MODERNIZING THE SYSTEM:

CALIFORNIA WATERFIX OPERATIONS

2

The second in a series of three policy papers prepared for the consideration of Metropolitan's Board of Directors in advance of planned summer meetings and decisions in fall 2017.

Modernizing and improving California's water system are essential for the reliable delivery of water supplies to much of the state. About 30 percent of the water that flows out of taps in Southern California homes and businesses comes from Northern California watersheds and flows through the Sacramento-San Joaquin Delta. But the Delta's declining ecosystem and 1,100 miles of levees are increasingly vulnerable to earthquakes, flooding, saltwater intrusion, climate change and further environmental degradation. California WaterFix is the product of more than a decade of review, planning, rigorous scientific and environmental analysis in collaboration with fishery agencies and an unprecedented level of public comment.

Extensive analysis and work has been performed by state and federal water agencies and fish and wildlife agencies to determine conveyance system improvements and an operations framework to improve the direction of river flows in ways that will help native fish species, protect water supplies from climate change impacts and help restore the Delta ecosystem. Details of the proposed operations are addressed in Metropolitan's second white paper and summarized below.

WaterFix Operations Objectives

California WaterFix proposes a strong operations plan based on sound, collaborative science and adaptive management to meet the following objectives:

- Improve water supply reliability
- Enhance ecosystem fishery habitat throughout the Delta
- Allow flexible pumping operations in a dynamic fishery environment
- Improve export water quality
- Respond to climate change risks
- Reduce seismic risks

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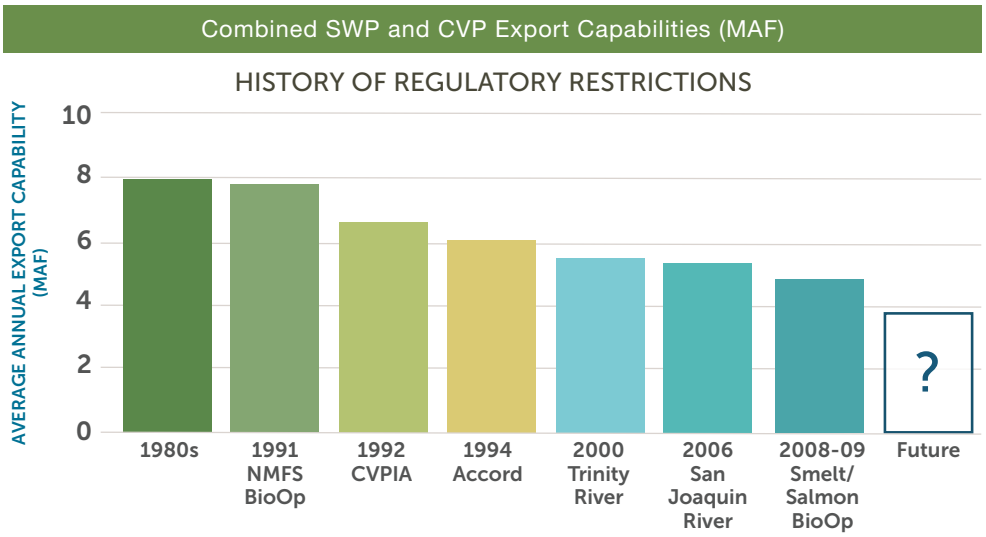
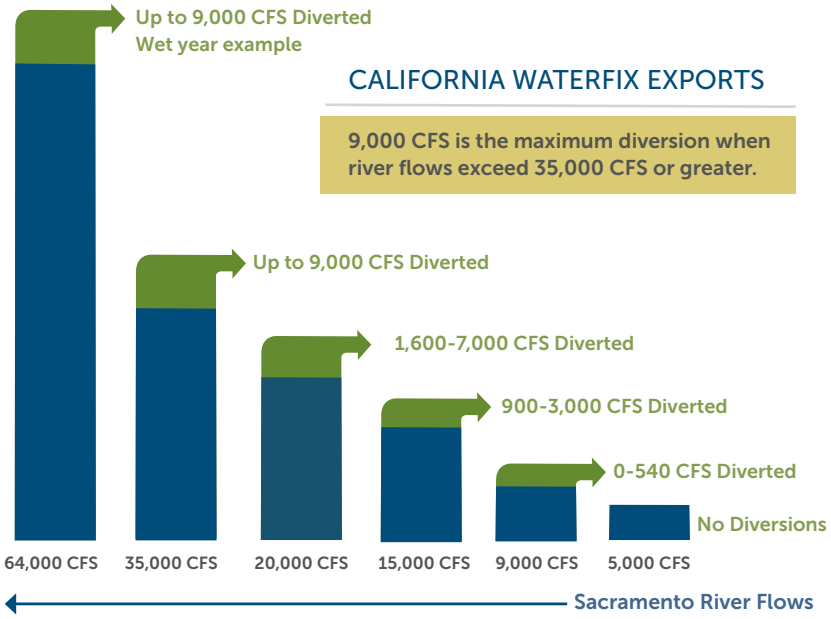
Regulatory Impacts

State Water Project and Central Valley Project operations have been, and continue to be, affected by regulations that seek to change flow regimes in the Delta by setting rules for outflow variables. This has decreased operational flexibility and reduced exports to 25 million Californians who receive water from the SWP and CVP south of the Delta and millions of acres of irrigated farmland.



Science-based Operations

As part of the California WaterFix planning process, extensive modeling and analysis has been done to evaluate the potential operational and water supply benefits and to determine the preferred project alternative that will advance the coequal goals of water supply reliability and protecting the Delta ecosystem. Creating a dual conveyance system with additional points of diversion for water exports in the Delta will improve river flow patterns, restore natural tidal fluctuations, reduce entrainment and improve habitat for native fish.



THE BAY-DELTA IS AN EVOLVING PLACE. UNCERTAINTY FROM CLIMATE CHANGE AND OTHER FACTORS WILL BE ADDRESSED BY CALIFORNIA WATERFIX THROUGH AN ADAPTIVE MANAGEMENT STRATEGY.

The most sensitive time of the year for Delta fisheries is December to June. Operations criteria would require a minimum Sacramento River flow before any water could be diverted at the north Delta intakes. The criteria also include biologically-based triggers to benefit fish species. A maximum possible diversion of 9,000 cfs is reached at river flows of 35,000 cfs or greater under the proposed operations.

Source: California WaterFix, State of California
CFS=cubic feet per second

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Key Operational Benefits

California WaterFix is an environmentally responsible plan that improves water supply reliability and operational flexibility. Many supply and environmental benefits that have been incorporated into the proposed project operations will:

IMPROVE WATER SUPPLY RELIABILITY

New intakes in the north Delta would provide greater flexibility and reliability by capturing more water in wet and above-normal years. Predicted future water supply for SWP and CVP with California WaterFix would range from 4.7 to 5.3 million acre-feet.

PROTECT FLOWS IN THE DELTA

A more natural flow direction in the Delta during critical fish protection periods will increase water supply reliability and minimize reverse flows. North Delta diversions, fish screen designs, bypass flow criteria and real time operations will be managed to limit effects on listed fish species.

IMPROVE EXPORT AND IN-DELTA WATER QUALITY

With the new north Delta intakes, the quality of water for exports would improve. The project will also protect in-Delta agricultural water quality by maintaining standards and limiting north Delta diversions when river flows are low.

REDUCE CLIMATE CHANGE RISKS

The SWP and CVP pumps in the south Delta are vulnerable to increased salinity from rising sea levels. New northern intakes would greatly improve water quality under future changing conditions.

ADHERE TO INTEGRATED WATER RESOURCE PLAN

Improved water supply reliability would advance Metropolitan's 2015 Integrated Water Resources Plan Update strategy and leverage investments made to the regional storage portfolio over the past two decades.

MINIMIZE ADVERSE IMPACTS TO COMMUNITIES

The footprint, construction activities and proposed operations reflect numerous efforts to minimize adverse impacts to Delta communities and areas of sensitive habitat for fish and wildlife.

