RTD-1015

DRAFT

California WaterFix Overview

Materials for Discussion and Decision

Compiled by the Kern County Water Agency

CALIFORNIA WATERFIX
RELIABLE. CLEAN. WATER.

NOTE TO READERS

This overview was compiled by Kern County Water Agency (Agency) staff from materials prepared by Paul Weiland and Rob Thornton at Nossaman, LLP, Stefanie Morris, general counsel for the State Water Project Contractors, the Metropolitan Water District of Southern California (Metropolitan) and Agency staff. The Agency thanks Paul, Rob and Stefanie for their contributions, as well as Metropolitan for allowing the Agency to use large portions of its "white papers" on physical facilities of California WaterFix[1] and operation of the California WaterFix.[2]

This overview is a public document and is intended to assist landowners, Agency Member Units and the Board of Directors with making decisions related to California WaterFix. Agency staff has compiled this overview from the best available information developed over 11 years of study and analysis performed by the California Department of Water Resources (DWR). DWR worked with the California Department of Fish and Wildlife (CDFW), the U.S. Bureau of Reclamation (USBR), the U.S. Fish and Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS) and a broad range of stakeholders to develop the concept for California WaterFix, and to perform the environmental analysis necessary to comply with the State and federal Endangered Species Acts, the California Environmental Quality Act and the National Environmental Policy Act, as well as several other State and federal environmental permitting requirements.

This draft version of the overview includes information on the infrastructure that will be constructed, and how that infrastructure will be operated. Additional information on the cost allocation methodology and potential methods for financing California WaterFix will be provided in the next version.

At the time this version of the overview was released, the environmental compliance for California WaterFix was complete for the State Endangered Species Act in the form of a 2081 permit issued by CDFW and for the federal Endangered Species Act in the form of Biological Opinions from USFWS and NMFS. Permits were in process for compliance with sections 401 and 404 of the Clean Water Act, and a permit for a change in point of diversion was under consideration by the State Water Resources Control Board, but potential issuance of that permit was more than a year away. Additional review is necessary by the Delta Stewardship Council, but has not yet started.

[1] Modernizing the System: California WaterFix Infrastructure. http://www.mwdh2o.com/DocSvcsPubs/WaterFix.

[2] Modernizing the System: California WaterFix Operations. http://www.mwdh2o.com/DocSvcsPubs/WaterFix.

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BACKGROUND

The State Water Project (SWP) was originally envisioned to convey water around the Sacramento-San Joaquin Delta (Delta), in a 22,000-cubic feet per second (cfs) canal, from intakes on the Sacramento River to a pumping plant at Clifton Court Forebay. While the SWP facilities at Oroville and in areas south of the Delta were completed in the 1960s, the link between the two that would carry water around the Delta was never built. The failure to construct the Delta conveyance link has forced the California Department of Water Resources (DWR) and the public water agencies (PWAs) it serves to spend the past 50 years working to protect their water supplies from reductions caused by moving water through rather than around the Delta.

During those five decades, the State and federal governments have increased their regulation of the SWP by implementing environmental regulations designed to protect endangered species that reside in or migrate through the Delta. After more than 30 years of environmental restrictions, the protected species remain imperiled. To address the continued decline of endangered species, the PWAs that receive water from the SWP and the Central Valley Project (CVP) have challenged and engaged the regulatory agencies to reduce the impact of environmental regulations that lack a strong scientific basis. The PWAs have created new scientific agencies and avenues of involvement in science that are working to produce better, more scientifically-based protections for endangered species that do not unnecessarily impact water supplies.

The regulatory process that began 30 years ago will continue with or without California WaterFix. Environmental regulations will continue to be imposed on the SWP and CVP by State and federal regulatory agencies in the hope of protecting the Delta's endangered species.

California WaterFix began in 2006 as the Bay Delta Conservation Plan (BDCP), which was structured under Section 10 of the Endangered Species Act (ESA) to provide for the recovery of the Delta's endangered species. The BDCP was intended to provide better protection for endangered species than the protections imposed by regulations, and to restore SWP and CVP exports.

Unfortunately, efforts to reach an agreement with the State and federal regulatory agencies were not successful, and the BDCP was modified to become California WaterFix, which required consultation under Section 7 of the ESA.

The California WaterFix concept has been in development for 11 years. State, federal and local agencies have spent hundreds of thousands of person-hours on the project. The PWAs that fund California WaterFix have invested more than $250 million in planning and environmental compliance documents for the project, and once constructed, the project is estimated to cost $14.9 billion in 2014 dollars. Without question, it is the single largest investment of time, effort and money in finding a solution for the Delta that protects the water supplies for 2.1 million acres of the nation's most productive farmland, more than 26 million Californians and the Delta's endangered species.

This overview compiles 11 years of study and analysis regarding the cost and benefits of California WaterFix. The overview attempts to provide an easy, yet complete reference for California WaterFix that may be used to help decision-makers determine whether to participate in the project.

This overview begins with a short section intended to provide context for the current situation in the Delta. It then provides details about the physical facilities, how they will be constructed and operated, how costs will be shared among the participants and how the project can be financed.

CURRENT REGULATORY CONTEXT AND FORECASTED SWP RELIABILITY

State Water Resources Control Board Water Quality Control Plan

SWCRB's Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (WQCP) identifies the beneficial uses of water in the Delta and establishes the water quality objectives necessary to protect those uses. The current WQCP, as implemented through Water Rights Decision-1641 (D-1641), requires the SWP and CVP to meet the protective standards established by the State Water Resources Control Board (SWRCB). DWR and USBR hold water rights permits that incorporate the applicable requirements of D-1641. DWR and USBR closely coordinate SWP and CVP operations to meet those obligations.

Biological Opinions

In addition to water right permits, DWR and USBR operate the respective projects pursuant to Biological Opinions issued by USFWS and NMFS under the federal ESA. DWR operates the SWP pursuant to an incidental take permit for Longfin smelt issued by CDFW under the state ESA, California Fish and Game Code section 2081(b), and consistency determinations under California Fish and Game Code section 2080.1.

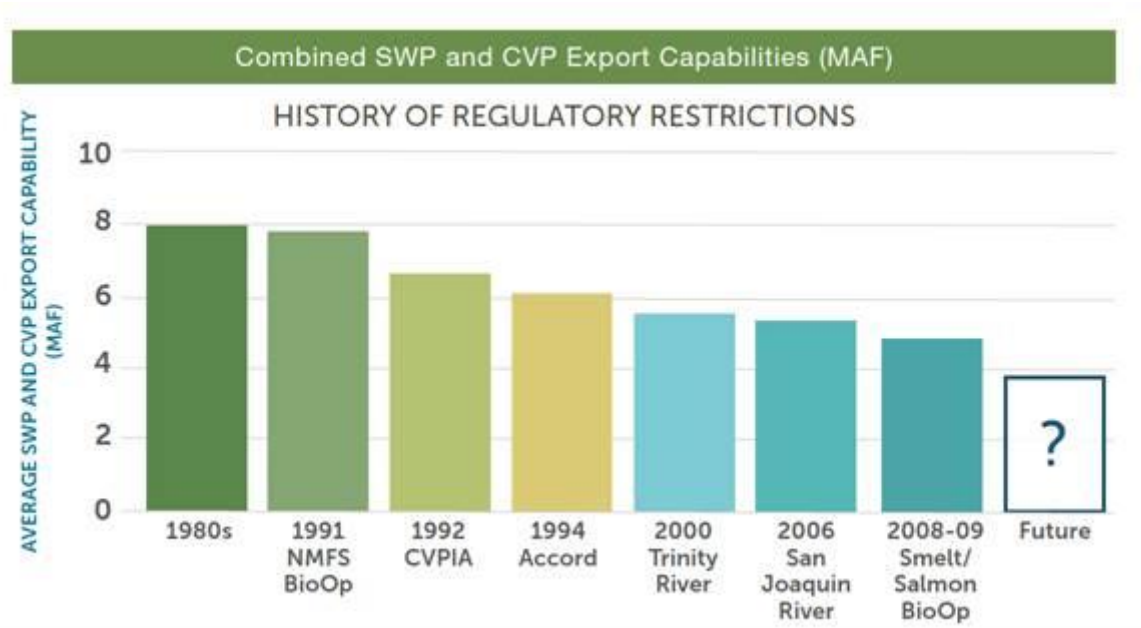
The SWP and CVP facilities have long been impacted by changing regulations governing both projects' diversion facilities in the south Delta. On average, D-1641 has reduced SWP and CVP diversions and increased Delta outflows to the San Francisco Bay by about 300,000 acre-feet (af) a year, as compared to prior Water Rights Decision-1485. Compounding the impacts, the Biological Opinions have decreased diversions and increased outflows by about another 1 million acre-feet (MAF) a year[3].

The increased Delta requirements and export constraints imposed by D-1641 and Biological Opinions issued by USFWS and NMFS in 2008 and 2009, respectively, have further constrained SWP and CVP operations by decreasing operational flexibility, and increasing environmental and water supply vulnerabilities during dry conditions. This, in turn, results in reductions in project reservoir storage, water deliveries and supply reliability. **Figure 1** illustrates the decreases in average SWP and CVP deliveries over time due to additional regulatory requirements. As shown in Figure 1, over the past 25 years, SWP and CVP exports have been reduced by over 3 MAF per year.

California WaterFix is intended to reverse this downward trend and restore pre-Biological Opinion exports.

[3] Source: MBK Engineers and HDR "Retrospective Analysis of Changed Central Valley Project and State Water Project Conditions Due to Changes in Delta Regulations," January 2013

FIGURE 1: HISTORY OF REGULATORY RESTRICTIONS



PURPOSES OF CALIFORNIA WATERFIX

California WaterFix is designed with three main purposes:

1. Allow for more natural flows in the south Delta to benefit salmon, smelt and other species.

2. Increase water supply reliability by the SWP and CVP with more flexibility to move water without harming fish.

3. Guard the SWP and CVP Delta water diversion point from natural disaster disruption, such as earthquake, flood and sea level rise resulting from climate change.

Allow for More Natural Flows

The natural flow in the Delta is from east to west. However, the SWP and CVP pumping plants in the south end of the Delta have the ability to change that flow pattern, or at least to significantly affect it, during some times of the year and during dry years when Delta inflow is limited. This change in the direction of flow is a primary factor considered by the State and federal regulatory agencies when they impose restrictions on the SWP and CVP. The most well-known of these flow-based restrictions is the Old and Middle River (OMR) restrictions. California WaterFix will allow the SWP and CVP to move water across the Delta in tunnels, thereby reducing or eliminating the effects of the SWP and CVP on the south Delta's natural flow direction. Restoring some or all of the south Delta's natural flow direction should result in benefits to the Delta's endangered species.

Increase Water Supply Reliability

The SWP and CVP export water from the same location in the south Delta. When fishery issues arise, the only option is to reduce exports. As a result, SWP and CVP operations are often limited by the lack of an alternative export location. California WaterFix provides additional points of diversion in a

different location in the Delta. The new diversion points on the Sacramento River provide an alternative when use of the south Delta pumping plants are limited by environmental concerns. The ability to coordinate pumping between the north and south Delta points of diversion make both the CVP and the SWP more reliable by increasing the amount of water that can be exported under the existing SWP and CVP water rights in ways that benefit the Delta's endangered species.

Protection from Earthquakes, Floods and Sea Level Rise

Water supplies moved through the Delta are currently protected by a series of levees; many of which are more than 100 years old. The vast majority of levees are well maintained and routinely inspected. However, levee failures resulting from earthquakes or floods remain one of the biggest long-term risks to the SWP and the CVP. More than 60 levee failures have occurred in the Delta for myriad reasons. While none are known to have occurred as a result of earthquakes, the U.S. Geological Survey recently estimated that an earthquake with a magnitude big enough to cause multiple levee failures in the Delta has a 62 percent probability of occurring between 2003 and 2032[4]. In addition, DWR published a report in 2011, Delta Risk Management Study, that estimated an earthquake resulting in multiple levee failures could interrupt all or a significant portion of SWP and CVP water supplies for up to one and a half years. The SWP and CVP pumping plants in the south Delta would remain at risk under such a scenario. However, water supplies moved across the Delta through California WaterFix are expected to be uninterrupted.

WHY BUILD IT NOW?

In 2005, Hurricane Katrina caused catastrophic levee failures that devastated the city of New Orleans. Dramatic video of the flooding brought home the risk of a similar event in the Delta and the effect levee failure could have on the water supplies for 25 million Californians and millions of as acres of farmland from Mendota to Bakersfield. Discussion among the SWP contractors' General Managers made it clear that the SWP needed a plan to secure the state's water supplies in the event of catastrophic levee failure.

At the same time, the Delta's environmental conditions were worsening for endangered species and the CALFED Bay-Delta Program was struggling to launch its water supply improvement initiative, the South Delta Improvement Program (SDIP). The SDIP was often referred to as "Banks 8,500" because of its goal of increasing pumping at Harvey O. Banks Pumping Plant from its current limit of 6,680 cfs to 8,500 cfs[5]. At the same time, the regional director of USFWS suggested that DWR abandon the Banks 8,500 program in favor of developing a Habitat Conservation Plan under the Endangered Species Act that would do more for the SWP and for endangered species in the Delta than the Banks 8,500 program.

DWR followed up on the regional director's suggestion, and through months of stakeholder meetings that included State, federal and local agencies, and the environmental community, a decision was made to pursue a Habitat Conservation Plan with a dual conveyance facility as the centerpiece of the project.

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[4] Delta Risk Management Strategy, Executive Summary, Phase 1, February 2009. California Department of Water Resources.

[5] SWP diversions from the south Delta are currently limited to about 6,680 cfs from mid-March to mid-December. From mid-December to mid-March, SWP diversions in the south Delta can be 6,680 cfs plus an amount equal to one-third of the San Joaquin River flow when it is 1,000 cfs or higher.

Support from California Governor Schwarzenegger's administration moved the project forward, and President Obama's administration adopted the project in 2008. The State's involvement and support for the project continued with the election of Governor Brown in 2010.

So why build it now? The convergence of three factors makes now the time to construct California WaterFix, if it can be done at an affordable cost and deliver the expected benefits to the PWAs that choose to fund it. First, as described in Figure 1 above, it is likely that the SWP and CVP facilities will continue to be regulated so that water supplies will continue to be reduced.

Second, the possibility of levee failures due to earthquakes, floods or rising sea levels reveals that the existing SWP and CVP facilities, designed more than 50 years ago, will not protect the water supply from those risks; risks that could shut off the SWP and CVP water supplies for up to one and a half years.

And third, the political will currently exists to implement the project at both the State and federal levels. While both the State and federal administrations have concerns about the project, both also have stated their clear support for the project and a willingness to move forward, provided that the PWAs that will benefit from the project are willing to participate in the project and provide the funding necessary to construct California WaterFix.

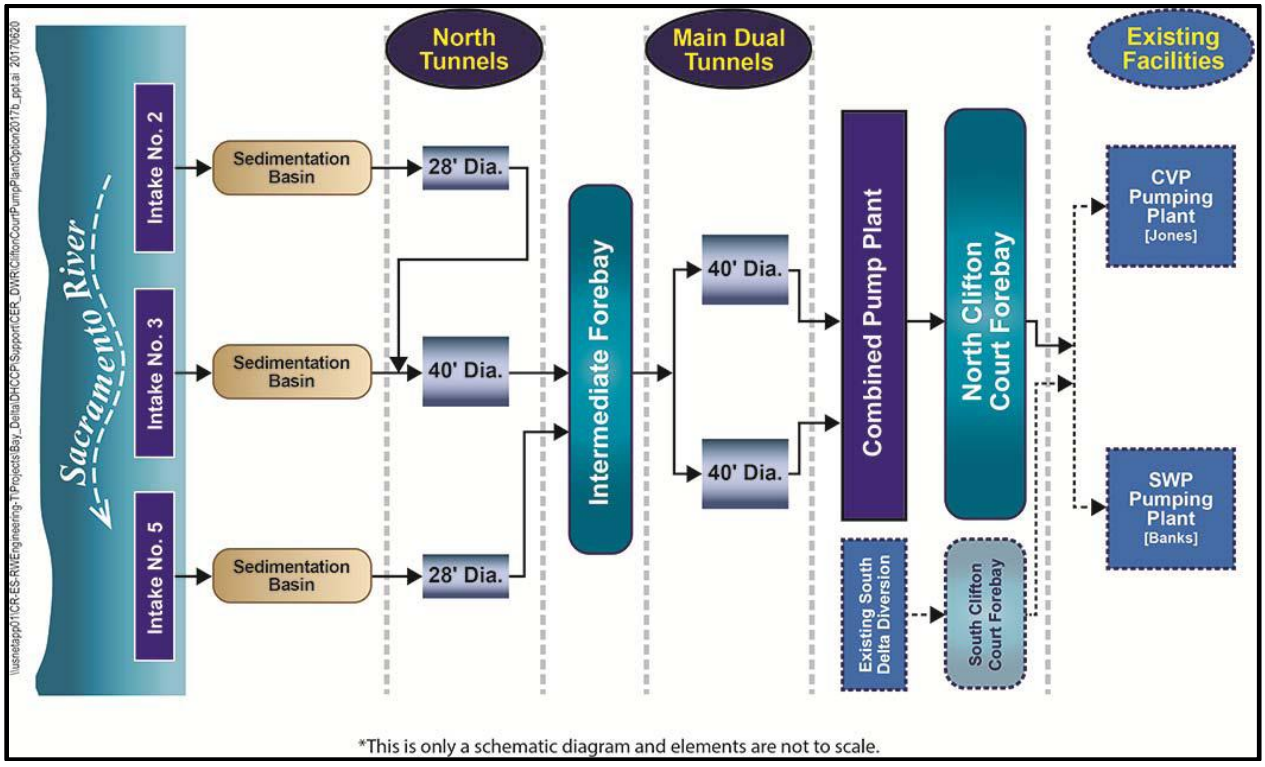
Minimizing water lost to past and future environmental regulations, protecting the SWP and CVP from catastrophic loss due to earthquakes, flood or sea level rise, and acting on the current political will to construct the project make now the right time to build California WaterFix, if it can be done at an affordable cost and deliver the expected benefits to the PWAs that choose to fund it.

CALIFORNIA WATERFIX FACILITIES

MAJOR COMPONENTS AND FACILITIES

California WaterFix connects the Sacramento River near Hood, California with the existing CVP C.W. Bill Jones Pumping Plant (Jones) and the existing SWP Harvey O. Banks Pumping Plant (Banks) near Tracy, California. Making this connection requires constructing a 35-mile-long project composed of intakes at the Sacramento River, tunnels from the intakes to an intermediate forebay, gravity-fed tunnels from the intermediate forebay to a new pumping plant at a modified Clifton Court Forebay, and finally connection to the existing Jones and Banks pumping plants. **Figure 2** provides a schematic of the major components of California WaterFix.

FIGURE 2: SCHEMATIC OF CALIFORNIA WATERFIX FACILITIES



California WaterFix components have evolved over time. During the past 11 years, California WaterFix has changed from a surface canal to underground tunnels, it has reduced the number of intakes from five to three and its capacity was reduced from 15,000 cfs to 9,000 cfs. These changes facilitate easier, less costly construction, some facilitate better or less costly operations and some improve environmental protection. The tunnel alignment was modified several times to avoid sensitive areas and to ensure that the few necessary surface facilities would be located in areas that caused the least disruption to local communities, while minimizing construction costs. Changes to the design also reduced operational costs by allowing for gravity-fed tunnels instead of energy intensive pumped operations. The following sections of this overview provide a more detailed description of the components that make up California WaterFix.

Sacramento River Intakes

Three intakes, each with a capacity of 3,000 cfs, are proposed along the Sacramento River (see **Figure 3** on page 14). Each intake location was determined by extensive collaboration between DWR and State and federal fishery agencies to minimize incidental take of listed species.

Each intake facility consists of on-bank screened intake structures; gravity-fed intake conduits; flow meters and control gates; sedimentation basins to allow suspended material from the river to be removed from the water before the water enters the tunnel system; and a drop-shaft at the far end of the sedimentation basins to connect the intakes to the adjacent tunnel network.

A main factor in sizing and configuring the intake structures was the need to meet specific flow velocities for the water moving past and through the screens. To meet recommended criteria set by State and federal fishery agencies to protect Delta smelt and migrating salmon, the screen area has been set to ensure the approach velocity of the water toward the screens would be no greater than 0.2 feet per second under design flow conditions.

Tunnels and Shafts

The California WaterFix tunneling portion has been divided into two general sections, the North Tunnels and the Main Tunnels (Figure 3). The North Tunnels extend from the intakes to the intermediate forebay and have been sized so that water flows from the diversions could be equally split between any or among all of the three river intakes that are in operation at any given time. The two Main Tunnels extend from the intermediate forebay to the combined pump plant at Clifton Court Forebay, and have been sized so that each tunnel would be capable of delivering up to 4,500 cfs under design conditions. Dual parallel tunnels for the Main Tunnel reaches are proposed to meet the total desired capacity of 9,000 cfs and ensure system reliability, allowing one tunnel to be isolated for maintenance or major repairs while the second tunnel is kept in operation.

