RECLAMATION

Managing Water in the West

DRAFT Technical Memorandum:

Portfolio Evaluation

American River Basin Study

February 2020

Contents

Figures

Tables

Attachments

Abbreviations and Acronyms

AF	acre-feet
ARBS	American River Basin Study
DWR	California Department of Water Resources
SSJBS	Sacramento-San Joaquin Basin Study
UWMP	Urban Water Management Plans

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Chapter 1
Introduction

As stewards of the water systems that support the quality of life and well-being of nearly 2 million residents, the water agencies in the American River Basin constantly strive to maintain a reliable and safe water supply. The American River watershed, the region's primary surface water source, provides an average annual runoff of 2.7 million acre-feet, which is well in excess of the water supply needs of the region. The Sacramento River, the state's largest river in both volume and length, also runs through the heart of the region. In addition, much of the urban core overlies groundwater basins that provide 30 to 40 percent of the region's annual water supply. Despite the seemingly ideal setting for water supply, there are vulnerabilities to the reliability of the region's water resources.

For purposes of this study, ***vulnerabilities*** *are physical, operational, or institutional threats to a water system that could result in temporary, long-term, or even permanent loss of supply necessary to meet water demands.*

Adaptation Measures/ Management Actions *are specific strategies, actions, or tactics that contribute to addressing vulnerabilities or alleviating climate change impacts responses.*

Adaptation Portfolios *are theme-based and represent project/action concepts that are locally supported and provide both regional and federal benefits.*

Background

Water agencies in the American River Basin have been and continue to work on coordinated planning to improve regional water supply reliability. The latest products of the regional planning efforts include the 2016 Sacramento and San Joaquin Rivers Basin Study (SSJRBS), 2017 North American Basin Regional Drought Contingency Plan, 2018 update to the American River Basin Integrated Regional Water Management Plan (IRWMP), and 2019 Regional Water Reliability Plan. The Water Forum is also working to balance future water needs with environmental protections and the individual voluntary Purveyor Specific Agreements that outline dry year actions. In addition, agencies have developed individual Water Shortage Contingency Plans (WSCP) that define water use reduction stages during emergency condition. The American River Basin Study (ARBS) builds on these existing regional and agency-specific efforts.

Recent drought conditions (January 2012 through April 2017) in the State have revealed greater potential risks to agencies' water supplies in the greater Sacramento region than previously assumed. For example, north of Delta CVP water allocations were reduced by 75 percent, while past planning efforts by local water agencies assumed no more than a 25 percent reduction in supplies in critically dry years. Agency response to these significant supply reductions have revealed additional opportunities for collaboration and cooperation to enhance regional reliability.

The ARBS intends to integrate the considerations of surface water and groundwater uses as well as environmental water needs in a way that the region, including Reclamation, can better manage all of its water resources.

Document Purpose

This Technical Memorandum (TM) presents the evaluation and comparison of the formulated adaption portfolios.

Chapter 2
Adaptation Portfolio Overview

Overall, a wide variety of adaptation portfolios were developed in an effort to address all identified vulnerability pathways in the region. Some features are common to all or most of the portfolios (e.g., assumptions that certain foundational institutions will be in place) as they are needed to ensure that the other major features unique to a given portfolio can function. Table 2-1 provides an overview of the major features included in each adaptation portfolio. The table also summarizes the vulnerability pathways addressed, the benefits to Reclamation, and the area of Federal interest addressed by each portfolio.

Formulated portfolio themes are:

A. Future baseline conditions, including foundational actions for demand management, upper watershed management, and CVP water contracts, is called the **"Foundational Institutions"** Portfolio. This portfolio is used as a baseline to evaluate other portfolios. It is also included as the basic building block for other portfolios.

B. Future baseline conditions, with no assurances for long-term CVP water contracts but include the other foundational actions for demand management and upper watershed management, is called the **"No Assurances for Long-term CVP Water Contracts"** Portfolio. This portfolio is developed to highlight the importance of CVP water contracts to this region.

C. Upper watershed storage to replace some of the reduced snowpack and earlier snowmelt is called the **"Alder Creek Storage and Conservation Project"** Portfolio. Alder Creek Reservoir is selected to represent the concept of this theme because of the existing Federal authorization for Alder Creek Storage and Conservation Feasibility Study. This portfolio evaluates the contribution of upper watershed storage to climate change adaptations.

D. A new diversion on the Sacramento River to relocate some of the diversions from Folsom Reservoir and American River to the Sacramento River is called the **"Sacramento River Diversion Project"** Portfolio. This portfolio evaluates the contribution of added system flexibility toward climate change adaption. This portfolio also builds on existing Federal authority. A variation of this concept is currently being developed by multiple local agencies as **the RiverArc Project**.

E. Expansion of surface water and groundwater conjunctive, along with market-oriented mechanism to incentivize the practice and fund infrastructure, is called the **"Federally Recognized Groundwater Bank (North and South Basin)"**. This portfolio builds on existing Reclamation authority to approve Federally recognized groundwater banks under the Central Valley Project Improvement Act. A variation of this concept is currently being developed by local agencies. This portfolio evaluates the contribution of expanded conjunctive use operations to climate change adaptions.

F. Implementation of forecast-informed flood operations, along with flood managed aquifer recharge, is called the **"Folsom Dam Raise with Groundwater Banking (South Basin)"** Portfolio. This portfolio builds on existing Reclamation authority to raise Folsom Dam for flood storage. A variation of this concept is currently being developed by Sacramento Area

Flood Control Agencies in cooperation with other local agencies and US Army Corps of Engineers. This portfolio evaluates the contribution of modified flood operations and flood managed aquifer recharge to climate change adaptions.

G. Changes to operations of Folsom Reservoir to conform to the Modified Flow Management Standard (minimum flows, end of May and December targets, and spring pulse flow), along with temperature device on Folsom Dam, is called the **"Modified Flow Management Standard"** Portfolio. This portfolio builds on exiting Federal authority for Folsom Dam temperature device and ongoing negotiations for Long-term Coordinated Operations for CVP and SWP. This portfolio evaluates the contribution of the proposed Modified Flow Management Standard to climate change adaption.

Additional details on facilities, operations, potential benefits, and formulation of each portfolio are provided in the *Draft Adaptation Portfolio Formulation and Refinement TM*.

Table 2-1. Adaptation Portfolio Overview

Adaptation Portfolio	Major Features[1]	Pathways of Vulnerability Addressed[2]	Benefits to Reclamation[3]	Area of Federal Interest Addressed[4]
Foundational Institutions (Future Baseline Conditions)	• Demand management (1a, 1b) • Working with U.S. Forest Service for proper forest management and implementing cohesive strategy (4a) • Execution of pending CVP long-term water supply contracts (City of Roseville, SMUD, SCWA and PCWA) (5a) • Execution of the Fazio water supply contract (EDCWA) (5a) • Alignment of individual contract CVP service area with corresponding water right Place of Use as much as possible (5a) • Accelerated CVP water transfer program permitted under the Central Valley Project Improvement Act (5a) • EDCWA-PCWA exchange agreement for serving Georgetown Divide Public Utility District (embedded American River Pump Station capacity authority) (3a)	1 2 3 4 5 6 7 8 9	1 2 3	1 2 3 4 5 6 7 8
No Assurances for Long-term CVP Water Contracts	• Demand management (1a, 1b) • Working with U.S. Forest Service for proper forest management and implementing cohesive strategy (4a)	1 2 3 4 5 6 7 8 9	1 2 3	1 2 3 4 5 6 7 8
Alder Creek Storage and Conservation Project	• Foundational Institutions (1a, 1b, 3a, 4a, 5a) • Upstream, offstream reservoir with additional water rights to replace losing snowpack and power generation capacity (3c) • Provide water supply reliability and drought protection for upper watershed (foothills) (2d) • Capacity exchange and other operational agreements to ease Folsom Reservoir operation and storage need (3c) • Limited exchange and operational agreements to augment water supply reliability needs for certain water purveyors (3a) • Flexibility of occasional water market participation (with primary focus in support Reclamation's program) (5a)	1 2 3 4 5 6 7 8 9	1 2 3	1 2 3 4 5 6 7 8

Table 2-1. Adaptation Portfolio Overview (contd.)

Adaptation Portfolio	Major Features[1]	Pathways of Vulnerability Addressed[2]	Benefits to Reclamation[3]	Area of Federal Interest Addressed[4]
Sacramento River Diversion Project	• Foundational Institutions (1a, 1b, 3a, 4a, 5a) • An alternative point of delivery for existing water rights and contract entitlement through exchange to leverage the different hydrologic conditions in different river basin (3a) • Implementation of Water Forum Agreement voluntary diversion reductions in certain hydrologic conditions (3a)	1 2 3 4 5 6 7 8 9	1 2 3	1 2 3 4 5 6 7 8
Federally Recognized Groundwater Bank (North and South Basin)	• Foundational Institutions (1a, 1b, 3a, 4a, 5a) • Enhanced regional conjunctive use using existing infrastructure, levering in-lieu operation in the urban core of the north and south basins (3b) • Water market-oriented operation (focusing on CVP contractors and Reclamation's needs) (5a)	1 2 3 4 5 6 7 8 9	1 2 3	1 2 3 4 5 6 7 8
Folsom Dam Raise with Groundwater Banking (South Basin)	• Foundational Institutions (1a, 1b, 3a, 4a, 5a) • Forecast-based flood operation (3c) • Folsom Dam Raise with limited allowable storage without increasing flood risk and infrastructure risk (3c) • Upstream reservoir outlet modifications for additional flood storage made available by prerelease per forecast (3c) • Pre-release and limited storage releases through Folsom South Canal for groundwater banking in the south basin (3b) • Groundwater banking through rural area spreading grounds for water market opportunity likely for Cosumnes River benefits (3b, 5a)	1 2 3 4 5 6 7 8 9	1 2 3	1 2 3 4 5 6 7 8
Modified Flow Management Standard	• Foundational Institutions (1a, 1b, 3a, 4a, 5a) • Water Forum modified flow management standards as included in the Report on Compliance with planning minimum storage targets (3c, 4b) • Potential incorporation of "intentionally created surplus" like concept for maintaining the targeted storage (3c)	1 2 3 4 5 6 7 8 9	1 2 3	1 2 3 4 5 6 7 8

Key:
CVP = Central Valley Project
EDCWA = El Dorado County Water Agency
PCWA = Placer County Water Agency
Reclamation = U.S. Department of the Interior, Bureau of Reclamation
SCWA = Sacramento County Water Agency
SMUD = Sacramento Municipal Utility District

Table 2-1. Adaptation Portfolio Overview (contd.)

Notes:
1. The alpha-numerical ID corresponds to the numbering of adaptation measures from Tables 4-2 and 4-4.

2. Pathways of Vulnerability Addressed

Definitions:

❶ = Folsom Reservoir is too small for the potential runoffs from the watershed.
❷ = Basin-wide water supply heavily depends on one river, especially in the north basin
❸ = Lack of opportunity in setting back levees in Sacramento urban areas for increasing volume of floods in the future
❹ = Individual water rights and contract entitlements become less reliable or less protected
❺ = Reclamation's operation of Folsom Reservoir for the CVP purposes is not fully coordinated with regional protection and needs
❻ = Lack of meaningful groundwater in the foothills as a supplemental water supply source
❼ = Inappropriate forest management and fire abatement practices that have adverse effects on snowpack retention and fuel management
❽ = Regional conjunctive use potential is not fully developed due to high investment costs and lack of accepted governance framework
❾ = Inefficient water use for urban and agricultural purposes

Coloring Legend:

● pathway is addressed by this portfolio
● pathway addressed is unique to the portfolio
● pathway is not addressed by this portfolio
❶ ❺ pathways addressed by all portfolios because of their large influence
❹❼❾ pathways addressed by to the major features in the Foundational Institutions portfolio

3. Benefits to Reclamation

Definitions:

❶ = affirming equality among CVP contractors in terms of basis of long-term operation
❷ = reducing direct demands on Folsom Reservoir operation (needs are satisfied via alternative means) on a long-term basis or an as-needed basis
❸ = increasing Folsom Reservoir's regulating capacity for flow and storage (capacity increase surrogates)
(Note ❶ is assumed in all CVP operations but not implemented. Both ❷ and ❸ make it possible for Reclamation to operate Folsom Reservoir easier to meet all authorized purposes including meeting Delta WQCP and BiOps – provided that it would not compromise other part of the CVP operation beyond applicable law and regulations allow)

Coloring Legend:

● portfolio provides this benefit
❶ benefits multiple portfolios due to the major features in the Foundational Institutions portfolio
● portfolio does not provide this benefit

4. Area of Federal Interest Addressed

Definitions:

❶ = ability to deliver water, including the impacts of droughts
❷ = hydroelectric power generation
❸ = recreation
❹ = fish and wildlife habitat
❺ = listed species protection
❻ = water quality issues (including salinity level)
❼ = flow and water dependent ecological resiliency
❽ = flood control and/or management, including impacts of extreme events

Coloring Legend:

● primary focus of the portfolio
● Federal interest addressed is unique to the portfolio
● secondary focus of the portfolio
❶ Federal interest is addressed by all portfolios
● portfolio does not address this area of federal interest

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Chapter 3
Summary Evaluation and Comparison of Adaptation Portfolios

This section provides a summary comparison of the relative performance of the adaptation portfolios.

Evaluation Metrics

The adaptation portfolios were then quantitatively evaluated using CalSim 3.0. The purpose of evaluating the adaptation portfolios is to inform how they provide benefits to both (1) region by mitigating the vulnerability pathways and (2) Reclamation by improving flexibility in Folsom Reservoir operations and addressing areas of Federal interest. The metrics used to evaluate the adaptation portfolios are organized based on their contribution to the following categories:

- Water supply reliability
- Water Quality
- Fish and Wildlife Habitat
- Flood management
- Recreation

Table 3-1 describes the evaluation metrics associated with each of the above categories, with respect to system-wide and American River Basin.

Summary of Evaluation Results

Table 3-2 compares the performance of the adaptation portfolios relative to the Future Baseline under 2070 Central Tendency climate scenario. Tables 3-3 and 3-4 provide similar comparisons under the 2070 Hot-Dry and Warm-Wet climate scenarios, respectively. For each of the evaluation metrics, these three tables present the v; for the Future Baseline and the relative performance of each portfolio, expressed as percentage change relative to the Future Baseline value. The tables are color coded to highlight changes that are greater than 5 percent (±), between 2 and 5 percent, and less than 2 percent. Note that change percentages are do not necessarily indicate benefits or impacts; rather they indicate the extent to which a portfolio affects a given evaluation metrics.

