Exhibits for Sierra Club California et al.

Protest Of DWR Petition

for Changes to the Delta Conveyance Project

Exhibit 1

REGION 9
SAN FRANCISCO, CA 94105

January 19, 2024

State Water Resources Control Board
Division of Water Rights
Attn: Bay-Delta & Hearings Branch
Submitted via Email: SacDeltaComments@waterboards.ca.gov

Re: Comment Letter – Sacramento/Delta Draft Staff Report

The U.S. Environmental Protection Agency (EPA) appreciates the opportunity to comment on the State Water Resources Control Board's (State Water Board) September 28, 2023 *Draft Staff Report in support of updates to the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta Plan) for the Sacramento River and Delta watersheds* (Staff Report). The State Water Board identified the need to comprehensively review and, if necessary, amend flow objectives in response to growing concern over deteriorating aquatic life conditions, climate change, and pelagic organism decline.[1] This Staff Report is a critical step to provide the State Water Board with the information necessary to make appropriate updates to the Bay-Delta Plan and EPA applauds the State Water Board for its efforts in reaching this milestone. Once the State Water Board concludes this process, EPA will review and act upon any new or revised water quality standards pursuant to Clean Water Act section 303(c), including government-to-government consultation in accordance with EPA Policy on Consultation with Indian Tribes and compliance with Section 7 of the Endangered Species Act, as appropriate.

The San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta) is the water hub of California, draining over 40% of California's land area, providing flow, flow-related habitat, and water quality benefits to support millions of acres of farmland as well as drinking water for millions of people, and vital recreational, commercial, and subsistence fisheries. As recognized in the Staff Report, many Native American Tribes are deeply connected to the aquatic life of the Bay-Delta. These Native American Tribes have historical and current reliance on the Bay-Delta ecosystem to provide food and to support cultural and spiritual practices, a profound connection with the watershed that must be taken into account. The Bay-Delta Plan establishes protections for this large, diverse, and singularly

[1] *See*, State Water Resources Control Board. August 4, 2009. Staff Report on the Periodic Review of the 2006 Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary. Adopted by Resolution 2009-0065. EPA notes that water quality standards for the waterbodies covered in this Staff Report were last updated in 1995, despite a Clean Water Act requirement that States consider and as appropriate, make such updates at least once every three years. CWA § 303(c)(1).

important ecosystem. While EPA's attached comments focus primarily on potential updates to the Bay-Delta Plan related to flow objectives to support fish and wildlife designated uses, EPA acknowledges the importance of improving water quality throughout the Bay-Delta watershed to protect all uses, including Tribal Beneficial Uses (TBUs). EPA continues to urge the State Water Board to expeditiously adopt and implement long-delayed updates to the Bay Delta Plan to ensure that this important ecosystem can continue to support these uses for future generations.[2]

The Staff Report includes alternatives for both numeric and narrative flow objectives to protect aquatic life uses. While narrative water quality criteria can be appropriate in some cases, in general, narrative criteria are usually established where numeric criteria cannot be established or as supplements to numeric criteria. 40 C.F.R. 131.11(a)(2). Numeric criteria serve as consistent and transparent targets to drive implementation and EPA strongly recommends that the State Water Board include numeric flow objectives in its amendments to the Bay-Delta Plan. Importantly, EPA notes that the State Water Board has completed a significant amount of work to develop the scientific rationale for numeric flow objectives.[3] EPA supports the regulatory framework outlined in the proposed Plan amendment alternative that would pair numeric flow objectives with a flexible program of implementation.

The Staff Report also assesses a Proposed Voluntary Agreement (VA) Alternative that includes a new narrative objective and a framework to provide a combination of flow and non-flow habitat measures (VA assets). EPA is concerned that the Staff Report does not provide sufficient evidence to demonstrate that the proposed VA assets will protect beneficial uses in the Sacramento River and Delta watersheds. Enclosed, EPA provides recommendations regarding the information necessary to demonstrate that the VA Alternative will protect beneficial uses.

EPA strongly supports the State Water Board's proposal to incorporate TBU definitions into the Bay-Delta Plan, as expressed in our June 1, 2023 letter. Adopting TBUs into the Bay-Delta Plan will place these important Tribal cultural and subsistence uses on the same footing as other beneficial uses addressed by the Bay-Delta Plan. Although Native American Tribes have asked the State Water Board to apply TBUs throughout the watershed rather than utilizing the Regional Board-specific designation process, the State Water Board has not identified or discussed a timeline to designate TBUs for specific Bay-Delta waterways. EPA encourages the State Water Board to consult with affected Tribes to take into consideration tribal cultural practices within the Bay-Delta and expeditiously designate beneficial uses and protective criteria for such waters.

EPA supports the State Water Board in its efforts to amend the Bay-Delta Plan, however, the ongoing delays in completing revisions to the Bay-Delta Plan remain a significant concern given the consequences of these delays on Bay-Delta communities.[4] EPA will continue to provide technical

[2] See U.S. EPA webpage, "EPA Comments on the SF Bay Delta Water Quality Control Plan" https://www.epa.gov/sfbay-delta/epa-comments-sf-bay-delta-water-quality-control-plan.

[3] The Staff Report discussion of the Plan Amendment alternative builds on the State Water Board's 2017 Scientific Basis Report and July 2018 Framework for the Sacramento/Delta Update to the Bay-Delta Plan.

[4] In 2016, Delta aquatic resource advocates petitioned EPA to initiate a federal promulgation of new Bay-Delta Plan provisions. In 2022, both EPA and the State Water Board received formal petitions for rulemaking to develop water quality standards that are protective of aquatic life and tribal beneficial uses. EPA also received a Title VI civil rights complaint about, among other issues, the delayed Bay-Delta Plan revisions. The federal complaint and petition are pending.

assistance and guidance to the State Water Board, as appropriate to ensure that CWA requirements are fulfilled.

EPA appreciates the opportunity to inform the State Water Board's rulemaking process and remains committed to our partnership to protect and restore water quality in the Bay-Delta watershed. Please don't hesitate to contact me or my team if you would like to discuss further.

Sincerely,
TOMAS TORRES
Digitally signed by TOMAS TORRES
Date: 2024.01.19 16:29:39 -08'00'

Tomás Torres
Director, Water Division

ENCLOSURE

1. EPA Comments on the September 28, 2023 *Draft Staff Report in support of updates to the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary for the Sacramento River and Delta watersheds*

Enclosure

EPA Comments on the September 28, 2023 *Draft Staff Report in support of updates to the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary for the Sacramento River and Delta watersheds*

Introduction

EPA's comments are focused on two alternatives described in the Staff Report: the proposed Plan amendment and the proposed Voluntary Agreement (VA) alternatives. EPA will continue to engage as the State Water Board refines amendments to the Bay-Delta Plan. Once the State Water Board concludes this process, EPA will review and act upon any new or revised water quality standards pursuant to Clean Water Act section 303(c). The CWA and its implementing regulations (40 C.F.R § 131.11(a)(1)) require States to develop criteria based on sound scientific rationale and that contain sufficient parameters or constituents to protect all designated uses. Because the Staff Report does not include proposed amendment language, EPA's comments do not address whether the alternatives presented would be consistent with the CWA and its implementing regulations. EPA's comments are intended to assist the State Water Board with developing Bay-Delta Plan amendments that are based on a sound scientific rationale.

To comprehensively assess whether any potential Bay-Delta Plan amendment protects all designated uses, comparability is key. EPA encourages the State Water Board to provide a side-by-side comparison of environmental outcomes across the proposed Plan amendment and the proposed VA alternative that relies on a consistent definition of the baseline flows (including minimum required Delta outflow, or MRDO). This will enhance public understanding of the potential plan amendments and their outcomes and improve public participation in the plan amendment process.

The Staff Report[1] along with previous State Water Board reports in which the State Water Board compiled and analyzed a significant amount of comprehensive scientific information, recognize that substantially more flow is needed in the Delta and Sacramento-San Joaquin watersheds to support aquatic life.[2] Currently, six fish species (Delta smelt, longfin smelt, green sturgeon, Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead) are listed or proposed as threatened or endangered under the Endangered Species Act. Scientific consensus indicates that native fish population abundance is positively associated with flow volumes (e.g., Jassby et al. 1995, Sommer et al. 1997, Mac Nally et al. 2010, Tamburello et al. 2019) and that largescale increases in both flow and habitat restoration are needed to recover and protect these and other native species. The Bay-Delta and its watersheds have also experienced increased frequency of harmful algal blooms (HABs) affecting aquatic life and human health. Restoration of higher flow volumes may

[1] "Flow is commonly regarded as a key driver or master variable governing the environmental processes in riverine and estuarine systems such as the Bay-Delta and its watershed (cites omitted)." Staff Report p. 3-2.

[2] "The State Water Board further cautions that flow and physical habitat interact in many ways, but they are not interchangeable. The best available science suggests that current flows are insufficient to protect public trust resources." State Water Resources Control Board. August 3, 2010. Development of Flow Criteria for the Sacramento-San Joaquin Delta Ecosystem, p. 1-2.

address key drivers of HABs, including increased stream temperature and water residence time (Kudela *et al.* 2023; Berg & Sutula 2015, Lehman *et al.* 2013). EPA reiterates that swift action is needed to address the imperiled state of the Delta and the species, communities, and economies that depend on this ecosystem for survival.[3]

As explained by the State Water Board, the September 28, 2023 *Draft Staff Report in support of updates to the Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta Plan) for the Sacramento River and Delta watersheds* (Staff Report):

> assesses a range of alternatives that may be considered for adoption by the State Water Board. Alternatives include several stand-alone alternatives that are based on flow scenarios evaluated in the State Water Board's 2017 Scientific Basis Report for potential Sacramento/Delta updates to the Bay-Delta Plan (*Scientific Basis Report in Support of New and Modified Requirements for Inflows from the Sacramento River and Its Tributaries and Eastside Tributaries to the Delta, Delta Outflows, Cold Water Habitat, and Interior Delta Flows*), as well as a proposed stand-alone voluntary agreements alternative, and several modular alternatives that would add to or modify the stand-alone alternatives. The draft Staff Report includes an alternative that is referred to as the proposed Plan amendments that is based on the State Water Board's 2018 Framework for a possible Sacramento/Delta Update to the Bay-Delta Plan (2018 Framework) that was identified prior to the VAs proposal.

Staff Report at p. 1.2.

The Proposed Plan Amendment Alternative

The proposed Plan amendment alternative includes "new inflow and cold water habitat objectives for the Sacramento/Delta tributaries, new and modified Delta outflow objectives, modified Suisun Marsh objectives, and new and modified interior Delta flow objectives" and a revised program of implementation (Staff Report p. 5-3). Overall, EPA supports a regulatory framework such as that outlined in the proposed Plan amendment alternative that would pair numeric flow objectives with a flexible program of implementation to restore a more natural flow regime in the Bay-Delta watershed to support fish and wildlife designated uses.

EPA is encouraged by the scientific approach that the State Water Board uses to justify the need for amended flow objectives and to assess the potential impacts of the proposed Plan amendment on fish and wildlife designated uses. The Staff Report leverages empirical evidence to illustrate how the proposed Plan amendment may result in substantial improvements to aquatic life in the Delta and its watersheds. For example, the Staff Report uses empirically derived biological indicators of fish population health to demonstrate that an inflow and inflow-based outflow objective at or above 55% unimpaired flow (UF), in particular, increases the frequency of providing many key flow-related benefits to estuarine and anadromous fish,

[3] See U.S. EPA webpage, "EPA Comments on the SF Bay Delta Water Quality Control Plan" https://www.epa.gov/sfbay-delta/epa-comments-sf-bay-delta-water-quality-control-plan.

including improved estuarine habitat conditions (Table 3.14-6) and improved Chinook fall-run and winter-run outmigration (Tables 3.14-4 to 3.14-5). While any improvements in aquatic conditions to benefit imperiled fish and habitat in the Delta are valuable, the State Water Board should include in its impact analyses an indication of conditions (i.e., unimpaired flow percentages and resulting water temperatures) required to protect designated uses, including restoration and full protection for viable native fish populations, and not just indicate improvements from baseline.

EPA agrees with the State Water Board's ecosystem-wide approach, using new and revised objectives to augment and link tributary inflow, cold water habitat, Delta outflow, and interior Delta flows. Utilizing an ecosystem-wide approach to protect designated uses appropriately recognizes the critical connections that natural, unimpaired flows provide across the watershed and estuary, including habitat for diverse fish and wildlife species, migration corridors for anadromous and migratory fish, and critical food exports and subsidies from productive floodplains to downstream habitats (Jeffres *et al.* 2020).

EPA strongly supports the use of year-round numeric objectives for unimpaired flows, Delta inflow, and inflow-based-outflows to protect and augment existing flows and water quality characteristics that are impacted by flow, and to provide habitat conditions necessary to support native anadromous and estuarine fish species.[4] Year-round flow objectives based on sound scientific rationale would provide clear water quality goals and transparent regulatory requirements.[5]

EPA recommends the State Water Board consider scientific studies published since the State Water Board's 2017 Final Scientific Basis Report was released in the final Staff Report to support draft plan amendments. Studies published after 2017 may refine the State Water

[4] "This Report describes how year-round inflow requirements are needed to provide for ecological processes including continuity of flows and specifically to protect anadromous and other fish and wildlife species that inhabit the Bay-Delta and its tributaries throughout the year as juveniles or adults. Those inflows are needed to provide appropriate habitat conditions for migration and rearing of anadromous fish species (primarily Chinook salmon and steelhead) that have runs that inhabit the Delta and its tributaries all year. Those flows are also needed to contribute to Delta outflows to protect estuarine species. The Report specifically finds that flows are needed that more closely mimic the conditions to which native fish species have adapted, including the frequency, timing, magnitude, and duration of flows, as well as the proportionality of flows from tributaries. These flow attributes are important to protecting native species populations by supporting key functions including floodplain inundation, temperature control, migratory cues, reduced stranding and straying and other functions. Providing appropriate flow conditions throughout the watershed and throughout the year is critical to genetic and life history diversity that allows native species to distribute the risks that disturbances from droughts, fires, disease, food availability, and other natural and humanmade stressors present to populations." State Water Resources Control Board. 2017. Scientific Basis Report in Support of New and Modified Requirements for Inflows from the Sacramento River and its Tributaries and Eastside Tributaries to the Delta, Delta Outflows, Cold Water Habitat, and Interior Delta Flows, p. 1-18.

[5] "Existing regulatory minimum Delta outflows would not be protective of the ecosystem, and without additional instream flow protections, existing flows may be reduced in the future, particularly with climate change and additional water development absent additional minimum instream flow requirements that ensure flows are preserved in stream when needed for the reasonable protection of fish and wildlife." Staff Report p. 1-9.

Board's identification of critical flow thresholds that benefit native fish species and estuarine habitat. For example, recent studies on flow-survival relationships for Chinook salmon in the Sacramento River and Delta provide scientific support for the positive relationship between flow and outmigration survival and recruitment of Chinook salmon, including for late-fall, fall, and winter-run salmon (Michel, 2019), late-fall run and spring-run smolts (Cordoleani et al., 2018; Henderson et al., 2019; Michel et al., 2021; Perry et al., 2018), wild origin salmon fry (Munsch et al., 2020), and winter-run juveniles (Hassrick et al., 2022). Furthermore, since the 2016 draft Scientific Basis Report and the 2017 Final Scientific Basis Report identified a flow range of 11,400-29,200 cfs as protective of fish and wildlife uses for the February-June period, recent research has demonstrated that even greater flow magnitudes over a period longer than February-June are needed to be protective of zooplankton populations (Hassrick *et al.* 2023), which are a foundational group in the food web to support species at higher trophic levels, including listed salmonids.

EPA also supports the concept of provisions to allow for flexibility in implementation of unimpaired flow objectives to enable adjustment to real-time and watershed-specific conditions within a specified range. Such provisions primarily involve adjusting the magnitude and/or timing of dedicated flows within a defined range of variation. EPA notes that flexible implementation should be utilized to provide protection for the season-specific needs of fish and wildlife designated uses. Unimpaired flows should not be reduced as part of flexible implementation if it would result in adverse impacts on native aquatic life. The State Water Board has noted in the Staff Report and in related actions[6,7] that it may choose to adaptively manage unimpaired flows under a "block of water" approach (Staff Report p. 5-20) with flexibility to apply that block of water pursuant to real time management. If this approach is incorporated into the Bay-Delta Plan amendment, the State Water Board should provide estimates of how large that "block of water" would be on each covered tributary under the expected range of hydrological circumstances. This will provide the public with a better understanding of how flows could be distributed across space and time, and of the potential benefits of real-time management using this tool.

EPA recommends the State Water Board demonstrate how fall flows anticipated under the proposed Plan amendment will be protective of all designated uses, even if implemented under an unimpaired "natural flow regime." EPA understands the implication that natural flows are generally lower in the Delta and its tributary watersheds during late summer and fall, and thus summer and fall seasonal conditions have the potential to stress aquatic life, particularly during dry conditions. However, within the balance of water resources that the State Water Board is evaluating in the proposed Plan amendment (i.e., unimpaired flow, cold water storage, and water diversion) there may be conditions that could mitigate seasonal impacts on aquatic life during the late summer and fall that are not currently provided in the Staff Report. Therefore,

[6] State Water Resources Control Board. 2017. Scientific Basis Report in Support of New and Modified Requirements for Inflows from the Sacramento River and its Tributaries and Eastside Tributaries to the Delta, Delta Outflows, Cold Water Habitat, and Interior Delta Flows, p. 1-18.

[7] State Water Resources Control Board. July 2018 Framework for the Sacramento/Delta Update to the Bay-Delta Plan, p. 25.

EPA recommends the State Water Board provide a more comprehensive analysis that evaluates sufficient combinations of unimpaired flow and diversion rates with the corresponding effects on year-round reservoir storage and downstream temperatures to enable a complete assessment of potential benefits and impacts of the proposed Plan amendment on designated uses.

The Proposed Voluntary Agreement Alternative

The State Water Board is considering a proposed Voluntary Agreement alternative as a possible path forward for updating the Bay-Delta Plan:

> The VAs include a combination of proposed flow and non-flow habitat restoration measures on a portion of the Sacramento/Delta tributaries over 8 years (with the intent to extend the term), including varying amounts of increased flows, depending on water year type, and non-flow habitat restoration actions targeted at improving spawning and rearing capacity for juvenile salmonids, estuarine species, and other native fish and wildlife. The proposed VA flows are intended to be additive to the Delta outflows required by State Water Board Decision 1641 (D-1641) and resulting from the 2019 Biological Opinions (collectively "2019 BiOps condition") though the VAs acknowledge that the BiOps may change. The flow and non-flow habitat actions are proposed as implementation measures for an existing and proposed new water quality objective in the Bay-Delta Plan. Specifically, the VAs propose: 1) a new narrative objective to achieve the viability of native fish populations; and 2) to provide the participating parties' share, during implementation of the VAs, to contribute to achieving the existing Narrative Salmon Protection Objective, and propose doing so by 2050. The VAs also include proposed governance and science programs to direct flows and habitat restoration, conduct assessments, and develop strategic plans and annual reports.

Staff Report at p. 9-1.

The proposed VA described in the Staff Report applies to the largest salmon-producing tributaries in the Sacramento River and Delta watershed, including the mainstem Sacramento River, the Feather River, the American River, and the Mokelumne River, which collectively support the largest run of Chinook salmon in California and a significant proportion of recreational and commercial salmon fisheries. Improving flow conditions and habitat in these watersheds is crucial to restore and protect salmon, estuarine species, and other native fish.

The proposed VA alternative includes a new narrative objective and a framework to provide a combination of flow and non-flow habitat measures (VA assets) for the major Sacramento River and Delta tributaries to achieve both the new narrative objective and the existing narrative Salmon Protection Objective (salmon doubling goal). The new narrative objective requires the State Water Board to maintain flow conditions in the Delta and its tributaries to "support and maintain the natural production of viable native fish populations" (Staff Report p. 9-7). EPA notes that under the CWA implementing regulations, States can establish narrative criteria

where numeric criteria cannot be established or to supplement numeric criteria (40 C.F.R. § 131.11(b)). Recognizing the difficulties in implementing narrative criteria, EPA recommends the Water Board provides clear definitions of critical terms, including "viable," that reflect biologically relevant goals (i.e., quantitative metrics) to protect aquatic life to avoid inconsistent interpretation and assessment of the narrative objective.

As demonstrated in the comments below, EPA is concerned that the Staff Report does not yet include a sound scientific rationale that demonstrates how the proposed VA alternative will provide protections for all designated uses in the Sacramento River and Delta watersheds. EPA notes its previous comments on scientific limitations related to analytical approaches used to support the proposed VA remain applicable to this Staff Report.[8] Below EPA provides additional comments related to the scientific approach described in the Staff Report regarding the proposed VA alternative. In addition, EPA provides comments related to the implementation structure outlined in the proposed VA alternative.

Proposed Flow Assets

As cautioned by the State Water Board: "flow and physical habitat interact in many ways, but they are not interchangeable. The best available science suggests that current flows are insufficient to protect public trust resources."[9] Further, scientific consensus indicates that native fish population abundance is positively associated with increasing flow volumes (e.g., Jassby et al. 1995, Sommer et al. 1997, Mac Nally et al. 2010, Tamburello et al. 2019) and that largescale increases in both flow and habitat restoration are needed to recover and protect these and other native species. Clearly, flow is a critically important driver of the health of the Bay-Delta watershed. However, the VA alternatives, as currently proposed, do not provide flow to ensure year-round protection or protection in critical dry years. Rather, flow assets provided by the proposed VAs are concentrated January through June, with priority in April and May, during Dry, Below Normal, and Above Normal water years (Staff Report p. 9-5). As noted in the Staff Report, one or more life stages of native estuarine and anadromous fish, including threatened and endangered Chinook salmon and steelhead, require access to habitats across the entire watershed at all times of the year (Staff Report Table 3.4-1 and footnote 4). For this reason, it is important that the State Water Board include provisions to ensure adequate flow is available for year-round protection of designated uses in its Bay-Delta Plan amendments. Native salmonids are particularly at-risk during drought conditions.[10] However, potential VA flow assets are not required for critical dry years on most tributaries, the Sacramento River, and

[8] February 8, 2023 EPA Comment Letter to the State Water Board, Re: Comment Letter – Draft Scientific Basis Report Supplement.

[9] State Water Resources Control Board, August 3, 2010, Development of Flow Criteria for the Sacramento-San Joaquin Delta Ecosystem, p. 1-2.

[10] "Drought and low flows cause water temperatures in river systems to rise, reducing spawning and increasing disease risk for fish and reducing survival for eggs, youth, and adult fish." NOAA Fisheries West Coast Regional Office. 02/03/2023. Available at: https://www.fisheries.noaa.gov/west-coast/climate/drought-west-coast-region#:~:text=Drought%20Impacts,-Drought%20poses%20significant&text=Drought%20and%20low%20flows%20cause,%2C%20youth%2C%20and%20adult%20fish.

the Delta (Staff Report Table 9.3-1). Further, the Staff Report indicates that during critical dry years the proposed VA alternative will result in a decrease of flows from baseline (Tables 9.5-2 to 9.5-5). When stream flow protections were inadequate during the 2012-2016 drought, Chinook, coho Salmon, and steelhead experienced widespread negative population-level consequences (Willmes *et al.* 2018; Williams *et al.* 2016). In a landscape increasingly defined by climate change impacts, including increased frequency and intensity of drought conditions (Cook et al. 2015, Williams et al. 2015), flow protections in critical years are essential to support fish and wildlife designated uses. For this reason, it is important that the State Water Board include provisions to provide flow to protect designated uses in the Bay-Delta Plan amendments in critical dry years.

Currently, key analyses used in the Staff Report to demonstrate aquatic life benefits of the proposed VA alternative suggests that VA flow assets provide only minimal benefits relative to both current baseline conditions and compared to the modeled benefits of the proposed Plan amendment. [11] For example, the Staff Report summarizes potential benefits of both alternatives on achieving critical flow thresholds identified in the Staff Report as beneficial to specific estuarine species and to fall-run and winter-run Chinook salmon outmigration. [12] Across all comparable metrics, Delta outflow provided under the proposed Plan amendment is modeled to achieve those critical flow thresholds at a higher frequency than the VA alternative across all UF scenarios 35% and greater, with substantial differences (and perceived benefits) observed at higher UF scenarios (Tables 9.6-4, 3.14-4, and 3.14-6). Delta inflow and outflow anticipated under the VA alternative versus the proposed Plan amendment also results in substantial differences in modeled changes to the median X2 position [13] for January through June relative to baseline conditions, where a westward change indicates a perceived benefit to estuarine habitat and species. Under the VA alternative, the median of average January through June X2 position is anticipated to move one km westward of the Baseline (Figure 9.7-1), while that under the proposed Plan amendment is anticipated to move four km westward overall and five km westward during critically dry water-year types at 55% UF (Figure 7.6.2-2).

Although the flow assets identified in the proposed VA may provide some benefit to aquatic life, EPA is concerned that the total volume and timing of Delta inflow and outflow provided under the proposed VA alternative relative to baseline is not large enough to adequately restore and protect aquatic ecosystems, as described by the State Water Board in analyzing the proposed Plan amendment alternative. Under the proposed VA SacWAM modeling, mean total

[11] EPA finds it useful to compare benefits of the VA alternative to the baseline and the proposed Plan amendment alternative, given the robust scientific analysis underlying the proposed Plan amendment alternative.

[12] Chapter 3 and Chapter 9 of the Staff Report identify ecological flow thresholds for specific native fish and estuarine habitat that, if achieved or exceeded, indicate protection. Therefore, the higher frequency at which flows provided meet or exceed critical flow thresholds, the greater the perceived protective benefit is to a given species or estuarine habitat indicator.

[13] X2 is a physical attribute of the estuary used as a habitat indicator for the location of the low salinity zone. X2 is the location in kilometers from the Golden Gate Bridge where water salinity is 2 ppt (parts per thousand) of isohaline salt. Historically, the low salinity zone was associated with high primary productivity, zooplankton population, and abundance of native species. See https://viewperformance.deltacouncil.ca.gov/pm/salinity

Delta inflow for all water year types (including Tuolumne River contributions) would provide an additional 119 TAF of Delta inflow over baseline (Tables 9.5-29 and 9.5-31). Notably, this is less than that provided under the proposed Plan amendment at 35% UF (provides an addition of 193 TAF) and five times smaller than that provided at 55% UF (provides an addition of 543 TAF). See Table A1-100. Similarly, mean total Delta outflow for all water year types under the VA alternative (excluding San Joaquin River contributions) is modeled to provide an additional 109 TAF Delta outflow over baseline (Tables 9.5-40 and 9.5-42), which is less than half of the expected Delta outflow at 35% UF and more than 13 times smaller than that provided at 55% UF (1,466 TAF; Table A1-102). This magnitude difference is anticipated to be greatest in Below Normal water year types, when the VA alternative is modeled to provide nearly 40 times less Delta outflow than the proposed Plan amendment at 55% UF.

The State Water Board explains that flows provided under the proposed VA alternative are intended to be additive to minimum Delta outflows required by State Water Board Decision 1641 (D-1641) and resulting from the 2019 Biological Opinions (Staff Report p. 9-1). The Staff Report also notes that current average minimum Delta outflows are not protective of the Bay-Delta ecosystem and that further protections are necessary to protect instream flows for fish and wildlife (e.g., Staff Report p. 1-9 and p. 9-199). Additional depletions, pursuant to either existing but unexercised rights or under newly granted rights,[14] could reduce flows during some times of the year to levels substantially below existing baseline conditions, even if the flow assets provided under the proposed VA are protected. The State Water Board should consider how any such additional potential depletions will impact the range of potential benefits of the proposed VA alternative. Further, the proposed VA alternative indicates that the flow assets would be implemented in three out of eight years on the American River (Staff Report p. 9-4, footnote to Table 9.3-1) but does not describe how that that asset allocation frequency is protective of aquatic life, or what outcomes (i.e., species-specific flow threshold attainment frequency or temperature exceedance probabilities for sensitive salmonid life stages) are expected.

The analysis of the proposed VA alternative indicates that peak flows "would generally be similar to baseline" (Staff Report p. 9-109) conditions, which would limit the benefits of higher peak flows above baseline conditions that "maintain channel size, shape, and bed texture" (p. 9-108) and "provide beneficial disturbance to both the channel and its adjacent floodplain and riparian corridor" (Staff Report p. 9-108). It is important to note that high flows can lead to riverbed scour of salmon eggs in redds (Staff Report p. 9-109) and potentially exacerbate habitat degradation in heavily altered rivers with substrate deficits and no consistent sediment supply (Merz and Setka 2004). However, as stated in the literature cited in the proposed Plan amendment (Staff Report Chapter 7.6.2), flood flows are needed to create the geomorphic conditions and water quality in interstitial space within spawning gravels that salmon eggs and

[14] For example, the State Water Board currently has several large pending applications for diversions out of the watershed, including but not limited to the Sites Project Authority Application A025517X01 for 1.5 MAF; the Turlock I.D./Modesto I.D. Application A033277 for 2.7 MAF, and the Merced Irrigation District Application A033098 for 400kaf. The State Board will evaluate each of these applications on their own merits.

embryos need. For example, the Geomorphic Flows section (Staff Report 7.6.2-53) cites peer-reviewed research that supports the need for peak flows that are unhindered by unnaturally low-flow baseline conditions.

Proposed Non-Flow Habitat Assets

As discussed in EPA's recent technical comments on the draft Scientific Basis Report supplement regarding the proposed VA,[15] the State Water Board has not yet provided scientific support for the proposal that that minimal increases in flow and non-flow habitat restoration will provide the benefits needed to protect designated fish and wildlife designated uses. This Staff Report does not demonstrate that suitable habitat area in the Sacramento and Delta watersheds is a limiting factor on estuarine and anadromous fish population growth, nor does the Staff Report provide an adequate scientific rationale to demonstrate that habitat restoration assets will increase fish abundance without meaningful increases in tributary flows protected as Delta outflows. Any improvements in habitat will likely be achieved only if pursued alongside substantial increases in flow rates, because flow is strongly and positively correlated with many indicators of native fish survival, including for salmon survival out-migrating from natal tributaries (Michel, 2019, Henderson et al. 2019), salmon survival in and through the Delta (Perry et al. 2018), and Delta Smelt post-larval survival (Polansky et al. 2021). Targeted habitat restoration with insufficient flow, on the other hand, is associated with low salmonid inhabitation (Munsch et al. 2020). Therefore, the State Water Board will need to provide additional analyses that demonstrate how allocation of non-flow assets, in combination with the flow assets identified in the VA proposal, will be sufficient to protect designated uses.

EPA recommends the State Water Board apply a quantitative analysis to the proposed VA alternative that links changes in flow and non-flow assets to changes in species abundance like the statistical models used in the Plan Amendment based on empirical correlations between changes in flow and changes in species abundance. EPA recognizes that the effects of VA non-flow assets on species abundance are likely complicated due to numerous factors like habitat-flow relationships, temperature dynamics, and predation rates that may affect fishes throughout their life cycle. In addition, the effects of VA non-flow assets will partly depend on assumptions about how asset types or functions limit species recruitment (Hayes et al. 1996). More detail and scientific references on the assumption in the proposed VA analysis that habitat is a primary limiting factor on salmon recruitment in the Sacramento and Delta watersheds, as well as on the assumption that habitat assets will produce and export substantial prey resources to Delta fish, can be found in the Enclosure to EPA's February 8, 2023 Comment Letter to the State Water Board (Re: Comment Letter – Draft Scientific Basis Report Supplement).

[15] February 8, 2023 EPA Comment Letter to the State Water Board, Re: Comment Letter – Draft Scientific Basis Report Supplement.[16] California can, within limits of relevant federal law, revise its governance structures for implementing a federal program, as it did in 2015 when the California Legislature transferred federal Safe Drinking Water Act functions from the California Department of Public Health to the State Water Board.

To provide necessary analytical support for the proposed VA alternative, EPA recommends that the State Water Board use life cycle modeling (e.g., Hendrix et al. 2019, Peterson and Duarte 2020, Smith et al. 2023). Life cycle models may provide similar analytical support for assumed habitat benefits compared to published correlations of flow and abundance of Delta fishes (e.g., Tamburello et al. 2019) and salmonids (e.g., Munsch et al. 2020). More specifically, life-cycle modeling will help demonstrate whether a reliance on habitat restoration in the Delta and Sacramento-San Joaquin watersheds will be equally protective compared to reliance on ecosystem-wide flow augmentation proposed in the Plan amendment alternative.

Temperature

Staff Report analyses of the proposed VA indicate that "changes in temperature associated with the proposed VA alternative on the Sacramento, Feather, and American Rivers are small as shown in Appendix G3e (most monthly 10th, 50th, and 90th percentiles of daily average VA temperatures are within 1°F of baseline temperatures)" (p. 9-142). This finding suggests that the proposed VA flow assets will have an insignificant impact on improving temperature conditions. Given that salmon in these rivers are adversely impacted by temperatures that often exceed thermal tolerance thresholds under existing baseline conditions, the proposed VA alternative does not appear to provide protection. The Staff Report analysis of the proposed VA alternative suggests that mitigation measures (reservoir management and habitat restoration) will avoid or reduce temperature impacts on native species in the Sacramento River and Delta. However, any such assertions about reduction in impacts of high temperature should be supported by empirical evidence and analyses.

Incomplete Description of VA Alternatives

EPA appreciates the State Water Board efforts to model and evaluate a "best guess" as to what a final VA alternative may contain. Nevertheless, the public cannot effectively comment on major elements of the proposal because the proposal is, at this time, uncertain. For example, tables describing the suggested flow assets in the VA Term Sheet (MOU Advancing a Term Sheet for the VAs Staff Report Appendix 1), the Staff Report (p. 9-4 to 9-5), and the Draft Strategic Plan (Staff Report Appendix G1, p. 8) include different descriptions of the asset caveats. Each, however, clarifies that the flow asset tables were still being negotiated at the time of submission or evaluation. Given the critical role these flow assets will play in resource protection, it is important for the State Water Board to provide a consistent and complete description of the VA proposal being offered as an alternative.

Complex Governance Proposals

The draft Governance Proposal (Voluntary Agreement Draft Strategic Plan Appendix B, pp. 146 *et seq*.) is complex, and includes a broad Systemwide Governance Committee consisting of representation from State and Federal Agencies, tribes, water agencies, and environmental groups, as well as individual tributary governance structures, a Program Office, an Executive Director, a Flow Operations Team, and a Science Committee, as well as additional committees established as needed. While it is difficult to understand how this complex system will work at this stage, EPA is concerned that the draft governance proposal may lead to confusion about accountability. EPA notes that the State Water Board is the "federal water pollution control

agency" for purposes of the federal CWA, and as such is responsible for all CWA program responsibilities (including requirements for conducting triennial reviews under CWA section 303(c) and complying with financial assistance and accountability provisions).[16] EPA urges the State Water Board to explicitly articulate the anticipated relationship between the State Water Board and any new governance structure to enable both transparency and accountability. Relatedly, the State Water Board frequently requires regulated entities to conduct monitoring and evaluate data and such requirements generate valuable data that can inform assessment of designated use attainment and, where relevant, adaptive managment. EPA notes that the California State Legislature considered the issue of coordinating objective scientific monitoring in the Bay-Delta when it established the Independent Science Board in the 2009 Delta Reform Act. We note further that the highly successful Interagency Ecological Program (IEP) has been coordinating monitoring and evaluation activities in the Delta for more than 50 years. The VA alternative proposes that, rather than utilizing the well-established IEP, the VA alternative set up yet another separate and extensive monitoring and science effort. While EPA supports robust data collection, it is important that there is significant coordination around monitoring objectives and science communication.

Tribal Beneficial Uses

As explained in the Staff Report, California Native American Tribes have a deep and abiding connection to the Bay-Delta watershed and rely on sufficient flow and water quality to support subsistence fishing and other important tribal uses of water (Staff Report Chapter 11). A healthy Bay-Delta watershed is one that provides the water and water-dependent vegetation (e.g. willow and tule) and animals (e.g. native fisheries) to support Tribal spiritual and cultural practices. The Staff Report further asserts that the State Water Board, as the only entity with direct authority to regulate diversions of water, adopted the Bay-Delta Plan because "water diversions from the Bay-Delta watershed's rivers and streams, including large export diversions from the Delta by the [State and Federal Water Projects] have […] degraded the ecosystem, contributing to the decline of native fish populations" (Staff Report p. 11-12). EPA appreciates that the State Water Board has clearly identified the importance of meaningful engagement with tribes and the importance of flow for tribal uses of water (Staff Report p, 11-11).

EPA strongly supports incorporation of Tribal Beneficial Uses (TBUs) into the Bay-Delta Plan. The Staff Report explains that the State Water Board "is expected to make a decision on the pathway for incorporating, designating, and protecting TBUs [Tribal Beneficial Uses] when Plan amendments are for adoption at a Board Meeting in 2024" (Staff Report p. 11-10). However, the Staff Report also states that "[i]ncorporation of the TBU definitions into the Bay-Delta Plan is not proposed as a formal 'designation' of the uses as applying to specific waterbodies or waterbody segments within the Bay-Delta" (Staff Report p. 11-11). While the Staff Report clearly identifies the need for TBUs in the Bay-Delta Plan, the Staff Report stops short of

[16] California can, within limits of relevant federal law, revise its governance structures for implementing a federal program, as it did in 2015 when the California Legislature transferred federal Safe Drinking Water Act functions from the California Department of Public Health to the State Water Board.

proposing how the State Water Board will address this need in the Bay-Delta Plan. EPA encourages the State Water Board to expeditiously designate appropriate beneficial uses and protective criteria for such waters in the Bay-Delta Plan, based on available data and information including information provided by the Tribes.

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Exhibit 2

State of California
Department of Fish and Wildlife

Memorandum

Date: December 29, 2022

To: Erin Chappell
Regional Manager
Bay Delta Region

From: James White
Environmental Scientist
Bay Delta Region

Subject: 2022 Fall Midwater Trawl annual fish abundance and distribution summary

The California Department of Fish and Wildlife (CDFW) has conducted the Fall Midwater Trawl Survey (FMWT) to index the fall abundance of pelagic fishes annually since 1967 (except 1974 and 1979). FMWT equipment and methods have remained consistent since the survey's inception, allowing the indices to be compared across time. These relative abundance indices are not intended to approximate population sizes; however, indices reflect general patterns in population change (Polansky et al. 2019).

Presently, the FMWT conducts 4 monthly surveys from September through December and calculates a monthly abundance index for each survey. The annual abundance index, for each pelagic species, is the sum of the monthly survey indices. Monthly abundance indices are calculated by averaging catch per tow for index stations in each region, multiplying each regional average by its respective weighting factor (i.e., a scalar based on water volume) for each region, and summing those products for all 14 regions (White and Baxter 2022). Sampling regions range from San Pablo Bay upstream to Stockton on the San Joaquin River, to near Hood on the Sacramento River, and into Cache Slough and through the Sacramento River Deep Water Ship Channel (SRDWSC). During each monthly survey, one 12-minute oblique midwater trawl tow is conducted at each of 100 index stations used for index calculation and at an additional 22 non-index stations that provide enhanced distribution information (Fig. 1). All fish are identified and counted at each station.

The 2022 sampling season began September 6 and was completed on December 16. During all four months, all 122 fish tows were conducted. Here we report catch from index and non-index stations, species distributions by region, and annual abundance indices for seven pelagic fish species; Delta Smelt (native), Striped Bass (introduced), Longfin Smelt (native), American Shad (introduced), Threadfin Shad (introduced), Splittail (native), and Wakasagi (introduced). A map of species distribution by station is also publicly available online: (FMWT Species Distribution Map).

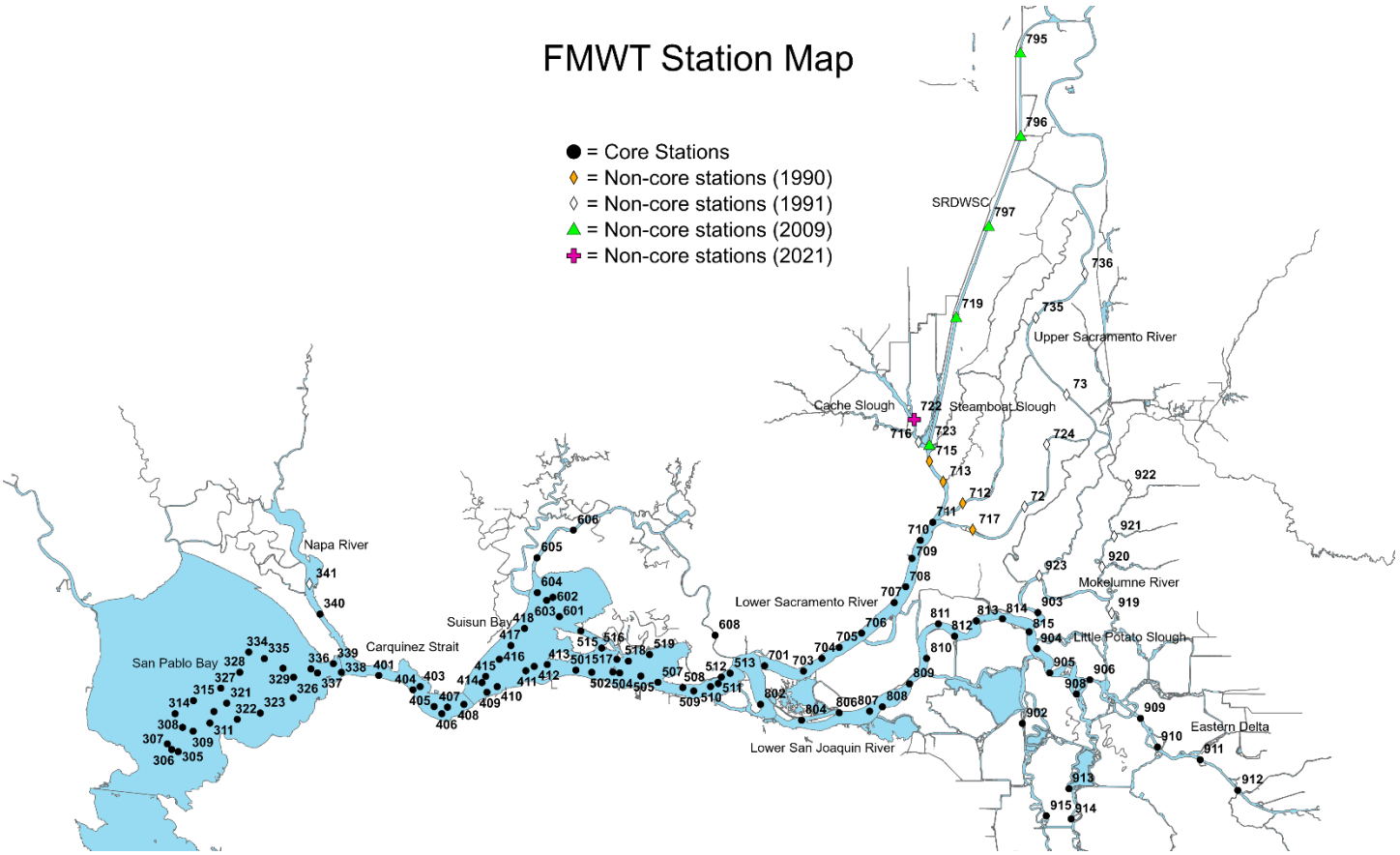

Figure 1. Map of CDFW Fall Midwater Trawl Survey monthly sampling sites among index and non-index stations in the upper San Francisco Estuary, California, USA.

