Bay Area Regional Reliability Drought Contingency Plan

Final

December 19, 2017

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FINAL

Bay Area Regional Reliability Drought Contingency Plan

Prepared for
East Bay Municipal Utility District (Lead Agency)
and Bay Area Regional Reliability Agencies:
Alameda County Water Agency
Bay Area Water Supply and Conservation Agency
Contra Costa Water District
Marin Municipal Water District
Santa Clara Valley Water District
San Francisco Public Utilities Commission
Zone 7 Water Agency

December 19, 2017

Reissued February 26, 2018 with a correction to
Alameda County Water District's service area boundary.

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- Bay Area Regional Collaborative
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- Bay Planning Coalition
- California Sportfishing Protection Alliance
- California State Coastal Conservancy
- California Water Impact Network
- Clean Water Action
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- Environmental Water Caucus
- Foothill Conservancy
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- Natural Resources Defense Council
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- Pacific Institute
- Planning and Conservation League
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- Sierra Club, Loma Prieta Chapter
- Sierra Club, San Francisco Bay Chapter
- Silicon Valley Leadership Group
- SPUR
- Stanford University, Water in the West
- Tuolumne River Trust
- Western Recycled Water Coalition
- Wholly H2O

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°C	degree(s) Celsius
ABAG	Association of Bay Area Governments
ACWD	Alameda County Water District
AF	acre-foot/feet
AFY	acre-foot/feet per year
AMI	advanced metering infrastructure
BARR	Bay Area Regional Reliability
BAWAC	Bay Area Water Agency Coalition
BAWSCA	Bay Area Water Supply and Conservation Agency
BBID	Byron Bethany Irrigation District
BiOp	Biological Opinion
CA	California
Cal Water	California Water Service Company
Cawelo	Cawelo Water District
ccf	hundred cubic feet
CCWD	Contra Costa Water District
CDFW	California Department of Fish and Wildlife
CEQA	California Environmental Quality Act
cfs	cubic foot/feet per second
CII	commercial, industrial, and institutional
CVP	Central Valley Project
CWC	California Water Code
DAC	disadvantaged community
DCP	Drought Contingency Plan
DDW	State Water Resources Control Board Division of Drinking Water
Delta	Sacramento-San Joaquin Delta
DMP	Drought Management Program
DOC	dissolved organic carbon
DOT	Department of Transportation
DPR	direct potable reuse
DSRSD	Dublin San Ramon Services District
DWR	California Department of Water Resources
EA	Environmental Assessment
EBMUD	East Bay Municipal Utility District
EBRPD	East Bay Regional Park District
ECCID	East Contra Costa Irrigation District
EDA	economically distressed area
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
FIRO	Forecast Informed Reservoir Operation
FRWA	Freeport Regional Water Authority
FRWP	Freeport Regional Water Project
GHG	greenhouse gas
gpcd	gallons per capita per day
IFA	Infrastructure Finance Act
IPCC	Intergovernmental Panel on Climate Change
IPR	indirect potable reuse
IRWM	Integrated Regional Water Management
ISD	Ironhouse Sanitary District
JPA	joint powers authority
LV	Los Vaqueros
M&I	municipal and industrial
MAF	million acre-feet
mgd	million gallons per day
MMWD	Marin Municipal Water District
MOA	Memorandum of Agreement
msl	mean sea level
NDF	Newark Brackish Groundwater Desalination Facility
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
O&M	operations and maintenance
P3	public-private partnership
PREP	Potable Reuse Exploratory Plan
R&R	repair and replacement
Reclamation	United States Bureau of Reclamation
RWQCB	Regional Water Quality Control Board

RWS	Regional Water System
SBA	South Bay Aqueduct
SBx7-7	Water Conservation Bill of 2009
SCVWD	Santa Clara Valley Water District
Semitropic	Water Storage District
SFPUC	San Francisco Public Utilities Commission
SGWP	Sustainable Groundwater Planning
SRA	Shortage Response Action
SRF	State Revolving Fund
State Board	State Water Resources Control Board
SVAWPC	Silicon Valley Advanced Water Purification Center
SWP	State Water Project
TBD	to be determined
TDS	total dissolved solids
TM	technical memorandum
TOC	total organic carbon
TSS	total system storage
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
UV	ultraviolet
UWMP	Urban Water Management Plan
WCWTP	Walnut Creek Water Treatment Plant
WSCP	Water Shortage Contingency Plan
WSIP	Water System Improvement Program
WTP	water treatment plant
Zone 7	Zone 7 Water Agency

Executive Summary

Through this Drought Contingency Plan (DCP), BARR agencies are working together to leverage existing assets and resources and strengthen the region's water supply reliability in ways uniquely possible through the partnership.

While drought is a recurring feature for California, the drought over the past five years was extreme and unprecedented, as punctuated by the two hottest years (2014 and 2015) and the lowest snowpack (2015) since record keeping began in 1895. As noted in the California Water Action Plan, the state's roadmap for sustainable water management, hydrologic and environmental conditions have reduced the reliability of California's traditional supplies, requiring water providers to consider alternative sources and new approaches to improve reliability in light of uncertainties.

A Regional Approach

Though supply conditions for water agencies in the San Francisco Bay Area have improved significantly in the current water year (2016/2017), the recent drought and opportunities to better leverage area resources have inspired more integrated regional water management and drought mitigation efforts, resulting in the Bay Area Regional Reliability (BARR) partnership among eight of the largest Bay Area water agencies (see inset) that collectively serve more than 6 million people in 6 counties (Figure ES-1).

To provide supply reliability and resilience in light of future uncertainties, each of the BARR agencies is steadfast in implementing strategies such as demand management; water supply portfolio diversification; aging infrastructure repairs/replacement; and interagency facility connections. Through implementing these strategies, the BARR agencies aim to maintain a reliable water system at affordable rates while protecting the environment and preparing for the future.

Amid the recent drought, the BARR partnership was established to cooperatively address water supply reliability concerns and drought preparedness on a mutually beneficial and regionally focused basis. After adopting principles in 2014 to guide the partnership, the agencies executed a Memorandum of Agreement (MOA) in 2015.

Bay Area Regional Reliability Partnership

- Alameda County Water District (ACWD)
- Bay Area Water Supply and Conservation Agency (BAWSCA)
- Contra Costa Water District (CCWD)
- East Bay Municipal Utility District (EBMUD)
- Marin Municipal Water District (MMWD)
- San Francisco Public Utilities Commission (SFPUC)
- Santa Clara Valley Water District (SCVWD)
- Zone 7 Water Agency (Zone 7)

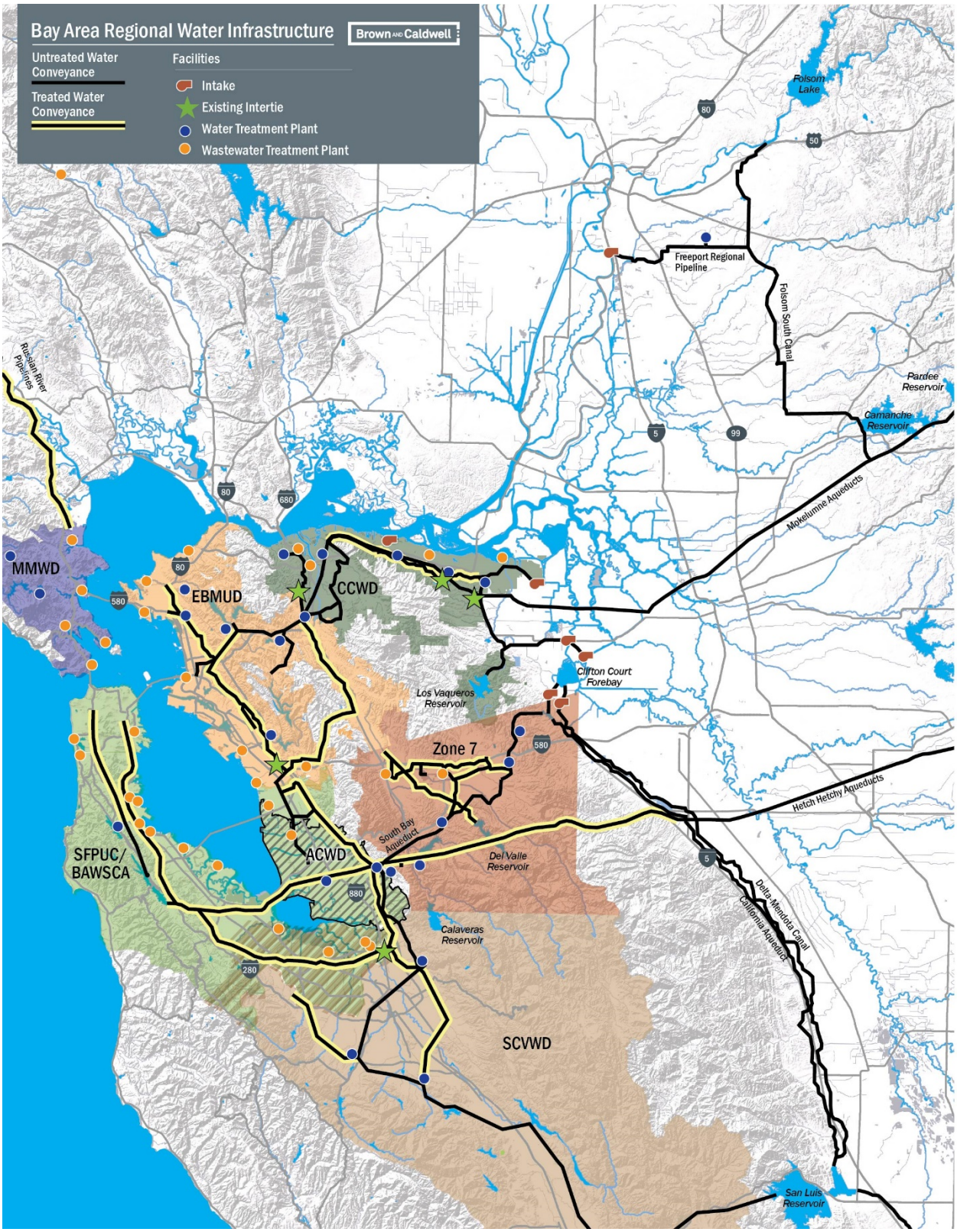


Figure ES-1. BARR agencies, which include eight of the Bay Area's largest water providers, are working together to optimize regional water supply reliability.

Drought Contingency Plan

To improve supply reliability, BARR agencies collaboratively developed this regional DCP—a project funded in part by the United States Department of the Interior, United States Bureau of Reclamation (Reclamation). The BARR DCP differs from past efforts because it approaches drought planning from a regional, integrated perspective and takes stock of BARR agencies' existing water assets and resources.

Plan Objectives

BARR agencies aim to cooperatively develop regional projects to strengthen the Bay Area's long-term water supply reliability and resilience. This effort focuses on combining and integrating existing assets and resources and exploring new operations strategies to improve resilience for droughts and other emergency conditions.

Though the DCP focuses primarily on drought reliability, it provides benefits for three distinct aspects of regional water, including:

1. Emergency response
2. Drought mitigation and response
3. Replacement or alternative supplies

The BARR DCP specifically addresses drought-related vulnerabilities through consideration of drought response actions and mitigation measures. The DCP is not a water supply master plan to accommodate growth. Future supply planning is addressed separately by the BARR agencies through their Urban Water Management Plans (UWMPs) and other efforts. The agencies also prepare for catastrophic events through emergency response plans and programs that establish strategies and operating procedures for the days and weeks following an emergency.

The primary focus of the DCP is drought mitigation and response; however, the BARR strategies considered in this plan may provide ancillary benefits for emergency response, replacement, and/or alternatives supplies.

The DCP's crux includes the strategies identified to improve regional reliability and resilience—**drought response actions and drought mitigation measures**—and an operational and administrative framework for implementation.

Plan Development and Key Elements

General managers and staff from each of the eight BARR agencies collaborated in defining the DCP's direction and developing its content. The agencies convened a Drought Task Force representing a broad range of stakeholder interests and solicited their input on interim work products through written comments and three workshops. In addition, the agencies held a public meeting to receive broader input on the Draft DCP prior to submitting it to Reclamation.

The BARR agencies developed this DCP using Reclamation's "Guidance Regarding the Drought Contingency Planning Process" as a framework. This plan uses BARR agencies' 2015 UWMPs as a primary source of information[1], and reflects a compilation and high-level overview of the Bay Area water system, including existing and projected demands, water use efficiency, and supplies. A collation of information from BARR agencies' UWMPs was used to create the comprehensive picture presented here.

A vulnerability assessment identifies risk factors contributing to potential compromise or loss of critical regional water resources. The DCP's crux includes the strategies identified to improve regional reliability and resilience—drought response actions and drought mitigation measures—and an operational and administrative framework for implementation.

[1] For more detailed agency-specific data, readers are directed to the BARR agencies' individual UWMPs and other longer-term water supply planning studies. It should be noted that UWMPs are required by state law every five years to document projected demands and supplies under different hydrologic conditions, and as such reflect relatively conservative estimates. BAWSCA member agencies are urban water suppliers that prepare individual UWMPs.

Regional Water Demand and Water Use Efficiency

Water use varies year-to-year depending on a number of factors, such as climate, regulatory and environmental drivers, and the economy. Despite this annual variability, BARR agencies' collective water use over the last two decades demonstrates a downward trend (Figures ES-2 and ES-3).

More substantial water use reductions over the last decade, and particularly over the last several years, are largely due to recession, drought water use restrictions, and changing culture. Some lasting efficiencies were gained during the recent drought; however, extreme water use reductions over the last several years are due in part to short-term actions taken in response to the emergency drought mandate, such as shorter showers and limited outdoor watering.

A recent statewide public survey sponsored by ACWA reports that two-thirds of survey participants felt they made "reasonably substantial reductions in their households' water use over the past few years." Most indicated their efforts focused on behavior changes rather than efficiency upgrades, and on outdoor rather than indoor reductions (FM3, 2017).

Future water use is currently challenging to project. California water management is amid a transformation due in part to state initiatives, legislation, and regulations such as a new statewide long-term water use efficiency framework, the California Water Action Plan, and the Bay-Delta Water Quality Control Plan.

Though the effects of these state efforts on future demands and water management are not yet fully defined, the long-term regional trend for water use efficiency will certainly continue. When considering demand projections from 2015 UWMPs, BARR agencies anticipate their collective municipal and industrial (M&I) demands for potable water will grow by 18 percent or less from 1995 to 2035—even as the population is expected to grow by more than 40 percent, fueled by a robust and growing Bay Area economy. "Smart growth"— increasing population and density in an environmentally preferred manner and with a regional outlook—will drive much of the Bay Area's future water demand.

Since the time BARR agencies developed 2015 UWMPs, the Association of Bay Area Governments (ABAG) released a draft version of Plan Bay Area 2040, which is the transportation and land use roadmap for the region's future growth. The plan reflects policy decisions and is based on assumptions considering the region's key economic, demographic, and financial trends over the last four years. The draft plan includes population and employment projections that are significantly higher than those included in BARR agencies' 2015 UWMPs (ABAG, 2017). The outcome of the Plan Bay Area 2040 process will affect the region's projected demands and future water use.

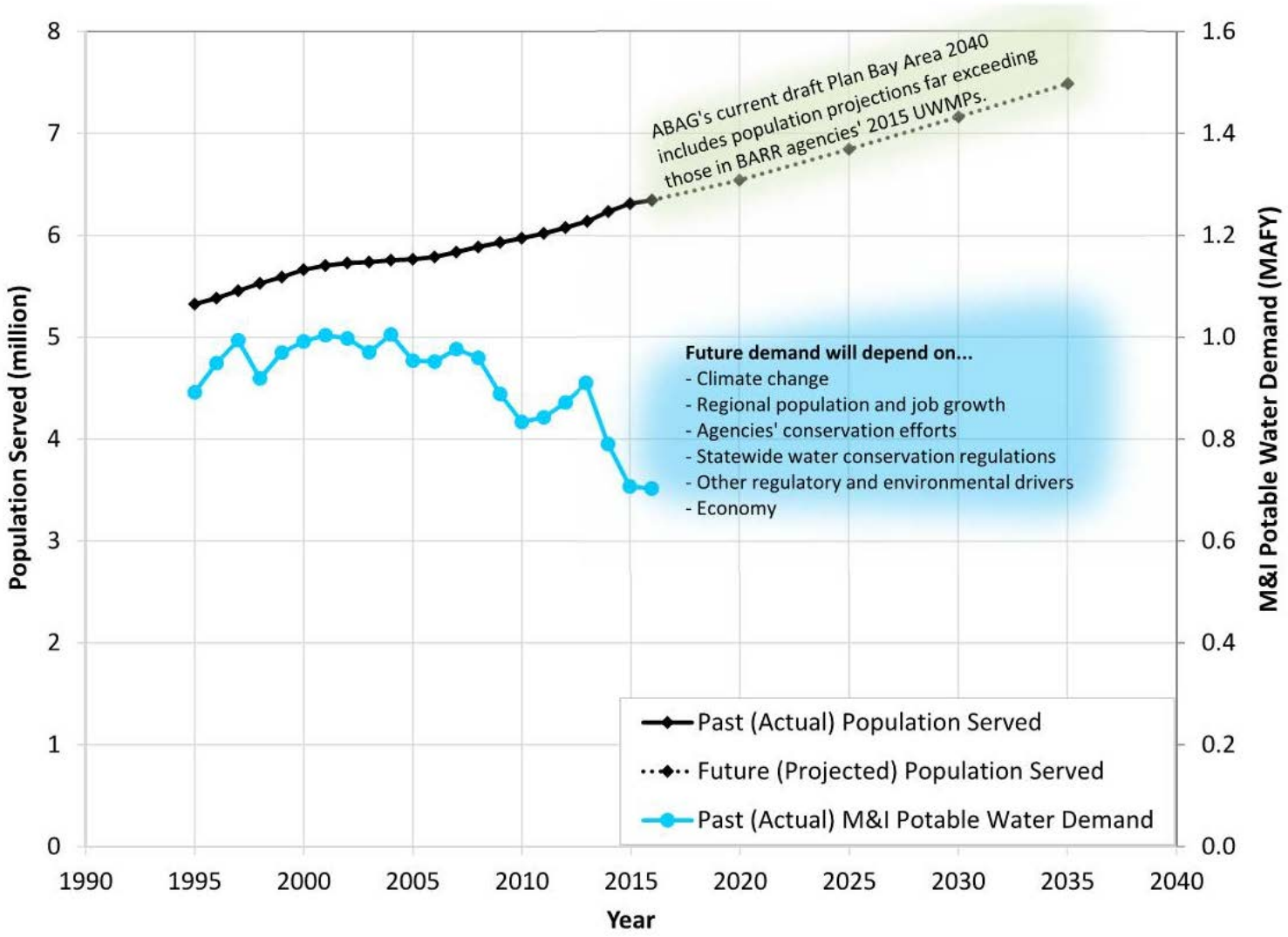
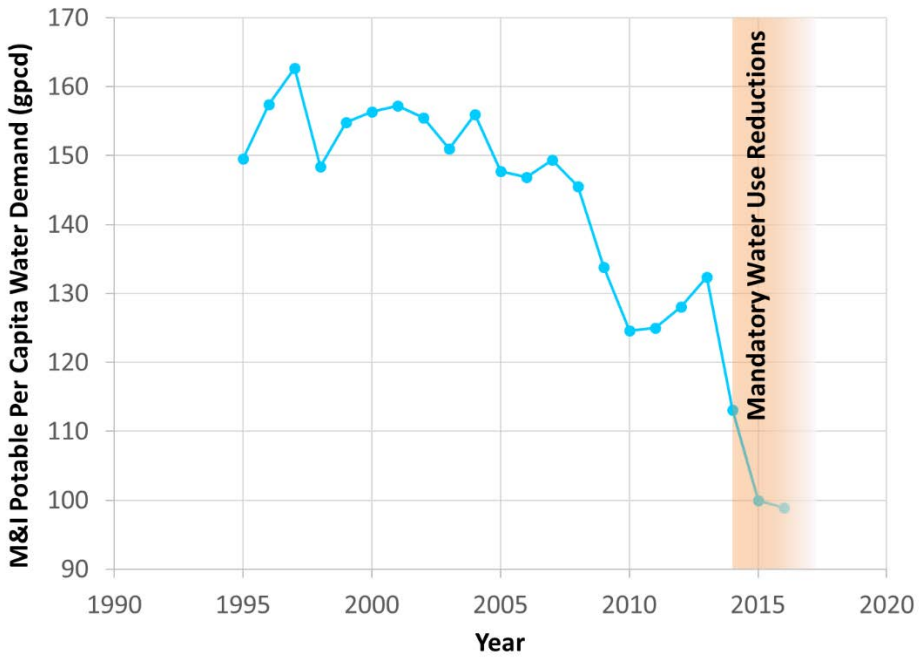


Figure ES-2. Even with robust population growth, the region's potable demand for urban uses declined over the past two decades.



BARR agencies have long been committed to water use efficiency, demonstrating real progress over the last two decades. They continue to prioritize investments in significant demand management programs, driving lasting cultural changes to further reduce future per capita water use while also being ready to invoke additional short-term emergency drought response reductions when needed.

Figure ES-3. Although recent reductions were largely due to emergency conservation during drought, the Bay Area's collective per capita M&I potable demand is trending downward over the long-term.

Existing and Planned Water Supplies

In addition to their aggressive water conservation programs, BARR agencies have been diversifying their water resource portfolios to ensure reliability for their customers. Collectively, existing and planned water supply sources among the agencies are diverse, and include surface water from local and imported sources, groundwater, recycled water (non-potable reuse), purified water (potable reuse), and desalination, as shown in Figure ES-4.

While traditional supply sources will remain an important foundation to the region's supply portfolio, BARR agencies see non-potable and potable water reuse as critical elements to future Bay Area supplies, and they are currently working on a wide range of reuse projects. One example is SCVWD's expansion of the Silicon Valley Advanced Water Purification Center to develop additional supplies for groundwater replenishment.

Some BARR agencies are also expanding other sustainable local sources of supply, such as rainwater, stormwater, graywater (sinks, washers, and showers), blackwater (wastewater; same elements as graywater, with the addition of toilets), and foundation drainage. Several BARR agencies have already obtained water rights to local runoff from flood and storm events, and are considering opportunities to expand urban stormwater capture for water supply augmentation.

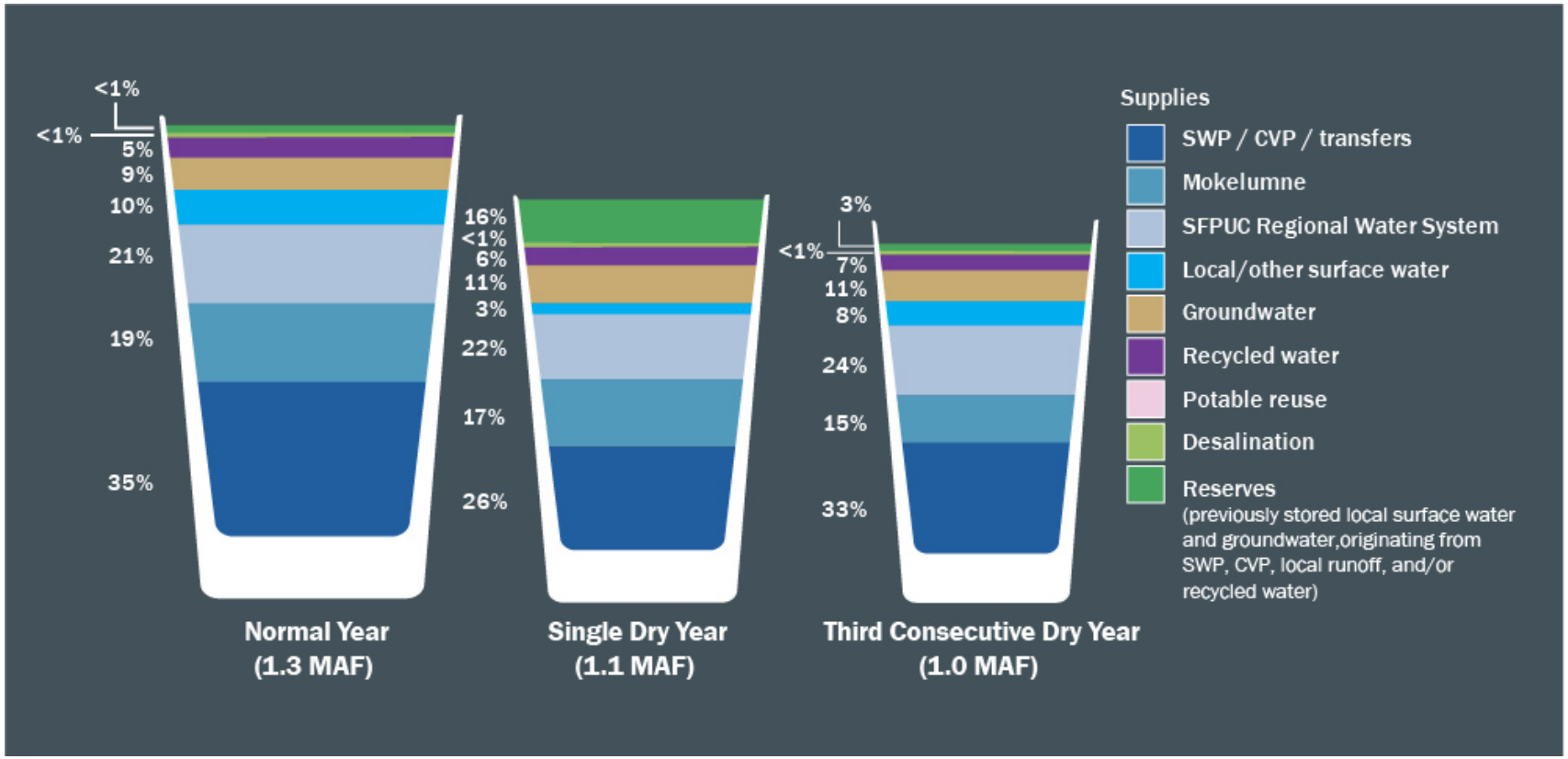


Figure ES-4. Total supply and composition of the future (2020) regional supply portfolio is expected to vary over hydrologic conditions.

Stormwater is an integral part of the state's water supply portfolio. Bay Area and upcountry precipitation runoff is collected in the state's network of surface water and groundwater reservoirs as part of basic operations, serving many BARR agencies and other water providers.

Some BARR agencies have also been capturing local rainfall runoff and urban stormwater and using it to meet water demands for decades. However, the agencies account for stormwater in their local surface water or groundwater supplies, not as a separate supply source. The agencies continue to work toward greater capture and use of local urban stormwater for supply where feasible. For example, SCVWD is currently incorporating stormwater projects into their Water Supply Master Plan and collaborating with Municipal Regional National Pollutant Discharge Elimination System (NPDES) Stormwater co-permittees in Santa Clara County to develop a Storm Water Resources Plan.

The Bay Area's collective supply varies with hydrology in terms of total volume available and diversity of the supply portfolio, as shown in Figure ES-4. By 2020, the total available annual supply in a normal year is expected to reduce from about 1.3 million acre-feet (MAF) to 1.1 MAF in a single dry year, and 1.0 MAF in a third consecutive dry year. When additional supply is available in normal years, groundwater and surface water storage are typically replenished.

In addition to the total volume, the composition of BARR supplies also varies from normal, to single dry year and third consecutive dry year scenarios. In a single dry year, reliance on storage increases significantly. By the third consecutive dry year, overall storage is expected to be significantly depleted. To make up the shortfall, emergency drought response measures will be needed to varying degrees by different BARR agencies.

Drought Monitoring

The California Department of Water Resources (DWR), Reclamation, and others monitor water supply conditions on a statewide level.

BARR agencies independently monitor drought by regularly assessing their supply conditions and comparing to triggers (thresholds) that correlate to various drought stages. The agencies each define drought triggers and response actions in their individual Water Shortage Contingency Plan (WSCP). Retail and wholesale urban water suppliers in California are required to adopt and submit a WSCP to DWR every five years. Though currently pending, legislative action is anticipated within the next year to establish new WSCP guidelines including a requirement for agencies to submit annual water budget forecasts to DWR each spring based on six standard supply shortage levels.

While BARR agencies acknowledge the importance of regional coordination, opportunities for regional drought monitoring and response are limited by agencies' individual WSCPs and their unique supply portfolios. However, the agencies have identified next steps to improve regional drought monitoring and response. For example, BARR agencies will assess the region's supply conditions by compiling their individual annual water budget forecasts to be submitted to DWR each spring using the six standard supply shortage levels. The agencies will develop a color-coded Bay Area drought monitor map displaying the shortage level in each agency's service area. The agencies will post the map online once a year (after spring supply forecasting) with links to the individual agencies' websites for more detailed current information about supply conditions and response actions.

Potential Vulnerabilities

To create a framework for drought contingency planning, specific threats to the region's critical water resources and factors contributing to those threats must be understood. In addition, past climate, water supply, and water use trends and a range of potential future drought conditions and climate change impacts must be considered.

In the context of this framework, drought vulnerability is the extent to which the Bay Area's critical resources are exposed or susceptible to risks and able to cope with or adjust to the adverse effects. Risk is a combination of frequency of occurrence and magnitude and severity of consequences. BARR agencies used the resulting baseline risk assessment to inform potential drought response actions and mitigation measures described in this plan.

Bay Area water supplies face many drought risks due to climate change; infrastructure susceptibility in the event of an emergency; supply limitations; regulatory, environmental, and water rights constraints; cost constraints and affordability; and source water quality degradation. BARR agencies assessed the underlying causes to risks for the region's critical water resources. The significance of the region's critical water resources varies by agency based on their individual supply portfolio.

In 2015 UWMPs, BARR agencies quantified projected supply availability by source under various hydrologic conditions, considering historic reliability (using hydrologic data) and risks facing each supply source. This information was compiled to quantify potential regional supply shortfalls for the collective BARR agencies in 2020 and 2035, based on comparing the region's future direct demands to projected total supplies under normal, single dry year, and third consecutive dry year conditions. As noted, future demand projections are largely uncertain due to a handful of factors, ranging from future population growth to new expectations for water use efficiency.

It is also important to note that direct demand projections do not consistently account for storage replenishment from surface water, groundwater, and banking that occurs in wetter years when supplies are available. Agencies account for these storage demands differently within their UWMPs. For example, Zone 7 explicitly accounts for storage demands in normal years, required to meet single dry year and third consecutive dry year demands.

Also, some reservoirs are not managed solely for a single agency or purpose. For example, water in the Mokelumne River and Hetch Hetchy Regional Water systems are managed by and for EBMUD and SFPUC, respectively, and for in-stream fish flows and other water rights holders. Further, some agencies consider stored water a reserve supply, while other consider storage integral to operations but not a distinct supply source. Given these factors, a simple comparison of UWMP projected demands and supplies can be misleading and must be considered in the broader context of "supply utilization" versus "supply availability."

Despite the minor differences in the agencies' methodologies, Figure ES-5 gives a general sense of potential future supply surpluses and/or gaps for the region. The comparison of supplies and demands varies by BARR agency, with some agencies projecting shortages for timeframes and hydrologic conditions when others anticipate surplus supplies. When considered from a regional perspective, BARR agencies anticipate meeting normal year demands for wet/normal water supply years in the near term (2020) and long term (2035). However, the region collectively faces increased challenges for meeting demands in the same time range during dry years.

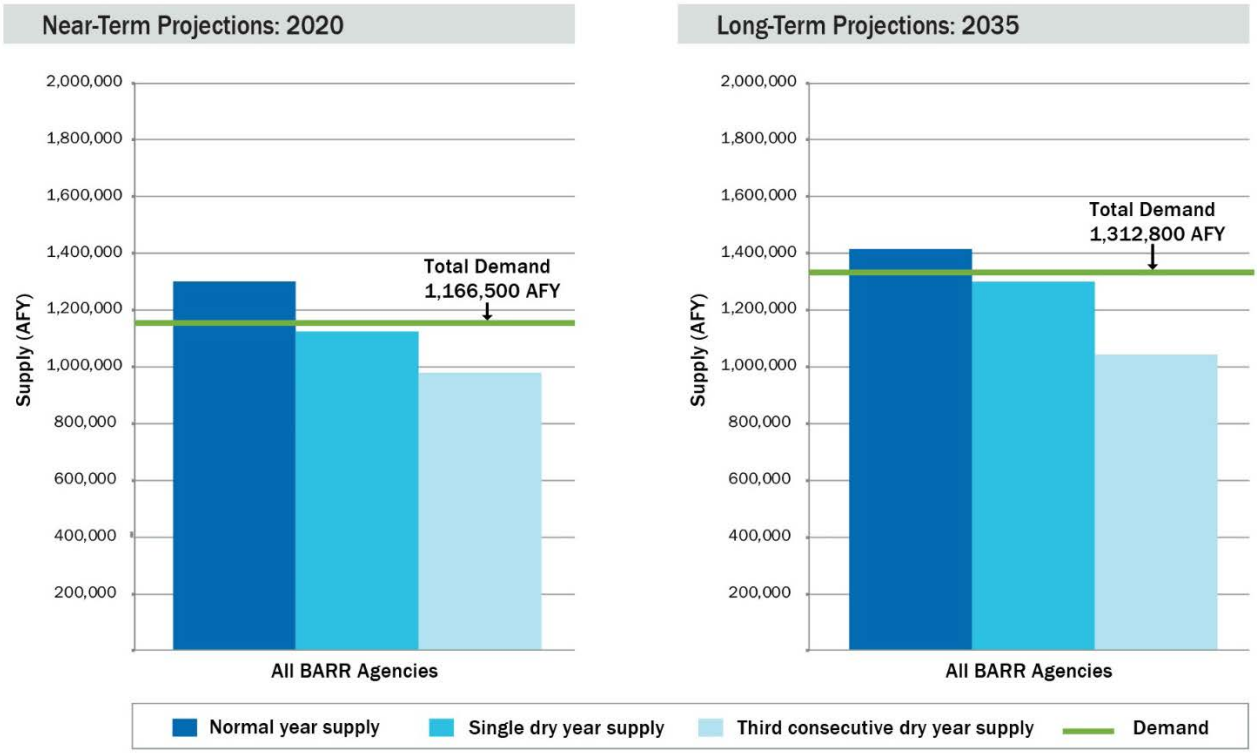


Figure ES-5. BARR agencies collectively anticipate adequate supplies through 2035 for meeting demands in normal years and increased vulnerabilities and challenges for meeting demands in dry years.

For details on individual agencies' projections, refer to 2015 UWMPs.

Drought Response Actions

Response actions are triggered during specific stages of drought to manage limited supplies and decrease the severity of immediate impacts over short periods. Each BARR agency has a unique set of drought response actions dictated by agency-specific conditions and documented in WSCPs, which are submitted with UWMPs every five years.

During the recent drought, BARR agencies implemented their WSCPs and expanded their conservation efforts to increase public awareness, restrict specific water uses, prohibit wasteful water practices, and increase conservation rebate program funding. Some agencies assessed drought surcharges and/or water waste fines.

In addition, the agencies complied with state mandates, specifically the Emergency Water Conservation Regulation initially adopted by the State Water Resources Control Board (State Board) in May 2015 and subsequently re-adopted with amendments. Among other actions, the Emergency Regulation required urban water agencies to restrict specific outdoor water uses, report monthly water use data, and reduce potable urban water use between June 2015 and February 2016. The State Board lifted the Emergency Regulation in Spring 2017 as a result of substantially improved water supply conditions.

While each WSCP is unique, BARR agencies are moving toward more consistency across their plans, which will facilitate better regional coordination and response. Governor Brown's May 2016 Executive Order (EO) and subsequent water use efficiency framework—released by DWR, State Board, and other state agencies[2] in April 2017—directs urban water agencies to submit water budget forecasts annually and Drought Risk Assessments every five years with their UWMPs, based on six standard shortage levels.

In addition to actions defined in individual WSCPs, the BARR agencies have identified response actions that could be implemented regionally:

- **Regional drought response communications.** Consistent regional messaging may improve reaching the public regarding the need for water savings. The effectiveness of this action was demonstrated in the 2012-2016 drought using Caltrans signs throughout the region and state to communicate the drought severity and urge the public to reduce outdoor water use. BARR agencies will benefit from economies of scale by coordinating regional outreach campaigns building on effective local programs and/or leveraging models from other regions. This response action will be triggered when multiple agencies within the BARR service area have identified a water shortage.

Drought Response Actions

Defined as short-term actions triggered during drought to manage limited supplies and decrease the severity of immediate impacts.

Each BARR agency has its own set of drought response actions defined in its WSCP. A consistent communications strategy and mobile water treatment facilities are potential drought response actions that could be implemented regionally.

[2] Other state agencies involved in developing the Making Conservation a California Way of Life report include the California Public Utilities Commission, the California Department of Food and Agriculture, and the California Energy Commission. Aspects of the report pertaining to the BARR DCP are under the purview of DWR and the State Board.

- **Mobile water treatment facilities.** In the event of a critical water shortage emergency, short-term leases of mobile trailers with various treatment units could be used to treat saline surface water, groundwater, and/or recycled water. Significant logistical challenges would need to be explored, including mobilization and startup, as well as operation, maintenance, and legal or environmental issues. Given the BARR agencies' ability to manage the recent extreme drought, mobile water treatment may not be necessary for comparable droughts. However, given confounding future uncertainties that may reduce supply availability—such as climate change, regional growth, supply limitations, earthquakes, environmental regulations—mobile water treatment is an option to consider for extreme, and likely isolated, circumstances.

Drought Mitigation Measures

BARR agencies focused on drought mitigation measures that would increase regional water supply reliability, benefiting multiple agencies and justifiably characterized as "regional in nature," as summarized in Table ES-1. BARR agencies provided the Drought Task Force, an advisory stakeholder group, a preview of the measures for their review and input.

Many of the measures would leverage or expand existing assets while others would require new facilities—such as interties, storage, and treatment—which typically require detailed and often lengthy planning and implementation. BARR agencies are also exploring a few early-action measures to further exercise the partnership and produce tangible joint outcomes that can be implemented relatively quickly. For example, one initial proposed measure, for which the BARR agencies recently secured funding, is to develop a regional water market program to facilitate voluntary exchanges and transfers and maximize efficient use of existing assets and resources. The mitigation measures are at various stages of planning, and are described in the DCP based on current knowledge and planning objectives, which will evolve over time.

Table ES-1 lists these possible mitigation measures and the BARR agencies engaged in each. In characterizing the measures, the BARR agencies have applied several factors including benefits (e.g., yield, flexibility/sustainability, and timing), costs, implementability, and social and environmental considerations. The potential timing for implementing is categorized as either near-term, medium-term, or long-term, based on project status and whether funding has been secured (Figure ES-6). While early efforts are underway to advance some measures (e.g., Los Vaqueros Reservoir Expansion, Transfer-Bethany Pipeline, Walnut Creek Water Treatment Plant [WCWTP] Pretreatment Facility, and the Bay Area Water Market Program), others are in conceptual or planning stages and may or may not be necessary with future evolving conditions. BARR agencies consider the entire list of 15 measures viable possibilities depending on need and timing.

Drought Mitigation Measures

Defined as actions, programs, and strategies implemented before a drought occurs to increase regional water supply reliability and improve long-term resilience.

Drought mitigation measures engage two or more BARR agencies.

These efforts require detailed and often lengthy planning and implementation, and they may involve reconfiguring or expanding existing assets or constructing new facilities.

Table ES-1. BARR Drought Mitigation Measures

No.	Drought Mitigation Measure	Engaged BARR Agencies
Interties		
1	Transfer-Bethany Pipeline	ACWD, BAWSCA, CCWD, EBMUD, SFPUC, SCVWD, and Zone 7
2	Zone 7-EBMUD Intertie	Zone 7 and EBMUD
3a	ACWD-SFPUC Intertie and Local Supply	ACWD, BAWSCA, and SFPUC
3b	ACWD-SFPUC Intertie and indirect potable reuse (IPR)	ACWD, BAWSCA, and SFPUC
4	West Side SFPUC-SCVWD Intertie	SFPUC, BAWSCA, and SCVWD
5	SFPUC-Zone 7 Intertie	SFPUC, BAWSCA, and Zone 7
6	MMWD-EBMUD Intertie	MMWD and EBMUD
Expanded Storage		
7	Los Vaqueros (LV) Expansion	ACWD, BAWSCA, CCWD, EBMUD, SFPUC, SCVWD, and Zone 7
Treatment/Supply		
8	Walnut Creek Water Treatment Plant Pretreatment Facility	ACWD, BAWSCA, CCWD, EBMUD, SFPUC, SCVWD, and Zone 7 (to be confirmed at a later time)
9	Regional Desalination Plant	CCWD, EBMUD, SCVWD, SFPUC, and Zone 7
10	Silicon Valley Advanced Water Purification Center (SVAWPC) Expansion	SCVWD, SFPUC, and BAWSCA
11	Mid-Peninsula Potable Reuse Exploratory Plan (PREP)	SFPUC and BAWSCA
12	Joint Tri-Valley Potable Reuse Feasibility Study	Zone 7* and other regional partners to be determined (TBD) (potentially including CCWD, EBMUD, and/or SFPUC)
Operations		
13	Regional Advanced Metering Infrastructure (AMI) Feasibility Assessment	ACWD, CCWD, EBMUD, MMWD, and SCVWD
14	Del Valle Reservoir Water Supply Storage Expansion Project	ACWD, SCVWD, Zone 7, and other potential regional partners TBD (CCWD, EBMUD, and/or SFPUC)
15	Bay Area Regional Water Market (Exchanges/Transfers) Program	ACWD, BAWSCA, CCWD, EBMUD, SCVWD, SFPUC, and Zone 7

** = Other water agency partners include California Water Service, City of Livermore, City of Pleasanton, and Dublin San Ramon Services District (DSRSD).*

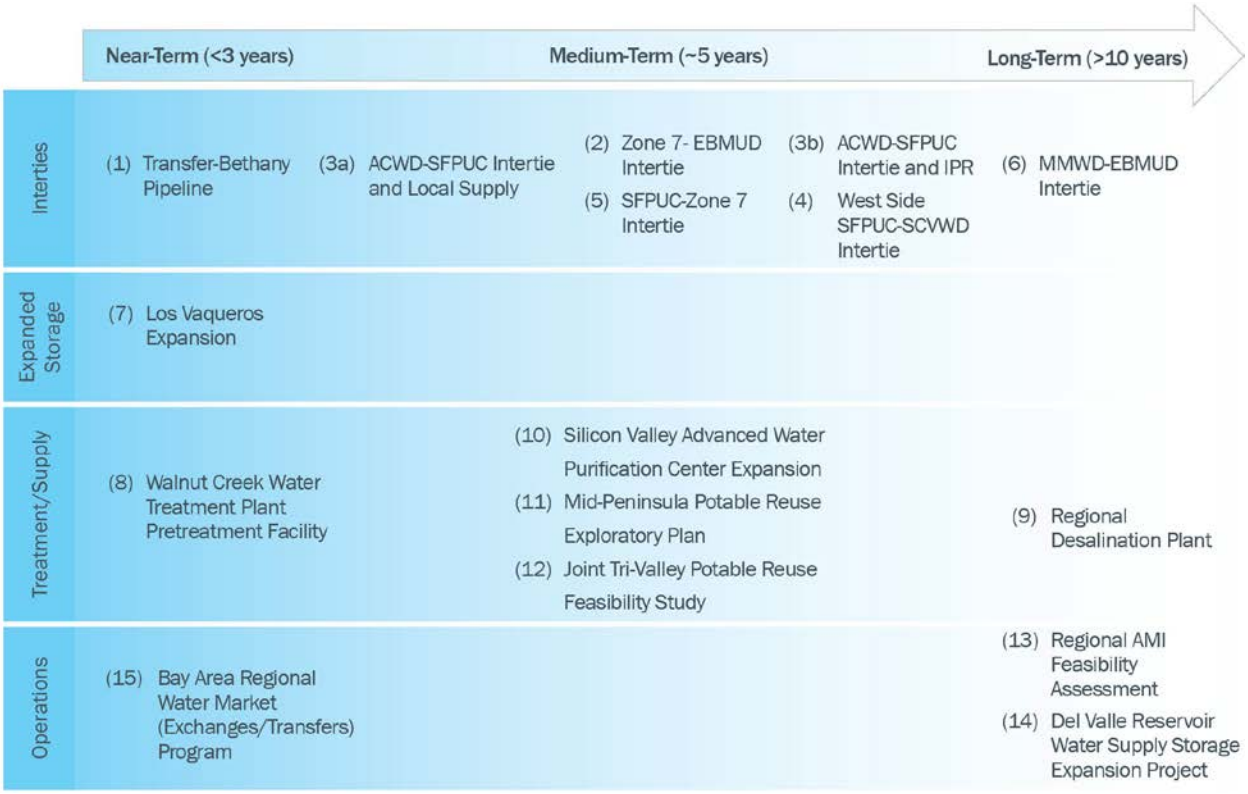


Figure ES-6. Potential timing for mitigation measure implementation [3]

BARR agencies acknowledge and appreciate the value of other ongoing efforts to improve water supply reliability across the state. One example is the work by the Western Recycled Water Coalition, which includes several BARR members who are pursuing projects to expand recycled water supplies (both potable and non-potable reuse) throughout the region.

In addition to local and regional efforts, the state is advancing programs intended to enhance reliability. Several examples closely connected to the California Water Action Plan include the Sustainable Groundwater Management Act (a framework for sustainable local and regional groundwater management), the Water Storage Investment Program (a $2.7 billion fund under Proposition 1 dedicated to the public benefits of water storage projects), and California WaterFix.

BARR agencies are also pursuing projects individually or with other partners outside of the BARR framework to further improve Bay Area supply reliability. Many of these ongoing projects are expected to enhance reliability in the Bay Area and might involve multiple non-BARR partners. However, the BARR partnership's objective is more narrowly focused on advancing a smaller suite of projects that engage multiple BARR agencies and are uniquely enabled by this regional effort.

[3] Los Vaqueros Expansion is considered near-term, though construction will likely begin in 2022. The design is already underway with plans for construction. The delay in implementation is due to construction sequencing and the need to drain the existing reservoir prior to construction.

Operational and Administrative Framework

Sharing regional water resources and facilities requires new operational and administrative mechanisms that reflect many of the following considerations:

- **Governance and Institutional.** Transferring water and/or sharing infrastructure among users often requires new institutional agreements to specify roles, responsibilities, and key implementation steps. BARR agencies may consider forming a joint powers authority (JPA) in future phases of work to operate as a single agency to accomplish specific common goals.
- **Operational.** To achieve regional water solutions, BARR agencies may need to modify current operations. For example, agencies may need to coordinate water quality monitoring and changes in water treatment operations needed to blend transferred supplies, including water quality effects like taste and odor, treatability, or corrosion concerns.
- **Permitting and environmental documentation.** Implementation of drought mitigation measures requires obtaining regulatory approvals and permits; coordinating with relevant governmental agency(ies) issuing the needed permit(s) at federal, state, and/or local levels; and completing specific environmental analysis and documentation as mandated by federal and state regulations.
- **Water rights.** Supply transfers often trigger modifications to water-rights permits to address changes in points of diversion, place of use, and/or purpose of use. While specific operational and legal limitations apply, two potential areas of flexibility show promise:
  - Conjunctive use of transferred supplies (transferring water to storage in non-dry years for use during dry years), which would improve water management.
  - Changes to points of diversion or places of use, which would allow water exchanges between BARR agencies, especially those that have local storage capability.
- **Funding.** Viable funding sources can expedite and facilitate implementation of mitigation measures or drought response actions. Several state, federal, and local funding sources are currently available, including grant and loan opportunities. Funding eligibility and other requirements, such as local cost-share for grants and repayment terms for loans, are important considerations. In addition, grant funding is competitive and less certain to materialize. Alternative funding mechanisms, such as public-private partnerships (P3), are other pathways to consider.

Next Steps

This DCP outlines strategies that BARR agencies can implement together to improve water supply reliability for the entire Bay area.

The BARR partnership holds tremendous potential to forge new regional approaches for reliable water supply in the Bay Area. Together, BARR agencies are pursuing measures and actions that would use existing infrastructure and water resources more fully to produce greater efficiencies and improved drought reliability for the entire region. Through this collaborative process, BARR agencies now have a regional platform for water management—one that enables joint measures and actions to meet Bay Area water needs while also meeting individual agencies' site-specific needs.

Future DCP Updates

BARR agencies plan to develop annual status reports to update stakeholders regarding progress in implementing the drought mitigation measures and response actions identified in the DCP. The annual status reports will be posted to the BARR website, and BARR agencies will distribute alerts through email push notifications to direct stakeholders to the website.

Future revisions to the DCP will be guided and developed through the Bay Area Water Agency Coalition (BAWAC), which is a forum where the region's largest water suppliers coordinate on water supply reliability improvements, water quality protection, flood control, and current water supply issues. During bi-monthly BAWAC meetings, general managers hold roundtable discussions about water supply conditions and other current topics. The role of BAWAC chair rotates between the agencies about every two years. All the BARR member agencies are active participants in BAWAC, making it an ideal mechanism for maintaining the DCP in the future.

Consistency in UWMPs

In addition to this joint DCP, BARR agencies individually maintain their UWMPs that outline long-term plans to ensure reliable, adequate water supplies for existing and future water demands. UWMP data have traditionally been presented in various forms to reflect agency-specific conditions. In the future, BARR agencies will integrate aspects of the DCP into their UWMPs for greater consistency among the regional partnership.

Statewide Efforts

DWR and the State Board are implementing a new water use efficiency framework, which is described in the "Making Water Conservation a California Way of Life" final report (DWR, State Board, et al, 2017), California Water Action Plan, and Bay-Delta Water Quality Control Plan. The effects of these efforts on future Bay Area water demands are not yet fully defined. At the same time, climate change uncertainties and the potential for catastrophic events to threaten water supply require that Bay Area water agencies take further actions to guard against these challenges and improve reliability and resilience. Along with continued progress in sustainable water use efficiency, the measures and actions laid out in this DCP better prepare BARR agencies for the future.

Near-Term Efforts

In the near-term, the BARR agencies will further advance plans, explore funding options, and study feasibility for the projects and programs described in this DCP. As previously mentioned, early efforts are underway to advance some BARR drought mitigation measures (e.g., Los Vaqueros [LV] Reservoir Expansion, Transfer-Bethany Pipeline, and Bay Area Water Market Program).

Beyond the measures considered in this plan, BARR agencies are also pursuing other projects individually or with agencies outside

of the BARR partnership to further improve Bay Area supply reliability. Taken together, joint BARR and individual agency efforts are solidifying systems and resources to provide drought reliability with a sustainable, reliable, high-quality water supply and for a healthy community and vibrant Bay Area economy.

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Section 1 //
Introduction

California's recent drought has inspired more integrated regional water management and drought mitigation.

California recently experienced an extraordinary and unprecedented drought (2012 through 2016) as marked the two hottest years (2014 and 2015) and the lowest snowpack (2015) since record keeping began in 1895. As noted in the California Water Action Plan, the state's roadmap for sustainable water management, hydrologic and environmental conditions have reduced the reliability of California's foundational supplies, including those critical to the Bay Area such as the Sacramento-San Joaquin Delta (Delta) and watersheds that collect snowmelt from the Sierra Nevada and the Cascades.