Table 3-1. Evaluation Metrics for Portfolio Performance Evaluation and Comparison

Evaluation Metrics		Units	Description / Purpose
Water Supply Reliability			
System-Wide	CVP end-of-September Storage (Folsom/Shasta/Trinity)	TAF	Indicator of storage available for water reliability for the CVP
	Delta CVP Exports - Jones	TAF	Indicator of CVP ability to meet urban, agricultural, and environmental demands
	Delta SWP Exports - Banks	TAF	Indicator of SWP ability to meet urban and agricultural demands
American River Basin	Upper Basin - Total End-of-September Storage	TAF	Indicator of water reliability for the upper basin
	Upper Basin - Total Demand	TAF	Long-term average urban and agricultural demands at 2070 level of development
	Upper Basin - Demand Met by Surface Water	TAF	Long-term average demand met with available surface water
	Upper Basin - Unmet Demand	TAF	Indicator of long-term average supply-demand imbalance in the upper basin (foothills area)
	Lower Basin - Folsom End-of-September Storage	TAF	Indicator of water reliability for the lower basin
	Lower Basin - Total Demand	TAF	Total lower basin urban and agricultural demands at 2070 level of development and climate
	Lower Basin - Demand Met by Surface Water	TAF	Long-term average demand met with available surface water and groundwater. Conjunctive use operations are indicated by the shift between the two sources to meet demands.
	Lower Basin - Demand Met by Groundwater	TAF	
	Net Change in Annual Groundwater Basin Storage	N/A	Indicator of the groundwater basin sustainability
Water Quality			
System-Wide	Total Delta Outflow	TAF	Indicator of Bay-Delta water quality and ecosystem health
	% Months where Salinity at Rock Slough > 150 mg/l Cl	%	Indicator of M&I water quality specific to Contra Costa Canal
	% Months where Salinity at Rock Slough > 250 mg/l Cl	%	Indicator of M&I water quality for all Delta export locations
Fish and Wildlife Habitat			
System-Wide	System end-of-April Storage (Folsom/Shasta/Trinity/Oroville)	TAF	Indicator of available cold-water storage in the system
	Feb-Jun Delta Outflow (Spring X2)	TAF	Indicator of Delta's spring salinity per D1641 requirements for spring X2
	Sep-Nov Delta Outflow (Fall X2)	TAF	Indicator of Delta's fall salinity per 2009 Biological Opinion requirements for Fall X2
American River Basin	Mar-May Folsom Storage	TAF	Indicator of flow stressor period for steelhead and fall-run Chinook salmon.
	Jun-Nov Folsom Storage	TAF	Indicator of temperature stressor period for steelhead and fall-run Chinook salmon.
	Mar-May Lower American River Flow	TAF	Indicator of flow stressor period for steelhead and fall-run Chinook salmon.
	Jun-Nov Lower American River Flow	TAF	Indicator of temperature stressor period for steelhead and fall-run Chinook salmon.
	% Months when Lower American River flows < 500 cfs	%	Indicator of flow level that create adverse conditions for spawning and rearing
	% Months when Lower American River flows < 800 cfs	%	Indicator of flow level that provides 80% of available spawning habitat
	American River Flow at Sacramento River Confluence	TAF	Outflow of the American River Watershed
Flood Management - American River Basin			
	Annual Folsom Reservoir Spills	TAF	Indicator of flood releases
Recreation - American River Basin			
System	May-Sep Surface Area (Folsom/Shasta/Trinity/Oroville)	TA	Indicator of recreation suitability for major Sacramento Valley Reservoirs
ARB	May-Sep Folsom Reservoir Surface Area	TA	Indicator of recreation suitability in Folsom Reservoir

Key:
cfs = cubic feet per second CVP = Central Valley Project mg/l Cl = chloride concentration in milligram per liter N/A = Not Applicable SWP = State Water Project
TA = 1,000 acres. TAF = 1,000 acre-feet X2 = Distance of the 2 parts per thousand salinity isohalines from the Golden Gate Bridge in kilometers.

Notes:
[1] D1641 = Water Resources Control Board Water Right Decision 1641 implementing the water quality objectives of the 1995 San Francisco Bay/Sacramento-San Joaquin-Delta Water Quality Control Plan.
[2] The Lower American River Modified Flow Management Standard, a Drought Buffer for the Environment and Local Water Supplies, the Sacramento Water Forum, October 2015

Table 3-2. Performance of Adaptation Portfolios Relative to the Future Baseline Under 2070 Central Tendency Climate Scenario

Evaluation Metrics		2070 Future Baseline	Change Relative to the 2070 Future Baseline					
			No Assurance for Long-Term CVP Contracts	Modified Flow Management Standard	Federally Recognized GW Bank	Sacramento River Diversion	Alder Creek Reservoir	Folsom Dam Raise with Groundwater Banking
Water Supply Reliability								
System	System end-of-Sep Storage (Folsom/Shasta/Trinity/Oroville)	3,971 TAF	+34.5 TAF (+0.9%)	-107 TAF (-2.7%)	+6.3 TAF (+0.2%)	+3.9 TAF (+0.1%)	+13 TAF (+0.3%)	0 TAF (0%)
	Delta CVP Exports - Jones	1,954 TAF	-1 TAF (-0.1%)	+3.5 TAF (+0.2%)	-2.1 TAF (-0.1%)	-14.2 TAF (-0.7%)	+3.1 TAF (+0.2%)	0 TAF (0%)
	Delta SWP Exports - Banks	2,100 TAF	+15.2 TAF (+0.7%)	+1.6 TAF (+0.1%)	+2.9 TAF (+0.1%)	-2.7 TAF (-0.1%)	-3.2 TAF (-0.2%)	0 TAF (0%)
American River Basin (ARB)	Upper Basin - Total End-of-September Storage	332 TAF	-1.2 TAF (-0.4%)	+5.8 TAF (+1.8%)	-1 TAF (-0.3%)	-0.5 TAF (-0.2%)	+58.5 TAF (+17.6%)	0 TAF (0%)
	Upper Basin - Total Demand	211 TAF	--	--	--	--	--	--
	Upper Basin - Demand Met by Surface Water	134 TAF	-0.1 TAF (-0.1%)	-0.1 TAF (-0.1%)	-0.1 TAF (-0.1%)	+0.1 TAF (+0.1%)	+68.4 TAF (+51%)	0 TAF (0%)
	Upper Basin - Unmet Demand	77 TAF	+0.1 TAF (+0.1%)	+0.1 TAF (+0.1%)	+0.1 TAF (+0.1%)	-0.1 TAF (-0.1%)	-68.4 TAF (-89%)	0 TAF (0%)
	Lower Basin - Folsom End-of-September Storage	226 TAF	+7 TAF (+3.1%)	+161 TAF (+71%)	-8.1 TAF (-3.6%)	+24.3 TAF (+11%)	+4.9 TAF (+2.2%)	0 TAF (0%)
	Lower Basin - Total Demand	1278 TAF	--	--	--	--	--	--
	Lower Basin - Demand Met by Surface Water	802 TAF	-70.9 TAF (-8.8%)	-5.9 TAF (-0.7%)	-7.5 TAF (-0.9%)	+23 TAF (+2.8%)	-0.2 TAF (0%)	0 TAF (0%)
	Lower Basin - Demand Met by Groundwater	467 TAF	+71.3 TAF (+15.3%)	+5.7 TAF (+1.2%)	+4.6 TAF (+1%)	-17 TAF (-3.6%)	+0.6 TAF (+0.1%)	0 TAF (0%)
	Net Change in Annual Groundwater Basin Storage	N/A	-71.3 TAF (-15%)	-5.7 TAF (-1.2%)	+13.3 TAF (+3%)	+17 TAF (+3.6%)	-0.6 TAF (-0.1%)	0 TAF (0%)
Water Quality								
System	Total Delta Outflow	15,095 TAF	+9.5 TAF (+0.1%)	-38 TAF (-0.2%)	+6.2 TAF (+0%)	+10 TAF (+0.1%)	-66 TAF (-0.4%)	0 TAF (0%)
	% Months where Salinity at Rock Slough > 150 mg/l Cl	24%	+0 TAF (+0.2%)	0 TAF (-0.7%)	0 TAF (-0.8%)	0 TAF (-0.4%)	0 TAF (-0.2%)	0 TAF (0%)
	% Months where Salinity at Rock Slough > 250 mg/l Cl	1%	+0 TAF (+0.1%)	+0 TAF (+0.4%)	+0 TAF (+0.3%)	+0 TAF (+0.2%)	+0 TAF (+0.4%)	0 TAF (0%)
Fish and Wildlife Habitat								
System	System end-of-April Storage (Folsom/Shasta/Trinity/Oroville)	8,383 TAF	+21 TAF (+0.3%)	-144.3 TAF (-1.7%)	+8.4 TAF (+0.1%)	-10.1 TAF (-0.1%)	+9.6 TAF (+0.1%)	0 TAF (0%)
	Feb-Jun Delta Outflow (Spring X2)	9,134 TAF	+7.1 TAF (+0.1%)	-55.5 TAF (-0.6%)	+7.9 TAF (+0.1%)	-2.9 TAF (0%)	-36.7 TAF (-0.4%)	0 TAF (0%)
	Sep-Nov Delta Outflow (Fall X2)	1,461 TAF	+6.2 TAF (+0.4%)	+13.7 TAF (+0.9%)	-2.8 TAF (-0.2%)	+3.3 TAF (+0.2%)	-4.5 TAF (-0.3%)	0 TAF (0%)
ARB	Mar-May Folsom Storage	657 TAF	+6.3 TAF (+1%)	-11.4 TAF (-1.7%)	-4.7 TAF (-0.7%)	+9.5 TAF (+1.4%)	-3.8 TAF (-0.6%)	0 TAF (0%)
	Jun-Nov Folsom Storage	287 TAF	+10.7 TAF (+3.7%)	+141.1 TAF (+49%)	-6.4 TAF (-2.2%)	+22 TAF (+7.7%)	+3.4 TAF (+1.2%)	0 TAF (0%)
	Mar-May Lower American River Flow	605 TAF	+5 TAF (+0.8%)	+4.3 TAF (+0.7%)	+6.1 TAF (+1%)	+13 TAF (+2.1%)	-27 TAF (-4.5%)	22 TAF (-4%)
	Jun-Nov Lower American River Flow	729 TAF	+27.9 TAF (+3.8%)	-118.4 TAF (-16%)	-3.9 TAF (-0.5%)	+8.6 TAF (+1.2%)	-1.7 TAF (-0.2%)	0 TAF (0%)
	% Months when Lower American River flows < 500 cfs	9%	-1.8 % (-19%)	-9 % (-94%)	-0.4 % (-4.7%)	-2.1 % (-22%)	+0.1 % (+0.9%)	0 TAF (0%)
	% Months when Lower American River flows < 800 cfs	24%	-1.9 % (-8%)	-12 % (-49%)	+0.5 % (+2.2%)	-3.4 % (-14%)	-0.1 % (-0.4%)	0 TAF (0%)
	American River Flow at Sacramento River Confluence	2,027 TAF	+43.2 TAF (+2.1%)	-44.6 TAF (-2.2%)	+4 TAF (+0.2%)	+53 TAF (+2.6%)	-64.9 TAF (-3.2%)	0 TAF (0%)
Flood Management								
ARB	Annual Folsom Reservoir Spills	516 TAF	+6.5 TAF (+1.3%)	-36.7 TAF (-7.1%)	-5.6 TAF (-1.1%)	+14.9 TAF (+2.9%)	-46.3 TAF (-9%)	-32 TAF (-6%)
Recreation								
System	May-Sep Surface Area (Folsom/Shasta/Trinity/Oroville)	44.6 TA	+0.3 TA (+0.6%)	-0.2 TA (-0.4%)	+0 TA (+0%)	-0.1 TA (-0.3%)	+0.1 TA (+0.2%)	0 TAF (0%)
ARB	May-Sep Folsom Reservoir Surface Area	6.4 TA	+0.1 TA (+1.8%)	+1.3 TA (+19.5%)	-0.1 TA (-1.4%)	-0.1 TA (-1.9%)	+0 TA (+0.1%)	0 TAF (0%)

Legend: <2% change | 2-5% Decrease (-) | >5% Decrease (-) | 2-5% Increase (+) | >5% Increase (+)

Note: change percentages do not necessarily indicate benefits or impacts. They indicate the extent to which a portfolio affects a given evaluation metrics.

Key:
cfs = cubic feet per second CVP = Central Valley Project GW = groundwater mg/l Cl = chloride concentration in milligram per liter N/A = Not Applicable SWP = State Water Project
TA = 1,000 acres TAF = 1,000 acre-feet X2 = Distance of the 2 parts per thousand salinity isohalines from the Golden Gate Bridge in kilometers.

Table 3-3. Performance of Adaptation Portfolios Relative to the Future Baseline Under 2070 Hot-Dry Climate Scenario