Delta Smelt (*Hypomesus transpacificus*)

The 2022 abundance index was zero and continues the trend of no catch in the FMWT since 2017 (Fig. 2). No Delta Smelt were collected from any stations during our survey months of September-December. An absence of Delta Smelt catch in the FMWT is consistent among other surveys in the estuary. The Enhanced Delta Smelt Monitoring (EDSM) survey of the U.S. Fish and Wildlife Service (USFWS) caught 3 Delta Smelt among 61 sampling days (between 9/6 and 12/15) comprised of 1,997 tows (U.S. Fish and Wildlife Service 2022). On November 29-30, 2022, the Experimental Release Technical Team released 12,942 marked adult Delta Smelt from culture into the Sacramento River near Rio Vista (U.S. Fish and Wildlife Service 2022b). Neither FMWT nor EDSM caught these released Delta Smelt during December sampling. While FMWT did not catch any Delta Smelt, it does not mean there were no smelt present, but the numbers are very low and below the effective detection threshold by most sampling methods.

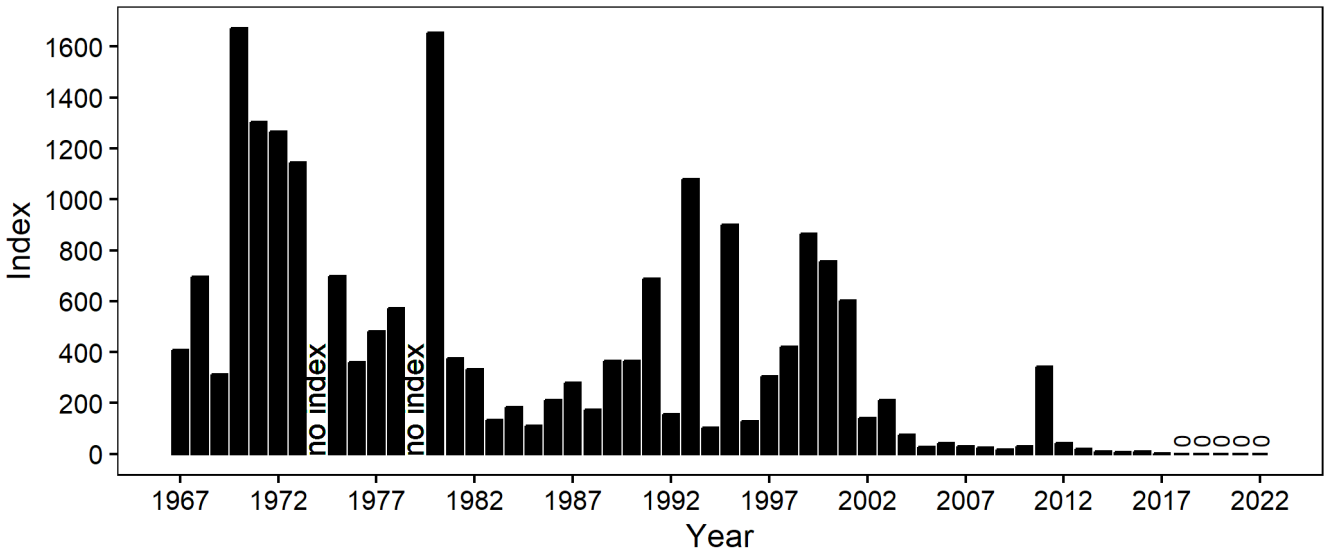

Figure 2. FMWT Delta Smelt annual abundance indices (all ages), 1967-2022. Index values for the past 5 years are shown in detail.

Age-0 Striped Bass (*Morone saxatilis*)

The 2022 abundance index was 66, representing a 15% increase from last year's index (Fig. 3).

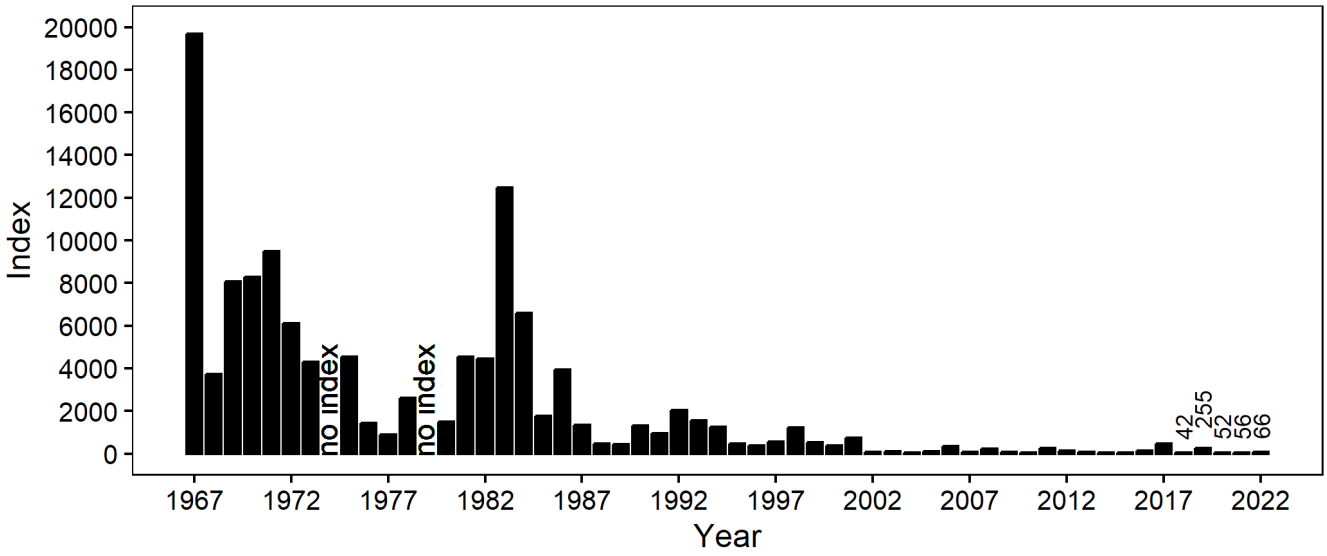

Figure 3. FMWT age-0 Striped Bass annual abundance indices, 1967-2022. Index values for the past 5 years are shown in detail.

Striped Bass were collected every month during September-December. A total of 53 age-0 Striped Bass were collected at index stations and 7 from non-index stations. Monthly catch was highest in October, with catch being highest in Suisun Bay among months (Table 1).

Table 1. Age-0 Striped Bass catch among regions during the 2022 Fall Midwater Trawl survey sampling at index and non-index stations. SRDWSC = Sacramento River Deepwater Shipping Channel.

Month	*Type*	*Region*	*Catch*
September	Index	Lower Sacramento River	2
September	Index	Suisun Bay	7
September	Non-Index	Mokelumne River	4
October	Index	Carquinez Strait	1
October	Index	Eastern Delta	8
October	Index	Lower Sacramento River	3
October	Index	Lower San Joaquin River	1
October	Index	Suisun Bay	13
November	Index	Lower Sacramento River	4
November	Index	Lower San Joaquin River	1
November	Index	Suisun Bay	5
November	Non-Index	SRDWSC	1
December	Index	Carquinez Strait	1
December	Index	Eastern Delta	4
December	Index	Suisun Bay	3
December	Non-Index	Mokelumne River	1
December	Non-Index	SRDWSC	1
Total			**60**

Longfin Smelt (*Spirinchus thaleichthys*)

The 2022 abundance index was 403, representing a 20% increase from last year's index (Fig. 4).

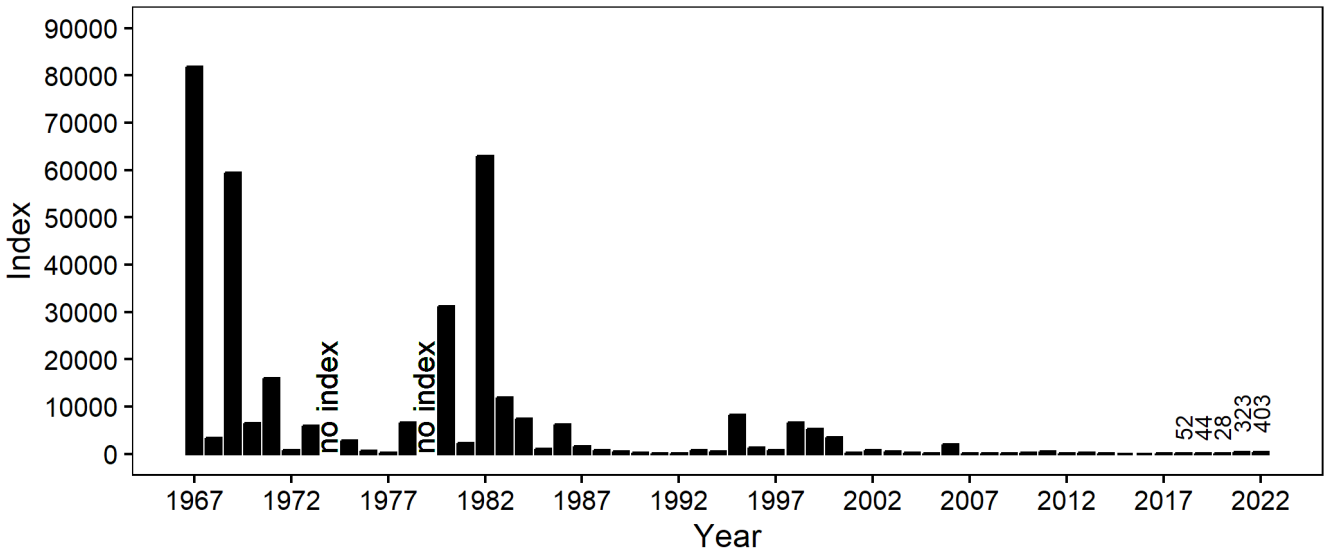

Figure 4. FMWT Longfin Smelt annual abundance indices, 1967-2022. Index values for the past 5 years are shown in detail.

A total of 187 Longfin Smelt were collected at index stations and none from non-index stations. Monthly catch was highest in October, with catch being highest in San Pablo Bay among months (Table 2). Higher catch is usually expected in December as Longfin Smelt adults return to the estuary from the ocean to spawn as water temperatures drop in the late fall or winter. The majority (>88%) of Longfin Smelt caught have been age-0 (Table 3). The FMWT only measures the first 50 individuals of any fish species caught during a tow. The adjusted length frequency adjusts for the fish not measured by calculating the ratio of total catch to the number of fish measured multiplied by the length frequency.

Table 2. Longfin Smelt catch among regions during the 2022 Fall Midwater Trawl survey sampling at index and non-index stations.

Month	*Type*	*Region*	*Catch*
September	Index	Carquinez Strait	1
September	Index	Lower Sacramento River	2
September	Index	Suisun Bay	2
October	Index	San Pablo Bay	95
October	Index	Suisun Bay	4
November	Index	Lower Sacramento River	2
November	Index	Lower San Joaquin River	1
November	Index	San Pablo Bay	8
November	Index	Suisun Bay	18
December	Index	Carquinez Strait	1
December	Index	Lower San Joaquin River	1

Month	*Type*	*Region*	*Catch*
December	Index	San Pablo Bay	12
December	Index	Suisun Bay	40
Total			**187**

Table 3. Longfin Smelt catch per station, fork length (mm), frequency, and age class data during the 2022 Fall Midwater Trawl survey sampling at all stations.

Month	*Station*	*Catch*	*Fork Length*	*Adjusted Length Frequency*	*Age Class*
September	408	1	54	1.00	Age 0
September	418	1	61	1.00	Age 0
September	503	1	101	1.00	Age 1+
September	704	1	50	1.00	Age 0
September	705	1	57	1.00	Age 0
October	307	86	44	1.72	Age 0
October	307	86	49	3.44	Age 0
October	307	86	50	1.72	Age 0
October	307	86	52	6.88	Age 0
October	307	86	53	15.48	Age 0
October	307	86	54	12.04	Age 0
October	307	86	55	3.44	Age 0
October	307	86	56	3.44	Age 0
October	307	86	57	10.32	Age 0
October	307	86	58	3.44	Age 0
October	307	86	59	1.72	Age 0
October	307	86	60	5.16	Age 0
October	307	86	61	1.72	Age 0
October	307	86	62	10.32	Age 0
October	307	86	66	1.72	Age 0
October	307	86	91	1.72	Age 1+
October	307	86	95	1.72	Age 1+
October	309	2	55	1.00	Age 0
October	309	2	56	1.00	Age 0
October	311	3	56	1.00	Age 0
October	311	3	57	1.00	Age 0
October	311	3	65	1.00	Age 0

Month	*Station*	*Catch*	*Fork Length*	*Adjusted Length Frequency*	*Age Class*
October	314	3	55	1.00	Age 0
October	314	3	57	1.00	Age 0
October	314	3	64	1.00	Age 0
October	325	1	53	1.00	Age 0
October	515	1	80	1.00	Age 1+
October	601	1	68	1.00	Age 0
October	603	1	83	1.00	Age 1+
October	606	1	61	1.00	Age 0
November	315	4	59	1.00	Age 0
November	315	4	67	1.00	Age 0
November	315	4	68	1.00	Age 0
November	315	4	72	1.00	Age 0
November	323	1	60	1.00	Age 0
November	328	1	60	1.00	Age 0
November	329	1	56	1.00	Age 0
November	336	1	62	1.00	Age 0
November	411	1	64	1.00	Age 0
November	415	1	55	1.00	Age 0
November	417	1	65	1.00	Age 0
November	418	1	100	1.00	Age 1+
November	503	1	66	1.00	Age 0
November	509	5	56	1.00	Age 0
November	509	5	59	2.00	Age 0
November	509	5	63	1.00	Age 0
November	509	5	67	1.00	Age 0
November	510	2	63	1.00	Age 0
November	510	2	64	1.00	Age 0
November	511	1	72	1.00	Age 0
November	512	1	95	1.00	Age 1+

Month	*Station*	*Catch*	*Fork Length*	*Adjusted Length Frequency*	*Age Class*
November	513	1	70	1.00	Age 0
November	515	2	57	1.00	Age 0
November	515	2	63	1.00	Age 0
November	603	1	63	1.00	Age 0
November	704	1	74	1.00	Age 0
November	706	1	63	1.00	Age 0
November	802	1	66	1.00	Age 0
December	314	2	60	1.00	Age 0
December	314	2	64	1.00	Age 0
December	315	1	60	1.00	Age 0
December	321	1	80	1.00	Age 0
December	327	1	67	1.00	Age 0
December	329	4	57	1.00	Age 0
December	329	4	63	2.00	Age 0
December	329	4	67	1.00	Age 0
December	336	2	62	1.00	Age 0
December	336	2	70	1.00	Age 0
December	337	1	94	1.00	Age 1+
December	404	1	99	1.00	Age 1+
December	416	3	67	1.00	Age 0
December	416	3	71	1.00	Age 0
December	416	3	73	1.00	Age 0
December	417	6	60	1.00	Age 0
December	417	6	63	1.00	Age 0
December	417	6	69	1.00	Age 0
December	417	6	87	1.00	Age 1+
December	417	6	97	1.00	Age 1+
December	417	6	101	1.00	Age 1+
December	418	6	61	1.00	Age 0

Month	*Station*	*Catch*	*Fork Length*	*Adjusted Length Frequency*	*Age Class*
December	418	6	63	2.00	Age 0
December	418	6	69	1.00	Age 0
December	418	6	71	1.00	Age 0
December	418	6	84	1.00	Age 0
December	502	1	71	1.00	Age 0
December	504	1	74	1.00	Age 0
December	508	3	65	1.00	Age 0
December	508	3	77	1.00	Age 0
December	508	3	94	1.00	Age 1+
December	510	5	63	1.00	Age 0
December	510	5	97	1.00	Age 1+
December	510	5	104	1.00	Age 1+
December	510	5	110	1.00	Age 1+
December	510	5	125	1.00	Age 1+
December	511	2	98	1.00	Age 1+
December	511	2	107	1.00	Age 1+
December	515	1	70	1.00	Age 0
December	517	2	72	1.00	Age 0
December	517	2	74	1.00	Age 0
December	604	4	65	2.00	Age 0
December	604	4	78	1.00	Age 0
December	604	4	95	1.00	Age 1+
December	605	1	70	1.00	Age 0
December	606	5	59	1.00	Age 0
December	606	5	65	1.00	Age 0
December	606	5	67	1.00	Age 0
December	606	5	73	1.00	Age 0
December	606	5	80	1.00	Age 0
December	811	1	108	1.00	Age 1+

Threadfin Shad (*Dorosoma petenense*)

The 2022 abundance index was 257, representing a 14% increase from last year's index (Fig. 5).

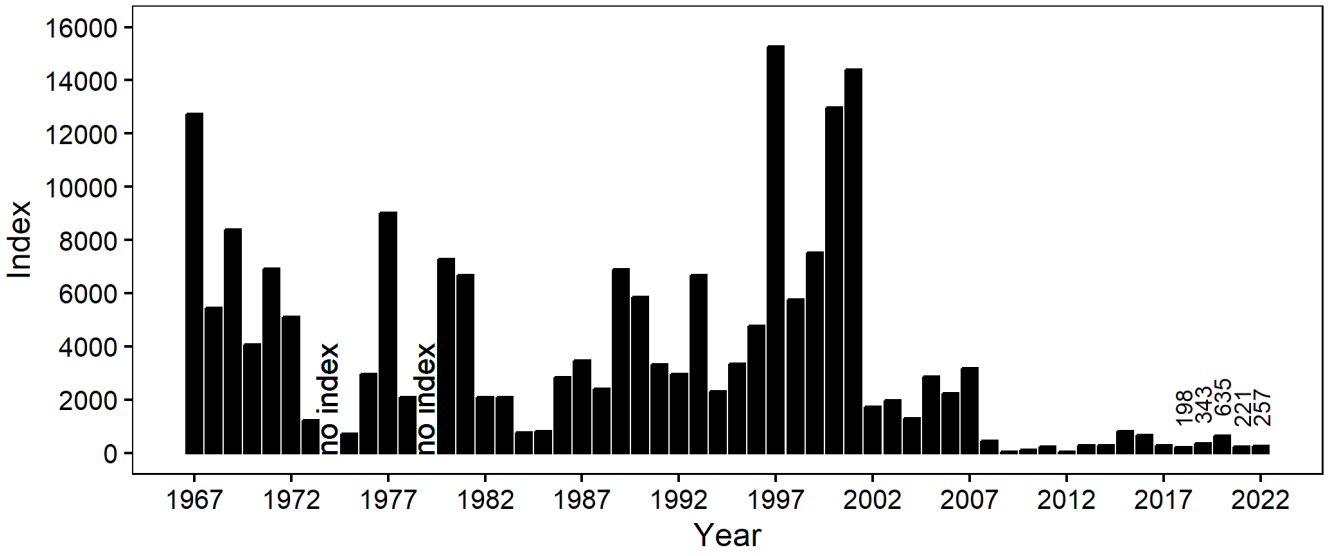

Figure 5. FMWT Threadfin Shad annual abundance indices, 1967-2022. Index values for the past 5 years are shown in detail.

A total of 211 Threadfin Shad were collected at index stations and 1,340 from non-index stations. The greatest monthly catch was in December, with catch being highest in SRDWSC among months (Table 4).

Table 4. Threadfin Shad catch among regions during the 2022 Fall Midwater Trawl survey sampling at index and non-index stations. SRDWSC = Sacramento River Deepwater Shipping Channel.

Month	*Type*	*Region*	*Catch*
September	Index	Lower Sacramento River	2
September	Index	Lower San Joaquin River	4
September	Non-Index	SRDWSC	495
October	Index	Lower Sacramento River	24
October	Index	Lower San Joaquin River	4
October	Index	Suisun Bay	5
October	Non-Index	SRDWSC	336
November	Index	Lower Sacramento River	20
November	Index	Lower San Joaquin River	36
November	Index	San Pablo Bay	1
November	Index	Suisun Bay	7
November	Non-Index	SRDWSC	36

Month	*Type*	*Region*	*Catch*
December	Index	Carquinez Strait	6
December	Index	Eastern Delta	12
December	Index	Lower Sacramento River	23
December	Index	Lower San Joaquin River	57
December	Index	San Pablo Bay	2
December	Index	Suisun Bay	8
December	Non-Index	Cache Slough	3
December	Non-Index	Mokelumne River	1
December	Non-Index	SRDWSC	467
December	Non-Index	Upper Sacramento River	2
Total			**1,551**

American Shad (*Alosa sapidissima*)

The 2022 abundance index was 698, representing a 43% increase from last year's index (Fig. 6). Abundance indices have fluctuated substantially during the period 2018-2022, ranging from a low of 398 to a high of 1,955.

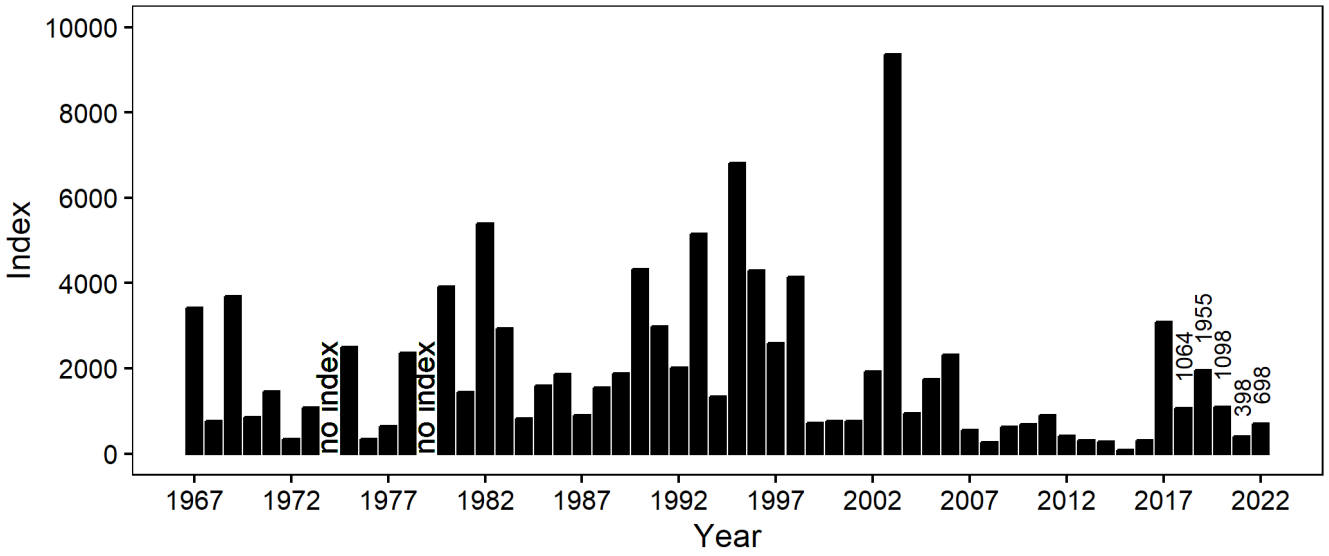

Figure 6. FMWT American Shad annual abundance indices, 1967-2022. Index values for the past 5 years are shown in detail.

A total of 432 American Shad were collected at index stations and 150 from non-index stations. American Shad were collected mostly from Suisun Bay with the greatest monthly catch in December (Table 5).

Table 5. American Shad catch among regions during the 2022 Fall Midwater Trawl survey sampling at index and non-index stations. SRDWSC = Sacramento River Deepwater Shipping Channel.

Month	*Type*	*Region*	*Catch*
September	Index	Carquinez Strait	35
September	Index	Lower Sacramento River	9
September	Index	Lower San Joaquin River	1
September	Index	San Pablo Bay	4
September	Index	Suisun Bay	7
September	Non-Index	Mokelumne River	1
September	Non-Index	SRDWSC	45
September	Non-Index	Steamboat Slough	9
October	Index	Carquinez Strait	20
October	Index	Lower Sacramento River	25
October	Index	Lower San Joaquin River	4
October	Index	San Pablo Bay	2
October	Index	Suisun Bay	69
October	Non-Index	SRDWSC	33
November	Index	Carquinez Strait	17
November	Index	Lower Sacramento River	10
November	Index	Lower San Joaquin River	3
November	Index	San Pablo Bay	32
November	Index	Suisun Bay	51
November	Non-Index	SRDWSC	35
December	Index	Carquinez Strait	28
December	Index	Eastern Delta	4
December	Index	Lower Sacramento River	1
December	Index	Lower San Joaquin River	12
December	Index	San Pablo Bay	22
December	Index	Suisun Bay	76
December	Non-Index	Cache Slough	7

Month	*Type*	*Region*	*Catch*
December	Non-Index	Mokelumne River	3
December	Non-Index	Napa River	1
December	Non-Index	SRDWSC	16
Total			**582**

Splittail (*Pogonichthys macrolepidotus*)

The 2022 Splittail abundance index was zero which shows a continuing trend of very little to no catch of Splittail in FMWT (Fig. 7). During most years, FMWT data does not accurately reflect trends in age-0 Splittail abundance, as the index is low or zero except in relatively wet years, such as 2011, when age-0 fish tend to be abundant. FMWT operates in water >2 m deep, whereas Splittail, particularly age-0 fish, appear to primarily inhabit water <2 m deep (Sommer et al. 1997; Moyle et al. 2004). However, FMWT does effectively detect strong year classes, such as the one in 1998 and the most recent one in 2011.

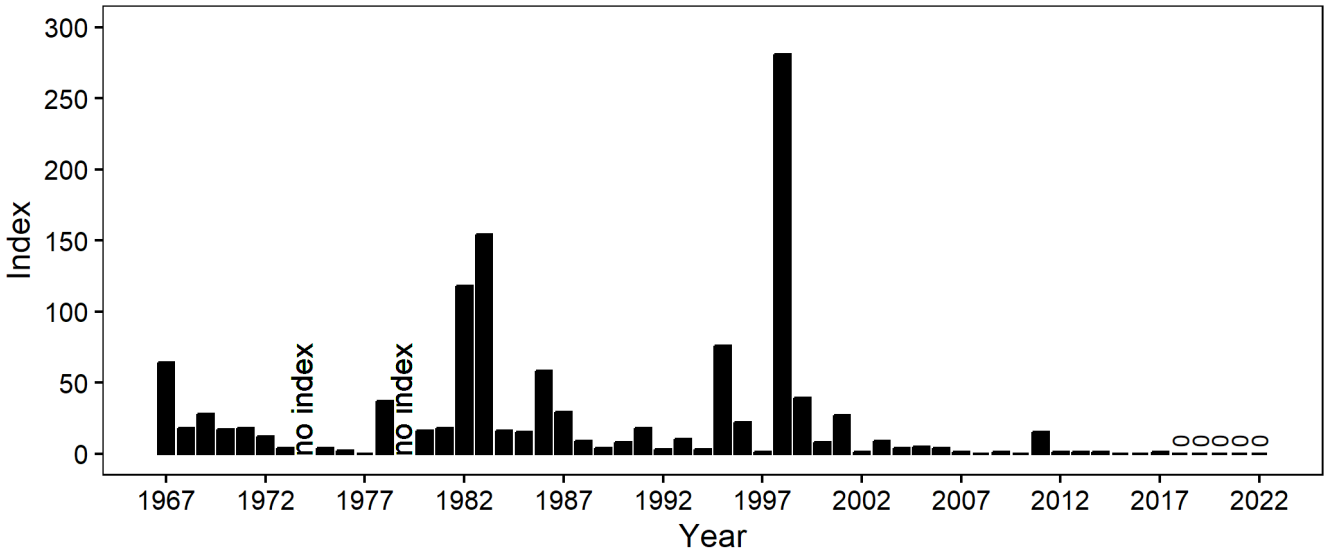

Figure 7. FMWT Splittail annual abundance indices, 1967-2022. Index values for the past 5 years are shown in detail.

Wakasagi (*Hypomesus nipponensis*)

Wakasagi were first introduced to northern California reservoirs by California Fish & Game in 1959 to provide forage for rainbow trout and other salmonids. It is believed they were present in the SF Estuary as early as 1974, but they were not detected in the Estuary until 1990 by other surveys (Moyle 2002; Davis et al. 2022). The first detection of Wakasagi by the FMWT survey was in 1995. The 2022 abundance index was zero because Wakasagi were only caught at non-index stations (Fig. 8).

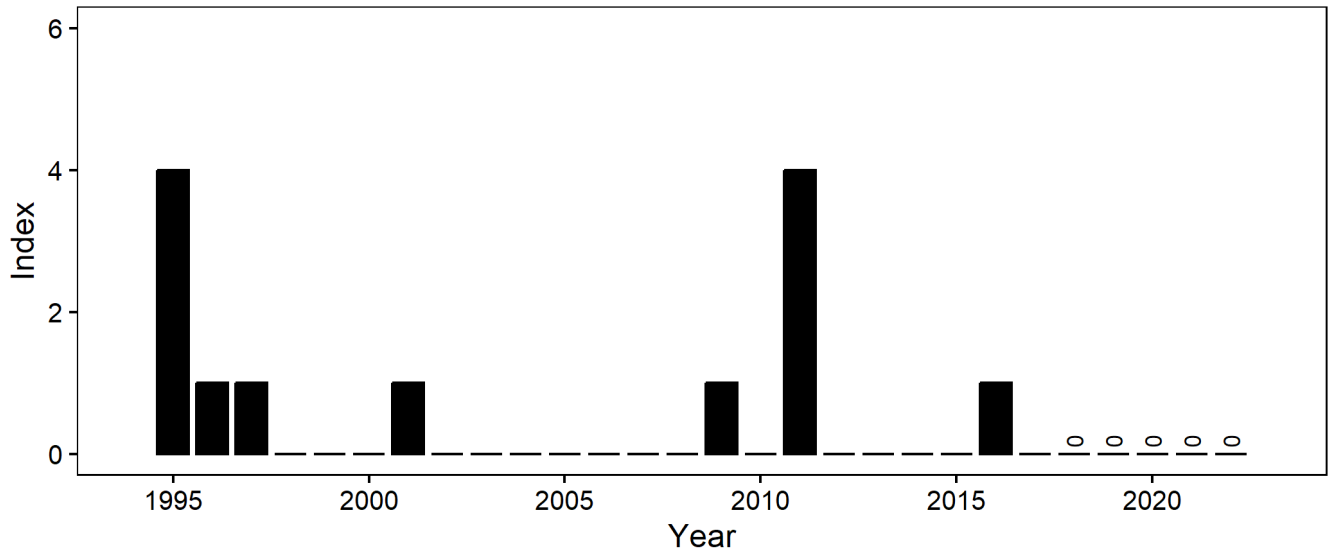

Figure 8. FMWT Wakasagi annual abundance indices, 1995-2022. Index values for the past 5 years are shown in detail.

A total of zero Wakasagi were collected at index stations and 25 from non-index stations. Monthly catch was highest in October and December, with catch being highest in SRDWSC among months (Table 6). Little is known about the life history of the California population of Wakasagi compared to the Japanese populations. Wakasagi in the SF Estuary have yet to become abundant, despite broad temperature (2-29°C) and salinity (0-29 ppt) tolerances (Moyle 2002). FMWT tends to catch this species in the freshwater areas of the north Delta, catch is infrequent and in higher numbers during wet water years.

Table 6. Wakasagi catch among regions during the 2022 Fall Midwater Trawl survey sampling at index and non-index stations. SRDWSC = Sacramento River Deepwater Shipping Channel.

Month	*Type*	*Region*	*Catch*
September	Non-Index	SRDWSC	15
October	Non-Index	SRDWSC	1
November	Non-Index	SRDWSC	7
December	Non-Index	SRDWSC	2
Total			**25**

cc: Jim Hobbs, Steve Slater, Lauren Damon, Kathy Hieb

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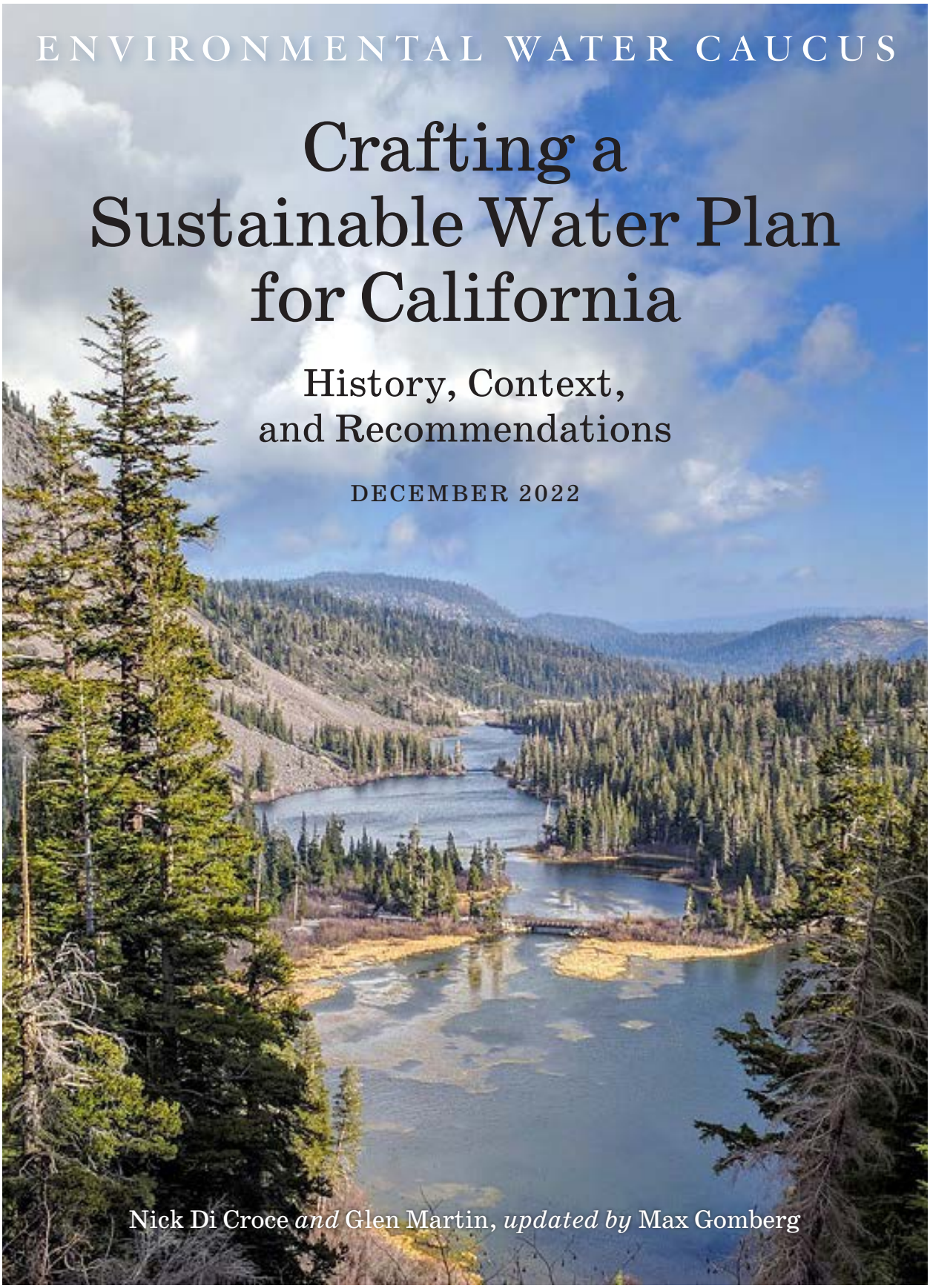
Exhibit 3

ENVIRONMENTAL WATER CAUCUS

Crafting a Sustainable Water Plan for California

History, Context, and Recommendations

DECEMBER 2022



Nick Di Croce *and* Glen Martin, *updated by* Max Gomberg

Contents

Crafting a Sustainable Water Plan for California

Executive Summary

California is at a crossroads. Intensifying impacts from climate change are straining the state's infrastructure, diminishing the resilience of the environment, and reducing quality of life for its population of nearly 40 million people. During the past two decades the state has experienced two extreme droughts, increasingly devastating wildfires, higher average temperatures and more extreme heat than ever before. In addition, the long-term trends for major flood events, aridification, and sea level rise are well documented and will compound existing harms.

The state's current patchwork of water law and policy is not adequate to provide healthy communities, ecosystems, and reliable food security in an era of increasing climate extremes. **Surface water has been vastly over-allocated, groundwater use has been under-regulated, and laws intended to safeguard the environment and public health remain unenforced.** Indeed, the Bay-Delta Watershed is already in a state of ecological collapse and hundreds of thousands of people still lack safe and accessible drinking water while agriculture and forestry contribute 7 percent of statewide greenhouse gas emissions.

There is a more equitable way to build economic and ecological stability. Just as the state is transitioning away from fossil fuels and toward a decarbonized grid, the state can transition away from harmful agricultural practices and toward revitalized ecosystems and reliable access to adequate supplies of clean water. But incremental measures, such as those proposed by the current administration[1], will not redress the ongoing harms to communities and ecosystems. We need a comprehensive approach rooted in environmental and economic justice, and responsive to climate change.

The Environmental Water Caucus (EWC) has a plan for addressing the state's water crisis. The plan is based on three fundamental goals:

1) Implementing and enforcing a water distribution system that prioritizes the ecological health of the Bay-Delta Watershed, and the human right to water.

2) Prioritizing food security and equitable allocation of agricultural water along with urban conservation and utilization of local supplies.

[1] See https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Water-Resilience/CA-Water-Supply-Strategy.pdf, accessed October 5, 2022.

3) Transitioning away from large storage and conveyance projects, and toward conservation, efficiency, and ecological restoration.

EWC recognizes the state is obligated by law to repair historical injustices, undo current inequities, and prevent future disproportionate impacts on tribes and disadvantaged communities. The state has taken important steps in recent years to redress historical racism and more equitably allocate resources, including a law that requires formal tribal consultation.[2] But institutional racism remains embedded in many state laws and policies, including those associated with the water rights system, operations of state and federal water projects, and groundwater management. We cannot achieve a fair and secure future for all Californians without confronting and remedying the injustices hobbling our existing systems.[3]

Likewise, a sustainable future requires transformation of the state's agricultural sector. It must include a net reduction in irrigated land, prioritization of food system security, support for small farmers, and public investment in alternate economic development and job creation. Although there has been some research on converting agricultural land to other uses (such as renewable energy), these studies have not analyzed the scale of change necessary to revitalize the Bay-Delta Watershed.[4] EWC recommends the adoption of a state agricultural policy that identifies the specific actions necessary for achieving these actions in tandem with agricultural water delivery reductions.

The state must also evaluate the benefits associated with ecosystem restoration. These benefits, including recreation, fishing, energy conservation (from reduced pumping),

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[2] AB 52 (2014) created requirements for Tribal consultations within California Environmental Quality Act (CEQA) processes. AB 3121 (2020) created a Reparations Task Force. SB 535 (2012) created investment requirements for projects in disadvantaged communities within the state's greenhouse gas reduction fund. Multiple state agencies, including the Transportation agency, Air Resources Board, Public Utilities Commission, and State Water Board are or have developed racial equity plans and policies. The state's Strategic Growth Council maintains a website with resources for state agencies developing racial equity plans. See: https://www.sgc.ca.gov/programs/racial-equity/, accessed October 5, 2022.

[3] See: https://www.restorethedelta.org/wp-content/uploads/2022-05-24-Petition-for-Rulemaking-FINAL.pdf, accessed September 28, 2022, and https://www.pcl.org/media/2022/02/Updating-California-Water-Laws-to-Address-with-Drought-and-Climate-Change.pdf, accessed October 5, 2022, for documentation of how the water rights system is built on a foundation of violence against Native Americans and continues to perpetuate injustices. See: https://www.communitywatercenter.org/sgmaresources, accessed October 5, 2022, for multiple analyses of how the structure and implementation of the Sustainable Groundwater Management Act is not protecting access to drinking water in contravention of the Human Right to Water law.

[4] See, for example, publications from the Public Policy Institute of California, such as: https://www.ppic.org/publication/land-transitions-and-dust-in-the-san-joaquin-valley/, accessed October 5, 2022, and https://www.ppic.org/publication/exploring-the-potential-for-water-limited-agriculture-in-the-san-joaquin-valley/, accessed October 5, 2022.

flood attenuation, water quality, and tribal uses often get overlooked in discussions about impacts to livelihoods and current farming economies. It is also time to abandon infrastructure projects that cannot pass a full benefit-cost evaluation. In the transportation sector, it is well-known that traffic increases in lockstep with the addition of new highway lanes.[5] Likewise, adding water storage and conveyance infrastructure increases demand for water[6] without necessarily increasing supply. EWC opposes proposals to raise Shasta Dam, build a Delta tunnel and create new reservoirs such as Sites and Temperance Flat because they are the water equivalent of adding highway lanes. Instead of using bond funds and ratepayer dollars for these projects, we should fund ecologically responsible farmland retirement, habitat restoration, non-agricultural jobs in the Central Valley, and urban conservation and supply diversification.

