Lower Mokelumne River Project

FERC Project No. 2916

2021 Project Operations Report

EAST BAY MUNICIPAL UTILITY DISTRICT

Submitted to the Federal Energy Regulatory Commission in Compliance with Ordering Paragraph (C) of the November 27, 1998 Order Approving Settlement Agreement and Amending License

February 2022

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ABBREVIATIONS

AFRP	Anadromous Fish Restoration Program
AOP	Annual Operations Plan
CAMP	Comprehensive Assessment and Monitoring Program
CBDA	California Bay Delta Authority
CDFW	California Department of Fish and Wildlife
CVPIA	Central Valley Project Improvement Act
CWT	Coded Wire Tag
DCC	Delta Cross Channel
DWR	Department of Water Resources
EBMUD	East Bay Municipal Utility District
FERC	Federal Energy Regulatory Commission
HOS	Hypolimnetic Oxygenation System
JSA	Joint Settlement Agreement
LMRMP	Lower Mokelumne River Management Plan
LMRSP	Lower Mokelumne River Stewardship Program
LWWC	Lodi-Woodbridge Winegrape Commission
MRA	Mokelumne River Association
MRDUA	Mokelumne River Day Use Area
MRFH	Mokelumne River Fish Hatchery
MRTAC	Mokelumne River Technical Advisory Committee
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System Permit
PCC	Partnership Coordinating Committee
PSC	Partnership Steering Committee
SAFCA	Sacramento Area Flood Control Agency
SCWA	Sacramento County Water Agency
SJCOG	San Joaquin Council of Governments
SJCRCD	San Joaquin County Resource Conservation District
SWRCB	State Water Resources Control Board
TNC	The Nature Conservancy
USFWS	United States Fish and Wildlife Service
USBR	United States Bureau of Reclamation
USGS	United States Geological Survey
WID	Woodbridge Irrigation District
WQRMP	Water Quality and Resource Management Program

I. PURPOSE AND SCOPE

This report is submitted to the Federal Energy Regulatory Commission (FERC) in compliance with Ordering Paragraph (C) of the FERC's November 27, 1998 Order Approving Settlement Agreement and Amending License (FERC Order), which provides:

"On February 15 of each year, the licensee shall file a report describing all measures completed pursuant to the Settlement during the previous calendar year, and actions proposed to be completed during the then-current calendar year."

In this report, "Settlement Agreement" refers to the March 23, 1998 Joint Settlement Agreement (JSA) among the East Bay Municipal Utility District (EBMUD), the United States Fish and Wildlife Service (USFWS), and the California Department of Fish and Wildlife (CDFW), and "License" refers to the license for EBMUD's Lower Mokelumne River Project, FERC Project No. 2916.

This report summarizes the measures EBMUD implemented in the previous calendar year (2021), and those that it plans to implement in the current calendar year (2022), pursuant to the JSA, to protect and enhance the fishery resources and ecosystem of the lower Mokelumne River.

II. INTRODUCTION

This submittal is EBMUD's Project Operations Update Report[1] for 2021. EBMUD actions in 2021 were designed to improve water quality, flow regimes, and physical habitat in the lower Mokelumne River area for the benefit of the river's anadromous and resident fish populations, the riparian zone, associated uplands, and recreational angling. In 1993, EBMUD began voluntarily releasing flows consistent with the Lower Mokelumne River Management Plan (LMRMP), and in March 1996, voluntarily began releasing flows to the lower Mokelumne River consistent with the flow requirements of the then proposed JSA. As part of EBMUD's implementation of the JSA and FERC Order, EBMUD continues to release flows consistent with the requirements of the JSA.

Additional efforts to improve the health of the river ecosystem have been implemented through the Water Quality and Resource Management Program (WQRMP). This program, developed by the Partnership Steering Committee (PSC) consisting of representatives from EBMUD, CDFW, and USFWS, in cooperation with NOAA Fisheries and the Mokelumne River Technical Advisory Committee (MRTAC) members, and in accordance with Sections E.3, F.5, and H.5 of the JSA, was approved by FERC on May 9, 2001. The

[1] EBMUD submitted earlier Project Operations Reports to FERC prior to the JSA (for the years 1990-94, 1995-96) and after the JSA (for the years 1997-1998 through 2020).

WQRMP includes a comprehensive monitoring and applied research program integrated with a well-coordinated program to adaptively manage water and power supply operations, flood control, hatchery operations, and ecosystem rehabilitation actions. The PSC oversees the implementation of the measures identified in the JSA and the WQRMP.

This report is composed of five sections. Section I describes the purpose and scope of EBMUD's Project Operations Update Report and Section II is an introduction to the report. Section III contains current and past data on the status of the lower Mokelumne River salmon populations, including escapement data, redd counts, and outmigration. Section IV covers six key areas in which EBMUD and the JSA partners have made efforts to restore, enhance, and protect the fisheries resource and ecosystem of the lower Mokelumne River. These areas are Flow, Water Quality, Lower Mokelumne River Partnership, Mokelumne River Technical Cooperation, Research and Monitoring, and Habitat Improvements. This section describes efforts made during the 2021 calendar year and efforts planned for 2022. Section V contains the appendices.

III. STATUS OF THE LOWER MOKELUMNE RIVER SALMON POPULATION

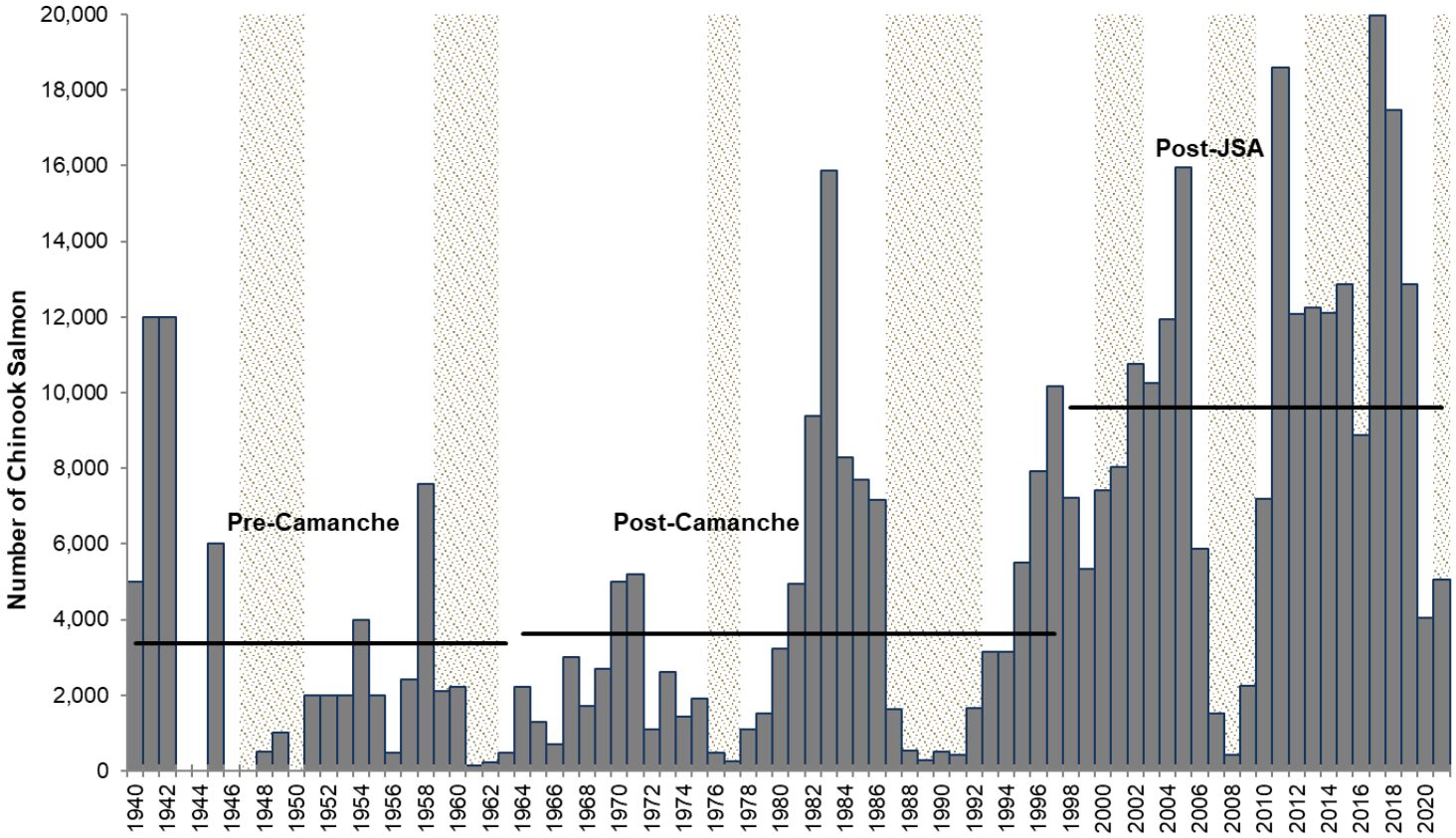
Through the 1990s and into 2021, the lower Mokelumne River Chinook salmon population continues to demonstrate characteristics consistent with long-term sustainability. As of January 11, 2022, the Mokelumne River fall-run Chinook salmon escapement in 2021/2022 was 5,043 (Table 1; Figure 1). EBMUD and Woodbridge Irrigation District (WID) continue to work cooperatively in managing operations to maximize the accuracy of monitoring systems.

Table 1: Lower Mokelumne River Fall-Run Chinook Salmon Data, 1989–2021

Year	Outmigration		Total Escapement	Hatchery Returns	Natural Spawners	Percent Natural Spawners of Total	Number of Redds
	Fry	Smolts					
1989	no data	no data	280	81	199	71	no data
1990	See note 3	78,179	497	68	429	86	71
1991	See note 3	31,025	410	42	368	90	127
1992	See note 3	69,993	1,645	710	935	57	345
1993	11,006	172,442	3,157	2,164	993	31	530
1994	554	142,670	3,157	1,919	1,238	39	777
1995	260,103	174,103	5,517	3,323	2,194	40	888
1996	103,270	80,744	7,921	3,883	4,038	51	929
1997	405,350	135,116	10,175	6,494	3,681	36	1,325
1998	1,336,768	511,771	7,213	3,091	4,122	57	1,116
1999	1,232,958	302,481	5,333	3,150	2,183	41	627
2000	107,134	61,391	7,423	5,450	1,973	27	987
2001	37,754	81,580	8,035	5,728	2,307	29	843
2002	11,791	66,132	10,753	7,913	2,840	26	848
2003	8,297	132,174	10,239	8,117	2,122	21	807
2004	45,467	42,187	11,944	10,356	1,588	13	835
2005	197,390	235,484	15,969	5,563	10,406	65	2,170
2006	1,008,289	179,264	5,871	4,139	1,732	30	755
2007	10,349	29,278	1,521	1,051	470	31	306
2008	1,835	16,512	412	239	173	42	63
2009	960	29,654	2,250	1,553	697	31	248
2010	4,243	63,106	7,196	5,275	1,921	27	314*
2011	228,829	52,288	18,596	15,922	2,674	14	564
2012	13,888	38,049	12,091	6,556	5,535	46	1,287
2013	49,102	98,488	12,252	5,170	7,082	58	1,823
2014	15,764	154,100	12,117	8,817	3,300	27	909
2015	12,599	48,707	12,879	8,295	4,584	36	1,357
2016	7,182	127,411	8,871	6,887	1,984	22	405*
2017	261,209	209,696	19,963	14,319	5,644	28	1,255
2018	10,569	29,548	17,475	7,280	10,195	58	2,432
2019	2,669,037	130,172	12,870	8,509	4,361	34	1,051
2020	3,672	20,427	4,044	3,443	601	15	290
2021	21,349	60,791	5,043	4,217	826	16	371

Notes:
1. Escapement monitoring generally occurs from August through January, but dates vary each year.
2. Hatchery Returns: count by CDFW at the Mokelumne River Fish Hatchery.
3. Estimates were not segregated into fry and smolts.
4. The data for the most recent year may change as estimates are finalized and new information is analyzed.

* Redd survey incomplete due to high flows.



Horizontal lines indicate pre-Camanche, post-Camanche, and post-JSA periods, respectively.

1. "Pre-Camanche" escapement (3,374) is the average estimate at Woodbridge Dam for the period from 1940 through 1963 (excluding years when no data were recorded: 1943, 1944, 1946, 1947, and 1950).
2. "Post-Camanche" escapement (3,636) is the average estimate at Woodbridge Dam for the period 1964 through 1997.
3. "Post-JSA" escapement (9,598) is the average estimate at Woodbridge Dam since implementation of the JSA in 1998.
4. Dithered shaded areas are periods of drought in California. Historical drought data are based on California Department of Water Resources, *California's most Significant Droughts: Comparing Historical and Recent Conditions*, January 2022. More recent drought designations follow guidelines presented at https://water.ca.gov/Water-Basics/Drought.

Figure 1: Estimated Annual Spawning Escapement of Fall-Run Chinook Salmon in the Lower Mokelumne River, 1940–2021

Eight of the past eleven years have seen run sizes of over 10,000 adult salmon returning to the Mokelumne River, including the highest three returns in 2011, 2017, and 2018. The trend of above average returns is indicative of positive response to the adaptive management actions (discussed in later sections) implemented during 2009–2021. Despite having been mired in a multi-year drought and associated flow regimes, along with deteriorating ocean conditions, the lower Mokelumne River Chinook salmon population continues to demonstrate characteristics consistent with long-term sustainability. In fact, the Mokelumne produces one of the few salmon populations nearing the natural production doubling goal relative to baseline 1967–1991 levels established by the USFWS Anadromous Fish Restoration Program (AFRP) through the 1992 Central Valley Project Improvement Act (CVPIA). The AFRP-established doubling goal for the Mokelumne is 9,300, while the river's 1992–2015 average natural production was 8,976 as of the last official AFRP update published in 2016. This represents a higher percentage of attainment (97%) for the Mokelumne River than any other Central Valley river salmon population. However, the 2021 Mokelumne River salmon escapement was lower than expected. While the causes are currently unknown, the October atmospheric river that brought historic rainfall to the Central Valley caused dramatic flow increases in rivers, streams, creeks, and sloughs throughout the region which most likely contributed to widespread straying of Mokelumne origin salmon.

Due to the consistently strong runs on the Mokelumne River in recent years, the Mokelumne River Fish Hatchery (MRFH), owned by EBMUD and operated by the California Department of Fish and Wildlife (CDFW), reported in the 2017 MRFH Annual Operations Plan (AOP) that it would continue into the long-term the import ban of eggs originating from other hatcheries whenever possible. Due to the long-term nature of the egg importation ban, EBMUD and CDFW are focused on achieving hatchery production goals through spawning only Mokelumne-origin fish returning to MRFH. However, in 2021 due to low fish returns, large proportion of grilse females, and egg losses due to thiamine deficiencies at MRFH, CDFW coordinated the import of approximately 2.4 million eyed salmon eggs from the Nimbus Fish Hatchery to support MRFH production goals. Imported eggs will not be used to satisfy the mitigation production requirement of 3.4 million fish, which will be produced using Mokelumne River broodstock. It is estimated that the imported eggs will yield 2.1 million smolts, which will be applied towards the ocean enhancement target production goal of 3 million fish once the Mokelumne River broodstock supply is exhausted. From October 2021 through January 11, 2022, approximately 826 salmon spawned within the river, constructing approximately 371 redds (nests) in the 10-mile reach below Camanche Dam (Figure 2). Based on salmon emergence temperature models the peak of Brood Year 2021 fry emergence will occur during the first two weeks of February 2022 and be completed by early April 2022.

Outmigrating juvenile salmon from Brood Year 2020 were sampled at the beginning of 2021 through spring. The estimated outmigration of juvenile salmon in 2021 was 82,140 (Table 1).

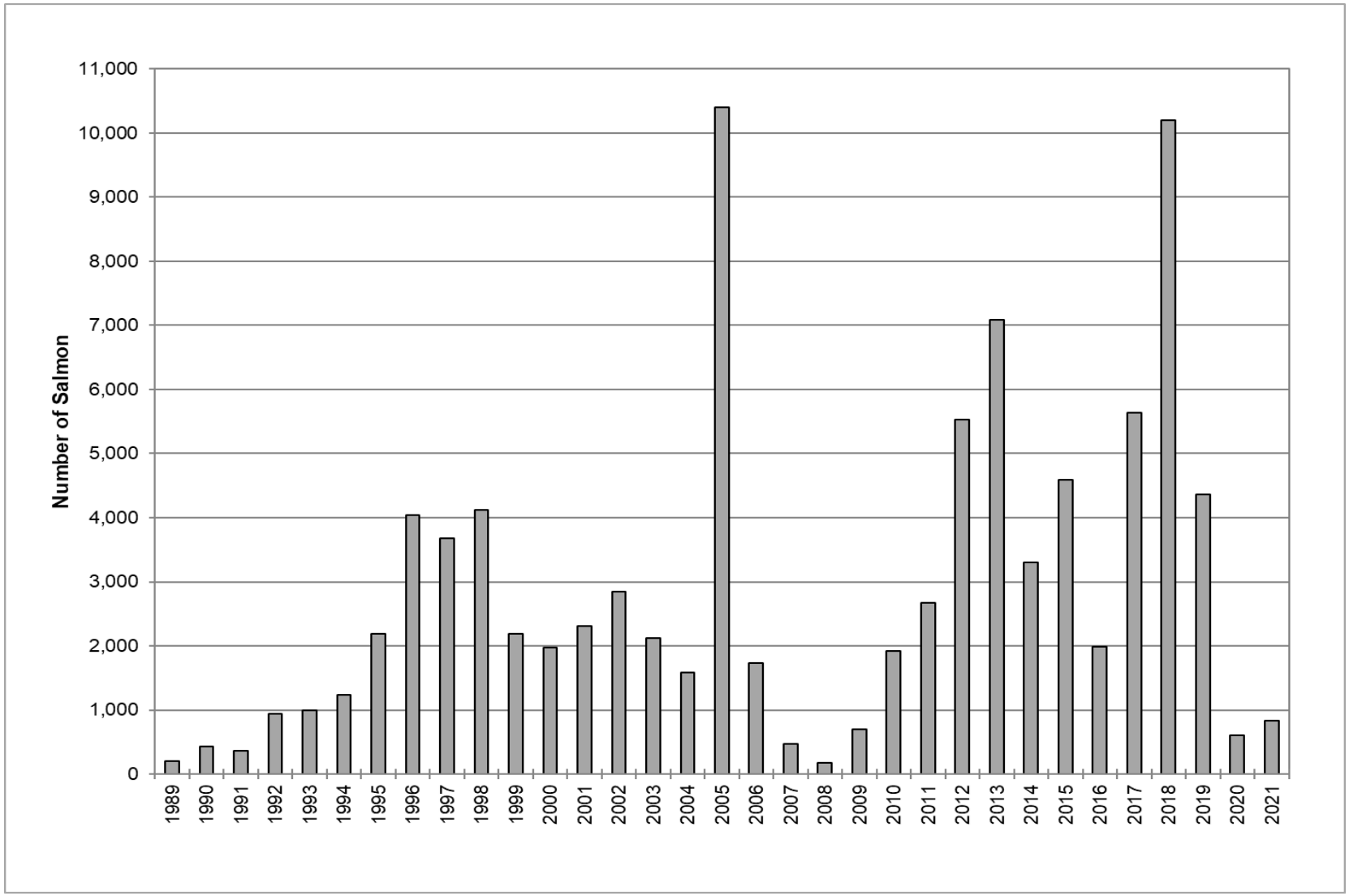


Figure 2: Fall-Run Chinook Salmon Naturally Spawning in the Lower Mokelumne River, 1989–2021

IV. EBMUD EFFORTS TO RESTORE, ENHANCE, AND PROTECT THE FISHERIES RESOURCES AND ECOSYSTEM OF THE LOWER MOKELUMNE RIVER

Responding to drought conditions, increased environmental concerns, and an improved understanding of fishery resource needs on the lower Mokelumne River, in 1987 EBMUD began to develop a multifaceted plan to protect and enhance the fishery and riparian resources of the lower Mokelumne River. This plan, known as the Lower Mokelumne River Management Plan (LMRMP), was developed over five years and was voluntarily implemented by EBMUD beginning in 1993. The 1998 Joint Settlement Agreement (JSA) incorporates the knowledge gained through the development of the LMRMP and contains additional actions to protect the lower Mokelumne River resource beyond those already undertaken by EBMUD under the LMRMP. Actions taken by EBMUD in 2021, and those actions planned for 2022, are described in this section.

A. FLOW

Consultation with CDFW and USFWS, on a real-time basis, began during the 1992–1993 salmon run with voluntary flow releases consistent with the LMRMP, and real-time consultation has continued since that time. In March 1996, EBMUD voluntarily began releasing flows to the lower Mokelumne River consistent with the flow requirements of the JSA. The 2021 releases to the lower Mokelumne River are summarized in this section.

EBMUD owns and operates the gaging stations below Woodbridge Dam and below Camanche Dam and measures the flow in accordance with United States Geological Survey (USGS) stream gaging procedures. Releases were measured at Camanche Dam using its Accusonic flow meters. The flow data is verified by USGS staff annually and subsequently published in the USGS Water Data Reports, approximately one to two years later. Because of the delay between the time flow data are collected and the timing of publication in the USGS Water Data Reports, the 2021flow data included in this report have not yet been verified or published by the USGS.

On December 29, 1999, the State Water Resources Control Board (SWRCB) issued Water Right Decision 1641 (D-1641), a decision involving numerous parties throughout the Central Valley. Among other regulatory changes, D-1641 modified water rights on the Mokelumne River, significantly increasing assurances that operations under the JSA will provide the expected flows below Woodbridge Dam. D-1641, which was re-confirmed by the SWRCB's Water Right Order 2000-2 on March 15, 2000, modified the water rights of both EBMUD and the Woodbridge Irrigation District (WID). It conforms EBMUD's water rights to the FERC-approved JSA flow requirements and requires WID to curtail its diversions at Woodbridge Dam that exceed its Permanent Regulated Base Supply

entitlement released from Camanche Dam under its 1965 Agreement with EBMUD to ensure that the JSA flows are met below Woodbridge Diversion Dam.

2021

In accordance with the November 27, 1998 FERC approval of the JSA and based upon EBMUD's end of September forecast of total Pardee and Camanche Reservoir storage on November 5, 2020, EBMUD provided "Below Normal" JSA water year type Camanche dam flow releases from October 1, 2020 through March 31, 2021, with the exception for a JSA Adaptive Management flow reduction of 30 cubic feet per second (cfs) in February and March 2021, as approved by the California State Water Resources Control Board. Pardee and Camanche Reservoir actual total storage on November 5, 2020 was 449,270 acre-feet.

Based on the California Department of Water Resources (DWR) April 1, 2021 forecast of 325,000 acre-feet of unimpaired runoff into Pardee Reservoir, EBMUD operated under a "Dry" JSA water year type for Camanche Dam flow releases from April 1, 2021 through September 30, 2021. Actual runoff for Water Year 2021 was 218,000 acre-feet, which would have been within the "Critically Dry" year type criteria. EBMUD is making, at a minimum, "Dry" JSA water year type Camanche Dam flow releases from October 1, 2021 through March 31, 2022. This is based on EBMUD's total Pardee and Camanche Reservoir storage on November 5, 2021. Actual Pardee and Camanche reservoir storage on November 5, 2021 was 333,160 acre-feet.