OPERATIONAL AND ENVIRONMENTAL BENEFITS

WATER DELIVERY FORECAST

PREDICTED FUTURE WATER SUPPLY FOR SWP/CVP
WITHOUT CALIFORNIA WATERFIX
3.5 TO 3.9 MILLION ACRE-FEET/YEAR*

PREDICTED FUTURE WATER SUPPLY FOR SWP/CVP
WITH CALIFORNIA WATERFIX
4.7 TO 5.3 MILLION ACRE-FEET/YEAR**

Total SWP and CVP water deliveries
* Proposed w/o northern intake (existing conditions high outflow scenario)
** California WaterFix preferred alternative 4A H3-H4

Reinstate a more natural direction of river flows in the south Delta, minimizing reverse flows.

Protect against saltwater intrusion.

Safeguard against vulnerabilities that threaten water reliability such as earthquake risk and climate change.

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Environmental Benefits

MITIGATION

The biological opinions and EIR/EIS for California WaterFix outline mitigation measures related to the construction and future operations of the project. Some of the benefits of the fishery habitat that will be created and restored include:

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

These measures will enhance other state-sponsored programs to restore natural communities and ecological processes including California EcoRestore and the Delta Smelt and Sacramento Valley Salmon Resiliency Plans, both of which contain actions to improve the status of the species. Metropolitan is a strong proponent and active participant with the state on these programs.

CALIFORNIA ECORESTORE

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 of the project, to improve the long-term health of the Delta. EcoRestore seeks to advance at least 30,000 acres of habitat restoration including 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.

AFTER TWO YEARS IN OPERATION, CALIFORNIA ECORESTORE HAS MADE SIGNIFICANT PROGRESS:

2 RESTORATION PROJECTS STARTED CONSTRUCTION IN 2016

600+
Acres of tidal restoration

Fish passage improvement in the Yolo Bypass

4 PROJECTS IN 2017

2
Multi-benefit floodplain projects

2
Tidal marsh restoration efforts

over 1,300
Acres acquired from willing sellers for restoration projects

OUR MISSION

The mission of the Metropolitan Water District of Southern California is to provide its service area with adequate and reliable supplies of high-quality water to meet present and future needs in an environmentally and economically responsible way.

For a full version of the Operations Policy Paper, visit mwdh2o.com/waterfix

ABOUT METROPOLITAN

The Metropolitan Water District of Southern California is a state-established cooperative of 26 member agencies – cities and public water agencies – that serve nearly 19 million people in six counties. Metropolitan imports water from the Colorado River and Northern California to supplement local supplies and helps its members develop increased water conservation, recycling, storage and other resource management programs.

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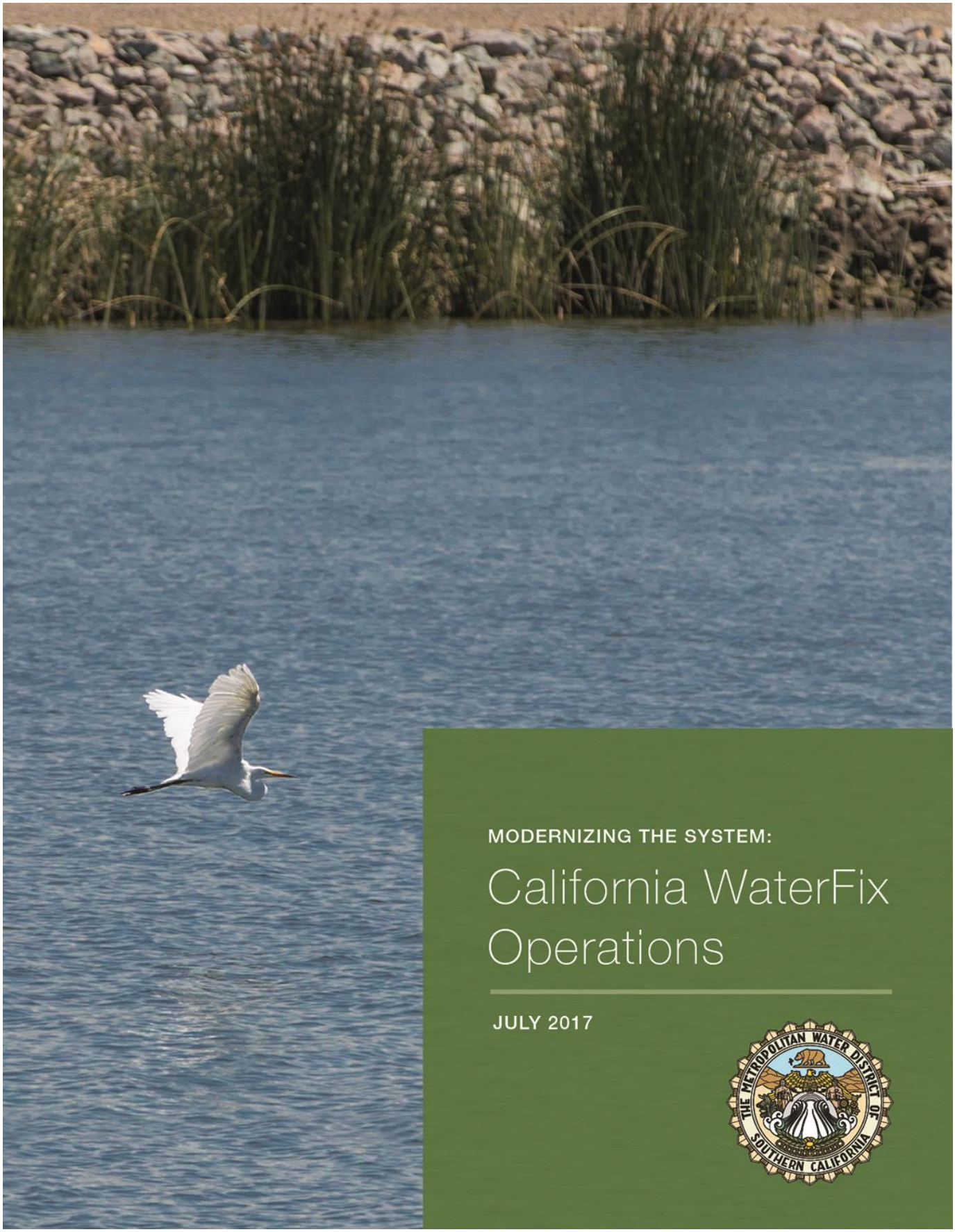


MODERNIZING THE SYSTEM:

California WaterFix Operations

JULY 2017

Contents

Introduction

This is the second of three policy white papers prepared for the Metropolitan Water District of Southern California's Board of Directors on the proposed California WaterFix. The overall objective of these papers is to provide relevant information in preparation for the Board's decisions on the project.

This paper focuses on the proposed operations and performance of California WaterFix to advance the state's coequal goals of improving water supply reliability and the Delta ecosystem. It describes how the planned operations of California WaterFix's proposed three new intakes in the northern Sacramento-San Joaquin Delta (Delta) are to be operated in conjunction with existing State Water Project (SWP) and Central Valley Project (CVP) facilities in the south Delta. The paper also describes elements of the proposed project that aim to reduce risks and uncertainties regarding operations and ecological processes and to improve environmental conditions. The other two white papers focus on the project's infrastructure improvements and the financing/cost allocation.

The objectives of this white paper are:

A. Describe the regulatory requirements and the challenges and issues that are imposed on the operation of existing SWP and CVP facilities;
B. Describe the new features and the proposed operation of California WaterFix under the requirements of current and projected state and federal regulations;
C. Describe the impact of operating California WaterFix on overall SWP and CVP performance and identify the major risk elements and risk management approaches;
D. Describe California WaterFix and its relationship to ongoing efforts to restore the Delta ecosystem, to preserve the Delta as an evolving place, and to prepare California for an evolving Delta future.

Summary

The Sacramento River and San Joaquin River meet in the Delta, which is the hub of the state's water distribution system. Both of California's two largest water projects – SWP and CVP – operate within the Delta and deliver water to about two-thirds of all Californians and millions of acres of irrigated farmland.

The Delta is a vitally important ecosystem that supports hundreds of aquatic and terrestrial species, some of which are protected under federal and state endangered species laws. To protect listed species, the U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), and the California Department of Fish and Wildlife (CDFW) have issued biological opinions and incidental take permits requiring the state Department of Water Resources (DWR) and federal Bureau of Reclamation (Reclamation) to substantially alter the way the agencies operate the SWP and CVP facilities. These operational changes have reduced SWP and CVP deliveries and water supply reliability south of the Delta. In addition, the Delta is at risk from earthquake damage, persistent land subsidence, floods and rising sea levels.

