

## Benefit Calculation, Monetization, and Resiliency Tab

### Attachment 12: Uncertainty Analysis

*A.12 Attach the uncertainty analysis. See regulations section 6004(a)(8).*

*WSIP Application Instructions, March 2017*

#### Response

This attachment describes the analysis of sources of uncertainty for Sites Reservoir. Such sources include climate change, future projects and water management actions, water supply projects, and drought performance.

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# Sites Reservoir Project Sources of Uncertainty Analysis

August 9, 2017

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## Acronyms and Abbreviations

Authority	Sites Project Authority
CALFED	CALFED Bay-Delta Program
cfs	cubic feet per second
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
CWC	California Water Commission
Delta	Sacramento-San Joaquin River Delta
DEW	Drier/Extreme Warming
DWR	California Department of Water Resources
GCID	Glen Colusa Irrigation District
M&I	municipal and industrial
MAF	million acre-foot (feet)
Operations Plan	Sites Reservoir Project Operations Plan
Reclamation	Bureau of Reclamation
SWP	State Water Project
SWRCB	State Water Resources Control Board
TAF	thousand acre-feet
T-C Canal	Tehama-Colusa Canal
TCCA	Tehama-Colusa Canal Authority
TRR	Terminal Regulating Reservoir
WMW	Wetter/Moderate Warming
WSIP	Water Storage Investment Program

# Introduction

Sites Reservoir is able to provide operational flexibility to sustain both public and non Proposition 1 benefits under a range of future uncertain conditions including climate change, potential future projects and water management actions, and severe extended droughts. As an off-stream reservoir located in the Sacramento Valley north of the Sacramento-San Joaquin River Delta, Sites Reservoir provides a unique opportunity to provide public physical benefits and improve the operation and resiliency of the Central Valley water system.

The with-project conditions include a 1.81-million-acre-foot (MAF) reservoir, which would be located in the Sacramento Valley west of the town of Maxwell, and associated conveyance facilities including use of existing Tehama-Colusa Canal (T-C Canal) and Glenn-Colusa Irrigation District (GCID) Main Canal diversion and conveyance facilities, plus a proposed new diversion and discharge pipeline. The proposed reservoir would be filled by diversion of excess Sacramento River water that originates from unregulated tributaries to the Sacramento River downstream from Keswick Dam. These flows are “excess” to those needed to meet current regulatory requirements or other water demands.

Operation of the proposed reservoir would be in cooperation with the operations of existing Central Valley Project (CVP) and State Water Project (SWP) system facilities to facilitate and maximize the potential for a wide range of benefits.

The operation of Sites Reservoir Project would allow for the development and administration of an ecosystem enhancement storage account (EESA) that could be managed by the State to provide water for ecosystem and water quality purposes. Such an account would provide a pool of dedicated storage to manage in cooperation with existing operations to improve coldwater conservation storage, stabilize river flows during critical fisheries periods, increase flows through certain watercourses and/or facilities (such as, Yolo Bypass), improve water quality, and/or enhance habitat restoration.

Sites Reservoir Project would be operated in cooperation with CVP and SWP operations to coordinate releases from Shasta Lake, Lake Oroville, and Folsom Lake. Releases from Sites Reservoir would allow reduced releases from other reservoirs while still meeting requirements for minimum instream flow objectives, Sacramento River temperature requirements, and Delta salinity control assigned to CVP and SWP. Through this reduction in releases, storage could be conserved in Shasta Lake, Lake Oroville, and Folsom Lake to significantly increase operational flexibility to improve river water temperatures for fish survival, Delta water quality, flood control, and recreation.

Sites Reservoir Project EESA operations would achieve multiple public benefits over a wide range of hydrologic conditions. These public benefit objectives include the following actions:

- Increase coldwater pool conservation in Trinity Lake, Shasta Lake, Lake Oroville, and Folsom Lake
- Help regulate Sacramento River summer flows for best use of cold water for control of temperature conditions adverse to anadromous fish
- Provide (via upstream actions) incidental Delta water quality improvements in the summer and fall
- Stabilize Sacramento River fall flows for improving spawning and rearing success of anadromous fish
- Provide water to the Yolo Bypass to support salmon migration and summer food production for delta smelt
- Provide water to increase the quantity and frequency of deliveries to Level 4 refuge deliveries per CVPIA

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In dry and critically dry years Sites Reservoir operations as proposed would prioritize improving Shasta Lake storage to preserve coldwater and improve water temperatures in the Sacramento River to protect Chinook salmon.