As further described in the Adaptive Management and Pulse Flow Operations sections of this report, EBMUD's 2021 flow operations included close coordination with the Partnership Coordinating Committee (PCC) and EBMUD's Fisheries and Wildlife Division to utilize necessary Camanche Permit Extension (CPE) Mitigation releases to provide three pulses for salmon attraction during adult up-migration. Flows at the Woodbridge Dam were also modulated to create three additional fish attraction pulse flow releases in October. Through EBMUD coordination with the PCC, this management strategy made efficient use of CPE Mitigation releases. In general, pulse flows are credited with helping improve the salmon returns to the Mokelumne through reduced straying to other systems.

Calendar year 2021 actual Camanche Dam average daily flow releases and JSA agreed flow releases from Camanche Dam are shown in Table 2 and Figure 3. JSA agreed releases represent JSA minimum releases with any approved JSA Adaptive Management flow reductions. The average daily flows below Camanche Dam did not fall below the required minimum daily flow.

Calendar year 2021 actual average daily flows and expected JSA flows below Woodbridge Dam are shown in Table 3 and Figure 4. The average daily flows below Woodbridge Dam did not fall below the required minimum daily flow. EBMUD will continue to coordinate with WID to share information and data as it becomes available to make best faith efforts to continue to operate to meet JSA expected daily flows.

Provisional fifteen-minute flow readings indicated temporary excursions from expected minimum flows below Woodbridge Dam. The excursions in the fifteen-minute data appear to have occurred during WID's routine maintenance operations, such as fish screen cleaning and canal maintenance. These excursions, at EBMUD's gaging station, USGS No. 11325500 ("Mokelumne River below Woodbridge Dam") are included in Appendix B (Tables B-1 through B-3) of this report.

Table 2: Calendar Year 2021 Average Daily Release in Cubic Feet per Second from Camanche Dam

Date	Actual Camanche Release	JSA Agreed Release	Date	Actual Camanche Release	JSA Agreed Release	Date	Actual Camanche Release	JSA Agreed Release	Date	Actual Camanche Release	JSA Agreed Release	Date	Actual Camanche Release	JSA Agreed Release
1/1/2021	255	250	3/16/2021	255	220	5/29/2021	368	220	8/11/2021	230	100	10/24/2021	225	220
1/2/2021	255	250	3/17/2021	247	220	5/30/2021	386	220	8/12/2021	234	100	10/25/2021	225	220
1/3/2021	255	250	3/18/2021	232	220	5/31/2021	363	220	8/13/2021	225	100	10/26/2021	226	220
1/4/2021	255	250	3/19/2021	235	220	6/1/2021	260	100	8/14/2021	212	100	10/27/2021	226	220
1/5/2021	255	250	3/20/2021	235	220	6/2/2021	245	100	8/15/2021	213	100	10/28/2021	226	220
1/6/2021	255	250	3/21/2021	235	220	6/3/2021	245	100	8/16/2021	209	100	10/29/2021	225	220
1/7/2021	253	250	3/22/2021	235	220	6/4/2021	244	100	8/17/2021	200	100	10/30/2021	225	220
1/8/2021	255	250	3/23/2021	237	220	6/5/2021	232	100	8/18/2021	202	100	10/31/2021	225	220
1/9/2021	255	250	3/24/2021	236	220	6/6/2021	228	100	8/19/2021	200	100	11/1/2021	545	220
1/10/2021	255	250	3/25/2021	235	220	6/7/2021	231	100	8/20/2021	202	100	11/2/2021	701	220
1/11/2021	255	250	3/26/2021	236	220	6/8/2021	227	100	8/21/2021	200	100	11/3/2021	501	220
1/12/2021	255	250	3/27/2021	245	220	6/9/2021	212	100	8/22/2021	200	100	11/4/2021	301	220
1/13/2021	255	250	3/28/2021	245	220	6/10/2021	215	100	8/23/2021	200	100	11/5/2021	225	220
1/14/2021	254	250	3/29/2021	255	220	6/11/2021	210	100	8/24/2021	200	100	11/6/2021	225	220
1/15/2021	254	250	3/30/2021	270	220	6/12/2021	210	100	8/25/2021	200	100	11/7/2021	225	220
1/16/2021	252	250	3/31/2021	302	220	6/13/2021	210	100	8/26/2021	200	100	11/8/2021	225	220
1/17/2021	255	250	4/1/2021	342	220	6/14/2021	215	100	8/27/2021	200	100	11/9/2021	226	220
1/18/2021	255	250	4/2/2021	346	220	6/15/2021	234	100	8/28/2021	200	100	11/10/2021	225	220
1/19/2021	252	250	4/3/2021	345	220	6/16/2021	235	100	8/29/2021	200	100	11/11/2021	225	220
1/20/2021	254	250	4/4/2021	345	220	6/17/2021	233	100	8/30/2021	200	100	11/12/2021	225	220
1/21/2021	255	250	4/5/2021	345	220	6/18/2021	232	100	8/31/2021	202	100	11/13/2021	224	220
1/22/2021	255	250	4/6/2021	345	220	6/19/2021	249	100	9/1/2021	202	100	11/14/2021	225	220
1/23/2021	252	250	4/7/2021	337	220	6/20/2021	250	100	9/2/2021	201	100	11/15/2021	225	220
1/24/2021	255	250	4/8/2021	330	220	6/21/2021	249	100	9/3/2021	200	100	11/16/2021	224	220
1/25/2021	255	250	4/9/2021	325	220	6/22/2021	246	100	9/4/2021	200	100	11/17/2021	225	220
1/26/2021	255	250	4/10/2021	315	220	6/23/2021	247	100	9/5/2021	200	100	11/18/2021	225	220
1/27/2021	255	250	4/11/2021	315	220	6/24/2021	237	100	9/6/2021	201	100	11/19/2021	225	220
1/28/2021	255	250	4/12/2021	315	220	6/25/2021	235	100	9/7/2021	203	100	11/20/2021	225	220
1/29/2021	255	250	4/13/2021	315	220	6/26/2021	239	100	9/8/2021	201	100	11/21/2021	225	220
1/30/2021	255	250	4/14/2021	318	220	6/27/2021	236	100	9/9/2021	200	100	11/22/2021	225	220
1/31/2021	255	250	4/15/2021	315	220	6/28/2021	237	100	9/10/2021	205	100	11/23/2021	225	220
2/1/2021	255	220	4/16/2021	315	220	6/29/2021	237	100	9/11/2021	192	100	11/24/2021	225	220
2/2/2021	255	220	4/17/2021	315	220	6/30/2021	237	100	9/12/2021	160	100	11/25/2021	224	220
2/3/2021	255	220	4/18/2021	316	220	7/1/2021	240	100	9/13/2021	140	100	11/26/2021	224	220
2/4/2021	253	220	4/19/2021	321	220	7/2/2021	237	100	9/14/2021	142	100	11/27/2021	225	220
2/5/2021	255	220	4/20/2021	318	220	7/3/2021	237	100	9/15/2021	140	100	11/28/2021	225	220
2/6/2021	237	220	4/21/2021	319	220	7/4/2021	237	100	9/16/2021	140	100	11/29/2021	225	220
2/7/2021	225	220	4/22/2021	324	220	7/5/2021	236	100	9/17/2021	136	100	11/30/2021	225	220
2/8/2021	225	220	4/23/2021	319	220	7/6/2021	237	100	9/18/2021	130	100	12/1/2021	229	220
2/9/2021	225	220	4/24/2021	330	220	7/7/2021	238	100	9/19/2021	130	100	12/2/2021	225	220
2/10/2021	225	220	4/25/2021	330	220	7/8/2021	238	100	9/20/2021	126	100	12/3/2021	225	220
2/11/2021	225	220	4/26/2021	332	220	7/9/2021	237	100	9/21/2021	122	100	12/4/2021	225	220
2/12/2021	226	220	4/27/2021	336	220	7/10/2021	240	100	9/22/2021	121	100	12/5/2021	225	220
2/13/2021	227	220	4/28/2021	325	220	7/11/2021	240	100	9/23/2021	120	100	12/6/2021	225	220
2/14/2021	225	220	4/29/2021	337	220	7/12/2021	240	100	9/24/2021	107	100	12/7/2021	226	220
2/15/2021	225	220	4/30/2021	347	220	7/13/2021	237	100	9/25/2021	110	100	12/8/2021	226	220
2/16/2021	225	220	5/1/2021	347	220	7/14/2021	240	100	9/26/2021	110	100	12/9/2021	225	220
2/17/2021	232	220	5/2/2021	345	220	7/15/2021	237	100	9/27/2021	110	100	12/10/2021	225	220
2/18/2021	228	220	5/3/2021	350	220	7/16/2021	235	100	9/28/2021	110	100	12/11/2021	225	220
2/19/2021	225	220	5/4/2021	347	220	7/17/2021	239	100	9/29/2021	111	100	12/12/2021	225	220
2/20/2021	223	220	5/5/2021	359	220	7/18/2021	238	100	9/30/2021	181	100	12/13/2021	225	220
2/21/2021	225	220	5/6/2021	366	220	7/19/2021	238	100	10/1/2021	225	220	12/14/2021	225	220
2/22/2021	225	220	5/7/2021	375	220	7/20/2021	238	100	10/2/2021	225	220	12/15/2021	225	220
2/23/2021	222	220	5/8/2021	372	220	7/21/2021	241	100	10/3/2021	225	220	12/16/2021	225	220
2/24/2021	225	220	5/9/2021	372	220	7/22/2021	240	100	10/4/2021	225	220	12/17/2021	225	220
2/25/2021	225	220	5/10/2021	372	220	7/23/2021	240	100	10/5/2021	510	220	12/18/2021	224	220
2/26/2021	225	220	5/11/2021	371	220	7/24/2021	238	100	10/6/2021	601	220	12/19/2021	224	220
2/27/2021	222	220	5/12/2021	373	220	7/25/2021	238	100	10/7/2021	401	220	12/20/2021	224	220
2/28/2021	223	220	5/13/2021	362	220	7/26/2021	240	100	10/8/2021	263	220	12/21/2021	225	220
3/1/2021	252	220	5/14/2021	365	220	7/27/2021	249	100	10/9/2021	225	220	12/22/2021	225	220
3/2/2021	298	220	5/15/2021	365	220	7/28/2021	250	100	10/10/2021	225	220	12/23/2021	225	220
3/3/2021	300	220	5/16/2021	363	220	7/29/2021	247	100	10/11/2021	225	220	12/24/2021	226	220
3/4/2021	300	220	5/17/2021	365	220	7/30/2021	248	100	10/12/2021	224	220	12/25/2021	226	220
3/5/2021	280	220	5/18/2021	365	220	7/31/2021	249	100	10/13/2021	225	220	12/26/2021	225	220
3/6/2021	228	220	5/19/2021	363	220	8/1/2021	250	100	10/14/2021	226	220	12/27/2021	225	220
3/7/2021	225	220	5/20/2021	362	220	8/2/2021	247	100	10/15/2021	226	220	12/28/2021	225	220
3/8/2021	225	220	5/21/2021	365	220	8/3/2021	255	100	10/16/2021	226	220	12/29/2021	225	220
3/9/2021	251	220	5/22/2021	364	220	8/4/2021	252	100	10/17/2021	226	220	12/30/2021	226	220
3/10/2021	295	220	5/23/2021	360	220	8/5/2021	246	100	10/18/2021	550	220	12/31/2021	226	220
3/11/2021	296	220	5/24/2021	358	220	8/6/2021	245	100	10/19/2021	702	220			
3/12/2021	273	220	5/25/2021	361	220	8/7/2021	245	100	10/20/2021	500	220			
3/13/2021	252	220	5/26/2021	362	220	8/8/2021	247	100	10/21/2021	301	220			
3/14/2021	252	220	5/27/2021	360	220	8/9/2021	239	100	10/22/2021	225	220			
3/15/2021	255	220	5/28/2021	358	220	8/10/2021	232	100	10/23/2021	225	220			

1. Flow measured using Accusonic Flow meter (USGS Gage #11323500 - Mokelumne River below Camanche Dam
2. Actual flow data has not yet been verified and published by the U.S. Geological Survey

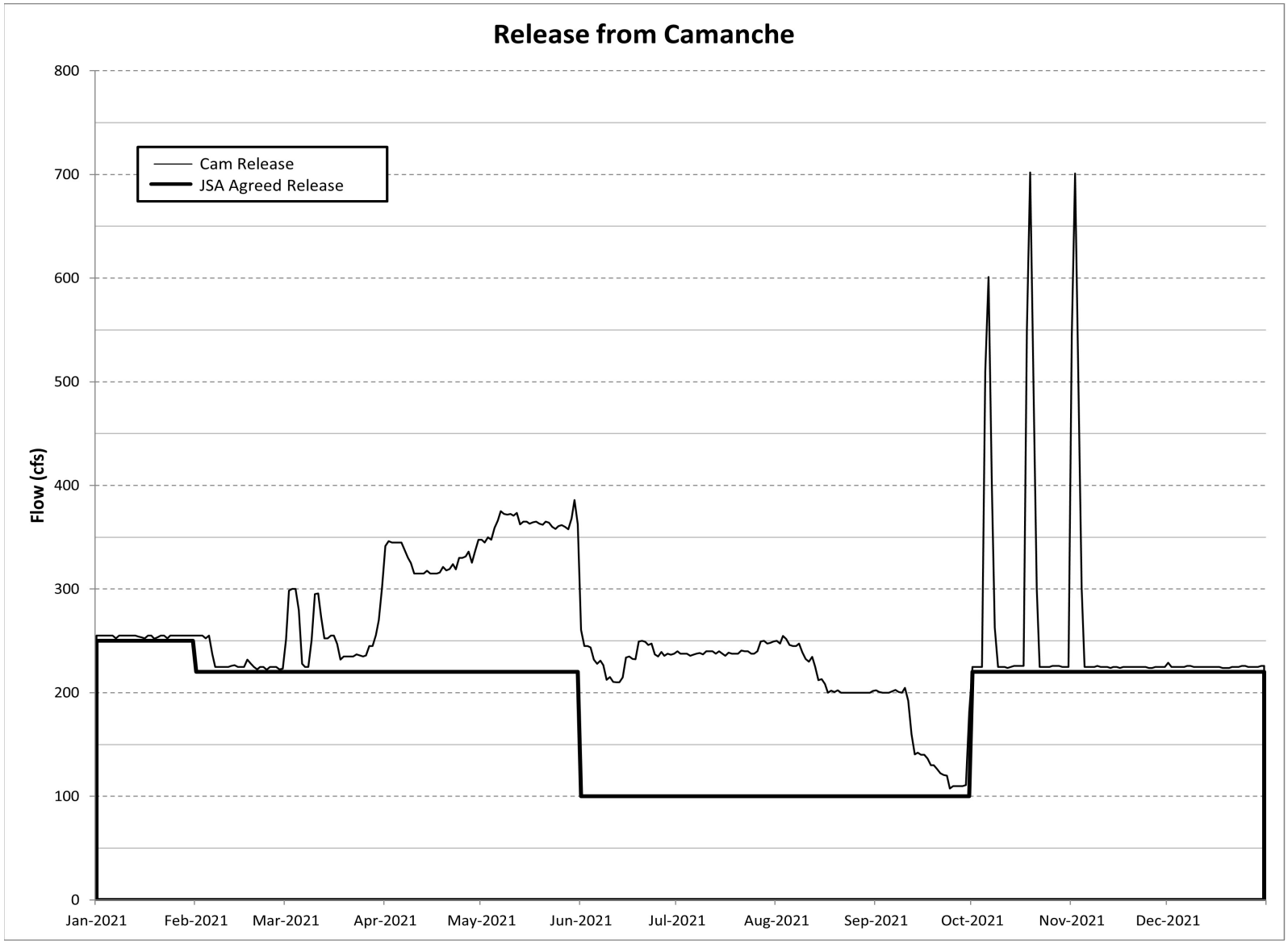


Figure 3: Calendar Year 2021 Average Daily Release in Cubic Feet per Second from Camanche Dam

Table 3: Calendar Year 2021 Average Daily Flow in Cubic Feet per Second below Woodbridge Dam

Date	Actual Flow	JSA Expected Flow	Date	Actual Flow	JSA Expected Flow	Date	Actual Flow	JSA Expected Flow	Date	Actual Flow	JSA Expected Flow	Date	Actual Flow	JSA Expected Flow
1/1/2021	200	100	3/16/2021	124	100	5/29/2021	156	150	8/11/2021	26	20	10/24/2021	366	80
1/2/2021	197	100	3/17/2021	123	100	5/30/2021	155	150	8/12/2021	26	20	10/25/2021	382	80
1/3/2021	195	100	3/18/2021	124	100	5/31/2021	153	150	8/13/2021	26	20	10/26/2021	245	80
1/4/2021	207	100	3/19/2021	124	100	6/1/2021	44	20	8/14/2021	25	20	10/27/2021	193	80
1/5/2021	193	100	3/20/2021	119	100	6/2/2021	31	20	8/15/2021	25	20	10/28/2021	139	80
1/6/2021	198	100	3/21/2021	119	100	6/3/2021	31	20	8/16/2021	25	20	10/29/2021	263	80
1/7/2021	198	100	3/22/2021	120	100	6/4/2021	31	20	8/17/2021	25	20	10/30/2021	173	80
1/8/2021	200	100	3/23/2021	121	100	6/5/2021	30	20	8/18/2021	24	20	10/31/2021	169	80
1/9/2021	196	100	3/24/2021	120	100	6/6/2021	31	20	8/19/2021	24	20	11/1/2021	159	80
1/10/2021	197	100	3/25/2021	120	100	6/7/2021	31	20	8/20/2021	24	20	11/2/2021	665	80
1/11/2021	196	100	3/26/2021	121	100	6/8/2021	30	20	8/21/2021	25	20	11/3/2021	538	80
1/12/2021	196	100	3/27/2021	122	100	6/9/2021	30	20	8/22/2021	25	20	11/4/2021	372	80
1/13/2021	193	100	3/28/2021	121	100	6/10/2021	30	20	8/23/2021	25	20	11/5/2021	198	80
1/14/2021	196	100	3/29/2021	121	100	6/11/2021	30	20	8/24/2021	25	20	11/6/2021	177	80
1/15/2021	194	100	3/30/2021	122	100	6/12/2021	30	20	8/25/2021	25	20	11/7/2021	164	80
1/16/2021	193	100	3/31/2021	120	100	6/13/2021	30	20	8/26/2021	25	20	11/8/2021	163	80
1/17/2021	192	100	4/1/2021	159	150	6/14/2021	29	20	8/27/2021	24	20	11/9/2021	191	80
1/18/2021	192	100	4/2/2021	163	150	6/15/2021	29	20	8/28/2021	24	20	11/10/2021	167	80
1/19/2021	191	100	4/3/2021	162	150	6/16/2021	29	20	8/29/2021	25	20	11/11/2021	160	80
1/20/2021	190	100	4/4/2021	163	150	6/17/2021	29	20	8/30/2021	24	20	11/12/2021	163	80
1/21/2021	194	100	4/5/2021	167	150	6/18/2021	29	20	8/31/2021	24	20	11/13/2021	159	80
1/22/2021	212	100	4/6/2021	168	150	6/19/2021	28	20	9/1/2021	24	20	11/14/2021	162	80
1/23/2021	195	100	4/7/2021	167	150	6/20/2021	29	20	9/2/2021	24	20	11/15/2021	162	80
1/24/2021	197	100	4/8/2021	165	150	6/21/2021	29	20	9/3/2021	24	20	11/16/2021	156	80
1/25/2021	200	100	4/9/2021	166	150	6/22/2021	29	20	9/4/2021	25	20	11/17/2021	159	80
1/26/2021	197	100	4/10/2021	164	150	6/23/2021	30	20	9/5/2021	25	20	11/18/2021	160	80
1/27/2021	279	100	4/11/2021	164	150	6/24/2021	29	20	9/6/2021	24	20	11/19/2021	155	80
1/28/2021	280	100	4/12/2021	166	150	6/25/2021	29	20	9/7/2021	24	20	11/20/2021	156	80
1/29/2021	340	100	4/13/2021	163	150	6/26/2021	29	20	9/8/2021	23	20	11/21/2021	157	80
1/30/2021	234	100	4/14/2021	159	150	6/27/2021	30	20	9/9/2021	23	20	11/22/2021	156	80
1/31/2021	313	100	4/15/2021	160	150	6/28/2021	29	20	9/10/2021	23	20	11/23/2021	153	80
2/1/2021	450	100	4/16/2021	160	150	6/29/2021	29	20	9/11/2021	23	20	11/24/2021	160	80
2/2/2021	453	100	4/17/2021	160	150	6/30/2021	29	20	9/12/2021	24	20	11/25/2021	156	80
2/3/2021	321	100	4/18/2021	160	150	7/1/2021	28	20	9/13/2021	24	20	11/26/2021	153	80
2/4/2021	256	100	4/19/2021	161	150	7/2/2021	28	20	9/14/2021	24	20	11/27/2021	157	80
2/5/2021	241	100	4/20/2021	159	150	7/3/2021	28	20	9/15/2021	23	20	11/28/2021	158	80
2/6/2021	234	100	4/21/2021	158	150	7/4/2021	28	20	9/16/2021	25	20	11/29/2021	156	80
2/7/2021	212	100	4/22/2021	160	150	7/5/2021	29	20	9/17/2021	26	20	11/30/2021	157	80
2/8/2021	202	100	4/23/2021	159	150	7/6/2021	28	20	9/18/2021	28	20	12/1/2021	162	80
2/9/2021	193	100	4/24/2021	161	150	7/7/2021	28	20	9/19/2021	28	20	12/2/2021	157	80
2/10/2021	194	100	4/25/2021	162	150	7/8/2021	28	20	9/20/2021	28	20	12/3/2021	159	80
2/11/2021	199	100	4/26/2021	161	150	7/9/2021	28	20	9/21/2021	28	20	12/4/2021	154	80
2/12/2021	209	100	4/27/2021	159	150	7/10/2021	28	20	9/22/2021	28	20	12/5/2021	157	80
2/13/2021	197	100	4/28/2021	158	150	7/11/2021	29	20	9/23/2021	28	20	12/6/2021	155	80
2/14/2021	193	100	4/29/2021	158	150	7/12/2021	28	20	9/24/2021	28	20	12/7/2021	164	80
2/15/2021	191	100	4/30/2021	159	150	7/13/2021	28	20	9/25/2021	27	20	12/8/2021	158	80
2/16/2021	189	100	5/1/2021	159	150	7/14/2021	28	20	9/26/2021	27	20	12/9/2021	167	80
2/17/2021	189	100	5/2/2021	162	150	7/15/2021	28	20	9/27/2021	28	20	12/10/2021	160	80
2/18/2021	188	100	5/3/2021	160	150	7/16/2021	27	20	9/28/2021	28	20	12/11/2021	158	80
2/19/2021	188	100	5/4/2021	158	150	7/17/2021	28	20	9/29/2021	29	20	12/12/2021	167	80
2/20/2021	186	100	5/5/2021	156	150	7/18/2021	28	20	9/30/2021	41	20	12/13/2021	243	80
2/21/2021	185	100	5/6/2021	157	150	7/19/2021	27	20	10/1/2021	101	80	12/14/2021	255	80
2/22/2021	186	100	5/7/2021	157	150	7/20/2021	28	20	10/2/2021	131	80	12/15/2021	201	80
2/23/2021	184	100	5/8/2021	158	150	7/21/2021	27	20	10/3/2021	147	80	12/16/2021	212	80
2/24/2021	181	100	5/9/2021	159	150	7/22/2021	27	20	10/4/2021	146	80	12/17/2021	182	80
2/25/2021	182	100	5/10/2021	158	150	7/23/2021	27	20	10/5/2021	208	80	12/18/2021	167	80
2/26/2021	180	100	5/11/2021	158	150	7/24/2021	26	20	10/6/2021	624	80	12/19/2021	171	80
2/27/2021	179	100	5/12/2021	159	150	7/25/2021	27	20	10/7/2021	450	80	12/20/2021	161	80
2/28/2021	155	100	5/13/2021	157	150	7/26/2021	27	20	10/8/2021	259	80	12/21/2021	163	80
3/1/2021	126	100	5/14/2021	158	150	7/27/2021	27	20	10/9/2021	140	80	12/22/2021	179	80
3/2/2021	124	100	5/15/2021	157	150	7/28/2021	27	20	10/10/2021	148	80	12/23/2021	236	80
3/3/2021	121	100	5/16/2021	159	150	7/29/2021	27	20	10/11/2021	162	80	12/24/2021	229	80
3/4/2021	122	100	5/17/2021	157	150	7/30/2021	27	20	10/12/2021	255	80	12/25/2021	215	80
3/5/2021	118	100	5/18/2021	156	150	7/31/2021	27	20	10/13/2021	93	80	12/26/2021	218	80
3/6/2021	115	100	5/19/2021	157	150	8/1/2021	27	20	10/14/2021	107	80	12/27/2021	210	80
3/7/2021	115	100	5/20/2021	158	150	8/2/2021	27	20	10/15/2021	243	80	12/28/2021	214	80
3/8/2021	115	100	5/21/2021	157	150	8/3/2021	28	20	10/16/2021	93	80	12/29/2021	219	80
3/9/2021	115	100	5/22/2021	157	150	8/4/2021	27	20	10/17/2021	108	80	12/30/2021	192	80
3/10/2021	118	100	5/23/2021	158	150	8/5/2021	26	20	10/18/2021	184	80	12/31/2021	181	80
3/11/2021	124	100	5/24/2021	158	150	8/6/2021	27	20	10/19/2021	716	80			
3/12/2021	125	100	5/25/2021	156	150	8/7/2021	26	20	10/20/2021	538	80			
3/13/2021	122	100	5/26/2021	157	150	8/8/2021	29	20	10/21/2021	369	80			
3/14/2021	120	100	5/27/2021	156	150	8/9/2021	32	20	10/22/2021	227	80			
3/15/2021	124	100	5/28/2021	155	150	8/10/2021	30	20	10/23/2021	178	80			