While urban water use has been declining due to conservation behaviors, installation of efficient appliances and fixtures, and, in some cases, price signals, there is still opportunity for additional reductions in use, particularly in the suburban communities of the Southern Bay Area and Southern California that receive State Water Project water. In addition, there is significant untapped potential for boosting local supplies to reduce reliance on imported water sources.[7] EWC supports stronger regulations and progressive funding for diversified urban water supplies, including, conservation; recycled water; stormwater capture and reuse; publicly-owned, environmentally sustainable, small-scale desalination, and groundwater cleanup. In particular, EWC recommends state policy directing the Metropolitan Water District of Southern California to meet targets for imported water reductions, support increased use of local supplies, and ensure goals pertaining to the human right to water are met within its service area.

When the state's human right to water law was passed in 2012, it did not include the resources and authority necessary to achieve its goals. However, in the past decade, multiple laws have been passed that have augmented the original law's funding, regulatory authority, and data and analysis requirements; these supporting laws have led to significant increases in the number of people with access to safe drinking water.[8]

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[5] Duranton, Gilles, and Matthew A. Turner. 2011. "The Fundamental Law of Road Congestion: Evidence from US Cities." American Economic Review, 101 (6): 2616-52.

[6] Di Baldassarre, G., Wanders, N., AghaKouchak, A., Kuil, L., Rangecroft, S., Veldkamp, T.I.E., Garcia, M., Van Oel, P.R., Breinl, K., and Van Loon A.F. (2018). Water shortages worsened by reservoir effects. https://www.nature.com/articles/s41893-018-0159-0, accessed October 5, 2022.

[7] https://pacinst.org/publication/california-urban-water-supply-potential-2022/, accessed October 5, 2022.

[8] See: Ved P. Nanda, The Human Right to Water: Challenges of Implementation, 50 U. Pac. L. Rev. 13 (2018).; https://www.waterboards.ca.gov/drinking_water/safedrinkingwaterplan/docs/SDW-HR2W-FS-2021-web.pdf, accessed October 5, 2022; and https://iwaponline.com/wp/article/23/5/1189/83931/Monitoring-the-human-right-to-water-in-California, accessed October 5, 2022.

While the state does not have an environmental right to water law, it does have the 2009 Delta Reform Act, the 2014 Sustainable Groundwater Management Act, and numerous constitutional and statutory requirements that safeguard the public trust, protect endangered species, allow for fish passage, maintain water quality, and restrict wasteful and unreasonable use.

In sum, these laws and statutory requirements constitute a potent legal framework for maintaining healthy freshwater ecosystems; to be effective, they simply must be enforced. To date, such enforcement has been lacking.

The EWC recommendations below identify tangible actions the state legislature, state agencies, and the state and federal courts should take to enforce existing law, equitably allocate resources, and provide clear authority and direction to state and federal agencies tasked with managing water resources. EWC is committed to a robust legal strategy to hold state and federal agencies accountable through the courts; in accord with other environmental and social justice organizations, we also advocate vigorously at state and federal the legislatures and regulatory agencies.

Policy and Legal Recommendations and Desired Outcomes

Reducing Diversions from the Bay-Delta Watershed

LEGISLATURE

- Direct the State Water Board to submit a report on an equitable transition of the water rights system
    - Authorize a budget allocation through water rights fees to form a unit dedicated to an equitable transition of the water rights system
- Direct the State Water Board to adopt a policy with specific actions to recognize and assure tribal beneficial uses
- Establish goals and timelines for the Metropolitan Water District of Southern California to reduce use of the State Water Project water (and Colorado River water)

- Provide additional funding for:
    - Urban conservation and supply diversification
    - Economic transition
    - Habitat restoration

DEPARTMENT OF WATER RESOURCES (DWR)

- Consider a range of reasonable alternatives to the Delta Conveyance Tunnel Project including no-tunnel and export reducing alternatives including the Policy Recommendations and Desired Outcomes set forth in this Plan
    - Reduce deliveries from the State Water Project (SWP) and the Central Valley Project (CVP) down to 3 MAF over the next 5-10 years
    - Abandon infrastructure projects such as the Delta tunnel and new reservoirs and instead of using bond funds and rate payer dollars for these projects, develop and fund water conservation, water recycling, ecologically responsible farmland retirement including drainage-impaired lands, and other such modern measures
    - Renegotiate Table A allocations in the SWP contracts to reflect safe yield water availability, climate change analysis, and allocation of public trust resources

STATE WATER BOARD

- Adopt a time schedule order for reducing deliveries from the SWP and CVP down to 3 MAF over the next 5-10 years
    - Adopt Conclusions of Law that the public trust doctrine supersedes existing contract allocations (e.g., Settlement Exchange Contractors)
    - Declaration of climate change emergency and allowance for continuous annual use of emergency regulations to curtail senior water rights ahead of a proposal to redo the water rights system
- Submit a report to the State Legislature on an equitable transition of the water rights system

STATE COURTS

- Make findings and conclusions of law that:
    - The State Water Board has not fulfilled its legal duties to uphold the public trust doctrine
- Issue orders that:
    - Require the State Water Board to complete the following by June 2024, with non-compliance resulting in court supervision
        - Update the Bay-Delta Water Quality Control Plan
        - Adopt public trust policy to:
            - Prohibit Temporary Urgency Change Petitions and water transfers that do not protect public trust resources
            - Define "surplus water" in the context of climate change and the protection of public trust resources

FEDERAL COURTS

- Make findings and conclusions of law that:
    - The Bureau of Reclamation and the Army Corps of Engineers are subject to state law requirements for fish passage over, around, or through dams
    - US Public Law 84-99 standards for Delta levees are inadequate in light of climate change
- Issue orders that:
    - The Bureau of Reclamation and the Army Corps of Engineers must come into compliance with fish passage requirements by June 2027, with non-compliance resulting in court supervision

Transforming Agriculture in the Central Valley

LEGISLATURE

- Direct the State Water Board, after consultation with relevant agencies and community stakeholders, to submit a report to the legislature on a plan to reduce total irrigated land by up to 3 million

acre-feet to protect public trust resources, eliminate waste and unreasonable use, and achieve the human right to water. In drafting the report, the State Water Board shall incorporate recommendations from its report on an equitable transition of the water rights system

- Provide funding for economic development, including:
    - Job training
        - Regenerative agriculture
        - Renewable energy
        - Drinking water infrastructure and operations
    - Habitat restoration and recreation
- Add two voting members to the State Water Board, appointed by the Legislature, with expertise in environmental justice
- Direct DWR to renegotiate the Table A allocations in the State Water Project contracts to reflect safe yield water availability, including a climate change analysis
- Make findings and conclusions that:
    - The transfer of the Kern Water Bank was illegal under the public trust doctrine
- Issue orders to:
    - Return the Kern Water Bank to the state for the sole purpose of public trust protection and human right to water compliance
    - Mandate that the State Water Resources Control Board issue regulations to manage inflows and withdrawals from the Kern Water Bank

STATE WATER BOARD

- Submit a report on reducing total irrigated land beginning with the drainage impaired lands south of the Delta

FEDERAL COURTS

- Direct the Bureau of Reclamation to renegotiate all Central Valley Project contracts to reflect climate change water availability analysis

Urban Water Management

LEGISLATURE

- Require urban water agencies to adopt stronger conservation rate structures, consistent with Proposition 218
- Place an initiative on the 2024 ballot to reform Proposition 218 to allow to direct rate assistance to low-income households
- Fund direct installation of water conservation fixtures and devices for disadvantaged communities
- Require the Metropolitan Water District to ensure equitable cost allocation and assume responsibility for achieving the Human Right to Water goals within its service area

STATE WATER BOARD

- Adopt strong standards for urban water use efficiency that place the greatest conservation responsibility on households and businesses that use the most water and have the most financial capacity

STATE COURTS

- Make findings and conclusions that:
    - Urban water agencies that do not charge large users commensurate with their strain on infrastructure and water supply are in violation of Proposition 218's cost-of-service requirements
- Issue orders that:
    - The State Water Board shall oversee rate setting for agencies failing to comply with Proposition 218

Ending the Era of Destructive Storage and Conveyance Infrastructure

LEGISLATURE

- Allocate all future funding for water projects to the State Water Board
- Require State Water Board review and approval of all CEQA documents created by the Department of Water Resources

- Prohibit the Department of Water Resources from funding positions not related to the operation of the State Water Project from State Water Project funds

STATE WATER BOARD

- Deny permits to current proposed storage and conveyance projects as inconsistent with maintaining the public trust and related statutory requirements

STATE COURTS

- Make findings and conclusions that:
    - Current proposed storage and conveyance projects, namely, Sites Reservoir and the Delta tunnel, are inconsistent with state laws relating to the protection of environment

FEDERAL COURTS

- Make findings and conclusions that:
    - Federal agencies must operate storage and conveyance facilities consistent with state public trust regulations

EWC's full report details both the policies that must be undone and those that must be acted upon and enforced to build a more equitable and resilient future. These policies are feasible alternatives to the perpetuation and of community and ecological harms from projects designed to maintain unsustainable diversions from the Bay-Delta Watershed. We know the right thing to do: the only question now is whether we have the political will to do it.

The Environmental Water Caucus

This document represents decades of research, collaboration, and public advocacy. Formed in 1991 by David Nesmith, The Environmental Water Caucus (EWC) is a coalition of environmental organizations working toward sustainable and equitable water policy in California. United by a strong opposition to the water export model of The Delta Plan, the EWC first submitted an alternative plan in 2010. The plan was updated in 2017 in response to the Twin Tunnel Project, and now in 2022 in reponse to the single tunnel Delta Conveyance Project.

It is the position of the EWC that not all impacts of the Delta Conveyance Project have been taken into account, not all alternatives adequately explored, nor all existing laws appropriately considered.

Aqualliance
California Sportfishing Protection Alliance
California Striped Bass Association
California Water Impact Network
Center for Biological Diversity
Desal Response Group
Environmental Justice Coalition for Water
Environmental Protection Information Center
Fly Fishers International
Friends of the River
Institute for Fisheries Resources
Pacific Coast Federation of Fishermen's Associations
Planning and Conservation League
Sacramento River Council
Save the American River Association
Sierra Club California
Southern California Watershed Alliance

Crafting a Sustainable Water Plan for California

History, Context, and Recommendations

December 2022

"The supply of water is the primary resource battleground for the twenty-first century."[1]

JAMES G. WORKMAN

The consensus diagnosis for the Delta's future is dire. To speed recovery of this critical West Coast watershed, the EWC prescribes greater river flows and reduced water exports. Our proposal specifies the actions that must be taken to prioritize the needs of the environment, communities, and small farmers; increase oversight and transparency, and equitably allocate costs. These criteria and recommendations could well decide the fate of the Delta – and the millions of Californians who live with water insecurity.

A Vision for Undoing Historical and Ongoing Harms

Our current water infrastructure was based on excessively optimistic assumptions about water supply volume and reliability.[2] This error was compounded through water allocation laws that instituted and reinforced inequitable diversions.

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[1] From *The Heart of Dryness* by James G. Workman

[2] On the Colorado River, for example, it is well documented that the allocations between the basin states and Mexico vastly overestimated water availability. See: https://www.inkstain.net/colorado_river/, accessed October 11, 2022, and https://pubs.er.usgs.gov/publication/sir20185049, accessed October 11, 2022. Likewise, the recent history of State Water Project allocations demonstrates that planners were overoptimistic about the amount of water available for diversion. See: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/State-Water-Project/Management/SWP-Water-Contractors/Files/1996-2022-Allocation-Progression-083022b.pdf, accessed October 11, 2022.

It didn't have to be this way. At the beginning of the 20th century, excessive and inequitable water rights claims led to legal challenges by state residents. The California State Legislature responded in 1913, passing the Water Commission Act – the first attempt to administer new surface water rights. However, the act also gave legal cover for pre-1914 water rights, many of which were established through white settlers' illegal and violent land-taking from Native Americans.[3] Fifteen years later, voters amended the California Constitution following a state Supreme Court decision *(Herminghaus v. Southern Calif. Edison, 200 Cal. 81 (1926)*) that prioritized water use by certain rights claimants regardless of "reasonableness." This landmark constitutional amendment stipulated that all water use in California must be "reasonable" and "beneficial."

But, as the state grew, the letter and spirit of this amendment were never realized. California's water management is still deeply inequitable and ultimately unsustainable. Major water projects, including the State Water Project and the Central Valley Project, were developed and operated to benefit large agriculture and cities at the expense of the environment and small communities. The historical and ongoing harms are well documented, and contemporary legislation, including the 2009 Delta Reform Act, the 2012 Human Right to Water Act, and the 2014 Sustainable Groundwater Management Act have created frameworks and intent to improve conditions for disadvantaged communities and the environment. However, these laws do not eliminate some of the institutional arrangements that allow for damaging and unsustainable water use. EWC's focus is on the decisions and practices that must be revoked or transformed to achieve an equitable and resilient water management system.[4] Specifically, EWC recommends the following:

- Eliminate irrigation of drainage-impaired farmlands south of the Bay-Delta
- Reduce or eliminate water transfers from the Sacramento Valley through the Delta to the San Joaquin Valley
- Undo the destructive provisions of the Monterey Amendments to the State Water Project
    - Return the Kern Water Bank to state control

[3] See: https://www.restorethedelta.org/wp-content/uploads/2022-05-24-Petition-for-Rulemaking-FINAL.pdf, accessed September 28, 2022.

[4] As explained in the Executive Summary, the water rights system must be eliminated and replaced with an equity-oriented allocation system. Elaborating a plan for that transition is not addressed in this document.

  - Eliminate the surplus water provisions in the State Water Project contracts
  - Return the "urban preference" (Article 18a)
  - Restore the safeguard against "paper water" (Article 18b)
- Set and enforce water quality standards for the entire Bay-Delta watershed and cap Delta exports at 3 million acre-feet per year
- Create new policies for sustainable and equitable groundwater management
- Fund and implement comprehensive habitat restoration, fish passage, and upper watershed management programs

Eliminate Irrigation of Drainage-Impaired Farmlands South of the Bay-Delta

The Central Valley Project (CVP) has been supplying water to approximately 1.3 million acres of drainage-impaired land on the west side of the San Joaquin Valley since the late 1960s. The San Luis Act of 1960 requires a drain system as a condition of approval for the San Luis Unit CVP contracts, including the Westlands Water District. Initially, the U.S. Bureau of Reclamation planned to build a San Luis Master Drain that would transport drainage water from the irrigated units to the Bay-Delta, but the project was stopped after 93 miles of infrastructure were completed; the terminus was Kesterson Reservoir. By the early 1980s, thousands of migratory birds were dying from selenium poisoning at Kesterson due to toxic drain water.

Selenium, arsenic, boron, molybdenum, mercury and numerous other toxic salts and minerals are concentrated in the soils of the large portions of the San Joaquin Valley. Descriptions of these impaired soils are presented in the 1990 joint federal and state analysis popularly known as *The Rainbow Report*.[5] In 2007, the United States Geological Survey estimated that it would take 65 to 300 years to eliminate the selenium deposited in San Joaquin Valley groundwater by agricultural activity even if the San Luis Drain were completed and irrigation of the San Luis Unit of the CVP halted. Further, completion of the drain would increase the risk to fish and wildlife in the

[5] U.S. Department of the Interior, California Resources Agency. September 1990. A Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley. P. 2-3.

A crew pumps selenium-laden water out of the concrete-lined San Luis Drain into a field near Tranquility, California, in the 1980s as part of a previous cleanup project for selenium-contaminated farm runoff that poisoned birds at the Kesterson National Wildlife Refuge. (The Fresno Bee)

Bay-Delta, given it would result in the annual discharge of 42,500 pounds of selenium to the estuary.[6]

While farmers and water districts throughout the western San Joaquin Valley have been trying to reduce their drainage water, much remains to be done. Retiring impaired lands on the Westside of the Valley from irrigated agriculture is a cost-effective and reliable option available for eliminating harmful discharges to our surface water and aquifers. Any approach that is not based on land retirement will likely result in the increased concentration of selenium and salts in the shallow aquifers of the San Joaquin Valley, where they will be mobilized during flood events and groundwater transport. Eliminating or greatly reducing irrigation on these impaired lands would save up to two million acre-feet of water annually.[7]

Taking these tainted "badlands" out of agricultural production would reduce demand for Delta water diversions and greatly improve water quality in the San Joaquin River. A staged program of land retirement and associated drainage volume reduction

[6] Presser, Theresa S., and Samuel N. Luoma. 2007. Forecasting selenium discharges to the San Francisco Bay-Delta Estuary: Ecological effects of a proposed San Luis Drain Extension. The US Geological Survey, Professional Paper 1646. Abstract P. 1. http://pubs.usgs.gov/pp/p1646/, accessed October 25, 2022.

[7] Pacific Institute. 2008. More with Less: Agricultural Water Conservation and Efficiency in California. See: https://pacinst.org/publication/more-with-less-agricultural-water-conservation-and-efficiency-in-californiaa-special-focuson-the-delta/, accessed November 16, 2022.

actions also would mitigate impacts to the farm labor community resulting from reduced cropland acreage. As noted in *The Rainbow Report*, these lands ultimately will go out of land production, even if irrigation continues. Further irrigation simply accelerates drainage impairment. Solar energy arrays – ideally supported by state and/or federal incentives – are a far more reasonable and productive use of these impaired croplands.[8]

Reduce Water Transfers

Water transfers via market transactions have been used since the early 1900s to ameliorate "inflexibilities" in water rights priorities – i.e., "first in time, first in right." Such transfers are most evident to the public during drought years, when junior rights holders such as the Central Valley Project and the State Water Project endure cutbacks as more senior water rights holders exert their priority over the available water. Junior water rights holders typically obtain more surface water by offering to purchase water directly from willing sellers – usually senior water rights holders. There are three ways this is accomplished:

- Crop shifting
- Fallowing
- Groundwater substitution

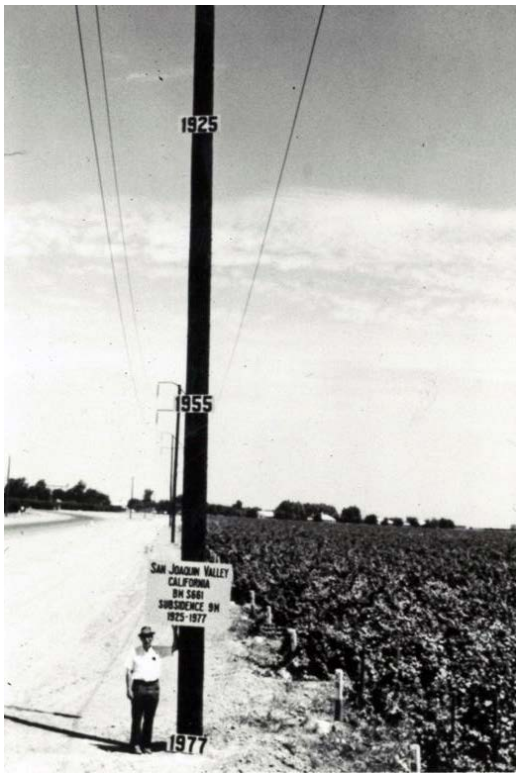
Fallowing and groundwater substitution have been the usual methods for water sellers. The U.S. Bureau of Reclamation and the California Department of Water Resources oversee fallowing and groundwater substitution transfers, but these methods are hobbled by an inadequate monitoring, mitigation, and reporting process; this means the environmental and economic impacts of the associated transfers are not readily apparent.[9]

Fallowing exerts negative impacts on downstream stakeholders and wildlife dependent on tailwater, as well as on local economies – but these downside effects are not

[8] See: https://www.latimes.com/business/la-fi-agriculture-farmlands-solar-power-20190703-story.html, accessed October 14, 2022, for a description of solar projects built and planned on impaired farmland.

[9] DWR Water Transfer White Paper (December 2019), available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/State-Water-Project/Management/Water-Transfers/Files/Draft_WTWhitePaper_20191203.pdf, accessed October 11, 2022. See also, Table 3-1 "Description of County Ordinances Related to Groundwater Substitution Transfers," available at: https://water.ca.gov/-/media/DWR-Website/Web-Pages/Programs/State-Water-Project/Management/Water-Transfers/Files/Table3-1_County_Ordinances_GWSubs_Transfers_Ver1_021121.pdf, accessed October 11, 2022.

quantified, given the deficiencies in monitoring and reporting.[10] Groundwater substitution occurs when surface water is sold, and groundwater is pumped to maintain crop production (usually rice). The agencies know that the most immediate and significant impacts from these transfers are felt by neighboring well users, streams and rivers, and the fish and wildlife dependent on rivers and riparian lands.[11] In sum, the current monitoring, analysis, and public reporting of the impacts of water transfers based on fallowing and groundwater substitution are wholly inadequate and mitigation measures are deficient.



San Joaquin Valley land surface elevations have been sinking for as long as California has been pumping groundwater, as seen in this well-know image of USGS scientist Joseph Poland near Mendota. (Public Domain)

While water transfers are intended to address water rights priority imbalances, they may also result in declining groundwater levels, overdraft (i.e., pumping outpacing the rate of aquifer recharge), land subsidence (sinking land surface elevation due to aquifer collapse resulting from over pumping), negative impacts to groundwater-dependent native vegetation, aquifer storage capacity loss associated with land subsidence, and accelerating stream flow losses due to falling groundwater tables.

All these phenomena have been observed in the Santa Clara Valley, the San Joaquin Valley, and in multiple groundwater basins in the greater Los Angeles region. They typically combine to destabilize formerly healthy hydrologic systems, and they are the result of the "conjunctive use" strategies that underpin state and federal water policy.[12] They must not be repeated in the Sacramento Valley, where groundwater already is in a depleted state (see Table 1, next page).

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[10] USBR and San Luis Delta Mendota Water Authority 2014. Final Environmental Assessment/Mitigated Negative Declaration for the 2014 San Luis/Delta Mendota Water Authority Water Transfers.

[11] Ibid.

[12] See: https://www.usgs.gov/publications/enhancing-drought-resilience-conjunctive-use-and-managed-aquifer-recharge-california, accessed October 14, 2022, for a description of the ongoing support for conjunctive use strategies.

Deep Wells (Max decrease gwe)

County	FALL '04 - '18	FALL '04 - '17	FALL '04 - '16
Butte	-36.4	-13.9	-28.3
Colusa	-42.6	-67.2	-66.4
Glenn	-141.4	-166.3	-65.8
Tehama*	-47.6	-44.0	-35.8

Intermediate Wells (Max decrease gwe)

County	FALL '04 - '18	FALL '04 - '17	FALL '04 - '16
Butte	-23.8	-22.1	-28.3
Colusa	-61.5	-62.4	-78.9
Glenn	-62.7	-51.5	-58.3
Tehama*	-34.0	-35.0	-29.3

Shallow Wells (Max decrease gwe)

County	FALL '04 - '18	FALL '04 - '17	FALL '04 - '16
Butte	-14.7	-10.8	-18.3
Colusa	-50.8	-51.8	-51.7
Glenn	-63.8	-58.7	-59.6
Tehama*	-31.5	-28.9	-36.3

** Tehama County portion in the Sacramento Valley groundwater basin.*

TABLE 1

NORTHERN SACRAMENTO GROUNDWATER CHANGES

Maximum and average groundwater elevation decreases for the Sacramento Valley's Butte, Colusa, Glenn, and Tehama Counties; measurements were taken for three aquifer levels between the fall of 2004 and the fall of 2013.[13]

Annual transfers (frequently called "temporary" or "one year" transfers) occur congruently with the State Drought Water Bank Program, which is sometimes activated during drought years. These combined sales of Sacramento Valley surface water to South-of-Delta buyers cause two significant hydrological problems: First, the water that is sold must be transported through the Delta to the massive CVP and SWP export pumps, a process that degrades Delta ecosystems generally and is responsible for extensive fish kills. Second, landowners who sell their surface water may then pump

[13] Groundwater elevation data is available through the California Statewide Groundwater Elevation Monitoring (CASGEM) Program. CASGEM data is available through a public portal located at: https://water.ca.gov/Programs/Groundwater-Management/Groundwater-Elevation-Monitoring--CASGEM, accessed October 11, 2022.

groundwater to irrigate their crops; this can cause groundwater tables to drop precipitously, adversely affecting all users, ecosystems, and all regional bodies of water.

The Sacramento Valley's surface waters, economy, ecology, and aquifer structure are highly dependent on natural groundwater abundance. All these values and resources are in dire jeopardy because of the state's conjunctive use programs. Accordingly, no additional water should be exported from north of the Delta. Such a policy would protect the Delta from new export pumping impacts and provide long-term protection of the Sacramento Valley's groundwater supplies.

Implementation of this proposed policy is the only way the Sacramento Valley's aquifers, which are already facing increasing subsidence (see Figure 1) and loss of contribution to streamflow[14] and GDEs can be protected from the catastrophic groundwater depletion that has afflicted the aquifers of the San Joaquin Valley. In addition, water transfers should be taxed to fund the oversight necessary to ensure that Water Code requirements are met.

The Water Code states that transfers employing the facilities of any state, regional or local agency must meet certain criteria that are confirmed by the facility owners, including[15]:

- Water transfers cannot adversely affect any other legal water user
- Transfers cannot harm fish and wildlife
- Transfers may not have unreasonable negative economic impacts on the overall economies of the counties that are their origin points

Unfortunately, while the State Water Board process requires written findings regarding transfer requests, the Board is not required to hold hearings to determine that transfers meet these criteria, leaving only litigation as a compliance mechanism. EWC supports new legislation to require the Board to conduct a hearing with written testimony and witnesses and issue a decision with a finding of facts and conclusions of law prior to approving any transfers.

There are far better ways to manage California's water than maintaining maximum north-to-south Delta exports. As described throughout this report, EWC maintains

[14] Per testimony of Dan Wendell from the Nature Conservancy as reported in Maven's Notebook, see https://mavensnotebook.com/2014/04/28/groundwater-management-workshop-part-1-sustainable-groundwater-management-panel/, accessed October 20, 2022.

[15] Water Code Sections 386 and 1725 through 1737.

that the most sustainable and equitable water policies include retiring marginal land, prioritizing water for food security, and investing in ecosystem management that builds climate change resilience.

Accordingly, EWC makes the following recommendations regarding water transfers:

LEGISLATURE

- Adopt legislation to:
    - Require the State Water Board to hold hearings and make findings on water transfer applications
    - Authorize the State Water Board to collect fees from transfer applicants to cover the hearing costs
    - Levy a tax on approved water transfers and direct funds to be used for ecosystem restoration projects in the region where the water is being transferred
    - Make a policy declaration that no additional water should be exported from the Sacramento Valley to users South of the Delta and direct the State Water Board to require CEQA analysis for serial "annual" transfers by sellers
    - Provide funds for the State Water Board to hire sufficient personnel to administer expeditious and fair hearings on water transfer applications

STATE WATER BOARD

- When reviewing water transfer applications for compliance with Water Code section 1727(b)(1) and (2) (see text below), make a comprehensive assessment of potential impacts including:
    - The potential for consecutive years of extreme dryness during the transfer period
    - Impacts to domestic wells
    - Impacts to tribal beneficial uses
    - A determination that likely harm to fish and wildlife is unreasonable

Water Code section 1727 states:

> *(a) The board shall review a petition for a temporary change of water rights in accordance with this section.*
>
> *(b) The board shall approve a temporary change if it determines that a preponderance of the evidence shows both of the following:*
>
> *(1) The proposed temporary change would not injure any legal user of the water, during any potential hydrologic condition that the board determines is likely to occur during the proposed change, through significant changes in water quantity, water quality, timing of diversion or use, consumptive use of the water, or reduction in return flows.*
>
> *(2) The proposed temporary change would not unreasonably affect fish, wildlife, or other instream beneficial uses.*

Undo the Destructive Provisions of the Monterey Amendments to the State Water Project

The Monterey Amendments changed major provisions of the original State Water Project, ultimately resulting in increased exports from the Delta. This excessive pumping has undermined the ecological health and stability of the Delta, degrading water quality for the region's family farms, threatening commercial and sport fisheries, and impairing wildlife habitat.

These destructive impacts are a direct result of four provisions in the Monterey Amendments:

- The elimination of Article 18a, aka, the "urban preference"
- The elimination of Article 18b, the safeguard against "paper water"
- The change of orientation for Article 21, or "surplus water"
- The privatization of the Kern Water Bank

To mitigate the damage caused by the Monterey Amendments, the following changes should be made to the SWP. These adjustments will reduce reliance on the Delta[16],

[16] For background on the Monterey Amendments, see: https://www.c-win.org/the-monterey-amendments/, accessed, October 14, 2022. For a review of the unsuccessful legal challenges to the Monterey Amendments, see: https://www.californialandusedevelopmentlaw.com/2022/01/10/after-27-years-litigation-over-the-monterey-agreement-comes-to-an-end/, accessed October 18, 2022.

Pumps at the Kern Water Bank. (© Chris Austin)

confirm public trust doctrine protections for our most essential resource, and enhance water security for urban ratepayers:

- "Paper water" must be eliminated. The state has failed to quantify the amount of water that is available under varying precipitation scenarios, and it has also neglected to bring user water allocations in line with supplies. As a result, each time the state faces consecutive drought years, despite minimal SWP allocations (e.g., 5%) and curtailments in some watersheds, reservoirs reach dangerously low levels, fish die, and increased groundwater pumping leads to dry domestic wells and additional land subsidence. "Paper water" cannot be justified in state water policy, nor sustained in the physical transport and use of water.

- The Kern Water Bank must be returned to the public. Originally, this aquifer was a public asset: it underlies land purchased by the California Department of Water Resources in the 1980s for the creation of a drought emergency water supply for California ratepayers. In a highly inappropriate move, it was transferred to private interests as part of the Monterey Amendments. This decision must be reversed. The Kern Water Bank must be returned to the ownership and operational control of the state and managed for its original purpose: providing water to south-of-Delta urban water users during drought.

- The urban preference must be reinstated; California must return to its original doctrine of prioritizing water access for people rather than corporate agriculture.

- The pumping of Article 21 water – also known as "surplus water" – must be curtailed. Article 21 implementation is unnecessary as effective water policy, and it is profoundly damaging to the fisheries and ecology of the Bay-Delta watershed – especially during dry years. The pumping and transport of Article 21 water should never be permitted during drought. EWC Recommendations:

LEGISLATURE

- Pass legislation requiring the Department of Water Resources to conform all future amendments to the State Water Project contracts with the following policy goals:
    - Revise allocations downwards to reflect long-term aridification from climate change
    - Return the Kern Water Bank to state ownership
    - Elimination of Article 21 "surplus" allocations in all but the wettest years
    - Prioritize supply for urban and domestic users
- The legislation should also require State Water Board concurrence on all future State Water Project amendments

STATE WATER BOARD

- Evaluate all proposed State Water Project amendments to ensure terms and project operations will protect public trust resources
- Adopt regulations setting rules for operation of the Kern Water Bank once it is returned to state ownership

Set and Enforce Water Quality Standards in the Bay-Delta Watershed that Cap Delta Exports at 3 Million Acre-Feet per Year

The federal Clean Water Act and the state Porter-Cologne Water Quality Control Act both stipulate that California's water quality control plans are intended to improve water quality – not simply maintain it. However, the operational history of the state and federal water projects and the awarding of excess water allocations has resulted in deteriorating water quality and ecosystem health over the past six decades.

Since at least 1960, Department of Water Resources staffers knew it would be impossible to convey more than 3.2 million acre-feet of water from the Delta without the contribution of North Coast Rivers.[17] [18] All the evidence since then validates contemporary state policy of reducing reliance on the Delta for water supplies. It also confirms that any export level above 3 million acre-feet annually for all water year types is imprudent.

Moreover, data presented to the State Water Board during 2012 hearings on updating the Bay-Delta Water Quality Control Plan showed that water allocations exceeded water availability during "normal" years by a factor of five.[19] Updating the Water Quality Control Plan for the Delta is an ongoing process. The current iteration began in 2009 with a staff report that identified issues requiring extended analysis. Notably, the Board's own report concluded Delta flows were indeed too low and that exports probably were too high to sustain declining fish populations. The report stated that "...flow and physical habitat interact in many ways, but they are not interchangeable..." and that "...scientific certainty is not the standard for agency decision making."[20]

Work on the Water Quality Control Plan is proceeding through four phases[21]:

Phase One: Establish flow standards for the San Joaquin River and its major tributaries and evaluate South Delta salinity standards.

Phase Two: Set standards for Sacramento River inflow, Delta inflow, Delta outflow, and Delta/Suisun Marsh water quality.

Phase Three: Incorporate the revised standards into water rights permits via evidentiary hearings.

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[17] California Department of Water Resources. 1960. Bulletin 76 Delta Water Facilities. Water Sources and Uses Table, Page 11.

[18] Ibid

[19] Testimony on Water Availability Analysis submitted by Tim Stroshane (C-WIN) before the State Water Resources Control Board, October 26, 2012. P. 11. See: https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/docs/comments111312/tim_stroshane.pdf, accessed October 25, 2022.

[20] http://www.swrcb.ca.gov/waterrights/water_issues/programs/bay_delta/deltaflow/final_rpt.shtml, accessed October 25, 2022.

[21] Information about the State Water Board's process is available on its website: https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/, accessed October 21, 2022. A valuable description of the history of actions (and inaction) on the water quality control plan(s) is contained in the petition filed by Restore the Delta, Tribes, and environmental justice advocates requesting that the State Water Board expeditiously complete a rulemaking to review and revise the Bay-Delta water quality standards. The petition, request for reconsideration, and State Water Board responses are available on Restore the Delta's website at: https://www.restorethedelta.org/2022/09/23/ca-state-water-board-issues-denial-of-request-for-reconsideration-on-delta-plan-implementation/, accessed October 21, 2022.

Spring Chinook salmon. (Michael Bravo)

Phase Four: Establish instream flows for the Sacramento River's major tributaries.

As with many planning processes, exigent events, and politics – including drought response – have intervened with the Water Quality Control Plan efforts, resulting in delays. In December 2018, the State Water Board adopted water quality standards with increased environmental flow requirements for the Lower San Joaquin River watershed (Phase 1). However, implementation of those standards was put on hold while the Newsom administration attempted to facilitate voluntary agreements for increased flows and habitat restoration.

When those voluntary agreements failed to produce significant commitments, the State Water Board re-started its regulatory implementation process in July 2022[22]. In October 2022, the U.S. Fish and Wildlife Service proposed adding the San Francisco Bay population of longfin smelt to the endangered species list, marking yet another grim milestone in the decline of the Bay-Delta ecosystem.[23]

The EWC is committed to a total annual Delta water export figure of 3 million acre-feet or less. This baseline must apply to all state and federal export policies, projects, and operations – including any new Delta conveyance project. When exports exceed

[22] See: https://www.waterboards.ca.gov/public_notices/notices/20220715-implementation-nop-and-scoping-dwr-baydelta.pdf, accessed October 18, 2022.

[23] See: https://fws.gov/press-release/2022-10/service-seeks-public-comment-proposed-listing-san-francisco-bay-population, accessed October 18, 2022.

the 3 million acre-feet figure, any meaningful restoration of the Delta's ecology and fish populations effectively becomes impossible.

State policy as framed in every proposed Delta conveyance project – from the peripheral canal to the current single tunnel – promotes a fallacy: it's somehow possible to increase exports while simultaneously restoring ecosystems and fish species.

The potential export capacity of the current single tunnel proposal could match the existing combined capacity of the Delta's federal and state pumps.[24] The single tunnel thus continues the current and unsustainable approach to Delta water management. Moreover, its $16 billion price tag constitutes a huge opportunity cost. That money could fund a significant amount of physical and social infrastructure to transition agricultural and urban water use to more resilient levels and reduce the growing risk of flooding and salinity intrusion from climate change.EWC recommendations:

LEGISLATURE:

- Update the Delta Reform Act of 2009 to:
    - Adopt state policy to reduce Delta exports to 3 million acre-feet per year by 2030
    - Prohibit the Department of Water Resources from spending money on additional planning for new Delta conveyance infrastructure
    - Direct the State Water Board to incorporate this policy in the Bay-Delta Water Quality Control Plans
- Provide funding and set a statutory deadline for the State Water Board to adopt the Bay-Delta Water Quality Control Plans

STATE COURTS

- Make findings that the Environmental Impact Report for the single tunnel project (the Delta Conveyance Project) did not sufficiently analyze the No Project Alternative pursuant to California Environmental Quality Act requirements

[24] Chapter Two of the Draft EIR for the single tunnel project, known as the Delta Conveyance Project, states that DWR is proposing the project to "restore and protect the reliability of State Water Project water deliveries ...". The Draft EIR is available at: https://www.deltaconveyanceproject.com/read-the-document, accessed October 21, 2022.

- Order that the state courts may need to oversee the completion of the Water Quality Control Plans if the State Water Board does not complete its update by a specified date

Equitable and Sustainable Groundwater Management

The EWC has long supported public groundwater management over the construction or expansion of additional surface storage facilities. We've also advocated for mandatory reporting of groundwater pumping and for the implementation of sustainable practices for groundwater management and utilization. In addition, EWC supports utilizing access to safe and reliable domestic supplies and groundwater dependent ecosystem health as keystone criteria in defining "sustainable' levels of pumping.

The legislature took an important step toward these goals with the Sustainable Groundwater Management Act of 2014 (SGMA). SGMA authorizes the establishment of "groundwater sustainability agencies" (GSAs) to manage local groundwater basins. The legislature granted broad discretionary powers to these agencies, including the authority to allocate groundwater supplies among users within their boundaries and to regulate, limit or suspend groundwater extractions.

GSAs may adopt rules, regulations, ordinances, and resolutions related to groundwater management, and they have broad powers over groundwater monitoring, the operation of established wells, and the construction and function of new wells. They may levy fees to fund the cost of sustainability programs, including permit fees, groundwater extraction fees and ad valorem property taxes.

The Act applies to groundwater within 515 basins identified throughout the state by the California Department of Water Resources.[25] DWR has categorized each of these basins as high, medium, low, or very low priority. The 94 basins designated as high or medium priority, along with the 26 adjudicated basins, account for 98% of total groundwater pumping (20 million acre-feet).[26]

The GSAs are required to develop sustainability plans for all high- and medium-priority basins within their respective jurisdictions; DWR reviews each plan to ensure it meets sustainability goals. If, after a GSA is given the opportunity to cure deficiencies

[25] The Act does not apply to 26 basins – most in Southern California – that were previously adjudicated by the courts.

[26] See: https://water.ca.gov/Programs/Groundwater-Management/Basin-Prioritization, accessed October 12, 2022.

Ivan Rubio of Self-Help Enterprises checks the water level of a well at a home. (Matt McClain/The Washington Post)

in a sustainability plan, DWR determines that a sustainability plan is inadequate, the State Water Board may place the basin on probationary status and adopt an interim plan of the Board's own creation.[27] Broadly speaking, the 2040 deadline for achieving sustainable pumping is too long – especially given the worrisome status of the medium- and high-priority basins, critical overdraft areas, and the ongoing reliance on substantial groundwater pumping as surface water supplies shrink due to climate change.

The Department of Water Resources recently released its statutory reviews of plans for 10 of the Central Valley's 11 critically overdrafted basins. DWR judged them to be incomplete because the submitted plans failed to satisfy the objectives of the Act.[28]

Some plans underestimated the extent of overdraft in their basins, and the need for solutions, while most of the plans appeared overly optimistic about the potential for new supplies to meet demand. There is a clear reluctance on the part of some agencies to seriously consider managing the demand side, including access for domestic wells, with most or exclusive emphasis placed on increasing supply.[29] Some plans allow aquifer level operational ranges that are significantly lower and wider than historical

[27] A summary of SGMA can be found on "Dark Clouds Over California", a blog by Wes Strickland http://privatewaterlaw.com/2014/11/19/dark-clouds-over-california/, accessed October 13, 2022.

[28] Information on DWR's assessment of Groundwater Sustainability Plans can be found on its SGMA portal at: https://water.ca.gov/Programs/Groundwater-Management/SGMA-Groundwater-Management, accessed October 12, 2022.

levels and even suspend level goals during dry years. These plans jeopardize shallow domestic wells and groundwater dependent ecosystems (GDE).[30]

There have been several well-documented critiques of SGMA's deficiencies[31], and even former State Senator Fran Pavley, one of the SGMA authors, has stated publicly that the Act is inadequate as a response to California's rapidly changing climate.[32] EWC shares in these critiques and makes the following recommendations for improving and expediting SGMA implementation with a focus on equity and environmental restoration.

LEGISLATURE

- Update SGMA to:
    - Ensure equity on GSA Boards
    - Accelerate compliance timelines and provide a quicker route to state control and more stringent requirements to exit state control for non-compliant GSAs
    - Allow for automatic state takeover for inability to protect domestic and GDE uses
    - Direct the State Water Board to adopt a regulation with mandatory restrictions on pumping in areas with documented subsidence
    - Ensure that SGMA GSPs do not supersede local ordinances that oversee groundwater substitution transfers.
- Pass legislation that creates a new framework for managed aquifer recharge
    - Create a water use priority system for stored water with the

[29] See comment letters from State Water Board staff to the Department of Water Resources on various groundwater sustainability plans: https://www.waterboards.ca.gov/water_issues/programs/sgma/gsp-comment-letters.html, accessed October 12, 2022.

[30] See: https://aqualliance.net/solutions/litigation/northstate-groundwater-pumping-threats-provoke-lawsuits/, accessed October 19, 2022, for a description of lawsuits filed based on Groundwater Sustainability Plans allowing for excess pumping and inoperable domestic wells.

[31] See, for example: https://static1.squarespace.com/static/5e83c5f78f0db40cb837cfb5/t/5f3ec0c82c478a6bfc59e68a/1597948109576/Groundwater-Management-and-Safe-Drinking-Water-in-the-San-Joaquin-Valley-Brief-6-2020.pdf, accessed October 12, 2022, and: https://civicwell.org/civic-news/sgma-small-farmers/, accessed October 12, 2022.

[32] See: https://www.latimes.com/environment/story/2021-12-16/its-a-race-to-the-bottom-for-agricultural-wells, accessed October 12, 2022.

highest priority for domestic and environmental uses including GDEs.