The following sections describe how the expected public physical benefits would be provided and sustained under the following sources of uncertainty:

- Climate Change
- Future Project and Water Management Actions
- Drought
- Other Sources of Uncertainty

## Climate Change

The California Water Commission (CWC) provided three CalSim II models that represent a range of climate scenarios under year 2070 conditions. The primary WSIP 2070 model is required to be used as the basis for the analysis of project operations as part of the WSIP application. The two other models provided by the CWC represent alternative extreme climate scenarios. One is characterized by Wetter/Moderate Warming (WMW) conditions and other by Drier/Extreme Warming (DEW) conditions. Both climate conditions demonstrate more extreme hydrologic scenarios resulting in increased winter precipitation and reduced winter and spring snowpack, which causes higher winter runoff and reduced spring snow melt and decreased inflows to Central Valley rim reservoirs. In the WMW scenario there is increased precipitation and higher reservoir inflows and storage levels, and fewer dry years. In the DEW scenario, there are longer more severe dry periods and decreased reservoir inflows. These scenarios provide a range of uncertainty to allow evaluation of how the benefits of the project can be sustained under potential future extreme climate conditions.

Investigatory level analyses were performed for both the WMW and DEW scenarios with the inclusion of the Sites Reservoir project. These model runs were conducted as a sensitivity analysis and are not refined to a level where their numerical results can be used directly, but the results provide a strong indication of how the project will perform under these extreme future climate conditions.

The public benefits provided by Sites Reservoir are largely dependent on the capability to divert Sacramento River water into the reservoir when all other regulatory and water right requirements are met. In both the WMW and DEW climate scenarios, the average annual diversion to Sites Reservoir illustrates the resiliency of the project, as diversions are only reduced by six percent and three percent, respectively, when compared to the base WSIP 2070 model results. The results of the investigatory model runs for the 2070 WMW and DEW climate scenarios demonstrate that Sites Reservoir operations can be adapted to future conditions and provide sustained public benefits as described below.

## Operational Flexibility

Sites Reservoir has the operational flexibility to deliver water to provide public benefits where and when it is needed most, based on changing conditions and ecosystem priorities. In the 2070 WMW climate scenario, less water is needed to preserve the coldwater pool in Shasta Lake, Lake Oroville, and Folsom Lake due to wetter hydrologic conditions, so more water can be prioritized for other public benefits such as late summer deliveries to the Yolo Bypass and increasing the quantity and frequency of deliveries to wildlife refuges.

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In the 2070 DEW climate scenario, more public benefit water is needed to increase storage in Shasta Lake and other Central Valley reservoirs to preserve coldwater pools and enhance water temperature management for salmonids. Therefore, EESA operations may be adapted to emphasize coldwater pool management and less public benefit water could be allocated to other purposes.

## EESA in Sacramento Valley Reservoirs

Increased water storage in Shasta Lake, Lake Oroville, and Folsom Lake would benefit salmonids through the conservation of coldwater pool in each reservoir and improved temperature management downstream. The additional water storage also provides the flexibility to release more water when needed to maintain stable flows for salmon habitat to provide better spawning and rearing conditions.

In the 2070 WMW climate scenario, increased inflows to Sacramento Valley reservoirs lead to higher storage levels. In this scenario, less public benefit water is needed to increase Shasta Lake and Lake Oroville storage since the reservoirs have sufficient water to provide flow stabilization and temperature management. Average annual September storage in Shasta Lake and Lake Oroville is increased slightly compared to the base WSIP 2070 condition. The primary benefit is a significant increase of 12 percent in average annual Folsom Lake storage in September to provide improved coldwater pool and flow management in the American River. This demonstrates the operational flexibility of the Sites Reservoir project to provide water for public benefits in responses to future climate change.

In the 2070 DEW climate scenario, public benefit water from Sites Reservoir can be used to significantly increase storage in central valley reservoirs year-round. During dry periods, there is sufficient EESA water in Sites Reservoir to support increased storage in Shasta Lake, Lake Oroville, and Folsom Lake compared to the without project WSIP 2070 condition. During critical drought periods, the average September storage in Shasta Lake is increased by 19 percent, Lake Oroville is increased by 14 percent, and Folsom Lake is increased by 10 percent, respectively. These storage increases help preserve and maintain coldwater in these reservoirs which provides operational flexibility to improve temperature management and downstream habitat for salmonids.

## Yolo Bypass

In both the 2070 WMW and DEW climate scenarios, Sites Reservoir has adequate water stored in the EESA to sustain public benefit flows to the Yolo Bypass in the late summer and early fall through the Colusa Basin Drain and Knights Landing Ridge Cut. In the 2070 WMW scenario, water deliveries to the Yolo Bypass occur in over 90 percent of the years, as compared to 70 percent in the base WSIP 2070 condition.

