously been committed to delivery of water to other customers. The District may require payment of water charges prior to the delivery of any water ordered. Water delivery problems must be

called into the Dispatch office immediately. Problems turned in after the day of occurrence may not be acted upon. Customer shall be responsible for the payment of water ordered until the procedures and time requirements described above have been complied with.

Minimum Order: Customers must order a minimum of one half (1/2) cubic foot per second for at least twenty four (24) hours (1 acre foot). Delivery orders of less than this amount, or in amounts not readily measurable or controllable, will not be accepted or processed by the District. Any water ordered by a customer must be accepted by the customer on a continuous basis until the entire amount so ordered or deliverable has been delivered, unless the proper turn-off procedure and time requirements thereof have been complied with. All water shutoff times will be the same as the start time, unless previously specified by the customer and agreed upon by the District. There is a grace period for water overruns of up to four (4) hours, over four (4) hours will be charged one half (1/2) day, over six (6) hours will be charged for one (1) full day of water.

Non-acceptance: A customer who fails to accept delivery of water, which has been ordered, and which the District is prepared to deliver, shall be charged for the amount of water so ordered, unless the proper shutoff procedure and time requirements thereof have been complied with. In the event of breaks in private ditches, laterals, or other private water-carrying facilities, or other emergency circumstances or conditions where it becomes necessary for the customer to turn the delivered water back into the District's facilities, the District must be notified before the water is turned back to the District (Dispatch number is 661-834-4653 and is answered 24 hours a day, either by the Dispatcher or the answering service) and the District must consent to such return. The customer shall be responsible for any and all loss or damage caused by the turning back of water into the District's canal if said water causes any loss or damage. The customer shall not be responsible for payment of water not accepted if non-acceptance is the result of an unavoidable and unanticipated emergency. It is within the Manager's sole discretion to determine whether or not an unavoidable and unanticipated emergency situation has occurred.

Condition of Property: Customers must have their land and facilities in reasonable condition in order to care for and accept delivered water without undue waste or damage.

Reasonable care in applying the water must also be undertaken in order to eliminate excessive drainage.

Water Level: The District shall not be required to raise water levels to an excessive height in any canal or other facility of the District in order to provide water service to a customer.

Priority: At such times as the District's facilities are being used to capacity, water will be delivered as far as practicable to consumers on those canals in order of priority of water orders.

Split Heads: In the event two or more customers are supplied water through the same turnout ("split head"), the District may require that all customers being served by a combined turnout furnish to the District, in a form suitable to the District, an agreement executed by each customer which may include, among other provisions, terms regarding acceptance of water delivery through the turnout, granting of easements among the customers, and authorization for one individual to represent the others in all matters relating to delivery of water through the turnout. It is the customers' responsibility to make sure the water is divided appropriately.

Temporary Deliveries: Delivery of water for unscheduled, temporary, or special purposes may be made in the manner and upon such terms and conditions as are required by the Manager, or his designee.

Transferability: No water delivered or deliverable by District, or any rights that may pertain to such waters or to the delivery thereof may be permanently transferred from one customer to another or from one property to another. Monthly or annual transfers of District water service is permitted under the following circumstances and with approval from the Board or General Manager upon acceptable terms and conditions:

(a) Kern River Utility water shall only be delivered within the water right Service Area of origin, except during mandatory release.

(b) Balfour Guthrie, Bloomfield, or Eastside Contract water entitlements shall be delivered to their respective contract lands only.

(c) Transfers of Kern River prorations and/or service rights between eligible recipients may be permitted within the same Service Area. Transfers of State Water allocations are permitted within the District with no Service Area restrictions; however, the original State Water Rate will follow the State Water delivery.

(d) Transfers by the original allocatee into a pool established by the District for general reallocation are permitted.

(e) During proration periods, all transfers shall be subject to all of these Rules and Regulations and:

(1) Parties to the transfer will notify the Dispatcher. No water may be transferred without a written Transfer Agreement between the parties on file with the District.

(2) Payment for the transferred water will be the responsibility of the receiving party.

(3) From time to time the Board of Directors will review the status of unused allocations and, at their discretion, may recall such supplies as they deem to be prudent and practical.

(4) Transfers may not adversely affect the prorations or canal capacity of other Customers.

Exchanges: Exchanges may be permitted on a case by case basis subject to Manager's approval in emergency situations, and subject to Board approval under non-emergency conditions. The term "exchange" refers to the substitution of any water supply available to the District or any person for use by any person, provided however, the recipient pledges in good faith to repay the party or entity of origin at the earliest practical point in time. Any such exchange shall be conditioned upon terms and conditions deemed appropriate by the Manager or the Board.

District Well Water: District Well Water, produced by District owned wells, will not be available for use by individual customers.

Customer Well Water: District facilities may be used to transport such water upon terms and conditions deemed appropriate by the Manager, including but not limited to:

(a) Unused capacity is and is anticipated to be available in the District's facility.

(b) Prior to delivery into a District facility, Customer shall install a District approved flow meter, in addition to any other turn-in delivery facility deemed appropriate by the District, in accordance with District specifications. Cost of the meter and its installation will be paid by the Customer.

(c) Delivery of Customer Well Water into the District's facility may be terminated at any time, and without notice, by the District, in its sole discretion.

(d) Customer shall provide District ingress and egress to and from the groundwater well location site and any other areas deemed relevant by the District so as to account for and monitor the delivery of Customer Well Water to the facility.

(e) The Customer's well site may be labeled by the District for District reference purposes.

(f) Scheduling of the Customer's Well Water pump-in shall follow the same procedures as ordering for turnouts (See Rules and Regulations section "Delivery"). Customer shall provide the District Dispatch as much notice on a proposed well turn ON and/or turn OFF as possible, with a minimum notice of 24 hours.

(g) Customer, and NOT District personnel, shall operate the Customer's well. Customer shall only make flow changes upon prior approval of the District. The Customer shall call and notify the District Dispatch at the exact time of turn ON, turn OFF, or change in flow and provide a corresponding meter reading.

(h) Customer shall have the sole responsibility to maintain the well and related "turn-in" facilities (i.e. check oil, water levels, operate valves, etc.)

(i) District staff will endeavor to read meters daily, and upon each ON, OFF, or change of flow.

(j) District staff will endeavor to verify the meter is measuring accurately (i.e. full pipe flow). District may require the Customer to have the meter tested for accuracy and/or repaired/recalibrated, at Customer's expense.

(k) Customer Well Water may only be transported within the District's Groundwater Zone of Benefit of origin of said Well Water (Zone of Benefit may differ from the Service Area).

(l) Customers may only transport Customer Well Water in District facilities within a three mile radius of the well. The District's Wheeling Rate for this transportation is $2.50 per acre-foot, and is subject to change by the Board of Directors. If the District conveyance facility

is not in operation, and if approved by the District, customers may transport Customer Well Water in District facilities (the three mile radius still applies). Customers must pay all costs and expenses through District facilities.

(m) Customers must provide annual water quality tests for Well Water pumped into District facilities. Constituents to be tested for will be determined by the District and will include at a minimum an Irrigation water quality test. The District may also require more frequent tests and a full Title 22 or other test(s) if District water is being delivered to another agency, or upon other circumstanced as determined by the District.

(n) The constituents of the water quality tests may change from time to time as determined by the District Manager.

(o) Customer shall indemnify, defend, and hold the District harmless from any and all claims and liability related to delivery of the Customer's Well Water quality into District facilities, including but not limited to any and all effects on water quality, and damages related to delivery into District facilities, upstream or downstream of the turn in.

(p) The Customer must enter into and sign the District's Well Water Pump-In Agreement.

CONTROL

Hazards:

(a) No customer shall use, cause to be used, or suffer to be used on lands located within the District, water distributed by the District in any manner which creates, or is likely to create, an unsafe or hazardous condition, and the District shall have the authority to immediately cease water deliveries where an unsafe or hazardous condition is known to exist, and the delivery will not restart until the District is satisfied that the condition has been rectified.

(b) If a violation of subparagraph (a) is found to exist, the District may discontinue service without notice if the unsafe or hazardous condition creates a clear and imminent danger to the public health, welfare, or safety such that immediate action is required in order to avert or mitigate said danger. Immediately thereafter, the District shall notify the customer of the reasons for the discontinuance and the corrective action which must be taken by the customer before

service will be restored. Such notification shall be in writing and shall be personally served upon the customer or mailed to the customer at his last known address. A copy of such notice shall also be left in a conspicuous place on the affected premises. If the owner of the affected premises differs from the customer, a copy of such notice shall also be personally served upon the landowner or mailed to the landowner at his last known address.

(c) In all other cases in which a violation of subparagraph (a) is found to exist, the District may discontinue service after the District has given the customer at least five (5) days' written notice of such intention. Said notice shall include the reasons for the proposed action, a description of the corrective action which must be taken by the customer in order to avert discontinuance of service, and the date on which the District proposes to discontinue the service. A copy of such notice shall be personally served upon the customer or mailed to him at his last known address. A copy of such notice shall also be left in a conspicuous place on the affected premises. If the owner of the affected premises differs from the customer, a copy of such notice shall also be personally served upon the landowner or mailed to the landowner at his last known address.

Diversions: No water delivered by the District shall be diverted or allowed to be diverted by a customer at any time from lands within the District service area to lands outside of the District service area, from one improvement District to another, or to lands for which no application for water service has been filed with the District, without the prior consent of the Board of Directors.

Control Outside District Facilities: District shall not be responsible for the control, carriage, handling, use, disposal or distribution of water delivered to a customer whenever such water is outside of facilities then being owned, operated and maintained by District. Customer agrees to indemnify and shall hold harmless the District and its officers, agents, and employees from any and all loss, expenses, damage, liability, claims or causes of action of every nature whatsoever, for damage to or destruction of property of whatever nature, including District's property, or for injury to or death of persons, in any manner arising out of or incidental to the control, carriage, handling, use, disposal or distribution of water outside such facilities.

