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TECHNICAL MEMORANDUM

DATE: April 17, 2019

TO: Carol Mahoney, Manager of Integrated Water Resources
Valerie Pryor, General Manager

FROM: Amparo Flores, Integrated Planning Manager
Wes Mercado, Assistant Engineer

SUBJECT: 2019 Water Supply Evaluation Update

Executive Summary

The 2019 Water Supply Evaluation (WSE) Update incorporates new developments into Zone 7's water supply planning activities and serves as the basis for recommendations to the Zone 7 Board of Directors. It was developed in consultation with water retailer staff, Zone 7's Water Resources Committee, and the Zone 7 Board of Directors.

This update makes a *high-level preliminary forecast* of total demand on Zone 7 at buildout of approximately 55,500 acre-feet per year (AFY), which is a reduction of approximately 5,000 AFY, relative to the 2016 WSE Update forecast. Demand includes the direct demand on Zone 7's system from treated and untreated customers and unaccounted-for water. On the supply side, this update gives special attention to Table A and Arroyo Valle as Zone 7's primary sources of incoming water. Given the Department of Water Resources' projections and recent actual conditions, Zone 7 made the assumption that with the State Water Project's (SWP's) aging condition and increasingly stringent environmental regulations, the SWP's existing and future reliability will be on average 49% of Zone 7's Table A contract amount without the California WaterFix (39,500 AFY); additionally, Zone 7 continued to incorporate potential climate change impacts on the Arroyo Valle yield (5,500 AFY).

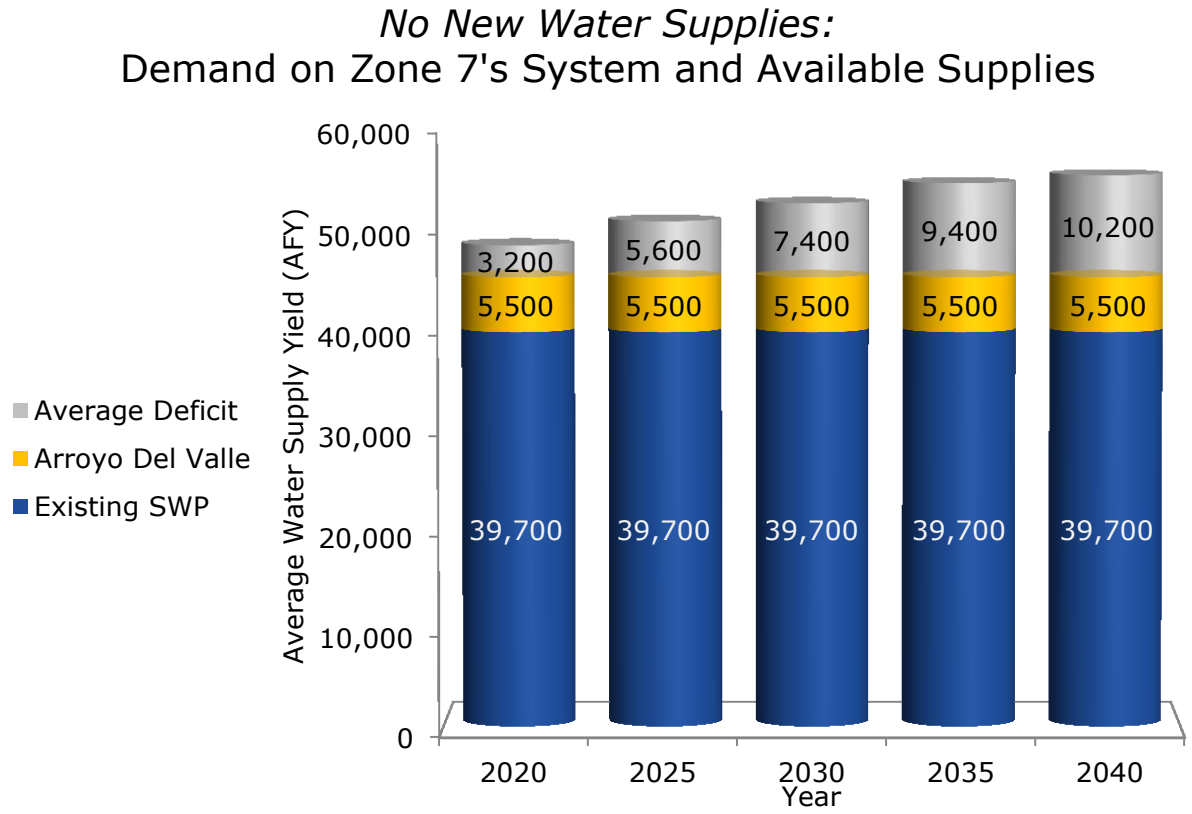
The "No New Water Supply" scenario is significantly constrained by a supply deficit (Figure ES-1), which demonstrates a clear and urgent need for actions to develop

new water supplies through buildout around 2040 in order to meet policy targets based on current assumed demands. Furthermore, other projects that could increase storage or provide alternative conveyance should also be considered for improved system reliability. Zone 7 is therefore evaluating a number of water supply reliability projects:

- Primarily storage: Los Vaqueros Reservoir Expansion
- Supplies: Bay Area Regional Desalination Project, California WaterFix, Potable Reuse, Sites Reservoir, and SWP Short-Term and Other Transfers

The cost, timing, and benefits of these projects vary; two key performance metrics drove the analysis and recommendations in this update: reliability and cost. Other considerations and risks were evaluated on a qualitative basis. While this WSE Update was developed under a scope focused on water supply issues, a more comprehensive future update will look more broadly at other factors—such as water quality—that could affect the ultimate selection of the best portfolio to pursue.

Figure ES-1: Forecasted average total water supply yield and average deficit against demand under the No New Water Supply scenario through buildout at 2040.



Zone 7 uses a Water Supply Risk Model to aid reliability-based decision-making and planning. Zone 7 has also set goals for reliability as a matter of policy. Without new

water supply reliability projects, reliability is forecasted to decline well below target levels starting in the early 2020s, and continuing beyond 2040 with no recovery. Steady annual transfers are needed at least through 2030 to continue meeting reliability policy goals until long-term projects could be in-service. Given available projects and forecasted demand, multiple new water supply reliability projects will be needed in the long-term to meet reliability goals; fortunately, multiple pathways exist to meet the goals. More conservation—beyond what has already been incorporated in the current demand forecast—would also improve reliability.

The following recommendations were developed in consultation with the staff of the local retailers and at public meetings with members of the Board, and are listed in no particular order:

- Continue to support California WaterFix.
- Participate in the next phase of Sites Reservoir, for an average net yield of 10,000 AFY.
- Participate in the next phase of Los Vaqueros Reservoir Expansion and Transfer Bethany Pipeline.
- Pursue short-term transfers of at least 5,000 AFY through 2030.
- Conduct technical studies to support selection of the best potable reuse option.
- Continue to investigate brackish water desalination with other agencies.
- Continue to pursue other water supply opportunities.
- Continue to advance the use of the Chain of Lakes for Zone 7 water management, including the construction of new diversion and conveyance infrastructure.
- Consider revising Zone 7's Reliability Policy.
- Complete a more comprehensive regional demand and water conservation program study.
- Develop a regional plan for meeting the long-term conservation framework.
- Enhance public outreach programs to engage the public on water supply reliability issues.

These recommendations will be implemented over the next few years, and beyond. While continued pursuit of various water supply and storage projects are recommended, the results of other recommended actions (i.e., any policy revisions and/or changes in demand projections) could affect the ultimate selection of projects to implement. The WSE will be updated again within the next couple of years as the projects are developed further and demands are refined, and Zone 7 makes decisions about continued participation in existing projects or pursuit of new ones. Information from the demand and conservation studies, and from the next WSE Update, will be incorporated into the 2020 Urban Water Management Plan to be completed by mid-2021.

1 Purpose of the 2019 WSE Update

Zone 7 Water Agency (Zone 7) last updated its evaluation of water supply conditions in the Tri-Valley area in 2016 (2016 Water Supply Evaluation Update or 2016 WSE Update[1]). Since then, there have been significant developments that affect long-term water supply planning for the Tri-Valley, such as:

- **Availability of Drought Recovery Data**: Data charting the recovery of demands after the 2014-2016 drought is now available.
- **New Regulations**: The State of California (State) has begun mandating new goals for conservation and water use efficiency that will affect future long-term demands.
- **Decreased Reliability of Existing Water Supplies**: Zone 7 has more modest expectations of the future reliability of existing water supplies including the State Water Project, Arroyo Valle, and the Byron-Bethany Irrigation District transfer agreement.
- **New and Updated Water Supply Reliability Projects**: Zone 7 has been pursuing additional opportunities for water supply reliability projects, and new information is available for projects included in the 2016 WSE Update.
- **Required Project Commitments**: Two new projects, Sites Reservoir and Los Vaqueros Reservoir Expansion, required renewed commitments by early 2019 for Zone 7's continued participation.

The 2019 WSE Update was undertaken to incorporate these developments into Zone 7's water supply planning activities and to serve as the basis for recommendations to the Zone 7 Board of Directors. Furthermore, the 2019 WSE Update serves to inform Zone 7's water retailers (California Water Service – Livermore District, City of Livermore, City of Pleasanton, and Dublin San Ramon Services District) and other customers; governing bodies in the Tri-Valley; and the general public about the Tri-Valley's water supply conditions and future plans.

2 Development of the 2019 WSE Update

The development process for the 2019 WSE Update is outlined below, along with the relevant sections in this report:

1. Updated the planning-level long-term water demand forecast to be used in the development of water supply portfolios. (Section 3)

[1] 2016, Zone 7 Water Agency. Water Supply Evaluation Update. https://www.zone7water.com/images/pdf_docs/water_supply/wse-update_2-16.2.pdf

2. Set conservative yet realistic expectations of the future water supply reliability of Zone 7's existing main sources of water: the State Water Project and the Arroyo Valle. (Section 4)
3. Adapted and expanded Zone 7's Water Supply Risk Model (Risk Model) to incorporate new data, and to provide new views and new metrics of water supply reliability, system response, and performance. (Sections 8 and 9)
4. Evaluated baseline water supply conditions relative to Zone 7's Reliability Policy goals to determine future needs and options. (Sections 5 and 9.1)
5. Established a list of water supply reliability projects to be considered, and characterized their yield and availability, other operational parameters, benefits, and cost. (Section 6)
6. Developed portfolios of water supply projects and used the Risk Model to forecast their impacts on water supply reliability and risk. (Sections 9 and 10)
7. Developed recommendations based on the portfolio analyses. (Section 11)

The 2019 WSE Update was developed in consultation with retailer staff, Zone 7's Water Resources Committee, and the Zone 7 Board. The Committee and Board meetings are public meetings, which provided opportunity for the general public to be informed about Zone 7's water supply planning activities and provide feedback. Comments and directions received were integrated at various stages of the process. The dates and subjects of the stakeholder meetings are listed below.

August 15, 2018	Zone 7 Board: Overview
August 27, 2018	Retailer Staff: Project Kickoff Meeting
October 12 & 16, 2018	Retailer Staff: Preliminary Findings
November 5, 2018	Water Resources Committee: Preliminary Findings
November 14, 2018	Zone 7 Board: Draft Findings
December 13, 2018	Retailer Staff: Draft Recommendations
December 21, 2018	Water Resources Committee: Draft Recommendations
January 16, 2019	Zone 7 Board: Draft Recommendations
January 23, 2019	Tri-Valley Water Liaison Committee: Findings

This report is posted on Zone 7's website[2]. Agenda items, minutes, and presentations for the Water Resources Committee and the Zone 7 Board are also posted for public access on Zone 7's website[3].

[2] https://www.zone7water.com/publications-reports/reports-planning-documents
[3] https://www.zone7water.com/about-us/board-of-directors/board-meetings

3 Updated Water Demand Forecast

Zone 7's long-term water demand forecast through buildout—projected at around 2040—was re-evaluated for this update. The total demand includes treated water deliveries to the retailers and Zone 7's direct customers, untreated water deliveries to agricultural customers, and system losses (unaccounted-for water). This update uses a total demand at buildout of approximately 55,500 acre-feet per year (AFY), which is a reduction of approximately 5,000 AFY, relative to the 2016 WSE Update forecast. The updated forecast is a *high-level preliminary update* based on current trends and reasonable assumptions of post-drought demand recovery, future regulations, and reductions of water loss and waste. For the near-term, it used the mean values of each retailer's delivery requests[4] for the years 2019 through 2023.

In parallel with developing the 2019 WSE Update demand forecast, the consultant West Yost was hired to evaluate the retailers' treated water use and establish bookend projections of their future water demands. West Yost's results showed potential for greater demand reductions, and indicated that 55,500 AFY at buildout is reasonably conservative for planning purposes. West Yost's Technical Memorandum, *High Level Water Demand Study for the Tri-Valley Retail Water Agencies*, is included as Attachment A.

Figure 3-1 graphs the total water demand forecast used in this update, the bookend demand forecasts developed by West Yost, forecasts used in previous studies, and actual historical water demand. Table 3-1 summarizes the forecasts up to the year 2040, when buildout demand is expected to have been reached. The total demand on Zone 7's system includes treated and untreated customer demand, and unaccounted-for water, and the individual demands at buildout are shown in Table 3-2.

Key factors contribute uncertainty to the demand forecast, including:

- **Drought recovery:** The most recent drought forced major changes in customers' water use and resulted in dramatic short-term demand reductions; while demands have partially recovered to pre-drought levels, it is still unclear what the lasting impacts will be on customer behavior.
- **Conservation Regulations:** In response to Governor Brown's Executive Order B-37-16 *(Making Water Conservation a California Way of Life)*, the State is developing new regulations for water efficiency, but requirements for some of the largest water use categories (e.g. outdoor residential use) have not yet been set. Furthermore, Zone 7 and the retailers are still evaluating existing

[4] Retailers annually provide 'with conservation' and 'without conservation' delivery requests to Zone 7, which is used as the basis for Zone 7's near-term water supply operations planning.

consumption patterns and developing plans for compliance with these emerging regulations.

- **Service Area Growth:** Population within Zone 7's service area has been increasing, and growth is expected to continue. The relationship between population and water use is complex; moreover, it is uncertain at what rate the population will grow and stabilize. Different forecasts of aggregate Tri-Valley population have been developed by local retailers, regional entities such as the Metropolitan Transportation Commission, and the California Department of Finance. This update assumes that the growth in water use attributed to population will taper off by 2040; this assumption is consistent with the 2015 Urban Water Management Plans but will continue to be monitored.

Attachment A provides more details on drought recovery trends (including a detailed analysis of per capita water consumption) and the new conservation regulations. Given the uncertainties, demand forecasts will continue to be refined as new data emerge and regulations are promulgated. A more comprehensive regional demand forecast update will be completed as part of the 2020 Urban Water Management Plan (2020 UWMP), which is due to the State in mid-2021. Retailers will be updating their growth and demand projections formally at that time, and a regional study is planned to incorporate these new data. Any new conservation regulations and conservation plans for the region will also be incorporated at that time.

Table 3-1: Forecasts of total annual treated and untreated demand on Zone 7 to buildout in 2040 (units in acre-feet)

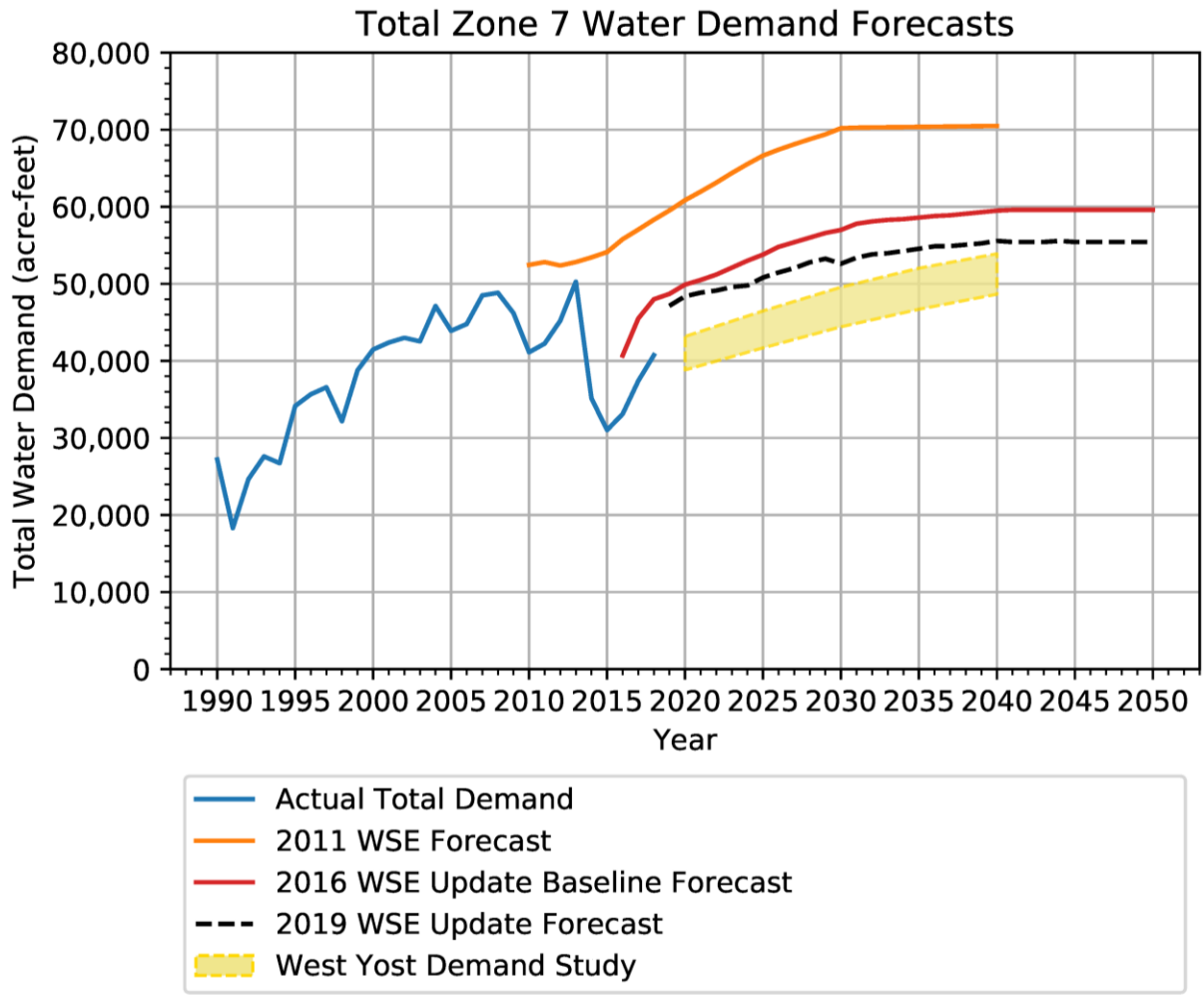
Year	2011 WSE	2016 WSE Update	2019 WSE Update	West Yost Upper Bookend	West Yost Lower Bookend
2020	60,900	49,900	48,400	43,200	38,800
2025	66,600	53,800	50,800	46,500	41,700
2030	70,200	57,000	52,600	49,600	44,400
2035	70,400	58,600	54,600	52,000	46,700
2040	70,500	59,500	55,500	53,900	48,700

Table 3-2: Forecast of demands on Zone 7 at buildout (2040): retailer, untreated, unaccounted-for water, and direct treated demand (units in acre-feet)

	Total Demand on Zone 7*	Retailer Demand	Untreated Demand	Unaccounted-for Water	Direct Treated Customers
Buildout (2040)	55,500	44,500	8,300	2,500	250

* Results may not sum to total due to rounding.