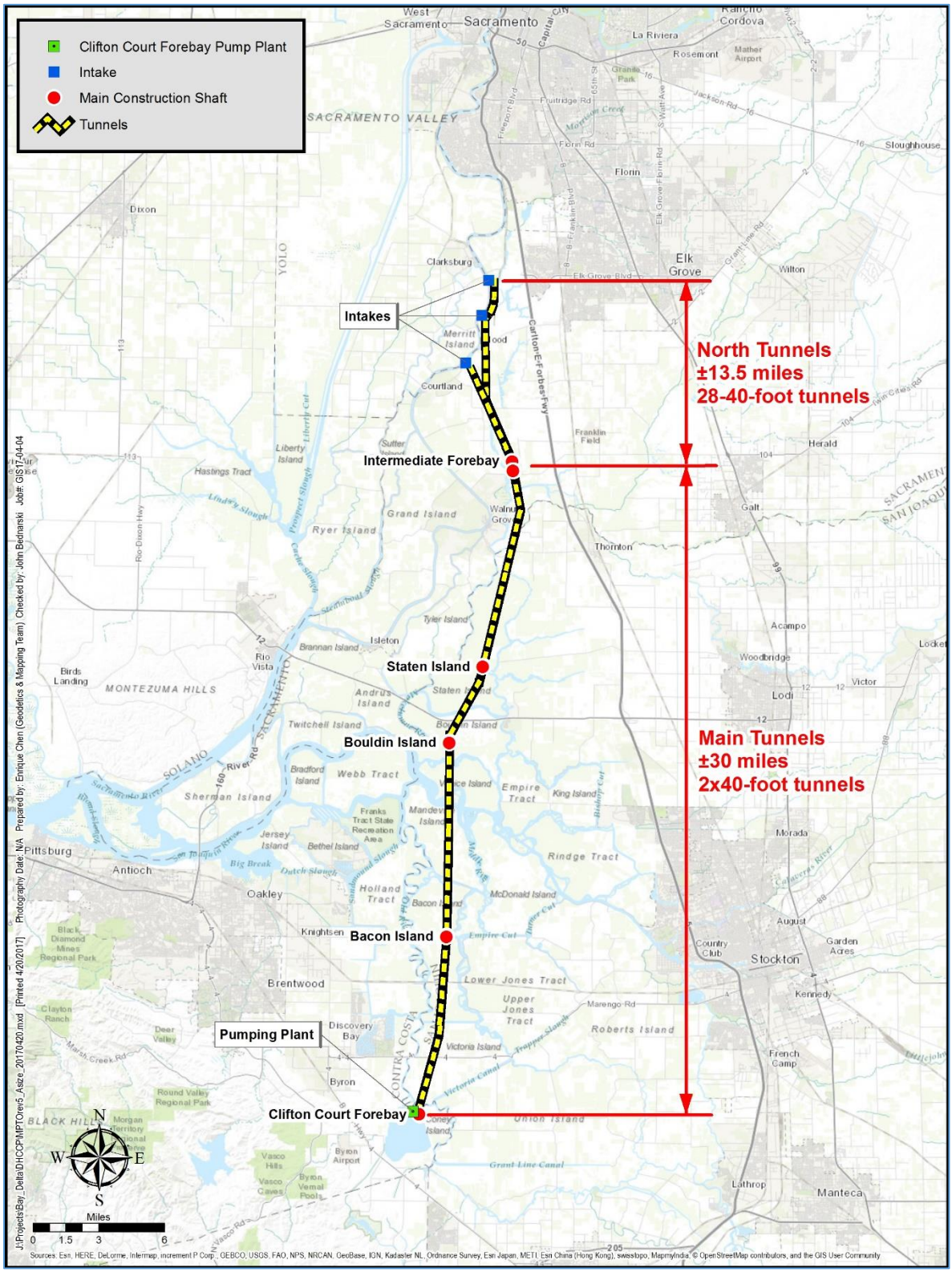
All tunnels would be excavated using tunnel boring machines (TBMs) instead of cut-and-cover construction. Although the Main Tunnels span about 30 miles, the tunnels would be constructed in segments or reaches about six to eight miles long. Each reach would be connected to subsequent tunnel reaches at shaft structures located along the alignment, as shown in Figure 2. As the TBMs advance, soil would be removed from the tunnel and concrete segments would be installed to form the tunnel lining system. This concrete segmented liner serves as the final lining system for the tunnels. This approach is commonplace on construction projects throughout the world, and is used in both transportation and water infrastructure projects. The liner would be sealed with a series of gaskets and bolted connections between the adjacent segments to avoid leakage.

Much of the Delta geology is covered with organic peat deposits. Although the peat deposits are very advantageous for agricultural purposes, they present a significant risk of liquefaction in a seismic event. However, the extent of the peat deposits is relatively well understood in the Delta, and ground conditions beneath the peat are generally characterized as dense deposits of silts, sands and clay layers. These dense layers would be very suitable for the planned tunnels because they would not be subject to liquefaction or settlement in the event of a seismic event. The tunnels would be constructed at sufficient depth below the ground surface (about 150 feet from ground surface to bottom of tunnel) to avoid both existing surface infrastructure and liquefiable soil materials like peat. It is not anticipated that any cut-cover pipelines in the challenging Delta surface geology conditions would be part of the California WaterFix facilities.

Deep shafts would be required along the tunnel alignments to facilitate construction, operation and maintenance of the conveyance system. During construction, the shafts would be used to launch and retrieve the TBMs, provide an access point into the tunnels for delivery of tunnel building supplies and labor, and provide a location to join adjacent tunnels to the larger tunnel system. After construction, some of the construction shafts would be modified and used to support long-term operations and maintenance needs for the tunnels. Other shafts used in the construction process, such as TBM retrieval shafts, would be sealed and buried to a depth that would support farming activities after construction concludes.

A significant area for investigation during the design activities would be developing the tunnel and shaft connection. Special construction details would be developed through computer modeling to ensure that the tunnel-shaft connection points would be well understood, and so that the two interact to sustain anticipated movement during a seismic event.

FIGURE 3: CALIFORNIA WATERFIX FACILITIES – ALIGNMENT AND MAJOR COMPONENTS



Intermediate Forebay

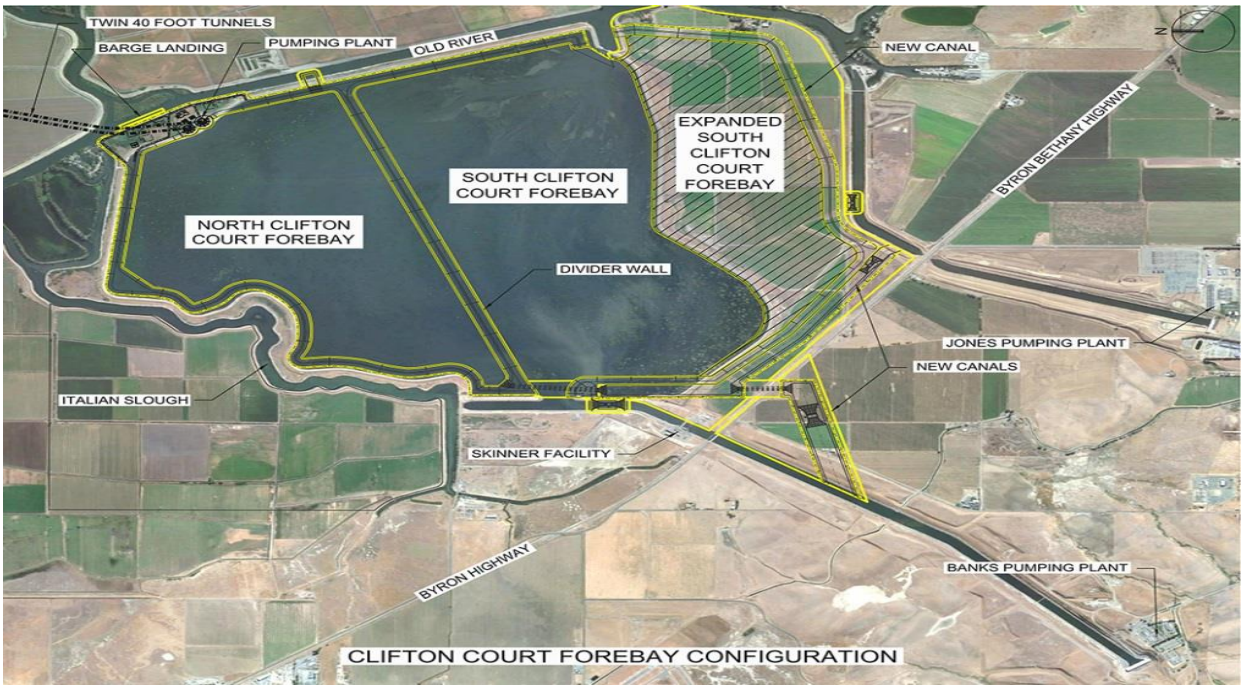
The 30-acre Intermediate Forebay allows for flows from the three separate intakes to be blended before entering the two Main Tunnels. The forebay would help dampen hydraulic surge waves that could occur in the Main Tunnels if there is a power outage at the Clifton Court pump station. The forebay, along with flow meters and control gates in the intakes, would enhance the ability for independent operation of each river intake and the two Main Tunnels, while providing for the overall operational stability of the system. The forebay would be comprised of earthen embankments and tunnel shaft structures, with the shaft structures allowing water to enter at the forebay's north end and exit at the south end of the forebay.

Clifton Court Forebay

To achieve the dual goal of isolating delivery of water diverted from the Sacramento River to the pumps at the south end of the Delta while maintaining south Delta export capabilities, the existing Clifton Court Forebay would be separated into the North Clifton Court Forebay and the South Clifton Court Forebay (see Figure 4). Water from the new conveyance system would be pumped or flow from the tunnels into North Clifton Court Forebay. South Delta diversions would enter the South Clifton Court Forebay through the existing Old River gate structure.

The new South Clifton Court Forebay would be expanded by creating an additional storage area to the south of the existing levees, as shown in **Figure 4**. Separating the existing forebay into two sections allows fish-screened water from the north Delta intakes to be isolated from other waters throughout the delivery system. Additional new canals, gate structures and flow meters would also be constructed so water from the North and South Clifton Court Forebays can be conveyed to the existing Jones and Banks pumping plants. These canals and gates would be designed to allow single-mode diversion or simultaneous dual-mode deliveries of both waters to the pumping plants.

FIGURE 4: CLIFTON COURT FOREBAY, INCLUDING PROPOSED MODIFICATIONS



Pumping Station at Clifton Court Forebay

A 9,000-cfs pumping station would be constructed at the Clifton Court Forebay to lift the water from the Main Tunnels into the North Clifton Court Forebay. The pumping station would consist of two pumping plants, each rated at 4,500-cfs capacity. Each pumping plant would be located directly above the end of the Main Tunnel (see Figure 5 on page 15). Water flowing south in the Main Tunnels would fill up a pumping well in the bottom of each pump plant before vertical turbine pumps lift the water into the North Clifton Court Forebay.

Under certain hydraulic conditions in the Sacramento River, it would be possible to flow water by gravity from the Sacramento River into North Clifton Court Forebay without using the pumps in the stations. In these conditions, the pumps would be shut off, and water would flow by gravity directly from the tunnels through the surge channel in the pump plant and into North Clifton Court Forebay. In the event of a power outage at the pump plant, hydraulic surge waves would be dissipated at the pump station by allowing water to flow over the surge channel and into North Clifton Court Forebay.

SUPPORTING INFRASTRUCTURE

In addition to the major components of the project, construction of supporting infrastructure would be required for the operation of the new facilities and as a prerequisite for construction activities. Some of the required permanent and temporary infrastructure includes:

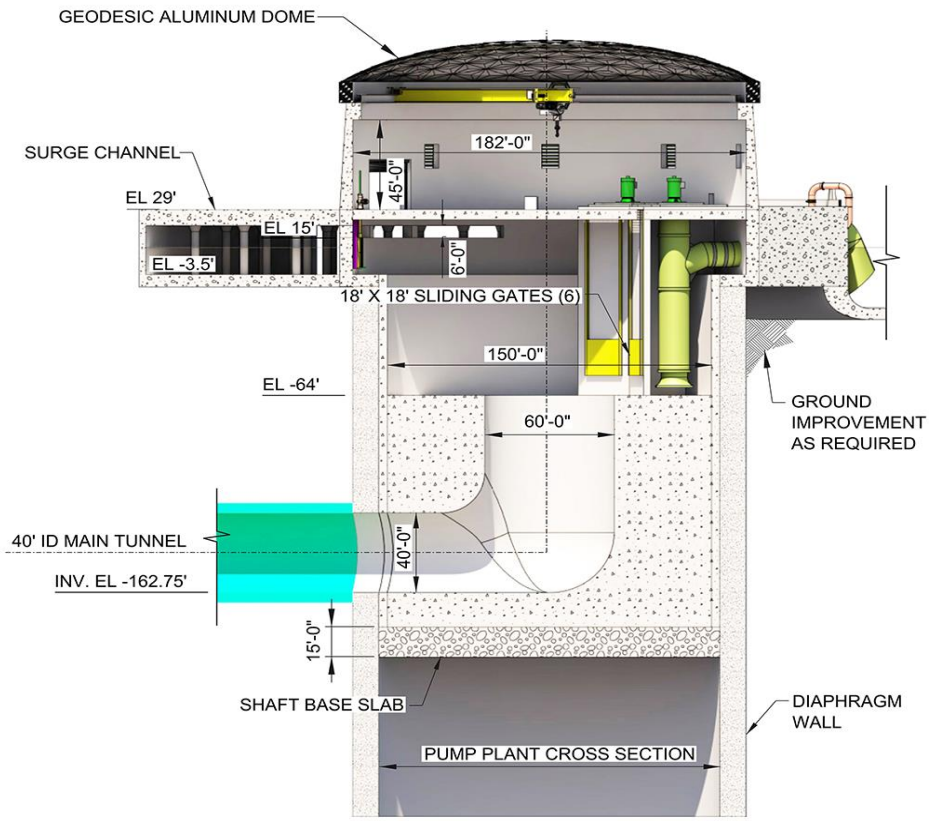
- High voltage electrical power lines to run the TBMs and operate the pumping facilities;
- Initial site grading and site preparation work;
- Access roadways and barge landings at key work sites;
- Improvements to existing municipal/private roads to support anticipated construction traffic;
- Restoration of public and private roads used to support project activities to pre-construction conditions once the project is complete;
- Improvements around critical infrastructure, including levees, to ensure stability during subsequent work; and
- Removal/relocation of existing gas and water wells that could conflict with tunnel or intake construction.

Completion of these activities prior to the major construction work would ensure that the overall program schedule and budgets would be maintained.

APPROACH TO DESIGN AND CONSTRUCTION

The proposed California WaterFix configuration resulted from an extensive planning process evaluating various alignments, facility configurations and environmental considerations. The results of this conceptual planning/engineering effort are documented in a series of Conceptual Engineering Reports, with the final draft report being released in July 2015, and in the environmental impact report/environmental impact statement (EIR/EIS), which was released in 2016. As part of the environmental documentation process, all alternatives received extensive environmental analysis consistent with California Environmental Quality Act (CEQA), National Environmental Policy Act (NEPA), and the Delta Reform Act, which included consideration of comments received during initial scoping and the public review periods of the draft EIR/EIS (2013), partially recirculated draft EIR/supplemental draft EIS (2015) and the proposed Final EIR/Final EIS (2016).

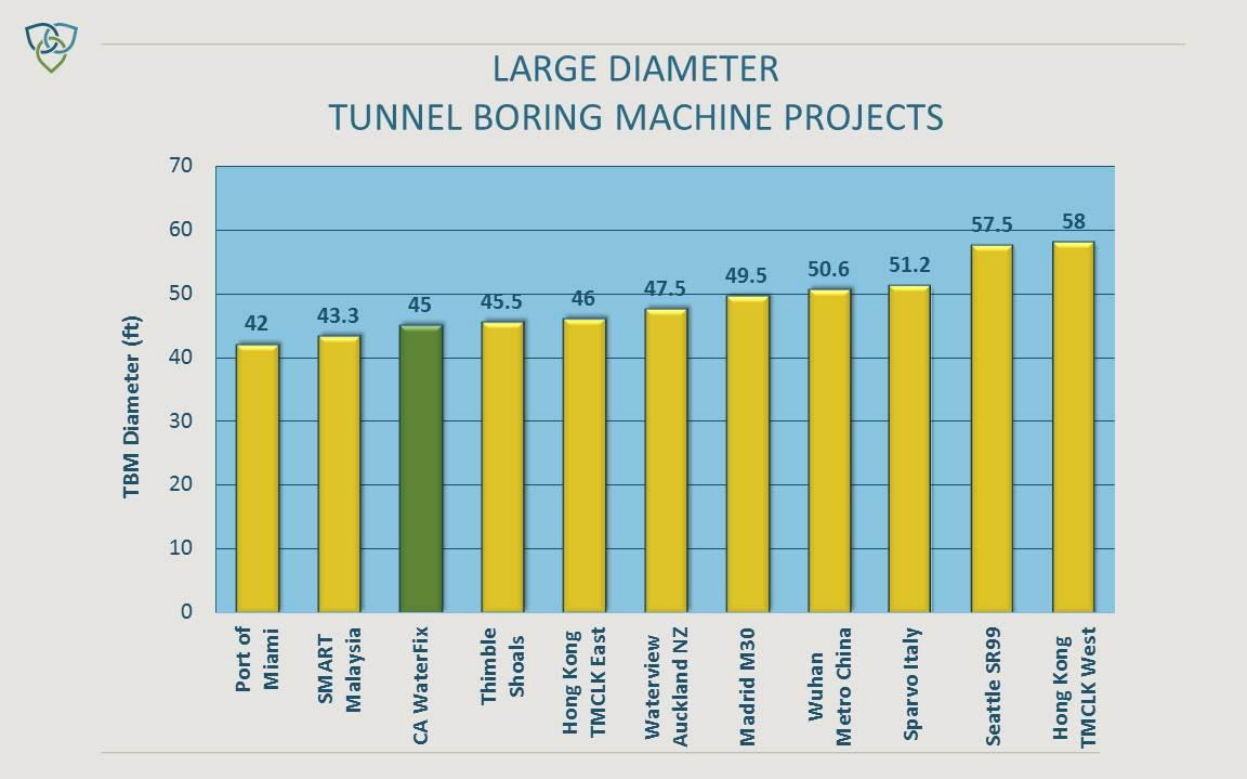
FIGURE 5: PROPOSED PUMPING FACILITIES AT CLIFTON COURT FOREBAY



Constructing dual 40-foot main tunnels would use technologies and methodologies that are well understood within the construction industry. Constructing tunnels this size has been successfully completed, or are in the planning/design phase in many locations throughout the world (see **Figure 6**). As shown in this figure, the planned California WaterFix tunneling machines are at the lower end of the range for large tunnel projects that have been implemented.

During the planning process, an alternative to a twin tunnel configuration for California WaterFix, a single-bore main tunnel, sized to convey up to 9,000 cfs, was also investigated. Preliminary analysis indicated that a single-bore tunnel option would require a tunnel with an inside diameter of about 56 feet. This tunnel size would require a TBM size of 60 feet or more in diameter (assuming use of a 24-inch thick concrete segmental liner). Currently, the two largest TBM projects in the world are the Tuen Mun – Chek Lap Kok Link Hong Kong TBM at 57.7 feet in diameter and the Alaska Way TBM in Seattle, Washington at 57.3 feet in diameter. At the time, the TBM used in the Seattle project was the largest TBM ever built, and the issues and multi-year delays experienced on this project are well documented. A potential California WaterFix single-bore TBM at about 60-feet in diameter would represent a machine that is 4 percent larger than current technology experience, and a tunnel that large would set an engineering design and construction precedent, increasing the overall project risk.

FIGURE 6: LARGE DIAMETER TBM PROJECTS



ENVIRONMENTAL CONSIDERATIONS

California WaterFix facilities have been planned and configured in response to comments and input received during the environmental planning process to reduce the impacts of construction and operation of the facilities on the existing Delta environment. Specific steps taken during the design effort to limit or eliminate the impact of the new facilities on the environment include:

A. **Reducing the Size of Overall Project:** As originally configured in the BDCP, water conveyance facilities consisted of five (5) screened intakes along the Sacramento River, each sized at 3,000 cfs, for a total system capacity of 15,000 cfs. The overall capacity was eventually reduced to 9,000 cfs, using only three of the original five intake locations.

B. **Using Tunnels Instead of Open Canals:** The original alignment consisted of a series of large canals to convey water from the three intakes to Clifton Court. The main canal footprint was estimated to be approximately 1,400-feet wide (including embankment width). This project configuration would have caused significant impacts to surface features in the Delta. The surface impacts alone of this alternative totaled more than 19,000 acres. The surface canal approach would have split or eliminated many private property holdings, disrupted irrigation patterns, caused migration barriers for terrestrial species, been subject to potential deformation during seismic events and generated substantial quantities of air pollutants associated with earthmoving during construction. The proposed all-tunnel configuration reduces surface impacts by approximately 90 percent with the use of tunnels, a majority of the tunnel construction equipment is electrically operated, subsurface tunnel easements will reduce disruptions to surface features, and terrestrial migration patterns remain undisturbed.

C. **Expanding the Use of Tunnels Instead of Pipelines:** Early non-canal conveyance alignments relied on a combination of open-cut, high-head pipelines and tunnels to convey water from the intakes to the intermediate forebay. Construction of the open-cut pipelines would have been very disruptive to local communities because of the size of the pipelines required. Under those conditions, excavations suitable for installation of double-barreled 16-foot high-head pipelines would be required in some locations, and would potentially run for several miles. In addition, it was anticipated that surface deposits of peat and high groundwater tables could be encountered during construction. Engineering refinements during the environmental process identified the use of tunnels as a preferred way to connect the river intakes to the intermediate forebay. Relatively short tunnels significantly reduce disruptions to the local communities and provide a way to efficiently address groundwater table conditions.

D. **Revising Tunnel Alignments and Tunnel Contracting:** As originally configured, the project's main 40-foot diameter tunnels crossed under numerous rivers, sloughs and other waterways. At each of these locations, additional construction activities would have been necessary to protect the levees that line each of the waterways while the TBMs were being operated, potentially leading to unnecessary project risks. Additionally, the original Main Tunnel alignment crossed under a number of sensitive surface features, travelled under many private property holdings and would have required nearly double the number of construction contracts when compared to the current revised plans. Mitigation measures employed during the planning and conceptual engineering process attempted to minimize as many of these issues as possible. The current alignment (1) reduces tunneling under most sensitive surface features and private property,

instead tunneling under publically held lands and avoiding crossing U.S. Army Corps of Engineers (USACE) levees wherever feasible; (2) minimizes the number of water features crossing with the tunnel alignment; and (3) reduces the number of tunnel contracts to avoid unnecessary surface disruptions.

E. **Revising the Size and Location of Intermediate Forebay:** The original forebay configuration consisted of about 750 acres of water surface area, along with the area required for the forebay embankments. Following input from local communities and reclamation districts, the size and location of this facility were revised. Current plans call for an intermediate forebay site of about 100 acres, which includes the forebay surface area, embankments and appurtenant facilities required for construction and operation.

F. **Reducing Pumping Requirements for Overall System:** The original configuration of California WaterFix facilities relied on pumping plants at each of the three river intakes to lift water out of the Sacramento River and into the tunnel system for conveyance to Clifton Court in the south Delta. This configuration did not allow the system to be gravity-fed, even under extremely high water levels in the Sacramento River. Based on input received during the planning process, and the need to address certain technical tunnel design issues, the configuration was changed so the three individual pump stations at the Sacramento River were consolidated and moved to a single pumping plant located at Clifton Court Forebay. As currently configured, under some hydraulic conditions in the Sacramento River, and under certain delivery scenarios, California WaterFix would operate as a fully gravity-fed delivery system that can divert up to 4,500 cfs to Clifton Court Forebay. The remainder of the time, the pumps at Clifton Court Forebay would be operated. This approach would reduce the overall conveyance system's energy consumption when compared to the original concept.

G. **Reducing Construction Impacts along Sacramento River:** Replacing the three river intake pumping plants with a consolidated pump plant at Clifton Court Forebay and revising the construction methods for the intake sedimentation basins would reduce temporary and permanent impacts to the communities that surround the intake locations. Eliminating the pump plants at the Sacramento River also significantly reduces overall construction impacts at all three river intakes and avoids the permanent aesthetic impacts of the pump plants at each location, including the need for permanent overhead high voltage power lines and traffic impacts associated with DWR's operation of the pump plants. In addition, the design of the sedimentation basins, originally configured as pile-supported concrete basins, was revised to the current earthen configuration. This change would significantly reduce construction impacts at each intake site by eliminating the need to transport thousands of foundation support piles and the construction work associated with placing thousands of cubic yards of concrete in the basins.