In the 2070 DEW climate scenario, water is delivered to the Yolo Bypass in over 50 percent of the years, as compared to 70 percent in the base WSIP 2070 condition. In this scenario, Shasta Lake and other reservoir storage levels are lower so more EESA water from Sites Reservoir is dedicated to preserving storage and coldwater in Shasta Lake, Lake Oroville, and Folsom Lake. Therefore, slightly less EESA is delivered to the Yolo Bypass.

## Refuge Deliveries

In both the 2070 WMW and DEW climate scenarios, Sites Reservoir has adequate water stored in the EESA to sustain public benefit deliveries to wildlife refuges in the Central Valley to meet CVPIA Level 4 targets. In the 2070 WMW scenario, Level 4 refuge deliveries increase due to more available water in storage. In the 2070 DEW scenario, refuge deliveries would possible decrease as EESA operations shift to support the conservation of coldwater in Shasta Lake, Lake Oroville, and Folsom Lake for dry and critical year temperature management.

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## Non-Proposition-1 Water Supply Benefits

Water deliveries to project participants would be sustained under potential future extreme climate conditions as diversions of excess Sacramento River flow to storage only decrease slightly as noted previously. CVP and SWP project water deliveries are reduced under these two extreme conditions, as compared to the without project WSIP 2070 condition. Therefore, water deliveries from Sites Reservoir in the 2070 WMW and DEW climate scenarios to supplement existing water sources provides additional water supply reliability under these future extreme climate conditions.

## Future Projects and Water Management Actions

This uncertainty analysis of future projects and water management actions is consistent with the list of projects evaluated in the Draft EIR/EIS cumulative impact assessment

The projects and actions identified are organized in the following groups:

- Multi-regional water resources projects and actions
- Water supply projects
- Ecosystem improvement projects and actions

Qualitative descriptions of the potential effects to public physical benefits, as well as potential improvements are provided below. Some of the descriptions are based on rough investigatory analyses or post-processing of WISP 2070 results to attempt to characterize the operational flexibility to sustain public benefits under these potential future conditions.

### Multi-region Projects and Actions

The multi-region projects and actions considered in this discussion that may affect the potential public benefits are:

- Bay-Delta Water Quality Control Plan Update
- Bay Delta Conservation Plan/California WaterFix
- Sustainable Groundwater Management Act (SGMA)
- Reclamation and DWR Request for Reinitiation of Section 7 Consultation Addressing the Long-term Operation of the CVP and SWP (also referred to as Reconsultation)
- NMFS Public Draft Recovery Plan for Sacramento River Winter run Chinook Salmon, Central Valley Spring-run Chinook Salmon, and Central Valley Steelhead
- U.S. Fish and Wildlife Service (USFWS) Recovery Plan for the Sacramento-San Joaquin Delta Native Fishes

### Bay-Delta Water Quality Control Plan Update

The State Water Board is in the process of developing and implementing updates to 2006 WQCP that protect beneficial uses in the Bay-Delta watershed. This update is broken into four phases, some of which are proceeding concurrently. Phase 1 of this work, currently in progress, involves updating San Joaquin River flow and southern Delta water quality requirements for inclusion in the WQCP. Phase 2 will involve comprehensive changes to the WQCP to protect beneficial uses not addressed in Phase 1, focusing on Sacramento River driven standards. Phase 3 will involve implementation of Phases 1 and 2 through changes to water rights and other measures; this phase requires a hearing to determine the

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appropriate allocation of responsibility between water rights holders within the scope of the Phase 1 and Phase 2 plans. Phase 4 will involve developing and implementing flow objectives for priority Delta tributaries upstream of the Delta.

There is considerable uncertainty associated with the future development and implementation of flow criteria in the Sacramento River watershed to address tributary-specific public trust needs and other beneficial uses. Water stored in the EESA in Sites Reservoir could be used to enhance public benefit objectives in addition to public trust needs over a wide range of potential future regulatory and operational conditions. The EESA provides the operational flexibility to manage the water associated with the Sites Project to the highest priority needs on an adaptive management basis. Implementation of actions to provide public benefits will be adaptively managed on a continuing basis in response to changing system characteristics (such as reservoir storage), ecological needs, forecasts of future hydrologic conditions, and system operations.