Drainage: Except for drains and water ways built, or formally accepted, by the District expressly for the conveyance of drainage water and/or storm water, no person will be allowed to drain irrigation or other water into or upon District-owned property or facilities, unless consent to such drainage has been obtained from the Manager. Such consent may only be given on a case-by-case basis.

Landowner Wheeling Rates: Upon terms and conditions acceptable to the Manager, an in-District landowner may bring outside surface water into the District for delivery in the District using District facilities. Kern Delta must review and approve the request on a case by case basis. If the canal is running and there is available capacity, the Wheeling Rate is $2.50 per acre-foot and no water losses (floated on District water). If the canal is dry, the Wheeling Rate is $2.50 per acre-foot for all water diverted into District facilities. All water losses associated with this wheeling becomes the property of the District for any legal use and/or purpose.

3rd Party Wheeling Rates (Non-District Landowner or Water User): Upon terms and conditions acceptable to the Manager, A 3rd party may wheel water in Kern Delta District facilities, if capacity is available, and under the following conditions:

(a) Kern Delta staff must review and approve the request.
(b) Administration fee of $1000.00. (Non-refundable)
(c) A $12.50 per acre-foot Wheeling Rate. (No water losses if the canal is operating)
(d) A $12.50 per acre-foot Wheeling Rate. (Plus water losses if the canal is dry) All water losses become the property of Kern Delta for any legal use and/or purpose.
(e) Kern Delta personnel will operate District facilities at all times.

WATER SHORTAGE

Water Shortage: In the event of actual or perceived water shortages, as determined by the District, the District may prorate the anticipated total deliverable amount of water among District customers. Proration may be calculated on a monthly basis or by using any other time period, and shall be calculated based upon (1) anticipated total deliverable water to specific areas within the District Service Areas, (2) total acres within those Areas, (3) acres owned or operated by each customer within those Areas, and (4) any other equitable factors deemed necessary and appropriate by the District.

LIABILITY

Negligence: The District shall not be liable for any damage caused by the negligence, carelessness, or intentional acts or omissions of any customer in the use of water, or for the failure on the Customer's part to maintain any ditch, lateral, or other facility not owned and controlled by the District. The Customer shall not be liable for any damage caused by the negligent act or omission of the District.

Water Availability: The District shall not be responsible or liable for any damage to crops resulting from insufficient water supply to the crops, regardless of the cause of the insufficiency.

Water Orders: Customer shall be responsible for any loss, damage, or expense caused by customer not using the full amount of water ordered by the customer.

Damage to District Facilities: If any damage whatsoever is done to District facilities by customers and/or their agents, including damage caused by moving farm equipment, livestock, or otherwise, it shall be the responsibility of the customer to pay for any such damage. District shall be entitled to make any necessary repairs and customer shall be responsible for paying the costs of any such repairs within ten (10) days of being notified by mail of such costs.

DISCLAIMER

The District may sell and distribute water for any legal purpose. Any water purchased by a customer shall be used for irrigation purposes only unless otherwise allowed in these Rules and Regulations or by other agreement. District waters include, but are not limited to, Kern River Water, State Water Project (SWP) water, well water, storm water runoff, exchange water, transferred water, and other 3rd party waters. Water furnished by the District is unfit for human consumption and may be unfit for other purposes, and is not warranted by the District. The District hereby expressly disclaims any and all warranties, including merchantability, either

express or implied, as to the fitness or suitability of water for any purpose whatsoever. The District does not represent, express or imply as to the availability, condition, quantity, quality or suitability of water at any time for any purpose. The District does not represent, express, or imply as to the integrity, availability, capacity, condition, quality, or suitability of the District's facilities at any time or for any purpose.

The District treats canals, waters, and other District facilities with chemicals, herbicides, surfactants, and other materials. Customer assumes all risks associated with the use of said water and any consequences thereof, except for any negligent act of the District.

WATER RATES, BILLS, AND PAYMENT

Rates: Water rates, standby charges, equalization charges, and any other charges permitted by law shall be determined from time to time by the Board of Directors of the District.

Billing: Invoices for water service shall normally be mailed to the person designated in the application for water service no later than the tenth of each month for those water deliveries which occurred during the preceding month. Payments are to be made at the District offices, located at 501 Taft Highway, Bakersfield, California 93307, and must be paid upon receipt. All water bills must be paid no later than the last business day of the month the bill is issued.

Delinquent Accounts: A Water Account will be considered delinquent if billings and invoices are not paid in full on or before the last business day of the month in which the invoice was mailed to the Customer. Delinquent Water Accounts will be charged interest at the rate of 1.5% per month until paid. An Assessment Account will be considered delinquent if the Assessment is not paid in full on or before June 30th of the year assessed. Delinquent Assessment Accounts will be charged with a 10% penalty on the delinquency date and interest at the rate of 9% per year until paid. No water will be delivered to a customer if their water account becomes delinquent or the property assessments become delinquent.

Landowner Responsibility: The landowner is ultimately responsible for and shall be liable for all water charges and other costs invoiced by the District which have been incurred for

water services, water deliveries, or otherwise incurred pursuant to these Rules and Regulations, or as allowed by law.

Requests Re: Equalization Charge: In the event a customer owns lands which are not farmed, nor intended to be farmed, nor anticipated to be farmed, but who is charged the District's Equalization Charge upon said non-farmed land, the customer may request of the District, prior to the imposition of such charge, in a form prescribed by the District, to have the equalization charge against said non-farmed property withdrawn and/or cancelled. The District may approve the request, in its sole discretion, upon such terms as it deems appropriate.

COMPLAINTS/ERRORS

Complaints: Complaints of any kind against the District must be made in writing to the Manager immediately after the acts complained of have occurred. Water delivery problems must be brought to the attention of the District by calling the Dispatch office immediately. Problems reported after the day of occurrence may not be acted upon.

Errors: All claims for errors in the measurement of water must be made in writing to the Manager within 30 days after the mailing of the invoice containing the error. If no claim is made within that time, the measurement as reported by the District personnel shall be the basis for the water charge.

FACILITY MODIFICATIONS

Customer Requests: Any customer desiring a structural change, realignment, or modification of any canal or District facility may petition the Board of Directors, in writing, for permission to make such change or realignment. Any such petition must be accompanied by a map showing the desired charges, and customer shall be required to pay for any such changes in advance. Any modifications or changes, if allowed by the District in its sole discretion, shall be conditioned upon terms and conditions acceptable to the District and shall, upon acceptance, become the property of the District.

TERMINATION OF SERVICES

Waste: Water delivery or services may be discontinued to any customer found to be wasting water either willfully, carelessly, or as a result of defective or inadequate ditches, laterals, pipelines, or inadequately prepared land or improper management, and said water delivery will not be resumed until such conditions are corrected to the satisfaction of the District. However, the customer shall in no way be relieved of any responsibility for payment of any charges or obligations by reason of such discontinuance of water service.

Violations of Rules and Regulations: Water delivery or services may be discontinued by the District for any violation of these Rules and Regulations by the customer. Water delivery will not be resumed until the customer complies with all the Rules and Regulations of the District. However, the customer shall in no way be relieved of any responsibility for payment of any charges or obligations by reason of such discontinuance of water service.

Maintenance: Water delivery or services may be discontinued by the District in order to perform maintenance, modifications, or construction of canals or other facilities or for any other necessary purpose(s), at any time or times. District facilities may be drained of water during shut down periods. Customers receiving usable water during a drain down will be charged normal and customary rates for water delivered. District staff may make arrangements to drain canals for maintenance or emergencies at no cost to customers or landowners.

Delinquency: Water delivery or services shall be discontinued to any customer or property for which there exists a delinquency in the payment of any charges or assessments. Water service shall be resumed only upon full payment of all delinquencies, including water charges, assessments, penalties, and interest.

Non-liability: In any event of water service termination, District shall not be responsible or liable for any damage occasioned by such discontinuance of water service.

ENFORCEMENT

Manager's Responsibility: The Manager of the District shall be responsible for the enforcement of these Rules and Regulations. Nothing in these Rules and Regulations are intended to, nor shall have the effect of limiting any rights granted the District under any laws of the State of California. The failure or refusal of the Manager to enforce any provision of these Rules and Regulations shall not constitute a waiver of the right to enforce any or all of the provisions contained herein at any subsequent time for the same violation or for any other.

Records: In administering these Rules and Regulations, the District will rely upon the Kern County Assessment Roll, last equalized, and upon District records regarding matters of title to land, addresses of landowners, authorizations, appointments, designations and the like filed with the District by a customer. These records shall be considered continuing representations upon which the District is entitled to rely unless and until the District has received actual written notice of any changes from the customer, the transferee, or the County of Kern.

Unauthorized Tampering: No person shall molest, tamper with, or interfere with structures, meters, or devices used for the delivery of water. In this connection, attention is directed to **California Penal Code section 592** which provides as follows:

"**(a)** Every person who shall, without authority of the owner or managing agent, and with intent to defraud, take water from any canal, ditch, flume, or reservoir used for the purpose of holding or conveying water for manufacturing, agricultural, mining, irrigating, generation of power, or domestic uses is guilty of a misdemeanor.

(b) If the total retail value of all the water taken is more than four hundred dollars ($400), or if the defendant has previously been convicted of an offense under this section or any former section that would be an offense under this section, or of an offense under the laws of another state or of the United States that would have been an offense under this section if committed in this state, then the violation is punishable by imprisonment in the county jail for not more than one year, or in the state prison.

ACCESS

Customer Property: The authorized agents or employees of the District shall have free

access at all times to all lands irrigated from the District facilities, for the purpose of operation or maintenance of District facilities or for the purpose of examining the ditches and flows of water therein and for the further purposes of ascertaining the acreage of crops on lands irrigated or to be irrigated, or for any other purposes reasonably related to conducting District business or enforcing these Rules and Regulations.