H. **Optimizing Location of Key Construction Sites:** While located relatively close to major urban communities such as Sacramento and Stockton, the Delta is considered a uniquely remote environment from a construction standpoint because of its limited highway access. Two State highways cross the Delta in an east-west direction, but north-south transportation routes though the Delta are generally limited to water routes. The original configuration placed several of the key construction sites in areas that were logistically difficult to access for major construction purposes. To access these sites, new roads, along with the use of existing levee roads or water access points, would have to be established, potentially impacting local residents

and agricultural interests. Based on comments received during the planning process, some construction sites were relocated closer to major transportation routes, reducing potential disruptions to local communities and traffic patterns.

Incorporating these revisions and comments into the overall project planning process has led to the development of modernized conveyance facilities that are sensitive to the environment, landowners and public use of the Delta, while retaining the operational features required to reliably and efficiently deliver water to the State and federal water projects.

MANAGEMENT OF DESIGN AND CONSTRUCTION

INTRODUCTION AND OVERVIEW

California WaterFix will be designed and constructed as an element of the SWP. DWR, and a joint powers authority (Authority) to be formed by PWAs that elect to participate in California WaterFix, propose to enter into an agreement governing the management of the design and construction of the California WaterFix. DWR and the Authority will enter into a Joint Exercise of Powers Act (JEPA) authorizing the Authority to manage the design and construction of California WaterFix subject to DWR oversight and control as described in JEPA. The key provisions of JEPA are discussed below.

Statutory Authority for Design and Construction Governance Structure

California Water Code sections 11100 et.seq. govern the design and construction of the SWP. Water Code section 11551 provides that DWR shall design works that are part of the SWP, and section 11451 provides that DWR shall have full charge and control of the construction of the SWP.

JEPA authorizes two or more public agencies to jointly exercise their common powers through a joint exercise of powers agreement (Government Code section 6502). The powers may be exercised either through a JEPA among the parties to the JEPA, or through a separate public agency established by the agreement (Government Code section 6507). Here, the participating PWAs propose to form a separate Authority, and that Authority will enter into a joint exercise of powers agreement with DWR concerning the management of the design and construction of California WaterFix.

The proposed governance structure is modeled on the structure utilized by DWR in the management of the design and construction of portions of the Coastal Branch of the SWP. DWR entered into a joint exercise of powers agreement with the Central Coast Water Authority regarding the management of the design and construction of portions of the Coastal Branch project.

Summary Description of Proposed Joint Exercise of Powers JEPA

The JEPA that governs the relationship between DWR and the Authority contains the following major elements:

Administering Agency: DWR designates the Authority as the administering agency with authority to cause the design and construction of California WaterFix.

Project Specifications: Describes California WaterFix and the design specifications (Specifications) of California WaterFix, and authorizes the Authority to make non-material revisions to the design Specifications.

DWR Authority Regarding Material Changes to Project Specifications: Requires DWR approval of "material changes" to the Specifications. DWR approval of these types of changes is necessary to remain consistent with Water Code section 11451, which requires DWR to have full charge and control of the construction of the SWP.

"Material changes" are defined to include:

- Changes that cumulatively result in an increase of more than 5 percent of the budget cost of California WaterFix elements;

- Changes that increase California WaterFix schedule by greater than six months;
- Actions that impact California WaterFix's water delivery capacity, reduce California WaterFix life, or significantly increase California WaterFix operation and maintenance costs, and
- Actions that are inconsistent with or require amendment of a California WaterFix "Permit." "Permit" is defined to include the major environmental permit and approvals.

Coordination by DWR and the Authority: Establishes mechanisms for coordination of the activities of DWR and the Authority on their respective roles on design and construction.

Authority as DWR Agent on Construction Permits: Authorizes the Authority to act as DWR's agent with regard to construction permits issued to DWR, and to obtain construction permits.

Compliance with Permit Terms and Conditions: Obligates the Authority to comply with California WaterFix permit terms and conditions, including the applicable mitigation measures.

Authority Liability: Imposes sole liability on the Authority for violation of permits.

Authority Obligation to Perform Work: Requires the Authority to perform the work under the JEPA upon DWR notice.

Authorization to Enter Into Design and Construction Contracts: Authorizes the Authority to enter into contracts regarding design and construction.

Applicability of State Contract Act and Little Brooks Act: Requires the Authority to comply with the Little Brooks Act (governing procurement of design services) and with the State Contract Act (governing public works construction contracts). The Authority retains the ability to utilize alternative design and construction delivery methods, if allowed by law.

DWR Reservation of Contracting Authority: DWR reserves right to enter into complimentary contracts; and, for good cause, to participate in design and construction. DWR also retains the discretionary authority to approve Specifications, solicitation documents, drawings, data, addenda, change orders, and contracts by written notice to the Authority.

DWR Authority to Terminate JEPA: DWR reserves the right to terminate the JEPA if the Authority fails, or is likely to fail, to construct California WaterFix in accordance with the budget and schedule.

Project Design: Requires the Authority to provide DWR with design drafts, and imposes requirements on DWR for timely review of design.

Property Acquisition: Authorizes the Authority to acquire property from willing sellers, and reserves to DWR eminent domain authority.

Reimbursement of Authority: Establishes invoicing procedures, and obligates DWR to reimburse the Authority for design and construction work.

Indemnification: The Authority indemnifies DWR for claims and losses, except for those caused by DWR sole negligence or willful misconduct.

Dispute Resolution: Establishes a non-binding dispute resolution process, including a three-member outside review panel. The DWR Director is authorized to resolve disputes that remain unresolved at the end of the process, subject to judicial review.

BENEFITS OF GOVERNANCE STRUCTURE

The proposed design and construction governance structure provides the key benefit that allows the PWAs that are members of the Authority with lead responsibility for managing design and construction. Thus, the PWAs who will bear the risk of increases in California WaterFix design and construction costs will have direct management control over those costs. The Authority's management of design and construction, however, is subject to material DWR oversight, and to DWR's reserved rights under the JEPA.

The governance structure contemplates and requires close coordination between DWR and the Authority during the design and construction process. The JEPA—which governs the relationship between DWR and the Construction Joint Powers Agreement (JPA)—seeks to facilitate timely decision-making by vesting most DWR decision authority within DWR's Delta Conveyance Office, and by imposing limitations on DWR reviews of design and construction documents. For example, the Authority is not required to obtain DWR's approval of changes to California WaterFix Specifications, except for "material changes" defined in the JEPA. The definition of "material changes" will minimize the Construction JPA's risks to some extent by limiting DWR's required approval to those changes of California WaterFix Specifications that have very significant increases in the cost of budgeted California WaterFix elements (greater than 5 percent), significant California WaterFix delays (greater than six months), and other changes with major California WaterFix impacts such as California WaterFix's water delivery capacity, and significant increases in operation and maintenance costs. DWR, however, has a reserved discretionary authority to approve specifications, solicitation documents, drawings, data, addenda, change orders and contracts upon notice to the Authority.

SCOPE OF DWR DELEGATION OF DESIGN AND CONSTRUCTION MANAGEMENT

DWR designates the Authority as the administering agency for the design and construction of California WaterFix. The Authority has the responsibility to cause the design and construction of California WaterFix in accordance with the Specifications. The Authority has the ability to refine California WaterFix Specifications as the level of design advances to final design documents. The JEPA, however, requires that DWR retain approval of "major changes" to California WaterFix Specifications.

The JEPA authorizes the Authority to conduct property acquisitions from willing sellers with the involvement of the DWR acquisition coordinator. DWR has the responsibility to acquire property using DWR's eminent domain powers, if necessary.

Limitations on Authority Management of Design and Construction

Consistent with Water Code section 11451, the JEPA reserves to DWR material responsibility for the management of the design and construction of California WaterFix. As discussed, DWR approval is required for "major changes" to California WaterFix Specifications.

The JEPA contemplates that DWR will play a continuing and important role in the review of California WaterFix design and construction documents. The JEPA establishes a process for DWR review of

California WaterFix documents, and imposes time deadlines on DWR's review. DWR also retains the discretionary authority to approve Specifications, solicitation documents, drawings, data, addenda, change orders and contracts by written notice to the Authority.

DWR retains the right, for good cause, to participate in the design and construction of California WaterFix. "Good cause" is defined to mean (1) a threatened or actual material breach of the JEPA; or (2) an action or anticipated action inconsistent with, or that would require an amendment of, a permit. After the exhaustion of the dispute resolution process, DWR retains the right to terminate the JEPA and therefore assume management of design and construction if the Authority fails, or is likely to fail, to construct California WaterFix in accordance with the budget and schedule.

Dispute Resolution Process

The JEPA includes a dispute resolution process consisting of the following sequential steps:

Step 1: Establishing technical workgroups to attempt to resolve issue;

Step 2: Meeting between staff of the DWR Delta Conveyance Office and the Authority staff;

Step 3: Meeting between DWR and Authority managers;

Step 4: Meeting between the Deputy Director of the DWR Delta Conveyance Office and the equivalent Authority personnel;

Step 5: Engaging a three-member outside review panel. DWR and the Authority each select one member. The third member to be jointly selected by the two DWR/Authority-appointed panel members; and

Step 6: Making a decision if the issue remains unresolved after the above process. In this case, a decision by the DWR Director, subject to judicial review regarding whether the DWR Director's decision is arbitrary and capricious.

The Liability of the Authority

The Authority (and indirectly the entities that secure the Authority's obligations) has material liability under the JEPA. The Authority has responsibility for the liability assumed by the Authority under the design and construction contract. The Authority is liable for any penalties assessed for violation of California WaterFix Permits. With the exception of losses attributable to the sole negligence or willful misconduct of DWR, the Authority indemnifies the State from all liability, claims and losses accruing or resulting to any and all contractors furnishing services in connection with the JEPA, and from any and all damages to persons who may be injured by the Authority.

COST ESTIMATE

OVERVIEW

The current cost estimate for California WaterFix is summarized below in **Figure 7**. All costs have been adjusted by the State to July 2014 dollars. The cost estimate will be updated periodically as additional information becomes available, particularly with respect to environmental mitigation.

FIGURE 7: CALIFORNIA WATERFIX – PROGRAM ESTIMATE

ITEM	AMOUNT ($BILLIONS)
Overall Cost	$ 15.74
Conveyance System Cost	$ 14.94
Program management, construction management, and engineering	$ 1.91
Tunnels/Shafts construction	$ 6.82
Remaining construction	$ 2.68
Contingency (~36% for Tunnel/Shafts and Remaining Construction)	$ 3.38
Land Acquisition (includes 20% contingency)	$ 0.15
Environmental Mitigation (includes 35% contingency)	$ 0.80

Program Estimate in 2014 Dollars

The resources used to develop the construction cost estimate include the items listed below:

1. Conceptual Engineering Report (CER), Modified Pipeline/Tunnel Option – Clifton Court Forebay Pumping Plant, Volume 2- Conceptual Engineering Report Drawings, Final Draft: April 1, 2015.
2. Wage and Workman's Compensation rates used by the consultant (5RMK) are Prevailing Rates as listed by the California Department of Industrial Relations, General Decision Number: CA140029 08/08/2014 CA29.
3. Equipment Ownership and Operating Cost. 5RMK used USACE rates EP-1110-1-8, Vol. 07 published April 2014.

COST ESTIMATE CONFIDENCE

Estimate Methodology

The methodology used to prepare the overall California WaterFix estimate as listed in Figure 7 was as follows:

A. **Program Management, Construction Management, and Engineering:** The $1.91 billion cost is based on the anticipated program organization, the program schedule and the CER. For each organizational team, the number of full time equivalents needed to perform the functions of the

team and the expected duration consistent with the program schedule was established. The program schedule accounts for staffing the organization in a sequential manner to allow for initiation, planning and execution of the needed functions. Costs for various levels of managers and staff were applied to the program schedule.

B. **Tunnels/Shafts and Remaining Construction:** The construction cost estimate for the tunnels, shafts and remaining construction was prepared by 5RMK. 5RMK is a construction management and cost estimating firm specializing in large construction projects worldwide. The construction cost estimate is a detailed Class 3 bottoms-up cost estimate as defined by the Association for the Advancement of Cost Engineering International (AACEI). A Class 3 estimate requires a design definition between 10 to 30 percent complete; the design definition for California WaterFix currently is between 5 to 10 percent complete. The common design definition between the Class 3 requirement and the current design definition for California WaterFix was 10 percent, and 5RMK was instructed to use this value to provide a more detailed Class 3 estimate.

   Cost estimators used the same basic approach that a construction contractor would use if bidding the project. Based on information in the CER and past knowledge and experience, the cost estimators developed a work-breakdown structure for all project features (such as intakes, tunnels, forebays, pump plants and utilities, etc.). Each feature was further broken down to components and systems to develop detailed quantities of material, labor and equipment to construct the facilities. Cost estimators established crews and equipment, production rates, and assumed work schedules. Once these were established, the cost estimators applied prevailing wage rates, and material and equipment costs based on vendor and subcontractor quotations.

   The cost estimate for the tunnels/shafts and remaining construction also includes the following:
   - Engineering, quality control and environmental staff time required to manage subcontracts;
   - Construction contractor's management, supervision and staff along with all support staff and expendables (office supplies, communications, utilities);
   - General automotive expenses for management and staff; and
   - General plant expenses including offices, warehouse, site roads, etc., and other administrative costs.

   Overhead, profit and General and Administrative (G&A) expenses were calculated as 12 percent of the construction cost.

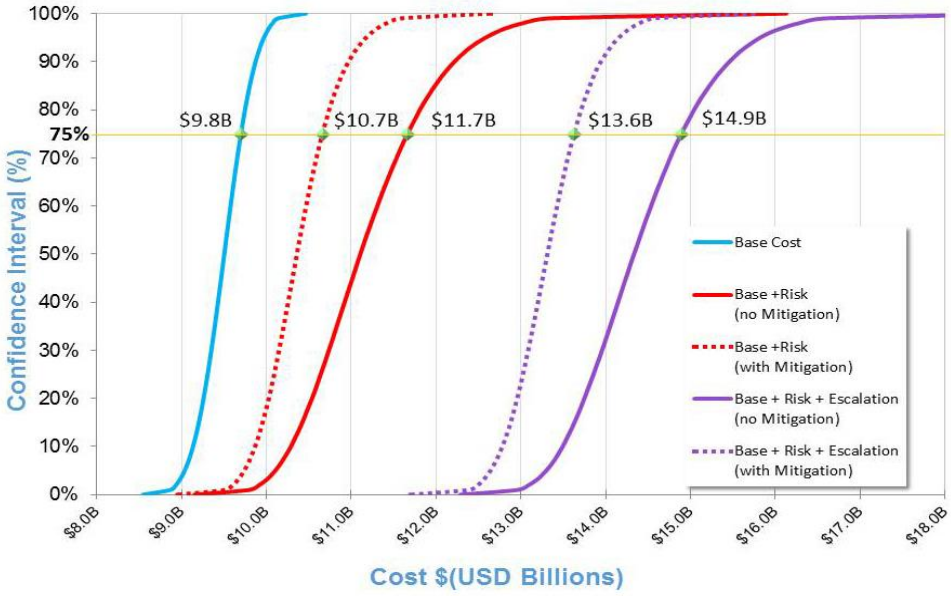
C. **Contingency:** Contingency as a percent of construction was established at 35.6 percent, which is consistent with an AACEI design definition of 7.5 percent, and is consistent with the level of design completed for California WaterFix to date.

D. **Land Acquisition:** The land acquisition cost of $0.15 billion was developed based on the number of acres for the surface footprint, staging, borrow and subsurface easements, multiplied by the current market rate per acre required for California WaterFix. The costs include mineral rights, gas well relocation, due diligence and transaction costs. A 20 percent contingency for unknown expenses related to land acquisition is also included.

E. **Mitigation Cost:** California WaterFix is carrying a mitigation cost estimate of $800 million. This includes estimated costs for environmental commitments such as natural communities protection, channel margin enhancement, tidal and riparian natural community, grassland and non-tidal marsh restoration, natural communities management, localized reduction of predatory fish, protections for cultural and biological resources, and air quality enhancements. The cost also includes program administration, monitoring of terrestrial and aquatic species, and property tax revenue replacement. In addition, a 35 percent contingency was added to account for unknown expenses/scope related to this project component.

For California WaterFix, Aldea Services developed confidence curves for a variety of different cost scenarios, ranging from base cost, which does not consider mitigation costs or risk, to a total cost that includes the base cost, risk, mitigation and inflation. The resulting confidence curves, which were based in part on the risk assessment workshops and probabilistic analyses conducted by Aldea Service and the California WaterFix team, are presented below in **Figure 8**. The results of these analyses indicate a 75 percent confidence level that California WaterFix would be completed within the budget estimate, based on information available at this stage of the project. A typical confidence level for projects of similar scope and size is 60 percent; however, because of the size and complexity of the program; a more conservative confidence interval of 75 percent was targeted.

FIGURE 8: CALIFORNIA WATERFIX – COST ESTIMATE CONFIDENCE CURVES



At a 75 percent confidence level, the chart in **Figure 9** (below) shows how the base costs (blue) along with risk costs (red) and inflation costs (purple) are distributed over the estimated construction period on a year-by-year basis. The risk costs (red) are a direct calculation from the risk analysis, and inflation is based on the average inflation rate over 20 years prior to the analysis and applied to the scheduled construction period. The chart is consistent with the risk adjusted cost estimate and schedule included in the CER. As funding is available, additional information would be gathered and the program would be refined during design, and the risk management process would be adjusted to the charted confidence curves.

FIGURE 9: ANNUAL CONSTRUCTION EXPENDITURES FOR BASE, RISK AND INFLATION

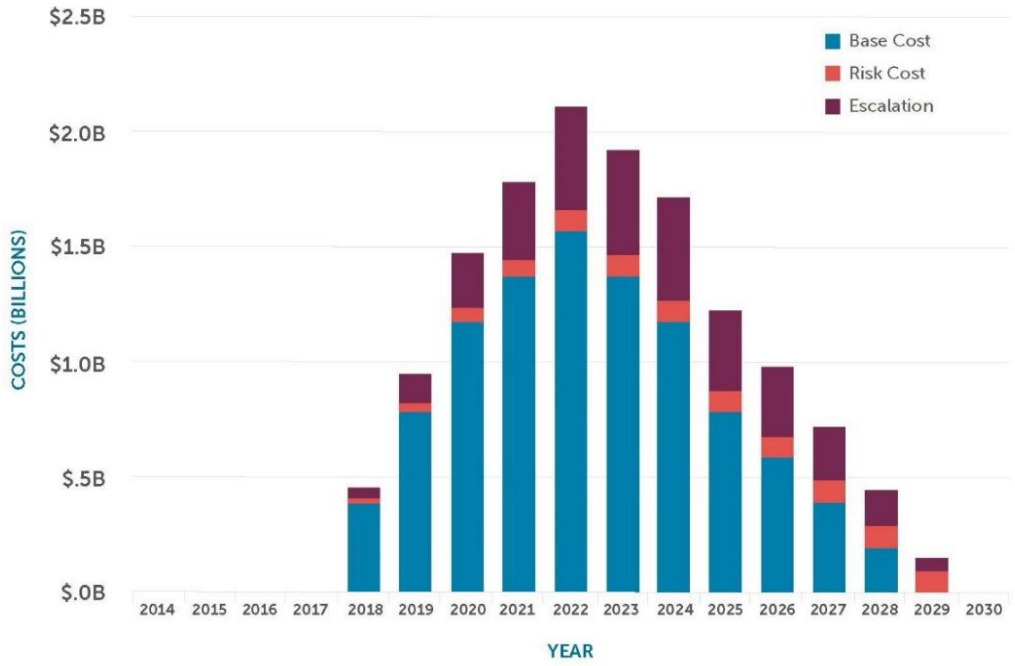


Table 1 shows the comparison between the risk adjusted cost at a 75 percent confidence level in the second column and the 5RMK construction cost estimate in the third column. The table also includes the results of the Class 3 bottoms-up construction estimate prepared by Jacobs Engineering as a check estimate. Jacobs Engineering prepared its estimate independent of the 5RMK estimate. The 5RMK and Jacobs Engineering estimates include a contingency of approximately 36 percent. Program Management (PM), Construction Management (CM) and Engineering (Eng) costs are held constant at $1.91 billion, and land acquisition costs at $150 million. This table uses three separate estimates to show the program can be completed within the proposed budget of $14.94 billion.

TABLE 1: COST COMPARISON, RISK ADJUSTED COST AT 75% CONFIDENCE LEVEL VS. INITIAL COST ESTIMATES

Item	(1) 5RMK Estimate (*),(**) (Billions)	(2) Jacobs Eng Estimate (*),(**) (Billions)	(3) Risk Adjusted Estimate with Mitigation at 75% Confidence Interval (*)(***) (Billions)
Construction	$9.50	$8.86	$10.66
Contingency	$3.38	$3.15	—
Construction Subtotal	$12.88	$12.01	$10.66
PM/CM/Eng	$1.91	$1.91	$1.91
Land acquisition	$0.15	$0.15	$0.15
Grand Total	$14.94	$14.07	$12.72

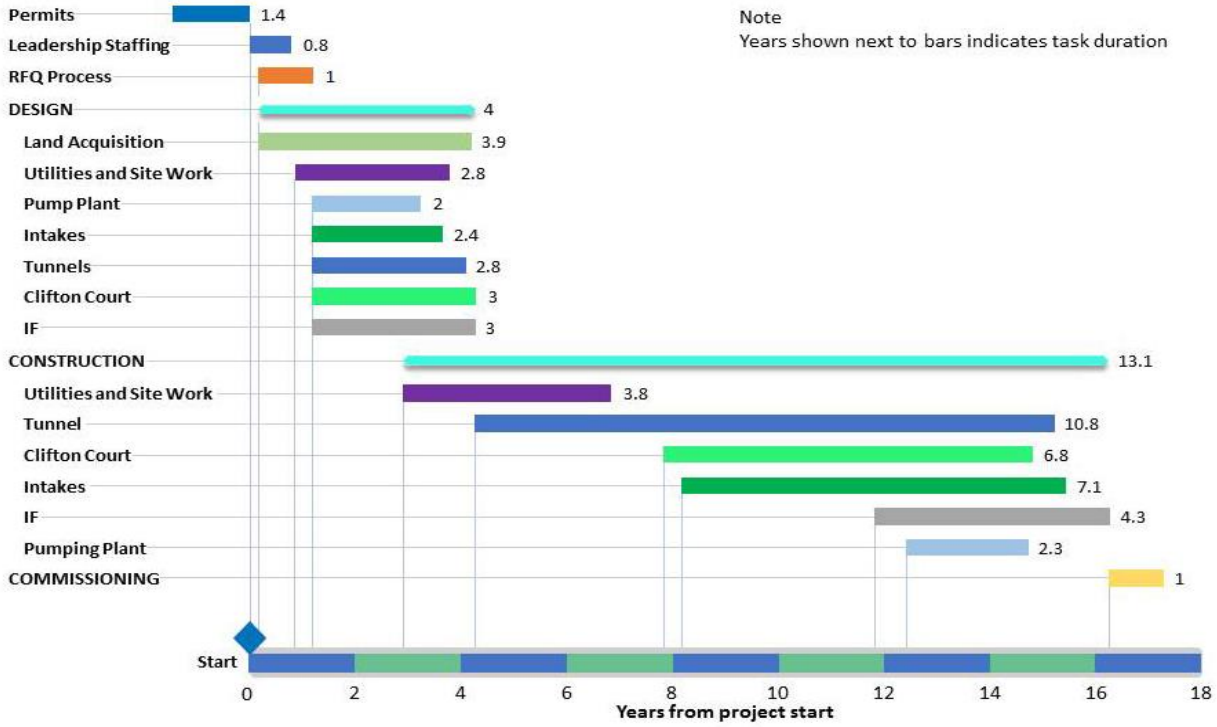
(*) Program estimates in 2014 dollars
(**) ~36% Contingency on construction for 5RMK and Jacob Engineering estimates
(***) Based on risks known at time of assessment

PROJECT SCHEDULE

The current high-level program summary schedule is presented in **Figure 10**. The schedule is primarily based on the information in the 2015 CER as well as other available data for similar large-scale construction projects. The schedule estimates it would take 12 to 15 months to fully staff the Construction JPA, up to four years to complete the design phase and about 13 years to complete construction. Once the Authority is established and the design is advanced, the design and construction teams would look for opportunities to reduce the overall schedule.