A Regional Approach

Though supply conditions for water agencies in the San Francisco Bay Area have improved significantly in the current water year (Fall 2016 through Spring 2017), the recent drought has inspired more integrated regional water management and drought mitigation, resulting in the Bay Area Regional Reliability (BARR) partnership among eight of the largest Bay Area water agencies (see inset) that collectively serve more than 6 million people in 6 counties (Figure 1).

To provide supply reliability and resilience and to adapt to future uncertainties, each of the BARR agencies is steadfast in implementing strategies such as demand management; water supply portfolio diversification; aging infrastructure repairs/replacement; and interagency facility connections. Through implementing these strategies, the BARR agencies aim to maintain a reliable water system at affordable rates while protecting the environment and preparing for the future.

Amid the recent drought, the BARR partnership was established to cooperatively address water supply reliability concerns and drought preparedness on a mutually beneficial and regionally focused basis. After adopting principles in 2014 to guide the partnership, the agencies executed a Memorandum of Agreement (MOA) in 2015.

Bay Area Regional Reliability Partnership

- Alameda County Water District (ACWD)
- Bay Area Water Supply and Conservation Agency (BAWSCA)
- Contra Costa Water District (CCWD)
- East Bay Municipal Utility District (EBMUD)
- Marin Municipal Water District (MMWD)
- San Francisco Public Utilities Commission (SFPUC)
- Santa Clara Valley Water District (SCVWD)
- Zone 7 Water Agency (Zone 7)

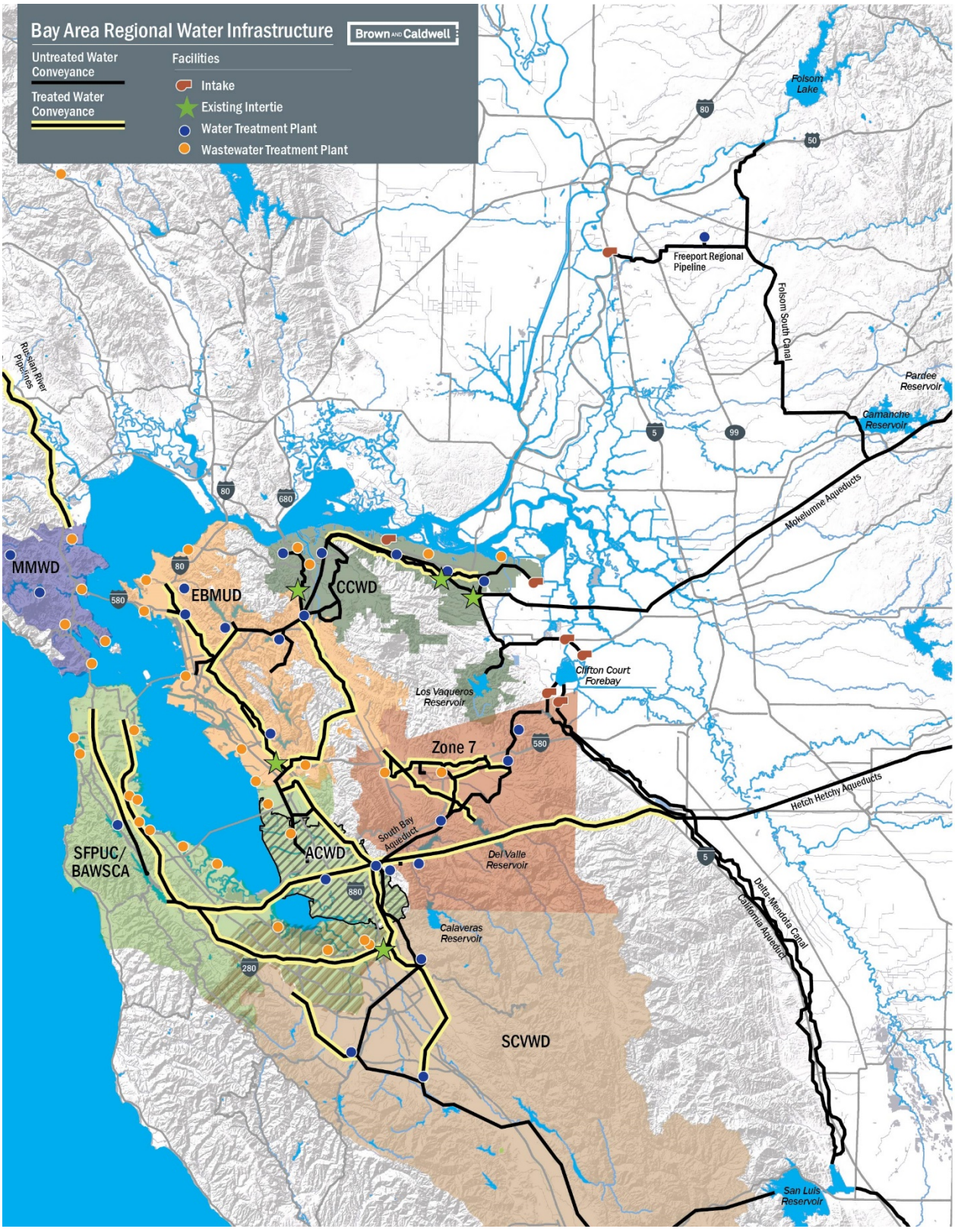

Figure 1. BARR service areas and existing Bay Area regional water systems

Drought Contingency Plan

BARR agencies collaboratively developed this regional Drought Contingency Plan (DCP)—a project funded in part by the United States Department of the Interior, Bureau of Reclamation (Reclamation). This plan differs from past efforts because it approaches drought planning from a regional, integrated perspective and takes stock of BARR agencies' existing water assets and resources. BARR agencies convened a Drought Task Force representing a broad range of stakeholder interests to provide advice throughout the DCP development.

Plan Objectives

The recent drought was a stark reminder of the need to further improve resilience for individual agencies and the collective region. Some agencies were extremely challenged by the drought, and as the Bay Area continues to grow, the need for robust drought mitigation and response will be needed even more.

BARR agencies aim to cooperatively develop regional projects to strengthen the Bay Area's long-term water supply reliability and drought resilience. This effort focuses on combining and integrating existing assets and resources and exploring new operations strategies to improve resilience for emergencies and droughts.

Though the DCP focuses primarily on drought reliability, it provides benefits for three distinct aspects of regional water, including:

1. Emergency response
2. Drought mitigation and response
3. Replacement or alternative supplies

The BARR DCP specifically addresses drought-related vulnerabilities through consideration of drought response actions and mitigation measures. The DCP is not a water supply master plan to accommodate growth. Future supply planning is addressed separately by the BARR agencies through their Urban Water Management Plans (UWMPs) and other efforts. In planning adequate supplies to meet demands, a balance is needed without over-projecting and constructing stranded assets. Demand projections reflect the outcome of BARR agencies' other planning documents. The agencies continually update demand forecasts and will reflect lessons learned from the recent drought in updated projections.

The agencies also prepare for catastrophic events through emergency response plans and programs that establish strategies and operating procedures for the days and weeks following an emergency.

The primary focus of the DCP is drought mitigation and response; however, the BARR strategies considered in this plan may provide ancillary benefits for emergency response, replacement, and/or alternatives supplies.

Plan Development Steps and Elements

The BARR DCP was developed using Reclamation's "Guidance Regarding the Drought Contingency Planning Process" as a framework. This plan is based on BARR agencies' 2015 UWMPs as a primary source of information[4], and reflects a compilation and high-level overview of the Bay Area water system, including existing and projected demands, water use efficiency, and supplies.

A vulnerability assessment identifies factors contributing to the potential compromise or loss of critical regional water resources. The DCP's crux includes the strategies identified to

[4] For more detailed agency-specific data, readers are directed to the BARR agencies' individual UWMPs and other longer-term water supply planning studies. It should be noted that UWMPs are required by the California Department of Water Resources every five years to document projected demands and supplies under different hydrologic conditions, and as such reflect relatively conservative estimates. BAWSCA member agencies are urban water suppliers that prepare individual UWMPs.

improve regional reliability and resilience—drought response actions and drought mitigation measures—and an operational and administrative framework for implementation.

Drought planning must account for potential climate change impacts and other water supply uncertainties. While extensive scientific research has explored potential climate change impacts with findings published in peer-reviewed technical literature, existing climate models predict a wide range of potential water-resources effects. Nonetheless, given the potential for increased extreme climatic events such as the unprecedented recent drought, as well as infrastructure and regulatory risks, the BARR agencies are evaluating several measures aimed at improving the region's collective drought resilience. Through this coordinated regional approach to drought contingency planning, the BARR agencies plan to improve water supply reliability, leverage existing infrastructure investments, facilitate water transfers during shortages, and improve climate change resilience. The plan also describes additional potential regional projects being explored by BARR agencies and other Bay Area water and wastewater agencies outside of the BARR partnership to improve regional supply reliability. Many of these projects, described in Section 6, are similar in nature to BARR measures. Collectively, these joint BARR and individual agency efforts are solidifying systems and resources to provide a sustainable, reliable, high-quality water supply for a healthy community and vibrant economy in the Bay Area.

The steps involved in the development of the BARR DCP are summarized in Table 1. General managers and staff from each of the eight BARR agencies collaborated in defining the DCP's direction and developing its content. The agencies convened an advisory group, the Drought Task Force, to provide feedback on strategies and work products developed for the DCP. The Drought Task Force represents a broad range of stakeholder interests, including business, environmental, environmental justice, public policy, regional planning, and other water/wastewater/recycled water agencies. The Drought Task Force process provided stakeholders and interested parties an opportunity for substantive engagement on the development of the DCP, providing input to the BARR agencies at key milestones and interim work products (Technical Memorandum [TM] 1 and TM2), which were combined to create the DCP. Drought Task Force member provided input through written comments and three workshops. In addition, the agencies held a public meeting to receive broader input on the Draft DCP prior to submitting it to Reclamation.

Table 1. Agency and Stakeholder Engagement in DCP Development

Activity/Step	Agency Staff	General Managers	Drought Task Force	Public
Routine project coordination	• Ranging from weekly to monthly calls and emails	• Nine bi-monthly meetings		
Project kickoff	• Workshop 1, March 2016	• Meeting, April 2016	• Workshop 1, April 2016	
TM 1. Bay Area Water System, Drought Monitoring, and Vulnerability Assessment	• TM 1 review and input, July 2016 • Workshop 2, August 2016	• Meeting, June 2016	• TM 1 review and input, September 2016 • Workshop 2, September 2016	
TM 2. Drought Mitigation Action Plan	• TM 2 review and input, January 2017 • Workshop 3, February 2017	• Workshop to select drought mitigation measures, August 2016	• TM 2 review and input, March 2017 • Workshop 3, March 2017	
Draft DCP	• Draft DCP review and input, May 2017	• Executive Summary review and input, May 2017 • Meeting, June 2017	• Draft DCP review and input, June 2017	• Public meeting, June 2017

Water Conservation and Demand Reductions

BARR agencies acknowledge the distinction between long-term water conservation (ongoing water use efficiency) and short-term emergency water use reductions (temporary cutbacks) and the difference between actions to appropriately support each.

Water shortage conditions, such as the recent drought, can require actions to support short-term emergency water use cutbacks. However, extraordinary cutbacks are unsustainable and can result in potential unintended consequences, such as long-term economic impacts (e.g., California business climate and residential property values), utility revenue instability, water affordability issues, disincentive for future capital investment to improve local reliability, compromised quality of life and other potential long-term impacts.

Water use over the past several years has been significantly reduced because of the recent drought, based on policy changes and actions taken at the state and local levels. Public awareness and actions during the drought have resulted in lasting efficiencies (cultural changes and passive savings) and temporary reductions (behavioral changes).

Long-term water use efficiency is a fundamental, core component of BARR agencies' water management. The BARR agencies remain committed and will continue ongoing water conservation efforts, regardless of hydrologic conditions. When properly designed and implemented, water use efficiency programs result in sustainable potable demand offsets that support the economy, environment, and communities.

Future Bay Area water demands are uncertain. The California Department of Water Resources (DWR) and the State Water Resources Control Board (State Board) are implementing a new water use efficiency framework described in the "Making Water Conservation a California Way of Life" final report (DWR, State Board, et al, 2017), the California Water Action Plan, and the Bay-Delta Water Quality Control Plan, and the effects of these efforts on future Bay Area water demands are not yet fully defined. In addition, ABAG's draft Plan Bay Area 2040 includes significantly higher population and employment projections for the Bay Area. At the same time, climate change uncertainties and the potential for catastrophic events to threaten water supply require that Bay Area water agencies take further actions to guard against these challenges and improve reliability and resilience.

Along with continued progress in sustainable water use efficiency, the measures and actions laid out in this DCP better prepare BARR agencies for the future. All or some BARR agencies expect to further advance plans, explore funding options, and study feasibility for at least some of these measures in the near term. BARR agencies are pursuing funding for the Bay Area Water Market Program to facilitate exchanges and transfers during droughts. In the coming years, the agencies may also update or expand this BARR DCP.

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Section 2 //
Bay Area Water System Review

Understanding the eight BARR agencies' service areas, existing water facilities, and key water resources provides a critical foundation to the DCP. Regional and individual agencies' water service areas, systems, and supplies are described in this section. Existing planning documents, such as water supply master plans and UWMPs, describe similar topics for the individual agencies in greater detail.

2.1 Water Supply Sources

The BARR agencies rely upon a diverse network of infrastructure and portfolio of supplies to deliver high-quality, reliable water within their respective service areas. Each BARR agency has its own unique water supply portfolio, as summarized in Table 2.

Table 2. All existing sources of supply within BARR agencies' service areas

Supply	ACWD	BAWSCA	CCWD	EBMUD	MMWD	SCVWD	SFPUC	Zone 7
CVP/SWP/transfers	✓	✓	✓	✓		✓		✓
SFPUC Regional Water System	✓	✓				✓	✓	
Mokelumne				✓				
Local/other surface water	✓	✓	✓	✓	✓	✓	✓	✓
Groundwater	✓	✓	✓	✓		✓	✓	✓
Recycled water		✓	✓	✓	✓	✓	✓	✓
Desalination	✓	✓						
Reserves			✓			✓		

a. *All BARR agencies have active water use efficiency/conservation programs. For this effort, those programs are not considered as sources of supply.*

b. *This matrix represents existing supply sources within each individual BARR agency's service area.*

c. *Semitropic Water Storage District and Cawelo Water District groundwater banking are included in SWP/CVP/transfers.*

d. *MMWD's purchases from Sonoma County Water Agency are included in local/other surface water.*

e. *EBMUD's Bayside Groundwater Project and Zone 7's conjunctive use are included in groundwater.*

f. *Reserves reflect previously stored local surface water and groundwater, originating from SWP, CVP, local runoff (such as Los Vaqueros), and/or recycled water.*

g. *Recycled water may be served by other non-BARR agencies.*

Imported sources serve a substantial portion of the Bay Area's water demands and include the following:

- **State Water Project:** Owned and operated by DWR, the State Water Project (SWP) collects water from Northern California, which flows through the Feather and Sacramento rivers to the Delta. The system conveys water from the Delta to the Bay Area and Southern California, primarily for municipal and industrial (M&I) purposes, and to the Central Valley for agricultural and municipal uses. The SWP is one of the world's largest state-owned utilities, with 21 dams and more than 700 miles of canals, pipelines, and tunnels.
- **Central Valley Project:** Owned and operated by Reclamation, the Central Valley Project (CVP) collects water from Northern California, which flows through the American and Sacramento Rivers to the Delta. The system conveys water from the Delta for delivery for agricultural and municipal uses. The extensive CVP system includes 20 dams/reservoirs and approximately 500 miles of major canals. The CVP and SWP share some facilities and can interchange water between canals as needed to meet peak requirements.
- **SFPUC Regional Water System:** SFPUC's Regional Water System (RWS) serves retail and wholesale customers (including BAWSCA member agencies). The RWS supplies water from the Tuolumne River watershed and local reservoirs in the Alameda and Peninsula watersheds (Hetch Hetchy, Alameda, and Peninsula systems). The RWS consists of more than 280 miles of pipeline and 60 miles of tunnels, 11 reservoirs, 5 pump stations, and 2 water treatment plants (WTPs).
- **Mokelumne River Watershed:** This watershed is EBMUD's primary source of water supply. Rainfall and snowmelt from the watershed is captured in the Pardee and Camanche reservoirs, located northeast of the Delta on the western slope of the Sierra Nevada. EBMUD's raw water aqueducts (Mokelumne Aqueducts) are used to convey that supply over approximately 91 miles to EBMUD's service area.

BARR agencies have been diversifying their water resource portfolios to ensure reliability for their customers. Collectively, existing and planned water supply sources among the agencies are diverse, and include surface water from local and imported sources, groundwater, recycled water (non-potable reuse), purified water (potable reuse), and desalination, as shown in Figure 2.

While traditional supply sources will remain an important foundation to the region's supply portfolio, BARR agencies see non-potable and potable water reuse as critical elements to future Bay Area supplies, and they are currently working on a wide range of reuse projects. One example is SCVWD's expansion of the Silicon Valley Advanced Water Purification Center (SVAWPC) to develop additional supplies for groundwater replenishment.

Some BARR agencies are also expanding other sustainable local sources of supply, such as rainwater, stormwater, graywater (sinks, washers, and showers), blackwater (wastewater; same elements as graywater, with the addition of toilets), and foundation drainage. Several BARR agencies have already obtained water rights to local runoff from flood and storm events, and are considering opportunities to expand urban stormwater capture for water supply augmentation.

Stormwater is an integral part of the state's water supply portfolio. Bay Area and upcountry precipitation runoff is collected in the state's network of surface water and groundwater reservoirs as part of basic operations, serving many BARR agencies and other water providers.

Some BARR agencies have also been capturing local rainfall runoff and urban stormwater and using it to meet water demands for decades. However, the agencies account for stormwater in their local surface water or groundwater supplies, not as a separate supply source. The agencies continue to work toward greater capture and use of local urban stormwater for supply where feasible. For example, SCVWD is currently incorporating stormwater projects into their Water Supply Master Plan

and collaborating with Municipal Regional National Pollutant Discharge Elimination System (NPDES) Stormwater co-permittees in Santa Clara County to develop a Storm Water Resources Plan.

Some reservoirs are not managed solely for a single agency or purpose. For example, water in the Mokelumne River and Hetch Hetchy Regional Water systems are managed by and for EBMUD and SFPUC, respectively, and for in-stream fish flows and other water rights holders. Further, some agencies consider stored water a reserve supply, while other consider storage integral to operations but not a distinct supply source. Given these factors, a simple comparison of UWMP projected demands and supplies can be misleading and must be considered in the broader context of "supply utilization" versus "supply availability."

The Bay Area's collective supply varies with hydrology in terms of total volume available and diversity of the supply portfolio, as shown in Figure 2. By 2020, the total available annual supply in a normal year is expected to reduce from about 1.3 million acre-feet (MAF) to 1.1 MAF in a single dry year, and 1.0 MAF in a third consecutive dry year. When additional supply is available in normal years, groundwater and surface water storage are typically replenished.

In addition to the total volume, the composition of BARR supplies also varies from normal, to single dry year and multiple dry year scenarios. In a single dry year, reliance on storage increases significantly. By the third consecutive dry year, overall storage is expected to be significantly depleted. To make up the shortfall, emergency drought response actions will be needed to varying degrees by different BARR agencies.

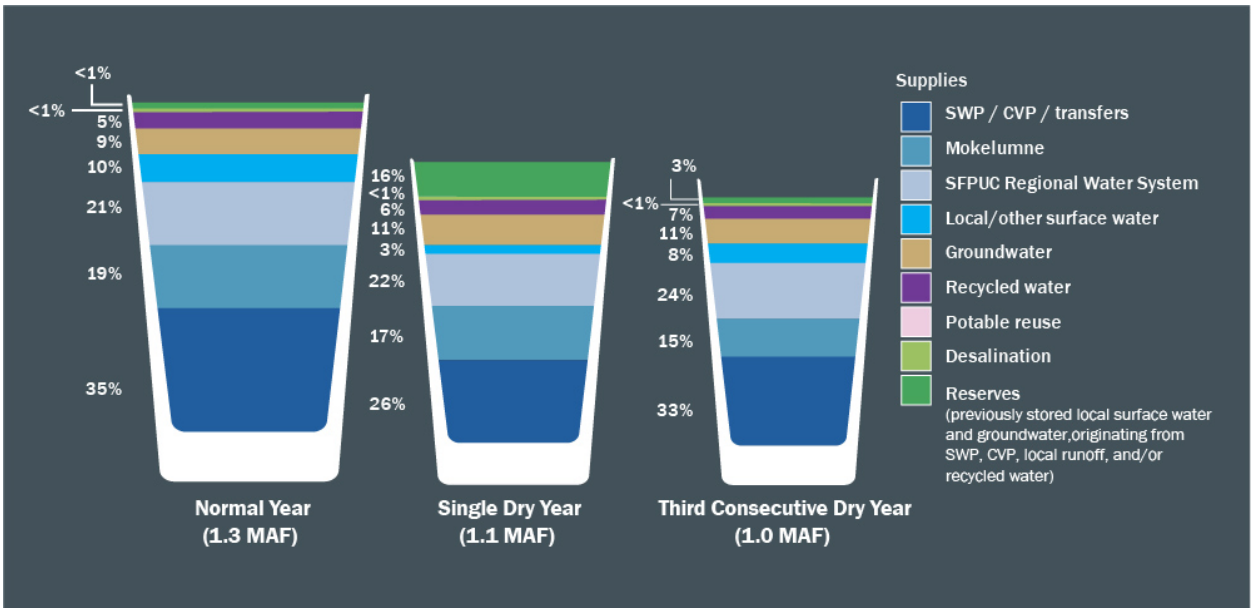


Figure 2. Projected Bay Area regional water supply portfolio for 2020

2.2 Service Areas and Existing Water Facilities

A brief description of each BARR agency's service area and existing water supplies and facilities follows.

Alameda County Water District

ACWD provides water to businesses, industrial users, and more than 330,000 residents in Alameda County (East San Francisco Bay Area).

- **Type of agency:** Retail (BAWSCA member agency) water agency. ACWD coordinates with a counterpart wastewater supplier in the service area to serve recycled water.
- **Service area:** Fremont, Newark, and Union City (104.8 square miles).
- **Current population served:** 343,499 (January 2015; source: California Department of Finance)
- **Sources of supply:** SWP, SFPUC RWS, Alameda Creek watershed runoff.
- **Water conveyance/distribution facilities:** Approximately 880 miles of pipe.
- **Storage facilities:** 12 reservoirs and tanks.
- **Treatment facilities:** (4) Mission San Jose WTP (decommissioned), WTP 2 (26 million gallons per day [mgd] capacity), Newark Brackish Groundwater Desalination (NDF) Facility (12.5 mgd capacity), Blending Facility (48 mgd capacity).
- **Other:** Along with SCVWD and Zone 7, ACWD participates in a groundwater banking program with the Semitropic Water Storage District (Semitropic) in Kern County. When surplus water is available—typically during normal or wet years—and when other supply sources are sufficient to meet needs, ACWD and the other participating agencies deliver their surplus SWP supply to Semitropic for storage. When necessary, Semitropic returns the stored water for use by its partners either by exchanging its SWP allocation or by pumping groundwater into the California Aqueduct for delivery to the partners via exchange.

Bay Area Water Supply and Conservation Agency

BAWSCA does not directly provide water at this time, but it has the authority to develop regional supplies on behalf of its member agencies.

- **Type of agency:** BAWSCA was formed by legislative action in 2003 and represents the 26 retail water suppliers that receive water from the SFPUC RWS, which is owned and operated by SFPUC. Together, the BAWSCA agencies account for two-thirds of water consumption from the system. For the purposes of BARR, BAWSCA is considered a wholesaler, though it is not subject to all of the same legislative and regulatory requirements of traditional wholesalers.
- **Service area:** 24 cities and water districts and two private utilities in Alameda, Santa Clara, and San Mateo counties
- **Current population served:** 1.77 million
- **Sources of supply:** SFPUC RWS. Some BAWSCA agencies also receive water from SCVWD and/or other imported sources, and some have local supplies.
- **Water conveyance/distribution facilities:** N/A
- **Storage facilities:** N/A
- **Treatment facilities:** N/A

Contra Costa Water District

CCWD provides water to businesses, industrial users, and municipalities, serving more than 500,000 customers in eastern and central Contra Costa County (East San Francisco Bay Area).

- **Type of agency:** Retail and wholesale treated and untreated water agency. CCWD coordinates with counterpart wastewater suppliers in the service area on recycled water deliveries.
- **Service area:** North, central, and east Contra Costa County, a total area of more than 140,000 acres
- **Current population served:** Approximately 500,000
- **Sources of supply:** CCWD obtains its water supply from the CVP, direct Delta withdrawals, and local surface water.
- **Water conveyance/distribution facilities:** The 48-mile-long Contra Costa Canal for untreated water conveyance and approximately 800 miles of treated water distribution pipeline
- **Storage facilities:** In addition to treated water storage reservoirs, CCWD has four untreated water storage reservoirs, the largest of which is the Los Vaqueros Reservoir (160,000 acre-feet [AF]).
- **Treatment facilities:** CCWD operates two WTPs: the Bollman WTP (75 mgd capacity) and the Randall-Bold WTP (50 mgd capacity). Additionally, on behalf of the City of Brentwood, CCWD operates the City of Brentwood WTP, which serves the portion of the city that is outside of CCWD's service area boundary.

East Bay Municipal Utility District

EBMUD supplies water and provides wastewater treatment for a large part of Alameda and Contra Costa counties.

- **Type of agency:** Retail water supplier and wastewater treatment agency
- **Service area:** Approximately 332 square miles in the San Francisco East Bay area.
- **Current population served:** Approximately 1.4 million[5]
- **Sources of supply:** The Mokelumne Aqueducts convey the Mokelumne River water approximately 91 miles from the Pardee Reservoir across the Delta to local storage and treatment facilities. EBMUD also has a supplemental dry year supply from the CVP that is diverted through the Freeport Regional Water Project (FRWP).
- **Water conveyance/distribution facilities:** The Mokelumne aqueduct system transports untreated water from the Pardee Reservoir approximately 91 miles to the EBMUD WTPs. Once treated, the water is distributed through a network that includes 4,200 miles of pipe.
- **Storage facilities:** EBMUD has five local water supply reservoirs, termed by EBMUD as "terminal reservoirs," and 165 water distribution reservoirs.
- **Treatment facilities[6]:** EBMUD has six WTPs with a total permitted capacity[7] of 495 mgd, including: Walnut Creek WTP (115 mgd), Lafayette WTP (35 mgd), Orinda WTP (175 mgd), Upper San Leandro WTP (60 mgd), San Pablo WTP (50 mgd), and Sobrante WTP (60 mgd). Of the six

[5] EBMUD also provides wastewater treatment services to a subset of its water customers (about 685,000 people).

[6] This description of EBMUD's treatment facilities focuses on major water treatment plants only and does not include recycled water, groundwater, and/or wastewater treatment plants.

[7] Refers to permitted capacity issued by the State Water Resources Control Board Division of Drinking Water. However, the actual capacity of the WTPs is a function of raw water quality, season, and other factors.

WTPs, three (Walnut Creek, Lafayette, and Orinda) are in-line treatment plants with a total capacity of 325 mgd that usually treat water directly from Pardee. The in-line treatment process is acceptable because the Pardee Reservoir water source is pristine and has low turbidity. The other three WTPs (Upper San Leandro, San Pablo, and Sobrante), with a combined capacity of 170 mgd, are equipped with conventional treatment capabilities, and these reservoirs treat water from the terminal reservoirs.

Marin Municipal Water District

MMWD serves the populous eastern corridor of Marin County from the Golden Gate Bridge northward up to, but not including, Novato.

- **Type of agency:** Retail water agency. MMWD coordinates with one counterpart wastewater supplier in the service area to supply users with recycled water.
- **Service area:** Eastern corridor of Marin County, a total area that covers approximately 147 square miles
- **Current population served:** Approximately 190,000
- **Sources of supply:** Local surface water and wholesale supplies from Sonoma County Water Agency
- **Water conveyance/distribution facilities:** Once treated, water is distributed to customers via MMWD's potable water distribution network that includes 886 miles of pipe.
- **Storage facilities:** MMWD has seven untreated supply reservoirs and 127 treated water storage tanks.
- **Treatment facilities:** MMWD has three WTPs: Bon Tempe WTP, San Geronimo WTP, and Ignacio WTP. Together, these facilities have a combined design capacity of 71 mgd.

Santa Clara Valley Water District

SCVWD provides water and other services to businesses, industrial and agricultural users, and more than 1.9 million residents in Santa Clara County.

- **Type of agency:** Wholesale water supply, groundwater management, flood protection, and stream stewardship agency. SCVWD coordinates with counterpart wastewater suppliers in the service area to provide water reuse.
- **Service area:** Santa Clara County (approximately 1,300 square miles)
- **Current population served:** Approximately 1.9 million
- **Sources of supply:** SCVWD's water supply consists of local surface water, imported water from the Delta (both SWP and CVP), and groundwater. SCVWD also constructed and operates an advanced water purification facility capable of providing potable reuse supplies, and partners with recycled water producers to expand non-potable reuse.
- **Water conveyance/distribution facilities:** Once treated, water is distributed through a network that includes 142 miles of pipe.
- **Storage facilities:** SCVWD has ten untreated supply reservoirs and 393 acres of recharge ponds. SCVWD also operates 91 miles of controlled in-stream recharge.
- **Treatment facilities**: SCVWD operates three surface WTPs
- **Other:** SCVWD participates in a groundwater banking program with Semitropic (see the "Other" description under ACWD for more information).

San Francisco Public Utilities Commission

SFPUC supplies water in San Francisco and throughout the Bay Area, including BAWSCA member agencies, via its RWS.

- **Type of agency:** Retail and wholesale water supplier, retail wastewater service provider, and municipal power supplier
- **Service area:** SFPUC provides water service in San Francisco, Santa Clara, Alameda, San Mateo, and Tuolumne counties and wastewater service within the City and County of San Francisco.
- **Current population served:** SFPUC serves approximately 2.6 million.
- **Sources of supply:** Most of SFPUC's RWS supply (85 percent) is Sierra Nevada rain and snowmelt collected and stored in the Hetch Hetchy Reservoir, situated on the Tuolumne River in Yosemite National Park. The remaining 15 percent is local surface water supply drawn from the Alameda and Peninsula watersheds. Some retail customers in and outside San Francisco also receive groundwater supply.
- **Water conveyance/distribution facilities:** The SFPUC RWS consists of more than 280 miles of pipe and 60 miles of tunnels. The in-city distribution system consists of approximately 1,250 miles of pipe.
- **Storage facilities:** The SFPUC RWS has 11 reservoirs. The in-city distribution system is composed of ten reservoirs and eight water storage tanks.
- **Treatment facilities:** SFPUC operates one ultraviolet (UV) treatment plant and two WTPs. The Tesla treatment plant (315 mgd capacity) is a UV facility that provides secondary disinfection for water from the Hetch Hetchy Reservoir, which is an unfiltered drinking water system. The Harry Tracy WTP (140 mgd average capacity) and Sunol Valley WTP (160 mgd capacity) treat all water that is derived from sources other than the Hetch Hetchy Reservoir.

Zone 7 Water Agency

Zone 7 is one of ten active zones of the Alameda County Flood Control and Water Conservation District. Zone 7 is the only zone among the ten that provides water services in addition to flood protection.

- **Type of agency:** Wholesale water agency, groundwater basin manager, and flood protection agency. Zone 7 coordinates with counterpart wastewater agencies in the service area that provide recycled water.
- **Service area:** Approximately 425 square miles of the eastern portion of Alameda County, including the Livermore-Amador Valley, Sunol Valley, and portions of the Diablo Range. Zone 7 also serves a portion of Contra Costa County through an out-of-service area agreement with Dublin San Ramon Services District (DSRSD).
- **Current population served:** Approximately 240,000
- **Sources of supply:** Zone 7's main sources of water supply consist of local surface water, imported surface water from the SWP through the South Bay Aqueduct (SBA), transfer agreement with Byron Bethany Irrigation District (BBID), and groundwater (previously stored surface water)
- **Water conveyance/distribution facilities:** Zone 7's treated water transmission system consists of approximately 35 miles of pipelines.
- **Storage facilities:** Zone 7 can store local runoff in Lake Del Valle, which is owned and operated by DWR for storage of SWP supplies. Zone 7 also uses the groundwater basin conjunctively to store both local runoff and SWP supplies. Zone 7 also has four treated water storage reservoirs

within the system. In the future, the series of gravel mining pits known as the Chain of Lakes will be used to enhance Zone 7's raw water storage capacity and groundwater recharge capabilities.

- **Treatment facilities:** Zone 7 operates one groundwater demineralization plant and two WTPs. The Mocho Groundwater Demineralization Plant (6.1 mgd capacity) was designed to mitigate salt buildup in the groundwater basin and to improve delivered water quality. The Del Valle WTP (36 mgd capacity) and Patterson Pass WTP (19 mgd capacity) treat water delivered via the SBA.
- **Other:** Zone 7 participates in a groundwater banking program with Semitropic and the Cawelo Water District (Cawelo) in Kern County. Both the Semitropic and Cawelo groundwater banking programs store water for Zone 7 for use during dry conditions (see the "Other" description under ACWD for more information).

2.3 Regional Water Demand and Water Use Efficiency

BARR agencies collectively serve more than six million customers, providing water for municipal, industrial, landscape, and agricultural uses. Water use varies year-to-year depending on many factors, such as climate, regulatory and environmental drivers, and the economy. Despite this annual variability, BARR agencies' collective water use over the last two decades demonstrates a downward trend (Figures 3 and 4).

More substantial water use reductions over the last decade, and particularly over the last several years, are largely due to recession, drought water use restrictions, and changing culture. Some lasting efficiencies were gained during the recent drought; however, extreme water use reductions over the last several years are due in part to short-term actions taken in response to the emergency drought mandate, such as shorter showers and limited outdoor watering.

A recent statewide public survey sponsored by ACWA reports that two-thirds of survey participants felt they made "reasonably substantial reductions in their households' water use over the past few years." Most indicated their efforts focused on behavior changes rather than efficiency upgrades, and on outdoor rather than indoor reductions (FM3, 2017).

Future water use is currently challenging to project. California water management is amid a transformation due in part to state initiatives, legislation, and regulations such as a new statewide long-term water use efficiency framework, the California Water Action Plan, and Bay-Delta Water Quality Control Plan.

Though the effects of these state efforts on future demands and water management are not yet fully defined, the long-term regional trend for water use efficiency will certainly continue. When considering demand projections from 2015 UWMPs, BARR agencies anticipate their collective M&I demands for potable water will grow by 18 percent or less from 1995 to 2035—even as the population is expected to grow by more than 40 percent, fueled by a robust and growing Bay Area economy. "Smart growth"— increasing population and density in an environmentally preferred manner and with a regional outlook—will drive much of the Bay Area's future water demand.

Agencies regularly revise their demand projections in response to changing conditions, such as new regulations, demographics, city and county general plans, customer behavior, and other factors. The demands presented in 2015 UWMPs were based on information available to the agencies at that time.

Since the time BARR agencies developed 2015 UWMPs, the Association of Bay Area Governments (ABAG) released a draft version of Plan Bay Area 2040, which is the transportation and land use roadmap for the region's future growth. The plan reflects policy decisions and is based on assumptions considering the region's key economic, demographic, and financial trends over the last four years. The draft plan includes population and employment projections that are significantly

higher than those included in BARR agencies' 2015 UWMPs (ABAG, 2017). The outcome of the Plan Bay Area 2040 process will affect the region's projected demands and future water use.

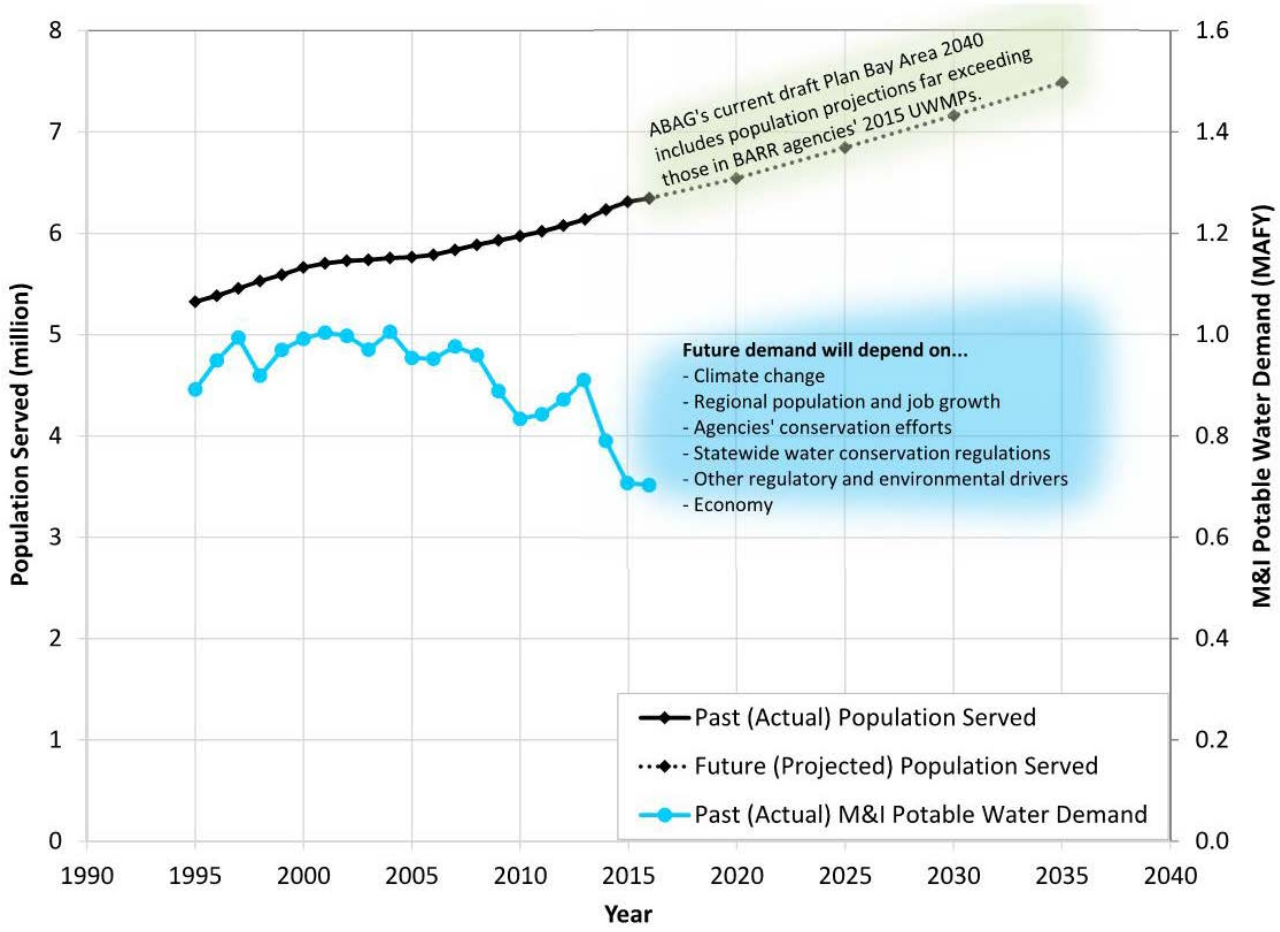
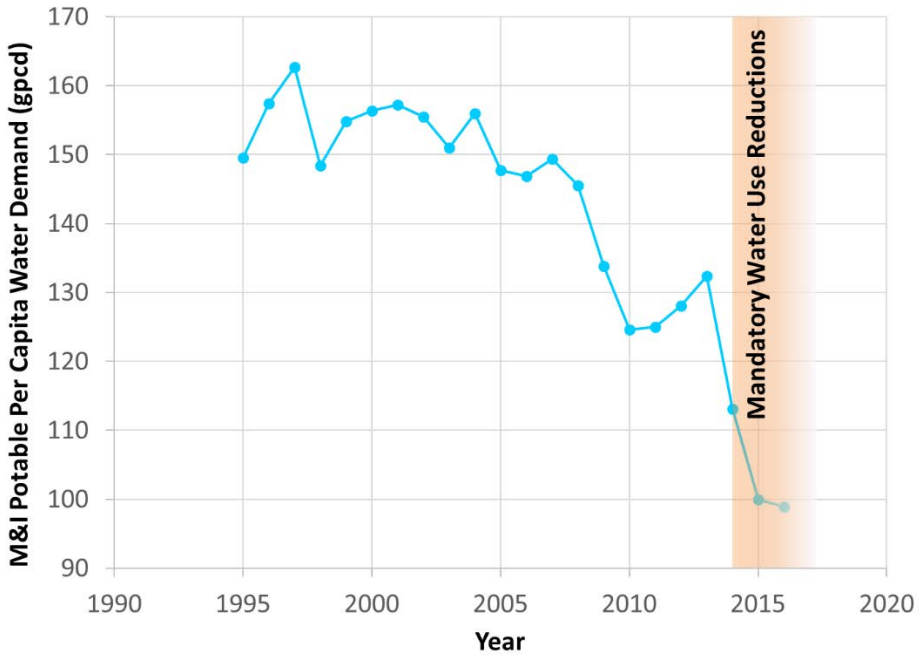


Figure 3. Regional M&I potable demands and population served



BARR agencies have long been committed to water use efficiency, demonstrating real progress over the last two decades. They continue to prioritize investments in significant demand management programs, driving lasting cultural changes to further reduce future per capita water use while also being ready to invoke additional short-term emergency drought response reductions when needed.

Figure 4. Although recent reductions were largely due to emergency conservation during drought, the Bay Area's collective per capita M&I potable demand is trending downward over the long-term.

2.3.1 Recent Statewide Water Use Policies and Drought Actions

BARR agencies acknowledge the distinction between long-term water use efficiency (ongoing efficiency) and short-term emergency water use reductions (cutbacks)—and the difference between actions to appropriately support each. Water shortage conditions, such as the recent drought, can require actions to support short-term emergency water use cutbacks. However, extraordinary cutbacks are unsustainable and can result in unintended consequences, such as long-term economic impacts (e.g., California business climate and residential property values), utility revenue instability, water affordability issues, disincentive for future capital investment to improve local reliability, compromised quality of life, as well as other potential long-term impacts.

Long-term water use efficiency is ongoing, regardless of hydrologic conditions. When properly designed and implemented, water use efficiency programs result in sustainable potable demand offsets that support the economy, environment, and communities.

The Water Conservation Bill of 2009 (i.e., SBx7-7) established a regulatory framework to support the statewide reduction in urban per capita water use. As directed by specific methodology in the legislation, SBx7-7 required retail water suppliers to establish and report a historical per capita water use baseline (in gallons per capita per day [gpcd]) and targets for 2015 (interim milestone) and 2020 in their 2010 UWMPs. Retail water agencies reported on interim progress toward meeting the targets in their 2015 UWMPs. Although water wholesalers are not subject to SBx7-7, BARR agencies that are wholesalers have implemented conservation programs and policies to support their retail agencies in achieving long-term water use efficiency goals.

Recent drought has led to extreme water use reductions, based on policy changes and actions taken at the state and local levels, as illustrated in Figure 5. In January 2014, Governor Brown issued an Emergency Proclamation declaring a drought emergency and calling for voluntary conservation.

After that time, the governor issued several additional drought-related Executive Orders (EOs) that significantly influenced water use. The State Board adopted an Emergency Water Conservation Regulation in May 2015 to address specific provisions of the April 2015 EO, including specific outdoor water use restrictions and a mandatory 25 percent statewide reduction in potable urban water use between June 2015 and February 2016. The State Board established tiered water use reduction mandates for each retail urban water supplier in the state (i.e., retail agencies serving more than 3,000 connections or 3,000 acre-foot/feet per year [AFY]), using past water use data. In February 2016, the State Board adopted an updated Emergency Regulation to extend restrictions on urban water use through October 2016 while making modest adjustments for issues raising statewide water use equity concerns. In recognition of improved supply conditions throughout the state, the State Board further revised the Emergency Regulation in May 2016, enabling water suppliers to submit a supply-based self-certification to determine any needed water use reduction standards. The Emergency Regulation was lifted in Spring 2017 as a result of substantially improved water supply conditions.

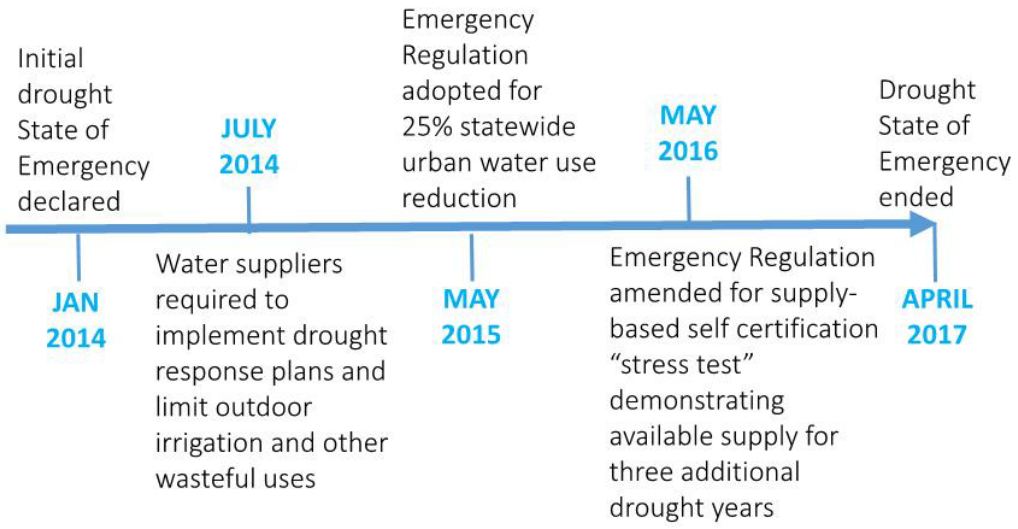


Figure 5. Timeline of state drought mandates affecting recent BARR demands

The state's actions also affected water supplies. In June 2015, the State Board issued an unprecedented curtailment notice for pre-1914 appropriative claims in the Sacramento-San Joaquin River and Delta watersheds, which was lifted in September 2015.

In addition to directing the State Board to update the Emergency Regulation, the Governor's May 2016 EO directed state agencies to develop a long-term water use efficiency framework that builds upon SBx7-7 and generates more statewide conservation than existing requirements. The EO stated that "water use targets shall be customized to the unique conditions of each water agency" and directed the DWR and State Board to develop a framework for long-term water use efficiency through a stakeholder process. To address the EO, DWR, the State Board, and other state agencies[8] released the "Making Conservation a California Way of Life" final report in April 2017, and proposed legislation that tiers off the state agencies' report is currently pending.

In addition to the long-term water use efficiency framework, implementation of the broader California

[8] Other state agencies involved in developing the Making Conservation a California Way of Life report include the California Public Utilities Commission, the California Department of Food and Agriculture, and the California Energy Commission. Aspects of the report pertaining to the BARR DCP are under the purview of DWR and the State Board.

Water Action Plan and the Bay Delta Water Quality Control Plan are also expected to change the way California water is managed. The effects of these state efforts on future demands and water management are not yet fully defined, but one certainty is known: the long-term regional trend for water use efficiency will continue.

2.3.2 BARR Agencies' Commitment to Water Use Efficiency

BARR agencies have implemented water use efficiency programs over decades to manage demands and effectively reduce per capita demands. As part of this ongoing commitment to water use efficiency, the agencies continue to expand and update their programs to integrate new practices and policies. Table 3 summarizes BARR agencies' ongoing water use efficiency programs.

Table 3. BARR Agencies' Ongoing Water Use Efficiency Programs								
Program Type	ACWD	BAWSCA	CCWD	EBMUD	MMWD	SCVWD	SFPUC	Zone 7
Utility Operations Programs								
Water waste prohibitions	✓	N/A	✓	✓	✓	N/A	✓	✓
Water loss control	✓	N/A	✓	✓	✓	✓	✓	✓
Metering	✓	N/A	✓	✓	✓	✓	✓	✓
Conservation pricing	✓	N/A	✓	✓	✓	N/A	✓	N/A
Education and Outreach								
Public information	✓	✓	✓	✓	✓	✓	✓	✓
School education	✓	✓	✓	✓	✓	✓	✓	✓
Residential								
Indoor water surveys	✓		✓	✓	✓	✓	✓	N/A
Outdoor water surveys	✓		✓	✓	✓	✓	✓	N/A
Residential plumbing retrofit	✓		✓	✓	✓	✓	✓	N/A
High-efficiency washing machine rebate programs	✓	✓	✓	✓	✓	✓	✓	✓
Toilet replacement programs (ultra-low flow/high efficiency)	✓	✓		✓	✓	✓	✓	✓
Landscape rebate programs	✓	✓	✓	✓	✓	✓	✓	✓
Water use reports	✓	✓	✓	✓	✓	✓	✓	N/A
Commercial, Industrial, and Institutional (CII)								
Conservation programs for CII (e.g., process water use reduction, laundry retrofits, water-efficient commercial dishwashers, etc.)	✓		✓	✓	✓	✓	✓	N/A
Landscape								
Landscape water surveys/budgets	✓	✓	✓	✓	✓	✓	✓	✓
Landscape rebate/grant programs	✓	✓	✓	✓	✓	✓	✓	✓
Program Summary								
Annual water conservation savings (FY 15–16 [a]) in AFY	12,700 [b]	8,600 [c]	12,500	38,000	7,500 [d]	63,000	10,706	16,700 [d, e]
Annual water conservation budget (FY 15–16 [f, g])	$1.35M	$1.1M	$2.6M	$4.5M	$3.0M	$10.8M	$6.2M	$539k
Annual water conservation budget (FY 16–17[g])	$1.16M		$2.4M	$4.6M	$3.1 M	$6.8M	$5.9M	$547k

N/A = Not applicable to wholesale agencies but may be implemented by retailers and/or other agencies in the service area.

a. *Annual savings associated with cumulative historical programs (active and passive savings). However, these data do not consistently reflect the mandated savings due to the State Board's Emergency Regulation.*

b. *ACWD's conservation savings were 8,300 AF in FY 15–16 if excluding drought effects.*

c. *Cumulative annual savings for all programs with quantifiable savings, through FY 15–16. Includes only BAWSCA programs, not individual measures implemented by member agencies separate from BAWSCA.*

d. *Total includes drought-related conservation relative to 2013 demands.*

e. *Zone 7 does not generally track passive conservation.*

f. *Agencies' conservation program budgets during the drought were larger than normal to achieve the State Board's mandated water use reduction targets.*

g. *Annual budget associated with active programs.*

h. *Zone 7 is a wholesaler; additional conservation programs in Zone 7's service area may be undertaken at the retailer level.*

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Section 3 //
Drought Monitoring

Water supply conditions are monitored on a statewide level by DWR, Reclamation, and others. BARR agencies also regularly monitor supply conditions, compare available supplies to projected demands to effectively manage operations and water use, and prepare Water Shortage Contingency Plans for responding to water shortages.

3.1 Statewide Snowpack and Water Supply Monitoring

DWR tracks precipitation, estimates mountain snowpack, calculates river flows, and operates storage facilities. DWR sets annual water allocations for SWP contractors based on actual and forecasted precipitation, snowpack, and rate of snowmelt. DWR also coordinates with Reclamation, which manages the CVP, and other state and federal agencies[9] on SWP and CVP water operations. Agencies that receive water from the SWP or CVP consider their allocations when evaluating current and future supply availability.