The existing Delta water conveyance system needs to be improved and modernized to address these issues. For example, the current system has diversions in the south Delta. Many of the operational and environmental challenges with the current system would be addressed by the California WaterFix, which proposes three new diversion structures in the north Delta. The structures would have state-of-the-art fish screens that would be operated in coordination with the existing south Delta SWP and CVP diversion facilities. These infrastructure and operational improvements would help restore and protect ecosystem health, improve the reliability of SWP and CVP deliveries, and protect water quality consistent with statutory and contractual obligations.

The SWP supplies from Northern California account for about 30 percent of the water used in Southern California. Recognizing the need to modernize the state's conveyance system, Metropolitan's Board of Directors adopted the Delta Action Plan and Delta Conveyance Criteria in 2007 (Conveyance Criteria). The following Conveyance Criteria serve as benchmarks for evaluating the effectiveness of the proposed California WaterFix:

- Provide water supply reliability;
- Allow flexible pumping operations in a dynamic fishery environment;
- Improve export water quality;
- Reduce seismic risks;
- Reduce climate change risks;
- Enhance ecosystem fishery habitat throughout the Delta.

Underlying all these benchmarks is the principle that they would be achieved in an environmentally responsible manner.

California WaterFix would improve system operational capability to support more reliable Delta water exports, and greater assurances to guard against risks. Increased flexibility to strategically move water from either the north or south Delta and better real-time management of export operations in response to actual conditions would better protect fish. The proposed dual conveyance system would improve river flow patterns with a more natural upstream to downstream flow pattern during periods important for fishery protection and less fish entrainment in the south Delta diversion facilities. Having flexibility to divert in the north or the south Delta will help native fish species migrate to and from the ocean and better utilize Delta habitat. It also would ensure greater water supply certainty for the 25 million Californians and millions of acres of agriculture receiving water from the Delta, and offer greater resiliency to climate change and seismic events. With these physical and operational changes, California WaterFix would help advance and achieve the state's co-equal goals of ecosystem restoration and water supply reliability.

The potential impacts of the proposed system facilities and operations have been carefully and thoroughly reviewed. Appropriate risk management measures have been incorporated into the project to restore and protect ecosystem health, water supplies, and water quality within a stable regulatory framework, consistent with statutory and contractual obligations. An Adaptive Management Program would be implemented through a collaborative process with regulatory agencies, project operators, and water contractors. This would provide a structured science process to develop adaptive means of improving conditions for both the ecosystem and water supply. Project operations that respond to real-time Delta conditions would also advance these objectives and provide greater certainty for water deliveries.

With the proposed conveyance improvements, management actions, and framework for operation, the project would have a significant positive impact on water supplies and water quality when compared to current conditions. Without California WaterFix, it is estimated that combined future SWP and CVP average annual exports could potentially decrease to 3.5 to 3.9 million acre-feet (MAF) from the current average annual supply of 4.9 MAF. With California WaterFix, the range of combined annual exports in future years is projected to be 4.7 to 5.3 MAF.

California WaterFix has undergone an unprecedented level of public outreach, review, and comment, along with extensive scientific analysis as part of the environmental planning process. Significant refinements to both the physical configuration and operational characteristics were made to address issues raised during the environmental review to reduce impacts and to better protect species. These refinements have accomplished that while maintaining the underlying core capabilities of the proposed system.

DWR and Reclamation have completed the environmental review documents under the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA). In addition, USFWS and NMFS have issued biological opinions on the project. These biological opinions determined that California WaterFix as proposed would neither jeopardize the continued existence of species listed under the federal Endangered Species Act (ESA) nor destroy or adversely modify critical habitat for those species.

Based on the information available to date, it is staff's assessment that California WaterFix operation, system capabilities and adaptive management would meet Metropolitan's adopted policy direction and achieve greater supply reliability.

Challenges and Issues with the Existing System

The location of the existing SWP and CVP diversion facilities in the south Delta, within habitat for protected fish species, leads to a significant problem: unreliable water supplies. This is because the rules to protect beneficial uses in the Delta and the listed species greatly restrict operations.

The Bay-Delta Water Quality Control Plan (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).

In addition, DWR and Reclamation operate their respective projects pursuant to biological opinions issued by USFWS and NMFS under the federal Endangered Species Act. DWR operates the SWP pursuant to an incidental take permit for longfin smelt issued by the CDFW under the state Endangered Species Act, 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 a year as compared to the SWRCB's prior requirements. Compounding the impacts, the biological opinions have decreased diversions and increased outflows by about another 1 MAF a year (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).

The increased Delta requirements and export constraints have further affected SWP and CVP operations by decreasing operational flexibility and increasing water supply vulnerabilities during dry conditions. This, in turn, reduces project reservoir storage, water deliveries, and supply reliability. Figure 1 illustrates the decrease in average SWP and CVP delivery capability over time due to additional regulatory requirements. As shown in the figure, over a period of a little more than 25 years, the export capability of the two projects has been reduced by over 3 MAF per year. California WaterFix is intended to reverse this downward trend.

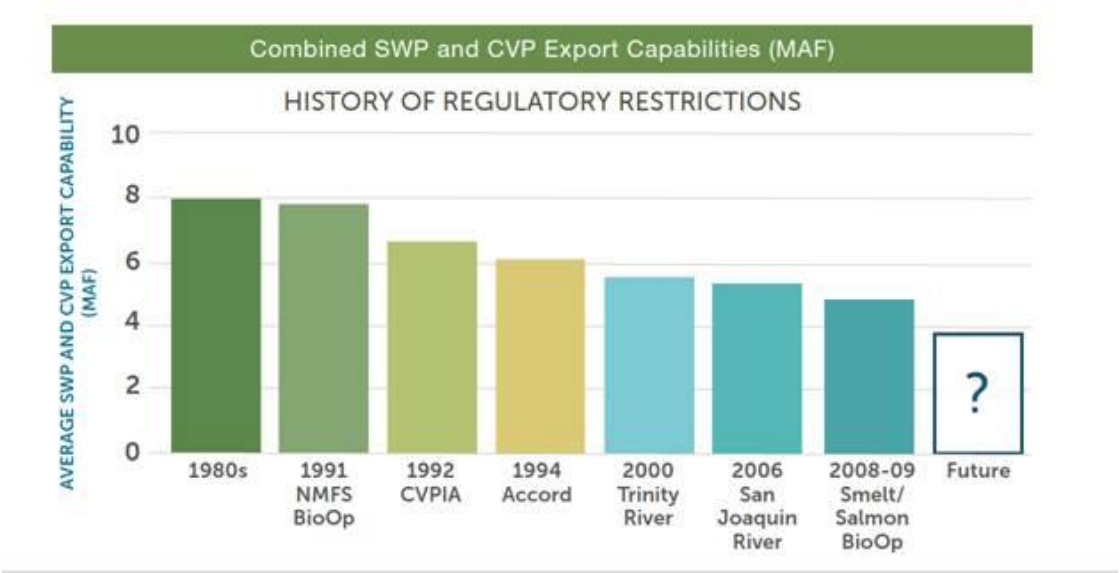


FIGURE 1: HISTORY OF SWP AND CVP EXPORT RESTRICTIONS DUE TO ENVIRONMENTAL REGULATIONS

California WaterFix Components

DESCRIPTION OF CALIFORNIA WATERFIX PHYSICAL COMPONENTS

The proposed infrastructure improvements are described in the first policy white paper ("Modernizing the System: California WaterFix Infrastructure"). The proposed facilities include three intake facilities along the east bank of the Sacramento River between the communities of Clarksburg and Courtland in the north Delta and dual tunnels that would carry water from the intakes to a pumping plant at Clifton Court Forebay. From there, water moved through these proposed facilities would connect with the SWP's existing California Aqueduct and the CVP's Delta-Mendota Canal for downstream deliveries (see Figure 2). Under California WaterFix, DWR and Reclamation would continue to use the existing south Delta facilities as appropriate in coordination with the north Delta facilities.