Evaluation Metrics		2070 Future Baseline	Change Relative to the 2070 Future Baseline					
			No Assurance for Long-Term CVP Contracts	Modified Flow Management Standard	Federally Recognized GW Bank	Sacramento River Diversion	Alder Creek Reservoir	Folsom Dam Raise with Groundwater Banking
Water Supply Reliability								
System	System end-of-Sep Storage (Folsom/Shasta/Trinity/Oroville)	3,254 TAF	+30.7 TAF (+0.9%)	-74.7 TAF (-2.3%)	-6.2 TAF (-0.2%)	-28.1 TAF (+0.9%)	+0.3 TAF (+0%)	0 TAF (0%)
	Delta CVP Exports - Jones	1,837 TAF	+4.9 TAF (+0.3%)	-9.2 TAF (-0.5%)	-6 TAF (-0.3%)	-13.8 TAF (-0.8%)	+0.8 TAF (+0%)	0 TAF (0%)
	Delta SWP Exports - Banks	1,861 TAF	+8.3 TAF (+0.4%)	-5.4 TAF (-0.3%)	+1.6 TAF(+0.1%)	-4.1 TAF (-0.2%)	-6.6 TAF (-0.4%)	0 TAF (0%)
American River Basin (ARB)	Upper Basin - Total End-of-September Storage	297 TAF	+1.2 TAF (+0.4%)	+5.9 TAF (+2%)	-0.3 TAF (-0.1%)	+0 TAF (+0%)	+48.6 TAF (+16%)	0 TAF (0%)
	Upper Basin - Total Demand	222 TAF	--	--	--	--	--	--
	Upper Basin - Demand Met by Surface Water	134 TAF	+0.1 TAF (+0.1%)	+0.1 TAF (+0.1%)	-0.1 TAF (-0.1%)	+0.4 TAF (+0.3%)	+71.4 TAF (+53%)	0 TAF (0%)
	Upper Basin - Unmet Demand	88 TAF	-0.1 TAF (-0.1%)	-0.1 TAF (-0.1%)	+0.1 TAF (+0.1%)	-0.4 TAF (-0.5%)	-71.4 TAF (-81%)	0 TAF (0%)
	Lower Basin - Folsom End-of-September Storage	179 TAF	+3.7 TAF (+2.1%)	+145 TAF(+82%)	-2 TAF (-1.1%)	+24.7 TAF(+14%)	-1.6 TAF (-0.9%)	0 TAF (0%)
	Lower Basin - Total Demand	1332 TAF	--	--	--	--	--	--
	Lower Basin - Demand Met by Surface Water	770 TAF	-65.4 TAF (-8.5%)	-2.8 TAF (-0.4%)	-5.5 TAF (-0.7%)	+31.7 TAF (+4%)	-0.9 TAF (-0.1%)	0 TAF (0%)
	Lower Basin - Demand Met by Groundwater	547 TAF	+65.9 TAF (+12%)	+3 TAF (+0.5%)	+3.8 TAF (+0.7%)	-20.5 TAF(-3.7%)	+1.2 TAF (+0.2%)	0 TAF (0%)
	Net Change in Annual Groundwater Basin Storage	N/A	-65.9 TAF (-12%)	-3 TAF (-0.5%)	+8.1 TAF (+1.5%)	+20.5 TAF (+4%)	-1.2 TAF (-0.2%)	0 TAF (0%)
Water Quality								
System	Total Delta Outflow	13,705 TAF	+27.1 TAF (+0.2%)	+2.3 TAF (+0%)	+14 TAF (+0.1%)	+11 TAF (+0.1%)	-58 TAF (-0.4%)	0 TAF (0%)
	% Months where Salinity at Rock Slough > 150 mg/l Cl	24%	0 TAF (+0.1%)	0 TAF (-0.8%)	0 TAF (-0.3%)	0 TAF (-0.5%)	0 TAF (-0.3%)	0 TAF (0%)
	% Months where Salinity at Rock Slough > 250 mg/l Cl	1%	0 TAF (-0.1%)	0 TAF (-0.3%)	0 TAF (+0.4%)	0 TAF (-0.2%)	0 TAF (-0.2%)	0 TAF (0%)
Fish and Wildlife Habitat								
System	System end-of-April Storage (Folsom/Shasta/Trinity/Oroville)	7,717 TAF	+27.1 TAF (+0.4%)	-126.2 TAF(-1.6%)	-6.4 TAF (-0.1%)	+23 TAF (+0.3%)	-4.7 TAF (-0.1%)	0 TAF (0%)
	Feb-Jun Delta Outflow (Spring X2)	8,093 TAF	+16.2 TAF (+0.2%)	-50.6 TAF (-0.6%)	+13 TAF (+0.2%)	+1 TAF (+0%)	-35.8 TAF (-0.4%)	0 TAF (0%)
	Sep-Nov Delta Outflow (Fall X2)	1,318 TAF	+7 TAF (+0.5%)	+21 TAF (+1.6%)	-3 TAF (-0.2%)	+4.1 TAF (+0.3%)	+5.2 TAF (+0.4%)	0 TAF (0%)
ARB	Mar-May Folsom Storage	601 TAF	+7.5 TAF (+1.3%)	-18.6 TAF (-3.1%)	-2.4 TAF (-0.4%)	+15 TAF (+2.5%)	-6.6 TAF (-1.1%)	0 TAF (0%)
	Jun-Nov Folsom Storage	233 TAF	+5.5 TAF (+2.4%)	+126.1 TAF (+54.1%	-4.1 TAF (-1.7%)	+17.8 TAF (+8%)	-2.5 TAF (-1.1%)	0 TAF (0%)
	Mar-May Lower American River Flow	471 TAF	+9.6 TAF (+2%)	+21.7 TAF (+4.6%)	+5.2 TAF (+1.1%)	+8.6 TAF (+1.8%)	-18.1 TAF (-3.8%)	17 TAF (-4%)
	Jun-Nov Lower American River Flow	668 TAF	+24.2 TAF (+3.6%)	-111 TAF (-16.6%)	-1.6 TAF (-0.2%)	+16 TAF (+2.4%)	-7.2 TAF (-1.1%)	0 TAF (0%)
	% Months when Lower American River flows < 500 cfs	13%	-2.3 % (-17.1%)	-11.3 % (-83.6%)	+0.71 % (+5.3%)	-1.3 % (-9.9%)	+0.8 % (+5.9%)	0 TAF (0%)
	% Months when Lower American River flows < 800 cfs	32%	-2.7 % (-8.6%)	-13.4 % (-41.7%)	-0.35 % (-1.1%)	-3.6 % (-11.3%)	+1.86 % (+5.8%)	0 TAF (0%)
	American River Flow at Sacramento River Confluence	1,814 TAF	+43.4 TAF (+2.4%)	-41 TAF (-2.3%)	+4.4 TAF (+0.2%)	+43 TAF (+2.4%)	-67 TAF (-3.7%)	0 TAF (0%)
Flood Management - American River Basin								
	Annual Folsom Reservoir Spills	452 TAF	+7.6 TAF (+1.7%)	-28.3 TAF (-6.3%)	-3.3 TAF (-0.7%)	+12 TAF (+2.7%)	-38.9 TAF (-8.6%)	-32 TAF (-7%)
Recreation								
System	May-Sep Surface Area (Folsom/Shasta/Trinity/Oroville)	39.7 TA	+0.2 TA (+0.6%)	-0.1 TA (-0.2%)	-0.1 TA (-0.2%)	+0.3 TA (+0.7%)	0 TA (-0.1%)	0 TAF (0%)
ARB	May-Sep Folsom Reservoir Surface Area	5.7 TA	+0.1 TA (+1.6%)	+1.2 TA (+21.5%)	0 TA (-0.8%)	+0.3 TA (+4.5%)	0 TA (-0.9%)	0 TAF (0%)

Legend:

<2% change	2-5% Decrease (-)	>5% Decrease (-)	2-5% Increase (+)	>5% Increase (+)

Note: change percentages do not necessarily indicate benefits or impacts. They indicate the extent to which a portfolio affects a given evaluation metrics.

Key:

cfs = cubic feet per second CVP = Central Valley Project GW = groundwater mg/l Cl = chloride concentration in milligram per liter N/A = Not Applicable SWP = State Water Project
TA = 1,000 acres TAF = 1,000 acre-feet X2 = Distance of the 2 parts per thousand salinity isohalines from the Golden Gate Bridge in kilometers.

Table 3-4. Performance of Adaptation Portfolios Relative to the Future Baseline Under 2070 Warm Wet Climate Scenario

Evaluation Metrics		2070 Future Baseline	Change Relative to the 2070 Future Baseline					
			No Assurance for Long-Term CVP Contracts	Modified Flow Management Standard	Federally Recognized GW Bank	Sacramento River Diversion	Alder Creek Reservoir	Folsom Dam Raise with Groundwater Banking
Water Supply Reliability								
System	System end-of-Sep Storage (Folsom/Shasta/Trinity/Oroville)	5,473 TAF	+26.9 TAF (+0.5%)	-75.8 TAF (-1.4%)	-19 TAF (-0.3%)	+14.6 TAF (+0.3%)	+17.3 TAF (+0.3%)	0 TAF (0%)
	Delta CVP Exports - Jones	2,211 TAF	+3.9 TAF (+0.2%)	-0.4 TAF (0%)	-3.5 TAF (-0.2%)	-15.7 TAF (-0.7%)	+2.9 TAF (+0.1%)	0 TAF (0%)
	Delta SWP Exports - Banks	2,671 TAF	+6 TAF (+0.2%)	-8.5 TAF (-0.3%)	-4.1 TAF (-0.2%)	-4.8 TAF (-0.2%)	-1.1 TAF (0%)	0 TAF (0%)
American River Basin (ARB)	Upper Basin - Total End-of-September Storage	386 TAF	-0.2 TAF (-0.1%)	+8.1 TAF (+2.1%)	0 TAF (0%)	-2.9 TAF (-0.7%)	+85.4 TAF (+22%)	0 TAF (0%)
	Upper Basin - Total Demand	202 TAF	0 TAF (0%)	0 TAF (0%)	0 TAF (0%)	0 TAF (0%)	0 TAF (0%)	0 TAF (0%)
	Upper Basin - Demand Met by Surface Water	137 TAF	0 TAF (0%)	0 TAF (0%)	-0.2 TAF (-0.1%)	0 TAF (0%)	+61.5 TAF (+45%)	0 TAF (0%)
	Upper Basin - Unmet Demand	64 TAF	0 TAF (0%)	0 TAF (0%)	+0.2 TAF (+0.3%)	0 TAF (0%)	-61.5 TAF (-96%)	0 TAF (0%)
	Lower Basin - Folsom End-of-September Storage	320 TAF	+13.6 TAF (+4.3%)	+146 TAF (+46%)	-7.1 TAF (-2.2%)	+39 TAF (+12.2%)	+8.5 TAF (+2.6%)	0 TAF (0%)
	Lower Basin - Total Demand	1,278 TAF	0 TAF (0%)	0 TAF (0%)	0 TAF (0%)	0 TAF (0%)	0 TAF (0%)	0 TAF (0%)
	Lower Basin - Demand Met by Surface Water	834 TAF	-74.3 TAF (-8.9%)	-5.9 TAF (-0.7%)	-0.8 TAF (-0.1%)	+19 TAF (+2.2%)	-1.7 TAF (-0.2%)	0 TAF (0%)
	Lower Basin - Demand Met by Groundwater	440 TAF	+74.2 TAF (+16.9%)	+6.1 TAF (+1.4%)	-4.5 TAF (-1%)	-17.9 TAF (-4.1%)	+1.3 TAF (+0.3%)	0 TAF (0%)
	Net Change in Annual Groundwater Basin Storage	N/A	-74.2 TAF (-16.9%)	-6.1 TAF (-1.4%)	+30.3 TAF (+7%)	+18 TAF (+4%)	-1.3 TAF (-0.3%)	0 TAF (0%)
Water Quality								
System	Total Delta Outflow	19,812 TAF	+26.2 TAF (+0.1%)	-30 TAF (-0.2%)	+9.8 TAF (+0%)	+14 TAF (+0.1%)	-62 TAF (-0.3%)	0 TAF (0%)
	% Months where Salinity at Rock Slough > 150 mg/l Cl	19%	+0 TAF (+0.4%)	0 TAF (-0.8%)	0 TAF (-0.4%)	0 TAF (-0.9%)	0 TAF (-0.2%)	0 TAF (0%)
	% Months where Salinity at Rock Slough > 250 mg/l Cl	2%	0 TAF (-0.2%)	0 TAF (-0.1%)	0 TAF (-0.3%)	0 TAF (-0.6%)	0 TAF (-0.4%)	0 TAF (0%)
Fish and Wildlife Habitat								
System	System end-of-April Storage (Folsom/Shasta/Trinity/Oroville)	9,784 TAF	+3.4 TAF (+0%)	-108.8 TAF (-1.1%)	-16.3 TAF (-0.2%)	-5.6 TAF (-0.1%)	-5.6 TAF (-0.1%)	0 TAF (0%)
	Feb-Jun Delta Outflow (Spring X2)	11,421 TAF	+16.8 TAF (+0.1%)	-44.7 TAF (-0.4%)	+3.8 TAF (+0%)	-4.6 TAF (0%)	-31.4 TAF (-0.3%)	0 TAF (0%)
	Sep-Nov Delta Outflow (Fall X2)	18,86 TAF	+3 TAF (+0.2%)	+5.9 TAF (+0.3%)	-2.4 TAF (-0.1%)	+5.3 TAF (+0.3%)	-4 TAF (-0.2%)	0 TAF (0%)
ARB	Mar-May Folsom Storage	731 TAF	+3.7 TAF (+0.5%)	-15.6 TAF (-2.1%)	-2.2 TAF (-0.3%)	+7 TAF (+1%)	-4 TAF (-0.5%)	0 TAF (0%)
	Jun-Nov Folsom Storage	399 TAF	+13.4 TAF (+3.3%)	+123.3 TAF (+31%)	-6.4 TAF (-1.6%)	+32.4 TAF (+8%)	+3.4 TAF (+0.9%)	0 TAF (0%)
	Mar-May Lower American River Flow	652 TAF	+10.8 TAF (+1.7%)	+7.3 TAF (+1.1%)	+3.3 TAF (+0.5%)	+16 TAF (+2.4%)	-23.4 TAF (-3.6%)	26 TAF (-4%)
	Jun-Nov Lower American River Flow	858 TAF	+19.7 TAF (+2.3%)	-114 TAF (-13.3%)	-3.4 TAF (-0.4%)	+2.6 TAF (+0.3%)	+4.3 TAF (+0.5%)	0 TAF (0%)
	% Months when Lower American River flows < 500 cfs	5%	-0.98 % (-18.97%)	-5.1 % (-98%)	-0.44 % (-8.6%)	-1.06 % (-20%)	-0.1 % (-1.7%)	0 TAF (0%)
	% Months when Lower American River flows < 800 cfs	14%	-2.22 % (-16.03%)	-10.8 % (-78%)	-0.35 % (-2.6%)	-3.55 % (-25%)	0 % (0%)	0 TAF (0%)
	American River Flow at Sacramento River Confluence	2,503 TAF	+45.4 TAF (+1.8%)	-62.8 TAF (-2.5%)	-4.9 TAF (-0.2%)	+62 TAF (+2.5%)	-59.4 TAF (-2.4%)	0 TAF (0%)
Flood Management								
ARB	Annual Folsom Reservoir Spills	698 TAF	+10.9 TAF (+1.6%)	-48.3 TAF (-6.9%)	-8.7 TAF (-1.3%)	+19.1 TAF (+2.7%)	-44.6 TAF (-6.4%)	-19 TAF (-3%)
Recreation								
System	May-Sep Surface Area (Folsom/Shasta/Trinity/Oroville)	54.1 TA	+0.2 TA (+0.3%)	-0.1 TA (-0.2%)	-0.1 TA (-0.3%)	+0.2 TA (+0.3%)	+0 TA (+0%)	0 TAF (0%)
ARB	May-Sep Folsom Reservoir Surface Area	7.7 TA	+0.1 TA (+1.6%)	+1 TA (+13.4%)	-0.1 TA (-1.2%)	+0.3 TA (+4%)	+0 TA (+0.1%)	0 TAF (0%)

Legend:

<2% change	2-5% Decrease (-)	>5% Decrease (-)	2-5% Increase (+)	>5% Increase (+)

Note: change percentages do not necessarily indicate benefits or impacts. They indicate the extent to which a portfolio affects a given evaluation metrics.

Key:

cfs = cubic feet per second CVP = Central Valley Project GW = groundwater mg/l Cl = chloride concentration in milligram per liter N/A = Not Applicable .. SWP = State Water Project
TA = 1,000 acres TAF = 1,000 acre-feet X2 = Distance of the 2 parts per thousand salinity isohalines from the Golden Gate Bridge in kilometers.