DWR's Hydrology and Flood Operations Office, part of the Division of Flood Management, estimates runoff for the major watersheds of the Sacramento and San Joaquin River basins based on precipitation, snowpack, runoff, and other hydrologic conditions to forecast reservoir storage, releases, flows, and deliveries under various conditions. These forecasts, typically conducted from February through May each year, provide general guidance for annual water delivery, storage management, and power planning.

During the recent drought, DWR staff provided biweekly reports to the State Board on statewide water supply conditions, and DWR and State Board staff regularly referenced the U.S. Drought Monitor Index (National Drought Mitigation Center), statewide precipitation (National Oceanic and Atmospheric Administration [NOAA] Regional Climate Center), and DWR California Data Exchange Center monitoring data, including snowpack, snow water equivalents, and reservoir storage.

3.2 Local Supply Monitoring

In addition to statewide monitoring, many BARR agencies conduct their own supply monitoring and regular reporting.

ACWD. ACWD has three primary sources of supply, two imported and one local, and all sourcing from different hydrologic regions of California with differing supply availability from year to year. At the center of ACWD's water supply system is the Niles Cone Groundwater Basin, which is operated conjunctively, storing both surplus local surface water and SWP supply. The Niles Cone Groundwater Basin has both normal year and dry year storage components and serves as a single monitoring point for the health of the overall supply. As part of annual water supply planning, ACWD models

[9] California Department of Fish and Wildlife, State Water Resources Control Board, U.S. Fish and Wildlife Service, and National Marine Fisheries Service.

local groundwater conditions to project year-end storage. Production and water import schemes are adjusted to ensure that local groundwater levels are maintained above target thresholds. When groundwater levels fall below these targets, various water management strategies are employed and, depending on the severity of drawdown, may indicate the need to enact the Water Shortage Contingency Plan (WSCP).

CCWD. In addition to the statewide snowpack monitoring and water supply forecasting, CCWD monitors Delta water quality at its intakes and at compliance monitoring locations throughout the Delta. All of CCWD's water supply comes from the Delta and is therefore subject to variations in quality caused by salinity intrusion, Delta hydrodynamics, and discharges into the Delta and its tributaries. CCWD participates in weekly coordination meetings with CVP and SWP operators to keep abreast of changing Delta conditions and to receive a short-term forecast of Delta operations and water quality. CCWD also monitors regulatory proceedings of the State Board to determine if local water rights are or will be subject to curtailment during dry conditions.

EBMUD. EBMUD evaluates the adequacy of its water supplies each year in keeping with its Water Supply Availability and Deficiency Policy (Policy 9.03). Under this Policy, the EBMUD Board of Directors receives a preliminary assessment by March 1 of each year evaluating the adequacy of that year's projected water supplies. Following this preliminary assessment, the Board adopts a final Water Supply Availability and Deficiency Report by May 1, which updates the water supply projections based on the April 1 snow survey by DWR. EBMUD uses this report as the basis to determine whether to declare a drought and implement response actions in accordance with its Drought Management Program (DMP) Guidelines, which are based on two potential drought scenarios: local conditions or a state mandate. In the first scenario, EBMUD estimates its end of season total system storage (TSS) and, if it falls below certain predetermined levels, different levels of response actions are triggered, including the acquisition of additional water supplies and increasing levels of customer demand reduction. The second scenario occurs when the State Board mandates specific customer demand reduction requirement.

MMWD. MMWD monitors the volume in the seven district lakes. These lakes are located in Marin County along the California Northern Coast Range. The lake levels are reported monthly to the Board of Directors. The lake levels are reviewed against the lake volumes of 30,000 AF on December 1 and 40,000 AF and 50,000 AF on April 1. Those lake levels determine the level of drought and required drought mitigation measures.

SCVWD. SCVWD monitors monthly changes in drought severity (U.S. Drought Monitor), weather, and its water supplies and operations (local water and releases, groundwater storage and use, imported water availability, and water production). To measure the response to its drought strategies, SCVWD monitors monthly water use by water type for all 13 water retailers in the county and reports the monthly and cumulative water use reductions compared to a target. A comprehensive list of SCVWD drought strategies and actions taken by cities, the County, and retailers are also reported on their website (http://www.valleywater.org/drought/).

SFPUC/BAWSCA. SFPUC regularly monitors system-wide conditions and state guidance and reports them to its Commission and the public. SFPUC monitors TSS, precipitation, snowpack, deliveries, and savings over both the short and long terms to determine any necessary response actions.

Zone 7. In addition to monitoring state-level conditions, Zone 7 monitors local precipitation and runoff conditions to determine its available local surface water supply and potential replenishment of the groundwater basin. Zone 7 also monitors groundwater levels regularly to quantify available local groundwater storage. Local precipitation and temperature conditions are also good indicators of water demands, as a significant amount (40 percent) of demands in the summer months is used for irrigation.

3.3 Water Use Monitoring and Reporting

BARR agencies track water use and provide regular updates to their decision-making bodies (i.e., Board of Directors or Commission) on recent water use trends and projections compared to available supplies.

Since July 2014, the State Board has been tracking potable water production and conservation on a monthly basis for the state's urban water suppliers, and State Board staff provide monthly reports to summarize monthly and cumulative data provided by urban water agencies, including potable production and per capita water use. A total of 40 agencies within the BARR agencies' service areas are considered urban water suppliers and submit monthly water use and conservation data to the State Board.

3.4 Water Shortage Contingency Plans

Agencies regularly compare their amount of supply to triggers (thresholds) to determine whether drought conditions exist and, if so, what drought response actions will be taken. Retail and wholesale urban water suppliers in California are required to adopt and submit a WSCP every 5 years to DWR. WSCPs are required under the Urban Water Management Planning Act, which is in the California Water Code (CWC), Sections 10610 through 10656, and most recently amended in 2015. UWMPs document anticipated supplies and demands over a 20- to 25-year planning horizon under different hydrologic conditions and support long-term water supply planning.

3.4.1 Plan Elements

As part of UWMP development, urban water suppliers prepare WSCPs. WSCPs document water suppliers' plans for responding to water shortages and are required to include the following elements[10]:

- **Stages of action:** Stages of action implemented by water agencies in response to supply shortages, including up to a 50 percent supply reduction, and a framework to assign specific supply conditions to each stage (CWC Section 10632(a)). The WSCP must identify stages of action in response to water supply shortages and describe specific water supply conditions applicable to each stage. The WSCP must include up to a 50 percent reduction in water supply, and DWR recommends that the WSCP address conditions exceeding a 50 percent reduction in water supply. DWR also recommends that the triggers for each stage be clearly defined and be able to be assessed frequently.
- **Prohibitions on end users:** Additional, mandatory prohibitions against specific water use practices during water shortages, including, but not limited to, the use of potable water for street cleaning (CWC Section 10632(a)(4)). Applies only to retail agencies.
- **Penalties, charges, and other enforcement:** Penalties or charges for excessive use (CWC Section 10632(a)(6)). Applies only to retail agencies.
- **Consumption-reduction methods**: Consumption-reduction methods are actions to reduce water demand within a service area, whereas prohibitions limit specific uses of water. Each urban water supplier has a choice regarding the types of consumption-reduction methods to use in its WSCP analysis. The methods must be appropriate for the area and capable of reducing water use by up to 50 percent. CWC Section 10632(a)(5) requires the water supplier to implement consumption-reduction methods during the most restrictive stages of a water shortage.

[10] WSCP requirements are subject to periodic update based on state mandates and may change in the future.

- **Determining water shortage reductions:** A mechanism for determining actual reductions in water use. The BARR agencies record water production data. Totals are reported monthly and are incorporated into water supply reports. The BARR agencies maintain extensive water use records on individual customer accounts and monitor production figures during all stages of water shortages.
- **Revenue and expenditure impacts**: An analysis of the impacts of each water shortage action and condition on the water agency's revenues and expenditures, and proposed measures to overcome those impacts (e.g., development of reserves and rate adjustments) (CWC Section 10632(a)(7)).
- **Resolution or ordinance:** A draft water shortage contingency resolution or ordinance. For example, an ordinance may require implementation of mandatory conservation, a water restriction plan, and/or a drought surcharge and may prohibit various wasteful water uses (e.g., washing sidewalks and driveways with potable water, cleaning or filling decorative fountains, or allowing plumbing leaks to go uncorrected for more than 72 hours).
- **Catastrophic supply interruption plan:** WSCPs describe actions water agencies take to prepare for, and implement during, a catastrophic interruption of water supplies (e.g., a regional power outage, earthquake, or other disaster) (CWC Section 10632(a)(3)).
- **Three-year minimum water supply**: WSCPs include an estimate of the minimum water supply available during each of the next three water years based on the driest three-year historical sequence for the agency's water supply (CWC Section 10632(a)(2)).

3.4.2 Existing Plans

Each BARR agency's WSCP guides actions to be taken during drought, and their approaches vary widely based on a number of factors, such as supply sources, customer categories served, and policies and ordinances adopted by their decision-making bodies (Boards/Commissions). DWR's guidance for WSCPs provides a framework while allowing flexibility to adapt drought response actions based on agency-specific, local considerations.

The BARR agencies' WSCPs range from three to five stages of drought with various supply shortage triggers, based on factors affecting each agency's unique portfolio of supplies. The BARR agencies use different water supply reduction indicators and triggers to define each stage of action (Table 4). The indicators reflect each agency's basis for monitoring when demand reductions are necessary. Most BARR agencies have specific triggers that are clearly defined and can be assessed frequently, while one agency (Zone 7) moves from one stage to the next based on a combination of quantitative and qualitative supply conditions and as directed by their Board or Commission. SCVWD's WSCP differs from others in that its first drought stage is in effect at all times to promote long-term water use efficiency. SFPUC's WSCP is also unique, as it explicitly addresses supply reductions above 50 percent.

In responding to water shortages, most BARR agencies begin with voluntary conservation encouraged by public outreach, often with restrictions on outdoor water use. During the recent drought from 2012 through 2016, each BARR agency experienced some degree of water shortage and triggered varying stages of its WSCP. The BARR agencies vary widely in their responses to increasing shortages with mandatory water use restrictions, allowances, and/or penalties implemented, as follows:

- **ACWD**: Response actions elevate from voluntary to mandatory between Stages 1 and 2. Base consumption allowances are implemented at 20 to 30 percent supply reduction (Stage 3).
- **BAWSCA**: The BAWSCA member agencies (i.e., SFPUC's wholesale customers) are collectively subject to reductions in their RWS supply allocation starting when the SFPUC requires a 5

percent or less system-wide reduction in water use (Stage 1). The resulting allocation is equivalent to a 12 percent reduction in supply. BAWSCA is the only BARR agency to restrict water at Stage 1, and while there is a potential for supply allocations in Stage 1, this has never actually happened as voluntary requests for conservation have been the first step.

- **CCWD:** Penalties start at 20 to 40 percent supply reduction (Stage 3); new service connections are prohibited at 40 to 50 percent supply reduction (Stage 4).
- **EBMUD:** Drought surcharges are implemented when TSS drops below 90 percent of a threshold value of 500,000 AF (starting with Stage 2); excessive use charges for single-family homes are applied when TSS drops below 78 percent of the threshold value (starting with Stage 3).
- **MMWD:** Response actions elevate from voluntary to mandatory between Stages 1 and 2.
- **SCVWD**: SCVWD coordinates with the retailers and cities it serves to enact ordinances and water use restrictions when end-of-year groundwater storage is projected to drop below Stage 2 (below 83 percent of a 300,000 AF threshold for implementing the WSCP).
- **SFPUC**: May implement consumption allotments based on inside/outside allocation method), excess use charges, flow restrictors, and service shutoff at 21 to 50 percent reduction in system supply (Stage 2).
- **Zone 7**: Starting at Stage 2, Zone 7 requires its retailers to reduce demand up to 20 percent and may also implement surcharges.

3.5 Updates to WSCP Requirements

Governor Brown's May 2016 EO directed state agencies to "strengthen local drought resilience" by establishing a long-term framework for water use efficiency and drought planning. The EO specifically calls for updating WSCP requirements to include "adequate actions to respond to droughts lasting at least five years" and to remain "customized according to local conditions." In April 2017, DWR and the State Board released the final framework report, which describes the state agencies' recommendations for updated requirements for water use targets, monthly reporting, permanent water use prohibitions, and water loss reductions. Proposed legislation to establish the recommendation as law is currently pending. If the proposed legislation advances, water agencies will be required to submit specific drought planning/projection information at two different frequencies as follows:

- **Each year**, agencies will submit an Annual Water Budget Forecast (projecting supplies and demands based on current conditions and an additional dry year), Shortage Response Actions (SRAs) tied to specific water shortage levels, and protocols for implementing drought response actions (e.g., communication plan, customer compliance/enforcement, implementation authorities, financial plan for drought condition, and monitoring/reporting).
- **Every five years**, as part of their updated UWMPs, agencies will submit updated WSCPs that include a five-year drought risk assessment that examines shortage risks for the next five or more consecutive years, based on historical drought hydrology, plausible climate and regulatory changes, and demand projections.

Table 4. Summary of BARR Agencies' WSCPs - Drought Stages, Indicators, and Triggers

Agency	Indicator	Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
		Supply Reduction (%)	Water Supply Condition/Trigger	Supply Reduction (%)	Water Supply Condition/Trigger	Supply Reduction (%)	Water Supply Condition/Trigger	Supply Reduction (%)	Water Supply Condition/Trigger	Supply Reduction (%)	Water Supply Condition/Trigger
ACWD	Groundwater level	0%–10%	Local supply insufficient to maintain target groundwater levels > 10' mean sea level (msl).	10%–20%	Local and imported supply insufficient to maintain target groundwater levels > 5' msl.	20%–30%	Local and imported supply insufficient to maintain target groundwater levels above sea level.	30%–50%	Critical water supply shortage. Local groundwater levels at or projected to be below safe minimum of -5' msl.	N/A	N/A
BAWSCA	SFPUC RWS-wide shortage condition	12%	5% or less SFPUC RWS system-wide reduction.	17%	6%–10% SFPUC RWS system-wide reduction.	23%	11%–15% SFPUC RWS system-wide reduction.	28%	16%–20% SFPUC RWS system-wide reduction.	55%	50% SFPUC RWS system-wide reduction (or any system-wide reduction >20%)
CCWD	Reduction in supplies	<10%	Total supply able to meet ≥ 90% of anticipated demand.	10%–20%	Total supply is able to meet ≥ 80% of anticipated demand.	20%–40%	Total supply able to meet ≥ 60% of anticipated demand.	40%–50%	Total supply able to meet ≥ 50% of anticipated demand.	N/A	N/A
EBMUD [a]	Total system storage (TSS)		TSS drops below 500,000 AF threshold or state mandate requires up to 10% customer demand reduction.		TSS drops below 90% of threshold or state mandate requires 10%–15% customer demand reduction.		TSS drops below 78% of threshold or state mandate requires 15%–20% customer demand reduction.		TSS drops below 65% of threshold or state mandate requires ≥ 20% customer demand reduction.	N/A	N/A
MMWD	Reservoir storage	10%	Total reservoir storage below 63% of capacity on April 1.	25%	Total reservoir storage below 50% of capacity on April 1.	50%	Total reservoir storage projected to be ≤ 38% of capacity on December 1.	N/A	N/A	N/A	N/A
SCVWD	Groundwater storage	0%	Groundwater storage above threshold of 300,000 AF.	0%–10%	Groundwater storage 83%–100% of threshold.	10%–20%	Groundwater storage 67%–83% of threshold	20%–40%	Groundwater storage 50%–67% of threshold.	40% to at least 50%	Groundwater storage less than 50% of threshold
SFPUC	System-wide shortage condition	10%–20%	10% reduction in system supply.	21%–50%	21%–50% reduction in system supply.	> 50%	> 50% reduction in system supply.	N/A	N/A	N/A	N/A

Table 4. Summary of BARR Agencies' WSCPs - Drought Stages, Indicators, and Triggers

Agency	Indicator	Stage 1		Stage 2		Stage 3		Stage 4		Stage 5	
		Supply Reduction (%)	Water Supply Condition/Trigger	Supply Reduction (%)	Water Supply Condition/Trigger	Supply Reduction (%)	Water Supply Condition/Trigger	Supply Reduction (%)	Water Supply Condition/Trigger	Supply Reduction (%)	Water Supply Condition/Trigger
Zone 7	SWP allocation trend, storage levels, supply deficit, state-level emergency	Demand reduction: up to 20% (voluntary)	Specific events (e.g., sequential low SWP allocations, low storage levels) suggest that, in the next few years, water supplies might not meet projected normal water demands from retailers and/or water supply storage may need to be replenished to protect against future shortages (e.g., during drought recovery); or an EO from the governor because of state-level conditions.	Demand reduction: up to 20% (mandatory)	Specific events suggest that, in the current or upcoming year, water supplies might not meet projected normal water demands from retailers. This stage could also be independently triggered by an emergency (e.g., earthquake) or an EO from the governor because of state-level conditions.	Demand reduction: up to 35% (mandatory)	Specific events suggest that, in the current year, water supplies will not meet projected normal water demands from retailers, requiring a demand reduction from 21% to 35%. This stage may also be independently triggered by an emergency or an EO from the governor because of state-level conditions.	Demand reduction: >35% (mandatory)	Specific events suggest that, in the current year, water supplies will not meet projected normal water demands from retailers, requiring greater than 35% demand reduction. Critical condition: indoor water use may need to be curtailed and demands may need to be reduced to health and safety requirements. This stage may also be independently triggered by an emergency or an EO from the governor because of state-level conditions.	N/A	N/A

[a] *EBMUD uses Total System Storage (TSS) as a basis for its drought trigger determination. Since TSS is used as the gauge for measuring the adequacy of the District's supply, a supply reduction percentage is not provided.*

3.6 Regional Coordination

The four BARR agencies that are wholesalers collectively serve 44 other retail agencies that are not directly involved in BARR. Of the total 52 agencies within the collective BARR service areas, 40 are considered "urban water suppliers" (including retailers, wholesalers, and combined retailers/wholesalers) and are subject to the Urban Water Management Planning Act that requires the preparation of UWMPs and WSCPs every five years.

Each agency's WSCP reflects its unique mix of supplies, hydrogeology, infrastructure, authorities, contractual obligations, and service area characteristics. Due to the great variation in supply portfolios among Bay Area water suppliers, BARR agencies and their respective retailers have not reached consensus on regional indicators and triggers. Each of the BARR agencies may be in different stages of drought simultaneously, and in which case, it would not be appropriate to apply a single drought stage label to the entire region.

While BARR agencies acknowledge the importance of regional coordination, opportunities for regional drought monitoring and response are limited by agencies' individual WSCPs and their unique supply portfolios. However, the agencies have identified next steps to improve regional drought monitoring and response and are working towards a more unified approach.

Though currently pending, legislative action is anticipated within the next year to establish new WSCP guidelines expected to require development of annual water budget forecasts to be submitted to DWR each spring and Drought Risk Assessments to be submitted to DWR every five years with UWMPs. The annual water budget forecasts involve evaluating supply availability, considering current conditions and conditions of an additional dry year, based on six standard supply shortage levels:

Shortage Level 1: Up to 10 percent supply shortage

Shortage Level 2: Up to 20 percent supply shortage

Shortage Level 3: Up to 30 percent supply shortage

Shortage Level 4: Up to 40 percent supply shortage

Shortage Level 5: Up to 50 percent supply shortage

Shortage Level 6: Greater than 50 percent supply shortage

BARR agencies will assess the region's supply conditions using a coordinated effort through Bay Area Water Agency Coalition (BAWAC)—a forum where the region's largest water suppliers meet bi-monthly to coordinate on water supply reliability improvements, water quality protection, flood control, and current water supply issues. All the BARR member agencies are active participants in BAWAC. The agencies will compile their individual annual water budget forecasts to be submitted to DWR each spring using the six standard supply shortage levels, and develop a color-coded Bay Area drought monitor map displaying the shortage level in each agency's service area. The agencies will post the map online once a year (after spring supply forecasting) with links to the individual agencies' websites for more detailed current information about supply conditions and response actions.

The role of BAWAC chair rotates between the agencies about every two years. The current lead agency of BAWAC will be responsible for overseeing the Bay Area drought monitor map development.

In addition, the BARR agencies will coordinate regional messaging to inform customers of the region's supply conditions. This regional drought communication program is discussed in further detail in Section 5.

3.7 BARR Agencies' Recent Drought Water Management Actions

Each BARR agency has made substantial investments to improve dry year reliability and has implemented additional water management actions throughout the recent drought. The recent drought management actions implemented by each BARR agency are categorized as response actions and mitigation measures and are summarized in Table 5.

Drought response actions are specific actions triggered during specific drought stages to manage the limited supply and decrease the severity of immediate impacts (e.g., curtailing lawn watering). Response actions use temporary, short-term infrastructure and activities that agencies and the public can implement quickly and that provide expeditious benefits. Section 5 includes discussion on future drought response actions considered for BARR.

Drought mitigation measures are actions, programs, and strategies implemented to address potential risks and reduce potential drought-related impacts when the event occurs. Potential BARR drought mitigation measures are described in more detail in Section 6.

Table 5. Recent BARR Agencies' Drought Water Management Actions

Agency	Dry Year Supplies	Recently Implemented Drought Response Actions	Recently Implemented Drought Mitigation Measures
ACWD	• Semitropic Groundwater Bank • Brackish groundwater desalination	• Recovered Semitropic groundwater banking water. • Used carryover storage in San Luis Reservoir to optimize SWP water. • Transferred 5,000 AF of purchased water from CCWD. • Worked with SFPUC to suspend contractual minimum purchase requirement in SFPUC contract, enabling the optimization of alternative available supplies. • Declared water shortage emergency and passed ordinance with usage restrictions designed to achieve 20 percent demand reduction.	• Worked with DWR and Semitropic to develop alternative operations that maximized access to banked supplies in Semitropic. • Established ACWD/CCWD/Zone 7 agreement to pursue storage of recovered Semitropic water in Los Vaqueros Reservoir.
BAWSCA	• Water System Improvement Program (WSIP) (numerous projects) • BAWSCA projects (e.g., local groundwater, recycled water)	• Implemented public information campaign in coordination with SFPUC to achieve demand reductions. • Accelerated implementation of regional water conservation program.	--
CCWD	• Los Vaqueros Reservoir • Middle River Intake • East Contra Costa Irrigation District (ECCID)	• Proactively used Middle River Intake, which allowed for approximately 60,000 AF more water in Los Vaqueros Reservoir storage. • Provided water transfers to ACWD and BBID.	• Established ACWD/CCWD/Zone 7 agreement to pursue storage of recovered Semitropic water in Los Vaqueros Reservoir.
EBMUD	• Freeport Regional Pipeline • Bayside groundwater	• Used Freeport for CVP dry year water. • Secured short-term water transfers. Conveyed the transfer water through Freeport (transfer partners = Placer County Water Agency and CVP settlement contractors).	--

Table 5. Recent BARR Agencies' Drought Water Management Actions

Agency	Dry Year Supplies	Recently Implemented Drought Response Actions	Recently Implemented Drought Mitigation Measures
MMWD	• Sonoma County Water Agency intertie	• Used reserve reservoirs (Phoenix and Soulajule). • Maximized use of imported and recycled water.	--
SCVWD	• Semitropic Groundwater Bank • Recycled and purified water • Local groundwater reserves • Carryover storage (local and imported) • Transfers	• Recovered Semitropic groundwater banking water. • Utilized SWP carryover water. • Secured water transfers (e.g., Foresthill transfer). • Used local surface water and groundwater from storage. • Implemented a Water Waste Inspector program.	• Initiated a program to reverse flows in the California Aqueduct from Kern County to the San Luis Reservoir to access Semitropic banked water. • Worked with DWR and Semitropic to develop alternative operations that maximized access to banked supplies in Semitropic. • Accelerated development of a potable reuse program.
SFPUC	• WSIP (numerous projects) • Projects with BAWSCA agencies (e.g., local groundwater, recycled water)	• Reduced line flushing. • Increased monitoring and repair of leaks/losses.	• Rehabilitated the aqueduct that allows for Cherry Reservoir and Lake Eleanor water to connect with Hetch Hetchy Aqueduct with treatment at Sunol Valley WTP. Conducted system test in October 2015. •
Zone 7	• Semitropic Groundwater Bank • Cawelo Groundwater Bank • Groundwater • SWP carryover	• Declared local drought emergency and implemented voluntary then mandatory demand reduction. • Recovered Semitropic and Cawelo groundwater bank water. • Utilized SWP carryover water.	• Accelerated emergency drought projects including a new 2 mgd well and new pipeline to capture mining water that would otherwise have left the watershed. • Stored recovered groundwater bank water in San Luis Reservoir. • Established ACWD/CCWD/Zone 7 agreement to pursue storage of recovered Semitropic water in Los Vaqueros Reservoir.

3.8 Lessons Learned

The recent drought has led the state and many of the BARR agencies to take unprecedented actions to manage limited water supply. This experience has afforded BARR agencies with important lessons learned for future drought or reinforced institutional knowledge, summarized as follows.

General

- Keep all drought response options on the table initially and include all interested stakeholders.
- Plan for institutional agreements (exchanges/transfers) in advance of drought, as regional planning takes more time.
- Coordinate Bay Area water agencies' regional drought response through partnerships such as BARR or BAWAC in future droughts.
- Acknowledge that the window of opportunity to access some sources of supply can be more limited than previously expected (e.g., transfer window at export facilities, availability of dry year contract supplies).
- Recognize the potential for state regulatory changes to affect local drought water management. Much of the response to the recent drought was dictated by unprecedented regulatory changes promulgated by State Board.
- Closely monitor and follow up on leak reports.
- Begin contingency plans and coordination early (i.e., do not "wait and see" whether spring rains will materialize).
- Leverage participation in long-term water conservation programs and communicate the value of water.
- Explore potential for leveraging interties and local storage, as they are critical for bolstering regional reliability.

Demands

- Recognize that, in most areas, rationing levels required of customers increased with statewide mandates.
- Maintain and update WSCPs during non-drought periods.

Supplies

- Recognize that state-issued curtailment orders and federal and state contractor allocations may reduce water supply (i.e., to historical lows in the recent drought). Also, drought supplies transported through the SWP system can be limited by low SWP allocations and associated reductions in exchange capacity.
- Acknowledge recycled water limitations and treatment challenges because of more concentrated wastewater.
- Use drought sources more frequently.
- Establish contingency planning action thresholds for various combinations of supplies (if reliant on multiple supplies).

There is much to be learned from the unprecedented actions taken during the recent drought. BARR agencies can draw from these invaluable lessons when managing water supply during future droughts.

Water Quality

Plan for potential water quality issues that may include:

- Algal blooms in reservoirs because of low water levels and/or warmer water temperature
- Taste and odor impacts because of low reservoir levels and/or warmer source water
- Delta water quality degradations, because of low Delta inflows and increased salinity intrusion, can limit conveyance and supplies for agencies that rely on the Delta
- Disinfection by-product management challenges because of source water quality and lower flows/increased residence time in distribution systems

Other

- Record number of main breaks because of soil hardening
- Recognize that recreational impacts occur in multi-purpose reservoirs
- Recognize that fisheries impacts occur because of lower flows/less reservoir storage
- Anticipate potential infrastructure damage because of sustained dewatering of recharge facilities (substantial bank failure during refill) and/or use drought as an opportunity to perform maintenance on dewatered facilities

Section 4 //
Vulnerability Assessment

Specific threats to the region's critical water resources that may reduce availability and reliability of existing and future water supplies must be understood for effective drought contingency planning.

To create a framework for drought contingency planning, specific threats to the region's critical water resources and factors contributing to those threats must be understood. In addition, past climate, water supply, and water use trends and potential future drought conditions and climate change impacts must be considered.

In the context of this framework, drought vulnerability is the extent BARR agencies, and the region are exposed or susceptible to risk. Risk is a combination of frequency of occurrence, magnitude and severity, and consequences. BARR agencies used the resulting baseline risk assessment to inform potential drought response actions and mitigation measures described in this plan.

4.1 Future Conditions of Critical Resources for Drought Supply

Drought contingency planning requires assessing the potential for a range of future hydrologic conditions and corresponding risk to critical resources, which are highly important to protect considering drought consequences, magnitude, and severity. The significance of the region's critical water resources varies by agency based on their individual supply portfolio.

For this analysis, future conditions are evaluated for single dry year and third consecutive dry year scenarios. California water agencies were required to evaluate the impacts of normal years, single dry years, and third consecutive dry years on their water supply availability for their 2015 UWMPs. As a result, use of single dry year and third consecutive dry year for this vulnerability assessment ensures consistency across agencies and supplies. The BARR agencies' water supply availability by source is quantified and projected under single dry years and third consecutive dry year conditions considering historic reliability and corresponding risks to each supply source in their 2015 UWMPs[11]. The same single dry year and third consecutive dry year information is used in this vulnerability assessment. One of the primary recommendations and findings in this DCP is that the BARR agencies consider how to develop more consistent, regionally aligned approaches to evaluating supply reliability in future UWMPs.

Single dry year and third consecutive dry year future conditions are also appropriate for this analysis because these water year types describe realistic conditions under which the BARR agencies would be vulnerable to supply shortages due to legal, environmental, water quality, and climatic factors.

[11] BAWSCA is not required to develop a UWMP. However, SFPUC's UWMP includes information on the wholesale water provided to BAWSCA's service area, as well as projected wholesale demands. In addition, SCVWD's UWMP reflects the supplies and demands for Santa Clara County, which includes eight BAWSCA member agencies.

Future condition scenarios are applied to the remainder of this analysis for the following:

- Determining significance of supply source to BARR agencies' drought portfolios (as projected for a third consecutive drought year in 2020)
- Assessing regional and individual agencies' potential future supply shortfalls (as projected for a normal year, single dry year, and third consecutive dry year in 2020 and 2035)
- Comparing BARR agencies' supply portfolios and demands (as projected for a normal year, single dry year, and third consecutive dry year in 2020 and 2035)
- Plotting a risk matrix to illustrate the vulnerability of regional drought supplies (as projected for a third consecutive drought year in 2020)

Based on the supply projections from 2015 UWMPs for the third consecutive year of drought in 2020, Figure 6 illustrates the relative significance of supply sources to individual BARR agencies' overall supply portfolios.

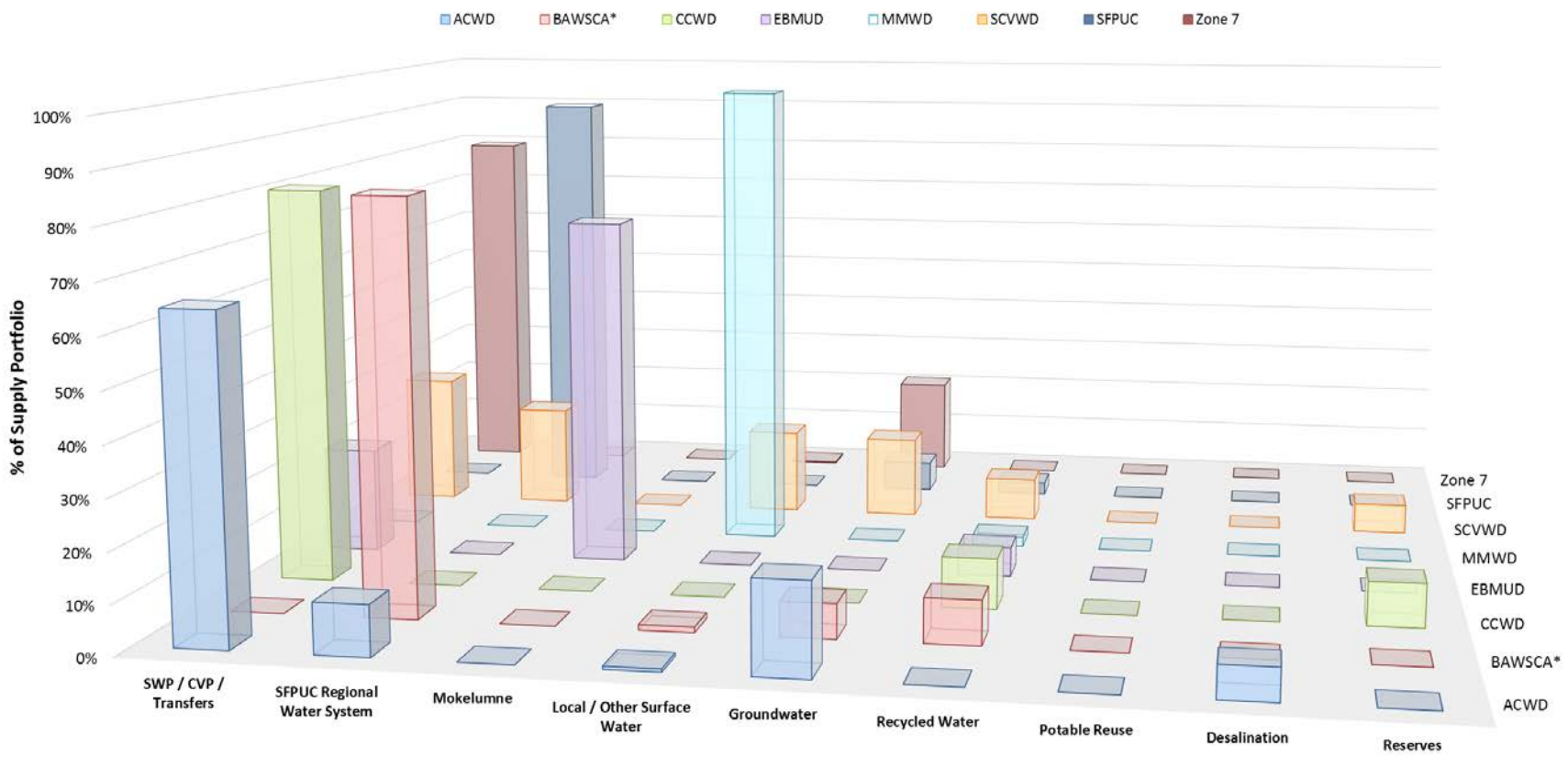


Figure 6. Significance of supply sources to BARR agencies' drought portfolios, as projected for a third consecutive drought year in 2020

** = BAWSCA's supply portfolio has been adjusted to avoid overlap (double-counting) with other BARR agencies.*

Recycled water may be served by other non-BARR agencies.

Reserves reflect previously stored local surface water and groundwater, originating from SWP, CVP, local runoff (such as Los Vaqueros), and/or recycled water.

4.2 Potential for Future Supply Shortfalls

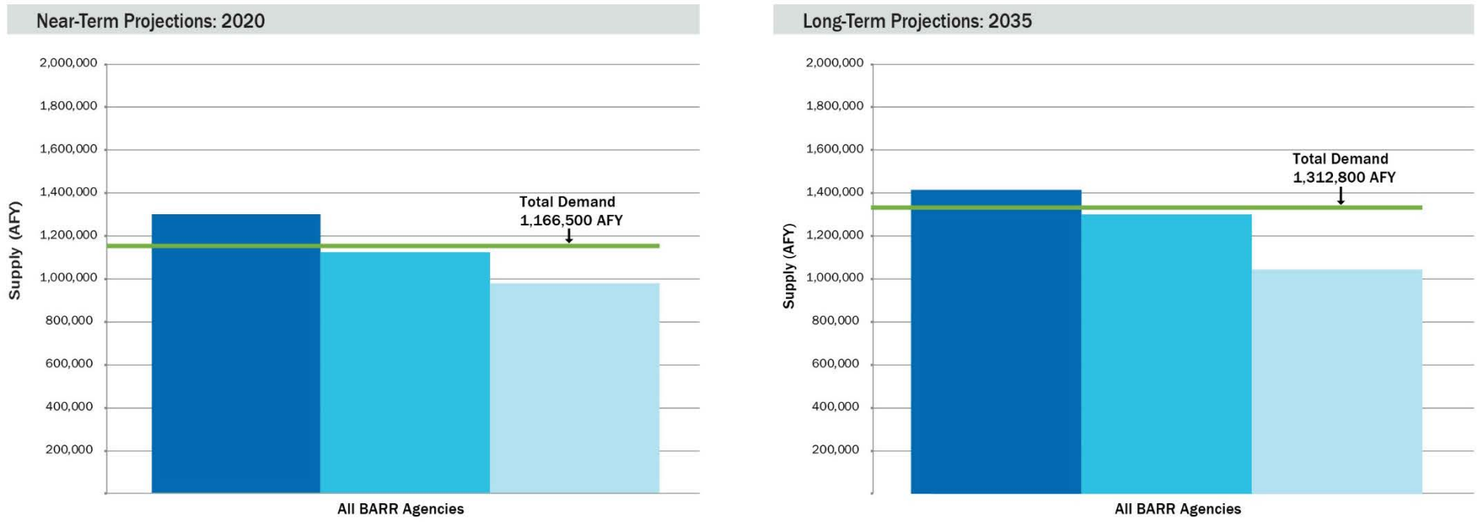
Information from BARR agencies' 2015 UWMPs was compiled to quantify potential regional supply shortfalls for the collective and individual BARR agencies in 2020 and 2035, based on comparing the region's future direct demands to projected total supplies under future conditions (normal, single dry, and third consecutive dry year conditions). As noted, future demand projections are largely uncertain due to a handful of factors, ranging from future population growth to new expectations for water use efficiency.

It is also important to note that direct demand projections do not consistently account for storage replenishment from surface water, groundwater, and banking that occurs in wetter years when supplies are available. Agencies account for these storage demands differently within their UWMPs. For example, Zone 7 explicitly accounts for storage demands in normal years.

Also, some reservoirs are not managed solely for a single agency or purpose. For example, water in the Mokelumne River and Hetch Hetchy Regional Water systems are managed by and for EBMUD and SFPUC, respectively, and for in-stream fish flows and other water rights holders. Further, some agencies consider stored water a reserve supply, while other consider storage integral to operations but not a distinct supply source. Given these factors, a simple comparison of UWMP projected demands and supplies can be misleading and must be considered in the broader context of "supply utilization" versus "supply availability."

Despite the minor differences in the agencies' methodologies, Figure 7 gives a general sense of potential future supply surpluses and/or gaps for the region and individual agencies. The comparison of supplies and demands varies by BARR agency, with some agencies projecting shortages for timeframes and hydrologic conditions when others anticipate surplus supplies. When considered from a regional perspective, BARR agencies anticipate meeting normal year demands for wet/normal water supply years in the near term (2020) and long term (2035). However, the region collectively faces increased challenges for meeting demands in the same time range during single dry year and third consecutive dry year conditions.

In addition to the total volume, the composition of BARR supplies also varies from normal, to single dry year and third consecutive dry year scenarios, as shown on Figure 8 for 2020 and 2035. In a single dry year, reliance on storage increases significantly. By the third consecutive dry year, overall storage is expected to be significantly depleted. To make up the shortfall, emergency drought response measures will be needed to varying degrees by different BARR agencies.



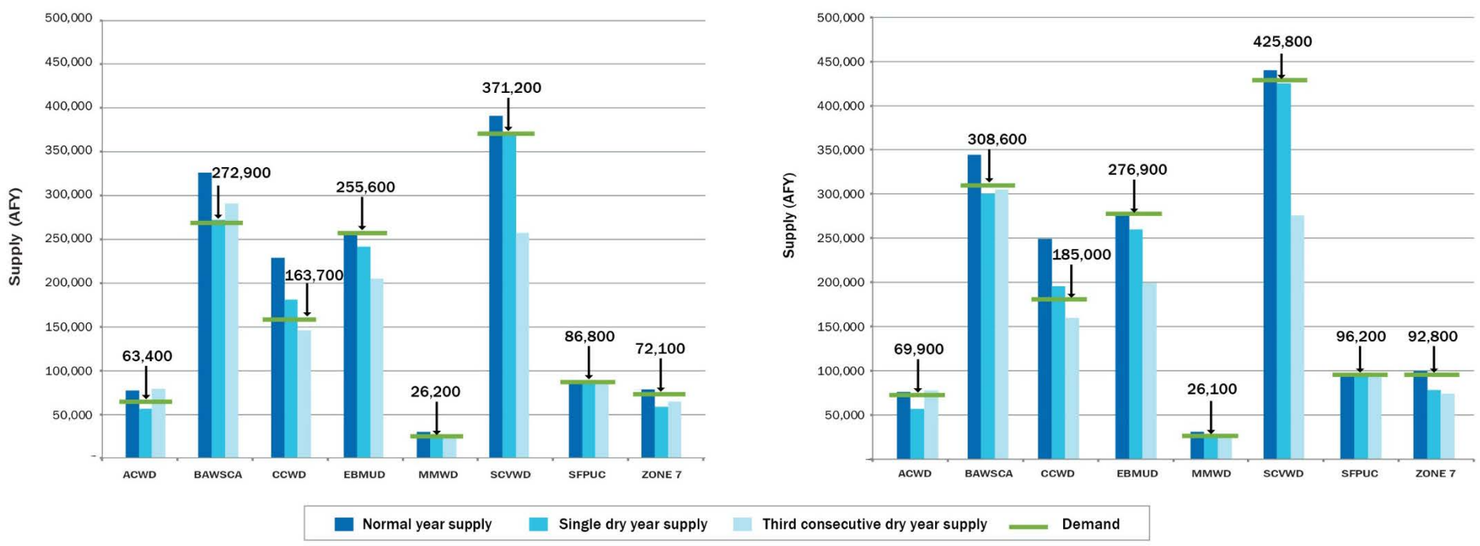


Figure 7. An assessment of regional and individual agencies' potential future supply shortfalls over various hydrologic conditions

For details on individual agencies' projections, refer to 2015 UWMPs.

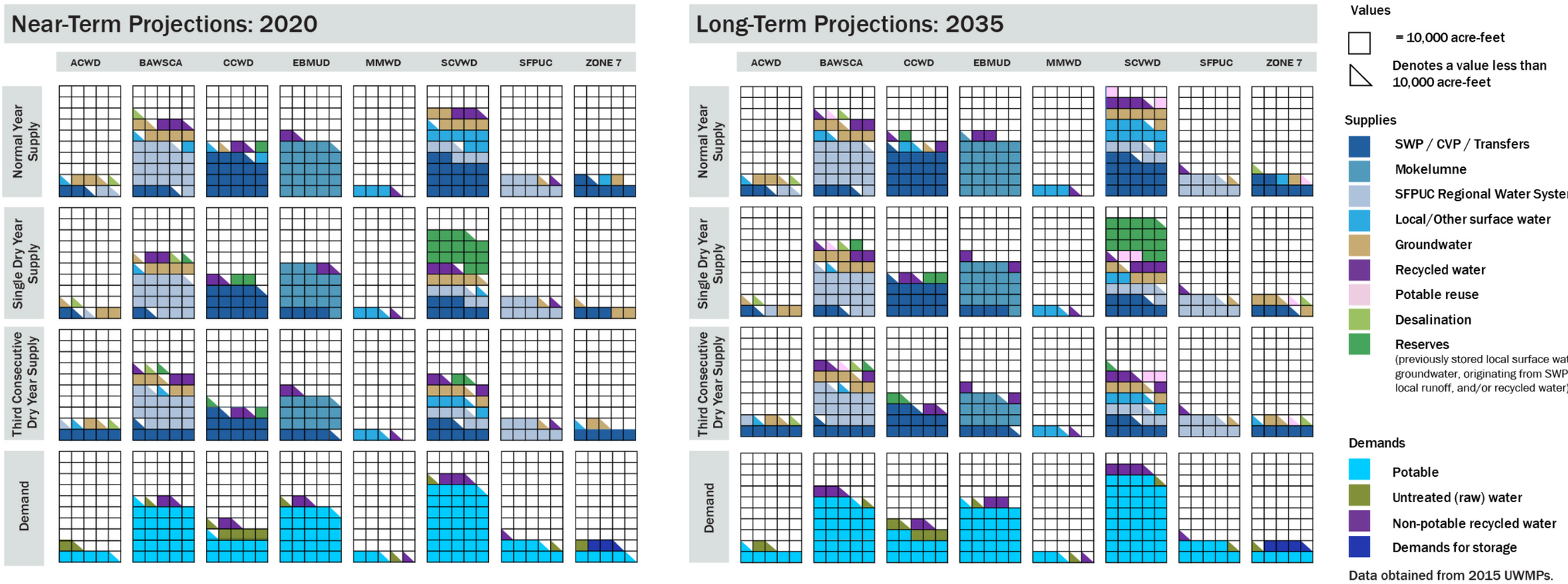


Figure 8. A comparison of BARR agencies' supply portfolios and demands for the near-term future (2020) and long-term future (2035)

Recycled water may be served by other non-BARR agencies.

Reserves reflect previously stored local surface water and groundwater, originating from SWP, CVP, local runoff (such as Los Vaqueros), and/or recycled water.

Per Zone 7's Water Supply Evaluation Update, 10,000 AFY of desalination and/or potable reuse may be included in long-term future (2035) projections. The 10,000 AFY was split evenly between potable reuse and desalination in this figure.

Zone 7's demands include water placed into storage for use during dry years.

4.3 Risks to Critical Resources

Critical Bay Area water resources face a number of threats and uncertainties, including impacts associated with climate change; infrastructure susceptibility in the event of an emergency; supply limitations; regulatory, environmental, and water rights constraints; cost constraints and affordability; and source water quality degradation. These factors may reduce availability and reliability of existing and future water supplies to serve the region's population. BARR agencies assessed the vulnerability of the region's critical water resources due to these uncertainty factors, as summarized by supply source in Table 6.

- **Climate Change.** Climate change is one of the most significant and challenging risks to future water supplies. Each BARR agency is evaluating potential climate change impacts to its specific portfolio of water demands and supplies. The uncertainty surrounding climate change, with the possibility of more frequent and more severe droughts in the future, requires consideration of drought mitigation measures that are resilient to a range of possible climatic conditions. The risks that climate change poses to the Bay Area's future water supplies are described in more detail in Section 4.3.1.
- **Infrastructure Susceptibility and Supply Limitations.** Infrastructure susceptibility broadly applies to each BARR agency. BARR agencies rely upon a diverse network of water-related infrastructure to help convey, treat, and distribute water supplies from the Sierra Nevada, the Delta, and local sources. These systems have limitations and are susceptible to damage from floods, earthquakes, or other events. Even in the absence of these disasters, some aging infrastructure is nearing the end of its useful life.

  Seismic activity poses a significant threat to the region's infrastructure, as all regional facilities are seismically vulnerable to some degree. A significant seismic event could lead to disruption in service for all the BARR agencies.

Drought Vulnerability

In the context of this framework, drought vulnerability is the extent the Bay Area's critical resources are exposed or susceptible to risks and able to cope with or adjust to the adverse effects.

For example, the Delta is a primary water resource for much of the Bay Area, and the levee system surrounding the Delta helps to convey water and protect its water quality. In the event of a massive levee failure, salinity in the Delta could increase substantially, causing an immediate adverse effect on water supplies. Critical water transmission infrastructure crossing the Delta, such as EBMUD's Mokelumne Aqueducts, could also be damaged by major flooding or a seismic event.

Delta stakeholders generally agree that action needs to be taken to protect and improve the Delta in various respects; however, many have conflicting visions of how best to resolve the many complex issues surrounding its improvement. Because of the Bay Area's dependence on the Delta as a critical water supply, the uncertainty of the Delta's future is a major concern for Bay Area communities that must be addressed by water agencies and considered through BARR and other planning efforts.

Agencies have taken preemptive action by conducting seismic vulnerability assessments and implementing seismic upgrades and improvements. However, even with the progress made to date, more improvements are needed. CVP and SWP deliveries are susceptible to Delta levee failures during earthquakes, and the RWS and Mokelumne systems bisect multiple faults between the Sierra Nevada and the Bay Area.

- **Regulatory, Environmental, and Water Rights Constraints.** Changes to water rights and environmental regulations also influence management and operations of water facilities. New or changing regulations can affect agencies' ability to access and use supplies as they have in the past; the availability of some supplies is reduced as day-to-day operations are modified to achieve compliance. New, and often costly, treatment technologies are needed to meet evolving regulations and/or decreasing water quality conditions. Agencies are obligated to maintain fiscal responsibility and balance increasing costs of maintaining and updating infrastructure.
- **Cost Constraints and Affordability.** Addressing aging infrastructure, securing alternatives supplies, and complying with evolving regulations are just several examples of factors contributing to the rising cost of water. By California law, water rates must reflect the cost of service, which can lead to customer affordability issues. BARR agencies serve many low-income customers and therefore recognize that affordability is a major issue in California that must be considered when setting water rates.
- **Source Water Quality Degradation.** Water suppliers are responsible for protecting public health. Providing high water quality starts at the source. Agencies apply a multi-barrier approach to protect public health, starting with protecting drinking water quality at its source, treating the supply, and distributing to customers through a safe, reliable system. The level of risk related to source water quality can vary largely depending on the supply.

As summarized in Table 6, BARR agencies assigned a relative ranking of the likelihood a particular supply source may be reduced or lost. The likelihood score is a qualitative score based on the cumulative likelihood of the reduction or loss of supply as a result of the uncertainty factors described. The likelihood score ranges from 1 to 5, with 1 being a low likelihood of loss or reduction and 5 being a high likelihood of loss or reduction.

To frame the consequence of reduction or loss, BARR agencies considered the significance of supply sources to the region's supply portfolio (assuming the third consecutive dry year in 2020). The consequence score is a quantitative score based on the weighted average of each individual supply source volume to total regional overall supply volume for all sources. A higher percentage indicates a supply that is a larger portion of the region's supply portfolio.

As illustrated on Figure 9, the vulnerability of the region's drought supply sources is assessed using a combination of the likelihood and consequence of supply reduction or loss. In addition, the significance of sources to individual agencies' drought supply portfolios is shown (as bar charts).