ADDITIONAL CALIFORNIA WATERFIX COMPONENTS

In addition to the physical facilities, California WaterFix includes a number of operational elements and environmental commitments to protect the Delta ecosystem. These include:

- A collaborative science and adaptive management program to address uncertainties and make adjustments over time;
- Continued real-time operation that makes adjustments to limit effects on listed species while maximizing water supply benefits;
- Environmental commitments to mitigate potential construction and operational impacts and to protect the Delta environment.

Each of these elements is described in more detail in the following sections of this paper.

Regulations and California WaterFix Proposed Operations

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. Because evolving science and changing conditions may lead to changes in the criteria during this time, 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 steps:

A. A set of criteria that would govern California WaterFix when it initially becomes operational was assumed to evaluate project effects for the environmental documents and biological opinions.
B. A robust collaborative science and adaptive management program that includes water contractor representatives 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.

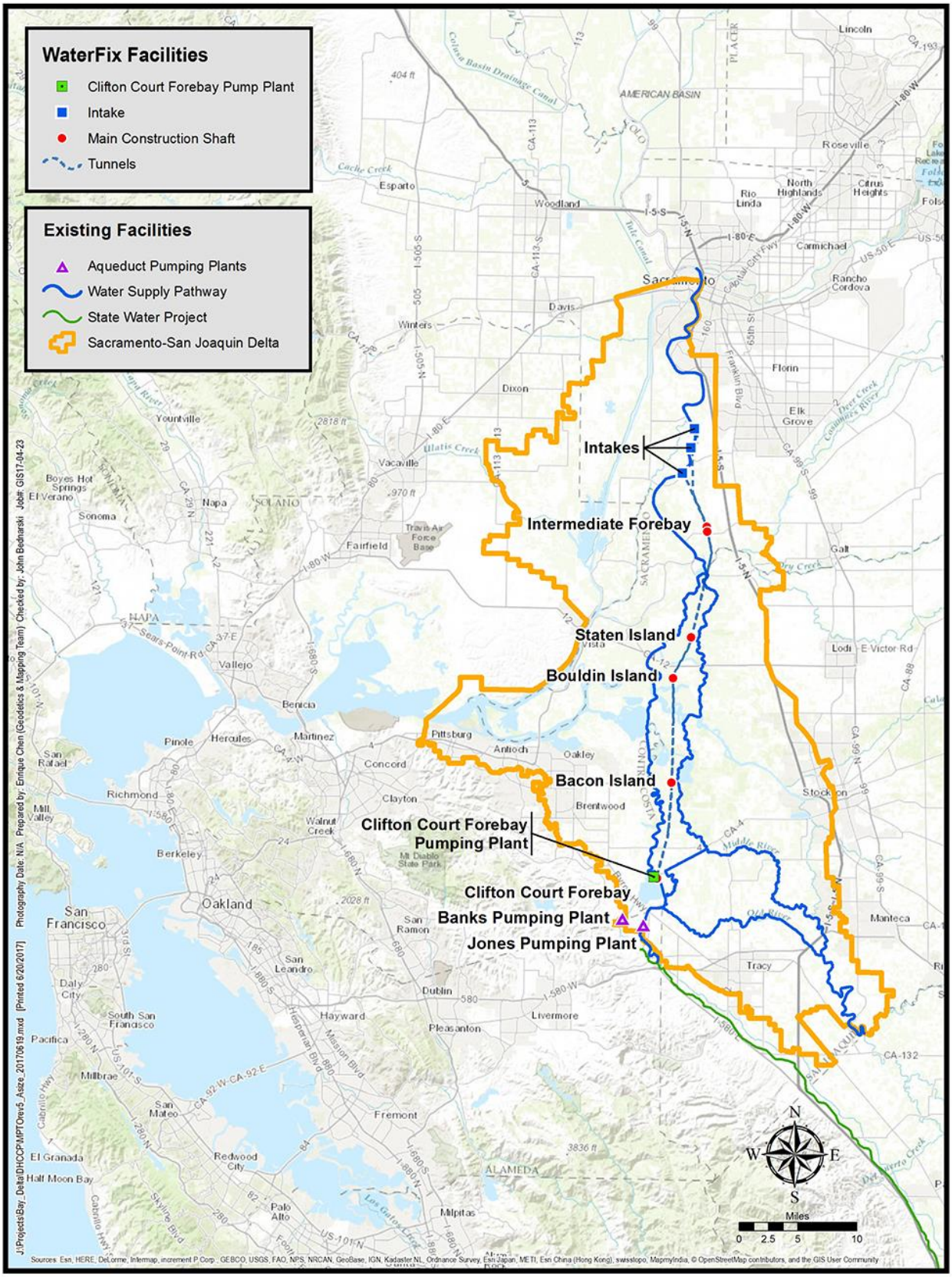


FIGURE 2: OVERVIEW OF THE DELTA AND CALIFORNIA WATERFIX FACILITIES

Initial Operating 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 Old and Middle Rivers and entrainment;
- Rio Vista flow.

New regulatory requirements in the assumed initial operation include additional limits on SWP and CVP diversions (i.e., Old and Middle River 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 Environmental Impact Report/Environmental Impact Statement (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 the 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 Old and Middle River criteria and spring outflows that are included with in 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.

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 3. Figure 4 presents a summary comparison of the key assumptions for these different scenarios.

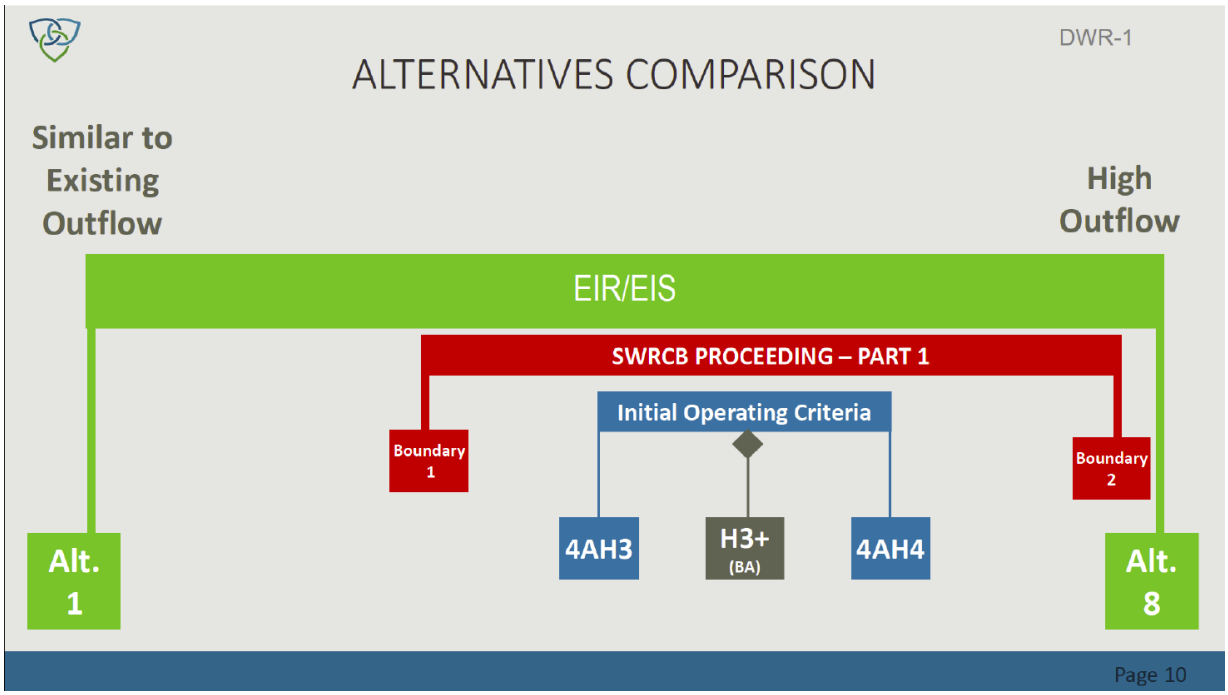


FIGURE 3: ALTERNATIVES COMPARISON

	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 Fish and Wildlife Service biological opinion and 2009 National Marine Fisheries Service biological opinion on SWP and CVP operations.

FIGURE 4: PROPOSED OPERATING ALTERNATIVES AND BOUNDARIES

SWP and CVP Operations and Performance with 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 involving 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. The No Action Alternative evaluated in the California WaterFix EIR/EIS is estimated to average about 4.7 MAF per year in year 2025 with climate change effects considered. 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, and allows for direct comparisons between future cases.