Total average annual diversions of excess Sacramento River flow to Sites Reservoir, based on CalSim II model results, for future 2070 conditions are 588 TAF. The volume of excess flow available for diversion in between December and March allows the seasonal timing of diversions during storm events to be adapted to potential future regulatory requirements. Examples of potential adaption measures include shifting the timing of primary diversion periods (including day-night operations to avoid salmon movements that occur predominantly during dark hours), shifting facility operations and maintenance periods, and shifting diversions between the three intake locations. Therefore, the project has the operational flexibility to adapt diversion, storage, and release operations to provide public physical benefits such as coldwater pool management, refuge deliveries, and Yolo Bypass flow enhancement under a range potential future regulatory regimes.

## Bay Delta Conservation Plan/California WaterFix

California Bay Delta Conservation Plan and the California WaterFix are being developed by federal and State agencies and other stakeholders to achieve the dual goals of a reliable water supply for California and a healthy California Bay-Delta ecosystem that supports the State's economy. The program would construct a new diversion and conveyance facility, modify operation of existing CVP and SWP Delta facilities, and reduce ecological stressors that impair the function or the use of the Delta by aquatic and terrestrial resources. The preferred project would convey water under the existing water rights held by DWR and Reclamation; however, DWR and Reclamation have requested changes in the points of diversion for these water rights. The existing 2008 USFWS and 2009 NMFS biological opinions will continue to be implemented until construction of the WaterFix is complete and Reclamation has submitted additional information or a request for reconsultation by the end of construction of the preferred project.

Investigatory level analyses were conducted to assess the interaction between the Sites Reservoir and the proposed WaterFix operations. These investigatory analyses were only developed for sensitivity evaluation purposes, but they do provide an indication of the potential performance of Sites Reservoir in coordination with WaterFix. The results indicate that there is sufficient excess Sacramento River flow available downstream of the Delevan Intake to avoid conflicts between the two projects. The spring outflow criterion for March through May proposed as part of the WaterFix operations would have minimal impacts on diversions to Sites Reservoir as the majority of Sites diversions occur between December and February. The seasonal timing of Sites Project diversions could be shifted to reduce or avoid diversions in March by changing Tehama Colusa Canal Authority (TCCA), Glen Colusa Irrigation District (GCID), and Sites Project facility operations and maintenance periods. Sites Project operations are designed to store water during wet periods and then release water later during periods of critical public benefit need. The investigatory analyses indicate the project has the operational flexibility to shift

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the timing of diversions, reservoir storage, and release operations to maintain and potential enhance public physical benefits such as coldwater pool management, refuge deliveries, and Yolo Bypass flow enhancement in cooperation with WaterFix facility operations.

## Sustainable Groundwater Management Act

The Sustainable Groundwater Management Act of 2014 (SGMA) provides a framework for long-term sustainable groundwater management across California. Under the legislation, local and regional authorities in medium and high priority groundwater basins will form Groundwater Sustainability Agencies (GSAs) that oversee the preparation and implementation of a local Groundwater Sustainability Plan (GSP). Local stakeholders have until 2017 to organize themselves in Groundwater Sustainability Agencies. Groundwater Sustainability Plans will have to be in place and implementation begun sometime between 2020 and 2022. GSAs will have until 2040 to achieve groundwater sustainability.

No groundwater benefits have been monetized; however, the Sites Reservoir project would potentially beneficially affect groundwater basins within service areas of project participants, particularly those within the Sacramento River Hydrologic Region. Some of the participants are designated as a GSA for affected groundwater basins, including but not limited to Colusa County, Colusa County Water District, Santa Clara Valley Water District, and Zone 7 Water Agency. Many other agencies participating in the Sites Project also participate in Groundwater Sustainability Agencies. These member agencies will be involved in the future integration of the Sites Project into their respective Groundwater Sustainability Plans (GSPs). Coachella Valley Water District, Desert Water Agency, Santa Clara Valley Water District, and Zone 7 Water Agency have each submitted prescribed Alternatives to a GSP, consisting of groundwater management plans or an analysis of basin conditions. The Sites Reservoir Project could be incorporated into future updates of these Alternatives.

In addition, Sites participants: Desert Water Agency, California Water Service, San Bernardino Valley Municipal Water District, Metropolitan Water District of Southern California and San Geronio Pass Water Agency are affiliated with adjudicated groundwater basins. Antelope Valley - East Kern Water Agency is affiliated with a groundwater basin that is pending adjudication. Water deliveries from the Sites Reservoir Project could be incorporated into the management strategy for these basins. The associated operations by participating agencies with adjudicated basins would be included in annual monitoring and reporting activities. Additional analysis is provided under the ELIGIBILITY TAB in attachment Sites\_A6C Groundwater Basins.