- Direct funding to areas with greatest capacity to recharge aquifers used for domestic and environmental protection purposes
- Require funding awards be contingent upon groundwater management operations that do not perpetuate damaging pumping levels
- Prohibit GSAs from using aquifer level operation ranges designed to create storage space for recharge projects.
- Require enforceable intergovernmental agreements that prevent GSAs that manage "sub-basins" from operating in ways that thwart achieving aquifer-wide sustainability and equity goals
- Codify that the State Water Board's public trust responsibilities extend to groundwater management

STATE COURTS

- Court rulings that the State Water Board has final authority over groundwater management as part of its constitutional and statutory responsibilities to uphold the public trust and prevent waste and unreasonable use

STATE WATER BOARD

- Adopt regulations for administration of groundwater basins that:
  - Prioritize management on behalf of domestic well users, small farmers, and groundwater dependent ecosystems
  - Issue clear timelines for reducing unsustainable extractions and create meaningful penalties for violating those timelines
  - Prohibit privatization of recharge projects
  - Prohibit conjunctive use recharge projects designed to integrate Sacramento Valley aquifers into the Central Valley wide water supply system

Fund and Implement Comprehensive Habitat Restoration, Fish Passage, and Upper Watershed Management Programs

In the 2009 Delta Reform Act, the legislature declared that the Delta watershed was in crisis and existing policies were unsustainable. While additional freshwater flows are critical to Delta watershed health, there is also a need for significant additional habitat restoration. Landscape-scale habitat networks are the only way to accommodate the full life cycles of many species.[33]

A comprehensive approach to habitat restoration includes measures to improve upper watershed function, such as forest thinning, meadow restoration, more cold water retention, and enhanced fish passage, along with lower watershed improvements to floodplains, improved fish screens and non-physical barriers. In addition to habitat restoration projects, the state should direct greater resources toward Delta levee reinforcement to reduce seismic and flood risks.

These actions all have well-documented benefits beyond those associated with ecosystem health. For example, forest thinning and prescribed burns using Indigenous knowledge provide significant reductions in impacts from catastrophic wildfires, while floodplain restoration provides flood risk reduction. For a full description of these actions and their benefits, see Appendix A.

Although, habitat restoration and flood management projects carry a large price tag, the state has invested large sums over the past decade. Moreover, the state will likely continue to make significant funding available since these projects are generally less politically fraught than proposals to reduce water deliveries. The need for greater funding is yet another reason why the Delta Conveyance Project (single tunnel) should be abandoned. The opportunity cost of the project's $16 billion price tag is fewer resources available for furthering the Human Right to Water and habitat and flood management projects.

To maximize the environmental and community benefits of habitat and levee projects, EWC recommends the following:

LEGISLATURE

- Set policy goals for state-funded restoration projects, including:
    - Habitat linkage

[33] See: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=18366&inline, accessed October 25, 2022, for a detailed description of California habitat connectivity information.

As part of the Pacific Flyway bird migration route, the Delta is an ecosystem of national and international significance. (Bob Wick)

  - Floodplain restoration with:
    - Levee removal or setbacks where possible
    - Levee re-vegetation with native flora
  - Upper watershed restoration within Integrated Regional Water Management Plans and through agreements with federal land management agencies
- Direct the State Water Board, in consultation with dam owners and other stakeholders, to develop a cost estimate and timetable for creating fish passage above all Central Valley rim dams
- Direct the Department of Water Resources to install enhanced fish screens and non-physical barriers at the intake zones for the South Delta export facilities
- Continue to fund habitat restoration projects in annual budget appropriations
- Conduct oversight hearings to ensure state agencies are funding projects in accordance with state policy goals

STATE WATER BOARD

- Require reporting by dam owners on compliance fish passage requirements
- Adopt regulations to maintain adequate cold water pool reserves

Transforming California's Agricultural Sector

California's 8-9 million irrigated acres generate over $50 billion per year.[34] Under the EWC plan, total irrigated acreage would likely decrease by at least 2 million acres.[35] While a disorderly transition could create price shocks and significant economic impacts in the San Joaquin Valley, an orderly transition can maintain high productivity, food security, employment in both agriculture and new industries (i.e., renewables), and other benefits, such as improvements in air quality.

Fundamental to achieving the goal of returning water to ecosystems while maintaining a vibrant agricultural sector is the reallocation of water and an equity-based approach to financial incentives. Eliminating the water rights system, creating equitable groundwater management, retiring marginal land, and incentivizing the growing of fruits, vegetables, and grains for human consumption would support core agriculture while reducing water-intensive investments in nuts, animal feed, and cotton.

As the OnThePublicRecord blog has argued, allocating water to the most productive farmland (generally on the East side of the Central Valley) to grow "table food" would minimize the risk of food shortages while ensuring that water is not taken from the environment in dry years to grow nuts.[36] Moreover, as other analyses have documented, there are numerous agricultural water use efficiency measures, which, if widely

[34] According to USDA, California had 7.8 million irrigated acres in 2017. See: https://www.ers.usda.gov/topics/farm-practices-management/irrigation-water-use/, accessed October 24, 2022. However, some estimates of total irrigated acreage are higher. For example, the 2019 water fact sheet published by the Public Policy Institute of California states that over 9 million acres are irrigated. See: https://www.ppic.org/wp-content/uploads/jtf-water-use.pdf, accessed October 25, 2022. According to the California Department of Food & Agriculture, 2021 total agricultural output was $51.1 billion. See: https://www.cdfa.ca.gov/Statistics/, accessed October 24, 2022.

[35] This is a rough estimate based on reducing total Delta exports and more restrictions on groundwater pumping. It is also consistent with other expert estimates. See: https://onthepublicrecord.org/2015/12/14/2434/, accessed October 25, 2022, for a comparison of estimates.

[36] See https://onthepublicrecord.org/2022/05/19/our-leaders-do-not-have-the-courage-and-vision-to-fix-this/, accessed October 24, 2022.

used (and without utilizing the saved water elsewhere), could result in conversation savings of 10-20% of total agricultural water use.[37]

In housing policy, decades of barriers to building set by local governments has resulted in a housing crisis. Over the past decade state leaders have finally recognized the need for greater usurpation of local powers to increase housing production and the legislature has passed several bills that reduce or override local decision making. Unfortunately, in the water sector, deference to local control is still the default policy position. Until the state exercises greater control over agricultural production and water use, we risk escalating ecologic crisis and growing food insecurity as more acreage is converted to nuts and grapes.

EWC supports the development of a state agricultural policy, which would map out how to achieve a smooth transition toward a more sustainable and equitable future. The policy should be developed concurrently with the water and habitat management actions listed in this report.

Urban Conservation and Equity

While there is still further potential to reduce urban water use and invest in supply diversification to reduce reliance on imported water[38], current state policy reflects an over-emphasis on urban water use relative to total water use.[39] EWC supports equitable cost allocation for urban water conservation and supply diversification investments, including expanded economic analysis to demonstrate how urban ratepayers would benefit from forgoing payment for the single tunnel project.

As codified in the state's Human Right to Water Act, keeping water safe, clean, accessible, and affordable for people is the highest policy priority.[40] EWC supports the environmental justice organizations working toward that goal. The recommendations

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[37] See: Pacific Institute. California Water 2030: An Efficient Future. September 2005. http://www.pacinst.org/reports/california_water_2030/ca_water_2030.pdf, accessed October 24, 2022. Also see: National Resources Defense Council, et al. Wetter or Not. November 2014. https://www.nrdc.org/resources/wetter-or-not-actions-ease-current-drought-and-prepare-next, accessed, October 24, 2022.

[38] The Pacific Institute has written multiple reports documenting urban water conservation potential. See: https://pacinst.org/water-efficiency-and-reuse/, accessed October 25, 2022.

[39] The Newsom administration's approach to water management relies heavily on supply augmentation and urban water investments and contains minimal detail on reducing agricultural water use. See: https://resources.ca.gov/-/media/CNRA-Website/Files/Initiatives/Water-Resilience/CA-Water-Supply-Strategy.pdf, accessed October 25, 2022.

[40] California Water Code, Section 106.3

in this report draw from, and are complementary to, environmental justice advocacy goals, as they would improve equity in groundwater management, reduce affordability burdens associated with financing large infrastructure, and improve water quality for disadvantaged communities in the Central Valley.

In Conclusion

California is at an existential tipping point: our very future depends on the management of our water resources. The accelerating impacts of climate change have made the natural limits of our water supplies obvious. Simultaneously, the profound inequities of our current water policies are receiving greater visibility and creating urgent calls for change. Our policy makers must come to grips with the dire threats we face, and they must act.

The proposals contained in this report are more efficient, equitable, and economically sound than new dams, reservoirs, and canals. California needs a water system that provides sufficient water for people, fish and wildlife, and sustainable agriculture. We know the right thing to do: the only question now is whether we have the political will to do it.

Appendix A: Habitat Restoration, Fish Passage, and Levee Improvements

Restore Floodplains

One integral part of Delta watershed restoration is revitalizing floodplains. Floodplains are extremely productive ecosystems that support high levels of biodiversity and provide numerous valuable ecosystem services.[1] Riverine floodplains consist of relatively level areas on both sides of a given stream bed that transport excess water during flood events. When a flood occurs, the floodplain becomes an expanded part of the stream.

This allows flood waters to spread out and slacken, expending downstream energy and velocities, reducing the risk to human life and minimizing damage to buildings and infrastructure. If a channel is narrowed, dredged, or riprapped, the floodplain cannot perform its proper function. Downstream flows are accelerated and concentrated, resulting in levee breaches or wholesale collapse, and damage becomes widespread. Channelization and dredging also destroy wildlife habitat, including sandbars and islands.

Floodplains also support wetlands that slow and filter water, improving water quality. These wetlands provide habitat for a broad variety of wildlife and serve as nurseries and foraging areas for fish. Other floodplain benefits include groundwater recharge, water filtration, and recreation. All these services and benefits underscore the extremely high monetary value of healthy floodplains.

To function properly, floodplains must flood periodically. By storing floodwaters over a broad landscape, floodplains recharge groundwater supplies, maintain proper instream flows, prevent bed/bank scour, sequester organic carbon, and support a broad suite of aquatic species essential to both local ecosystems and economies.[2]

Unfortunately, functional floodplains have been reduced dramatically in California by levees, dams, flood control projects, and general development. To reverse these losses,

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[1] Postel, Sandra. Richter, Brian. 2003. Rivers for Life. Island Press. P 20-21. https://islandpress.org/books/rivers-life.

[2] Sommer T.R., Nobriga M. L., Harrell B., Batham W., Kimmerer W. J. 2001. Floodplain rearing of juvenile Chinook salmon: evidence of enhanced growth and survival. Canadian Journal of Fisheries and Aquatic Sciences. P. 325-333. https://www.waterboards.ca.gov/waterrights//water_issues/programs/bay_delta/docs/cmnt091412/sldmwa/sommer_et_al_2001a.pdf

a variety of agencies and organizations have devoted significant resources to restore floodplains as part of a larger effort that also addresses flood risk reduction.

Ongoing hydrologic impacts from climate change, including stronger atmospheric rivers and accelerated spring snow melts are increasing flood risk.[3] Connecting natural floodplains to their rivers and proscribing future floodplain development are essential to community security and ecological sustainability.

The following actions must be incorporated in all floodplain restoration strategies:

- Removing or setting back levees from riverbanks wherever possible to allow floodwater dispersal across historic floodplains
- Where levee removal or setback is not possible, levees should be revegetated with native flora to provide maximum ecosystem benefits.
- Prioritizing the purchase of floodplain or flowage easements by flood control agencies
- Banning all new levee construction in floodplains
- Integrating the needs of low-income communities affected by floodplain restoration plans, ensuring that all impacts are fully mitigated

Invest in Healthy Headwaters and Meadow Restoration

There is a clear recognition among agencies and organizations concerned with water policy that we must do more to manage our headwaters systems for multiple benefits, including improved water quality, improved water supplies, and healthy ecosystems.[4] Persistent drought and high temperatures associated with climate change are producing consistently bigger and more destructive Sierra wildfires, with devastating effects on water supplies, fish, and wildlife habitat.

Investments in ecologically sound forest management should therefore be a high priority with both state and federal agencies. In addition to the quantified benefits of stable and resilient watersheds, effective headwater management can reduce wildfire and flood impacts; minimize erosion and sediment loss; improve water quality;

[3] See: https://pubmed.ncbi.nlm.nih.gov/35960799/, accessed October 25, 2022.

[4] See: https://waterinthewest.stanford.edu/publications/state_climate_policy_and_nature-based_solutions, accessed October 25, 2022.

improve human health by reducing illnesses associated with polluted air and water; and reduce insect pests.

Better headwater and meadow management can provide myriad benefits, including improvements in the natural water supply volume and storage; protection of existing supplies; improvements in natural water percolation; improvements in runoff water quality due to reduced silt and ash deposition; protection of fish and wildlife inhabiting upstream and headwaters areas; enhanced recreational opportunities; reduced damage and monetary loss to public and private properties located in headwater areas; protection of the scenic values of headwater habitats; and reduction of CO2 in the atmosphere due to carbon sequestration in headwater and meadow plants and soil.

EWC will continue to advocate for:

- Implementation of catastrophic wildfire risk reduction projects across the Sierra Nevada and Cascade ranges, including prescribed burns, forest thinning, and the conservation and enhancement of summer base flows in forested streams, meadows, wetlands, and springs.
- Ongoing documentation of the significant groundwater storage benefits and dry year surface water benefits of forested watersheds, specifically those that connect to groundwater sources in the Delta and existing surface storage facilities. Given the high value of these watersheds, they warrant priority in any catastrophic wildfire risk reduction and ecology enhancement plans.
- Incorporating headwater and meadow management plans into local Integrated Regional Water Management Plans (IRWMPs). All relevant resource agencies should function as active stakeholders in IRWMPs, including the U.S. Forest Service, the California Department of Water Resources, the U.S. Bureau of Reclamation, and the California Department of Fish and Wildlife.

Reinforce Core Levees Above Current Standards

The EWC accepts and fully supports the Delta Protection Commission's 2012 recommendation to *"…. improve many core Delta levees beyond the Public Law (PL) 84-99 standard that addresses earthquake and sea level rise risks, improve flood fighting and emergency response, and allow for vegetation on the water side of levees to*

improve habitat....”[5] (The Delta Stewardship Council’s current recommendations for levee upgrades are less protective and carry a lower price tag).[6]

Improving most core Delta levees to this higher standard was estimated to cost between $2 to $4 billion.[7] Given that the Delta serves as a water source and water conveyance facility for much of California, there is a justifiable public interest in providing public funds to Delta reclamation districts and other Delta stakeholders for levee upgrades. To protect their water supplies, water exporters must identify all levees within their jurisdictions that require upgrades to higher standards (e.g., greater earthquake resistance). Delta counties and communities should be assisted in their efforts to comply with federal flood protection and emergency management programs.

Public safety and flood protection must remain the top priority for the State Plan for Flood Control and all associated levees and bypasses. Levees should be vegetated with native flora to aid in structure stabilization and the support of endangered species.

Earthquake risks to levees are cited as a major justification for Delta conveyance projects and the current single tunnel project is no different. However, given the costs between levee strengthening ($2 to $4 billion) and a new trans-Delta conveyance ($16 billion), there is clear incentive for the state to initiate levee reinforcement immediately; such a program would negate the “catastrophic levee failure” justification for a new conveyance.

Install Improved Fish Screens at Existing Delta Pumps

As noted in a 2010 report, the fish protection facilities at the South Delta pumps – including fish screens and salvage systems – remain largely unchanged since they were first engineered more than 40 years ago.[8] Currently, only between 11% to 18% of the salmon and steelhead entrained in the Clifton Court Forebay survive. Numerous studies by DFW, DWR, and academic researchers indicate that 75% of fish entering

[5] Economic Sustainability Plan for the Sacramento-San Joaquin River Delta, January 19, 2012. See: https://delta.ca.gov/wp-content/uploads/2021/05/Delta-Economic-Sustainability-Plan-2012-508.pdf, accessed October 25, 2022.

[6] See: https://deltacouncil.ca.gov/pdf/dlis/2022-08-26-dsc-initial-statement-of-reasons-rrp1.pdf, accessed October 25, 2022.

[7] Economic Sustainability Plan for the Sacramento-San Joaquin River Delta, January 19, 2012, page 57.

[8] Larry Walker Associates. A Review of Delta Fish Population Losses from Pumping Operations in the Sacramento-San Joaquin River Delta. January 2010. P. 2. See: https://calsport.org/news/wp-content/uploads/2011/07/LarryWalkerfishlosses.pdf, accessed October 25, 2022.

Clifton Court forebay are lost to predation. Of the survivors, 20% to 30% are lost at the salvage facility louvers, one percent to 12% are lost during handling and trucking, and 12% to 32% are lost to post-release predation.[9] Losses of other species (such as Delta smelt), salmon fry, and the egg and larval stages of multiple pelagic species are believed to be even higher. Some species – including endangered Delta smelt – cannot survive salvage and transport; their losses approach 100%.

According to the draft report for the earlier dual tunnel proposal (the Bay-Delta Conservation Plan), South Delta export facilities may increase the entrainment of:

- Juvenile steelhead in dry and critical years
- Juvenile winter-run Chinook salmon in above normal and below normal years
- Juvenile fall-run Chinook salmon in all below normal and dry years
- Fall-run Chinook smolts in all years
- Juvenile late fall-run Chinook salmon in dry and critical dry years
- Juvenile longfin smelt in above normal, below normal, and dry years
- Adult longfin smelt in critical dry years
- Juvenile Sacramento splittail in all years[10]

DWR's 2011 *Delta Risk Management Strategy (DRMS) Phase 2 Report* found that the South Delta's pumping facilities could be successfully mitigated by installing in-canal vee-type screens with a 2,500 cubic feet per second capacity for each module. Placed at the entrance to the Clifton Court Forebay, such state-of-the-art screens would eliminate the ongoing predation of 75% of the Forebay's fish species of concern and protect fish longer than 25mm in length.[11]

New screens would be expensive, and they would not eliminate the need for the transport of salvaged fish, completely resolve debris removal issues, or eliminate all fish

[9] Ibid

[10] ICF International. BDCP Effects Analysis, Entrainment, Appendix 5.B, Entrainment, Administrative Draft Bay Delta Conservation Plan. March 2012. PP. B.7-2 – B.7-4.

[11] DWR. Delta Risk Management Strategy, final Phase 2 Report, Risk Report, Section 15, Building Block 3.3: Install Fish Screens. June 2011. P. 15-18. DWR has removed the report from its website, however, a summary can be found at: https://www.waterboards.ca.gov/waterrights/water_issues/programs/bay_delta/strategic_plan/comments/080319_strwp_dwr_ab1200report.pdf, accessed October 25, 2022.

entrainment. They would, however, dramatically reduce the appalling fish losses that currently occur at the export facilities.[12]

Modernization of the fish screens at the South Delta pumps is an essential component of the EWC's Sustainable Water Plan; the South Delta pumps will remain as the primary diversion facilities under this plan.

EWC supports applying the best available technology to the development and installation of modernized fish screen systems at the South Delta facilities and at all other existing in-Delta diversions. This effort would also include the installation of positive barrier fish screens on all diversions greater than 250 cubic feet per second in the Sacramento and San Joaquin River Basins, as well as installing the same devices on a significant percentage of the smaller unscreened diversions operating in the same regions.

An alternative course is the use of non-physical barriers to deter fish from entering the intake zones of the South Delta pumps. Non-physical barriers include the following methods:

- Electrical barriers
- Strobe lights
- Acoustic fish deterrents
- Bubble currents
- Velocity barriers
- Chemical toxicants
- Pheromones
- Magnetic fields

The U.S. Bureau of Reclamation has logged some research results on the use of non-physical barriers.[13] Given the necessity of restoring fish populations through reduced mortality at the pumps, the feasibility of these alternative fish exclusion options must be thoroughly investigated.

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[12] Id. 15.5.2.1 Conclusion at PP. 15-19 & 15-20.

[13] Bureau of Reclamation. Non-Physical Barrier (NPB) for Fish Protection Evaluation: Can an Inexpensive Barrier Be Effective for Threatened Fish? http://www.usbr.gov/research/projects/detail.cfm?id=8740, accessed October 25, 2022.

Provide Passage for Fish Species of Concern Above and Below Central Valley Rim Dams

Dams have been a major factor – in many cases the prime mover – in the decline or extinction of numerous fish species, especially anadromous species. Anadromous fish migrate to and from rivers and the ocean, and they must have access to prime upper river habitats for spawning and rearing young fish[14]. Before the turn of the century, every Central Valley salmon and steelhead run went extinct, became endangered, or was in precipitous decline due to the habitat destruction and degradation caused by dams.[15] The most serious fishery impact of California's major dams is the blockage of migratory fish passage. More than 95% of the historic salmon and steelhead spawning habitat in the Central Valley's River systems have been eliminated by large dams[16]; no significant river has escaped unscathed.

Figure 1 (next page) illustrates the long-term downward trend for Central Valley Chinook salmon. It is obvious that salmonids are doomed to extinction in the Central Valley biome unless we can get them above the major dams to their native habitats; no below-dam restorative measures, including hatcheries, can possibly save them.

Numerous solutions exist to mitigate dam impacts to fish. These include fish ladders; upstream fish channels; fish elevators; trap-and-truck operations; downstream by-passes; removal of small fish barriers; and dam removal.

All these techniques have been used at various locations with varying success. Some of the larger dams on the Columbia River system have operated fish ladders for many years. While the costs of many of these techniques are substantial, the commercial and recreational return provided by healthy rivers and robust fish stocks justifies the investment.

Furthermore, by providing Native American tribes essential access to historic cultural resources, fish passage above the dams would also rectify many of the treaty violations the state and federal governments committed by proceeding with these massive

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[14] National Marine Fisheries Service, Southwest Region. June 4, 2009. Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and State Water Project. See: https://www.fisheries.noaa.gov/resource/document/biological-opinion-and-conference-opinion-long-term-operations-central-valley, accessed October 25, 2022.

[15] Friends of the River. 1999. Rivers Reborn: Removing Dams and Restoring Rivers. P 4-16. See: https://docslib.org/doc/5819452/rivers-reborn-removing-dams-and-restoring-rivers-in-california, accessed October 25, 2022.

[16] See: https://usbr.gov/mp/bdo/docs/20130827-bergpresentation.pdf, accessed October 25, 2022, for an overview of habitat loss studies.

reclamation projects. Native beneficiaries would include the Winnemen Wintu on the Upper Sacramento, McCloud, and Pit Rivers; the Karuk on the Klamath River; and the California Valley Miwok and Maidu on the American and Feather Rivers.

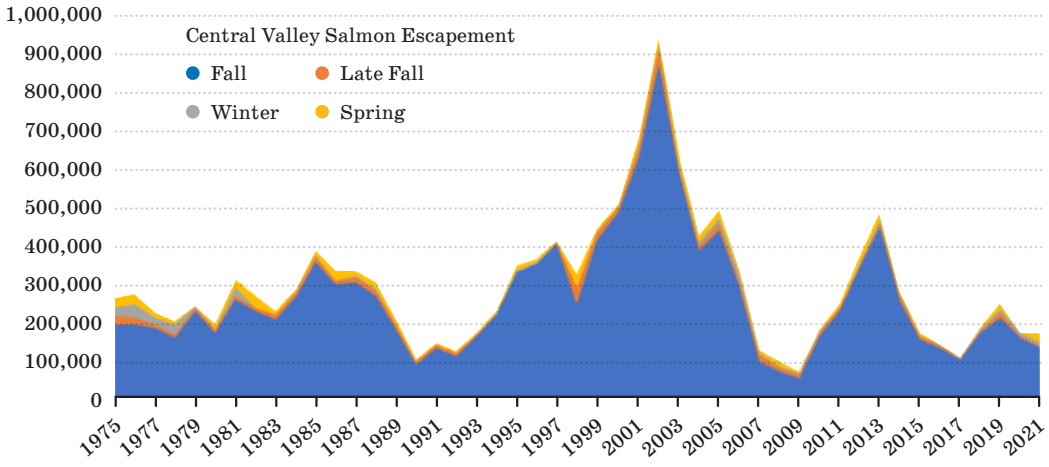

FIGURE 1

CENTRAL VALLEY CHINOOK SALMON POPULATION[17]

The EWC supports the National Marine Fisheries Service's 2009 biological opinion on CVP and SWP operations. This opinion recommends fish passage pilot programs and analyses for dams associated with the Delta (e.g., those on the Sacramento, American, and Stanislaus Rivers), and advises the State Water Resources Control Board to direct the controlling agencies of each Delta-connected Central Valley rim dam to evaluate fish passage feasibility for any facility that blocks listed salmonid migration. [18]

Retain Cold Water for Fish in Reservoirs

Salmon, steelhead, and trout need cold water to exist. As California has grown over the decades, dams have been erected on every major river, changing both upstream and downstream flows. Downstream water temperatures have risen dramatically as a result. Temperatures ranging between 57-67°F are ideal for upstream

[17] California Department of Fish & Game, Native Anadromous Fish & Watershed Branch. See: https://www.calfish.org/ProgramsData/Species/CDFWAnadromousResourceAssessment.aspx, accessed October 25, 2022, for data sets.

[18] National Marine Fisheries Service, Southwest Region. June 4, 2009. Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and State Water Project.

salmonid migration; water temperatures over 70˚F can be lethal to anadromous fish. Unfortunately, such high temperatures are now common in California's major rivers during the summer.

Some fish populations have been able to adapt to at least some degree, spawning and rearing young below major barriers; but their numbers have dwindled dramatically from than their historic figures.

Because farms need most of their water in the summer when crops are growing and maturing, reservoir water levels typically are low and warm by fall. This coincides with the return of the state's remaining anadromous fish to their rivers of origin. At this juncture, the lack of cold reservoir water constitutes a clear threat to spawning fish, their eggs, emergent fry, and smolts.

Many of the affected fish are now listed under the U.S. Endangered Species Act (ESA). Maintaining water temperatures suitable for fish survival is thus required under the ESA and must become a central tenet of state water policy. However, the maintenance of cold-water pool reserves must not be accomplished through reliance on "supplemental" groundwater pumping in lieu of river diversions by settlement contractors.

About the Authors

Nick Di Croce is a lifelong public advocate and fisherman, serving on the board of CalTrout and as an advisor and facillitator of the the Environmental Water Caucus since 1998. He was instrumental in the precedent-setting CalTrout I and CalTrout II decisions that employed the principals of The Public Trust Doctrine to save Mono Lake. He has served on the Public Advisory Committee for the State Water Plan and he was the lead author of the EWC's *California Water Solutions Now* report. He is currently an advisor of the California Water Impact Network.

Nick's degree in economics from the Wharton School and experience in senior management at Toyota Corporation bring a unique economics-based approach to environmental solutions.

Glen Martin, a writer and media consultant for C-WIN, is a former senior environmental reporter for the San Francisco Chronicle. He has freelanced for more than 50 magazines and websites, including Audubon, Discover, the Utne Reader, Forbes, Men's Journal, Science Digest, Wired, Re/code, National Wildlife, BBC Wildlife, Outside and Sierra. He has published three books. His latest, Game Changer: Animal Rights and the Fate of Africa's Wildlife (University of California Press), was well-received by both the popular and peer-reviewed presses, and is considered a seminal work on conflicting African wildlife policies.

Mr. Martin was a Pulitzer nominee and has received numerous awards for his work, including the Associated Press Award for Enterprise Reporting, the Bay Institute Education Award, the California Newspaper Publishers Award for Environmental Reporting and the Council for the Advancement and Support of Education gold medal.

Max Gomberg is an independent consultant working with California-based and national advocates on water affordability and climate equity. Previously, he served as the water conservation and climate change manager at the State Water Resources Control Board (Water Board) where he led development of water conservation, access, affordability, and climate change policies across California. Under his leadership, the Water Board developed a statewide plan for low-income water rate assistance, acquired $1 billion for water debt relief, adopted a comprehensive climate change mitigation and adaptation policy, and implemented regulations to reduce urban water use. Mr. Gomberg has 15 years of water policy experience and holds a BA from the University of Chicago and a Masters in Public Policy from UCLA.

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Exhibit 4

Sierra Club California's Smart Water Alternatives:

To The Bay Delta Conveyance Project

Photo by Molly Culton - Isleton Bridge - The Delta

William Martin . Heinrich Albert . Charming Evelyn

December 2022

Sierra Club California Water Committee Volunteers

INTRODUCTION

California needs a statewide water policy that gives all Californians adequate clean drinking water; respects and protects our rivers, streams, bays and deltas; and supports a sustainable economy. We need an approach that recognizes the water supply and demand challenges that will come with global climate change and population growth. One that offers responsible, cost-effective solutions.

Since passage of legislation in 2009, California's water policy debate has been dominated by the controversy over a proposed tunnel that would divert water from the Sacramento River around the San Francisco Bay Delta for export south. It would accelerate the decline of the largest estuary on the West Coast of the northern hemisphere, a key component in the state's fishing industry and rich wildlife biodiversity. It would do nothing to reverse the damage related to the flow change created by the existing Tracy pumps. It recycles an old idea voters rejected decades ago, during an earlier Brown administration, when they rejected the Peripheral Canal and will burden Californians statewide with the financial and environmental impacts of an unnecessary and costly construction project that ultimately won't fix the state's water problems. The Draft Environmental Impact Report (DEIR) for the most recent tunnel proposal was released in late July 2022.

The Sierra Club opposes the proposed Delta Conveyance/Tunnel. Instead, we believe Californians should pursue a range of strategies that together will sustainably meet water needs while protecting the environment. With this document, Sierra Club California presents alternatives to the Delta Conveyance proposal. The list of alternatives in this document demonstrates that there are reasonable ways to meet California's water demand without diverting more water from the Delta.

Best Water Management Strategies to Restore the Delta

- Increased agricultural and urban conservation
- Groundwater storage and management
- Increased water reuse
- Stormwater capture

Potential Water Savings/Additional Supplies from a Portfolio of Resilient Strategies

Resource Strategy	Water Savings/Supplies (million acre-feet/year)
Agriculture Water Use Efficiency	5.6 - 6.6
Urban Water Use Efficiency	2.0 - 3.1[1]
Recycled Municipal Water	1.8 - 2.1[1]
Stormwater Capture	0.5 - 3.0[1]
Groundwater Storage and Conjunctive Management*	0.5 - 2.0[2]
TOTAL	10.4 - 16.8

This table has been compiled from a 2022 analysis by the Pacific Institute and 2016 analysis by the Department of Water Resources (DWR).

The Sierra Club opposes the more aggressive operation of reservoirs and the Delta pumping plants DWR proposes in order to achieve maximum gains from conjunctive groundwater storage as we believe these gains can be achieved using more sustainable and environmentally-friendly techniques. *

1.The Untapped Potential of California's Urban Water Supply: Water Efficiency, Water Reuse, and Stormwater Capture by Heather Cooley, Anne Thebo, Sonali Abraham, Morgan Shimabuku, Peter Gleick, Sarah Diringer

2. California Department of Water Resources, Conjunctive Management and Groundwater, A Resource Management Strategy of the California Water Plan, July 2016.

The Delta's Multi-Faceted Role in California

The San Francisco Bay Delta is the freshwater body formed where the Sacramento, San Joaquin and several smaller rivers meet, near the city of Stockton. Snowmelt from the Sierra Nevada Mountain range in Northern California flows down the rivers and through the Delta on the way to the Suisun and San Francisco bays, before emptying into the ocean at the Golden Gate Bridge. The Delta and the two bays constitute the largest natural estuary on the West Coast, covering more than 1,100 square miles, an area about three times the size of the City of San Diego.

The Bay Delta is vital to the California economy. Massive pumps operated by the federal and state water projects near the San Joaquin County town of Tracy deliver water supplies from the Delta to 70 percent of the state's urban population and to much of the intensive agriculture in the southern half of the Great Central Valley.

The Bay Delta ecosystem has collapsed because of excessive water diversions, introduced nonnative invasive species, and water pollution. As water exports out of the Bay Delta have grown, populations of critical fish species that live in or migrate through the Delta have crashed. Since 1990, the amount of water that has been pumped out of the Delta has increased from an average of about 3.0 million acre-feet per year to over 5.2 million acre-feet. (A single acre-foot of water is 325,000 gallons, or enough water to serve two households for a year.) The number of salmon migrating back from the ocean through the Delta to spawn in Northern California rivers plummeted between 1990 and 2010. The commercial salmon season had to be canceled from 2008 to 2010 because there were not enough spawning salmon.

A History of the 'Now' Delta Conveyance/Tunnel

The California tunnel project's first iteration was the Peripheral Canal and was reintroduced as the Bay Delta Conservation Plan (BDCP). The Department of Water Resources held the first meeting to discuss the BDCP in May of 2006[3], two months after the Emergency Petition to declare the Delta Smelt an endangered species was filed.[4]

3. Bay Delta Conservation Plan Steering Committee. Agenda, May 19, 2016.

4. Center for Biological Diversity, The Bay Institute, and Natural Resources Defense Council. "Emergency Petition to List the Delta Smelt (Hypomesus transpacificus) as an Endangered Species Under the Endangered Species Act," March 8, 2006.

The BDCP was proposed as a comprehensive Habitat Conservation Plan for the Delta which would address the collapse of endangered fish populations.

By November 2007, the steering committee, which included DWR, the Federal Bureau of Reclamation, water agencies, fishery agencies, the California Farm Bureau, and some environmental groups, had agreed on "a dual conveyance system the ultimate acceptability of which will turn on important design, operational and institutional arrangements that the Steering Committee will develop and evaluate through the planning process."[5] In 2009, the Delta Reform Act, which enacted the BDCP planning process into law, came before the legislature and was passed, though strongly opposed by Sierra Club, other environmental organizations and Delta stakeholders.

The BDCP steering committee proposed an enormous new conveyance in 2010, with five 3,000 cubic feet per second intakes in the North Delta, which would feed two 33-foot diameter pressurized tunnels. A draft Environmental Impact Report / Environmental Impact Statement was circulated in 2013. Environmental organizations that had initially supported the project protested the new two tunnels design.[6,7] In 2015, the project was changed to two 40-foot gravity flow tunnels, the number of intakes was reduced to three, and the tunnel alignment was moved to the east. The extensive federal Habitat Conservation Plan component of the project was dropped, and the remaining habitat restoration program[7] was rebranded as EcoRestore.[8]

When Gavin Newsom became Governor in 2019, he declared that a single tunnel was sufficient. The "preferred alternative," as described in the 2022 DEIR, places the tunnel further east than other alignments and reduces the number of intakes. The Sierra Club opposes Governor Newsom's proposal. Also, U.S. Congressmen representing the Delta have introduced legislation in Congress to prevent the tunnel from being approved.

The following sections present our portfolio alternative to the tunnel: increased agricultural and urban conservation, groundwater storage and management, increased water reuse, and stormwater capture.

5. Bay Delta Conservation Plan Steering Committee. "The Bay Delta Conservation Plan: Points of Agreement for Continuing into the Planning Process," Draft, November 16, 2017.

6. John Cain et. al., "NGO letter to Messr.s Laird, Hayes, Meral and Connor," September 30, 2011.

7. CALFED Bay Delta Program, Programmatic Record of Decision, August 28, 2000.

8. Acreage cited in comments by Local Agencies of the North Delta on the 2018 Draft California Water Action Plan Update.

Alternatives - The Sierra Club California Water Portfolio

Our alternative plan proposes managing supplies in a way that sustains beneficial uses, including environmental uses, and safeguarding the water needs of the natural environment while avoiding hardship to humans due to shortages. A diverse water portfolio helps solve California's serious environmental and social problems:

- Harmful algal blooms throughout the Bay-Delta Estuary
- Inequity in water rights and availability of clean water
- Harm to endangered species such as chinook salmon and Delta smelt
- Socioeconomic harm to the Delta communities most affected by tunnel construction and operation

Agricultural Water Conservation

Photo: USDA ERS

Water conservation in agriculture is crucial to reducing water consumption in California since agricultural water use represents about 80% of total annual human water use.[9] To avoid further diversions of water from the Bay Delta and its watersheds, new management systems and investment are required. Thanks to improved irrigation techniques, agricultural water use efficiency increased for most crops in California between 2001 and 2010, according to estimates by the UC Davis Water Management Research Laboratory.[10]

9. Jeff Mount and Ellen Hanak. "Just the Facts: Water Use in California," Public Policy Institute of California, July 2016

10. Samuel Sandoval-Solis, Ph.D., et. al. Spatial Analysis of Application Efficiencies in Irrigation for the State of California Water Management Research Laboratory, UC Davis, June 2013

Even though water efficiency has increased, water savings are still being directed towards agricultural production and more needs to be done to return water savings to the environment.

Price irrigation water to incentivize water conservation: Irrigation water supplied by public infrastructure is often very cheap, far below market prices. This enables wasteful use and puts environmentally responsible growers that invest in modern irrigation systems at a competitive disadvantage.[11] Public agencies that supply irrigation water must charge market prices to make crop irrigation sustainable.

End irrigation subsidies that incentivize unsustainable cropping decisions: Low value crops (e.g. Alfalfa and other forage) that require large amounts of water continue to make up a large fraction of California acreage.[12] Alfalfa and other hay crops use about 10% of all irrigation water.[13] Crops like this are profitable only if water is very cheap. As public agencies that deliver irrigation water do so at an unsustainably low price, this constitutes a major subsidy to agribusiness and promotes cropping decisions that would not be made if irrigation water was priced at market rates.[14] Water prices that reflect market value and the true costs of public water infrastructure could encourage selection of more water efficient crops. In addition, winter crops (e.g., winter wheat) that require very little irrigation water would become more attractive in the face of quantity-limited or expensive irrigation water.[15]

Increase irrigation efficiency: Flood and furrow remain the predominant irrigation methods, accounting for 43% of all irrigated acres.[16] However, adoption of drip and micro-irrigation systems has been spreading rapidly, accounting for 39% of irrigated acres. This shift can be attributed partly to federal assistance mechanisms – farmers can benefit from a 50% discount on drip irrigation systems – and partly to the higher efficiency of new irrigation systems. Using these systems can result in increases in efficiency of applied water, from 10% to 20% or more.[17,18]

11. MacKenzie Elmer. These Imperial Valley Farmers Want to Pay More for Their Colorado River Water. Voice of San Diego, 5 Dec. 2022

12. California Department of Food and Agriculture. "Statistics Review 2020-2021"

13. Renee Johnson and Betsy Cody, California Agricultural Production and Irrigated Water Use, Congressional Research Service, June 30, 2015.

14. Ellen Bruno. "Pricing groundwater will help solve California's water problems." Knowable Magazine 12 Oct. 2022.

15.Caitlin Petersen , et. al. "Exploring the Potential for Water-Limited Agriculture in the San Joaquin Valley" Public Policy Institute of California, July 2022

16. Renee Johnson and Betsy Cody, California Agricultural Production and Irrigated Water Use, Congressional Research Service, June 30, 2015.

17. Samuel Sandoval-Solis, Ph.D., et. al. Op. cit.

18. United States Environmental Protection Agency, Water Efficiency Management Guide Landscaping and Irrigation, November 2017. Available at. 19. https://www.greenbuildermedia.com/hubfs/Documents/Irrigation_Study.pdf.

But the impacts on local groundwater basins must be carefully evaluated before implementing high-efficiency irrigation systems, as they can have detrimental impacts on groundwater recharge and can result in greater overall water use.[19]

Employ soil management: The Pacific Institute identifies irrigation technology, irrigation scheduling and regulated deficit irrigation for specific crops as the main water-saving practices in agriculture.[20] However, soil management techniques such as mulching, rotational grazing, cover crops integration, and conservation tillage,[21,22] not only provide significant water savings due to reduced evaporation, they also sequester and store carbon in the soil. Selecting water-efficient crops in arid regions over water-intensive ones is increasingly important as evapotranspiration rates increase due to climate change.

Upgrade agricultural water district infrastructure: To boost water savings, capital investments need to be directed towards upgrading the infrastructure of agricultural water districts. In a district like the Oakdale Irrigation District, in which annual water losses amount to 100,000 acre-feet per year (AFY), with 45-55% of these coming from on-farm losses, reducing water spills by 75% could save 15,000 AFY of water.[23]

Shift land uses: Another way to increase water efficiency in agriculture would be reclaiming and retiring degraded lands on the western side of the San Joaquin Valley to repurpose them for more sustainable uses. Partial or complete fallowing of degraded fields holds a high potential for water conservation. A comprehensive study in 1990 projected a total of 1,000,000 drainage impaired acres of land on the western side of the San Joaquin Valley by 2000.[24] Drainage impaired land has been going out of production. Westlands Water District reported 89,000 acres of retired land in 2006.[25]

20. Heather Cooley et. al., *Agricultural Water Conservation and Efficiency Potential in California*, Pacific Institute and Natural Resources Defense Council, June 2014.

21.Jeffrey P. Mitchell et. al., "No-tillage and high-residue practices reduce soil water evaporation," *California Agriculture* 66(2):55-61.

22.D.G. Sullivan et. al., "Potential impact of conservation tillage on conserving water resources in Georgia," Journal of Soil and Water Conservation, May/June 2007 vol. 62 no. 3 145-152.

23.Deanna Wulff, "California's Choices: Two Big Expensive Tunnels or Just Better Water Management," Bilingual Weekly, March 6, 2012.

24.A Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley : Final Report of the San Joaquin Valley Drainage Program. U.S. Department of the Interior and California Natural Resources Agency, 1990.

24.A Management Plan for Agricultural Subsurface Drainage and Related Problems on the Westside San Joaquin Valley : Final Report of the San Joaquin Valley Drainage Program. U.S. Department of the Interior and California Natural Resources Agency, 1990.

25. Tom Birmingham, Testimony before the House Committee on Natural Resources, Subcommittee on Water and Power, September 21, 2006

The Department of Land Conservation's most recent report found a further net reduction of 276,000 irrigated acres of land in the San Joaquin Valley between 2006 and 2012[26] and a further reduction of almost 71,000 irrigated acres between 2012 and 2014.[27] A consortium of entities could consider buying more drainage-impaired acres of land – and associated water rights. Given its location, adjacent to major interties to the state electrical grid, the land could be used for the development of solar farms.

Assess and manage water transfers: Further legislative efforts should be made to establish and enforce rules and regulations aimed at assessing the environmental and economic impacts of water transfers. Transfers of water from one agricultural district to another (for example from Sacramento Valley to San Joaquin Valley) particularly deserve scrutiny during drought periods, while transfers from agricultural districts to urban agencies should be consistent with regional plans.

Urban Water Conservation

The least expensive, least energy -intensive, and most environmental way to reduce water use is through conservation and public education. With existing technology as well as new landscaping, plumbing, metering, and green building ordinances, water savings in urban areas has increased over the years but we can still do more. The Pacific Institute states that with current technology only, California has the means to save between 2.0 and 3.1 million AFY through urban conservation.[28] Additionally, water efficiency appliances along with conservation contribute to not just water savings but energy savings water affordability, particularly for under-resourced communities. More effort should be made to include renters in water efficiency benefits.