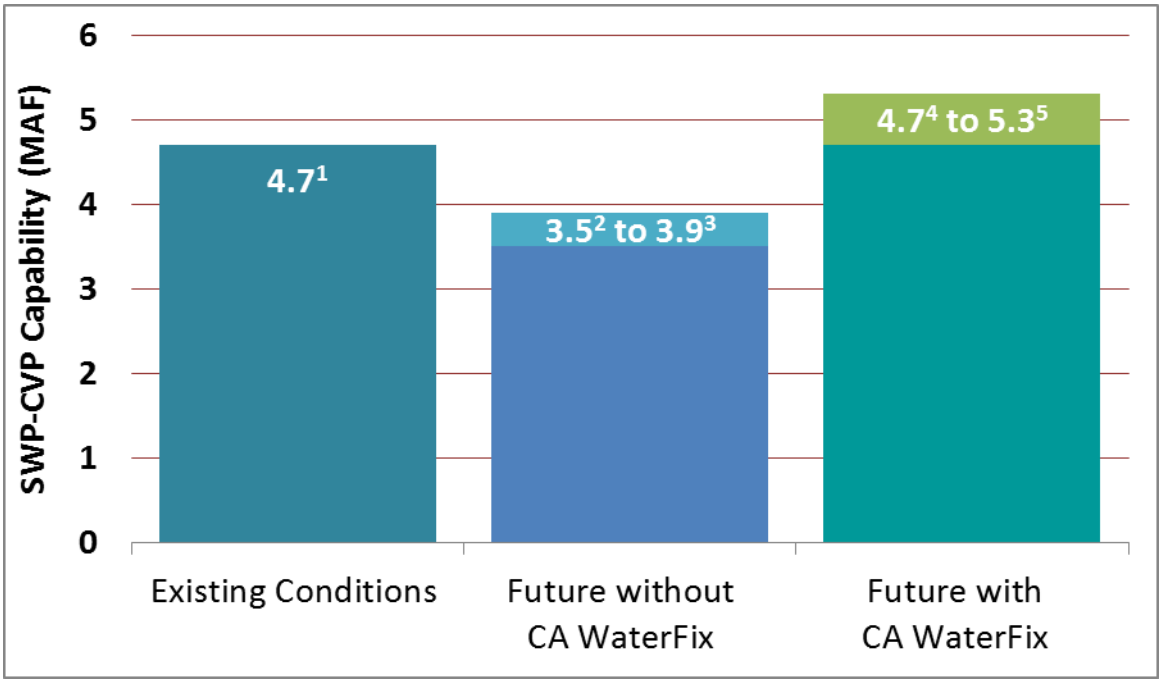
The estimated future supply without California WaterFix assumes increasing future regulatory constraints. Since the long-term trend has been toward increased regulation and reduced supply of the SWP and CVP, it is assumed that this trend would continue into the future. For example, the SWRCB is reviewing its Water Quality Control Plan (WQCP), which includes analysis of several new outflow scenarios as part of that process. The USFWS and NMFS also are reviewing the existing 2008 and 2009 biological opinions for existing SWP and CVP operations, which could lead to new operational restrictions. Next year, 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 Old and Middle River 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 for its Existing Conveyance High Outflow (ECHO) and Existing Conveyance Low Outflow (ECLO) scenarios. 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.

Total deliveries 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.

California WaterFix and Metropolitan's Integrated Water Resource Plan

Southern California's plan for a reliable water supply future depends on a reliable SWP supply and conveyance system, which requires much greater capability to move water into storage in wet periods and more flexibly to manage around fishery needs. Metropolitan's 1996 Integrated Water Resources Plan (IRP) identified the risk and variability associated with future SWP supplies, accurately projecting declines in water supplies because of projected future regulatory restrictions on SWP operations. As a result, Metropolitan embarked on a diversified strategy of local supply development, conservation, storage, and transfers to reduce future reliance on imported supplies, particularly reduced SWP deliveries in dry years. Much of the long-term investments in local supply development, conservation, storage, and transfers identified in the 1996 IRP have been made. Metropolitan today has more than 5.5 MAF of total storage capacity to help manage the highly variable imported supplies, particularly SWP deliveries. Reliable SWP supplies and flexibility of project operations remain key elements in the 2015 IRP Update.



[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

FIGURE 5: TOTAL DELIVERIES WITH AND WITHOUT CALIFORNIA WATERFIX

The 2015 IRP Update was grounded with a "Do Nothing" or "No New Investment" case for the SWP to identify the resource development needed to secure supply reliability to 2040. Under a "Do Nothing" or no new investment forecast for the SWP, notable changes would occur over time that would affect deliveries under the current system configuration.

The most notable change was the projected decline of SWP supply reliability that would take place because of climate change and the probability of more restrictive regulatory and operating conditions. Under current conditions, in 2016, total projected SWP and CVP water deliveries of 4.9 MAF on average translate to estimated SWP deliveries to Metropolitan of 1.2 MAF on average. Consistent with the prior discussion regarding increasing regulation and Delta flow restrictions, that projection was assumed to decline over time.

To reflect a future with no new actions or investments in the SWP, conservative approach was taken by estimating the decline using the Existing Conveyance High Outflow (ECHO) Scenario from the 2015 DWR Delivery Capability Report (Capability Report). Under this scenario, with total SWP and CVP water deliveries projected to be 3.5 MAF on average, SWP deliveries available to Metropolitan would drop to 837,000 acre-feet on average.

The 2015 IRP Update found that California WaterFix would improve the long-term reliability of Metropolitan's water supplies, comparing projected supplies in Table 1 with Table 2. One of the key reliability goals of the 2015 IRP Update is to stabilize SWP supplies. The IRP describes an approach for achieving this goal that includes adaptive management of flow and export regulations in the near-term and attainment of a long-term Delta solution through California WaterFix.

TABLE 1: SUMMARY OF SWP SUPPLIES AVAILABLE TO METROPOLITAN WITHOUT ADDITIONAL INVESTMENTS (ACRE-FEET)

SWP	2016	2020	2025	2030	2035	2040
Minimum	210,000	154,000	154,000	154,000	154,000	154,000
Average	1,202,000	837,000	837,000	837,000	837,000	837,000
Maximum	2,022,000	1,695,000	1,695,000	1,695,000	1,695,000	1,695,000

The 2015 IRP Update developed assumptions for SWP supplies with California WaterFix and evaluated the resulting reliability improvements in comparison to the "Do Nothing" case. In a manner similar to the "Do Nothing" case, SWP supplies were also estimated to decline in the near-term, but assumed to be less severe than in the "Do Nothing" scenario. The declines were assumed to be less due to the commitment to California WaterFix near-term adaptive management efforts. In this scenario, Metropolitan used the Existing Conveyance Low Outflow (ECLO) Scenario from the Capability Report as a proxy for near-term SWP supplies under less restrictive conditions. Under the ECLO Scenario, total SWP and CVP water deliveries were projected to be 3.9 MAF per year on average. Under this scenario, SWP deliveries to Metropolitan drop to 984,000 acre-feet on average (Table 2, Year 2025).

At the time of the 2015 IRP Update, Alternative 4A provided the best available estimate of total SWP and CVP yield, based on long-term land-use and climate change and assumed operating and regulatory conditions. It also factored in a change in project facilities to include conveyance consistent with California WaterFix. The IRP update analyses used Alternative 4A-H4 as the estimated deliveries with California WaterFix. It was estimated that the flexible operations from California WaterFix facility improvements would provide total average SWP and CVP deliveries of 4.9 MAF, with average SWP deliveries available to Metropolitan of 1.2 MAF starting in 2030 (Table 2).

TABLE 2: SUMMARY OF SWP SUPPLIES AVAILABLE TO METROPOLITAN WITH CALIFORNIA WATERFIX (ACRE-FEET)

SWP	2016	2020	2025	2030	2035	2040
Minimum	210,000	229,000	229,000	314,000	314,000	314,000
Average	1,202,000	984,000	984,000	1,213,000	1,213,000	1,213,000
Maximum	2,022,000	1,695,000	1,695,000	1,863,000	1,863,000	1,863,000

The IRP analyses showed that California WaterFix would have a significant positive impact on the total supply reliability for Metropolitan's service area. Under the "Do Nothing" case, IRP analyses showed that Metropolitan's service area would experience water shortages 33 percent of the time in 2035 and 58 percent of the time in 2040. In addition, the region's dry-year storage reserves would be drawn down to critical levels (less than 1 MAF dry year supplies) 55 percent of the time in 2035 and 80 percent of the time in 2040.