## Reclamation and DWR Request for Reinitiation of Section 7 Consultation Addressing the Long-term Operation of the CVP and SWP (Reconsultation)

On August 2, 2016, Reclamation and DWR requested the USFWS and NMFS to reinitiate consultation under Section 7 of the Endangered Species Act of the Long-term Coordinated Operation of the CVP and SWP to review the Reasonable and Prudent Alternative presented in the 2008 USFWS Biological Opinion and 2009 NMFS Biological Opinion, respectively. This request for reconsultation was based upon new information collected and analyzed during multiple years of drought, additional data that indicated continued low Delta smelt populations, and new information being developed during ongoing collaborative science processes (e.g., Collaborative Science and Adaptive Management Team and Collaborative Adaptive Management Team processes). Reclamation and DWR also requested that the California Department of Fish and Wildlife participate in this ongoing program.

There is considerable uncertainty associated with the potential outcome of reinitiation of Section 7 consultation for the long-term operations of the CVP and SWP. Water stored in the EESA in Sites

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Reservoir could be used in cooperation with CVP/SWP operations to enhance public benefits over a wide range of conditions. The EESA provides the operational flexibility to manage the water associated with the Sites Project to the highest priority needs on an adaptive management basis. Implementation of actions to provide public benefits would be evaluated on a continuing basis in response to changing system parameters, ecological needs, forecasts of future hydrologic conditions, and system operations. For example, as described in the operations plan, water stored the EESA in Sites Reservoir could be exchanged for water normally delivered from other Sacramento Watershed reservoirs and by that exchange Sites EESA water would be “backed” into Lake Shasta, Oroville, or Folsom to increase water storage and thereby help preserve the coldwater pool to enhance fisheries benefit operations.

It is not anticipated that the outcome of the reconsultation will change the ability of the Sites Project to divert excess Sacramento River flows into reservoir storage during major storm events. Results of the CALSIM II future WSIP 2070 condition simulation show an average annual diversion of 588 TAF of excess Sacramento River flow to Sites Reservoir. With an average annual volume of about 2 million acre-feet (MAF) of excess flow available, the seasonal timing of diversions during storm events could be adapted to accommodate potential changes in future CVP/SWP operational and regulatory requirements.

Examples of potential adaption measures include shifting the timing of primary diversion periods, shifting facility operations and maintenance periods, and shifting diversions between the three intake locations. Therefore, the project has the operational flexibility to adapt diversion, storage, and release operations to provide public physical benefits such as coldwater pool management, refuge deliveries, and Yolo Bypass flow enhancement under a range potential future operations and regulatory regimes.

### NMFS Public Draft Recovery Plan for Sacramento River Winter-run Chinook Salmon, Central Valley Spring-run Chinook Salmon, and Central Valley Steelhead

The NMFS Draft Recovery Plan provides a roadmap that describes the steps, strategy, and actions that should be taken to return winter-run Chinook salmon, spring-run Chinook salmon, and steelhead to viable status in the Central Valley, California, thereby ensuring their long-term persistence and evolutionary potential.

Excess Sacramento River flow diversions to Sites Reservoir would only take place when flow monitoring indicates that bypass flows are present in the river due to storm event flows. Several existing and additional proposed bypass flow criteria are designed to make certain only excess water would be diverted into Sites Reservoir to maintain and protect existing downstream water uses. As a mitigation measure to more fully avoid and minimize entrainment and impingement of juvenile salmonids and other poor-swimming aquatic species, diversions to Sites Reservoir would also be restricted to protect fish migration during naturally occurring, storm-induced, pulse flow events in the Sacramento River. The proposed pulse protection period would extend from October through May to address outmigration of juvenile winter-, spring-, fall- and late-fall-run Chinook salmon, as well as steelhead.

Due to the combination of operational flexibility and mitigation measures to protect fish during outmigration, it is not anticipated that the NMFS Recovery Plan will change the ability of the Sites Project to provide identified public physical benefits. Water stored in the EESA in Sites Reservoir could be used in cooperation with CVP/SWP operations to enhance public benefits to support chinook salmon, steelhead and sturgeon. The EESA provides the operational flexibility to manage the water associated with the Sites Project to the highest priority needs on an adaptive management basis. As described above, water in stored the EESA in Sites Reservoir could be exchanged and “backed” into Lake Shasta, Oroville, or Folsom to increase water storage and thereby help preserve the coldwater pool to enhance fisheries temperature and flow management operations.