Upon California WaterFix authorization, detailed schedules would be prepared for various project activities, based on the detailed Work Breakdown Structure and applicable project documents. These detailed schedules would identify major milestones, time-sensitive areas and critical path activities. Any issues that have a real or potential impact on the schedule would be highlighted, and would include the source of the issue and any mitigation measures taken to minimize or eliminate the impact. Schedule reports would be issued on a regular basis as determined during program start-up.

FIGURE 10: CALIORNIA WATERFIX – PROGRAM SUMMARY SCHEDULE

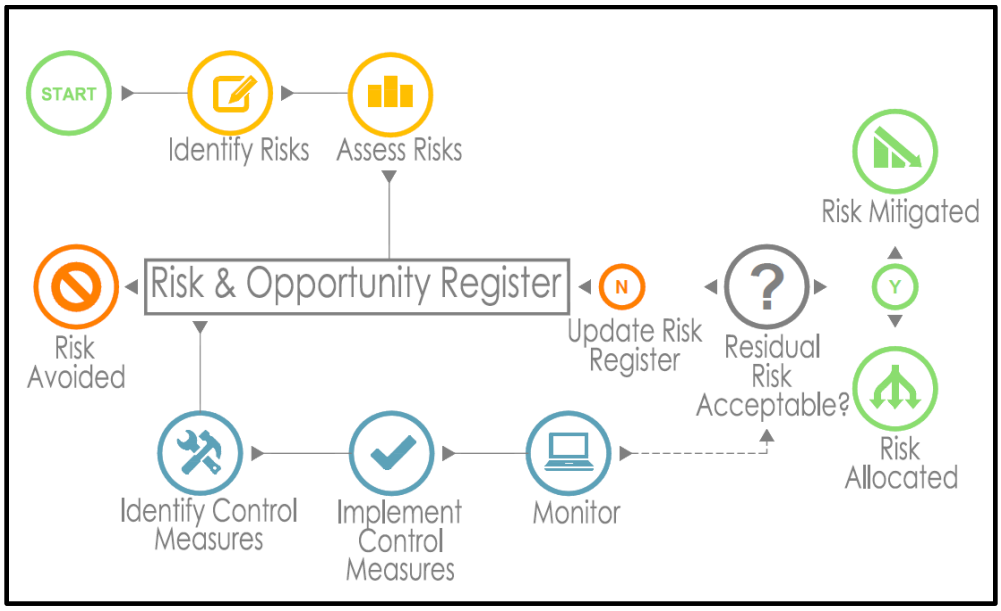


RISK MANAGEMENT AND MITIGATION

RISK MANAGEMENT PROCESS

The goal of the risk management process for California WaterFix would be to identify problem areas early. Each identified risk would be evaluated for its potential impact to cost, schedule, quality and safety. Risks that have the potential to have a significant impact on any of these items would be highlighted. The Safety and Risk Management Team, in coordination with program staff, would develop a methodology to identify and quantify specific risks to the project, determine their consequences and associated probability, and develop mitigation strategies. The overall risk management process is summarized in **Figure 11**.

FIGURE 11: RISK IDENTIFICATION PROCESS



The Safety and Risk Management Team would be responsible for initially identifying project risks, with input as necessary from other groups and teams. The focus would be on risks that could impact project scope, schedule or budget, with each identified risk being added to a Project Risk Register for further discussion and evaluation. The Risk Register would be the basis for developing a "Risk Dashboard," which would provide a simplified list of high-priority risks, a summary of the associated action plan and a summary of any known impacts. If a risk moves from "potential" to "actual," the risk would become part of the Project Change Authorization process and incorporated into the project estimate.

DESIGN, CONSTRUCTION AND OPERATION

A number of critical issues related to the design, construction and operation of California WaterFix were investigated and addressed through the course of the planning and conceptual engineering efforts. These issues included the following:

1. The ability to successfully design and construct large tunnels;
2. The suitability of facilities to withstand anticipated seismic events that may occur in the Delta;
3. The risk of flooding and future sea level rise in the Delta;

4. The potential for various tunnel-related issues, including leakage, surface settlement and tunnel-induced vibrations; and
5. The risks associated with levels of understanding regarding Delta geology.

Each issue and potential mitigation measures for each of these issues are described below:

Large Tunnels

As part of planning and conceptual engineering for California WaterFix, the engineering team performed a survey of large-diameter tunnel projects to determine whether other large tunnel projects used TBMs similar in size to the 45-foot diameter machines that would be used as part of California WaterFix. The survey confirmed that numerous large-diameter (greater than 40-feet) soft-ground TBM projects have been successfully performed throughout the world and that several more large-diameter tunnel projects are planned in the near future. The survey results confirmed that the proposed California WaterFix TBMs are well within the existing industry knowledge and experience.

A separate survey was undertaken to gain a better understanding of recent challenges on large tunnel projects and to identify best management practices to ensure project success. This survey attempted to identify tunnel projects that contained similarities to California WaterFix tunnels in key areas such as design, construction and project management in order to anticipate and manage similar issues that could occur. A total of nine projects were surveyed, including projects in the U.S., Asia and Europe. Each of these projects is well documented by media and industry coverage, and each has been recently completed or is considered substantially complete from a tunneling perspective.

The survey results provided valuable lessons-learned that would be evaluated as part of the design process for California WaterFix, including the following:

- Extensive and high quality geotechnical information is the key for success on any tunnel project; and
- A proactive risk identification and management program is critical to success of large or mega projects.

Tunnel Leakage

The segmented lining system to be used for California WaterFix tunnels would be designed to withstand the maximum internal pressure calculated for the conveyance system, which is anticipated to be present in the northern-most reaches of the tunnel system, as well as all applicable static and ground loads. The individual segments would be fitted with embedded gaskets that would be compressed against one another as the tunnel rings are constructed. The installation of the tunnel segments, along with the compression of the gaskets during the tunnel ring building process, would be designed and constructed to minimize inflows or outflows from the tunnel under a wide range of operational and maintenance conditions.

An assessment of the potential leakage rates from the tunnels completed in February 2017 concluded that there would be negligible leakage from the tunnels or inflow to the tunnels. In fact, when taken as a complete system, it is estimated that there would be a net inflow of 3 cfs to the tunnel over the roughly 73.5 miles of project tunnels, or an inflow rate of 18 gallons-per-minute per mile of tunnel. Inflow to the tunnels and leakage from the tunnels calculated based on anticipated conditions for filling, dewatering, and operation are anticipated to be minimal and well within typical ranges for tunnels of the size and length proposed for California WaterFix.

Tunnel-Induced Ground Vibration

California WaterFix tunnel alignments pass under or near sensitive surface structures such as historic buildings, levees, aqueducts and residential communities. In these locations, it is anticipated that the proposed tunnels would be constructed a minimum of 100 feet below ground. That depth would ensure that material over the tunnels would dampen and absorb any energy generated during tunneling and construction activities. Induced vibration to structures should be minimal and not likely to be perceptible to the communities on the surface, and are not anticipated to have any impact on any of these structures.

Surface Settlement Along the Tunnel Alignment

California WaterFix would use the following to mitigate the risk of settlement effects and structural damage:

- Detailed geotechnical exploration;
- Pre-construction surveys for critical and settlement-sensitive facilities, utilities and surface features;
- Development and implementation of acceptable tunneling protocols and permissible settlement criteria;
- Real-time sophisticated TBM control and monitoring systems;
- Improved structure protection methodologies, including pre-excavation grouting; and
- Advanced ground settlement and vibration monitoring systems.

Seismic Considerations and Mitigation:

Preliminary modeling of active and potentially active earthquake faults in the region was developed and evaluated as part of the Delta Risk Management Strategy (DRMS) study conducted in 2007. The results of this study are summarized below:

A. **Tunnel Alignment:** The proposed Delta tunnel alignment does not cross any major fault rupture or creep zones.

B. **Seismic Sources:** Potential seismic sources in the form of "blind" faults were identified. These blind faults have no surface features and there is limited information or data available to characterize these fault zones.

C. **Ground Motion Estimates:** Estimates of potential ground motions during a seismic event were developed as part of the conceptual engineering studies based on a 1,000-year event (85th percentile) and adjusted for buried tunnel lining systems.

D. **Liquefaction:** Liquefaction was investigated, primarily as it would potentially affect surface facilities such as intakes, forebays, pumping stations and tunnel shafts. Studies indicate the deep tunnels would not be subject to liquefaction potential because they would be constructed below the elevation where liquefiable materials occur.

E. **Lined and Grouted Tunnels:** Studies indicate that lined and grouted tunnels, such as those utilized in California WaterFix, perform better than unlined tunnels. Performance can be further enhanced by improving the contact between the liner and the ground (grouting of annular space between the liner and the surrounding soil).

Based on the results of the studies already conducted, seismic mitigation would be addressed as follows:

- For surface facilities and tunnel shafts, additional geotechnical investigations would be conducted on a site-specific basis to gain a more complete understanding of the expanse and depth of liquefiable material at each site. Based on the investigation results, appropriate design and construction methodologies would be used to eliminate or minimize the impacts of liquefaction on surface facilities.

- Additional field explorations and design solutions, including finite element modeling of the tunnels and shafts, would occur in the design phase of the project. These measures would address any seismically induced liquefaction or deformation potential at the specific locations where the tunnels connect to the shafts.

- The tunnel design concept includes the use of precast segmental lining systems. This system was selected because the same concept has been successfully used on an extensive basis in seismically active areas such as Japan, Puerto Rico, Taiwan, Turkey, Italy, Greece and U.S. since the 1980s. Results of segmentally lined tunnel performance in seismic events show the tunnels would perform very well during and after such an event.

Geotechnical Considerations and Mitigations

The Delta is an arm of the San Francisco Bay estuary that extends into the Central Valley. The geology of the Delta has been shaped by the landward spread of tidal environments resulting from sea level rise after the last glacial period. Since the last glacial age, flood-borne deposits, supplied by the major river systems in the Delta, have overlaid the region with sediment deposits and biomass accumulations. Taken together, the region, prior to the advent of agricultural interests in the late-1800s, was largely a tidal wetlands and alluvial floodplain consisting of consolidated silts, sands and clays overlain with peat and peat muds.

During the development of the planning documents for California WaterFix, approximately 240 boring and cone penetrometer tests were conducted at the intakes, forebays and along the various conveyance alignments. Most of the investigations were conducted at depths between 100 and 200 feet, well within the foundational depth of planned facilities, including the tunnels and pump plants. Based on these investigations, and the use of existing historical information on the Delta, a preliminary geologic understanding of the Delta in the vicinity of California WaterFix facilities was developed.

At tunnel depths ranging from 100 to 150 feet below the ground surface, dense layers of silts, sands and clays are anticipated. This material would be suitable for the planned tunneling activities. At the ground surface, widely varying depths of peat and other organic material is expected. Data indicates that depths of peat in the Delta along the alignment vary from non-existent to about 40 feet deep, with the deepest deposits located in the center of the Delta near Bouldin, Venice and Mandeville Islands. Construction in peat conditions would require specialized design approaches because of the unstable nature of the material.

In some locations along the alignment, there are geotechnical data gaps of several miles, due to the inability to gain access to private property during the planning phase of the project for geotechnical investigations. To mitigate these data gaps and other known uncertainties related to geology along the alignment, California WaterFix would rely on existing information, along with the implementation of a

new two-phase geotechnical investigation program. Under this multi-phased investigation plan, up to 2,000 additional investigations would be conducted, consisting of borings, cone penetrometer tests and other physical data collection methods. The initial phase of the effort would focus on determining whether variations exist in what otherwise appears to be relatively consistent subsurface conditions. Based on the findings from the first phase of work, additional investigations are planned to fine-tune information and gather sufficient information so that accurate estimates of subsurface construction methods and costs can be determined. Additionally, this information would be used to finalize methods to successfully address constructing in ground conditions that are overlain with peat and contain high groundwater levels.

Flood Protection Considerations

Flood protection for California WaterFix facilities would be consistent with DWR's Proposed Interim Levee Design for Urban and Urbanizing Area State-Federal Project Levees (DWR 2009). The conceptual engineering completed to-date includes plans that the facilities would be engineered and designed to withstand water level rise resulting from both a 200-year storm event plus sea level rise of 18 inches in the Delta. This sea level rise estimate corresponds with 55 inches of sea level rise at the Golden Gate Bridge that has been used in the State's long-term planning criteria over the next 100 years. Such protection would be provided by constructing the new facilities at elevations above those identified for flooding or sea level rise through a combination of raising and strengthening levees in all project construction locations, as well as other embankment and equipment pad layouts and elevations.

ENVIRONMENTAL MITIGATION

DWR has adopted a Mitigation Monitoring and Reporting Program that includes Avoidance and Minimization Measures, Environmental Commitments and Mitigation Measures to avoid or substantially lessen construction and operational impacts of California WaterFix. Mitigation may also be required to fulfill conditions in the Biological Opinions, California Endangered Species Act (CESA) incidental take permit and other project permits.

California WaterFix is designed to mitigate its own construction impacts and for operations to not jeopardize any listed species. This project and its mitigation complement other important State efforts to address the coequal goal of a restored Delta, including California EcoRestore, the Smelt Resiliency Plan and the Salmon Resiliency Plan.

CALIFORNIA WATERFIX OPERATIONS AND RELATED REGULATIONS

DESCRIPTION OF PROPOSED CALIFORNIA WATERFIX OPERATIONS

In the future, the SWP and CVP would continue to operate under regulatory conditions imposed for water quality and fisheries protection.

Operating criteria for California WaterFix would include both existing regulatory requirements and new criteria and requirements associated with the proposed new facilities.

California WaterFix facilities would not become operational for many years, and during that time, evolving science and changing conditions may lead to changes in the criteria. As a result, a robust collaborative science and adaptive management program to respond to such changes is a prominent feature of the overall operations strategy. In summary, the strategy involves the following:

A. A set of criteria that would govern California WaterFix when it initially becomes operational was assumed to evaluate California WaterFix effects for the environmental documents and Biological Opinions.
B. A robust collaborative science and adaptive management program, which includes PWAs, would evaluate initial operating criteria in light of additional focused studies and evolving science, and propose appropriate changes in the criteria before and after California WaterFix becomes operational.
C. Flexible real-time operations would respond to day-to-day conditions to maximize water supply and fish protection within the bounds of existing criteria.

Initial Operational Criteria for California WaterFix

The initial operating criteria for California WaterFix includes regulatory requirements that were established through D-1641, the 2008 and 2009 Biological Opinions for existing water project operations, and new criteria developed through California WaterFix's environmental permitting process.

Existing regulatory requirements in the assumed initial operating criteria include:

- Salinity standards;
- Spring and fall outflow to manage the overall salinity gradient (known as "X2");
- Cross Channel Gate, Suisun Marsh Gate, and temporary agricultural barrier operations;
- Limits on SWP and CVP diversions to manage flows in OMR and entrainment; and
- Rio Vista flow.

New regulatory requirements in the assumed initial operation include additional limits on SWP and CVP diversions (i.e., OMR flow reversals) and flow (i.e., spring outflow, north Delta diversion bypass flow). California WaterFix also includes a permanent operable gate at the Head of Old River for fish migration protection and criteria for its operation.

Range of Potential Operations for Environmental Review

The California WaterFix preferred alternative is identified in the final EIR/EIS as Alternative 4A. The proposed initial operations scenario, known as H3+, falls within a range of initial Delta outflows known

as H3 to H4. Before California WaterFix begins operation, specific initial operating criteria would be established as set forth in the related Biological Opinions. These criteria may change based on adaptive management.

To support the potential changes, an analysis was adopted during SWRCB water rights proceedings to identify potential effects of California WaterFix over a broad range of operating criteria. As presented to SWRCB, this range is defined as Boundary 1 and Boundary 2. Boundary 1's operational scenario has most of the existing regulatory constraints, but does not include the additional OMR criteria and spring outflows that are included within the H3-H4 range. Boundary 2's operational scenario assumes a significant increase in Delta outflows, similar to a scenario presented in the EIR/EIS that was developed in coordination with SWRCB staff.

Upper Range (Alternative 4A-H3)

The upper end of the range is referred to as Alternative 4A-H3. In this scenario, spring outflow requirements are consistent with D-1641, and south Delta operations are somewhat less restrictive than described in the initial operating criteria. The lessened requirements result in more water being exported than presented in the California WaterFix preferred alternative.

Lower Range (Alternative 4A-H4)

The lower end of the range is referred to as Alternative 4A-H4. In this scenario, additional spring outflow requirements beyond D-1641 are required. The increased spring outflow requirement results in less water being exported than presented in the California WaterFix preferred alternative.

The final State-federal environmental documents also evaluated other alternatives, including alternatives outside of Boundary 1 and Boundary 2.

These different assumed initial operating alternatives and each boundary are illustrated in **Figure 12**. **Table 2** (below) presents a summary comparison of the key assumptions for these different scenarios.

FIGURE 12: ALTERNATIVES COMPARISON

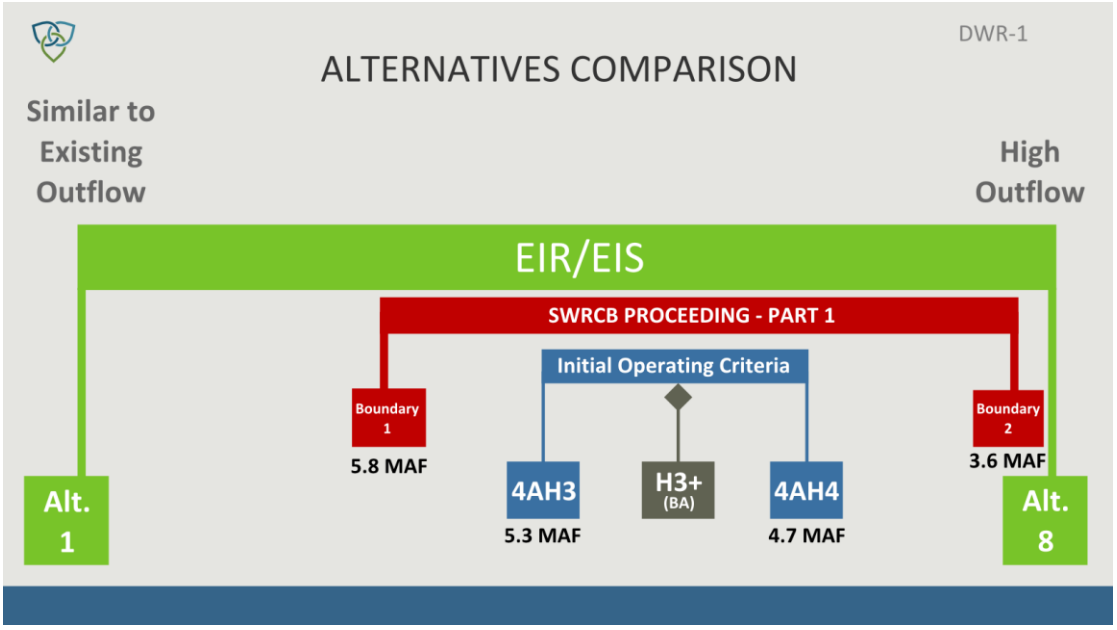


TABLE 2: PROPOSED OPERATING ALTERNATIVES AND BOUNDARIES

	9,000 cfs North Delta Diversion	Fall X2	Delta Outflow requirements	NMFS BiOp SJR i/e ratio	OMR Requirements	Head of Old River Barrier/Gate
No Action Alternative	No	Yes	Per D-1641	Yes	Yes; per BiOps	Temporary barrier installed in fall months
Boundary 1	Yes	No	Per D-1641	No	Yes; per BiOps	Permanent gate operating in fall months consistent with NAA
H3	Yes	Yes	Per D-1641	No	Yes; more restrictive of either BiOps or new OMR requirements identified in the RDEIR/SDEIS for Alternative 4A	Permanent gate operating in fall, winter and spring months (partial closure)
H4	Yes	Yes	Per D-1641 and increased Delta Outflow requirements during March-May	No		
Boundary 2	Yes	Yes	Per D-1641 and increased Delta Outflow goals in all months	No	Yes; more restrictive of either BiOps or new OMR requirements identified in the RDEIR/SDEIS Appendix C	Permanent gate operating in fall, winter and spring months (full closure)

Note: *The term "BiOp" refers to the 2008 USFWS Biological Opinion and 2009 NMFS Biological Opinion on SWP and CVP operations.*

SWP AND CVP OPERATIONS, AND PERFORMANCE OF CALIFORNIA WATERFIX

The facilities and operational features of California WaterFix would have a positive impact on water supply and water quality, and provide significant capability to adapt to climate change and seismic concerns.