Limit landscaping water use: On average, outdoor water uses accounts for about half of the water consumed in urban areas in the state. In areas such as Los Angeles, that amount increases to around 70%. Since most water use occurs outdoors, there's the potential for even greater water savings there. Water agencies should promote the use of soil-moisture based irrigation systems as well as regionally appropriate native plants. In July 2015, California's governor signed The Model Efficient Landscape Ordinance (MWELO) into law to reduce water use for new landscaping projects with more than 500 square feet of irrigated area, as well as

26. California Department of Conservation, Division of Land Resource Protection, California Farmland Conversion Report, 2015, p. 24

27. California Department of Conservation, Division of Land Resource Protection, *2014-2016 Farmland Conversion Report.*

28. The Untapped Potential of California's Urban Water Supply: Water Efficiency, Water Reuse, and Stormwater Capture, April 2022

landscape renovations greater than 2,500 square feet. Implementation of the new laws have been left to county and local government agencies and enforcement varies throughout the state. The legislature should revisit the existing program and determine if changes are required to ensure it applies to all areas of the state and that it reaches the maximum water savings.

***Capture rainwater*:** Rainwater capture reduces the reliance on potable water for landscaping needs and provides a recharge benefit to underlying groundwater aquifers. While legislation has made it easier and more cost effective to increase rainwater capture,[29] more needs to be done to encourage and help homeowners install rainwater capture systems. Collecting the first quarter inch of rain from a 1,000 square foot roof can produce as many as 150 gallons. If all of the approximately 3.5 million housing units in Los Angeles were to install just one single rain barrel, the city could save approximately 590 AFY of water.

Reuse greywater: Greywater is primarily the byproduct of household water used for washing. This includes water from sinks, showers, bathtubs, and washing machines. With a greywater system, homeowners could reuse up to 80% of this water to irrigate plants and trees within their property, saving up to 50,000 gallons a year.[30] While the permitting process for greywater has been streamlined, interpretation of the codes is often left to individual inspectors. Continued education and resources could lead to greater implementation and water savings.

Fix aging infrastructure: A 2016 Validated Water Audit Data of California Water Utilities states: California water utilities distribute more than 1.2 trillion gallons of water a year to residents (equal to about a fifth of agricultural use), according to government data.[31] At least 7 percent of residential accessed water—or at least 84 billion gallons—is lost to known leaks. [32] If recovered this could provide water for 4 million Californians on an annual basis.[33] In Los Angeles alone, water officials estimate that almost 25 thousand AFY of water is lost to leaky pipes, firefighting, evaporation, theft and other unaccounted losses.[34]

29. In 2012, the Rainwater Recapture Act allowed residential users, and other private and public entities, to capture and use rainwater harvested from rooftops. In 2018, California Proposition 72 allowed Rainwater Capture systems to be added to the value of the home yet be excluded from property tax assessments.

30. Lucy Allen, Juliet Christian-Smith, and Meena Palaniappan, Overview of Greywater Reuse: The Potential of Greywater Systems to Aid Sustainable Water Management, The Pacific Institute, November 2010.

31. United State Geological Survey, **"Estimated Use of Water in the United States County-Level Data for 2015,** ScienceBase-Catalog.

32. With the 7 percent water loss estimated by a sample of 268 water utilities by Kunkel Water Efficiency Consulting, 2018. *Report on the Evaluations of 2016 Validated Water Audit Data of California Water Utilities*. Philadelphia, Penn.: Kunkel Water Efficiency Consulting, April, p. 7.

33.American Society of Civil Engineers, 2017 Infrastructure Report Card

34.Ben Poston and Matt Steven, "L.A.'s aging water pipes; a $1-billion dilemma," Los Angeles Times, February 6, 2015

The Bipartisan Infrastructure Law via the U. S. Environmental Protection Agency allocated $609 million in capitalization grants to California for water infrastructure improvements in 2022. Many leaks go undetected and unreported, though technology is available for early detection. Water districts may be reluctant to find leaks because California law requires districts to report leaks they find and then repair those with water losses greater than "acceptable" loss levels.[35]

Desalinate brackish groundwater: The opportunities are great for providing water supply from brackish groundwater desalination as well as recovering contaminated groundwater. Brackish water desalination can be used to help relieve drought conditions, replace water lost from other sources, and replace water that can be used for river and stream ecosystem restoration. Although most estimate that brackish groundwater desalination will contribute less than 10% of the total water supply needs in California, this still represents a significant portion of the state's water supply portfolio.[36] Currently, there are more than 24 inland brackish water desalination plants in California and more coming online every year. Additional focus should be placed on brackish water desalination as it is generally cheaper and much less energy intensive than ocean water desalination. Newer projects in Antioch (6 million gallons per day or MGD),[37] Camarillo (3.4 MGD)[38] and Los Angeles (WRD 18 MGD)[39] will be adding to California's water portfolio.

Water Reuse and Recycling

By investing in the infrastructure to maximize the amount of recycled water generated and reused while planning for the future of direct potable reuse (DPR), we can increase local water supply significantly, which promotes self-reliance and resiliency. Section 13561.2 of the California Water Code states: On or before December 31, 2023, the state board shall adopt uniform water recycling criteria[40] for direct potable reuse through raw water augmentation. With expected DPR legislation coming in 2023, many cities/water agencies are investing in Pure Water Facilities. The largest of these is a joint partnership between Metropolitan Water District

35.California Leaking: People, Pipes, and Prices By John McKenzie and Richard B. McKenzie

36. Heather Cooley and Rapichan Phurisamban, The Cost of Alternative Water Supply Efficiency Options, Pacific Institute, October 13, 2016.

37. Antioch Brackish Water Desalination Project

38. Brian J Varela, Ventura county Star, November 30, 2021 Camarillo's next wave of water unveiled with long-awaited desalter facility

39. Water Replenishment District's Regional Brackish Reclamation Project

40. National Water Research Institute: California state Water Board division of Drinking Water, Memorandum of Findings Expert Panel Preliminary Findings and Recommendations on Draft DPR Criteria , June 23, 2022

and Los Angeles County Sanitation District, which will produce 150 MGD when completed and provide purified water for up to 15 million people.[41] San Diego's, when completed, will produce 87 MGD.[42]

The 2019 proposed amendment to the State's Recycled Water Policy aims to "increase the use of recycled water...to 1.5 million AFY by 2020 and to 2.5 million AFY by 2030."[43] In 2015 the amount of recycled water used in the state was 714,000 AFY, today it is up to 785,000 AFY with an additional 285,000 AFY of treated wastewater reserved for instream flow and other environmental purposes. This increase is significant but is still below the reuse potential. Southern California is home to the state's more prominent reuse initiatives as compared to the rest of the state.

Orange County's Groundwater Replenishment System (OCGWRS) is one of the largest purification systems for indirect potable reuse in the world and is expanding to produce 130, 000 MGD of indirect potable water in 2023.[44] Sanitation Districts of Los Angeles County (SDLAC) has 10 facilities that recycle water, and during the 2020-2021 fiscal year, SDLAC reused 104,162 AFY of 153,150 AFY, which is at 54.5% operating capacity.[45] Additionally, the Inland Empire and San Diego County utilize various programs to introduce recycled water into their water supplies.

To put things into perspective, the 104,162-acre feet of recycled water beneficially used in FY 20-21 by the Los Angeles County Sanitation District (LACSD) is equivalent to the water supply for a population of 62,497,23 nearly the size of the city of Louisville, KY, the 29th largest city in the U.S.[45] The use of locally produced recycled water reduces the need to pump State Project water over the Tehachapi Mountains at a net energy cost of roughly 3,000 kilowatt-hours (kWh) per acre-foot.[45] Thus, over 312 million kWh of electricity were conserved in FY20-21, equivalent to the annual output of a 35.7-megawatt power plant with the energy equivalent of 169,338 barrels of oil. At $0.15/kWh (based on Southern California Edison residential billing rate), this equates to an annual savings of nearly $46.9 million in electricity. At $73.47/barrel, this equates to an annual savings of approximately $12.4 million in oil.[45] For years, tertiary-treated recycled water has been supplied to a number of reuse sites for fire protection

41. Metropolitan Water District's Pure Water Southern California

42. Pure Water San Diego

43. State Water Resources Control Board, Water Quality Control Policy for Recycled Water, 2018.

44. Orange County Water District's GroundWater Replenishment system (GWRS)

45. Los Angeles County Sanitation District's 32nd Annual Status Report on "Recycled Water Use" FY 2020 – 2021

throughout Los Angeles County. At these existing recycled water use sites, as well as some potential use sites, the fire suppression system is tied into the site's primary source of water, whether it is for irrigation or industrial processes, because of storage and gravity flow requirements for firefighting. Therefore, in many of these cases, a separate potable fire service is not physically possible unless the entire reuse site is converted back to using potable water.[46] To abandon the successful use of recycled water and return to using increasingly scarce potable water is not only in direct conflict with the mandate of the State Legislature, which has declared the use of potable water for such non-potable applications to be a "waste" and a violation of the State Constitution, but also in direct conflict with past emergency drought declarations from the Governor's office in 2014, 2015 and 2021.[47]

Managing Groundwater Sustainably

As noted in the Delta Plan, more than 40% of Californians rely on groundwater for part of their water supply, and many small to moderate-size towns and cities are entirely dependent on groundwater for their drinking water systems. Groundwater is also a critical part of California's water storage.

According to DWR, California's groundwater basins have the capacity to hold somewhere between 850 million and 1.3 billion acre-feet. In comparison, surface storage from all the major reservoirs in California is less than 50 million acre-feet.[48] The state's most significant groundwater use occurs in regions that also rely on water from the Delta watershed, including the San Joaquin Valley, Tulare Lake, Sacramento Valley, Central Coast, and South Coast. The Tulare Lake region alone, in the southern San Joaquin Valley, accounts for more than one-third of the state's total groundwater pumping, according to the Department of Water Resources. [49]

Because of historical groundwater overdraft and resulting land subsidence experienced in these regions, water users switched to using surface water when the Central Valley Project and the State Water Project were completed in the late 1960s. However, groundwater pumping and overdraft became more severe as water demands exceeded available supplies. Satellite imaging published by Jay Famiglietti, of the University of California Center for Hydrologic Modeling, and

46. Los Angeles County Sanitation District': Using Recycled Water For Fire Fighting

47. Los Angeles County Sanitation District': Using Recycled Water For Fire Fighting

48. Source: https://storymaps.arcgis.com/stories/ff075c25b77e4b1d95ce86a82bf0fe96

49.Delta Stewardship Council, Delta Plan, adopted May, 2013

others reveals that the Central Valley lost approximately 25 million acre-feet of stored groundwater during the period of October 2003 to March 2010.[50]

California was one of the last states in the nation to regulate groundwater. Governor Jerry Brown signed major new groundwater management legislation, the Sustainable Groundwater Management Act (SGMA) in September 2014. For the first time in its history, California has a framework for sustainable groundwater management. SGMA empowers local agencies to form Groundwater Sustainability Agencies (GSAs) to manage basins sustainably and requires those GSAs to adopt Groundwater Sustainability Plans for crucial groundwater basins in California.

SGMA requires governments and water agencies of high and medium priority basins to halt overdraft and bring groundwater basins into balanced levels of pumping and recharge. However, the timelines for reaching this new sustainability stretch very far into the future. Under SGMA, the most over-drafted basins should reach sustainability within 20 years of implementing their sustainability plans. For critically over-drafted basins, that will be 2040. For the remaining high and medium priority basins, 2042 is the deadline.

The amount of groundwater that is at risk, and could be used more efficiently, is huge. Although the Bay Delta is a major source of water supply for California (approximately five million AFY), the Bay Del-ta supply is less than the amount of groundwater that is pumped by farmers (approximately eight mil-lion AFY). The State Water Board estimates that more than 30% of California's water for agriculture and urban use is pulled from the ground and reliance on groundwater increases to 40% during dry years when surface water supplies shrink.

The Public Policy Institute of California (PPIC) reviewed 36 plans across 11 overdrawn basins in the San Joaquin Valley, California's largest farming region. It found that those plans rely on boosting water supplies to fix more than three-quarters of their groundwater overdraft and use demand management to fix less than a quarter. This is the exact opposite of PPIC's own estimate of what's a reasonable way to solve that region's problems.[51]

We have a crisis building in the state. Groundwater reserves that could be a critically needed resource in times of drought for both farms and urban customers are shrinking. In 2015, DWR reported that groundwater is being depleted at a rate of 2 to 2.5 million AFY[52] though some

50. J.S. Famiglietti et al, "Satellites Measure Recent Rates of Groundwater Depletion in California's Central Valley", Geophysical Research Letters, February 2011.

51. Source: https://knowablemagazine.org/article/food-environment/2022/pricing-groundwater-will-help-solve-california-water-problems

52. California Department of Water Resources, California Water Plan Update 2013

estimates taking a shorter time period (October 2003 through March 2009) into account put the depletion rate much higher, as high as 4.4 million AFY.[53] The problem is especially critical in the San Joaquin Valley. It is estimated that groundwater reserves are shrinking by 2.5 million AFY in the Central Valley. "That is enough water to supply the needs of nearly 22 million people each year," Famiglietti told the Modesto Bee in November 2013.[54] "People need to truly understand groundwater is disappearing …without intervening, that water is not coming back."

The Sierra Club has the following recommendations to improve California's groundwater management:

Amend the Sustainable Groundwater Management Act (SGMA): SGMA should ensure there is equitable representation on GSA Boards. The timeline for compliance must be accelerated. There needs to be a quicker route for the state to step in when a GSA is not performing. And there should be stricter rules regarding when the state turns over the management to the GSA, once the problems have been solved. SGMA also needs to direct the SWRCB to adopt a regulation with mandatory restrictions on pumping in areas with documented subsidence.

Pass legislation that creates a new framework for aquifer recharge: Legislation needs to direct funding to areas with greatest capacity to recharge aquifers used for domestic and environmental protection purposes. It should require funding awards to be contingent upon groundwater management operations that do not perpetuate damaging pumping levels. Require enforceable intergovernmental agreements that prevent GSAs that manage "sub-basins" from operating in ways that thwart achieving aquifer-wide sustainability and equity goals. Codify that the State Water Board's public trust responsibilities extend to groundwater management.

Adopt new regulations for administration of groundwater basins: New regulations are needed to prioritize management on behalf of domestic well users, small farmers, and groundwater dependent ecosystems. There should be clear timelines for reducing unsustainable extractions and create meaningful penalties for violating those timelines. Regulations need to **prohibit privatization of recharge projects,** including prohibition of conjunctive use recharge projects designed to integrate Sacramento Valley aquifers into the Central Valley wide water supply system.

53. Peter Gleick, Stealing Water from the Future – California's Massive Groundwater Overdraft Newly Revealed, Circle of Blue Water News, December 16, 2009,

54. J.N. Sbranti, "Groundwater levels falling at alarming rate while lawmakers decide what to do," Modesto Bee, November 9, 2013

Impact of Climate Change

One of the predictions about climate change is that California will get more rain overall, but this rain will be less evenly distributed over time.[55] There will be more intense storms with big rainfall years, and longer, more severe droughts. We're already beginning to see this change. One of the worst California droughts and the four biggest rainfall years post-1900 have all occurred since 1980.[56] Our water management and water use will have to change in response.

A key change will be the restoration of our groundwater reserves, which provide crucial supplies in drought, and are a day-to-day water source for many, particularly in disadvantaged Central Valley communities. To do this, we must accelerate the implementation of SGMA and aim for an increase in the current levels of groundwater, not just the avoidance of undesirable results compared against a degraded baseline.

Once our groundwater basins are managed so that no single individual or corporation is able to exploit them, we can ramp up efforts to restore our groundwater with the water from big rainfall years that climate change will bring.

Financing

A white paper on alternatives to the Delta tunnel proposal would be remiss if it did not address alternative ways to spend the huge amount of money it will take to build the tunnel. The only official estimate, a cost of approximately $17 billion in 2016[57] is completely out of date. First, the current project is different. Second, inflation is now running much higher than it was when the last cost estimate was generated, especially in the construction industry.

A key issue in financing this project is that it will not produce one drop of new water. It will only, at best, facilitate the conveyance of water around the Delta which is currently conveyed through the Delta. Every one of the alternative approaches discussed above has the potential to add some new amount of water to California's portfolio of sources. The Sierra Club believes that it is in the best interests of the state to examine the costs and benefits of implementing the above strategies, versus the costs and benefits of the proposed Delta tunnel.

55. U.C. Riverside, "Global warming, El Niño could cause wetter winters, drier conditions in other months," AAAS Eureka Alert, September 4, 2018

56. NOAA National Centers for Environmental Information data mapper

57. Mariah, Restore The Delta, August 30, 2017, California WaterFix: The Real Costs, Choices and Criticisms

Focus on smaller scale projects: Spending the state's precious treasure on projects which increase the total amount of water is the more prudent approach. Advantages to small projects:

- ➢ The size of each project.
- ➢ Less time elapsing until implementation.
- ➢ Lower costs because short-term financing costs are typically lower than longer-term.
- ➢ Shorter time frames and less complexity, leading to fewer cost overruns and more accurate estimating.
- ➢ Frequently provides more local jobs and greater local economic benefits dispersed around the state

All of the alternatives listed have real-world examples currently operating today, thus providing a robust data set for implementation and operation that does not exist for the Delta tunnel proposal.

California's water managers need to **abandon** their "tunnel vision" and instead focus on all of the ways the state can improve its use of nature's bounty. Spending untold billions on a huge project which does not produce one drop of new water, but **does create irreparable environmental and socio-economic harm,** is a waste of everyone's dollars, no matter who is paying for it.

The State should determine the cost per acre-foot per year to produce the new water from each specific source.

- ➢ ***Brackish water desalination*** **-** The City of Antioch[58] has begun the construction of a brackish water desalination plant. The results of their bidding process could provide an estimate for the construction cost of the reclaimed water per acre-foot.
- ➢ ***Urban water recycling*** **-** The City of San Diego[59] invested in a substantial water recycling project of which Phase 1 is now under construction. Since June 2011, the city has produced 1 million gallons of purified water every day at its Pure Water Demonstration Facility.[60] Actual construction and operational costs are available, allowing finance experts to calculate the cost of the new water source per acre-foot.

58. Antioch Brackish Desalination Project

59. City of San Diego: Pure Water San Diego

60. City of San Diego: Pure Water San Diego Program Fact Sheet

- ***Fixing aging infrastructure*** - Every leak fixed is a new source of water, but will require investment. Cost per leak will vary significantly, but it is possible to estimate averages for agricultural and urban repairs.
- ***Stormwater capture -*** The County of Los Angeles has embarked on an ambitious plan, The Safe Clean Water Program[61] which could be used as a model for other counties.
- ***Conservation*** - Substantial research exists for what it has cost urban areas to reduce their per capita water consumption. Efficient fixtures never use more water once installed, and the replacement costs are low compared to the long-term water savings generated.
- ***Funding opportunities through U.S. government programs*** - Water reuse and recycling programs funded by the U.S. Bureau of Reclamation is one example.

In Conclusion

Notably, these local and regional approaches to improve water efficiency and conservation create good jobs. In a 2011 report, the Economic Roundtable estimated that water efficiency measures in Los Angeles creates more jobs per million dollars invested than either motion picture and video production or housing construction.

The State of California already acknowledges the feasibility of these conservation programs. However, the political will to fund and implement them on a wide scale throughout the state is lacking. As noted in the 2013 Delta Plan, adopted by the Delta Stewardship Council, the Department of Water Resources estimates that the state could reduce water demand and increase water supplies in the range of five to ten million acre-feet per year by 2030 through the use of existing strategies and technologies If the state developed only half this water (about five million acre feet) through water efficiency and new local supplies, it would be sufficient to support the addition of almost 30 million residents, more than the population growth that is expected to occur by 2050. This means that water savings from water reclamation and other programs yields approximately as much "new water" savings as is currently exported from the Bay Delta.

California's water supply problems can be addressed without building the Delta Conveyance.

61. Los Angeles County's Safe Clean Water Program (Measure W)

Photo: CA Department of Fish and Wildlife

Exhibit 5

Department of Water Resources

Its Forecasts Do Not Adequately Account for Climate Change and Its Reasons for Some Reservoir Releases Are Unclear

May 2023

REPORT 2022-106

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Grant Parks *State Auditor*

May 25, 2023
2022-106

The Governor of California
President pro Tempore of the Senate
Speaker of the Assembly
State Capitol
Sacramento, California 95814

Dear Governor and Legislative Leaders:

As directed by the Joint Legislative Audit Committee, my office conducted an audit of the Department of Water Resources (DWR) and the State Water Resources Control Board. Our assessment focused on DWR's water supply forecasting and surface water management, and we determined that DWR has made only limited progress in accounting for the effects of climate change in its forecasts of the water supply and in its planning for the operation of the State Water Project. Until it makes more progress, DWR will be less prepared than it could be to effectively manage the State's water resources in the face of more extreme climate conditions.

DWR is responsible for developing water supply forecasts that are important to both state and local efforts in managing California's finite water resources. Despite acknowledging more than a decade ago that it needed to adopt a new forecasting method that better accounts for the effects of climate change, DWR has continued to rely heavily on historical climate data when developing its forecasts. In fact, in water year 2021, DWR significantly overestimated the State's water supply—an error that DWR attributed to severe conditions due to climate change. DWR has since begun planning to adapt its forecasting model and associated procedures, but it could better ensure that it is using the best approach available if it adopted a formal process for evaluating the quality of its forecasts.

Large numbers of California's residents and much of its agriculture depend on DWR's effective management of the State Water Project. Although researchers project that climate change will significantly challenge the project's operations, DWR has not developed a comprehensive, long-term plan for the State Water Project that meets best practices for proactively mitigating or responding to drought—particularly more frequent or more severe future droughts. Further, DWR has not maintained sufficient documentation to demonstrate that some releases it made from the Lake Oroville reservoir in water years 2021 and 2022 were appropriate in volume. DWR's limited documentation in this key operating area impairs its capacity to demonstrate adequate stewardship of the State Water Project. Insufficient documentation also hinders DWR's ability to effectively evaluate and, to the extent necessary, improve its management of the State Water Project to ensure the most efficient use of the State's limited water supply.

Respectfully submitted,

GRANT PARKS
California State Auditor

Selected Abbreviations Used in This Report

CNRFC	California Nevada River Forecast Center
DWR	Department of Water Resources
FEMA	Federal Emergency Management Agency
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
NDMC	National Drought Mitigation Center
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service

Contents

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Summary

Climate change has had significant ramifications for the State's water supply, and researchers project that its effects will increase in the future. Nonetheless, the Department of Water Resources (DWR) has been slow to account for the effects of climate change on key responsibilities related to managing the State's water resources.

For example, one of DWR's responsibilities is to develop water supply forecasts on which both state and local water agencies rely. However, DWR has not adequately ensured that its forecasts account for the effects of climate change. Similarly, it has not developed a comprehensive, long-term plan for managing the State Water Project—a water storage and delivery system that collects surface water from the northern part of the State and delivers it to both the Bay Area and Southern California—during periods of more severe future drought. Addressing these issues will better prepare DWR to more effectively manage the State's water resources in the face of increasingly extreme conditions.

DWR Has Not Adequately Ensured That Its Water Supply Forecasts Account for the Effects of Climate Change

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In water year 2021, DWR significantly overestimated the State's water supply. For example, in its February median forecasts, DWR projected that runoff would be at least twice the volume that actually occurred in the majority of watersheds for which it produces forecasts. Significant errors in DWR's forecasts can affect state and local efforts to effectively manage the water supply, in part because of operational requirements tied to the forecasts. DWR attributed its error to the extreme conditions brought on by climate change. However, DWR has continued to rely heavily on historical climate data when developing its forecasts, despite its own acknowledgment more than a decade ago that its forecasting methods needed to better account for the effects of climate change. DWR's limited progress in adopting a new forecasting model and related procedures stands in contrast to the efforts of other agencies we reviewed. Although those agencies' specific forecasting models differ, each directly incorporates observed or modeled data that is relevant to climate change, such as temperature and soil moisture. Following the significant error in its water year 2021 forecasts, DWR developed a plan to make its forecasting more resilient to the effects of climate change, and DWR has entered into various contracts for technical assistance to improve its forecasts. However, if DWR also adopted a formal process for evaluating the quality of its own forecasts, it would be better positioned to ensure that it is using the best forecasting approach available.

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DWR Must Do More to Prepare for the Impact of More Severe Droughts on the State Water Project's Operations

DWR has not developed a long-term plan for the State Water Project that aligns with best practices for proactively mitigating or responding to drought. In particular, although DWR has published strategies for responding to immediate conditions after droughts have begun, it has not developed comprehensive plans to respond to the effects that more severe future droughts may have on State Water Project operations. Such a plan could, for example, take into account the project's ability to meet water quality and flow standards for the protection of wildlife in the face of more extreme conditions. In addition, DWR has not maintained sufficient documentation explaining how it decided that significant releases it made from its Lake Oroville reservoir in water years 2021 and 2022 were appropriate in scale. Improved recordkeeping would better position DWR to explain its decision making to water stakeholders and the general public as well as allow it to more consistently and reliably evaluate its release decisions and improve its future operations.

Agency Response

DWR generally disagrees with our report findings and recommendations. Specifically, DWR does not believe it has been slow to account for climate change in its forecasts, does not believe it lacks a comprehensive, long-term plan for responding to droughts, and does not believe it lacks sufficient records demonstrating the need for certain water releases from the State Water Project. Further, it believes many of our audit's recommendations will add an additional layer of processes and procedures that it equates to "paperwork."

Recommendations

The following are the recommendations we made as a result of our audit. Descriptions of the findings and conclusions that led to these recommendations can be found in the sections of this report.

DWR

To ensure that its B120 water supply forecasts are as accurate as possible, DWR should implement a forecast verification process by November 2023 that includes the following:

- An annual evaluation of the accuracy of each of its monthly forecasts using multiple means in accordance with best practices, including an assessment of whether actual runoff fell within its probability range and an assessment of the accuracy of its median forecast.
- Identification of the likely causes of greater-than-expected forecast errors.
- An annual assessment of opportunities for improvement and enhancement, including identifying and evaluating available and emerging forecasting technologies.
- The development and implementation of plans to improve its forecasts based on the findings from its annual evaluation.
- Annual reporting on its water supply forecasting web page about the above actions so that the public is aware of the steps it is taking to improve and enhance the accuracy and predictive capability of its forecasts.

To ensure that its water supply forecasts better account for the observed effects of climate change as soon as possible, DWR should continue to implement its plan to adopt an updated water supply forecasting model and updated procedures. By November 2023 DWR should also do the following:

- Publish on its website a timeline affirming when it will implement its updated model and procedures across all of the watersheds for which it produces a water supply forecast.
- Establish and publish the specific criteria that it will employ to determine when its updated model has demonstrated sufficient predictive capability to be ready for use in each of the watersheds.
- Provide annual updates on its website regarding the status of its implementation of the updated model and procedures.

To better prepare to effectively manage State Water Project operations during future, possibly more extreme drought periods, DWR should, by May 2024, develop a long-term plan for proactively mitigating and responding to the impacts of drought on the project. In accordance with drought preparation best practices, DWR should include the following components in the plan:

- An assessment of the potential impacts of drought on the State Water Project that accounts for the possibility that climate change may result in more severe droughts.
- An assessment of DWR's current capability to address those potential impacts, as well as the identification of any steps that DWR must take to gain needed capabilities.
- Specific strategies for operating the State Water Project to mitigate and respond to the identified impacts of drought while still achieving the project's objectives.
- A description of the circumstances that would trigger DWR to begin implementing its drought response strategies.
- Provisions requiring DWR to update the drought plan at least once every five years and also after each drought to incorporate lessons learned.

To ensure that it can demonstrate effective oversight of State Water Project operations and efficient use of the project's water supply, DWR should, by May 2024, develop and implement a policy and set of procedures for documenting the following:

- Its monthly and annual plans for operating the State Water Project, including the amount of water that it intends to release, store, and export.
- The rationale behind its plans and an explanation of how the plans will help it to achieve the project's objectives.
- A description of any changes that it makes during its operations that deviate from its plans.
- The rationale for any changes that it makes, including the conditions that led to the change, the specific reason for the change, and any viable alternatives that it considered.
- The degree to which it succeeds in achieving each of the project's various objectives on a monthly and annual basis.

To ensure that its operation of the State Water Project reflects the possibility of more extreme climate conditions, DWR should, by May 2024, evaluate the data and information that it relies upon in its monthly and annual planning for its Lake Oroville reservoir operations, including the volumes of water that it will need to store to achieve its objectives. It should update the data and information as needed.

To ensure that it continually improves the effectiveness of its management of the State Water Project, DWR should develop and implement a formal, written process for reviewing its planning and operations at least once annually. This process should include the following:

- An assessment of DWR's success at achieving each of the project's various objectives.

- An evaluation of DWR's actions to achieve its objectives, including the decisions that it made in its planning and in its day-to-day management of the project. DWR should identify actions that assisted it in achieving its objectives and that would benefit its operations in the future, as well as actions that were less effective.

- Documentation of lessons learned from the evaluation of its actions and, if necessary, updates to its planning or procedural documents to incorporate changes.

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Introduction

Background

State law requires the Department of Water Resources (DWR) to develop annual forecasts of the State's seasonal water supply, which DWR does each water year.[1] Surface water—supplied by runoff from rain and snowfall—makes up a significant proportion of the water that California uses for agricultural, residential, municipal, and industrial purposes. During winter storms, snow accumulates in the mountains, generally reaching its highest total amounts in early April. In the spring and summer, the snow melts, running down the mountains and flowing into rivers and streams. Some of this water makes its way into reservoirs. DWR's forecasts of the water supply have important implications for water management for many parts of the State.

DWR's Statewide Water Supply Forecasts

As Figure 1 shows, DWR provides water supply forecasts for various watersheds across the State.[2] From February through May, DWR's Snow Surveys and Water Supply Forecasting unit (forecasting unit) issues a monthly publication called the *Bulletin 120* (B120). The B120 presents DWR's forecasts of the total surface water that it predicts will run off through each watershed from April through July. As we describe in more detail later, DWR generally bases those forecasts on rain, snow, and runoff. As part of doing so, it obtains data on snow through measurements of the snow in the Sierra and Shasta-Trinity mountains, via the California Cooperative Snow Surveys program (Snow Survey). Led by DWR, the Snow Survey is a collaborative effort among local, state, federal, and private entities that involves the periodic measurement of snow levels at predetermined locations.

When publishing its B120 forecast, DWR provides both its *median* forecast and its *80 percent probability range* (probability range). The median forecast represents roughly the midpoint in the probability range. The probability range represents broader parameters for possible runoff with an expected 80 percent chance that the runoff will fall somewhere within it. For example, DWR's March 2021 median forecast of the total inflow to the Lake Shasta reservoir was 1.2 million acre feet of water, and its probability range projected an 80 percent chance that the total inflow would be from 0.97 million to 1.52 million acre feet of water.

According to DWR, the B120 forecast is a key tool for water managers across the State, and it has important legal impacts for water rights holders. The text box includes examples that DWR has identified of water forecasts' uses. Moreover, DWR's B120 forecasts affect requirements for state, federal, and certain local water agencies, such as the volume of water

Examples of How DWR's Water Supply Forecasts Are Used

Agricultural

- Determining crop planting patterns.
- Developing irrigation schedules.
- Evaluating the need to pump ground water.

Municipal

- Evaluating city and county water supplies.
- Informing water conservation decisions.

Public Utilities

- Determining the percentage of energy generation that will be hydro power.

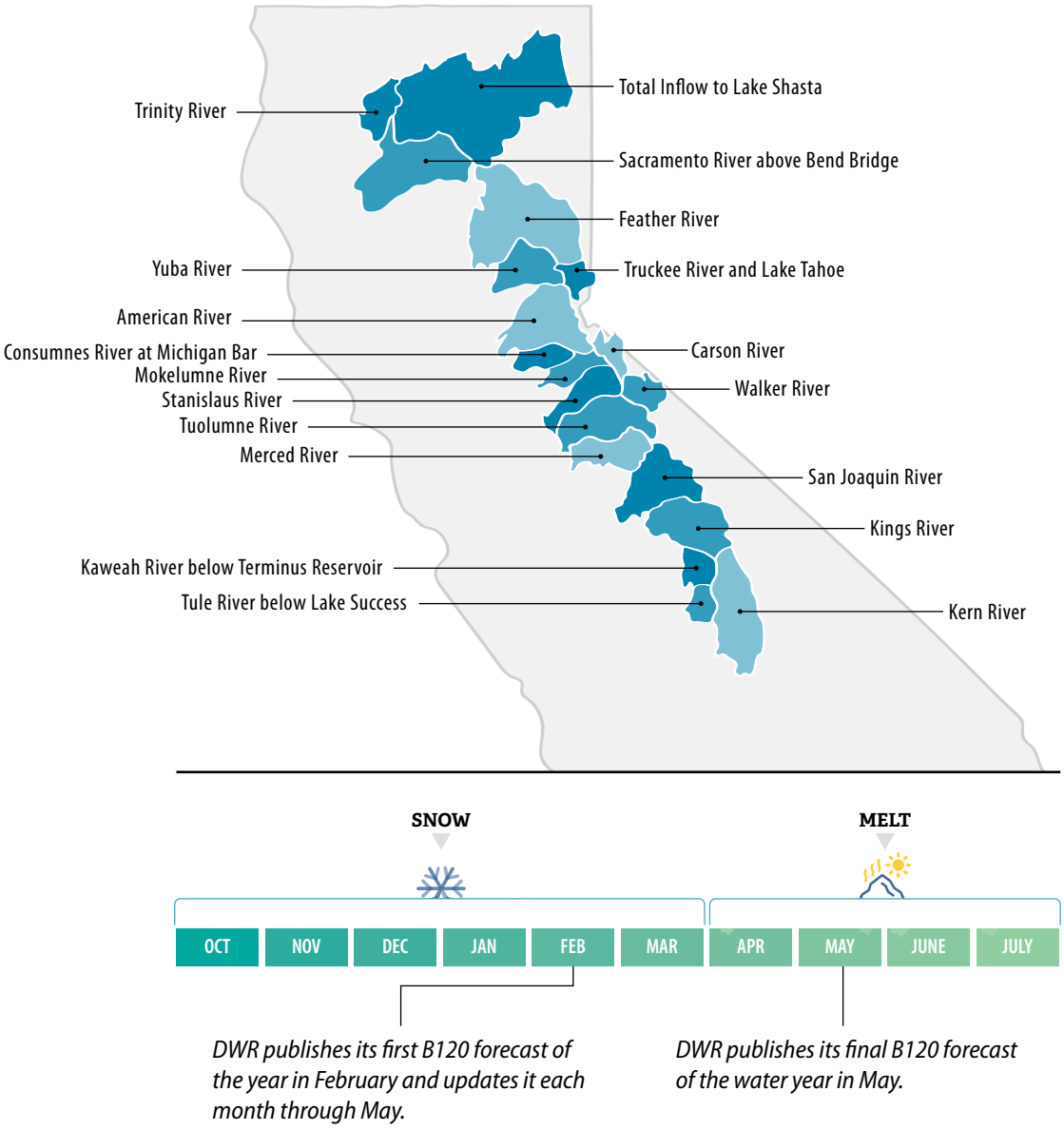
Source: DWR.

[1] A water year runs from October 1 through September 30 and is labeled by the year in which it ends. For example, water year 2022 began on October 1, 2021, and ended on September 30, 2022.

[2] A watershed is the land area from which water drains into a stream, river, or reservoir.

they must release from reservoirs. Some of these requirements are affected specifically by the B120's median forecast. Thus, variances between DWR's forecasts and actual runoff can affect water management in the State.

Figure 1
From February Through May, DWR Publishes B120 Water Supply Forecasts for Watersheds Across the State



Source: DWR water supply forecasting documentation.

DWR's Administration of the State Water Project

In addition to providing forecasts of the State's surface water supply, DWR manages the State Water Project, a multipurpose water storage and delivery system made up of canals, pipelines, and reservoirs. The State Water Project delivers water through contracts DWR has with 29 cities, counties and water districts, known collectively as *State Water Project contractors*. The State Water Project collects surface water from the northern part of the State in the project's largest reservoir, Lake Oroville. From there, water flows through the Feather and Sacramento rivers into the Sacramento-San Joaquin Delta (Delta). The State Water Project captures water from the Delta by exporting it via pumping plants and conveys it through several facilities to State Water Project contractors. In total, the State Water Project supplies water to almost 27 million Californians and 750,000 acres of farmland.

As Figure 2 shows, various legal obligations affect DWR's operation of the State Water Project. For example, DWR holds contracts with various water rights holders that require DWR to provide those water rights holders with specified amounts of water each year, depending in part on the water supply. Moreover, federal law requires DWR to operate the Lake Oroville reservoir, in part, for flood control purposes by reserving a certain amount of storage space in the reservoir for flood control.

In addition, important requirements related to water quality and flow in the Delta also affect DWR's operation of the State Water Project. The Legislature has declared that the Delta is a critically important natural resource for the State and the nation, noting that it serves as both the hub of the California water system and the most valuable estuary and wetland ecosystem on the west coast of North and South America. Moreover, the Delta provides habitat to threatened and endangered species, such as the Delta smelt and the Chinook salmon. Given the Delta's importance, the State Water Project is subject to a number of requirements to ensure proper flow and water quality in the Delta, such as ensuring that the concentration of salt (salinity) remains below thresholds established to protect agriculture and wildlife.

The federal Bureau of Reclamation (Reclamation) operates the related Central Valley Project, which delivers water in 29 counties in the State for agriculture, municipal and industrial use, and wildlife refuges. Reclamation shares responsibility with DWR for meeting Delta water quality and flow requirements, which both agencies may do by making releases from reservoirs and adjusting the amount of water that they pump from the Delta. To meet the water quality and flow requirements, the two agencies must coordinate their efforts.

Figure 2
Multiple Legal Obligations Affect DWR's Operation of the State Water Project

DWR and Reclamation are able to pump some of the water out of the Delta to supply State Water Project and Central Valley Project contractors. The amount they can pump depends, in part, on water quality, Delta outflow requirements, and protected wildlife conditions.

Additional contracts require DWR to provide water to various water rights holders.

Federal law requires the department to operate Lake Oroville reservoir partly for flood control purposes, which may necessitate releases to provide adequate space in the reservoir to guard against flooding.

Delta water quality and outflow standards may require releases from Lake Oroville to ensure proper flow and water quality for agricultural, municipal, and industrial uses and for the protection of wildlife.

Regulatory licenses or agreements may require DWR to release water from Lake Oroville to protect wildlife.

Source: Federal and state law; DWR licenses, permits, and agreements with water rights holders or federal or state entities; and the *Department of Army Report on Reservoir Regulation for Flood Control for the Sacramento River Basin*.

The Role of the State Water Board

The State Water Resources Control Board (State Water Board) also plays a role in managing water in the State. State law gives the State Water Board responsibilities that include administering water rights and coordinating and controlling water quality. Consequently, the State Water Board established several of the standards that affect DWR's and Reclamation's operation of the State Water Project and Central Valley Project, respectively, including those related to Delta outflow and water quality.[3] The State Water Board does not participate in DWR's development of water supply forecasts. However, several of the water quality standards that the State Water Board has established and that affect the State Water Project and Central Valley Project are connected to DWR's B120 water supply forecasts: during various times of the year, the particular water quality or outflow standard that the State Water Project and Central Valley Project must meet is determined in part by those forecasts. In other words, the State Water Project and Central Valley Project may need to adhere to different standards, depending in part on the amount of water that DWR forecasts in the B120.

The Effects of Climate Change on California's Water Supply

The increasing effects of climate change have had ramifications for the State's water supply. Over the last 15 years, the State has experienced extreme weather conditions, including multiple droughts and periods of flooding. In October 2022, DWR reported that water years 2020 through 2022 represented the driest three-year period on record, breaking the record previously established from 2013 through 2015. The severity of the drought led the Governor to proclaim a state of emergency in October 2021, and the State Water Board issued orders imposing water rights curtailments. These temporary curtailments prohibited various water rights holders from diverting water when the Board determined that the water supply was insufficient to support their particular water rights. Further demonstrating the potential for sudden and significant shifts in weather conditions, the unusually dry conditions from 2020 through 2022 have been followed by significantly higher-than-average precipitation and snowpack during water year 2023, as well as storms and flooding.

Climate researchers project that the effects of climate change will continue to increase, causing greater fluctuation in rainfall patterns and severe weather—including prolonged drought. Hotter temperatures dry out the soil through increased evaporation and reduce the amount of snow in the mountains, both of which can lessen the subsequent spring runoff. At the same time, DWR has projected that rising sea levels could increase the intrusion of salt into the Delta, requiring the release of more water to protect water quality. In an October 2008 report, DWR stated that climate change had already had a profound impact on water resources, and it pledged to play a leadership role in adapting to those impacts.

[3] For the sake of simplicity, we use the term "standards" throughout this report to refer to water quality standards and objectives implemented by State Water Board Decision 1641 and certain other requirements governing State Water Project operations.

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DWR Has Not Adequately Ensured That Its Water Supply Forecasts Account for the Effects of Climate Change

Key Points

- In water year 2021, DWR significantly overestimated the water supply as late as its April B120 forecasts. Large errors in DWR's forecasts can affect state and local efforts to effectively manage the water supply.
- Despite acknowledging the need to do so more than a decade ago, DWR has not fully updated its forecasting model and related procedures to better account for the effects of climate change. Some other federal and local agencies use models that directly account for factors that are relevant to climate change, such as temperature and soil moisture.
- DWR lacks a formal process for evaluating its forecasting model. Such a process could help DWR identify opportunities to improve the model and related procedures to produce more accurate forecasts.