District Facilities: No customer shall use or enter upon any District facilities, property, or rights-of-way without the express permission of the Manager. Prior to sampling or testing of District's water supplies in District facilities, an encroachment permit from the District stating the conditions governing the same shall be obtained. No chemicals may be added by customers, private parties, or their agents to waters within District facilities, rights-of-ways, or easements. Suitable measures to prevent back flow into the District's facilities shall be provided as required by the District.

MODIFICATION OF RULES

Board of Directors: These Rules and Regulations shall become effective when adopted by the Board of Directors of the District and may be amended or repealed, in whole or in part, from time to time within the sole discretion of the Board of Directors.

Special Conditions: The Board of Directors may authorize a temporary variance from these Rules and Regulations to meet any special conditions as deemed appropriate by the Board of Directors.

SEVERABILITY

Invalidity: If any provision of these Rules and Regulations, or the application thereof to any person or circumstance, is held invalid, the remainder of these Rules and Regulations and the application of its provisions to the same or other persons or circumstances shall not be affected thereby.

Captions: All captions accompanying these Rules and Regulations are for convenience and ease of reference and are not intended to limit the applicability of any rule or regulation.

APPENDIX E

KDWD Drought Plan

KERN DELTA WATER DISTRICT

Drought Plan

FINAL March 19, 2021

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1 INTRODUCTION

The foundation of Kern Delta Water District's (KDWD or District) Drought Plan consists of optimizing conjunctive management, groundwater banking, and best use of additional source water (such as recycled water) as available. In brief, District landowners are incentivized to rely on surface water resources when available to preserve groundwater resources for use in drought conditions. Groundwater banking consists of numerous strategies including intentional recharge along unlined canals, in-District banking for out-of-basin participants, and out-of-District banking for both recovery and overdraft protection. In addition, the District incorporates out-of-basin storage in Isabella Reservoir. Finally, the District is active in optimization of all local water sources obtained through cooperative transfers, exchanges, and agreements with other water districts and even shared recharge facilities. Incorporation of these policies and strategies as components of the Drought Plan are summarized in the sections below.

1.1 BACKGROUND

On April 1, 2015 Governor Brown issued Executive Order B-29-15, mandating agricultural water suppliers to prepare a detailed Drought Plan describing actions and measures taken to manage water demand during drought. The 2018 Water Conservation Legislation (AB 1668) added the Drought Plan requirement as part of the AWMP contents and includes details on what must be included. The new requirements include both resilience planning and drought action/response planning.

This Drought Plan for the KDWD builds upon existing KDWD shortage allocation policies and describes the determination of available water supply, drought responses, and water shortage impacts.

KDWD was formed in 1965 to provide a contracting agency for importing State Water Project (SWP) water through the Kern County Water Agency (KCWA) and to protect the existing Kern River water rights of the landowners within its boundaries.

1.2 PURPOSE

The purpose of this Drought Plan is to detail how KDWD prepares for droughts and manages water supplies and allocations during drought conditions. It fulfills requirements of Executive Order B-29-15 and 2018 Legislation, including addition of resilience and response planning components.

2 DROUGHT RESILIENCE PLANNING

2.1 DATA AND INDICATORS

KDWD manages three primary water sources – local surface water, groundwater, and imported water – conjunctively for beneficial uses in the District. Kern River water is made available to agricultural and M&I customers to supplement groundwater pumping by individual water users. The District also recharges water for the City of Bakersfield (City or COB), California Water Service-Bakersfield District (Cal Water), Greenfield County Water District (Greenfield CWD), and Lamont Public Utility District (Lamont PUD) by selling them canal operational losses (canal seepage). In addition, KDWD has secured imported SWP water rights and obtains other water sources as available through various contracts and exchanges.

Monitoring of hydrologic conditions such as rainfall, Kern River flows and groundwater levels are key components of determination of available water supply. KDWD conducts annual or more frequent evaluations of supply availability which includes review of:

- Rainfall records, including patterns and projections.
- Kern River flow indices and streamflow measurements.
- SWP water delivery projections.
- Groundwater elevation trends.

Rainfall is measured at the Bakersfield Meadows Field Airport Station (#040442) and long-term average precipitation at is approximately 6 inches per year (NOAA, 2019). Because most of the rain occurs outside of the primary irrigation season and varies significantly from year to year, precipitation is not a main source of agricultural supply. An analysis suggested that an average of approximately 20 percent of total rainfall could be used effectively by crops (Todd, 2013).

Kern River flow is a better indicator of hydrologic conditions than rainfall because the river is the primary surface water supply for the region. Because Kern River headwaters are in the Sierra Nevada more than 50 miles east of KDWD, precipitation patterns that control river flow are not always consistent with rainfall patterns on the valley floor. Kern River flows are typically represented by the river index, a calculated value that relates annual flow to the long-term average. The river index is a daily river model developed by the City of Bakersfield using monthly forecasts from the California Department of Water Resources (DWR). Diversions of river flow occur on a daily basis through a cooperative effort and are summarized in annual Kern River Watermaster reports.

Each year, the DWR announces SWP Table A allocations which inform water contractors' SWP deliveries of available Table A, Carryover, and Article 21 water. This information is on DWR's website: https://water.ca.gov/Programs/State-Water-Project/Management.

KDWD measures some wells for groundwater levels monthly and other wells are only measured in the Spring and Fall. KDWD monitors 18 wells in the Agricultural Management Area (MA) as part of the Kern River Groundwater Sustainability Agency. KDWD also monitors water levels as part of additional District-specific programs involving more than 60 wells.

2.2 DROUGHT VULNERABILITY

KDWD has a diverse portfolio of supplies to improve supply reliability and reduce vulnerability to drought. First, it has Kern River water rights. Flows in the River consist of regulated and managed releases from Lake Isabella. Its Water Allocation Plan (WAP) (Todd, 2011) was developed to optimize the use of water available to the District, provide operational flexibility, and maximize the beneficial use of its remaining Kern River water rights. Second, it utilizes groundwater to supplement surface water supplies and rainfall. Its Groundwater Management Plan (GWMP) (Todd, 2013) provides local groundwater management and monitoring for its portion of the underlying groundwater resource. The Groundwater Sustainability Plan (GSP) for the Kern River Groundwater Sustainability Agency[1] (KRGSA) (Todd, 2020) and subsequent annual reports are prepared and updated to cooperatively manage shared groundwater resources in a sustainable manner. Furthermore, the District also has SWP water, recycled water, and leave behind water from groundwater banking in its supply portfolio.

Several factors enhance KDWD's resilience to drought conditions. Most notable are the conjunctive management programs including conveyance, distribution, recharge and use in the KDWD and surrounding area. Examples of local conjunctive use include (but are not limited to) the following:

- Storage space in Isabella Reservoir is managed for Kern River water and, by exchange, imported SWP water.
- Recycled water is used for recharge and irrigation.
- Kern River water is intentionally discharged to unlined canals to promote surface water seepage and groundwater recharge.
- Recharge basins and banking programs in the area and managed recharge in the Kern River Channel.
- Water banking programs are active with participation by local agencies and out-of-basin agencies.

Recognizing the intensity of local conjunctive use, recharge, and banking operations, numerical models have been developed and/or applied by local agencies for specific purposes, including the water budget and water management programs for the KRGSA GSP.

[1] KRGSA member agencies are KDWD, City of Bakersfield, Kern County Water Agency (KCWA) Improvement District No. 4 (ID4), North of the River Municipal Water District/Oildale Mutual Water Company (NORMWD/OMWC), and East Niles Community Services District (ENCSD).

The water resources programs are coordinated among local agencies for optimized use of water resources. Kern River water and SWP are managed through exchanges and sales to others. Banking programs, including intentional recharge along canals, provide flexibility for storing water when available and recovering water for use during times of water scarcity. These programs also incorporate monitoring networks to measure performance and avoid adverse impacts. These issues are also being addressed through regional coordination of sustainable management criteria for the entire Kern County Subbasin.

2.3 PLANS FOR INCREASED DROUGHT RESILIENCE

KDWD actively reviews and updates its drought resilience planning. This is accomplished through new technologies, additional supplies, and other actions, specifically the programs associated with the KRGSA GSP.

2.3.1 Technology and Information

The District incorporates new technology and available water supply and use information when such technology and information will be beneficial for the long-term supply and demands within the District. The District is a key member of the KRGSA and is actively involved in expanded monitoring of the water supplies within the KRGSA area. The monitoring network is described in detail in the KRGSA GSP Section 6. This information will demonstrate progress toward groundwater sustainability objectives and monitor changes in groundwater conditions and quantify annual changes in the water budget components.

The District is considering the initiation of local evapotranspiration (ET) monitoring stations that will provide field-specific data for crop consumptive use. These stations allow for a more accurate documentation of crop ET and offer potential improvements in water use efficiency.

In addition, the KRGSA is working on policies and procedures for a groundwater extraction monitoring program that may incorporate features such as meters, telemetry, and built-in data loggers. The District is participating in this project with the goal of monitoring all agricultural wells within the District. This data will provide site-specific groundwater depths to correlate with the KRGSA's Minimum Thresholds and Measurable Objectives and allow the District to determine areas that may benefit from additional recharge.

2.3.2 Additional Water Supplies

The District is a participant in ongoing, planned, and future programs to strengthen and diversify its water sources and provide flexibility in years with limited water supply. This diversification of water sources (Kern River, SWP, groundwater, recycled water) coupled with conjunctive use (intentional canal recharge, in-district banking programs, and out-of-district/in-basin banking programs) provides the District with extensive operational flexibility. This flexibility results in optimizing use of available water supplies, especially during drought times.

The District's WAP (Todd, 2011) allows for optimization of the District's surface water allowing more groundwater supplies to be available throughout the District during periods when surface water supplies are limited. The District has historically and will continue to purchase excess water in Pioneer Storage Project, just northwest of the KDWD, for overdraft protection because this water will not be recovered and will lead to increased groundwater levels in northwestern KDWD. The City of Bakersfield provides recycled water to growers in KDWD. Use of recycled water offsets groundwater pumping.