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There are number of options being evaluated by the Yolo Bypass-Salmonid Habitat Restoration and Fish Passage Project to modify Fremont Weir to pass a range of flows between 3,000 and 12,000 cfs to provide fish passage and extend periods of inundation. Investigatory level analyses were conducted to provide an indication of the performance of Sites Reservoir operations in coordination with the fish passage project. The results indicate that there is sufficient excess Sacramento River flow available downstream of the Delevan Intake to avoid conflicts with potential future Fremont Weir modifications and operations. Sites Reservoir water could also be released to the Sacramento River or through the Colusa Basin Drain and Knights Landing Ridge Cut to supplement flows into the Yolo Bypass to increase flow levels to promote activation of the flood plain and extend periods of inundation. This concept could also be applied to other isolated floodplains and future weir modifications.

The investigatory analyses indicate the Sites Project has the operational flexibility to shift the timing of diversions, reservoir storage, and release operations to maintain and potentially enhance public physical benefits such as coldwater pool management, refuge deliveries, and Yolo Bypass flow enhancement in cooperation with actions included in the NMFS Public Draft Recovery Plan.

### USFWS Recovery Plan for the Sacramento-San Joaquin Delta Native Fishes

The USFWS Recovery Plan addresses the recovery needs for several fish species that occupy the Delta, including delta smelt, Sacramento splittail, longfin smelt, green sturgeon, Chinook salmon (spring-run, late fall-run, and San Joaquin fall-run), and Sacramento perch (believed to be extirpated). The objective of the plan is to establish self-sustaining populations of these species that will persist indefinitely. This would be accomplished by managing the estuary to provide better habitat for aquatic life in general and for the fish addressed by the plan. Recovery actions include tasks such as increasing freshwater flows; reducing entrainment losses to water diversions; reducing the effects of dredging, contaminants, and harvest; developing additional shallow-water habitat, riparian vegetation zones, and tidal marsh; reducing effects of toxic substances from urban non-point sources; reducing the effects of introduced species; and conducting research and monitoring.

Excess Sacramento River flow diversions to Sites Reservoir would only take place when flow monitoring indicates that bypass flows are present in the river due to storm event flows. Several existing and additional proposed bypass flow criteria are designed to make certain only excess water would be diverted into Sites Reservoir to maintain and protect existing downstream water uses. As a mitigation measure to more fully avoid and minimize entrainment and impingement of juvenile salmonids and other poor-swimming aquatic species, diversions to Sites Reservoir would also be restricted to protect fish migration during naturally occurring, storm-induced, pulse flow events in the Sacramento River. The proposed pulse protection period would extend from October through May to address outmigration of juvenile winter-, spring-, fall- and late-fall-run Chinook salmon, as well as steelhead and other anadromous fish.

It is not anticipated that the USFWS Recovery Plan will change the ability of the Sites Project to provide identified public physical benefits. Water stored in the EESA in Sites Reservoir could be used in cooperation with CVP/SWP operations to enhance public benefits to support fish species in the Delta. The EESA provides the operational flexibility to manage the water in Sites Reservoir storage for the highest priority needs on an adaptive management basis. Water stored the EESA in Sites Reservoir could be released through the Colusa Basin Drain and Knights Landing Ridge Cut during summer and fall months (i.e., August through October) to help increase productivity in the Yolo Bypass in the lower Cache Slough and lower Sacramento River areas to increase desirable food sources for Delta smelt and other key fish species.

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## Water Supply Projects

The water supply projects considered that may affect potential public benefits include:

- Shasta Lake Water Resources Investigation
- North Bay Aqueduct Alternative Intake
- Los Vaqueros Reservoir Expansion Phase II

### Shasta Lake Water Resources Investigation

The Shasta Lake Water Resources Investigation is currently being conducted by Reclamation to determine the type and extent of federal interest in a multiple purpose plan to modify Shasta Dam and Reservoir to increase the survival of anadromous fish populations in the upper Sacramento River and increase water supplies and water supply reliability for agricultural, municipal, industrial, and environmental purposes. To the extent possible through meeting these objectives, alternatives include features to benefit other identified water and related resource needs including ecosystem conservation and enhancement, improved hydropower generation capability, flood damage reduction, increased recreation opportunities, and improved water quality conditions in the Sacramento River and the Delta. Anticipated alternatives for expansion of Shasta Lake include, among other features, raising the dam from 6.5 to 18.5 feet above current elevation, which would result in additional storage capacity of 256,000 to 634,000 acre-feet, respectively. The increased capacity is expected to improve water supply reliability and increase the coldwater pool, which would provide improved water temperature conditions for anadromous fish in the Sacramento River downstream of the dam. The final EIS and Feasibility Study for the project were completed in July/August 2015.