1. Flow measured at USGS Gage #11325500 - Mokelumne River at Woodbridge
2. Actual flow data has not yet been verified and published by the U.S. Geological Survey

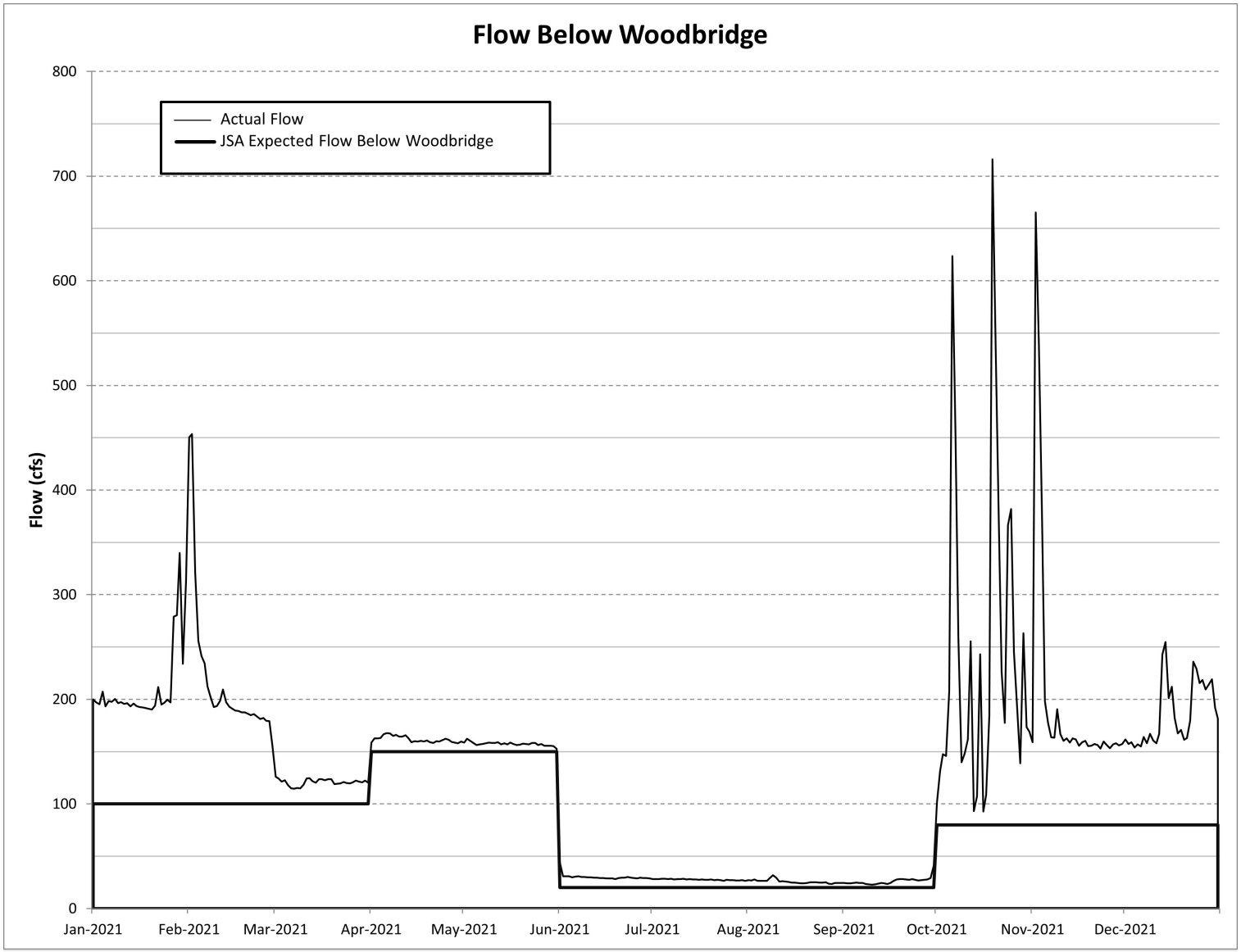


Figure 4: Calendar Year 2021 Average Daily Flow in Cubic Feet per Second below Woodbridge Dam

Adaptive Management

The JSA contains an adaptive management provision related to minimum flows. The flow schedule may be changed to optimize fishery habitat and other ecosystem values as long as the total quantity of water released in any given year will not be less than the quantity of water provided by the flow requirements for that type of year. In 2021, because water year conditions were dry; EBMUD maintained Camanche releases at the JSA minimum flows in the spring, summer, and fall (with the exception of pulse flows during operations in the fall, as described in the section below). Pursuant to Condition 5 of D-1641, flows were adaptively managed in February and March of 2021. Camanche releases were reduced from 255 cfs to 220 cfs, which conserved 1,948 acre-feet of water for the pulse flows released in October 2021.

Pulse Flow Operations

The fall pulse attraction flows were a result of successful collaboration between several different agencies and stakeholders, primarily through the PCC. Due to the dry conditions in 2021, flood control releases were not available for fall pulse flows. However, the CPE Mitigation Measure FISH-1 requires the release of up to 2,000 acre-feet of additional water above required releases during the September through February period in Below Normal and Dry water years to facilitate adult salmonid fish passage below Woodbridge Dam. The EBMUD Fisheries and Wildlife Division closely coordinated with the PCC to manage these necessary releases so that they could be used to provide fish attraction pulse flows, with a goal of maximizing returns to the Mokelumne River by reducing straying of Mokelumne-origin salmon to other systems. Each pulse resulted in an increase in salmon numbers entering the Mokelumne River (see Figure 5).

Water for 2021 pulse flows came from releases from the CPE FISH-1 requirement, 1,948 acre-feet from adaptive management, as well as an additional 2,341 acre-feet of gainsharing releases to support the Lower Mokelumne fishery. Three pulses were planned for October. The first pulse had a peak flow of 725 cfs, the second and third pulses had peak flows of 825 cfs, while the base flow was maintained at 225 cfs. An additional three pulses were developed through collaboration with the Woodbridge Irrigation District (WID) on reoperation of Woodbridge Dam elevations to support Chinook salmon passage in October.

Fish Straying during Up-migration

Coded Wire Tag (CWT) return data clearly indicate that release locations for hatchery-reared juvenile salmon play a significant role in straying.[2] In 2007, CDFW released nearly the entire MRFH production in the San Pablo Bay region. While this practice may increase overall survival, it significantly increases straying rates when fish return to spawn. With the MRFH AOP long-term import ban of eggs originating from other hatcheries, the overall impact straying has on Mokelumne returns is significant. In 2021, CDFW continued the practice of releasing the mitigation production in net pens at Sherman Island. Previous return data has indicated that releasing fish at Sherman Island balances the need to increase survival through the Delta while reducing straying (when compared to further downstream release locations) which has led to better returns to the Mokelumne River. Releases occurred during outgoing tides and for not more than two consecutive days in order to improve overall survival by reducing predation on later release groups.

Analysis of return data collected through a 2010 5-year study with the USBR indicated that adaptive management of Mokelumne River pulse flows and Delta Cross Channel (DCC) closures during the up-migration period could reduce straying of Mokelumne-origin salmon to the Sacramento River watershed. In October 2019, the 2019 Biological Opinions for the Central Valley Project and California's State Water Project issued by NOAA under Endangered Species Act Section 7 Consultation proposed to "within 48 hours of start of Lower Mokelumne River attraction flow release, close the Delta Cross Channel gates for up to 5 days (dependent upon continuity of favorable water quality conditions)". In 2021, DCC gates were closed six times between October and November, and then closed for the season on December 1 (Figure 5). Each pulse flow was coordinated with the USBR for parallel DCC gate closure to provide protection from potential straying to the Sacramento River watershed.

In 2021, approximately 54% of up-migrating Mokelumne fish strayed to the Sacramento River watershed, based on preliminary coded wire tag recovery data. In order to limit the amount of straying to San Joaquin tributaries, EBMUD coordinated pulse flow release timing with the Stanislaus and Tuolumne Rivers. However, 10% of Mokelumne River hatchery reared salmon strayed to San Joaquin River tributaries. Many factors play a role in annual escapement numbers to the Mokelumne River. It is currently unknown what specific factors caused the high stray rate in 2021. However, the October 2021 atmospheric river that brought historic rainfall to the Central Valley caused dramatic flow increases in rivers, streams, creeks, and sloughs throughout the region which most likely contributed to widespread straying of Mokelumne origin salmon.

[2] M. Palmer-Zwahlen, and B. Kormos. December 2013. Recovery of Coded-Wire Tags from Chinook Salmon in California's Central Valley Escapement and Ocean Harvest in 2011. California Department of Fish and Wildlife Fisheries Branch Administrative Report 2013-02.

2022

EBMUD is committed, pursuant to the FERC Order, to "Dry" JSA year type Camanche Dam flow releases through March 31, 2022, with adjustments made in timing due to approved adaptive management actions. In accordance with the stipulation in Attachment 1 of the JSA, EBMUD will determine the JSA water year type which will govern EBMUD's flow schedule for the period April 1, 2022 through September 30, 2022 based on the DWR forecasted unimpaired runoff into Pardee Reservoir as identified in the April 1, 2022 DWR Bulletin 120. EBMUD will report to the FERC in the February 2022 report on the flow releases made in accordance with the JSA during the entire calendar year 2021. EBMUD will include finalized flow data in an Appendix of the report as it is verified and published by USGS. Refer to Appendix C (Tables C-1 through C-4) for finalized flow data for the 2019 and 2020 calendar years.

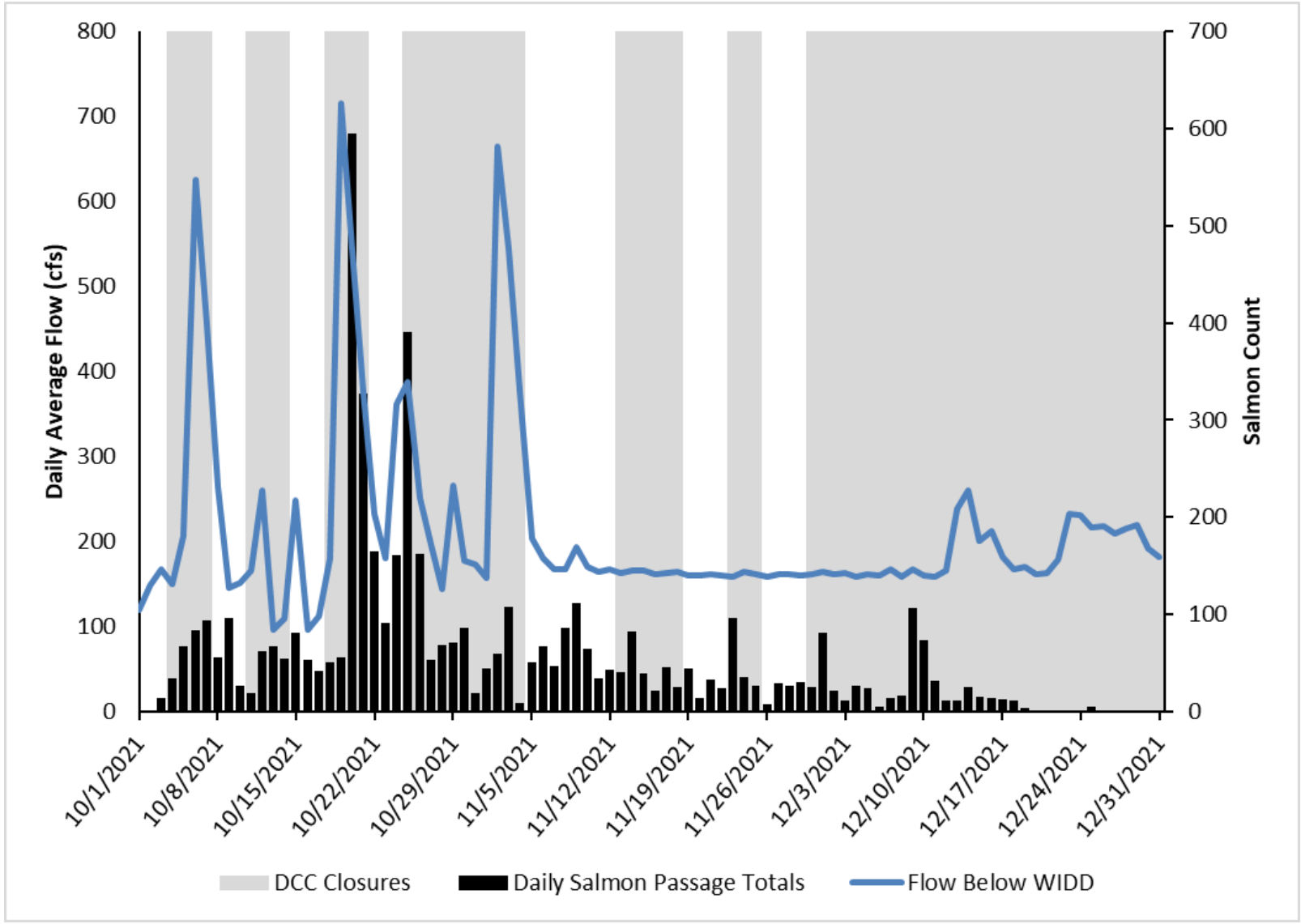


Figure 5: Daily Upstream Passage of Chinook Salmon at Woodbridge Dam Relative to Flow and Delta Cross Channel Closure, October 1, 2021–December 31, 2021

B. WATER QUALITY

Water quality in the MRFH and lower Mokelumne River continues to be actively managed by EBMUD through its extensive data collection and analysis, reservoir operations, and the use of EBMUD's Hypolimnetic Oxygenation System (HOS). Supplemental chillers are used to sustain MRFH water temperatures in the optimal range for egg incubation. Sand filters remove suspended solids from the hatchery water supply. Ultraviolet (UV) disinfection equipment continuously protects against pathogenic organisms. These measures increase fish survival and decrease the need for use of medicated feed or chemical treatment of the water supply and have reduced the effort needed to comply with provisions of the hatchery's National Pollution Discharge Elimination System (NPDES) Permit. The operation of Pardee and Camanche Reservoirs is coordinated to maintain thermal stratification in Camanche Reservoir through October and manage water temperature for native fish in the lower Mokelumne River. The HOS is operated to prevent hydrogen sulfide formation in Camanche Reservoir (the functions of the HOS system are described in Section IV.B.2 of this report).

1. Reservoir Operations

EBMUD has developed and implemented adaptive reservoir operations plans (which include management of cold water in the reservoir; reservoir water quality monitoring; and weekly review of conditions, modeling and forecasting of conditions, and scheduling of operations) that effectively meet the water temperature needs in the MRFH and the lower Mokelumne River. EBMUD manages temperatures in water released from Camanche Reservoir by keeping Camanche Reservoir thermally stratified until its surface waters naturally cool, usually in the fall. To maintain the volume of Camanche Reservoir's hypolimnion, which is needed to keep the reservoir thermally stratified, EBMUD manages the release of cold water available in Pardee Reservoir.

EBMUD's approach to managing the system is based on direct control of the cold water hypolimnion in both Camanche and Pardee Reservoirs. This approach has been developed operationally; incorporating a flexible response to several unique features of the Pardee Reservoir/Camanche Reservoir system and is possible because of extensive monitoring during operation. The operational criteria for reservoir stratification in EBMUD's reservoir operations plan are:

1. Maintain stratification in Camanche Reservoir to the extent feasible from May through October to provide cold water releases to the lower Mokelumne River and the MRFH during the fall.
2. Maintain the stratification in Camanche by scheduling inflows of cold water from Pardee Reservoir, as needed, to replenish the hypolimnion of Camanche Reservoir. Releases from Pardee are normally not necessary for temperature management

from approximately mid-November to April when Camanche Reservoir is cold and de-stratified.

3. Make best efforts to maintain a minimum of 28,000 acre-feet of hypolimnetic volume in Camanche Reservoir through October whenever Pardee Reservoir volume exceeds 100,000 acre-feet.

2021

The operational plan used by EBMUD since 1990 has proven effective in maintaining thermal stratification in Camanche Reservoir during Normal and Above, Below Normal, Dry, and Critically Dry JSA water year conditions. Average daily water temperatures in the Mokelumne River resulting from 2021 operations are shown in Figure 6.

From April 1, 2021 through September 30, 2021 EBMUD operated under a "Dry" JSA water year type, with releases at the JSA minimum flows. Consistent with the JSA, EBMUD continued to adaptively manage its reservoir and was successful in maintaining stratification in Camanche Reservoir through the majority of October by coordinating releases from Pardee Reservoir. The ability to maintain the hypolimnion volume of 28,000 acre-feet in Camanche Reservoir through the end of October 2021 was challenging due to persistent dry conditions from the previous year, diminished storage in Camanche Reservoir, and a series of heavy storms at the end of October. In close coordination with the PCC and consistent with the JSA, EBMUD continued to adaptively manage its reservoir and use its best efforts to maintain a hypolimnion volume of 28,000 acre-feet in Camanche Reservoir. EBMUD maintained releases through Camanche Reservoir's warmer, high-level outlet through May 29, 2021, after which Camanche Reservoir surface elevation fell below elevation 202 feet and surface water could no longer be drawn. As a best effort to retain cold water in Camanche Reservoir and prevent an early turnover, Pardee Reservoir released approximately 53,500 acre-feet of cold water to Camanche from June through October, drawing down Pardee to elevation 545 feet at the end of the month. Camanche Reservoir stratification was maintained for most of October, however, the three atmospheric river storms during October 23-25 led to mixing in Camanche Reservoir. Although EBMUD was not able to maintain a hypolimnion volume above 28,000 acre-feet in Camanche Reservoir through the end of October, due to the strong winds from the October storms noted above. EBMUD implemented best efforts in its reservoir operations and ended the month with 27,000 acre-feet of hypolimnion volume.

Pardee and Camanche reservoirs were operated to provide cold water releases in the lower Mokelumne River through the critical spawning period from October through December. EBMUD also provided bypass (sluice) flows from Camanche Reservoir to increase dissolved oxygen levels in the lower Mokelumne River when needed during 2021.

2022

EBMUD will continue to manage Pardee and Camanche Reservoir operations based on real-time reservoir and riverine conditions. Pursuant to Section H.4 of the JSA, EBMUD will continue to consult with the resource agencies about changes in real-time Lower Mokelumne River Project operations.

2. Hypolimnetic Oxygenation System

EBMUD takes proactive steps to prevent naturally occurring hydrogen sulfide in Camanche Reservoir from entering the river. EBMUD studies found that when pure oxygen is added to Camanche Reservoir's anoxic hypolimnion, hydrogen sulfide production in the oxygenated area is eliminated. In response to these studies, EBMUD designed and installed, and began operating in 1993, a Hypolimnetic Oxygenation System (HOS) to add pure oxygen into the Camanche Reservoir hypolimnion. EBMUD monitors oxidation-reduction potential and dissolved oxygen concentrations in the hypolimnion (at elevation 115 ft.). The annual decision to activate the HOS is based on the dissolved oxygen concentration in the hypolimnion. The HOS is deactivated in anticipation of reservoir turnover in the fall. The HOS has proven to be very effective in preventing hydrogen sulfide formation in the Camanche Reservoir hypolimnion.

2021

The HOS was activated from June 25, 2021 through October 26, 2021. The HOS has effectively prevented hydrogen sulfide formation.

2022

In 2022 EBMUD will continue to operate the HOS to manage the hydrogen sulfide concentrations for the benefit of the Camanche Reservoir, the lower Mokelumne River, and the MRFH.