Table 6. Summary of Uncertainty Factors Contributing to Potential Reduction or Loss of Critical Resources

Supply Source	Climate Change	Infrastructure Susceptibility and Dry Year Supply Limitations	Regulatory, Environmental, and Water Rights Constraints	Cost Constraints and Affordability	Source Water Quality Degradation	Likelihood – Cumulative Effect of Factors (scale of 1 to 5, low to high impact)	Consequence – Significance to Regional Drought Supply Portfolio (in 2020, third consecutive dry year)
CVP	• Altered/extreme precipitation patterns (less in spring, higher-intensity storms in winter) • More frequent and severe droughts • Higher air temperatures/reduced snowpack • Higher water temperatures/degraded surface water quality • Sea-level rise (seawater intrusion/water quality impacts and threats to aging Delta levees)	• Subject to Reclamation allocations (M&I Water Shortage Policy) and potential dry year curtailments • Reliant on aging infrastructure (susceptible to failure) • If California WaterFix does not proceed, potential reduction in CVP contractors' reliability • Aging Delta levees and CVP infrastructure vulnerable to seismic events	• Regulatory uncertainties that can change timing of exports, reduce deliveries, and impact transfer capacities • Increased environmental regulations • California WaterFix requires approval by SWRCB of changes to Reclamation's water rights	• Rising costs of service to address needed infrastructure improvements and regulatory compliance, including subsidence of aqueducts caused by groundwater overdraft • Cost of potential California WaterFix construction • Customer affordability issues with rising cost of water	• Saltwater intrusion due to droughts • Levee failure • Sea level rise • Algal by-products/ blooms during drought • Increased levels of TOC/dissolved organic carbon (DOC) and turbidity	5	34%
SWP	• Altered/extreme precipitation patterns (less in spring, higher-intensity storms in winter) • More frequent and severe droughts • Higher air temperatures/reduced snowpack • Higher water temperatures/degraded surface water quality • Sea-level rise (seawater intrusion/water quality impacts and threats to aging Delta levees)	• Potential dry year curtailments • Decreasing reliability due to climate change and environmental restrictions • During drought, limited access to remotely banked supplies due to limited exchange capacity • Reliant on aging infrastructure (susceptible to failure) • Susceptible to Delta water quality disruptions due to earthquake, level failure, sea level rise, etc. • If California WaterFix does not proceed, continuing decline in SWP contractors' reliability • Aging Delta levees and SWP infrastructure vulnerable to seismic events	• Regulatory uncertainties that can change timing of exports, reduce deliveries, and impact transfer capacities • Increased environmental regulations • California WaterFix requires approval by SWRCB of changes to DWR's water rights	• Rising costs to address needed infrastructure improvements and regulatory compliance, including subsidence of aqueducts caused by groundwater overdraft • Cost of potential California WaterFix construction • Customer affordability issues with rising cost of water	• Saltwater intrusion due to droughts • Levee failure • Sea level rise • Algal by-products/ blooms during drought • Increased levels of TOC/DOC and turbidity		
SFPUC RWS	• Altered/extreme precipitation patterns (less in spring, higher-intensity storms in winter) • More frequent and severe droughts • Higher air temperatures/reduced snowpack • Higher water temperatures/degraded surface water quality • Wildfire impacts on watersheds and water quality • Changes to watershed vegetation	• Highly reliable, but susceptible to in-stream flow release requirements and potential climate change effects • Relatively minimal seismic risk • San José and Santa Clara are interruptible SFPUC customers; if SFPUC deliveries to them are interrupted or reduced, then they will rely more on other supplies	• Regulatory uncertainties impacting water supply (in-stream flow release requirements and water rights' curtailment) • New water quality regulations, relicensing (in-stream flow releases), and filtration avoidance • Entitlements to Turlock Irrigation District and Modesto Irrigation District to the natural flow of the Tuolumne River • During multiple dry years, SFPUC's water diversions limited to previously stored water in system reservoirs and Don Pedro Reservoir	--	• Very high quality; potential filtration avoidance changes could impact supply (also a reliability and regulatory issue)	3	24%
Mokelumne	• Altered/extreme precipitation patterns (less in spring, higher-intensity storms in winter) • More frequent and severe droughts • Higher air temperatures/reduced snowpack • Higher water temperatures/degraded surface water quality • Wildfire impacts on watersheds and water quality • Changes to watershed vegetation.	• Susceptible to droughts (particularly multi-year droughts) • In a seismic event, Camanche Main Dam embankment is susceptible to potential liquefaction and deformation to the toe area (not affecting dam stability or causing failure) • Delta floods leading to levee failures that affect EBMUD's Mokelumne Aqueducts	• Potential curtailments and obligation to meet multiple operating objectives (e.g., in-stream flow requirements, flood control, etc.)	• High cost for rehabilitating or replacing aging aqueducts	• Turbidity due to extreme weather and/or forest fires	4	15%

Table 6. Summary of Uncertainty Factors Contributing to Potential Reduction or Loss of Critical Resources

Supply Source	Climate Change	Infrastructure Susceptibility and Dry Year Supply Limitations	Regulatory, Environmental, and Water Rights Constraints	Cost Constraints and Affordability	Source Water Quality Degradation	Likelihood – Cumulative Effect of Factors (scale of 1 to 5, low to high impact)	Consequence – Significance to Regional Drought Supply Portfolio (in 2020, third consecutive dry year)
Local/other surface water	• Altered/extreme precipitation patterns (less in spring, higher-intensity storms in winter) • More frequent and severe droughts • Higher water temperatures/degraded surface water quality	• Varies by agency/water source and based on hydrologic conditions • Susceptible to supply reductions and changes in timing • Regulatory uncertainty related to in-stream/ downstream flow requirements • If facilities to maintain/increase delivery capacity from Sonoma County Water Agency not constructed, potentially reduced reliability (MMWD) • Seismic risk varies by agency/water source and infrastructure condition and proximity to faults	• Potential changes in current water rights • In-stream/downstream flow requirements • Unforeseen changes in release requirements and storage rights • Maintaining water rights • Water right permit extension/licensing in process (ACWD and Zone 7) • Supplies subject to Term 91 (CCWD) • Water rights challenges due to fishery impact concerns (SCVWD)	• Pumping costs • Infrastructure (e.g., storage) costs, including rehabilitation and replacement of aging infrastructure • Purchased water price	• Varies by agency/water source • Salinity and nutrients • Agriculture runoff • Wastewater discharges • Algal blooms (also potentially affect treatability and decrease production capacity)	4	8%
Groundwater	• Altered/extreme precipitation patterns (less in spring, higher-intensity storms in winter) • More frequent and severe droughts (adverse impacts to reliable yield and reduced groundwater recharge/deliveries) • Sea-level rise (seawater intrusion/water quality impacts, threats to facilities near coast lines, and limited ability to drawdown the aquifers)	• Moderately reliable source during normal years • Special care must be taken to avoid overdrafting, which can lead to subsidence • Facilities and infrastructure susceptible to seismic events • Potentially reduced natural groundwater recharge with continued development (SCVWD) • Need firm commitments from in-lieu partners (SFPUC)	• More stringent water quality regulations that could impact the way agencies operate and manage this supply • Uncertain impacts of the Sustainable Groundwater Management Act • Water right permit extension/licensing in process (ACWD and Zone 7), which could affect access to recharge supply	• Costly fisheries projects to maintain access to recharge supply • Treatment costs with increasingly stringent water quality regulations	• Varies by agency and basin • Some constituents of concern to BARR agencies include: hardness, salinity, nutrients, Chromium 6, and arsenic	3	9%
Recycled water	• More frequent and severe droughts, which may reduce wastewater flows and the amount of available recycled water available • Concentrated wastewater flows (with reduced flows), necessitating treatment changes	• Highly reliable local supply in the event of a drought	• Increasingly stringent regulations on recycled water treatment and distribution • Unclear rights to wastewater effluent and institutional agreements needed • Competition for wastewater effluent between potable and non-potable reuse	• High cost of building and maintaining separate distribution system for recycled water and retrofitting customer sites	• Challenging to provide recycled water quality that meets customers' standards • High salinity problematic for sensitive end uses	1	6%
Potable reuse	• More frequent and severe droughts, which may reduce wastewater flows and the amount of available recycled water available • Concentrated wastewater flows (with reduced flows), necessitating treatment changes	• Highly reliable local supply in the event of a drought • Ability to use/store purified water in wetter years	• Feasibility of potable reuse in California highly subject to regulatory requirements including detention times for storage, blending requirements, water quality requirements, wastewater discharge permit requirements, and others • Unclear rights to wastewater effluent and institutional agreements needed • Competition for wastewater effluent between potable and non-potable reuse • Public acceptance and timing for direct potable reuse (DPR)	• Infrastructure requirements and operational requirements (e.g., monitoring)	• Any potable reuse option considered would have to be protective of public health and provide high-quality water	1	0%
Desalination	• Sea-level rise (seawater intrusion/water quality impacts and threats to facilities near coast lines)	• Highly reliable supply in the event of a drought • In seismic events, potential vulnerability to pipelines supplying ACWD's facility	• Fisheries protection • Concentrate discharge under NPDES permit • Relatively high energy requirements	• Potentially increased per unit costs with increased salinity • Increasing energy costs (depending on source)	• Very high-quality water • Potentially rising salinity handled by treatment technology	1	1%
Reserves (previously stored local surface water and groundwater, originating from SWP, CVP, local runoff, and/or recycled water)	• Altered/extreme precipitation patterns (less in spring, higher-intensity storms in winter) • More frequent and severe droughts • Higher air temperatures/reduced snowpack • Higher water temperatures/degraded surface water quality • Sea-level rise (seawater intrusion/water quality impacts and threats to aging Delta levees)	• Aging Delta levees and CVP/SWP infrastructure vulnerable to seismic events	• Regulatory uncertainties that can change timing of exports, reduce deliveries, and impact transfer capacities • Increased environmental regulations • California WaterFix requires approval by SWRCB of changes to Reclamation's water rights	--	--	2	3%

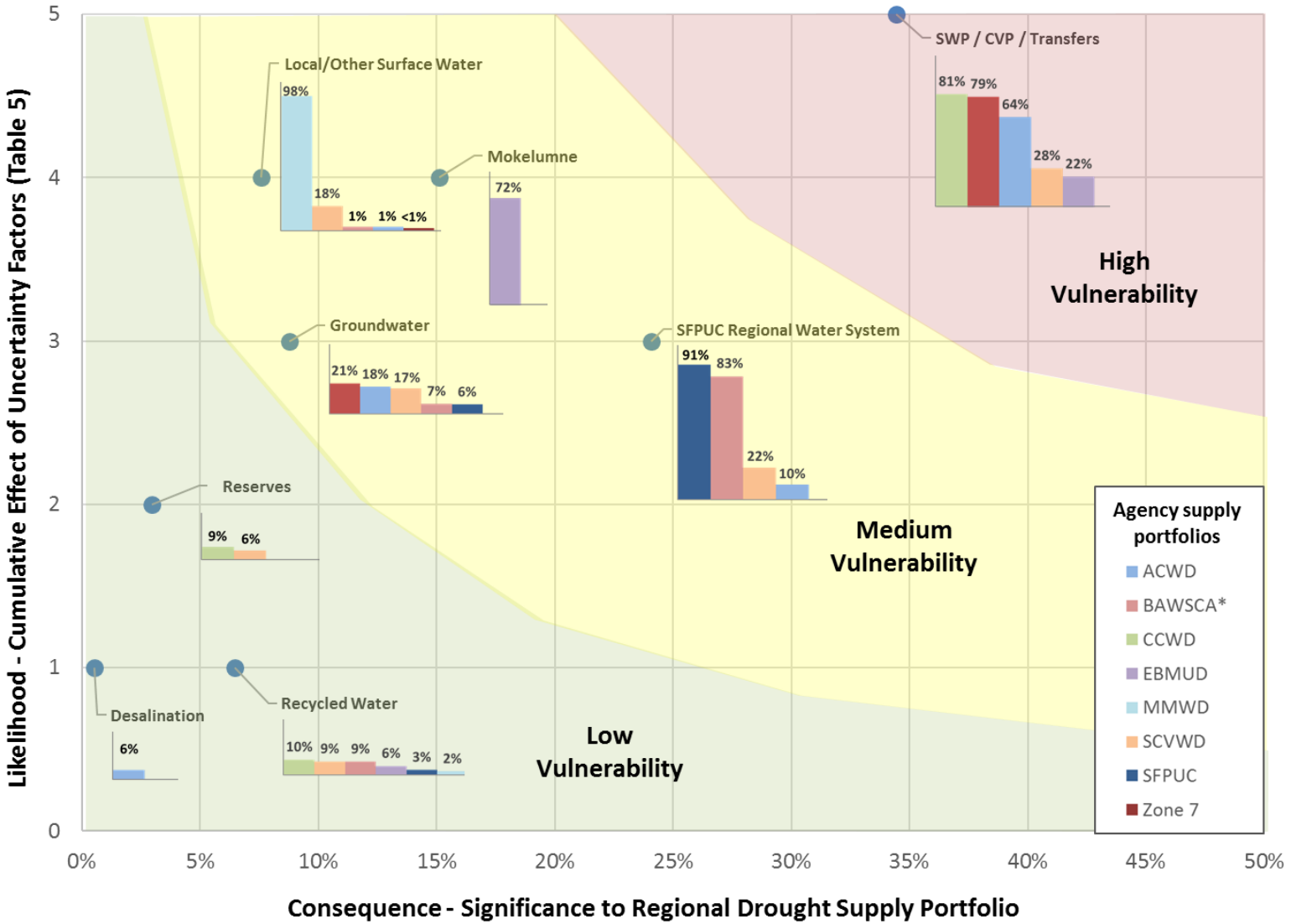


Figure 9. Vulnerability of regional drought supplies as projected for third consecutive dry year conditions in 2020

** = BAWSCA's supply portfolio has been adjusted to avoid overlap (double-counting) with other BARR agencies.*

4.3.1 Climate Change

Climate change is one of the greatest sources of uncertainty in long-term (more than 50 years) water supply planning. Recent climate change projections from the Intergovernmental Panel on Climate Change (IPCC)[12] and SCRIPPS Institute of Oceanography indicate that global temperatures could increase by 4 degrees Celsius (°C) by the end of the century. Warmer temperatures are expected to result in more of California's precipitation occurring as rain rather than snow, and snowmelt from the Sierra Nevada Mountains and Cascades is expected to shift earlier into the spring. Seven of the eight BARR agencies rely on the snowpack and surface water supplies from the Sierra-Nevada Mountains and Cascades to meet the majority of their demands.

Historically, California has had a hydroclimate with significant inter-annual variability even in the absence of anthropogenic climate change. Anthropogenic climate change may increase the frequency of extreme hydrologic events such as floods or droughts. While there is a range of forecasts for changes in total precipitation (i.e., wetter or drier), most climate projections indicate that there will be greater variability in annual precipitation[13].

Each of the BARR agencies is evaluating potential climate change impacts to its specific portfolio of water demands and supplies. The uncertainty surrounding climate change, with the possibility of more frequent and more severe droughts in the future, necessitates consideration of mitigation measures that are resilient to a range of possible climatic conditions.

4.3.1.1 Water Demands

An increase in temperature could lead to an increase in customer demand for water. Increased irrigation (outdoor landscape or agricultural), increased evaporative losses, and a longer growing season are expected to contribute to increased demands. Existing water treatment and distribution systems may not be designed to accommodate significant increases in maximum day demand. For example, EBMUD estimates that its water demand would increase by 10 mgd if average temperature in the service area increases by 4°C[14].

4.3.1.2 Surface Water Resources

Central Valley Project and State Water Project

The CVP and SWP depend on snowpack in, and runoff from, the Sierra Nevada Mountains and Cascades. Both the CVP and SWP own and operate a complex network of infrastructure including reservoirs, canals, and pump stations. In 2014 Reclamation completed the Central Valley Project Integrated Resource Plan[15], which evaluated the performance of the CVP under six potential future climate scenarios and three potential future economic conditions. Under scenarios where the climate is hotter and drier, the CVP is able to meet fewer of its contract demands, resulting in greater water supply shortages than currently experienced. Over the 21st century, simulated average annual unmet demands range from 2.7 to 8.2 MAF/year across the range of socioeconomic-climate scenarios. The unmet demands are forecasted to occur predominantly in the South-of-Delta

[12] IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

[13] 2015 Perspectives and Guidance for Climate Change Analysis. California Department of Water Resources Climate Change Technical Advisory Group.

[14] 2014 Climate Change Monitoring and Response Program. East Bay Municipal Utility District.

[15] 2014 Central Valley Project Integrated Resources Plan. U.S. Department of Interior Bureau of Reclamation. http://www.usbr.gov/mp/SSJBasinStudy/documents.html

Divisions (Delta, San Felipe, West San Joaquin, and Friant). The CVP contractors (EBMUD, CCWD, and SCVWD) participating in developing the DCP are located in regions where unmet demands are projected to increase.

The SWP produces a biennial report evaluating water supply reliability. The scenarios in the 2015 State Water Project Delivery Capability Report[16] account for climate change impacts based on 2025 emission levels and 15-centimeter sea level rise. The 2015 report indicates that the climate change scenario evaluated would result in a reduction of SWP Table A deliveries compared to existing conditions; unmet demands would increase by 3 percent. Furthermore, minimum allocations would be reduced and occur with greater frequency. The SWP contractors participating in the DCP (ACWD, SCVWD, and Zone 7) have incorporated the results of the 2015 report into their long-term planning.

Mokelumne River

EBMUD's primary water supply is derived from the Mokelumne River, which makes up approximately 90 percent of EBMUD's water supply during normal years. EBMUD also has a supplemental dry year supply from the CVP that is diverted through the FRWP. Changes in the timing, intensity, location, and amount of precipitation could have impacts on the reliability of those supplies.

Carryover storage in reservoirs could be reduced by changes in the timing of snowpack melt. Winter reservoir capacity is needed to provide flood control; if snowmelt occurs earlier in the spring it is likely that some runoff that was previously able to be captured and stored for water supply would be spilled to maintain flood control. The 2014 Climate Change Monitoring and Response Program Report[17] found that carryover storage in the system will most likely be reduced and to a greater degree as temperature increases and runoff occurs earlier. For 4°C of warming, carryover storage in reservoirs would be reduced in 56 percent of the years modeled, with an average decrease of 6 percent during those years.

EBMUD first developed a Climate Change Monitoring and Response Plan in 2010 and most recently updated it in 2014. EBMUD continues to invest in climate change research, risk assessment, education, and mitigation.

Tuolumne River[18]

Most (85 percent) of SFPUC's RWS supply is Sierra Nevada Mountains rain and snowmelt collected and stored in the Hetch Hetchy Reservoir, situated on the Tuolumne River in Yosemite National Park. In its 2012 report titled "Sensitivity of Upper Tuolumne River Flow to Climate Change Scenarios," SFPUC assessed the sensitivity of runoff into the Hetch Hetchy Reservoir to a range of changes in temperature and precipitation due to climate change. Key conclusions from the report include the following:

- With differing increases in temperature alone, the median annual runoff at Hetch Hetchy could decrease by as much as 2 percent from present-day conditions by 2040 and by as much as 10 percent from present-day conditions by 2100.
- With decreases in precipitation coupled with temperature increases, the median annual runoff at Hetch Hetchy could decrease by as much as 9 percent from present-day conditions by 2040 and by as much as 29 percent from present-day conditions by 2100.
- In critically dry years, reductions in annual runoff at Hetch Hetchy could be up to 47 percent from present-day conditions by 2100.

[16] http://baydeltaoffice.water.ca.gov/swpreliability/index.cfm

[17] 2014 Climate Change Monitoring and Response Program. East Bay Municipal Utility District.

[18] 2015 UWMP SFPUC.

Currently, SFPUC is planning to conduct a comprehensive assessment of the potential effects of climate change on water supply. The assessment will incorporate an investigation of new research on the current drought and is anticipated to be completed in the next few years.

North Bay[19]

MMWD's water supply does not come from snowmelt, but rather from local runoff and the rainfall-driven Russian River. Total precipitation is not projected to change significantly, although there may be less precipitation in the spring. Timing of runoff is expected to shift to earlier in the year, affecting reservoir storage, especially in the spring and summer months. Variability in annual precipitation is expected to continue, with vulnerability to droughts and dry periods. More intense storms anticipated may affect surface water runoff, storage, and stored water quality.

Climate Ready North Bay, a coalition of conservation leaders, land managers, decision makers, and scientists, completed a customized climate vulnerability assessment for the Marin County study area. This assessment provided climate-change-related data products for Marin County. MMWD, using these data products, built and ran a dynamic systems model to analyze its resilience under different climate change scenarios. The results of this analysis were included in MMWD's 2040 Water Resources Plan, which was finalized in 2017.

Other Local Supplies

Changes in climate that affect the amount and frequency of local rainfall can have dramatic impacts on available local surface supplies. Decreased inflow from more flashy or more intense runoff, increased evaporative losses, and warmer and shorter winter seasons can reduce the amount of water stored in surface water reservoirs and aquifers. For example, conservative rainfall forecasts in Zone 7's service area[20] indicate that median rainfall is expected to decrease by 2 inches per year[21]. Such a decrease in local precipitation could substantially decrease flows in Alameda Creek and natural groundwater recharge in the region.

4.3.1.3 Groundwater Resources

Changes in local hydrology could affect natural recharge to the local groundwater aquifers and the quantity of groundwater that could be pumped sustainably over the long term in some areas. Reductions in imported surface water supplies, combined with changes in local hydrology, could lead to less water available for recharge of local groundwater basins. For example, ACWD pumps out brackish groundwater that is trapped in portions of the otherwise freshwater Niles Cone Groundwater Basin. In 2010 ACWD completed the second phase of a brackish water desalination facility that treats the brackish groundwater and is now part of its supply portfolio. Every unit of brackish water pumped from the basin must be replaced with an equal amount of fresh water at ACWD's recharge facilities. Therefore, while the amount of brackish water in the Niles Cone Groundwater Basin is vast, the annual extraction is limited by the sustainable yield of the freshwater recharge available[22]. Reductions in imported supplies, combined with a reduction in local precipitation, would limit the amount of brackish groundwater that could be pumped and treated, thus further reducing supplies available to meet demands.

[19] 2015 UWMP MMWD.

[20] http://cal-adapt.org/precip/decadal/

[21] http://www.zone7water.com/images/pdf_docs/water_supply/wse-update_2-16.2.pdf

[22] 2015 UWMP ACWD.

4.3.1.4 Sea Level Rise

Over the coming decades, sea level is projected to increase by 4 to 66 inches along the California coast by 2100[23]. Projected sea level rise could increase seawater intrusion into the Delta, thus increasing Delta salinity. Increased Delta salinity could reduce water supplies in two ways: (1) Delta water may need to be blended with other less salty sources to achieve water quality delivery goals, and (2) CVP and SWP supplies may be reduced because they are required to meet water quality objectives at various locations in the Delta as defined by State Board Decision 1641 (D-1641). Increased Delta salinity could necessitate a reduction in Delta exports or increased releases from upstream reservoirs to meet the regulatory water quality objectives. Such changes to CVP and SWP operations could result in a decrease of water available for other beneficial uses.

Sea level rise may also increase salinity intrusion into coastal aquifers. For example, the Niles Cone Groundwater Basin, currently managed by ACWD, is a coastal aquifer system hydraulically connected to the Bay and is subject to saltwater intrusion should groundwater levels fall below mean sea level in the Newark Aquifer[24]. ACWD's operational goals are to maintain groundwater levels above sea level in the Newark Aquifer system in order to protect the Niles Cone Groundwater Basin from further saltwater intrusion. As sea level rises, it may become increasingly difficult to maintain a positive groundwater level gradient to keep saline waters from intruding into the aquifer.

Rising sea level could also increase the risk of levee failure in the Delta and therefore increase the risk of water supply disruption. The Delta levee system is vulnerable to sea level rise and provides conveyance for CVP and SWP supplies pumped at the export facilities. CCWD also relies on the Delta levee system to convey its CVP supplies and other Delta supplies. EBMUD's aqueducts traverse the Delta and rely on Delta levees to protect the infrastructure. The Delta Levee Investment Strategy Risk Analysis Methodology Report[25] indicates that the annual probability of levee failure will increase because of sea level rise. The incremental increase in the likelihood of levee failure associated with sea level rise depends on many factors including levee location upstream of the Golden Gate and river inflow. Many state, federal, and local efforts are under way to evaluate and upgrade the integrity and resilience of the Delta levee system.

4.3.1.5 Water Quality

Warmer temperatures may increase algae growth in the Delta and other surface water reservoirs[26]. Increases in algae growth can increase the frequency of taste and odor events, increase total organic carbon (TOC), and increase the formation of disinfection by-products. Algae growth already presents a problem in several key reservoirs throughout the state. For example, when water levels in the San Luis Reservoir (jointly owned and operated by CVP and SWP) reach very low levels during late summer and early fall months, the high temperatures foster growth of an algae layer, as much as 35 feet thick, on the reservoir's surface. The presence of algae combined with the low water levels in the reservoir can interrupt water deliveries during the peak demand season, affecting the ability of water agencies to provide a reliable supply of healthy, clean drinking water[27]. During the recent drought, many BARR partner agencies experienced water quality problems because of increased algal growth in the Delta and surface water reservoirs.

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[23] 2012 National Research Council, Sea-Level Rise for the Coasts of California, Oregon, and Washington: Past, Present, and Future report.

[24] 2015 ACWD UWMP.

[25] Delta Levee Investment Strategy: Risk Analysis Methodology. Delta Stewardship Council. July 2016.

[26] Lehman et al. 2013. Long-term trends and causal factors associated with Microcystis abundance and toxicity in San Francisco Estuary and implications for climate change impacts. Hydrobiologia 718: 141–158.

[27] http://www.valleywater.org/services/sanluisreservoirlowpointimprovement.aspx

Increases in flash floods may increase surface water turbidity in imported and local water supplies. A drier climate may also lead to an increase in wildfires, which can degrade surface water supplies and result in reduced groundwater recharge.

4.4 Impacts of Drought Across Various Sectors

Potential drought impacts extend beyond the supply sources themselves. A lack of water can trigger impacts to various sectors across the region, as summarized in Table 7 and further described by sector below. These impacts include those experienced by BARR agencies during the recent drought as well as impacts that are likely to occur in a future Bay Area drought. Although not every agency is affected to the same degree, all BARR agencies are susceptible to most if not all of these impacts.

Table 7. Drought Impacts Across Sectors

Potential Drought Impact	Agriculture	Energy	Environmental (Fish/Wildlife)	Commercial Fishing	Local Business	Public Health	Recreation	Residential	Tourism
Increased water temperatures	X		X	X					
Increased nutrient levels, harmful algal blooms			X	X	X	X	X		X
Increased salinity in water and soil	X	X	X	X	X				
Reduced reservoir levels	X	X	X	X	X		X	X	
Reduced stream flow	X	X	X	X	X	X	X	X	X
Reduced groundwater supply	X	X	X	X	X	X		X	
New development limitations/moratorium					X			X	
Loss of vegetation, wetlands, crops	X		X	X	X	X		X	X
Air quality degradation			X		X	X	X		X
Land subsidence	X		X		X			X	
Increased soil erosion	X		X	X	X	X	X	X	X
Increased evapotranspiration	X		X	X	X		X	X	
More frequent and intense wildfires[28]		X	X	X	X	X	X	X	X

4.4.1 Agriculture

Stakeholders: Farmers/ranchers, processors, farm workers, agricultural equipment suppliers, grocery stores, consumers

During drought conditions, soil salinity can increase because there is less water available to leach salts from the soil. This can significantly reduce agricultural production, since many crops are sensitive to salinity levels. Drought can also lead to higher soil erosion, since dry soil is more easily

[28] Although the cause of wildfires is nuanced, periods of drought following periods of above average rainfall can result in very favorable wildfire conditions.

swept away by wind. When topsoil erodes, the land becomes less fertile. Overall reduced water supply can limit the crop production. All of these factors can lead to higher consumer costs for agricultural products and loss of income for the supply chain.

4.4.2 Energy

Stakeholders: Local businesses and residents, water agencies, wastewater agencies, electricity providers

Lower stream flow and reservoir levels lead to a decrease in available hydropower, and an increase in use of non-renewable energy sources may occur, resulting in greater greenhouse gas (GHG) emissions. Lower groundwater levels require more energy for pumping, and wildfires may impact energy transmission lines.

In addition, higher salinity in source water may increase the energy required for water treatment (e.g., reverse osmosis can remove salinity, but it is an energy-intensive treatment method). Increased salinity can also increase the cost to refine petroleum products and thus increase energy costs across many sectors.

4.4.3 Environmental (Fish/Wildlife)

Stakeholders: Wildlife, ecosystems, tribal communities, environmental NGOs

Drought can degrade habitat and trigger holistic ecosystem impacts and system failures. Low streamflow, higher temperatures, and degraded water quality affect aquatic ecosystems as well as terrestrial wildlife that rely on surface water, floodplains, wetlands/marshes, and surrounding soil and vegetation. The rate and extent of soil erosion and wildfires increase with drought and can further degrade water quality. In addition, low groundwater levels can impact stream flows by causing reduced baseflow.

4.4.4 Commercial Fishing

Stakeholders: Fishers, consumers, environmental NGOs

Because commercial fisheries depend heavily on anadromous species, most of the factors impacting the environment also affect fishing. Reduced stream flows, water quality degradation, and increased water temperature can be fatal to certain species. Lower water levels and increased temperature have been shown to promote algae growth and lower dissolved oxygen levels, which can also harm a variety of aquatic species.

In the Bay Area, reduced habitat and freshwater inflow into the Delta can impact many of the area's fishery resources, such as salmon. As reported by numerous media outlets in 2017, the impact of drought on the Bay Area's commercial salmon industry can linger beyond the end of a drought cycle.

4.4.5 Local Business (Commercial/Industrial) and Regional Economy

Stakeholders: Businesses, employees

Drought may affect local businesses, employment rates, and the region's economy directly and indirectly. Water use restrictions can directly affect businesses and industries that provide water-related services (e.g., power-washing). Degraded water quality can affect industrial users and limit specific applications. In addition, drought impacts to other sectors (e.g., agriculture and energy) can increase product costs and potentially reduce discretionary consumer spending (e.g., entertainment, dining, and retail). Water rates may increase as agencies rely on supplemental/alternative supply sources or incur increased O&M costs. Supply limitations can also lead to land development restrictions.

4.4.6 Public Health

Stakeholders: Residents, visitors, businesses, hospitals, other health related facilities, environmental NGOs

Increased soil erosion and wildfires can lead to degraded air quality, causing respiratory health problems and increasing the number of patients at local hospitals and health clinics. Degraded source water quality can impact public health due to increased harmful algal blooms and toxins in water bodies. Lower stream flows can cause vector issues, such as mosquitos and rodents. Personal hygiene can be impacted during drought as people wash their hands less frequently. In addition, a lack of water can contribute to higher stress and anxiety levels.

4.4.7 Recreation

Stakeholders: Residents, visitors, businesses, environmental NGOs

Lower stream flows and reduced reservoir/lake levels can impact recreational activities, such as rafting, kayaking, boating, and fishing, and access to boat launches. Degraded water quality can compromise the safety of swimming or fishing. Harmful algal blooms may also increase and can cause illness or death if ingested. Increased evapotranspiration and soil erosion can make it harder to maintain playing fields and hiking trails. Wildfires can cause closures of recreation areas and impact the user experience.

4.4.8 Residential

Stakeholders: Residents, businesses

Water rates may increase as agencies rely on supplemental/alternative supply sources or incur increased O&M costs. Supply limitations can also lead to land development restrictions. Additionally, drought can adversely affect residential landscapes due to outdoor watering restrictions or tree health and lead to a decrease in property values. In some locations, residential land and properties also become more vulnerable to damage from wildfires.

4.4.9 Tourism

Stakeholders: Visitors, businesses

Drought can affect local scenery (e.g., through wildfires, soil erosion, and algal blooms), causing certain tourist attractions to be less desirable or inaccessible. Loss of aquatic species and reduced environmental flows lead to less fishing, boating, hiking, and recreational activities.

Many of the impacts discussed above are interconnected and may result in a positive feedback cycle, increasing the intensity of drought impacts on other sectors. For example, the death of forest, meadows, and other vegetation increases wildfire intensity, which causes additional erosion and worsens water quality, which impacts the aquatic food chain, which impacts recreational and commercial fisheries.

In addition, BARR agencies acknowledge that many drought impacts, especially those related to public health and residential impacts, fall disproportionately on low-income communities, communities of color, and other frontline communities (e.g., disabled and/or homeless populations), thereby exacerbating environmental justice issues.

4.5 Opportunities to Reduce Regional Drought Vulnerability

BARR agencies aim to cooperatively develop regional projects to strengthen the Bay Area's long-term water supply reliability and drought resilience. This effort focuses on combining and integrating existing assets and resources and exploring new operations strategies to improve resilience for emergencies and droughts.

As a guiding principle, all BARR drought strategies engage two or more BARR agencies and provide increased regional water supply reliability during water supply shortages. For the purpose of this DCP, drought strategies are defined in the following two distinct ways:

- **Drought response actions** are specific actions triggered during specific drought stages to manage the limited supply and decrease the severity of immediate impacts (e.g., curtailing lawn watering). Drought response actions use temporary, short-term infrastructure and activities that agencies and the public can implement quickly and that provide expeditious benefits. Section 5 includes further discussion on the drought response actions identified by the BARR agencies.
- **Drought mitigation measures** are actions, programs, and strategies implemented during non-drought periods to address potential risks and reduce potential drought-related impacts when the event occurs. Many drought mitigation measures identified by the BARR agencies involve leveraging/expanding existing assets and/or potentially constructing new facilities—such as interties, storage, and treatment—which typically require thoughtful and often lengthy planning and implementation. In addition, the BARR agencies are exploring actions that can be implemented relatively quickly, including development of a regional water market program to facilitate water exchanges/transfers. Potential drought mitigation measures are described in more detail in Section 6.

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Section 5 //
Regional Drought Response Actions

Drought response actions are near-term actions triggered during specific stages of drought to manage the limited supply and decrease the severity of immediate impacts. Response actions can be quickly implemented and provide expeditious benefits.

BARR agencies acknowledge the distinction between long-term water conservation (ongoing water use efficiency) and short-term emergency water use reductions (temporary cutbacks) and the difference between actions to appropriately support each. Water shortage conditions, such as the recent drought, can require actions to support short-term emergency water use cutbacks.

Each BARR agency has its own unique set of drought response actions, established for specific stages of drought and guided by corresponding triggers and goals, as summarized in Section 3 and described in detail in Appendix A. During the recent drought, BARR agencies implemented their WSCPs and expanded their conservation efforts to increase public awareness, restrict specific water uses, prohibit wasteful water practices, and increase conservation rebate program funding. Some agencies assessed drought surcharges and/or water waste fines.

While BARR agencies each maintain individual drought response plans, there are some issues of regional concern that are better addressed through a unified, regional response. Together, the BARR agencies developed potential regional response actions by reviewing the agencies' individual response plans and aligning common elements.

The following two drought response actions, listed in order of priority, may be implemented on a regional scale:

- **Regional drought response communications:** Consistent regional messaging may improve reaching the public regarding the need for water savings. Given the Bay Area's dense population, conflicting, inconsistent messages from individual water agencies can confuse and mislead the public. BARR agencies can benefit from an economy of scale by coordinating an expanded regional outreach campaign (e.g., press releases; media; and public service announcements on television, radio, and billboards) across the Bay Area to provide consistent messaging to the public. The effectiveness of this action was demonstrated in the 2012-2016 drought using Caltrans signs throughout the region and state to communicate the drought severity and urge the public to reduce outdoor water use. Such a regional communications program could leverage successful large-scale outreach campaign examples from places such as Australia and/or build on effective local programs. This response action would be triggered at the onset of a drought, when more than one BARR agency has identified a supply shortage in their annual supply budget forecast. The compiled annual water budget information and Bay Area drought monitor map (discussed in Section 3) will be used to identify drought stages by service area.

- **Mobile water treatment facility:** In the event of a critical water shortage emergency, use of mobile treatment units would enhance the BARR agencies' ability to provide drinking water. This would protect health and safety and improve economic resilience and quality of life during emergency conditions. The concept involves leasing mobile trailers containing microfiltration pretreatment units and reverse osmosis filters to treat saline surface water, groundwater, and/or recycled water. BARR agencies would deploy the units in Bay Area locations experiencing severe water shortage (because of drought or a catastrophic event), as long as power and appropriate waste disposal are available.

  Mobile package water treatment plants are commonly used by the military and emergency relief organizations where access to a local high-quality potable water supply is limited or absent. Off-the-shelf packages are also available to provide water treatment in small developments isolated from centralized water treatment and distribution systems. These package plants can offer both conventional treatment and advanced treatment systems, like reverse osmosis.

  Significant logistical challenges would need to be addressed by participating agencies, and implementation is expected to be challenging. Studies to date have not identified potential sites well-suited for the units. Institutional, environmental, permitting, and engineering challenges will need to be overcome. Developing and permitting use scenarios, conducting environmental analysis, working with local agencies, designing and engineering built-in flexibility to operate under various use scenarios, construction, and startup will all pose challenges. Appropriate waste disposal would be needed to avoid environmental impacts. Energy needs of such units are anticipated to be high.

  Given the BARR agencies' ability to manage the recent extreme drought, mobile water treatment may not be necessary for comparable droughts. However, given confounding future uncertainties that may reduce supply availability—such as climate change, regional growth, supply limitations, environmental regulations—mobile water treatment is an option to consider for extreme, and likely isolated, circumstances.

  This response action would be triggered by exceptional drought or emergency conditions that necessitate supplemental supply for meeting non-discretionary water demands (e.g., sanitation, health, and safety requirements).

Although both of these response actions show promise for potential regional implementation, the regional drought communication program is more likely to be implemented, as it would be triggered whenever multiple Bay Area agencies are experiencing a supply shortage. Mobile water treatment facilities would only be deployed in dire circumstances, and would require substantial logistical coordination. Additionally, the need for these responses may evolve based on future conditions. For example, as drought mitigation measures (identified in Section 6) are implemented, the need for response actions will be reduced. Furthermore, implementation of drought mitigation measures may lead to further opportunities for regional drought response actions. For example, further interconnected systems may allow for emergency supply transfers.

In addition to planning for drought, preparing for catastrophic events is also critical for ensuring the region's health, safety, and prosperity. The agencies prepare for catastrophic events through emergency response plans and programs that establish strategies and operating procedures for the days and weeks following an emergency. In addition, emergency response staff from the BARR agencies and other local entities are working directly with the ABAG to develop a complementary program that will identify coordinated regional emergency response procedures and actions (the Regional Lifelines Council). The threat of a major earthquake or other "black sky event" (i.e., a catastrophic event severely disrupting critical infrastructure for long durations) is serious, and water service both for drinking and firefighting is essential to restore within hours. Communications, mobile

treatment facilities, water-sharing agreements are all areas that cross over disaster management and drought response. Actions taken for disaster preparedness (i.e., agreements and equipment/supplies) could benefit drought contingency planning and vice versa. Thus, the BARR agencies see benefit and synergy in potentially coordinating the BARR DCP with other emergency response efforts in the future.

The primary focus of the DCP is drought mitigation and response; however, the BARR strategies considered in this plan may provide ancillary benefits for emergency response, replacement, and/or alternatives supplies.

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Section 6 //
Regional Drought Mitigation Measures

Drought mitigation measures are actions, programs, and strategies implemented during non-drought periods to address potential risks and impacts and reduce the need for response actions. To address the vulnerabilities described in Section 4, the BARR agencies developed a list of regional drought mitigation measures that will mitigate risks posed by drought.

In developing the drought mitigation measures, the BARR agencies established several guidelines. Each measure must increase long-term regional resilience and reliability, benefit two or more BARR agencies, and be justifiably characterized as regional in nature.

This section describes the characteristics used to identify and frame the drought mitigation measures, presents an overview of the potential BARR drought mitigation measures considering future conditions for single dry year and third consecutive dry year, and summarizes other projects that BARR agencies are developing or considering to increase water supply reliability.

6.1 Characteristics

To identify and frame the drought mitigation measures, the BARR agencies and project team developed four categories of characteristics—benefits, costs, implementability, and social and environmental considerations. Table 8 summarizes the characteristics by category. These factors do not reflect a grading and ranking of the measures relative to each other; rather, they are used to characterize some key strengths and challenges of each potential measure.

Water supply yield and availability during future dry years as well as regional resilience are key characteristics directly related to reducing the risk and vulnerability of critical Bay Area water resources identified in Section 4. Because supply portfolios vary widely among Bay Area water suppliers, some BARR agencies may be in drought while others are not. The mitigation measures discussed in this DCP were developed by considering ways in which agencies could share or expand existing resources to improve the resilience of the region.

Table 8. Characteristics to Frame BARR Drought Mitigation Measures	
Characteristics	**Definitions**
Benefits: • Reduction in regional vulnerability • Water supply yield and availability • Regional resilience • Efficiency • Flexibility/sustainability • Water quality considerations	The positive impacts and attributes of a measure with respect to the following factors: • The ability of the measure to address vulnerabilities (as identified in Section 4). • The amount of water made available under various hydrologic conditions (wet, normal, single dry and third consecutive dry year), supply storage for multi-year droughts, and emergency supply (AFY). Note that yield does not necessarily represent a new water supply source to the region. • Improvement of supply reliability for two or more agencies through diversification of supply portfolios and/or expansion of local sources to improve regional self-reliance and prevent economic loss (from a qualitative perspective). • Increased efficiency in use of existing assets, facilities, and resources. • Ease of adaptation to changes in physical or statutory conditions (e.g., climate change, catastrophic events, population or economic growth, regulatory changes). • Potential to change water quality, including improvements, degradation, treatment compatibility, and/or stability. • Fit-for-purpose water, as a function of water quality.
Costs: • Capital costs • O&M costs	The financial costs associated with a measure, including the following assessment factors: • Estimated total capital cost and unit cost of water supply developed ($/AF yield). Capital costs typically include planning, permitting, public outreach, engineering, legal and administrative, and construction costs, but as the BARR agencies developed the cited measure costs on a case-by-case basis, the exact details of the approach to each cost estimate varies somewhat. • Annual cost to operate and maintain a measure may be presented qualitatively as a range of costs, low (≤$300/AF), moderate ($300–$700/AF), or high (>$700/AF), to reflect uncertainty or changes in conditions. • Anticipated annualized rehabilitation and replacement costs, which may be presented qualitatively as a range of costs.
Implementability and timing	The ability to take a measure from concept to execution during non-emergency conditions. Implementability considers the following factors: local control, regulatory/permitting requirements, institutional needs, water rights, hydraulic constraints, water quality compatibility, constructability, and funding. The potential for a measure to be advanced in the near-term to address pending needs or longer-term efforts.
Social and environmental considerations	The effects of a measure on the community, economy, and environment, potential impacts (positive or negative) on disadvantaged communities (DACs), energy, instream flows, and the acceptability of the measure to customers/ratepayers and local interest groups.

AF = acre-foot.

O&M = operations and maintenance.

6.2 Potential BARR Drought Mitigation Measures

In August 2016, BARR agencies' general managers and staff participated in a workshop to develop a list of potential drought mitigation measures for the DCP. Given that some agencies were still grappling with drought conditions at that time, the drought mitigation measures reflect strategies that would have alleviated individual agencies' supply shortage issues and strengthened regional resilience if the measures had been implemented before the recent drought.

When collectively selecting drought mitigation measures, the BARR agencies focused on those that are characterized as "regional in nature." More specifically, given the objective of the BARR effort—to jointly advance a suite of projects uniquely enabled by this regional partnership effort—all BARR drought mitigation measures must increase regional water supply reliability during drought and engage two or more BARR agencies.

The drought mitigation measures are each at various stages of planning. The measures considered in this DCP are based on current knowledge and planning objectives, which will evolve over time. Though they each meet the guidelines for consideration, they are not guaranteed to proceed to implementation.

For this DCP, each of the 15 potential BARR drought mitigation measures falls into one of the following four categories:

- **Interties:** construction of new physical pipeline connections between agencies that would allow transfer of water supply between and among BARR agencies
- **Expanded Storage:** expansion of water storage capacity in existing reservoirs (i.e., no new surface water reservoirs)
- **Treatment/supply:** creation of access to additional water supplies that leverages existing water supply sources, creates new sources of supply (e.g., through indirect potable reuse [IPR]), and/or improves treatment capacity in existing plants to treat new, more challenging local water supplies
- **Operations:** changes in water management practices that do not require new infrastructure (e.g., alternative storage locations)

Each of the potential measures feature shared benefits including the reduction in regional vulnerability to drought and the availability and yield of water under future conditions for multiple BARR agencies and, wherever possible, make use of existing resources, facilities, and infrastructure to reduce both the overall cost and the environmental footprint of the measure, as summarized in Table 9. Figure 10 presents the geographic coverage areas of the eight BARR agencies and highlights some key existing water infrastructure, as well as the general location of the potential drought mitigation measures.

The measures are each described in individual profiles in Appendix C. The profiles identify the characteristics of each measure based currently available information from existing resources (e.g., technical studies/plans and funding applications). The intent of the individual profiles is to package the information for each BARR drought mitigation measure as standalone two-page fact sheets.

The potential timing for implementing the mitigation measures is categorized as either near-term, medium-term, or long-term, based on project status and whether funding has been secured (Figure 11). Early efforts are underway to advance some of these measures, such as the Los Vaqueros Reservoir Expansion, Transfer-Bethany Pipeline, Walnut Creek Water Treatment Plant (WCWTP) Pretreatment Facility, and the Bay Area Water Market (Transfers/Exchanges) Program. Other projects are still conceptual and may or may not be necessary with future evolving conditions. BARR agencies consider the entire list of 15 measures viable possibilities depending on need and timing.

Figure 10. Existing Bay Area regional water systems and potential drought mitigation measures

Table 9. Summary of BARR Drought Mitigation Measures' Defining Characteristics

No.	Drought Mitigation Measure	Engaged BARR Agencies [a]	Description	Reduction in Regional Vulnerability to Drought	Cost [b]	Availability and Yield of Water Under Future Conditions (AFY)	Status	Implementability	Timing	Social & Environmental Considerations
Interties										
1	Transfer-Bethany Pipeline	ACWD, BAWSCA, CCWD, EBMUD, SFPUC, SCVWD, and Zone 7	Connects LV Reservoir, CCWD's intakes, and EBMUD's intakes to the Bethany Reservoir and enable water conveyance to the South Bay Aqueduct (SBA) using a new pipeline around the east side of Mt. Diablo.	Diversifies the regional supply portfolio in the event of SWP/CVP allocations or other supply limitations.	Capital: $200 million* O&M: To be determined (TBD) (likely moderate) *Not including costs of related measures (LV Expansion and WCWTP Pretreatment Facility)	217,000 AFY capacity in all water year types; actual yield would depend on system operations	Preliminary design	Final supplement to the Environmental Impact Report (EIR)/Environmental Impact Statement (EIS) due in November 2018. Modification of water rights may be required to share water among potential partners. New easements are required for construction.	Permitting and final design to start as early as 2019. Construction could start as early as 2022.	Benefits Delta fisheries by diverting water through state-of-the-art fish screens and increased operational flexibility in the Delta. Presents potential partnership opportunity with Central Valley wildlife refuges.
2	Zone 7-EBMUD Intertie	Zone 7 and EBMUD	Connects EBMUD's water delivery system to Zone 7's system, providing potential water sharing during emergencies and transfer/exchange opportunities.	Reduces Zone 7's reliance on diversions from the Delta and SWP during emergencies.	Capital: $43 million O&M: TBD (likely low from EBMUD to Zone 7 and likely moderate from Zone 7 to EBMUD, because of pumping costs)	11,200 to 28,000 AFY (10 to 25 mgd), depending on the need and water availability Wet/normal year yield may be limited by EBMUD's wheeling transmission capacity of approximately 10 mgd. More transmission capacity may be available during dry years and emergencies.	Conceptual	Permits and traffic control plans would be needed to construct the intertie pipeline.	California Environmental Quality Act (CEQA) review could be completed in one year. Full implementation could be completed within four to five years.	Requires mitigation of environmental impacts and community impacts (e.g., disruptive traffic conditions).
3a	ACWD-SFPUC Intertie and Local Supply	ACWD, BAWSCA, and SFPUC	Connects ACWD's Newark Brackish Groundwater Desalination Facility (NDF) with SFPUC's Bay Division Pipeline to provide emergency supplies and water transfer opportunities. NOTE: Measure 3b is a variation of Measure 3a. If Measure 3b were constructed, all elements of Measure 3a would be included.	Diversifies the regional supply portfolio in the event of SWP allocations or other supply limitations.	Capital: $7.7 million O&M: TBD (likely moderate)	Up to 5,600 AFY (to be stored) in normal and wet years	Conceptual	Permits would be needed to construct the intertie pipeline. An operating plan and booster pump station would be needed to address the differential in the ACWD and SFPUC systems' operating pressures.	Implementable within two to five years	Provides environmental benefits by reducing demand on surface water supplies within ACWD's service area. Warrants outreach and communications with customers regarding modifying water supply.
3b	ACWD-SFPUC Intertie and IPR	ACWD, BAWSCA, and SFPUC	Produces purified local wastewater effluent to recharge the Niles Cone Groundwater Basin as a new source of supply. Measure 3b is a variation and extension of Measure 3a and includes all elements of Measure 3a, as well as IPR. IPR capacity could range from 4 mgd up to 15 mgd depending upon future demands, distribution system modifications, and facility sizing.	Diversifies the regional supply portfolio in the event of SWP allocations or other supply limitations and creates a reliable supply resilient to climate change.	Capital: $93 million to $500 million O&M: TBD (likely high)	4,480 to 17,000 AFY in single dry and third consecutive dry years 10,000 to 22,600 AFY in normal and wet years	Conceptual	Permits would be needed to construct the intertie pipeline. An operating plan and booster pump station would be needed to address the differential in the ACWD and SFPUC systems' operating pressures. Additional limnological studies would be needed to evaluate the effect of advanced treated water for IPR into Quarry Lakes, a park facility with recreational and human contact (e.g., swimming and fishing) beneficial uses.	Implementable within five to ten years	Provides environmental benefits by reducing demand on surface water supplies within ACWD's service area. Warrants outreach and communications with customers regarding modifying water supply and adding advanced treated water to Quarry Lakes.
4	West Side SFPUC-SCVWD Intertie	SFPUC, BAWSCA, and SCVWD	Adds a second intertie between SFPUC and SCVWD, providing potential water sharing during emergencies and transfer/exchange opportunities, including potable reuse opportunities.	Provides system redundancy for emergency water supply shortages.	Capital: $150 million O&M: TBD (likely moderate)	Up to 55,000 AFY capacity in normal and wet years	Conceptual	Permits would be needed to construct the intertie pipeline	Implementable within seven to nine years	Requires mitigation of environmental impacts and community impacts (e.g., disruptive traffic conditions). Any additions or modifications to water supply would involve outreach and communications with customers.