Table 3-5. Summary of Adaptation Portfolios Performance Relative to the Future Baseline

Evaluation Criteria	No Assurance for Long-Term CVP Contracts	Modified Flow Management Standard	Federally Recognized GW Bank	Sacramento River Diversion	Alder Creek Reservoir	Folsom Dam Raise with Groundwater Banking
Benefits to Reclamation's Operational Flexibility						
Folsom Storage	Increase in Folsom end-of-September storage by 3-14 TAF	Increase in Folsom end-of-September storage by 141-146 TAF	Provide 47 TAF/year of surface water during dry/critical years to allow for increased operational flexibility for Folsom Reservoir	Increase in Folsom end-of-September storage by 24-39 TAF Reduce demand on Folsom Reservoir	Increase in Folsom end-of-September storage by 8 TAF Reduce demand on Folsom Reservoir by 12 TAF/year Provide 30 TAF/year of surface water by shifting flood flows to summer months	Potential to reduce demand on Folsom Reservoir by shifting use to banked GW in dry periods
Water Supply Reliability						
System	*Limited effect*	*May reduce CVP storage due to carry-over requirements at Folsom*	*Limited effect*	*Limited effect*	*Limited effect*	*Limited effect*
ARB – Upper Basin	*Limited effect*	*Limited effect*	*Limited effect*	*Limited effect*	Reduce supply-demand imbalance by providing 68 TAF/year of additional surface water supplies Increase upper basin carryover storage by 59 TAF/year	*Limited effect*
ARB – Lower Basin	Loss of surface water (65-74 TAF), compensated by increase in GW use. Reduction in GW storage	Improve reliability by increasing Folsom carryover storage by over 140 TAF	Increase GW basin recharge by 34 TAF/year in wet years	Increase available surface water supplies by 23 TAF/year Increase GW basin recharge by 17 TAF/year	*Limited effect*	Increase GW basin recharge by 32 TAF/year
Water Quality						
System	*Limited effect*	*Limited effect*	*Limited effect*	*Limited effect*	*Limited effect*	*Limited effect*
Fish and Wildlife Habitat						
System	*Limited effect*	*Limited effect*	*Limited effect*	*Limited effect*	*Limited effect*	*Limited effect*
ARB	Increase in LAR flows during temperature stress period (Jun-Nov).	Increase in LAR flows during temperature and flow stress periods (Mar-May, Jun-Nov).	Provide flexibility to (1) increase cold water storage or (2) increase LAR flows.	Provide flexibility to (1) increase cold water storage or (2) increase LAR flows. Increased LAR flows during flow stress period (Jun-Nov).	Potential to coordinate Upper Basin storage with fish and habitat management on LAR.	Contribute restoration of Consumes River through GW recharge. Potential to coordinate shifting to banked GW to increase LAR flows.

Table 3-5. Summary of Adaptation Portfolios Performance Relative to the Future Baseline (Continued)

Evaluation Criteria	No Assurance for Long-Term CVP Contracts	Modified Flow Management Standard	Federally Recognized GW Bank	Sacramento River Diversion	Alder Creek Reservoir	Folsom Dam Raise with Groundwater Banking
Flood Management						
ARB	*Limited effect*	Reduce Folsom Reservoir Spills	*Limited effect*	*Limited effect*	Reduce Folsom spills and LAR peak flows by 630 cfs. Potential for conditional flood storage to support Folsom forecast-based operations.	Dam raise and forecast-based operations. Reduce spills through GW recharge (32 TAF/year)
Recreation						
System	*Limited effect*	*Limited effect*	*Limited effect*	*Limited effect*	*Limited effect*	*Limited effect*
ARB	*Limited effect*	Moderate increase of surface area in Folsom Reservoir (1,300 to 1000 acres)	*Limited effect*	Small increase in Surface area in Folsom Reservoir (300 acres)	provide recreation opportunities around Alder reservoir and downstream areas.	*Limited effect*
Hydropower						
	Limited effect	*Limited effect*	*Limited effect*	*Limited effect*	Provide up to 470,000 Megawatt-hour/year	*Limited effect*

Key:
ARB = American River Basin cfs = cubic feet per second GW = Groundwater LAR = Lower American River TAF = 1,000 acre-feet

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Chapter 4 Evaluation of Individual Adaptation Portfolios

This section evaluates the contribution of each of the theme-based Adaptation Portfolios towards water supply reliability, water quality, fish and wildlife Habitat, flood management, recreation, as well as to Reclamation's operational flexibility. Contributions of each Portfolio is measured against the Future Baseline.

- No Assurance for Long-Term CVP Contracts
- Modified Flow Management Standard
- Federally Recognized GW Bank
- Sacramento River Diversion
- Alder Creek Reservoir
- Folsom Dam Raise with Groundwater Banking

No CVP Contract Assurances

Regulatory uncertainty has contributed to less reliable/protected individual water rights and contract entitlements. Not only have water rights been curtailed in the recent past, but there are also uncertainties surround the contract entitlements amongst some of the region's water agencies. Uncertainty in renewal by Reclamation of CVP long-term water service contracts was a potential vulnerability identified by several water agencies in the region. The original long-term (40-year) water service contracts (LTWSC) for PCWA (35 TAF), City of Roseville (32 TAF), Sacramento County Water Agency (SMUD Reassignment Portion) (30 TAF), and Sacramento Municipal Utility District (30 TAF) all expired in the 2010 – 2012 timeframe. Since that time, Reclamation has executed successive two-year interim renewal contracts (IRC) with these contractors under authority of Central Valley Project Improvement Act (CVPIA) Section 3404(c)(1). Some agencies are still in IRC status and this introduces a significant degree of uncertainty for some of the agencies. Losing CVP water supply could represent a significant vulnerability especially during constrained hydrologic conditions.

Water Purveyor	Reduced CVP Contract Amount	Increased Groundwater Pumping
City of Roseville	32 TAF/year	23 TAF/year
Placer County Water Agency	35 TAF/year	31 TAF/year
Sacramento County Water Agency (SMUD reassignment portion)	30 TAF/year	13 TAF/year
Sacramento Municipal Utility District	30 TAF/year	2 TAF/year
Total	**127 TAF/year**	**69 TAF/year**

The loss of CVP water supplies could increase the region's reliance on groundwater by 69 TAF/year.

Modified Flow Management Standard Project Portfolio

The Sacramento Water Forum has developed a Modified Flow Management Standard (Modified FMS) for the lower American River, that represents the best path forward for protecting local ecosystem resources without re-directing negative impacts to other regions.

The 2006 FMS is a set of measures that includes minimum release requirements and water temperature objectives. These requirements considerably affect the operations of Folsom reservoir and flows in the American River. The main differences between the 2006 FMS and the modified FMS are that the modified FMS (1) adjusts the curves for determining minimum release requirements, using only the Sacramento River Index (SRI) and American River Index (ARI) as indicators of water availability; (2) adds end-of-May and end-of-December storage targets which can be used to adjust the minimum release requirement; (3) adds protective adjustments relating to chinook salmon and steelhead redd dewatering; (4) provides spring pulse flows; and (5) removes the prescriptive and discretionary adjustments to the release requirement, and the conference year and off-ramp conditions, which were contained in the 2006 FMS.

Regional Water Supply Benefits

Figure 4-1 shows that the Modified Flow Management Standard for Lower American River would increase storage in Folsom Reservoir due to lower minimum release requirements (MRR) during dry years and higher MRRs during wet years. It would provide higher end-of-September carryover storage by over 140 TAF. An increased storage would enhance water supply reliability in the American River Basin. The additional water available during wet periods could be used in lieu of the groundwater thus improving the groundwater storage in the region and providing additional operational flexibility.

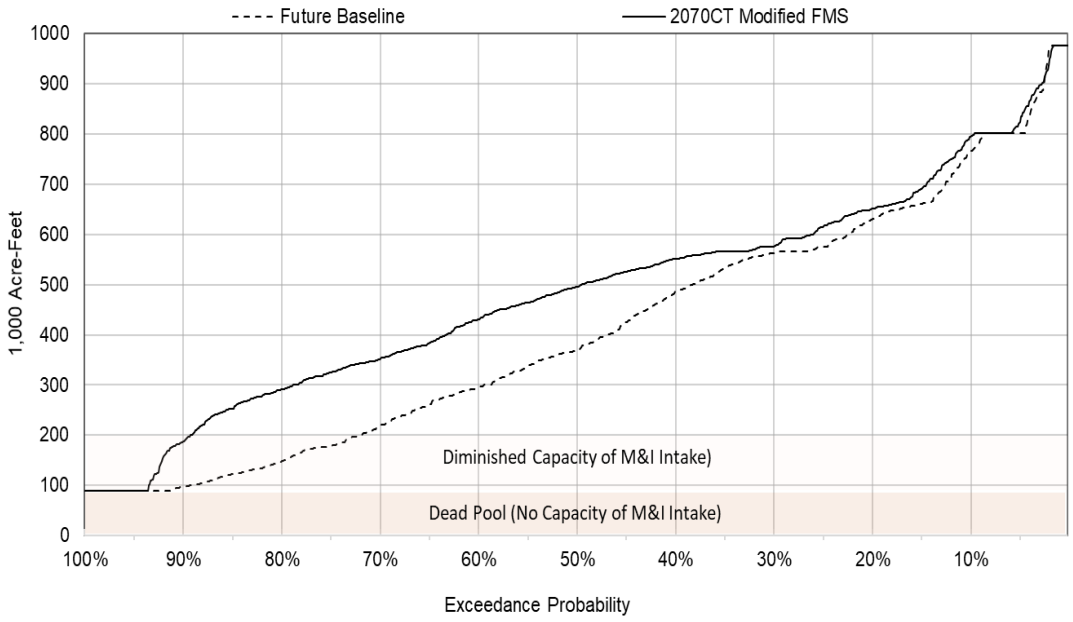

Figure 4-1. Folsom Reservoir 2070 Storage Exceedance under Modified Flow Management Standard Compared to Future Baseline

Contribution to Reclamation's Operational Flexibility Benefits

Increased storage in Folsom Reservoir would provide Reclamation with additional flexibility to increase CVP water supply benefits and ability to manage flow and temperature on the Lower American River. End-of-September carryover storage would increase by over 140 TAF. However, total CVP storage (Folsom, Shasta, Trinity) would decrease by 76 TAF on average.

Contribution to Ecosystem Benefits on the Lower American River

Flows in the lower American River of 800 cfs provide 80 percent of the available spawning habitat. flows of 500 cfs provide about 40 percent of the maximum amount of spawning habitat. flows below 500 cfs create adverse conditions for spawning and rearing.

Figure 4-2 shows that the Modified FMS Portfolio would provide higher June-November Folsom Reservoir storage. On average, June-November storage would increase by over 100 TAF compared to the Future Baseline. June through October can be stressful due to excessively warm water temperatures. The higher storage provides greater flexibility to manage cold water pool and improve flow and temperature conditions in the Lower American River. Under the Modified FMS Portfolio, flows in the Lower American River would drop below 500 cfs in only 1 percent of all months compared to 9 percent of months under the Future Baseline. Similarly, flows below 800 CFS would occur in 12 percent of all months compared to 24 percent under Future Baseline.

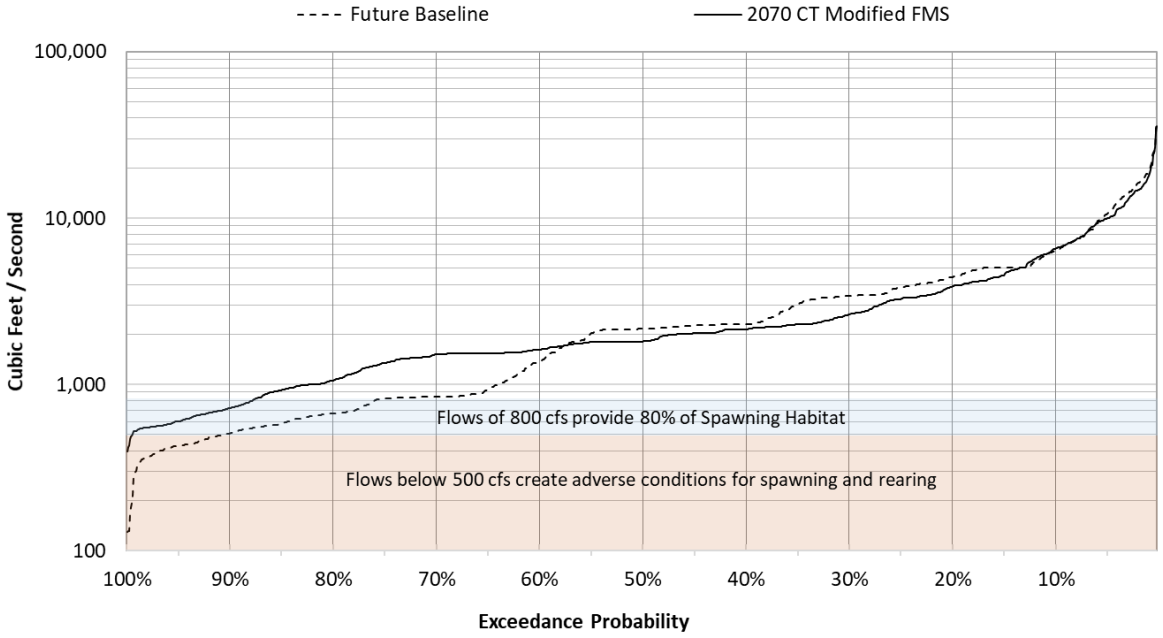

Figure 4-2. Lower American River 2070 Flow Exceedance under Modified Flow Management Standard Compared to Future Baseline

Federally Recognized Groundwater Bank Portfolio

This portfolio evaluates potential regional and system-wide benefits of a project concept for a federally recognized groundwater bank in the North and South American River groundwater

basins. The project representation used in this portfolio relies on information developed as part of the Regional Water Authority's Regional Water Reliability Plan (2019). It should be noted that project concept formulated for this portfolio will be further refined under subsequent studies.

The groundwater bank operations would rely primarily on in-lieu recharge by shifting urban groundwater use to surface water supplies during wetter period to create banked water credit, subject to leave-behind requirement and an annual storage loss. Some groundwater recharge is also possible through injection wells. The banked water would be used during drier periods by urban surface water users and their foregone surface water diversions would be stored in Folsom Reservoir for use by Reclamation and/or other CVP partners.

Contribution to Regional Water Supply Benefits

Figure 4-3 shows the simulated operations of the Federally Recognized Groundwater Bank under 2070 Central Tendency climate scenario. Figure 4-4 shows that during WFA wet and average years, the groundwater bank would recharge 34 TAF/year on average. The banked water would be used in place of foregone surface water diversions during drier periods. The groundwater bank withdrawals would be 47 TAF/year during drier periods, with similar amount of surface water supplies made available to Reclamation and other CVP banking partners.

The groundwater bank would enhance water supply reliability through integrating the use of water rights and contract entitlements with groundwater resources. Expanded groundwater banking during wetter conditions would enhance groundwater sustainability. Figure 4-3 shows the leave-behind banked water (5 percent of recharged amount), which would increase groundwater storage by over 90 TAF over the 93-year simulation period.