Figure 3-1: Forecasts of total treated and untreated water demand on Zone 7, and unaccounted-for water.



4 Existing Water Supplies: Future Water Supply Reliability

4.1 Overview of Zone 7's Water Supplies

Zone 7's yearly incoming water supplies are all surface water supplies, delivered to the Tri-Valley via the South Bay Aqueduct (SBA). These supplies are primarily comprised of State Water Project (SWP) water (Table A, Article 21, and Turnback/Multi-Year Pools), a transfer agreement with Byron Bethany Irrigation District (BBID), and local water from Arroyo Valle captured in Lake Del Valle, as described in Table 4-1. Other supplies include the Yuba Accord and the Dry Year Transfer Program.

In years of abundant supply, Zone 7 is able to place water in storage both locally and outside its service area to prepare for future dry years. Incoming supplies are stored in the Livermore-Amador Valley Groundwater Basin (main groundwater basin) through artificial recharge when excess surface water is available from either the SWP or from Arroyo Valle runoff stored in Lake Del Valle. Once local recharge capacity has been exhausted, any remaining unused SWP water is "carried over" (i.e., stored in State Water Project facilities such as San Luis Reservoir) or transferred to nonlocal storage in groundwater banks in Kern County (i.e., Semitropic Water Storage District and Cawelo Water District). Unused Arroyo Valle runoff is stored in Lake Del Valle for use during the following year. If needed during dry years, emergencies, or facility outages, stored water is released to meet demands.

Using the groundwater basin as a storage reservoir is critical for long-term reliability in the Tri-Valley. On average, imported surface water directly provides 80% of the water that Zone 7 supplies, locally-captured watershed runoff makes up on average 10%, and previously-imported supplies stored in the local groundwater basin make up the remaining 10%. Groundwater is not considered a separate source of water supply, because Zone 7 only extracts groundwater that is recharged from surface water supplies. Table 4-1 provides more details on the various existing sources of Zone 7 water supply. Water supplies are used to meet treated water demands from municipal and industrial customers (i.e. retailers and direct retail) and untreated water demands from agricultural customers.

Table 4-1: Descriptions of existing Zone 7 water supplies

WATER SUPPLY	DESCRIPTION
Article 21	This is surplus SWP water that is made available, in addition to Table A water, when San Luis Reservoir is full and cannot store the surplus.
Article 56 (Carryover)	This is unused annual allocation of Table A water, which is "carried over" for future use by individual SWP contractors. In most years this water remains in San Luis Reservoir, but in wet years some of this water could be lost if the reservoir fills. Each year, Zone 7 typically reserves 10,000-15,000 AF as carryover in case the following year is dry.
BBID	Whenever BBID, a non-SWP contractor, has surplus supply, water can be made available (up to 5,000 AF annually) through a transfer agreement subject to approvals by the Department of Water Resources (DWR) and the Bureau of Reclamation. For planning purposes, BBID water is presumed unavailable as the agreement is being re-evaluated.
Dry Year Transfer Program	During dry years, the State Water Contractors negotiate water purchases with farmers north of the Delta and make that water available to interested SWP contractors.
Lake Del Valle or Arroyo Valle (Local Water)	Zone 7 has a water right for Arroyo Valle water captured in Lake Del Valle, which becomes available for use once it has been stored for 30 days. Between 2008 and 2017, the average yield of this source has been 6,200 AFY; the long-term average has been 7,300 AFY. Water captured in Lake Del Valle must be used within the following year.
Local Groundwater	Zone 7 recharges the Livermore-Amador Valley Groundwater Basin with surface water and later extracts the water for peaking, dry years, and emergencies. Zone 7 only pumps what it has stored; over the last fifteen years, the average Zone 7 recharge is 8,000 AFY with the long-term average groundwater pumping rate at 7,300 AFY. The estimated maximum pumping capacity is 34,000 AFY. The basin has 126,000 AF of operational storage capacity, in addition to the emergency storage capacity of 128,000 AF.
Offsite Groundwater Banks (Kern County)	Zone 7 has agreements with Semitropic Water Storage District and Cawelo Water District in Kern County for 78,000 AF and 120,000 AF of storage capacity, respectively. Zone 7 recovers water from these banks during dry years (e.g. in 2014 and 2015). Recovered water is delivered to the SBA through exchanges with surface water from the Delta.
Table A	This source is Zone 7's portion of the SWP annual allocation and represents the largest portion of Zone 7's 'new' water each year. Zone 7's maximum possible annual allocation is 80,619 acre-feet (AF); however, the average allocation since 2008 has been 46.5%, or 37,500 AF.
Transfers (Other)	This category includes any other sources of transfer water (e.g., temporary transfer with River Garden Farms in 2018). In the future, this could include transfers with private entities, agricultural districts, and other water agencies (e.g., a municipal SWP contractor).
Turnback and Multi-Year Pools (MYP)	This is water made available by other SWP contractors who wish to sell excess supply. The Multi-Year Pool was a two-year pilot program that ended in 2016, but it may be reconsidered in the future as a permanent replacement for the Turnback Pool.
Yuba Accord	This water is available mostly in dry years through agreement with DWR and Yuba County Water Agency.

Of all the sources described in Table 4-1, the primary sources of new water are SWP Table A water and local yield from Arroyo Valle. The other sources are either far more intermittent (e.g. Article 21, Yuba Accord), or come from storage reserves. Zone 7's water transfer agreement with Byron Bethany Irrigation District (BBID) is currently being re-evaluated by the Department of Water Resources and its future is uncertain at this time. Therefore, this update gives special attention to Table A and Arroyo Valle as Zone 7's primary sources of incoming water.

Note that in addition to water provided by Zone 7, additional groundwater pumping and recycled water supplement water supplies for the Tri-Valley. Two of the retailers, California Water Service – Livermore District and the City of Pleasanton, pump groundwater under their Groundwater Pumping Quotas (3,069 AFY and 3,500 AFY, respectively), which supplement the potable water supply provided by Zone 7 in their service areas. Dublin San Ramon Services District (DSRSD) and the City of Livermore produce recycled water to meet non-potable or irrigation water demands in the Tri-Valley; for 2018, recycled water use was 2,618 AFY and 2,360 AFY, respectively, for the two agencies.

4.2 State Water Project Reliability

4.2.1.1 Delivery Capability: Existing and Future

For this update, the average reliability of the State Water Project (SWP) is assumed to be 49% of Zone 7's Table A allocation of 80,618 AF (39,500 AF). In its 2015 Delivery Capability Report[5], the California Department of Water Resources (DWR) projected that existing conditions subjected to climate change impacts would result in a long-term average reliability of 62%. Anticipated further diversion restrictions ("high outflow scenario") in the Delta could lower reliability to between 46% and 51%. Taking the average of the restricted scenarios, the long-term reliability is about 49%. Notably, the actual average Table A allocation from 2008 to 2018 is nearly 47%, indicating that the SWP is already experiencing the predicted decline in reliability. The 2016 WSE Update used the full range of projections summarized above; however, given recent observations, Zone 7 made the assumption that without a new project (i.e., California WaterFix, described in Section 6.2.2) to address the SWP's aging condition, and with increasingly stringent environmental regulations, the SWP's existing and future reliability will be 49%.

Figure 4-1 presents historical allocations from 1986 to 2018. As shown on Figure 4-1, allocations had never been less than 30% until 2014.

[5] 2015, Department of Water Resources. State Water Project Delivery Capability Report 2015. https://water.ca.gov/Library/Modeling-and-Analysis/Central-Valley-models-and-tools/CalSim-2/DCR2015

Figure 4-1: Historical State Water Project allocations

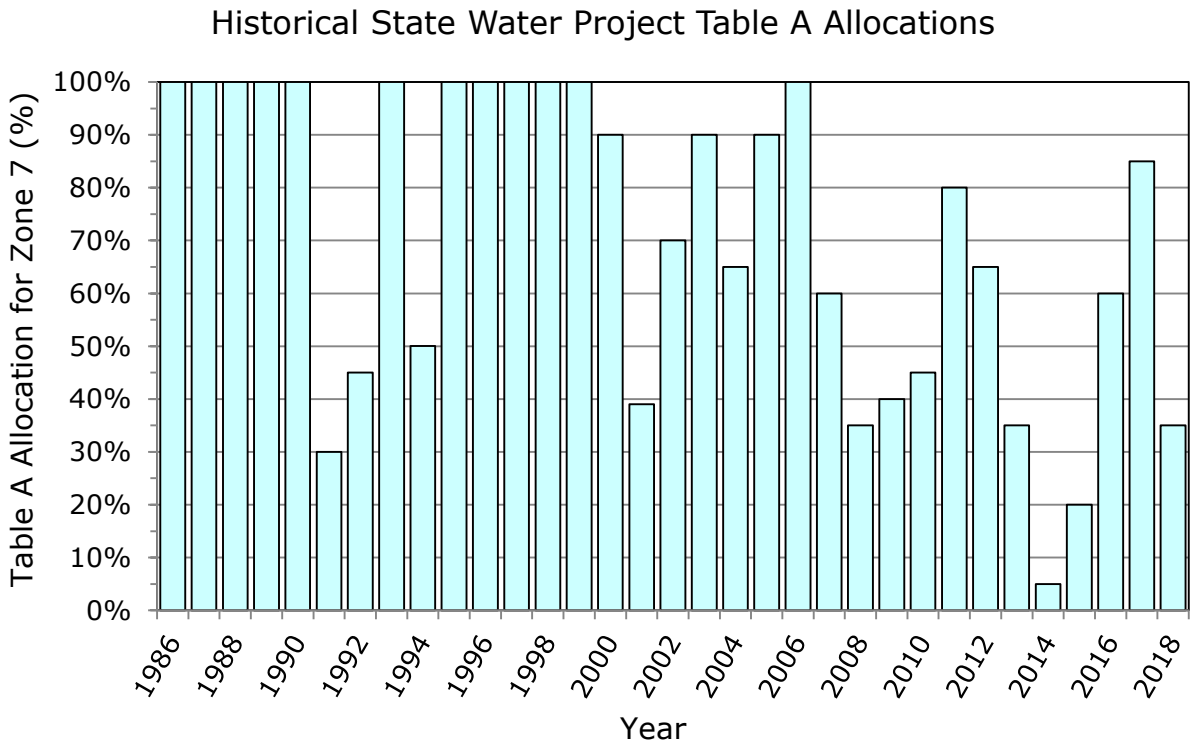
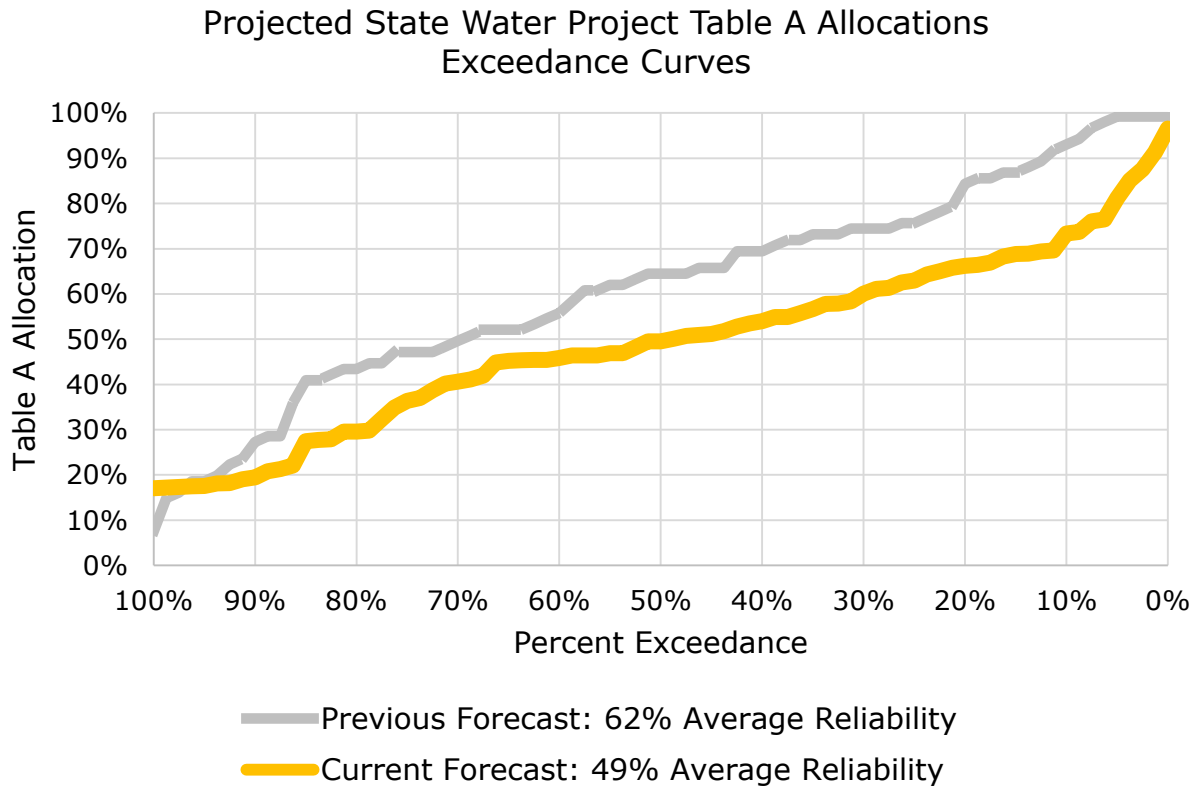


Figure 4-2 compares the previous, 62% average allocation projection with the current, 49% average allocation, using exceedance curves to communicate the probability and range of expected allocations. The y-axis represents Table A allocations, and the x-axis represents exceedance percentages, decreasing from left to right. To give an example for reading the graph, the current projection with the 49% average is depicted by the orange line, and it shows that a 70% Table A allocation has about an 11% exceedance. This means that there is an 11% chance of receiving a Table A allocation greater than 70%; in other words, the chance of receiving more than a 70% allocation is fairly small, given the current forecast. To give another example, the orange line shows that a 30% Table A allocation has about an 80% exceedance; this mean that 80% of the time, the Table A allocation should be greater than 30%. In other words, there is a large chance of receiving more than a 30% allocation in the current forecast. In both examples, over the long-term, the average allocation is expected to be 49%.

Figure 4-2: Exceedance curves for projected State Water Project Table A Allocations



4.2.1.2 Bay-Delta Plan Amendments

In the last few years, the State Water Resources Control Board (State Board) has been undertaking amendments to the Bay-Delta Plan, which establishes water quality control measures and flow requirements needed to protect beneficial uses in the San Francisco Bay/Sacramento – San Joaquin Delta watershed. The Bay-Delta Plan is being updated through two separate phases. Phase 1 focused on San Joaquin River flows and southern Delta salinity. Phase 2 is focused on the Sacramento River and its tributaries, Delta eastside tributaries (including the Calaveras, Cosumnes, and Mokelumne rivers), Delta outflows, and interior Delta flows; this phase will have a direct impact on SWP operations and reliability.

The State Board completed Phase 1 in December 2018, with the decisions expected to significantly reduce water supplies for agencies reliant on the San Joaquin River system. Anticipating the Phase 2 process, DWR and the Department of Fish and Wildlife presented a comprehensive package of Proposed Voluntary Settlement Agreements (VSA) to the State Board in December 2018 meant to address Bay-Delta-wide issues. The VSA was coordinated among many water users and other stakeholders, presenting a collaborative and holistic approach to species management and habitat restoration and establishing how funding will be secured

and how science will inform adaptive management to ultimately achieve the State Board's goals.

State Board staff agreed to evaluate the VSA in Phase 2. With Phase 2 in progress, there is uncertainty regarding how SWP water supplies would be impacted by the final Bay-Delta Plan Amendments. Zone 7 will continue to advocate for protection of SWP water supply beneficial use, and monitor this process so that any new information can be incorporated into the next future water supply evaluation.

4.3 Arroyo Valle Reliability

This update also decreases the average yield expected from local supplies from the Arroyo Valle. The average yield previously assumed was 7,300 AFY. More recently, the observed ten-year (2008 to 2017) average has been 6,200 AFY. Meanwhile, simulations of local climate change effects on the watershed predict an average of 5,500 AFY due to changing rainfall patterns, and this conservative average yield was used for this update, consistent with the treatment of local climate change in the 2016 WSE Update.

The yield of this supply will continue to be evaluated as Zone 7 proceeds with the water right perfection process for Arroyo Valle, as well as infrastructure planning. The long-term yield will be affected by climate change impacts, as noted above, as well as Zone 7's future ability to capture stormwater flows using the planned Arroyo Valle diversion structure into the Chain of Lakes and the planned Chain of Lakes Pipeline. Zone 7 will continue to seek ways—through infrastructure and operations—to optimize this local supply and increase its yield.