Additional KRGSA-related programs described in the next section also result in increased supply availability in times of drought.

2.3.3 Other Actions to Improve Drought Resilience Planning

The KRGSA GSP identified projects and management actions to achieve groundwater sustainability that will also result in drought resilience because groundwater can be used during times of limited surface water supply. The KRGSA already has under its control sufficient Kern River and imported SWP water to achieve sustainability under a variety of future demand scenarios. By using all of its Kern River entitlement (less obligations) conjunctively with imported water and recycled water supplies, the KRGSA is implementing six Phase One projects that collectively provide:

- Increases in recharge and banking to offset potential future deficits and avoid overdraft
- Decreases in municipal and agricultural pumping
- Optimal conjunctive management of surface water and groundwater resources
- Improvements in drinking water quality for disadvantaged communities
- Mitigation for the potential of land subsidence in disadvantaged communities.

Three water supply projects have been identified to meet potential future deficits in the historical and projected water budgets, thereby reducing the potential for future overdraft conditions while providing adequate supply to support projected demands. One project provides for demand reduction with increased urbanization of former agricultural lands. Two water quality projects provide improvements to drinking water quality for disadvantaged communities (DACs) in the KRGSA. A summary of the six Phase One water supply projects is provided in **Table 1**. Additional details and status of these projects and additional future projects can be found in the KRGSA GSP annual reports.

Table 1. Phase One Project Summary for KRGSA GSP

Project	Description	New KRGSA Water Supply
Water Allocation Plan	KDWD plans to use its full Kern River entitlement as prioritized in its Water Allocation Plan (WAP) for the Agricultural MA. The WAP total average supply has been corrected for planned sales to NKWSD.	20,797 AFY
Kern River Optimized Conjunctive Use	The City plans to use its full Kern River entitlement, less current obligations, to mitigate undesirable results for water levels and water quality in the Urban MA.	89,619 AFY
Expand Recycled Water Use in the KRGSA	The City will increase recycled water use inside of the KRGSA from its WWTP No. 3 in 2026 when a contract for use outside of the KRGSA expires (about 72% is currently used outside of the KRGSA).	11,556 to 13,407 AFY
Conversion of Agricultural Lands to Urban Use	Approximately 10,000 acres of current KRGSA agricultural lands is expected to be urbanized; this future urban demand is already included in the projected water budget, so 100% of this agricultural water use represents a demand reduction.	27,000 AFY
ENCSD North Weedpatch Highway Water System Consolidation	Up to six small water systems in the northeast KRGSA will be consolidated into the ENCSD system for benefits to drinking water quality, including to disadvantaged communities (DACs).	No new supply; improved water quality to DACs
Possible Water Exchange	KRGSA member agencies can perform exchanges of surface water and groundwater for benefits to water quality, including to DACs	No new supply; improved water quality to DACs

3 DROUGHT RESPONSE

During periods of potential water supply shortage, District staff will monitor the projected supply and demand for water and will recommend to the District General Manager the anticipated extent of the shortage and the recommended drought level response. The District General Manager will then recommend to the Board of Directors the declaration or termination of the appropriate drought level. The sections below discuss water shortage indicators and drought stages and actions.

3.1 WATER SHORTAGE INDICATIONS

Declaration of a water shortage is dependent upon many factors because the District has a suite of water supplies available to them. The first step is to determine if one or more of the District's supplies has the potential to be available in limited quantities in the near future.

The SWP water availability is posted in the State's Notices to SWP Long-Term Water Supply Contractors (NTCs). The NTCs contain information on SWP water allocations, water supply programs, billing information, and other administrative matters. Table A SWP allocations differ each year and also can change over the course of the year. Initial allocations are based primarily on a conservative dry hydrology, current storage, and releases to be made through the year, and these allocations can change over winter and through spring to reflect the actual and forecast water supply. This information is available on the DWR website for SWP Water Contractors https://water.ca.gov/Programs/State-Water-Project/Management/SWP-Water-Contractors.

To provide a means of comparison between current Kern River flows and long-term average flow conditions, an annual river index is calculated and included in annual Kern River Hydrographic Reports. A preliminary river index is also modeled between February and June by the City of Bakersfield under the supervision of the Kern River Watermaster using the DWR's B-120 forecast. In addition, KDWD conducts its own internal modeling on Kern River water supplies. KDWD employs its own hydrographer who monitors precipitation, snow fall, temperature, and other weather indicators that will affect the flows of the Kern River on a daily basis. This information is reviewed and used to predict near-term and long-term river flows and estimate the District's Kern River entitlement.

Table 2 provides a general guideline to initiate internal discussions of a potential shortage. **Table 3** is a list of KDWD wells with Sustainable Management Criteria in the KRGSA GSP (Todd, 2020) Monitoring Well Network. The historic low water levels in select wells (GSP minimum thresholds) can be used as indicators of groundwater level declines and potential shortages.

Table 2. Water Shortage Indicators for KDWD

Water Source	Indicator	Comments	Potential Shortage
Kern River	Kern River flow is measured at First Point. Annual river index is calculated and included in annual Kern River Hydrographic Reports.	First Point flows can vary considerably. Annual Kern River Indices for a 22-year period from 1995 through 2016 ranged from 19 percent (2015) to 236 percent (1998), with an average of 94 percent	April Index below 50%
SWP	Table A allocation and Article 21 water	18,655 AFY historical average (from Todd, 2020)	Less than 5,000 AFY
Groundwater	Groundwater levels	Historic low water levels in select wells (GSP minimum thresholds) are used as an indicator of an undesirable result for the GSP	See minimum thresholds in **Table 3**

Table 3. KDWD Wells with Sustainable Management Criteria in the KRGSA GSP Monitoring Well Network

GSP RMW State Well Number	Well Use	Other Monitoring Program	Historic High Water Level	Historic Low Water Level (ft, msl)	Adjustment to Historic Low for MT	Minimum Threshold (ft, msl)	Measurable Objective (ft, msl)	Controlling Sustainability Indicator	Monitoring Frequency
30S/28E-11F01	Inactive	KDWD Monthly	181	125	0	125	153	Water Levels, Quality	Monthly
30S/28E-29B02	Recovery/inactive	KDWD Monthly	213	84	0	84	149	Water Levels, Quality	Monthly
30S/28E-35L01	Inactive	KDWD Monthly	234	86	0	86	160	Water Levels, Quality	Monthly
30S/29E-31C	Production	CASGEM	183	76	0	76	130	Water Levels, Quality	Monthly
31S/26E-10J01	Irrigation	KDWD Monthly	212	82	-50	32	122	Water Levels	Semi-annually
31S/26E-16P01	Irrigation	KDWD Monthly	202	59	-50	9	106	Water Levels	Semi-annually
31S/26E-32B	Irrigation	KDWD Monthly	191	5	-50	-45	73	Water Levels	Semi-annually
31S/27E-07B	Irrigation	CASGEM	197	104	-50	54	126	Water Levels	Semi-annually
31S/27E-12Q	Irrigation	CASGEM/ILRP	233	97	-50	47	140	Water Levels	Semi-annually
31S/27E-19D01	Irrigation	KCWA/DWR	200	97	-50	47	124	Water Levels	Semi-annually
31S/27E-25D01	Irrigation	KCWA/DWR	241	114	-50	64	153	Water Levels	Semi-annually
31S/27E-33K	Irrigation	KDWD StToll	218	151	-50	101	160	Water Levels	Semi-annually
31S/28E-14D	Irrigation	KDWD Monthly	176	104	-20	84	130	Subsidence	Semi-annually
31S/28E-20D	Irrigation	CASGEM	264	79	-50	29	147	Water Levels	Semi-annually
31S/29E-28C	Irrigation	CASGEM	185	55	-50	5	95	Water Levels	Semi-annually
31S/29E-30J01	Inactive	DWR/KCWA	213	60	-20	40	127	Subsidence	Semi-annually
32S/27E-07N	Irrigation	KDWD Monthly	170	58	-20	38	104	Subsidence	Semi-annually
32S/28E-01P	Irrigation	KDWD Monthly	161	26	-20	6	84	Subsidence	Semi-annually

3.2 DROUGHT RESPONSE STAGES OF ACTIONS AND DECLARATION OF A WATER SHORTAGE

A drought response stage and associated actions will be declared by the District's Board of Directors at a regular or emergency meeting. Three drought response levels have been established and are:

Level 1 – Drought Advisory
Level 2 – Moderate Drought
Level 3 – Severe Drought

Level 1 – Drought Advisory
A Level 1 Drought Advisory will be declared if at least one of the Potential Shortage indicators in **Table 2** is reached or is expected to be reached in the near future. The primary focus of this early level is to initiate public awareness of the drier than normal conditions and encourage voluntary reductions in water use and or consideration of using other supplies that are more plentiful.

Potential Actions:

- Provide information to District landowners and growers of the Drought Advisory Level and include this information in the District's weekly newsletter
- Provide information on the District's website along with suggestions for water use reductions
- Monitor closely the current and projected water supply and compare it with the projected demand in anticipation of the possible need to upgrade to Drought Level 2 - Moderate Drought.

Level 2 – Moderate Drought
A Level 2 Moderate Drought will be declared if more that one of the Potential Shortage indicators in **Table 2** is reached. When a Level 2 drought is declared, KDWD staff and Board of Directors will discuss which of the Water Shortage Allocations and Response Actions are appropriate. The next section provides details on these Water Shortage Allocations and Response Actions. Because the District has a portfolio of supplies, each situation will be unique depending upon the level and type of shortages.

Potential Actions:

- All the potential actions for a Level 1 Drought
- Allocation of the District's SWP supplies as per Resolution No. 2009-05
- Prorate Kern River Utility Water as per the District's 2015 Rules and Regulations.