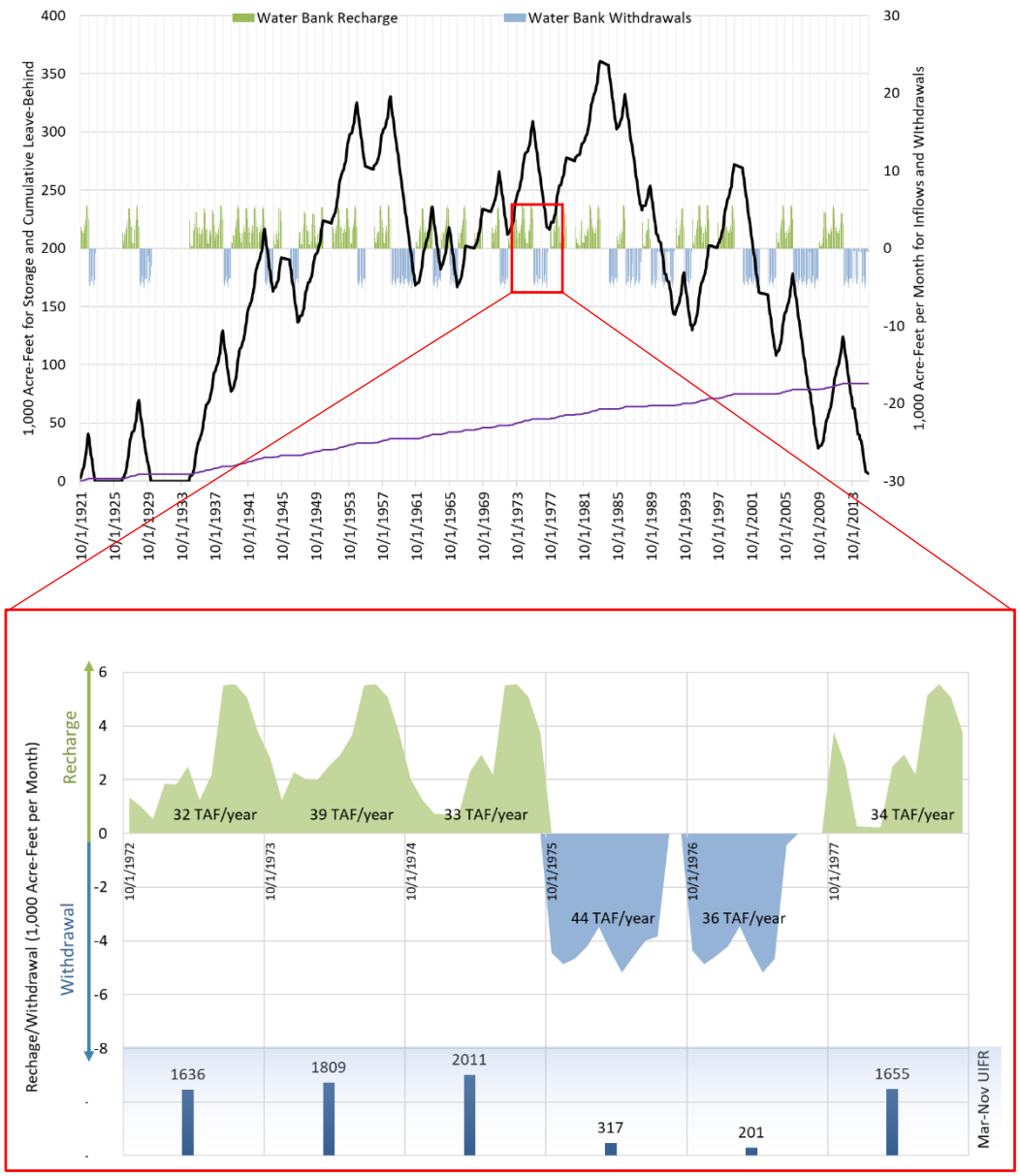

Figure 4-3. Simulated Operations of the Federally Recognized Groundwater Bank under 2070 Central Tendency Climate Scenario

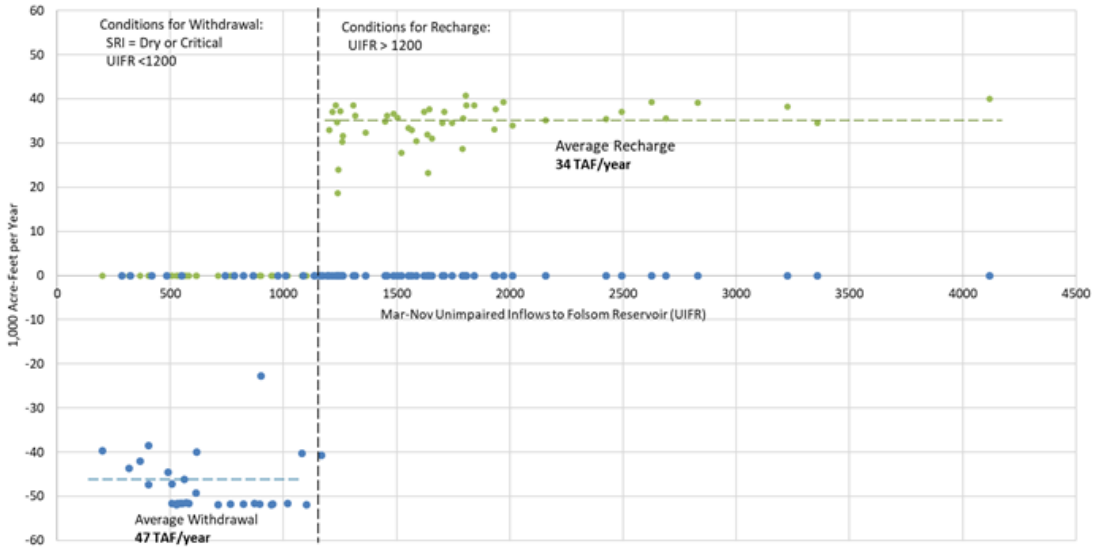

Figure 4-4. Simulated Recharge and Withdrawals of the Federally Recognized Groundwater Bank Portfolio under 2070 Central Tendency Climate Scenario

Contribution to Reclamation's Operational Flexibility Benefits

A regional groundwater bank would provide Reclamation with operation flexibility. Foregone surface water deliveries during drier periods would be made available at Folsom Reservoir for Reclamation. Figure 4-4 shows that an average of 47 TAF per year would be made available to Reclamation during drier years. Figure 4-5 shows that by relying on banked groundwater during dry periods demands, the groundwater bank could reduce the demands on Folsom Reservoir by about 7 TAF per month, during months of peak demand.

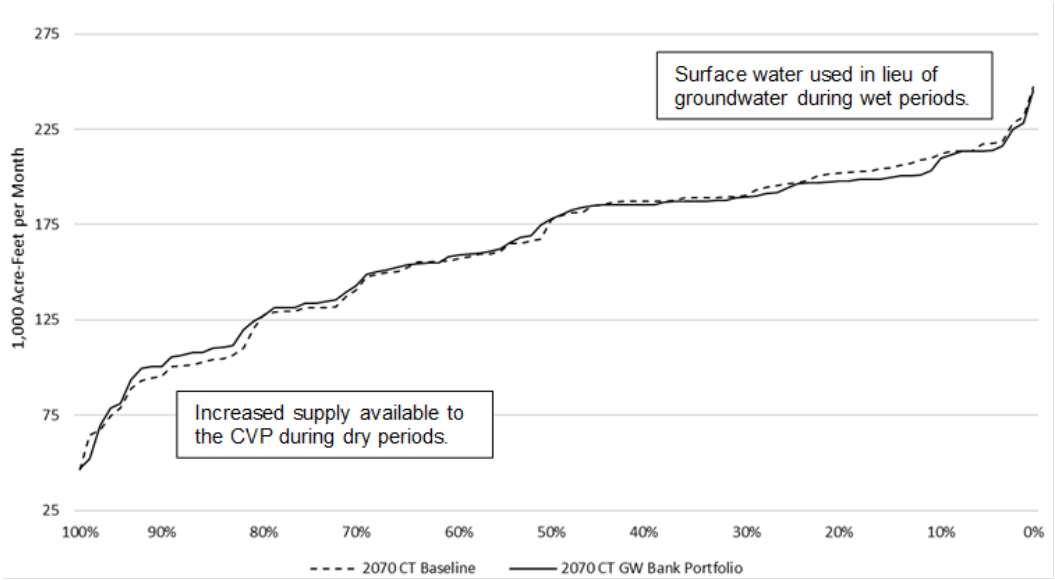

Figure 4-5. Comparison of Lower American River Flows (June-August Monthly Average) Under the Federally Recognized Groundwater Bank Portfolio and Future Bassline for 2070 Central Tendency Climate Scenario

Contribution to Ecosystem Benefits on the Lower American River

Project Partners may coordinate with Reclamation to switch from surface diversions (including their CVP deliveries) to use of banked groundwater to enhance cold water conditions in Folsom Reservoir and downstream in the American and Sacramento Rivers. Foregone deliveries stored in Folsom Reservoir can be released to maximize fall temperature benefits in the American River. The water can be used in two ways: (1) backed up into Folsom Reservoir to improve cold water pool management, or (1) released to improve Lower American River flow conditions.

Sacramento River Diversion Portfolio

This portfolio evaluates potential regional and system-wide benefits of a project concept for a new Sacramento River Diversion. The project representation used in this portfolio relies on information developed under previous and ongoing studies, with the aim to assess and demonstrate the project concept potential to improve regional and system-wide adaptation to climate change effects. It should be noted that project concept formulated for this portfolio is being further refined and developed by local agencies as the RiverArc Project.

The Sacramento River Diversion would shift diversions from the American River and Folsom Reservoir to existing Natomas Mutual Water Company's intakes. The Sacramento River Diversion would diversify surface water supplies for the City of Sacramento, Sacramento Suburban Water District (SSWD), City of Roseville, and Placer County Water Agency (PCWA) by shifting some of its diversions to the Sacramento River, including:

- Up to 7.1 TAF/year of City of Roseville Middle Fork Project (MFP) water supplies
- Up to 81.1 TAF/year of City of Sacramento water right for the area north of the American River
- Up to 35 TAF/year of PCWA's CVP water supplies
- Up to 29 TAF/year of SSWD's MFP water supplies (drier years only)

Regional Water Supply Benefits

Shifting diversions from American River and Folsom Reservoir to the Sacramento River would enhance regional water supply reliability, especially during dry conditions, and increase the resiliency of regional groundwater supplies. This portfolio would increase available surface water supplies to region by 23 TAF/year over the long term, and by 45 TAF/year during drought periods compared to the Future Baseline. The increase in surface water supply reliability, especially during droughts, would reduce the region's reliance on groundwater by 17 TAF/year. In addition, the new infrastructure would also help meet the buildout urban demand in Western Placer County and Sacramento County. Table 4-1 summarize key water supply reliability benefits for local agencies. Figures 4-6 and 4-7 compare the change in water supply composition.

Table 4-1. Regional Water Supply Reliability Benefits under Sacramento River Diversion Portfolio Compared to the Future Baseline

City of Sacramento		Sacramento Suburban Water District	City of Roseville	Placer County Water Agency
North Basin	**South Basin**			
• 5 TAF/year Less Reliance on Groundwater • 53 TAF/year less reliance on the American River	• Improved water supply reliability during dry periods by utilizing Fairbairn WTP	• 11 TAF/year less reliance on groundwater	• 6 TAF/year less reliance on Folsom Reservoir water supplies • Relief from WFA dry year restrictions	• 30 TAF/year less reliance on American River supplies • Reliable supply for West Placer

Key:
TAF = 1,000 acre-feet WFA= Water Forum Agreement WTP = water treatment plant

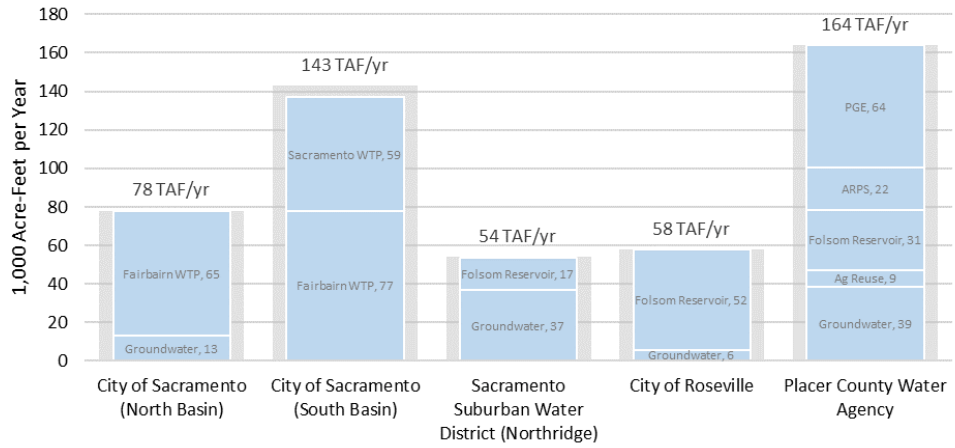

Figure 4-6. 2070 Water Supply Composition under Future Baseline for City of Roseville, City of Sacramento, SSWD, and PCWA Under Central Tendency Climate Scenario

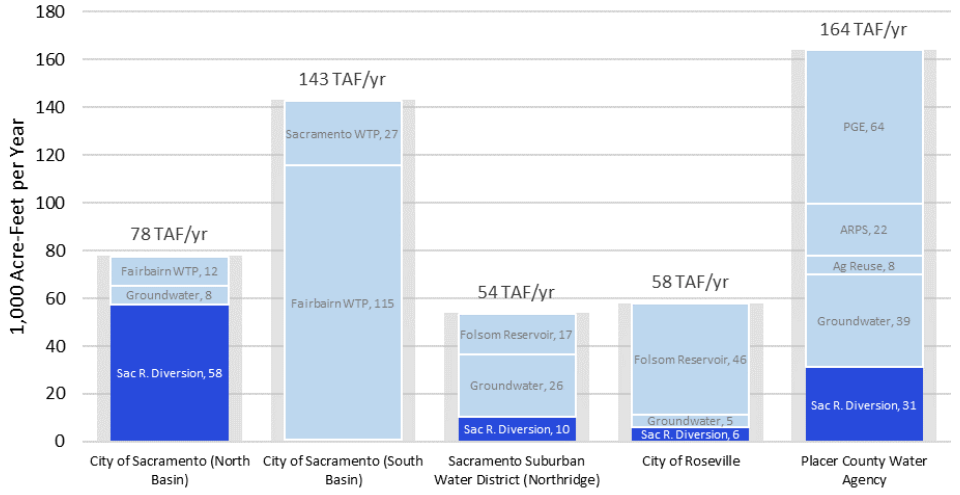

Figure 4-7. 2070 Water Supply Composition under Sacramento River Diversion Portfolio for City of Roseville, City of Sacramento, SSWD, and PCWA Under Central Tendency Climate Scenario

City of Roseville

Figure 4-8 shows that the Sacramento River Diversion Portfolio would increase City of Roseville's surface water reliability across all hydrologic conditions, with largest improvement during WFA Dry conditions restrictions (Folsom inflows below 950 TAF). The Sacramento River Diversion would increase available surface water supplies to the City of Sacramento by an up to 5 TAF/year under dry conditions.