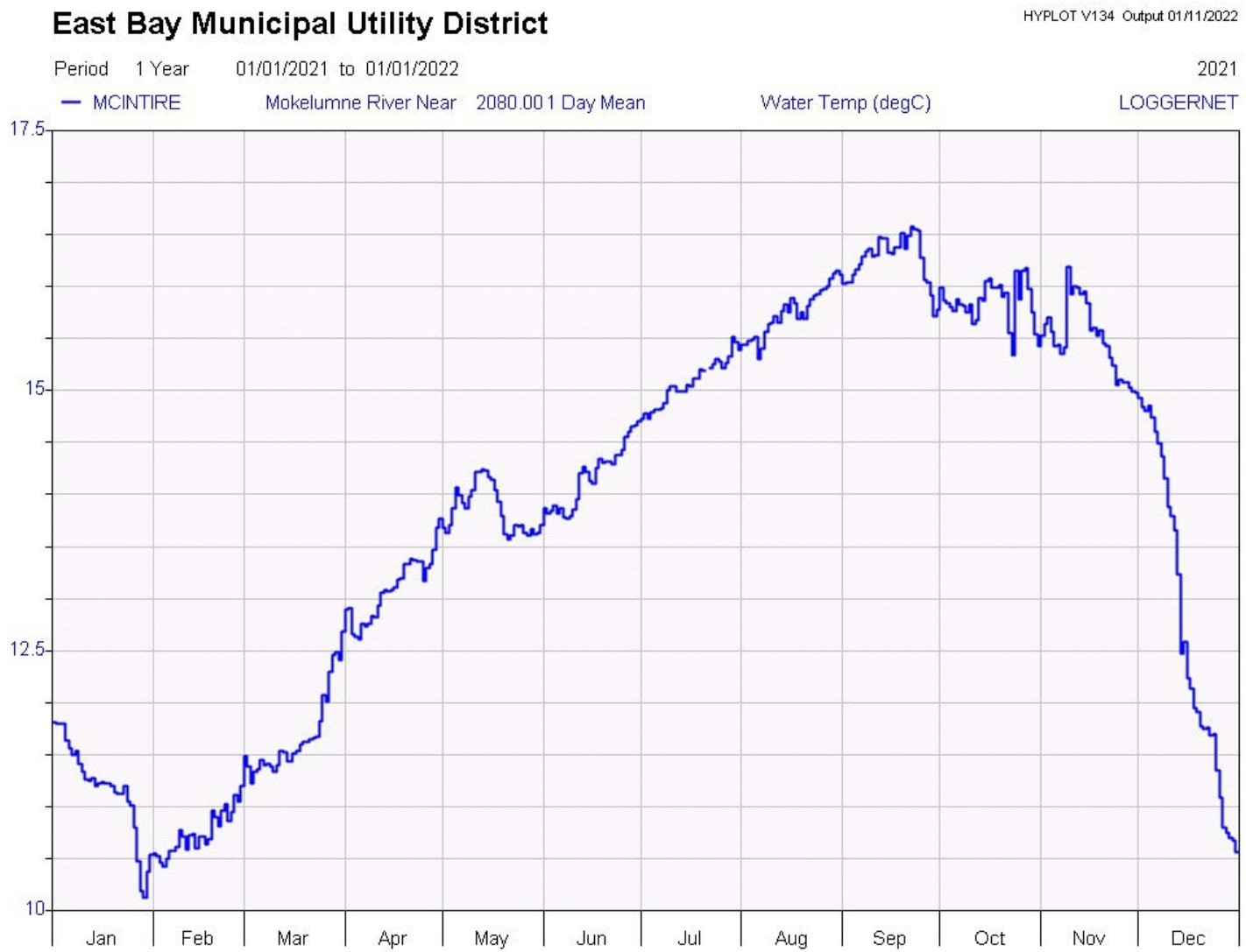


Figure 6: Calendar Year 2021 Mokelumne River Water Average Daily Temperatures of the Release from Camanche Dam

C. THE LOWER MOKELUMNE RIVER PARTNERSHIP

1. The Partnership Steering Committee

The Partnership Steering Committee (PSC), consisting of representatives from EBMUD, CDFW, and USFWS in cooperation with NOAA Fisheries, met on December 7, 2021. Minutes of the PSC meeting are included in Appendix D. The PSC continued to oversee the operation of the Partnership Coordinating Committee (PCC), the technical group of Partnership representatives that meets biannually to ensure timely implementation of the measures identified in the JSA and the Water Quality and Resource Management Program (WQRMP). The PCC met on April 20, 2021 and September 10, 2021. A total of 50 projects have been approved since 1999 for Partnership funding (three were subsequently cancelled by the applicant). See Section IV.C.2 of this report for projects approved for Partnership funding in 2021 and projects with activity in 2021. For recent news articles on Partnership projects and Mokelumne River fisheries, refer to Appendix A.

2. The Partnership Fund

EBMUD established the $2 million Partnership Fund in 1999, pursuant to Section E.2 of the JSA, to provide support to the Partnership programs. The interest income earned provides operating funds to pay for projects and programs that protect and enhance the lower Mokelumne River ecosystem. Since its inception, the fund has earned $1,034,610. The available balance, subtracting the funds that have been obligated to approved projects, was approximately $180,000 as of December 31, 2021.

Projects funded by the PSC with activity in 2021 for ecosystem protection and restoration in the lower Mokelumne River are summarized in Table 4 on the following page.

Table 4: Partnership Fund-Supported Projects 2021 Activity Summary

Project Title	Project Sponsor	Project Description	Partnership Fund			Additional Funding	
			Date Approved by PSC	Anticipated Project Completion	Amount Obligated or Expended	Amount	Program
Mokelumne River Salmon Life-Cycle Models	Cramer Fish Sciences	Use long-term data to measure management action effects on JSA Goals	5/13/20	Completed	$89,183.50		
2020-21 Lower Mokelumne River Watershed Education Legacy Project	City of Lodi	Educational field trips for students, educational videos	10/27/20	Completed	$4,950.00		

3. Water Quality and Resource Management Program

The Water Quality and Resource Management Program (WQRMP), developed by the PSC in cooperation with NOAA Fisheries and the Mokelumne River Technical Advisory Committee (MRTAC) members, and in accordance with Sections E.3, F.5, and H.5 of the JSA, was submitted to FERC in June 1999 and approved by FERC on May 9, 2001. The WQRMP vision includes a comprehensive monitoring and applied research program integrated with a well-coordinated program to adaptively manage water and power supply operations, flood control, hatchery operations, and ecosystem rehabilitation actions.

EBMUD, the USFWS, and CDFW began implementing the specific WQRMP measures in 1999. These measures, including the ones implemented in 2021, are described in detail in Section IV.E, Research and Monitoring.

4. Lower Mokelumne River Stakeholders Group

The members and the role of the Lower Mokelumne River Stakeholders Group are specified in Section E.5 of the JSA. These members include public resource agency representatives, private landowners, community and non-profit organizations, and local government staff. At the time the Lower Mokelumne River Stakeholders Group was convened, the Mokelumne/Cosumnes Watershed Alliance (Watershed Alliance) and the Lower Mokelumne Watershed Stewardship Program (Stewardship Program) were already functioning organizations. These two groups' areas of interest overlap geographically and share the same stakeholder base as the Lower Mokelumne River Partnership. To improve effectiveness and to eliminate redundant efforts, the PSC agreed that Partnership representatives would concentrate outreach activities by working directly with the existing Watershed Alliance and the Stewardship Program.

Since 2006, the stakeholder outreach efforts of the Partnership have focused on support and cooperation with the Lower Mokelumne River Watershed Stewardship Group, which is led by a Steering Committee. The Watershed Stewardship Steering Committee meets monthly and includes participation from private landowners, farmers, community groups, local government staff, and agency representatives, including representatives for EBMUD and the Partnership Coordinating Committee (PCC), and the Partnership Fund administrator.

A Lower Mokelumne River Watershed Stewardship Plan (LMRWSP), 2002, was initiated as a proposal to the former CALFED made by the San Joaquin County Resource Conservation District. EBMUD was a key contributor to this proposal, coordinating the implementation and participating in the biological monitoring necessary to complete the proposal. The Plan is available at http://sjcrcd.com/articles/MokP.htm.

During 2021, EBMUD and the Partnership continued as regular participants in the work of the Watershed Stewardship Steering Committee to implement elements of the LMRWSP. The Watershed Stewardship Steering Committee continued to work towards increasing watershed stewardship awareness among urban landowners along the Mokelumne River and elsewhere in the watershed through the distribution of the updated LMRSP *Mokelumne River Watershed Owner's Manual* and researching grant opportunities that would support the implementation of the Lower Mokelumne River Watershed Stewardship Plan. The Owner's Manual can be obtained by contacting the San Joaquin County Resource Conservation District.

Additional activities during 2021 of the Watershed Steering Committee included:

- Updating the 2002 LMR Stewardship Plan to include a groundwater element.
- Began process for finding a new web host for the Stewardship Plan as well as other documents and resources to stakeholders, including growers and landowners.
- Supported the California Indian Basketweavers Association (CIBA) connection to white sedge beds for a gathering day at Lodi Lake Park along the Mokelumne River. A 2021 sedge root gathering day weekend took place again at Lodi Lake, April 9-11, 2021. A video about the gathering was produced. About 20 CIBA basket makers from all over California attended.
- Monthly LMRWSC meetings that allow communication between landowners, League of Women Voters, SJC representative, county and city agencies, and growers, which has benefited most especially the San Joaquin County Public Works Agency, whose task for SGMA is to connect with actual watershed stakeholders. The SJC Water Resources Manager began attending these meeting.

5. Additional EBMUD Stakeholder Activities

2021

In 2021, EBMUD pursued numerous opportunities to solicit Mokelumne River stakeholder participation independently of, but coordinated with, Partnership activities. Collaborative stakeholder activities that EBMUD representatives were involved with in 2021 included the following:

- Participation in the Mokelumne River Association (MRA). The mission of the MRA is to stimulate a greater understanding and cooperative atmosphere and to provide information to the private owners, political entities, and public agencies responsible for the operation, maintenance, control, and management of Mokelumne River water systems. The MRA membership consists of representatives of any duly constituted public or private entity within the Mokelumne River Watershed. There are 19 public

and private entities that are members of the MRA (1993–present). The MRA meets quarterly.

- Ongoing cooperation with the U.S. Fish and Wildlife Service to implement the Central Valley Project Improvement Act's Anadromous Fish Restoration Program (AFRP) on the Mokelumne River. The goal of AFRP is to make all reasonable efforts to at least double natural production of anadromous fish in California's Central Valley streams on a long-term, sustainable basis. EBMUD continues to monitor anadromous fish populations in the lower Mokelumne River using AFRP protocols, participates cooperatively in restoration activities through cost sharing, provides scientific data for the analysis of AFRP projects, and supports biological research activities throughout the lower Mokelumne River basin and Sacramento-San Joaquin Delta. In 2020, EBMUD completed actions on two AFRP-funded habitat restoration projects:

  (1) Creation of a 1.2-acre site designed to function as ephemeral floodplain for juvenile salmonids and native fish and maintenance of a 1-mile restoration reach in the lower Mokelumne River. Construction included the addition of 1,000 yd^3 of gravel to the river and removal of 6,700 yd^3 of material to create off channel rearing habitat.

  (2) The Mokelumne River Riparian Diversion Screening Project added protective fish screens to three privately owned water diversions within the lower Mokelumne River.

- Participation in the CVPIA Science Integration Team to develop a structured decision making (SDM) model to develop CVPIA funding priorities for FY2021 and ultimately a 5-year plan. Staff are providing accurate empirical physical and biological data into the model to ensure the Mokelumne River is fairly represented in the process and contributing technical input into the model scenarios to determine priorities.

- Participation in annual Sandhill Crane Festival in Lodi, CA. The festival provides information and education as well as field trips to various locations along the lower Mokelumne River. The Sandhill Crane Festival seeks to promote broad public awareness of lower Mokelumne River natural resource values. EBMUD staff has led field trips to view bald eagles at Pardee Reservoir. (1997–present) (Cancelled in 2020 & 2021 due to COVID-19 pandemic)

- Participation in Central Valley Birding Symposium in Stockton, CA. (Cancelled in 2020 &2021 due to COVID-19 pandemic)

- Continuing participation in the Upper Mokelumne River Anadromous Fish Restoration Work Group. The workgroup's mission statement is to "Reestablish a successfully reproducing population of fall-run Chinook salmon and/or Central Valley steelhead in the upper Mokelumne River." EBMUD staff is participating in the group to provide

technical assistance based on sound science and addresses concerns from multiple stakeholders, resource agencies and other local entities. The group has developed a draft pilot project study plan, has implemented a fish pathology study with the USFWS, and completed a habitat assessment in the upper watershed. Ongoing activities include continued evaluation of issues related to pathology and seeking additional funding.

- Continuing active involvement with the state's Biologically Integrated Orchard Systems Program (BIOS) in San Joaquin County. BIOS is designed to support local agricultural growers through the use of biological pest control and ecologically friendly (Integrated Pest Management Program) agricultural methods. EBMUD biologists participate as advisors to individual farmers, UC Cooperative Extension specialists, and Natural Resource Conservation Service staff on wildlife issues in San Joaquin County. (1998–present)
- Continuing active involvement with the Lodi-Woodbridge Winegrape Commission (LWWC). The LWWC is designed to support local grape growers through the use of biological pest control and ecologically friendly (Integrated Pest Management Program) agricultural methods. EBMUD biologists participate as advisors to the LWWC, individual farmers, UC Cooperative Extension specialists, and Natural Resource Conservation Service staff on wildlife issues in the lower Mokelumne River watershed. (1998–present)
- Presentations on fish and wildlife issues to local sportsmen's groups, community groups, local schools, and local fishing and environmental organizations. (Ongoing)
- Periodic participation as docents for the Lodi Parks and Recreation Department by giving presentations, nature tours, and demonstrations on fish and wildlife issues in the lower Mokelumne River. (1998–present)
- Providing continuing technical support to the San Joaquin County Resource Conservation District (SJCRCD) and private landowners to enhance anadromous fish habitat.
- Participating in San Joaquin Council of Governments Habitat Technical Advisory Committee meetings.
- Participating in Mokelumne River Clean-up Day, which was associated with the Greater Sierra River Cleanup events. EBMUD provided dumpster, watercraft and personnel for the event. In 2021, EBMUD did not participate due to staffing issues related to the Covid-19 pandemic.
- Continue to participate with the U.S. Fish and Wildlife Service in the "Lower Mokelumne Safe Harbor Cooperative Agreement" (SHA). The SHA covers the valley elderberry longhorn beetle on EBMUD land in San Joaquin County. (2007–present)

- Continue to participate with the U.S. Fish and Wildlife Service in the "Safe Harbor Agreement for East Bay Municipal Utility District Lands in San Joaquin, Amador, and Calaveras Counties", which was implemented in 2009. The SHA covers valley elderberry beetles, California tiger salamanders, and California red-legged frogs on EBMUD land in the aforementioned counties.
- Participate in an annual "Kids Fishing Day" at Camanche South Shore. EBMUD partners with Camanche Concessionaire staff, local residents, and local fishing groups to provide free angling opportunities and instruction to children under 12 years of age. (2014–present) (Cancelled in 2020 & 2021 due to COVID-19 pandemic)
- Participation in the City of Lodi's "Watershed Education Legacy" Program which connects Lodi Unified School District students to the Mokelumne River and watershed. (2016–present)

2022

In 2022, EBMUD plans to continue the above activities, as well as consider new opportunities to participate in collaborative stakeholder activities. Specific efforts will be made to support the goals of the Lower Mokelumne River Watershed Stewardship Plan through development of a website with resources for landowners and growers and, for implementation efforts consistent with Partnership objectives, to determine how Partnership funding could support the Watershed Stewardship Stakeholder Group.

6. Mokelumne River Technical Advisory Committee

EBMUD established the Mokelumne River Technical Advisory Committee (MRTAC) in 1988 to improve communication and coordination among a variety of state and federal agencies, EBMUD, irrigation districts, and interest groups. Agencies and organizations that currently participate in the MRTAC include EBMUD, CDFW, USFWS, NOAA Fisheries, and Woodbridge Irrigation District (WID). California Sportfishing Protection Alliance (CSPA), San Joaquin County, the State Water Resources Control Board (SWRCB), and the Federal Energy Regulatory Commission (FERC) are also members of the MRTAC, but do not attend consistently. The MRTAC provides an interactive and proactive forum in which factors affecting lower Mokelumne River aquatic resources are identified, specific scientific investigations are formulated, technical data and analyses are presented and discussed, and agency activities are coordinated to improve the aquatic resources of the lower Mokelumne River.

2021

In 2021, the MRTAC met semiannually (alternating quarterly meetings between the MRTAC and the PCC). Representatives from WID, CDFW, EBMUD, USFWS, NOAA

Fisheries, CA State Water Resources Control Board, and the North San Joaquin Water Conservation District participated in the MRTAC meetings held on February 2, 2021 and July 29, 2021.

2022

Pursuant to Section H.1 of the JSA, EBMUD, USFWS, and CDFW agree that they will continue to actively support the MRTAC as a technical information-sharing forum and that the Partnership Steering Committee will review the need for the MRTAC periodically, with input from the Stakeholders Group. The first meeting of 2022 will be held in February.

7. Mokelumne River Science Database

Section H.2 of the JSA specifies that EBMUD will develop a science database for the lower Mokelumne River. In 2020, EBMUD continued updating this database. The Mokelumne Science Database consists of two parts, the written record (reports, correspondence, scientific literature and historic documents) and an electronic database (Oracle® format). The written record is compiled and cataloged by EBMUD. EBMUD also provides scientific data to the Central Valley Project Improvement Act (CVPIA) Comprehensive Assessment and Monitoring Program (CAMP) to evaluate the relative effectiveness of CVPIA actions in restoring anadromous fish production. This includes regular transfers of all EBMUD juvenile trapping data collected on the lower Mokelumne River to the CAMP standardized database for juvenile outmigration monitoring in the California Central Valley.

D. RESEARCH AND MONITORING

In 1987, EBMUD initiated and presently continues proactive, comprehensive programs to monitor, research, and improve anadromous salmonids in the lower Mokelumne River and to investigate potential ecological factors affecting the lower Mokelumne River anadromous fishery. The programs encompass every freshwater life phase of lower Mokelumne River salmon including upstream migration, spawning, egg incubation, fry and juvenile rearing, and outmigration. As a result, EBMUD has carried out some of the most extensive monitoring and research activities on anadromous fish and their habitats in the Central Valley. EBMUD has made a significant commitment and contribution to improving the technical understanding of the lower Mokelumne River salmon resource through intensive in-river scientific investigations. The results of those investigations were used to develop the agreed upon flows and non-flow measures identified in the Joint Settlement Agreement.

2021

The ongoing research and monitoring actions undertaken pursuant to the JSA and WQRMP include:

- Seasonal monitoring of fish populations in the lower Mokelumne River from Camanche Dam downstream to the San Joaquin River.
- Enumeration of migrating adult Chinook salmon and steelhead by video monitoring at Woodbridge Dam.
- Salmon and steelhead redd surveys in the lower Mokelumne River between Camanche Dam and the Elliott Road Bridge.
- Estimation of redd production and emigration of juvenile Chinook salmon and steelhead by operation of rotary screw traps.
- Monitoring Camanche Reservoir water to measure temperature, pH, dissolved oxygen, conductivity, and oxidation-reduction potential.
- Collection of monthly water samples in the lower Mokelumne River at the Elliott Road Bridge and in Camanche Reservoir at PENN20 to measure hardness, cadmium, copper, and zinc.
- Monitoring of spawning reach substrate characteristics, including channel configuration and gradient.
- Monitoring temperature, pH, dissolved oxygen, conductivity, and oxidation-reduction potential of the Mokelumne River Fish Hatchery water supply and effluent.
- Continuing seasonal electrofishing and seining surveys of the lower Mokelumne River fish community (limited in 2021 under COVID-19 pandemic field protocol restrictions).
- Cooperation with the state-wide Constant Fractional Marking (coded-wire tagging) of Chinook salmon released from the Mokelumne River Fish Hatchery.
- Continuing predation management and research program by acoustic tracking of non-native salmonid predators from the Mokelumne River and developed Predator Event Records to assess predation rates.
- Genetic analysis of steelhead broodstock.
- Adaptive management actions to promote healthy fish populations including fall pulse flows to attract salmon and steelhead into the Mokelumne River and managing Camanche cold water pool to maximize benefit for fall-run Chinook salmon.

- Bathymetry surveys to develop a 2D model of the riverbed to Woodbridge Dam to aid in habitat restoration projects.
- Successfully added protective fish screens to three privately owned water diversions within the lower Mokelumne River. Assessment of the effects of feed rate on hatchery Chinook maturation rates, to manage the return of 2-year-old fish to the spawning population.
- Implemented an acoustic telemetry study to assess Mokelumne River salmon smolt migration pathways, route entrainment, and outmigration survival.

2022

EBMUD will continue similar research and monitoring activities in 2022.

E. HABITAT IMPROVEMENTS

1. Ongoing Efforts

EBMUD has continued to enhance the instream and riparian habitat of the lower Mokelumne River. These ongoing projects include:

2021

Gravel Enhancement: Gravel enhancement projects began in 1990. They consist of placing clean, washed gravel of a size suitable for salmon and steelhead spawning in the river to increase spawning habitat. In 2021, long-term maintenance of a 1-mile restoration reach continued with placement of 1,000 yd^3 of gravel into the reach. Since 1998, EBMUD has placed approximately 53,800 yd^3 of spawning gravel in the Lower Mokelumne River.

Floodplain Restoration: Floodplain habitat (1.2 acre) was created in the Mokelumne River Day Use Area to provide juvenile fish rearing and growth opportunities. The new floodplain habitat was designed to inundate at about 700 cfs and function as ephemeral habitat.

Riparian Habitat Enhancement: EBMUD continues working with winegrape and walnut growers to enhance and restore riparian vegetation. This is achieved primarily through development of a cooperative program with local interests to improve land management with agricultural best management practices and livestock grazing along riparian zones to reduce stream bank erosion and fine sediment input.

Lower Mokelumne River Watershed Stewardship Program: EBMUD has continued to support and collaborate with the Lower Mokelumne River Watershed Stewardship Program, including, but not limited to, the following projects:

- Providing technical support in seeking grant funding to continue implementation of the *Lower Mokelumne River Stewardship Plan*, primarily in restoration and invasive plant removal. Anticipated funding sources include the Wildlife Conservation Board, USFWS Partners for Fish and Wildlife and Private Stewardship Grant Program, LMR Partnership, DWR, CBDA, Central Valley Joint Venture, and Ducks Unlimited.
- Continuing to work with the San Joaquin County Farm Bureau to educate local teachers about farming and conservation practices along the Mokelumne River through the Ag in the Classroom program. (2002–present).
- Continuing to work with NGO Environmental Defense, USFWS, and California Association of RCDs to conduct management activities noted in the Lower Mokelumne River Safe Harbor Agreement for the valley elderberry longhorn beetle on EBMUD property in the Mokelumne River Watershed in San Joaquin County.
- Continuing to work with the U.S. Department of Agriculture's Natural Resources Conservation Service to promote Environmental Quality Incentives Program (EQIP), Wildlife Habitat Incentive Program (WHIP), and other federal programs that benefit watershed resources.

2022

Many of the above habitat improvement activities will continue in 2022.

2. Fish Guidance Fence

The guidance fence is put in place in conjunction with opening the fish ladder and is used to guide fish towards the ladder opening. The fence was installed on October 7, 2021. It is anticipated that it will be installed on the first Monday in October 2022 and operated through the steelhead migration season unless high flows require early removal.