SWP AND CVP SUPPLY RELIABILITY

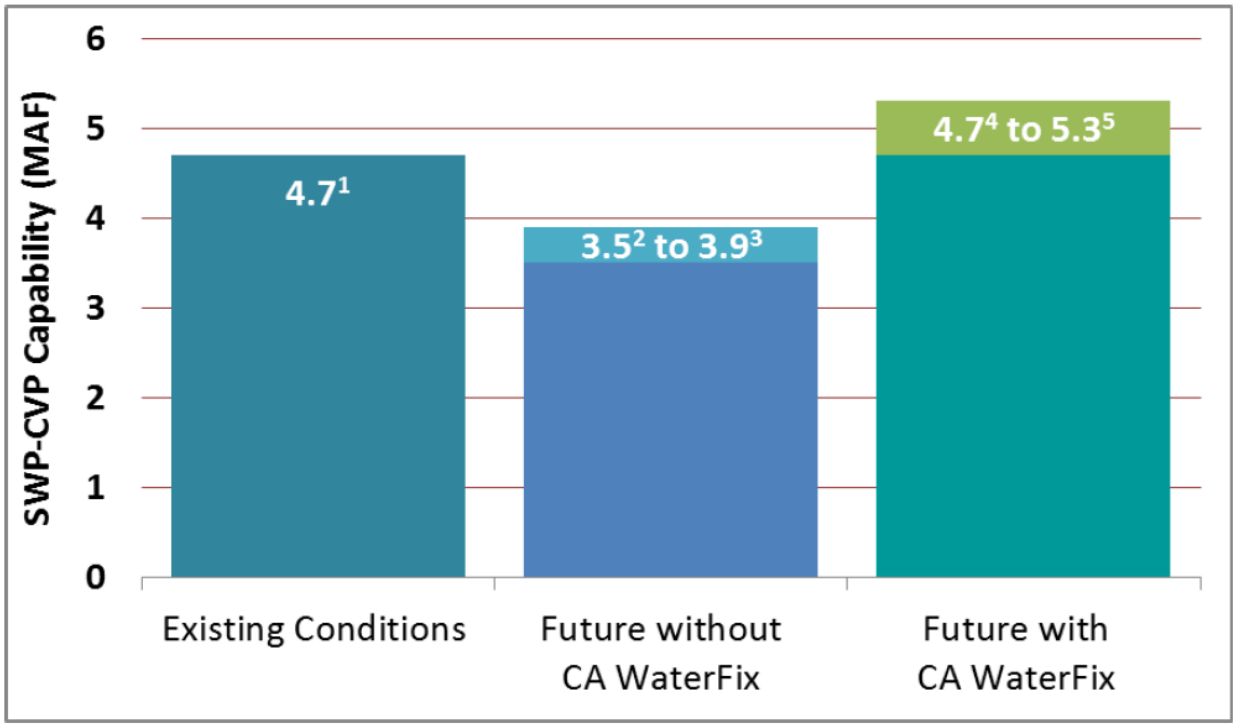
Extensive modeling and analysis has evaluated the potential operational and water supply benefits of California WaterFix. This work involved developing forecasts of SWP and CVP deliveries for a number of scenarios including climate change, both with and without California WaterFix. The total water supply from the SWP and CVP under current conditions averages about 4.9 MAF of water per year. In year 2025, the No Action Alternative evaluated in the California WaterFix EIR/EIS is estimated to average about 4.7 MAF per year with climate change effects considered **(Figure 13)**. The No Action Alternative incorporates an estimate of climate change and sea level rise that is consistent with the future cases with and without California WaterFix. In this way, the No Action Alternative isolates the impact of California WaterFix from the impact of climate change (approximately 0.2 MAF of water per year), and allows for direct comparisons between future cases.

The estimated future supply without California WaterFix assumes increasing future regulatory constraints. Since the long-term trend has been toward increased regulation and reduced supply of the SWP and CVP, it is assumed that this trend would continue into the future. For example, SWRCB is reviewing its WQCP, which includes analysis of several new outflow scenarios as part of that process. USFWS and NMFS are also reviewing the existing 2008 and 2009 Biological Opinions for existing SWP and CVP operations, which could lead to new operational restrictions. In 2018, CDFW will review its Fish and Game Code section 2081 permit regarding ongoing SWP operations, which could impose further restrictions on exports.

More specifically, it is assumed that future regulatory restrictions could include further reductions in direct diversions, as regulated using OMR flow, as well as increased outflow as measured by outflow or X2. To approximate a future without California WaterFix, Alternative 4A without the proposed north Delta diversions was used in this report. This approach is consistent with DWR's planning activities, as evidenced by its 2015 DWR Delivery Capability Report (Capability Report), which used the same approach to estimate future regulatory constraints on SWP and CVP pumping by analyzing an Existing Conveyance High Outflow (ECHO) scenario and an Existing Conveyance Low Outflow (ECLO) scenario. The predicted future water supply without California WaterFix under the ECHO Scenario is estimated to be 3.5 MAF per year on average, and 3.9 MAF under the ECLO Scenario. The Alternative 4A range of exports without California WaterFix would be about the same as the range for the ECHO and ECLO scenarios.

Total exports with California WaterFix are estimated to range from 4.7 MAF under Alternative 4A-H4 to 5.3 MAF under Alternative 4A-H3 per year on average. The range in average exports with California WaterFix is based on uncertainties surrounding initial operating criteria and the effectiveness of the collaborative science process.

FIGURE 13: TOTAL EXPORTS WITH AND WITHOUT CALIFORNIA WATERFIX



[1]California WaterFix EIR/EIS No Action Alternative, existing conditions with 2025 climate change impacts
[2]2015 Delivery Capability Report Existing Conveyance High Outflow scenario
[3]2015 Delivery Capability Report Existing Conveyance Low Outflow scenario
[4]California WaterFix EIR/EIS Alternative 4A-H4, initial operating criteria lower range
[5]California WaterFix EIR/EIS Alternative 4A-H3, initial operating criteria upper range

OPERATIONAL FLEXIBILITY WITH CALIFORNIA WATERFIX

There are two ways that the operational flexibility provided by California WaterFix can increase water supply reliability within a given year. The first is through the increased ability to manage intermittent high-flow events in the Delta watershed. The second is through the increased conveyance capacity that could facilitate voluntary water transfers between north and south Delta interests.

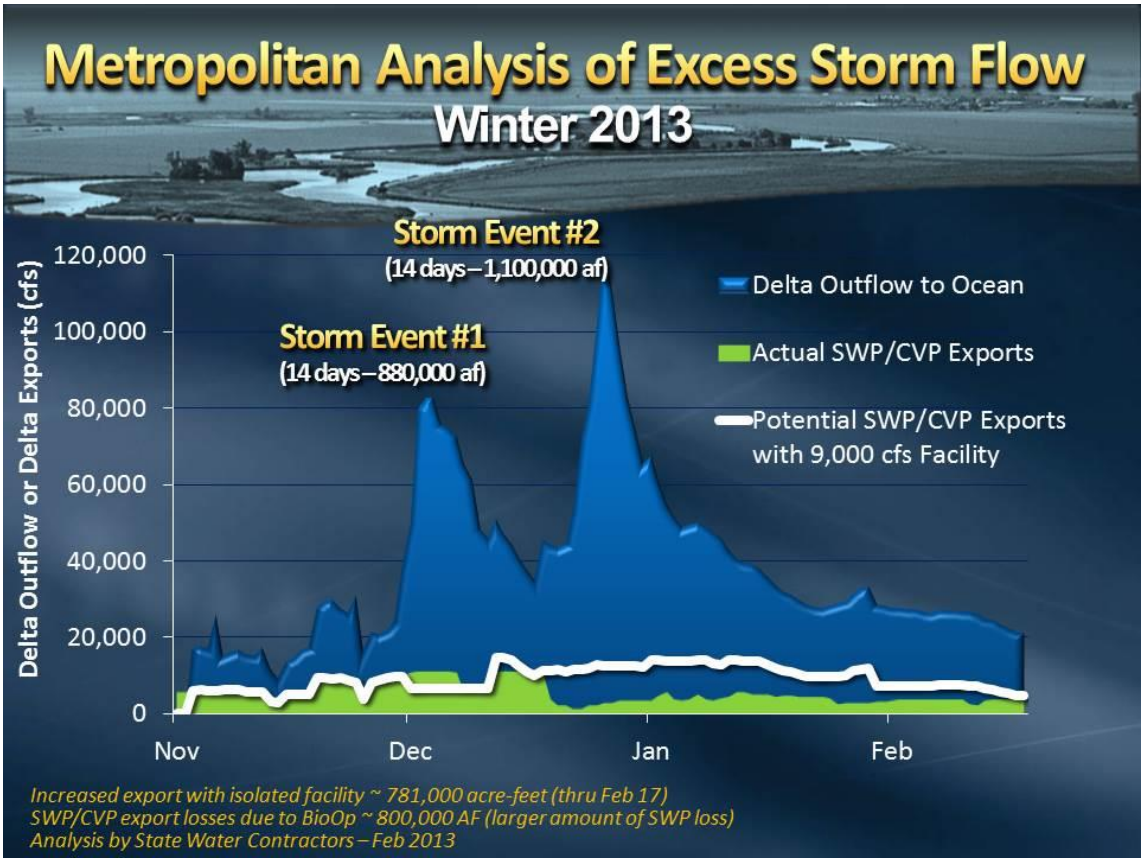
Management of High Flow Events

California WaterFix is intended to capture additional flows during wet periods when unregulated flow is available. An analysis by the Metropolitan demonstrates the ability of California WaterFix to divert water during such high flow events.

Using the winter of 2012/2013 as an example, **Figure 14** shows that major storm flows produced significant volumes of water flowing through the Sacramento River past the location of the new intakes, through the Delta, and out to the San Francisco Bay. One 14-day storm event in December 2012 resulted in about 880,000 af of water flowing out to the Pacific Ocean. A second 14-day storm event resulted in about 1.1 MAF of Sacramento River outflow. As shown in Figure 14, exports were relatively minor in comparison to the Delta outflow of these two storms. With the additional flexibility of California WaterFix's proposed north Delta intakes, Metropolitan estimates that several hundred

thousand acre-feet of additional water could have been captured in these two storm events (as shown by the difference between the green and white lines in Figure 14). These results suggest that periodic high-flow events could potentially provide re-operation benefits consistent with existing water service contracts, while at the same time meeting all criteria intended to protect fish, water quality and existing water rights.

FIGURE 14: WINTER 2013 REOPERATION ANALYSIS WITH CALIFORNIA WATERFIX



As part of SWCRB's California WaterFix petition process, DWR presented a similar analysis illustrating the flexibility of California WaterFix using water year 2016 as an example. DWR's analysis showed that an additional 1.2 MAF could have been diverted if California WaterFix had been operational in 2016[6].

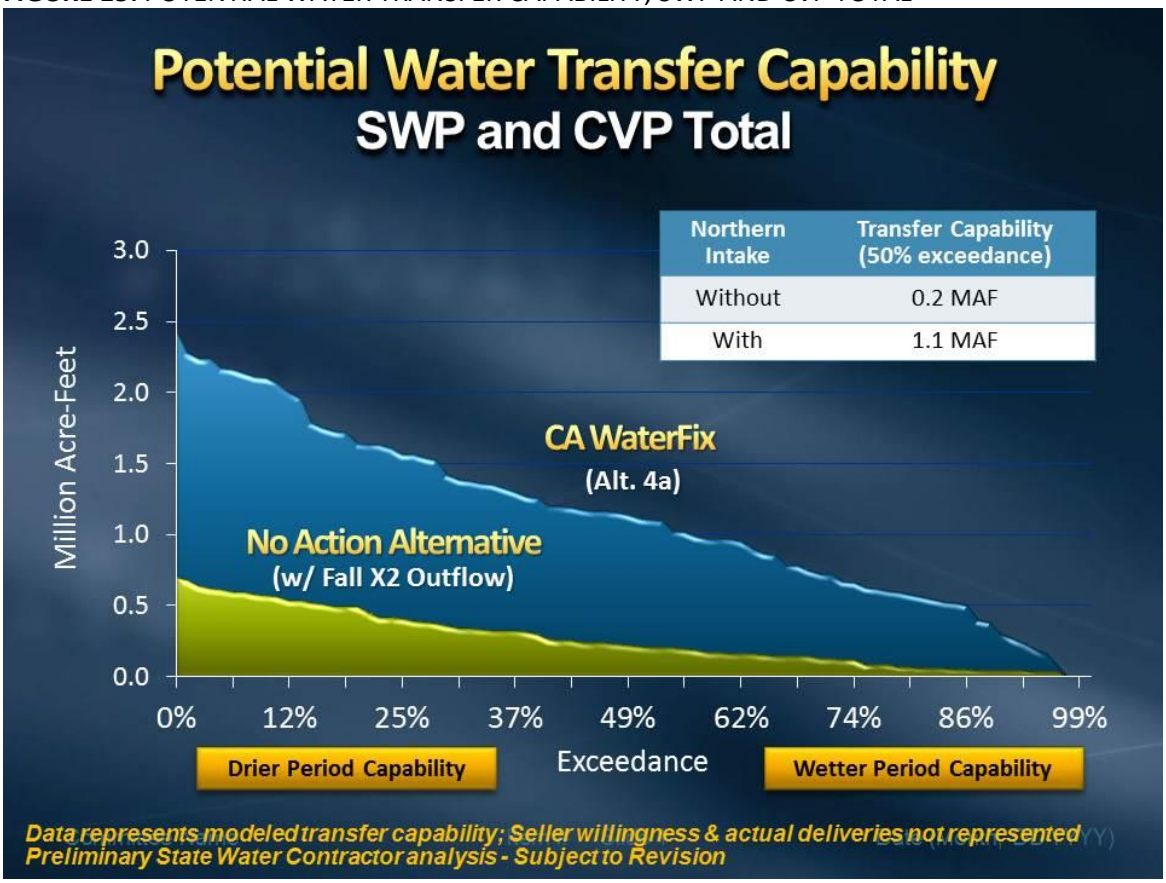
This analysis is consistent with the average annual analysis presented in the environmental documents. All of the existing and new operating criteria for California WaterFix that are intended to protect fish and water quality would be maintained. Consequently, any diversions during high-flow events would take place consistent with criteria intended to protect fish, water quality and existing water rights. The analysis did not account for available south Delta storage or demand, so the actual quantity that may be diverted under similar circumstances in the future could be less than predicted.

[6] Source: J. Leahigh testimony, SWRCB Hearing Proceedings Regarding Changes in Water Rights for the California WaterFix Project, DWR Exhibit 61.

Increased Capacity for Water Transfer Agreements

The flexibility provided by California WaterFix also improves the capability of moving water transfer supplies across the Delta. The increased conveyance and operational flexibility would significantly increase the amount of available capacity to accommodate the movement of water transfers across the Delta and the SWP and CVP systems. **Figure 15** shows the estimated increase in available transfer capacity with and without California WaterFix.

FIGURE 15: POTENTIAL WATER TRANSFER CAPABILITY, SWP AND CVP TOTAL



It is important to note that California WaterFix only serves to improve the available capacity and capability to accommodate water transfer agreements. Future water transfers or particular quantities of transfers are not components of California WaterFix. Because specific, future transactions for water transfers and other non-California WaterFix voluntary water market transactions depend on future water supply, market and other conditions, any amounts and locations of future water transfers are speculative. Future transactions and water transfer agreements would be subject to regulatory approvals and environmental review. Even with these considerations, California WaterFix would provide much greater capability to manage transfers.

COMPLIANCE WITH D-1641 WATER QUALITY STANDARDS WITH CALIFORNIA WATERFIX

California WaterFix would provide added flexibility to comply with flow and salinity criteria required by SWRCB and other regulatory obligations, included for the protection of fish species. The additional

location for SWP and CVP diversion in the north Delta enhances the flexibility of the water management system, allowing State and federal water system operators to balance flows for more optimal and precise salinity management. With California WaterFix, the SWP and CVP would still be required to meet all of the same salinity and flow requirements they must meet today, regardless of which diversion location would be used. However, the variable split between north and south diversions would allow a flexible and improved approach toward compliance with flow and salinity standards. For example, if salinity increased on the lower Sacramento River, the SWP and CVP could opt to increase diversions in the south Delta and thereby allow greater flow down the lower Sacramento River. In contrast, if salinity increased on the lower San Joaquin River, the SWP and CVP could decrease water diverted in the south Delta and increase diversions in the north Delta, thereby increasing flow in the lower San Joaquin River and south Delta. The flexibility offered by this example would limit reverse flows in the central Delta near Jersey Point, which in the past have drawn saltier water from the San Francisco Bay into the central Delta.

With California WaterFix, the SWP and CVP would continue to meet existing and any future regulatory requirements. Increased diversion flexibility afforded through the approval of California WaterFix would only enhance the capabilities of SWP and CVP projects to meet existing Delta requirements. Because California WaterFix can take advantage of opportunities to divert and store wet-period storm flows and allow for south Delta diversions in drier periods, in-Delta water quality can be better managed. As a result, the proposed California WaterFix operations would continue to be as protective, if not more, of existing beneficial uses.

EXPORT WATER QUALITY

California WaterFix would improve SWP and CVP export water quality. The PWAs are concerned with the levels of salinity (electrical conductivity (EC), bromide, and total dissolved solids (TDS)), organic carbon, and nutrients in their imported water supplies. The concern is related to meeting State and federal drinking water regulations to protect human health, preventing taste and odor complaints and enhancing local water management programs.

California WaterFix would improve SWP and CVP export water quality through the use of the dual intake system. This is because water quality on the Sacramento River at the proposed intakes is generally lower in salinity, organic carbon and nitrates as compared to the San Joaquin River and south Delta. Modeling of Alternative 4A compared to no action shows lower levels of EC (18-22 percent improvement), TDS (17-22 percent improvement), bromide (31-43 percent improvement), organic carbon (2-11 percent improvement) and nitrates (5-27 percent improvement).

With these improvements, source water quality would be improved both for human health protection as well as regional water management.

ALLOW FLEXIBLE PUMPING OPERATIONS TO ADDRESS CHANGING FISHERY RESTRICTIONS

The proposed north Delta diversion would allow SWP water exports, consistent with applicable criteria, during high-flow periods. Accordingly, north Delta diversions would be greatest in wet years and lowest in dry years. North Delta bypass flow criteria and the south Delta initial operations were developed with fishery agency involvement and are based on the scientific information available at the time of

document preparation. These criteria are intended minimize project effects on listed fish species while providing water supply reliability gains, with the following considerations:

- **Real-time operations -** Real-time operations also would be used to adjust operations and further protect listed species, while maximizing water supply benefits. Additionally, proposed initial operations would include a preference for south Delta facility pumping from July through September to limit potential water quality degradation in the south Delta. Delta channel flows and diversions may be modified to address real-time operational needs such as those related to OMR, Delta Cross Channel operations, or north Delta bypass flows.

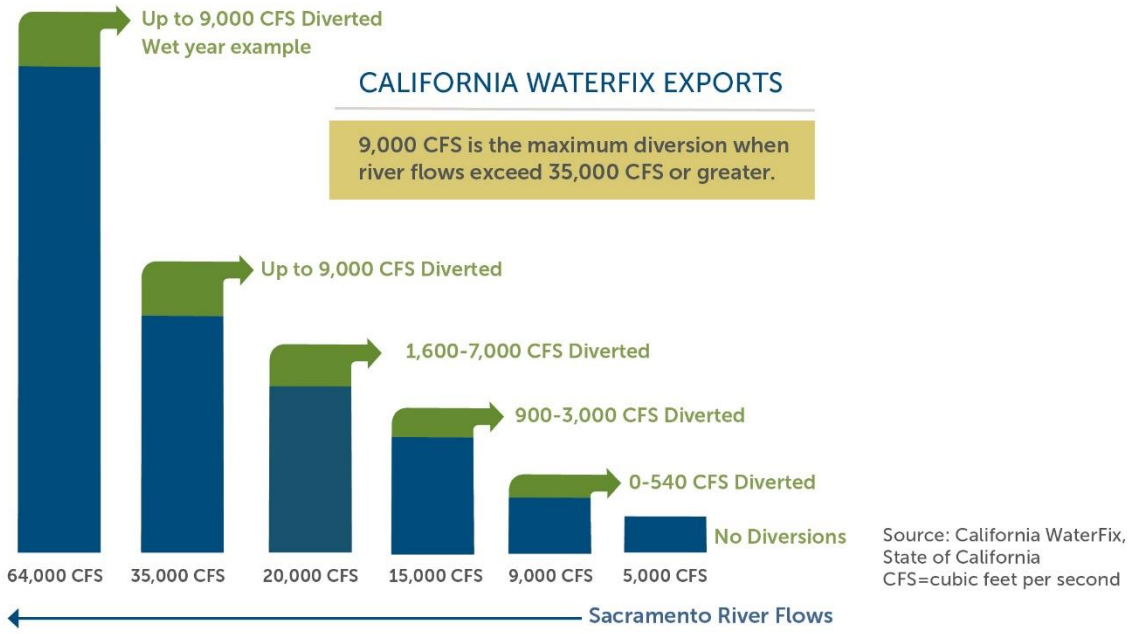
- **North Delta bypass flows -** The objectives of the north Delta diversion bypass flow criteria include regulation of flows to maintain fish screen sweeping velocities; minimize potential increase in upstream transport of productivity in the channels downstream of the intakes; support salmonid and pelagic fish movements to regions of suitable habitat; reduce losses to predation downstream of the diversions; and maintain or improve rearing habitat conditions in the north Delta (see **Figure 16** below).

- **Salmon restriction on north Delta diversions –** To meet bypass flow objectives, diversions must be restricted at certain times of the year that support the main juvenile salmon migration period (primarily from December through June). This can be achieved by lowering the north Delta diversion pumping (maximum diversion of 6 percent of Sacramento River flow measured upstream of the intakes up to 900 cfs, or 300 cfs per intake) when the juvenile fish begin their outmigration. This fish movement generally coincides with seasonal high-flows triggered by fall/winter rains followed by a ramping up of allowable diversion rates, while ensuring flows are adequate to be protective of aquatic species during the remainder of the outmigration. Additional but less restrictive requirements apply for the late spring to late fall period.

- **Water quality restrictions on north Delta diversions** – The proposed operational north Delta bypass criteria also protect water quality and flow for downstream water users. As shown in Figure 16, the north Delta diversion would not be operated during low-flow periods on the Sacramento River. The full 9,000 cfs diversion rate would not occur until Sacramento River flows are at least 35,000 cfs. Compliance with D-1641 standards further restricts the north Delta diversion rate because the facility could not reroute water that the SWP and CVP need to satisfy D-1641 water quality requirements, which is generally a concern during low flows. Compliance with D-1641 water quality requirements further restrict north Delta diversion operations that is in addition to the bypass flow requirements. As a result of all of the restrictions placed on north Delta diversion, there will be sufficient water downstream for both the fishery and water quality requirements.

Overall, the flexibility provided by California WaterFix would better respond to the needs of the fishery.

FIGURE 16: NORTH DELTA DIVERSION BYPASS CRITERIA



REDUCE CLIMATE CHANGE RISKS

Climate change will affect northern California watersheds and the Delta region in a number of ways. Questions remain about the exact timing, magnitude, and regional impacts of temperature and precipitation changes, but climate researchers have identified several areas that could affect water supply availability and the future operation of SWP and CVP facilities.