5 Baseline "CIP-Only" Water Supply Conditions

A baseline water supply reliability forecast scenario was developed as a benchmark for comparison with alternative scenarios that incorporate new water supply portfolios. Named the "CIP-Only" scenario, it completes all planned water supply reliability infrastructure projects that are specifically identified in Zone 7's Fiscal Year 2018/2019 Ten-Year Water System Capital Improvement Plan (CIP)[6], but it does not include any new water supply projects. The CIP-Only scenario is also known as the "No New Water Supply" scenario. Infrastructure projects in the CIP include the following:

[6] 2017, Zone 7 Water Agency. Fiscal Year 2018/2019 Ten-Year Water System Capital Improvement Plan. https://www.zone7water.com/images/pdf_docs/cip/2018-19_water_system_cip.pdf

- **Chain of Lakes Diversion Structures** – two diversion structures are currently planned in the CIP: the Arroyo Mocho diversion structure and the Arroyo Valle diversion structure.
    - *Arroyo Mocho:* Zone 7 can release excess surface water supplies from the SBA and into the Arroyo Mocho, where water can then be diverted by a new 100-cfs (cubic feet per second) structure into Lake H and ultimately to Lake I for storage and recharge; this structure is planned to be in-service over the next few years to be constructed by Hanson Aggregates as part of the reclamation agreement for Lake H.
    - *Arroyo Valle:* Stormwater flows released from Lake Del Valle into the Arroyo Valle could be captured by a 500-cfs diversion structure and conveyed into Lake A and ultimately to Lake I for storage and recharge. This diversion structure along with the storage in the Chain of Lakes (COL) would allow Zone 7 to increase its 'beneficial use' of Arroyo Valle water, which could result in a higher yield when the water right is perfected and a license is issued by the State Water Resources Control Board. Currently, much of the large stormwater releases end up in the Alameda Creek and the Bay. This structure is planned to be in-service around 2025 to be constructed by CEMEX as part of the reclamation agreement for Lake A.

- **Chain of Lakes Pipeline** – a multi-purpose, two-way pipeline (36-inch diameter, approximately 7 miles) connecting the DVWTP and the SBA with the COL, which will increase local groundwater recharge capacity and local storage, increase local water yield from Arroyo Valle, and provide local emergency surface water supply; the pipeline is planned to be in-service by 2025 at a cost of about $65 million in future dollars.

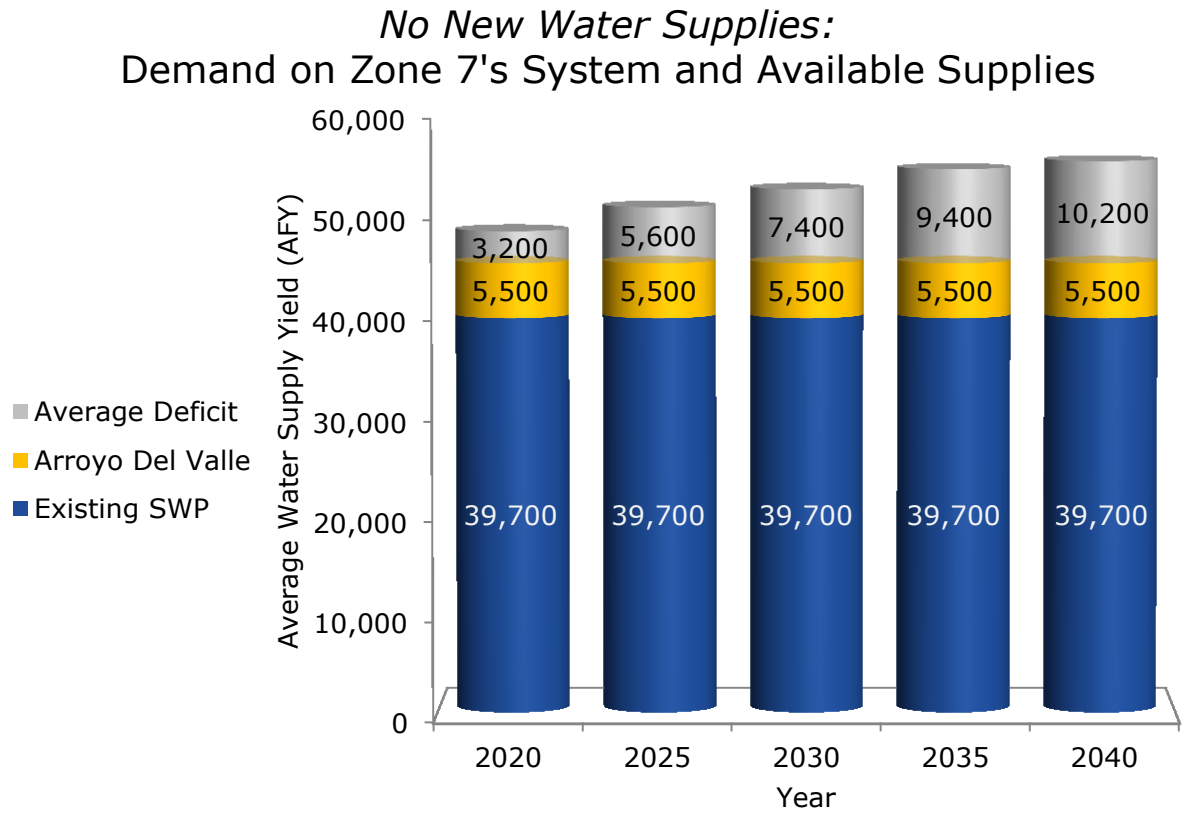
- **New supply wells** – additional municipal water supply wells could maximize access to existing local storage in the Livermore-Amador Valley Groundwater Basin during droughts and facility outages; these wells would be constructed in the Chain of Lakes (two wells, 8.6 MGD), Busch Valley wellfield (one well, 2.9 MGD), and the Bernal wellfield [3.6 MGD (million gallons per day)], resulting in about 15 MGD of additional capacity; new wells are planned to be in-service incrementally by 2030 at a total cost of about $93 million in future dollars.

- **Reliability Intertie** – a treated water pipeline (30-inch diameter, seven-miles) connection with EBMUD on the west side of Zone 7's transmission system, that would provide an additional or alternative means of delivering water to Zone 7 during Delta and/or SBA outages; the intertie is planned to be in-service by 2030 at cost of about $65 million in future dollars.

Together, the projects above will significantly improve the reliability of Zone 7's water supply system. The COL—a string of ten connected lakes created from former gravel quarries—will serve as the heart of the system providing increased groundwater recharge, local storage, and emergency surface water supply. However, there is much uncertainty with the transition of the full COL system to Zone 7 as this is tied to gravel mining economic conditions and reclamation activities. Zone 7 continues to actively engage with the gravel mining operators and Alameda County to acquire Zone 7's full use of the COL for water management purposes as soon as possible and to protect the groundwater basin.

Given lower yields from existing supplies such as the SWP and the Arroyo Valle, supply deficits—based on average conditions—are expected starting at about 3,000 AFY in 2020 and increasing to about 10,000 AFY by buildout (Figure 5-1). The CIP-only scenario demonstrates the need to develop new water supplies. Furthermore, other projects that could further improve the reliability of Zone 7's system through increased storage or alternative conveyance also need to be considered. Section 9.1 will further demonstrate the long-term reliability and risk impacts of the projected supply deficits under the CIP-only scenario.

Figure 5-1: Forecasted average total water supply yield and average deficit against demand under the CIP-Only scenario (no new water supplies) through buildout at 2040.



6 Water Supply Reliability Projects

The CIP-only scenario described in the previous section reveals that Zone 7's future water supply reliability is significantly constrained by a supply deficit. Zone 7 is therefore pursuing a number of water supply projects. To further bolster the reliability of Zone 7's water supply system, Zone 7 is also pursuing additional water storage and alternative conveyance.

The following potential water supply reliability projects—classified into storage and supply—were evaluated as part of this update. Sites Reservoir provides both storage and supply, but is primarily being pursued as a supply project by Zone 7. Los Vaqueros Reservoir Expansion is primarily a storage project but also comes with alternative conveyance (the Transfer-Bethany Pipeline).

Many of the projects had been analyzed in some form in previous evaluations; any new information has been incorporated in this update. Sites Reservoir is a new project, while the Los Vaqueros Reservoir project has been modified to incorporate the reservoir's expansion and new facilities. Findings from a recently completed study of potable reuse have been incorporated. A variety of new transfer opportunities is being evaluated.

Cost estimates were developed to be as comparable as possible between projects of varying nature, and reflect the cost of delivering water to the headworks of Zone 7's water treatment plants, or to recharge facilities for the local groundwater basin. The additional costs of treating and conveying the water and Zone 7's other operational costs (e.g., staffing, maintenance) are not included in the cost estimates presented below.

6.1 Water Storage Project

6.1.1 Los Vaqueros Reservoir Expansion

6.1.1.1 Project Overview

Constructed in 1997, Los Vaqueros Reservoir is an off-stream reservoir owned by Contra Costa Water District (CCWD) and located in southeastern Contra Costa County (Figure 6-1). It currently has a capacity of 160,000 acre-feet (AF) following its expansion (Phase 1) from 100,000 acre-feet in 2012. CCWD is planning for further expansion of the reservoir to 275,000 AF (Phase 2) and construction of the Transfer-Bethany Pipeline, which would connect the reservoir to the South Bay Aqueduct (SBA) system.

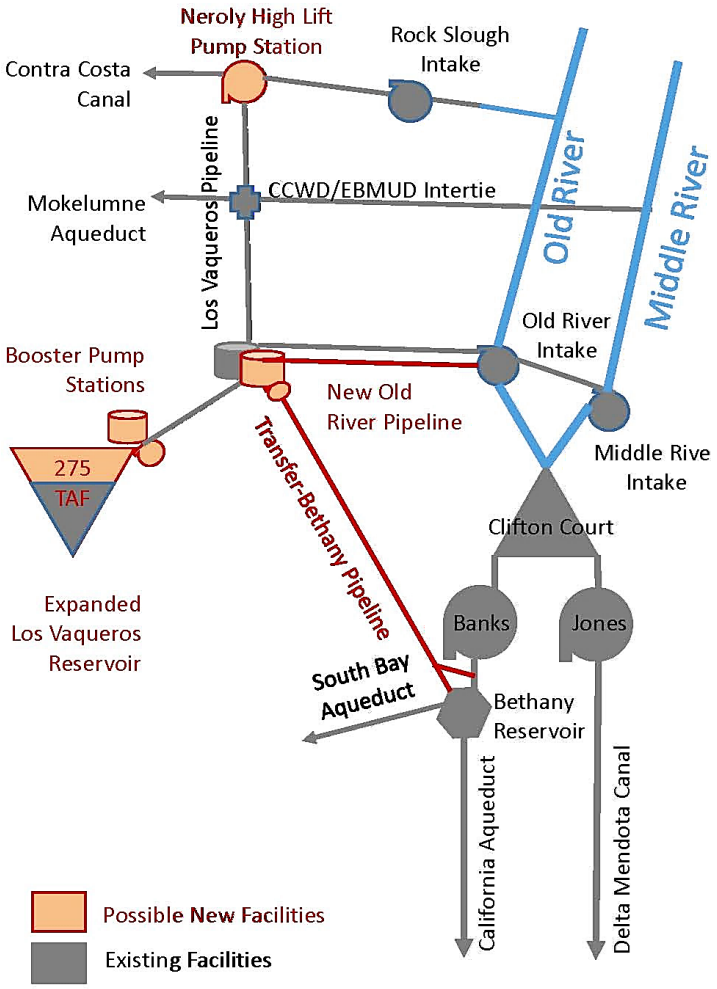
In September 2016, the Zone 7 Board approved participation in the Los Vaqueros Reservoir Expansion (LVE) Project Planning as a 'Local Agency Partner' with a $100,000 cash contribution towards the preparation of required environmental documents. LVE's key objectives are (1) to develop water supplies for environmental water management and (2) to increase water supply reliability for Bay Area water agencies. In addition, the Project would improve water quality for municipal and industrial customers in the San Francisco Bay Area while providing improved habitat, and recreation and flood control benefits.

Figure 6-1: Location of Los Vaqueros Reservoir

Under the LVE, water would be diverted from the Sacramento-San Joaquin River Delta (Delta) at CCWD's Rock Slough, Old River, and Middle River Intakes, and at the Freeport Intake[7] on the Sacramento River. This water could then be delivered to agencies within CCWD's service area, the Bay Area, the Delta, neighboring regions, and the south-of-Delta wildlife refuges. Under existing and new water right and permit conditions, CCWD would be able to divert different types of water, including: Delta surplus water under CCWD's Los Vaqueros water right, Central Valley Project water, SWP water, Mokelumne River water, and other water acquired by project partners through transfer agreements. Existing and new facilities would be used to store and convey water under LVE (Figure 6-2).

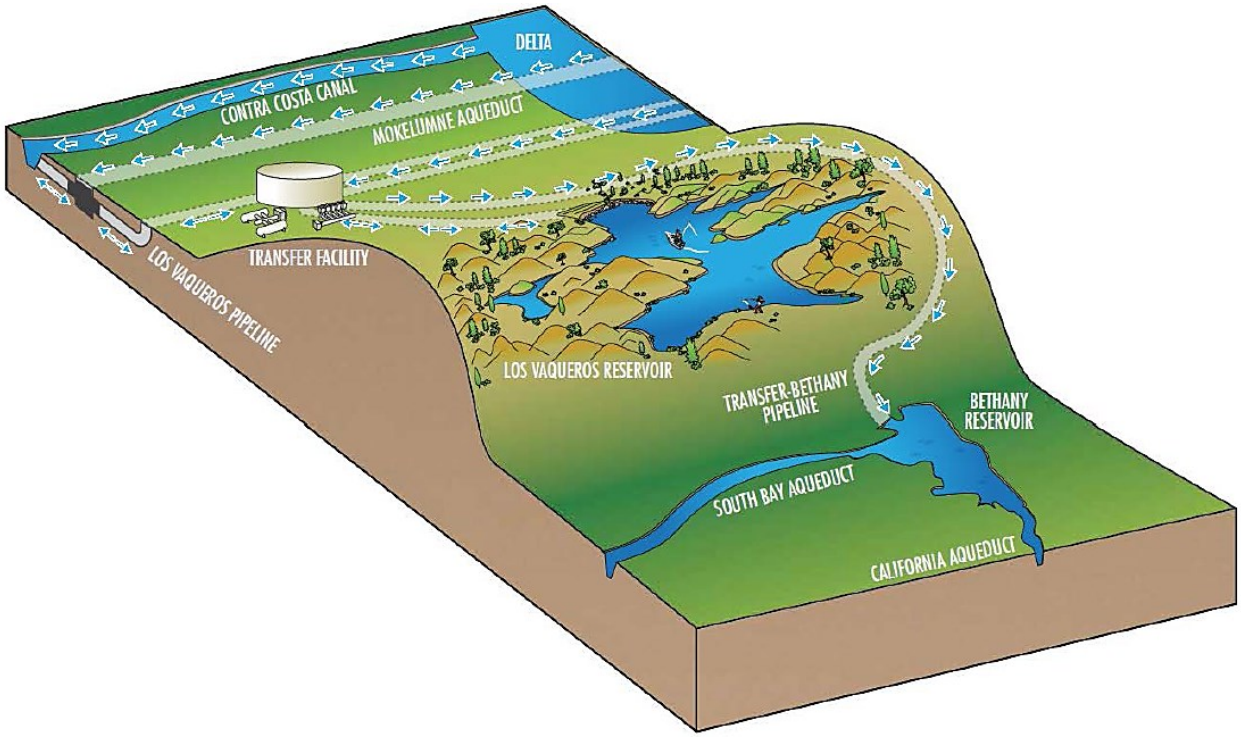
[7] Freeport Intake is owned and operated jointly by Sacramento County Water Agency and the East Bay Municipal Utility District (EBMUD). It is located ten miles south of downtown Sacramento.

Figure 6-2: Existing and new facilities planned as part of the Phase 2 Los Vaqueros Reservoir Expansion (Source: CCWD)



Water could be stored in Los Vaqueros Reservoir for later use or delivered directly to partners. Potential LVE participants envision different operational schemes for their use of the reservoir and associated facilities, and these various scenarios are continuing to be evaluated through modeling by CCWD staff. While some new water supply may be available from LVE, Zone 7 is primarily evaluating the project as storage due to the uncertainty of the availability of such supplies given increasing Delta restrictions. Figure 6-3 shows the various water conveyance routes, including conveyance of water from the Delta to the South Bay Aqueduct via the new Transfer-Bethany Pipeline.

Figure 6-3: Water conveyance routes under the Los Vaqueros Reservoir Expansion. (Source: CCWD)



In 2017, CCWD and the US Bureau of Reclamation (Reclamation) completed the Draft Supplement to the Final EIS/EIR for LVE. The project was successfully selected for funding under the State's Water Storage Investment Program (WSIP) in July 2018. LVE's next phase is starting in early 2019, and a Multi-Party Agreement has been developed to establish the terms of continued participation.

Emergency storage in Los Vaqueros Reservoir—with or without the reservoir expansion and without the Transfer-Bethany Pipeline—was included in the 2016 WSE Update in the amount of 10,000 AF. In this update, the LVE project components were incorporated and a range of operational scenarios were modeled.

A Joint Powers Authority (JPA) is planned to be formed in mid- to late 2019 to oversee project planning and design and operation.

6.1.1.2 Project Costs

The total capital cost for LVE is estimated at $863 million in 2018 dollars. The dam raise is the largest cost component at $403 million, followed by the Transfer-Bethany Pipeline at $195 million. CCWD's financial consultant has been developing a *Pro forma* Financial Model to develop preliminary cost estimates for partners and evaluate different cost allocation methods. The model incorporates assumed State and Federal funding. The key principle is that costs would be allocated according to

proportional use of the facilities, with proportional use determined through operations modeling.

The cost allocation principles and methods will continue to be refined as LVE moves into the next phase. Under one scenario that has been modeled, *preliminary* cost estimates for different types of use of LVE range from $240/AF to $3,300/AF in 2018 dollars, after accounting for State and Federal funding and bond financing. For Zone 7, the *preliminary* estimate is about $1,500/AF of water delivered to Zone 7, based on 10,000 AF of storage and average annual delivery of Zone 7's water at 1,600 AFY, including debt service, usage fees, and other O&M fees. These unit costs are expected to continue to shift significantly as participation conditions evolve with greater project definition. The project will likely be financed with long-term bonds as it proceeds closer to construction.

In July 2018, the California Water Commission approved WSIP funding of up to $459 million for LVE, with early funding of up to $14 million. The early funding from the State, as well as potential funding from the Federal government's Water Infrastructure Improvements for the Nation Act (WIIN Act), will cover some of the costs as LVE moves into the next phase, reducing participant costs.

6.1.1.3 Project Schedule

The Transfer-Bethany Pipeline is planned for operation by 2025 with the expanded reservoir in service by 2030.