Under Alternative 4A-H4, the likelihood of water shortages would be reduced to 4 percent in 2035 and 10 percent in 2040. Storage reserves also improved under the proposed plan, with reserves being drawn down to critical levels 9 percent of the time in 2035 and 8 percent of the time in 2040. These findings were the primary driver in the development of the 2015 IRP Update's target to stabilize the reliability of SWP supplies through California WaterFix.

California WaterFix advances the overall 2015 IRP Update strategy, leveraging the investments Metropolitan has made in regional storage capacity over the past two decades to provide supply reliability into the future. The data and estimates for available water supply from the SWP and the impacts of increased regulation used in the 2015 IRP Update analyses were based on the best available information and modeling at the time. Updated modeling

results of water deliveries that incorporate the latest information on future regulations and project facilities, shown in this paper, are consistent with (and improved over) those used in the 2015 IRP Update analyses. These findings confirm that California WaterFix remains an important part of the overall portfolio of water resource development strategy that is key to Southern California's water supply future.

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

The California WaterFix is intended to capture additional flow during wetter periods when unregulated flow is available. Metropolitan has analyzed the ability of California WaterFix to divert during such high flow events.

Using the winter of 2012/2013 as an example, Figure 6 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 acre-feet 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 6, state and federal water project exports were relatively minor in comparison to the outflows of the two storms. With the additional flexibility of California WaterFix's proposed north Delta intakes, Metropolitan's analysis 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 on Figure 6). These results suggest that periodic high flow events could potentially provide reoperation benefits consistent with existing delivery contracts while at the same time meeting all criteria intended to protect fish, water quality, and existing water rights.

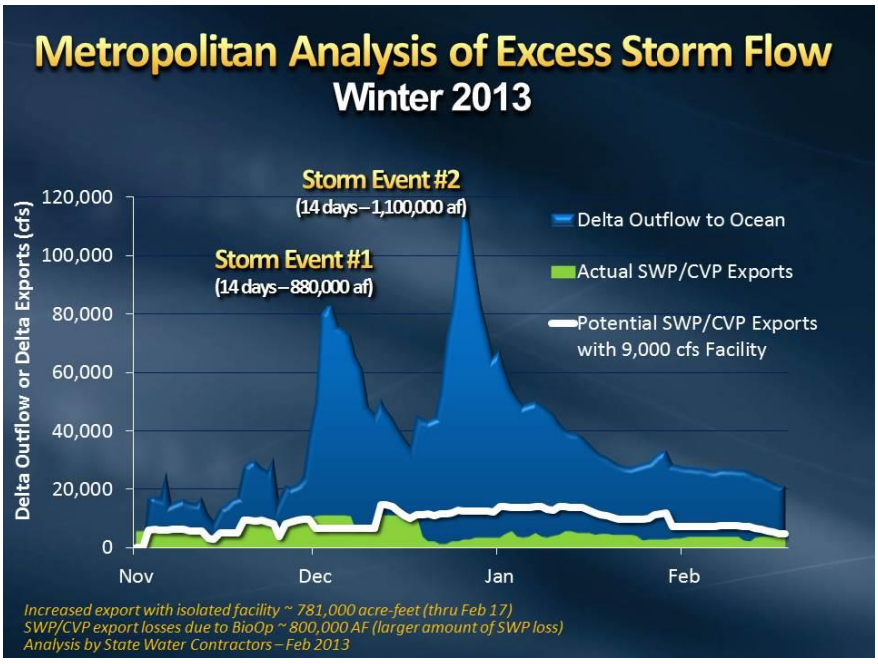


FIGURE 6: WINTER 2013 REOPERATION ANALYSIS WITH CALIFORNIA WATERFIX

As part of SWCRB's California WaterFix petition process, DWR presented a similar analysis illustrating the flexibility of the proposed project 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. (Source: J. Leahigh

testimony, SWRCB Hearing Proceedings Regarding Changes in Water Rights for the California WaterFix Project, DWR Exhibit 61.)

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.

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 system. Figure 7 shows the estimated increase in available transfer capacity with and without California WaterFix.

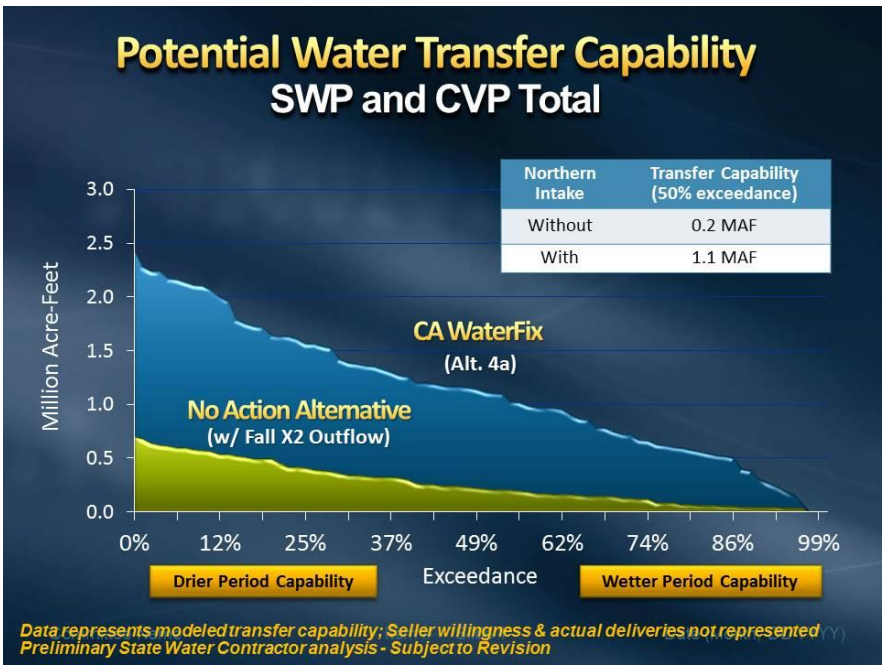


FIGURE 7: POTENTIAL WATER TRANSFER CAPABILITY, SWP AND CVP TOTAL

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-project 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 the SWRCB and other regulatory obligations, including 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, pursuant to D-1641, the SWP and CVP would still be required to meet all salinity and

flow objectives regardless of which diversion location is being 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 Delta water quality, fishery objectives, 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 Bay-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. Urban water users, including Metropolitan, are concerned with the levels of salinity (electrical conductivity (EC), bromide, and total dissolved solids (TDS)), organic carbon, and nutrients in their imported 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. As shown in Table 3, modeling of Alternative 4A compared to no action shows lower levels of EC (18-22% improvement), TDS (17-22% improvement), bromide (31-43% improvement), organic carbon (2-11% improvement), and nitrates (5-27% 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 IN A DYNAMIC FISHERY ENVIRONMENT

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 wetter years and lowest in drier 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:

- Proposed initial operations would include a preference for south Delta facility pumping from July through September to manage water quality conditions in the south Delta. Additionally, real-time operations would be used to adjust operations and further protect listed species, while maximizing water supply benefits.
- 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.

TABLE 3: WATER QUALITY CONSTITUENTS

Banks Pumping Plant	No Action (Early Long-Term)	Alternative 4A (Early Long-Term)
Electrical Conductivity (µmohs/cm)[1]		
All	505	395
Drought	632	518
Total Dissolved Solids (TDS) (mg/L)[2,3]		
All	286	228
Drought	354	293
Bromide (µg/L)[4,5]		
All	391	223
Drought	482	334
Dissolved Organic Carbon (mg/L)[6]		
All	3.8	3.4
Drought	4.1	4.0
Nitrate (mg/L-N)[7]		
All	0.70	0.51
Drought	0.55	0.52

[1]Source: Final EIR/S at Appendix 8H, p. 8H-32.
[2]Source: Conversion from EC using conversion formula: (TDS (mg/L) = 19.2 + (0.529 * EC).
[3]EC data from Final EIR/S at Appendix 8H, p. 8H-32.
[4]Source: Final EIR/S, Appendix 8E, p. 8E-23.
[5]Mass-balance approach.
[6]Source: Final EIR/S, Appendix 8K, p. 8K-12.
[7]Source: Final EIR/S, Appendix 8J, p. 8J-43.