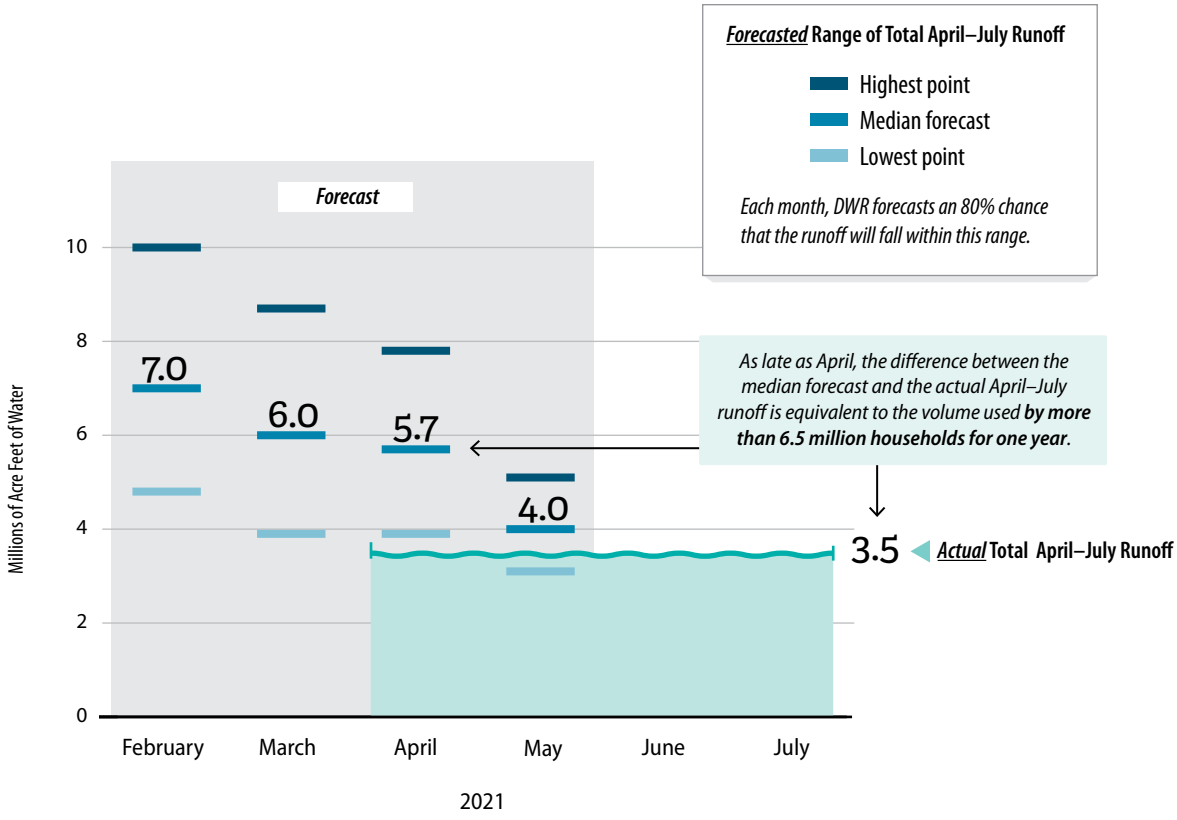
DWR Significantly Overestimated the 2021 Water Supply

For water years 2017 through 2021, we reviewed DWR's B120 forecasts of the total April through July runoff in each watershed for which it develops forecasts. In water year 2021, which DWR later noted was an extreme year, DWR's median forecasts in its initial February B120 report projected that runoff would be at least twice the volume that actually occurred for the majority of those watersheds. This average error rate of more than 100 percent, as measured across all of the forecasts that we reviewed, was significantly higher than the average error rate of DWR's median forecasts during the previous four years, which ranged from about 20 percent to about 50 percent.

As an example, Figure 3 displays the error rate in DWR's 2021 median forecasts for two important regions—Sacramento and San Joaquin. Together, these two regions help supply fresh water, via the Delta, to two-thirds of the State's population, as well as to thousands of square miles of agriculture. As the figure shows, DWR's error rate was still significant as late as April 2021, a month before its final B120 forecast. In fact, even the lower limits of DWR's probability range at that point overestimated actual runoff by 385,000 acre feet. The actual runoff did not fall within DWR's probability range until it further reduced its forecast for its final B120 in May.

Figure 3
DWR Significantly Overestimated the State's 2021 Water Supply as Late as April 2021

The chart below shows the magnitude of the errors in DWR's forecasts for two key regions, the Sacramento Valley and San Joaquin Valley.



Source: DWR's water supply forecasting procedures, B120 water supply forecasts, and actual runoff calculations.

As we describe in the Introduction, the volume of runoff DWR projects in its B120 forecasts can affect the State Water Project's releases of water to protect water quality and its determinations about how much water will be provided to certain water rights holders. We reviewed a range of State Water Project requirements that are influenced by the B120 forecasts, including several that are affected in particular by DWR's median forecast. In general, the latter requirements are determined by a calculation called the *Sacramento Valley Water Year Hydrologic Classification Index* (Sacramento Valley Index), which DWR publishes in its February B120 forecast and updates each month through May. DWR calculates the Sacramento Valley Index according to measured and estimated current water year runoff, the previous water year's Sacramento Valley Index, and the median forecast for four locations in the Sacramento River region. This calculation results in a classification for the water year—such as *wet*, *dry*, or *critical*—that in turn triggers certain water management requirements.

Despite the high error rate in DWR's forecasts for water year 2021, the error rate did not ultimately affect the Sacramento Valley Index water year classification and the corresponding requirements on the State Water Project. Due to dry conditions during water year 2020, which were present again as of February of water year 2021, DWR's initial B120 forecast included a Sacramento Valley Index classification of *critical* for the year—the lowest classification in terms of runoff. DWR's subsequent downward revisions to its forecasts did not change the water year classification because DWR was already expecting the water year to be in its lowest tier. Therefore, DWR's forecasting error fortunately did not result in a misclassification of the water year that would have required the State Water Project and Central Valley Project to meet stricter Delta water quality and outflow standards. However, under different circumstances, the magnitude of DWR's forecasting error could have led to a misclassification of the Sacramento Valley Index, thereby potentially requiring the projects to release more water from their reservoirs or export less water from the Delta. As we discuss later in the report, we identified months in water year 2021 during which DWR released more water than required by certain water flow standards, but for which it could not provide sufficient documentation to explain.

Inaccuracies in DWR's B120 forecasts can also affect some local water agencies' management of their own reservoir water supply. For example, we reviewed three federal hydroelectric project-related licenses that require certain local dam operators to maintain a minimum amount of streamflow for the protection of wildlife, based on particular DWR forecasts. Maintaining that minimum streamflow may require the dam operators to release certain volumes of water, and generally, higher forecasts dictate higher required releases of water. In all three licenses, the requirements on dam operators are affected not just by DWR's May B120 forecast, but also by its earlier forecasts. In two of the licenses, requirements are based specifically on DWR's median forecasts—one on the February B120 forecast and the other on the April B120 forecast.

DWR's water year 2021 forecast error affected at least some local water agency requirements. El Dorado Irrigation District's license to operate its hydroelectric project establishes the minimum streamflow requirements from the district's dams according to DWR's monthly median forecasts of inflow into Lake Folsom, starting with its February B120 forecast. DWR's overestimation of the inflow for Lake Folsom established higher required streamflow levels for El Dorado Irrigation District's operations than would have been required if DWR's forecast had been more accurate. The director of operations for the district indicated that, because of DWR's April 2021 overestimation of projected runoff, the district had to forego diverting water into storage that it would have otherwise been able to capture in its reservoir. He estimated that the district was unable to divert 925 acre feet of water, or about the amount of water used by 2,750 households over a full year. As this example demonstrates, significant errors in DWR's forecasts can affect other entities' efforts to effectively manage the State's finite water supply.

When explaining the inaccuracies in its 2021 forecasts, DWR referenced the effects of climate change. In a September 2021 report about water year 2021, DWR noted that, although snowpack levels were about 60 percent of average, the ultimate streamflow within major Central Valley watersheds was significantly lower than the amount of snow would suggest. The report further explained that prolonged warm and dry conditions created a moisture deficit in the climate system, reducing runoff efficiency. The manager

of DWR's hydrology section also explained to us that wildfires and hot, dry conditions in 2020 dried the soil and cleared a lot of vegetation. He indicated that, as a result, the soil absorbed the 2021 spring snow melt and that much of the winter snowfall did not make it down the mountains to flow into rivers and reservoirs. In May 2021, DWR rapidly decreased its forecasts by more than 25 percent from its April levels and noted that runoff to date had been significantly below average.

As we acknowledge in the Introduction, hotter temperatures and extreme weather conditions have affected the State's water supply. Indeed, DWR publicly reported that its significant overestimation in its spring 2021 forecasts illustrates the importance of shifting away from its statistical approaches that rely on a historical record that is no longer reflective of observed conditions. However, as we describe in the following section, DWR has made only limited progress toward adopting and implementing a forecasting model that can better account for the effects of a changing climate.

DWR Has Not Fully Implemented Changes to Its Water Supply Forecasting Model and Procedures to Account for the Effects of Climate Change

DWR has known for over a decade that it must adjust its surface water forecasting methods to account for the effects of climate change. In an October 2008 report on climate change adaptation strategies, DWR stated that climate change was already affecting the State's water resources and increasing uncertainty for the water supply. The report specifically cited the State's changing rain and runoff patterns. DWR further explained that historical patterns could no longer be solely relied upon to forecast the water future and that, going forward, water supply forecasting model calibration must happen more frequently and new forecasting tools must be developed. DWR concluded that a standard of practice that explicitly considers climate change must be adopted. Similarly, DWR noted in a 2018 presentation that its forecasting errors had increased for most basins between 1997 and 2018. DWR once again referenced climate change, indicating that it might be causing the increasing errors.

However, DWR still has not fully adopted a new model and associated procedures for developing its B120 water supply forecasts.[4] DWR's current model is a statistical equation that uses the most recent data DWR has on observed precipitation, snow levels, and runoff. DWR also incorporates estimates of likely future precipitation, snow, and runoff until observed data becomes available. DWR generally uses historical medians to develop its future estimates, entering the observed and estimated data into a statistical equation that predicts the total amount of runoff based on historical runoff patterns. As a result, DWR's forecasting model relies heavily on historical weather and runoff behaviors.

In contrast to DWR, some local and federal agencies use forecasting models that leverage additional data that may allow them to better account for the changing climate and its effects on the water supply. We reviewed the water supply forecast

[4] At the end of April 2023, DWR stated that it was continuing to make progress on its efforts toward fully adopting new forecasting procedures during the current water year; however, because of the timing of this information, we will assess its progress when DWR provides its updates on the implementation of our recommendations.

models used by four other agencies: the Turlock Irrigation District (Turlock), the San Francisco Public Utilities Commission (San Francisco), the Merced Irrigation District (Merced), and the California Nevada River Forecast Center (CNRFC).[5] Although the specific models the agencies use differ, each agency's model incorporates observed or modeled data that is relevant to climate change, such as temperature and soil moisture. DWR's forecasting model does not incorporate modeled or observed data on those same factors.

As part of our review of other agencies' forecasting models, we compared the accuracy of their forecasts to DWR's forecasts for water years 2017 through 2021, to the extent that they were available. Of the four agencies we reviewed, two could provide records of their historical water supply forecasts from before water year 2022: CNRFC and Turlock.[6] We reviewed the median forecasts that the two agencies provided and found that both agencies overestimated the 2021 water supply and that Turlock did not have consistently lower error rates than DWR. Although CNRFC's initial forecasts for the five years we reviewed started out with roughly the same average error rate as DWR's, CNRFC's forecasts became more accurate than DWR's in subsequent months, as Figure 4 shows. For example, in water year 2021, CNRFC adjusted its forecasts downward during the water year to account for the dry conditions much more quickly than DWR did.

Email records from March 2021 show that DWR staff contacted CNRFC to understand why its forecasts were so much lower than DWR's. Through those emails, CNRFC staff explained to DWR that the difference was likely because CNRFC's forecasting model accounted for the abnormally dry soil moisture levels in the State. CNRFC uses a model called the *hydrologic ensemble forecast service* that incorporates observed and forecasted data, including precipitation and air temperature, and also accounts for other hydrologic processes, such as soil moisture and the effect of rain on snow. The emails further show that in response to the information from CNRFC, DWR attempted to adjust its own model to account for the soil moisture data but struggled to do so—likely because its model is not designed to directly incorporate those data.

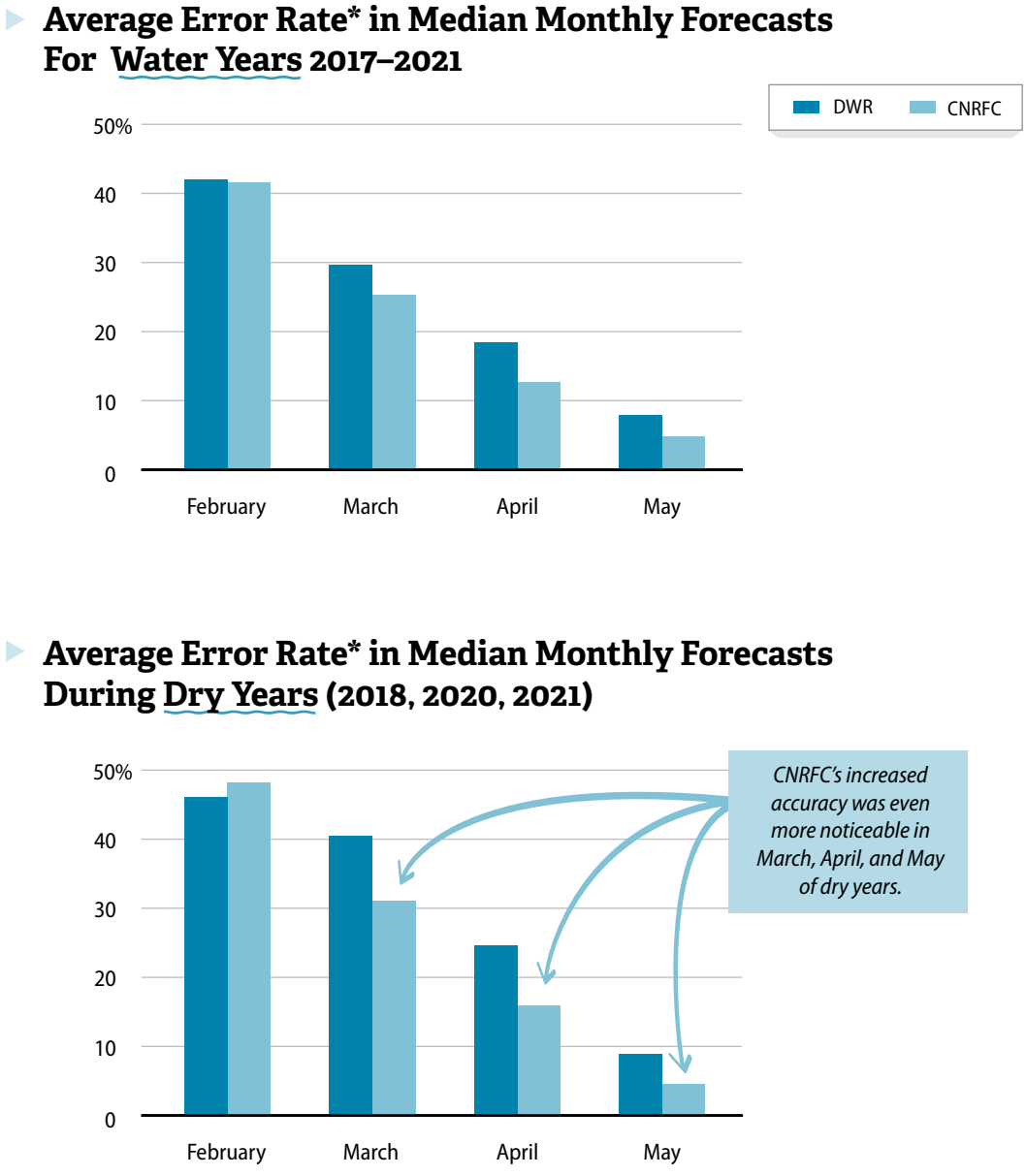
Although other agencies have incorporated additional data into their forecasting, DWR has made only limited progress toward adopting and implementing a forecasting model that can better account for the effects of a changing climate. In response to our request for records related to its efforts to adapt its forecasting model, staff at DWR pointed us to multiple different models and collaborative efforts with the University of California (UC) and other entities. However, the majority of these efforts either focused on evaluating or developing models for other purposes, such as predicting extreme flooding events, or began after the water year 2021 forecasting season. In fact, the records we reviewed suggest that before water year 2021, DWR made only one formal attempt to adopt another water supply forecasting model. Specifically, in 2010 it contracted with the U.S. Geological Survey (Geological Survey) to, among other things, develop new forecasting models for selected watersheds.

[5] CNRFC is a field office of the National Weather Service, which is an agency of the National Oceanic and Atmospheric Administration.

[6] At the time of our audit, San Francisco was still in the process of calibrating its new model and had not yet transitioned completely to using it to produce its forecasts. Merced's formal water supply forecasts were not readily available for our review.

However, DWR confirmed that its efforts to develop those models ended in April 2019. The manager of DWR's hydrology section explained that DWR stopped pursuing those models because they were taking too long to develop and because DWR determined that the complexity of running and updating the models made them impractical to use.

Figure 4
For the Past Five Years, CNRFC's Median Water Supply Forecasts Have Had a Lower Average Error Rate Than DWR's Median Forecasts



Source: DWR's B120 water supply forecasts and reports on actual flow, and CNRFC ensemble forecasts.

* The error rate is the difference between the forecast and actual April-through-July runoff as a percentage of the actual April through July runoff.

Because of DWR's limited progress in updating its forecasting model, its own forecasts have not fully benefitted from another substantive effort that the department made before water year 2021 to improve water supply forecasting in the State more broadly. Specifically, in March 2013 DWR began partnering with the National Aeronautics and Space Administration (NASA) to fund observatory flights to measure the water volume of snow in the Sierra at selected locations. In its contract with NASA, DWR noted that the conventional approach to measuring volumes of water in snow did not provide sufficiently accurate data and that the observatory flights would provide water managers with the ability to more accurately forecast the timing of snow melt. DWR continues to fund flights over nine watersheds, including the Merced and Tuolumne watersheds. One local agency told us that it has begun inputting the data from those flights directly into its water supply forecasting model, and another agency is using it to evaluate the modeled data its forecast produces. Despite the noted benefits that these flights provide, the manager of DWR's forecasting unit stated that the data from the flights cannot be incorporated into its model; instead, DWR staff review the data and the modeled results from the flights and then make some manual adjustments to snow measurements, based on the staff's experience.

Following the significant error in its water year 2021 B120 forecasts, DWR took steps intended to improve its forecasting. It contracted with different entities to use various tools and models to support its water supply forecasting, as the text box shows. For example, DWR contracted with UC Davis in the fall of 2021 to expand on a model for extreme weather events by, among other things, incorporating weather and climate forecasts from the National Oceanic and Atmospheric Administration (NOAA) to produce water supply forecasts. These efforts are consistent with a plan that DWR drafted later, between the summer and fall of 2022, for adopting various technologies and observational methods to make its forecasting more resilient to the effects of climate change. It finalized this plan in March of 2023. The plan states that one of DWR's forecasting goals is to transition to modeling tools that are physically based and climate-informed, such as models that simulate the physical process of snow accumulation and melt.

Key Contracts DWR Has Entered Into to Improve Its B120 Forecasts

- **September 2021:** Contracted with UC San Diego to develop an experimental forecast system using machine learning and hydrologic modeling that tracks soil moisture, weather, and other factors, in an effort to modernize the B120 forecast process.
- **October 2021:** Contracted with UC Davis to expand on a model for extreme weather events to produce water supply forecasts that incorporate NOAA's weather and climate forecasts, and to train DWR staff on the model's use.
- **March 2022:** Contracted with a firm for continued snow observatory flights over areas for which it produces B120 forecasts. The contract also covers snow and hydrologic modeling to provide data and models for use in producing forecasts, including soil moisture and snowmelt.

Source: DWR contracts.

Additionally, the manager of the forecasting unit stated that DWR piloted a new model for forecasts in certain watersheds in water year 2022, and DWR provided documentation of some of the model's early results. DWR's plan indicates that its goal is to transition to the new model to create water supply forecasts by water year 2025, which begins in October 2024. The manager of DWR's forecasting unit explained that DWR needs until water year 2025 to calibrate and validate the effectiveness of the new model, as well as to train its staff on its use.

Yet DWR's plan does not include any accountability mechanisms to ensure that it implements its new model promptly. Further, although the plan includes the objective of developing forecast model performance tools, it does not contain specific criteria for determining whether the new model is sufficiently accurate for use. The manager of the forecasting unit described criteria that he indicated DWR is considering in evaluating the new model, which include the timeliness with which the model produces results and the ability of the model to produce reliable results in different types of watersheds. However, he confirmed that DWR has not yet established more specific criteria for how accurately it expects its model to perform. Until its new model is operational, DWR plans to continue to generate its forecasts using its existing methods, although it told us that it narrowed the historical data it uses from a 50-year period to the most recent 30 years, to better reflect the current climate.

When we asked why DWR had delayed pursuing improvements to its forecasting model to account for the effects of climate change, the manager of the forecasting unit disagreed that it had done so. He stated that DWR had worked tirelessly for years to develop and evaluate the models that it had contracted with the Geological Survey in 2010 to develop, an effort that we describe earlier. However, DWR has acknowledged that its significant overestimation in its spring 2021 forecasts illustrates the importance of shifting away from statistical approaches that rely on historical records that no longer reflect observed conditions.

DWR Needs a Formal Process for Monitoring and Improving the Quality of Its Forecasts

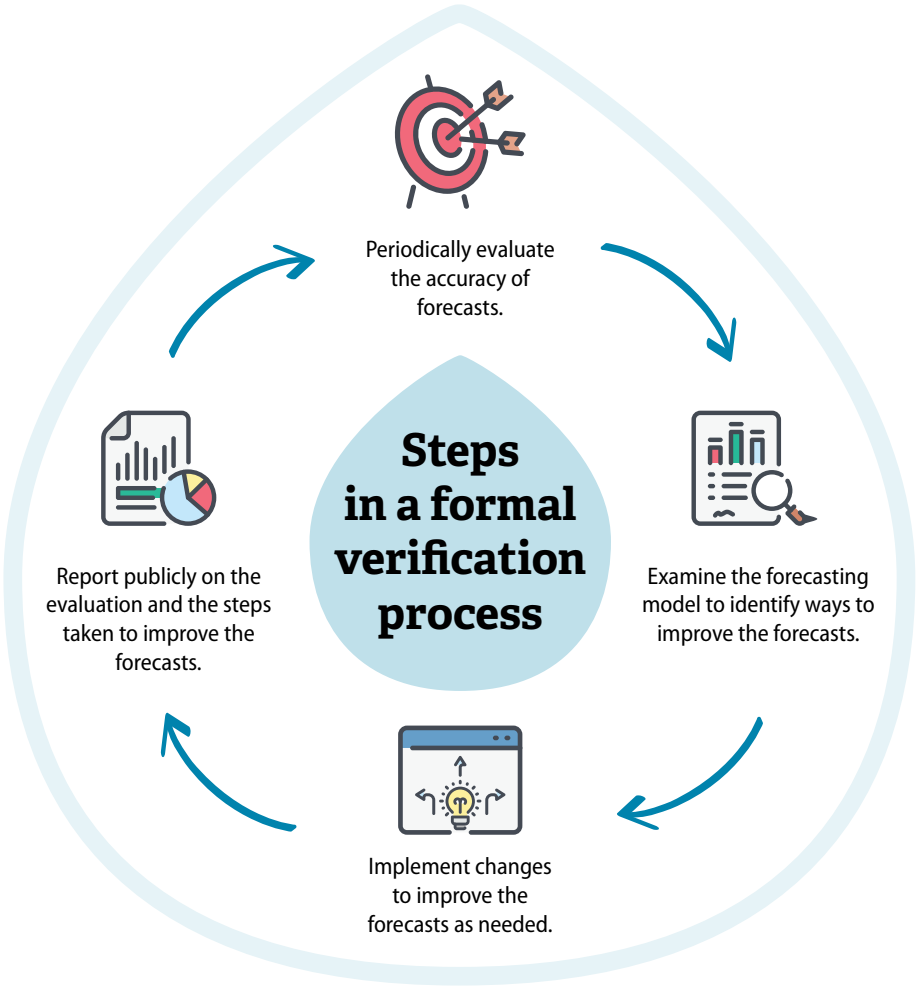
Despite the importance of its B120 forecasts, DWR does not have a formal process for evaluating its forecasting model or the accuracy of its forecasts. According to the National Center for Atmospheric Research (NCAR), every activity focused on providing forecasts to users should have an associated verification activity to monitor the performance of the system and identify possible improvements. As Figure 5 shows, forecast verification is an iterative process for assessing forecast accuracy that allows for systematic and objective evaluation of the quality of a forecasting system. DWR could benefit from a formalized verification process through which it regularly evaluates the quality of its forecasts by comparing its water supply forecasts to the actual, observed water supply. After doing so, DWR could then use the results of that evaluation to examine its forecasting model and identify any opportunities for improvement. However, DWR does not currently have a formal verification process in place.

The manager of the forecasting unit asserted that although DWR has not established a formal process for continuously improving its forecast, the forecasting unit constantly reviews and evaluates its forecasting model. He indicated that whenever reasonable, the forecasting unit creates new statistical equations for the model and recomputes the data that the model uses to ensure that the forecasting unit is using the most up-to-date information. The documentation he provided shows that DWR has developed different variations on its existing model and has compared its probability range and median forecast to actual runoff.

However, that documentation did not demonstrate that DWR has implemented a formal verification process in accordance with the best practices we reviewed. Best practices from meteorological and water supply forecasting organizations contain multiple methods of evaluating a forecast's accuracy, each of which may provide different insight into the quality of the forecast and the nature of forecast errors. For instance, guidance from the World Weather Research Program describes several methods relevant to assessing the quality

of a forecast, such as its relative accuracy over other forecasts or its tendency to under- or overforecast outcomes. However, in the examples DWR provided of its evaluations efforts, it typically used only one or two methods to evaluate its forecasts each time. For example, the assessment DWR provided of its water year 2021 forecast displayed the observed runoff compared to the probability range and its median forecast. By contrast, CNRFC reviewed its forecasting model using five different statistical metrics for a simulated 26-year period and then compared the results of those metrics to one another. These evaluations allowed CNRFC to make detailed assessments about the performance of its forecasting model, such as whether its median forecast tended to over- or underforecast the water supply, how the model performed in years that were wet versus dry, and how the model performed in extreme conditions. Such assessments were generally absent from the evaluation documentation that DWR provided. Performing additional analyses similar to CNRFC's analyses could provide DWR with additional useful information about the performance of its forecasting model and specific areas of needed improvement.

Figure 5
A Formal Verification Process Allows for Systematic and Objective Evaluation of a Forecasting System



Source: Best practices from CNRFC, NRCS, NCAR, the World Meteorological Organization, and verification research.

Additionally, the records contained little information about DWR's conclusions regarding the possible causes of the forecast errors it identified or improvements it planned to make. We were able to identify evidence of DWR's considering the cause of the forecast errors only in the 2018 presentation materials, which stated that the increase in the errors in its forecasts over the preceding decade "could be due to climate change." Although DWR also described reevaluating and adjusting its forecast model equations after the 2018 presentation, the documentation it provided indicates a stand-alone effort and not a formal, recurring evaluation process.

Further, guidance from the Natural Resources Conservation Service (NRCS)—which develops the water supply forecasts for 13 western states—explains that forecast verification should be conducted each year once data on actual runoff is available. A formal process that outlines the specific methods that DWR will use to evaluate its forecasts and describes how DWR will use the outcomes of that evaluation to improve its forecasts may help DWR to better ensure ongoing improvement in its forecasts' predictive capability.

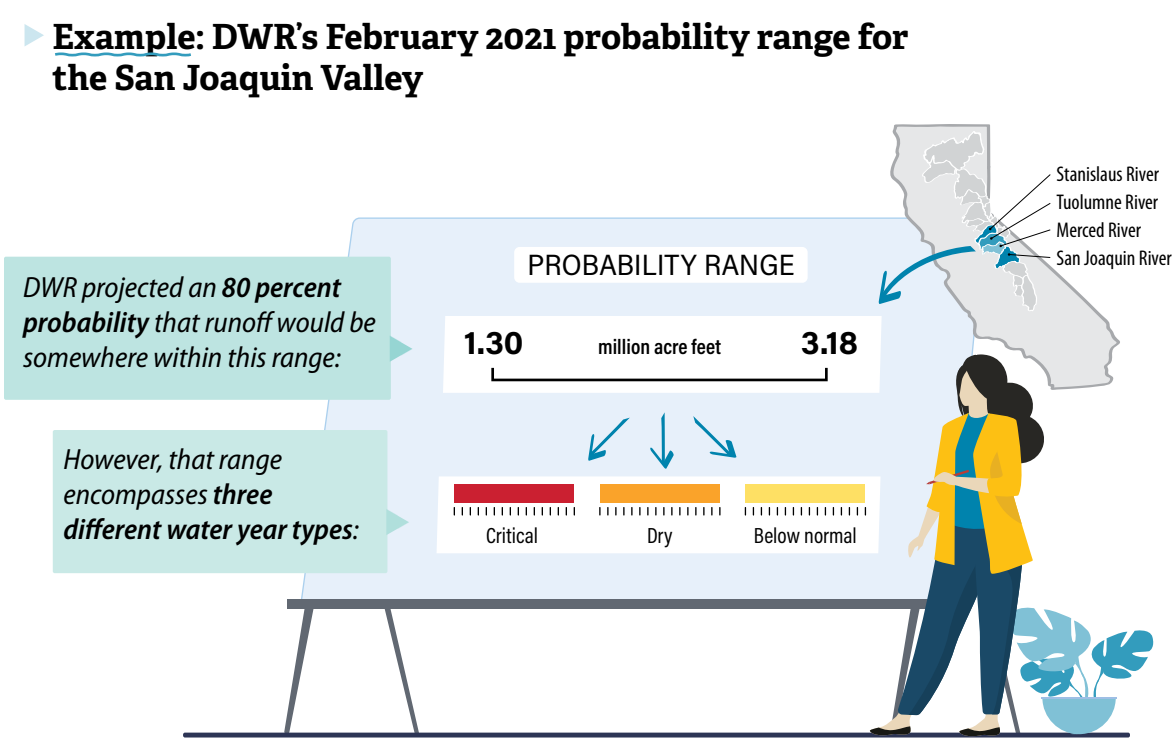
DWR should also reevaluate the criteria by which it judges the success of its forecasts. The manager of the forecasting unit explained that DWR's formal accuracy goal for its monthly forecasts is that observed water supply falls within each forecast's probability range. The probability range can be valuable to water managers because it provides them with a broader understanding of possible water supply volumes and enables risk-based decision making. However, determining whether the observed runoff falls within the entire probability range is not sufficient as the sole measure of the quality of DWR's forecasts. NRCS guidance indicates that it is important to know more specifically where actual runoff falls relative to a probability range. Consistently analyzing and documenting this information could help DWR assess the degree to which actual runoff is consistent with or deviates from its forecasts' expected outcomes. NRCS indicates that, to the extent necessary, this type of measurement may help lead to model refinements in preparation for the next season.

Additionally, DWR's probability ranges can be broad, particularly earlier in the water year. As Figure 6 shows, DWR's probability range in its water supply index for the San Joaquin Valley in February 2021 was so broad that it encompassed three different water year classifications for the area—*critical*, *dry*, and *below normal*. Therefore, a forecast with a wide probability range could successfully predict the eventual runoff while still not providing much certainty to the forecast's users. Indeed, the manager of the forecasting unit also stated that DWR's goal is to forecast as accurately as possible as early in the season as possible. Using multiple methods to evaluate accuracy simultaneously, as we describe above, might allow DWR to reach more nuanced, but potentially important, conclusions about its forecasts.

A comprehensive evaluation of DWR's forecasting accuracy should also include an analysis of its median forecast. The manager of the forecasting unit expressed concerns about an evaluation that focuses only on the median forecasts, asserting that it would be misleading. He emphasized that DWR publishes its forecast as a probability range. However, one of the indicators of forecast quality is the degree to which a forecast benefits decision makers. The median forecast has important implications for the management of the State Water Project as well as for the

requirements that certain local water management agencies must meet. Further, both CNRFC and NRCS describe evaluating the accuracy of their median forecasts, and the documents DWR provided to demonstrate its past evaluation efforts show that it used its median forecast in those efforts.

Figure 6
DWR's Runoff Probability Ranges Can Be Broad, Limiting Their Usefulness as the Sole Measure of Its Forecasts' Accuracy



Source: DWR's water supply forecasts and indices.

The manager of the forecasting unit agreed that documenting a formal process for evaluating the quality of DWR's forecasts would be beneficial and would provide transparency about the department's efforts to improve its forecasts. He also acknowledged that although DWR intends to keep the probability range as the main criteria for verifying its forecasts, it will not limit its review to that single metric; he stated that DWR would instead use various statistical charts and graphics that it would post to its website. However, DWR had not yet established criteria or a methodology for its review. A formal process that requires consistent, thorough evaluation of its forecasts' accuracy would assist DWR in more proactively taking the steps necessary to make those forecasts as accurate as possible.

Please refer to the section beginning on page 3 to find the recommendations that we have made as a result of these audit findings.

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DWR Must Do More to Prepare for the Impact of More Severe Droughts on the State Water Project's Operations

Key Points

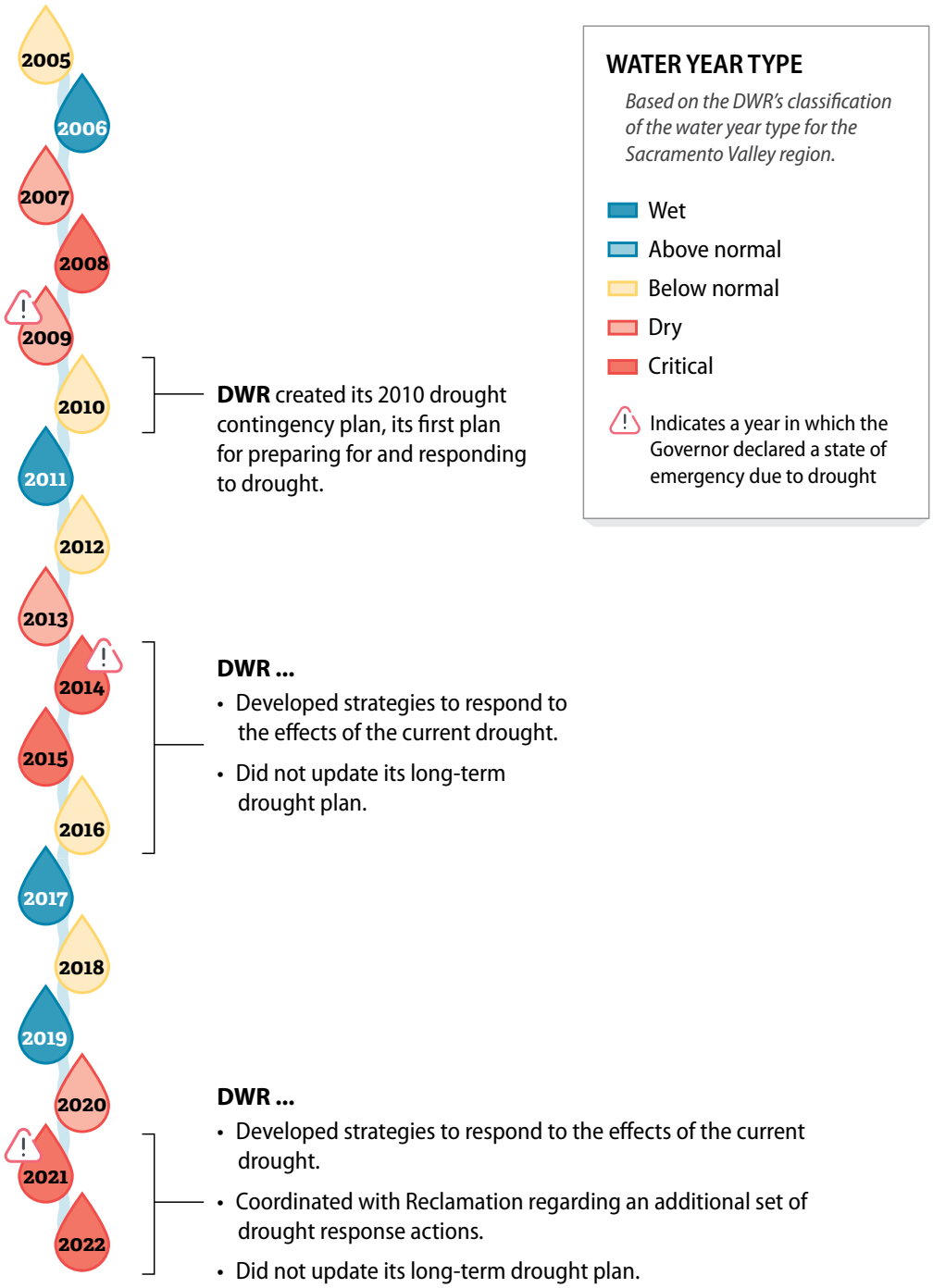
- DWR does not have a comprehensive, long-term plan for identifying, mitigating, or responding to the effects of more severe future droughts on the State Water Project.
- Whether planned or in reaction to conditions in the Delta, DWR's decisions to release water from the Lake Oroville reservoir have important implications for water stakeholders and the public. However, DWR has not consistently documented the reasons for its planned and actual water releases.
- DWR has not accounted for the possibility of more extreme future conditions when it develops its monthly water allocation analysis and water storage target for the Lake Oroville reservoir.
- DWR lacks a formal process for periodically evaluating certain State Water Project operations to identify opportunities for improvement.

DWR Does Not Have a Comprehensive, Long-Term Plan for Mitigating or Responding to the Effects of More Severe Drought on the State Water Project

Millions of California's residents and 750,000 acres of its farmland depend on the State Water Project—a water storage and delivery system that collects surface water from the northern part of the State and delivers it to both the Bay Area and Southern California. Given the importance of the State Water Project to California, DWR's effective management of the project's operations is essential. Moreover, this need for effective management is becoming more critical as climate change threatens to increase the frequency, duration, and severity of droughts. DWR itself has concluded that long-term hydrologic changes caused by climate change pose serious challenges to its operation of the State Water Project.

Best practices from the Federal Emergency Management Agency (FEMA) and from the National Drought Mitigation Center (NDMC) indicate that agencies should develop long-term plans for mitigating and responding to hazards, such as droughts, before they happen. The guidance further suggests that doing so can help reduce the impact of droughts. However, DWR did not develop its first long-term drought plan, the 2010 Drought Contingency Plan (2010 drought plan), until November 2010, more than two years after the 2008 statewide drought had been declared. The 2010 drought plan contains potential actions by DWR and other agencies to prepare for drought, including some that are relevant to the State Water Project. At the time, DWR indicated that it intended to update the plan every five years. As Figure 7 shows, DWR has not done so, nor has it developed any other comprehensive long-term plan for managing State Water Project operations during droughts.

Figure 7
Rather Than Updating Its Long-Term Drought Plan, DWR Has Instead Developed Short-Term Strategies During Critically Dry Periods



Source: DWR data on water year types, drought contingency plans and strategies, and Drought Toolkit, and governor executive orders pertaining to drought from 2007 through 2022.

Instead, DWR has documented drought-related strategies for managing State Water Project operations only after dry conditions have already occurred. Under the terms of a 2020 permit it received from the California Department of Fish and Wildlife, DWR must, in coordination with Reclamation, develop a drought contingency plan (contingency plan) when the previous two years' water supply falls below a certain threshold.[7] If dry conditions continue, DWR and Reclamation must update the contingency plan each month based on hydrologic conditions. The contingency plans contain response strategies that describe how DWR and Reclamation will jointly manage the limited water supply to meet their various objectives, such as meeting water quality standards in the Delta and making deliveries to State Water Project and Central Valley Project contractors.

DWR's response strategies are specific to the immediate conditions and do not include the type of long-term planning to prepare for future droughts that best practices recommend. For example, in a contingency plan that DWR developed after the Governor declared a state of emergency because of drought in 2014, DWR stated that the purpose of the plan was to provide an overview of current conditions and to address projected water operations over a three-month period. Its next contingency plan, which it published at the end of that three-month period, described the same purpose for responding to the ongoing drought. These documents play roles in responding to acute conditions that have already arisen, but they do not look beyond the circumstances under which they were created.

By not updating its 2010 drought plan in more than a decade, DWR has missed opportunities to incorporate into the plan the lessons learned from the significant drought and dry periods that occurred during that time. FEMA and NDMC both recommend that an agency reevaluate and update its plans periodically, as well as after each drought. Their guidance indicates that evaluation of plans allows an agency to incorporate lessons learned from past droughts. Further, NDMC's guidance states that without post-drought evaluations, learning from past successes and mistakes is difficult, as institutional memory fades. However, DWR did not update its 2010 drought plan even after the period from 2013 through 2015, which it later identified as having been the driest in recorded history to that point. For example, DWR's 2010 plan includes a potential drought response action that calls for it to lead the development of a program for temporary transfers of water for instream flows to protect native fish and sports fisheries. Because DWR has not updated the plan, it does not make clear whether DWR implemented this action during subsequent droughts and, if so, whether the action was successful and whether adjustments to the program are necessary.

In addition to being outdated, DWR's 2010 drought plan does not incorporate the assessment of more severe future droughts as FEMA and NDMC recommend. Those entities suggest that after an agency considers the potential effects of a more severe drought than it has historically faced, it should then assess its ability to respond to these impacts, identify any gaps in its ability, and determine what it can do to

[7] The permit is DWR's Incidental Take Permit for long-term operation of the State Water Project in the Delta. The permit establishes certain requirements on DWR's operation of the State Water Project, including limiting exports of water at certain times for the protection of threatened and endangered wildlife.

address the gaps. Its drought planning should describe the actions the agency will take to respond to the identified impacts of drought and include specific triggers for when the agency will initiate those actions.

In addition, FEMA's guidance on planning for hazards, including drought, recommends that an agency should assess how a changing climate is affecting the frequency and intensity of those hazards. The guidance notes that understanding the potential future effects of climate change may require the creation of plans that are flexible and scalable. As early as 2008, DWR itself has advised local agencies that they should plan for droughts that are at least 20 percent more frequent and longer lasting than droughts in the past. For its part, the 2010 drought plan states that warming, changes in precipitation, and increases in extreme events—including drought—are expected to affect the functioning of ecosystems. It further states that reduced snowpack, changes in water flows, and other effects will have negative effects on many native species. However, the plan does not identify how the expected, more severe impacts of drought may specifically strain the State Water Project's responsibilities to meet water quality and flow standards for the protection of wildlife. It also does not describe whether DWR may need to take new actions to address these more severe impacts or the challenges it might face in doing so.