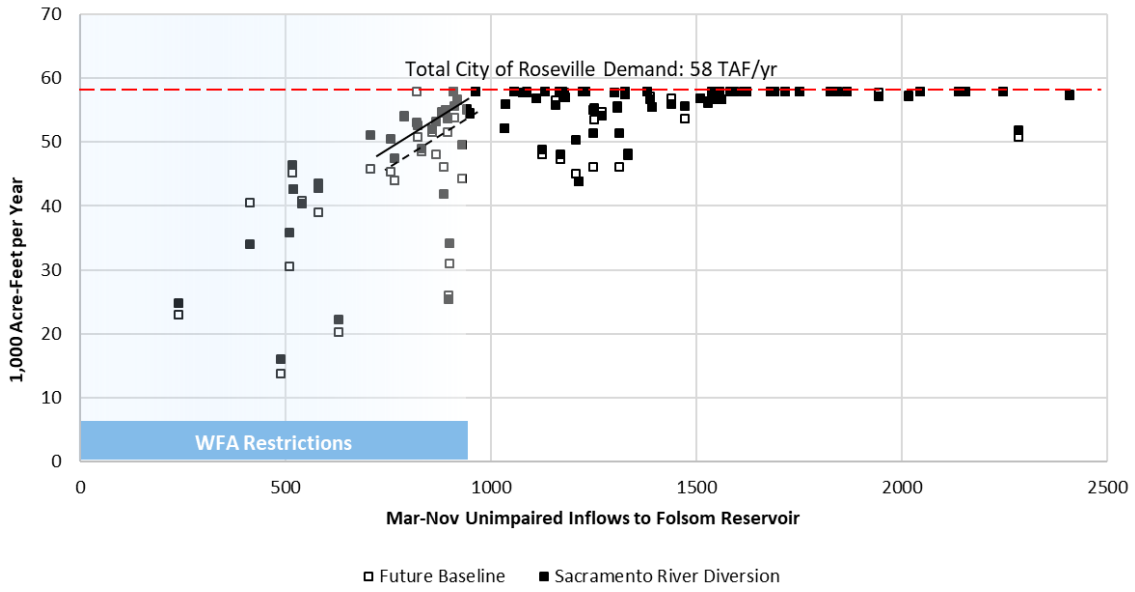

Figure 4-8. City of Roseville's 2070 Annual Surface Water Diversions Under Sacramento River Diversion Portfolio Compared to the Future Baseline

City of Sacramento

Under existing conditions, the Fairbairn Water Treatment Plant (WTP) provides water supply to the City of Sacramento North and South of the American River. In months where Hodge criteria limits diversions at Fairbairn, this single water supply source is heavily stressed and is unable to provide reliable supplies. The City of Sacramento south of the American River is especially susceptible to dry conditions because of limited groundwater pumping capacity. Under 2070 conditions, Hodge flows would limit diversions six months each year on average.

Sacramento River Diversion would provide relief when Hodge Criteria are limiting diversions at Fairbairn WTP. With the Sacramento River Diversion, the City of Sacramento north of the American River will receive some of its supply from the Sacramento River Diversion, freeing up Fairbairn WTP capacity to provide reliable supplies to the City of Sacramento south of the American River.

Figure 4-9 shows the increase in the City of Sacramento's 2070 annual diversions under the Sacramento River Diversion Portfolio compared to the Future Baseline. It shows increase in diversions across all flow conditions on the American River, with the largest increase during Water Forum Agreement (WFA) dry conditions restrictions (Folsom inflows below 950 TAF). The Sacramento River Diversion would increase available surface water supplies to the City of Sacramento by an additional 20 TAF/year on average. Under the most restrictive conditions, the Sacramento River Diversion would provide up to 74 TAF/year of additional water supply reliability for the City of Sacramento. In addition to increasing water supply reliability for the City of Sacramento south of the American River, this portfolio would also reduce reliance on groundwater in the City of Sacramento north of the American River by 10 TAF/year during dry conditions.

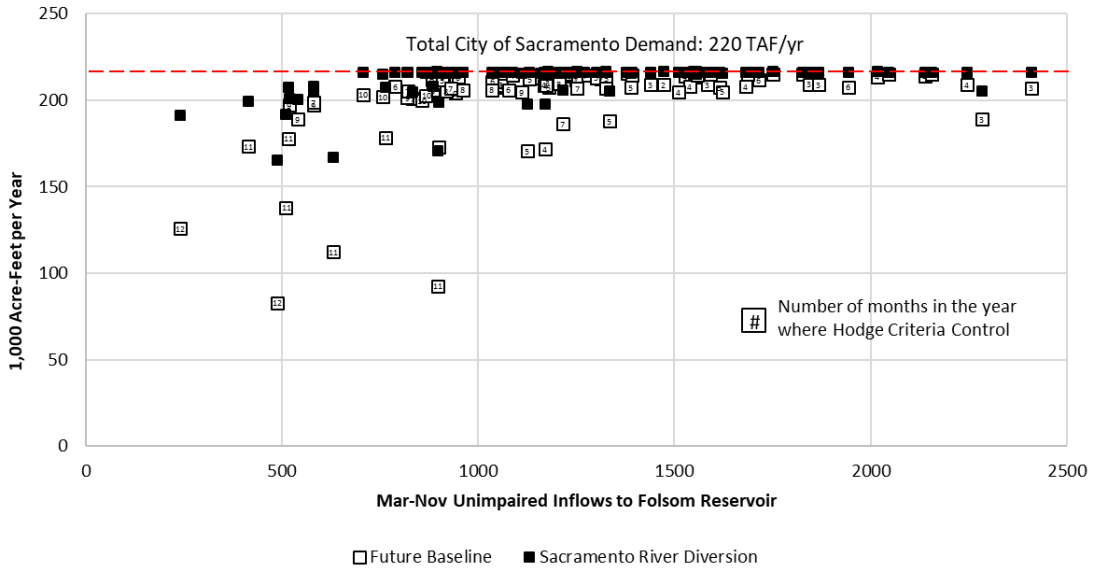

Figure 4-9. City of Sacramento's 2070 Annual Surface Water Diversions Under Sacramento River Diversion Portfolio Compared to the Future Baseline

Placer County Water Agency

Figure 4-10 show the 2070 annual water supply sources for PCWA (not including Zone 3) relative to March-November unimpaired inflow to Folsom Reservoir (UIFR). Supply sources include American River water supplies (CVP and MFP), PG&E water suppliers, and groundwater supplies. During drier years (Mar-Nov UIFR < 950 TAF), more of the water supply would be comprised of groundwater, as the PG&E allocation would decrease. Figure 4-13 shows that PCWA would be able to fully satisfy demands within its service areas under the 2070 Future Baseline.

Figure 4-11 shows that, under the Sacramento River Diversion Portfolio, 30 TAF/year of American River diversions would be shifted to the Sacramento River. Therefore, this portfolio would diversify PCWA's water supply sources and reduce the volume of water supplies (from 51 to 21 TAF/year) that would be subject to WFA mitigation water requirements.

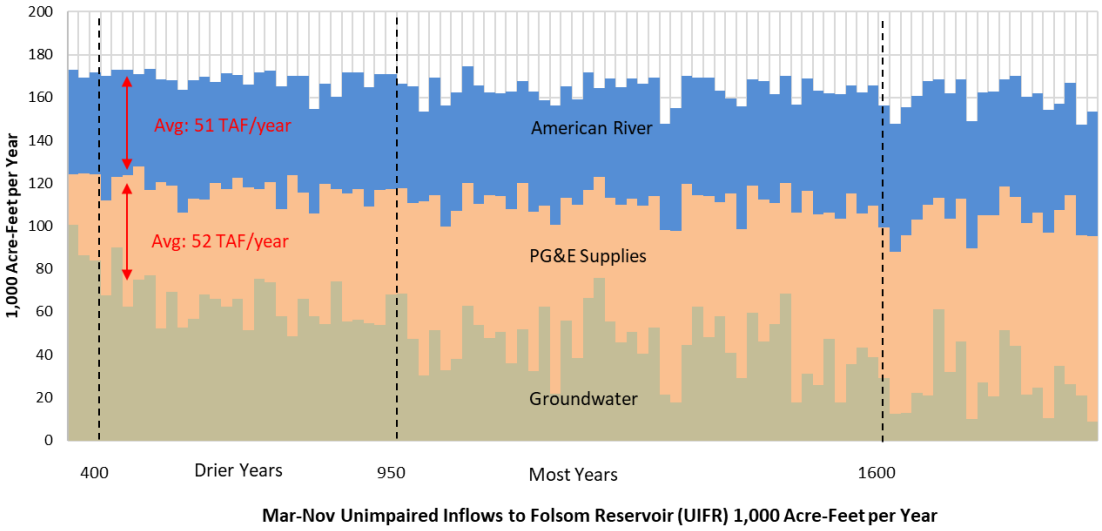

Figure 4-10. PCWA's 2070 Water Supply Composition Under Future Baseline (not including Zone 3)

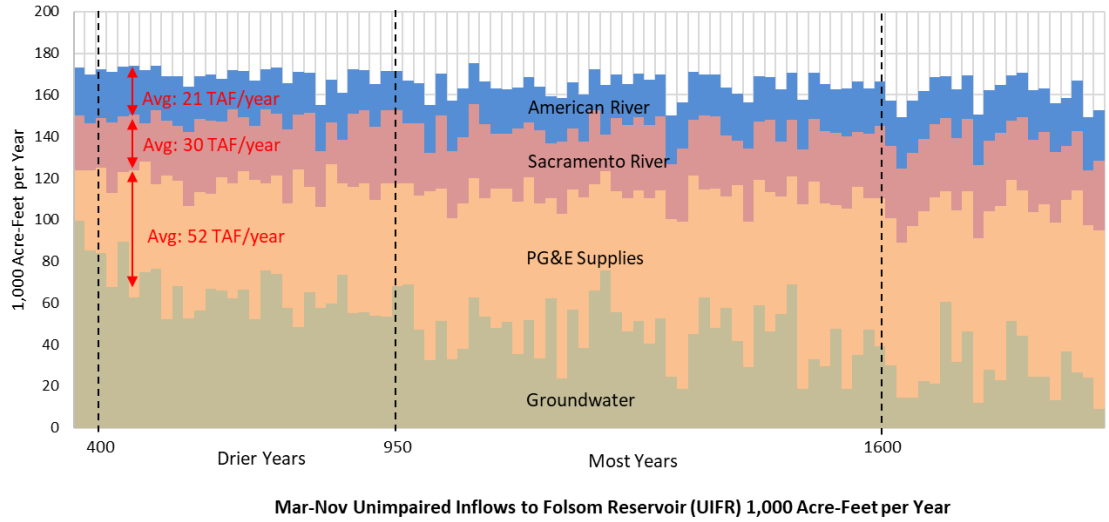

Figure 4-11. PCWA's 2070 Water Supply Composition Under Sacramento River Diversion Portfolio (not including Zone 3)

Sacramento Suburban Water District

SSWD (Northridge supply area) receives 29 TAF of PCWA's MFP water from Folsom Reservoir during wet/average years. During drier years, SSWD pumps groundwater instead. Under this, surface water supply in non-wet years would be provided through the Sacramento River Diversion. In wet years, SSWD still would continue to receive 29 TAF of PCWA's MFP water from Folsom Reservoir. Sacramento River Diversion portfolio would improve water supply reliability for SSWD by diversifying its supply sources and reducing reliance on groundwater during non-wet years by 11 TAF/year (see Figures 4-6 and 4-7).

Contributions to Reclamation's Operations Flexibility

Shifting diversions from American River and Folsom Reservoir to the Sacramento River would increase stored water supplies in Folsom Reservoir. This would provide Reclamation with operational flexibility to: (1) increase South of Delta exports during periods when export capacity is available, and (2) meet environmental requirements on the American River, Sacramento River, and/or the Delta.

Figure 4-12 shows that end-of-September storage in Folsom Reservoir could be maximized to provide an increase in storage of up to 24 TAF. The increased flows and storage increases would provide Reclamation with the flexibility to increase CVP water supply reliability, enhance Lower American River flows for fish habitat and spawning, and/or improve temperature management on both the American and Sacramento Rivers.

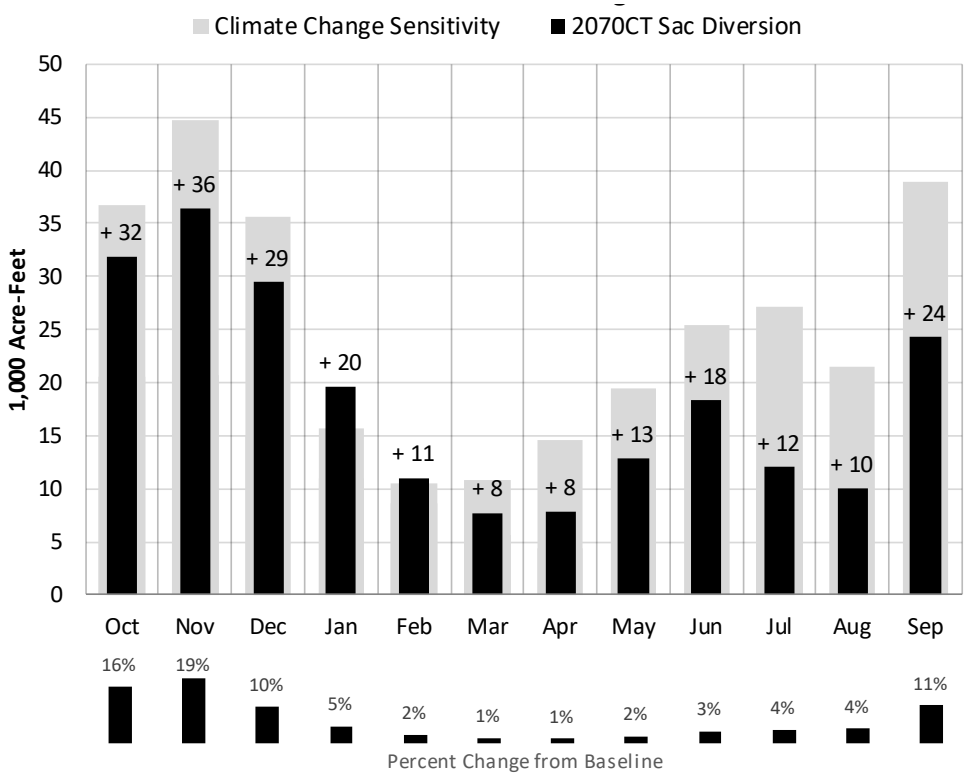

Figure 4-12. Change in Folsom Reservoir 2070 Storage Under Sacramento River Diversion Portfolio from the Future Baseline

Contribution to Ecosystem Benefits on the Lower American River

Under the Sacramento River Diversion Portfolios, flows that are currently diverted from the American River and Folsom Reservoir would be held in Folsom Reservoir to the maximum extent possible, thus enhancing cold water conditions in Folsom Reservoir and downstream in the American and Sacramento Rivers. Figure 4-12 shows that June-November storage in Folsom Reservoir could increase by up to 10%, providing operational flexibility for operators to maintain colder water and flows in the Lower American River. Stored supplies can also be released to

maximize fall temperature benefits in the American and Sacramento Rivers for fish habitat and spawning.