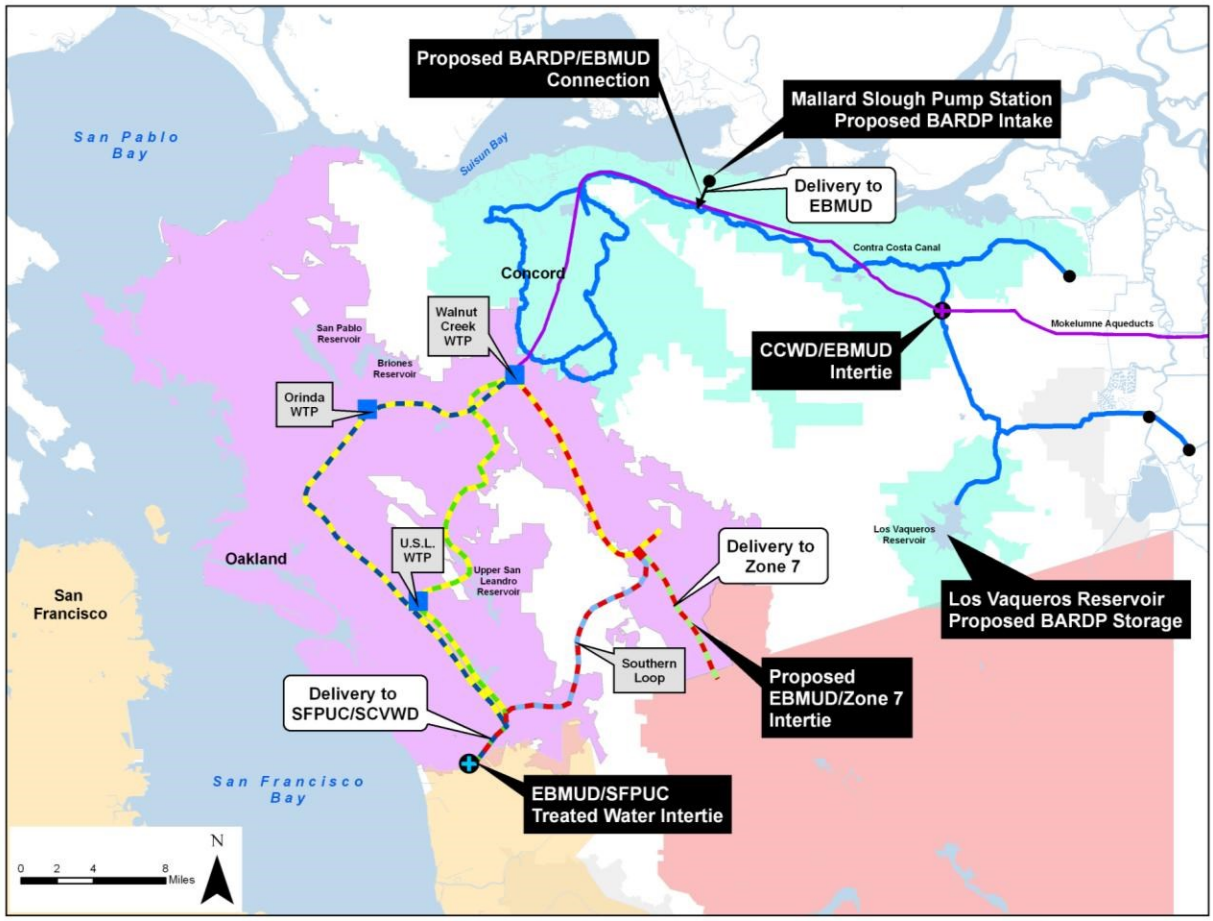
6.2 Water Supply Projects

6.2.1 Bay Area Regional Desalination Project

6.2.1.1 Project Overview

Brackish water desalination for Zone 7 would be accomplished through a joint venture among five Bay Area water agencies known as the Bay Area Regional Desalination Project (BARDP). The project would involve constructing a regional brackish water treatment plant in eastern Contra Costa County producing 10-20 million gallons per day (MGD). Water would be diverted using CCWD's Mallard Slough Pump Station (Figure 6-4). Through the use of an existing water right license and permit, both held by Contra Costa Water District (CCWD), and/or a new water right, Zone 7 could potentially receive a steady 5,600 AFY. Zone 7 could take delivery of this new water supply through a reliability intertie with East Bay Municipal Utility District (EBMUD) or through the SBA by exchanging water with CCWD. Furthermore, this project could potentially provide a new water supply component for the LVE project, and make use of LVE's additional storage and new conveyance facilities.

Figure 6-4: Potential location of the Bay Area Regional Desalination Project: diversion structure in eastern Contra Costa County (CCWD's Mallard Slough Pump Station)



Desalination was included in the 2016 WSE Update and there has not been any new analysis of this project since that time. However, there has been recent renewed interest in the project as part of the Bay Area Regional Reliability Partnership, and there may be new developments in the near-term. For this update, desalination was assumed to behave similarly to potable reuse (raw water augmentation), providing a steady drought-resistant supply of about 5,600 AFY. Water from this potential project could be available to the Tri-Valley as treated water directly supplying the west side of Zone 7's transmission system. This mode of delivery provides an alternative conveyance not subject to Delta outages.

6.2.1.2 Project Costs

Costs from the 2016 WSE Update were inflated to July 2018. The costs were based on a 10-MGD facility with Zone 7's share at 5 MGD. The total capital cost is estimated at $150 million with Zone 7's share at about $80 million. The unit costs range from $1,800 to 2,200/AF, with the higher end reflecting delivery of treated water through the reliability intertie.

6.2.1.3 Project Schedule

The project could be constructed in eight to twelve years with a potential in-service year assumed at 2027.

While the project has been in hiatus over the last two years, project partners are re-initiating discussions in 2019 to consider potential partners, yields, and financing options.

6.2.2 California WaterFix

6.2.2.1 Project Overview

The California WaterFix (CWF or WaterFix), which would provide infrastructure upgrades to the 50-year old through-Delta conveyance of the SWP, is a key component of the California Water Action Plan[8], the State of California's blueprint for "a sustainable and resilient future." WaterFix would provide water supply reliability and water quality improvement, and would help protect the SWP—the State's largest source of supply—from disruptions due to failure of levees in the Delta and saltwater intrusion. The likelihood of such failure increases with time due to seismic vulnerability, climate change, and aging infrastructure.

The proposed infrastructure (Figure 6-5) for WaterFix—as defined in current environmental documents—includes dual forty-foot diameter pipelines that will stretch about 38 miles from the three intakes on the Sacramento River to Clifton Court Forebay and the Banks Pumping Plant in the Delta. Each of the three new intakes would have a 3,000 cfs capacity.

Extensive modeling, involving forecasts of SWP and Central Valley Project (CVP) deliveries for a number of scenarios involving climate change, both with and without WaterFix, has been done to evaluate the project's operational water supply benefits. The combined export capability of the SWP and CVP has been steadily decreasing due to a number of regulatory restrictions and increasing maintenance-related outages typical of aging infrastructure. With existing and future regulatory constraints alone, the combined annual yield from the SWP and CVP water system is expected to drop further from the current average of 4.7 million acre-feet (MAF) (equivalent to 62% SWP reliability) to 3.5 to 3.9 MAF (46-51% SWP reliability, average of 49%). As noted in Section 4.2, this forecasted condition now reflects observed conditions over the last 11 years.

WaterFix would increase water supplies by improving operational flexibility. Operators can take better advantage of intermittent high-flow events—which occur even during dry years—allowing the SWP to capture excess storm flows that would

[8] 2014, State of California. California Water Action Plan. http://resources.ca.gov/docs/california_water_action_plan/2014_California_Water_Action_Plan.pdf

otherwise flow to the Bay. The project will also increase the SWP system's capacity to facilitate transfers between north and south of the Delta. Based on a reliability increase from 49% up to 62%, WaterFix is expected to restore 13% of Zone 7's Table A supply or about 11,000 AFY. WaterFix will primarily improve wet year supply conditions, providing water that could be stored for use during droughts or outages.

In February 2019, newly-elected Governor Newsom stated his support for modernizing California's water conveyance system in the Delta but with a single-tunnel version of WaterFix. The project is expected to evolve over the next few years; at this time, the impacts on the project yield is unknown. Zone 7 will continue to monitor this project and update plans as appropriate.

6.2.2.2 Project Costs

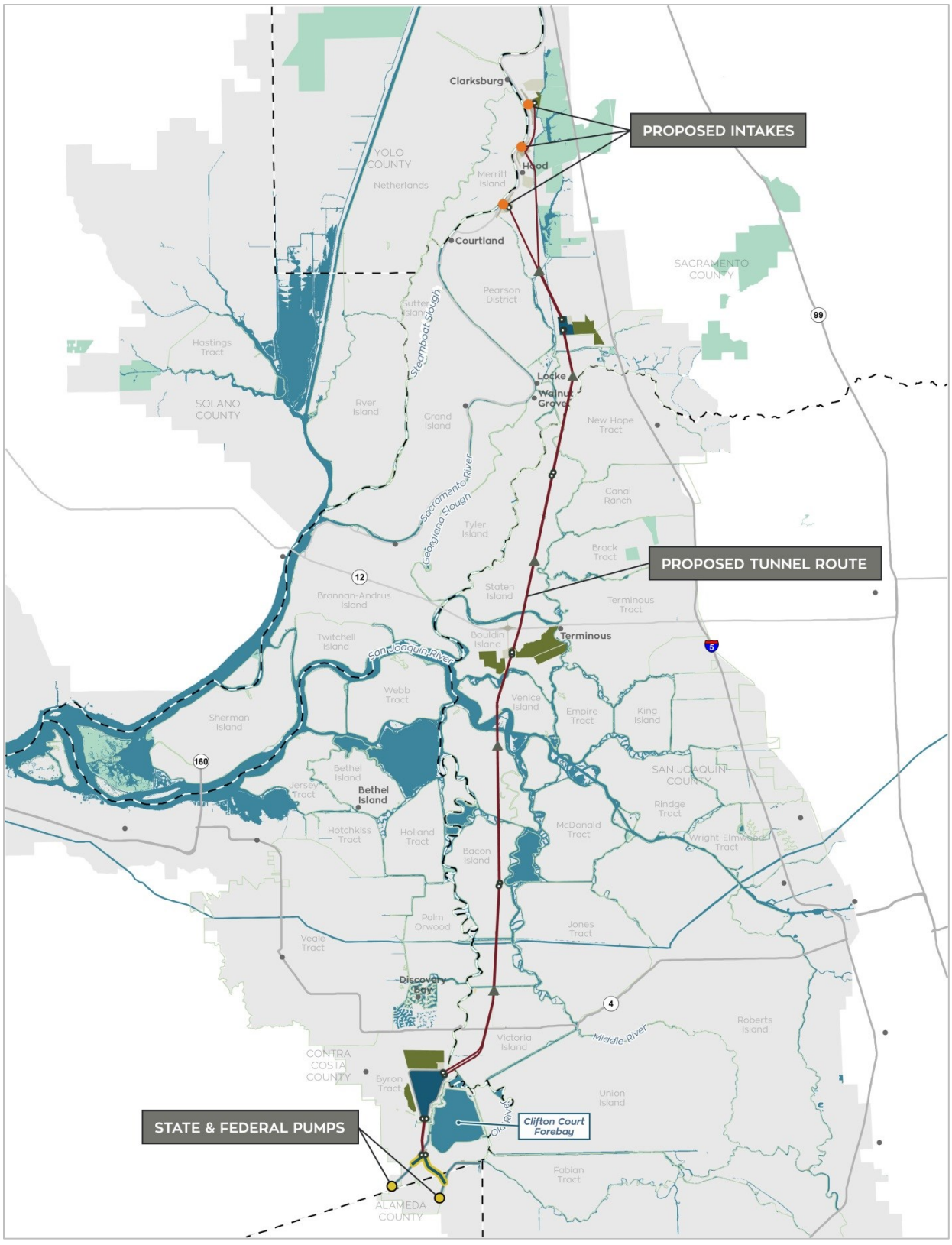
The total project cost for WaterFix—as defined above—is $17 billion; Zone 7's share of the capital cost is estimated at $220 million. The estimated unit cost is $700/AF in 2017 dollars for Zone 7 including debt financing and O&M costs. This unit cost is for raw water delivered upstream of Zone 7's water treatment plants, or to the groundwater basin. The unit cost was estimated using the total expected incremental yield from the project—about 11,000 AFY—from its completion through the year 2080, along with the total cost expected between the years 2016 and 2080. The project would ultimately be financed by DWR through the issuance of several long-term bonds to be paid through 2080 by the SWP contractors and any other project participants. These costs may change as the project is modified as noted above.

6.2.2.3 Project Schedule

WaterFix is currently expected to be fully operational around 2035. However, as noted above, the project may be modified; the impact of this change on the schedule is currently unknown.

Key project milestones achieved recently include the formation of two new JPAs in 2018: 1) the Delta Conveyance Design and Construction Authority (DCA), which, under DWR direction, will design and construct the project and 2) the Delta Conveyance Finance Authority (Finance Authority), which will secure financing for WaterFix implementation. Work continues on securing the necessary permits and regulatory approvals for the project.

Figure 6-5: California WaterFix will construct new intakes and new tunnels as part of the SWP infrastructure upgrades (Source: California Natural Resources Agency)



6.2.3 Potable Reuse

6.2.3.1 Project Overview

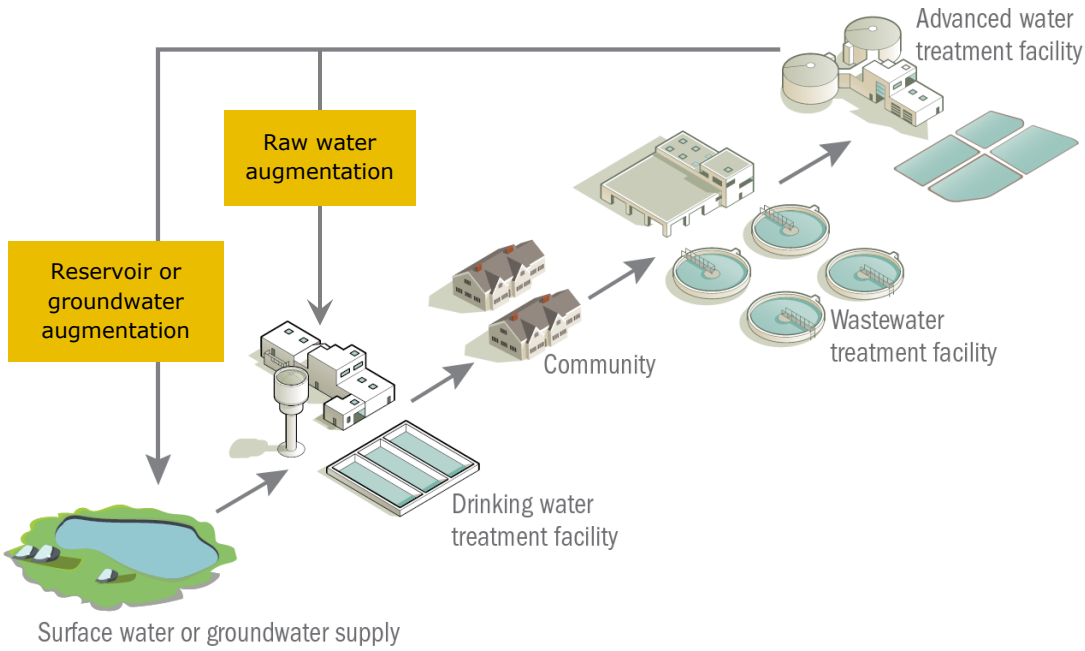
Potable reuse is the use of purified water derived from wastewater effluent to supplement potable water supplies. While recycled water, the use of treated wastewater for non-potable uses such as irrigation, has been available for many years in the Tri-Valley, potable reuse would be a new use of local wastewater resources collected by DSRSD and the City of Livermore. Its main benefits are that it would be a locally-generated and -controlled supply, it is drought-resistant, and it makes use of an existing water resource.

Potable reuse was included in the 2016 WSE Update water supply options. In 2018, the Tri-Valley Water Agencies completed the Joint Tri-Valley Potable Reuse Technical Feasibility Study[9] with these goals: 1) to evaluate the feasibility of a wide range of potable reuse options for the Tri-Valley based on technical, financial, and regulatory considerations and 2) assuming that potable reuse is found to be technically feasible, to recommend next steps for the agencies. The study also refined cost estimates for potable reuse.

The study investigated three potential end uses for purified water in detail: 1) groundwater augmentation or recharge via injection wells, 2) groundwater recharge via Chain of Lakes surficial recharge, and 3) raw water augmentation to Zone 7's Del Valle Water Treatment Plant. Conceptual schematic of these uses are illustrated in Figure 6-6. The study, which looked at annual yields ranging from 5,500 to 10,000 AFY, concluded that potable reuse is technically feasible for the Tri-Valley with benefits to reliability and water quality. The lower yield would use only Livermore wastewater supply with year-round operations; the higher yield would be achieved with seasonal availability of DSRSD wastewater supply. Water availability would increase over time as development occurs in the Tri-Valley and more wastewater is generated and collected. In other words, the maximum yield is expected to only be available after a certain point in the future; only a fraction of the maximum yield is available before buildout.

[9] 2018, Carollo Engineers. Joint Tri-Valley Potable Reuse Technical Feasibility Study. https://www.dropbox.com/s/pxcyajryga5j61s/potable_reuse_feasibility_study_May-2018.pdf?dl=0

Figure 6-6: Conceptual schematic of potential potable reuse options (Credit: *Potable Reuse 101*, AWWA, 2016)



In this update, raw water augmentation was modeled with the option for a two-phased project that initially produces a lower yield, but increases to the maximum yield in 2035 once the available wastewater has grown with time. Reflecting a more conservative estimate of future wastewater availability, the yield used in this analysis was reduced to 4,000 AFY starting in 2027 and 7,000 AFY after 2035. Conservation regulations, as discussed in Section 3, have set low indoor water use targets for California, which are expected to reduce wastewater amounts into the future. The estimates in the Joint Tri-Valley Potable Reuse Technical Feasibility Study had not incorporated the recently set statewide indoor water use targets. The estimated yield for potable reuse will be adjusted in future analysis, as necessary, based on actual indoor water use trends and updated projections of wastewater availability for potable reuse.

6.2.3.2 Project Costs

For the purposes of this study, Zone 7 was assumed to cover the full cost of potable reuse. The full range of cost estimates from the Joint Tri-Valley Potable Reuse Technical Feasibility Study was adjusted to 2018 dollars and the cost of additional studies was incorporated. The capital cost is estimated to range from $120 to 250 million with unit costs ranging from $2,500 to 2,700/AF of water delivered upstream of Del Valle Water Treatment Plant, or to the groundwater basin. Both raw water augmentation and groundwater augmentation projects were included in the cost bookends, and debt service was assumed at 5% for 30 years. Because this

study assumes a reduced yield of 4,000 to 7,000 AF—accounting for 30% reduction in wastewater flows—this could result in smaller facilities and potentially lower capital costs. However, the unit costs—as presented in the table—are assumed to be comparable even with the yield reduction.