These areas include:

- Reduction in Sierra Nevada snowpack and loss of natural storage from snowpack;
- Increased intensity and frequency of extreme precipitation events; and
- Rising sea levels and seawater intrusion into Delta.

The past 10 years have heightened the concerns and associated challenges that future climate change may bring. The northern California watershed in the Sierra and the Delta have already experienced the range of higher temperatures and reduced snowpack that was predicted by climate change scientists. The hot and dry records experienced in the recent drought, followed by the extreme wet conditions in 2016/2017, highlighted the challenges that SWP and CVP storage and conveyance facilities face in managing increasingly variable water supplies and conditions.

Current SWP and CVP pumping plant locations in the south Delta are vulnerable to the increased salinity levels that rising sea levels could bring. For example, rising sea levels could increase the pressure on the existing levee system, making the levees more vulnerable to failure.

REDUCE SEISMIC RISKS

Because of their age and general methods of original construction, many Delta levees are at risk of failure as a result of continued land subsidence, flood conditions, sea level rise and seismic events. Failure of the Delta levee system would inundate the surrounding islands, allowing saline water from San Francisco Bay to intrude into the Delta and contaminate freshwater supplies that are delivered by the SWP and CVP. If climate change and rising sea levels lead to such a levee failure in the future, California WaterFix would allow continued diversions at the north Delta intakes.

The new northern Delta intakes provided by California WaterFix would greatly improve the reliability of SWP and CVP deliveries under future climate change conditions. California WaterFix would allow for additional water diversions during extreme wet periods or rapid snowmelt events, both of which are predicted to increase in frequency with climate change. Additionally, the location of the north Delta diversion intakes is less vulnerable to the effects of saltwater intrusion.

In 2009, DWR released the final DRMS Phase 1 report. The DRMS Phase 1 report evaluated the risk and consequences to California and the Delta associated with the failure of Delta levees and concluded that a seismic event is the single greatest risk to levee integrity. The U.S. Geological Survey found a 62 percent probability of a magnitude 6.7 or greater earthquake occurring in the San Francisco Bay Area between 2003 and 2032. The DRMS Phase 1 report estimated that a major earthquake could result in multiple levee failures that would simultaneously flood 20 or more Delta islands. Under such a scenario, SWP and CVP exports could be interrupted for up to one and a half years.

Implementing California WaterFix would help reduce the risks from a catastrophic seismic event in the Delta. With the uncertainty of where a seismic event might occur, the addition of the new north Delta diversion and conveyance facilities provides redundancy in critical water supply infrastructure. Additionally, all California WaterFix infrastructure would be built to meet current seismic standards, as applicable.

ENHANCE ECOSYSTEM FISHERY HABITAT THROUGHOUT DELTA

The environmental benefits of California WaterFix include reduced south Delta pumping, providing a more natural upstream-to-downstream flow pattern during periods important for fishery protection and less direct fish entrainment in the south Delta diversion facilities. California WaterFix also offers mitigation measures that would improve the existing environmental conditions as well as mitigate the effects of California WaterFix.

Improved Flow Patterns in the Delta

Current pumping in the south Delta causes water from the Sacramento, Feather and American Rivers to be pulled across the Delta into the south Delta. This cross-Delta water movement can confuse migrating salmon heading for the ocean or trying to return to their natal streams. As a result, migrating salmon may take longer to reach the sea or have difficulty finding their spawning grounds. With California WaterFix, south Delta water diversions would be reduced, improving flow and habitat conditions for salmonids.

Reduced south Delta pumping also could lessen direct entrainment in existing south Delta water facilities. For example, when a high turbidity pulse flow comes down the Sacramento River, diversions

could be switched to the north Delta. This operational flexibility would help avoid drawing that turbidity, and potentially Delta smelt, toward the south Delta pumping facilities. Conversely, when salmon are migrating out of the upper tributaries and into the Sacramento River, diversions could be switched to the south Delta, away from the main migratory routes. The flexibility of having diversion facilities in the north and the south would provide opportunities to preferentially operate the facilities to minimize effects to sensitive fish species.

Physical Habitat Actions

California WaterFix Biological Opinions and the EIR/EIS incorporate a variety of measures designed to mitigate potential construction and operation impacts and to enhance environmental conditions in the Delta.

With the State-directed pivot from the BDCP to California WaterFix in April 2015, many of the previously proposed BDCP Conservation Measures were no longer applicable to the newly proposed preferred alternative. However, some actions were adopted as part of the California WaterFix alternative. These actions, identified in **Table 3**, below, consist primarily of habitat restoration, protection, enhancement and management activities.

TABLE 3: ENVIRONMENTAL COMMITMENTS UNDER CALIFORNIA WATERFIX

Environmental Commitment 3: Natural Communities Protection and Restoration	
Valley/Foothill Riparian	Up to 103 acres
Grassland	Up to 1,060 acres
Vernal Pool Complex and Alkali Seasonal Wetland Complex	Up to 188 acres
Nontidal Marsh	Up to 119 acres
Cultivated Lands	Up to 11,870 acres
Total:	**Up to 13,340 acres**
Environmental Commitment 4: Tidal Natural Communities Restoration	Up to 295 acres
Environmental Commitment 6: Channel Margin Enhancement	Up to 4.6 levee miles
Environmental Commitment 7: Riparian Natural Community Restoration	Up to 251 acres
Environmental Commitment 8: Grassland Natural Community	Up to 1,070 acres
Environmental Commitment 9: Vernal Pool and Alkali Seasonal Wetland Complex Restoration	Up to 48 acres
Environmental Commitment 10: Nontidal Marsh Restoration	Up to 832 acres
Environmental Commitment 11: Natural Communities Enhancement and Management	At sites protected or restored under Environmental Commitments 3–10
Environmental Commitment 12: Methylmercury Management	At sites restored under Environmental Commitment 4

Environmental Commitment 15: Localized Reduction of Predatory Fishes	At north Delta intakes and at Clifton Court Forebay
Environmental Commitment 16: Nonphysical Fish Barrier	At Georgiana Slough

(Source: Final EIR/EIS (2016), Table 3-9, Page 3-55)

The final Biological Opinions add 80 acres of rearing habitat upstream on the Sacramento River and an additional 1,800 acres of tidal habitat restoration in the Delta.

In addition to the enhancement actions identified above, a variety of construction-related environmental commitments, best management practices, and avoidance and minimization measures have been incorporated that would be implemented as part of the construction activities. These actions have been designed to lessen or eliminate potential effects to environmental resources during construction of the new conveyance infrastructure and ancillary facilities.

Some measures have been specifically developed to provide enhanced protection to sensitive species and their habitats. These include measures for the following resources: vernal pool crustaceans, California tiger salamander, California red-legged frog, valley elderberry longhorn beetle, Swainson's hawk, California clapper rail, Greater sandhill crane, tricolored blackbird, Suisun song sparrow, yellow-breasted chat, least Bell's vireo, western yellow-billed cuckoo, western burrowing owl, San Joaquin kit fox, riparian woodrat and riparian bush rabbit, salt marsh harvest mouse and Suisun shrew.

The benefits of the fishery habitat created and restored through California WaterFix include:

- Improved habitat conditions along important juvenile salmon migration routes;
- Restored tidal and non-tidal wetlands;
- Restored native riparian forest habitat;
- Increased food production;
- Increase spawning and rearing areas;
- Natural refuge from predators and changing climate conditions; and
- Improved connectivity between existing areas of natural habitat.

These environmental benefits combined with other State-sponsored programs currently underway to restore natural communities and ecological processes throughout the Delta. Three such programs include California EcoRestore, Delta Smelt Resiliency Strategy and Sacramento Valley Salmon Resiliency Strategy. Highlights of the restoration goals of these programs are outlined below.

In addition to the mitigation activities above, California EcoRestore represents the State's near-term effort to accelerate habitat restoration in the Delta. California EcoRestore is being developed in parallel to California WaterFix, but separate from the mitigation requirements related to the construction and operation of California WaterFix. EcoRestore includes the restoration necessary to achieve regulatory requirements of the 2008 and 2009 Biological Opinions for existing SWP and CVP operations as well as additional projects to help improve the long-term health of the Delta unrelated to the operations of the water projects. In total, EcoRestore seeks to advance at least 30,000 acres of habitat restoration. Those 30,000 acres include:

- 3,500 acres of managed wetlands;
- At least 17,500 acres of floodplain restoration;
- 9,000 acres of tidal and sub-tidal habitat restoration; and

- At least 1,000 acres of aquatic, riparian and upland habitat projects and multi-benefit flood management projects.

The State has committed to improving conditions for species through the Delta Smelt Resiliency Strategy and the Sacramento Valley Salmon Resiliency Strategy. These plans contain actions that can be achieved in the near-term to improve the status of the species.

The Delta Smelt Resiliency Strategy was developed by the State in 2016 to voluntarily address the immediate and near-term needs of Delta smelt, to promote their resiliency to drought and variable habitat conditions. The primary objective of the Delta smelt strategy is to improve the status of the species through management actions meant to address many of the environmental and habitat stressor of the species. Although specific implementation details are still under development, the actions included in the Delta Smelt Resiliency Strategy include:

- Aquatic weed control;
- North Delta food web adaptive management projects;
- Outflow augmentation;
- Re-operation of the Suisun Marsh salinity control gates;
- Sediment supplementation in the low salinity zone;
- Spawning habitat augmentation;
- Roaring River distribution system food production;
- Coordinated and managed wetland food and drain operations in Suisun Marsh;
- Franks Tract Restoration Feasibility Study;
- Adult fish salvage operation during summer and fall;
- Stormwater discharge management;
- Rio Vista Research Station and Fish Technology Center; and
- Near-term Delta smelt habitat restoration.

The Sacramento Valley Salmon Resiliency Strategy has been prepared by the State to voluntarily address the needs of sensitive Chinook and steelhead salmon. The actions included in this strategy represent a variety of habitat restoration management actions necessary to improve the immediate and long-term resiliency of Sacramento Valley salmonids. Although not all known stressors affecting salmonids can be addressed, this strategy is intended to focus on habitat restoration actions critical to improving population resiliency to known and future stressors associated with spawning and rearing habitat, through-Delta survival and adult fish passage. The actions contained in the Sacramento Valley Salmon Resiliency Strategy include:

- Multiple actions on Battle Creek;
- Provide instream flows to protect Chinook salmon and steelhead on Deer Creek, Mill Creek, Antelope Creek and Butte Creek;
- Restore fish passage and habitat in Upper Sacramento tributaries;
- Implement McCloud reintroduction plan;
- Improve fish habitat by removing Sunset Pumps Rock Dam on Feather River;
- Restore off-channel rearing, streambank, and riparian habitats and migratory conditions along Upper, Middle, and Lower Reaches of the Sacramento River;
- Complete fish screen construction on major diversions along the Sacramento River;
- Improve Sutter Bypass and associated infrastructure to facilitate adult fish passage and improved stream flow monitoring;
- Improve Yolo Bypass adult fish passage;

- Increase juvenile salmonid access to Yolo Bypass, and increase duration and frequency of Yolo Bypass floodplain inundation;
- Construct permanent Georgiana Slough non-physical barrier; and
- Restore tidal habitat in the Delta.

California WaterFix would include implementation of portions of both of the resiliency plans.
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CONSIDERING DELTA COMMUNITIES AND ENVIRONMENT

CALIFORNIA WATERFIX IS SIZED TO PROTECT THE DELTA ENVIRONMENT

The proposed California WaterFix was originally planned as a 15,000 cfs diversion facility. In response to consideration by the fishery agencies regarding intake size and issues raised in the environmental review process that included Delta community concerns, California WaterFix was reduced to a 9,000 cfs diversion facility. A 9,000 cfs facility was selected over a smaller facility (i.e., 3,000 cfs) because the smaller facility would not serve California WaterFix purposes of a more reliable water supply and protection of the environment. A copy of the letter from the California Natural Resources Agency (Resources Agency) dated February 19, 2014, and a memorandum providing analysis for the need of a 9,000 cfs facility is available at the following link:

http://baydeltaconservationplan.com/Libraries/Dynamic_Document_Library/Natural_Resources_Agency_Response_Re_NRDC_Portfolio_2-19-14.sflb.ashx

According to the Resources Agency, a 3,000 cfs facility would not meet California WaterFix purposes because a facility of that reduced size would lack redundancy and would not provide sufficient benefits to justify the cost. A 3,000 cfs facility would also fail to provide fishery benefits because pumping would continue to be predominantly in the south Delta. Operational flexibility to better manage water quality and species concerns would also be largely non-existent with a smaller facility.

CALIFORNIA WATERFIX IS DESIGNED TO AVOID IMPACTS TO DELTA COMMUNITIES

As described above in the section titled California WaterFix Facilities, numerous refinements over the years have dramatically reduced the short- and long-term project impacts. Switching from a canal to tunnel conveyance design was the largest such modification, which preserves Delta farms, avoids every Delta community, maximizes the use of public lands, and minimizes the need to acquire private property.

California WaterFix was refined to include other important modifications to reduce or avoid impacts to the Delta area:

- Reducing visual impacts near the community of Hood;
- Increase the use of state-owned property;
- Eliminating all pumping plant facilities adjacent to the three proposed intakes and consolidating all necessary pumping at the existing SWP site at Clifton Court Forebay;
- Eliminating numerous permanent power lines in the Delta and reduce power requirements;
- Eliminating tunnel launch facilities on Staten Island, a popular destination for Sandhill Cranes and bird watchers, to protect wildlife habitat; and
- Removing planned power transmission lines near the Stone Lakes Wildlife Refuge.

The construction footprint of California WaterFix–less than 2,000 acres–represents about one-third of 1 percent of the acreage in the Delta region. Significant changes to the proposed California WaterFix facilities and operations made throughout the planning process reduced the overall California WaterFix footprint by one-half of its original size, greatly minimizing impacts to communities.

California WaterFix Would Protect In-Delta Agricultural and Municipal Water Quality

California WaterFix must adhere to the in-Delta water quality objectives and criteria set by SWRCB for the protection of urban, agricultural and fishery beneficial uses. DWR and USBR constantly monitor Delta water quality conditions. Their water system operational decisions take into account real-time conditions as well as regulatory requirements.

The State and federal water projects have been in compliance with SWRCB water quality standards in the Delta 98.9 percent of the time over the past 37 years[7]. The SWP and CVP exceed water quality standards from time-to-time because of extreme, and sometimes uncontrollable circumstances or unforeseen weather conditions. There are some D-1641 standards that are currently met 100 percent of the time, while some are met less often. For example, the agricultural salinity standard at the Old River at Tracy is met less often because of local sources of salinity and because the SWP and CVP are generally unable to control salinity at that location.

SWP and CVP compliance with D-1641 standards should be the same under California WaterFix as under the without California WaterFix condition. Modeling of future water quality under California WaterFix generally shows that compliance with D-1641 water quality standards is the same under California WaterFix as compared to the future without California WaterFix. The only potential exception is agricultural water quality at the Emmaton compliance location. Under certain limited conditions, modeling shows water quality at Emmaton is somewhat more saline with California WaterFix than without. However, as DWR testified before SWCRB, real-time actions that project operators take to avoid water quality exceedances cannot be modeled. Thus the modeled Emmaton results are modeling anomalies that would not actually occur in the future under actual operations.

[7] J. Leahigh Power Point, SWRCB Hearing Proceedings Regarding Changes in Water Rights for the California WaterFix Project, DWR-4, errata, p. 18.

MANAGING UNCERTAINTIES

Given the uncertainties involving the effects of water operations on listed species and the ecological benefits from enhanced outflow and habitat restoration, California WaterFix incorporates processes designed to address uncertainty in scientific understanding, and reduce risks to sensitive resources and critical water supplies.

Table 4 highlights some of the key uncertainties and mitigation measures associated with the operations of California WaterFix. The addition of north Delta diversions, and the operational flexibility provided by dual conveyance facilities would help to directly mitigate some of these uncertainties. Additionally, a commitment to continue collaborative science efforts and a robust Adaptive Management Program would play an essential role in managing many of these future uncertainties.

TABLE 4: KEY UNCERTAINTIES AND MITIGATION MEASURES

Key Uncertainties	Mitigation Measures
Regulatory Uncertainties	• Adaptive Management Program would inform SWP and CVP operations under existing regulations, inform implementation of California WaterFix initial operational criteria, and inform SWP and CVP operations under future regulations with California WaterFix. • North Delta diversions would allow flexibility to minimize fish and water quality impacts. • Real-time operations would adjust to observed conditions to limit effects on fisheries.
Fisheries and Ecosystem Uncertainties	• Adaptive Management Program would inform habitat restoration and other mitigation measures. • Collaborative science efforts would continue to advance the field of knowledge surrounding California WaterFix operations and fisheries. • Efforts to restore habitat and decrease other stressors would help improve the health of the Delta ecosystem and fisheries. • Real-time operations would adjust to observed conditions to limit effects on fisheries.
Seismic Risks	• North Delta diversions would be physically isolated from the water quality impacts of a catastrophic levee failure event. • Infrastructure would be built to a high seismic resiliency level. • Additional conveyance would be available following seismic events to restore supplies to California WaterFix users.
Climate Change Risks	• North Delta diversions would be physically isolated from the impacts of salinity intrusion due to sea-level rise. • Additional diversion capacity and operational flexibility would allow for increased diversion to reduce impacts of lost natural storage from snowpack. • Additional operational flexibility would allow for increased diversions during high-flow storm events. • Increased diversion and storage of high river-flow events would help protect against more frequent and extreme dry conditions.

ADAPTIVE MANAGEMENT

INTRODUCTION AND PURPOSE

The California WaterFix Adaptive Management Program (AMP) is intended to promote collaborative science; identify, prioritize and fund scientific investigations and monitoring for permit compliance and adaptive management; apply new information to management decisions; and establish a long-term, funded scientific infrastructure. These purposes, the organizational structure for accomplishing them and the methods by which they will be implemented, are described in the Agreement for Implementation of an Adaptive Management Program for Project Operations (AMP Agreement), which is finalized but not yet executed.

BACKGROUND

Continued operations of the SWP and CVP occur within the context of rules imposed by multiple regulatory agencies, including principally, SWRCB, CDFW, NMFS and USFWS.

In the event that USBR, DWR, and/or the PWAs seek to change the rules governing SWP and CVP operations, they may be able to do so without obtaining the approval of any regulatory agencies (in the event that such changes do not lead to the violation of one or more requirements imposed by the regulatory agencies), or they may need to first seek further approval by one or more regulatory agencies (for example, in the event that such changes would trigger the reinitiation of consultation under the ESA or lead to the violation of one or more requirements imposed by the regulatory agencies). Presently, the PWAs do not have the ability to seek changes to the operational rules except by convincing USBR or DWR to do so.

The current process for making changes to operational rules is cumbersome and unresponsive to the changing science in the Delta. One purpose of the AMP from the perspective of the PWAs (in addition to those set forth above and agreed upon by NMFS, USFWS, DFW, USBR and DWR), is to formalize an adaptive management process whereby the PWAs may seek changes to the operational rules.

ADAPTIVE MANAGEMENT PROGRAM

The AMP Agreement was negotiated between NMFS, USFGWS, DFW and the PWAs. The AMP Agreement establishes the organizational structure for the AMP and assigns duties and responsibilities to NMFS, USFWS, DFW, USBR, DWR and the PWAs. The significant elements of the AMP Agreement are described below.

Changing the criteria that controls operation of California WaterFix through the AMP makes it possible to change the amount of water supply that is available from the SWP and CVP. Adaptive management allows new science to be considered in making any changes to other operational criteria and could result in increases or decreases to water supplies while providing better protection for endangered species.

Institutional Organization

A decision-making body known as the Interagency Implementation Coordination Group (IICG) will be established and given the primary responsibility to support, coordinate, and implement the AMP. The IICG includes one representative each from NMFS, USFWS, DFW, USBR, DWR and the SWP and CVP

contractors. Any member of the IICG may propose an adaptive management change. In addition, the IICG will identify and support priority science needs, review scientific information and recommend changes to monitoring and management actions, secure resources to support scientific activities including monitoring and review and approve an annual monitoring and research plan.

Decisions Covered by Adaptive Management

Adaptive management changes will be implemented on an annual or longer-term basis. Adaptive management is not intended to apply to real-time operational decisions (within one year or within a season). However, the IICG will maintain a subcommittee to consider real-time operational opportunities to provide ecological or water supply benefits without reducing water supplies or adversely impacting protected species within 24 hours.

While California WaterFix does not expressly change real-time operations decision-making, it does not preclude the PWAs from seeking to pursue changes to real-time operations decision-making.

IICG Decision-Making

The IICG will seek to act by consensus. Where there is disagreement, any IICG member may initiate non-binding review of the matter. If the parties cannot resolve the matter via a meet and confer process, they will seek review by the long-term Biological Opinions independent review panel (LOBO IRP) or a similar body. That review will be provided to the final decision-making authority.

The AMP does not define the final decision-making authority. In most cases, USBR or DWR as the California WaterFix operator is the final authority. In other cases, NMFS, USFWS or DFW may be the final authority.

Funding and Agreement among the Parties

DFW will impose conditions requiring funding of all or a portion of the AMP as a condition of the 2081 permit. In addition, the final draft USFWS California WaterFix Biological Opinion indicates that USBR and DWR provided funding assurances to USFWS.

The parties have agreed to execute an agreement for implementation of the AMP, but they have not done so.

CONSULTATION UNDER SECTION 7 OF THE ENDANGERED SPECIES ACT

FUTURE CONSULTATIONS

California WaterFix is required to comply with the ESA in the same way the current SWP facilities must comply with the ESA. USBR and DWR normally lead those consultations with USFWS and NMFS. The PWAs are not included in those consultations because they do not own the SWP or the CVP and are not responsible for operating either project. However, in recently passed federal legislation, the PWAs were given a specific role during all ESA consultations that involve the SWP and CVP, including consultations related to California WaterFix. This direct involvement role was not available to the PWAs in the past.

Anticipated Consultations

There are at least three consultations anticipated to occur under the ESA prior to commencement of operations of California WaterFix.

A. USBR and DWR have already reinitiated consultation with respect to the continued operation of the existing SWP and CVP facilities.

B. USACE will consult with NMFS and USFWS on issuance of Clean Water Act section 404 and 408 permits for California WaterFix.

C. Prior to the start of operations of California WaterFix, USBR and DWR will consult with NMFS and USFWS to establish the operational criteria that will be applied to California WaterFix at the time California WaterFix becomes operational.

Scope and Duration of California WaterFix Consultation

Decisions regarding scope and duration of the Biological Opinions issued for operation of California WaterFix have not been made at this time. These decisions are unlikely to be made until those consultations are initiated, more than 10 years from now. Because of new requirements put in place by the Water Infrastructure Improvements for the Nation Act (WIIN Act), representatives for the Agency and other SWP and CVP contractors will be included in those consultations. It is expected that the consultations will begin at least one year before California WaterFix becomes operational.