Figure 4-13 shows that the Sacramento River Diversion Portfolio would increase throughout the spring and most of the summer. The decrease in September flows correspond to the increase in end-of-September carryover storage at Folsom Reservoir (see Figure 4-15).

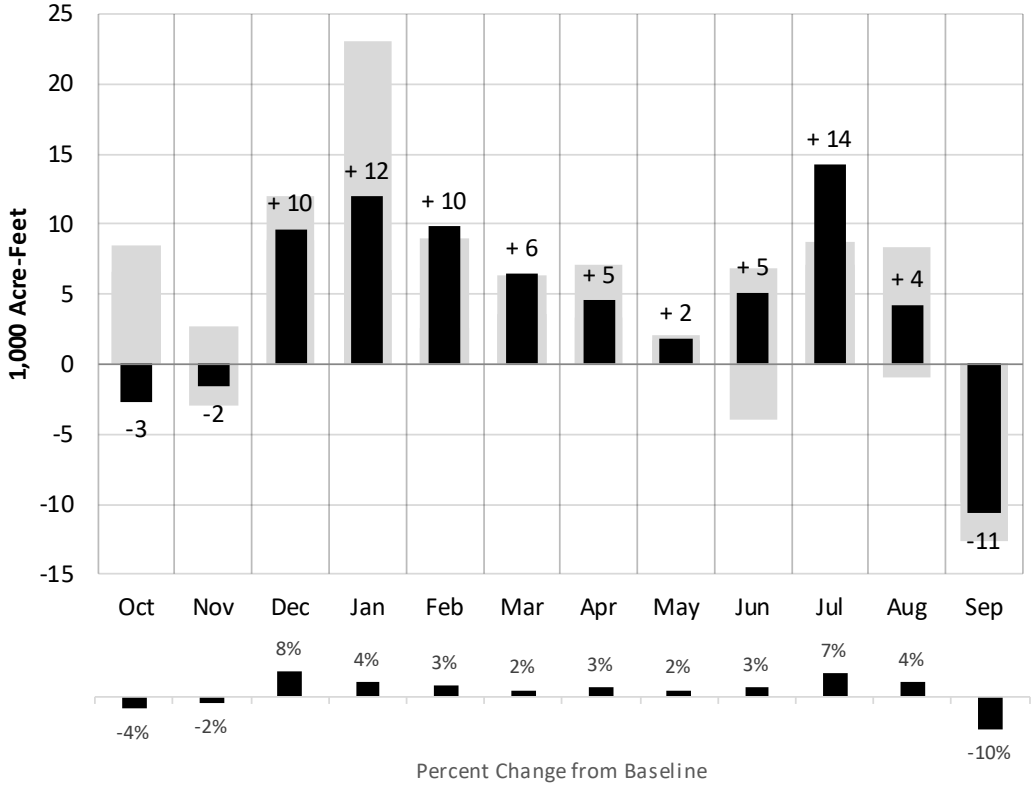

Figure 4-13. Change in 2070 American River at Sacramento River Confluence Flows Under Sacramento River Diversion Portfolio from the Future Baseline

Alder Creek Storage and Conservation Project Portfolio

This portfolio evaluates potential regional and system-wide (federal, state and local) benefits of a project concept for Alder Creek Dam Reservoir. The project representation used in this portfolio relies on information developed under previous studies, with the aim to assess and demonstrate how upper watershed storage to mitigate for reduction in snowpack under climate change may contribute to regional and system-wide adaptations. It should be noted that project concept formulated for this portfolio would likely be further refined under the future Alder Creek Dam and Reservoir Feasibility Study.

Contribution to ARB Upper Basin Water Supply Reliability

In El Dorado County, demands are anticipated to exceed available supplies in the future by about 70 TAF/year (refer to *the Supply-Demand Imbalance TM*). There is no meaningful groundwater supply in the region, and water supply can be vulnerable due to reliance on a surface water alone. Alder Creek Reservoir would greatly improve the surface water availability in the Upper Basin and would virtually eliminate the supply-demand imbalance. Over the long-term, an additional 68 TAF/year of surface water supply and 58 TAF/year of additional surface water carryover storage. Figure 4-14 shows that El Dorado County's 2070 demands would be fully met in 100, 85, and 75 percent of all years under 2070 Warm-Wet, Central Tendency, and Hot-Dry climate scenarios, respectively.

Additional yield from Alder Creek Reservoir and future SMUD supplies would decrease the reliance on existing facilities and Folsom Reservoir. Figure 4-15 shows that under 2070 future conditions, reliance on Folsom Reservoir could decrease by up to 12 TAF/year. Therefore, Alder creek reservoir would be an important feature to diversify water supply composition for the Upper Basin region. In adition, carryover storage in the reservour would also provide drought protection.

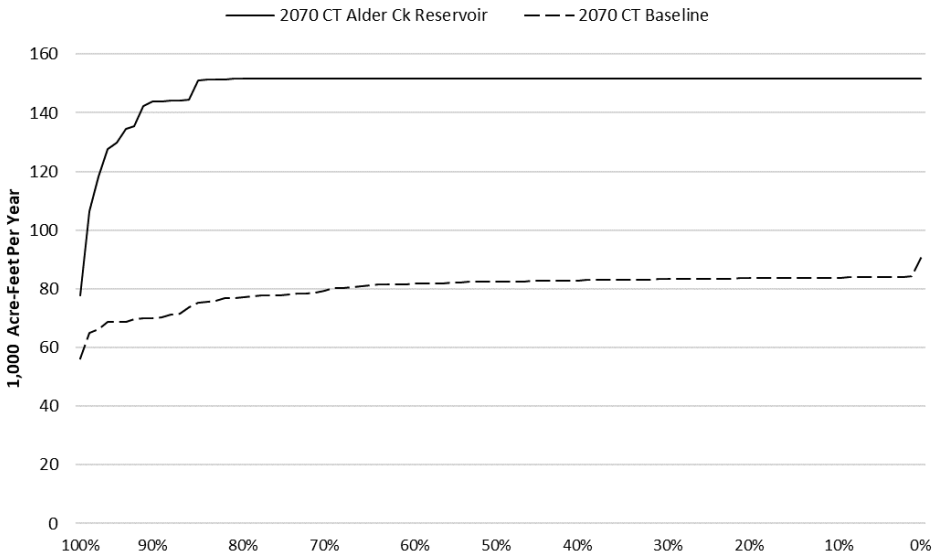

Figure 4-14. Annual Water Deliveries to El Dorado County to Meet 2070 Demands Under Alder Creek Portfolio compared to the Future Baseline Conditions

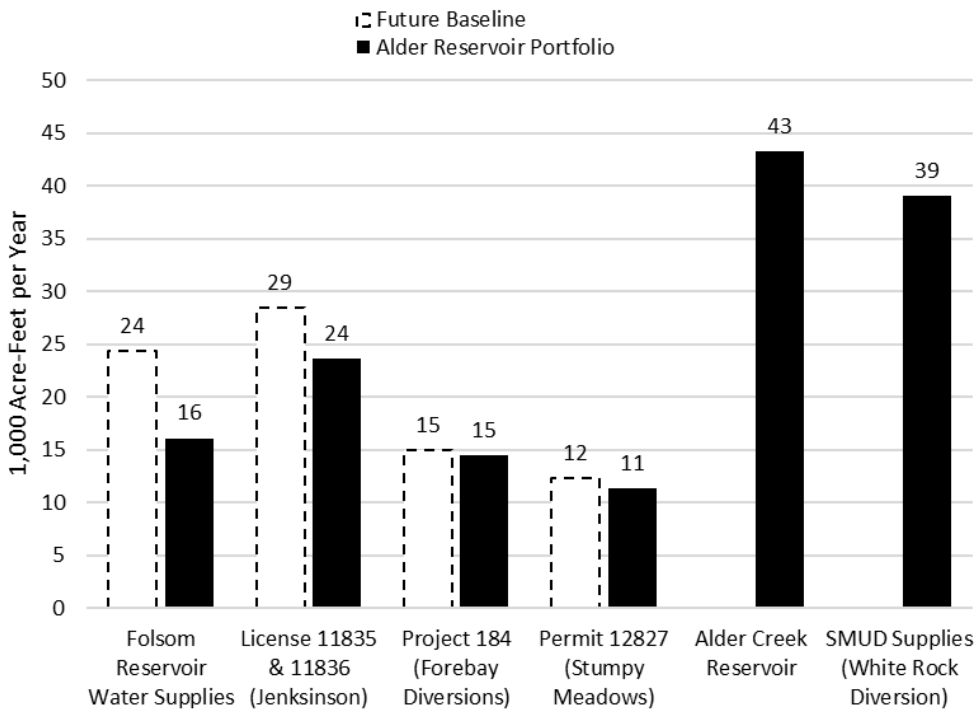

Figure 4-15. El Dorado County 2070 Water Supply Composition under Alder Creek Reservoir Portfolio Compared to the Future Baseline Conditions

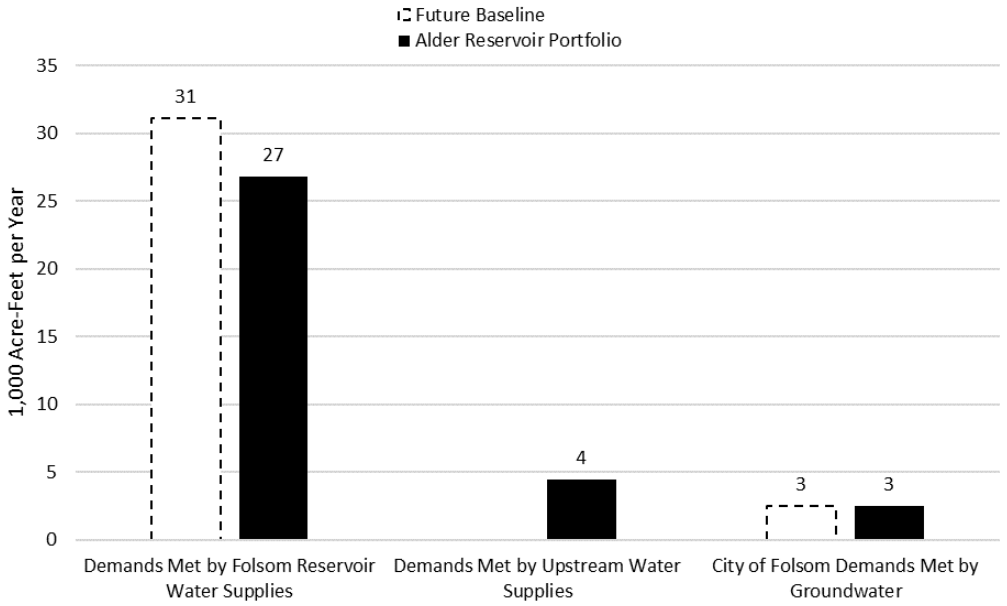

Figure 4-16. City of Folsom 2070 Water Supply Composition under Alder Creek Reservoir Portfolio Compared to the Future Baseline Condition

Contribution to Reclamation's Operational Flexibility

Climate change would likely result in increased runoff during winter months, and reduced snowmelt in the spring months; therefore, affecting water supply deliveries from existing, which are facilities designed and operated based on current and past hydrology. These facilities, including Folsom Reservoir, would be overwhelmed and unable to provide adequate flood protection or reliable water supply to meet all its beneficial uses.

Alder Creek Reservoir, an upper watershed storage, can provide a degree of snowpack replacement. During wet conditions, Alder creek reservoir can capture flows that would otherwise have spilled from Folsom Reservoir and shift releases to the summer during periods of high demand. Figure 4-17 shows that attenuating the unimpaired inflows to Folsom Reservoir during winter months would shift up to 30 TAF/year of flood flows to summer months as water supply benefits to Reclamation. Therefore, effectively increasing Folsom Reservoir capability to provide water supply, increasing end-of-September carryover storage, and reducing spills during flood season. Figure 4-18 shows the portion of Alder Creek dedicated to local consumptive use and that allocated for increasing Reclamation operational flexibility.

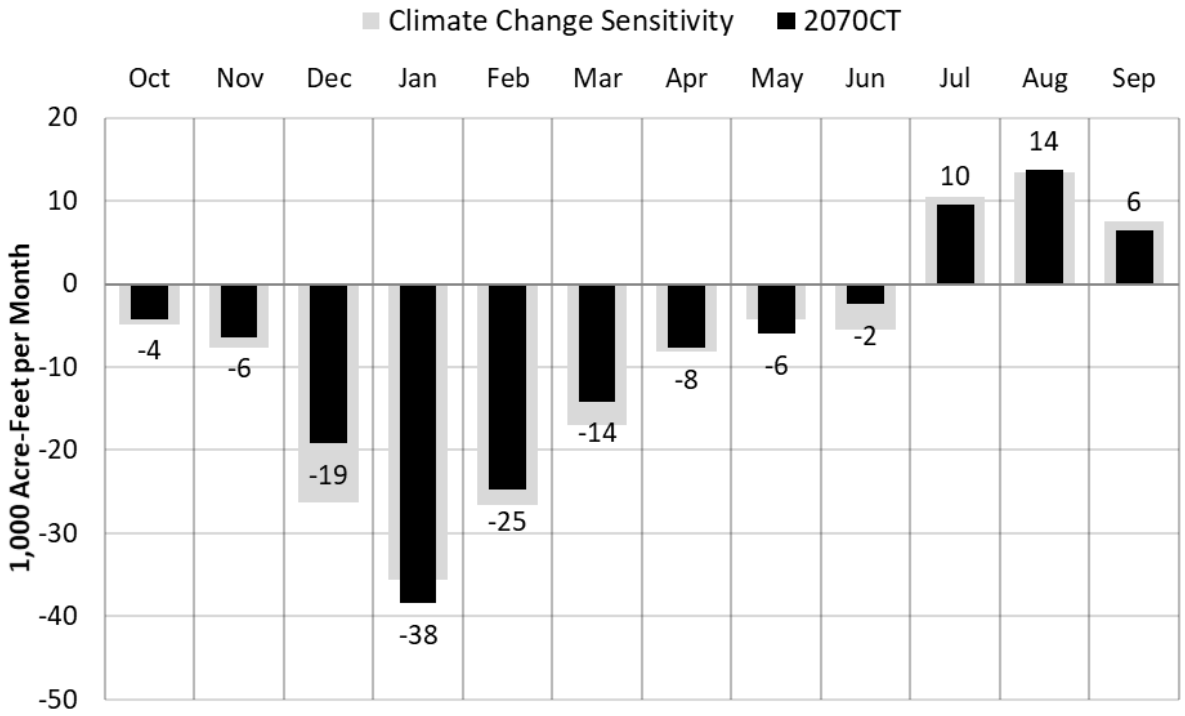

Figure 4-17. Monthly Change in Folsom Reservoir 2070 Inflows during Wet Years Under Alder Creek Portfolio Compared to the Future Baselines.