DWR's manager of water operations stated that she was not aware of specific plans to prepare the State Water Project for droughts that are more severe than past droughts. She also explained more generally that State Water Project drought planning has taken place and continues to take place through more focused planning efforts, including the response strategies we describe above. We reviewed those response strategies and several other documents DWR provided, such as the Drought Toolkit. Published by Reclamation in August 2021 in collaboration with DWR and other agencies, the Drought Toolkit contains a set of potential drought actions for DWR, Reclamation, and other agencies, such as the California Department of Fish and Wildlife. However, the documents we reviewed do not—even collectively—address all of the elements of best practices. Some contain high-level discussions of certain impacts of drought, and some describe actions that DWR may take when managing the State Water Project during a drought. However, none of the documents sufficiently assess the potential impacts of more severe future droughts on State Water Project operations or the degree to which such droughts may challenge DWR's ability to meet the project's objectives. They also do not contain clear steps that DWR intends to take to address those challenges.

For example, DWR pointed to its delivery capability reports as evidence of its drought-planning efforts. These reports provide information to State Water Project contractors about the project's water delivery capability; they are not themselves plans for operating the State Water Project during a drought. DWR's 2021 delivery capability report noted that DWR recognized the risk posed by climate change to future hydrologic and water supply conditions, and it provided estimates of its capacity to deliver water to its contractors under different scenarios, including during dry years. However, the report does not describe specific anticipated effects of climate change on other key State Water Project operations, such as the potential need to release water from its reservoirs to meet water quality conditions in the Delta. When we shared these observations with DWR, the deputy director

of the State Water Project indicated that although the delivery capability reports do not describe those anticipated effects, the reports still accounted for them because the methodology that DWR used to develop the reports assumes that all of DWR's regulatory requirements and other obligations are met before providing water to State Water Project contractors.

Notwithstanding the analysis DWR describes performing, the reports still lack fundamental elements of a long-term drought plan. For example, the purpose of performing an analysis of drought impacts during drought planning is to inform the development of specific strategies for responding to and mitigating those impacts. However, beyond possible reductions to contractor deliveries, the delivery capability reports do not describe any actions that DWR would take to respond to severe drought, such as adjustments it might make to the volume of water it stores in its reservoirs. The plan also does not describe challenges DWR might face in meeting the project's regulatory requirements or how DWR would respond to those challenges. Indeed, as we describe in the following section, DWR did not always meet its water quality requirements during the period of State Water Project operations we reviewed.

When we raised these concerns, DWR's water operations manager pointed to various actions that DWR has taken to prepare for and respond to drought. Examples of those efforts include the Delta Conveyance Project, a project to construct new conveyance facilities in the Delta to improve the reliability of the water supply in the face of more extreme climate events, including drought. Another effort is the construction of drought salinity barriers—physical obstacles placed in the Delta to assist with maintaining water quality during a drought. These projects may assist the State in mitigating and responding to the effects of drought in practice. However, if DWR had a long-term drought plan, it could specify how and when it would leverage these measures. Further, DWR could better identify whether the measures it is currently undertaking will be sufficient if its planning incorporated an assessment of the full range of impacts that more severe drought may bring and an evaluation of whether it has the capacity to respond.

When we shared these conclusions with DWR, the water operations manager provided us with more documentation that she indicated responded to our concerns. This documentation generally fell into one of three categories, none of which amount to a long-term drought plan for the State Water Project. One document listed various short-term efforts DWR took or planned to take in response to the drought that was ongoing at the time. Others were broader reports from DWR about droughts that have occurred in the State in the past, some of which were published decades ago. Finally, several of the documents concerned processes not directly related to the State Water Project, such as DWR's review of local water agencies' groundwater sustainability plans.

The importance of the State Water Project to California and the extremity of the water conditions the State has faced in the past decade make a strong argument for DWR's development of a comprehensive, consolidated plan. This plan should attempt to anticipate and provide practical solutions to the longer-term challenges the State Water Project is likely to face. In doing so, the plan could not only more

clearly identify the roles played by DWR's efforts to date, such as its salinity barriers and Delta Conveyance Project, but also explain the strategies that DWR will employ in the face of specific challenges it has acknowledged are likely to occur, including increasing salinity in the Delta and the demands of managing reservoir storage in the context of an increasingly variable climate.

DWR Lacks Sufficient Records Explaining Some Releases From Its Lake Oroville Reservoir

As Figure 8 shows, DWR balances multiple demands on State Water Project water. For example, it must decide how much water it will allocate to State Water Project contractors while reserving sufficient water in Lake Oroville to address water quality issues in the Delta. It generally makes these decisions through a monthly planning process, which we describe in more detail below.

In addition to this monthly process, DWR monitors conditions such as precipitation and water quality in the Delta on an ongoing basis to determine whether to adjust its plans. To meet their joint obligations in the Delta, including maintaining water quality, DWR and Reclamation take actions that include increasing or reducing exports from the Delta to change water outflow, operating a gate that can help to prevent saltwater from intruding into the Delta, and changing reservoir releases. As the text box shows, multiple factors influence the volume of water that DWR releases from its Lake Oroville reservoir for these purposes. For example, a 1983 agreement with the California Department of Fish and Wildlife (Fish and Wildlife agreement) establishes a minimum amount of water that DWR must release from Lake Oroville each month for the protection of fish and wildlife.

Key Factors That Influence DWR's Releases From the Lake Oroville Reservoir for Water Quality and Outflow Purposes

- **Minimum required releases:** DWR must maintain a minimum volume of releases from the reservoir for the protection of fish and wildlife.*
- **Water quality in the Delta:** DWR may need to release water to address water quality in the Delta.†
- **Delta outflow:** DWR may need to release water to comply with standards requiring a certain amount of water to flow into and out of the Delta.†
- **Coordination with Reclamation:** DWR and Reclamation are jointly responsible for meeting Delta water quality and flow standards, and they coordinate operations to do so.

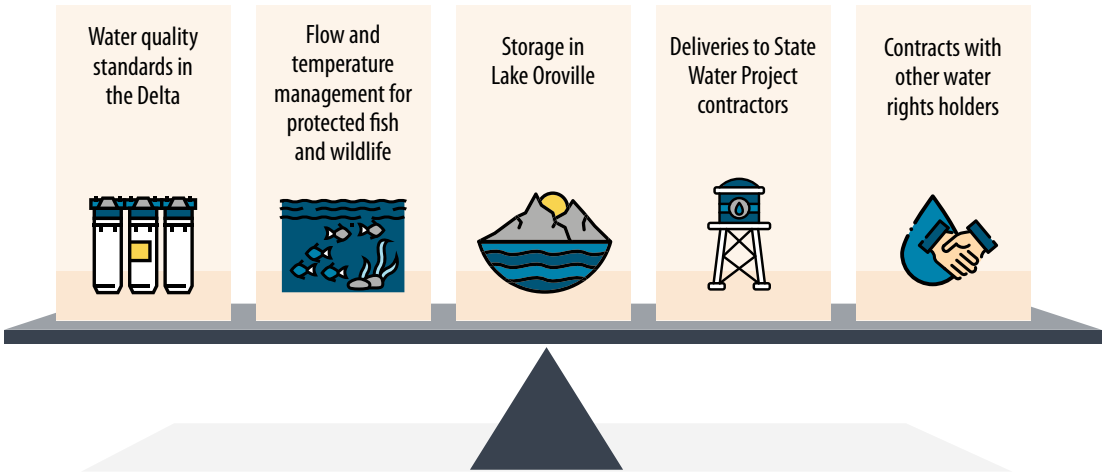
Source: State Water Board Decision 1641; agreement between DWR and the California Department of Fish and Wildlife; and DWR and Reclamation's Agreement for Coordinated Operation of the Central Valley Project and the State Water Project.

* This requirement comes from an agreement between DWR and the California Department of Fish and Wildlife.

† The State Water Board established the Delta water quality and outflow standards.

Whether planned or in reaction to conditions in the Delta, DWR's decisions to release and distribute water affect the volume of water that remains available for delivery to water users, protection of wildlife, and storage for future needs. Given the importance of these decisions and their impacts on different stakeholders, DWR should consistently document the reasoning behind its releases to ensure transparency and to provide water stakeholders and the public greater confidence in its operation of the State Water Project. Consistently documenting the reasoning behind its decisions would also better assist DWR in assessing and evaluating its rationales for its releases.

Figure 8
DWR Balances Various Objectives When Allocating Water From the State Water Project



Source: Analysis of State Water Project documentation, including State Water Board Decision 1641 and various DWR contracts and agreements.

However, we identified significant gaps in DWR's available records related to its planned and actual water release activities. These gaps limited our ability during the audit to understand and evaluate DWR's water release decisions. Specifically, we reviewed data regarding DWR's releases of water from the Lake Oroville reservoir for a selection of 14 months during water years 2021 and 2022. Through that review, we identified two types of scenarios in which DWR made decisions regarding releases without documenting sufficient justification for its actions. Specifically in some instances, DWR released more water than the minimum required by various standards but did not consistently document how it determined the volume of those releases. In other instances, DWR's lack of documentation inhibited its ability to demonstrate the specific steps it took to ensure water quality.

First, in nine of the 14 months, DWR released more water than the Fish and Wildlife agreement required it to release from Lake Oroville while also allowing more water to flow into the Delta and out to the ocean than related water quality or flow standards required. For example, as Figure 9 shows, DWR released about 153,000 acre feet—or about twice the amount the Fish and Wildlife agreement requires—in October 2020. The releases above the minimum required amounts may have been necessary; however, the records we reviewed for these nine months lacked meaningful details that would reveal DWR's rationale for why its releases were appropriate in scale.

We were unable to verify the appropriateness of DWR's releases because of the vague and limited nature of its planning documentation. DWR maintains two primary types of records that it uses to document its plans for operating the Lake Oroville reservoir. The first is its Delta Coordinated Operation Forecast (allocation analysis), which DWR updates each month and which establishes different sets of options

for meeting its objectives under various water supply scenarios. These options include the amounts of water it may elect to store in its reservoirs, release from Lake Oroville, export from the Delta, and deliver to State Water Project contractors. However, the allocation analysis does not identify DWR's ultimate decisions regarding the options or its rationale for those decisions.

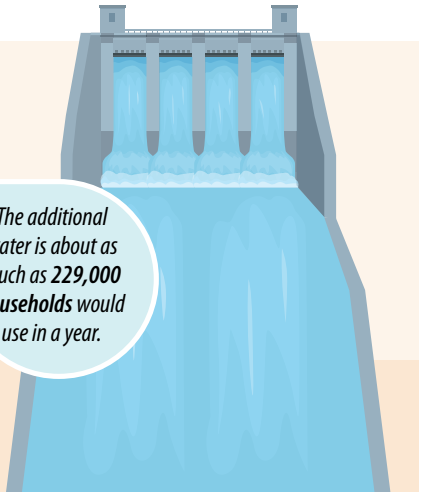
Figure 9
DWR Did Not Adequately Document Its Reasons for Certain Reservoir Releases

In nine of the 14 months we reviewed, DWR released more than the minimum required amount of water from Lake Oroville without documenting its rationale for those releases.

For example, in October 2020 ...

DWR released about 153,000 acre feet of water from Lake Oroville—about twice the amount required by its Fish and Wildlife agreement.

*The additional water is about as much as **229,000 households** would use in a year.*



It also allowed more water to flow out of the Delta than required by flow standards established by the State Water Board.

Complying with water quality standards may require increased releases; however, DWR often lacked documentation showing that this was the case.

DWR generally did not document:

- A written plan for these specific releases.
- A stated rationale for why the amount released was necessary.

DWR needs better documentation to demonstrate its decision making when managing the State Water Project's water supply.

Source: Analysis of DWR's release data, State Water Board Decision 1641, Agreement Concerning the Operation of the Oroville Division of the State Water Project for Management of Fish and Wildlife, and DWR planning documentation.

The second form of monthly planning documentation that DWR provided us was its contingency plans, which we describe earlier and which DWR is required to develop if the water supply falls below a certain threshold during the previous two years. DWR published contingency plans in eight of the 14 months we reviewed. The contingency plans contain records of its release decisions, as well as some rationale for those decisions. However, the rationales that DWR included in the contingency plans often lacked specificity. For example, in May 2021, DWR released 120,000 acre feet—more than double the minimum amount required by the Fish and Wildlife agreement. The additional releases represent enough water to supply about 210,000 households for one year. However, the plan did not contain specific explanations about the need for the volumes of releases, stating instead that DWR expected "that slightly higher outflow will be needed, in combination with the minimal exports, to maintain sufficiently low salinity in the Delta." The plan also indicated that DWR's primary objective was to maintain the lowest possible releases in order to conserve storage. In contrast, we expected to see a discussion in DWR's records about how it determined that this specific volume of additional water was necessary, as opposed to less or even more water.

DWR could provide even less documentation about its rationale for five of the nine months in which it released more water than the minimum required by its Fish and Wildlife agreement while also allowing more water to flow out of the Delta than required by outflow or water quality standards. Across all five months, DWR released almost 200,000 acre feet of water, or about 57 percent, more than the minimum amount required by the agreement. DWR did not publish a contingency plan during those months, and the water operations manager noted that it was not required to do so under the terms of the permit that requires it to develop those plans. Consequently, it has limited record of the specific reasons for its releases or documentation of whether it considered alternatives to the magnitude of these releases, such as adjusting the amount of water it exported from the Delta during those months.

We acknowledge that these significant additional releases may have been necessary to maintain appropriate water quality and flow in the Delta. However, DWR's limited and, at times, absent documentation prevents external parties—including auditors—from evaluating or understanding its decision making. For example, in January 2021 DWR exceeded the minimum releases from Lake Oroville required by the Fish and Wildlife agreement by more than 18,000 acre feet, or about 30 percent, but it could provide no internal records explaining why it did so. The additional volume of water that DWR released is enough to supply water for about 54,000 households for one year.

When we raised concerns about DWR's lack of documentation regarding its release decisions, the manager of its water operations scheduling section (water operations scheduling manager) asserted that the rationale for DWR's decisions could be drawn from the allocation analysis, the environmental data that the department tracks daily regarding the water supply and conditions in the Delta, and the other documentation discussed above. The data she described are limited to factual information, such as the amount of precipitation that fell and the volume of water exported from the Delta. On review of the data, the water operations scheduling manager was

able to provide some insight into DWR's release decisions in October through December 2020. Nevertheless, the data provided represent possible inputs that DWR used in its decision making on water releases, as opposed to an explanation of how it used those inputs to determine the specific amounts it released. The water operations scheduling manager explained that the rationales for DWR's decisions are not specifically written out in the data, but that she was able to "piece together" what DWR did and why. Overall, the water operations scheduling manager's explanations were consistent with the general idea that water quality issues had required additional releases, but she did not specifically address the magnitude of the releases in question. She stated that experience plays a large role in the decisions that DWR makes and that hindsight about a specific release action is of limited value because DWR does not see the same conditions all the time. We do not dispute that DWR staff should use experience and judgment when making release and other operational decisions. However, documenting the rationale for those decisions is critical for both external accountability and internal oversight of DWR's decision making.

DWR's inadequate documentation of the rationale behind its decisions also prevents it from conclusively demonstrating that it took appropriate and necessary actions to meet water quality and flow standards in the Delta, the second scenario we mention above. In seven of the 14 months we reviewed, DWR and Reclamation did not meet water quality or flow standards.[8] In some of those months, the circumstances demonstrate that DWR took some steps to achieve compliance with the standards, including increasing its releases from Lake Oroville above what it had originally planned or was required. However, the internal records that DWR maintained regarding changes to its planned releases in response to Delta conditions were even less specific than its planning documentation. For example, several records stated only that the increases were in response to "Delta needs" with no information about when DWR discovered the deficiencies in water quality or flow, the specific nature of the deficiencies, the options it considered to address them, or the reasons for the specific volumes of water that it chose to release in response. In the absence of such documentation, DWR cannot adequately demonstrate that it took appropriate steps to remain in compliance with water quality standards. The lack of documentation further hinders DWR's ability to review its own actions to assess their sufficiency.

For some of the months during which DWR did not meet water quality or flow standards, it subsequently provided a better explanation for its actions. It did so twice in the contingency plans we reviewed. However, the more detailed explanations we identified for DWR's decisions existed in letters notifying the State Water Board that it did not meet water quality or flow standards. For example, one such letter explained that higher-than-expected tidal conditions in June and July 2021 had increased salinity in the Delta and that DWR made specific increases to releases as a result. The letter also explained the limitations that DWR faced because of the drought conditions and described efforts DWR had made in place of releasing more water, such as closing the Delta gates to maintain fresher water.

[8] In four of the seven months, DWR asserted that it was unlikely that the water quality issues were a direct result of the projects' operations.

However, these letters varied in the extent of their explanations. Further, the letters exist only because the water quality standards in question were not met; DWR is required to provide written notification to the State Water Board when it does not meet water quality objectives. Therefore, the letters are not a substitute for improved, ongoing documentation of the rationale for DWR's actions. More timely, centralized, and consistent documentation of the options that it considers and the reasons for its choices would better enable DWR to evaluate the effectiveness of those actions and adjust its future decision making if and when necessary.

DWR's limited documentation explaining its water release decisions not only hinders its ability to monitor the effectiveness and appropriateness of those decisions but also impairs its capacity to demonstrate adequate stewardship of the State Water Project. In addition to the challenges it faced in meeting certain of its water quality and flow standards, DWR struggled to meet its objectives in other ways. In 2021 and 2022, DWR's allocations to State Water Project contractors were among the lowest that they had been in 25 years, and the storage levels at Lake Oroville fell significantly below DWR's goals. DWR has attributed these outcomes to the extreme conditions resulting from the drought. We acknowledge both the extreme conditions and the possibility that the releases we observed were necessary to ensure water quality. However, the difficulties DWR faced in meeting State Water Project objectives demonstrate the importance of DWR's consistently documenting clear and detailed information regarding the rationale for the volume of its water releases. Without that documentation, DWR cannot sufficiently demonstrate that it managed those releases to best ensure water quality while also balancing its other objectives, such as maximizing its reservoir storage and providing water to its contractors.

Although DWR's water operations scheduling manager expressed a belief that the department's recordkeeping has been sufficient in the past, she agreed that formally tracking DWR's decisions and rationale for those decisions would assist the department's efforts to review its operations. She further stated that all of DWR's releases were necessary to address water quality or flow issues in the Delta and that DWR did all that was possible to meet water quality and flow standards given the extreme conditions.

Notwithstanding the manager's perspective that DWR's recordkeeping has been sufficient, water releases have a significant effect on a wide range of external stakeholders. This audit was requested in part because of uncertainty about how DWR made its water release decisions, particularly in water year 2021. Our primary critique is therefore the lack of documentary evidence available to understand DWR's decision making in this area. Improved recordkeeping would better position DWR to explain its water release decisions to stakeholders and the general public, and allow it to evaluate its judgment when making specific release decisions.

DWR Needs to Update Key Data for Managing the Lake Oroville Reservoir to Reflect the Possible Effects of Climate Change

As we describe throughout this report, research indicates that climate change has already begun to affect the State's water supply and will continue to do so. Research by DWR and others has identified numerous effects that climate change may have in the State, several of which may directly affect State Water Project operations. For example, DWR has noted that rising sea levels may increase salinity in the Delta, potentially requiring the State Water Project to release more water from its Lake Oroville reservoir to protect water quality. All else remaining constant, such releases would likely result in less water available for other objectives, such as deliveries to water contractors. Indeed, citing the effects of climate change and other factors, DWR has indicated to State Water Project contractors that it will most likely need to reduce water deliveries in future years.

Nonetheless, DWR has not incorporated an assessment of the effects of climate change into its near-term operations. Instead, it has largely relied on historical and possibly outdated data and information when developing its allocation analysis to inform its Lake Oroville reservoir releases and storage. For example, since at least 2005, DWR has based its initial November estimates of the State Water Project's water supply entirely on historical data from 1962 through 2002. It also currently uses those data to estimate the amount of water that will arrive in Lake Oroville during the first three months of the water year. This approach does not account for the extreme conditions that have occurred since 2002, including states of emergency declared because of severe droughts in 2014 and 2021 and flooding in 2017 and 2023. In fact, the estimated water runoff in the Lake Oroville area during the 40-year period from 1962 through 2002 was about 20 percent higher than during the most recent 10 years.

DWR's water operations scheduling manager agreed that its data need to be updated, but she indicated that doing so takes time because of steps that the department must take to verify the quality of the data and because it must coordinate and have concurrence with Reclamation so that they can be consistent in the assumptions they make about hydrology in their planning. However, DWR has been using the same set of data for about 18 years, giving it considerable time to have taken these steps. The water operations scheduling manager stated that DWR is currently coordinating with Reclamation to update the data but was not sure when the update would be complete.

Similar to its estimates of the water supply, DWR has based its Lake Oroville storage target—the amount of water it believes it should retain in storage at the reservoir at the end of each water year in September—on historical water supply data. According to DWR, the storage target represents the amount of water it deems necessary to meet important objectives during subsequent years, such as protecting water quality standards. It is therefore reasonable to expect that DWR would try to account for the possibility of more extreme dry periods when setting its target. Specifically, in 2019 DWR increased its storage target from 1 million acre feet to 1.6 million acre feet, noting that climate change was among its reasons for doing so. However, documentation regarding the increase indicates that DWR established the storage

target using data about historical conditions going up to only 2003, and DWR staff confirmed that the model on which the target was based did not consider the effects of climate change.

In response to our concerns about the limitations of its approach, the deputy director of the State Water Project stated that DWR used the best available tool and data at the time. However, in 2008 DWR advised local agencies that they should plan for droughts that are at least 20 percent more frequent and longer lasting than droughts in the past, a method DWR did not apply when establishing its own storage target. As a result, its approach raises questions about whether its current storage target will enable it to meet its obligations if conditions become drier longer than they have been historically.

In addition to its inconsistently or incompletely documenting its rationale for reservoir release decisions, we found that DWR has not accounted for the possible effects of climate change on certain data that it uses in its reservoir planning. Such documentation issues may affect DWR's planning for reservoir releases and exports from the Delta. Specifically, the allocation analysis that DWR develops each month includes the volume of water that it has determined must flow through the Delta to meet water quality standards. However, when we asked how DWR determined these monthly volumes, its water operations scheduling manager stated that the monthly volumes were in use when she took her position in 2005 and that she believed they might have been based on an older set of water quality standards that are no longer in effect.

DWR's water operations scheduling manager agreed that the department needs to update the storage and water quality data we describe. She said that based on recent extremes in hydrology and potential changes in regulatory requirements, it is likely that DWR will reassess its storage target; however, she also stated that there is not yet a timeline for that reassessment. She also explained that in the past, she considered evaluating the figures DWR uses to determine necessary flow to address water quality standards, but she did not do so because of other priorities. By acting now, DWR may improve its chances of managing and mitigating the projected effects of climate change.

DWR Needs a Regular Process for Evaluating Its Monthly Water Allocation Plans and Water Storage Target

Given the importance of the State Water Project's various objectives, we expected that DWR would have a formal process for periodically evaluating the effectiveness of its reservoir operations planning to ensure the achievement of those objectives. Both state law and federal guidance regarding the management of public programs emphasize the importance of a formal process for monitoring government operations to ensure that an agency is efficiently and effectively achieving its objectives. Further, the guidance indicates that an agency should regularly evaluate the effectiveness of its monitoring process.

However, DWR does not have a formal process for evaluating the effectiveness of its reservoir operations planning. The federal guidance suggests that such reviews should be documented and should include established measures of performance against which an agency can evaluate its success. The reviews should also document corrective actions the agency will take to address any deficiencies in its processes. For example, DWR could assess the frequency with which it meets water quality and Delta outflow standards in a given water year then evaluate its allocation analysis to determine whether changes in that planning could address any deficiencies in its ability to meet the standards. However, DWR lacks policies or procedures requiring any periodic review of this type.

The water operations scheduling manager acknowledged that DWR lacks a formal and regular review process, but she asserted that DWR always assesses and evaluates its current or recent operations with the intention of making improvements. However, the examples of these reviews that she provided did not demonstrate that DWR's informal process is consistent with the formal, regular review and documentation that federal guidance recommends. For instance, she pointed us to informal comments that users of DWR's allocation analyses had added to those planning documents, indicating the desired volume of stored water for a given month. However, the comments do not explain what DWR hoped to achieve through making that adjustment, what deficiency it had observed that led to the adjustment, or what it planned to do, if anything, to achieve the indicated storage level.

A formal process might help DWR identify needed changes to its approach to developing its monthly plans for managing the State Water Project as well as improvements it could make to the data underlying those plans. California's residents, industries, agriculture, and protected wildlife rely on the State Water Project. It is thus critical that DWR take steps to ensure that it manages the project as effectively as possible.

Please refer to the section beginning on page 3 to find the recommendations that we have made as a result of these audit findings.

Other Areas We Reviewed

To address the audit objectives approved by the Joint Legislative Audit Committee (Audit Committee), we reviewed two temporary urgency change petitions (urgency change petitions) that DWR submitted in 2021 and 2022 to the State Water Board, both of which the State Water Board approved with certain conditions. Specifically, we determined whether those urgency change petitions affected water rights holders by requiring them to give up water to which they would otherwise have had access. We also identified the number and status of lawsuits pertaining to the two urgency change petitions.

DWR's Recent Urgency Change Petitions Did Not Require Water Rights Holders to Forfeit Water That They Had a Right to Receive

Urgency change petitions are formal requests to the State Water Board to temporarily change certain conditions of a water rights permit because of an urgent need. Under state law, the State Water Board may approve the urgency change petition by issuing a temporary change order if it makes specific findings established by law. The findings include that the party filing the petition can make the change without injury to any other lawful user of water and without unreasonable effect upon fish, wildlife, or certain other uses of water.

Our review found that DWR's urgency change petitions did not prohibit water rights holders from receiving water that they had the right to receive. DWR and Reclamation filed two joint urgency change petitions in the last two years—one in 2021 and one in 2022. Both were in response to drought conditions. In the petitions, DWR and Reclamation requested modifications to their water rights permits to allow them to reduce the amount of previously stored water that the State Water Project and Central Valley Project were otherwise required to release from their reservoirs upstream of the Delta. The stated purpose of the modifications was to increase water storage for future releases necessary to meet water quality and other standards.

Although state law protects the continuation of a river's natural flow against a change in use by another appropriator, it does not assure the release of stored water, as such water constitutes artificial supply and flow. Consequently, downstream water right holders are not entitled to water previously stored by another party. The temporary change orders found that reductions in DWR's and Reclamation's releases of water that they had previously stored in their reservoirs did not injure downstream water rights holders.

We identified two lawsuits filed against the State Water Board related to its approval of these urgency change petitions. One of the lawsuits includes claims that the State Water Board approved the urgency change petitions without due consideration of the possible impacts on fish and wildlife. The other lawsuit challenges a State Water Board order that, in part, involved a reconsideration of the 2021 urgency change petition. Both lawsuits were ongoing as of March 2023.

We conducted this performance audit in accordance with generally accepted government auditing standards and under the authority vested in the California State Auditor by Government Code section 8543 et seq. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on the audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Respectfully submitted,

GRANT PARKS
California State Auditor

May 25, 2023

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Appendix

Scope and Methodology

The Audit Committee directed the State Auditor to conduct an audit of DWR's management of surface water. The table below lists the objectives that the Audit Committee approved and the methods we used to address them.

Audit Objectives and the Methods Used to Address Them

	AUDIT OBJECTIVE	METHOD
1	Review and evaluate the laws, rules, and regulations significant to the audit objectives.	Reviewed relevant state and federal laws and regulations related to the objectives listed below.
2	Identify the predictive models that DWR and the State Water Board used to prepare for the 2021 drought. To the extent possible, evaluate the accuracy of the current models and whether the departments need to modify these models to perform more accurately going forward to take into consideration California's persistent drought.	• Documented the predictive model that DWR uses to predict the water supply, including whether conditions will be dry or critically dry, and compared it to models used by the agencies identified under Objective 6. • Reviewed water management requirements that are dependent in whole or in part on DWR's water supply forecasts, including in years projected to be dry or critically dry. • Researched and documented best practices for water supply forecasting and reviewed the models available and used by federal and local agencies to develop their water supply forecasts. • Compared DWR's water supply forecasts to the actual observed runoff for water years 2017 through 2022. • Interviewed staff at DWR and reviewed documentation to identify DWR's efforts over roughly the last 10 years to improve its water supply forecasts and adapt them to climate change. • Determined that the State Water Board does not participate in the development of DWR's water supply forecasts.
3	Determine for water year 2021 (October 1, 2020, to September 30, 2021) DWR's projection of how much water would be captured and how much was actually captured to determine whether the State miscalculated the amount of water that would be captured. If so, determine why, by how much, and what was done to ensure miscalculations will not be repeated, including whether responsible parties have been held accountable. Also determine how much water was released from the State's reservoirs and for what reasons.	• Documented the error rates for DWR's forecasts in water year 2021 and, to the extent possible, compared the error rate in its median forecast to the error rates of other agencies identified under Objective 6. • Interviewed DWR staff and reviewed documentation to determine the reasons for DWR's increased error rate in water year 2021. The DWR staff who oversaw the water supply forecasts in water year 2021 still oversaw forecasting at the time of our review. • Interviewed DWR staff and collected documentation to assess DWR's efforts to improve the accuracy of its forecast. • Interviewed staff and collected documentation from a selection of local agencies regarding the effects of DWR's forecasts on their water management operations. • Reviewed State Water Project releases from Lake Oroville to determine the reasons for those releases. We focused our review on Lake Oroville for several reasons, including its size, its importance to the State Water Project's operations, and the relative volume of releases from it compared to other State Water Project reservoirs.

continued on next page . . .

AUDIT OBJECTIVE	METHOD
4 Evaluate whether operational procedures and requirements for reservoirs are appropriate to ensure that sufficient water will be stored. Determine the State's recourse if it determines that too much water has been released or insufficient water is stored.	• Documented best practices for preparing for a drought. We also reviewed and evaluated DWR's relevant planning documents against those best practices. • Reviewed and documented the requirements, including contracts and permits, that govern DWR's storage and release of water from its Lake Oroville reservoir. Again, we focused our review on Lake Oroville because of its size and importance to the State Water Project's operations. • Reviewed and evaluated DWR's Lake Oroville reservoir operational planning process for a selection of months during water years 2021 and 2022, including the methods DWR used to decide how much water it would release, store, and allocate to State Water Project contractors. • Documented steps that the State can take during times of drought, including the State Water Board's curtailment and urgency change petition processes.
5 Identify the real-time feedback mechanisms DWR relies on to determine when it should release water. Specifically, review releases made from reservoirs, including Lake Oroville in July 2021 and February 2022, to determine how state officials decided when and how much water to release.	• Reviewed DWR's process for increasing and decreasing releases from its Lake Oroville reservoir, including the data that it monitors to inform those decisions. • Reviewed releases DWR made from the Lake Oroville reservoir in July 2021, February 2022, and a selection of 12 other months from water years 2021 and 2022. Deficiencies in DWR's records regarding its releases limited its ability to demonstrate the specific reasons for those releases, including releases that were higher than the minimum required amounts in February 2022 and eight other months. July 2021 was among several months we identified in which DWR did not meet water quality standards and had limited documentation of the specific steps it took to attempt to meet those standards.
6 To the extent possible, compare Sierra runoff predictions among the state, federal, and local agencies, such as Turlock, Merced, and CNRFC, to identify the factors that resulted in different predictions and the magnitude of any differences. Assess the extent of collaboration DWR and the State Water Board have conducted with local agencies to improve the State's modeling and data collection.	• Contacted more than 26 local water agencies to determine which agencies developed their own water supply forecasts. The majority we spoke to do not. Of those that did, we selected three: Turlock, Merced, and San Francisco. We documented the water supply forecasting methods that each uses. We documented the same for the CNRFC. • To the extent they were available, compared the forecasts that the local water agencies and CNRFC developed to the actual runoff for water years 2017 through 2021. We compared each agency's error rate in its median forecast to DWR's error rate for the geographic areas where DWR and the agency both developed forecasts. • Compared DWR's, CNRFC's, and the local agencies' models. We determined whether the local agencies and CNRFC considered different or additional data as compared to DWR. • Interviewed staff at DWR and reviewed documentation to determine the steps DWR has taken to improve the accuracy of its forecasts, including any efforts in which it collaborated with other agencies.
7 Review the State's plan to meet its contractual obligations to maintain salinity standards in the Delta and to provide adequate flow to sustain native fish populations. a. Identify how frequently the State has granted urgency change petitions releasing water designated for other purposes. b. Determine how often such petitions have resulted in legal challenges and the outcomes of those legal challenges. c. Determine whether the State requires water rights holders to give up water they would otherwise have had access to if it fails to accurately predict and manage stored water supplies.	• Assessed how DWR accounts for the need to meet Delta water quality and flow standards in its Lake Oroville reservoir operations planning. • For the months we reviewed under Objective 4, documented the frequency with which DWR and Reclamation did not meet water quality or flow standards. We reviewed DWR's records of its actions to attempt to comply with those standards. • Documented the urgency change petitions the State Water Board granted from DWR during water years 2019 through 2022. We determined whether the State Water Board's granting of those urgency change petitions allowed for the release of water that had been designated for other purposes and whether it prevented other water rights holders from receiving water to which they were legally entitled. • Reviewed and documented whether the State Water Board's granting of those urgency change petitions led to lawsuits. We documented the status of those lawsuits.
8 Review and assess any other issues that are significant to the audit.	None identified.

Source: Audit workpapers.

Assessment of Data Reliability

The U.S. Government Accountability Office, whose standards we are statutorily obligated to follow, requires us to assess the sufficiency and appropriateness of the computer-processed information we use to support our findings, conclusions, and recommendations.

In performing this audit, we relied on various electronic data files from DWR, including data on the water supply, reservoir releases, reservoir storage levels, and Delta conditions. To evaluate the data, we interviewed staff knowledgeable about the data and performed testing of the data where appropriate. In all instances, we found the data to be sufficiently reliable for our audit purposes.

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STATE OF CALIFORNIA – CALIFORNIA NATURAL RESOURCES AGENCY **GAVIN NEWSOM**, *Governor*

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May 9, 2023

Grant Parks, CPA*
California State Auditor
1621 Capitol Mall, Suite 1200
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Dear Auditor Parks,

The California Department of Water Resources acknowledges receipt of the California State Auditor's redacted draft report titled, "Department of Water Resources: Its Forecasts Do Not Adequately Account for Climate Change and Its Reasons for Some Reservoir Releases Are Unclear."

DWR appreciates the California State Auditor staff's effort to fulfill the direction of the Joint Legislative Audit Committee to review DWR's 2021 runoff forecasts and State Water Project reservoir operations in 2020 and 2021. DWR wholeheartedly agrees that managing water resources in an era of climate change requires regular, vigorous examination of standard practices. DWR embraced that ethos starting in 2008, when it created its climate change program. Though managing water supplies for 27 million people through the extraordinary hydrology of the last 10 years is easier in hindsight than in the moment, DWR appreciates the complexity of the examination summarized in the report.

Findings

DWR respectfully disagrees with the audit declaration that DWR has been slow to account for the effects of climate change on key responsibilities related to managing the State's water resources. DWR established a climate change program in 2008 and has released progressive phases of its Climate Action Plan in 2012, 2018, 2019, 2020, and 2022. Each phase of the plan provided cutting-edge analyses and responses to climate change challenges. DWR's leadership in addressing climate change has been recognized by the Climate Registry, at the Climate Leadership Conference, the U.S. Environmental Protection Agency, and the Center for Climate and Energy Solutions. Since 2012, DWR has won 14 awards for climate action including the most prestigious national award available, membership in the Climate Leadership Awards Hall of Fame (2022). ① ②

* California State Auditor's comments begin on page 53.

While there is always more that DWR can do to adapt to a changed climate, DWR has demonstrated leadership in accounting for the effects of climate change in the field of water resources forecasting and water resources management.

No single, simple model produces a forecast. Forecasting involves a collection of tools that include multiple computer models that inform the forecast assembled by engineers and others working as a team. All the pieces must fit together, and each of the tools must be developed to a certain threshold to be useful in an operational setting.

③ Responding to new climate extremes and conditions outside the bounds of historical experience – like those experienced in water year 2020-21, the focus of the audit -- requires time, because new tools must be developed to characterize conditions and shape forecasts in meaningful ways. Anticipating extreme years like 2020-21, DWR years ago began to develop partnerships with the National Atmospheric and Space Administration (NASA), the U.S. Geological Survey (USGS), the National Oceanic and Atmospheric Administration (NOAA), Scripps Institution of Oceanography, the National Weather Service, California-Nevada River Forecast Center, and other institutions to facilitate the transition of research concepts into relevant forecasting applications. DWR also has increased the use of Aerial Snow Observatory flights that provide data in expanded areas of the Sierra Nevada mountains to help provide more accurate snowpack forecasting. Other areas of completed improvements from the period of June 2021 to February 2022 include:

- Narrowing of hydrologic datasets to the most recent 30-year period (1991-2020) from a 50-year (1966-2015) period in order to better reflect the effect of climate change on snow, precipitation, and runoff.
- Development of new statistical models (Eqn 2022) based on updated, 30-year hydrology using machine learning techniques.
- Improved automation of daily and monthly data collection and calculations.
- Establishment of a new methodology to evaluate and improve 90 percent and 10 percent exceedance forecasts.
- Updating of Water Supply Index methodologies to better account for future precipitation distribution across exceedances, volume prediction, and historical flow regimes.
- Expanded use of machine learning to better classify data based on new climate change models.
- Training for staff on iSnobal to support Aerial Snow Observatory work.

- Development of iSnobal models for the Tuolumne, Merced, San Joaquin, Kings, and Kaweah watersheds.
- Launching of a pilot program in partnership with Airborne Snow Observatories, Inc. and the National Center for Atmospheric Research to develop coupled atmosphere watershed models in the San Joaquin and Feather River watersheds.

DWR appreciates and will implement the audit recommendation that it establish a formal process to evaluate forecasting models. DWR has been discussing that idea with collaborators, with the intention of incorporating changes to that effect. DWR also agrees that a public-facing web page with annual updates would be helpful for both the department and stakeholders.

DWR respectfully disagrees with the auditor's conclusion that the department does not have a comprehensive, long-term plan for mitigating or responding to the effects of more severe future droughts on the State Water Project. Multiple DWR initiatives mitigate the effects of climate change including severe droughts on the State Water Project. Those initiatives – some complete, others underway – are not encapsulated in a separate document called the "long-term drought plan," but these initiatives nevertheless constitute a comprehensive strategy to mitigate the effects of future droughts. DWR's efforts to respond to future droughts include: ④

- Identifying a set of actions for use during dry periods, described within a Drought Toolkit published by the U.S. Bureau of Reclamation. The Drought Toolkit is developed in coordination with DWR, the California Department of Fish and Wildlife (CDFW), National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), and the State Water Resources Control Board (SWRCB). The Toolkit includes actions that can either mitigate or avoid drought impacts throughout the Central Valley. It was last updated in 2022 and is a living document that will be updated to include additional actions.
- Issuing a "Delivery Capability Report" every two years in which the effects of drought upon the State Water Project's ability to provide water to its customer agencies is quantified. The public water agencies that depend upon State Water Project supplies use this key water resource planning document in their planning and water resource portfolio development. This report has included an estimate of climate change impacts on State Water Project deliveries since 2009. In the most recent 2021 Delivery Capability Report, DWR provided estimates of future conditions that include substantial warming and up to 55 inches of sea level

rise. For the upcoming 2023 Delivery Capability Report, DWR will continue to deepen the climate analysis by reporting multiple risk-informed scenarios to provide a greater exploration of both droughts and extreme wet weather events.

- Regularly updating DWR's "Climate Action Plan," which was first issued in 2012. DWR recently completed the first part of Phase III of the plan, which assesses the vulnerability of the State Water Project to future, climate change-driven droughts. DWR efforts to address the vulnerabilities captured in the Climate Action Plan include the Delta Conveyance Project, increased storage reserved in Lake Oroville as protection against drought the following year, implementation of Forecast Informed Reservoir Operations for Lake Oroville, and repairs to restore the full capacity of the California Aqueduct to convey water and to prevent future damage to the Aqueduct from subsidence caused by groundwater pumping. DWR is currently developing the second part of the Phase III of the Climate Action Plan, which is an adaptation plan that will include an updated assessment of the effectiveness of the measures already in development and an evaluation of whether additional long-term measures are needed.

The audit report declares that DWR lacks sufficient records explaining some releases from its Lake Oroville Reservoir. DWR contends otherwise. DWR maintains records and detailed data sufficient to demonstrate the rationale for reservoir releases to the State Water Project's most engaged
⑤ stakeholders. Regulators of the State Water Project – including CDFW, NMFS, USFWS, the U.S. Army Corps of Engineers, and SWRCB – have not raised concerns about record keeping, nor have the 29 public water agencies who depend upon State Water Project deliveries. Nonetheless, water management is complex, and DWR acknowledges that its
⑥ documentation may be confusing to non-experts. DWR sees the value in presenting existing records in a more publicly accessible way and will explore reasonable alternatives to make those records accessible.

DWR takes issue with multiple statements in the audit claiming that DWR released more water from Lake Oroville than the minimum required.
⑦ These statements imply that an alternative use exists for the water DWR released to meet multiple water quality and environmental requirements. For example, Figure 9 calls out that "the additional water [released] is about as much as 229,000 households would use in a year," suggesting that this was a viable alternative use for this water. DWR would have had to knowingly and willfully violated environmental and water quality requirements in order to make this water available for municipal water supply.