Level 3 – Severe Drought
A Level 3 Severe Drought will be declared if at least two of the Potential Shortage indicators in **Table 2** are reached. Response actions to a Level 3 drought will be discussed and voted upon by the KDWD Board of Directors. Response actions are detailed in the next section and a combination of actions will likely occur. As mentioned before, each water supply shortage

situation will be unique and different combinations of response actions would be appropriate depending upon the types of shortages, season, water demands, and availability of other water supplies at that time.

Potential Actions:

- All the potential actions for Drought Levels 1 and 2
- Take proactive steps to purchase additional water supplies and participate in Dry Year Programs provided through Kern County Water Agency
- Consideration of Dry Year Programs to reduce Kern River Power Flow obligations to increase storage in Isabella Reservoir for use during peak irrigation season.

3.3 WATER SHORTAGE ALLOCATIONS AND RESPONSE ACTIONS

Kern River Water

Kern River Utility Water may be prorated during times of shortage based on: (1) anticipated total deliverable water to specific areas within the District Service Areas, (2) total acres within those Areas, (3) acres owned or operated by each customer within those Areas, and (4) any other equitable factors deemed necessary and appropriate by the District (KDWD 2015 Rules and Regulations). During periods of severe water shortage, the District may deliver Utility Water on a rotational basis. The rotation may cause growers to go several days or weeks between deliveries.

The District's WAP (Todd, 2011) prioritizes Kern River water use as follows:

1. Irrigation deliveries within each Service Area
2. Irrigation deliveries within the District
3. Municipal and industrial use
4. In-District groundwater recharge
5. Pioneer Project groundwater recharge
6. Other uses (including meeting additional surface demands, groundwater recharge, and transfers to out-of-district agencies).

Imported SWP Water

Allocation of the District's SWP supplies is governed by Resolution No. 2009-05 and the "2nd Amendment to the 1974 Plan for Water Allocation and Procedure for Setting State Water Tolls" according to the following process:

1. The Board of Directors shall have the option to sell up to 2,000 acre-feet/year of Kern Delta's State Water Project (SWP) contractual water supply out-of-district but within Kern County.
2. The annual SWP contractual water supply, less any water sold out-of-district pursuant to Paragraph 1, shall be allocated as follows:
   a) 12,500/30,000 to Eastside Utility lands and Eastside Area Non-Utility lands capable of receiving service from the Eastside Canal or the Central Branch of the Kern Island Canal.

b) 17,500/30,000 to Stine, Farmers, and Buena Vista Utility lands and Non-Utility lands lying west of the Kern Island Central Canal that are capable of receiving service.

3. Specific allocations to individual service areas shall be determined based on the following guidelines:
   a) 20% of the amounts allocated to the Eastside and Westside Areas shall be reserved to cover operational recharge within the District's canals. The remaining 80% of the Eastside and Westside Area supplies shall be allocated to individual District consumers.
   b) Water will be allocated to Eastside Area consumers (utility and non-utility) on an equal acre-foot per acre basis.
   c) The Westside Area supply shall be allocated to Stine, Farmers, and Buena Vista Utility consumers and Westside Non-Utility consumers, i.e., located west of Highway 99, capable of receiving service in amounts such that the total water deliveries to each area (based on projected long term average Utility Water deliveries and available SWP supply for that year) shall be equal in terms of acre-feet per acre.

Groundwater
Landowners in the District pump groundwater to cover shortages in surface water supplies.. The District may shut off deliveries or refuse to make deliveries if private facilities are not reasonably maintained.

The District's conjunctive use program operations have been developed to maximize its surface water supplies in order to maintain sustainable groundwater quality and quantity and preserve groundwater supplies for drought conditions. In its GWMP, the District identifies its Groundwater Basin Management Measures to protect and sustain its groundwater and surface water supplies.

3.4 ENFORCEMENT AND APPEALS

Water users and landowners will be informed of the specific drought requirement through public notices, mailers, and/or information posted on the District's website. The District may consider fines for knowingly disregarding drought requirements. A customer can request a variance by submitting in writing an application that includes reasons and supporting documentation for the request. The District may request a non-refundable processing fee for review of the application.

3.5 MONITORING AND EVALUATION

Monitoring and evaluation of the effectiveness of the Drought Plan is important for identifying methods that worked and ones that did not provide the anticipated benefits. District landowners are encouraged to use surface water when available to preserve groundwater resources for drought conditions. Accordingly, all surface water brought into

the District is measured along with seepage losses, which result in groundwater recharge. Delivered water is recorded at each turnout.

To evaluate the effectiveness of the Drought Plan, water availability and use of various water sources during a drought may be compared to water demands and use in past years, including dry, normal and wet conditions. This information may be helpful to understand the shift in use of water supplies during a drought and to ascertain if water use practices change over the course of the drought and between droughts. These assessments may also provide information on the effectiveness of the District's drought-related communications to its customers. For example, did water use practices change after the District issued a Level 1 Drought Advisory or did changes not occur until a Level 2 – Moderate Drought was declared?

The Drought Plan will be updated every five years in conjunction with the AWMP and the monitoring and evaluation information collected will be useful information when updating the Drought Plan.

3.6 COMMUNICATION PROTOCOLS

KDWD coordinates and collaborates regularly with others regarding local and regional water management in all years. These activities intensify during periods of drought in order to minimize adverse drought impacts across a range of stakeholders. KDWD is a key member of the KRGSA, which cooperatively manages water supply sources in the area to achieve groundwater sustainability. Drought declarations and actions are announced and posted to the District's website along with information on actions being taken to address these reductions.

3.7 FINANCIAL IMPACTS

During a drought, water use may decrease resulting in a decrease in water sales and corresponding District revenue. There may also be a potential increase in expenditures that result from the implementation of drought management actions. Measures to overcome revenue impacts could include use of reserve funds and/or a rate adjustment. The District anticipates that reserves would be used to offset the revenue impact. If the water shortage is or appears to be long-term or if District reserves are low, the District may elect to initiate rate adjustments or drought surcharges to offset these losses.

4 REFERENCES

National Oceanic and Atmospheric Administration (NOAA), 2019, National Climatic Data Center (NCDC), Bakersfield Monthly Precipitation, 1889-2010 and 2011-2018 data downloads, accessed March 2018 and February 2019. https://www.ncdc.noaa.gov/cdo-web/, accessed March 2018 and February 2019.

Todd Engineers, 2011, Kern Delta Water District Water Allocation Plan.

Todd Engineers, 2013, Final Groundwater Management Plan Update, Kern Delta Water District, October 11.

Todd Groundwater, 2020, Final Groundwater Sustainability Plan (GSP) Kern River Groundwater Sustainability Agency (KRGSA), January.

APPENDIX F

Farm-Gate Delivery Report for 2019 and Water Deliveries Report, 2017

WUEdata - Kern Delta W.D.

Sign Out

Agricultural Aggregated Farm-Gate Delivery Reporting Form for Article 2

Title 23, Division 2, Chapter 5.1, Article 2 of the CCR requires water supplier subject to the regulation to report to DWR the previous calendar year□s aggregated farm gate delivery by April 1 of the subsequent year

1. Water Supplier (auto-populated)		2. Contact Information (auto-populated)	
Name	Kern Delta W.D.	Name	Jana Marquez
Address	501 Taft Highway	Title	Groundwater Manager
Phone #	6618344656	Address	501 Taft Highway, Bakersfield, CA 93307
Fax	6618361705	Phone #	6618344656
		Fax	6618361705
		Email	jana@kerndelta.org

Total Number of Farm-Gates	513		
Number of Measured Farm-Gates	269	Submittal Date	03/31/2020
Irrigated Acreage for Reporting Period	128960	Reporting Year	2019
Total Service Area Acreage	128960		

3. Aggregated Farm-Gate Delivery Data**: (provide monthly or bimonthly data in acre-feet, by one groundwater basin or sub-basin per row)

Monthly Deliveries

Basin/SubBasin #	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
San Joaquin Valley/Kern County 5-022.14	5,989	2,163	7,040	16,231	16,303	28,535	29,949	26,357	15,055	10,257	5,646	1,137	164,662
Total	**5,989**	**2,163**	**7,040**	**16,231**	**16,303**	**28,535**	**29,949**	**26,357**	**15,055**	**10,257**	**5,646**	**1,137**	**164,662**

Bimonthly Deliveries

Basin/SubBasin #	Jan-Feb	Mar-Apr	May-Jun	Jul-Aug	Sep-Oct	Nov-Dec	Total
							0
Total							0

4. Explanations, Comments and Best Professional Practices***:

Note: An agricultural water supplier's total water use may be different from Aggregated Farm-Gate deliveries because measurement at these points may not account for other practices (such as groundwater recharge/conjunctive use, water transfers, wheeling to other agencies, urban use, etc).

* "Farm-gate" means the point at which water is delivered from the agricultural water supplier's distribution system to each of its individual customers as specified in the Agricultural Water Measurement Regulation (Title 23, Division 2, Chapter 5.1, Article 2 of the CCR).

** "Aggregated farm-gate delivery data" means information reflecting the total volume of water an agricultural water supplier provides to its customers and is calculated by totaling its deliveries to customers. Data shall be organized by basin or sub-basin per Water Code Section 531.10(a)(1). See DWR Bulletin 118 for list of groundwater basins and sub-basins.

*** "Best Professional Practices" is defined in Title 23, Division 2, Chapter 5.1, Article 2 of the CCR, Section 597.2.

DRAG-AND-DROP FILES HERE TO UPLOAD

Drag-and-Drop relevant files here (or click) to attach them to this submittal.