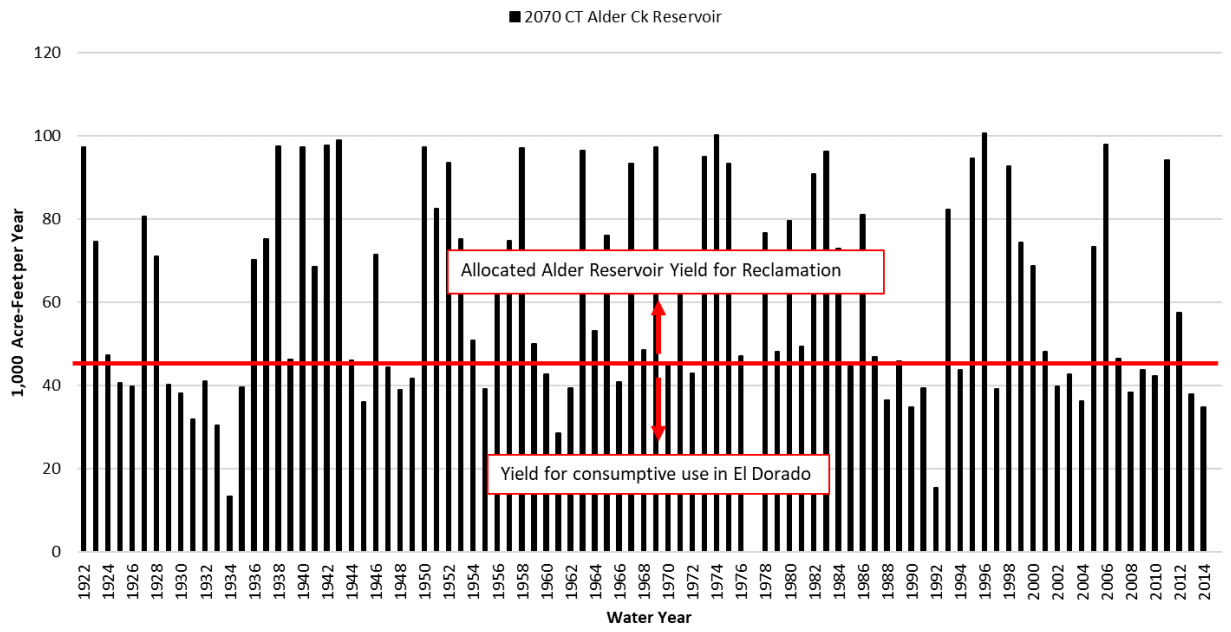

Figure 4-18. Alder Creek Reservoir Annual Yield (May-September Drawdown)

Contribution to Flood Management

Alder Creek reservoir proposed size of 160 TAF is small relative to the storms of concerns for the Lower American River, especially after the completion of the Joint Federal Project to provide the Sacramento region with a 200-year-level of flood protection. In the current formulation of this Portfolio, no dedicated flood space is included. However, flood management benefits would be realized a result of captured surplus water for water supply purposes. Note that it would also be possible to establish conditional flood storage that is tied to Folsom Dam forecast-based operations in cooperation with Sacramento Area Flood Control Agency (SAFCA).

Figure 4-19 shows that, by intercepting flood flows that would have reached Folsom Dam, Alder Creek Reservoir would reduce spills by up to 4% over the long term and reduce peak flows in the Lower American River at Fair Oaks by 630 CFS in average years and 670 CFS in wetter years.

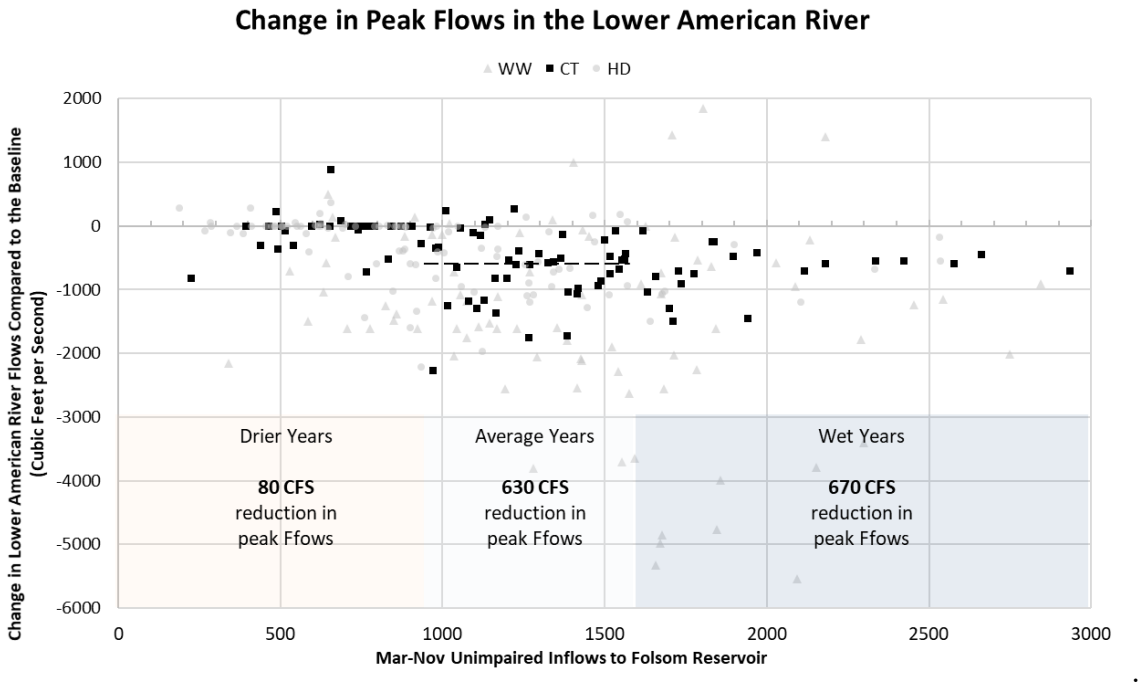

Figure 4-19. Change in Lower American River 2070 Peak Flows at Fair Oaks Under Alder Creek Portfolio Compared to the Future Baseline

Contribution to Ecosystem Benefits on the Lower American River

June through October can be stressful due to excessively warm water temperatures in the Lower American River. The increased storage higher up in the American River basin provides greater flexibility to manage cold water pool and improve flow and temperature conditions in the Lower American River. However, this would be subject to Folsom Reservoir operations and hydrology.

As formulated, Alder Creek Dam Portfolio operations prioritize releasing water during months of peak demand, resulting in increased flows during summer months. However, the additional upstream storage affords Reclamation additional flexibility to shift the timing of releases for fish and wildlife habitat needs or water supply needs.

Contribution to Recreation Benefits

Alder Creek Dam would provide recreation opportunities around the reservoir and downstream areas.

Contribution to Hydropower Benefits

Alder Creek Dam is anticipated to be equipped with 3 powerhouses (total capacity of 110-Megawatt) and could provide power generation of up to 470,000 Megawatt-hour annually. Depending on the facility ownership, its potential energy production can be integrated with Western Area Power Authority (WAPA) operations or EID's project 184 to create greater collective regional and systemwide benefits.

Folsom Dam Raise with Groundwater Banking

This portfolio evaluates potential regional and system-wide benefits of an authorized Folsom Dam raise together with groundwater banking in the South American River Basin. The project representation used in this portfolio relies on information developed under previous and ongoing studies, with the aim to assess and demonstrate the project concept potential to improve regional and system-wide adaptation to climate change effects. It should be noted that project concept formulated for this portfolio would likely be further refined under ongoing regional studies.

Key components of the Portfolio include: (1) the authorized Folsom Dam Raise with limited allowable interim storage (30 to 60 days) without increasing flood risk and infrastructure risk (facilitated by the new auxiliary spillway); (2) modifications of upstream reservoirs (Hell Hole, French Meadows, and Union Valley) for additional flood storage made available by prereleases enabled by 7- to 10-day forecast-based operations; (3) pre-release and limited storage releases through the Folsom South Canal for groundwater banking in the south basin (focusing on the rural areas); and (4) groundwater banking through rural area spreading grounds along the Consumes River for water market opportunities and Cosumnes River flow augmentation benefits.

Key assumptions for the banking operations include: (1) recharge capacity of 10 TAF/year (limited by recharge basins capacity), (2) up to 50 TAF /year extraction/recovery capacity, (3) maximum allowable storage limited to 300 TAF, (4) leave-behind of 5 percent of recharged volume, and (5) annual loss 1 percent of banked water volume.

Contribution to Regional Water Supply Reliability

Expanded groundwater banking during wetter conditions would enhance groundwater sustainability. The groundwater banking operations would use recharge basins along the Cosumnes River using redirected flood releases to Folsom South Canal that would otherwise have spilled from Folsom Dam. Limited allowable storage of up to 60 days would be used to extend the period over which redirected spills could be capture and conveyed to recharge basins. Recharged surface water during wetter periods (Delta excess conditions) would be used create banked water, subject to leave-behind requirement and an annual storage loss. This banked water would contribute to improving groundwater overdraft conditions in the south American River groundwater subbasin; therefore, enhancing sustainability and drought resiliency.

Contribution to Reclamation's Operational Flexibility Benefits

Regional groundwater banking would provide CVP water supply benefits and operation flexibility. Banked CVP water supplies during wetter periods could be used by Project Partners, and an equal amount of surface water would be made available at Folsom Reservoir for Reclamation to meet south-of-Delta CVP contractors' needs.

During dryer conditions, the region could use banked groundwater to make up for the reduction in surface water supplies made available to banking partners. The banked water could be pumped during drier conditions by:

- Urban surface water users and their foregone surface water diversions would be stored in Folsom Reservoir for use by Reclamation and/or other partners

- Agricultural recycled water users in South Sacramento County, where the foregone recycled water would be released to the Sacramento River for use by Reclamation to meet CVP contractor demands or environmental requirements.

Figure 4-20 shows the simulated recharge and withdrawals of the banking operations under 2070 Central Tendency climate scenario. Table 4-2 shows that recharged surface water would average 32 to 19 TAF/year. Recovered banked water would average 13 to 27 TAF/year.

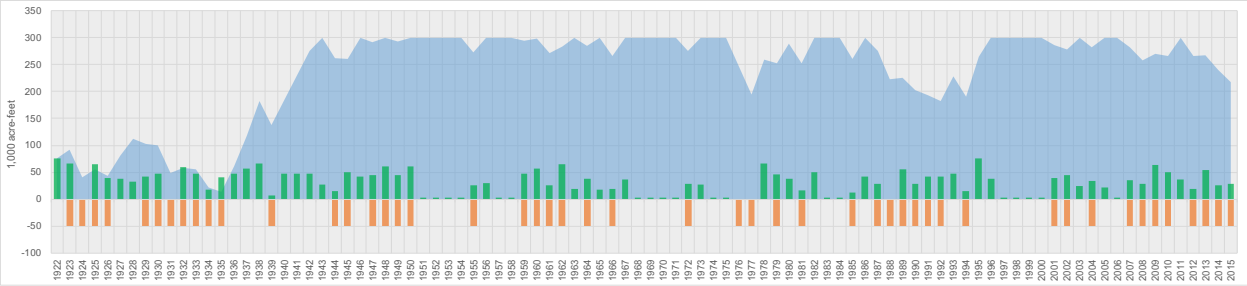

Figure 4-20. Simulated Recharge and Withdrawals of the Folsom Dam Raise with Groundwater Banking Portfolio under 2070 Central Tendency Climate Scenario

Table 4-2. Simulated Results of Folsom Dam Raise with Groundwater Banking Portfolio

	2070 Central Tendency	2070 Hot-Dry	2070 Wet-Warm
Recharge (TAF/year)	32.3	32.2	19.3
Recovery (TAF/year)	26.1	27.3	13.3
Loss (TAF/year)	4.0	3.7	3.7
Groundwater Bank Storage (TAF)	237.2	205.7	276.5

Key:
TAF = 1,000 acre-feet

Contribution to Flood Management

By coordinating pre-releases and limited storage releases upstream of Folsom Reservoir together with Folsom Reservoir operations, this portfolio would lead to increased flood protection downstream throughout the Lower American River. Additionally, raising Folsom Dam would provide additional storage that would improve operational flexibility for Folsom Reservoir operators. In addition to the Dam raise benefits, groundwater recharge would reduce Folsom Dam spills by 32 TAF/year on average.

Contribution to Ecosystem Benefits

Figure 4-20 and Table 4-2 show that the Portfolio would contribute 205 to 276 TAF of banked water to increase groundwater storage in the South American River groundwater subbasin over the 93-year simulation period. This banked water would contribute to reversing groundwater overdraft conditions, which in combination with other initiatives, would accelerate achieving the goal of reestablishing hydraulic connectivity between the groundwater aquifer and the Consumes

River. This hydraulic connectivity is key in support efforts for ecosystem restoration along the Consumes River, which is also an important tributary to the Delta.

In addition, Project Partners may coordinate with Reclamation to switch from surface diversions (including their CVP deliveries) to use of banked groundwater to enhance cold water conditions in Folsom Reservoir and downstream in the American and Sacramento Rivers. Foregone deliveries stored in Folsom Reservoir can be released to maximize fall temperature benefits in the American River.

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Chapter 5 Findings

Reclamation Benefits

- **30 TAF** (9%)[1] increase in CVP allocation in Wetter Years [Alder Creek]
- **24 TAF** (7%)[1] increase to CVP allocation in Most Years [Sac Div]
- **47 TAF** (15%)[1] increase in CVP allocation in Drier Years [GW Bank]

Regional Benefits

- **68 TAF** Reliable Foothills supply in Most Years [Alder]
- **45 TAF** Drought Protection Valley Floor supply [Sac Div]
- **47 TAF** Drought Protection Valley Floor supply [GW Bank]
- **55 TAF** Regional water supply by assuring renewal of CVP LT Contracts [CVP LTC]

Fish and wildlife habitat

140 TAF Higher Folsom Jun-Nov Folsom Reservoir Storage [M.FMS]

53 TAF increased lower American river flows [Sac Div]

Flood Reduction Benefits

22 TAF Flood Reduction Benefit [SAFCA]

65 TAF Flood Reduction Benefit [Alder Creek Reservoir]

Systemwide CVP and SWP water supply: Across all Adaptation Portfolios, the CVP and SWP long-term exports and Delta outflows showed less than a 2% change from the future baseline. Generally, the water supply yield developed in the ARBS portfolios are about 20-70 TAF, and are relatively minor when compared to systemwide hydrology, especially during periods of high flows.

While volumes of less than 20-70 TAF of benefits are relatively small in regard to systemwide operations, such volumes are significant to the Reclamation's operations in the American River Basin, considering that the American River CVP M&I Contracts total 313.7 TAF.

[1] Percent of total American River CVP M&I Contracts (313.7 TAF)