V. APPENDICES

Appendix A: Sample of Lower Mokelumne River Related Stories from Local Press

Appendix B: Temporary Flow Excursions Below Woodbridge Dam

Appendix C: USGS Verified Flow Data for 2019 and 2020

Appendix D: Meeting Minutes of the Partnership Steering Committee

Appendix E: Correspondence Related to Fall 2021 Attraction Flow

APPENDIX A

SAMPLE OF LOWER MOKELUMNE RIVER RELATED STORIES FROM LOCAL PRESS

Amid drought, state curtails water for valley farmers

STAFF AND WIRE REPORTS

State regulators cut off central San Joaquin Valley farmers from their main irrigation supplies Tuesday, banning them from drawing water from the California's main rivers and streams as the drought worsens.

The State Water Resources Control Board heard hours of debate before unanimously voting to impose an "emergency curtailment" order covering the rivers of the Sacramento-San Joaquin Delta watershed — essentially the entire Central Valley.

It's the most dramatic step taken to date by state regulators since the drought was officially declared in most of California's counties, and it surpasses any of the moves made during the previous drought.

"This is a terrible situation that we're all in," said board member Sean Maguire.

The board decision is the latest blow to California agriculture and the state's $50 billion-a-year farm economy. Already, most of the farmers who rely on the State Water Project or the federal government's Central Valley Project have had their allocations slashed to nothing or nearly nothing. The state board's order affects those with direct legal rights to divert water from the rivers.

The drought year sets farmers up for difficult decisions on fallowing land.

Lodi attorney Jennifer Spaletta represents several San Joaquin County farmers and ranchers, and said it was anticipated the water board's deputy director will issue orders on a rolling basis to different geographic areas, tributaries and priorities.

"In our area, it is very possible that curtailment orders will be issued to senior right diverters on local rivers such as the Calaveras, Mokelumne and Stanislaus," she said. "Farmers along these rivers, upstream of the Delta, generally have access to groundwater wells as an alternate source. However, if the deputy director issues curtailment orders to senior right diverters in the Delta the situation will be different. Most of them do not have access to groundwater."

Spaletta said there is concern among diverters who do have access to groundwater about increasing reliance on it, as the re-

PLEASE SEE WATER, PAGE 2

BRIAN VAN DER BRUG/LOS ANGELES TIMES

Receding water levels at Folsom Lake, part of the Sacramento-San Joaquin Delta Watershed in Northern California, revealed a dry, cracked lakebed in early July.

WATER

CONTINUED FROM PAGE 1

with declining groundwater levels.

And while farmers with access to groundwater can use it, she said there will be long-term consequences that will only get worse if the next water year is dry.

She said the regulations should be implemented in about two weeks and remain in effect for a full year.

Jeffrey Michael, director of the Center for Business and Policy Research at University of the Pacific said he doubted the board's decision would have any significant impacts on food prices in the near term.

"For some farmers, it may be pretty difficult to comply with this, but it's also been signaled ahead of time and anticipated," Jeffrey Michael, director of the Center for Business and Policy Research at University of the Pacific, said in wire reports.

"Most farmers have some ability to substitute water supplies, sometimes tapping groundwater or alternative supply," he said.

Joe Del Bosque's farmland straddles Merced and Fresno counties. He said recently the drought this year means he had to fallow a 100-acre asparagus field worth "hundreds of thousands of dollars" and he's looking at how much he'll have to cut back on melon fields.

"If you look at California, it's been 50 years since we've built new water storage. That's too long," he said. "It's very daunting."

The board said it needed to curtail farmers' usage to preserve river flows for drinking water as well as endangered fish species. "Adoption of an emergency regulation is necessary to address the immediate and dire water shortages in the Delta watershed," the order says.

Some farm groups, while not contesting the decision, said the order underscores the desperate need for more reservoirs and dams to store water.

The state board imposed emergency curtailment orders on limited groups of farmers in 2014 and 2015, but never on such a broad scale as it did Tuesday. The new order is expected to take effect in about two weeks.

Assemblymember Adam Gray, D-Merced, denounced the idea before the vote in a letter to the board.

"In no other industry would the destruction of billions of dollars in economic productivity and thousands of jobs by a state regulator be tolerated," Gray wrote in his letter.

"The Board must stop acting as a political entity, intent on promoting the anti-agriculture, anti-growth mentality of special interests, and instead prioritize its limited function as a regulator."

The vote came a day after board issued a separate order forbidding anyone from pulling water from the Upper Russian River, "except as needed to ensure human health and safety."

The California Farm Water Coalition said the state's dire water situation only highlights the lack of planning in wetter years.

"California's climate is now punctuated by wetter wet years and drier dry ones," the coalition said in a statement. "We've known for years that we need to increase our ability to capture water during the wet years so it is available when dry years return, as well as increase recycling, fix our aging infrastructure and provide for habitat restoration."

Some small farmers said they worried curtailing drawing any water from rivers would end with dried up ponds usually used to water cattle, like those owned by Ken Perano, whose ranch is in the foothills.

"To have to cease (water) diversion means we'd have to cease our cattle operation, which is something our family has done for 50 years," he said.

Water board staffers stressed there are carve outs in the curtailment that should protect smaller water users and places where the water is used for drinking.

News-Sentinel reporter Wes Bowers, Fresno Bee reporter Thaddeus Miller and Los Angeles Times reporter Julia Wick contributed to this story.

Article rank | *27 Nov 2021* | *Lodi News-Sentinel* | *Wes Bowers NEWS-SENTINEL STAFF WRITER*

Local group honors Sac biologist with Beeler Award

Lower Mokelumne River Watershed committee thanks Cruz for protecting pollinators

Each year, the Lower Mokelumne River Watershed Stewardship Steering Committee awards the Frank R. Beeler Stewardship Award to someone who works hard to protect the local watershed.

While the award is typically announced during the annual East Bay Municipal Utility District's Pardee Barbecue in October, this year's event was canceled due to COVID-19 concerns.

Instead, this week, the steering committee, along with EBMUD, the Lower Mokelumne River Partnership, and U.S. Fish and Wildlife Service, named Jessa Kay Cruz to receive the 2021 award.

Cruz is the senior pollinator conservation specialist for The Xerces Society in California, an international nonprofit organization that protects the natural world through the conservation of invertebrates and their habitats. It is a science-based organization, conducting research and using the most up-to-date information to guide their conservation work.

Cruz is also a partner biologist with the Natural Resources Conservation Service.

While she lives and works in Sacramento, Cruz said her work with the Xerces Society takes her all over California.

Cruz has been with the Xerces Society for more than 13 years, and said she loves everything about working there, as well as its science-based approach to conservation. "When I started working with Xerces, I focused mostly on protecting and creating biodiversity and conserving pollinators on working lands, such as farms and ranches," she said. "Since then, I have expanded my work to include even more diverse landscapes such as natural areas, forests, urban farms and city parks. I love the way my work connects me to the entire ecosystem in which I'm working — from the pollinators to the plants to the people."

Cruz holds a Master of Science degree in environmental entomology and integrated pest management from California State University, Chico, and a bachelor's degree in sustainable farming from Hampshire College in Amherst, Mass.

Since joining Xerces in 2008, Cruz has worked in agricultural and natural lands to create habitat for pollinators and other beneficial insects, and to promote practices that support them.

She provides education and technical support to a range of individuals and agencies, including farmers and ranchers, agricultural professionals and land managers.

A collaboration between Cruz and the USDA Natural Resources Conservation Service, the Lockeford Plant Materials Center (CAPMC) on the Lower Mokelumne River provides information on pollinator establishment and management.

Kathy Grant, the City of Lodi's watershed program coordinator, said Cruz is a frequent speaker at outreach events and training sessions that occur in the area, including the CAPMC Field Days and Open Days, CAPMC training events, and Lodi Winegrape Commission grower meetings.

Cruz has also created outreach materials for Lodi grape growers, including an article on beneficial insects in the recent publication "What Every Winegrower Should Know: Viruses."

Grant said miles of new hedgerows have been planted in the past two years thanks to Cruz's outreach and skills connecting local growers with the resources they need to select native plants, obtain financial assistance through grants, and access technical information for hedgerow management.

"Jessa embodies the Beeler Award spirit by enthusiastically supporting stewardship practices based on sound science, assisting others with conservation efforts to enhance the Mokelumne River watershed to encourage them to make the best use of the natural resources, and engaging with the community through education," Grant said.

The Frank R. Beeler Watershed Stewardship Award is presented annually to acknowledge and recognize an individual or organization within the Lower Mokelumne River watershed who has shown outstanding leadership, responsibility, or activism in the promotion of sound and innovative natural resource stewardship practices that help sustain the environment and enhance productivity and profitability in the Mokelumne River watershed.

"Despite a busy schedule full of diverse responsibilities, Jessa always makes time to provide help that really makes an impact, and even saves growers money in the long run by reducing the need for irrigation and pesticides," Grant said.

The Lower Mokelumne River Watershed stretches from the base of Camanche Reservoir to the confluence with the Cosumnes River.

City officials say Lodi has ample water supply

Wes Bowers
NEWS-SENTINEL STAFF WRITER

During the Lodi City Council meeting Tuesday night, Mayor Alan Nakanishi said he had received several phone calls from residents worried their water supply would be shut off in the near future.

The calls, Nakanishi said, came earlier Tuesday after the State Water Resources Control Board banned California farmers from drawing water from rivers and streams as the drought worsens.

Nakanishi asked the city's Public Works Department to explain where Lodi gets its water supply from, and that it will not be affected by the water curtailment.

Public works director Charlie Swimley said Lodi has an adequate water supply that will last through 2045.

"We have a very robust water supply for city of Lodi," he said. "And that is the result of really smart council actions in the past and a very proactive program with conservation that extends back to the '80s."

Travis Kahrs, superintendent of the city's surface water treatment facility, said the plant can process 10 million gallons of water every day, which is equivalent to drawing water from as many as six groundwater wells.

The city has not had to drill new wells in years, he said, and having the treatment facility means water does not have to be drawn from existing wells.

The surface water is drawn from the Woodbridge Irrigation District canal that traverses through the city, he said.

"That provides 50% of the water we produce in Lodi," Kahrs said. "By balancing our dependency on groundwater and surface water, we've done the best we can to mitigate the negative effects that would come in drought years when you have surface water curtailment or a groundwater issue.

There's not much more you can do besides split your usage fifty-fifty between the two most available sources."

The city has had an agreement with WID since 2003 that stipulates the agency provide Lodi with a minimum 50% of its total Mokelumne River water allotment

PLEASE SEE SUPPLY, PAGE 2

SUPPLY

CONTINUED FROM PAGE 1

from East Bay Municipal Utility District.

Currently, that minimum is 3,000 acre-feet, or 978 million gallons. However, WID has been providing the city with 6,000 acre-feet of water, or 1.96 billion gallons, each year.

During the current water year, Kahrs said WID has asked the city to draw only 5,000 acre-feet of water. Even with that reduction, the city stands to still have enough water for years to come, he said.

The contract with WID lasts 40 years, Kahrs said, with the option to extend it another 40 years.

Lodi's population in 2020 was 67,938, and it used 13,978 acre-feet of water, well below its supply of 21,000 acre-feet, Kahrs said.

Based on a 1.13% population growth each year, Kahrs said the city should have 90,008 residents by 2045, and water usage is estimated at 18,365 acre-feet, or nearly 6 billion gallons. The city's total water supply would still be 21,000 acre-feet, 0r 6.85 billion gallons.

However, the water usage estimate does take into account future capital improvement projects that might rely on water.

As an example, the city is planning to undertake a water treatment facility expansion project some time in the future that would double its capacity. As result, the city's water supply is expected to increase by 6,000 acre feet each year once the project is complete, Kahrs said.

City manager Steve Schwabauer said that even in difficult years that include reduced rainfall and severe drought conditions, the city's groundwater basin is actually increasing. He credited that increase to conservation efforts undertaken by previous city councils.

"You've done a phenomenal job putting in water meters," he said. "It was an expensive proposition, but it is the number one most effective way to conserve water — ensure people are paying based on consumption, and it's been a very effective conservation strategy for the city."

In 2004, the State of California mandated that all water suppliers install meters on all customer connections by Jan. 1, 2025. The city began installing its meters in 2011.

"We've been conserving water a long time, and we have two sources — the wells and the river," Nakanishi said. "We're not afraid of losing access to water 20 or 40 years away. We are doing well considering what other parts of the state are doing."

Splashes

June 10, 2021

Fish transfers

The California Department of Fish and Wildlife determined that water temperatures in the Lower American River are rising and approaching unhealthy limits for the survival of young steelhead trout this summer. Drought conditions have pushed reservoir storage and cold-water pool volumes to historically low levels in Folsom Reservoir on the Lower American River, which likely means elevated water temperatures at the Nimbus Fish Hatchery this summer.

Temperatures above 68°F cause stress and disease for rearing steelhead, and temperatures above 70°F can result in significant mortality.

To support healthy fisheries, the California Department of Fish and Wildlife in coordination with the US Bureau of Reclamation and EBMUD, temporarily relocated 500,000 juvenile American River steelhead from the Nimbus Fish Hatchery to the Mokelumne River Fish Hatchery below Camanche Reservoir. This hatchery is owned by EBMUD and operated by the California Department of Fish and Wildlife. The young steelhead will be moved back to their home at the Nimbus Fish Hatchery in the fall when river temperatures cool.

This is not the first time the Mokelumne River has served as a temporary haven for cold-water fish. During the 2015 drought, when temperatures on the Lower American River were predicted to be lethal for cold-water fish, catchable-size trout were successfully moved to the Mokelumne River Hatchery.

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The Discovery

How a sharp-eyed ranger found a wondrous prehistoric trove in the foothills east of Lodi

The heat was building in the foothills east of Lodi — it would reach 97 that July afternoon — but Greg Francek was not about to seek shade. He'd spotted something, something different. A ranger for the East Bay Municipal Utility District, Francek, 54, was on foot patrol in the sprawling Camanche-Pardee corridor near Valley Springs. He sometimes patrols in his big Ford 550 utility truck, complete with first aid kit, Gatorade, chainsaw and 600 feet of firefighting hose.

COURTESY PHOTOGRAPHS/RICH TURNER**Greg Francek, a ranger for the East Bay Utility District, helps patrol and protect a 28,000-acre tract owned by the utility in the foothills east of Lodi. The rangers have an eclectic range of duties, including fighting fires. On a recent afternoon Francek donned his turnouts and responded to a fire reported in Camanche Village.**

Francek, though, prefers to hike when he can. Fit and athletic, he moves at a brisk pace. He is an expert caver, and on foot patrol he follows the mantra of those who survey caverns: look right, left, up and down. On that hot afternoon last July 18, alone on patrol, Francek looked down. His intense blue eyes spotted a strange object protruding from the earth. As it turned out, that object would lead to the discovery of a prehistoric trove unlike any in California history. Seized by adventure

The Marines were on the roof, and Francek was mesmerized.

He was a freshman at his Walnut Creek high school, and the Marines were staging a demonstration. One by one, they rappelled from the gymnasium roof, a study in strength and agility.

When they asked if a student would like to make a descent, Francek's arm shot up. He made two drops that day, and one of the Marines gifted him with a souvenir carabiner.

Those descents changed his life. Francek knew he loved being in motion, outdoors, exploring and adventuring. In the years since, he has climbed soaring walls of rock, dived into watery caves in the Yucatan, helped chart deep, inky-black caverns. He's been part of many search and rescue operations in the Sierra and foothills. He's an expert scuba diver and a skilled skier.

Francek, it seems, was born to move.

He did not join the Marines after those drops off the roof, but he began venturing. He started climbing rocks, devoured every climbing book he could get his hands on, and honed his skills at Rock City near Mount Diablo.

At 17, he worked a summer at a family camp near Yosemite as a baker's aide. He rose before dawn to get the breakfast rolls and muffins baked and returned in the late afternoon to start the bread for dinner.

In between, he roamed the granite of Yosemite.

"My job was great because I had almost the whole day to climb and explore," he said.

He scaled El Capitan and Half Dome and roped up with legendary climbers Jim Bridwell and Royal Robbins.

Bright and absorptive, Francek attended college off and on. Yet he found the siren's song of adventure irresistible. For a few years, Francek worked as the manager of the Black Chasm cavern outside Volcano in Amador County. In 1995, he moved to Florida and earned his license as a commercial maritime captain. He piloted charter tours, research vessels, commercial diving craft. He delivered new vessels, once piloting a jet boat from Florida around Cuba to the Cayman Islands.

"That boat wasn't meant for much action beyond the reef, so it was rough going at times," he said.

Perhaps his most abiding passion is caving, including the exploration of caves that are filled with both water and mystery.

In 2014, he was part of a National Geographic-supported team documenting the exploration of a deep, water-filled cave in Mexico's Yucatan known as Hoyo Negro, the black hole. Francek's assignments included rigging, lighting and safety.

The team's discovery was historic — the nearpristine skeletal remains of a girl who lived 13,000 years ago. Scientists named her Naia, for the Greek water nymph, and hers are among the earliest human remains found in the Americas. The resulting PBS NOVA episode is titled, "First Face of America."

Francek has explored caves in the rugged mountains of Mexico, including the Sotano de las Golodrinas, or Cave of Swallows, which boasts the largest cave shaft by volume in the world.

In New Mexico, he was part of a team that spent eight days underground in Lechuguilla Cave, part of Carlsbad Caverns National Park. His team charted and photographed a newly discovered chamber dubbed Motherlode as big as a basketball arena.

On his eight days underground, he saw spectacular sites and endured surrealistic conditions.

"It was extremely humid, and everyone smelled like a goat, but you couldn't take a bath or shower. So the best we could do is clean ourselves with baby wipes," he said.

Midway through the journey, he said, came a refreshment, of sorts.

"We kept clothes to a minimum as we had to travel really, really light," he said. "Halfway through, we changed into the single set of fresh underwear we had, and devoured one of our favorite freeze-dried meals; mine was beef stroganoff. That kept us going."

After their mission was done, they emerged from the damp and dark to a glorious sunrise.

"The dry, cool air hit us as we came out and the desert was in bloom. The blossoms smelled so good. I'll never forget that exhilaration — or that fragrance," he recalled.

He's comfortable exploring the depth and darkness, but not keen on the jungle.

He helped coordinate Eco-Challenge competitions in Borneo in the late '90s, requiring frequent journeys into remote jungles. On one trek from the interior, an area known as the Lost World, he contracted a foot infection and had to hobble 20 miles to the coast and civilization.

"It was pretty much a suffer-fest of rain, humidity and leeches," he recalled.

All of it, though — the adventuring, the attention to detail, the affinity for stone and earth — was preamble for the discovery ahead.

Of wildflowers and chainsaws

He came to rangering at 40, later than some, but the fit was right.

Francek worked as a seasonal wilderness ranger for the U.S. Forest Service, patrolling the rugged region between Kirkwood and Bear Valley, before being hired fulltime as a ranger for East Bay 10 years ago. He lives in Jackson with his wife.

Francek is part of a 15ranger/naturalist corps charged with wildly eclectic duties. The job examination, he recalled, included identifying wildflowers, tying down a small bulldozer on a trailer, assembling a chainsaw that had been torn down, and explaining how to swap out a propellor on a boat. He also had to cover two miles wearing a 25-pound vest in less than 30 minutes.

"And you couldn't run. You had to walk. Fast," he said.

The job calls on people skills, public safety training, a love of the outdoors, and a grounding in science.

Asked about a typical day, Francek says there is no such thing. On a recent shift, for example, he responded to a grass fire, a report of a person threatening violence in a campground, assisted medics with a heart attack victim, and finished with a latenight boat search for a fisherman who was overdue from an outing on Lake Camanche.

Some rangers have college degrees. Francek doesn't. Yet he has impeccable credentials: years of outdoors experience, intelligence, energy — and relentless curiosity.

A friend and former colleague, Lisa Boulton, said Francek absorbs concepts with startling quickness.

"He has this spark of energy and intellect. He's soaks up technical information in a flash," she said. "In my opinion, he's a brilliant guy."

An object, ancient and stony

Francek and his fellow rangers patrol a sprawling realm once widely populated by the indigenous Miwok people and later by miners and ranchers.

It's defined by the Mokelumne River, and the dams that contain it.

East Bay operates two major dams on the river, Pardee and Camanche. Encircling the dams and reservoirs are 28,000 acres owned by the district, a mix of recreation and open space. There are campgrounds and homes and stores, marinas and even tennis courts.

Beyond the developed areas are lush canyons choked with buckeye and blackberries, forests of oak and pine, grassy meadows and sandy shorelines. Along with cattle grazing through the fields and forests, there are mule deer, foxes, bobcats and rattlesnakes.

The area was heavily mined, and vestiges are seemingly everywhere. Old mine tunnels, the adits boarded over, piles of rock flung aside in the mad search for gold, flumes long overgrown with manzanita and poison oak.

Francek sometimes stumbles over old whiskey bottles, shovels or picks discarded by the miners.

His eyes are scanning, always scanning.

On that foot patrol last July, he bent low to examine the object peeking from the earth. He had a hunch.

It was brownish with shades of gray, about two feet long. He brushed away some dirt and gravel and knew his hunch was right. It was petrified wood, ancient and stony.

His adrenaline was pulsing now. He continued searching, probing. He found another piece of petrified wood. Then another. Francek would return to the area repeatedly in coming days, finding not just petrified wood but things even more precious.

Bones, very old bones. And many of them.

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The Discovery R

As fossils are revealed in the foothills, so are the mysteries

Russell Shapiro, a paleontologist and geology professor, and an expert hunter of fossils, was stunned. He'd spent the day scouring the foothills east of Lodi, assessing a site reportedly holding petrified wood and fossils. "We knew right away: This was a significant discovery," he said. It was, in fact, a vast buried menagerie. Most of the fossils were from megafauna, huge beasts such as mastodons and camels and horses. But the trove, Shapiro saw, was incredibly diverse. There were remains of a bird, of tortoises, of a fish. "Is was just mindblowing," he said. "And I knew we were just scratching the surface." The site is in a remote part of the East Bay Municipal Utility District holdings, not close to a road or trail, and it is not being publicly revealed. Yet, by the time Shapiro arrived, looters had already made off with an agatized length of petrified wood. It would be a race, in a way. To secure the site and others that would be found nearby, organize a major dig, and remove the best of the bones. The initial discovery had been made, one of the most notable in the history of California. But there was much work ahead. The mysteries, really, were just starting to unfold. Hound on the hunt

COURTESY PHOTOGRAPH/EAST BAY MUNICIPAL UTILITY DISTRICT**Above: Ranger Greg Francek with the East Bay Municipal Utility District at the site of a fossil dig in the Mokelumne watershed east of Lodi. Francek discovered the first fossil in the area and has found 90% of the specimens recovered so far. Top: The jaw and teeth of a mastodon or gomphothere are being cleaned and prepared for public viewing at the Gateway Science Museum in Chico.**

Shapiro was led to the location by Greg Francek, an East Bay ranger who a few weeks before had found and unearthed a chunk of petrified wood.

A caver and naturalist, Francek was like a hound on the hunt. He returned to the area day after day, including his days off, uncovering a petrified forest that would eventually include more than 600 trees.

About three weeks in, on Aug. 7 of last year, he found not wood but bone. It was the fossil of a still-unidentified vertebrate; that is, a creature with a backbone.

Francek studied earth science at Columbia and American River colleges. He'd gleaned a boots-underground understanding of geology as the former manager of the Black Chasm cavern in Amador County.

He knew what he was uncovering could be big. His supervisors at East Bay agreed, hiring the consulting firm of Environmental Science Associates (ESA) to help investigate the discovery.