6.2.3.3 Project Schedule

A potable reuse project could take eight to ten years from planning to construction. In the evaluation, the first phase is assumed to be completed by 2027, and a second phase (if any) would be completed by 2035.

6.2.4 Sites Reservoir

6.2.4.1 Project Overview

The Sites Reservoir Project would construct a new 1.8 million AF off-stream reservoir in Colusa County, 75 miles northwest of Sacramento and approximately 10 miles west of the city of Maxwell (Figure 6-7). The new reservoir is intended to supplement and optimize use of the CVP's Shasta Reservoir and the SWP's Oroville Reservoir, which collects much of the water for the SWP system.

The Sites Project Authority (Authority) was formed on August 26, 2010 as a JPA to pursue the development and construction of Sites Reservoir. The Authority is governed by a 12-member Board of Directors representing Sacramento Valley leadership in government and water management. Water agencies across California that are investing in the project are members of the Sites Reservoir Project Committee, which oversees the planning efforts and provides recommendations to the Authority.

The project could provide both water supply and storage for Zone 7. In December 2016, the Zone 7 Board authorized participation in Phase 1 of the project with a request for 20,000 AFY of Sites Reservoir yield. Phase 1 ends in March 2019 and the first part of Phase 2 will cover April through December 2019.

Sites Reservoir is intended to capture excess flows in the Sacramento River system, to be filled during major storm events after all environmental compliance obligations and senior water right demands have been met. While the reservoir is largely expected to be filled during wet years, these conditions can occur even during dry years. Sites Reservoir is expected to yield up to about 500,000 AFY on average, with more water made available during dry years to participants. Operations modeling continues to be refined to reflect a range of permit and operational conditions, which could reduce the average annual yield of the project; preliminary analysis indicates that the yield could be lowered by as much as 40% under extreme permitting conditions. In addition to capturing and storing water supply for municipal and agricultural use, Sites Reservoir can reserve a pool of water for environmental uses.

Figure 6-7: Sites Reservoir Project (Source: Sites Project Authority)

For Zone 7, water could be released from Sites Reservoir annually to the Sacramento River, generally during dry and critical years, then conveyed by the SWP system through the Delta and to the SBA. In the evaluation, a net average delivery of 5,000 to 10,000 AFY at the SBA was considered. Because storage operational parameters for Sites Reservoir are still being evaluated and developed, Sites Reservoir is being considered primarily as a supply project at this time, with anticipated future benefits from storage access.

6.2.4.2 Project Costs

Sites Reservoir's total capital cost is estimated at $5.5 billion (2018 dollars). For every 10,000 AFY of participation (2% of yield), the project capital cost is approximately $110 million. The project's financial consultant estimates the overall water supply cost at $630 to $900/AF for water delivered to Banks Pumping Plant in the Delta based on certain yield, bond financing, and State/Federal cost share assumptions. Accounting for 20% carriage loss through the Delta and the cost of conveyance from the Delta to the SBA, the unit cost of Sites Reservoir is currently estimated at $900-$1,200/AF of water delivered upstream of Zone 7's water treatment plants or to the groundwater basin, including debt service and operation and maintenance costs. Costs will continue to be refined as part of Phase 2, along with more refined operations and yield modeling.

In July 2018, the California Water Commission decided to award the project up to $816 million in State funding to cover public environmental benefits. The Project was also selected for early funding of up to $40.8 million to assist in completing the necessary environmental analyses and obtaining permits. The early funding from the State, as well as potential funding from the Federal government's Water Infrastructure Improvements for the Nation Act (WIIN Act), will cover some of the costs as the project moves into Phase 2, reducing participant costs.

6.2.4.3 Project Schedule

The project is planned for full operation in 12 years in 2030. In 2019, efforts will be focused on refining project operations and developing principles of agreement with DWR and Reclamation, preliminary permit planning and applications, preliminary right of way activities, and other supplemental analysis (e.g., storage operations modeling, etc.).

6.2.5 SWP Long-Term Transfers

6.2.5.1 Project Overview

As part of CWF, there may be opportunities to purchase the additional yield from other SWP contractors who do not need the water or cannot afford the cost of CWF. For a given Table A amount, different yields of CWF water would be available to the purchaser depending on the hydrology (generally more water available during wetter years). This type of transfer is envisioned to be a long-term contract through 2080.

6.2.5.2 Project Costs

The cost of a SWP long-term transfer will vary depending on the seller and the associated terms. One example considers Tulare Irrigation District. At a proposed 85% of Tulare Irrigation District's projected CWF cost, the unit cost of this option is about $640/AF. Similar to CWF, this option be financed over the term of the SWP contracts through 2080.

6.2.5.3 Project Schedule

This option's schedule is tied to CWF, with water available around 2035.

6.2.6 SWP Short-Term and Other Transfers

6.2.6.1 Project Overview

These transfers represent potential temporary water transfer agreements that supplement Zone 7's water supply before long-term projects come online. The major water supply reliability projects are projected to only come online by 2030; these short-term transfers (generally up to ten years) could help in the interim. Water from the Yuba Accord and other existing or known potential water transfers are counted as part of this category. Transfer water would be conveyed to Zone 7 through the Delta and the SBA, and the assumed short-term transfers include 5,000 AFY, 10,000 AFY, and 12,500 AFY.

Examples of such transfer agreements include transfers between Zone 7 and another SWP contractor, or transfers between another water agency or a private entity and Zone 7. A transfer of Table A supplies between Zone 7 and another SWP contractor is likely one of the most expedient and cost-effective transfer options, and Zone 7 has been exploring possible options.

In 2018, Zone 7 piloted a transfer agreement with River Garden Farms, which has a CVP contract and post-1914 appropriative water rights on the Sacramento River. River Garden Farms made 1,000 AF of water available to Zone 7 through

groundwater substitution[10], and this water (after losses in the Delta) was delivered to Zone 7 through the Delta and SBA.

Zone 7 will continue to pursue and evaluate transfer opportunities in the Bay Area, and State-wide. Through the Bay Area Regional Reliability Partnership, Zone 7 is participating in a Reclamation grant-funded project to develop a "Regional Water Market Program", which will identify transfer types and opportunities and develop a road map to facilitate transfers and exchanges in the Bay Area.

6.2.6.2 Project Costs

Short-term transfers are expected to have a very small capital cost since they will mainly rely on existing infrastructure. Water purchase costs for a SWP transfer are estimated at about $350/AF of water delivered upstream of the water treatment plants or to the groundwater basin. When the administrative costs are included ($30,000 per year, as well as a one-time $200,000 expense for setting up agreements, environmental review, etc.), the estimated total unit cost of transfers is about $420/AF. A multi-year agreement could be expected to have lower unit costs than a one-year agreement. For the River Garden Farms one-year agreement, the unit cost ranged from $700-1,000/AF depending on hydrology and after accounting for water loss through the Delta. The actual cost in 2018 (a below normal year) was $1,030/AF.

6.2.6.3 Project Schedule

Short-term transfers could be implemented as quickly as within a year, depending on the nature of the transfer agreement.

6.3 Summary of Projects

Table 6-1 summarizes the average estimated yield and various cost metrics of the water supply reliability projects described in the previous section. Unit costs reflect the cost of delivering water upstream of the water treatment plants or to the groundwater basin; the additional costs of treating and conveying the water and Zone 7's other operational costs (e.g., staffing, maintenance) are not included in the cost estimates presented. Annual debt service reflects varying financing mechanisms and terms for the different projects. Footnotes in Table 6-1 provide additional details. Figure 6-8 compares the development timelines between the projects, including both water supply/storage projects and the Zone 7 infrastructure projects described in Section 5. Table 6-2 provides an overview of the projects' key benefits and risks/challenges. Figure 6-9 identifies the various project locations.

[10]River Garden Farms pumped additional groundwater for their use and reduced their surface water diversion from the Sacramento River, leaving that water for Zone 7 to divert downstream.

Table 6-1: Assumed yields and preliminary estimated costs of raw water from the water supply reliability projects.

PROJECT	Average Assumed Yield (AFY)	Total Capital Cost ($M)	Zone 7 Share of Capital Cost ($M)	$/AF (Inc. Debt Service And O&M)[i]
WATER STORAGE				
Los Vaqueros Reservoir Expansion[d]	*max. storage: 10,000 AF avg. delivery: 1,600 AFY*	$863		$1,540
WATER SUPPLY				
Bay Area Regional Desalination Project[e]	5,600	$150	$80	$1,800
CA WaterFix[a]	11,000	$16,700	$220	$740
Potable Reuse[b]	4,000-7,000	$120-250	$120-250	$2,500-2,700
Sites Reservoir[c]	5,000 to 10,000	$5,500	$110	$900-1,200
SWP Long-Term Transfers[h]	5,000-7,000	$16,700	$100	$640
SWP Short-Term and Other Transfers[f,g]	5,000-12,500	$0.2	$0.2	$420-$1,100

Notes/assumptions:

a. CA WaterFix will restore yield to 62% from 49% (11,000 AF). Project cost: $16.7B (2017 $), Zone 7 at 2% of the 6,000 cfs portion, 40-yr bonds issued over time through 2080. $/AF: total annual costs through 2080 (inc. debt service) divided by yield over 50 yrs. O&M: sum of fixed minimum and addtl power during operations.

b. For the purposes of this table, Zone 7 assumed to carry full cost of potable reuse. Costs from Joint Tri-Valley Technical Feasibility Study (2018), inflated to July 2018 $ plus addtl $6M in studies. Lower end represents Livermore effluent only, higher end includes DSRSD effluent. Both raw water augmentation and groundwater augmentation projects were included in cost bookends. Debt service assumed at 30 yrs @ 5%. Note that the risk model assumes reduced yield to 4,000 and 7,000 AF, accounting for 30% reduction in wastewater flows, largely from implementing California's Long Term Conservation Framework; this could result in smaller facilities (and potentially lower capital costs) but the unit costs--as presented in the table--are assumed to be comparable.

c. Sites' total capital cost at $5.5B (2018 $), with Z7 share assumed at 2% (10,000 AF of 500,000 AF ave annual yield). More water supply is potentially available but the risk model currently looks at net yield up to 10,000 AFY. 40-yr bonds @ 5% assumed.

d. Unit cost from CCWD's Pro forma Financial Model (version 2.0)--*preliminary* cost estimate based on one modeled scenario: 10,000 AF of storage and average annual delivery of Zone 7's water at 1,600 AFY; includes debt service, usage fees, and other O&M fees. Costs are expected to change significantly as participants adjust their participation levels.

e. BARDP: Costs from 2016 WSE Update inflated to July 2018; 10 MGD facility - Zone 7's share at 5 MGD; 30 yrs @ 5%. The cost shown is for the delivery of raw water upstream of Zone 7's water treatment plants, or to the groundwater basin, through exchange in the Delta. The delivery of <u>treated</u> water from BARDP using the reliability intertie is estimated to cost $2,200/AF.

f. Short-Term Transfers: 2020-2029. Assumed purchase price at $350/AF and O&M at estimated variable cost of $60/AF. Assumed app. $200K in admin/legal/enviro costs in year 1 ('capital cost') then $30K/yr for admin costs. Purchase is included in annual O&M costs.

g. This could also include River Garden Farms (RGF) or other transfer and exchange opportunities. Cost estimate reflects recent RGF agreement, factoring in Delta carriage loss.

h. SWP Transfers (e.g., Tulare) 2017 $; purchase half of Tulare CWF yield at 85% of cost. Tulare Table A is 87,500 AF.

i. When project is operational. Raw water delivery upstream of WTPs or to groundwater basin. Includes SWP variable charge estimated at $60/AF for Delta/SBA delivery. Annual debt service reflects varying financing mechanisms and terms for the different projects.

Figure 6-8: Preliminary timeline for water supply reliability projects

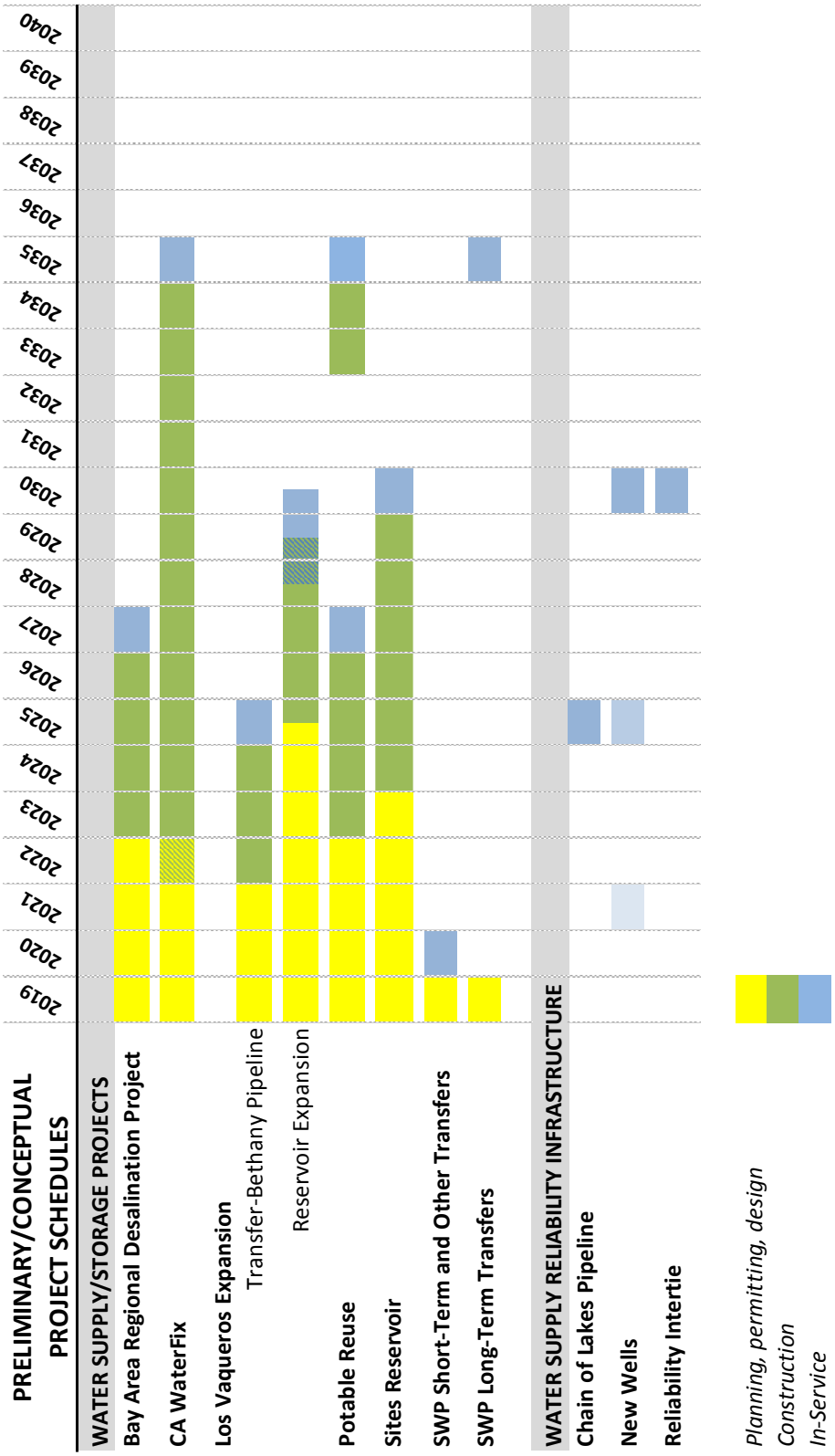
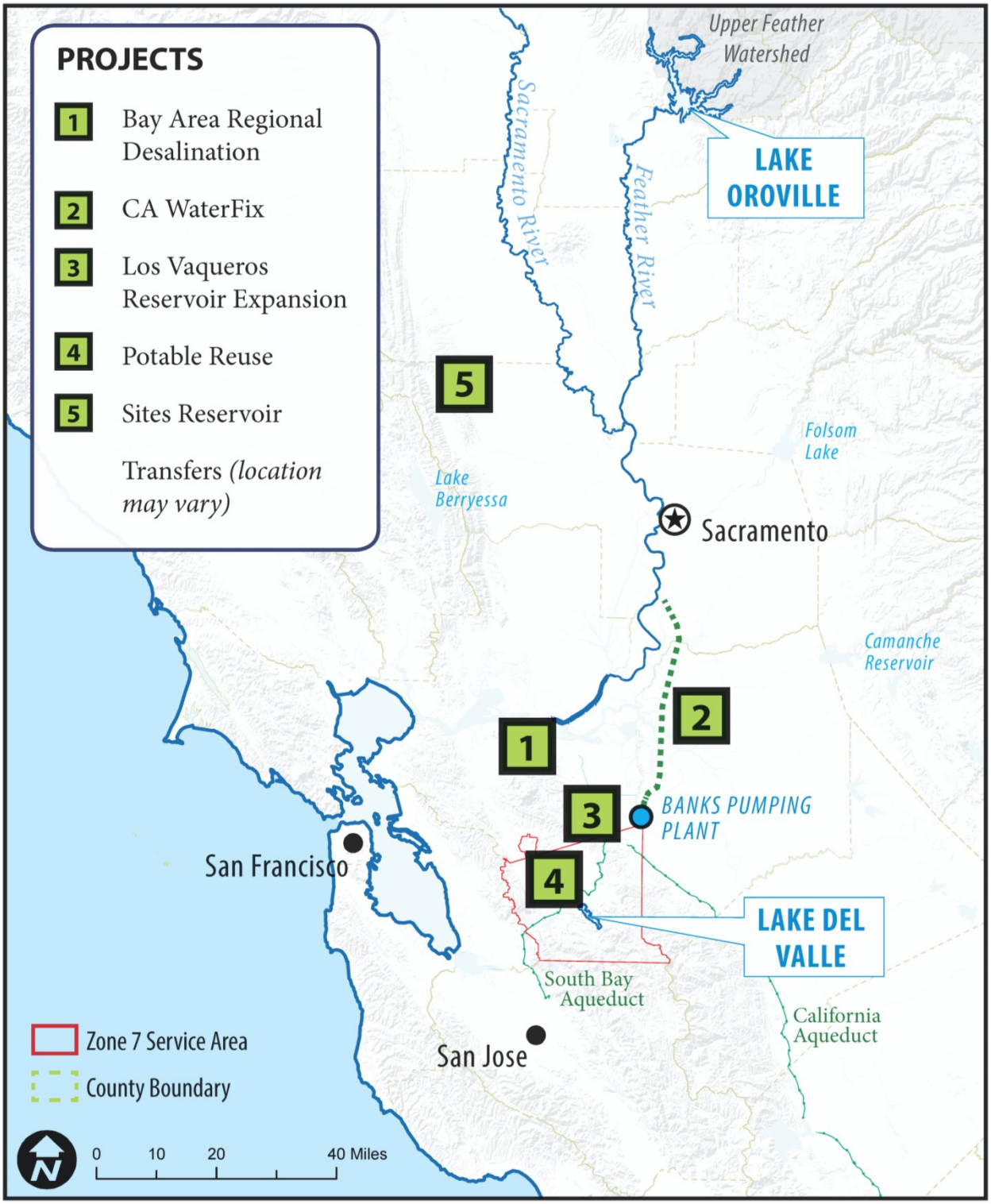


Table 6-2: Summary of key project benefits and risks/challenges

PROJECT	$/AF[a]	KEY BENEFITS	KEY RISKS/ CHALLENGES
WATER STORAGE			
Los Vaqueros Reservoir Expansion	$1,540	•Adds operational flexibility for timing of water deliveries •Increases emergency conveyance options, especially during Delta outages	•Storage only—no new supply •Value may be limited to very rare events
WATER SUPPLY			
Bay Area Regional Desalination Project	$1,800-2,200	•Regional supply •Reliable except during critically dry conditions •Could serve as source of new supply for Los Vaqueros	•Ability to obtain permits & other regulatory approvals •Acceptance by environmental groups •High unit cost
CA WaterFix	$740	•Protects SWP investments •Restores SWP reliability to 62% (~11,000 AFY of average supply) •Low $/AF relative to other long-term projects	•Ability to obtain permits & other regulatory approvals •Potential cost increases given scale & nature of the project
Potable Reuse	$2,500-2,700	•Locally-controlled •Reliable under all hydrologic conditions •Not subject to Delta outages	•Public acceptance •Reduced yield due to conservation *(as reflected in yield estimates)* •High unit cost
Sites Reservoir	$900-1,200	•Large reliability benefits due to dry-year availability •Adds operational flexibility with access to storage/supply • Low $/AF relative to other long-term projects	•Reduced yield (higher unit costs) due to permit conditions •Coordination with SWP/CVP operations • Potential cost increases given scale & nature of the project • Risk from conveying water through Delta increases without CA WaterFix
SWP Long-Term Transfers	$640	•Low $/AF relative to other long-term projects •Lowers overall unit cost of CA WaterFix	•See under CA WaterFix. •Greater reliance on SWP.
SWP Short-Term and Other Transfers	$420-$1,100	•Available within a short timeframe •Uses existing infrastructure •Does not require major capital investment	•Availability and cost depend on market conditions

a. Note: For details on the assumptions for $/AF calculations, see Table 6-1. These costs are preliminary and subject to change.