Uploaded Attachments			
Filename	**File Size**	**Date Uploaded**	

Submit Form to DWR

QUESTIONS / ISSUES? CONTACT THE WUEDATA HELP DESK

KERN DELTA WATER DISTRICT
WATER DELIVERIES REPORT

July 2017

Submitted to:

Kern Delta Water District
Board Members
501 Taft Highway
Bakersfield, CA 93307

Department of Water Resources
Water Use and Efficiency Branch
Agricultural Water Use Efficiency Unit
Attention: Fethi BenJemaa
VIA EMAIL: AgWUE@water.ca.gov

Prepared by:

Kern Delta Water District
501 Taft Highway
Bakersfield, CA 93307

State of California | The Natural Resources Agency | Department of Water Resources

Agricultural Aggregated Farm-Gate[1] Delivery Reporting Form for Article 2

Title 23, Division 2, Chapter 5.1, Article 2 of the CCR requires water supplier subject to the regulation to report to DWR the previous calendar year's aggregated farm gate delivery by July 31 of the subsequent year

1. Water Supplier Information

Name: Kern Delta Water District

Address: 501 Taft Highway Bakersfield, CA 93307

Phone Number: (661) 834-4656

Fax: (661) 836-1705

Total Number of Farm-Gates:

Number of Measured Farm-Gates:

Irrigated Acreage for Reporting Period:

Total Service Area Acreage:

2. Contact information

Name: Mark Mulkay

Title: General Manager

Address: 501 Taft Highway Bakersfield, CA 93307

Phone Number: (661) 834-4656

Fax: (661) 836-1705

E-mail: mark@kerndelta.org

Submittal date: July 31, 2017

Reporting year: 2016

3. Aggregated Farm-Gate Delivery Data[2]: (*provide monthly or bimonthly data, acre-feet*)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Total**
Monthly Deliveries	6,172.06	9,028.55	15,752.63	15,655.71	12,898.11	30,392.52	28,631.68	19,329.97	6,330.10	3,978.41	4,528.99	2,354.15	155,052.88

	Jan-Feb	Mar-Apr	May-Jun	Jul-Aug	Sep-Oct	Nov-Dec	**Total**
Bimonthly Deliveries							

4. Explanations, Comments and Best Professional Practices[3]:

SEE ATTACHED REPORT

Note: An agricultural water supplier's total water use may be different from Aggregated Farm-Gate deliveries because measurement at these points may not account for other practices (such as groundwater recharge/conjunctive use, water transfers, wheeling to other agencies, urban use, etc)

1. "Farm-gate" means the point at which water is delivered from the agricultural water supplier's distribution system to each of its individual customers as specified in the Agricultural Water Measurement Regulation (Title 23, Division 2, Chapter 5.1, Article 2 of the CCR).
2. "Aggregated farm-gate delivery data" means information reflecting the total volume of water an agricultural water supplier provides to its customers and is calculated by totaling its deliveries to customers.
3. "Best Professional Practices" is defined in Title 23, Division 2, Chapter 5.1, Article 2 of the CCR, Section 597.2.

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1. INTRODUCTION

In order to ensure all customers in the Kern Delta Water District (District) service area receive the water supplies they require, and in accordance with SBx 7-7, the District has been and continues to implement measuring technologies with increased accuracy, enabling the District to supply all deliveries ordered by its customers. These technologies include standard canal measuring structures such as weirs as well as modern measuring technologies that measure flow rates through the use of Doppler and ultrasonic technologies. In recent years the District has been converting to wireless sensors, allowing for instantaneous access to and observation of flow rates measured throughout the its service area. Through the use of these technologies and measuring devices, the District has been able to accurately measure where water resources within its systems are at any time and, as a result, continues working towards optimizing the operations within its systems to allow for the optimal use of its resources.

As the District employs several metering technologies, it is necessary to provide specialized training regarding how to accurately work with each type of meter and to maintain each meter as required. District staff responsible for the measurement of flow rates in District facilities undergo extensive training regarding methodologies for obtaining and recording measurements, ensuring that these measuring devices both measure and are reported accurately. Additionally, each device is calibrated by the District maintenance department at a minimum of the manufacturer's required interval in order to maintain accurate and precise measurements.

This report is intended to detail the measuring devices employed by the District as well as the methods of measurement and accuracy of each measuring technique used with by District staff for its deliveries. Also included in this report is a listing by month of the deliveries made to each gate within the Kern Delta Water District during the 2013 water year. This data is also presented in the condensed "Agricultural Aggregated Farm-Gate Delivery Reporting Format for Article 2" form provided by the State as stipulated in SBx 7 and included in Appendix B.

Detailed information regarding each of the measuring devices and their measurement methodologies and accuracies may be reviewed in its entirety through publications by the Department of the Interior: Bureau of Reclamation or by the individual manufacturer of the meters used within the District. A condensed description of each device along with any special provisions implemented specifically within the District service area is included herein.

2. BACKGROUND

Kern Delta Water District (KDWD) was formed in December 1965, pursuant to the provisions of California Water District Law (Division 13 of the California Water Code) to consolidate water rights and provide area landowners with the ability to contract with the Kern County Water Agency for the delivery of supplemental imported water from the State Water Project.
The District supplies are obtained via three sources: water served in the District is primarily diverted from the Kern River with groundwater and State water supplemental to it. The District's service area includes 128,960 acres of primarily agricultural lands, south of the City of Bakersfield.

Between the years of 1972 to 1976, the District contracted with the Kern County Water Agency (KCWA) to secure annual entitlement to State water; however, at the time the District did not have facilities to convey State water to its service area. The District did have access to Kern River water via canals owned by the Kern Island Water Company that ran through its service area. In 1972, the District entered into a water exchange agreement with the Buena Vista Water Storage District to trade its annual State water entitlement for an equal amount of Kern River Water. Soon thereafter, the District also entered into a water distribution agreement with the Kern Island Water Company for the use of its canals.

The Kern Island Water Company was formed in 1966 in accordance with a directive (Decision No. 71684) of the Public Utilities Commission. The formation of the Kern Island Water Company was the result of a merger of five canal companies: Kern Island Canal Company, Farmer's Canal Company, Stine Canal Company, Buena Vista Canal Company, and East Side Canal Company. These canal companies, with the exception of East Side Canal Company, had pre-1914 rights to divert water from the Kern River. Kern Island Water Company inherited all historical agreements for delivery and allocation of water held by the five canal companies.

The District acquired Kern Island Water Company in 1976 from the City of Bakersfield including all of its facilities and its historical water rights to diversions from the Kern River. The service areas of Kern Delta Water District and Kern Island Water Company largely overlapped.

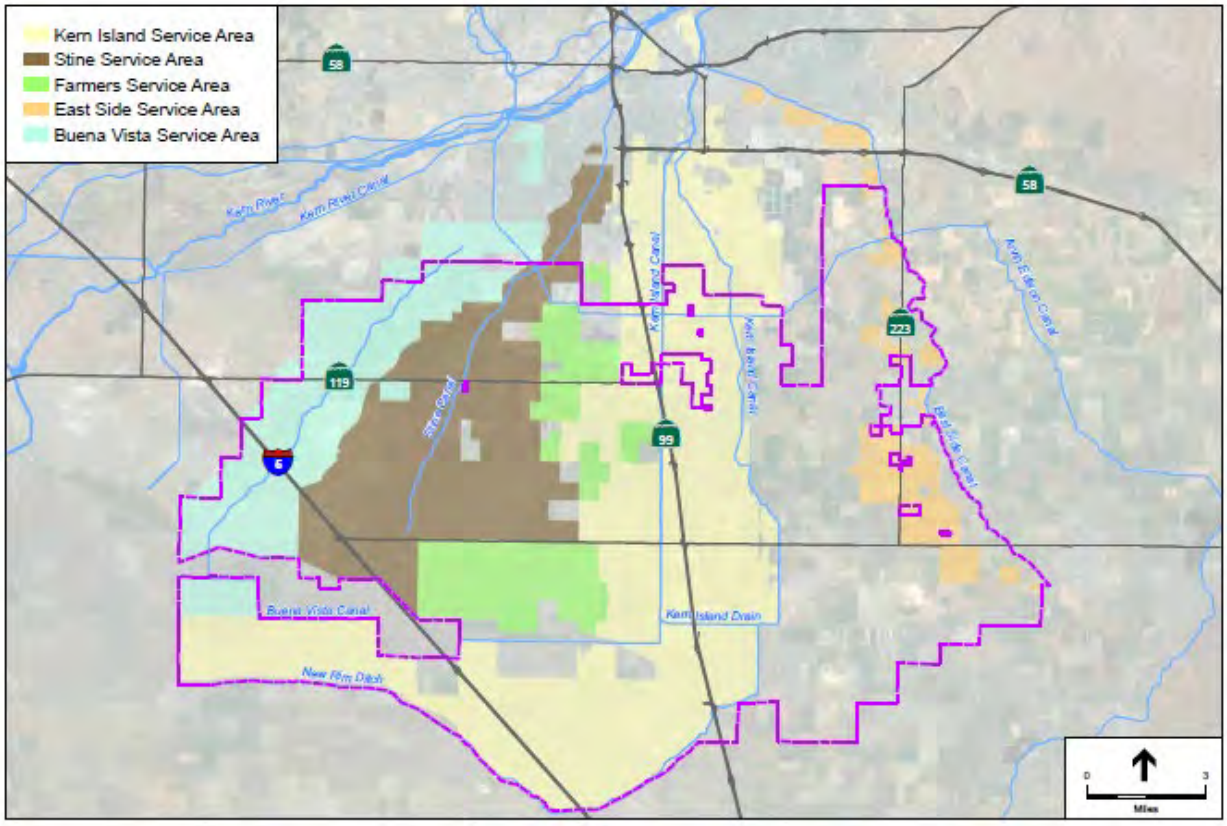

Figure 1: Kern Delta Water District Service Areas

Since the District's organization and acquisition of the Kern Island Water Company, water rights in California and the San Joaquin Valley have been a much debated and fought over resource. Considerable time and effort was spent during the early to mid 18th century refining measuring principles to be applied with the existing a structures in the canals; many of these structures are presently still in use for measuring diversions into District facilities.