Enter Shapiro, professor at Chico State, and a member of ESA's scientific team.

An affable sort with a quick wit, Shapiro is renowned for his knowledge of California prehistory.

He loves nothing more than getting his fingernails grimy at a dig.

"Going after fossils is a blast. It's like being a hunter, but you don't have to kill anything," he said.

Piecing together fossils is a mix of hard science and well-informed speculation, he said. It's often not clear, at least at first, what kind of creature a fossil is from, where it originated, or when it lived.

"Some of my faculty colleagues say all we do is sit around, drink beer, and make up stories," he quipped.

Among other projects, he's helped assess remains of a 15million-year-old whale calf in Southern California and an ichthyosaurus, similar to a porpoise, unearthed near Lake Shasta.

After hearing a bit about what Francek uncovered, Shapiro made the trip to the foothills last September. The site is on the 28,000-acre watershed owned by East Bay fringing the utility's Camanche and Pardee reservoirs near Valley Springs.

Shapiro did not have high expectations. Aside from a fossilized horse tooth, there had been few discoveries in this part of California.

Yet on his first day on site, Shapiro viewed dozens of fossils which Francek had already discovered and carefully tucked back into the earth, awaiting the professor's inspection.

He'd also seen the petrified tree that had been ravaged by looters.

"Within a few hours, we'd seen the ankle of a camel, a small skull, several tortoise shells, and the jaw of a rhino with a tooth. It was terrific, and I said, 'this site has to be immediately protected.'"

A bestiary fantastic

Francek is fond of a credo, favored in ranger circles: "You catch it, you clean it." After Shapiro and his team arrived, Francek could have stepped back.

Instead, he redoubled his commitment, taking on the role of project coordinator. He's immersed himself in the study of paleontology, devouring numerous books and scientific papers.

Last October, Francek and Shapiro, as science team leader, organized a major dig including East Bay employees, scientists and Chico State earth science students.

"We wanted to attack it intensively, to make sure we gathered what we could while we could," Shapiro said.

With shovels and power drills, with hammers and chisels and even leaf blowers, they went at it, revealing a bestiary fantastic that included:

- Rhinos, which crossed into North America from Asia and became extinct in North America about 5 million years ago.
- Mastodons, much like elephants, with long, arcing tusks.
- Three-toed horses.
- Gigantic camels, large as giraffes, which were actually native to North America 25 million years ago — though without the signature hump.
- A gomphothere, like an elephant, but with four tusks. To extract a 350-pound gomphothere specimen, workers had to use a backhoe.
- A baby tapir, a pig-like creature now extinct in North America but still found in Central and South America.
- Remains of giant tortoises, indicating the region may have been warmer than previously suspected.
- There were bones from a fish and a bird, still unidentified.

Most of the fossils were from grazers, Shapiro said. The search continues for predators. During the Miocene epoch when the unearthed animals lived, giant dogs, known as Bear-dogs, and Saber-toothed cats lived, too, and devoured the flesh of the grazers.

While no big dogs or cats have been found yet, the remains of a small weasel-like creature were.

Another remnant of an apparent meat-eater has been taken from the site.

"It's a pile of petrified poop with crushed bones in it," Shapiro said.

What hasn't been found, and won't be, he said, are the remains of dinosaurs, which lumbered around when most of California was underwater, a good 50 million years before the Miocene time.

It's quite unlikely the trove contains any human remains, as sapiens came on the scene perhaps 12,000 years ago in California, long after the camels and rhinos and mastodons perished.

Still, the variety of fossils, their relatively good condition, and their sheer number make the Mokelumne site uniquely important, Shapiro said.

Mudflows and jigsaw puzzles

The Miocene was a time of great geologic violence in California. As Shapiro describes it, the animals dwelled on a coastal plain, the shoreline probably running along what is now the western edge of the Central Valley. To the east, where the Sierra are now, volcanoes erupted, spewing lava and creating massive mudflows.

In fact, Shapiro says the creatures were likely not inhabitants of the area where their bones were found. The fossils are mostly, he said, "disarticulated" — that is, they are individual pieces, not whole skeletons.

That shows they likely were pushed by mud or lava — or a blend — to the spot where Francek found them.

"They came from somewhere else, but not too far, because they are still in good shape," Shapiro said.

If you were to view California in its entirety from high above, in terms of prehistoric knowledge, the state is like a jigsaw puzzle. There have been fossil discoveries, big ones, in just a handful of locations.

"The discovery on the Mokelumne is a new, sizable piece of the puzzle," Shapiro said. "It will fill in a very large blank."

Beyond the initial discovery site, researchers have found fossils dispersed in a lengthy geologic vein along the CamanchePardee corridor, reflecting both the richness of life in the overall region and the immense flow of mud or lava.

That vein, according to Shapiro, may stretch for miles.

Fossils get a beauty treatment

The Gateway Science Museum, on the Chico State campus, is a spa for fossils.

Here, they are pampered, cleaned and strengthened.

That's not unusual; rib bones, for instance, are often set aside or placed in storage, as they are pretty common and it can be difficult to determine their species.

Teeth, on the other hand, are like fossilized gold. Their size, shape, color and texture often lead to a reasonably quick and certain identification.

Nies approaches his work with near-reverence.

After all, by Shapiro's estimate, the fossils Nies touches are likely 8 to 10 million years old. There are no complete skeletons from the Mokelumne, at least not yet. So Nies typically works with individual fossils or clusters of bone. If the bones haven't been identified in the field, he will attempt to do that in the lab. He will clean the fossil, in some cases leaving a crust of the dirt or rock — the matrix — in which it was discovered. The residual matrix can make for a more authentic display.

Nies sometimes even sketches the specimens.

"By sketching, you have to really study the fossil, look quite carefully at the shape, the texture, the coloration," he said.

The sketches help him imagine the animal from which the fossil was obtained.

"It's not hard to see the beauty in these, the elegance, the way the bones fit together," he said.

There is one telltale sign Nies and others always look for on the bone: teeth marks, signs of predation or scavenging.

To strengthen delicate fossils, Nies painstakingly paints them with a mix of acetone and Butvar, a plastic resin.

He's prepping the largest and most unusual of the bones for an exhibit planned at the museum in September.

Yet the bones keep coming. In the museum storehouse, there are plastic bins full of fossils wrapped in aluminum foil that haven't been opened, analyzed or cleaned yet.

In coming weeks, they will all be placed on tables for a massive sorting by species. All the camel ankles will go in one spot, the tortoise shells in another, and so on.

Eventually, the most prized fossils will reside at the UC Berkeley Museum of Paleontology. Shapiro said there may be enough fossils remaining to be shared with schools and museums, perhaps including the Worlds of Wonder museum in Lodi, for further study and display. The fossils remain the property of the utility.

How many fossils have been pulled from the East Bay lands?

No one is quite sure, but the number is surely in the hundreds.

The quest continues

The Mokelumne vein is not played out. Almost every week, Francek discovers new bones. In fact, nearly all of the items wrapped in foil at the Gateway storeroom were found, packaged and sent in by Francek; he's responsible for 90 percent of the fossils found so far.

And with each new fossil are the questions. Horse? Camel? Rhino?

How old? Where from? How did it live and die?

One oak leaf fossil has been found, and there could be more flora recovered in the months to come. Plants can often reveal more about a specific environment than animals, Shapiro said.

"That's because animals can move around a lot. Plants don't," he said.

The search for big predators continues. Even lions may have roamed the grassy plains of California once. And maybe, just maybe, entombed somewhere in the Mokelumne complex, there could be an entirely new species.

As for the ranger who made the discovery, the ranger who conjured beasts great and small from the stone of the foothills, he is ready for a break.

"For ten months, my brain has been lit by this," Francek said. "I have been consumed. I'd like to take a little time off with my wife, maybe read something by Steinbeck instead of another scientific paper."

A break is deserved, no doubt. But he made the discovery, and now the discovery dwells within him.

If there is a lion to be revealed, a giant Bear-dog, or something never found before, he will find it.

After all, as the old ranger saying goes:

You catch it, you clean it.

Officials: 'Nearly all' juvenile salmon could die in Sac River

Dale Kasler
SACRAMENTO BEE

The drought is making the Sacramento River so hot that "nearly all" of an endangered salmon species' juveniles could be cooked to death this fall, California officials warned this week.

In a brief update on the perilous state of the river issued this week, the California Department of Fish and Wildlife made a dire prediction about the endangered winter-run Chinook salmon and its struggles against consistently hot weather in the Sacramento Valley.

"This persistent heat dome over the West Coast will likely result in earlier loss of ability to provide cool water and subsequently it is possible that nearly all in-river juveniles will not survive this season," the department said.

Given that the salmon generally have a three-year life cycle, a near-total wipeout of one year's run of juveniles "greatly increases the risk of extinction for the species," said Doug Obegi, a lawyer with the Natural Resources Defense Council.

The winter-run salmon endured two years of severe mortality during the last drought as well.

Unlocking the Mokelumne's secrets

The high-tech rover, tethered to the Jetcraft vessel, features a GPS guidance system and a powerful acoustic doppler profiler that will allow scientists to gaze deeper and with greater focus into the waters of the Mokelumne River and Lodi Lake.

Scientists say new rover is smart, safe and revolutionary

This week, a very smart little rover has been plying the waters of Lodi Lake and the Mokelumne River.

It has three hulls, a GPS system, and innovative sensors allowing it to peer underwater with amazing acuity.

While it is a small boat, expectations for it are sizable.

In fact, scientists with the East Bay Municipal Utility District believe the trimaran will allow them to see the lake and river as never before. And it may also spare water scientists the sometimes-risky job of plunging into the river, or sometimes dangling over it, manually checking water flows.

The bright-orange rover's powerful acoustic system will allow hydrographers to chart the depths of the lake and river, providing a detailed, 3-D portrait. The sensors are also able to mark the speed and shape of currents through the river and lake.

Coupled with a temperature gauge, the craft is expected to provide an unprecedented lode of data.

In coming months, in fact, the rover could unlock many of the Mokelumne's secrets.

PLEASE SEE ROVER, PAGE 6

Jeff Toone, a supervising hydrographer with EBMUD, and John Urness, assistant water resources specialist, carry the rover to the launching ramp at Lodi Lake.

"We're in a revolution, an exciting one, from analog to analytical and digital. And it comes at an important time. The climate is changing. We need better tools to predict weather patterns and runoff, to keep the river and ecosystem healthy."

JEFF TOONE, EBMUD SUPERVISING HYDROGRAPHER

ROVER

CONTINUED FROM PAGE 1

'The fun part of the job'

It's a sunny morning at the Lodi Lake launching ramp. Red-winged blackbirds dart through the nearby tules and honey bees cruise the blackberries.

The East Bay team is assembled for a shakedown cruise.

"This is the fun part of the job," said John Urness, an assistant water resources specialist. "Being outside, heading out on the water."

Urness and Jeff Toone, supervising hydrographer, are co-leaders of the rover program. Together, they carried the trimaran to the grey-green waters of Lodi Lake and prepared for launch.

Along with a GPS system, the boat is fitted with what's known as an acoustic doppler profiler. It's the brains and brawn of the operation. Similar to a fish finder on steroids, the instrument shoots out sound waves. It captures their rebounds, or echos, and records them, sort of like a giant robotic ear that can take notes.

Ultimately, notes from the profiler, called a Hydrosurveyor, can be translated into pictures, 3-D images of the lake and river bottoms. (In water circles, the study of river and lake beds is known at bathymetry.)

Previously, much of the river and lake were mapped with an aerial Lidar system. Those data are still useful, but the new rover can gaze more deeply into water, up to 200 feet.

Plus it has an adaptive focus allowing it to see features, both deep and shallow, in greater detail.

The boat is equipped with an electric motor and is entirely capable of being remotely piloted. But these maiden voyages are to check and recheck the craft's workings and learn their complexities.

So the rover is tethered to a pole jutting from the bow of a 22-foot Jetcraft fishing-type vessel. The Jetcraft pulls the little boat along, making sure it stays precisely on a pre-established grid.

COURTESY PHOTOGRAPH/RICH HANNER

The rover, tethered to a Jetcraft vessel, scans the Mokelumne River during a test run as a paddle boarder cruises nearby.

The crew aboard the Jetcraft — seasoned scientists all — share a bubbly sense of excitement.

"This is sort of like exploring," said Urness "We'll be seeing new things in new ways."

Piloting the Jetcraft is Ed Rible, a fisheries and wildlife biologist whose job it is to help manage and nourish the river's fish population. Through years of research, East Bay biologists have learned how super-sensitive the Mokelumne's steelhead and Chinook salmon are to the flow, depth and temperature of the water.

"We're hoping this system can add to our knowledge of the river and our ability to manage the fishery," he said.

As the rover and its gadgetry become fully operational, they will answer important questions.

Are mud and gunk building up in the lake and river, and if so, where? How deep? How fast?

Is the capacity of Lodi Lake changing?

Are water temperatures rising or dropping in the lake and river? How might that affect the fishery?

Are flows around ag pumps affecting fish?

Moreover, the information will help EBMUD meet legal and environmental requirements, said Toone. The utility operates both the Camanche and Pardee dams upstream from Lodi Lake and sends Mokelumne water to customers in the East Bay area.

For years, Kathy Grant, the City of Lodi's watershed coordinator, has worked with local students and teachers to measure the clarity and temperature of Lodi Lake.

She's not directly involved in the East Bay's explorations, but is keenly interested in the results.

"We see the lake getting more shallow and warmer over time," she said. "If this program can shed light on that, it would be really useful."

Making the Mokelumne safer

The system is designed and built in San Diego by SonTek, which sells Hydrosurveyors and related technology all over the globe. Depending on varied options and upgrades, most of the units run around $30,000, said Joel Edelman, senior product and sales specialist for the firm.

By allowing water agencies to view the bottom of a river or stream, scientists have a much better idea of where and how to chart the flow.

"From the surface, a spot may look perfect for measurement. But there could be a boulder disrupting the flow there that can't be seen from above," he said.

With advanced equipment, workers don't have to slog around in the water placing measuring devices.

"There's a real safety advantage," Edelman said.

In Australia, SonTek's gear has been used to probe water at the base of mining pits, allowing workers to stay a safe distance away.

On the Mokelumne, Toone said there are two measuring stations that once required hydrographers to climb aboard small carts and pull themselves out over the water on a cable.

"You could lose a finger if it got caught between the cable and a pulley. If you slipped out in a storm, you could be in real trouble," Toone said.

The new addition will largely take over those duties.

The trial sessions this week went well, with minor glitches resolved. Initially, the GPS signal between a base station and the rover was weak; adding a taller antenna fixed that.

The rover's promise, Toone said, could mean a cleaner, safer river. And it reflects an ongoing revolution in environmental monitoring. For instance, years ago weighted ropes and piano wires were the best tools to measure watery depths. No more.

Today, Toone and his East Bay colleagues must blend a passion for the environment and a zeal for technology.

"We're in a revolution, an exciting one, from analog to analytical and digital," he said. "And it comes at an important time. The climate is changing. We need better tools to predict weather patterns and runoff, to keep the river and ecosystem healthy."

Even during this week's trial runs, the smart little rover has been gleaning information. It will take a few weeks to scour the data and turn it into portraiture.

So while there aren't any major findings just yet, Toone, a SCUBA diver, is eager to see where the rover will lead.

"There is something exciting about revealing natural surroundings that are so close to us — but usually hidden from view."

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Lodi News Sentinel – May 13, 2021

Are water restrictions in store for SJ County?

EBMUD already asking customers to voluntarily reduce water use by 10%

Wes Bowers
NEWS-SENTINEL STAFF WRITER

This week, Gov. Gavin Newsom declared 41 counties in California are now under extreme drought conditions, and one of those is San Joaquin County.

What that means for residents in terms of conservation and restrictions remains to be seen.

When the governor declared an emergency in Sonoma and Mendocino counties last month, the East Bay Municipal Utilities District board of directors held a meeting to discuss its water supply and decide how to conserve it.

At an April 27 meeting, the board approved asking EBMUD customers districtwide to voluntarily reduce water use by 10%.

Andrea Pook, EBMUD spokeswoman, said the district is planning on securing supplemental water supplies through the Unites States Bureau of Reclamation and a Central Valley Projects contract later this summer.

"We know that not every customer can reduce their usage by exactly 10%," she said. "It's really difficult for each individual, household or business, because it depends on how much is done with the water they need or use. We're just asking people to look at a variety of ways to conserve."

The district controls the Camanche and Pardee reservoirs along the Mokelumne River, the former of which provides water to Woodbridge Irrigation District, which in turn provides a portion of water to the City of Lodi.

DROUGHT

CONTINUED FROM PAGE 1

Pook said that when conditions are as dry as they are now, WID's regulated base supply is 39,000 acre feet of water, or 12.7 trillion gallons. In a normal year, the district receives 60,000 acre feet, or 19.5 trillion gallons.

The last time EBMUD was under a water emergency and WID allotment was reduced was 2014-2016. During that time, allotment to Lodi was reduced from 6,000 acre feet to 3,500 acre feet, and the city implemented water conservation restrictions on residents.

Those included limiting the watering of lawns to specific days of the week depending on address, and prohibiting watering between 10 a.m. and 6 p.m.

Even-numbered addresses could water on Tuesdays and Saturday, while odd-numbered addresses could water on Wednesdays and Sundays.

As of Tuesday, Camanche Reservoir was at 52% capacity with 215,390 acre feet of water, down from 55% on April 22 when Newsom declared emergencies in Sonoma and Mendocino counties.

Pardee Reservoir was at 87% capacity Tuesday, with 177,250 acre feet of water. That was down from 88% capacity on April 22.

Pook said EBMUD will continue to monitor expected run-off and storage in its reservoirs, and adjust conservation efforts as needed.

She said efforts could result in mandatory cutbacks, fines or penalties if the 10% reduction is not met.

APPENDIX B

TEMPORARY FLOW EXCURSIONS BELOW WOODBRIDGE DAM

Table B-1: Flow Below Woodbridge Dam, April 1, 2021

Reading Date and Time	Interval	Unit	JSA Water Year Type	Golf Gage Measured Flow	JSA Expected Flow (below WID Dam)
4/01/2021 00:00	15 Minute	cfs	Dry	126	150
4/01/2021 00:15	15 Minute	cfs	Dry	126	150
4/01/2021 00:30	15 Minute	cfs	Dry	127	150
4/01/2021 00:45	15 Minute	cfs	Dry	129	150
4/01/2021 01:00	15 Minute	cfs	Dry	130	150
4/01/2021 01:15	15 Minute	cfs	Dry	132	150
4/01/2021 01:30	15 Minute	cfs	Dry	132	150
4/01/2021 01:45	15 Minute	cfs	Dry	133	150

1. On April 1, 2021, the required JSA flow release from Camanche Dam was 220 cfs. EBMUD released 342 cfs; however, due to downstream WID operations, the expected flow increase below WID dam appears to have been delayed. EBMUD reminded WID that the transition should begin before midnight “PST”.
2. The provisional average daily flow for 4/01/2021 is 159 cfs.

Table B-2: Flow Below Woodbridge Dam, May 31, 2021

Reading Date and Time	Interval	Unit	JSA Water Year Type	Golf Gage Measured Flow	JSA Expected Flow (below WID Dam)
5/31/2021 22:45	15 Minute	cfs	Dry	106	150
5/31/2021 23:00	15 Minute	cfs	Dry	81	150
5/31/2021 23:15	15 Minute	cfs	Dry	68	150
5/31/2021 23:30	15 Minute	cfs	Dry	59	150
5/31/2021 23:45	15 Minute	cfs	Dry	53	150

1. It appears that WID began reducing flow on May 31st early, at 10:45pm PST, reaching a minimum flow of 53 cfs at 11:45pm PST. EBMUD reminded WID that the transition should begin after midnight “PST”.
2. The provisional average daily flow for 5/31/2021 is 153 cfs.

Table B-3: Flow Below Woodbridge Dam, October 1-2, 2021

Reading Date and Time	Interval	Unit	JSA Water Year Type	Golf Gage Measured Flow	JSA Expected Flow (below WID Dam)
10/1/2021 18:45	15 Minute	cfs	Dry	62	80
10/1/2021 19:00	15 Minute	cfs	Dry	55	80
10/1/2021 19:15	15 Minute	cfs	Dry	52	80
10/1/2021 19:30	15 Minute	cfs	Dry	51	80
10/1/2021 19:45	15 Minute	cfs	Dry	51	80
10/1/2021 20:00	15 Minute	cfs	Dry	51	80
10/1/2021 20:15	15 Minute	cfs	Dry	51	80
10/1/2021 20:30	15 Minute	cfs	Dry	52	80
10/1/2021 20:45	15 Minute	cfs	Dry	53	80
10/1/2021 21:00	15 Minute	cfs	Dry	54	80
10/1/2021 21:15	15 Minute	cfs	Dry	57	80
10/1/2021 21:30	15 Minute	cfs	Dry	59	80
10/1/2021 21:45	15 Minute	cfs	Dry	60	80
10/1/2021 22:00	15 Minute	cfs	Dry	61	80
10/1/2021 22:15	15 Minute	cfs	Dry	63	80
10/1/2021 22:30	15 Minute	cfs	Dry	65	80
10/1/2021 22:45	15 Minute	cfs	Dry	67	80
10/1/2021 23:00	15 Minute	cfs	Dry	68	80
10/1/2021 23:15	15 Minute	cfs	Dry	71	80

Reading Date and Time	Interval	Unit	JSA Water Year Type	Golf Gage Measured Flow	JSA Expected Flow (below WID Dam)
10/2/2021 6:30	15 Minute	cfs	Dry	62	80
10/2/2021 6:45	15 Minute	cfs	Dry	57	80
10/2/2021 7:00	15 Minute	cfs	Dry	53	80
10/2/2021 7:15	15 Minute	cfs	Dry	52	80
10/2/2021 7:30	15 Minute	cfs	Dry	52	80
10/2/2021 7:45	15 Minute	cfs	Dry	52	80
10/2/2021 8:00	15 Minute	cfs	Dry	53	80
10/2/2021 8:15	15 Minute	cfs	Dry	54	80

10/2/2021 8:30	15 Minute	cfs	Dry	55	80
10/2/2021 8:45	15 Minute	cfs	Dry	57	80
10/2/2021 9:00	15 Minute	cfs	Dry	59	80
10/2/2021 9:15	15 Minute	cfs	Dry	61	80
10/2/2021 9:30	15 Minute	cfs	Dry	62	80
10/2/2021 9:45	15 Minute	cfs	Dry	63	80
10/2/2021 10:00	15 Minute	cfs	Dry	65	80
10/2/2021 10:15	15 Minute	cfs	Dry	66	80
10/2/2021 10:30	15 Minute	cfs	Dry	67	80
10/2/2021 10:45	15 Minute	cfs	Dry	68	80
10/2/2021 11:00	15 Minute	cfs	Dry	71	80
10/2/2021 11:15	15 Minute	cfs	Dry	71	80

Reading Date and Time	Interval	Unit	JSA Water Year Type	Golf Gage Measured Flow	JSA Expected Flow (below WID Dam)
10/2/2021 19:15	15 Minute	cfs	Dry	66	80
10/2/2021 19:30	15 Minute	cfs	Dry	62	80
10/2/2021 19:45	15 Minute	cfs	Dry	60	80
10/2/2021 20:00	15 Minute	cfs	Dry	60	80
10/2/2021 20:15	15 Minute	cfs	Dry	60	80
10/2/2021 20:30	15 Minute	cfs	Dry	60	80
10/2/2021 20:45	15 Minute	cfs	Dry	61	80
10/2/2021 21:00	15 Minute	cfs	Dry	62	80
10/2/2021 21:15	15 Minute	cfs	Dry	65	80
10/2/2021 21:30	15 Minute	cfs	Dry	66	80
10/2/2021 21:45	15 Minute	cfs	Dry	67	80
10/2/2021 22:00	15 Minute	cfs	Dry	68	80
10/2/2021 22:15	15 Minute	cfs	Dry	71	80

1. EBMUD provided WID with the Oct 1st minimum target Gauge Height that corresponded to a flow of 90 cfs (80 cfs minimum + 10 cfs buffer) at Golf. WID operated their dam to maintain a set Lodi Lake elevation, therefore, downstream flow fluctuations occurred due to oscillations in the dam height while the lake elevation settled. No daily flow deviations occurred during this period.
2. The provisional average daily flow for 10/01/2021 is 101 cfs.