Figure 6-9 Water supply reliability project locations



7 Performance Metrics

This update focused the analysis of water supply portfolios on two key performance metrics: impacts on water supply reliability and costs. While this WSE Update was developed under a scope focused on water supply issues, a more comprehensive future update will look more broadly at other factors—such as water quality—that could affect the ultimate selection of the best portfolio to pursue.

7.1 Reliability

As a matter of policy, Zone 7 is committed to meeting goals for the reliability of its municipal and industrial water supply. In particular, an excerpt from the Zone 7 Water Supply Reliability Policy sets the following goals:

> *Zone 7 will meet its treated water customers' water supply needs ... as follows:*
>
> - *At least 85% of M&I water demands 99% of the time*
> - *100% of M&I water demands 90% of the time*

There are many other ways to express these reliability goals. For example, by focusing on a single-year demand forecast:

- For any given year, there must be at least a 90% probability of meeting all demand that year. (This sets the expectation that all demand will be met most of the time.)
- For any given year, there may be up to a 9% probability of only meeting between 85% and 100% of demand. (This recognizes that moderate conservation may sometimes be necessary.)
- For any given year, there must be less than a 1% probability of meeting less than 85% of demand that year. (This sets the expectation that circumstances which require aggressive conservation only happen rarely.)

It is also possible to interpret the reliability goals in terms of water shortage:

- For any given year, there must be less than a 10% probability of any shortage whatsoever.
- For any given year, there may be up to a 9% probability of a shortage happening, but at a level no greater than 15% of demand.
- For any given year, there must be less than a 1% probability of a shortage greater than 15% of demand that year.

By defining the percentage of demand met as reliability, and the percentage of time that reliability meets or exceeds its goal as exceedance, the goals may be expressed in the following way:

- For any given year, meet 100% reliability at 90% exceedance.
- For any given year, meet 85% reliability at 99% exceedance.

Graphing reliability at 90% and 99% exceedance is one way to visualize risk, and it offers informative non-financial planning metrics for comparing projects.

7.2 Cost

The cost of projects and their combinations into portfolios were examined using a variety of metrics. Note that costs are based on raw water delivery upstream of Zone 7's water treatment plants, or to the groundwater basin; the additional costs of treating and conveying the water and Zone 7's other operational costs (e.g., staffing, maintenance) are not included in the cost estimates presented.

- **Total capital cost:** this metric is useful for understanding the scale of a project. However, since most of the available water supply reliability projects will be funded by multiple stakeholders, this metric does not represent the cost to Zone 7.
- **Zone 7 share of capital cost:** this metric represents the cost to Zone 7 for developing the project, but it does not include the subsequent operations and maintenance costs.
- **Unit cost per acre-foot**: this convenient metric accounts for capital, operations, and maintenance costs to Zone 7, relative to the amount of new water provided; it accounts for any debt-financing of the project.
- **Cumulative cost through 2050:** this metric helps put the cost of projects in a long-term perspective, especially useful for analyzing the high upfront costs of short-term transfers in the context of long-term, more permanent projects.

7.3 Other Considerations

As noted above, this update focused on reliability impacts and costs to compare the various projects and portfolios. However, there are many other factors that could drive the selection of projects that Zone 7 ultimately pursues. The following factors will be considered in a more comprehensive future WSE Update as the projects are better defined and more information is available to evaluate them:

- **Implementability** – As summarized in Table 6-2, there are risks associated with each project that could affect its implementation, including permitting/regulatory approvals, public opposition, and funding.

- **Financing** – Project financing could significantly impact the short-term and long-term cost of a project, and the project's unit cost of water. A large up-front investment increases the risk of sunk cost particularly if the project is not well-defined in the earlier phases, and may be a disincentive for continued participation. Projects requiring cash payments require a big initial capital investment while projects paid with bonds allow costs to be spread over a longer period of time over existing and future customers.
- **Ability to phase/off-ramp** – The ability to phase a project provides opportunities to off-ramp. Given the uncertainties with demands, there is lower risk of sunk cost if investments can be phased to meet demands as needed.
- **Local control** – The Zone 7 system is highly reliant on SWP imported water that is managed by DWR. Furthermore, Zone 7 only represents about 2% of the SWP's Table A allocation, giving Zone 7 limited influence. While SWP contractors pay the full cost of the SWP system, decisions are ultimately made by DWR on behalf of the State's overall interests. Projects that are locally developed will give Zone 7 and the retailers greater ability to manage construction schedules, costs, operations, etc.
- **Water quality impacts** – Groundwater basin quality and delivered water quality are critical for protecting public health and safety. Furthermore, Zone 7 is required by the Regional Water Quality Control Board to manage the water quality of the local groundwater basin. Projects that improve water quality therefore provide additional benefits.
- **Environmental impacts** – The environmental footprints of projects may differ based on energy consumption, impacts on threatened/endangered species, land use, etc. While these are important to consider from an environmental stewardship perspective, they also ultimately impact implementability (e.g., permitting and regulatory approvals) and project costs (e.g., mitigation costs, energy costs).

8 Zone 7 Water Supply Risk Model

Originally developed for the 2011 WSE Update, the Zone 7 Water Supply Risk Model is a powerful tool for water supply decision-making and planning. It was adapted and expanded to meet the needs of the 2019 WSE Update. The model simulates water system behavior and calculates reliability forecasts on an annual time scale, by using a Monte Carlo technique that generates a range of future water supply conditions, random Delta outage scenarios, and uncertain climate impacts. This allows the model to simulate thousands of possible future scenarios and draw conclusions from the collective results, such as the probability of meeting a target level of reliability in a given year. The Risk Model was updated with the working demand forecast, new options for water supply projects, and the latest expectations

of State Water Project and Arroyo Valle water supply reliability. It was also expanded to provide new visualizations of the water supply reliability metrics defined in the Zone 7 Reliability Policy. Because it is structured on an annual time scale, the Risk Model does not simulate monthly operations.

9 Analysis and Key Findings

9.1 Baseline "CIP-Only" Scenario (No New Water Supplies)

The Water Supply Risk Model simulated the baseline "CIP-Only" scenario to establish a minimum reliability forecast. Without new water supply reliability projects, reliability declines well below Zone 7 Reliability Policy goals starting in the early 2020s, and continuing beyond 2040 with no recovery.

Table 9-1 summarizes the decline in water supply reliability under the CIP-only scenario using two metrics. The first—reliability at 90% exceedance—represents the level of demand that has a 90% chance of being met in any given year. It also means there is a 10% chance of meeting less than the indicated level of demand in that year. The Reliability Policy sets a goal for 100% reliability at 90% exceedance. The second metric—reliability at 99% exceedance—represents the level of demand that has a 99% chance of being met in any given year. It also means there is a 1% chance of meeting less than the indicated level of demand in that year. The Reliability Policy sets a goal for 85% reliability at 99% exceedance.

For example, Table 9-1 shows that under the CIP-Only scenario, by the year 2040, the reliability at 99% exceedance is only 30%; this means there is a 1% chance of only meeting 30% of demand. In other words, under the CIP-Only scenario, by 2040 there would be a 1% chance of a 70% water shortage.

Figure 9-1 and Figure 9-2 complement Table 9-1 by graphing the projected decline in water supply reliability, and comparing the decline against the Reliability Policy goals. Figure 9-3 summarizes risk of a shortage of Zone 7 treated and untreated supply in the year 2040, and Figure 9-4 expresses the risk for treated supply at the Tri-Valley level, which includes the retailers' local groundwater pumping quotas, and compares the potential future supply against benchmarks for residential water use at buildout in 2040.

Table 9-1: Forecasted reliability metrics under the CIP-Only scenario

Year	Reliability at 90% Exceedance	Reliability at 99% Exceedance
2025	100%	60%
2030	80%	50%
2040	50%	30%
2050	40%	30%
Target Level	100%	≥ 85%

(This space is intentionally left blank.)

Figure 9-1: Forecast of declining reliability at 90% exceedance (i.e. 90% chance of achieving better reliability, 10% chance of having equal or worse reliability)

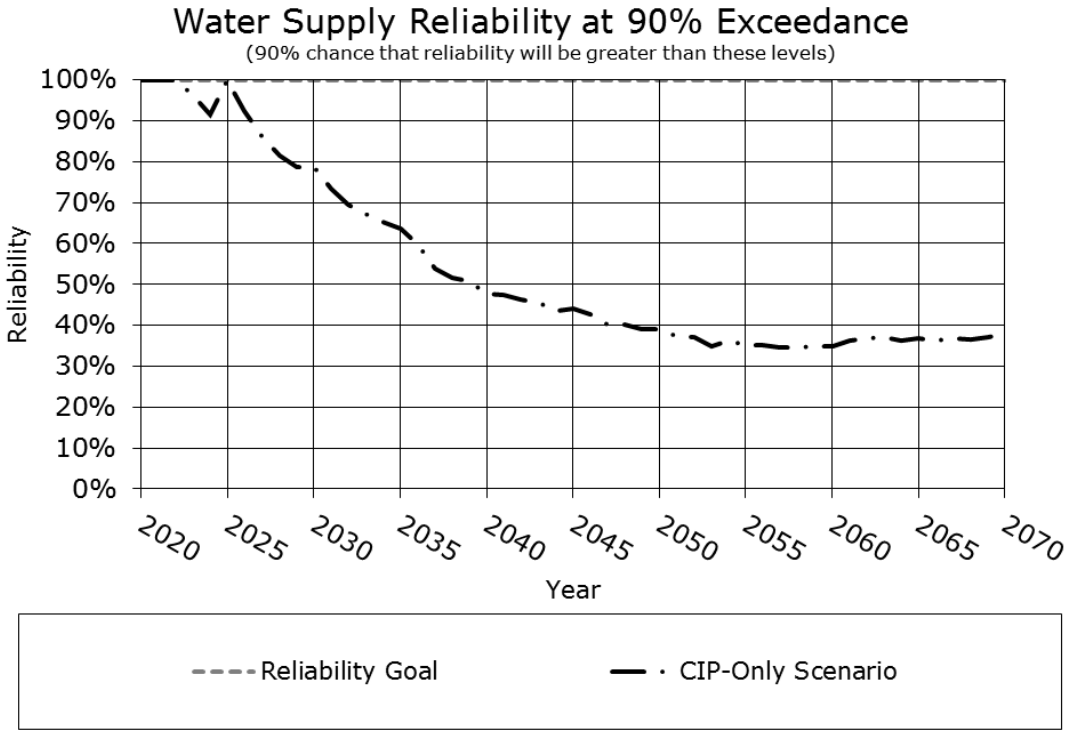


Figure 9-2: Forecast of declining reliability at 99% exceedance (i.e. 99% chance of achieving better reliability, 1% chance of having equal or worse reliability)

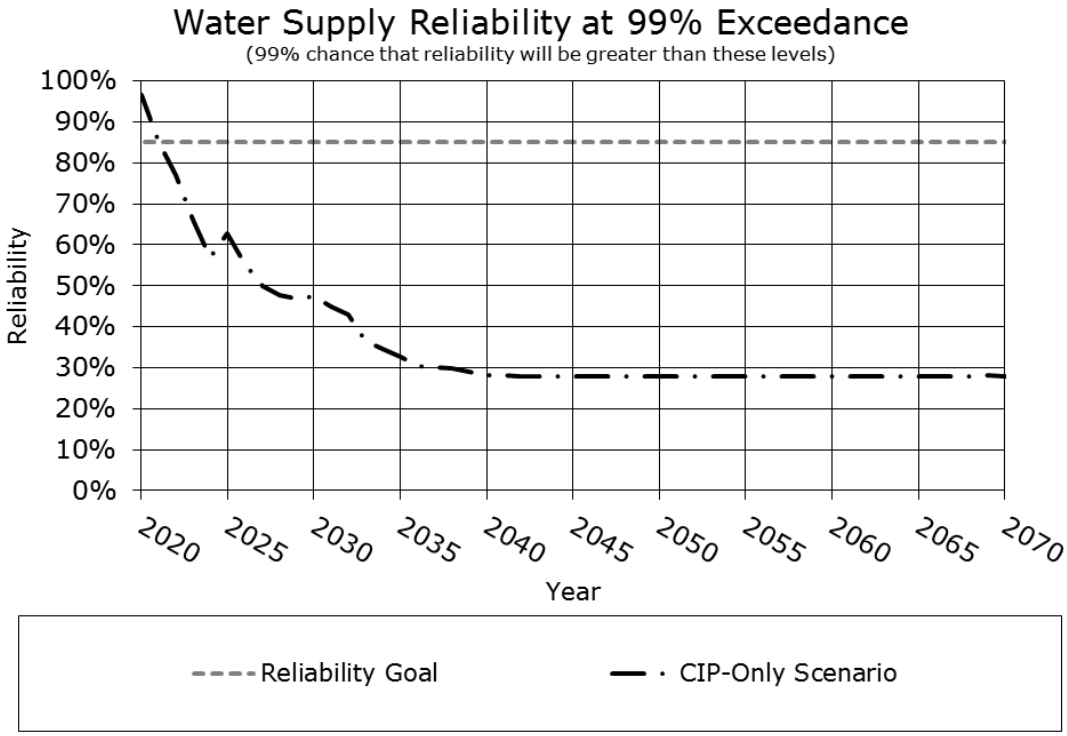


Figure 9-3: Zone 7 demand in 2040 vs. forecasted supply conditions with no new water supply projects