Table 9. Summary of BARR Drought Mitigation Measures' Defining Characteristics

No.	Drought Mitigation Measure	Engaged BARR Agencies [a]	Description	Reduction in Regional Vulnerability to Drought	Cost [b]	Availability and Yield of Water Under Future Conditions (AFY)	Status	Implementability	Timing	Social & Environmental Considerations
5	SFPUC-Zone 7 Intertie	SFPUC, BAWSCA, and Zone 7	Connects SFPUC's and Zone 7's water delivery systems, providing potential water sharing during emergencies and transfer/exchange opportunities.	Reduces Zone 7's reliance on diversions from the Delta and SWP during emergencies.	Capital: $66 million O&M: TBD (low from SFPUC to Zone 7; medium from Zone 7 to SFPUC, because of pumping costs)	11,200 to 28,000 AFY (10 to 25 mgd), depending on the need and water availability, in all water year types	Conceptual	Permits would be needed to construct the intertie pipeline. Some construction in a highly urbanized area can be challenging and disruptive.	CEQA review could be completed in one year. Full implementation could be completed within four to five years.	Requires mitigation of environmental impacts and community impacts (e.g., disruptive traffic conditions).
6	MMWD-EBMUD Intertie	MMWD and EBMUD	Connects EBMUD's and MMWD's water delivery systems either with a pipeline across the Richmond-San Rafael Bridge or across the Bay's bottom, providing potential water sharing and transfer opportunities.	Diversifies MMWD's supply portfolio in the event of extreme drought or other water shortage emergencies.	Capital: $45 million O&M: $100/AF (low)	5,600 to 10,000 AFY capacity in all water year types	Conceptual	Pipeline construction in an urban area would necessitate CEQA compliance; coordination with many jurisdictions, property owners, and permitting agencies; permits; an agreement with Caltrans for access and use of to the Richmond-San Rafael Bridge; and traffic control plans. Water rights modifications may be needed. Construction across the bridge could be challenging and disruptive to traffic flow.	Long term (>10 years)	Requires mitigation of environmental impacts and community impacts (e.g., disruptive traffic conditions).
Expanded Storage										
7	LV Expansion	ACWD, BAWSCA, CCWD, EBMUD, SFPUC, SCVWD, and Zone 7	Expands reservoir capacity and connect to the Transfer-Bethany Pipeline. Measures 1 and 8 are companion measures to the LV Expansion.	Diversifies the regional supply portfolio in the event of SWP/CVP allocations or other supply limitations.	Capital: $600 million* O&M: TBD (likely low) *Not including costs of related measures (Transfer-Bethany and WCWTP Pretreatment Facility)	115,000 AF (expansion of existing 160,000 AF capacity reservoir to 275,000 AF capacity) in all water year types	Preliminary design	Final supplement to the EIR/ EIS due in November 2018. Modification of water rights may be required to share water among potential partners. New easements are required for construction.	Permitting and final design to start as early as 2019. Construction could start as early as 2022.	Benefits Delta fisheries by diverting water through state-of-the-art fish screens and increased operational flexibility. Inundates additional areas in the watershed and may affect terrestrial habitat and cultural resources.
Treatment/Supply										
8	Walnut Creek Water Treatment Plant (WCWTP) Pretreatment Facility	ACWD, BAWSCA, CCWD, EBMUD, SFPUC, SCVWD, and Zone 7 (to be confirmed)	Allows EBMUD to treat water from the Sacramento River, LV Reservoir, and other sources, enabling EBMUD to deliver supplies to neighboring water agencies. Measures 1 and 7 are companion measures to the WCWTP Pretreatment Facility.	Diversifies the regional supply portfolio in the event of SWP/CVP allocations or other supply limitations. Enables use of LV supply by addressing treatability issues.	Capital: $35-60 million* (depending on scale of capacity) O&M: TBD (likely moderate) *Not including costs of related measures (Transfer-Bethany and LV Expansion)	128,800 AFY in normal and single dry and third consecutive dry years WCWTP capacity: 115 mgd. Pretreatment facility must match treatment plant, aqueduct, and wheeling capacity.	Preliminary design	The pretreatment facility is feasible from a constructability standpoint. However, community involvement and outreach for the project would be required.	Conceptual plans and land acquisition are done. In the mid-1990s, EBMUD completed an EIR that included sedimentation basins (similar to pretreatment). Depending on the design, scope, and phasing, EBMUD may issue either an addendum to the existing EIR or a supplemental EIR. Detailed design and construction may take up to three years.	Improves EBMUD's ability to provide high-quality drinking water during droughts, emergencies, and planned and unplanned shortages. Reduces energy use and GHGs produced to treat supplemental drought supply. No significant environmental effects are anticipated.

Table 9. Summary of BARR Drought Mitigation Measures' Defining Characteristics

No.	Drought Mitigation Measure	Engaged BARR Agencies [a]	Description	Reduction in Regional Vulnerability to Drought	Cost [b]	Availability and Yield of Water Under Future Conditions (AFY)	Status	Implementability	Timing	Social & Environmental Considerations
9	Regional Desalination Plant	CCWD, EBMUD, SCVWD, SFPUC, and Zone 7	Provides a new water supply source for the region; install a 20 mgd brackish WTP at CCWD's Mallard Slough Pump Station.	Diversifies the regional supply portfolio in the event of SWP/CVP allocations or other supply limitations.	Capital: $175 million O&M: $300–$390/AF (moderate)	22,400 AFY treated water in all water year types (28,000 AFY diverted to the intake; ~80% recovery)	Preliminary design	Environmental review has not been completed. In the past, similar desalination projects in the region have lacked public support or received strong public opposition. Conveying new supplies and transferring/exchanging supplies may be challenging and require new agreements and additional infrastructure. Water rights modifications would be required to share water among partner agencies. During critically dry water years, operations would need to be coordinated with CVP/SWP and the City of Antioch to avoid potential impacts.	Feasibility study, pilot testing, and Delta modeling have been conducted. Environmental review is needed. The plant could be constructed by 2030.	Lacks public support/faces public opposition regarding potential impacts to fisheries, increased energy consumption, increased GHG emissions. Potential impacts on fisheries could be reduced or avoided through operational best practices and facility design. Recent advances in treatment technologies may also decrease energy usage.
10	Silicon Valley Advanced Water Purification Center (SVAWPC) Expansion	SCVWD, SFPUC, and BAWSCA	Expands the existing SVAWPC to provide purified water directly to regional partners or indirectly through banking/exchanges/transfers.	Diversifies the regional supply portfolio in the event of SWP/CVP allocations or other supply limitations.	Capital: $600 million O&M: $700/AF (high)	Up to 25,000 AFY in all water year types	Preliminary design – SVAWPC Expansion; Planning – regional partnerships	Challenges include managing reverse osmosis concentrate; fully utilizing purified water during low-demand periods; and determining the allocation of wastewater flows between potable reuse, non-potable reuse, and outflows to the Bay. Close coordination and collaboration with the City of San Jose on securing source water and managing reverse osmosis concentrate management/disposal.	Implementable within five to ten years (estimated)	Improves supply reliability which protects and benefits health and safety, customers' quality of life local agriculture, and many Silicon Valley businesses that contribute significantly to the economic health of the Bay Area. Requires CEQA review and engineering controls to mitigate increased salinity concentrate disposal that could increase receiving water salinity.
11	Mid-Peninsula Potable Reuse Exploratory Plan (PREP)	SFPUC and BAWSCA	Develops an IPR partnership for the mid-peninsula region.	Diversifies the regional supply portfolio in the event of SWP/CVP allocations or other supply limitations.	Capital: TBD O&M: TBD (likely high)	Up to 6,720 AFY (6 mgd) in all water year types	Planning	The initial feasibility study will identify implementation challenges. Interagency agreements would be required to share water among partner agencies. The project may require a wastewater change petition, as well as significant permitting and CEQA review.	An initial feasibility study is currently underway and will be complete in mid-2017.	Improves supply reliability which protects and benefits health and safety, customers' quality of life, and many Silicon Valley businesses that contribute significantly to the economic health of the Bay Area. Concentrate disposal could increase salinity in receiving waters and would have an environmental impact (which may be positive). Rigorous analysis would be needed to select the best disposal option(s).
12	Joint Tri-Valley Potable Reuse Feasibility Study	Zone 7 and other regional partners TBD (potentially including CCWD, EBMUD, and/or SFPUC)	Provides a potential supplemental/alternative water supply for the Tri-Valley region (Zone 7 and its retailers), which could make water available and enable transfers and/or water marketing opportunities with other BARR partners through interties (i.e., EBMUD, SFPUC) and/or exchanges of SWP supplies in above normal/wet years).	Diversifies the regional supply portfolio in the event of SWP allocations or other supply limitations.	Capital: $76M - $152M O&M: $3M to $6M/year (high)	4,800 to 7,700 AFY in all water year types	Planning	The initial feasibility study will identify implementation opportunities and challenges. Interagency agreements would be required among water/wastewater agencies to implement. The project would likely require significant permitting and CEQA review. Local control of this water supply would likely be a motivating factor and implementation driver.	An initial feasibility study is currently underway and will be complete by early 2018.	Improves supply reliability which protects and benefits health and safety, customers' quality of life, local agriculture, and businesses that contribute significantly to the economic health of the Bay Area. Concentrate disposal may increase salinity in receiving waters and may have an environmental impact (which may be positive). Analysis would be needed to select the best disposal option(s). Effective public communication and education will be needed to address any public concerns over the safety of potable reuse.
Operations										
13	Regional Advanced Metering Infrastructure (AMI) Feasibility Assessment	ACWD, CCWD, EBMUD, MMWD, and SCVWD	Assesses the feasibility for potential regional AMI expansion.	Reduces the region's collective water demands and water loss.	Capital: $250/meter installed ($250 million for 1 million meters) O&M: moderate	0.07 AFY/meter installed, in all water year types (70,000 AF for one million meters)	Conceptual	Based on the results of existing AMI programs, the most significant concern of AMI implementation is related to cost. AMI meter installation may be phased over time.	The regional feasibility assessment is currently conceptual, though some agencies are further along in planning or implementing AMI.	Requires significant customer outreach to garner support for implementation. Increased accuracy of water use data can improve billing equity among ratepayers and support collection of fees for all water used, eventually providing dividends that delay the need for water rate increases. Improves customer understanding of where and how they can use water more efficiently to reduce demand on surface water and groundwater supplies.

Table 9. Summary of BARR Drought Mitigation Measures' Defining Characteristics

No.	Drought Mitigation Measure	Engaged BARR Agencies [a]	Description	Reduction in Regional Vulnerability to Drought	Cost [b]	Availability and Yield of Water Under Future Conditions (AFY)	Status	Implementability	Timing	Social & Environmental Considerations
14	Del Valle Reservoir Water Supply Storage Expansion Project	ACWD, SCVWD, Zone 7, and other potential regional partners TBD (CCWD, EBMUD, and/or SFPUC)	Modernizes the flood management rules to use a greater portion of existing reservoir capacity to capture additional local supply and store additional emergency water supply while maintaining necessary flood protection.	Improves flood control and water supply operations by implementing Forecast Informed Reservoir Operation (FIRO) and by using modeling, forecasting tools, and improved information.	Capital: $150 million (Study under way) O&M: TBD (likely low, studies under way)	Up to 35,000 AFY (additional storage) in normal and dry years	Conceptual	The SBA Contractors are completing a high-level evaluation of the feasibility of modernizing flood rules, expanding emergency storage, and replacing/relocating East Bay Regional Park District (EBRPD) facilities (which may be costly). Federal, state, and local review and permits would be required, and additional project constraints may be identified during that process that could affect implementation feasibility.	Long term (>10 years)	Benefits the environment by improving the operational flexibility of the SWP in managing pumping from the south Delta to minimize fish entrainment and meet water quality and flow objectives. Increases the area available for enhanced recreational opportunities, replaces EBRPD facilities, and improves water quality. Requires public support and cooperation from EBRPD to update recreational facilities.
15	Bay Area Regional Water Market (Exchanges/ Transfers) Program	ACWD, BAWSCA, CCWD, EBMUD, SCVWD, SFPUC, and Zone 7	Establishes a program for short-term interagency exchanges/transfers (specific TBD) to enable long-term resilience and flexibility for emergency conditions or events. Develops a tool (a "roadmap document") to guide future water exchanges and transfers.	Enables future water exchanges and transfers by leveraging best practices based on the short-term interagency transactions completed as part of this effort.	TBD (depends on exchange/transfer scenario; at least $1.6 million to convey and store 3,000 AF of transferred supply in LV)	One-time exchange of water (at least 3,000 AF)	Planning	Implementation challenges would be specific to the agencies, facilities, and water sources involved in the transfer/exchange. Most would involve filing for a short-term transfer with the State Board, modifying water rights, securing additional permits, determining restrictions, and seeking approvals by agencies at federal, state, and/or local levels. Participating agencies would resolve technical challenges (water quality, treatment, intertie operations) before conducting this one-time demonstration test.	The BARR agencies recently received funding for this program. It is anticipated to be implemented within one to three years.	Leverages existing resources, supplies, and assets, thereby lowering their environmental burden. Facilitates development of a regional exchange project to improve dry-year supply resilience, which improves economic security and quality of life for the Bay Area.

[a] Other non-BARR partner agencies may also be involved in drought mitigation measures. For example, the Joint Tri-Valley Potable Reuse Feasibility Study is co-funded by Zone 7's retailers (California Water Service Company [Cal Water], Cities of Livermore and Pleasanton, and DSRSD).

[b] Capital costs are listed in millions of dollars. O&M costs are estimated as low (≤$300/AF), moderate ($300–$700/AF), or high (>$700/AF)

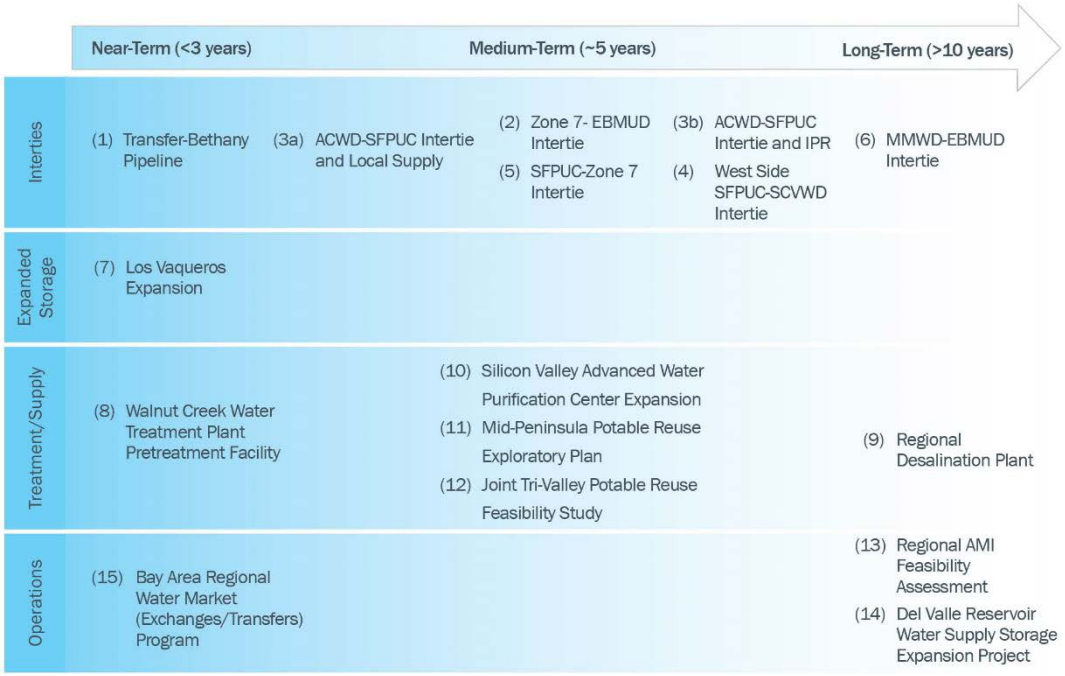

Figure 11. Potential timing for mitigation measure implementation [29]

6.3 Regional Resilience of BARR Drought Mitigation Measures

The BARR drought mitigation measures defined and characterized in Section 6.2 reduce potential risks of drought, climate change, planned outages, infrastructure/Delta levee failures, and other emergencies (e.g. earthquakes) by reducing the consequence of these factors on the BARR agencies. Most of the measures leverage existing infrastructure and water supply sources and increase the flexibility to move and share supply sources among the BARR agencies by utilizing water system facilities already in place. Table 10 summarizes how each drought mitigation measure improves regional water supply resilience, thus reducing the need for drought response actions.

6.4 Other Projects

The potential BARR drought mitigation measures do not reflect all water supply reliability projects that the BARR agencies are developing or considering. Appendix D describes some additional potential regional projects including some being explored by BARR agencies as well as other Bay Area water and wastewater agencies, such as a suite of Western Recycled Water Coalition projects. Many are similar in nature to the BARR measures, as they involve expanding groundwater recharge (i.e., using IPR and/or surface water), adding wells to increase production capacity for use during drought and emergencies, expanding stormwater capture, expanding non-potable reuse, and implementing direct potable reuse (DPR). While each project described in Appendix D provides unique value, many benefit only one BARR agency or multiple agencies that are not members of the BARR partnership. As a result, the list of projects in Appendix D are considered complementary to BARR's efforts, as they collectively build increased regional reliability and water use efficiency within the Bay Area.

[29] Los Vaqueros Expansion is considered near-term, though construction will likely begin in 2022. The design is already underway with plans for construction. The delay in implementation is due to construction sequencing and the need to drain the existing reservoir prior to construction.

Table 10. BARR Drought Mitigation Measure Improvement to Regional Water Supply Resilience			
No.	Drought Mitigation Measure	Engaged BARR Agencies	Improvement in Regional Water Supply Resilience
1	Transfer-Bethany Pipeline	ACWD, BAWSCA, CCWD, EBMUD, SFPUC, SCVWD, and Zone 7	Increases greater flexibility in water deliveries by connecting existing infrastructure between multiple agencies. Provides dry-year reliability by facilitating water transfers seasonally/during drought conditions [a]
2	Zone 7-EBMUD Intertie	Zone 7 and EBMUD	Increases greater flexibility in water deliveries by connecting existing infrastructure between Zone 7 and EBMUD. Provides dry year reliability by leveraging existing groundwater and surface water sources. Facilitates water transfers seasonally/during drought conditions [a] Reduces Zone 7's reliance on diversions from the Delta and SWP during emergencies/ drought conditions [a]
3a	ACWD-SFPUC Intertie and Local Supply	ACWD, BAWSCA, and SFPUC	Increases greater flexibility in water deliveries by connecting existing infrastructure between ACWA and SFPUC. Provides dry-year reliability by facilitating water transfers from ACWA to SFPUC for emergency supplies and/or to bank for use during drought conditions [a]
3b	ACWD-SFPUC Intertie and IPR	ACWD, BAWSCA, and SFPUC	Increases greater flexibility in water deliveries by connecting existing infrastructure between ACWD and SFPUC. Provides dry-year reliability by facilitating water transfers from ACWA to SFPUD for emergency supplies and/or to bank for use during drought conditions [a]
4	West Side SFPUC-SCVWD Intertie	SFPUC, BAWSCA, and SCVWD	Increases greater flexibility in water deliveries by connecting existing infrastructure between SFPUC and SCVWD. Increases system redundancy on the west side of SCVWD's treated water system. Provides dry-year reliability by leveraging existing water supply sources during drought conditions [a] Facilitates water transfers seasonally/during drought conditions [a]
5	SFPUC-Zone 7 Intertie	SFPUC, BAWSCA, and Zone 7	Increases greater flexibility in water deliveries by connecting existing infrastructure between SFPUC, BAWSCA, and Zone 7 in all year types. Provides reliability by leveraging existing water supply sources and connecting existing infrastructure during drought conditions [a]. Facilitates water transfers during drought and emergencies. Reduces Zone 7's reliance on diversions from the Delta and SWP during emergencies/ drought conditions [a] Reduces SFPUC's impact during loss of service through the Hetch Hetchy infrastructure.
6	MMWD-EBMUD Intertie	MMWD and EBMUD	Increases greater flexibility in water deliveries by connecting existing infrastructure between MMWD and EBMUD. Provides dry-year reliability by leveraging existing water supply sources and connecting existing infrastructure. Facilitates water transfers during drought conditions a and emergencies.
7	LV Expansion	ACWD, BAWSCA, CCWD, EBMUD, SFPUC, SCVWD, and Zone 7	Increases supply in emergencies, planned outages, and droughts by improving conjunctive use operations. Expands water quality benefits to regional partners and provides protection from future declines in Delta water quality. Improves water operations of regional partners increasing operational flexibility and interagency coordination. Has potential to improve operation of the CVP and SWP and approve the ability of CVP and SWP to meet regulatory requirements.

Table 10. BARR Drought Mitigation Measure Improvement to Regional Water Supply Resilience			
No.	Drought Mitigation Measure	Engaged BARR Agencies	Improvement in Regional Water Supply Resilience
8	WCWTP Pretreatment Facility	ACWD, BAWSCA, CCWD, EBMUD, SFPUC, SCVWD, and Zone 7 (to be confirmed)	Increases EBMUD water supply through WCWTP and convey/treat lower-quality raw water supplies. Increases opportunities for conjunctive use. Reduces vulnerability to water quality variations from impacts such as wildfire or landslides in EBMUD's watershed.
9	Regional Desalination Plant	CCWD, EBMUD, SCVWD, SFPUC, and Zone 7	Improves dry-year supply reliability if operated conjunctively with LV reservoirs.
10	SVAWPC Expansion	SCVWD, SFPUC, and BAWSCA	Provides a supplemental, local, drought-resistant water supply that could be directly used in the SCVWD, SFPUC, and BAWSCA service areas and indirectly throughout the region through exchanges and transfers. Leverages existing infrastructure to increase water supplies during emergencies, planned outages, and drought conditions [a]
11	Mid-Peninsula PREP	SFPUC and BAWSCA	Provides a supplemental, local, drought-resistant water supply for the SFPUC and BAWSCA service area, including Cal Water. Leverages existing infrastructure to increase water supplies during emergencies, planned outages, and drought conditions [a] by enabling treatment of water sources of varying quality.
12	Joint Tri-Valley Potable Reuse Feasibility Study	Zone 7 and other regional partners TBD (potentially including CCWD, EBMUD, and/or SFPUC)	Recovers a local water resource otherwise discharged to the San Francisco Bay. Provides a supplemental, local, drought-resistant supply for the Tri-Valley region.
13	Regional AMI Feasibility Assessment	ACWD, CCWD, EBMUD, MMWD, and SCVWD	Supports water use efficiency to help reduce reliance on critical water supply sources. Supports drought outreach and enforcement.
14	Del Valle Reservoir Water Supply Storage Expansion Project	ACWD, SCVWD, Zone 7, and other potential regional partners TBD (CCWD, EBMUD, and/or SFPUC)	Modernizes flood management rules to allow for using a greater portion of existing reservoir capacity to store water supply. Improves regional water supply reliability by increasing locally accessible supplies for SBA Contractors by storing water pumped from the south Delta and capturing additional runoff. Improves source water quality for SBA Contractors' WTPs. Improves regional conjunctive use for all SBA contractors. Increases emergency water supplies. Increases flexibility to accommodate environmental constraints in SWP Delta operations.
15	Bay Area Regional Water Market (Exchanges/ Transfers) Program	ACWD, BAWSCA, CCWD, EBMUD, SCVWD, SFPUC, and Zone 7	Leverages existing supply sources and infrastructure. Could lead to increases supplies in emergencies, planned outages, and droughts by providing supplemental supply to an agency experiencing a water shortage emergency. Lays the foundation for broader water sharing in the future.

a. *Drought conditions indicate single dry and third consecutive dry year*

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Section 7 //
Operational and Administrative Framework

Most BARR drought mitigation measures would involve using BARR agencies' individual assets and resources. An operational and administrative framework is critical for supporting implementation of the drought mitigation measures and to identify who is responsible for undertaking the actions necessary to implement various DCP elements.

The operational and administrative framework identifies roles, responsibilities and procedures necessary to do the following:

- **Conduct drought monitoring:** As described in Section 3, each of the BARR agencies have individual WSCPs that defines their drought response approaches and procedures.
- **Initiate response actions, including emergency response actions:** Relevant information is summarized in Sections 3 and 5, and more detailed information for each agency is provided in Appendix A.
- **Initiate mitigation actions (referred to as drought mitigation measures in this Plan):** Timely and successful implementation requires deliberate, thoughtful planning and ongoing coordination among project partners and with regulating agencies. This section (Section 7) provides an overview of the key steps to implement the drought mitigation measures.
- **Update the DCP:** The process to update the DCP is described in Section 8.

7.1 Key Implementation Steps to Initiate Drought Mitigation Measures

Advancing a drought mitigation measure from planning and design to construction and operation requires thoughtful planning and ongoing coordination. As shown in Figure 12, the critical-path steps for implementing drought mitigation measure are guided by several drivers—governance and institutional considerations, operational considerations, permitting and environmental documentation, water rights, and funding. These implementation drivers are described throughout the remaining sections of this chapter.

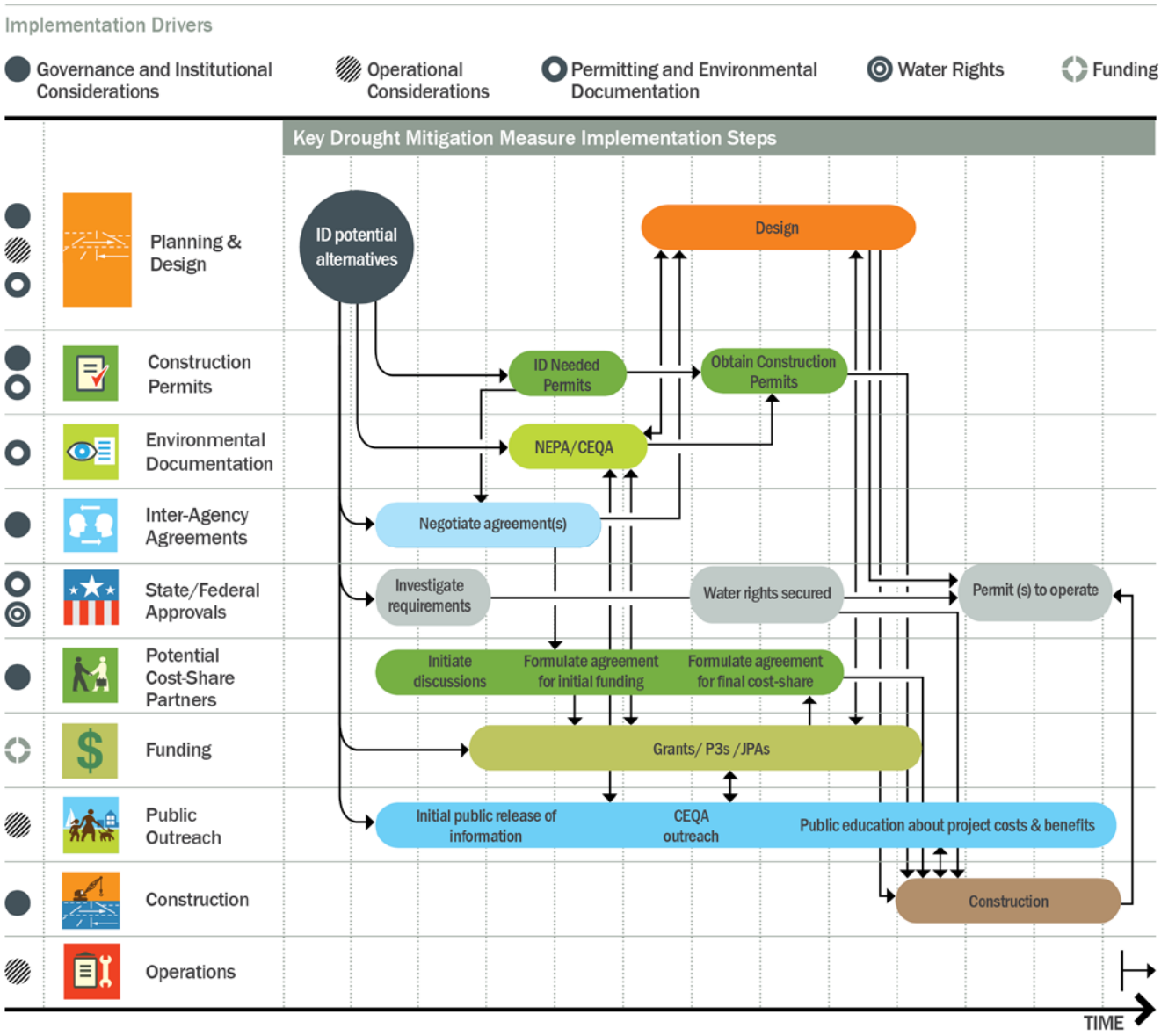

Figure 12. Drivers and critical-paths steps for implementing potential BARR drought mitigation measures

7.2 Governance and Institutional Considerations

BARR MOA. The BARR partnership was established in 2014 when each of the BARR agencies adopted principles to guide the collaboration, and subsequently, the agencies executed a MOA in September 2015 to specify roles, responsibilities, and key implementation steps for their partnership. The MOA acknowledges that each BARR agency owns and operates independent water systems, and that integrated use of capacity in existing infrastructure and new interconnections or facilities may provide water supply reliability and/or water quality benefits to multiple BARR agencies or other regional partners.

The BARR agencies approved a set of principles related to their partnership, including:

- The BARR agencies will participate in the evaluation of near- and long-term joint water supply reliability projects including, but not limited to, use of capacity of existing facilities; changes to infrastructure including new interconnections, recycled water, water conservation, expanded treatment, regional desalination, and water transfers and exchanges; and development of other projects or institutional arrangements that encourage a regional approach to achieving water supply reliability in the Bay Area.
- The BARR agencies will conduct BARR activities in an inclusive manner that encourages voluntary participation by BARR agencies as well as other interested persons or organizations.
- A specific project or activity does not have to involve all BARR agencies, but it is expected that each agency will endeavor to communicate planning efforts initiated by two or more BARR agencies to improve water supply reliability including water transfers, wheeling agreements, interties, and additional water supply infrastructure improvements.
- Partnerships are expected to result in betterment for the public served by the agencies involved and to be conducted in a manner that does not adversely affect any of the BARR agencies. The BARR agencies will not undertake Bay Area regional projects or activities that may impact the conditions within the service area of another agency without first obtaining that agency's approval.
- The BARR agencies will strive to achieve equitable cost and risk sharing for future projects or concepts commensurate with the benefits to be received.
- The BARR agencies agree to provide transparency with regard to costs and the expectation is that actual costs will be used in determining reimbursements unless another acceptable arrangement is determined by the participants.
- To the extent to which a partnership relies on regional, state, or federal grant money to evaluate regional reliability, the grant recipients will work with the BARR agencies to balance priorities for regional reliability against other individual agency priorities.
- The BARR agencies agree to coordinate prior to characterization and evaluation of facilities, water rights, or water contracts owned by another agency.
- The BARR agencies undertaking specific projects identified through the BARR partnership will cooperate in and, to the extent applicable, facilitate, efforts to obtain regulatory approvals necessary to conduct demonstration and full-scale projects.

The MOA specifies the following general responsibilities of all BARR agencies:

- Continue working cooperatively to develop the BARR studies (i.e., the DCP and Feasibility Study).
- Work with the BARR team in conducting the BARR studies.
- Share relevant engineering, permitting, regulatory, and operational information regarding their own facilities and permits with other BARR agencies for the benefit of the studies.
- Provide access to facilities and operational data that may be needed for the BARR studies (such as intakes, aqueducts and pumping plants, treatment plants, interties, etc.). If needed, conduct necessary analysis of their own facilities, permits, operational data, procedures or requirements, or any other data

that are needed by the BARR studies and share the information with other BARR agencies. Access to facilities will be consistent with, and will follow, the facility owner's standard safety and notification requirements.

- Provide engineering oversight and review of BARR studies' work products.
- Conduct general work that is needed to advance the BARR studies. These efforts may include state and federal grant applications, website update, and outreach.

In addition, the MOA identifies a few specific roles: CCWD is the lead in BARR's grant/funding application efforts, and EBMUD serves as the administering agency on behalf of BARR for grant/funding awards.

The MOA is an ongoing, long-term agreement among the agencies. However, as described in the MOA, a subset of agencies may advance some BARR measures through a separate, parallel process (particularly if a measure does not directly benefit all BARR agencies). Taken together, joint BARR partnership and individual agency efforts are connecting systems and resources to provide sustainable, reliable, high-quality water supply for a healthy community and vibrant economy in the Bay Area.

Other Regional Partnerships and Interagency Agreements. Bay Area regional partnerships extend beyond the BARR principles and MOA. BARR agencies also have other interagency agreements or basic principles in place for resources sharing, such as the following past and/or current agreements:

- **Intertie agreements**, including the Hayward Operating Agreement between SFPUC, Hayward, and EBMUD (2007)
- **Water transfer agreements**, including the EBMUD-BAWSCA Pilot Water Transfer Agreement (2012 and 2014) and the CCWD and ACWD Water Transfer Agreement (2014)
- **Shared use of a BARR agency's existing assets**, including EBMUD's Revised Principles for Use of Unassigned EBMUD Capacity in the FRWP (2017) and CCWD's agreements with individual agencies to partner to study the benefits of the next LV Reservoir expansion (including most BARR agencies: ACWD, BAWSCA, EBMUD, SCVWD, SFPUC, and Zone 7)

While these are examples of successful interagency agreements in the region, implementation of the BARR drought mitigation measures will require addressing additional governance and institutional considerations. When sharing water resources, other approvals may be needed depending on the source of the water and means of conveyance. For example, if one of the agencies were to execute a water transfer involving non-CVP water on the Lower American River, conveying that water to the Bay Area through the Folsom South Canal (a federal facility) would require obtaining a Warren Act revision from Reclamation.

Joint Powers Authority or Special District. A joint powers authority (JPA) is an entity formed between two or more public agencies that allows them to join together and exercise their powers as a single agency for the purpose of accomplishing specific common goals. JPAs typically outline the ownership, governance, and financing of joint projects. California Government Code Sections 6500–6538 provide the authority for public agencies to enter into JPAs. JPAs may form between local entities to acquire land, construct regional infrastructure, share maintenance, or operate shared facilities. Regional water districts, energy agencies, cities, counties, or any other entity described in California Government Code Section 6500 can be voting members of a JPA. Private businesses, individuals, and privately owned/investor-owned utilities are not allowed by law to be a voting member of a JPA. JPAs have the ability to arrange capital financing by selling bonds. These bonds create the capital needed to finance the design and construction of JPA projects. Bonds issued by the JPA are reimbursed over time by the JPA and from the revenue generated by the projects. By sharing resources and combining services, the member agencies (and their taxpayers) can use a JPA to leverage their combined resources to more effectively distribute the costs and benefits of new joint projects.

The formation of a legally recognized, fully funded governance structure is one option for advancing specific drought mitigation measures and partnerships. The governance structure (such as a JPA, Special District, or other entity) would allow for the following:

- Assume lead agency designation for environmental approvals and other permits
- Establish bylaws and agreements for membership, project participation and cost allocations
- Hire any necessary support staff
- Establish bank accounts, and an accounting system to engage consultants, contractors, and other professionals
- Develop a mission statement, branding, and focused community outreach including a website, and other materials
- Partner with other agencies, municipalities and other stakeholders.

7.3 Operational Considerations

In addition to institutional agreements that establish roles and responsibilities, BARR agencies must consider the effects of regional drought mitigation measures on system operations, such as water quality, conveyance, and distribution. The BARR agencies will need to develop coordinated operations and communications plans for individual measures that are implemented among two or more partners. Elements of operations plans may include:

- Water quality monitoring and evaluation
- Public notification of changes in water blends (particularly to address taste and odor concerns)
- Pressure differentials between interconnected systems and fire flows
- Water delivery timing
- Guidelines regarding how systems can, and cannot, be operated

BARR agencies will also coordinate with relevant federal/state agencies (e.g., Reclamation, State Board, DWR) and local agencies whose facilities are involved in potential BARR measures to ensure their respective operations are not affected.

7.4 Permitting and Environmental Documentation

Implementation of projects like most BARR drought mitigation measures requires obtaining regulatory approvals and permits and coordinating with relevant governmental agency(ies) issuing the needed permit(s) at federal, state, and/or local levels. In addition, specific environmental analysis/documentation are required, as mandated by federal and state regulations.

The specific permits and environmental analysis required vary depending on the nature and details of individual projects. Because the measures are each at various stages of planning, permitting and environmental requirements are more clearly defined for some measures than others. Based on currently available information, potential permitting and environmental requirements are summarized in Table 11.

7.5 Water Rights

The BARR agencies developed the list of potential drought mitigation measures with a primary focus on sharing and exchanging water among the BARR agencies. The BARR agencies collectively have a diverse portfolio of water supplies and water rights (DWR, 2016). For example, SFPUC has pre-1914 water rights for its Hetch Hetchy Project on the Tuolumne River. EBMUD has post-1914 water rights for its Pardee Project on the Mokelumne River. MMWD has local area both pre- and post-1914 water rights and receives approximately 25 percent of its water supply from the Sonoma County Water Agency. In addition, SCVWD has

contracts for water supply from both the SWP and CVP and local water rights, while CCWD has both CVP contracts and local water rights for LV.

Water rights issues must be considered and addressed for each drought mitigation measure. The BARR measures span a range of supplies with various water rights requirements, including some that may require water rights modifications. Several general categories of water rights modifications may apply to the measures, including:

- **Place of use modifications:** Allows use of transferred supply in an area outside the place of use specified in the original water rights. Place of use modifications may be required to individual agencies' water rights permits for local/other surface water supplies and/or SWP/CVP contract supplies.
- **Point of diversion modifications:** Allows for diversion of supply at a location other than the point specified in the original water rights.
- **Pre-1914 water rights "no injury" rule:** Allows pre-1914 water rights holders to change their place/purpose of use or point of diversion provided that the change causes "no injury" to other legal users of water (both junior and senior water right holders), per the CWC.
- **No Unreasonable Effects on Fish and Wildlife:** Allows changes to water rights in an expedited fashion to enable water transfers provided that the transfers do not result in "unreasonable effect of fish, wildlife or other instream beneficial uses."
  - CWC Section 1725: For short-term transfers (occurring in 1 year or less). Transfers approved by the State Board under CWC Section 1725 are exempt from CEQA.
  - CWC Section 1735: For long-term water transfers (occurring over more than 1 year).
- **New water rights:** Enables use or storage of a water supply not previously permitted.
- **Wastewater change petition:** Allows for diversion of wastewater flow for reuse/recycling.

Table 12 summarizes potential water rights modifications that may be needed to implement the BARR drought mitigation measures. When further evaluating implementation feasibility beyond the DCP, the BARR agencies may use this table as a guide to identify water-rights issues that require further assessment and warrant specific permit changes. The BARR agencies evaluated several different potential approaches for transferring SWP/CVP water supplies considering water rights and operational factors. (See Appendix E for more detail.) Two showed promise, including:

- **Conjunctive use of transferred supplies:** BARR agencies could purchase supplies from willing sellers during non-dry (normal/wet) years to transfer for local storage and for use during dry years. Factors directly affecting the viability of this approach include water availability, conveyance capacity, and storage availability.
- **Changes to points of diversion:** Changes to points of diversion for BARR agencies' existing CVP/SWP water rights could increase access to the agencies' storage facilities. Increased supply in storage could provide a mechanism for long-term regional exchanges. The BARR agencies could also take advantage of the currently permitted CVP/SWP joint point of diversion in their water-right permits when the conditions allowing its use are met.

Table 11. Initial Assessment of Potential Permitting and Environmental Documentation Needs for BARR Drought Mitigation Measures [a]

		Federal					Federal/ State	State											Local
No.	Drought Mitigation Measures	NMFS (ESA)	USACE (Section 404)	US Coast Guard (fisheries)	USFWS (EA compliance)	Western Power Administration (transmission and open access)	NEPA [a] / CEQA	CA DOT (encroachment)	CA Reclamation Board (encroachment)	CDFW (CA ESA)	Division of Safety of Dams	DDW (groundwater injection permit)	DWR (encroachment)	RWQCB (dewatering)	RWQCB (construction NPDES stormwater)	RWQCB (Section 401)	State Board (water right)	State Lands Commission	State Historic Preservation Office (Section 106)	Encroachment permits
Interties																				
1	Transfer-Bethany Pipeline	✓	✓		✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	Contra Costa County and/or Alameda County, cities
2	Zone 7-EBMUD Intertie		✓		✓		✓	✓		✓				✓	✓	✓	✓		✓	Contra Costa County and/or Alameda County, San Ramon, Dublin and San Leandro
3a	ACWD-SFPUC Intertie and Local Supply		✓		✓		✓	✓	✓	✓			✓			✓	✓			Alameda County, Newark
3b	ACWD-SFPUC Intertie and IPR		✓		✓		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓	Alameda County, Newark
4	West Side SFPUC-SCVWD Intertie		✓		✓		✓	✓	✓	✓				✓	✓	✓	✓		✓	Santa Clara County, Los Gatos, Saratoga, Cupertino, Los Altos, Palo Alto
5	SFPUC-Zone 7 Intertie		✓		✓		✓	✓	✓	✓			✓	✓	✓	✓	✓		✓	Alameda and/or San Joaquin County, Tracy, Livermore
6	MMWD-EBMUD Intertie		✓		✓		✓	✓		✓			✓	✓	✓	✓	✓	✓	✓	Contra Costa County and Marin County, San Rafael, Richmond
Storage																				
7	LV Expansion	✓	✓		✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	Contra Costa County and/or Alameda County, cities
Treatment/Supply																				
8	WCWTP Pretreatment Facility		✓				✓							✓	✓	✓	✓			Contra Costa County, Walnut Creek
9	Regional Desalination Plant	✓	✓	✓	✓		✓	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓	Contra Costa County, Antioch, Pittsburg
10	SVAWPC Expansion		✓		✓			✓		✓		✓		✓	✓	✓	✓	✓	✓	Santa Clara County, San José
11	Mid-Peninsula PREP [b]	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	Local county/ies, city/ies
12	Joint Tri-Valley Potable Reuse Feasibility Study		✓		✓		✓	✓		✓		✓		✓	✓	✓			✓	Local county/ies, city/ies
Operations																				
13	Regional AMI Feasibility Assessment [c]																			
14	Del Valle Reservoir Water Supply Storage Expansion Project		✓		✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	Local county/ies, city/ies
15	Regional Exchange Demonstration Project [d]		✓		✓		✓			✓										Local county/ies, city/ies

[a] NEPA may be required if federal agencies are involved.

[b] Potential permits listed, unknown which permits required until site(s) is/are selected.

[c] Minimal permitting requirements anticipated.

[d] Federal Warren-Act contract may be needed. Potential refill or conveyance agreements needed from CVP/SWP.

CA = California

CDFW = California Department of Fish and Wildlife

CEQA = California Environmental Quality Act

DDW = State Board Division of Drinking Water

DOT = Department of Transportation

DWR = California Department of Water Resources

EA = Environmental Assessment

ESA = Endangered Species Act

NEPA = National Environmental Policy Act

NMFS = National Marine Fisheries Service

NPDES = National Pollutant Discharge Elimination System

RWQCB = Regional Water Quality Control Board

USACE = United States Army Corps of Engineers

USFWS = United States Fish and Wildlife Service

Table 12. Water Rights Assessment for Specific Proposed Drought Mitigation Measures

No.	Drought Mitigation Measure	Summary	Potential Water Rights Modifications Needed								
			Place of Use for Local/Other	Place of Use for SWP	Place of Use for CVP	Point of Diversion	Pre-1914 Rights ("No Injury")	CWC Section 1725 (if ≤1 year)	CWC Section 1735 (if >1 year)	New Water Rights	Wastewater Change Petition
Interties											
1	Transfer-Bethany Pipeline	This intertie would likely require changes to existing permits to expand the place of use and add a new points of diversions. The necessary changes to water rights permits ultimately depend on which agencies participate and the terms of their water rights and contracts. CCWD would likely need permit changes to include new areas outside CCWD's existing permitted place of use. Other modifications to other partner's water rights and contracts may also be required.	✓	✓		✓		✓	✓		
2	Zone 7-EBMUD Intertie	For transfers from EBMUD to Zone 7, an EBMUD permit change would likely be needed to include Zone 7's service area as a place of use. For transfers from Zone 7 to EBMUD, EBMUD should review its permit and determine whether the existing SWP place of use covers all of EBMUD. If not, then EBMUD should seek a change in the SWP place of use or use local ACWD water rights and change the place of use for those water rights. These changes could be accomplished in any one year through CWC Section 1725 or, if longer than one year, CWC Section 1735. If using water supplied by SWP contracts, this transaction will need to be an exchange of water with EBMUD and not a sale. DWR would need to file the petition with the State Board.	✓	✓				✓	✓		
3a	ACWD-SFPUC Intertie and Local Supply	ACWD's NDF does not have a water-right permit because it does not divert from a "usable" water source. Thus, the expansion of use to SFPUC does not pose a water-right issue. However, if ACWD water-right water is moved to the SFPUC service area, ACWD should seek appropriate water-right changes to the places of use in those water rights. For SFPUC's pre-1914 water rights, SFPUC should check for "no injury" and notify the State Board of the change through its Report of Water Diversion and Use. ACWD may want to use CWC Section 1725 for a short-term transfer in any given year. If ACWD is using water supplied by SWP contracts, this transaction will need to be an exchange of water with SFPUC and not a sale. DWR would need to file the petition with the State Board.	✓	✓			✓	✓			
3b	ACWD-SFPUC Intertie and IPR	Same as above except that a Wastewater Change Petition will likely be needed.	✓	✓			✓	✓			✓
4	West Side SFPUC-SCVWD Intertie	Because this is a second connection, how the water rights for the first connection were handled will dictate how this second connection must be permitted. A place of use change may be needed for both SFPUC and SWP/CVP water rights. It is recommended that SFPUC and SCVWD avoid a CVP place of use change if possible. If SCVWD wants to use water supplied by SWP contracts, this transaction will need to be an exchange of water with SFPUC and not a sale. DWR would need to file the petition with the State Board.	✓	✓	✓						
5	SFPUC-Zone 7 Intertie	This intertie would likely require permit changes for both SFPUC and Zone 7 for place of use of local water rights and/or SWP water rights, depending on which water rights are used. For SFPUC pre-1914 water rights, SFPUC should check for "no injury" and notify the State Board of the change through its Report of Water Diversion and Use. If Zone 7 wants to transfer SWP water, this transaction will need to be an exchange of water with SFPUC and not a sale. DWR would need to file the petition with the State Board.	✓	✓			✓				
6	MMWD-EBMUD Intertie	This intertie would likely require permit changes for both MMWD and EBMUD to include areas to be served outside existing permitted places of use. These could be accomplished by a petition to the State Board for any one year through CWC Section 1725 or, if longer than one year, through CWC Section 1735.	✓					✓	✓		
Storage											
7	LV Expansion	This intertie would likely require changes to existing permits to expand the place of use and add a new points of diversions. The necessary changes to water rights permits ultimately depend on which agencies participate and the terms of their water rights and contracts. CCWD would likely need permit changes to include new areas outside CCWD's existing permitted place of use. Other modifications to other partner's water rights and contracts may also be required.	✓	✓		✓	✓			✓	
Treatment/Supply											
8	WCWTP Pretreatment Facility	Depending on whose water is diverted for treatment and delivery, EBMUD will likely need either place of use or point of diversion permit changes. These could be accomplished in any one year through CWC Section 1725 or, if longer than one year, CWC Section 1735.	✓			✓		✓	✓		
9	Regional Desalination Plant	Assuming the intake would be located at Mallard Slough, CCWD's existing water right permit and license would be used.	✓								
10	SVAWPC Expansion	A new Wastewater Change Petition would likely be needed to allow for additional wastewater to be treated and recycled. The change petition should also include any new places of use.									✓
11	Mid-Peninsula PREP	Changes to the existing Wastewater Change Order may be needed to include new places of use.									✓
12	Joint Tri-Valley Potable Reuse Feasibility Study										
Operations											
13	Regional AMI Pilot Project	No water-right issues apply to implementing AMI.									
14	Lake Del Valle Re-Operation	Currently planned to stay within existing water rights permits.									
15	Regional Exchange Demonstration Project	Depending on whose water rights are used to pump water for exchange, either a change in point of diversion or place of use would be needed.	✓			✓					

Where CVP Contract water is used, USBR will need to file the petition to modify place of use. Where SWP Contract water is used, DWR will need to file the petition to modify place of use or water exchange.

7.6 Funding

To advance a suite of regional drought mitigation measures, viable funding sources must be identified. This can often be the primary constraint in implementing any project. Several state, federal, and local funding sources are potentially available (i.e., current grants and loan opportunities). Funding eligibility and other requirements, such as local cost-share for grants and repayment terms for loans, are important considerations. In addition, grant funding is competitive (thus, less certain to materialize). Alternative funding mechanisms, such as public-private partnerships (P3s), are additional pathways to consider.

Like other water projects, costs associated with the BARR drought mitigation measures have three components—capital costs for initial construction and operations and maintenance (O&M) costs, and repair and replacement (R&R) costs for ongoing implementation once initial construction is complete. Some funding sources can be used only for capital expenditures, while others are more broadly applicable.

7.6.1 Grants and Loans

Agencies can use grant and loan programs to finance capital projects. Table 13 provides a summary of currently available federal and state funding sources. Such programs evolve with time, and current information is typically most efficiently found on websites (refer to the embedded hyperlinks in Table 13).

When pursuing grant funding, the following general guidelines typically apply:

- Grant applications require demonstration of the ability to construct, operate, and maintain the project without grant funding.
- Grant award or funding authorization is not a promise of grant reimbursement.
  - Most grants are reimbursements and not up-front cash, which means a funding source must be available for project construction.
  - Grant reimbursements are subject to annual budget and appropriations processes. As such, disbursement of grant funds is not guaranteed to follow an established schedule.
  - It may take several years after project completion to receive reimbursements, especially in difficult economic times.
  - Most grants require a minimum cost share by the project sponsor.
  - Federal grants typically require investment of additional resources.

Despite the competitive nature of grants, securing external funding can help to minimize ratepayer impacts and the rising cost of water services, which is particularly important to the BARR agencies concerning affordability issues in low-income DACs.

7.6.2 Public-Private Partnerships

In recent years, public agencies have explored P3s and other forms of private-sector financial involvement as possible ways to improve service, quality, and efficiency. P3s involve private financing and the sharing of a project's risks and rewards beyond the construction phase between public and private partners. In P3 projects, the private partner is typically responsible for the financing, design, construction, and O&M of the facility. In return, the private partner will typically receive a fee for the water from the public partner(s).

California's Infrastructure Finance Act (IFA) (IFA; published in California Government Code Section 5956) authorizes local governments to use private-sector investment capital for developing "fee-producing infrastructure facilities." It must be paid for by those benefiting from the facility. Among others, the IFA applies to cities (general law and charter), counties (general law and charter), public districts, JPAs, and any other public or municipal corporations. The government agency may grant ownership or leasing rights to the facility for up to 35-year terms.

Projects built under a P3 approach can offer some unique benefits. P3s provide a new source of funding for projects with costly infrastructure and/or operational costs. This approach can make otherwise unaffordable capital projects economically feasible. Private partners are often incentivized to complete the project as soon as possible because the private partner is usually not paid until after the project has been successfully constructed and is operating to predetermined performance requirements.

While P3s can offer many direct and indirect benefits, they also present challenges. Some types of P3 arrangements can be complex. Each agreement is unique and requires significant legal and technical input by both the public and private partners. Also, by forming a P3, an agency may concede some control of its water system to a private entity. Further, the public may perceive issues with respect to privatizing public infrastructure assets and the loss of public control over such assets. While these concerns can be mitigated by the terms of most agreements, they can pose challenges for a public agency to pursue projects on a P3 basis.