ROLE OF CONTRACTORS

Under section 4004 of the WIIN Act, the SWP and CVP contractors may opt to have a prominent role in consultations with respect to the SWP and CVP. Section 4004 expires in 10 years, so the SWP and CVP contractors' role in the consultation on operation of California WaterFix could expire before construction of California WaterFix is complete.

PERMITS

SWRCB PERMITS

Change in Point of Diversion

A change in point of diversion permit issued by SWRCB must be received before DWR can begin construction of California WaterFix. The permit requires SWRCB to hold public hearings, which started in 2016, and will not be completed until late fall 2018. A permit is expected by December 1, 2018.

Effects of the SWRCB Delta WQCP Update

In addition to issuing a change in the point of diversion, SWRCB is in the process of updating the WQCP. SWRCB's work to-date has focused on science related to unimpaired flows, and it appears that the SWRCB is looking for an additional block of water to manage for fishery purposes. Currently, DWR and USBR are obligated to meet certain water quality standards, known as D-1641, to protect reasonable and beneficial uses. Many participants in the process report there are likely to be increased regulatory requirements that will impact water supply from existing SWP and CVP facilities and from California WaterFix once it is constructed and becomes operational.

Adjustments to SWRCB's Change In Point of Diversion and WQCP Permits Over Time

There are several mechanisms that may result in changes to the operating criteria included in the Biological Opinions and 2081 permits for California WaterFix. They include adjustments made through adaptive management, upcoming reconsultation on the long-term operations of the existing SWP and CVP facilities, project-level consultation with USFWS for the operations and USACE-related items and periodic reviews of the WQCP. The exact adjustments that could be made are unknown and would be speculative.

COST ALLOCATION AND FINANCING

COST ALLOCATION

Split Between SWP and CVP Contractors

While California WaterFix would be a component of the SWP and owned and operated by DWR, it would provide benefits to SWP and CVP contractors. Consistent with the "beneficiary pays" principle, SWP contractors and participating CVP contractors would fund California WaterFix. It is proposed that water supply benefits attributable to California WaterFix be allocated 55 percent to the SWP contractors and 45 percent to the CVP contractors (55/45 split). Under this allocation, funding for capital costs and operations and maintenance (O&M) costs would follow this same 55/45 split.

Allocation Among SWP Contractors

For the SWP share, California WaterFix would be treated like any other major improvement to the SWP system. Under the California Water Code, DWR is responsible for the construction, maintenance and operation of the SWP, and for securing funding for related costs. The SWP share of California WaterFix costs would be paid by the SWP contractors in accordance with the water supply contracts between DWR and SWP contractors (SWP Water Supply Contracts).

In addition to establishing payment and other provisions for the SWP contractors' participation, the existing SWP Water Supply Contracts offer flexibility to allow individual SWP contractors to adjust their level of water reliability and financial responsibility through voluntary water transfers and other arrangements. The potential for these management actions are discussed later in this document.

The participating CVP contractors' share of California WaterFix costs would be funded by direct payments from them.

Funding Arrangements for Construction of SWP Facilities Under the State Water Contracts

DWR has signed long-term SWP Water Supply Contracts with the Agency and 28 other PWAs. These SWP Water Supply Contracts provide each agency with access to the SWP conveyance system and an annual proportional allotment of available water. The maximum amount of SWP water that a SWP contractor may request for delivery each year is set forth in Table A of its SWP Water Supply Contract. However, the amount of water that an SWP contractor actually receives is often much less than the contracted amount. Water deliveries are affected by hydrological conditions, SWRCB regulations, restrictions imposed under federal or California ESA, operational decisions and other limitations.

SWP contractors must make payments regardless of the amount of SWP water actually received. The SWP Water Supply Contracts require payments to DWR in return for participation in the SWP storage and conveyance system. All SWP contractors must make payments according to their respective Table A contract amounts and for the portion of the SWP conveyance system needed to deliver their contracted water. The amount of the base payment is not tied to the amount of water actually received. However, the cost of power to deliver water varies with the amount of water delivered.

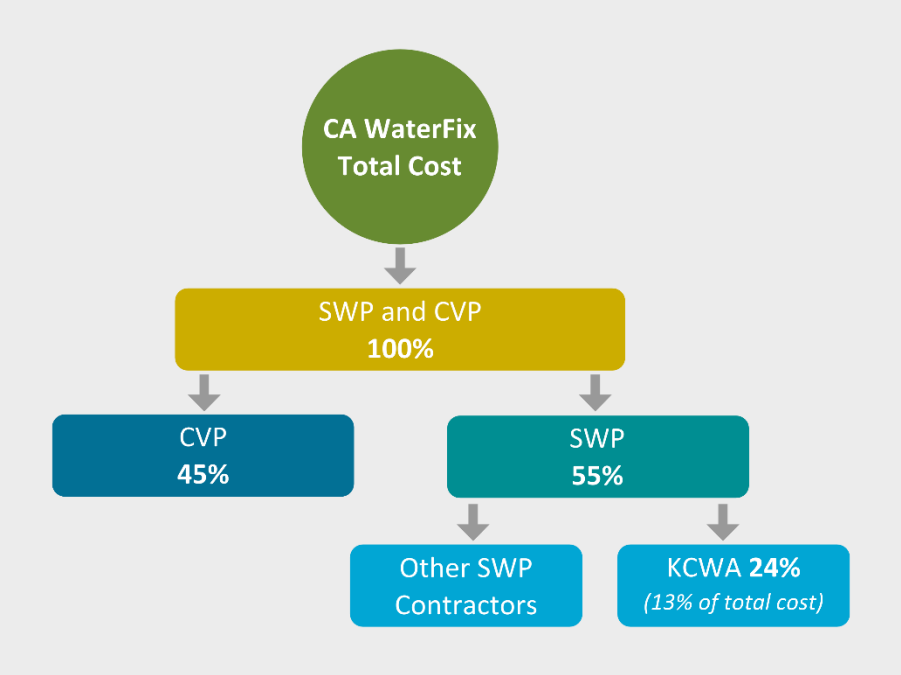
SWP contractors whose service areas are farther from the Sacramento-San Joaquin area must pay more SWP system costs than those that are located closer to it because of the capital costs associated with the Governor Edmund G. Brown California Aqueduct (Aqueduct) and other transportation facilities, as well as the increased pumping and O&M costs.

In exchange for SWP contractor payments, DWR is required to make all reasonable efforts to complete facilities necessary for water deliveries, subject to fiscal, construction scheduling and operational constraints. DWR is authorized to accept SWP contractor payments to complete design and construction of SWP facilities if DWR does not have the funds on hand. In such cases, the amount provided by a SWP contractor is credited by DWR against the contractor's obligation under the SWP Water Supply Contracts.

Conservation Costs Allocated on Table A Adjusted to Account for North of Delta not Participating

The five north of the Delta SWP contractors—County of Butte, City of Yuba City, Plumas County Flood Control & Water Conservation District, Napa County Flood Control & Water Conservation District and Solano County Water Agency—would not receive direct benefits from California WaterFix, and would not pay any California WaterFix costs. The remaining 24 SWP contractors would decide on their individual level of participation and would receive water supply benefits in direct proportion to their investment. The financing plan for the SWP share relies on the existing long-term SWP Water Supply Contracts as the vehicle for DWR to allocate costs to the SWP contractors and to pay the debt service for its bonds. Based on the schedule of maximum water allocations in these SWP Water Supply Contracts (known as Table A), and assuming the other 23 SWP contractors would participate at their full contract level, the Agency's share among the SWP contractors would be approximately 24 percent (the Agency's share of total California WaterFix costs would be approximately 13 percent). **Figure 17** shows the overall allocation of costs described above.

FIGURE 17: CALIFORNIA WATERFIX COST ALLOCATION FRAMEWORK



Options Available for Contractors to Manage Water Supply Risks and Costs

The costs of California WaterFix are substantial, and each SWP contractor faces different financial and water management challenges. Therefore, each SWP contractor may look to the flexibility in the SWP Water Supply Contracts to manage overall water reliability and cost exposure.

The SWP Water Supply Contracts have provisions and flexibility that provide SWP contractors with tools to manage their long-term costs and water supply reliability through various methods, including the

purchase and sale of Table A water, and exchanges and transfers of supplies. Individual SWP contractors would decide how to use those tools to manage the costs and water supply benefits attributable to California WaterFix.

Permanent Table A Adjustment

The SWP Water Supply Contracts provide a mechanism to assign or transfer rights and obligations to other entities. For example, one SWP contractor could transfer, on a permanent basis, some of its Table A water to another SWP contractor. Each transfer involves a price for the transferred Table A water that the acquiring contractor pays to the relinquishing contractor. The acquiring contractor also assumes all prospective charges associated with the transferred Table A water. If the contractor needs additional Aqueduct capacity to convey the acquired Table A water, there are additional transportation, capital and O&M charges for additional use of facilities. Finally, in SWP reaches where additional capacity is required, the acquiring contractor would have a one-time obligation for retroactive SWP transportation capital charges. This charge is redistributed among contractors based on repayment reach participation.

The SWP contractor relinquishing Table A water is relieved of the prospective charges for the amount of Table A water relinquished, and also receives the negotiated price for each acre-foot of Table A water relinquished.
To make the purchase of Table A water more manageable in the future, the SWP contractors have proposed reducing the period used to calculate the retroactive SWP transportation capital charge. This period is proposed to be changed from all past years to a lesser period, between 30 and 50 years. However, these discussions are in their early stages and not associated with California WaterFix.

Water Transfer and Exchange Programs

Another example of an assignment or transfer of contract rights and obligations is to develop programs that would adjust SWP Water Supply Contract payment obligations over a prescribed period of time, while still retaining Table A water participation rights. Historically, these adjustments included the Turnback Pool, and for years 2013-16, the Multi-Year Market Pool. The price for water in the Turnback Pool is a fraction of the Delta Water Charge. The price for water in the Multi-Year Market Pool was market-based.

Additional areas of flexibility under the existing SWP Water Supply Contract include extending the return period for water exchanges, and allowing: higher return ratios for exchanges, one-year exchanges, flexibility in cost compensation for exchanges, and multi-year transfers and exchanges. Flexibility in the exchange and transfer programs would enable SWP contractors to structure agreements between willing participants to meet the financial and water supply needs of each party. For example, an SWP contractor that desires to have long-term reliability can participate in California WaterFix by entering into medium-term agreements that cover costs in the early stages of construction and operation through multi-year transfers that ensure financial integrity of the selling party and boost reliability of the purchasing party. Multi-year exchanges would serve the same purpose and provide similar benefits to parties entering into those agreements.

Contractor Payment Default

The SWP Water Supply Contracts require the SWP contractors to pay for all water supply-related costs of the infrastructure capital and O&M for SWP facilities. Thus, a significant concern for DWR is the risk a contractor defaults on their payment obligations. This concern has been addressed through the provisions of the long-term SWP Water Supply Contracts themselves.

The SWP Water Supply Contract obligates each SWP contractor to make payments, and if necessary, compels the SWP contractor to levy taxes or assessments in the event of non-payment. Additionally, the State may suspend water deliveries, within health and safety limits, if an SWP contractor is in default for a significant period.

The SWP Water Supply Contract also provide for the State to protect bondholders and non-defaulting contractors against costs resulting from any SWP contractor's failure to make payments related to the revenue bonds.

In practice, the State administers this provision by maintaining a revenue bond reserve equal to one-half the maximum annual revenue bond debt service for all outstanding revenue bonds, and by adding a 25 percent refundable surcharge to the SWP contractor's revenue bond capital charge.

For California WaterFix, the SWP Water Supply Contracts would continue as the primary contracting vehicle between DWR and the SWP contractors. As such, these contracts would address uncertainties related to default of the payment obligations.

Managing Uncertainties

Uncertainties involving financing assumptions and approaches for California WaterFix would largely be addressed through the development of new agreements among the SWP and CVP contractors, the proposed JPAs and DWR, as well as through reliance on the considerable protections already in place under the existing SWP Water Supply Contracts. Processes and commitments would be included in these agreements to reduce financial risks and uncertainties. **Table 5** highlights some key uncertainties and strategies to reduce risks associated with financing California WaterFix.

TABLE 5: KEY UNCERTAINTIES AND RISK REDUCTION STRATEGIES

Key Uncertainties	Risk Reduction
Interest Rates	• Other financing options would be evaluated to optimize financing and reduce costs, such as short-term borrowing, pursuing Water Infrastructure Finance and Innovation Act (WIFIA) supplemental funding, or pursuing financing through the potential Water Infrastructure Loan Act (WILA) program.
SWP Contractor Default on Payments	• Protections are built into the SWP Water Supply Contracts, obligating SWP contractors to make payments, and if necessary, compels SWP contractors to levy taxes or assessments in the event of non-payment.
Participation in and Solvency of Finance JPA	• Agreements would provide that in the event DWR cannot make its payments, SWP contractors would "step up" to pay their fair share of debt service. • Decisions of the finance joint powers authority (Finance JPA) would be made by a Board of Directors that would include SWP contractors that participate in the Finance JPA.

Reimbursement of Direct Contractor Funding Contributions	• DWR would include in its first issuance of revenue bonds an amount sufficient to reimburse SWP contractor-provided gap funding as well as all prior funding contributions for planning costs.
Judicial Determination on DWR Authority to Issue Bonds	• During pendency of litigation, private placement bond sales with the Finance JPA would allow funding for California WaterFix implementation to proceed. • If DWR is found not to have the requisite authority, a process would be established leading to potential conveyance of interest in California WaterFix to the Finance JPA or designee.
CVP Contractor Participation	• DWR would not move forward with California WaterFix implementation without the commitment of a sufficient number of SWP and CVP contractors. • Discussions are ongoing concerning the risk of a participating CVP contractor to default during California WaterFix implementation.

FINANCING

The cost impacts of California WaterFix on the Agency would vary principally based on the structure and interest rate assumed for California WaterFix financing. The following sections will discuss how California WaterFix could be financed, and how changes to the financing assumptions would impact the cost of California WaterFix.

How DWR Historically Finances Capital Projects

The SWP contractors pay for the debt service and costs of revenue bonds issued by DWR to finance the cost of constructing SWP facilities. About 78 percent of the SWP construction costs have been financed by the sale of general obligation and revenue bonds which are paid by the SWP contractors, not the general State taxpayer. The SWP contractors are responsible for all water development and transportation-related costs, including those pertaining to the O&M of SWP facilities. General O&M costs are not financed through bonds.

The SWP Water Supply Contracts would remain in effect for: (1) 75 years from the effective date of an individual agency's contract; (2) December 31, 2035; or (3) until all bonds issued to finance SWP construction costs have been repaid, whichever period is longer. DWR and the SWP contractors are currently negotiating details of an extension of the SWP Water Supply Contracts. The parties reached an agreement in principle for this amendment in June 2014. The proposed amendment extends the term of the SWP Water Supply Contracts to December 31, 2085. In addition, the proposed amendment would change the current treatment of capital costs on an amortized basis to an annualized "pay as you go" basis for revenues needed by DWR in a given year for scheduled debt service to repay capital costs.

Financing the SWP Contractor Share of California WaterFix

For California WaterFix, the existing SWP Water Supply Contracts would be the mechanism to recover the SWP share of California WaterFix costs from all contractors downstream of the Delta.

The ultimate source of funds for the SWP contractors' share of California WaterFix costs would be revenue bonds. DWR plans to issue a series of new bonds, California WaterFix Revenue Bonds, for the SWP share of the total capital costs. Based on the 55/45 split, this amount is $8.4 billion in 2014 dollars,

or $9.2 billion in 2017 dollars. Bond proceeds would fund construction, planning and other preconstruction costs (including the reimbursement of funds and services previously provided by various State and federal contractors), and the costs of bond issuance. Scheduled principal and interest on California WaterFix bonds would be secured by a portion of revenues collected by DWR under the SWP Water Supply Contracts. Pledged funds under the SWP Water Supply Contracts would be deposited into a Revenue Fund maintained by DWR to ensure payment of the debt service.

For the SWP contractors' initial share of California WaterFix costs, DWR proposes to sell revenue bonds to the Finance JPA comprised of certain SWP and CVP contractors. This would facilitate the financing and marketability of its revenue bonds. DWR's direct sale of these revenue bonds is targeted for the middle of 2018.

Contributions by CVP Contractors

The overall financing plan calls for the remaining amount of California WaterFix costs to be contributed by the CVP contractors that would participate in California WaterFix. Based on the 55/45 split, this amount is $6.8 billion in 2014 dollars, or $7.5 billion in 2017 dollars. DWR and the participating CVP contractors are negotiating terms of a master agreement for use of California WaterFix facilities. This agreement would allow CVP contractors to purchase an interest in a set amount of capacity in California WaterFix facilities. Under the proposed agreement, and based on the 55/45 split, CVP contractors would pay for: (1) 45 percent of all capital and fixed O&M costs for California WaterFix, regardless of use; and, (2) all variable O&M costs associated with the CVP contractors' actual use of California WaterFix facilities. This agreement also would provide a payment mechanism for variable O&M costs incurred to move CVP water that is not classified as California WaterFix water.

Pursuant to the terms of the proposed agreement between DWR and the CVP contractors, CVP contractors would be entitled to transfer, or convey, portions of their rights to use California WaterFix facilities to other SWP or CVP contractors, but would not be allowed to sell, exchange or transfer their rights outside of the State and federal water contractors.

Article 51(e) and Gap Funding Contributions

To fund continuing design and preconstruction costs prior to the issuance of revenue bonds for California WaterFix, DWR proposes a pair of interim funding mechanisms. Through the end of 2017, DWR proposes to use Article 51(e) funds. Under Article 51(e) of the SWP Water Supply Contracts, DWR may allocate certain additional funds to mutually-agreed SWP purposes after conferring with SWP contractors on the appropriate use. DWR's proposed use of Article 51(e) funds through December 31, 2017 is subject to the DWR Director's discretion.

From January 2018 until the issuance of the first revenue bonds for California WaterFix, DWR plans to request the short-term contribution of additional funds from willing SWP and CVP contractors, or a joint powers agency representing participating contractors, for continuing pre-construction costs. Such additional contributions would be similar in concept to prior advances made for California WaterFix's planning, study, design and environmental assessment costs. Additional SWP and CVP contractor contributions would be made pursuant to a Gap Funding Agreement with DWR. Gap funding contributions would be subject to reimbursement from DWR's first bond issuance. Under the current schedule, Agency staff would provide options for its participation in a Gap Funding Agreement to the Agency Board of Directors for its consideration when it considers California WaterFix participation.

WATER CONTRACTOR FINANCE JOINT POWERS AUTHORITY

The marketability of California WaterFix Revenue Bonds to private investors may be affected by judicial challenges to DWR's authority over California WaterFix. Therefore, DWR proposes to make direct placement sales of California WaterFix Revenue Bonds to a yet to be established Finance JPA consisting of participating SWP and CVP contractors until resolution of such legal challenges.

Under this approach, the Finance JPA would purchase California WaterFix Revenue Bonds directly from DWR in phases, while the proceeds would be used to pay California WaterFix capital costs. In turn, the Finance JPA would finance its purchase of California WaterFix Revenue Bonds by issuing its own bonds.

The debt service for the Finance JPA bonds would be secured by DWR's pledge to pay a portion of the amounts collected under the SWP Water Supply Contracts to the Finance JPA as debt service payments for the DWR-issued California WaterFix Revenue Bonds.

DESCRIPTION OF POTENTIAL FINANCING STRUCTURES

In implementing the financing plan, there is a range of possible cost impacts to the SWP contractors. Capital financing costs would extend over the term of the bonds, while O&M costs would continue through the operating life of the facilities. All financing scenarios assume annual bond issuance, with the final bond sale in year 15 of California WaterFix construction when California WaterFix is scheduled to be operational. Due to the differences in how each SWP contractor generates revenue to pay for their SWP costs, three financing structures were evaluated to determine the cost impact of California WaterFix. Each financing structure assumes different financing terms. The interest rates selected for the analysis were based on consultation with bond counsel as appropriate estimates for what the market conditions could look like for a project the length and cost of California WaterFix. The advantages and disadvantages of each financing structure are described in the sections below.

Fixed Rate

Some SWP contractors prefer to use traditional financing or fixed rate financing for California WaterFix. Fixed rate financing would likely be the preferred financing structure for municipal and industrial contractors that can assign California WaterFix costs to their rate payers. The scenarios analyzed for this financing structure assumed 30- and 40-year terms with interest rates ranging from 3.55 percent for 30-year bonds, to 3.88 percent for 40-year bonds.

Advantages	Disadvantages
• Reduces the total California WaterFix financing cost. • Decreases exposure to interest rate increases in the future.	• Requires debt repayment during California WaterFix construction.

Interest Only

Some SWP contractors would prefer to minimize costs during construction. One way to minimize costs during construction is to defer the principal bond costs until after construction is completed. To do this, it was assumed that variable rate debt would be issued during construction at a rate of 2.5 percent. Only the interest portion of the debt would be paid during construction. Upon California WaterFix

completion, fixed rate debt would be issued on the entire principal. The fixed rate debt issuance scenarios analyzed were 30- and 40-year terms with interest rates ranging from 3.55 percent for 30-year bonds, to 3.88 percent for 40-year bonds.

Advantages	Disadvantages
• Reduces debt repayment during California WaterFix construction.	• Requires some payment during California WaterFix construction. • Increases the total California WaterFix financing cost. • Increases exposure to interest rate increases in the future.

Capitalized Interest

An additional way to minimize costs during construction is to capitalize the interest during construction by rolling the interest accrued during construction into a larger bond issuance once construction is completed. The scenarios analyzed were 30- and 40-year terms with interest rates ranging from 3.55 percent for 30-year bonds, to 3.88 percent for 40-year bonds.

Advantages	Disadvantages
• Minimal debt repayment during California WaterFix construction.	• Increases the total California WaterFix financing cost. • Increases exposure to interest rate increases in the future.

Other Financing Options

Assuming California WaterFix moves forward, the Agency would coordinate with DWR and the other SWP and CVP contractors to evaluate options to optimize financing and reduce costs. One way to accomplish this goal would be to use short-term borrowing (like commercial paper) to finance construction, and then periodically replace short-term borrowing with fixed rate bonds. This example would reduce debt service costs by taking advantage of the lower interest rates on the short-term borrowing and eliminating the negative carry on a long-term, fixed bond.

WIFIA

In addition to the outlined revenue bond financing structures, DWR and the SWP and CVP contractors may also leverage monies that may be available under WIFIA.

Authorized under the Water Resources Reform and Development Act of 2014, WIFIA is modeled after 1998's successful Transportation Infrastructure Finance and Innovation Act to provide low-interest financing (secured loans or loan guarantees) for the construction of water and wastewater infrastructure. WIFIA is similar to State Revolving Fund (SRF) programs, but is intended to provide

subsidized financing for large-dollar-value projects. Eligible recipients include corporations, partnerships, municipal entities and SRF programs.