Investigatory level analyses were conducted to assess the interaction between Sites Project operations and the proposed increase to Shasta Lake storage capacity. These investigatory analyses provide an indication of potential performance of Sites Project in coordination with an increase in storage in Shasta Lake. Sites Reservoir would be filled through the diversion of excess Sacramento River water that originates from unregulated tributaries to the Sacramento River downstream from Keswick Dam. Less than 1 percent of diversions to Sites Reservoir are assumed to be provided by flood releases or spills that flow through Shasta Lake. Therefore, there is sufficient excess Sacramento River flow available downstream of Keswick Dam so there is no conflict between the two facility operations.

As proposed, the increase in Shasta Lake storage will not change the ability of the Sites Project to provide identified public physical benefits. Water stored in the EESA in Sites Reservoir could be used in cooperation with CVP/SWP operations to enhance public benefits to support chinook salmon and steelhead. The EESA provides the operational flexibility to manage the water in Sites Reservoir storage to the highest priority needs on an adaptive management basis. As described above, water stored in the EESA in Sites Reservoir could be exchanged and “backed” into Shasta Lake to increase water storage and thereby help preserve the coldwater pool to enhance fisheries temperature and flow management. Increased storage capacity in Shasta Lake could provide additional opportunity to exchange water into storage in Shasta Lake and preserve coldwater resources during critical periods.

### North Bay Aqueduct Alternative Intake

DWR issued a Notice of Preparation on December 2, 2009 to construct and operate an alternative intake on the Sacramento River, generally upstream of the Sacramento Regional Wastewater Treatment Plant, and connect it to the existing North Bay Aqueduct system by a new segment of pipe. The proposed alternative intake would be operated in conjunction with the existing North Bay Aqueduct intake at Barker Slough. The project would be designed to improve water quality and to provide reliable deliveries

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of SWP supplies to its contractors, the Solano County Water Agency, and the Napa County Flood Control and Water Conservation District (DWR, 2011).

Based on a review of potential operations, it is not anticipated that the alternative intake project will affect the ability of the Sites Project to provide identified public physical benefits.

## Los Vaqueros Reservoir Expansion Phase II

Los Vaqueros Reservoir is an off-stream reservoir in the Kellogg Creek watershed to the west of the Delta. The Los Vaqueros Reservoir initial construction was completed in 1997 as a 100,000 acre-foot off-stream storage reservoir owned and operated by Contra Costa Water District (CCWD) to improve delivered water quality and emergency storage reliability for CCWD's customers. In 2012, the Los Vaqueros Reservoir was expanded to a total storage capacity of 160,000 acre-feet (Phase 1) to provide additional water quality and supply reliability benefits, and to adjust the timing of its Delta water diversions to accommodate the life cycles of Delta aquatic species, thus reducing species impact and providing a net benefit to the Delta environment. An additional expansion up to 275,000 acre-feet (Phase 2) is being evaluated by CCWD.

Preliminary investigatory level analyses conducted to assess the interaction between the Sites Project and the proposed Los Vaqueros expansion indicate that there is sufficient excess Sacramento River flow available downstream of the Delevan Intake to avoid conflicts between the two operations. Los Vaqueros Reservoir is located in the Delta which is the lowest point in the watershed, therefore it is the location with the greatest amount of surplus. The seasonal timing of Sites diversions between December and May could be coordinated with Los Vaqueros operations to maximize public benefits of both projects.

## Ecosystem Improvement Projects and Actions

The ecosystem improvement projects and actions considered in the cumulative impact assessment that may affect or be enhanced by potential public benefits include:

- Yolo County HCP/Natural Community Conservation Plan (NCCP)
- Yolo Bypass Wildlife Area Land Management Plan
- Cache Slough Complex Restoration

## Yolo County Habitat/Natural Community Conservation Plan

The Yolo County Habitat Joint Powers Authority, consisting of five local public agencies, launched the Yolo Natural Heritage Program in March 2007. This effort includes the continuing preparation of a joint HCP/NCCP. Member agencies include Yolo County and the Cities of Davis, Woodland, West Sacramento, and Winters. The HCP/NCCP describes the measures that local agencies will implement in order to conserve biological resources, obtain permits for urban growth and public infrastructure projects, and continue to maintain the agricultural heritage and productivity of Yolo County.

The Sites Reservoir Project has the ability to enhance public physical benefits in the Yolo bypass through the release water through the Colusa Basin Drain and Knights Landing Ridge Cut during summer and fall months (i.e., generally August through October when adequate capacity of the Colusa Basin Drain is available) to help increase fish productivity in the Yolo Bypass in the lower Cache Slough and lower Sacramento River areas. Building on what was learned in the 2016 pilot project, these enhancement flows will increase desirable food sources for Delta smelt and other key fish species in the late summer and early fall. In addition, releases of Sites EESA water into the bypass could be timed to provide water flows, depths, and durations to benefit other aquatic and terrestrial wildlife.