This report is intended to summarize the methods of measurement employed by the District within its facilities. Also included in this report is a thorough breakdown of all deliveries to customers by delivery point by month and, as a supplement, the same deliveries totalized as requested by the Department of Water Resources.

3. MEASUREMENT DEVICES

The District utilizes two main methods for the measurement of water in its systems: standard overpour measurement facilities and meters (manual and automated). These measurement devices are read and reported daily by District staff.

3.1. WEIRS

Kern Delta Water District has an extensive weir system in its canals. These weirs are used as a primary means of regulating large flows through its facilities and consist of both fixed grade weirs and variable timber weirs. While District staff is very adept at calculating and regulating flow rates through timber weirs, it is recognized that these weirs are not an accurate means of measurement for the purposes of reporting deliveries; thus, the District only uses fixed grade weirs, thin-walled weirs to measure any flow rates diverted into its system and regulated within the District facilities. Following is a summary of the studies and analysis the District and other agencies have conducted to verify measurement accuracy through the use of weirs.

3.1.1. CONCRETE, FIXED GRADE WEIR:

Weirs, being some of the oldest canal structures still in existence, measure the flow of water in open canal channels within the District. Due to their lengthy use, several studies have been conducted on weirs to improve accuracy of measurements via their use. The District has incorporated and made use of one study in particular: the Kindsvater and Carter study and method of determining flow rates over weirs. This method, also used by the United States Department of the Interior Bureau of Reclamation, may be found in *The Water Measurement Manual* and a summary of which is included hereafter.

Weirs constructed and maintained within the District that serve as accurate measuring points are required to be maintained and, when necessary, rehabilitated so as to conform to the requirements of fixed blade, thin-walled rectangular weirs. These conditions are:

(a) The upstream face of the weir plates and bulkhead should be plumb, smooth, and normal to the axis of the channel.

(b) The entire crest should be level for rectangular and trapezoidal shapes, and the bisector of V-notch angles should be plumb.

(c) The edges of the weir opening should be located in one plane, and the corners should have proper specified angles.

(d) The top thickness of the crest and side plates should be between 0.03 and 0.08 inch (in).

(e) All weir plates should have the same thickness for the entire boundary of the overflow crest. If the plates are thicker than specified in condition (d), the plate edges shall be reduced to the required thickness by chamfering the downstream edge of the crest and

sides to an angle of at least 45 degrees; 60 degrees is highly recommended for a V-notch to help prevent water from clinging to the downstream face of the weir.

(f) The upstream edges of the weir opening plates must be straight and sharp. Edges of plates require machining or filing perpendicular to the upstream face to remove burrs or scratches and should not be smoothed off with abrasive cloth or paper. Avoid knife edges because they are a safety hazard and damage easily.

(g) The bottom edge plates and fastener projection upstream should be located a distance of at least two measuring heads from the crest. If not, the plates must be inset flush with the upstream face of the supporting bulkhead, and the fasteners must be countersunk on the upstream pool side. Upstream faces of the plates must be free of grease and oil.

(h) The overflow sheet or nappe should touch only the upstream faces of the crest and side plates.

(i) Maximum downstream water surface level should be at least 0.2 foot (ft) below crest elevation. However, when measuring close to the crest, frequent observations are necessary to verify that the nappe is continually ventilated without waves periodically filling the under nappe cavity.

(j) To prevent the nappe from clinging to the downstream face of the weir, the head measurement should be greater than 0.2 ft. Conditions (d), (e), and (f) also help to prevent clinging. If measurements must be made at heads approaching this value for substantial periods, operators must ensure the head measuring system has commensurate precision with respect to needed accuracy and must continually check for clinging.

(k) The measurement of head on the weir is the difference in elevation between the crest and the water surface at a point located upstream from the weir a distance of at least four times the maximum head on the crest.

(l) Keep the approach to the weir crest free of sediment deposits. All the approach flow conditions as discussed in section 17 of chapter 2 of this manual apply. [1]

Upon verification that these conditions are met, each weir is then rated using the Kindsvater-Carter Method. The equation used to determine flow rate over the weir is:

$$Q = C_e L_e h_{1e}^{3/2}$$

[1] *The Water Measurement Manual*, United States Department of the Interior – Bureau of Reclamation, 2001.

Where: Q = discharge, cubic feet per second (ft^3/s)
e = a subscript denoting "effective"
C_e = effective coefficient of discharge, $ft^{1/2}/s$
$L_e = L + k_b$
$h_{1e} = h_1 + k_h$
k_b = a correction factor to obtain effective weir length
L = measured length of weir crest
B = average width of approach channel, ft
h_1 = head measured above the weir crest, ft
k_h = a correction factor with a value of 0.003 ft

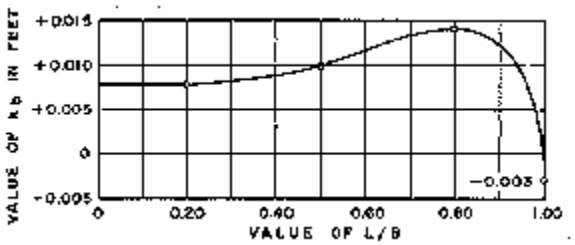

Figure 2: Value of width-adjustment factor from Georgia Institute of Technology tests (courtesy of American Civil Society of Engineers).

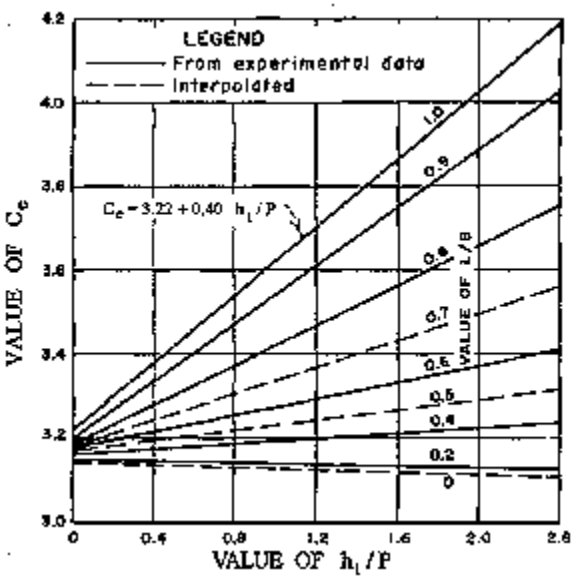

Figure 3: Effective coefficient of discharge, C_e, as a function of L/B and h_1/p, from Georgia Institute of Technology tests (courtesy of American Civil Society of Engineers).

The straight lines on Figure 2 have the equation form:

$$C_e = C_1 (h_1 / p) + C_2$$

where:

C_e = effective coefficient of discharge
C_1 = equation coefficient
h_1 = head on the weir (ft)
p = height of crest above approach invert (ft)
C_2 = equation constant

The District has also standardized measurement practices of thin-plate rectangular weirs. For a weir to provide an accurate source of flow rate measurement, the following conditions must be true (please note, other conditions are also necessary, but the primary sources of error within District service area are reflected by the conditions listed below):

1) Measurements must not be taken from the side of the canal or concrete box structure.
2) Measurements must be taken at a distance between four (4) to six (6) times the head (H) above the weir. (i.e. The water surface for a weir with one foot of head must be measured between four to six feet upstream of the weir).

Errors in measurement and calculation of flow rates over weirs are most often introduced through these two items.

Measurements cannot be taken from the sides of the canal or concrete box due to the reactions at the interface between the water surface and soil/concrete. The water velocities in these zones are slowed due to shearing forces and friction which cannot be accounted for in the traditional weir over pour calculation.

The greatest potential for error, however, is in the location the differential head measurement (head above the weir) is taken. Assuming steady flow and steady state conditions (typical for Kern Delta's service area) upstream of the weir, the water velocity and cross sectional area above the weir remains constant and uniform; however, beginning about four (4) to six (6) measuring heads upstream of the weir, and increasing in severity as the water approaches the weir, there is a contraction in the cross sectional area and increase in velocity. This results in a lower measured head as water approaches the weir crest, with a critical depth (lowest point in the water profile) occurring at the weir crest, before free-falling into the canal below the weir. Please note, per the Bureau's *Water Measurement Manual*, the formula widely used by water agencies including

Kern Delta requires that the head be measured at least four measuring heads upstream of the weir crest, before the change to the water profile due to approaching the weir occurs.

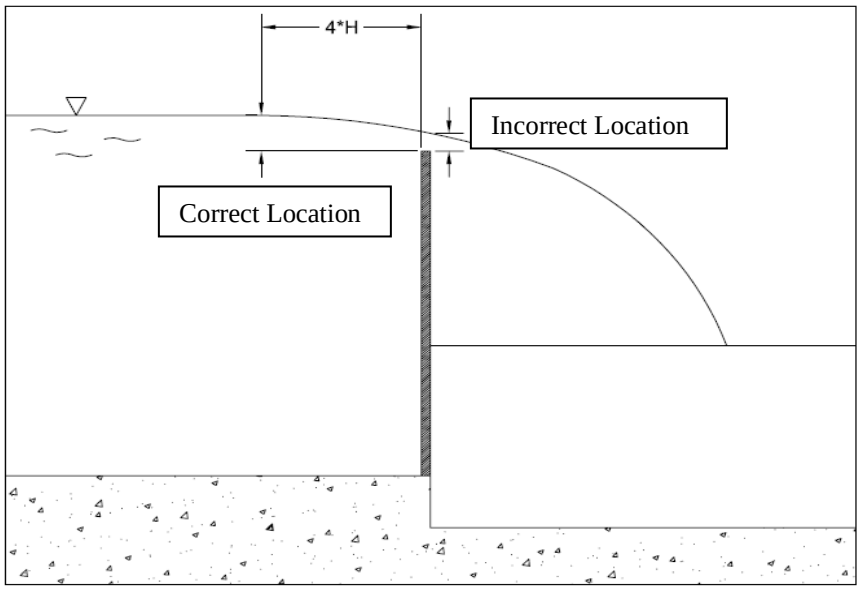

Figure 4: Typical Water Profile at a Sharp Crested Weir

In determining the flow rate over a weir, several variables (canal roughness, water turbulence, cross-sectional area vs. velocity, friction from air & other sources, etc.) are accounted for, based on the assumption that the water surface elevation is measured when the canal is still in a steady state and uniform condition. Measuring the water surface at the vena contracta introduces errors into the measured flow rates that result in measured flow rates being lower than the actual flow rates.