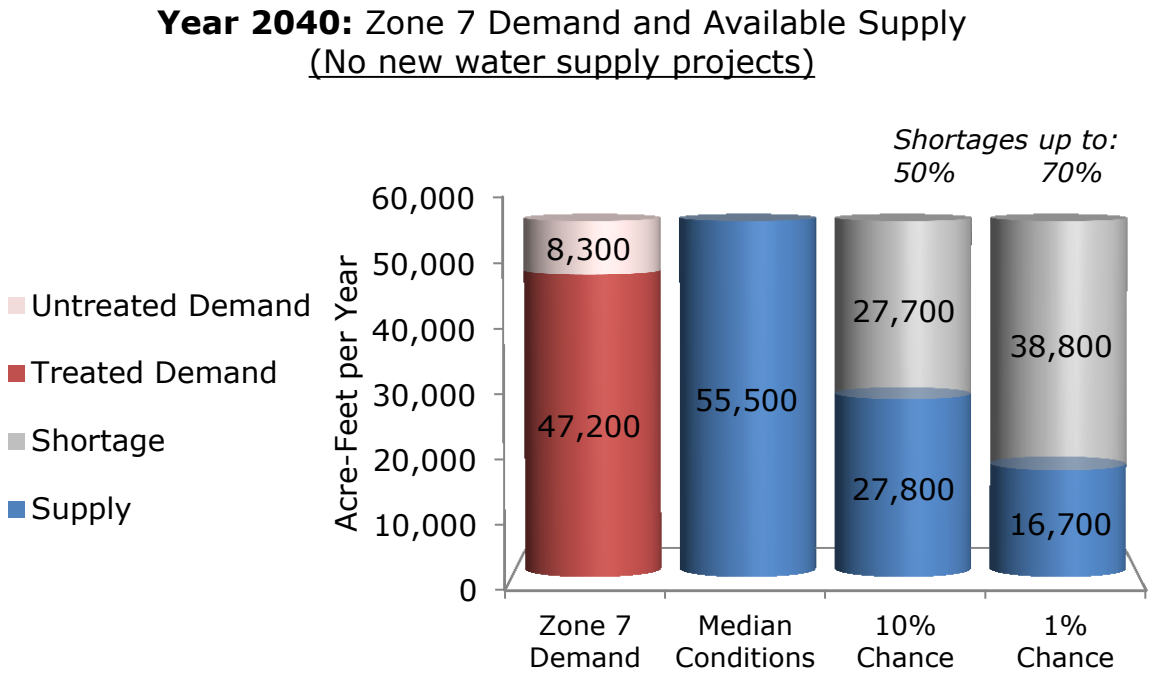
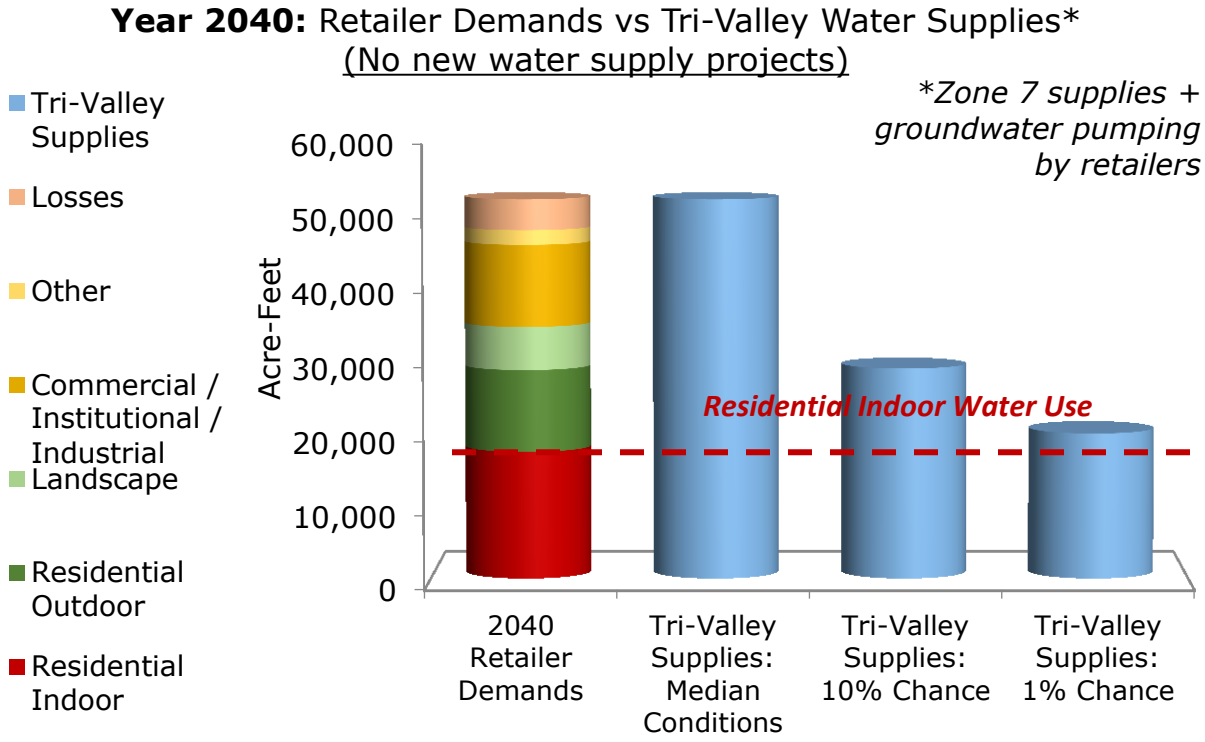


Figure 9-4: Comparison of retailer demands and available potable supply (Zone 7 supplies + groundwater pumping by retailers) in 2040 with no new water supply projects.



9.2 Los Vaqueros Reservoir Expansion

The Los Vaqueros Reservoir Expansion was analyzed separately as a storage and conveyance project. Modeling indicates that access to storage capacity in the reservoir has little effect and limited benefit to the annual reliability metrics computed in the Risk Model. Results indicate that Los Vaqueros Reservoir's benefits are largely limited by Zone 7's ability to access new supplies; that is, Zone 7 would need to acquire new water supplies that can then be stored in the reservoir to realize benefits. In addition, with only 10,000 AF currently earmarked for Zone 7, the project would not significantly help with prolonged water shortage conditions, which are a major risk to the water supply system. Instead, the benefits would mostly be seen during rare single-year Delta outage emergencies, when other supplies are inaccessible, and Los Vaqueros Reservoir could release water to compensate.

Although the Risk Model shows little benefit at the annual scale, Los Vaqueros Reservoir and the Transfer-Bethany Pipeline are expected to have other benefits that the Risk Model does not capture. Los Vaqueros Reservoir could add operational flexibility by facilitating water deliveries during summertime peak demands. Water that Zone 7 stores in the remote Kern County groundwater banks generally cannot be recovered in the summer, when demand is highest. With access to Los Vaqueros Reservoir, Zone 7 could instead recover water from the banks during the spring and fall, store the water in the reservoir, and then request delivery when Zone 7 needs the water. The Risk Model cannot quantify this benefit because it does not simulate monthly operations. The project could also create additional opportunities for regional transfers/exchanges. Finally, and most importantly, the Transfer-Bethany Pipeline could provide an alternative conveyance system during Delta outages, which are an increasing concern due to the age of the SWP system and the tightening environmental restrictions.

9.3 Key Findings

Several water supply scenarios were analyzed with the Risk Model in order to identify and understand challenges and to develop portfolios of water supplies that would address the challenges and meet future needs. The following are key findings from the Risk Model analysis:

- Steady annual transfers are needed in the short-term to continue meeting reliability policy goals.
    - Meeting 100% reliability at 90% exceedance requires 5,000 AFY of steady transfers until 2030.
    - Meeting 85% reliability at 99% exceedance requires larger transfers of at least 10,000 AFY.
- Given available projects and forecasted demand, multiple new water supply reliability projects will be needed in the long-term to meet reliability goals, and multiple pathways exist to do so.
- Diverse supply portfolios have better reliability. Hydrology affects how and when projects deliver water, so portfolios that mix wet-year, dry-year, and steady supplies ensure that more water is delivered across a variety of hydrologic conditions, reducing the need to withdraw from storage reserves.
- Reliability benefits from short-term transfers persist for years after the transfers end.
- It is generally easier to meet the goal for 100% reliability at 90% exceedance than it is to meet the goal for 85% reliability at 99% exceedance.
- The California WaterFix by itself stops the forecasted decline in Zone 7 reliability at 90% exceedance.
- Sites Reservoir tends to produce the largest reliability benefits for a single project. Sites Reservoir's key benefit is the availability of water during dry years when the shortage risk is greatest. This reflects the storage component of Sites Reservoir. However, without the California WaterFix in place, deliveries from Sites Reservoir would be at risk from outages in the Delta.
- Potable reuse or brackish water desalination produce water during dry years, and may be able to augment short-term reliability as early as 2027, and interrupt a decline that would otherwise continue until 2030, when other long-term projects come online.
- If both reliability goals can be met by 2035, then there is little need for additional projects beyond buildout, as it is likely the goals will continue to be met after demand has peaked.
- Additional conservation—beyond the 5,000 AFY reduction already included in the analysis—would greatly improve reliability.
    - Reliability Policy goals could be met with fewer projects, or projects that are scaled down.
    - Short-term transfers could be delayed until 2025, and their duration could be reduced to fewer than 10 years.
    - It is important to note, however, that with increased conservation, demands are expected to harden making demand reductions harder to achieve during dry years.

10 Portfolio Solutions, Contingencies, and Costs

Findings from the Water Supply Risk Model analysis informed the development of eight water supply portfolios and four contingency plans that collectively represent paths forward to achieve sustainable water supply reliability. At this time, no portfolios are being recommended as a preferred path forward; instead, they are presented to help clarify the scope of possible future scenarios.

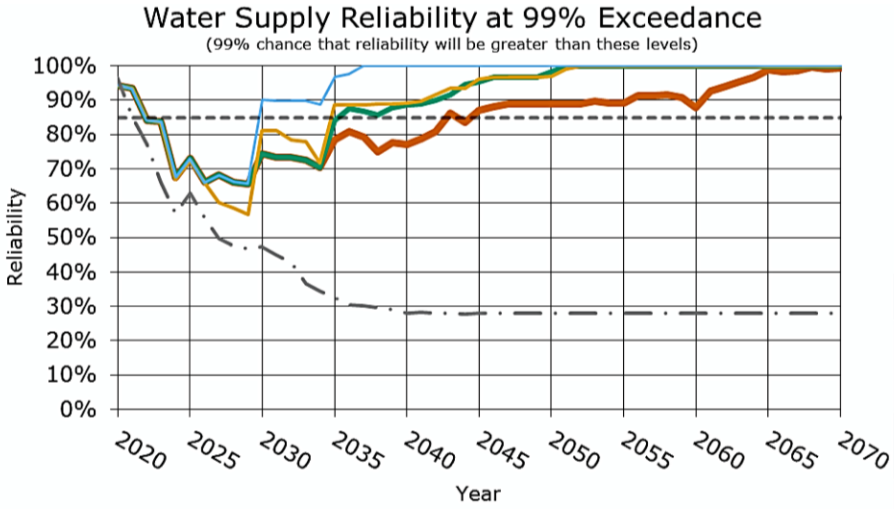
Because Risk Model simulations that included Los Vaqueros Reservoir Expansion produced results that were minimally different from simulations that did not, this section excludes the project for simplicity. It is reasonable to expect that a separate methodology will inform future decisions on participation in Los Vaqueros Reservoir Expansion.

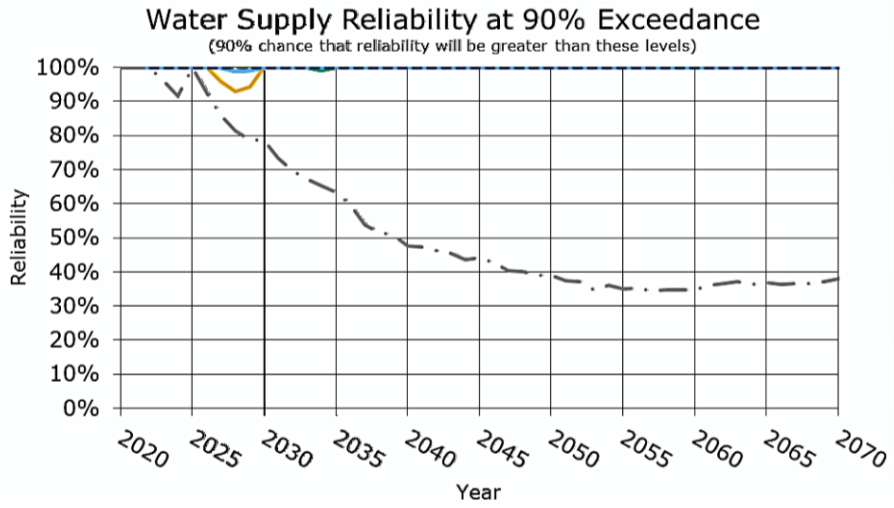
10.1 Portfolios 1 – 4

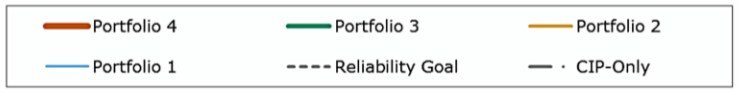
Portfolios 1 through 4 focus on meeting the goal for 100% reliability at 90% exceedance, and accept a delay in meeting the goal for 85% reliability at 99% exceedance. Figure 10-1 shows their performance with respect to the reliability policy goals. The following are characteristics of Portfolios 1 through 4:

- The delay in meeting the 99% exceedance goal lasts 10 to 25 years.
- Reliability starts improving in 2030.
- There is a 1% chance of a 43% shortage in the late 2020s for portfolios without potable reuse, brackish water desalination, or a similar project bringing new supply by 2027.
    - The inclusion of potable reuse or a similar project reduces the shortage risk by 9 percentage points, (i.e. to a 34% shortage).
- Goals can be met in the long-term without reducing short-term demands or the expected buildout demand of 55,000 AFY.
- Portfolios 1 through 4 require short-term transfers for 10 years at 5,000 AFY.
- Portfolios 1 through 4 require the California WaterFix.
- Portfolios 1 through 4 require participation in Sites Reservoir to some degree, either at an average yield of 5,000 AFY, or at 10,000 AFY.
- Portfolios require either potable reuse, a similar project, or participation in Sites Reservoir at 10,000 AFY.

Figure 10-1: Reliability goal forecasts for Portfolios 1 through 4 (Note: lines that overlap might not be visible)







(lines that overlap might not be visible)

	Portfolio 1	Portfolio 2	Portfolio 3	Portfolio 4
Short-Term				
Short-Term Transfer Duration	10 years	10 years	10 years	10 years
Short-Term Transfer (AFY)	5,000	5,000	5,000	5,000
Potable Reuse Short-Term Delivery (AFY)	4,000	0	4,000	4,000
Requires Short-Term Demand Reductions?	No	No	No	No
Long-Term				
Potable Reuse Expansion Delivery (AFY)	0	0	3,000	0
Average Sites Delivery (AFY)	10,000	10,000	5,000	5,000
WaterFix?	Yes	Yes	Yes	Yes
Max Buildout Demand (AFY)	55,500	55,500	55,500	55,500

10.2 Portfolios 5 – 8

Portfolios 5 through 8 fast-track meeting the 99% exceedance goal. Figure 10-2 shows their performance with respect to the reliability policy goals.

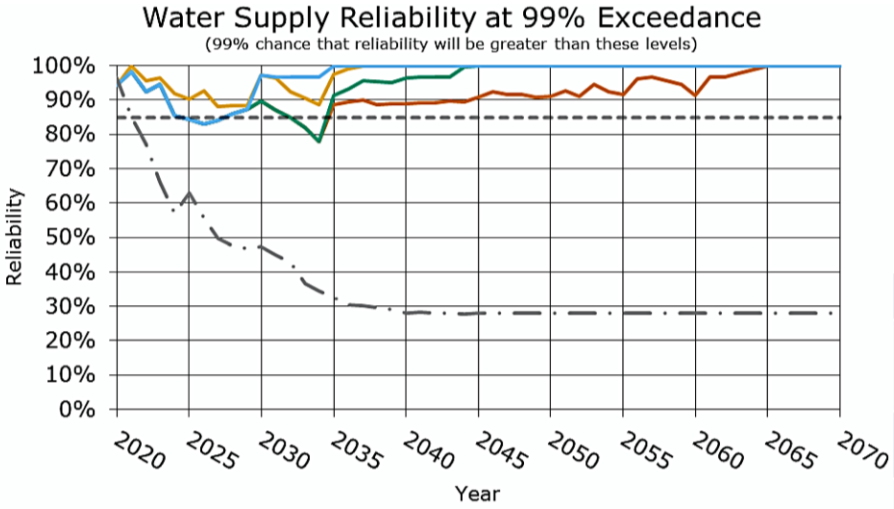
- Portfolios 5 through 8 meet the 90% exceedance goal at all times.
- Portfolios 5 through 8 require both 10,000 AFY of short-term transfers and potable reuse.
    - Without potable reuse, an even greater volume of transfers is required (12,500 AFY).
- To address a small dip in reliability in the mid-2030s, an average 10,000 AFY from Sites Reservoir is required.

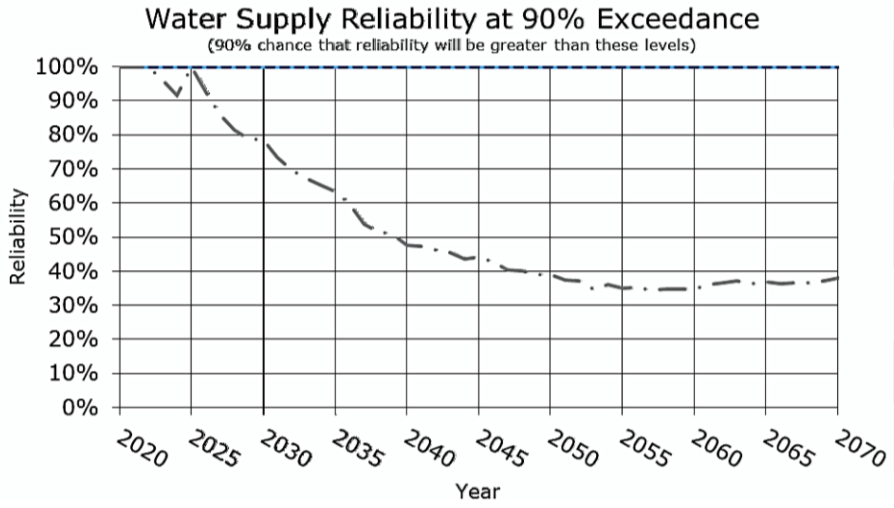
10.3 Contingencies (What-if Scenarios) 1 – 4

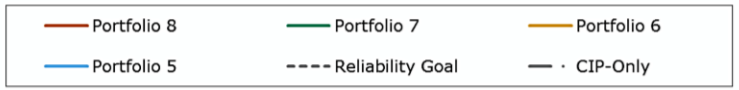
Contingencies or What-If Scenarios 1-4 represent potential paths in cases where certain non-local projects become unavailable. Transfers, Sites Reservoir, and California WaterFix involve external stakeholders that may prevent their development or availability. In such an event, the number of options that achieve reliability goals becomes more constrained. Figure 10-3 shows the contingencies' forecasted performance with respect to the reliability policy goals.

- In the absence of certain projects, additional water conservation may be required to meet the 99% exceedance reliability goal; without such conservation, the reliability at 99% exceedance may be as low as 65% in the short-term and 70% in the long-term.
- All contingencies require potable reuse or a similar project to some degree.
- Contingency 1: the combined absence of short-term transfers, Sites Reservoir, and California WaterFix requires meeting the 90% exceedance goal with demand reductions and potable reuse or a similar project. The necessary demand reductions would create the scenario from the West Yost study with the lowest forecasted demand, i.e. where buildout demand is 48,700 AFY, and the additional long-term demand reduction is 6,900 AFY relative to the 2019 WSE Update working demand forecast.
- Contingency 2: without California WaterFix and without reducing demand, all remaining available options would need to be developed.
- Contingency 3: without Sites Reservoir and without reducing demand, larger short-term transfers at a longer duration are needed, as well as potable reuse or a similar project.
- Contingency 4: without short-term transfers, short-term demand would need to be reduced, and potable reuse or a similar project would need to be implemented.