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Other Sites Project water release patterns to augment other environmental programs would be reasonable to consider in cooperation with future unrelated actions (e.g.; the new operational notching of the Fremont weir to support riparian and wetland habitat restoration in the Yolo Bypass) associated with the HCP/NCCP measures or the Central Valley Flood Protection Program.

## Yolo Bypass Wildlife Area Land Management Plan

The Yolo Bypass Wildlife Area consists of approximately 16,770 acres of managed wildlife habitat and agricultural land within the Yolo Bypass. The bypass conveys seasonal high flows from the Sacramento River to help control river stage and protect the cities of Sacramento, West Sacramento, and Davis, as well as other local communities, farms, and lands from flooding. Substantial environmental, social, and economic benefits are provided by the Yolo Bypass, benefiting the people of the State of California.

As noted previously, releases of Sites EESA water into the Yolo Bypass could provide water flows, depths, and durations to benefit aquatic species and terrestrial wildlife.

## Cache Slough Complex Restoration

The Cache Slough Complex is located in the northern Delta where Cache Slough and the southern Yolo Bypass meet. It currently includes Liberty Island, Little Holland Tract, Prospect Island, Little Egbert Tract and the surrounding waterways. Levee height on these tracts is restricted and designed to allow overtopping in large flow events to convey water from the upper Yolo Bypass. Since 1983 and 1998 respectively, Little Holland Tract and Liberty Island have remained breached. Restoration is occurring naturally on the islands. Restoration in the Cache Slough Complex was identified as an Interim Delta Action by Governor Schwarzenegger in July 2007.

As noted previously, releases of Sites EESA water into the Yolo Bypass could provide water flows, depths, and durations to benefit aquatic species and terrestrial wildlife.

## Drought Performance

To evaluate project performance during a five-year drought period, the results of the WSIP 2070 with Sites Reservoir simulation were compared to the base without project WSIP 2070 results for the period 1930 through 1934. During extended drought periods, the public benefit operations of Sites Reservoir prioritize increasing storage in Shasta Lake, Lake Oroville, and Folsom Lake to help preserve the coldwater pools and provide releases to maintain appropriate river water temperatures downstream. Public benefit water would also be used for other high priority needs on an adaptive management basis. Implementation of actions to provide public benefits would be evaluated on a continuing basis in response to changing system parameters (such as reservoir storage), ecological needs, forecasts of future hydrologic conditions, and system operations.

Table 1 presents the volume of water in system storage and in the Sites Reservoir EESA that could be used for public benefit over the course of the 5-year drought period. System reservoir storage is typically highest in May and lowest in September after releases have been made over the summer and before the first fall storm events. Sites Reservoir operations increase system storage for public benefits creating operational flexibility to provide manage cold water storage and temperature flows to benefit salmonids. As shown in Table 1, total system storage that could be used for public benefits in the first year of the drought (May of 1930) is 900 TAF declining to 300 TAF in end of the fourth consecutive year of drought (September of 1934).

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Table 1. Sites Reservoir Project Performance During Drought

Increase in Reservoir System Storage with Sites Reservoir over the 5-Year Drought Period From 1930 to 1934						
Year	System Storage for Public Benefits (TAF) (Shasta, Oroville, and Folsom)		Sites EESA for Public Benefits (TAF)		Total Public Storage Benefit (TAF)	
	May	Sep	May	Sep	May	Sep
1930	489	182	416	398	905	581
1931	668	623	253	0	921	623
1932	562	201	165	128	727	329
1933	507	475	103	0	611	475
1934	454	302	172	0	626	302

## Other Sources of Uncertainty

The preceding sections adequately cover the range of potential uncertain future conditions that may affect the public physical benefits identified. As discussed previously, the operation of Sites Reservoir Project would allow for the development and administration of an ecosystem enhancement storage account (EESA) that could be managed by the State to provide water for ecosystem and water quality purposes. The EESA provides the operational flexibility for the State’s resource managers delegated the responsibility to manage the water stored in Sites Reservoir to sustain public benefits to meet future needs on an adaptive management basis.

The volume of excess flow in the Sacramento River available for diversion primarily between December and March allows the seasonal timing of diversions during storm events to be adapted to potential future uncertain conditions. Examples of potential adaption measures include shifting the timing of primary diversion periods, shifting facility operations and maintenance periods, and shifting diversions between the three intake locations. Therefore, the project has the operational flexibility to adapt diversion, storage, and release operations to provide public benefits such as coldwater pool management, refuge deliveries, and Yolo Bypass flow enhancement over a range potential uncertain future conditions.