For fiscal year 2017, WIFIA received initial funding of $20 million, of which $3 million is to be used for administrative purposes, leaving $17 million to subsidize loans. WIFIA leverages federal dollars. This means that for every dollar Congress appropriates, $50 to $60 is expected to be loaned out. That means the $17 million would leverage an estimated $1 billion in federal loans based on an average rate subsidy of about 2 percent. On May 5, 2017, as part of an omnibus spending bill, Congress appropriated an additional $10 million for WIFIA. The additional $10 million brings WIFIA funding, in 2017, to $30 million, which can leverage an estimated $1.5 billion in federal loans. For fiscal year 2018, WIFIA is budgeted to receive an initial funding of $20 million.

Given the funding allocations and eligibility requirements, WIFIA may provide supplemental funding for California WaterFix and serve as part of the suite of funding tools. However, it would not serve as the sole source of California WaterFix funding.

WIFIA has several additional features that make it an attractive option for financing California WaterFix:

- Interest rates are set using the yield on U.S. Treasury securities as of the date of issuance.
- Interest rates are not subject to change during the term of the loan.
- Funds are made available based on submitted invoices, and interest does not accrue until the invoices are funded.
- Debt service repayment may begin as late as five years after substantial completion of California WaterFix, and payments can be "sculpted" to fit the cash flow of the completed project.
- WIFIA loans can be junior to other secured sources of funding, except in the case of bankruptcy in which case the WIFIA loan will be equal to the seniority of California WaterFix's other credit sources.

However, WIFIA has limitations that reduce its viability as a financing tool for California WaterFix, including:

- WIFIA can fund no more than 49 percent of any project.
- Congressional appropriations in 2017 and 2018 were far below the levels necessary to fund 49 percent of California WaterFix.
- The term of the loan must be the shorter of 35 years after the date of substantial completion or the useful life of the project.

Award of WIFIA loans depends on a standardized project selection process administered by the U.S. Environmental Protection Agency (EPA) and the amount of funding appropriated by Congress. 2017 was the first year in which the EPA awarded WIFIA loans. Based on the timing of the selection and award process, it is not possible to apply for and win a WIFIA loan prior to the scheduled start of the design and construction of California WaterFix. However, if a WIFIA loan is awarded after the design and construction begins, the WIFIA loan may be used to replace the funding used to begin the design and construction of California WaterFix if the WIFIA funding can provide a lower cost of financing. It will be necessary to ensure that any financing plan adopted for California WaterFix includes early payment of financing in the event that funding from WIFIA becomes available.

WILA

Unlike WIFIA, the proposed WILA is not an existing federal loan program, but rather conceptual legislation modeled after the existing Railroad Rehabilitation Improvement and Financing program. The proposed WILA program would be designed to provide financial resources for the maintenance, development and enhancement of water infrastructure, while protecting the interest of the taxpayers. WILA is draft legislation and as such, the program does not currently exist. However, with federal legislative action to authorize WILA, the program could provide alternative or supplemental California WaterFix financing with the following benefits:

- Low Interest Rate – Reduced Cost.
- Locked Interest Rate – Reduced Interest Rate Risk.
- Draw Down Feature – Reduced Interest Carry.
- Delayed Repayment – Repayment can be deferred until five years after substantial completion of the project.
- 100 percent of project construction costs financed through WILA.

As envisioned, a WILA program would not have the same limitations as the WIFIA program. The WILA program would not be limited to cover only 49 percent of project costs, and repayment periods could be longer than 35 years. However, while WIFIA is an established loan program, WILA is only a legislative concept.

The Agency is working to develop WIFIA and WILA options for financing California WaterFix. Staff from other PWAs, including Metropolitan and Westlands Water District, are interested in WIFIA and WILA and are working with the Agency to develop both programs as funding options for California WaterFix.

ANALYSIS OF CALIFORNIA WATERFIX COST IMPACTS

The following section presents the assumptions and results of the financial analysis performed to determine California WaterFix costs for SWP contractors and the Agency.

ASSUMPTIONS FOR COST IMPACT ANALYSIS

In order to determine the cost impact of California WaterFix, assumptions were made related to water supplies, construction costs and financing terms. The following sections describe the assumptions used in the cost impact analysis.

Water Supply Assumptions

This section summarizes the water supply assumptions for California WaterFix at the SWP contractor and Agency levels. More detailed information regarding the water supply yield can be found in the operations section of this document.

California WaterFix Estimated Supply

As noted in the above section titled "SWP and CVP Operations, and Performance of California WaterFix," the future total water supply from the SWP and CVP with California WaterFix is estimated to range from 4.7 to 5.3 MAF on a long-term average annual basis, while a future condition without California WaterFix is assumed to range from 3.5 to 3.9 MAF.

SWP Estimated Supply

At a 55/45 split, the average increment of 1.3 MAF per year in total SWP and CVP supplies translates to approximately 715,000 af of supplies available to the SWP with participation in California WaterFix based on cost and water allocation methodology.

The Agency's Estimated Supply

The Agency's share of the available SWP water supply is 24.23 percent. An average increment of 715,000 af per year in total SWP supplies translates to approximately 173,000 af of supplies available to the Agency.

California WaterFix Cost Assumptions

The following section presents the cost assumptions used for the cost impact analysis.

Total California WaterFix Cost Estimate

California WaterFix includes facilities, modifications to existing facilities, and mitigation for construction and operation. The costs for these activities can be divided into capital, which is assumed to begin in 2019 and end in 2035, and operations, which is assumed to begin in 2033 and continue through 2080. A conservative cost estimate was prepared by 5RMK in 2014 dollars. This cost estimate is higher than the estimate provided by Aldea Services at the 100 percent confidence interval. Therefore, it is a good high-cost estimate. Agency staff has also included a cost estimate based on a 75 percent confidence interval to identify the most likely cost for California WaterFix. All numbers in **Table 6** are converted to 2017 dollars. More detailed information can be found in the cost estimate section of this briefing book.

Estimated costs for mitigation and associated environmental commitments consider the measures adopted in the final EIR/EIS and likely requirements for the USACE Section 404 permit. The preliminary mitigation cost estimate would be revised to incorporate all mitigation-related costs, including those associated with ESA authorizations, USACE permits and other regulatory permits when finalized. The

estimated mitigation costs total $796 million in 2014 dollars, of which $367 million is capital and the remainder represents O&M costs for 25 years. In 2017 dollars, mitigation costs total $870 million, with $401 million of that being capital.

The estimated O&M costs come from Chapter 8 of the November 2013 BDCP. Because of subsequent California WaterFix refinements, O&M costs should be lower than these estimates.

TABLE 6: SUMMARY OF TOTAL CALIFORNIA WATERFIX CONSTRUCTION COST ESTIMATE

	5RMK Project Cost Estimate (2017 Dollars in Millions)	**75% Confidence Interval** (2017 Dollars in Millions)
CAPITAL (2019-2035)**:**		
Capital Construction	$16,329	$13,899
Capital Mitigation	$401	$401
Sub-Total Capital	$16,731	$14,301
O&M (2033-2080)**:**		
O&M	$2,115	$2,115
O&M Mitigation	$1,208	$1,208
Sub-Total O&M	$3,323	$3,323
TOTAL COSTS	**$20,053**	**$17,624**

SWP Estimated Cost Range

Table 7 shows the SWP share of California WaterFix costs assuming a 55/45 SWP/CVP split.

TABLE 7: SUMMARY OF SWP SHARE OF CALIFORNIA WATERFIX CONSTRUCTION COST ESTIMATE

	5RMK Project Cost Estimate (2017 Dollars in Millions)	**75% Confidence Interval** (2017 Dollars in Millions)
CAPITAL (2019-2035)**:**		
Capital Construction	$8,981	$7,644
Capital Mitigation	$221	$221
Sub-Total Capital	$9,202	$7,866
O&M (2033-2080)**:**		
O&M	$1,163	$1,163
O&M Mitigation	$664	$664
Sub-Total O&M	$1,828	$1,828
TOTAL COSTS	**$11,029**	**$9,693**

The Agency's Estimated Cost Range

When excluding the five north-of-Delta contractors, the Agency's share of the SWP Table A SWP Water Supply Contracts amount is 24.23 percent, which would be the basis for determining the Agency's pro-rata share of the SWP California WaterFix costs. The annual cost impact to the Agency for California WaterFix is shown in **Table 8**.

TABLE 8: SUMMARY OF AGENCY'S SHARE OF CALIFORNIA WATERFIX CONSTRUCTION COST ESTIMATE

	5RMK Project Cost Estimate (2017 Dollars in Millions)	**75% Confidence Interval** (2017 Dollars in Millions)
CAPITAL (2019-2035)**:**		
Capital Construction	$2,176	$1,852
Capital Mitigation	$53	$53
Sub-Total Capital	$2,230	$1,906
O&M (2033-2080)**:**		
O&M	$282	$282
O&M Mitigation	$161	$161
Sub-Total O&M	$443	$443
TOTAL COSTS	**$2,672**	**$2,349**

Financing Assumptions

The following analysis focuses on the financing of the 55 percent SWP share of California WaterFix. The financing scenarios assume that 100 percent of capital and mitigation costs are debt financed, and annual O&M costs are paid as incurred. Project and financing assumptions common to all scenarios are shown in **Table 9**. Capital financing costs would extend over the term of the bonds, while O&M costs would continue through the operating life of the California WaterFix facilities.

Various strategies to address individual SWP contractor cash flow and financing needs will need to be implemented. For example, some SWP contractors may desire to begin paying all financing costs as bonds are issued, while others may need to postpone repayment until construction is completed. In addition, the actual financing terms will be dictated by market conditions when the bonds are actually issued, which could be many years from now. For the purpose of analysis, the Agency is assuming a 3 percent escalation rate for both capital and O&M costs. For all present value presentations, the Agency is assuming a 3 percent discount rate. The Agency is using a 1.25 multiplier for annual debt service for bond issuance.

Finally, the Agency is analyzing three different financing mechanisms, including: (1) a traditional bond payment strategy (paying both principle and interest when the bond is issued) referred to below as "fixed rate"; (2) interest only payments; and (3) capitalized interest. A 40- and 30-year bond term are also analyzed. The assumptions used are summarized below in **Table 9**.

TABLE 9: SUMMARY OF CALIFORNIA WATERFIX FINANCING ASSUMPTIONS

California WaterFix Assumptions	
Project Start	2019
Water Facility Substantially Complete	2032
First Year Project Operational	2033 (Year 15)
Average Improvement in Project Water Supply	1.3 MAF/Year
SWP/CVP Share	55%/45%
Agency's Share of SWP	23.55%
Agency's Adjusted Share of SWP Agencies Participating in California WaterFix	24.23%
Agency's Overall Share of California WaterFix	13.33%
Financial Assumptions	
Escalation Rate	3.00%
Discount Rate	3.00%
Level Annual Debt Service	
Interest Rate	3.55%, 3.88% and 5% Scenarios
Underwriters Discount	$2.50 per $1,000
Cost of Issuance	$0.5M per issue
Bond Reserve	Financed, 1/2 max annual debt service
Bond Cover	25%

SWC developed a robust model to analyze the SWP statement of charges. The SWC model uses the assumptions above to generate estimated future statement of charges for each SWP contractor. The model output estimates nominal cost each year through 2080. The components of the costs include: (1) the costs of the SWP without California WaterFix; (2) the minimum and power costs associated with California WaterFix; and (3) the estimated capital costs for each California WaterFix financing scenario. The combination of these three components represent a total estimated statement of charges for each year.

RANGE OF SWP CALIFORNIA WATERFIX COSTS

A total of 12 financing scenarios were evaluated to estimate the potential future costs for the SWP contractors for existing facilities and California WaterFix. A summary of results are provided below in **Table 10**. Under the 5RMK cost estimate scenarios, the maximum annual capital cost for SWP contractors at the 55/45 split ranged from $635 million to $1.021 billion. Capitalizing interest during construction led to the highest debt service costs. Under the 75 percent confidence interval construction cost, the maximum annual debt service for the SWP contractors at the 55/45 split ranged from $543 million to $873 million. In all scenarios, the maximum capital cost service for California

WaterFix capital costs occurs in the year after completion of California WaterFix, which is assumed to be 2033.

TABLE 10: FINANCING SCENARIOS

$ in millions, results in nominal dollars.
CWF = California WaterFix.

Financing Structure	Fixed Rate	Fixed Rate	Interest Only Pmts	Interest Only Pmts	Capitalized Interest	Capitalized Interest
Bond Term (Yrs)	40	30	40	30	40	30
Coupon Rate	3.88%	3.55%	3.88%	3.55%	3.88%	3.55%
Results for 100% Cost Estimate:	1	2	3	4	5	6
Max Annual Capital Charges	$635	$703	$717	$801	$923	$1,021
Total fixed costs when fully operational in 2033[a]	$692	$759	$774	$858	$980	$1,078
Total CWF Charges (50 yrs)[b]	$39,137	$35,125	$39,149	$36,871	$41,426	$38,747
Results for 75% Conf. Interval:	7	8	9	10	11	12
Max Annual Capital Charges	$543	$600	$613	$684	$789	$873
Total fixed costs when fully operational in 2033[a]	$599	$657	$670	$741	$846	$930
Total CWF Charges (50 yrs)[b]	$35,573	$32,144	$35,586	$33,640	$37,539	$35,249

[a]Fixed costs include capital and O&M costs for California WaterFix.
[b]Total California WaterFix charges include capital, O&M and incremental power costs for California WaterFix.

As previously stated, California WaterFix is estimated to bring an average water supply yield improvement of 1.3 MAF per year based on a range of 1.2 MAF to 1.4 MAF, depending on future regulatory and operating requirements, of which about 55 percent would be the SWP's share. Dividing the maximum capital costs by the average water supply yield results in an estimated marginal cost range of $888/af to $1,427/af in the year 2033.

RANGE OF KERN COUNTY WATER AGENCY COSTS

Maximum Year Capital Cost

Under the 5RMK Cost Estimate scenarios, the maximum annual capital cost for the Agency at the 55/45 split ranged from $153.9 million to $247.5 million. Capitalizing interest during construction led to the highest capital costs. **Table 11** shows a summary of the maximum annual capital costs and the total California WaterFix costs for the Agency.

TABLE 11: SUMMARY OF KERN COUNTY WATER AGENCY COSTS ASSOCIATED WITH THE FINANCING SCENARIOS FOR 5RMK COST ESTIMATE

Scenario	Financing Terms	Financing Structure	Max CWF Cap Cost Year	Estimated Max CWF Cap Costs ($M)	Total CWF Cap Costs ($M)	Max CWF Cap Cost Change from Base Financing Assumption (55/45, 40 yrs, Fixed)	Total CWF Cost Change from Base Financing Assumption (55/45, 40 yrs, Fixed)
Scenario 1	3.88% @ 40 years	Fixed Rate	2033	$153.9	$6,007.4		
Scenario 2	3.55% @ 30 years	Fixed Rate	2033	$170.2	$4,962.5	$16.4	$(1,044.9)
Scenario 3	3.88% @ 40 years	Interest Only	2033	$173.8	$6,429.6	$19.9	$422.2
Scenario 4	3.55% @ 30 years	Interest Only	2033	$194.0	$5,385.5	$40.1	$(621.9)
Scenario 5	3.88% @ 40 years	Capitalized Interest	2033	$223.7	$7,068.0	$69.8	$1,060.7
Scenario 6	3.55% @ 30 years	Capitalized Interest	2033	$247.5	$5,839.9	$93.6	$(167.5)

Cost Impacts of Adjusting Financing Structure and Terms

For the purposes of this analysis, the base comparison scenario is the 40-year, fixed interest rate of 3.88 percent. Shortening the finance period to 30 years at 3.55 percent interest would increase the maximum capital cost from the base case by approximately 10.6 percent, but would reduce the overall California WaterFix total cost by 17.4 percent.

Paying only interest during construction would increase the maximum capital cost from the base case by approximately 13 percent, and would increase the overall California WaterFix total cost by approximately 7 percent, but would result in a reduction of payments during construction by approximately 51 percent. Paying only interest during construction, and shortening the financing period to 30 years, would increase the maximum capital cost from the base case by approximately 26.1 percent, but would decrease the overall California WaterFix total cost by approximately 10.4 percent.

Capitalizing interest during construction would increase the maximum capital cost from the base case by approximately 45.4 percent and increase the overall California WaterFix cost by approximately 17.7 percent, but would result in no payments during construction. Capitalizing interest during construction and shortening the financing period to 30 years would increase the maximum capital cost from the base case by approximately 60.8 percent and decrease the overall California WaterFix total cost by approximately 2.8 percent. **Table 12** shows the percent change from the base case for the 5RMK cost estimate scenarios.

TABLE 12: COST SUMMARY AND PERCENT CHANGE OF FINANCING SCENARIOS FOR 5RMK COST ESTIMATE

Scenario	Financing Terms	Financing Structure	Max CWF Cap Cost Year	% Change in Max CWF Cap Cost from Base Financing Assumption (55/45, 40 yrs, Fixed)	% Change in Total CWF Cost from Base Financing Assumption (55/45, 40 yrs, Fixed)
Scenario 1	3.88% @ 40 years	Fixed Rate	2033		
Scenario 2	3.55% @ 30 years	Fixed Rate	2033	10.6%	-17.4%
Scenario 3	3.88% @ 40 years	Interest Only	2033	13.0%	7.0%
Scenario 4	3.55% @ 30 years	Interest Only	2033	26.1%	-10.4%
Scenario 5	3.88% @ 40 years	Capitalized Interest	2033	45.4%	17.7%
Scenario 6	3.55% @ 30 years	Capitalized Interest	2033	60.8%	-2.8%

Under the 75 percent confidence interval construction cost, the maximum annual debt service for the Agency at the 55/45 split ranged from $131.5 million to $211.6 million. Capitalizing interest during construction led to the highest debt service costs. In all scenarios, the maximum year capital cost occurs the year after completion of California WaterFix, which is assumed to be 2033. **Table 13** shows a summary of the maximum capital cost and the total California WaterFix costs for the Agency under the 75 percent confidence cost interval scenarios.

TABLE 13: SUMMARY OF KERN COUNTY WATER AGENCY COSTS ASSOCIATED WITH THE FINANCING SCENARIOS FOR 75 PERCENT CONFIDENCE INTERVAL COST ESTIMATE

Scenario	Financing Terms	Financing Structure	Max CWF Cap Cost Year	Est. Max CWF Cap Costs ($M)	Total CWF Cap Costs ($M)	Max CWF Cap Cost Change from Base Financing Assumption (55/45, 40 yrs, Fixed)	Total CWF Cost Change from Base Financing Assumption (55/45, 40 yrs, Fixed)
Scenario 7	3.88% @ 40 years	Fixed Rate	2033	$131.5	$5,133.0	$(22.4)	$(874.4)
Scenario 8	3.55% @ 30 years	Fixed Rate	2033	$145.4	$4,240.2	$(8.4)	$(1,767.2)
Scenario 9	3.88% @ 40 years	Interest Only	2033	$148.5	$5,494.7	$(5.4)	$(512.7)
Scenario 10	3.55% @ 30 years	Interest Only	2033	$165.7	$4,602.6	$11.9	$(1,404.8)
Scenario 11	3.88% @ 40 years	Capitalized Interest	2033	$191.2	$6,042.4	$37.4	$35.0
Scenario 12	3.55% @ 30 years	Capitalized Interest	2033	$211.6	$4,992.5	$57.7	$(1,014.9)

For the purposes of this analysis, the base comparison scenario uses the 5RMK cost estimate, financed over 40 years at a fixed interest rate of 3.88 percent. When the base case is compared to the 75 percent confidence cost estimate, the maximum capital cost decreases from the base case by 14.6 percent and the total California WaterFix cost decreases by 14.6 percent. Shortening the financing period to 30 years would decrease the maximum capital cost from the base case by approximately 5.5 percent, and reduces the overall California WaterFix total cost by 29.4 percent.

Paying only interest during construction would reduce the maximum capital cost from the base case by approximately 3.5 percent, and decreases the overall California WaterFix cost by approximately 8.5 percent. Paying only interest during construction and shortening the financing period to 30 years would increase the maximum capital cost from the base case by approximately 7.7 percent, but decreases the overall California WaterFix total cost by approximately 23.4 percent.

Capitalizing interest during construction would increase the maximum capital cost from the base case by approximately 24.3 percent, and increases the overall California WaterFix total cost by approximately 17.7 percent. Capitalizing interest during construction and shortening the financing period to 30 years would increase the maximum capital cost from the base case by approximately 37.5 percent. This would decrease the overall California WaterFix total cost by approximately 16.9 percent. **Table 14** shows the percent change from the base case for the 75 percent confidence interval cost estimate scenarios.

TABLE 14: COST SUMMARY AND PERCENT CHANGE OF FINANCING SCENARIOS FOR 75 PERCENT CONFIDENCE INTERVAL COST ESTIMATE

Scenario	Financing Terms	Financing Structure	Max California WaterFix Cap Cost Year	% Change in Max CWF Cap Cost from Base Financing Assumption (55/45, 40 yrs, Fixed)	% Change in Total CWF Cost from Base Financing Assumption (55/45, 40 yrs, Fixed)
Scenario 7	3.88% @ 40 years	Fixed Rate	2033	-14.6%	-14.6%
Scenario 8	3.55% @ 30 years	Fixed Rate	2033	-5.5%	-29.4%
Scenario 9	3.88% @ 40 years	Interest Only	2033	-3.5%	-8.5%
Scenario 10	3.55% @ 30 years	Interest Only	2033	7.7%	-23.4%
Scenario 11	3.88% @ 40 years	Capitalized Interest	2033	24.3%	0.6%
Scenario 12	3.55% @ 30 years	Capitalized Interest	2033	37.5%	-16.9%

Cost Per Acre-Foot

SWP contractors do not purchase units of water from the SWP; however, the estimated marginal cost per af for California WaterFix is still useful for comparison and evaluation purposes.

The maximum capital costs for the SWP share of California WaterFix when it is fully operational is expected to range from $635 million to $1,021 million in 2033 under the 5RMK construction cost estimate scenarios, and ranges from $543 million to $873 million in 2033 under the 75 percent confidence interval construction cost estimate scenarios. As previously stated, California WaterFix is estimated to bring an average water supply yield improvement of 1.3 MAF per year based on a range of 1.2 MAF to 1.4 MAF, depending on future regulatory and operating requirements, of which about 55 percent would be the SWP's share. Dividing the maximum capital costs by the average water supply yield results in an estimated marginal cost range of $888/af to $1,427/af for the 5RMK estimate ($553/af to $889/af when discounted to 2017), and $759/af to $1,220/af for the 75 percent confidence interval construction cost estimate ($473/AF to $760/AF when discounted to 2017).

END