- To meet bypass flow objectives, diversions must be restricted at certain times of the year that support the main juvenile salmon migration period (mostly from December through June).
- The proposed operational north Delta bypass criteria also protect water quality and flow for downstream water users. The north Delta diversion would not be operated during low-flow periods on the Sacramento River. Generally, during the period from December through June, as illustrated in Figure 8, the full 9,000 cfs diversion rate would not occur until Sacramento River flows are approximately 35,000 cfs. Compliance with D-1641 standards further restricts the north Delta diversion rate.

As a result of the limitation on north Delta diversion, there would 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.

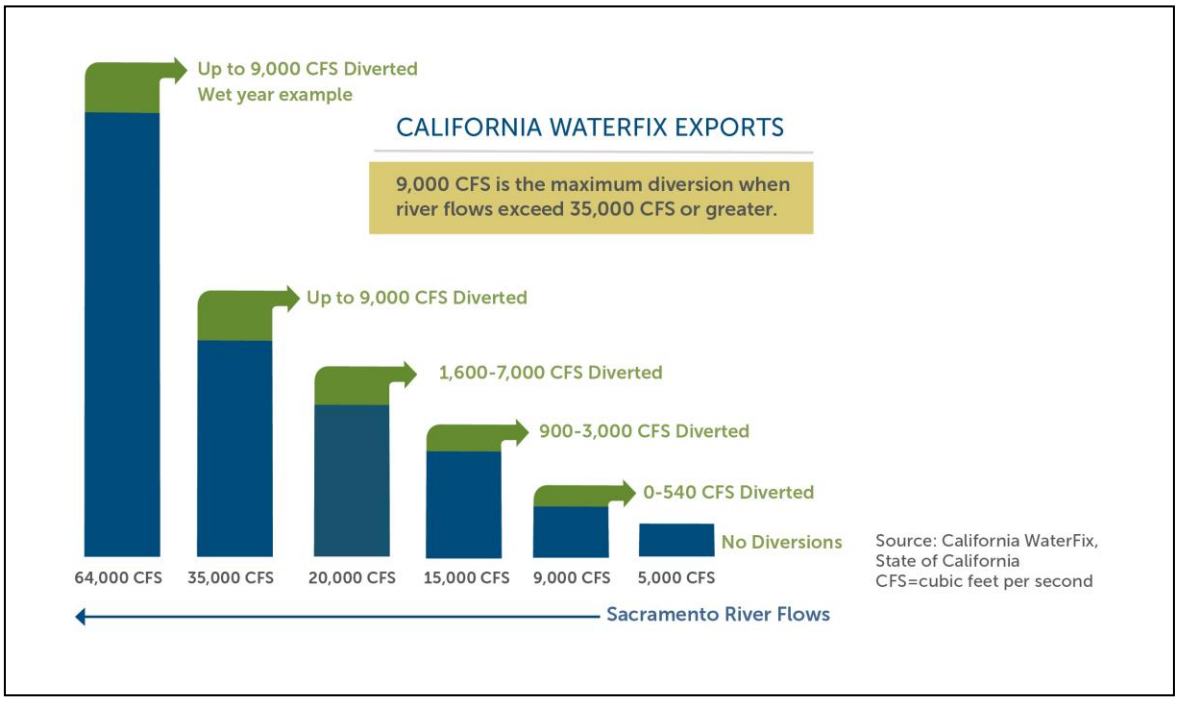


FIGURE 8: NORTH DELTA DIVERSION BYPASS CRITERIA

REDUCING 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;
- Rising sea levels and seawater intrusion into the Bay-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 2016/17, 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. 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.

REDUCING SEISMIC RISKS

In 2009, DWR released the final Delta Risk Management Strategy (DRMS) Phase 1 Report. The 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 US 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. The proposed project also offers mitigation measures that would improve the existing environmental conditions as well as mitigate the effects of the proposed project.

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

The 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 Bay-Delta Conservation Plan (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 the Table 4, below, consist primarily of habitat restoration, protection, enhancement, and management activities.

TABLE 4: 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 fix, 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;
- 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 the project. 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;
- At least 1,000 acres of aquatic, riparian and upland habitat projects and multi-benefit flood management projects.

The state of California also 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;
- Reoperation 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;
- 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;
- Restore tidal habitat in the Delta.

California WaterFix would include implementation of portions of both of the resiliency plans.

Consistency with Delta Conveyance Criteria

Recognizing the significance of the supply, and the need to modernize the state's conveyance system, Metropolitan's Board of Directors adopted the Delta Action Plan and Delta Conveyance Criteria ("Conveyance Criteria") in June 2007 and September 2007, respectively. As described in earlier sections of this white paper, and summarized in Table 5, the operational aspects of California WaterFix meet the Board's adopted Delta Conveyance Criteria by providing water supply reliability and improved water quality in an environmentally responsible manner.

TABLE 5: DELTA CONVEYANCE CRITERIA

Board-Adopted Delta Conveyance Criteria	California WaterFix
Enhance Ecosystem Fishery Habitat Throughout Delta	• Provides extensive restoration of tidal marshes and channel margin habitat.
Allow Flexible Pumping Operations in a Dynamic Fishery Environment	• Three new intakes in the northern Delta, along with the existing State Water Project intake in southern Delta, create the necessary flexibility to avoid conflicts between different fishery needs. • The ability to manage the system using north and south Delta diversion locations, allow for improved flow patterns in the Delta to benefit fish during fish sensitive times.
Provide Water Supply Reliability	• The California WaterFix proposal is consistent with Metropolitan's IRP.
Improve Export Water Quality	• Water quality from new northern Delta intakes is improved; salinity, for example, is improved approximately 20 percent.
Reduce Seismic Risks	• Twin tunnels to convey water from northern Delta would protect future critical supply needs from natural disasters.
Reduce Climate Change Risks	• Intakes in northern Delta are upstream of predicted long-term salinity intrusion due to climate change.

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, the project 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 the project purposes of a more reliable water supply and protection of the environment. A copy of the letter from the California Natural Resources Agency dated February 19, 2014 and memorandum providing analysis and the need for the importance 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 agency, a 3,000 cfs facility would not meet the project 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 detailed in the first white paper, 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;
- 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 project footprint by one-half of its original size, greatly minimizing community impacts.

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 the State Water Board for the protection of urban, agricultural, and fishery beneficial uses. DWR and Reclamation 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. (Source: J. Leahigh Power Point, SWRCB Hearing Proceedings Regarding Changes in Water Rights for the California WaterFix Project, DWR-4, errata, p. 18). 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.

With California WaterFix, the SWP would continue to provide fresh water to in-Delta agricultural and municipal diverters by continuing to satisfy the water quality requirements contained in D-1641 to protect each of the beneficial uses defined by the SWRCB.

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 the project. 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 the project than without. However, as DWR testified before the 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.

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 6 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 mitigate some of these uncertainties directly. In addition, 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 6: 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 project 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 project 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

Scientific uncertainty exists regarding the Delta ecosystem, including the needs of protected fish species, the effects of SWP and CVP operations on those species and their habitats, and the related operating criteria and other actions intended to minimize or mitigate those effects. To address these uncertainties, California WaterFix proposes a structured program for conducting collaborative science and adaptive management.

The Adaptive Management Program would be implemented consistent with an agreement between DWR, Reclamation, USFWS, NMFS, CDFW, and water contractors. The Adaptive Management Program would be implemented to enhance application of science to support decision making related to the operations of the SWP and CVP. The California WaterFix Adaptive Management Program includes a collaborative process for decision-making that would be essential to the success of the overall program. Key to this is the establishment of the Interagency Implementation and Coordination Group (IICG). Convened by Reclamation and DWR, the IICG would have primary responsibility for coordinating and implementing the Adaptive Management Program. The IICG would be composed of one representative from each of the "Five Agencies" (DWR, Reclamation, USFWS, NMFS, and CDFW) as well as one each from the participating SWP and participating CVP contractors. Metropolitan would participate in the Adaptive Management Program through its representation by the water contractors.