APPENDIX C

USGS VERIFIED FLOW DATA FOR 2019 AND 2020

Table C-1: Calendar Year 2019 – USGS Verified Average Daily Flow from Camanche Dam

11323500 Mokelumne River below Camanche Dam, CA

DISCHARGE, CUBIC FEET PER SECOND CALENDAR YEAR 2019

DAILY MEAN VALUES

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	336	1060	2000	2000	2400	2900	1300	854	452	452	451	329
2	336	1250	2000	2000	2400	2900	1300	855	452	772	451	329
3	338	1250	2000	2130	2400	2900	1300	851	453	1370	450	330
4	335	1250	2000	2200	2400	2900	1300	851	451	1490	452	329
5	335	1250	2180	2330	2410	2900	1300	851	451	1190	451	330
6	335	1250	2580	2400	2410	2900	1300	851	452	891	452	331
7	336	1300	2800	2400	2400	2900	1300	850	450	592	452	330
8	337	1350	2800	2400	2400	2900	1300	850	452	455	452	330
9	379	1350	2800	2400	2400	2900	1420	850	452	774	451	330
10	401	1350	2800	2400	2400	3150	1700	850	452	1370	451	329
11	400	1350	2800	2400	2400	3300	1700	850	451	1490	452	329
12	400	1530	2800	2400	2400	3300	1700	850	452	1190	451	329
13	400	1860	2800	2400	2400	3300	1700	850	454	892	450	330
14	401	2180	2800	2400	2400	3300	1700	850	453	590	451	330
15	401	2580	2610	2400	2400	3300	1700	849	451	452	418	330
16	401	2800	2400	2390	2400	3300	1620	848	665	773	370	332
17	402	2800	2400	2400	2400	3300	1400	849	1070	1370	352	331
18	452	2800	2400	2400	2400	3300	1300	850	1460	1490	351	331
19	500	2800	2400	2400	2400	3300	1190	851	1800	1190	351	331
20	500	2800	2400	2400	2400	3090	1100	853	1900	893	351	331
21	500	2800	2220	2400	2400	2900	1100	854	1810	592	350	331
22	501	2800	1820	2400	2400	2900	1030	790	1660	452	346	331
23	595	2800	1600	2400	2400	2900	896	690	1510	771	340	331
24	750	2800	1600	2400	2450	2690	851	594	1370	1370	340	330
25	751	2800	1600	2400	2500	2290	850	490	1220	1490	340	330
26	750	2800	1600	2400	2500	2000	850	451	1060	1190	341	332
27	750	2640	1600	2400	2500	1790	850	450	915	893	340	332
28	749	2220	1600	2400	2670	1600	850	450	764	613	340	333
29	822	---	1780	2400	2900	1390	850	452	614	488	336	332
30	900	---	2000	2400	2900	1300	850	451	490	452	329	331
31	899	---	2000	---	2900	---	851	451	---	451	---	331
Total	15,690	57,820	69,190	70,650	76,540	83,800	38,460	23,140	25,090	28,449	11,910	10,240
Mean	506	2065	2232	2355	2469	2793	1241	746	836	918	397	330
Max	900	2800	2800	2400	2900	3300	1700	855	1900	1490	452	333
Min	335	1060	1600	2000	2400	1300	850	450	450	451	329	329
Ac-ft	31,130	114,700	137,200	140,100	151,800	166,200	76,280	45,890	49,760	56,430	23,630	20,320

Note- Data published by USGS

Table C-2: Calendar Year 2020 – USGS Verified Average Daily Flow from Camanche Dam

11323500 Mokelumne River below Camanche Dam, CA

DISCHARGE, CUBIC FEET PER SECOND CALENDAR YEAR 2020
DAILY MEAN VALUES

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	330	331	328	328	364	360	301	320	289	265	256	255
2	330	331	330	322	364	336	301	320	290	265	256	255
3	330	331	330	314	365	311	301	317	286	266	256	255
4	330	330	331	316	364	291	299	311	280	265	256	254
5	330	330	332	315	364	295	299	310	280	265	256	255
6	330	330	331	306	366	305	301	310	280	440	256	256
7	329	330	330	294	376	305	301	310	280	478	256	255
8	330	330	330	290	385	305	301	310	282	328	256	255
9	330	330	330	290	384	305	303	310	276	265	256	255
10	330	330	330	290	386	305	302	304	265	265	255	254
11	330	330	330	290	385	306	301	300	265	265	255	255
12	330	330	329	290	385	304	307	300	265	475	255	254
13	330	330	330	289	386	306	320	300	265	559	255	255
14	330	330	329	291	387	305	320	300	265	408	255	255
15	331	330	330	292	387	316	320	299	265	294	255	255
16	332	331	331	291	387	325	320	300	266	265	256	255
17	331	331	330	290	386	325	316	300	265	265	256	255
18	331	332	329	290	385	324	310	300	260	265	257	255
19	330	332	330	295	385	319	311	300	255	433	257	256
20	330	330	331	305	385	315	311	300	255	468	255	255
21	328	330	330	312	386	315	311	300	255	319	255	255
22	330	330	330	328	384	315	310	301	255	255	255	255
23	331	330	330	355	384	329	311	301	255	256	254	255
24	332	330	333	364	385	335	314	300	255	255	255	255
25	332	331	331	365	396	328	320	300	256	255	255	255
26	331	331	331	365	412	320	320	299	255	255	254	255
27	330	331	331	365	431	320	320	300	255	256	255	255
28	331	329	330	365	441	320	320	297	254	429	255	255
29	330	328	330	365	446	313	320	291	255	468	255	255
30	331	---	331	364	455	301	320	291	259	319	256	253
31	331	---	331		442	---	320	290	---	256	---	255
Total	10,240	9,579	10,240	9,536	12,140	9,459	9,631	9,391	7,988	10,121	7,664	7,903
Mean	330	330	330	318	392	315	311	303	266	327	256	255
Max	332	332	333	365	455	360	320	320	290	559	257	256
Min	328	328	328	289	364	291	299	290	254	225	254	253
Ac-ft	20,310	19,000	20,310	18,910	24,070	18,760	19,100	18,630	15,840	20,080	15,200	15,670

Note- October through December data provisional until approved by USGS

Table C-3: Calendar Year 2019 – USGS Verified Average Daily Flow below Woodbridge

11325500 Mokelumne River at Woodbridge, CA

DISCHARGE, CUBIC FEET PER SECOND CALENDAR YEAR 2019
DAILY MEAN VALUES

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	271	914	2230	1890	2210	2670	1260	656	199	332	340	330
2	276	1,380	2090	1920	2210	2680	1240	650	212	369	354	333
3	275	1,270	2120	1930	2210	2680	1230	646	209	796	393	297
4	274	1,340	1980	2050	2210	2680	1210	642	208	1190	394	317
5	283	1,310	1960	2100	2220	2690	1200	639	201	1040	386	290
6	325	1,250	2290	2240	2220	2690	1200	629	204	812	384	287
7	297	1,230	2590	2260	2210	2660	1190	620	211	577	381	319
8	281	1,320	2670	2270	2210	2650	1190	613	217	360	474	299
9	290	1,350	2670	2270	2200	2660	1170	610	228	381	360	291
10	330	1,400	2650	2270	2200	2690	1430	586	230	803	336	283
11	325	1,370	2560	2290	2200	2910	1500	591	232	1200	387	289
12	328	1,360	2590	2290	2200	3010	1500	584	223	1050	382	285
13	328	1,700	2600	2300	2200	3030	1500	580	220	824	379	284
14	329	1,980	2600	2310	2210	3020	1510	573	233	584	481	284
15	360	2,290	2590	2310	2230	3030	1510	563	238	367	364	285
16	367	2,640	2330	2310	2270	3030	1500	559	305	383	346	283
17	507	2,770	2260	2310	2230	3040	1340	555	584	806	309	280
18	385	2,800	2260	2310	2250	3030	1160	568	891	1210	298	285
19	424	2,810	2260	2320	2290	3030	1120	559	1200	1050	290	284
20	427	2,830	2280	2320	2240	3030	977	562	1430	824	292	278
21	422	2,840	2260	2320	2240	2780	967	552	1460	582	289	278
22	421	2,850	1980	2310	2240	2710	962	534	1360	360	288	286
23	423	2,850	1700	2280	2230	2680	834	456	1250	383	283	281
24	594	2,860	1590	2280	2230	2660	731	375	1130	808	280	278
25	650	2,880	1570	2270	2300	2380	706	300	1020	1200	287	277
26	655	2,950	1570	2260	2320	2030	692	233	890	1040	304	280
27	664	2,950	1570	2250	2320	1830	684	202	774	820	359	278
28	672	2,660	1560	2240	2330	1650	678	202	649	594	303	281
29	678	---	1570	2240	2560	1450	675	196	519	407	306	286
30	793	---	1840	2220	2660	1280	664	198	403	358	297	281
31	821	---	1890	---	2670	---	663	196	---	382	---	282
Total	13,480	58,150	66,680	66,940	70,520	78,360	34,190	15,430	17,130	21,890	10,330	8,971
Mean	435	2077	2151	2231	2275	2612	1103	498	571	706	344	289
Max	821	2950	2670	2320	2670	3040	1510	656	1460	1210	481	333
Min	271	914	1560	1890	2200	1280	663	196	199	332	280	277
Ac-ft	26,730	115,300	132,300	132,800	139,900	155,400	67,820	30,600	33,980	43,420	20,480	17,790

Note- Data published by USGS

Table C-4: Calendar Year 2020 – USGS Verified Average Daily Flow below Woodbridge

11325500 Mokelumne River at Woodbridge, CA

DISCHARGE, CUBIC FEET PER SECOND CALENDAR YEAR 2020
DAILY MEAN VALUES

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	279	311	132	202	169	80.6	35.4	36.1	36	102	175	188
2	281	311	166	189	169	91.3	35.6	37.1	37	109	127	188
3	281	309	177	173	170	56.9	35.4	37.3	36	105	244	192
4	280	309	209	161	171	37.7	35.5	35.7	36	105	104	191
5	280	321	219	215	171	38.5	36.5	35.5	35	105	102	189
6	280	309	209	225	171	39.8	36	34.5	36	126	244	185
7	281	305	214	184	171	40.1	36.4	35.1	36	368	102	193
8	282	302	217	163	172	55.8	36.4	35.4	36	275	106	185
9	294	299	205	163	173	42.8	36.3	35.3	37	109	261	220
10	283	295	196	164	175	42.5	35.8	37.4	36	106	108	260
11	284	292	190	165	174	42.8	35.3	35	36	106	148	201
12	284	290	194	165	174	42.5	36.1	34.5	35	116	176	214
13	284	289	190	164	177	42.4	36.9	34.1	35	422	181	244
14	286	290	209	164	179	42.7	36.7	35.3	36	337	183	199
15	284	291	242	165	180	43.1	36.7	34.5	36	211	181	200
16	310	290	255	165	182	43.6	36.7	35.2	36	120	184	200
17	286	290	225	164	184	42.7	36.4	35.2	35	106	191	207
18	288	288	218	164	187	43.3	36.2	34.6	35	108	201	196
19	285	289	218	165	188	42.7	36.2	34.6	35	147	185	201
20	287	288	219	167	188	42.7	36.5	34.8	35	355	188	197
21	286	284	220	166	189	43.3	36.6	35.3	35	268	184	199
22	293	284	219	161	191	41.4	35.9	35.4	35	118	183	202
23	290	285	224	164	193	36.2	35.9	35.4	35	105	186	203
24	410	279	218	168	193	36.6	36.8	35.7	35	104	187	197
25	463	236	222	169	195	36.2	36.8	35.8	36	104	190	200
26	439	256	209	170	197	35.6	37.5	35.8	35	101	181	208
27	381	161	213	169	199	36.1	37.2	35	36	97	187	197
28	327	108	212	168	199	36.5	36.5	35.3	36	130	189	201
29	317	127	204	169	197	41.7	36.4	34.7	36	352	189	196
30	314	---	202	170	201	35.7	36.3	35	38	269	193	196
31	313	---	210	---	201	---	36	35	---	191	---	203
Total	9,532	7,988	6,457	5,161	5,679	1,334	1,125	1,096	1,071	5,377	5,260	6,252
Mean	307	275	208	172	183	45	36	35	36	173	175	202
Max	463	321	255	225	201	91	38	37	38	422	261	260
Min	279	108	132	161	169	36	35	34	35	97	102	185
Ac-ft	18,910	15,840	12,810	10,240	11,270	2,646	2,232	2,174	2,125	10,665	10,432	12,401

Note- October through December data provisional until approved by USGS

APPENDIX D

MEETING MINUTES OF THE PARTNERSHIP STEERING COMMITTEE

Lower Mokelumne River, Joint Settlement Agreement Annual Partnership Steering Committee Meeting December 7, 2021 9:30 am to 12:00 pm

JSA Steering Committee Representatives: Kevin Thomas, CDFW; Daniel Welsh, USFWS; Mike Tognolini, EBMUD; ~~Monica Gutierrez, NMFS~~

JSA Coordinating Committee Representatives: Colin Purdy, CDFW; J. D. Wikert, USFWS; Michelle Workman, EBMUD; Savannah Bell, NMFS

Others in attendance:
EBMUD: Chris Potter, Shirley Lu, Casey Del Real, Jon Bauer CDFW: Morgan Kilgour, Jason Julienne
USFWS: Stephanie Milsap NMFS: Meiling Colombano

Minutes

Water Supply Update – Shirley Lu, EBMUD

- Rainfall Year 2021 was 24.72", 51% of average. 2nd driest year after 1977.
- Runoff was 218 TAF; 745 is average. 3rd lowest year.
- Total System Storage on 9/30/21 was 437 TAF; 630 is average.
- Camanche Reservoir temperatures and Mokelumne River temperatures for 2021 were discussed.
- The JSA Year Type October 2021 – March 2022 is DRY.
- Current Water Supply through November 28, 2021 is 13.81, 154% of average.
- Caples Lake snow from October has melted off.
- East Bay Watershed precipitation is 8.74" or 179% of average; Mokelumne Basin 4-station average is 13.81" or 154% of average. The average is dropping by the day as we move further from the October atmospheric river with little additional rain. EBMUD is prioritizing storage for water supply.
- Reservoir Storage at Pardee and East Bay is 97% of average; total system storage is 82% of average or 58% of capacity.
- Water supply projections for 2022 were shown.
- Camanche Reservoir Releases for April 2020 – March 2021 were shown. 6,289 AF was used for fall attractive pulse flows (1,948 AF Adaptive Management, 2,000 Fish-1, 2,341 Gainsharing). May have up to approximately 4,700 AF of gainsharing water for next Fall, if full CVP allotment is received in the upcoming months. Through March 2022 the plan is to maintain minimum releases.
- Flow below Woodbridge Dam for April 2020 – March 2021 were shown.

2021 Mokelumne Fisheries Review – Michelle Workman, EBMUD
Brood Year 2020 outmigration monitoring
In fall 2020, escapement was 4,044. In spring 2021, EBMUD fished two rotary screw traps, one at Rkm 87 (Vino Farms/upstream) and one at Rkm 62 (GOLF/downstream) just below Woodbridge Irrigation

District (WID) Dam. Also fished the bypass trap at WID later in the season. The Salmon catch and abundance estimates for each location were shown: 21,471 catch and 196,356 abundance at Vino Farms; 36,102 catch and 82,145 abundance at GOLF and Bypass combined. 2021 was an average fish year for Dry year types.
Brood Year 2021 escapement monitoring
Total Pulse Flow volume was 6.3 TAF. There were three pulse flow events, each two weeks apart, in the off-weeks there were two small pulses conducted by WID below Lodi Lake. DCC gates were closed six times before the December 1 seasonal closure. Salmon Passage counts were shown for the river during October/November 2021. 2010-2020 pulse flows were summarized. Historic adult salmon returns were shown; cumulative chinook salmon passage is 4,538 as of 11/23/21 – numbers tapered off after October 25th atmospheric river. The Brood Year 2021 Salmonid Redd Survey counted 237 Chinook salmon redds through 11/30/21; 84% were in reach 6, and 16% in reach 5. No O. mykiss redds through 11/30/21. Basinwide escapement was discussed, with the Sacramento River providing the majority of the Central Valley escapement; in the San Joaquin River, the Moke was the largest escapement. Mokelumne origin fish contributed 16% of the recreational harvest and 13% of the commercial harvest. Projections of the harvest for next year are low.
2021 Acoustic Telemetry Study – EBMUD switched the technology use to JSATS, deploying 25 receivers and released 960 acoustically tagged hatchery salmon smolts in April/May 2021, plus 51 salmon tagged for a tag life study. Only one tagged fish seems to have survived to Benicia Bridge, but the full data set has yet to be analyzed.

2022 Habitat Restoration Plans – Michelle Workman, EBMUD
2021 Habitat Monitoring and Restoration, and 2022 plans – In 2021 the north floodplain was expanded by 1.2 acres with 6,700 cu. yd. excavated, the floodplain will inundate at 700 CFS. Gravel, cobbles, and fines were distributed to various locations, and excess stockpiled for future projects. Also in August, 2021 maintenance of existing spawning and rearing habitat occurred. In fall of 2020, $450,000 in Proposition 68 funding was awarded to EBMUD for gravel enhancement maintenance, gravel augmentation, and floodplain creation; the 2021 work used about $330,000 of this, the rest of this work will be implemented in August/September of 2022. Funds expire in May of 2023.

2021 MRFH Operations Summary – Michelle Workman, EBMUD, and Jason Julienne, CDFW.
Michelle reported that production from BY2020 for Chinook Salmon and Steelhead were 7,128,263 (this number included eggs from Feather to meet enhancement targets) and 349,915 respectively. Hatchery trapping numbers through 11/30/21 were 3,690 total salmon and 4,843,670 eggs in inventory – for the 2nd year in a row EBMUD has to import eggs to support the 3 million enhancement goal. If there is a surplus, the Moke brood will take priority. Recovery data through 11/18 showed that Age 2 and Age 3 fish dominated at Mokelumne and Nimbus. Steelhead annual hatchery trapping data and production results were shown. Coded wire tag data show that the stray rate of out-of-basin fish into the Mokelumne was low, i.e., lots of Moke fish in the Moke River.

Jason reported on a low survival rate from green eggs to the eyed egg stage, consistent with other state hatcheries. Pathologists are working on understanding this, but it could be tied to thiamine deficiency, which early samples shows was a problem in the ocean fisheries this year. Colin shared a slide from Rachel Johnson on thiamine deficiency, supporting Jason's points.
JD reported that the Merced Hatchery won't meet production goals this year and so can't provide calibration fish for the Stanislaus River screw trapping. He wanted to know if the Moke hatchery could make up the difference with several thousand study fish. Jason and Colin will discuss this with JD as there are some concerns and the Moke Hatchery is not meeting production goals either.

AFRP Diversion Screens Grant Wrap-Up – Casey Del Real, EBMUD
Casey reported that the $320K received from the federal grant, plus $34K of EBMUD in-kind support (environmental planning, project management, etc.) is fully spent. Fifty-seven water diversions were originally identified within the study area, with 84% unscreened. Three locations were selected for the screens, which were designed by Intake Screens, Inc. and installed along the LMR. The design and construction phases went well. This project tiered off of a diversion priority assessment prepared in 2017 that ranked unscreened diversions by their diversion timing and location overlap with juvenile salmonid outmigration. The three screened diversions were in the top 10 priority, and had landowner support.

JSA Partnership Fund and Projects – Jon Bauer, EBMUD
• The Partnership Fund has about $180,000 available for projects as of 9/30/21. Over $1M in interest has been earned on the $2M principal since inception, however over 80% of that was earned in the first decade of the Fund. Interest rates have been much lower since the Great Recession, and were hit harder just as they were starting to recover by the global pandemic. The interest earned is now only about $10K per year, not expected to recover much during the remaining decade of the JSA / FERC License, and due to inflation, the Fund is currently losing value despite interest earnings. Jon Bauer has started to work with EBMUD's new Investment Manager to consider investment options other than the State's Local Agency Investment Fund, such as low-risk Treasury Bonds, similar to what was successfully done in 2012-13.

• The 2020-2021 Lodi Education Legacy project was wrapped up in 2021 and the six watershed videos that were produced can be seen here: http://library.lodi.gov/1007/Watershed-Education-Programs

• Michelle Workman reported that the Cramer Fish Sciences Life Cycle project is nearly wrapped up. EBMUD staff realized that some of the data that EBMUD supplied to Cramer wasn't being used right, and had to pull the draft report to get the data set cleaned up. The final report was resubmitted and should be finalized by the end of 2021.

• Michelle also reported that the Partnership Coordinating Committee is considering a project submittal from the NMFS Science Center in Santa Cruz, and is working with the applicant to revise the request.

The stakeholder's group continues to meet monthly, is still comprised of staff from the City of Lodi watershed staff, local landowners and growers, the Lockeford NOAA Plant Materials Center, the Lodi Winegrape Commission, and others. In 2021 they have continued to support the North San Joaquin Water Conservation District Water Smart grant for the South System Groundwater Recharge Project; update the 20-year-old LMR Stewardship Plan to include a groundwater element; and find a new home for the website (currently hosted by the SJCRCD) with updated information of value to LMR stakeholders.
The annual LMR Stewardship Award, aka Frank R. Beeler award, was presented this year to Jessa Kay Cruz of the Xerces Society. More information is available here: https://www.lodigrowers.com/kay-cruz-of-xerces-honored-with-beeler-award/. It was not possible to present the award at the annual Pardee BBQ, 2nd year in a row, but the Lodi Winegrape Commission is considering having the award presented officially at a spring 2022 conference.

The Stakeholders, along with Partnership Fund Administrator Jon Bauer, are considering ways to present information of value to LMR stakeholders on a new website, possibly to be housed on EBMUD's webpage. This will be an effort in early 2022.

SWRCB Delta Water Quality Control Plan Update – Mike Tognolini
Mike reported that the process has been ongoing for four years now. EBMUD is concerned about proposals that would impact water temperatures that would negatively impact the fishery. EBMUD is still hopeful for the Voluntary Agreements process.