The audit report asserts that "… DWR has not incorporated an assessment for the effect of climate change in its near-term operations." This is false. In 2019, DWR increased by 23 percent the target amount of storage saved in Lake Oroville each year to better prepare for drought. This adjustment was made as the direct result of assessing the effect of climate change on near-term operations of the State Water Project. The audit report discounts this adjustment as unrelated to climate change because the size of the adjustment was informed by an analysis using the CalSim 2 model. The audit report does not mention that CalSim 2 is widely used by water resource professionals and was the best available tool at the time. Also missing is a more general acknowledgement that all models have limitations, and yet operational decisions must still be made. These decisions are not made by blindly applying the output of a model, they are made by considering numerous factors, including the limitations of the model and how competing considerations must be balanced. ⑧

As for the audit statement that "DWR needs a regular process for evaluating its Monthly Water Allocation Plans and Water Storage Target," DWR has an established process that includes monthly reviews of previous water supply forecasts and an annual workshop to review operations at the end of the water year. This process includes both internal and external reviews conducted with numerous representatives of the public water agencies that receive water from the State Water Project. ⑨

Recommendations

Many of the audit report recommendations would layer additional processes and procedures on reservoir operations. DWR notes that there is an opportunity cost in terms of human and financial resources to expanding such processes. Neither the regulators nor the customers of the State Water Project have called for DWR to impose the additional, formal processes and reviews the audit recommends. Furthermore, the State Water Project is required to conduct an annual review of its operations to the California Water Commission. The Commission submits that annual review to the California State Legislature. Through its monthly, public meetings, the Water Commission provides a venue for review of State Water Project operations and presentation of information in a manner accessible to non-water experts. ⑩ ⑪

What the California State Auditor seeks to accomplish with its recommendations – ensuring that DWR manages water resources adaptively based on experience – happens in ways apart from the labor- and documentation-intensive processes that would have to be established to fulfill many of the recommendations of the audit. ⑫

⑫ No amount of paperwork will solve the challenges of climate change. However, a collaborative team of scientists, academic partners, and water managers dedicated to improved forecasting and water management through extreme flood and drought will help keep Californians safe, with secure water supplies, and that is DWR's approach.

Conclusion

DWR would like to share a few points of additional information:

- The shift at DWR is well underway to move from a statistical, record-based forecasting model to water supply forecasts that simulate the physics of interactions among the atmosphere, water as rain or snow, and the land surface – and to do so for individual watersheds, incorporating site-specific features like slope orientation and depth of soil. This shift requires substantial financial and human resources.

- DWR contributed nine of 50 technical papers underpinning the State's Fourth Climate Assessment in 2019 – a demonstration of the department's commitment to climate science. That research included an assessment of the impacts of climate change on the State Water Project.

- DWR continues to work with partner federal agencies (NASA, USGS, NOAA, U.S. Army Corps of Engineers, and U.S. Bureau of Reclamation) to coordinate development of forecasting and water management capabilities for the benefit of all. DWR also is strengthening its partnerships with land stewardship agencies including the U.S. Forest Service, National Park Service, and CAL FIRE for better observations that support better resource management across the watersheds.

- DWR continues to work with academic partners to pivot the best elements of emerging technology and analytical techniques from a research concept to operational implementation. While not every technology or model makes a successful transition, sustained partnerships ensure that the State has the opportunity to keep pace with climate change and its water-related impacts.

The hydrologic conditions in spring 2021 – the focus of much of this audit – were influenced by climate change. DWR reacted quickly to the extreme hydrology and immediately embraced the runoff forecasting error of 2021 as an opportunity to learn, adjust, and improve. We recognize the importance of forward-looking forecasting that embraces extremes. This high-priority work is crucial to water management and governance in

California. It will be the focus of continual effort and improvement at DWR.

Thank you again for the opportunity to comment on the draft, redacted audit report.

Sincerely,

Karla A. Nemeth

Karla Nemeth
Director, California Department of Water Resources

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Comments

CALIFORNIA STATE AUDITOR'S COMMENTS ON THE RESPONSE FROM THE CALIFORNIA DEPARTMENT OF WATER RESOURCES

To provide clarity and perspective, we are commenting on the response to our audit from DWR. The numbers below correspond to the numbers we have placed in the margin of the response.

DWR's statements are misleading. Our conclusion is not that DWR has not been involved in climate change related efforts, but rather that it has not adequately accounted for the effects of climate change on key aspects of its management of surface water. Despite DWR's acknowledgement in 2008 that a standard of practice that explicitly considers climate change must be adopted along with new forecasting tools, as we describe on pages 16 through 18, it has made only limited progress toward implementing a forecasting model that can better account for the effects of climate change. Prior to its significant forecasting error in water year 2021, DWR made only one formal attempt to adopt a new model that could better account for the changing climate. Similarly, on page 25 we quote text from the Climate Action Plan that DWR references in its response when we state that DWR has reported that climate change poses serious challenges to its operation of the State Water Project. However, as we describe on pages 25 through 29, despite its acknowledgment of those challenges, DWR has not developed a comprehensive plan for mitigating or responding to the effects of more severe future drought caused by climate change. ①

Notwithstanding the awards DWR references, it can do more to demonstrate leadership in addressing climate change. For example, to date DWR has not fully modified its approach to forecasting the available water supply, despite noting in 2018 that climate change might be causing increased errors in its forecasts. Further, DWR's approach for estimating runoff into Lake Oroville as part of its State Water Project planning is based in part on historical data from 1962 through 2002, which was a period when runoff was roughly 20 percent higher than during the last 10 years. ②

We acknowledge that adopting new forecasting methods takes time, but we are concerned with the significant amount of time that has passed between DWR's acknowledgment in 2008 that it needed a new approach to forecasting and the limited progress it has made to date. ③

We disagree with DWR's assertion that the initiatives it references in its response constitute a comprehensive strategy to mitigate the effects of future droughts. As we describe beginning on page 28, we reviewed all of the documentation that DWR provided—including all of the documentation it describes in its response—and concluded that, even collectively, those documents did not address all elements of the best practices for drought planning that we discuss in the report. Specifically, those documents contain high-level discussions of certain impacts of drought, and the Drought Toolkit describes potential actions DWR, Reclamation, and other agencies may take during a drought. However, none of the documents sufficiently assess the potential impacts of more severe future droughts on State Water Project operations or the degree to which such droughts may challenge DWR's ability to meet the project's objectives. ④

They also do not contain clear steps that DWR intends to take to address those challenges. Our conclusion is consistent with the acknowledgment by DWR's manager of water operations on page 28 that she was not aware of specific plans to prepare the State Water Project for droughts that are more severe than past droughts.

⑤ DWR's statement that it maintains records sufficient to demonstrate the rationale for its reservoir releases is inaccurate. We reviewed all of the records that DWR asserted contained this information, and identified significant gaps in those records. As we describe on page 34, when we asked DWR's leadership in the field for an explanation for the specific amounts of water released, DWR was only able to provide limited insight and "piece together" what it did and why. As we conclude on page 35, DWR's limited documentation explaining its reservoir release decisions impairs its ability to externally demonstrate adequate stewardship of the State Water Project and also hinders its own ability to monitor the effectiveness and appropriateness of its release decisions. To illustrate, Figure 9 on page 32 shows that DWR released 153,000 acre feet from Lake Oroville in October 2020, but could not explain how it determined that amount was appropriate versus alternatively higher or lower water releases.

⑥ DWR's suggestion that its reservoir release records are not deficient, but rather too complex for "non-experts" to understand is misleading. Our review of DWR's release decisions was not impeded by the complexity of DWR's data, but rather by the absence of documentation supporting fundamental aspects of those decisions. As we describe on page 34, DWR itself could not provide specific explanations of its rationale for its releases, and instead claimed that hindsight about a specific release has limited value.

⑦ DWR takes issue with factual statements from our report indicating that DWR released more water than the minimum amount required by various standards, criticizing the audit report for incorrectly implying this water could have been used for alternative uses (such as by households). DWR's response misconstrues our report and requires clarification. In order to provide our report's readers with context on the magnitude of DWR's water release decisions, the report equates 153,000 acre feet as enough water to supply 229,000 households for a year. Our point—as we highlight in Figure 9 on page 32—is that DWR could not explain why releasing this specific amount of water was necessary and how the amount released was specifically determined versus potential alternatives. For example, DWR might have instead released 100,000 acre feet or 200,000 acre feet. As we acknowledge on page 33 and elsewhere in the report, DWR's water release decisions may have been necessary to maintain water quality and flow in the Delta; however, the often absent or limited documentation explaining how DWR determined the magnitude of these releases prevented us from evaluating DWR's decisions, as directed by the audit's objectives.

⑧ We acknowledge DWR's 2019 update to its storage target on page 36. We also note on page 37 DWR's confirmation that the model on which the update was based did not consider the effects of climate change. Further, contrary to DWR's assertion, we also acknowledge its perspective that the model it used was the best available tool at the time. However, we conclude that DWR did not apply methods responsive to the assumption of more frequent and longer lasting droughts, as it advised local agencies

to employ, when it established its own target. Finally, as we state on page 37, DWR's manager in the field agreed that the department needs to update its storage target, and that it will likely do so in part based on recent extremes in hydrology.

As we describe on page 38, the records DWR provided for its operational reviews did not demonstrate consistency with the formal, regular review and documentation processes that federal guidance recommends. Federal guidance suggests that such reviews should be documented and should include established measures of performance against which an agency can evaluate its success. The reviews should also document corrective actions the agency will take to address any deficiencies in its processes. The records DWR provided showed that DWR's reviews lacked each of those elements. For instance, to demonstrate DWR's reviews, the water operations scheduling manager pointed us to informal comments that users of DWR's allocation analyses had added to those planning documents, indicating the desired volume of stored water for a given month. However, the comments do not explain what DWR hoped to achieve through making that adjustment, what deficiency it had observed that led to the adjustment, or what it planned to do, if anything, to achieve the indicated storage level. Additionally, as we note on the same page, DWR's water operations scheduling manager confirmed that DWR lacks a formal, regular review process for its reservoir operations planning. (9)

DWR does not specify which of our recommendations it believes would result in unnecessary processes, procedures, and costs. Nonetheless, we stand by the importance of each recommendation in helping DWR ensure improved management of the State's water supply. Our recommendations are informed by best practices in water supply forecasting, drought and emergency planning, and effective management of public programs. (10)

Our recommendations are the result of a comprehensive and detailed audit process that is not broadly comparable to the role played by DWR's external stakeholders. Further, we question DWR's assertion that no such stakeholders or regulators have called for additional processes and reviews. Specifically, in an April 2021 letter to both DWR and Reclamation after the two entities did not meet certain water quality standards during February through May 2021, the State Water Board called for improvements, including to the State Water Project's and Central Valley Project's long-term drought planning and preparedness. (11)

In various places, DWR's response attempts to downplay the audit's recommendations by casting them as bureaucratic, paper-intensive exercises that will not improve its operations. What DWR is not acknowledging in its response is that our recommendations seek to establish an accountability structure where DWR is better positioned to explain its water management decisions to others, particularly with respect to water supply forecasting and water releases from the State's reservoirs. Regardless of whether DWR releases 100,000 or 200,000 acre feet of water, doing so has tangible consequences for households, agriculture, and the environment as the State navigates increased volatility with precipitation and other effects of climate change. Throughout the audit, we held numerous (12)

discussions with DWR staff to understand how they made water release decisions. DWR's water operations scheduling manager summed it up best by explaining that DWR's decisions are not specifically written out, but one can "piece together" what DWR did and why. Given the critical importance of water to the State's various stakeholders, we do not believe DWR is currently well-positioned to promote accountability and transparency for its decision making.

Exhibit 6

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105-3901

March 16, 2023

Michael Jewell
Regulatory Division
U.S. Army Corps of Engineers
1325 J Street
Sacramento, California 95814

Subject: Draft Environmental Impact Statement for the Delta Conveyance Project, Sacramento California (EIS No. 20220183)

Dear Mr. Jewell:

The U.S. Environmental Protection Agency has reviewed the U.S. Army Corps of Engineers' above-referenced project pursuant to the National Environmental Policy Act, Council on Environmental Quality regulations (40 CFR Parts 1500-1508) and our NEPA review authority under Section 309 of the Clean Air Act. The CAA Section 309 role is unique to EPA. It requires EPA to review and comment publicly on any proposed federal action subject to NEPA's environmental impact statement requirement.

The proposed action is referred to as the Bethany Reservoir Alignment and the Draft EIS identifies it as the California Department of Water Resource's Preferred Alternative. The Bethany Reservoir Alignment would include two new intakes along the Sacramento River, a 45-mile-long tunnel, and a new pumping plant and aqueduct complex, among many other associated infrastructure facilities to support construction. Operating the new facilities in conjunction with the current State Water Project and Central Valley Project existing facilities would create a dual conveyance system. The Draft EIS states that DWR does not intend to apply for water rights to expand water quantity yet would achieve water supply increases relative to today's baseline in certain water year types and dual pumping scenarios.

The Draft EIS states that the U.S. Army Corps of Engineers has prepared the analysis to support its federal action to evaluate a Clean Water Act Section 404 permit regarding the placement of dredged or fill material into Waters of the U.S. as a result of construction of the proposed project. In addition, the applicant, DWR, previously prepared a Draft Environmental Impact Report (public comment period closed on December 16, 2022) to comply with the California Environmental Quality Act that analyzes impacts from the construction, as well as operation, of the project. The Draft EIS indicates that USACE has incorporated by reference the analysis of operational impacts presented in DWR's EIR. EPA reviewed applicable portions of the Draft EIR while reviewing the Draft EIS to inform our understanding of the potential impacts from both construction and operations. Please consider the recommendations described below, and further explained in the enclosed detailed comments, for your consideration as the project advances.

EPA 309 Review Summary

While the project has been significantly scaled back since its inception, EPA continues to believe that the operation of the proposed project has the potential to cause or contribute to long-term exceedances of regulatory water quality standards. Our enclosed detailed comments identify opportunities to improve the analysis and modify the project to ensure these impacts are avoided as a part of the preferred alternative in the Final EIS. EPA requests continued engagement with USACE, as the lead NEPA agency, to resolve these issues.

Compliance with CWA Section 404(b)(1) Guidelines

EPA notes that the Draft EIS presents information relevant to the USACE decision of whether to issue a CWA Section 404 permit for the proposed project, including information to evaluate compliance with the Section 404(b)(1) Guidelines. The Draft EIS assesses the effects of project operations qualitatively and refers readers to the Draft EIR for a quantitative analysis of project operations. While project operations have not yet been fully defined, even in the EIR, assessment of their potential impacts is required. The Guidelines require factual determinations of the secondary effects "associated with but not resulting directly from the actual placement of dredged or fill material," and consideration of how the direct and secondary effects of the proposed project would contribute to cumulative effects on the aquatic ecosystem. In consideration of the CWA Section 404 permit issuance and compliance with the Guidelines, we continue to recommend analysis and disclosure of secondary effects, including, but not limited to: changes in the salinity gradient and the location and volume of the low salinity zone in all seasons; adverse effects on water quality including the amplification of water quality impairments; disruption of migratory corridors for salmonids and sturgeon; degradation of aquatic life beneficial uses; disruption and loss of ecosystem processes; reductions in cold water supply for migratory fishes in the upper watershed; and changes to wetland or river hydrology.

EPA reaffirms that the Delta Conveyance Project is a candidate for elevation pursuant to the 1992 Memorandum of Agreement between EPA and the Department of the Army implementing Section 404(q) of the Clean Water Act ("1992 MOA"). In EPA's November 9, 2015 letter (herein after, "2015 3(b) letter") on the California WaterFix project signed by Regional Administrator Blumenfeld, EPA stated that the proposed project will have substantial and unacceptable impacts on aquatic resources of national importance. In EPA's October 10, 2020 letter on USACE's Public Notice for the proposed project, EPA affirmed that the Delta Conveyance Project, while modified, includes the same impacts identified in the 2015 3(b) letter and thus remains a candidate for elevation to EPA Headquarters, Office of Water pursuant to the 1992 MOA.

Operational Constraints

Because the operations proposed in the Draft EIR do not reflect all potential operational scenarios likely to be generated by ongoing regulatory processes, the amount of water that will be available for diversion through the proposed conveyance facilities may differ significantly from what was assumed for purposes of this EIS. The project should be designed and operated to meet all water quality standards, including those updates proposed by the State Water Resources Control Board. We reaffirm our recommendation that the federal and state lead agencies for Delta Conveyance carefully consider reasonably foreseeable operational constraints to ensure that the project is appropriately designed and operated to achieve water quality improvements and avoid unnecessary costs and environmental impacts.

Community Engagement
We note that DWR, as the lead agency under CEQA, has taken important first steps to gather input from the community regarding the potential impacts of the project. The proposed Delta Conveyance Project includes a Community Benefits Program that acknowledges that the direct project benefits related to State Water Project water supply reliability do not directly benefit the communities of the Delta and the project could have potential adverse effects that Delta communities would experience through the term of construction. EPA recommends continued engagement and implementation of meaningful and lasting positive projects with the tribes and disadvantaged communities that will be affected by the construction and ongoing presence of water infrastructure in the Delta.

We recommend synchronizing the NEPA and CEQA process as the project continues, including the publication of a joint Final EIS/EIR to best inform the public and decisionmakers, and to reduce the burden for the public to review two separate final documents. The EPA appreciates the opportunity to review this Draft EIS. When the Final document is released for public review, please provide an electronic copy and notification to Stephanie Gordon, the lead reviewer for this project, at (415) 972-3098 or gordon.stephanies@epa.gov. If you have any questions, please contact Stephanie Gordon or me at (415) 972-3308.

Sincerely,

Janice Chan
Acting Manager, Environmental Review Branch

Cc via email: Zachary Simmons, United States Army Corps of Engineers
Evan Sawyer, National Marine Fisheries Service
Brooke White, Bureau of Reclamation
Jana Affonso, United States Fish and Wildlife Service
Diane Riddle, State Water Resources Control Board
Kristina Reese, California Department of Water Resources
Melissa Farinha, California Department of Fish and Wildlife

Enclosure: EPA's Detailed Comments

EPA'S DETAILED COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE DELTA CONVEYANCE PROJECT, SACRAMENTO, CALIFORNIA – MARCH 16, 2023

Clean Water Act Section 404

The Draft EIS presents information relevant to the U.S. Army Corps of Engineers decision of whether to issue a Clean Water Act Section 404 permit for the proposed project, including information to evaluate compliance with the Section 404(b)(1) Guidelines (Guidelines). Information to support factual determinations of the potential short-term or long-term effects of the discharges of dredged or fill material associated with the proposed project (40 CFR 230.11) on the aquatic ecosystem will ultimately help support findings of compliance or non-compliance with the Guidelines (40 CFR 230.12). The following comments concern additional information needed to support those factual determinations and findings.

Secondary and cumulative effects on waters of the United States

Section 1.8 of the Draft EIS assesses the effects of project operations qualitatively and refers readers to the Draft EIR for an in-depth analysis of project operations. While project operations have not yet been fully defined, assessment of potential operational impacts is required by 40 CFR 230. Specifically, factual determinations of the secondary effects "associated with but not resulting directly from the actual placement of dredged or fill material" (40 CFR 230.11(h)), and consideration of how the direct and secondary effects of the proposed project would contribute to cumulative effects on the aquatic ecosystem (40 CFR 230.11(g)) are required.

EPA's review of the proposed project, as evaluated in the Draft EIS, indicates potential secondary effects include, but are not limited to: (1) changes in the salinity gradient and the location and volume of the low salinity zone in all seasons (40 CFR 230.25); (2) adverse effects on water quality including the amplification of water quality impairments; (3) disruption of migratory corridors for salmonids and sturgeon (40 CFR 230.30, 40 CFR 230.51); (4) decreases in the reproduction and survival of fishes (40 CFR 230.31); (5) degradation of aquatic life beneficial uses; (6) disruption and loss of ecosystem processes; (7) reductions in cold water supply for migratory fishes in the upper watershed; and (8) changes to wetland or river hydrology (40 CFR 230.23). In addition, the proposed project (Bethany Alternative) would result in reduced direct (fill) impacts to aquatic resources relative to other alternatives, but would also result in the construction of a new 6000 cubic feet per second (cfs) pumping station to allow the North Delta Diversion to operate independently of the existing Jones and Banks pumping stations in the South Delta. Since this new Bethany pumping station could be operated concurrently with the existing Jones and Banks pumping station, it has a potential to result in substantially higher volumes of water diverted from the estuarine ecosystem, even compared to other build alternatives.[1] These are important secondary effects of the Bethany Alternative that must be considered in the determinations required under 40 CFR 230.11(h).

[1] "The project alternatives would provide an additional conveyance facility for transporting water from the north Delta for SWP/CVP export without changing the operational rules of other SWP/CVP facilities or the procedures for specifying the overall water supply allocations for their corresponding contractors. However, as part of a dynamic system, the opportunities for using the north Delta intakes for diversion of additional water supplies could result in changes in corresponding simulated river flows and reservoir storage levels even without any change in operational rules and procedures." -p. 5-13 (draft EIR)

***Recommendation*:**
Include a complete assessment of the secondary and cumulative[2] effects of each alternative, including those effects resulting from operations of the project when determining compliance with the Guidelines' restrictions on discharges (40 C.F.R. Part 230 Subpart B). While final project operations will be defined at a later date, the potential effects of increased water diversions under the proposed project, including the effects of increased diversion capacity under the Bethany Alternative, must be considered when determining compliance with the Guidelines. In the Final EIS, clearly identify what information will be used to assess secondary and cumulative effects of the discharges associated with the proposed project on waters of the United States in making the factual determinations required under 40 C.F.R. 230.11(h) and 40 C.F.R. 230.11(g).

Analysis of alternatives
As described in Chapter 3.5, the proposed project alternatives will require discharges of dredged or fill material into 61-226 acres of waters of the United States, including 13-85 acres of wetlands, as well as secondary and cumulative effects of project operations discussed above. The Guidelines require USACE to conduct an alternatives analysis that clearly demonstrates that the proposed discharges represent the Least Environmentally Damaging Practicable Alternative (LEDPA) that achieves the overall project purpose (40 CFR 230.10(a)). An alternatives analysis includes estimates of direct, secondary, and cumulative impacts on the aquatic ecosystem from each alternative considered. Secondary effects from the project alternatives, including the diversion of freshwater from Sacramento-San Joaquin Delta, present a potentially significant effect on the aquatic ecosystem and must be included in LEDPA identification.

Recommendation:
In the analysis of alternatives required under 40 CFR 230.10(a), consider all secondary and cumulative effects of each alternative, including the effects of increased diversions from the Sacramento-San Joaquin Delta though operations of a dual conveyance system. In the FEIS, include all relevant information to support a final LEDPA determination, including an assessment of the range of practicable alternatives following 40 CFR 230.10(a)(2) and an assessment of the direct, secondary, and cumulative effects on waters of the United States of each alternative.

Significant degradation of waters of the United States
The Guidelines also require that no discharge of dredged or fill material may be permitted which causes or contributes to significant degradation of waters of the United States, including significantly adverse effects on human health or welfare; life stages of aquatic life and other wildlife; aquatic ecosystem diversity, productivity, or stability; and recreational, aesthetic, and economic values (40 CFR 230.10(c)). As described in further detail below, the Delta is already experiencing degraded conditions due to

[2] Cumulative impacts include past, present and reasonably foreseeable direct and secondary impacts to the aquatic environment. Historical impacts from multiple stressors on aquatic ecosystems include: (1) decades-long declines in native and migratory fish populations; (2) the mortality of native and migratory fish from operating the south Delta pumps; (3) loss of natural cold water inputs caused by historic destruction of wetlands, depletion of groundwater aquifers, and the current and future loss of snow pack from climate change; and (4) modified and reduced phytoplankton and zooplankton community composition and abundance. Cumulative impacts analyses include estimating impacts from foreseeable projects and potential new storage projects (e.g. Sites Reservoir, temporary urgency change petitions and salinity barriers, etc.).

insufficient inflow, increased surface water temperatures, invasive animal and plant species, harmful algal blooms, and sea level rise. As described in the Draft EIS and Draft EIR, the proposed project will not ameliorate any of these stressors and is likely to exacerbate many of them. In particular, secondary effects of the discharge on flow conditions downstream of the proposed diversions are likely to result from decreased Sacramento River flows, with multiple potential effects including reduced primary production (Draft EIR p. 12-171-174), reduced through-Delta survival of migratory fish (e.g., Draft EIR p. 12-121, 12-152), and degraded habitat conditions in receiving waters due to decreased turbidity and increased salinity. The Draft EIS discusses the ongoing difficulties of highly invasive plants such as water hyacinth in the Delta but does not include measures that would be implemented to reduce the spread and introduction of invasive species within the proposed project area. Cyanobacteria Harmful Algal Blooms (CHABs) are an emerging and significant source of degradation of waters of the United States in the Delta affecting aquatic life and recreational uses.

> ***Recommendation:***
> Consider the direct, secondary and cumulative effects of the project as discussed above, practicable measures to minimize and compensate for adverse effects, and whether those effects would cause or contribute to significant degradation of waters of the United States before determining the project complies with the Guidelines required under 40 CFR 230.12. The Final EIS should include all information relative to permitting determination of no significant degradation, including water quality impairments and proposed avoidance, minimization and mitigation.

Compensatory mitigation

The EPA appreciates the inclusion of compensatory mitigation information in Appendix C3 in the Draft EIS, which will help guide development of a Mitigation Plan as required under 40 CFR 230.94(c). While compensatory mitigation requirements should not be determined until the applicant has demonstrated practicable avoidance and minimization required under the Guidelines as discussed above, compensatory mitigation actions may reduce the severity of those impacts to a level that would allow for the project to be permitted in compliance with the Guidelines without violating the prohibitions on significant degradation at 40 CFR 230.10(c).

Appendix C3 describes DWR's plan for compensatory mitigation for impacts to special-status species and aquatic resources. However, project impacts are not summarized in the appendix. Therefore, it is unclear how potential compensatory mitigation needs were used to develop this document, and whether the compensatory mitigation plan reflects consideration of the secondary and cumulative effects on waters of the United States discussed above. While the Guidelines direct USACE to first consider mitigation bank credits and in-lieu fee credits in determining mitigation requirements (40 CFR 230.93(b)), Appendix C3 describes a mixture of approaches to compensatory mitigation for aquatic resources, including both purchase of mitigation bank credits and development of permittee-responsible mitigation sites on Bouldin Island, the I-5 ponds, and tidal sites yet to be determined. Because the proposed project will impact a variety of aquatic resources for an extended period of time, EPA recommends the project be designed to incorporate a monitoring program with adaptive management to ensure compliance and assess effectiveness.

***Recommendations*:**
Clearly identify how proposed compensatory mitigation will replace aquatic functions and services lost due to the direct, secondary, and cumulative effects of the proposed project (see 40 CFR 230.94(c)(6)).[3] The Mitigation Plan must also include a long-term management plan (40 CFR 230.94(c)(11)), an adaptive management plan (40 CFR 230.94(c)(12)) and financial assurances (40 CFR 230.94(c)(13)) to support a high level of confidence that compensatory mitigation will be successfully completed. In consultation with other agencies, USACE should update the tidal habitat mitigation framework to prioritize the use of Reusable Tunnel Material (RTM) at established sediment reuse sites such as the Cullinan Ranch Restoration Project or Montezuma Wetlands Restoration Project. The current approach to permittee-responsible mitigation actions in Appendix C3 may require revisiting if credits from third-party mitigation providers such as mitigation banks and in-lieu fee programs become available in the future. In the Final EIS, USACE should include a draft Mitigation Plan including the elements discussed above.

Reusable Tunnel Material
A significant amount of RTM would be generated by the project alternatives. According to the Draft EIS, the Bethany Reservoir Alignment would generate approximately 14.4 million cubic yards of bulk material (p.3.10-12). Chapter 2 indicates that excess RTM would be stored as stockpiles on-site at the Twin Cities Complex and Lower Roberts Island on both a temporary (i.e., 4-5 years) and permanent basis. Two types of stockpiles would be created: the excavated RTM and the topsoil removed from upland construction areas. RTM would be mixed with soil conditioners prior to excavation from the tunnels. We do not recommend synthetic conditioners or those that might contain unwanted biological and chemical properties such as untreated biosolids.

Chapter 2 states that "RTM generated by the tunnel boring machine is not proposed for reuse during construction of DWR's Preferred Alternative" (pg 2-29) but it is not clear why RTM could not be reused for this alternative given the similarities in the project description among the alternatives. Further, the Draft EIS states "RTM handling at the Twin Cities Complex and Lower Roberts Island Tunnel Boring Machine launch shafts would be the same as described for other eastern alignment alternatives, except that mechanical dryers would not be used at Lower Roberts Island and no RTM would be transported for forebay construction" (p. 2-55). Finally, the Draft EIS states that the applicant would develop site-specific plans for the beneficial reuse of RTM to the greatest extent feasible for construction of the selected action alternative. EPA strongly advocates for the optimization of beneficial reuse of RTM for all Alternatives.

Due to the extensive quantities of soil and sediment material to be generated during construction of the project, we recommend USACE and DWR develop a holistic and proactive plan for soil and sediment management that addresses both short-term project goals and longer-term regional reuse opportunities. The plan should address both RTM and the sediment removed from operation of the sediment drying basins. We reiterate that RTM reuse during construction of the preferred alternative is ideal; for any material not reused during project construction, beneficial reuse is preferable to 'wasting' as permanent stockpiles with no functionality. Due to the Delta's significant subsidence issues, other regional projects

[3] Replacement ratios for lost aquatic resource functions can be defined using approved USACE methods, such as South Pacific Division's Mitigation Ratio Setting Checklist: https://www.spd.usace.army.mil/Portals/13/docs/regulatory/qmsref/ratio/12501-SPD.pdf

such as levee nourishment and wetland restoration could strongly benefit from this critical and limited 'building block' material. Depending on the soil conditioners used during excavation, a large portion of RTM will likely be relatively free of contaminants and thus a cost-effective source of potential clean building material. For development of such a plan, regional partners could help identify viable reuse opportunities in the near future and early logistical synergies with these projects (e.g., where best to stockpile for future offsite transport) and establish collaborative agreements to utilize the RTM. At this point in time, EPA is not aware of any Regional Sediment Management program within the Delta; this project could provide a leveraging impetus.

Recommendations:

Develop a holistic and proactive plan for soil and sediment management that addresses both short-term project goals and longer-term regional reuse opportunities in conjunction with DWR.

Clarify why RTM cannot be reused during construction.

To increase the broad applicability to reuse RTM for ecological restoration and levee improvements, we highly recommend the use of organic-based soil conditioners.

Coordinate with regional parters to help identify an appropriate strategy and document potential ideas in a collaborative agreement, including California Department of Fish and Wildlife as a partner in planning for soil stockpile storage and reuse. EPA is aware of several habitat restoration projects within the Delta that are in the planning process and could potentially benefit from RTM, such as CDFW's restoration of Franks Tract (contact: Melissa Farinha, CDFW Delta Habitat Conservation Environmental Program Manager), and Metropolitan Water District's Bouldin Island project.

Project Operations

The operation of the Proposed Project has potential to increase the extent of ecological impacts already impacting the Delta and Sacramento River, including salinity, temperature, nutrients, and chemical contaminants. Pelagic and migratory fish species in the Delta and Central Valley rivers and streams have undergone dramatic declines over the past 50 years and are now at perilous levels. The declines are due in large part to freshwater diversion from the Sacramento River as part of state and federal water conveyance projects. According to the Draft EIS and EIR in the descriptions of the No Action Alternative and Existing Conditions, water reduction in the Sacramento River has led to increased Delta salinity, increased temperature in the Sacramento River and the Delta, altered circulation patterns within the Delta, which interferes with fish migration and leads to entrainment of fish and other aquatic organisms, and less water available in the Sacramento River for dilution of chemical contaminants. Moderate to high freshwater flows in Central Valley rivers and tributaries provide significant health benefits to residential and migratory fish and are correlated to increased abundance and productivity. Conversely, current flow levels in the Sacramento Rivers are correlated with declines in species abundance and productivity. Given that the status of many Delta fish species is threatened, endangered, or other description of imperilment, further diversion of Sacramento River water under the Project could very well lead to greater impairment or extinction.[4]

[4] See EPA comments on the Bay-Delta Water Quality Control Plan(s) located at: https://www.epa.gov/sfbay-delta/epa-comments-sf-bay-delta-water-quality-control-plan.

Whether the Project will sustain and protect and ideally enhance Sacramento River and Delta ecology will depend predominantly on how it is operated, that is, the extent and schedule of diverted water and under what water year types the Project will be operated. The Draft EIS primarily evaluates construction and conveyance impacts and "incorporates by reference" operational impacts that were evaluated in the EIR. The operational impacts evaluated in the EIR were analyzed using only one scenario, namely existing operations under the Coordinated Operations Agreement as specified under the Bay Delta Water Quality Control Plan and applicable biological opinions under the Endangered Species Act. In evaluating ecological impacts, EPA recommends evaluation of multiple operational scenarios, especially operational scenarios in which ecological impacts are greatly minimized. In general, the Draft EIS lacks quantitative accounting of population-level impacts for species of management concern (e.g., changes in abundance, changes in population age-size structure due to life-cycle specific impacts) necessary to ensure that Project Alternatives adequately protect aquatic life designated uses for surface waters in the action area during the 12-14 year construction period and beyond.

The operational scenario evaluated in the Draft EIR (referenced to in the EIS) does not take into account significant recent and upcoming activities that affect the amount of available water for the Project. In particular, the Draft EIR's evaluation of operation impacts does not consider the impacts of future storage projects that would require Sacramento River water or recent and upcoming updates to the Bay-Delta Water Quality Control Plan (WQCP). Overestimation of available water will lead to underestimating ecological impacts or water available for water users. Recent updates to the WQCP were adopted in 2018 for the San Joaquin River basin and the southern Delta. Adoption of upcoming updates to the Sacramento River basin and central Delta are expected in 2023. Implementation of the flow objectives for the San Joaquin River tributaries is discussed in the Bay Delta Plan, and candidate flow objectives for the Sacramento inflows, interior Delta flows, and Delta outflow are provided in the 2017 Scientific Basis Report and the 2018 Implementation Framework for the Sacramento River basin and central Delta updates. Such information is reliable in determining operational impacts. In its December 2022 comments to DWR on the Draft EIR, the State Board indicated its availability to assist in how updates to the Bay Delta Plan may affect the evaluation of Project operations.

It is difficult to determine the frequency, magnitude, and duration of water quality exceedances and the subsequent effect on beneficial uses. If modeling shows salinity generally increasing in the Delta after consideration of all the modeling limitations, this indicates that there will be less operational flexibility to meet water quality criteria as a direct result of project operations, and little room for error in operating the system in the future. As a result, we are concerned that the proposed project would make future compliance with water quality standards more difficult, thereby increasing the chances of exceeding water quality standards and failing to protect multiple beneficial uses.

Recommendation:

Please continue to work with the State Water Resources Control Board to develop scientifically sound and reasonably foreseeable operational scenarios. Develop an operational scenario for the Preferred Alternative that would optimize water exports in tandem with improvements in Delta outflow, hydrodynamics, and upper watershed conditions that would optimize aquatic life and water quality protection.

Water Quality

Harmful Algal Blooms

The Draft EIS states that cyanobacteria harmful algal blooms (CHABs) already occur in the Delta so there would not be a significant increase in the frequency and magnitude of CHABs from construction of any of the Action alternatives (p. 3.17-40). There is limited analysis of the frequency or severity of current HABs and cyanotoxins, or the anticipated increases due to climate change, so the Draft EIS analysis assumes HABs are there and will be there, instead of any in-depth assessment of CHAB species occurrence (changes in species presence), variations, or the duration, severity or aerial extent of CHAB occurrence. Numerous CHAB species are known to occur in the Delta as well as other cyanotoxins (e.g., anatoxins), with quite varied public health effects. Operations of the project could affect HABs, but this is not included in the Draft EIS.

The analysis in the Draft EIS inappropriately focuses on CHABs from Microcystis (and thus microcystin concentrations) (p. 3.17-52). "Compensatory mitigation would not result in markedly higher electrical conductivity (EC) levels in the Delta, Suisun Marsh, Suisun Bay, San Francisco Bay, or the SWP/CVP export service areas. Therefore, this impact does not appear to be significant" (p. 3.21-7). Operation of the project will change flows in the Delta and thus Delta assimilative capacity for EC. Higher EC is linked to the occurrence of another type of Harmful alga called *Prymnesium parvum* (also called Golden Algae) that causes fish kills and is present in Californian lakes. The Draft EIS acknowledges that "while these discussions estimate recreational effects on the statutory Delta as a whole, it is possible that recreational opportunities and quality in specific areas within the Delta would be affected by activities of the action alternatives more than the Delta as a whole" (pg 3.17-13).

The Draft EIS states that CHABs are not problematic in Cache Slough or Yolo Bypass based on visual observations of Microcystis collected by the applicant and the California Department of Fish and Wildlife. Visual observation of microcystis in Cache Slough is not a sufficient measure for the presence of CHABs. While visual observations may identify microcystis, there are other forms of CHABs where this is insufficient. Furthermore, the visual observations may be useful for identifying pervasive, high levels of microcystis but it does not effectively assess the presence, trends, and therefore risks of microcystis in a waterbody (p. 3.21-17). In addition, the Draft EIS misrepresents the impacts and mitigation measures of HABs when it says "the presence of vegetation would generally decrease the potential for CHAB formation because plants would likely outcompete cyanobacteria for nutrients and sunlight." In actuality, Cyanobacteria tends to out compete native vegetation. Therefore, relying on the vegetation in the tidal habitat is not an adequate means of mitigating CHAB concerns.

The Draft EIS further states "the design of the tidal habitats is such that there would be daily hydrologic exchange that would ensure that there would not be substantially increased residence time compared to adjacent habitats…. Based on the above findings, under all action alternatives the effects on CHABs resulting from compensatory mitigation does not appear to be significant." (p. 3.21-17 & 18). The HAB event in San Francisco Bay this summer as well as regular blooms in the Delta demonstrate that mixing gradients and residence time do not prevent substantial cyanobacteria production.

The Draft EIS acknowledges that the project proposes to create waterbodies - the construction of one or two north Delta intake facilities between River Mile (RM) 42 (south of Freeport) and RM 37 (north of the town of Courtland), the Twin Cities Complex, other tunnel launch, reception, and maintenance sites, and the Southern Complex or Bethany Complex. Additionally, "certain tidal habitats could create new

"seed" areas for CHABs. This could result in long-term increases in the frequency and size of CHABs within the Delta in the vicinity of new tidal habitats, relative to the No Action Alternative and, therefore, could potentially increase health risks to people recreating in the vicinity." (p. 3.17-41). "Mitigation Measure WQ-14: Develop and Implement a CHAB Management and Monitoring Plan would be implemented with the goal to mitigate the potential for increases in CHAB formation and, thus, human exposure to cyanotoxins, within compensatory mitigation sites" (p. 3.17-53). However, the analysis incorrectly says "types of compensatory mitigation (i.e., valley/foothill riparian, freshwater emergent perennial wetland, seasonal wetland, lake/pond)…would not be hydrodynamically connected with Delta channels… As such, these other types of new habitats would not affect CHAB formation within the Delta, relative to the No Action Alternative." (p. 3.17-41). Hydraulic connection is not necessary for these areas to form CHABs and cyanotoxins that could impact public health e.g., thru direct contact, aerosol transport and other mechanisms of release of the CHABs or cyanotoxins, and the likelihood of CHABs should be addressed in the analysis.

Recommendations:

Revise the Final EIS to clearly address and analyze all types of CHABs and cyanotoxins to accurately reflect the current setting and potential impacts.

In the Final EIS, address the threats of increased salinity and potential to increase *Prymnesium parvum* blooms and fish kills; this should include the coordination with the Central Valley-Salinity Alternatives for Long-term Sustainability Program (CV-SALTS), Sustainable Groundwater Management Act and Irrigated Lands Regulatory Program regarding discharges of nitrates and salts to the Delta (CV-SALTS compliance point is in the San Joquin River at Vernalis).

Consider including more thorough testing measures and reporting requirements in the mitigation measures for the proposed project.

Environmental Justice

The Draft EIS identifies communities with environmental justice concerns throughout the California Sacramento-San Joaquin Delta that will be directly impacted by the proposed project's construction timeframe and long-term land management. Prior to publication of the Draft EIS and Draft EIR, DWR engaged with several communities. People of color, low-income households, and Tribes participated through multiple surveys and virtual public engagement sessions. DWR was unable to communicate project impacts because at the time of public engagement, the impacts were not yet known.[5] The Draft EIR states that participants would welcome further engagement and the opportunity to provide additional feedback. According to the Draft EIS, this outreach led to the development of a framework for a Community Benefits Program which would fund a broad range of programs and projects specifically designed to benefit communities. The Draft EIS presents the Community Benefits Program as a component of the proposed project intended to offset unavoidable construction impacts that communities would experience throughout a 13-year period. Should DWR approve the Delta

[5] "Because the CEQA environmental review process is just beginning and impacts are not yet identified, we were limited to indicating that there could be potential impacts and benefits to the project, but we could not describe what those impacts and benefits could include. However, not being able to share potential impacts meant that it was hard to gain attention from DAC [disadvantaged community] communities" (Environmental Justice Community Survey Report, Appendix 29A of the EIR, p. 115).

Conveyance Project, the Community Benefits Program would be a part of that approval and implemented consistent with all other components of the project.

Recommendations:

For the remainder of the environmental review process, engage the community throughout every future phase of the project (i.e., continuous feedback loop) and on an ongoing basis (e.g., monitoring and adaptive management). Continue extensive public outreach to ensure that potentially affected communities understand the project process and impacts and have the tools to provide feedback.

Explain how potential construction impacts of the project on roadways could affect low-income communities with high numbers of car-less households. Include information that focuses on how community members utilize roadways and obtain input from the community regarding the potential impacts of increased congestion and detours. Mitigation for construction-related impacts to people of color and low-income populations could include the provision of reduced-price bus passes during construction.

Consider communicating project impacts to the same individuals that participated during the public engagement sessions, and work closely with the community to make a recommendations regarding further minimization of impacts and next steps. Consider hiring a multilingual ombudsman that speaks Spanish, Chinese, and Tagalog.

As the project advances to final design, identify in the Final EIS, community perspectives regarding impacts, and how USACE has incorporated community perspectives into the project design, operations considerations, and mitigation measures. If USACE determines that specific community perspectives are not applicable to the proposed action, identify supporting information for such a determination in the Final EIS.

Describe how DWR plans to prioritize programs and/or projects funded through the Community Benefits Program and who will benefit from these programs and/or projects, and why. Include a timeline of when the community can expect these benefits to start and end. Include relevant information from Appendix 3G of the EIR in the Final EIS.