The Adaptive Management Program's broad purposes include the ability to (1) undertake collaborative science, (2) guide the development and implementation of scientific investigations and monitoring for both compliance and adaptive management, and (3) apply new information and insights to management decisions and actions. Adaptive management would determine the effectiveness and necessity of the operational criteria based on the best scientific and commercial data available when California WaterFix becomes operational.

The Adaptive Management Program includes monitoring and studies to determine the effectiveness and necessity for the initial operating criteria that would be enacted as part of the federal and state Endangered Species Act authorizations. These scientific investigations may lead to changes in the initial operating criteria prior to or after California WaterFix becomes operational. This approach would help address scientific uncertainty and identify opportunities to better refine operations of the new water conveyance facility to further species needs while improving water supply.

The adaptive management approach for the California WaterFix describes the interrelationship between the identification of uncertainties, development of management questions, objectives, management alternatives, monitoring and research design, synthesis, and decision making. The four-phase process diagram shown in Figure 9 illustrates the major components of the proposed adaptive management process.

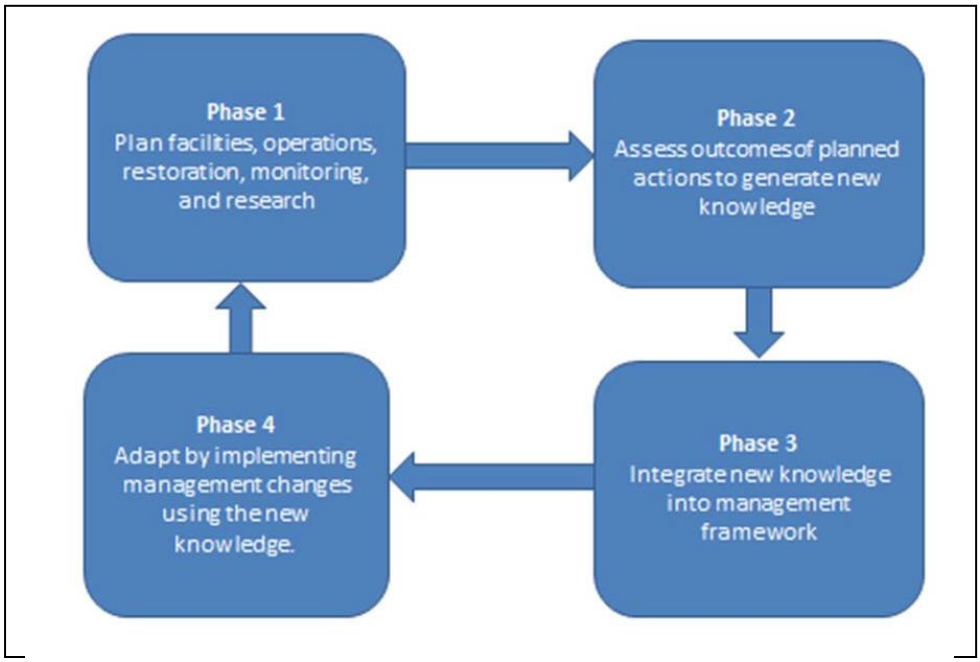


FIGURE 9: ADAPTIVE MANAGEMENT PROCESS

REAL-TIME OPERATIONS

As part of California WaterFix, real-time operations for existing Delta facilities and the new north Delta diversion facilities would be a part of the California WaterFix operating criteria. Real-time operations are meant to provide short-term adjustment to operations in response to observed environmental conditions to enhance endangered species protections while maximizing water supply benefits.

UPDATING SCIENCE TO SUPPORT DELTA FISH

In addition to the efforts of the Adaptive Management Program to advance science associated with operation of the SWP and CVP, Metropolitan would continue its independent science efforts for the Delta. Metropolitan's proactive science efforts supports water supply reliability and ecosystem restoration by reducing scientific uncertainty, driving better management decisions and project operations, and fostering effective policies and regulations.

An example of how such science efforts has resulted in real and meaningful change in the Delta is with respect to nutrients. Nutrient discharges to the Bay-Delta Estuary can affect phytoplankton growth and the composition of the phytoplankton community. Scientific studies addressing nutrient effects on phytoplankton and the food web that supports Delta fish led to more stringent water quality regulatory requirements and to investments to upgrade the Sacramento Regional County Sanitation District wastewater treatment plant.

As another example, Metropolitan participates in the Delta Condition Team process coordinated by the state and federal agencies to closely monitor trawl and turbidity data and evaluate turbidity forecast information as it relates to spawning conditions for Delta smelt. As part of its participation, staff collaborated with other technical scientists and experts to identify water project measures to reduce movement of turbidity toward the export pumps during the first significant storm of the wet season. Taking such measures to reduce the intrusion of turbidity into the south Delta reduced the number of adult Delta smelt spawning near the water project pumps and greatly reduced the need to reduce exports later in the season. This management action allowed more effective operations that protected the fish while at the same time preventing unnecessary restrictions on the SWP and CVP projects.

Conclusion

The reliable delivery of high-quality water through the Delta faces many challenges and risks, including fishery declines, earthquakes, floods, and rising sea levels. Despite previous actions and efforts by local, state, and federal agencies to address these issues, the region's ecosystem has continued to decline. California WaterFix addresses these long-standing issues with increased operational flexibility, new system capacity that provides more assurances, and adaptive management strategies to ensure improved water supply reliability while protecting habitat, species, and the Delta ecosystem. The project has undergone an unprecedented level of public review, comment, and scientific input. Extensive analyses and risk assessments have been conducted to better understand and address risks commonly associated with infrastructure projects of this size. For California WaterFix, the key risk areas have been identified, and tools to mitigate these risks have been incorporated into the project's risk management process and operating criteria.

In addition to meeting the needs of the state, California WaterFix as proposed meets all of the Delta Conveyance Criteria adopted by Metropolitan's Board in 2007. Metropolitan's 2015 Integrated Resources Plan Update, as adopted by Metropolitan's Board in 2016, includes a goal to stabilize SWP supplies, to pursue a successful outcome in California WaterFix, and to establish efforts for long-term average supplies of about 1.2 million acre-feet. The proposed project would achieve this goal. The physical project and the operational criteria meet the attributes of a successful project based on staff analysis, Metropolitan's long-term objectives, and the state's coequal goals.

Note: For additional information on Metropolitan's policies related to California WaterFix, including a policy white paper on infrastructure improvements that would modernize the state's water system, see http://mwdh2o.com/ or http://www.mwdh2o.com/DocSvcsPubs/WaterFix/

Attachment to
Modernizing the System: California WaterFix Operations

ACRONYM/TERMINOLOGY LIST

ITEM	DESCRIPTION
AMMs	Avoidance and minimization measures
BDCP	Bay Delta Conservation Plan
BiOps	Biological Opinions from the Fish and Wildlife Service and the National Marine Fisheries Service
BMPs	Best management practices
CALSIM	DWR modeling tool used to simulate SWP and CVP operations
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
CFS	Cubic feet per second
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
D-1641	Water Rights Decision-1641, implements the Bay-Delta Water Quality Control Plan (WQCP)
DRMS	Delta Risk Management Strategy
DWR	Department of Water Resources
EC	Electrical Conductivity
ECHO	2015 Delivery Capability Report Existing Conveyance High Outflow scenario
ECLO	2015 Delivery Capability Report Existing Conveyance Low Outflow scenario
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ESA	Endangered Species Act
IICG	Interagency Implementation and Coordination Group
IRP	Integrated Water Resources Plan, Metropolitan's blueprint for long-term water supply reliability
MAF	Million Acre-Feet
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
OMR	Old and Middle River
RDEIR	Recirculated Draft Environmental Impact Report

ITEM	DESCRIPTION
Reclamation	Federal Bureau of Reclamation
SDEIS	Supplemental Draft Environmental Impact Statement
SWP	State Water Project
SWRCB	State Water Resources Control Board
TDS	Total Dissolved Solids
USFWS	U.S. Fish and Wildlife Service
WQCP	Bay-Delta Water Quality Control Plan
X2	Indicator of the location of the low salinity zone, thought to be biologically important to Delta species