USFWS Updates – Daniel Welsh, JD Wikert
Daniel reported that Donnie Ratcliff was selected as the new Field Supervisor for the Bay Delta Office, replacing Kay Lee Allen. Stephanie Millsap is the Watershed Planning Division Manager, replacing Allison Willie.

CDFW Updates – Kevin Thomas, Colin Purdy
Jay Rowan was promoted to Fishery Branch Chief. Chris Mckibben was promoted to Drought Water Operations so the District Biologist position is under recruitment. A new Region 2 Supervisor position was created out of the Chico Field Office, so Central Valley Fisheries issues have been split and Morgan Kilgore can focus more on our region.

NMFS Updates – Meiling Colombano
Monica Gutierrez is the acting San Joaquin River Chief, and the permanent recruitment is underway.

Other Updates
Mike Tognolini reported that EBMUD is in a Stage 1 Drought Declaration. Due to 35 TAF CVP diversions at Freeport, the 20% Gainshare of 7,000 Acre Feet is available, and ~2,000 AF was used for 2021 fall pulse flows, leaving about 4,500 AF available in 2022. Future diversions, should there be any, will increase Gainshare water, possibly up to the 20,000 AF cap per 'drought'. Future diversions are more likely to be from transfer water rather than CVP allocations. Michelle reported an additional 2,000 AF of Camanche Permit Extension water.

Meeting Agenda

1. Introductions	All	10
2. Water Supply Update	Shirley Lu, EBMUD	10
• 2020/21 Mokelumne Fisheries Review • 2021 Outmigration and Escapement (and final 2020 escapement numbers) • 2020/21 Redd Survey • 2021 Habitat Restoration • 2021 Management Actions • Upcoming Year – and Gainshare Update	Michelle Workman, EBMUD	25
4. 2021 MRFH Operations Summary a) 2021 Spawning b) Meeting Goals for enhancement and mitigation c) Planting Schedule d) Steelhead Program	EBMUD and CDFW	15
5. AFRP Diversion Screens grant – final wrap up	Casey Del Real, EBMUD	5
6. 2022 Habitat Restoration Plans a) Prop 68 funds	Michelle Workman, EBMUD	10
7. JSA Partnership Fund and projects a) Fund balance b) 2021 Awarded Projects - Lodi Education Legacy 2020-21 - Cramer Life Sciences Life-cycles project	Jon Bauer, EBMUD	15
8. Lower Mokelumne River Stewardship Group Update a. 2021 Stewardship Award b. Web presence	Jon Bauer, EBMUD	10
9. SWRCB Delta Water Quality Control Plan Update	Mike Tognolini and Michelle Workman	10
10. USFWS Updates		10
11. CDFW Updates		10

12. NMFS Updates		10
13. Other Related Activities, updates, open forum. EBMUD a) 2022 Water Supply b) Any other topics?	All	10
Meeting Adjournment		Total: 150

APPENDIX E

CORRESPONDENCE RELATED TO FALL 2021 ATTRACTION FLOW

From:	Purdy, Colin@Wildlife
To:	Workman, Michelle; J.D. Wikert; Monica Guitierrez
Cc:	Barnard, Denise; Del Real, Casey; jake.rennert@noaa.gov; erin_strange@fws.gov; Julienne, Jason@Wildlife; Williamson, Nicole@Waterboards; Todd Versteeg (widversteeg@gmail.com); Kilgour, Morgan@Wildlife
Subject:	RE: PCC - Mokelumne Pulse Flow Plan
Date:	Thursday, September 16, 2021 6:23:31 PM
Attachments:	image001.png image002.png

Michelle,
I concur with the pulse flow proposal below and the relaxation of the ramping rates to accommodate it. I will brief Kevin and let him know to expect to see something soon.

Thanks,

Colin Purdy, M.S.
Environmental Program Manager - Fisheries
CA Department of Fish and Wildlife, North Central Region
1701 Nimbus Rd., Rancho Cordova, CA 95670
Office (916) 358-2943 I Cell (916) 704-2154 I Fax (916) 358-2912
Colin.Purdy@wildlife.ca.gov

*** Due to COVID-19 response, I will be teleworking until further notice. Cell phone and email are the best ways to reach me during this time. ***

From: Workman, Michelle <michelle.workman@ebmud.com>
Sent: Thursday, September 16, 2021 2:30 PM
To: Purdy, Colin@Wildlife <Colin.Purdy@wildlife.ca.gov>; J.D. Wikert <jdwikert@gmail.com>; Monica Guitierrez <monica.gutierrez@noaa.gov>
Cc: Barnard, Denise <denise.barnard@ebmud.com>; Del Real, Casey <casey.delreal@ebmud.com>; jake.rennert@noaa.gov; erin_strange@fws.gov; Julienne, Jason@Wildlife <Jason.Julienne@wildlife.ca.gov>; Williamson, Nicole@Waterboards <Nicole.Williamson@waterboards.ca.gov>; Todd Versteeg (widversteeg@gmail.com) <widversteeg@gmail.com>
Subject: FW: PCC - Mokelumne Pulse Flow Plan

Importance: High

PCC members,

Just a quick reminder, I am looking for email concurrence on the pulse plan and the relaxation of the ramping rates, so that I can move forward and prepare written response to the SWRCB on use of the adaptive management water this fall. This will go to your PSC representatives (Dan Welsh, Kevin Thomas) for signature – NMFS folks – Cathy Marcinkevage does not need to sign but will be included in the transmittal.

Please see highlighted correction below regarding WIDD support of the pulses in October, incorrectly stated as November.

Michelle

Michelle Workman
Manager of Fisheries and Wildlife
ph: 209-263-6350 cell: 209-256-4987
michelle.workman@ebmud.com / she/her/hers

From: Workman, Michelle <michelle.workman@ebmud.com>
Sent: Wednesday, September 15, 2021 11:58 AM
To: Colin.purdy@wildlife.ca.gov; Potter, Christopher <christopher.potter@ebmud.com>; Barnard, Denise <denise.barnard@ebmud.com>; Toone, Jeffrey <jeffrey.toone@ebmud.com>; Bauer, Jonathan <jon.bauer@ebmud.com>; Setka, Jose <jose.setka@ebmud.com>; Tognolini, Michael <michael.tognolini@ebmud.com>; Lu, Shirley <shirley.lu@ebmud.com>; monica.gutierrez@noaa.gov; Reza.Ghasemizadeh@Waterboards.ca.gov; john_wikert@fws.gov; Chris Shutes: <blancapaloma@msn.com>; jcvalente@softcom.net; jennifer@spalettalaw.com; jason.Julienne@wildlife.ca.gov; JAIsrael@usbr.gov; erin_strange@fws.gov; savannah.bell@noaa.gov; Williamson, Nicole@Waterboards <nicole.williamson@waterboards.ca.gov>; jake.rennert@noaa.gov; duane_linander@fws.gov; Smith, William@Wildlife <William.Smith@wildlife.ca.gov>; rfield@usbr.gov; McKibbin, Chris@Wildlife <Chris.McKibbin@wildlife.ca.gov>; Todd Versteeg (widversteeg@gmail.com) <widversteeg@gmail.com>; WID (widirrigation@gmail.com) <widirrigation@gmail.com>
Subject: PCC - Mokelumne Pulse Flow Plan
Importance: High

Hello All,

Thanks again for the great discussion at the PCC meeting regarding fall pulse flows on the lower Mokelumne River. WE have worked to incorporate everyone's thoughtful input into a plan to move forward. We are hoping to gain concurrence by the end of this week, so that we may provide the operations schedule to the State Water Resources Control Board to close the loop on the Adaptive Management action we conducted in late winter/early spring, and to coordinate with the United States Bureau of Reclamation on the Delta Cross Channel closures to maximize the value of the pulses. The discussion regarding the different implementation strategies of the 3-pulse flow plan helped highlight some key issues and operational constraints. Based on some initial email feedback and Woodbridge Irrigation District's on-going support for Mokelumne River salmon runs, we believe we have a confirmed plan that can gain support from each PCC member.

As stated during our last meeting, PCC members must confirm agency support for both our proposed ramping rates and the final pulse flow plan. We anticipate and appreciate input from all members, but especially need and would greatly appreciate PCC voting member (DFW and USFWS) responses related to the summarized sections below.

Ramping Rate

In order to implement the proposed 3-pulse flow plan, the ramping rates will be outside of the ramping down rates outlined within the Joint Settlement Agreement. For non-flood control releases, river flow reductions will not exceed 50 cfs per day from October 16 through March 31, and by not more than 100 cfs per day at other times, except in case of emergency. For our 3-pulse flow plan, maximum ramp down rates are 200 cfs per day reductions (in 100 cfs increments).

Recall during our discussions we highlighted that those ramping down rates were developed to protect against fish stranding and bank sloughing. At the flow rates in the river currently, and the proposed flows, our long term operational data tells us we will not see impacts to either during these flows, and additionally others commented that the JSA ramping rates were fairly restrictive based on their knowledge of other systems. In the meeting we heard verbal agreement that these ramping rates were acceptable, we just need confirmation from each agency as we move forward. Thanks again for the discussion.

Pulse Flow Plan

To recap, at our last PCC meeting we identified the importance of increasing the overall magnitude of the pulse flow events based on the available pulse flow volume, targeting the end of October as a critical period for salmon on the Mokelumne River, attracting salmon from each segment of the run, mobilizing the submerged aquatic vegetation within the basin below Camanche before the barrier fence is installed, and possibly using temperature triggers and/or salmon counts to guide pulse flow implementation. In addition, EBMUD fall pulse flow water must be released prior to November 5. Version 4 came the closest to addressing the issues discussed (see attached spreadsheet titled PCC Pulse Flow Worksheet to compare the different versions of the 3-pulse plan). However, it was unclear if Woodbridge Irrigation District (WID) would have the operational ability to conduct independent pulse flows during October to allow for wider spacing of the pulses from Camanche and include WID pulses in between to supplement.

We have discussed the value of this scenario with WID, and are happy to report that WID has confirmed their ability to implement pulse flow events during the month of October. With this commitment, we will be able to implement the 3-pulse flow plan which aims to increase the magnitude of each pulse flow event from Camanche, mobilize aquatic vegetation below Camanche Dam while not negatively impacting the barrier fence, conduct pulse flows throughout October and

into early November attracting salmon back to the Mokelumne River throughout the migration window thereby increasing the overall escapement while reducing straying to other systems. This is a tall order, but through open dialogue, collaborative spirit, and with fish in the Delta (the Stanislaus weir has documented 2 salmon to-date), version 4 (see attachment) looks to be our best option for the 2021 fall pulse flow plan. While there was interest in starting the pulses later, Oct. 11, based on the historical late timing of the run during dry years, EBMUD feels like this plan is supportable due to the fact that there are already fish showing up on the Stanislaus, and with the WID pulses we will be able to attract fish every week starting on Oct. 4th.

WE also would like to address the support for a flexible or adaptive start date approach. Given the late date currently, and the need for coordination with the SWRCB and USBR there would be little time to provide much adaptive flexibility this year. We do agree when conditions allow, providing some adaptive flexibility makes sense, but that discussion should occur in our July MRTAC meeting so that we are fully prepared by the PCC September meeting to implement an adaptable plan.

If you concur, version 4 will be initiated on Monday October 4th with a pulse peak from Camanche Reservoir of 725 cfs. Subsequent EBMUD pulse flow events, with pulse peaks of 825 cfs, would be initiated on October 18th and November 1st. WID would intersperse their pulse flow events with peaks ranging approx. between 700 – 800 cfs on ~~November~~ October 11th, 15th, 25th, and 29th. In addition, WID may conduct additional pulses following November 5th, if deemed appropriate.

Please respond by email by Friday, confirming your agency's support of the ramping rates and of the proposed 2021 pulse flow plan. If concerns remain, also please let us know. If we attain email concurrence, EBMUD will initiate the written requirement to the SWRCB for an operations plan, and will be requesting electronic signatures from the PCC voting members to finalize the plan.

Again, I would like to thank everyone at the table for the substantive input into the discussion. If I inadvertently missed a key member of your team, please forward as necessary.

Michelle

Michelle Workman
Manager of Fisheries and Wildlife
ph: 209-263-6350 cell: 209-256-4987
michelle.workman@ebmud.com / she/her/hers

From: Welsh, Daniel
To: Workman, Michelle
Cc: Millsap, Stephanie D; Wikert, John; Ratcliff, Donald
Subject: Fw: [EXTERNAL] PCC - Mokelumne Pulse Flow Plan
Date: Friday, September 17, 2021 8:21:47 AM
Attachments: image001.png
2021 DRAFT - Camanche Pulse Flows Scenario v.4.xlsx
PCC Pulse Flow Worksheet.xlsx

Michelle,

The USFWS supports the Mokelumne Pulse Flow Plan described in your email and attachments. We appreciate the thought and discussion that the Partnership Coordinating Committee put into development of this Plan in a challenging water year. Please let me know if you need anything more than this email to document USFWS support for the Plan.

Thanks,

Dan Welsh, Deputy Field Supervisor
U.S. Fish and Wildlife Service
San Francisco Bay-Delta Fish and Wildlife Office
650 Capitol Mall, Suite 8-300
Sacramento, CA 95814
(916) 930-5639 (office)
(916) 468-8470 (cell)
Daniel_Welsh@fws.gov

From: Wikert, John <john_wikert@fws.gov>
Sent: Wednesday, September 15, 2021 12:23 PM
To: Welsh, Daniel <daniel_welsh@fws.gov>
Subject: Fw: [EXTERNAL] PCC - Mokelumne Pulse Flow Plan

Hey Dan,

We covered this plan at the PCC meeting and it appears to be the best option available.

Let me know if you have any questions and I'll leave it to you to provide FWS feedback to EBMUD.

J.D. Wikert
U.S. Fish & Wildlife Service
Anadromous Fish Restoration Program

850 S. Guild Avenue, Suite 105,
Lodi , CA 95240
(209) 403-1046 - Cellular
email: john_wikert@fws.gov
Stanislaus River Salmon Festival: https://www.facebook.com/SRSFest

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From: Workman, Michelle <michelle.workman@ebmud.com>
Sent: Wednesday, September 15, 2021 11:57 AM
To: Purdy, Colin@Wildlife <colin.purdy@wildlife.ca.gov>; Potter, Christopher <christopher.potter@ebmud.com>; Barnard, Denise <denise.barnard@ebmud.com>; Toone, Jeffrey <jeffrey.toone@ebmud.com>; Bauer, Jonathan <jon.bauer@ebmud.com>; Setka, Jose <jose.setka@ebmud.com>; Tognolini, Michael <michael.tognolini@ebmud.com>; Lu, Shirley <shirley.lu@ebmud.com>; monica.gutierrez@noaa.gov <monica.gutierrez@noaa.gov>; Reza.Ghasemizadeh@Waterboards.ca.gov <Reza.Ghasemizadeh@Waterboards.ca.gov>; Wikert, John <john_wikert@fws.gov>; Chris Shutes: <blancapaloma@msn.com>; jcvalente@softcom.net <jcvalente@softcom.net>; jennifer@spalettalaw.com <jennifer@spalettalaw.com>; jason.Julienne@wildlife.ca.gov <jason.Julienne@wildlife.ca.gov>; Israel, Joshua A <JAIsrael@usbr.gov>; Strange, Erin L <erin_strange@fws.gov>; savannah.bell@noaa.gov <savannah.bell@noaa.gov>; Williamson, Nicole@Waterboards <nicole.williamson@waterboards.ca.gov>; jake.rennert@noaa.gov <jake.rennert@noaa.gov>; duane_linander@fws.gov <duane_linander@fws.gov>; Smith, William@Wildlife <William.Smith@wildlife.ca.gov>; FIELD, RANDI C <RField@usbr.gov>; McKibbin, Chris@Wildlife <Chris.McKibbin@wildlife.ca.gov>; Todd Versteeg (widversteeg@gmail.com) <widversteeg@gmail.com>; WID (widirrigation@gmail.com) <widirrigation@gmail.com>
Subject: [EXTERNAL] PCC - Mokelumne Pulse Flow Plan

Hello All,
Thanks again for the great discussion at the PCC meeting regarding fall pulse flows on the lower Mokelumne River. WE have worked to incorporate everyone's thoughtful input into a plan to move forward. We are hoping to gain concurrence by the end of this week, so that we may provide the operations schedule to the State Water Resources Control Board to close the loop on the Adaptive Management action we conducted in late winter/early spring, and to coordinate with the United States Bureau of Reclamation on the Delta Cross Channel closures to maximize the value of the pulses. The discussion regarding the different implementation strategies of the 3-pulse flow plan helped highlight some key issues and operational constraints. Based on some initial email feedback and Woodbridge Irrigation District's on-going support for Mokelumne River salmon runs, we believe we have a confirmed plan that can gain support from each PCC member.
As stated during our last meeting, PCC members must confirm agency support for both our proposed ramping rates and the final pulse flow plan. We anticipate and appreciate input from all members, but especially need and would greatly appreciate PCC voting member (DFW and USFWS) responses related to the summarized sections below.

Ramping Rate

In order to implement the proposed 3-pulse flow plan, the ramping rates will be outside of the ramping down rates outlined within the Joint Settlement Agreement. For non-flood control releases, river flow reductions will not exceed 50 cfs per day from October 16 through March 31, and by not more than 100 cfs per day at other times, except in case of emergency. For our 3-pulse flow plan, maximum ramp down rates are 200 cfs per day reductions (in 100 cfs increments).

Recall during our discussions we highlighted that those ramping down rates were developed to protect against fish stranding and bank sloughing. At the flow rates in the river currently, and the proposed flows, our long term operational data tells us we will not see impacts to either during these flows, and additionally others commented that the JSA ramping rates were fairly restrictive based on their knowledge of other systems. In the meeting we heard verbal agreement that these ramping rates were acceptable, we just need confirmation from each agency as we move forward. Thanks again for the discussion.

Pulse Flow Plan

To recap, at our last PCC meeting we identified the importance of increasing the overall magnitude of the pulse flow events based on the available pulse flow volume, targeting the end of October as a critical period for salmon on the Mokelumne River, attracting salmon from each segment of the run, mobilizing the submerged aquatic vegetation within the basin below Camanche before the barrier fence is installed, and possibly using temperature triggers and/or salmon counts to guide pulse flow implementation. In addition, EBMUD fall pulse flow water must be released prior to November 5. Version 4 came the closest to addressing the issues discussed (see attached spreadsheet titled PCC Pulse Flow Worksheet to compare the different versions of the 3-pulse plan). However, it was unclear if Woodbridge Irrigation District (WID) would have the operational ability to conduct independent pulse flows during October to allow for wider spacing of the pulses from Camanche and include WID pulses in between to supplement.

We have discussed the value of this scenario with WID, and are happy to report that WID has confirmed their ability to implement pulse flow events during the month of October. With this commitment, we will be able to implement the 3-pulse flow plan which aims to increase the magnitude of each pulse flow event from Camanche, mobilize aquatic vegetation below Camanche Dam while not negatively impacting the barrier fence, conduct pulse flows throughout October and into early November attracting salmon back to the Mokelumne River throughout the migration window thereby increasing the overall escapement while reducing straying to other systems. This is a tall order, but through open dialogue, collaborative spirit, and with fish in the Delta (the Stanislaus weir has documented 2 salmon to-date), version 4 (see attachment) looks to be our best option for the 2021 fall pulse flow plan. While there was interest in starting the pulses later, Oct. 11, based on the historical late timing of the run during dry years, EBMUD feels like this plan is supportable due to the fact that there are already fish showing up on the Stanislaus, and with the WID pulses we will be able to attract fish every week starting on Oct. 4th.

WE also would like to address the support for a flexible or adaptive start date approach. Given the late date currently, and the need for coordination with the SWRCB and USBR there would be little time to provide much adaptive flexibility this year. We do agree when conditions allow, providing some adaptive flexibility makes sense, but that discussion should occur in our July MRTAC meeting so that we are fully prepared by the PCC September meeting to implement an adaptable plan.

If you concur, version 4 will be initiated on Monday October 4th with a pulse peak from Camanche Reservoir of 725 cfs. Subsequent EBMUD pulse flow events, with pulse peaks of 825 cfs, would be

initiated on October 18th and November 1st. WID would intersperse their pulse flow events with peaks ranging approx. between 700 – 800 cfs on November 11th, 15th, 25th, and 29th. In addition, WID may conduct additional pulses following November 5th, if deemed appropriate.
Please respond by email by Friday, confirming your agency's support of the ramping rates and of the proposed 2021 pulse flow plan. If concerns remain, also please let us know. If we attain email concurrence, EBMUD will initiate the written requirement to the SWRCB for an operations plan, and will be requesting electronic signatures from the PCC voting members to finalize the plan.
Again, I would like to thank everyone at the table for the substantive input into the discussion. If I inadvertently missed a key member of your team, please forward as necessary.

Michelle

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State Water Resources Control Board

February 3, 2021

Michael T. Tognolini
Director of Water and Natural Resources
East Bay Municipal Utility District
michael.tognolini@ebmud.com

Dear Mr. Tognolini:

MODIFICATION OF MOKELUMNE RIVER FLOWS PURSUANT TO WATER RIGHT DECISION 1641

This letter responds to a letter dated January 26, 2021 (received January 28, 2021) from the East Bay Municipal Utility District (EBMUD) on behalf of the Lower Mokelumne River Partnership Steering Committee[1] requesting approval to adaptively manage flows on the Mokelumne River this year pursuant to condition 5 on page 176 of State Water Resources Control Board (State Water Board) Decision 1641 (D-1641). Condition 5 of D-1641 allows EBMUD to reschedule or modify flows required by D-1641 subject to approval of an operations plan acceptable to the Executive Director of the State Water Board and concurrence of CDFW and USFWS. EBMUD is proposing to modify releases to the lower Mokelumne River between February 1, 2021 and March 31, 2021 to provide an October 2021 attraction pulse flow for Mokelumne River salmon. Specifically, EBMUD proposes to reduce Camanche Reservoir releases from 255 cubic-feet per second (cfs) to 220 cfs in February and March 2021 to conserve approximately 2-4 thousand acre-feet of water for a pulse flow in October 2021. With its request, EBMUD included a letter of concurrence from CDFW and USFWS and a technical assistance letter from the National Marine Fisheries Service (NMFS).

The proposed adaptive management flow modifications are approved subject to submittal by EBMUD of a detailed operations plan no later than September 1, 2021, that includes a flow schedule identifying how the reduced releases during February and March 2021 will be used during October 2021, along with written concurrence from CDFW and USFWS on the proposed operations.

[1] The committee includes EBMUD, the California Department of Fish and Wildlife (CDFW), and U.S. Fish and Wildlife Service (USFWS).

In the future, please provide more advanced notice of proposed adaptive management requests. D-1641 requires that adaptive management requests be submitted at least thirty days in advance. In cases where this may not be feasible, the State Water Board should be notified as soon as practicable of potential requests. EBMUD's letter identifies that adaptive management of flows were discussed as early as December 4, 2020, but the State Water Board did not receive any information regarding this request until less than 2 business days before the change was requested to be effective.

If you have any questions and for any future coordination needs, please contact Nicole Williamson at Nicole.Williamson@waterboards.ca.gov.

Sincerely,

ORIGINAL SIGNED BY

Eileen Sobeck, Executive Director
State Water Resources Control Board

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