To illustrate the effects of these errors on the calculated flow rates in a specific example, and assuming a weir is to measured that has a weir crest length of 4'-6", all conditions regarding the weir installation are correctly met, the tail water elevation is a minimum of two (2) feet below the weir crest, the following is the difference between the calculated flow rate (whose head is measured at the weir crest) and the actual flow rate.

Table 1: Calculated Flow Rates of Example Weir

Calculated Flow Rates (H, being measured at the weir crest)		
H (in)	Q - Perceived (cfs)	Q – Actual (cfs)
0	0.00	0.00
1	0.33	0.40
2	0.90	1.10
3	1.64	2.00
4	2.52	3.07
5	3.52	4.28
6	4.61	5.61
7	5.80	7.06
8	7.08	8.62

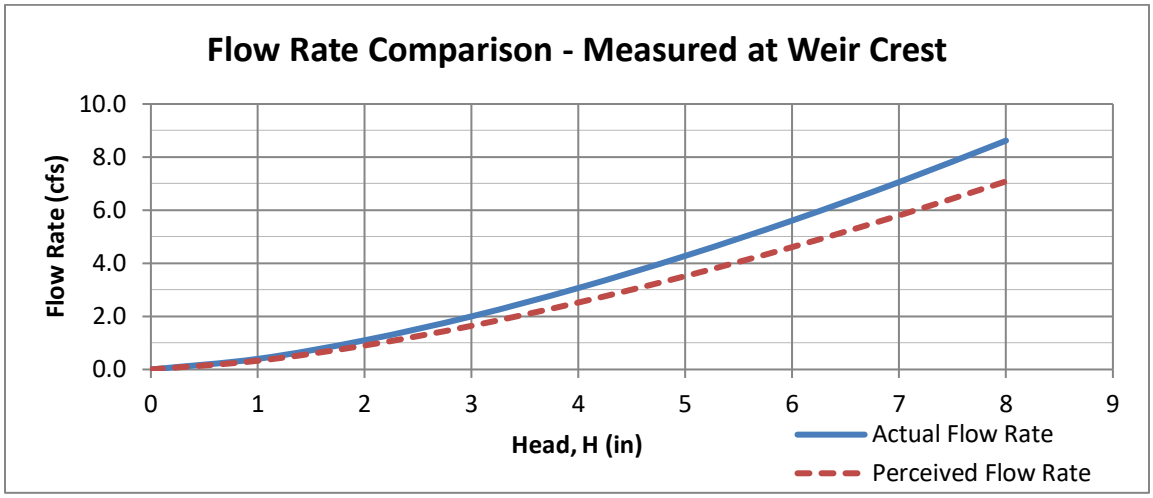

Figure 5: Perceived Flow Rate at Weir Crest vs. Actual Flow Rate

Based on the above discussion, District personnel record the head on each weir at a location approximately four (4) to six (6) measuring heads upstream of the weir. Measurements are also taken in (approximately) the centerline of the canal's flow path at the specified distance upstream from the weir.

3.2. FLOW METERS

Given the size of the District's service area and its limited staff, it has been deemed impractical to rely solely on fixed canal structures (such as weirs) that require staff to measure flow rates at

several times a day in addition to regulating the canals and diversion points. The District has explored the possibilities of implementing several metering technologies that would allow for its staff to be able to take measurements faster, to be able to record measurements over time that could be read at the locations, and to record measurements and transmit them wirelessly back to the office for observation. Through trial and error, the District has found that a few metering technologies work best at points throughout its systems; following is a detailed breakdown of metering technologies that have been implemented within the District, as well as a description of each meter and its specific application.

3.2.1. CANAL AND DIVERSION GATES:

Figure 6: Waterman C-10 Canal Gate

C-10 canal gates are used extensively throughout the District at major diversions and at individual farmer turnouts and delivery points. The gates are specifically designed to be used on canal and pipeline systems which operate at low heads. In the District, they are installed in two manners: the first being a typical installation at the head of a pipeline delivery or measurement point, and the second location is against a concrete headwall that discharges into a canal. The first type of installation is very typical for farm turnouts. The District has hundreds of turnout structures with gates installed on them. These gates regulate water into pipeline systems that are installed by farmers and used to distribute the water within their systems. Often times these pipelines networks are very long, necessitating the installation of a pipe riser behind the gate and turnout structure that serves to provide a pressure/vacuum release and to measure the instantaneous differential head behind the gate: this differential head measurement, along with height of the gate opening are used to determine deliveries to the farmer. Other times, the pipeline is very short and empties into a stilling well where a booster pump sends it to the farmer's required location. In this situation, the differential head can be measured in the stilling well while accounting for any losses from friction in the pipe.

The second installation is unique to the District and specifically for the purpose of metering diversions into canals throughout the District. A headwall is placed in a canal just downstream of a major diversion with a fixed water surface. Should the water surface rise, the water will overtop the fixed structure in the canal lateral and travel into the lateral as designed. The

headwall, however, has one to four C-10 gates installed on it which are opened to allow for a determined flow to pass through them into the main canal. Knowing the flow rates coming to

this diversion point, and the flow passing through the gates, District staff knows exactly how much of its resources are being sent into the canal lateral at any time.

3.2.2. DOPPLER ULTRASONIC & DEPTH SENSOR:

One of the primary meters the District uses in partially full pipelines is a Doppler ultrasonic technology with a depth sensor. The Doppler technology allows for hundreds of measurements of water velocity – specifically, the debris, organisms or sediment being transported by the water – to be taken in the pipe and averaged to determine the true water velocity in the pipeline. These readings are taken over the entire cross section of the pipe, accounting for increased friction along the pipe walls and other factors traditional measuring cannot take into consideration. The meters are also equipped with a pressure sensor, capable of calculating the depth of water in the pipe. The meter, upon measuring the depth of the water based upon the hydrostatic water pressure, is programmed to determine the flow area in the pipe. Thus, the measurements of both area and velocity yield the flow rate through each of these pipes.

The District also makes use of these devices in its open canals. After programming the cross sectional area of the canal section the meter is installed in, the meter is able to measure the velocity of the water and the depth of water above it and, using this data, compute the flow rates in an open canal. The same also holds true for measuring weirs throughout the District.

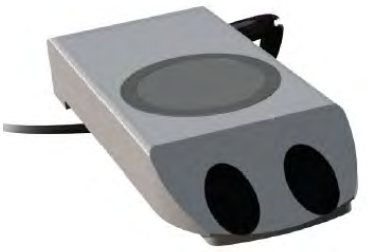

Figure 7: Mace Depth and Area Sensor

The accuracy of the Doppler Ultrasonic technology is within 1% with velocities below ten (10) feet per second. None of the facilities within the District operate with velocities above this threshold.

3.2.3. ECHOFLO ULTRASONIC SENSOR:

The District has installed and currently uses several EchoFlo meters to monitor water depths throughout the District. These meters are installed in District canals upstream of fixed-blade overpour weirs and are used in conjunction with the weirs to determine flow rates through a given canal reach. Using several of these weirs in series, the District is able to effectively calculate the differential flow through each reach, thereby indicating the amount of water delivered to its customers at large diversion points.

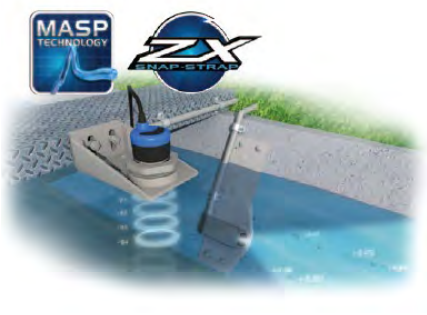

Figure 8: Mace EchoFlo Depth Sensor

The EchoFlo meter uses ultrasonic technology to transmit a signal out from the meter and, based upon the amount of time for that signal to be reflected and return to the meter, is able to determine the depth of water. In the case of fixed blade weirs, this can then be used to determine the head on the weir.

These meters are mounted throughout the District in one of two methods. The first method utilizes a stilling well that is attached to the headwall of the weir structure. This stilling well has pipes that extend below the water surface, approximately twenty (20) feet upstream of the headwall, allowing for the stilling well's water surface to present an accurate representation of the energy grade line of the canal and is used to determine the head on the weir. The second method involves the use of a swing arm specifically designed for these meters. The arm extends out approximately twenty (20) feet and is locked in place upstream of the weir, providing the same water surface, free from obstructions and changes in the water surface due to approach conditions at the weir crest.

The EchoFlo meters have an accuracy of +/- 0.2%.

3.2.4. PROPELLER METER

The District has canal reaches that have been placed in pipeline for several reasons including the regulation of its supplies into retention basins as well as for overcrossings due to further expansion of the City of Bakersfield. These pipelines have given the District the opportunity to install propeller meters that measure instantaneous flow rates through the pipelines.

A few conditions must be met for these meters to function accurately: namely, water velocities must be within a specified range (100 to 75,000 gallons per minute), pipes must be flowing full – partial flow through pipes will not be measured accurately, the meters must be installed a certain distance away from entrances or exits to allow for the velocity profile to pass through the propeller perpendicular to the meter, and the water must be free from large debris and objects that might obstruct flow through the propeller.

Accuracy of the Propeller meters is within +/- 2% of the true flow rate and the repeatability of the measurements taken is within +/- 0.25%.