Table 13. Federal and State Grant and Loan Funding Opportunities

Program	Agency	Type	Description	Funding Ceiling	Minimum Cost-Share Requirement
Federal					
Basin Studies Program	Reclamation	Grants: Planning	Basin studies are basin-wide efforts, cost-shared with non-federal partners, to evaluate and address the impacts of climate change. Funding is available for comprehensive water studies that define options for meeting future water demands in Western river basins where imbalances in water supply and demands exist or are projected. (http://www.usbr.gov/watersmart/bsp/index.html)	TBD	50% (non-federal cash or in-kind services)
Drought Response Program	Reclamation		The Drought Response Program is administered by the USBR. It supports a proactive approach for addressing drought by providing assistance to water users to conduct drought contingency planning and to take actions that build long-term resilience to drought. The program includes two funding areas described below. (http://www.usbr.gov/drought/)		
		Grants: Planning	• Drought Contingency Planning: Financial assistance will be made available on a competitive basis to non-federal entities to develop a new DCP or update an existing plan.	$200,000	50% (non-federal)
		Grants: Construction	• Drought Resiliency Project: Financial assistance will be made available to implement small-scale projects to increase the reliability of water supplies; improve water management; implement systems to facilitate the voluntary sale, transfer, or exchange of water; and benefit fish and wildlife and the environment.	$750,000	50% (non-federal)
Title XVI	Reclamation	Grants: Construction	USBR administers funds for recycled water feasibility, demonstration, and construction projects through the Water Reclamation and Reuse Program authorized by the Reclamation Wastewater and Groundwater Study and Facilities Act of 1992 (Title XVI) and its amendments. To meet eligibility requirements, a project must have a feasibility study, comply with environmental regulations, and demonstrate the ability to pay the remainder of the construction costs. Programs/projects that provide regional benefits are more likely to be funded under this program. Projects successful in the application process are authorized by Congress and included in USBR's annual budget request to the president. Congress then appropriates funds, and USBR ranks and prioritizes projects and disburses the money on a competitive grant basis each year. Prioritized projects are those that postpone the development of new water supplies, reduce diversions from natural watercourses, and reduce demand on federal water supply facilities, or that have a regional or watershed perspective. (http://www.usbr.gov/watersmart/title/)	Up to 25% of construction costs, with a maximum of $20 million	75% of construction costs
WaterSMART Water and Energy Efficiency Grants	Reclamation	Grants: Implementation	WaterSMART Water and Energy Efficiency Grants provide cost-shared funding for projects that save water, increase energy efficiency and the use of renewable energy in water management, support environmental benefits (i.e., make conserved water available instream or otherwise address endangered species issues), mitigate conflict risk in areas at a high risk of future water conflict, and accomplish other benefits that contribute to water supply sustainability in the western United States. Projects are selected through a competitive process and the focus is on projects that can be completed within 24 months that will help sustainable water supplies in the western United States. (http://www.usbr.gov/watersmart/weeg/index.html)	Up to 50%, with a maximum of $1 million	50% (non-federal)
Water Infrastructure Finance and Innovation Act (WIFIA)	EPA	Loans	The WIFIA program accelerates investment in the nation's water infrastructure by providing long-term, low-cost supplemental loans for regionally and nationally significant projects. The WIFIA program was established by the Water Infrastructure Finance and Innovation Act of 2014. EPA estimates that current budget authority may provide more than $1 billion in credit assistance and may finance over $2 billion in water infrastructure investment. (https://www.epa.gov/wifia).	Up to 49% of eligible project costs. Minimum project size: • $20 million for large communities (population greater than 25,000) $5 million for small communities (population of 25,000 or less)	Not applicable to loans.

Table 13. Federal and State Grant and Loan Funding Opportunities

Program	Agency	Type	Description	Funding Ceiling	Minimum Cost-Share Requirement
State					
Proposition 1	State Board		The Water Quality, Supply, and Infrastructure Improvement Act of 2014 (Proposition 1) authorizes $7.545 billion in general obligation bonds to fund ecosystems and watershed protection and restoration, water supply infrastructure projects, including surface water and groundwater storage, and drinking water protection. The State Board is administering funds for five programs, described below. (http://www.waterboardsa.gov/water_issues/programs/grants_loans/proposition1.shtml)		
		Grants: Planning and Construction	• Drinking Water (total funding: $260 million)	• Planning: $500,000 • Construction: $5 million	Variable, depending on inclusion of DACs and/or economically distressed areas (EDAs)

		Grants: Planning and Implementation	• Groundwater Sustainability (total funding: $800 million)	• Planning: $100,000 to $1 million
				• Implementation: Two types
				  • 1st type – Offers funding starting at $500,000 with no maximum funding limit
				  • 2nd type - Provides funding opportunities for drinking water treatment projects that only benefit a DAC/EDA. Applicants are eligible to receive up to $5 million. No minimum funding amount is set.
					Variable, depending on inclusion of DACs and/or EDAs. Non-DAC/EDA projects require a 50% match.

		Grants: Planning and Construction	• Small Community Wastewater (total funding: $260 million)	• Planning: $500,000 • Construction: $6 million	Variable, depending on inclusion of DACs and/or EDAs
		Grants: Planning and Implementation	• Stormwater (total funding: $200 million)	• Planning: $50,000 to $500,000 • Implementation: $250,000 to $10 million	50% (local)
		Loans	• Water Recycling (total funding: $625 million): Grant funds have been committed. However, loans currently remain available.	• TBD	Not applicable to loans.
	CWC	Grants: Implementation	• Water Storage Investment Program: Funding for storage projects. State funds can only be spent on the public benefits.	• $2.7B • ~$250M will be available for implementation in 2018.	50% cost share.
	CNRA	Grants: Planning and Implementation	• CVP Improvement Act Grant Program (total funding: $475 million; 2016/17 budget: $89.15 million)	• No maximum or minimum amounts have been set for 2016/17 budget	
Integrated Regional Water Management (IRWM) Implementation Grant Program	DWR	Grants: Planning and Implementation	The IRWM Grant Program provides funding for projects that help meet the long-term water needs of the state, including: • Assisting water infrastructure systems adapt to climate change • Providing incentives through each watershed to collaborate in managing the region's water resources and setting regional priorities for water infrastructure • Improving regional water self-reliance, while reducing reliance on the Delta Proposition 1 authorized a total of $510 million in IRWM funding. (http://www.water.ca.gov/irwm/)	• Updating an existing IRWM plan: $250,000 (minimum request of $50,000) • New IRWM plan: $1 million	50%
Sustainable Groundwater Planning (SGWP) Grant Program	DWR	Grants: Planning and Implementation	The SGWP Grant Program provides funds for projects that develop and implement SGWP and projects consistent with groundwater planning requirements outlined in CWC Division 6. Proposition 1 appropriated a total of $100 million for this program. (http://www.water.ca.gov/irwm/grants/sgwp/index.cfm)	• DACs/EDAs and critically over drafted: $500,000 • All other grant applicants: $250,000	50% (local)
Water Energy Grant Program	DWR	Grants: Implementation	The Water Energy Grant Program provides funds to implement water efficiency programs or projects that reduce GHG emissions and reduce water and energy use, including: • Commercial water efficiency or institutional water efficiency programs • Residential water efficiency programs that benefit DACs • Projects that reduce GHG, water use, and energy use • Projects with water conservation measures that also save energy DWR was appropriated $19 million of GHG Reduction Funds by Senate Bill 101 to administer the program. (http://www.water.ca.gov/waterenergygrant/index.cfm)	$3 million	None required. However, projects proposing a cost share may be prioritized for funding (i.e., a "tie-breaker advantage").

Table 13. Federal and State Grant and Loan Funding Opportunities

Program	Agency	Type	Description	Funding Ceiling	Minimum Cost-Share Requirement
Water Desalination Grant Program	DWR		DWR provides grants to local agencies for planning, design, and construction of desalination facilities (including pilot, demonstration, and research projects) for both brackish and ocean water. DWR has conducted three funding rounds since 2005 using Proposition 50 funds. The rules and procedures for funding vary depending on funding source/availability and DWR priorities at the time of funding. A fourth funding round is planned and will use primarily Proposition 1 funds (total funding of $100 million for desalination projects). The five relevant project categories follow below. (http://www.water.ca.gov/desalination/Water_Desal_Fund_Prog_OV.cfm)		
		Grants: Construction	• Construction projects	$3 million	50%
		Grants: Construction	• Pilot and demonstration projects	$1 million	50%
		Grants: Planning	• Feasibility studies	$250,000	50%
		Grants: Planning	• Environmental documents	$250,000	50%
		Grants: Research	• Research projects	$500,000	50%
Clean Water State Revolving Fund (SRF)	State Board	Loans	The Clean Water SRF program offers low-interest (below-market) financing for a wide variety of water quality projects, such as construction of wastewater treatment and water recycling facilities, implementation of nonpoint source and storm drainage pollution control solutions, and development and implementation of estuary plans to protect and promote the health, safety, and welfare of all Californians. Repayment periods are usually the lesser of 30 years or the expected useful life of the financed asset. (http://www.waterboards.ca.gov/water_issues/programs/grants_loans/srf/)	No maximum funding limit.	Not applicable to loans.
Drinking Water SRF	State Board	Loans	Established by an amendment to the federal Safe Drinking Water Act in 1996, the Drinking Water SRF provides low-interest loans, additional subsidy (principal forgiveness), and technical assistance to public water systems for infrastructure improvements to correct system deficiencies and improve drinking water quality for the health, safety, and welfare of all Californians. (http://www.waterboards.ca.gov/drinking_water/services/funding/SRF.shtml)	No maximum funding limit.	Not applicable to loans.

[a] *Though the IRWM Implementation Grant Program includes funding options for new IRWM Plans, the BARR agencies already participate in existing IRWM Plans. Thus, this funding option is not a viable option for BARR and is included only to provide a complete description of the grant program.*

Section 8 //
Summary and Next Steps

This section summarizes this DCP and discusses next steps to monitor, evaluate, and update the plan.

8.1 Summary

BARR represents an unprecedented partnership among Bay Area water agencies—a partnership with tremendous potential to forge new regional approaches and more fully optimize use of existing assets and resources to collectively strengthen reliability and resilience. Together, the BARR agencies are collaboratively pursuing measures and actions that would use existing infrastructure and water resources to produce greater efficiencies and improve water supply reliability for the area. Through a collaborative process, the BARR agencies have created a new regional water management platform that enables joint drought mitigation measures and response actions to meet the region's water needs while also meeting individual agencies' site-specific needs.

Although the potential BARR drought mitigation measures reflect a wide range of project types, all will require substantial changes in how agencies work together to manage water supplies both at the institutional and operational levels and in the agreements for water use (i.e., water rights and operational agreements). In addition, implementing joint measures may pose challenges related to financial, logistical, legal, social, and financial considerations. While more work remains to establish pathways for overcoming such challenges, the BARR DCP is a significant initial milestone for enabling the further advancement of the regional drought mitigation measures.

8.2 Next Steps

Roles, responsibilities, and procedures for updating and implementing elements of this plan follow.

8.2.1 Implementation of Mitigation Measures and Response Actions

As defined in the BARR MOA, CCWD is the lead in BARR's grant/funding application efforts, and EBMUD serves as the administering agency on behalf of BARR for grant/funding awards. Once funding is secured for a particular project or program, the BARR agency general managers meet to discuss the project schedule and how to involve various stakeholders in the process. Since not all BARR agencies are engaged in every project, some subset of the BARR agencies may proceed with individual projects outside of the BARR framework.

Beyond the drought mitigation and response strategies considered in this plan, BARR agencies are also pursuing other projects individually or with agencies outside of the BARR partnership to further improve Bay Area supply reliability. Taken together, joint BARR and individual agency efforts are bolstering systems and resources to provide drought reliability with a sustainable, reliable, high-quality water supply and for a healthy community and vibrant Bay Area economy.

8.2.2 Drought Contingency Plan Update Process

As described in Section 3.6, all eight BARR agencies are also involved in BAWAC. During bi-monthly BAWAC meetings, general managers hold roundtable discussions about water supply conditions and other current topics. Since all the BARR agencies are active participants in BAWAC, the agencies will maintain the DCP through BAWAC. The role of BAWAC chair rotates between the agencies about every two years, and the current lead agency of BAWAC will be responsible for overseeing DCP updates.

EBMUD will lead the BARR agencies in developing an annual status report to update stakeholders of progress made in implementing the drought mitigation measures and response actions identified in the DCP. Annual status reports will be posted to the BARR website, and BARR agencies will distribute alerts through email push notifications to direct stakeholders to the website.

In addition, each BARR agency will include a regional section in their UWMPs, which are updated every five years, where they will discuss the status of the BARR projects and programs in which they are involved. BAWAC will coordinate assembling these sections into an appendix or attachment to the DCP that provides an update on progress and priorities.

8.2.3 State Initiatives

In addition to local and regional efforts, the state is advancing programs intended to enhance reliability. Several examples closely connected to the California Water Action Plan include the Sustainable Groundwater Management Act (a framework for sustainable local and regional groundwater management), the Water Storage Investment Program (a $2.7 billion fund under Proposition 1 dedicated to the public benefits of water storage projects), and California WaterFix.

Future Bay Area water management and demands may transform with new state initiatives, legislation, and regulations such as the new water use efficiency framework, California Water Action Plan, and Bay-Delta Water Quality Control Plan. At the same time, climate-change uncertainties and potential catastrophic events require that the BARR water agencies take further actions to guard water supply against these challenges and improve reliability and resilience. The measures and actions laid out in this DCP better prepare BARR agencies for the future.

8.2.4 Near-Term Efforts

In the near term, the BARR agencies or some subset thereof expect to further advance plans, explore funding options, and study feasibility for the projects and programs described in this DCP. Early efforts are already underway to advance some BARR drought mitigation measures, such as the LV Reservoir Expansion, Transfer-Bethany Pipeline, WCWTP Pretreatment Facility, and the Bay Area Water Market (Transfers/Exchanges) Program, for which the agencies just received funding. Other projects are still conceptual, and the feasibility and timing of implementation will depend on future needs and funding opportunities.

The BARR agencies will also move toward more regional coordination in drought monitoring and response, as discussed in Sections 3 and 5, respectively. The BARR agencies plan to develop a color-coded Bay Area drought monitor map to display the shortage level in each agency's service area. This map will facilitate a more unified, regional response to drought, such as the proposed drought response communication program.

Beyond the measures considered in this plan, BARR agencies are also pursuing other projects individually or with agencies outside of the BARR partnership to further improve Bay Area supply reliability. Taken together, joint BARR and individual agency efforts are solidifying systems and resources to provide drought reliability with a sustainable, reliable, high-quality water supply and for a healthy community and vibrant Bay Area economy.

Section 9 //
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Appendix A: BARR Agencies' WSCPs

Table A-1. Stages of Drought, Triggers, and Actions (Summary of BARR Agencies' WSCPs)

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Table A-1. Stages of Drought, Triggers, and Actions (Summary of BARR Agencies' WSCPs)

Agency	Stage 1			Stage 2			Stage 3			Stage 4			Stage 5		
	Supply Reduction (%)	Water Supply Condition/Trigger (narrative)	Actions to Be Taken (narrative)	Supply Reduction (%)	Water Supply Condition/ Trigger (narrative)	Actions to Be Taken (narrative)	Supply Reduction (%)	Water Supply Condition/Trigger (narrative)	Actions to Be Taken (narrative)	Supply Reduction (%)	Water Supply Condition/Trigger (narrative)	Actions to Be Taken (narrative)	Supply Reduction (%)	Water Supply Condition/Trigger (narrative)	Actions to Be Taken (narrative)
ACWD	0%–10%	Local supply insufficient to maintain target groundwater levels above 10' msl	Maximize imports for groundwater recharge. Request voluntary 10% conservation.	10%–20%	Local and imported supply insufficient to maintain target groundwater levels above 5' msl	Reduce reliance on local water supply and maximize all imports. Adopt and enforce ordinance to prohibit water waste and limiting irrigation.	20%–30%	Local and imported supply insufficient to maintain target groundwater levels above sea level	Strengthen previous actions; implement consumption allowances	30%–50%	Critical water supply shortage, all supplies. Local groundwater levels at or projected to be below safe minimum of -5' msl.	Strengthen ordinance; intensify all existing measures; prohibit use of potable supply for irrigation or car washing	N/A	N/A	N/A
BAWSCA	12%	5% or less system-wide reduction	Reduce supply allocation to wholesale customers to 64.5% of available supply	17%	6%–10% system-wide reduction	Reduce supply allocation to wholesale customers to 64.0% of available supply.	23%	11%–15% system-wide reduction	Reduce supply allocation to wholesale customers to 63.0% of available supply	28%	16%–20% system-wide reduction	Reduce supply allocation to wholesale customers to 62.5% of available supply	55%	50% system-wide reduction (or any system-wide reduction >20%)	Follow procedures set forth in Water Shortage Allocation Plan to conduct negotiations between SFPUC and wholesale customers on appropriate allocations
CCWD	<10%	CCWD's total supply is able to meet at least 90% of anticipated demands	Prohibit landscape runoff and limit to non-daylight hours, filling of water features, washing hard-surfaced areas, non-essential flushing. Require automatic shutoff hoses, use recycled water for dust control. No penalties.	10%–20%	CCWD's total supply is able to meet at least 80% of anticipated demands	Same as Stage 1, plus no watering 48h after measurable rainfall, additional CII restrictions, no penalties for Stage 2	20-40%	CCWD's total supply is able to meet at least 60% of anticipated demands	Same as Stages 1 and 2, plus limit watering to 2 days/week, no watering of ornamental turf and public street medians, additional CII and other restrictions. Penalties in Stage 3.	40%–50%	CCWD's total supply is able to meet at least 50% of anticipated demands	Same as Stages 1, 2, and 3, plus prohibit new water service connections. Penalties in Stage 4.	N/A	N/A	N/A
EBMUD [a]		EBMUD enters a Stage 1 drought when TSS drops below 500,000 AF, or when a state mandate requires up to 10% customer demand reduction.	• Establish 0%–15% voluntary water use reduction goals and determine use restrictions • Initiate a public information campaign to explain the water supply situation and customer responsibilities • Outreach and education may include EBMUD's website, social media, media outreach, advertising, workshops and events, bill inserts, and bill messaging • Initiate community water waste hotline and online water waste reporting • Issue up to 50,000 Single Family Residential (SFR) home water reports • Provide commercial and residential landscape water budgets up to 5,000 accounts • Provide conservation audits and WaterSmart Home Survey Kits		EBMUD enters a Stage 2 drought when TSS drops below 450,000 AF, or when a state mandate requires 10%–15% customer demand reduction	In addition to elements in Stage 1: • Acquire up to 35,000 AF of supplemental supplies • Apply stage 2 drought surcharge • Continued outreach and education • Provide online EBMUD store ordering (restaurant and hotel tent cards, stickers) • Increase SFR home reports to 75,000 households • Increase commercial and residential landscape water budgets to 25,000 accounts • Issue up to 10,000 free water savings devices		EBMUD enters a Stage 3 drought when TSS drops below 390,000 AF, or when a state mandate requires 15%–20% customer demand reduction	• Institute mandatory 0%–15% customer demand reduction • Acquire 35,000–65,000 AF of supplemental supply • In addition to elements in Stage 2: • Under TSS scenario, declare water shortage emergency (depending on available supplies for future years) • Apply Stage 3 drought surcharge • Advanced media outreach/response • Advanced customer outreach and education • Consider water saving campaigns, challenges • Consider supplementing education and outreach with website tools and information; outdoor, radio, publications, and online advertising; drought theaters or other education for children; contests and pledges; promotional items, signs, drought newsletters, customer outdial messages, postcard mailings, etc.		EBMUD enters a Stage 4 drought when TSS drops below 325,000 AF, or when a state mandate requires ≥ 20 percent customer demand reduction	• Institute mandatory ≥ 15% customer demand reduction • acquire > 65,000 AF of supplemental supplies • In addition to elements in Stage 3: • Apply Stage 4 drought surcharge • Institute excessive use penalty for SFR customer with use > 40 ccf/month • Increase SFR home reports to 325,000 households • Increase commercial and residential landscape water budgets to 150,000 accounts • Issue up to 20,000 free water savings devices	N/A	N/A	N/A

Table A-1. Stages of Drought, Triggers, and Actions (Summary of BARR Agencies' WSCPs)

Agency	Stage 1			Stage 2			Stage 3			Stage 4			Stage 5		
	Supply Reduction (%)	Water Supply Condition/Trigger (narrative)	Actions to Be Taken (narrative)	Supply Reduction (%)	Water Supply Condition/ Trigger (narrative)	Actions to Be Taken (narrative)	Supply Reduction (%)	Water Supply Condition/Trigger (narrative)	Actions to Be Taken (narrative)	Supply Reduction (%)	Water Supply Condition/Trigger (narrative)	Actions to Be Taken (narrative)	Supply Reduction (%)	Water Supply Condition/Trigger (narrative)	Actions to Be Taken (narrative)
			• Issue up to 5,000 indoor plumbing fixture and appliance rebates • Issue up to 5,000 outdoor landscape and irrigation rebates • Conduct water audits • Provide up to 5,000 free water saving devices • Expand Water Loss Control Program (e.g., acoustic loggers, leak detection crews)						• Stakeholder and elected officials outreach • Institute excessive use penalty for SFR customers with use > 60 hundred cubic feet (ccf)/month • Initiate Supersaver Recognition Program • Increase SFR home reports to 100,000 households • Increase commercial and residential landscape water budgets to 50,000 accounts • Issue up to 7,000 indoor plumbing fixture and appliance rebates • Issue up to 8,000 outdoor landscape and irrigation rebates • Issue up to 15,000 free water savings devices • Provide field enforcement of regulations and water use restrictions						
MMWD	10	Total reservoir capacity is 79,566 AF. If total reservoir storage is less than 50,000 AF on April 1, Alert Stage (Voluntary Rationing) is triggered.	Encourage voluntary rationing: restrict runoff from landscape irrigation, covers for pools and spas, restrict water use for decorative water features, prohibit use of potable water for washing hard surfaces, repair leaks in timely manner.	25	Total reservoir storage is less than 40,000 AF on April 1	Limit landscape irrigation to specific times, restaurants may serve water only upon request, require automatic shutoff hoses, prohibit use of potable water to refill decorative fountains or pools, customers shall eliminate water wastage.	50	Total reservoir storage on December 1 is projected to be in the vicinity of, or less than, 30,000 AF	Limit landscape irrigation to specific times, restaurants may serve water only upon request, require automatic shutoff hoses, prohibit use of potable water to refill decorative fountains or pools, customers shall eliminate water wastage.	N/A	N/A	N/A	N/A	N/A	N/A
SCVWD	0%	Groundwater storage > 300,000 AF	SCVWD continues outreach strategies aimed at long-term water conservation targets. Messages focus on services and rebate programs provided.	0%–10%	Groundwater storage 250,000–300,000 AF	Warns that water use is tapping groundwater reserves. Augment Stage 1 efforts, promote immediate behavioral changes, and set the tone for the onset of shortages.	10%–20%	Groundwater storage 200,000–250,000 AF	Coordinate with retailers and cities to enact ordinances and water use restrictions. Requires significant behavioral change by water users. Messages reflect for dire circumstances.	20%–40%	Groundwater storage 150,000–200,000 AF	The most severe stage in a multiyear drought. Expand Stage 3 activities and encourage retailers and cities to enforce their WSCPs.	40% to at least 50%	Groundwater storage less than 150,000	Addresses an immediate crisis such as a major infrastructure failure. Water supply available only for health and safety needs.
SFPUC	10%–20%	10% reduction in system supply	• Request voluntary rationing of customers • Alert customers to water supply conditions • Remind customers of existing water use prohibitions • Increase education on, and possibly accelerate, incentive programs (e.g., toilet rebates)	21%–50%	21%–50% reduction in system supply	• Implement all Stage 1 actions • Assign all customers an "allotment" of water based on the inside/outside allocation method (based on base year water usages for each account) • Subject water use above the "allocation" level to	> 50	Over 50% reduction in system supply	• Implement all Stage 2 actions with further reduced allocations	N/A	N/A	N/A	N/A	N/A	N/A

Table A-1. Stages of Drought, Triggers, and Actions (Summary of BARR Agencies' WSCPs)

Agency	Stage 1			Stage 2			Stage 3			Stage 4			Stage 5		
	Supply Reduction (%)	Water Supply Condition/Trigger (narrative)	Actions to Be Taken (narrative)	Supply Reduction (%)	Water Supply Condition/ Trigger (narrative)	Actions to Be Taken (narrative)	Supply Reduction (%)	Water Supply Condition/Trigger (narrative)	Actions to Be Taken (narrative)	Supply Reduction (%)	Water Supply Condition/Trigger (narrative)	Actions to Be Taken (narrative)	Supply Reduction (%)	Water Supply Condition/Trigger (narrative)	Actions to Be Taken (narrative)
						excess use charges, installation of flow restrictor devices, and shutoff of water									
Zone 7	Up to 20% (voluntary)	Specific events (e.g., sequential low SWP allocations, low storage levels) lead to a reasonable probability that, in the next few years, Zone 7 water supplies may not be sufficient to meet the projected normal water demands from the retailers and/or water supply storage may need to be replenished to protect against future shortages (e.g., during drought recovery). This may also be triggered by an EO from the governor because of state-level conditions.	• Zone 7 Board declaration based on findings from the Annual Sustainability Report to determine voluntary vs. mandatory reductions (Stage 1 vs. Stage 2) • Public outreach to support voluntary conservation • Retailers asked to voluntarily reduce demands up to 20%	Up to 20% (mandatory)	Specific events (e.g., sequential low SWP allocations, low storage levels) lead to a reasonable probability that, in the current or upcoming year, Zone 7 water supplies may not be sufficient to meet the projected normal water demands from the retailers. The Zone 7 Board will consider the findings from the Annual Sustainability Report in deciding whether to declare voluntary or mandatory reductions (Stage 1 vs. Stage 2). This stage may also be independently triggered by an emergency (e.g., earthquake) or an EO from the governor because of state-level conditions.	• Zone 7 Board declaration based on findings from the Annual Sustainability Report to determine voluntary vs. mandatory reductions (Stage 1 vs. Stage 2), and retailers required to reduce demands accordingly up to 20%. • Water Shortage Surcharge may be implemented as determined by the Board. • Expanded public outreach to support conservation • Specific practices may be prohibited as determined by the Board	Up to 35% (mandatory)	Specific events (e.g., catastrophic loss of the Delta/SBA, historically low SWP allocation, and historically low storage levels) lead to a reasonable conclusion that, in the current year, Zone 7 water supplies will not be sufficient to meet the projected normal water demands from the retailers, requiring a demand reduction from 21% to 35%. This stage may also be independently triggered by an emergency (e.g., earthquake) or an EO from the governor because of state-level conditions.	• Zone 7 Board declaration based on findings from the Annual Sustainability Report with mandatory demand reduction between 20% and up to 35% and retailers asked to reduce demands accordingly. • Water Shortage Surcharge may be implemented as determined by the Board. • Intensified public outreach to support conservation. • Specific practices are prohibited as determined by the Board.	>35% (mandatory)	Specific events (e.g., catastrophic loss of the Delta/SBA, sequential historically low SWP allocation, and historically low storage levels) lead to a reasonable conclusion that, in the current year, Zone 7 water supplies will not be sufficient to meet the projected normal water demands from the retailers requiring greater than 35% demand reduction. This is a critical condition in which indoor water use may need to be curtailed and demands may need to be reduced to health and safety requirements. This stage may also be independently triggered by an emergency (e.g., earthquake) or an EO from the governor because of state-level conditions.	• Zone 7 Board declaration based on findings from the Annual Sustainability Report with mandatory demand reduction greater than 35% and retailers asked to reduce demands accordingly. • Water Shortage Surcharge may be implemented as determined by the Board. • Intensified public outreach to support conservation. • Specific practices are prohibited as determined by the Board	N/A	N/A	N/A

a. *EBMUD uses Total System Storage (TSS) as a basis for its drought trigger determination. Since TSS is used as the gauge for measuring the adequacy of the District's supply, a supply reduction percentage is not provided.*

Appendix B: Supply and Demand Projections

Table B-1. Demand Projections for 2020 (AFY)								
Supply Source Category	ACWD	BAWSCA [a]	CCWD	EBMUD	MMWD	SCVWD	SFPUC	Zone 7
Total Potable Demands	47,200	258,183	102,650	243,040	25,387	346,200	83,440	43,700
Total Non-Potable Demands	16,200	1,233	46,050	246	307 [b]	1,700	1,120	6,200
Total Recycled Water Demands	--	13,451	15,000	12,320	520	23,300	2,240	--
Demands for Storage	--	--	--	--	--	--	--	22,200
Total	63,400	272,867	163,700	255,606	26,214	371,200	86,800	72,100

a. *As of 8/15/2016, based upon BAWSCA member agency UWMPs and other sources.*

b. *Excludes demands for environmental releases (15,726 AFY).*

Table B-2. Supply Projections for 2020: Normal Year (AFY)								
Supply Source Category	ACWD	BAWSCA [a]	CCWD	EBMUD	MMWD	SCVWD	SFPUC	Zone 7
SWP/CVP/transfers [b]	27,500	36,663	185,800	--	--	171,000	--	62,145
SFPUC RWS	15,400	198,334	--	--	--	56,400	78,960	--
Mokelumne	--	--	--	243,000	--	--	--	--
Local/other surface water [c]	5,000	11,850	11,500	--	28,803 [d]	78,600	--	7,300
Groundwater [e]	24,200	52,021	6,500	--	--	60,900	5,600	9,200
Recycled water [f]	--	21,934	15,000	12,320	520	23,300	2,240	--
Potable reuse	--	--	--	--	--	--	--	--
Desalination	5,100	5,100	--	--	--	--	--	--
Reserves [g]	--	--	10,000	--	--	--	--	--
Total	77,200	325,902	228,800	255,320	29,323	390,200	86,800	78,645

a. *As of 8/15/2016, based upon BAWSCA member agency UWMPs and other sources.*

b. *Semitropic and Cawelo groundwater banking are included in SWP/CVP/transfers.*

c. *MMWD's purchases from Sonoma County Water Agency are included in local/other surface water.*

d. *Excludes supplies for environmental releases (15,726 AFY).*

e. *EBMUD's Bayside Groundwater Project and Zone 7's conjunctive use are included in groundwater.*

f. *Recycled water may be served by other non-BARR agencies.*

g. *Previously stored local surface water and groundwater, originating from SWP, CVP, local runoff, and/or recycled water and including LV Reservoir.*

Table B-3. Supply Projections for 2020: Single Dry Year (AFY)								
Supply Source Category	ACWD	BAWSCA [a]	CCWD	EBMUD	MMWD	SCVWD	SFPUC	Zone 7
SWP/CVP/transfers [b]	16,900	21,071	145,050	39,200	--	79,600	--	29,676
SFPUC RWS	8,200	171,324	--	--	--	55,900	78,960	--
Mokelumne	--	--	--	189,280	--	--	--	--
Local/other surface water [c]	--	1,574	--	--	25,643 [d]	6,000	--	--
Groundwater [e]	25,100	45,306	--	--	--	47,500	5,600	28,000
Recycled water [f]	--	19,176	15,000	12,320	520	23,300	2,240	--
Potable reuse	--	--	--	--	--	--	--	--
Desalination	5,100	5,100	--	--	--	--	--	--
Reserves [g]	--	8,294	20,000	--	--	158,300	--	--
Total	55,300	271,845	180,050	240,800	26,163	370,600	86,800	57,676

a. *As of 8/15/2016, based upon BAWSCA member agency UWMPs and other sources.*

b. *Semitropic and Cawelo groundwater banking are included in SWP/CVP/transfers.*

c. *MMWD's purchases from Sonoma County Water Agency are included in local/other surface water.*

d. *Excludes supplies for environmental releases (15,726 AFY).*

e. *EBMUD's Bayside Groundwater Project and Zone 7's conjunctive use are included in groundwater.*

f. *Recycled water may be served by other non-BARR agencies.*

g. *Previously stored local surface water and groundwater, originating from SWP, CVP, local runoff, and/or recycled water and including LV Reservoir.*

Table B-4. Supply Projections for 2020: Third Consecutive Dry Year (AFY)								
Supply Source Category	ACWD	BAWSCA [a]	CCWD	EBMUD	MMWD	SCVWD	SFPUC	Zone 7
SWP/CVP/transfers [b]	50,800	55,663	118,200	44,800	-	71,600	-	51,076
SFPUC RWS	8,000	153,827	-	-	-	55,500	78,960	-
Mokelumne	-	-	-	147,840	-	-	-	-
Local/other surface water [c]	500	5,534	-	-	25,643 [d]	46,500	-	150
Groundwater [e]	14,500	46,985	-	-	-	44,500	5,600	13,400
Recycled water [f]	-	21,280	15,000	12,320	520	23,300	2,240	-
Potable reuse	-	-	-	-	-	-	-	-
Desalination	5,100	5,100	-	-	-	-	-	-
Reserves [g]		1,093	13,000			16,100		
Total	78,900	289,483	146,200	204,960	26,163	257,500	86,800	64,626

a. *As of 8/15/2016, based upon BAWSCA member agency UWMPs and other sources.*

b. *Semitropic and Cawelo groundwater banking are included in SWP/CVP/transfers.*

c. *MMWD's purchases from Sonoma County Water Agency are included in local/other surface water.*

d. *Excludes supplies for environmental releases (15,726 AFY).*

e. *EBMUD's Bayside Groundwater Project and Zone 7's conjunctive use are included in groundwater.*

f. *Recycled water may be served by other non-BARR agencies.*

g. *Previously stored local surface water and groundwater, originating from SWP, CVP, local runoff, and/or recycled water and including LV Reservoir.*

Table B-5. Demand Projections for 2035 (AFY)								
Supply Source Category	ACWD	BAWSCA [a]	CCWD	EBMUD	MMWD	SCVWD	SFPUC	Zone 7
Total Potable Demands	53,700	285,625	119,850	256,480	25,260	391,000	90,380	50,300
Total Non-Potable Demands	16,200	1,569	47,450	246	329 [b]	1,700	1,120	8,300
Total Recycled Water Demands	--	21,392	17,700	20,160	520	33,100	4,710	--
Demands for Storage	--	--	--	--	--	--	--	34,200
Total	69,900	308,586	185,000	276,886	26,109	425,800	96,210	92,800

a. *As of 8/15/2016, based upon BAWSCA member agency UWMPs and other sources.*

b. *Excludes demands for environmental releases (15,726 AFY).*

Table B-6. Supply Projections for 2035: Normal Year (AFY)								
Supply Source Category	ACWD	BAWSCA [a]	CCWD	EBMUD	MMWD	SCVWD	SFPUC	Zone 7
SWP/CVP/transfers [b]	27,500	38,533	202,700	-	-	175,300	-	70,000
SFPUC RWS	15,400	202,917	-	-	-	58,000	85,900	-
Mokelumne	-	-	-	256,480	-	-	-	-
Local/other surface water [c]	5,000	13,093	11,500	-	30,343 [d]	92,400	-	10,300
Groundwater [e]	23,300	57,026	7,300	-	-	60,900	5,600	9,200
Recycled water [f]	-	26,119	17,700	20,160	520	33,100	4,710	-
Potable reuse	-	1,271	-	-	-	20,200	-	10,000 [h]
Desalination	5,100	5,100	-		-	-	-	
Reserves [g]		--	10,000					
Total	76,300	344,060	249,200	276,640	30,863	439,900	96,210	99,500

a. *As of 8/15/2016, based upon BAWSCA member agency UWMPs and other sources.*

b. *Semitropic and Cawelo groundwater banking are included in SWP/CVP/transfers.*

c. *MMWD's purchases from Sonoma County Water Agency are included in local/other surface water.*

d. *Excludes supplies for environmental releases (15,726 AFY).*

e. *EBMUD's Bayside Groundwater Project and Zone 7's conjunctive use are included in groundwater.*

f. *Recycled water may be served by other non-BARR agencies.*

g. *Previously stored local surface water and groundwater, originating from SWP, CVP, local runoff, and/or recycled water and including LV Reservoir.*

h. *Per Zone 7's 2015 UWMP and 2016 Water Supply Evaluation Update, 10,000 AFY will be provided by either potable reuse or desalination.*

Table B-7. Supply Projections for 2035: Single Dry Year (AFY)								
Supply Source Category	ACWD	BAWSCA [a]	CCWD	EBMUD	MMWD	SCVWD	SFPUC	Zone 7
SWP/CVP/transfers [b]	16,900	22,175	157,950	39,200	-	85,600	-	33,800
SFPUC RWS	9,300	175,382	-	-	-	57,500	85,900	-
Mokelumne	-	-	-	200,480	-	-	-	-
Local/other surface water [c]	-	2,693	-	-	25,643 [d]	19,100	-	-
Groundwater [e]	25,200	59,606	-	-	-	47,500	5,600	34,400
Recycled water [f]	-	25,160	17,700	20,160	520	33,100	4,710	-
Potable reuse	-	1,245	-	-	-	20,200	-	10,000 [h]
Desalination	5,100	5,100	-	-	-	-	-	
Reserves [g]	-	9,989	20,000	-	-	162,100	-	-
Total	56,500	301,349	195,650	259,840	26,163	425,100	96,210	78,200

a. *As of 8/15/2016, based upon BAWSCA member agency UWMPs and other sources.*

b. *Semitropic and Cawelo groundwater banking are included in SWP/CVP/transfers.*

c. *MMWD's purchases from Sonoma County Water Agency are included in local/other surface water.*

d. *Excludes supplies for environmental releases (15,726 AFY).*

e. *EBMUD's Bayside Groundwater Project and Zone 7's conjunctive use are included in groundwater.*

f. *Recycled water may be served by other non-BARR agencies.*

g. *Previously stored local surface water and groundwater, originating from SWP, CVP, local runoff, and/or recycled water and including LV Reservoir.*

h. *Per Zone 7's 2015 UWMP and 2016 Water Supply Evaluation Update, 10,000 AFY will be provided by either potable reuse or desalination.*

Table B-8. Supply Projections for 2035: Third Consecutive Dry Year (AFY)								
Supply Source Category	ACWD	BAWSCA [a]	CCWD	EBMUD	MMWD	SCVWD	SFPUC	Zone 7
SWP/CVP/transfers [b]	50,300	56,080	128,700	44,800	-	71,600	-	50,400
SFPUC RWS	9,100	156,463	-	-	-	56,800	85,900	-
Mokelumne	-	-	-	134,400	-	-	-	-
Local/other surface water [c]	500	5,858	-	-	25,643 [d]	47,600	-	150
Groundwater [e]	12,500	53,413	-	-	-	44,500	5,600	13,400
Recycled water [f]	-	25,276	17,700	20,160	520	33,100	4,710	-
Potable reuse	-	1,631	-	-	-	20,200	-	10,000 [h]
Desalination	5,100	5,100	-	-	-	-	-	
Reserves [g]	-	161	13,000	-	-	2,000	-	-
Total	77,500	303,983	159,400	199,360	26,163	275,800	96,210	73,950

a. *As of 8/15/2016, based upon BAWSCA member agency UWMPs and other sources.*

b. *Semitropic and Cawelo groundwater banking are included in SWP/CVP/transfers.*

c. *MMWD's purchases from Sonoma County Water Agency are included in local/other surface water.*

d. *Excludes supplies for environmental releases (15,726 AFY).*

e. *EBMUD's Bayside Groundwater Project and Zone 7's conjunctive use are included in groundwater.*

f. *Recycled water may be served by other non-BARR agencies.*

g. *Previously stored local surface water and groundwater, originating from SWP, CVP, local runoff, and/or recycled water and including LV Reservoir.*

h. *Per Zone 7's 2015 UWMP and 2016 Water Supply Evaluation Update, 10,000 AFY will be provided by either potable reuse or desalination.*

Appendix C: Complete BARR Drought Mitigation Measure Profiles

Drought Mitigation Measure 1: Transfer-Bethany Pipeline

Drought Mitigation Measure 2: Zone 7-EBMUD Intertie

Drought Mitigation Measure 3a: ACWD-SFPUC Intertie and Local Supply

Drought Mitigation Measure 3b: ACWD-SFPUC Intertie and IPR

Drought Mitigation Measure 4: West Side SFPUC-SCVWD Intertie

Drought Mitigation Measure 5: SFPUC-Zone 7 Intertie

Drought Mitigation Measure 6: MMWD-EBMUD Intertie

Drought Mitigation Measure 7: Los Vaqueros Expansion

Drought Mitigation Measure 8: Walnut Creek Water Treatment Plant Pretreatment Facility

Drought Mitigation Measure 9: Regional Desalination Plant

Drought Mitigation Measure 10: Silicon Valley Advanced Water Purification Center Expansion

Drought Mitigation Measure 11: Mid-Peninsula Potable Reuse Exploratory Plan

Drought Mitigation Measure 12: Joint Tri-Valley Potable Reuse Feasibility Study

Drought Mitigation Measure 13: Regional Advanced Metering Infrastructure Feasibility Assessment

Drought Mitigation Measure 14: Del Valle Reservoir Water Supply Storage Expansion Project

Drought Mitigation Measure 15: Regional Exchange Demonstration Project

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DROUGHT MITIGATION MEASURE 1

Transfer-Bethany Pipeline

CONTRA COSTA COUNTY

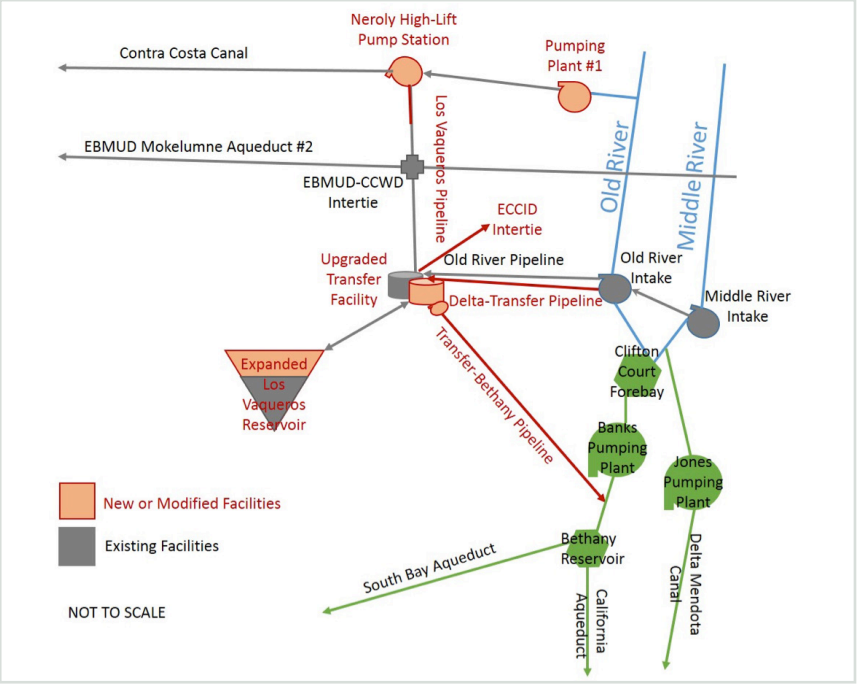
The Transfer-Bethany Pipeline would connect CCWD's Los Vaqueros (LV) Reservoir system and other conveyance facilities to the Bethany Reservoir, providing a mechanism to move water to the South Bay Aqueduct (SBA).

The pipeline would begin just east of the LV Reservoir Transfer Facility—the system hub that regulates flows into and out of the reservoir and into the Contra Costa Canal via the LV Pipeline—and continue approximately 8 miles to the southeast to tie into the Bethany Reservoir. With a diameter up to 96 inches, the Transfer-Bethany Pipeline would have capacity to convey up to 300 cubic feet per second (cfs) to Bethany Reservoir. From Bethany Reservoir, water could be pumped into the SBA via the South Bay Pumping Plant.

By enabling transfers to the SBA, this project would broaden the water sources stored in LV Reservoir and delivered to partner agencies. The new pipeline would allow greater flexibility in water deliveries to the region, provide dry-year reliability, and facilitate water transfers seasonally or during dry years. A companion project (LV Expansion) would increase LV Reservoir's storage capacity.

AT A GLANCE

PROJECT TYPE	Intertie/Conveyance
STATUS	Preliminary design
ENGAGED BARR AGENCIES	ACWD, BAWSCA, CCWD, EBMUD, SFPUC, SCVWD, ZONE 7
AVAILABILITY	All years
POTENTIAL YIELD	Up to 217,000 AFY
COST	Capital: $200M O&M: TBD (likely moderate)



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Transfer-Bethany Pipeline

DROUGHT MITIGATION MEASURE 1

Water Supply Yield and Availability

Enables conveyance of up to 217,000 acre-feet per year (AFY) (up to 300 cfs). Actual yield would depend on operations.

Regional Resilience

Increases supply reliability and resilience to droughts, climate change impacts, planned outages, Delta levee failures, and other emergencies (e.g., earthquakes).

Efficiency

Connects existing water system infrastructure. Leverages existing supply sources. Increases the regional use and benefits of LV Reservoir by broadening the sources stored in LV Reservoir and delivered to partner agencies.

Flexibility/Sustainability

Facilitates seasonal and dry year water transfers, providing greater flexibility in water deliveries to the SBA and the region. Increases operational flexibility and enables storage of State Water Project (SWP) and other supplies in LV Reservoir. Incorporates adaptive management of facilities and operations.

Water Quality Considerations

Supports CCWD's operational strategy to fill LV Reservoir during wet periods (i.e., when the Delta is lower in salinity) and release water during dry periods (i.e., when the Delta is more saline). Requires evaluation to determine whether partner agencies' facilities are compatible to treat Delta supplies.

Timing

Preliminary design and environmental analysis/documentation are in process. Construction of the pipeline could start as early as 2020 and conclude within 2 years.

Implementability

In 2017, CCWD will seek California Water Commission funding for this project and release the Supplement to the Final Environmental Impact Report (EIR)/Environmental Impact Statement (EIS), to be finalized by late 2018 along with the Federal Feasibility Study. While the pipeline has a smaller capacity, more efficient alignment, and fewer environmental impacts than the pipeline considered in the 2010 final environmental documentation, easements will need to be acquired for the pipeline. Water rights modifications may also be required to execute transfers/exchanges through the pipeline.

Social and Environmental Considerations

Benefits Delta fisheries through state-of-the-art fish screens and increased operational flexibility (i.e., avoiding diversions at critical times/locations and coordinating operations with SWP and Central Valley Project [CVP] Delta export facilities). Presents potential partnership opportunity with Central Valley wildlife refuges (south of the Delta), due to resulting ecosystem benefits such as supply for wetlands, terrestrial habitats, and waterfowl habitat for migratory birds.

BENEFITS

- Leverages existing supply sources and connects existing infrastructure for exchanges/transfers.
- Increases water supplies in emergencies, planned outages, and droughts.
- Increases resilience to climate change and future Delta constraints.
- Enhances ecosystem benefits.
- Improves water quality.

CHALLENGES

- Requires potential water rights modifications to enable transfers/exchanges.
- Requires new easements for construction.

DROUGHT MITIGATION MEASURE 2

Zone 7-EBMUD Intertie

ALAMEDA COUNTY AND CONTRA COSTA COUNTY

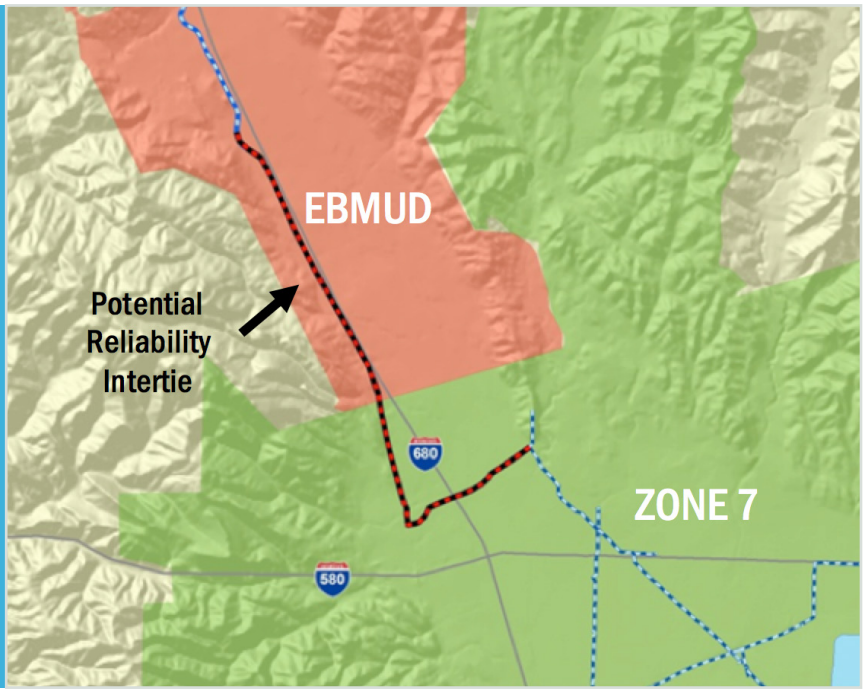
To connect Zone 7 and EBMUD (east of the Berkeley/Oakland hills), this project would involve constructing a 30-inch diameter intertie pipeline (about 36,000 linear feet [LF]), booster pump station, and rate control station through the cities of Dublin and San Ramon.

The intertie would enable the transfer of 11,200 to 28,000 acre-feet per year (AFY) (10 to 25 million gallons per day [mgd]) between the two water systems and provide regional water supply reliability and long-term sustainability by leveraging existing groundwater and surface water resources to meet regional needs.

The project would support transfers in both directions to provide a vital lifeline during droughts, a major earthquake, or other outage conditions. Transfers from EBMUD to Zone 7 are more likely, as the intertie could convey a major alternative supply for Zone 7 and reduce Zone 7's reliance on diversions from the Delta and State Water Project (SWP) during emergencies.

AT A GLANCE

PROJECT TYPE	Intertie
STATUS	Conceptual
ENGAGED BARR AGENCIES	Zone 7 and EBMUD
AVAILABILITY	All years
POTENTIAL YIELD	11,200 to 28,000 AFY
COST	Capital: $43M O&M: TBD (likely low from EBMUD to Zone 7 and medium from Zone 7 to EBMUD, due to pumping costs)



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Zone 7-EBMUD Intertie

Water Supply Yield and Availability

Enables conveyance of 11,200 to 28,000 AFY, depending on the need and supply availability. The intertie's capacity in normal and wet years could be limited to approximately 10 mgd by EBMUD's wheeling capacity. A greater capacity, up to 25 mgd, may be available during dry years and emergencies.

Regional Resilience

Facilitates water transfers between Zone 7 and EBMUD (both directions), increasing supply reliability and resilience to droughts, climate change impacts, planned outages, Delta levee failures, and other emergencies (e.g., earthquakes).

Efficiency

Connects existing water system infrastructure. Leverages existing groundwater and surface water supply sources within the region.

Flexibility/Sustainability

Increases flexibility to move water where needed and may enhance conjunctive use through recharge of Zone 7's groundwater basin.

Water Quality Considerations

Requires evaluation to determine the impact of blending and ensure that water quality stability is not affected (e.g., ensure corrosion protection to transmission and distribution pipelines and delivered water quality; minimize potential taste and odor issues). If used to recharge Zone 7's groundwater basin, lower-salinity water from EBMUD would reduce salt loading in the Livermore Valley Groundwater Basin, an ongoing water quality issue.

Timing

Conceptual plans are complete; detailed design has not begun. California Environmental Quality Act (CEQA) review could be conducted within 1 year, and the project could be fully implemented within 4 to 5 years.

Implementability

Constructing the intertie pipeline in an urban area necessitates permits and traffic control plans. Water rights modifications may be required to execute transfers/exchanges through the intertie pipeline.

Social and Environmental Considerations

Construction of this major infrastructure project will likely require mitigation of environmental impacts and community impacts (e.g., disruptive traffic conditions).

BENEFITS

- Leverages existing supply sources and connects existing infrastructure for exchanges/transfers.
- Provides water supply alternatives during emergencies, planned outages, and droughts.
- Increases resilience to climate change and future Delta constraints.

CHALLENGES

- Requires potential water rights modifications to enable transfers/exchanges.
- Involves construction in a highly-urbanized area (potentially disruptive to transportation and local community).
- Requires significant permitting and CEQA evaluation.

DROUGHT MITIGATION MEASURE 3A

ACWD-SFPUC Intertie and Local Supply

ALAMEDA COUNTY

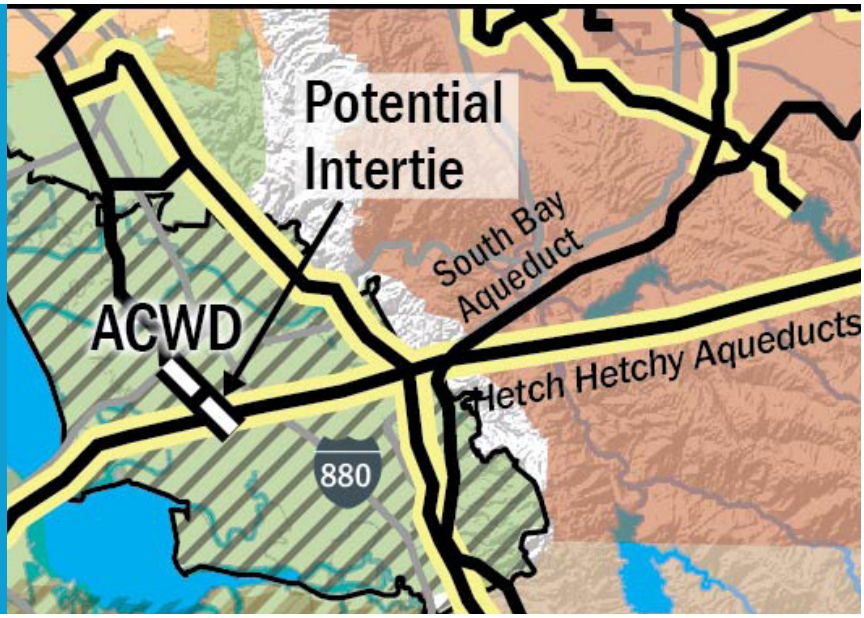
A new intertie pipeline (approximately 1,200 linear feet [LF]) would enable bi-directional water transfers between ACWD's Newark Brackish Groundwater Desalination Facility (NDF) and SFPUC's Bay Division Pipeline (BDP).

ACWD extracts trapped brackish groundwater and filters it into high-quality drinking water at the NDF. To create a pressure gradient and push brackish groundwater toward San Francisco Bay, ACWD adds runoff from the Alameda Creek watershed to the aquifer through the Quarry Lakes Groundwater Recharge System. The cycle of recharging runoff and extracting brackish groundwater is steadily restoring the Niles Cone Groundwater Basin, a critical drinking water supply under ACWD's service area. Freshwater recharge is a limiting factor for aquifer reclamation (i.e., annual reclamation cannot exceed annual recharge).

Though its production capacity is 12.5 million gallons per day (mgd), the NDF typically optimizes operations at 7 to 10 mgd due to hydraulic and recharge considerations. Connecting ACWD to SFPUC would allow additional hydraulic capability at NDF and enable use of available treatment capacity in average and above-average rainfall years, when freshwater recharges the aquifer. ACWD could transfer some product water to SFPUC and use some for local supply. Because the operating pressure in SFPUC's BDP (141 pounds per square inch [psi]) exceeds ACWD's system pressure (80 psi), a booster station would be installed.

AT A GLANCE

PROJECT TYPE	Intertie
STATUS	Conceptual
ENGAGED BARR AGENCIES	ACWD, BAWSCA, SFPUC
AVAILABILITY	Normal and wet years
POTENTIAL YIELD	Up to 5,600 AFY
COST	Capital: $7.7M O&M: TBD (moderate)



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ACWD-SFPUC Intertie and Local Supply

DROUGHT MITIGATION MEASURE 3A

Water Supply Yield and Availability

Enables conveyance of up to 5,600 AFY in normal and wet years.

Regional Resilience

Facilitates water transfers from ACWD to SFPUC in normal and wet years to provide emergency supply and/or to bank water within SFPUC's storage reservoir system for both agencies to use in dry years. Increases supply reliability and resilience to droughts, climate change impacts, planned outages, Delta levee failures, and other emergencies (e.g., earthquakes). ACWD and SFPUC have not yet conducted mutual water supply reliability analyses.

Efficiency

Leverages NDF's available treatment capacity. Connects existing water system infrastructure and stretches existing supply sources.

Flexibility/Sustainability

Provides ability for bi-directional transfers between ACWD and SFPUC. Increases flexibility for in-lieu exchanges and transfers using excess delivery capacity in SFPUC's system turnouts to ACWD.

Water Quality Considerations

Requires evaluation to determine the impact of blending and ensure that water quality stability is not affected (e.g., ensure corrosion protection to transmission and distribution pipelines and delivered water quality; minimize potential taste and odor issues). Anticipated to maintain/improve groundwater quality in ACWD's Niles Cone Groundwater Basin (because of increased desalination of trapped brackish groundwater).

Timing

This project is in the conceptual phase and could be implemented within 2 to 5 years.

Implementability

Constructing the intertie pipeline necessitates permits. An operating plan and booster pump station would also be needed to address the differential in system operating pressures—SFPUC's BDP operating pressure (141 psi) exceeds that of ACWD's system (80 psi).

Social and Environmental Considerations

The project may provide environmental benefits by reducing demand on surface water supplies within ACWD's service area. Any additions or modifications to water supply would involve outreach and communications with customers.

BENEFITS

- Leverages existing supply sources and connects existing infrastructure for exchanges/transfers.
- Increases water supplies in emergencies, planned outages, and droughts.
- Increases resilience to climate change and future Delta constraints.
- Improves groundwater quality (because of increased reclamation of trapped brackish groundwater).

CHALLENGES

- Requires a surplus of groundwater recharge (typically available only in average and above average rainfall years), which limits availability of this during dry years.
- Warrants significant customer outreach and communications before modifying water supply.

DROUGHT MITIGATION MEASURE 3B

ACWD-SFPUC Intertie and IPR

ALAMEDA COUNTY

This project builds on the ACWD-SFPUC Intertie and Local Supply (BARR Drought Mitigation Measure 3a), which involves constructing an intertie pipeline and booster pump station to enable water transfers from ACWD's Newark Brackish Groundwater Desalination Facility (NDF) to SFPUC's Bay Division Pipeline (BDP) during normal or wet years.

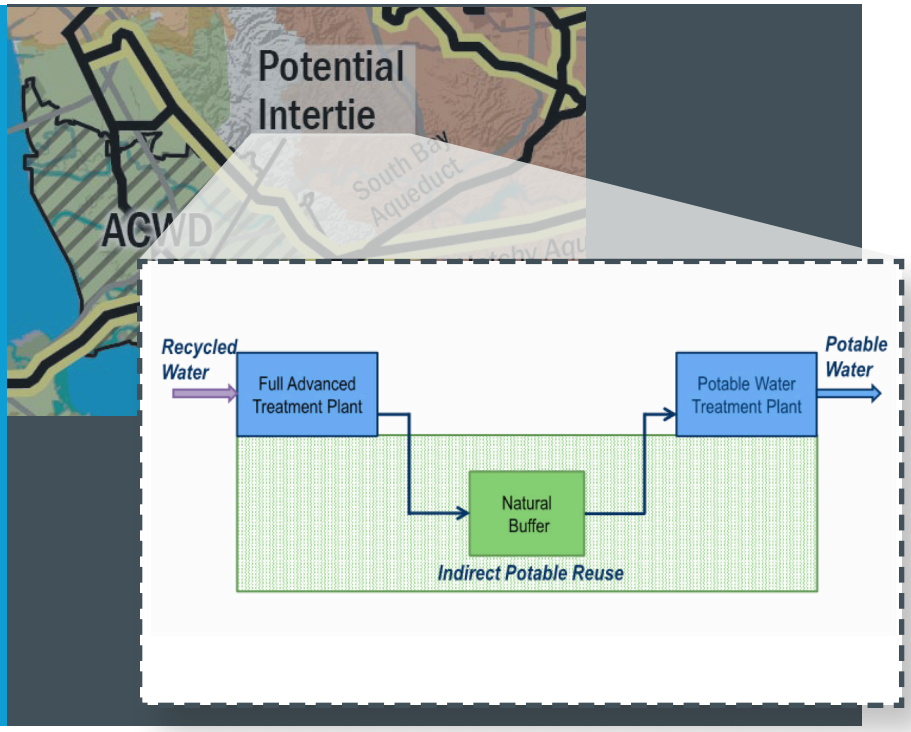
To address the dry-year constraint, this variation on the project involves constructing a 4 million gallons per day (mgd) facility providing advanced treatment to effluent from the Union Sanitary District Alvarado Wastewater Treatment Plant for indirect potable reuse (IPR). ACWD could inject the newly purified water into the Niles Cone Groundwater Basin and/or infiltrate it in the Quarry Lakes Groundwater Recharge System, thus allowing for more brackish groundwater to be extracted and treated at the NDF.

While Union Sanitary District's wastewater flows could produce up to 15 mgd of advanced treated water, ACWD cannot accommodate that level without massively redesigning the water supply system. Further, since ACWD alone cannot use more than approximately 4 mgd given projected demands, the additional supply could benefit SFPUC (and other regional partners) if transferred.

While the intertie pipeline would be located in Newark, proximate to ACWD's NDF, the location for an advanced water treatment facility has not yet been identified.

AT A GLANCE

PROJECT TYPE	Intertie
STATUS	Conceptual
ENGAGED BARR AGENCIES	ACWD, BAWSCA, and SFPUC
AVAILABILITY	All years
POTENTIAL YIELD	Dry years: 4,480 to 17,000 AFY Normal/wet years: 10,000 to 22,600 AFY
COST	Capital: $93M to $500M O&M: TBD (high)



Brown AND Caldwell

ACWD-SFPUC Intertie and IPR

Water Supply Yield and Availability

Enables treatment and conveyance of about 4,480 to 17,000 AFY in dry years and about 10,000 to 22,600 AFY in normal and wet years.

Regional Resilience

Facilitates water transfers from ACWD to SFPUC to provide emergency supply and/or to bank water within SFPUC's storage reservoir system for both agencies to use in all year types. Increases supply reliability and resilience to droughts, climate change impacts, planned outages, Delta levee failures, and other emergencies (e.g., earthquakes). ACWD and SFPUC have not conducted mutual water supply reliability analyses.

Efficiency

Leverages NDF's available treatment capacity. Connects existing water and wastewater system infrastructure. Stretches existing supply sources and recovers wastewater as a new, local, drought-resistant supply.

Flexibility/Sustainability

Provides ability for bi-directional transfers between ACWD and SFPUC in both wet and dry years. Increases flexibility for in-lieu exchanges and transfers using excess delivery capacity in SFPUC's system turnouts to ACWD.

Water Quality Considerations

Requires evaluation to determine the impact of blending and ensure that water quality stability is not affected (e.g., ensure corrosion protection to transmission and distribution pipelines; minimize potential taste and odor issues). Anticipated to maintain/improve groundwater quality in ACWD's Niles Cone Groundwater Basin (because of increased desalination of trapped brackish groundwater).

Advanced treatment, stabilization, and monitoring of purified water would protect groundwater quality from brackish inflow, dilute micro-contaminants already present in the native groundwater, and decrease nutrient discharges to the San Francisco Bay.

Timing

This project is in the conceptual phase and could be implemented within 5 to 10 years.

Implementability

Constructing the intertie pipeline necessitates permits. An operating plan and booster pump station would also be needed to address the differential in system operating pressures—SFPUC's BDP operating pressure (141 psi) exceeds that of ACWD's system (80 psi).

Additional limnological studies would be needed to evaluate the effect of advanced treated water for IPR into Quarry Lakes given its current use as park facility recreational activities and beneficial uses including human contact (e.g., swimming and fishing).

Social and Environmental Considerations

The project may provide environmental benefits by reducing demand on surface water supplies within ACWD's service area. Any additions or modifications to water supply would involve outreach and communications with customers. The partner agencies would conduct studies to ensure appropriate measures are taken to continue the recreational beneficial uses at Quarry Lakes and to provide related customer communications.

BENEFITS

- Leverages existing supply sources and connects existing infrastructure for exchanges/transfers.
- Increases water supplies in emergencies, planned outages, and droughts.
- Increases resilience to climate change and future Delta constraints.
- Increase groundwater quality (because of increased reclamation of trapped brackish groundwater).

CHALLENGES

- Warrants significant customer outreach and communications before modifying water supply..
- Requires an evaluation of the impacts of IPR discharges to Quarry Lakes.

DROUGHT MITIGATION MEASURE 4

West Side SFPUC-SCVWD Intertie

SANTA CLARA COUNTY

SFPUC and SCVWD currently have an emergency intertie connecting their systems in Milpitas—the east side of SCVWD's treated water system, which has pipeline and treatment facility redundancy. The intertie improves reliability for SFPUC and SCVWD customers during outages and planned interruptions. This project would construct a second bi-directional intertie pipeline between SFPUC and SCVWD, on the west side of SCVWD's system.

This second intertie would address SCVWD's lack of redundancy in its west side treated water system by connecting to the SFPUC system. SCVWD would extend the West Pipeline that conveys treated water from SCVWD's Rinconada Water Treatment Plant in Los Gatos about 29,500 linear feet (LF) to Page Mill Road in Palo Alto, where an intertie would connect to SFPUC's Bay Division Pipelines 3 and 4.

This project could transfer up to 50 million gallons per day (mgd) of water between the SFPUC and SCVWD systems, providing additional emergency backup supply to both agencies and redundancy for Palo Alto and other cities that rely heavily on SFPUC supplies.

AT A GLANCE

PROJECT TYPE	Intertie
STATUS	Conceptual
ENGAGED BARR AGENCIES	SFPUC, BAWSCA, and SCVWD
AVAILABILITY	Normal and wet years
POTENTIAL YIELD	Capacity of up to 55,000 AFY; actual yield would depend on need and water availability
COST	Capital: $150M O&M: TBD (likely moderate)

Brown AND Caldwell

West Side SFPUC-SCVWD Intertie

Water Supply Yield and Availability

Enables conveyance of up to 55,000 AFY in terms of capacity. However, the total yield would vary significantly from year to year depending on water need and availability. SCVWD has excess supply in normal and wet years.

Regional Resilience

Facilitates water transfers between SFPUC and SCVWD (both directions), increasing supply reliability and resilience to droughts, climate change impacts, planned outages, Delta levee failures, and other emergencies (e.g., earthquakes). Enables exchanges during any year type to support partnerships related to potable reuse and other sources of supply. Provides redundancy for Palo Alto and other cities that rely heavily on SFPUC supplies.

Efficiency

Connects existing water system infrastructure between SFPUC and SCVWD's west side treated water system. Leverages existing supply sources within the SFPUC and SCVWD systems.

Flexibility/Sustainability

Increases flexibility to move water between the SFPUC and SCVWD and among common water retailers as necessary.

Water Quality Considerations

Requires evaluation to determine the impact of blending and ensure that water quality stability is not affected (e.g., ensure corrosion protection to transmission and distribution pipelines; minimize potential taste and odor issues). Retail agencies' water quality needs are also a consideration, since SFPUC and SCVWD supplies are from different sources.

Timing

The project is in a conceptual phase and could be implemented within 7 to 9 years.

Implementability

Constructing the intertie pipeline necessitates permits and California Environmental Quality Act (CEQA) compliance.

Social and Environmental Considerations

Construction of this major infrastructure project will likely require mitigation of environmental impacts and community impacts (e.g., disruptive traffic conditions). Any additions or modifications to water supply would involve outreach and communications with customers.

BENEFITS

- Leverages existing supply sources and connects existing infrastructure for exchanges/transfers.
- Increases water supplies in emergencies, planned outages, and droughts.
- Increases resilience to climate change.
- Increases system redundancy on the west side of SCVWD's treated water system.

CHALLENGES

- Warrants significant customer outreach and communications before modifying water supply.

DROUGHT MITIGATION MEASURE 5

SFPUC-Zone 7 Intertie

ALAMEDA COUNTY

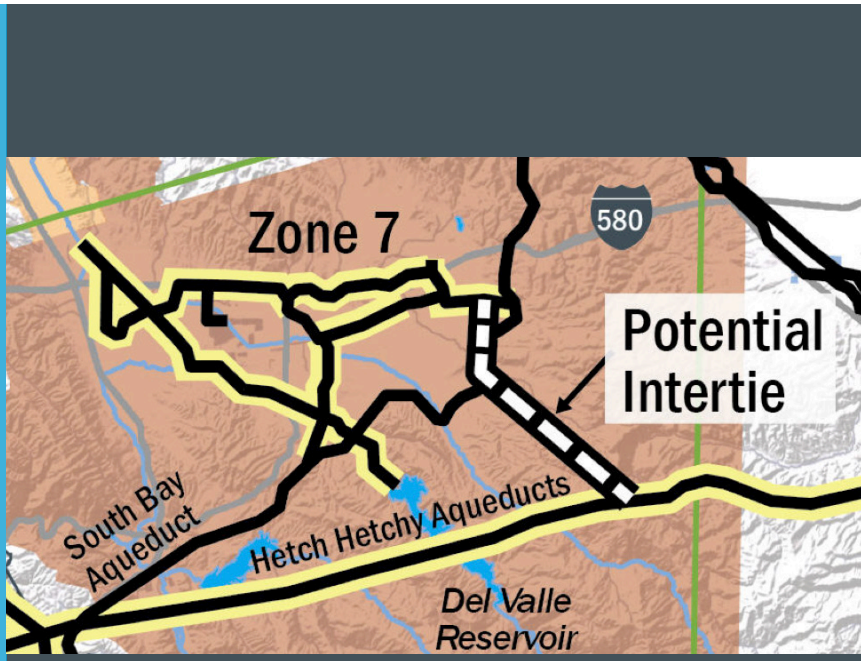
To enable water transfers, Zone 7 and SFPUC would construct an intertie pipeline (approximately 8.5 miles, 24-inch diameter) along with a pumping station, rate control station, and disinfection facility.

The pipeline would connect SFPUC's Hetch Hetchy Regional Water System and the east side of Zone 7's water service area. The intertie's general location would be east of Del Valle Reservoir, about 10 miles south of the City of Livermore. An alternate alignment could cross through the Sunol Valley, connecting to the west side of Zone 7's service area. A disinfection facility may not be necessary at the latter location. The intertie would allow the transfer of up to 11,200 to 28,000 acre-feet per year (AFY), or 10 to 25 million gallons per day (mgd), between SFPUC's aqueduct and Zone 7.

The project would enable transfers in both directions to provide a vital lifeline during drought, major earthquake, or other outage conditions. The project would reduce Zone 7's reliance on diversions from the Delta and State Water Project (SWP) during emergencies. The project also would benefit the SFPUC system during loss of service through the Hetch Hetchy San Joaquin pipelines or further upstream.

AT A GLANCE

PROJECT TYPE	Intertie
STATUS	Conceptual
ENGAGED BARR AGENCIES	SFPUC, BAWSCA, and Zone 7
AVAILABILITY	All years
POTENTIAL YIELD	Up to 11,200 to 28,000 AFY depending on the need and water availability
COST	Capital: $66M O&M: TBD (low from SFPUC to Zone 7; medium from Zone 7 to SFPUC, because of pumping costs)



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SFPUC-Zone 7 Intertie

Water Supply Yield and Availability

Enables transfer of up to 11,200 to 28,000 AFY, depending on the need and supply availability.

Regional Resilience

Facilitates water transfers between SFPUC/BAWSCA and Zone 7 in all year types. Increases supply reliability and resilience to droughts, climate change impacts, planned outages, Delta levee failures, and other emergencies (e.g., earthquakes).

Efficiency

Connects existing infrastructure in SFPUC's Hetch Hetchy Regional Water System and Zone 7 water service area. Leverages existing supply sources.

Flexibility/Sustainability

Provides ability for bi-directional transfers between SFPUC and Zone 7.

Water Quality Considerations

Requires evaluation to determine the impact of blending and ensure that water quality stability is not affected (e.g., ensure corrosion protection to transmission and distribution pipelines; minimize potential taste and odor issues). If used to recharge Zone 7's groundwater basin, low-salinity water from SFPUC would reduce salt loading in the basin, addressing a long-standing concern over salt accumulation within the Livermore Valley Groundwater Basin.

Timing

The project is in the conceptual phase. Design and California Environmental Quality Act (CEQA) environmental analysis could be completed in approximately 1 or 2 years, and the project could be fully implemented within 4 to 5 years.

Implementability

Constructing the intertie pipeline necessitates permits and CEQA compliance. Water rights modifications may be required to execute transfers/exchanges through the intertie pipeline.

Social and Environmental Considerations

Construction of this major infrastructure project will likely require mitigation of environmental impacts and community impacts (e.g., disruptive traffic conditions).

BENEFITS

- Leverages existing supply sources and connects existing infrastructure for exchanges/transfers.
- Provides water supply alternatives during emergencies, planned outages, and droughts.
- Increases resilience to climate change and future Delta constraints.

CHALLENGES

- Requires potential water rights modifications to enable transfers/exchanges.
- Involves some construction in a highly-urbanized area (disruptive to transportation and local community).
- Requires significant permitting and CEQA evaluation.

DROUGHT MITIGATION MEASURE 6

MMWD-EBMUD Intertie

CONTRA COSTA COUNTY AND MARIN COUNTY

To enable water transfers under emergency conditions, MMWD and EBMUD would build a bi-directional intertie pipeline (approximately 7 miles long) over the Richmond-San Rafael Bridge or across the floor of the San Francisco Bay (adjacent to the bridge). While the pipeline would enable flows both directions, transfers from EBMUD to MMWD are more likely to occur, because MMWD's supplies are more vulnerable.

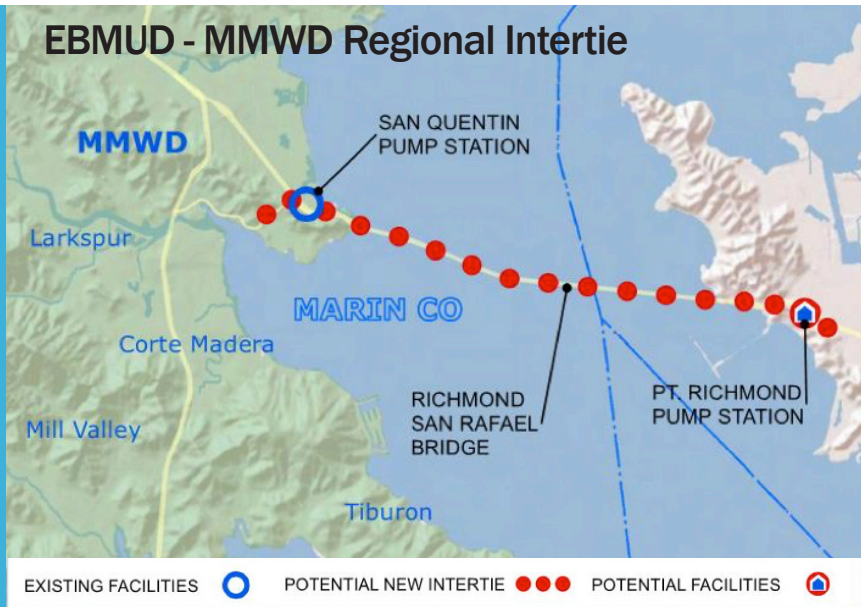
The pipeline would support a normal operating flowrate of 5 million gallons per day (mgd), allowing for transfers of up to 460 acre-feet (AF) per month or about 5,600 acre-feet per year (AFY). The pipeline design would provide flexibility for future expansion to increase the maximum flowrate to 8.9 mgd (10,000 AFY).

The intertie would be constructed in two phases. Phase I consists of approximately 21,400 linear feet (LF) of 24-inch diameter steel pipe installed on the Richmond-San Rafael Bridge. Pipelines must be constructed on the eastern side of the bridge to connect to EBMUD's water distribution system.

Phase II would involve installing pipe connections to the EBMUD and MMWD systems at each end of the bridge and constructing a new pumping station in Point Richmond. The connection point location must be suitable to allow conveyance of an acceptable volume of water, while also not adversely affecting EBMUD's users. The pumping station would convey water from the connection point to MMWD's distribution system. At the bridge's western end, the intertie pipeline would extend to MMWD's San Quentin Pump Station, which may require enhancements to deliver water effectively to MMWD's distribution system.

AT A GLANCE

PROJECT TYPE	Intertie
STATUS	Conceptual
ENGAGED BARR AGENCIES	MMWD and EBMUD
AVAILABILITY	All years
POTENTIAL YIELD	5,600 to 10,000 AFY
COST	Capital: $45M O&M: $100/AF (low)



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MMWD-EBMUD Intertie

Water Supply Yield and Availability

Enables conveyance of 5,600 to 10,000 AFY (normal operating flow rate of 5 mgd; future expansion maximum flow rate of 8.9 mgd).

Regional Resilience

Facilitates water transfers between MMWD and EBMUD (both directions), increasing supply reliability and resilience to droughts, climate change impacts, planned outages, Delta levee failures, and other emergencies (e.g., earthquakes).

Efficiency

Connects existing water system infrastructure. Leverages existing supply sources within the region.

Flexibility/Sustainability

Increases flexibility to move water where needed.

Water Quality Considerations

Requires evaluation to determine the impact of blending and ensure that water quality stability is not affected (e.g., ensure corrosion protection to transmission and distribution pipelines and delivered water quality; minimize potential taste and odor issues).

Timing

This project is in the conceptual phase and could be implemented within 3 to 5 years.

Implementability

Constructing the intertie pipeline in an urban area necessitates complying with the California Environmental Quality Act (CEQA); coordinating with many jurisdictions, property owners, and permitting agencies; securing permits; establishing an agreement with Caltrans for access and use of to the Richmond-San Rafael Bridge; and developing traffic control plans. Water rights modifications may be required to execute transfers/exchanges through the intertie pipeline. Construction across the bridge could be challenging and disruptive to traffic flow.

Social and Environmental Considerations

Construction of this major infrastructure project will likely require mitigation of environmental impacts and community impacts (e.g., disruptive traffic conditions).

BENEFITS

- Leverages existing supply sources and connects existing infrastructure for exchanges/transfers.
- Increases water supplies in emergencies, planned outages, and droughts.
- Increases resilience to climate change.

CHALLENGES

- Requires potential water rights modifications to enable transfers/exchanges.
- Involves construction in a highly-urbanized area (disruptive to transportation and local community) and may involve coordination with many jurisdictions, property owners, and permitting agencies.

DROUGHT MITIGATION MEASURE 7

Los Vaqueros Expansion

CONTRA COSTA COUNTY

CCWD's Los Vaqueros (LV) Reservoir is located in the foothills east of Mt. Diablo, between the cities of Brentwood and Livermore. This project would expand LV Reservoir capacity by 115,000 acre-feet (AF), from 160,000 AF to 275,000 AF.

A companion project (Transfer-Bethany Pipeline) would construct a pipeline between the LV Reservoir system and the South Bay Aqueduct (SBA). Together, the projects could broaden the sources of water diverted and stored in LV Reservoir to include State Water Project (SWP) supplies and other water supplies on behalf of agencies potentially partnering in the project. Facilities and operations would be adaptively managed in response to environmental conditions, new regulations, and climate change to ensure that water supply reliability is sustained in the future.

The project would improve water operations of regional partners and has the potential to improve operation of the Central Valley Project (CVP) and SWP. Increasing operational flexibility and interagency coordination could improve the ability of the CVP and SWP to meet regulatory requirements.

The project could increase opportunities for partnering agencies that rely on groundwater to improve conjunctive use operations. Coordinating LV Reservoir operations with partner groundwater operations and other independent recharge projects would lead to improved conjunctive use and groundwater management/sustainability throughout the region.

AT A GLANCE

PROJECT TYPE	Expanded Storage
STATUS	Preliminary design
ENGAGED BARR AGENCIES	ACWD, BAWSCA, CCWD, EBMUD, SFPUC, SCVWD, and Zone 7
AVAILABILITY	All years
POTENTIAL YIELD	An additional 115,000 AF
COST	Capital: $600M O&M: TBD (likely low)

Brown AND Caldwell

Los Vaqueros Expansion

Water Supply Yield and Availability

Expands the existing LV Reservoir capacity by 115,000 AF, from 160,000 AF to 275,000 AF.

Regional Resilience

Increases supply reliability and resilience to droughts, climate change impacts, planned outages, Delta levee failures, and other emergencies (e.g., earthquakes).

Efficiency

Leverages existing infrastructure such as CCWD's Delta intakes, the EBMUD Freeport Intake, regional interties, and the SBA. Leverages existing supply sources from the participating agencies, and also provides the opportunity for SCVWD to store, transfer, or exchange water produced at the Silicon Valley Advanced Water Purification Center expansion to other regional partners.

Flexibility/Sustainability

Increases operational flexibility and regional storage. Facilitates seasonal and dry year water transfers, providing greater flexibility in water deliveries in the region. Incorporates adaptive management of facilities and operations in response to environmental conditions, new regulations, and climate change to ensure water supply reliability.

Timing

The project is in the preliminary design phase. Construction could begin as early as 2022; however, the existing reservoir would need to be drained prior to construction, which would require at least 1 year. The dam expansion could be constructed in 2 years.

Water Quality Considerations

Supports CCWD's operational strategy to fill LV Reservoir during wet periods (i.e., when the Delta is lower in salinity) and release water during dry periods (i.e., when the Delta is more saline). Expands water quality benefits to regional partners and provides protection from future declines in Delta water quality (e.g., climate change impacts and emergencies). Requires evaluation of blending water (treatability and post-treatment stabilization).

Implementability

In 2017, CCWD will seek California Water Commission funding for this project and release the Supplement to the Final Environmental Impact Report (EIR)/ Environmental Impact Statement (EIS), to be finalized by late 2018 along with the Federal Feasibility Study. Water rights modifications may also be required to store others' supplies or execute transfers.

Social and Environmental Considerations

Benefits Delta fisheries through state-of-the-art fish screens and increased operational flexibility (i.e., avoiding diversions at critical times/locations and coordinating operations with SWP and Central Valley Project [CVP] Delta export facilities). Inundates new areas at LV Reservoir, which may affect terrestrial and cultural resources in the watershed.

BENEFITS

- Leverages existing supply sources and infrastructure.
- Increases water supplies in emergencies, planned outages, and droughts.
- Increases resilience to climate change and future Delta constraints.
- Enhances ecosystem benefits.
- Improves water quality.

CHALLENGES

- Requires potential water rights modifications to enable transfers/exchanges.
- Inundates new areas and may affect terrestrial and cultural resources in the watershed.

DROUGHT MITIGATION MEASURE 8

Walnut Creek Water Treatment Plant Pretreatment Facility

CONTRA COSTA COUNTY

As a companion project to the Transfer-Bethany Pipeline and Los Vaqueros (LV) Reservoir Expansion, this project involves upgrading the Walnut Creek Water Treatment Plant (WCWTP) to treat a more diverse range of supply sources by installing a 115 million gallons per day (mgd) (128,800 acre-feet per year [AFY]) pretreatment facility.

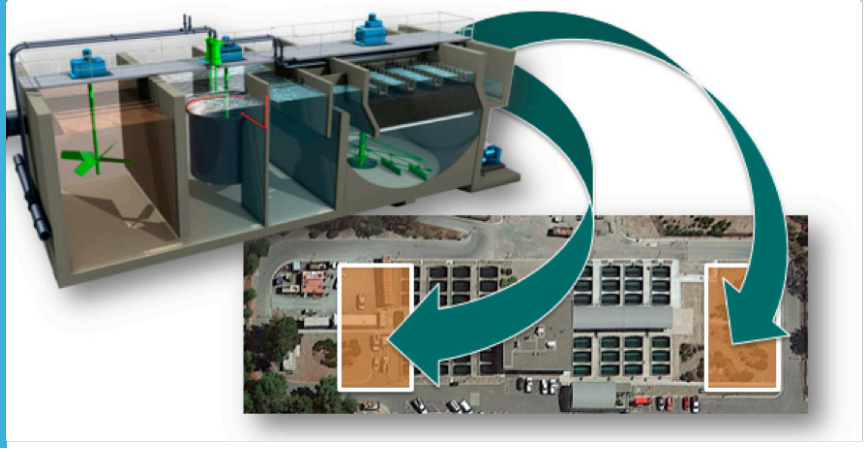
The WCWTP currently treats high-quality raw water from Pardee and Briones reservoirs with low turbidity and total organic carbon (TOC). The current system lacks the capability to treat raw water with relatively high TOC and turbidity (i.e., higher than that of the Mokelumne River). In addition, the current treatment process is vulnerable to water quality variations because of wildfire or landslides within EBMUD's watershed. If water quality were to suffer because of fire or landslide, the current WCWTP could not meet water quality requirements. Addressing this limitation is key in treating and conveying water for the benefit of neighboring agencies.

Pilot testing is currently under way to evaluate pretreatment alternatives to reduce TOC and high turbidity, and improve filterability. Predesign is also in progress on potential designs to solve these water quality challenges; the leading technology proposed is ballasted flocculation/sedimentation and pre-ozone.

AT A GLANCE

PROJECT TYPE	Treatment/supply
STATUS	Preliminary design
ENGAGED BARR AGENCIES	ACWD, BAWSCA, CCWD, EBMUD, SFPUC, SCVWD, and Zone 7 (to be confirmed)
AVAILABILITY	Normal and dry years
POTENTIAL YIELD	128,800 AFY
COST	Capital: $35-60M (depending on scale of capacity) O&M: TBD (likely moderate)

Process Diagram On-site Map



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Water Supply Yield and Availability

The pretreatment facility would be constructed to meet the hydraulic requirement of the WCWTP and to support the current capacity of 115 mgd (128,800 AFY). Depending on budget constraints, project implementation may be phased to reach the full water treatment plant capacity.

Regional Resilience

Complements regional reliability and resilience benefits of LV Expansion and Transfer-Bethany Pipeline. Allows EBMUD to expand its water supply through WCWTP and convey/treat lower-quality raw water supplies from other Bay Area agencies via existing or new interties.

Efficiency

Leverages existing water system infrastructure by utilizing the existing WCWTP for a wider range of supply sources. Stretches existing supply sources.

Flexibility/Sustainability

Greatly enhances EBMUD's water treatment flexibility to address a wider range of source water quality. For example, the upgraded plant could treat water from the Sacramento River, LV Reservoir, or other sources that require robust treatment. Other Bay Area agencies could receive treated water wheeled through EBMUD's distribution system and interties. Increases opportunities for local groundwater conjunctive storage projects.

Implementability

The proposed project is feasible from a constructability standpoint. However, community involvement and outreach for the project would be required.

Water Quality Considerations

Expands the range of source water quality treated at the WCWTP allowing for treatment of new water sources and blends into the WCWTP, the EBMUD interties, and the distribution system. Improves long-term water quality regulatory compliance during droughts, water quality fluctuations, and Mokelumne supply interruptions (e.g., natural disasters that threaten raw water conveyance). Requires evaluation to determine the impact of blending and ensure that water quality stability is not affected (e.g., ensure corrosion protection to transmission and distribution pipelines and delivered water quality; minimize potential taste and odor issues).

Timing

The project is in the preliminary design phase. Conceptual plans, California Environmental Quality Act (CEQA) evaluation, and land acquisition are complete. Detailed design and construction could require up to 3 years.

Social and Environmental Considerations

The project would improve EBMUD's ability to provide high-quality drinking water during droughts, emergencies, and planned and unplanned shortages. In addition, this project would reduce energy usage and greenhouse gases produced while treating supplemental drought supply. No significant environmental effects are anticipated.

BENEFITS

- Leverages existing supply sources and infrastructure.
- Increases water supplies in emergencies, planned outages, and droughts by enabling treatment of raw water sources of varying quality.
- Increases resilience to climate change and future Delta constraints.
- Increases opportunities for conjunctive use.
- Improves water quality (including taste and odor control, a multiple barrier approach for pathogen control, and emerging contaminants barrier).
- Provides a more energy-efficient mode of treatment for supplemental supply.

CHALLENGES

- Involves construction in a suburban area (disruptive to transportation and local community).
- Warrants significant customer outreach and communications.

DROUGHT MITIGATION MEASURE 9

Regional Desalination Plant

CONTRA COSTA COUNTY

The Bay Area Regional Desalination Project (BARDP) would construct a brackish water treatment plant at CCWD's existing Mallard Slough Pump Station to provide a supplemental water supply and enhance regional resilience during dry water years and emergencies (e.g., earthquakes, levee failures, and maintenance-related outages). The project partners (CCWD, EBMUD, SCVWD, SFPUC, and Zone 7) would work together to leverage and optimize existing infrastructure and assets to convey the desalination product water.

BARDP would use a two-stage reverse osmosis treatment train to filter 28,000 acre-feet per year (AFY) of brackish water from the Mallard Slough to produce 22,400 AFY (80 percent recovery). The remaining 5,600 AFY concentrate stream would be sent to the Central Contra Costa Sanitary District or Delta Diablo Sanitation District for disposal through an existing outfall equipped with a multi-port diffuser.

If operated conjunctively with Los Vaqueros (LV) Reservoir, the project would improve dry-year supply reliability to project partners and provide a base supply during normal years for some partners. Excess production could be stored in LV Reservoir in non-drought years through an exchange with CCWD, and the stored water could be released from LV Reservoir in dry years.

Water Supply Yield and Availability

Produces 22,400 AFY of treated water from a brackish water intake of 28,000 AFY (20 mgd).

AT A GLANCE

PROJECT TYPE	Treatment/supply
STATUS	Preliminary design
ENGAGED BARR AGENCIES	CCWD, EBMUD, SCVWD, SFPUC, and Zone 7
AVAILABILITY	All years
POTENTIAL YIELD	22,400 AFY
COST	Capital: $175M O&M: $300–$390/AF (moderate)

Brown AND Caldwell

Regional Resilience

Provides a local, drought-resistant source of supply for project partners, increasing supply reliability and resilience to droughts, climate change impacts, planned outages, Delta levee failures, and other emergencies (e.g., earthquakes). If operated conjunctively with LV Reservoir, the project would improve dry-year supply reliability and provide a base supply during normal years for some partners.

Efficiency

Leverages existing infrastructure and assets (e.g., LV Reservoir and transmission lines). Provides cost savings through economies of scale compared to individual supplemental supply projects by each agency.

Flexibility/Sustainability

Allows excess production to be stored in LV Reservoir or delivered to partners in non-drought years, through an exchange with CCWD. The stored water in LV could then be released from the reservoir in drought years.

Water Quality Considerations

Requires evaluation to determine the impact of blending and ensure that water quality stability is not affected (e.g., ensure corrosion protection to transmission and distribution pipelines and delivered water quality; minimize potential taste and odor issues). Brine disposal could increase salinity in receiving waters, but preliminary analyses show that increases in Delta salinity would be insignificant.

Timing

The project is in the preliminary design phase. A feasibility study, pilot testing, and Delta modeling have been conducted. California Environmental Quality Act (CEQA) documentation has not been completed. The project could be constructed as early as 2030.

Implementability

Environmental documentation assessing the potential impacts of the project has not been completed. In the past, similar desalination projects in the region have lacked public support or received strong public opposition.

Conveying new supplies and transferring/exchanging supplies among partner agencies may be challenging and require new agreements and additional interties and infrastructure. Water rights modifications would be required to share water among partner agencies. During critically dry water years, operations would need to be coordinated with the Central Valley Project (CVP)/State Water Project (SWP) and the City of Antioch to avoid potential impacts.

Social and Environmental Considerations

The public has voiced concerns about potential impacts to fisheries, increased energy consumption, increased greenhouse gas emissions. Potential impacts on fisheries could be reduced or avoided through operational best practices and facility design. Recent advances in treatment technologies may also decrease energy usage.

BENEFITS

- Increases water supplies in emergencies, planned outages, and droughts.
- Increases resilience to climate change and future Delta constraints.
- Provides cost savings through economies of scale, as compared to individual supplemental supply projects by each agency.
- Reduces potential adverse environmental impacts associated with construction of separate (decentralized) desalination plants.
- Promotes regional cooperation by joint ownership, operation, and management of the desalination facility.

CHALLENGES

- Requires potential water rights modifications to enable transfers if diversion is increased above 11,900 AFY at Mallard Slough.
- Requires significant permitting and CEQA evaluation.
- Lacks public support/triggers public opposition.

DROUGHT MITIGATION MEASURE 10

Silicon Valley Advanced Water Purification Center Expansion

SANTA CLARA COUNTY

An expansion of the Silicon Valley Advanced Water Purification Center (SVAWPC) of up to about 25 million gallons per day (mgd) would produce additional purified water that could be delivered directly to SCVWD or SFPUC systems and indirectly to regional partners through water banking, exchanges, or transfers. Regional partners are currently assessing the feasibility of such water sharing opportunities.

SVAWPC currently purifies up to 8 mgd of recycled water from the San Jose-Santa Clara Regional Wastewater Facility (RWF) using microfiltration, reverse osmosis, and ultraviolet light. The facility's current use is essentially a pilot project. Water from SVAWPC is blended with tertiary-treated effluent from the RWF to reduce total dissolved solids (TDS), sodium, silica, organics, and other constituents. The blended supply enhances the recycled water quality, enabling expanded recycled water use for non-potable purposes.

Independent of the BARR partnership, SCVWD is planning to construct a new treatment facility adjacent to the existing facility in San Jose.

The new facility will have advanced oxidation in the treatment train to produce a more purified product and will have a capacity of about 20 million gallons per day (mgd). Water from the new facility would be used for indirect potable reuse (IPR) through groundwater recharge and/or injection or both IPR and direct potable reuse (DPR) through augmenting SCVWD's raw water system. Adding this new supply would help to maintain groundwater storage and minimize the risk of land subsidence in northern Santa Clara County.

The project considered in the BARR partnership involves an incremental expansion of the new treatment facility from the baseline capacity of about 20 mgd to about 45 mgd.

AT A GLANCE

PROJECT TYPE	Treatment/supply
STATUS	Preliminary design (SVAWPC Expansion) and Planning (regional partnerships)
ENGAGED BARR AGENCIES	SCVWD, SFPUC, and BAWSCA
AVAILABILITY	All years
POTENTIAL YIELD	Up to 25,000 AFY
COST	Capital: $600M O&M: $10M/year; ~$700/AF (high)

Brown AND Caldwell

Water Supply Yield and Availability

Produces up to an additional 25,000 acre-feet per year (AFY) (25 mgd) of purified drinking water, operating year-round in all water year types.

Regional Resilience

Provides a supplemental, local, drought-resistant supply, increasing groundwater recharge, supply reliability, and resilience to droughts, climate change impacts, planned outages, Delta levee failures, and other emergencies (e.g., earthquakes).

Efficiency

Builds on existing infrastructure and assets, including the SVAWPC and San Jose-Santa Clara RWF. Recovers a local water resource otherwise discharged to the San Francisco Bay.

Flexibility/Sustainability

Provides an increased supply for groundwater recharge in Santa Clara County, a region that historically experienced subsidence because of groundwater over pumping. Contributes additional supply to storage, which may support increased conjunctive management.

Water Quality Considerations

Produces highly treated water with low TDS, and may improve lower-quality supplies if blended. Reduces wastewater flows and nutrient loading to the San Francisco Bay. Whether used for groundwater or surface water augmentation the water would receive post-treatment stabilization for corrosion control and aesthetics. Advanced treatment processes will be designed to ensure protection of public health and groundwater quality.

Timing

The project is in the preliminary design phase and is estimated to require 5 to 10 years to complete.

Implementability

Project implementation challenges include managing reverse osmosis concentrate and fully utilizing the purified water during low-demand periods. In addition, work is ongoing to determine the allocation of wastewater flows between potable reuse, non-potable reuse, and outflows to the Bay. The project will require close coordination and collaboration with the City of San Jose, which manages the RWF, on managing/disposing reverse osmosis concentrate and securing source water for purification.

Social and Environmental Considerations

The project would improve the agencies' ability to provide water during dry years, emergencies, and maintenance-related outages, which improves economic security and quality of life for customers. A reliable water supply in the agencies' service area is critical to health and safety, as well as local agriculture and the many businesses in Silicon Valley that contribute significantly to the economic health of the Bay Area.

California Environmental Quality Act (CEQA) analysis and engineering controls would be needed to mitigate increased salinity concentrate disposal that could increase receiving water salinity.

BENEFITS

- Leverages existing local, drought-resilient supply source and infrastructure.
- Capitalizes on large groundwater basin and multiple treatment facilities.

CHALLENGES

- Requires significant permitting.
- Requires significant cooperation and coordination with wastewater producer.
- Involves determining allocation of wastewater flows between potable reuse, non-potable reuse, and outflows to the Bay.
- Requires CEQA analysis and engineering controls to mitigate increased salinity concentrate disposal.

DROUGHT MITIGATION MEASURE 11

Mid-Peninsula Potable Reuse Exploratory Plan

SAN MATEO COUNTY

The Mid-Peninsula Potable Reuse Exploratory Plan (PREP) project involves a partnership among three water agencies (SFPUC, BAWSCA, and California Water Service Company [Cal Water]) and a wastewater agency (Silicon Valley Clean Water [SVCW]), to explore implementation of indirect potable reuse (IPR).

SVCW provides wastewater services including collection, treatment, and discharge of treated water to the San Francisco Bay. In addition, SVCW produces tertiary-treated recycled water for customers in the mid-peninsula region (south of San Francisco). In planning a facility upgrade and anticipating potential regulatory changes on the horizon, SVCW approached SFPUC, BAWSCA, and Cal Water to explore the feasibility and mutual interest in a collaborative IPR project that could address water supply reliability and drought preparedness for the mid-peninsula. The project would use reverse osmosis and other advanced purification technologies to produce up to 6,720 acre-feet per year (AFY) (6 million gallons per day [mgd]) of drinking water quality supply for the region.

The agencies will consider changes to infrastructure (including new interconnections), water transfers/exchanges, capacity of existing facilities, and institutional arrangements needed to support the collaborative partnership.

AT A GLANCE

PROJECT TYPE	Treatment/supply
STATUS	Planning
ENGAGED BARR AGENCIES	SFPUC and BAWSCA
AVAILABILITY	All years
POTENTIAL YIELD	Up to 6,720 AFY
COST	Capital: TBD O&M: TBD (high)

Brown AND Caldwell

Water Supply Yield and Availability

Produces up to approximately 6,720 AFY (6 mgd) of purified drinking water, operating year-round in all water year types.

Regional Resilience

Provides a supplemental, local, drought-resistant water supply for the SFPUC and BAWSCA service area, including Cal Water.

Efficiency

Recovers a local water resource otherwise discharged to the San Francisco Bay. Builds on SVCW's anticipated upgrade to existing recycled water infrastructure and assets to provide multiple, mutual benefits such as managing wastewater discharges, supporting discharge regulatory compliance, and producing a drought-resistant, reliable water supply.

Flexibility/Sustainability

Provides an additional reliable, drought-resistant local water supply for SFPUC and BAWSCA (including Cal Water), which may reduce demand on surface water and groundwater supplies.

Water Quality Considerations

Produces highly treated water with low total dissolved solids (TDS), and may improve lower-quality supplies if blended. Reduces wastewater flows and nutrient loading to the San Francisco Bay.

Whether used for groundwater or surface water augmentation the water would receive post-treatment stabilization for corrosion control and aesthetics. Advanced treatment processes would be designed to ensure protection of public health and groundwater/surface water quality.

Timing

An initial feasibility study is currently underway and will be complete in mid-2017.

Implementability

The initial feasibility study will identify implementation challenges. Interagency agreements would be required to share water among partner agencies. The project may require a wastewater change petition, as well as significant permitting and a California Environmental Quality Act (CEQA) evaluation.

Social and Environmental Considerations

The project would improve the agencies' ability to provide water during dry years, emergencies, and maintenance-related outages, which would improve the economic security and quality of life for customers. A reliable water supply is critical to health and safety, as well as the many businesses in Silicon Valley that contribute significantly to the economic health of the Bay Area.

Concentrate disposal could increase salinity in receiving waters and would have an environmental impact (which may be positive). Rigorous analysis would be needed to select the best disposal option(s).

BENEFITS

- Leverages existing local, drought-resilient supply source and infrastructure.
- Increases water supplies in emergencies, planned outages, and droughts by enabling treatment of raw water sources of varying quality.

CHALLENGES

- Requires potential wastewater change petition.
- Requires significant brackish waste disposal.
- Requires significant permitting and CEQA evaluation.

DROUGHT MITIGATION MEASURE 12

Joint Tri-Valley Potable Reuse Feasibility Study

ALAMEDA COUNTY AND CONTRA COSTA COUNTY

The Joint Tri-Valley Potable Reuse Feasibility Study involves a partnership among Zone 7, California Water Service Company (Cal Water), Dublin San Ramon Services District (DSRSD), and the Cities of Livermore and Pleasanton to explore potential regional potable reuse opportunities.

The partnership would complement other ongoing wastewater reuse efforts—such as joint powers authority formed in 1995 between DSRSD and EBMUD, the DSRSD-EBMUD Recycled Water Authority (DERWA).

The project would produce an estimated 4,800 to 7,700 acre-feet per year (AFY) of purified drinking water supply for the Tri-Valley region (Zone 7 and its retailers) through purification of wastewater using advanced treatment technologies—including membrane filtration, reverse osmosis, followed by ultraviolet light/advanced oxidation.

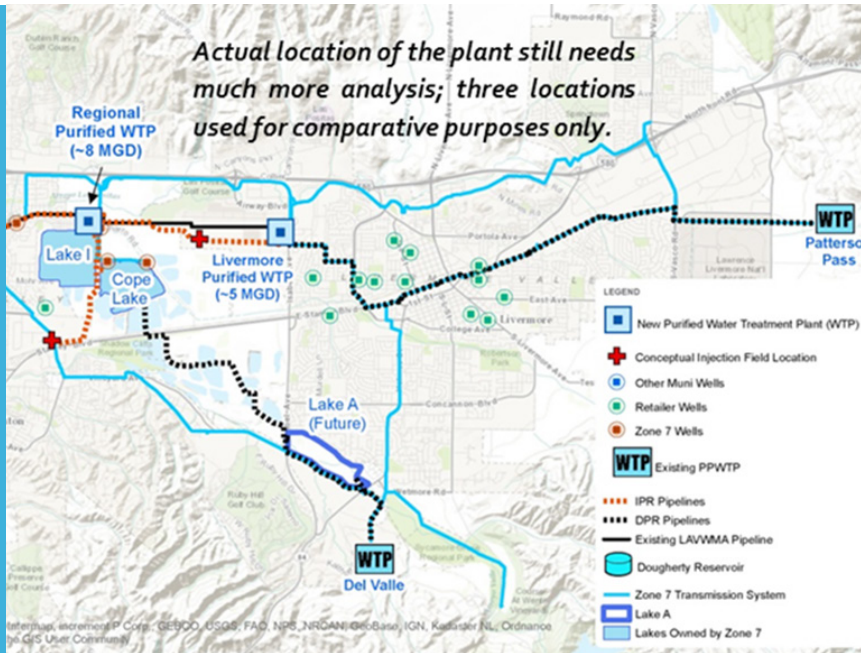
The project partners are considering potable reuse applications such as injecting the purified water into the groundwater basin before extracting for later use as a potable water supply, surface water recharge of the groundwater basin, and introduction of purified water upstream of a water treatment plant.

Water Supply Yield and Availability

Produces about 4,800 to 7,700 AFY of purified drinking water, operating year-round in all water year types. (Yield estimates are being refined through an ongoing feasibility study.)

AT A GLANCE

PROJECT TYPE	Treatment/supply
STATUS	Planning
ENGAGED BARR AGENCIES	Zone 7; other regional partners TBD, potentially including CCWD, EBMUD, and/or SFPUC
AVAILABILITY	All years
POTENTIAL YIELD	4,800 to 7,700 AFY
COST	Capital: $76M - $152M O&M: Likely high



Brown AND Caldwell

Regional Resilience

Provides a supplemental, local, drought-resistant supply for the Tri-Valley region, which could make water available and enable transfers and/or water marketing opportunities with other BARR partners through future interties (e.g., EBMUD, SFPUC) and/or exchanges of State Water Project (SWP) supplies in above normal/wet years). Increases groundwater recharge, supply reliability, and resilience to droughts, climate change impacts, planned outages, Delta levee failures, and other emergencies (e.g., earthquakes).

Efficiency

Builds on existing infrastructure and assets to the extent possible. Recovers a local water resource otherwise discharged to the San Francisco Bay.

Flexibility/Sustainability

Provides an increased supply for groundwater recharge. Contributes additional supply to storage, which may support increased conjunctive management.

Water Quality Considerations

Produces highly treated water with low TDS, and may improve lower-quality supplies if blended. Reduces wastewater flows and nutrient loading to the San Francisco Bay. Whether used for groundwater or surface water augmentation the water would receive post-treatment stabilization for corrosion control and aesthetics. Advanced treatment processes would be designed to ensure protection of public health and groundwater/surface water quality.

Timing

An initial feasibility study is currently underway and will be complete by early 2018.

Implementability

The initial feasibility study will identify implementation challenges. Interagency agreements would be among water/wastewater agencies. The project will likely require significant permitting and California Environmental Quality Act (CEQA) evaluation. Local control of this water supply would likely be a motivating factor and implementation driver.

Social and Environmental Considerations

The project would improve the agencies' ability to provide water during dry years, emergencies, and maintenance-related outages, which would improve the economic security and quality of life for customers. A reliable water supply is critical to health and safety, as well as local agriculture and the many businesses in that contribute significantly to the economic health of the Bay Area.

Concentrate disposal may increase salinity in receiving waters and may have an environmental impact. An analysis would be needed to select the best disposal option(s). Advanced treatment processes can be energy-intensive.

Effective public communication and education will be needed in order to address any public concerns over the safety of potable reuse.

BENEFITS

- Recovers a local water resource otherwise discharged to the San Francisco Bay.
- Provides a supplemental, local, drought-resistant supply for the Tri-Valley region.

CHALLENGES

- Requires concentrate disposal and possible concentrate treatment.
- Requires effective public communication and education to address any public concerns over the safety of potable reuse.

DROUGHT MITIGATION MEASURE 13

Regional Advanced Metering Infrastructure Feasibility Assessment

ALAMEDA, CONTRA COSTA, MARIN, AND SANTA CLARA COUNTIES

Advanced Metering Infrastructure (AMI) is a wireless technology effective for measuring/monitoring water consumption and leaks and for promoting customer awareness of water use. Most BARR agencies are already exploring or implementing AMI, and this project would involve a regional feasibility study to evaluate further AMI expansion on an agency-by-agency basis.

The study would leverage lessons learned, best practices, and key strategies from agencies that have implemented pilot and full-scale AMI projects. In addition to identifying opportunities for AMI expansion, the study would also involve identifying potential implementation barriers and a benefit-cost assessment, based on existing programs.

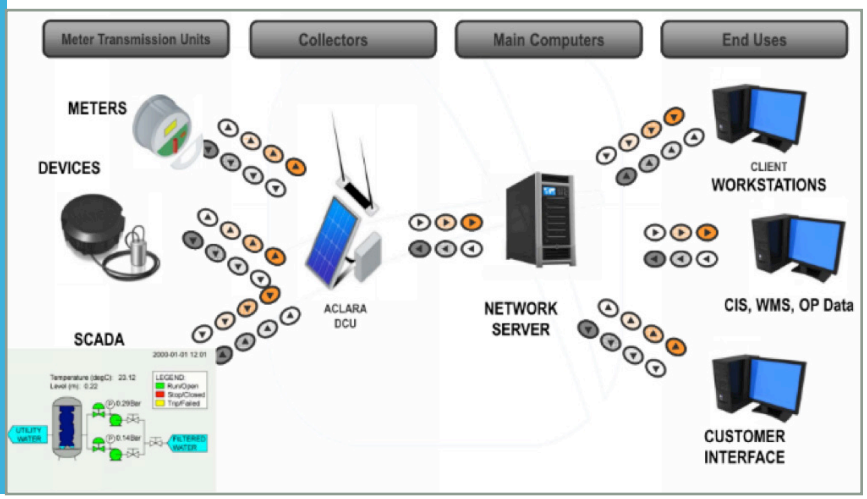
Data collected through AMI may improve water management at both the utility and customer levels, enabling prompt leak detection in distribution systems and on the customer side of meters.

The information produced through AMI can also serve a number of other applications that benefit utilities and customers, such as improvements related to customer service and operational efficiencies. Water agencies can recover revenue through reducing distribution system water losses from leaks and unauthorized uses. Improved accuracy of water use supports billing equity among ratepayers and collection of fees for all water used. AMI can also allow customers to access real-time information on their water use, which helps in identifying leaks and opportunities for other water use efficiency improvements (e.g., irrigation modifications).

The extent to which BARR agencies have implemented AMI in their systems and service areas varies by agency. Some agencies do not yet have AMI, while some agencies have conducted small-scale pilot projects with a subset of customers (e.g., EBMUD). Others have already implemented AMI either partially or fully (e.g., SFPUC).

AT A GLANCE

PROJECT TYPE	Operations
STATUS	Conceptual
ENGAGED BARR AGENCIES	ACWD, CCWD, EBMUD, MMWD, and SCVWD (through partnerships with water retailers)
AVAILABILITY	All years
POTENTIAL YIELD	0.07 AFY/meter installed (70,000 AFY for 1M meters)
COST	Capital: $250/meter installed ($250M for 1M meters) O&M: TBD (moderate)



Brown AND Caldwell

Water Supply Yield and Availability

Reduces water use by an estimated 5 to 10 percent of total demand, based on EBMUD's pilot test results. The supply yield depends on the number of AMI meters installed. Assuming a 1-million AMI meter installation project, water use could be reduced by about 70,000 acre-feet (AF).

Regional Resilience

Supports water use efficiency by enhancing customer awareness of water use (prompting behavioral changes and leak identification/ reduction) and utility monitoring.

Efficiency

Real-time AMI data helps utilities identify system leaks, detect unauthorized use, and improve system operation and facility sizing.

Flexibility/Sustainability

AMI increases water use efficiency, which may stretch existing supplies; delay planned development of new (or expanded) supply projects; and reduce pumping, treatment, distribution, and disposal costs.

Water Quality Considerations

AMI systems could be equipped with sensors to provide real-time water quality data to identify problems with pipeline integrity that may contribute to water quality degradation.

Timing

The regional feasibility assessment is currently conceptual, though some agencies are further along in planning or implementing AMI.

Implementability

Based on the results of existing AMI programs, the most significant concern of AMI implementation is related to cost. AMI meter installation may be phased over time.

Social and Environmental Considerations

Customer outreach is a critical element in garnering ratepayer support for AMI implementation. Communications should clearly address the economic and water conservation benefits to water metering. Increased accuracy of water use data can improve billing equity among ratepayers and support collection of fees for all water used, eventually providing dividends that delay the need for water rate increases. Providing customers with better usage data would also help them understand where and how they can use water more efficiently to reduce demand on surface water and groundwater supplies.

BENEFITS

- Reduces water loss (both in distribution systems and on customer side of meters).
- Elevates customer awareness of water use.
- Increases accuracy of meter reading (which can reduce injuries and claims and support planning/design for sizing future facilities).
- Supports drought outreach and enforcement.

CHALLENGES

- Costs may be prohibitively high for some agencies.
- Warrants significant customer outreach and communications.

DROUGHT MITIGATION MEASURE 14

Del Valle Reservoir Water Supply Storage Expansion Project

ALAMEDA COUNTY

Lake Del Valle is an off-stream reservoir located 10 miles south of the City of Livermore within Del Valle Regional Park and owned and operated by the California Department of Water Resources (DWR) as part of the State Water Project (SWP) system for water supply and flood storage. This project would modernize flood management rules to allow for using a greater portion of existing reservoir capacity to store water supply while maintaining necessary flood protection.

The change would make a greater amount of emergency water supply available to South Bay Aqueduct (SBA) Contractors (ACWD, SCVWD, and Zone 7) during system outages or periods when Delta pumping is limited due to environmental or water quality constraints.

The participating agencies would implement a Forecast Informed Reservoir Operation (FIRO) and use modeling and forecasting tools to improve flood control and water supply operations. Existing East Bay Regional Park District (EBRPD) facilities would be relocated to higher elevations or floatable structures to accommodate water storage goals while improving recreational opportunities.

Because the Del Valle Dam currently provides an excess amount of flood protection storage, it would not be physically altered as part of this project.

Additional storage and operational changes could help meet multiple water supply objectives while maintaining acceptable flood protection, including: (1) improve regional water supply reliability, (2) improve source water quality, (3) improve regional conjunctive use, (4) increase emergency water supplies, (5) increase flexibility to accommodate environmental constraints in the SWP Delta operations, (6) create new recreational opportunities, and (7) improve resilience to climate change and Delta pumping restrictions.

AT A GLANCE

PROJECT TYPE	Operations
STATUS	Conceptual
ENGAGED BARR AGENCIES	ACWD, SCVWD, and Zone 7
AVAILABILITY	Normal and dry years
POTENTIAL YIELD	Up to 35,000 AFY of additional storage
COST	Capital: $150M (initial estimate, studies under way) O&M: TBD (low, studies under way)

Brown AND Caldwell

Water Supply Yield and Availability

Up to 37,000 AFY of additional storage in normal and dry years.

Regional Resilience

Increases locally accessible supplies for SBA Contractors by storing water pumped from the south Delta when conditions are favorable and by capturing additional local runoff. Potentially more than doubles supply storage capacity from 30,000 acre-feet (AF) to as much as 67,000 AF, increasing supply reliability and resilience to droughts, climate change impacts, planned outages, Delta levee failures/pumping restrictions, and other emergencies (e.g., earthquakes).

Efficiency

Leverages existing infrastructure and assets at Lake Del Valle Reservoir and makes more effective use of existing supplies.

Flexibility/Sustainability

Increases SWP operational flexibility through the improved ability to manage pumping from the south Delta. Contributes additional supply to storage, which may support increased conjunctive management.

Water Quality Considerations

Increases water levels, which may reduce harmful algal blooms that occur at low reservoir water levels and improves water quality for both recreation and potable use. Reduces treatment needs for potable use due to improved source water quality.

Expanded supply storage increases blending of Delta and local supplies in the SBA, which can reduce disinfection by-products formation in treated supplies.

Timing

The project is in the conceptual phase and could be implemented within 5 years.

Implementability

In 2017, the SBA Contractors will seek California Water Commission funding for this project. The SBA Contractors are currently evaluating the feasibility of modernizing flood rules, expanding emergency storage, and replacing/relocating EBRPD facilities (which may be costly). Federal, state, and local review and permits would be required, and additional project constraints may be identified during that process that could affect implementation feasibility.

Social and Environmental Considerations

The project would benefit the environment by improving the operational flexibility of the SWP in managing pumping from the south Delta to minimize fish entrainment and meet water quality and flow objectives.

The project would increase the area available for enhanced recreational opportunities (e.g., boating and fishing), replace EBRPD facilities currently near the water's edge, and improve water quality leading to reduced algal blooms and use restrictions. Impacts to recreation, if any, would be addressed with enhanced recreational facilities, which would require both public support and cooperation from EBRPD.

BENEFITS

- Leverages existing supply sources and infrastructure.
- Increases water supplies in emergencies and planned outages for all SBA contractors.
- Increases resilience to climate change and future Delta constraints.
- Improves source water quality for SBA contractors' treatment plants.
- Improves regional conjunctive use for all SBA contractors.
- Enhances the Delta ecosystem.

CHALLENGES

- Requires costly relocation and enhancement of existing EBRPD facilities to higher elevations or floatable structures to increase water storage.
- Requires approvals by multiple agencies at federal, state, and local levels.

Bay Area Regional Water Market (Exchanges/Transfers) Program

SAN FRANCISCO BAY AREA

The Bay Area Water Market (Exchange/Transfer) Program would involve a one-time transfer of water between two or more Bay Area Regional Reliability (BARR) agencies, with the objective of developing and demonstrating an effective technical, institutional, and permitting framework for Bay Area partner agencies to secure and execute regional exchange projects.

This project would help to identify and resolve barriers that limit water transfer opportunities that would otherwise improve regional reliability and resilience. A tool in the form of a roadmap document would be developed to enable future water exchanges/transfers by documenting lessons learned and best practices based on interagency transactions completed as part of this effort and in the recent past.

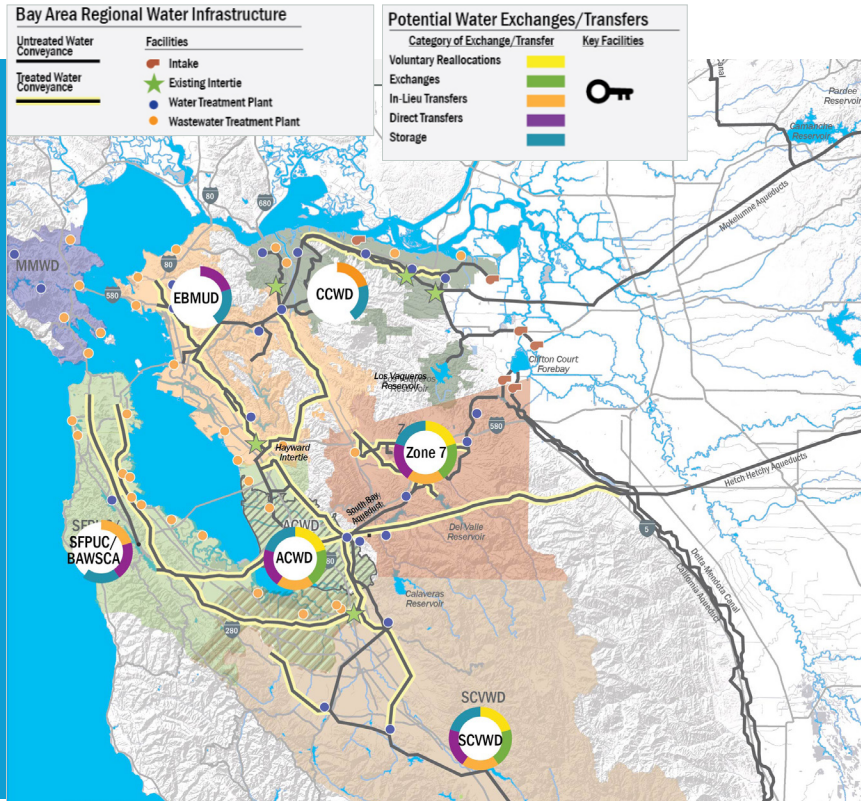
Though the project is currently at the conceptual stage, several potential variations are being considered. Water could be purchased from the Sacramento region and wheeled through EBMUD's Freeport facility and stored in Los Vaqueros (LV) Reservoir.

From LV Reservoir, there are several possible scenarios for transferring either treated or raw water to partner agencies. Exchanges (including in-lieu options) could be completed as well.

This water could provide a reliable supply for transfers and exchanges to BAWSCA member agencies in 2018 during SFPUC's temporary closure of Mountain Tunnel. The transferred water could also be delivered through existing and planned interties and/or exchanges to other participating agencies (ACWD, SCVWD, Zone 7, SFPUC, and/or BAWSCA).

AT A GLANCE

PROJECT TYPE	Operations
STATUS	Planning
ENGAGED BARR AGENCIES	ACWD, BAWSCA, CCWD, EBMUD, SCVWD, SFPUC, and Zone 7
AVAILABILITY	One Time
POTENTIAL YIELD	At least 3,000 AF
COST	TBD (based on exchanges/ transfers)



Brown AND Caldwell

Water Supply Yield and Availability

Entails a one-time transfer or exchange of at least 3,000 acre-feet (AF) between two or more Bay Area agencies.

Regional Resilience

Provides supplemental supply to an agency experiencing a water shortage emergency or temporary disruptions caused by planned maintenance. Lays the foundation for broader regional water sharing in the future by conducting near-term pilot projects.

Efficiency

Largely leverages existing resources, supplies, and assets, though new intertie pipelines and associated infrastructure would be needed to most flexibly and effectively share supplies in the region.

Flexibility/Sustainability

Helps identify and resolve barriers limiting opportunities to flexibly transfer supplies in the region.

Water Quality Considerations

Requires evaluation to determine the impact of blending and ensure that water quality stability is not affected (e.g., ensure corrosion protection to transmission and distribution pipelines and delivered water quality; minimize potential taste and odor issues).

Timing

The project is in the conceptual phase, and the timing depends on the specific exchange/transfer to be completed. The exchanges/transfers being considered for this program are anticipated to be completed within 1 to 3 years.

Implementability

The project involves 1 or more short-term pilot water transfer/exchange water among 2 or more BARR agencies within the next 3 years. Implementation challenges would be specific to the agencies, facilities, and water sources involved in the transfer/exchange. Most would involve filing for a short-term transfer with the State Water Resources Control Board, modifying water rights, securing additional permits, determining restrictions (e.g., timing constraints), and seeking approvals by agencies at federal, state, and/or local levels. Participating agencies would resolve technical challenges (water quality, treatment, intertie operations) before conducting this one-time demonstration test.

Social and Environmental Considerations

Water transfers largely leverage existing resources, supplies, and assets, thereby lowering their environmental burden. Facilitating development of a regional exchange project would allow the BARR agencies to improve their dry-year water supply resilience, which improves economic security and quality of life for the Bay Area.

BENEFITS

- Leverages existing supply sources and infrastructure.
- Could lead to increased water supplies in emergencies, planned outages, and droughts.
- Evaluates institutional, permitting, financial, and operational feasibility of regional exchanges.
- Lays the foundation for broader water sharing in the future.

CHALLENGES

- Requires approvals by multiple agencies at federal, state, and local levels.
- Requires institutional arrangements, permits, re-operation of regional water projects, and coordinated operations among participating agencies.
- Poses potential treatment compatibility issues, due to blending different source waters.
- Requires potential water rights modifications to enable transfers/exchanges.

Appendix D: Other Bay Area Drought Projects (outside the BARR DCP scope)

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Table D-1. Other Bay Area Drought Mitigation Projects (outside the scope of the BARR DCP)

No.	Project Sponsor or Partners	Project Name	Type (conveyance, storage, treatment/supply, operations)	Brief Description and Implementability (i.e., time frame to produce supply)	Yield and Availability of Water (AFY)	Status	Estimated Capital Costs	Estimated O&M Costs (high, moderate, low)	Other Comments
List of Western Recycled Water Coalition Member Projects in Bay Area (2016)									
1	Central Contra Costa Sanitary District (Central San)	Contra Costa County Refinery Recycled Water Project, Phase 1	Conveyance	Phased project to deliver recycled water for Shell and Tesoro refineries (for cooling towers and boiler feed water)	5,600	USBR Feasibility complete	$25M	High	
2	City of Benicia	Benicia Water Reuse Project	Conveyance	Pipeline, pump station, and additional filtration and ammonia removal for cooling tower use	2,200	Planning	$27M	TBD (likely low)	
3	City of Brentwood	Brentwood Recycled Water Project	Conveyance	Pipelines, pump stations, and storage to extend recycled water for irrigation users	1,406	Phases in construction	$21	TBD (likely low)	
4	City of Hayward	Hayward Recycled Water Project	Treatment/conveyance	New treatment facility and pipeline to serve new customers for irrigation and for cooling	290	USBR Feasibility complete	$12M	TBD (likely low)	
5	City of Mountain View	Mountain View Recycled Water System Expansion	Conveyance	Storage, pumping, pipelines to expand system and serve large customers in Mountain View and Moffett Field	2,750	Planning	$20M	TBD (likely low)	
6	City of Palo Alto	Palo Alto Recycled Water Pipeline	Conveyance	Pipelines and pump stations for residential, commercial, and municipal uses	916	USBR Feasibility complete	$33M	TBD (likely low)	
7	City of Pleasanton	Pleasanton Recycled Water Project	Conveyance	Pipelines expanding recycled water for irrigation users	1,720	In construction	$20M	TBD (likely low)	
8	City of Redwood City	Central Redwood City Recycled Water Project	Conveyance	Pipelines, pump stations, and storage to expand system to central Redwood City	507	USBR Feasibility complete	$32M	TBD (likely low)	
9	Delta Diablo Sanitation District	High Purity Treatment	Treatment/supply	Treatment to improve recycled water quality for industrial uses and urban landscape projects	5,600	USBR Feasibility complete	$50M	TBD (likely low)	
10	Delta Diablo Sanitation District	Delta Diablo Recycled Water Project	Conveyance	Phased storage and pipeline/expansion to serve new users	4,380	USBR Feasibility complete	$34M	TBD (likely low)	
11	Dublin San Ramon Services District (DSRSD)	Dublin and San Ramon Recycled Water Expansion	Treatment/conveyance/ storage	Treatment, pipelines, pump stations, and reservoirs for irrigation customers	6,460	USBR Feasibility complete	$22M	TBD (likely low)	Possible Wastewater Change Petition needed
12	Ironhouse Sanitary District (ISD)	ISD Cypress Recycled Water	Conveyance	Pipelines and pump station to serve recycled water to Cypress corridor	173	USBR Feasibility complete	$5M	TBD (likely low)	
13	ISD	ISD Industrial Recycled Water Project	Conveyance	Pipelines, pump station, and storage for various users	2,350	USBR Feasibility complete	$29M	TBD (likely low)	
14	ISD and CCWD	ISD Direct Potable Reuse Project	Treatment/supply	Recycled water to Contra Costa Canal DPR; implementability TBD, pending DPR regulations	4,350	USBR Feasibility complete	$40M	High	
15	San Jose Water Company	SJWC Recycled Water Project	Conveyance	Pipelines to expand system for irrigation and industrial users	1,203	USBR Feasibility complete; phases under way	$24M	TBD (likely low)	
16	SCVWD	Various IPR and DPR projects	Treatment/supply/conveyance	Long-term potable reuse projects	~80,000	Planning	>$800M	TBD (likely moderate to high)	
17	SCVWD	South Santa Clara County Recycled Water Project	Conveyance	Pipelines, pumping, and storage to expand service for agriculture and other irrigators	30,000	Phases in construction	$72M	TBD (likely low)	
18	SCVWD	Wolfe Road Recycled Water Project	Conveyance	Pipeline and pump station to expand service to Sunnyvale and Apple Campus 2	903	Under construction	$18M	TBD (likely low)	
19	Sunnyvale	Sunnyvale Continuous Recycled Water Production	Conveyance	Pump station to serve recycled water expansion	500	Under construction	$2M	TBD (likely low)	
20	West Bay Sanitary District	WBSD Recycled Water Project	Treatment/conveyance	Satellite treatment facility, pump station, and pipelines for irrigation	152	Planning	$19M	TBD (likely low)	

Table D-1. Other Bay Area Drought Mitigation Projects (outside the scope of the BARR DCP)

No.	Project Sponsor or Partners	Project Name	Type (conveyance, storage, treatment/supply, operations)	Brief Description and Implementability (i.e., time frame to produce supply)	Yield and Availability of Water (AFY)	Status	Estimated Capital Costs	Estimated O&M Costs (high, moderate, low)	Other Comments
Other Projects Involving BARR Agencies [a]									
21	Zone 7	Additional Wells in the Livermore Valley Groundwater Basin	Treatment/supply	Constructing several new wells in the Livermore Valley Groundwater Basin to increase total production capacity for use particularly during droughts and emergencies while also increasing potential exchange opportunities with other agencies	7,300	Planning	$54M	Low	Chain of Lakes 3 and 4 planned to be constructed by 2030, Busch Valley Well by 2020, and Bernal Wells by 2025
22	Zone 7	Chain of Lakes Pipeline	Treatment/supply	A 36-inch-diameter pipeline from Cope Lake to Del Valle WTP (~6 miles) and a 12 mgd pumping station, allowing Zone 7 the ability to better manage local water supplies, recharge the local groundwater basin, help perfect local water rights, and meet demands with stored water in the Chain of Lakes during catastrophic events (e.g., loss of the Delta)	TBD	Planning	$57M	Low	Planned for construction by 2020
23	Central San, EBMUD, and CCWD	Canal Loop Recycled Water Project	Treatment/supply	Central San would provide recycled water to existing irrigation customers currently served by EBMUD and CCWD on the loop portion of the Contra Costa Canal	6,700	Planning	TBD	High	Possible Wastewater Change Petition needed
24	All BARR Agencies	Regional Stormwater Capture	Treatment/supply	Develop centralized and decentralized stormwater capture projects to enhance local storm runoff capture for recharge or potable use offset	TBD	Conceptual	TBD	Low to high (would vary project to project	Possible Wastewater Change Petition needed for some projects
25	Central San and CCWD	Central San Direct Potable Reuse	Treatment/supply	Central San would provide CCWD with DPR supplies	26,800	Conceptual	$535M	High	Implementation pending regulations on DPR Possible Wastewater Change Petition needed
26	Central San, EBMUD, and DSRSD	Raw wastewater from Central San to DSRSD	Treatment/supply	New trunk sewer to increase supply to DSRSD's recycled water plant, 2.7 mgd	TBD	Conceptual	TBD	Moderate	Possible Wastewater Change Petition needed

a. *The agencies are considering many projects beyond those listed below as part of their long-term planning efforts.*

Appendix E: Water Rights Background and Water Transfer Mechanisms

Water Rights Background

Water rights in California have a complex history. Three different classes of rules—pre-1914, post-1914, and recycled water—come into play among the potential BARR drought mitigation measures.

Pre-1914 Water Rights

Prior to 1914, appropriative water rights were established by posting a notice near the point of diversion or filing a plan with the county and beginning work. After 1914, appropriative water rights were obtained by filing an application with the State Water Resources Control Board (State Board) to receive a permit for the water supply development project. These permits specify:

- The amount of water that can be appropriated by direct diversion to use, store, or both.
- The season of diversion, points of diversion, places of use, purposes of use, conditions to protect prior rights, public trust resources and the public interest, and a timeframe to put the water to reasonable use.

The California Water Code[30] (CWC) allows pre-1914 water-rights holders to change their points of diversion, place of use, or purpose of use provided that the change causes "no injury" to any legal user of water (see CWC 1706). The CWC does not allow expansion of the pre-1914 water right in terms of the amount of water diverted or the season of diversion. There is no formal process for changing the point of diversion, place of use, or purpose of use of pre-1914 water rights. Typically, the pre-1914 water-right holder reports such changes in its Statements of Water Diversion and Use filed annually with the State Board. The State Board does not have permitting authority over pre-1914 water rights and does not typically review such changes.

Post-1914 Water Rights

Changes in post-1914 water rights points of diversion, places of use, or purpose of use are allowed under the CWC (Sections 1701–1705), but the process is more complicated. While the "no injury" rule also applies to post-1914 rights, a change petition needs to be filed with the State Board. The petition is publicly noticed and specifically noticed to water right holders downstream. Protests can be filed. If protests cannot be resolved by the parties, the State Board holds a water right hearing on the change petition and issues an order either approving or denying the change petition.

Water Reuse

Early on, the State Legislature recognized the benefits of reusing wastewater discharges for beneficial use. It also recognized that some of these discharges to natural stream courses provided benefits to public trust resources, especially in areas and at times when natural flows are low. In 1980 and 2001, the legislature changed the CWC (adding Sections 1210 to 1211) to provide a process for the State Board to review changes in the point of discharge and place of use of wastewater discharges. The process calls for the discharger to file a wastewater change petition with the State Board, describing the amount of water to be removed from the receiving waterbody for reuse and the place of use for the treated reuse supply. The State Board publicly notices wastewater change petitions, and protests can be submitted. If protests cannot be resolved by the parties, the State Board holds a water right hearing on the change petition and issues an order either approving or denying the change petition.

[30] The California Water Code can be accessed as follows: http://leginfo.legislature.ca.gov/faces/codes.xhtml

Modifying Water Rights

The BARR drought mitigation measures focus primarily on sharing supplies through exchanges and transfers. Some measures involve potentially using water outside originally permitted conditions, requiring water rights permit modifications for points of diversion, place of use, and/or purpose of use. To enable exchanges and transfers, water rights changes can be accomplished in many ways, as summarized below and described in detail in the State's Board's "Guide to Water Transfers" (State Board, 1999).

1. **No Injury Rule**

   For pre-1914 and post-1914 appropriative water rights, a change to an existing water right must not injure any legal user of water. This principle, referred to as the "no injury rule," prohibits injury to other legal users of water (both junior and senior water rights holders), caused by a change in place or purpose of use or point of diversion for any reason, including changes necessary to facilitate a water transfer. For example, a water transfer could cause injury to other legal users of water by reducing the net downstream flow, or attempting to transfer previously abandoned flows that otherwise would have been available to other water users absent the transfer. The "no injury rule" is rooted in historical court doctrine dating back to the early days of California statehood and was codified in 1914.

2. **No Unreasonable Effects on Fish and Wildlife**

   The legislature changed the CWC after the 1976–77 drought to help expedite water transfers. CWC Sections 1725 and 1735 were added to allow water rights changes for both short-term (one year or less, CWC Section 1725) and long-term (longer than one year, CWC Section 1735) water transfers in an expedited fashion. Transfers conducted under CWC Section 1725 are exempt from CEQA. However, both CWC Sections 1725 and 1735 require that the water transfers not have an "unreasonable effect on fish, wildlife or other instream beneficial uses." This test is different from the "significant effect" test under CEQA and is generally considered a higher bar. The water right holder that petitions for a change under these CWC sections needs to provide the State Board an analysis that shows that the fish and wildlife effects of the water transfer are not "unreasonable."

3. **CWC 1810 and Economic Effects**

   In 1986 the legislature added CWC Section 1810, which requires state, local, and regional agencies to make excess conveyance capacity available to others (for a reasonable fee) for water transfers, provided that the action: (1) causes no injury to any legal user of water, (2) has no unreasonable effects on fish and wildlife, and (3) has no "unreasonable effects on the overall economy or environment of the county" from which the water was transferred. The economic effects evaluation required by CWC Section 1810 is a countywide assessment (not a person-by-person or a "third-party" evaluation).

Water Transfer Mechanisms

Short-term water transfers have been an effective tool for addressing water rights changes needed to move water from one water supplier to another. DWR's Background and Recent History of Water Transfers in California (DWR and State Board, 2015) includes a detailed review of water transfers from 1995 through 2015 from areas north of the Delta to areas south and west of the Delta.

BARR drought mitigation measures involving transfers of SWP water supplies will need to be part of a water exchange, where water is returned to the SWP contractor in a subsequent year. According to the SWP contracts, SWP water cannot be sold for use by another SWP contractor except through the

turn-back pool or a long-term reallocation of the Table A Entitlements (a complicated process). Furthermore, SWP water cannot be sold to a non-SWP contractor. However, in the cases of both SWP and non-SWP buyers, water can be exchanged for water that is returned to the original SWP contractor in a future year. These exchanges are still processed as water transfers with specific terms that call for the water to be "paid back" with a like amount of water in a future year on a 1:1, or perhaps 2:1 or better, basis, depending on what the parties negotiate.

Use of CVP or SWP water supply contracts in a flexible manner is a key consideration for Bay Area exchanges and transfers but must not result in changes to the operational rules of the CVP or SWP. Modifying those operational rules would require either re-consultation under the existing CVP/SWP Biological Opinions and/or changes to water-right permit conditions (NMFS 2009 and USBR 2008).

The BARR agencies considered five potential approaches for flexible use of SWP and CVP water supplies and facilities to support water transfers, including:

- Conjunctive use of transferred supplies
- Changes in points of diversion
- Changes in demand
- "Backing up" water in CVP or SWP reservoirs
- Water quality benefits

Conjunctive Use of Transferred Supplies

BARR agencies could purchase supplies from willing sellers during non-dry (normal/wet) years to transfer for local storage and for use during dry years. Factors directly affecting the viability of this approach include water availability, conveyance capacity, and storage availability.

Water transfers have been common in California for decades, particularly in dry years. In the past, DWR assembled water banks or dry-year programs that purchased water from willing sellers and sold it to willing buyers. During the last DWR Dry Year Program (in 2009), about three times the amount of water developed by the program was obtained by parties outside the program between willing sellers and buyers. In effect, the water market has matured to the point that DWR's facilitation is no longer needed. Over the years, interested parties have developed their own expertise in securing water transfers that meet the requirements of the CWC. Willing buyers and willing sellers are able to find each other without DWR involvement, bringing "new water" to systems through transfers. The roles of DWR and USBR have become focused solely on conveying water, including transfers, to areas south and west of the Delta.

Water Transfer Constraints. Two constraints limit the amount of water that can be transferred to BARR agencies—water availability and conveyance capacity to move water from north of the Delta to BARR partners' service areas. In terms of water availability for transfers, the price that potential buyers are willing to pay and water supply in the potential sellers' watersheds are critical factors. Higher prices typically bring more sellers into the water market.

Water availability in the sellers' watersheds can have a substantial effect on water transfers, as in 2015. In 2014, more than 400,000 AF of water was transferred from north of the Delta to areas south and west of the Delta. However, the low rainfall and historically low snowmelt in 2015 led the State Board to initiate curtailments to all post-1914 water rights in the Sacramento Valley watershed and curtailments to many pre-1914 water rights. Also, both the SWP and CVP curtailed deliveries to their water-right settlement contractors in the Sacramento Valley. Therefore, the water users in the Sacramento Valley needed almost all of their water to meet local demands and simply did not have very much water available for transfer to others regardless of price. As a result, in 2015 only a little

more than 250,000 AF of water was transferred, even though demand for water both south and west of the Delta was greater than in 2014.

The other factor that constrains water transfers to areas south and west of the Delta is excess capacity at the SWP or CVP pumping facilities in the southern Delta to convey water transfers for others. The priorities for pumping water by the SWP and CVP are: (1) water to meet the water allocations to their contractors and other firm commitments (like refuge water under CVP Improvement Act), (2) contractual access to excess conveyance capacity by the CVP and SWP water supply contractors, and (3) access to excess capacity by others.

The SWP operates two diversion systems in the Delta for conveying water to users south and west of the Delta—the North Bay Aqueduct, which draws water from Barker Slough, and the Harvey O. Banks Pumping Plant in the southern Delta, which diverts water from Clifton Court Forebay into the California Aqueduct. The long-term SWP contractors are required contractually to pay all SWP costs associated with the SWP water service; non-SWP contractors proposing to use SWP conveyance capacity are required to pay reasonable fees including power for this use. The Banks Pumping Plant often has excess capacity for conveyance of water transfers purchased by others in drier years but does not have capacity in average or wetter years. During the very dry years of 2013, 2014, and 2015, DWR had conveyance capacity for all requested water transfers. However, in 2016, a below-normal year in the Sacramento Valley, the Banks Pumping Plant had no excess capacity because all of the available pumping capacity was used to deliver SWP water to agencies with long-term contracts. The CVP has diversion facilities at the Jones Pumping Plant near Tracy. The maximum capacity at the CVP Jones Pumping Plant is less than that of the SWP Banks Pumping Plant. Typically, the CVP does not have excess conveyance capacity for water transfers except in the driest years.

A major factor that affects excess conveyance capacity of both the CVP and SWP is the 2008 and 2009 BiOps. These BiOps restrict the amount of water that can be diverted in the southern Delta in the winter and spring and result in forcing water diversions for CVP and SWP contractors into the summer. In addition, the BiOps limit the water transfers by others at the SWP and CVP facilities in the southern Delta to three months; July, August, and September. Therefore, excess CVP and SWP pumping capacity for water transfers exists in about one-third of the years (dry and extremely dry years and below normal years).

In normal and wetter years, available pumping capacity for water transfers will not be known until as late as April. This late of a "call" date for water for a prospective seller is often not acceptable, especially for crop idling water transfers. However, it can work for groundwater substitution transfers and reservoir re-operation transfers. Therefore, one way to increase water transfers in normal and wet years would be to pursue such late call date transfers. Wetter years also have more potential sellers, which often reduces price. While 1-year water transfers are more common currently, the BARR agencies should consider negotiating long-term water transfer agreements with willing sellers. These long-term agreements should contain flexible call dates to ensure that the water can be pumped in the Delta and a process to adjust price that is acceptable to all parties.

Points of Delta Diversions Farther Upstream. Use of southern Delta facilities, other than those of the SWP and CVP, is another consideration and includes the Freeport Regional Water Authority (FRWA) facilities near the town of Freeport on the Sacramento River. In February 2002, the JPA of the Sacramento County Water Agency and EBMUD created the FRWA. FRWA guides the financing, ownership, development, construction, and operation of the Freeport Regional Water Project (FRWP).

The FRWP diversion capacity is 286 cubic foot/feet per second (cfs) (185 mgd), which is a maximum possible annual diversion of 207,000 AF. The 2003 Draft EIR/EIS evaluated diversions at this location at "full build-out" with the maximum combined diversions of 155,000 AF. Sacramento

County Water Agency and EBMUD share the FRWP diversions. Sacramento County Water Agency is allowed up to 131 cfs (85 mgd) and EBMUD gets 155 cfs (100 mgd). Therefore, the maximum quantity EBMUD can divert in any year is 112,000 AF.

Assumptions in the 2003 Draft EIR/EIS for FRWP are contained in Technical Appendix 3, Modeling Appendix (starting on page 3-84). This appendix cites the constraints of EBMUD's use of FRWP for CVP water, which limit EBMUD to using FRWP facilities only in dry years (an assumption consistent with the EIR/EIS evaluation). The modeling studies were conducted for the historical hydrologic conditions experienced from 1922 to 1993. During this modeling sequence, only 22 years of the 72 years studied showed EBMUD water diversion. The average amount of water was 23,000 AF with a maximum of 112,000 AF, with the maximum occurring in only three years. Therefore, a significant amount of EBMUD FRWP unused capacity currently exists and could be used in the future.

The National Oceanic and Atmospheric Administration (NOAA) fisheries and USFWS BiOps for the FRWP do not contain operational restrictions on the Freeport diversions. They both conclude that the expected "take" of listed species (i.e., fish that are attracted by flows at the screen and are subsequently injured or become easy prey because of disorientation) is low, and not likely to harm the species. This finding is significant because FRWP, like the CCWD diversions at Rock Slough, Old River, and Victoria Canal intakes, is not constrained from pumping water transfers to just three months like the SWP and CVP facilities in the southern Delta. Also, FRWP diversions of transferred water could be accomplished in wetter years when the SWP and CVP excess pumping capacity in the southern Delta is unavailable.

While EBMUD has pumping capacity at FRWP, the following constraints exist on its use:

- CEQA evaluations would be needed unless the use was for water transfers under CWC Section 1725, which are exempted from CEQA but must go through the State Board expedited approval process.
- Because the FRWP water is moved through the Folsom South Canal, BARR agencies would need a Warren Act agreement with USBR for moving non-CVP water and this transfer would have NEPA implications that BARR agencies will need to address.
- EBMUD does not currently use the conveyance facilities from FRWP to the Mokelumne Aqueducts (including the Folsom South Canal) regularly and needs up to three months of advanced notice to prepare for facilities startup.
- Putting water into the Mokelumne Aqueduct 2, which is under pressure (head) from Pardee, comes with substantial pumping costs.
- Treatment concerns related to Delta water from FRWP are more restrictive than water from Pardee; therefore, EBMUD would need to plan to have the right treatment plants and associated operational facilities available for this water, and that can take time and include logistical considerations.
- Because of the way EBMUD's system is currently plumbed, both Aqueducts 1 and 2 are dedicated to FRWP operations, and thus use of Freeport needs to be scheduled when EBMUD's demands can be met using only Aqueduct 3 and its allotment of FRWP water (if available).
- Costs including startup and shutdown costs, O&M (including the aforementioned power costs), capital recovery, Sacramento Municipal Utility District fees, etc. can be significant; while this fee is a negotiated value, it could be about $400/AF, or perhaps higher.

EBMUD has agreements in place with CCWD and SCVWD for the use of the FRWP that have a small impact on capacity. EBMUD also has developed Principles for the Use of Unassigned Capacity and is in process of updating the Principles. Further, EBMUD has developed, internally, wheeling principles.

Generally, EBMUD is open to the Freeport Diversions for use by others and is actively working with other water districts to expand the use of the Freeport Diversion facility.

Points of Diversion Changes

Changes to points of diversion for BARR agencies' existing CVP/SWP water rights could increase access to the agencies' storage facilities. Increased supply in storage could provide a mechanism for long-term regional exchanges. The BARR agencies could also take advantage of the currently permitted CVP/SWP joint point of diversion in their water-right permits when the conditions allowing its use are met.

The changes in points of diversion have the largest potential expand Bay Area water supplies. Classic water transfers are basically a change in the point of diversion and the place of use of the seller water rights to those of the buyer. For water exchanges between or among BARR agencies, the agencies may need to change only the points of diversion.

The water exchange between CCWD (CVP contractor) and ACWD (SWP contractor) in the dry year of 2014 is a good example of applying a change in a point of diversion for a water exchange. ACWD purchased CCWD water held in storage in LV Reservoir. Because the CCWD system does not connect physically to ACWD, CCWD's CVP point of diversion was changed to the SWP Banks Pumping Plant. The State Board approved this change petition under CWC Section 1725, allowing CCWD CVP water to be pumped at the SWP Banks Pumping Plant for delivery to ACWD, and ACWD water held in LV was released to serve CCWD demand that would have been met if it had pumped the CVP water at its own facilities. In essence, ACWD indirectly leveraged another BARR agency's existing storage.

Use of SWP Allocations to "Store" Water by Exchange. In 2015, ACWD and Zone 7 attempted to place a small portion of their SWP allocations into virtual storage in LV. The storage was virtual because the CCWD would use the diverted water by allowing CCWD to provide ACWD and Zone 7 a virtual storage credit in LV. Though DWR did not support using an SWP allocation, they allowed ACWD and Zone 7 (through exchange within the SWP) to move ACWD and Zone 7 supplies stored in Semitropic to CCWD. This action required a point of diversion change petition to the State Board to allow CCWD to divert SWP water at its Delta facilities. The water would then return to the ACWD and Zone 7 in the same manner as in 2014 (i.e., move water from LV storage to ACWD). The State Board approved the petition but time ran out before the water could be physically diverted.

The BARR agencies could consider resolving the DWR concerns about use of SWP allocations for exchanges like the type ACWD used. Exchanges between CVP and SWP contractor water allocations south of the Delta occur regularly under the Consolidated Place of Use petition filed almost each year by DWR.

Comparing actual storage to virtual storage can be complicated. Storage from a water rights perspective is carrying water over from one season to another. The water rights regulations state that for licensing purposes, water held for less than 30 days is considered regulation and water held for more than 30 days is considered storage. When one gets a water right, it typically states, among many other things, the amount that can be diverted directly to use and the amount of water that can be stored by the water right holder. The past practice by the Division of Water Rights at the State Board has been to consider storage by the water right holder in its facilities. Once water is delivered to a contractor for use within the permitted place of use, the Division does not track if the water was subsequently stored by the contractor in its own facilities or those of other water users farther down the water delivery chain. The concern has been that taken to the extreme, the Division could be responsible for tracking storage in every swimming pool in Southern California. In the case of the Kern Water Bank and Diamond Valley, these local storage programs by contractors of the SWP are not considered storage by DWR under the DWR water right permits for the SWP. However, DWR water storage in San Luis Reservoir is covered in the water-rights permits of DWR for the SWP.

Conversations with the current Division Chief of the Division of Water Rights confirms that this past practice still applies (Division of Water Rights on Storage 2016). Therefore, contractors of SWP water like ACWD should be able to take their SWP allocation and store it into LV without the need for the virtual storage in the future once an agency resolves this issue with DWR.

Changes in Water Deliveries

Another consideration is the concept of changing BARR agencies' water deliveries to allow for new storage opportunities of CVP or SWP water locally in wetter years for use in drier years. BARR agencies with CVP or SWP water supply contracts have access to water that is in excess of that needed by SWP or CVP. While the SWP/CVP facilities may not have storage capacity available during these excess conditions, the SWP and CVP water supply contractors can store water in their own facilities or in facilities owned by others under contract arrangements.

For SWP water supply contractors, the use of excess water and SWP facilities to capture such supply is allowed under their SWP long-term water supply contracts in Article 21 or 56. Article 21 allows a contractor to use or store excess SWP water, while Article 56 allows a contractor to use SWP facilities for either conveyance or storage of water south or west of the Delta, provided that conveyance or storage is not needed by the SWP. The CVP water supply contracts in Articles 3 and 215 contain similar contract provisions.

BARR agencies with CVP or SWP water supply contracts have made arrangements to use these surplus flows to the extent possible considering available storage capacity (i.e., either locally or under contract for storage otherwise). Most arrangements for surplus flows were made before the federal fishery agencies adopted the current set of BiOps in 2008 and 2009. The BiOps required SWP/CVP to change their operations such that about one million AF (about 20 percent) goes towards protection of endangered species), as well as the reduced frequency of SWP/CVP excess water (i.e., beyond that capable of being used by the SWP or CVP). For example, before the BiOps were adopted, San Luis Reservoir (the major off-stream reservoir south of the Delta operated jointly for the SWP and CVP) filled during about four of five years and, once filled, typically held excess water available to CVP or SWP contractors. However, after the BiOps were adopted, San Luis Reservoir now fills only during about one of five years. Therefore, availability of excess water has been greatly reduced and now occurs rarely.

CVP and SWP contractors often struggle to meet demands when water allocations are reduced, as in recent years. When annual water allocations exceed the supply needed to meet that year's demands, agencies typically store the excess water if storage capacity is available in existing local reservoirs, local groundwater basins, or out-of-basin groundwater storage like that of Semitropic Water Storage District (Semitropic) or Cawelo Water District (Cawelo). Therefore, demand reduction could provide for more storage opportunities, especially in higher water allocation years. When the opportunity to acquire excess water presents itself, storing in local reservoirs or groundwater basins would be beneficial. While out-of-basin groundwater storage is another option, it is much more difficult, and in some years, virtually impossible, to bring water stored farther south back to the BARR agencies.

"Backing Up" Water in CVP or SWP Reservoirs

In the Delta, the SWP and CVP typically divert water for transfers based on the pattern in which the water is made available by the seller. As new water becomes available (by actions taken by the seller to reduce the consumptive use of surface-applied water or released from reservoirs beyond that which would otherwise accrue to the system), the water is pumped for the buyer at the SWP or CVP facilities, provided that excess capacity exists for pumping and the Delta is in balanced conditions. At times, water is made available by the seller, but the water cannot be pumped. This situation results in a water loss for the buyer.

The term “backing up” water into CVP or SWP reservoirs refers to the ability of the SWP and CVP to take advantage of the “new” water in the system made available by the water transfer to meet Delta outflow or water quality standards. This action reduces reservoir releases that would have been made if that “new” transfer water was not in the system. In this manner, the transfer water is not exported on the pattern that it is made available, but is in effect “backed up” into a CVP or SWP reservoir. This water is then released later and pumped in the Delta when the water transfer window opens, typically that same year.

Physical and Policy Issues. Both physical and policy issues exist with “backing up” water by the CVP or SWP. Physically, the new water made available by the water transfer activities must enter the system at a time and location that allows the reservoir releases from the SWP of CVP to meet Delta standards to be reduced. Such events occur only infrequently. Reservoir releases are often dictated by instream flow, temperature, or navigation requirements downstream of the reservoir. When these flows enter the Delta, they may be higher than that needed to meet Delta outflow or water quality requirements and instead of going out the Delta, the CVP or SWP pumps such water for its own purposes. Under these conditions, adding more water to the system in the form of a water transfer if that water accrues outside the water transfer window (July to September) does not provide a benefit to the reservoir storage and cannot be backed up. These conditions happen often.

However, in the past, the CVP and SWP have backed up water. The SWP does back up water when it can as part of its agreement under the Yuba Accord because the Accord has the potential to benefit all its contractors. Also, during the recent drought, the CVP did back up transfer water into Shasta for the CVP contractors to keep Shasta higher than it would have been otherwise in the summer to assist in meeting temperature requirements in the Sacramento River below Shasta. CVP then released this water for transfer later in the summer and early fall during an expanded water transfer window.

However, both the SWP and CVP hold to a policy position that these events are exceptions and cannot be relied upon in other circumstances. For the SWP, DWR does not interpret Article 56 (which allows contractors use of underutilized SWP facilities) to apply to water stored in Lake Oroville. DWR does not want to keep track of individual contractor water supplies in Lake Oroville. While DWR carries out such storage in San Luis Reservoir, it does so after it has allocated the water to individual contractors. The CVP has a similar policy opposition to backing up water into Shasta or Folsom Reservoirs for individual contractors. Therefore, BARR agencies should not rely on the ability to “back up” water without a change in the policy positions of both USBR and DWR.

Water Quality Benefits

Water quality benefits of operational flexibility by the BARR agencies is possible depending on where the water can be diverted. For example, water quality benefits could accrue if water can be diverted at the FRWP on the Sacramento River under the EBMUD diversion capability instead of diverting water in the southern Delta.

Summary

Currently water transfers pumped at the SWP or CVP facilities in the southern Delta are restricted to three summer months. Capacity to move water through transfers is now physically limited to the driest one-third of the water years. Using EBMUD's dedicated capacity at the FRWP could allow more water transfers rather than be limited only to use in dry years.

Changes in points of diversion between BARR agencies can allow for the access to storage capabilities of some BARR agencies without the need to construct new facilities. However, BARR agencies would need to build new physical connections to make such exchanges easier in the long term. Also, the BARR agencies should take advantage of the currently permitted joint point of diversion between the SWP and CVP in their water-right permits when the conditions that allow the use of the joint point of diversion are being met. The BARR agencies need to evaluate the place of use boundaries of the SWP and CVP to ensure that for any specific exchange, those places of use overlap; if they do not, then the BARR agencies should seek permit changes to the places of use sufficient to allow such exchanges.

In addition, the SWP contracts do not allow SWP water to be sold except through very complex processes set forth in the SWP contracts. The contracts do allow SWP water to be exchanged with others in one year so long as it is returned in a future year. The return rate can vary from 1:1 to 1:2 or greater depending on the agreement between the parties. The contracts do not limit the year in which the water is returned but the contractors must convince DWR that the water will be returned for DWR to allow the exchange to commence.

The other possible flexibilities evaluated, changes in demand and "backing up water," do not hold much promise. Reductions in demand could allow for more storage opportunities in higher water allocation years. However, with the water supply reductions to both the SWP and CVP resulting from the 2008 and 2009 BiOps, the BARR agencies with SWP and CVP water supply contracts may need to reduce demand just to match this reduced water supply.

The potential to back water up into SWP and CVP reservoirs has two burdens. First, the physical ability to back water up does not occur very often and can vary from week to week during the times when needed. Second, both DWR and USBR have policies against backing up water for individual contractors into upstream storage reservoirs except in limited circumstances that benefit either the ability to meet temperature requirements downstream or the benefit accrues to all their contractors.

Water quality benefits of changing the point of diversion for water supplies to BARR agencies can accrue if the revised point of diversion is farther from the influence of saltwater intrusion. A good example is the use of excess FRWP capacity of EBMUD.