Figure 10-2: Reliability goal forecasts for Portfolios 5 through 8 (Note: lines that overlap might not be visible)



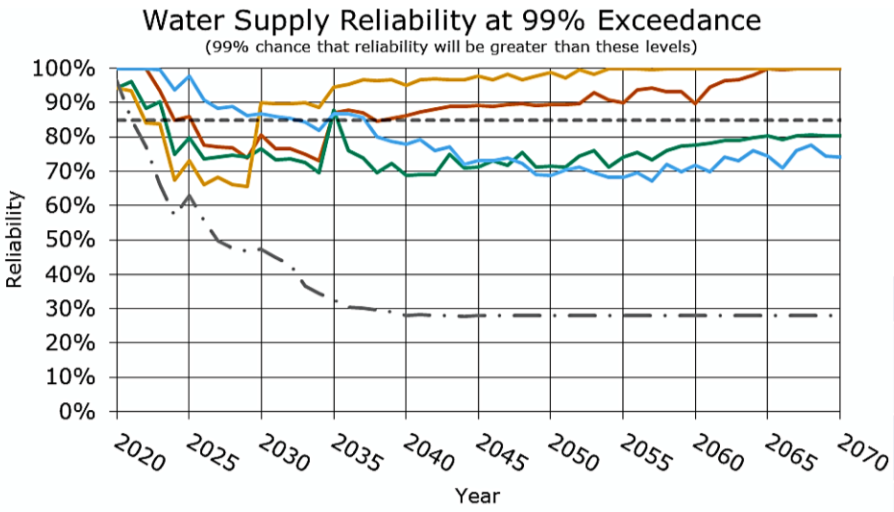


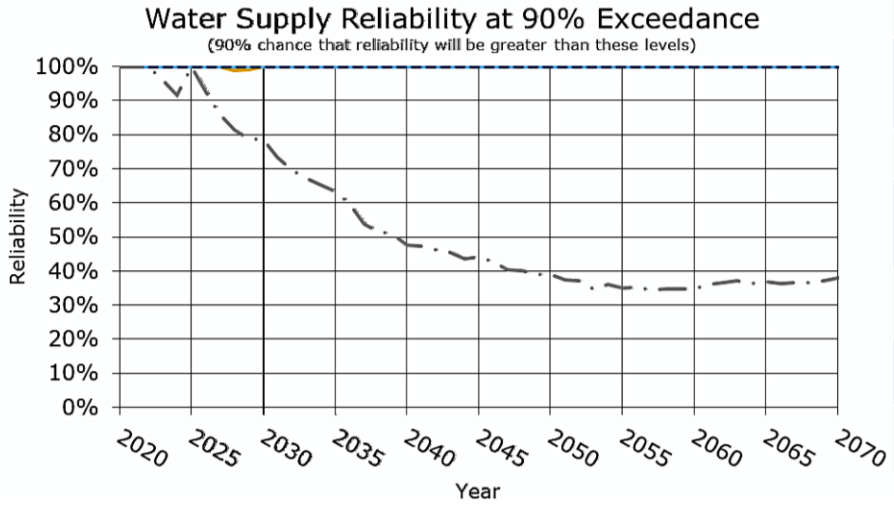


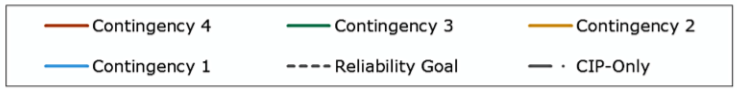
(lines that overlap might not be visible)

	Portfolio 5	Portfolio 6	Portfolio 7	Portfolio 8
Short-Term				
Short-Term Transfer Duration	10 years	10 years	10 years	10 years
Short-Term Transfer (AFY)	10,000	12,500	10,000	10,000
Potable Reuse Short-Term Delivery (AFY)	4,000	0	4,000	4,000
Requires Short-Term Demand Reductions?	No	No	No	No
Long-Term				
Potable Reuse Expansion Delivery (AFY)	0	0	3,000	0
Average Sites Delivery (AFY)	10,000	10,000	5,000	5,000
WaterFix?	Yes	Yes	Yes	Yes
Max Buildout Demand (AFY)	55,500	55,500	55,500	55,500

Figure 10-3: Reliability goal forecasts for Contingencies 1 through 4 (Note: lines that overlap might not be visible)







(lines that overlap might not be visible)

	Contingency 1	Contingency 2	Contingency 3	Contingency 4
Short-Term				
Short-Term Transfer Duration	0 years	10 years	15 years	0 years
Short-Term Transfer (AFY)	0	5,000	7,500	0
Potable Reuse Short-Term Delivery (AFY)	4,000	4,000	4,000	4,000
Requires Short-Term Demand Reductions?	Yes	No	No	Yes
Long-Term				
Potable Reuse Expansion Delivery (AFY)	3,000	3,000	3,000	0
Average Sites Delivery (AFY)	0	10,000	0	5,000
WaterFix?	No	No	Yes	Yes
Max Buildout Demand (AFY)	49,000	55,500	55,500	55,500

10.4 Costs

Figure 10-4 and Figure 10-5 show estimates of the cumulative cost of the portfolios and contingencies through the year 2050. Table 10-1 shows this information along with the key differentiating features of each option, and sorts the options by their cumulative cost. Analyzing the cumulative cost over time helps reveal a bigger picture of the long-term cost of water supply reliability.

The least costly portfolio is Portfolio 2, which includes transfers of 5,000 AFY, WaterFix, and Sites Reservoir yield of 10,000 AFY. However, this portfolio accepts temporary declines in reliability such that the 90% exceedance reliability dips below its target until 2030, and the 99% exceedance reliability dips below its target until 2035.

Portfolio 1 adds a 4,000 AFY potable reuse project that improves reliability at 90% exceedance such that it is always above its target. The potable reuse project also decreases the delay in re-achieving the 99% exceedance goal by five years, or from 2035 to 2030. However, the project increases the 2050 portfolio cumulative cost from $353 million to $592 million.

One challenge with meeting reliability goals at all times under the current demand forecast is that there would be a large short-term cost for transfers of at least 10,000 AFY. Portfolios 5 through 8 would have those costs. However, Figure 10-4 and Table 10-1 show that Portfolio 6 has the second lowest 2050 cumulative cost, even though it has the single highest cost for short term transfers, due to purchasing 12,500 AFY. The large investment in short-term transfers enables reliability goals to be maintained without investing in more expensive, long-term projects. In terms of long-term cumulative cost, short-term transfers are the least expensive way of supporting long-term reliability.

Figure 10-4: Cumulative total water supply portfolio costs through 2050 (Note: Los Vaqueros Reservoir is not included in these costs)

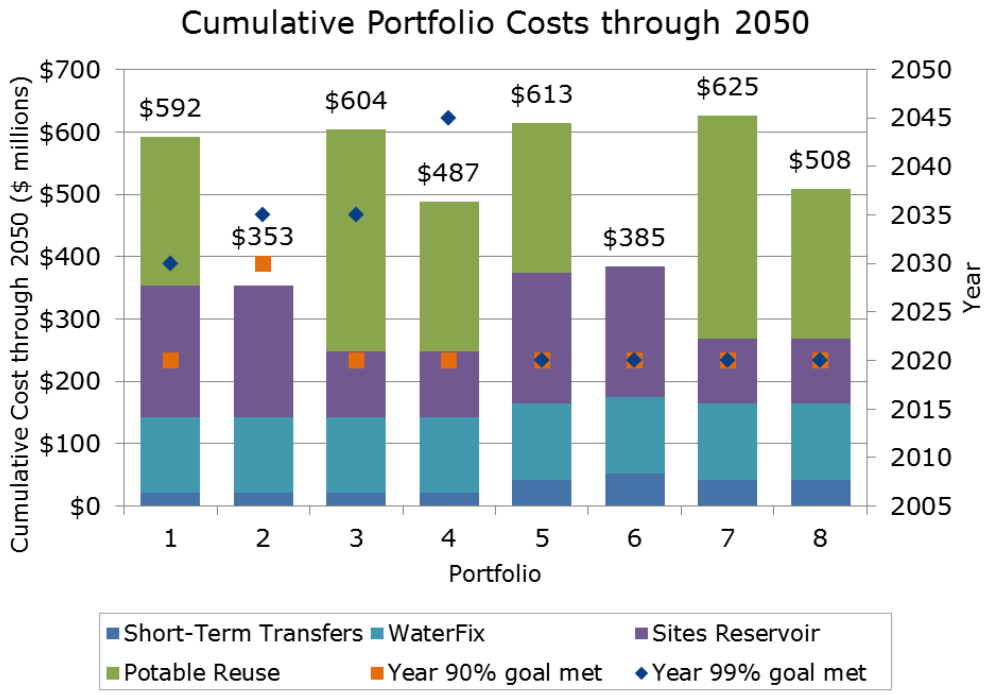


Figure 10-5: Cumulative total water supply contingency costs through 2050 (Note: Los Vaqueros Reservoir is not included in these costs)

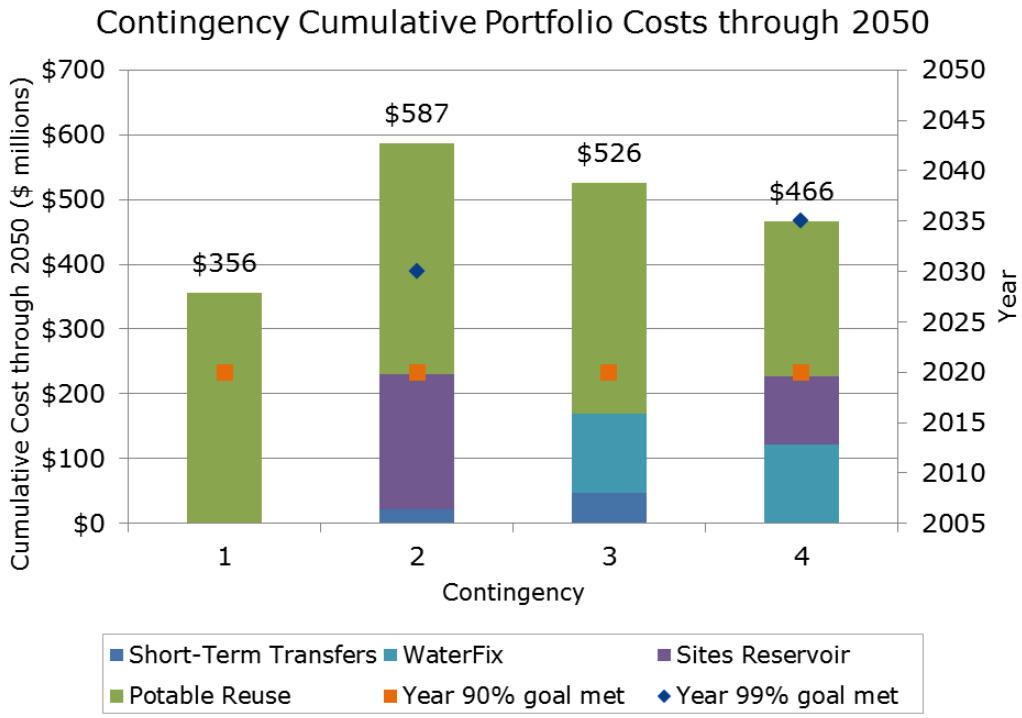


Table 10-1: Summary of water supply portfolio and contingency performance and features, sorted by cumulative cost in 2050. (Note: Los Vaqueros Reservoir is not included in these costs)

Note: All portfolios and contingencies use transfers, Sites, and WaterFix, unless indicated otherwise	2050 Cumulative Cost ($M)	Year 90% Exceedance Goal Met	Year 99% Exceedance Goal Met	Larger Short-Term Transfers	Larger Sites Reservoir	Potable Reuse	2-Phase Potable Reuse	Relevant Footnotes
Portfolio 2	$353	2030	2035		X			
Portfolio 6	$385	2020	2020	X	X			A
Portfolio 4	$487	2020	2045			X		
Portfolio 8	$508	2020	2020	X		X		
Portfolio 1	$592	2020	2030		X	X		
Portfolio 3	$604	2020	2035					
Portfolio 5	$613	2020	2020	X	X	X		
Portfolio 7	$625	2020	2020	X			X	
Contingency 1	$356	2020	Goal Not Met				X	B
Contingency 4	$466	2020	2035			X		E
Contingency 3	$526	2020	Goal Not Met	X			X	D
Contingency 2	$587	2020	2030		X		X	C

A. requires 12,500 AFY transfers until 2035
B. lacks transfers, Sites, and WaterFix, requires conservation
C. lacks WaterFix
D. lacks Sites
E. lacks transfers, requires short-term conservation

11 Recommendations and Next Steps

11.1 Recommendations

The following recommendations were developed in consultation with retailer staff and at public meetings with the Zone 7 Board. The recommendations are listed in no particular order.

11.1.1 Continue to support California WaterFix.

The California WaterFix restores reliability by safeguarding existing SWP supplies against Delta outages, climate change, and increased environmental restrictions. It is a project that protects an average 11,000 AFY of existing supply, and it has a low

unit cost relative to other long-term projects. Furthermore, improving the SWP facilities will protect the reliability of other potential imported supplies (e.g., Sites Reservoir) that will use Delta conveyance.

11.1.2 Participate in the next phase of Sites Reservoir, for an average net yield of 10,000 AFY.

Sites Reservoir is predicted to deliver potentially large supply reliability benefits at a low unit cost relative to other available projects. Because Sites Reservoir provides both storage and new supply, it adds flexibility to Zone 7's water supply system. For example, the timing of deliveries from Sites Reservoir could be modified to maximize yields from other water supplies and/or to accommodate delivery timing restrictions of other supplies. The bulk of the new supply deliveries could be reserved for dry years when the need and shortage risk are greatest. Note that there would be increased risk from conveying water through the Delta without an operational California WaterFix.

In January 2019, staff recommended to the Zone 7 Board a participation level of 10,000 AFY in the 2019 Sites Reservoir Project Agreement. This translates to an estimated net yield of 5,000 to 8,000 AFY. This amount considers Zone 7's water supply needs against the financial considerations for Phase 2 participation. This level demonstrates a serious commitment to the project, while lowering the financial risk for Zone 7 at this stage of project development. As the project is better defined, and there is more certainty on the project yield and Zone 7's demands, Zone 7 could consider increasing its level of participation. The Zone 7 Board approved continued participation in Sites Reservoir in 2019.

11.1.3 Participate in the next phase of Los Vaqueros Reservoir Expansion and Transfer-Bethany Pipeline.

The Los Vaqueros Reservoir Expansion increases Zone 7's capacity for local surface water storage, and the conveyance options afforded by the Transfer-Bethany Pipeline provide redundancy for delivering water. The primary benefit of the combination would be realized during Delta emergencies when Banks Pumping Plant is offline, but the South Bay Aqueduct is still operational. Water that Zone 7 previously stored in Los Vaqueros could be released via the Transfer-Bethany Pipeline to the SBA, or if conditions are favorable, Zone 7's SWP water could be wheeled or exchanged using Contra Costa Water District conveyance facilities. Another benefit relates to the month-to-month timing of water deliveries, which the Water Supply Risk Model does not simulate. Water from Los Vaqueros could be withdrawn during summertime peak demand to partially offset demand on the local groundwater basin and wellfields. As a storage project, it is important to know that the Los Vaqueros Reservoir Expansion is not expected to produce new water for

Zone 7, which is a reason why the Risk Model showed no significant benefits from the project. Also, as a small-capacity storage project (with currently 10,000 AF earmarked for Zone 7), the Los Vaqueros Reservoir Expansion would not help with prolonged water shortage conditions, which are major risks to the water supply system. Instead, the benefits would mostly be seen during single-year emergency conditions.

In January 2019, staff recommended continued participation in the next phase of the project, which the Board approved.

11.1.4 Pursue short-term transfers of at least 5,000 AFY through 2030.

Acquiring water transfers reduces short-term risk before long-term projects develop. Under the CIP-Only scenario, reliability falls below policy goals starting in the early 2020s. The earliest year that a long-term water supply reliability project can conceivably be constructed and operational is 2027, and most projects are expected to become operational no earlier than 2030. Therefore, barring additional water conservation, short-term transfers are the only available option to meet reliability goals under the current working demand forecast. Transfers of 5,000 AFY would help ensure that the 90% exceedance goal is maintained, while larger transfers would improve the 99% exceedance metric. The amount transferred each year could be adjusted to take advantage of years with low cost, but the target is an average of 5,000 AFY.

11.1.5 Conduct technical studies to support selection of the best potable reuse option.

Potable reuse has a high unit cost and public acceptance challenges[11] but offers a locally-controlled reliable supply. It makes sense to continue to advance it as an option, while monitoring progress on other water supply options, long-term conservation, and potable reuse regulations.

11.1.6 Continue to investigate brackish water desalination with other agencies.

Desalination has a high unit cost and environmental challenges but offers a relatively local supply, reliable except in the most critically dry conditions. Like potable reuse, it makes sense to continue to advance it as an option while monitoring progress on other water supply factors. Pairing regional desalination with a regional storage project such as Los Vaqueros may amplify the benefits from both projects.

[11] A January 2019 Tri-Valley wide survey noted that 55% supported potable reuse, and 39% opposed.

11.1.7 Continue to pursue other water supply opportunities, especially at the Bay Area regional level.

Zone 7 should continue to pursue and evaluate new opportunities to enhance water supply reliability. Continued engagement with the Bay Area Regional Reliability partnership may present such new opportunities.

11.1.8 Continue to advance the use of the Chain of Lakes for Zone 7 water management, including the construction of new diversion and conveyance infrastructure.

When completed, the Chain of Lakes will serve as the heart of Zone 7's water supply system, providing increased groundwater recharge, increased local storage, and emergency surface water supply. Zone 7 should continue to actively engage with the gravel mining operators and Alameda County to acquire Zone 7's full use of the Chain of Lakes for water management purposes as soon as possible.

11.1.9 Consider revising Zone 7's Reliability Policy.

It will be challenging and costly to meet the current reliability policy with demands as currently projected, as 10,000 AFY of additional supply is likely needed to meet the 99% reliability policy goal in the near-term. A revised policy could incorporate recent lessons learned from the drought and drought recovery response. Potential revisions to the reliability policy could be considered through a stakeholder engagement process; members of the Zone 7 Board of Directors have expressed support to discuss and consider a revision.

11.1.10 Complete a more comprehensive regional demand and water conservation program study over the next two years.

The demand study completed by West Yost provided a high-level outlook of potential future water conservation. Future decisions concerning water supply reliability planning can be informed by a more comprehensive study of Tri-Valley water demand. Such a study could examine and report on different subclasses of water use, and identify areas of water use that could be responsive to upcoming water efficiency regulations. Such a study could also examine and quantify the uncertainty in population forecasts and their correlation with water use.

11.1.11 Develop a regional plan for meeting the long-term conservation framework.

State regulations will require an increase in water efficiency, but as of yet, no plan exists at the local level to ensure compliance with the regulations. Key elements of the efficiency regulations have not yet been specified, such as standards for outdoor residential water use; however, while there is still considerable uncertainty in what the future standards will be, once they are set they will be going into effect in the mid-2020s. Having a plan to achieve long-term conservation is important, as

it can help narrow the uncertainty on the upper bounds of future demand, which may translate into cost savings if it determined that water supply projects can be delayed or reduced.

11.1.12 Enhance public outreach programs to engage the public on water supply reliability issues.

One way or another, large investments will be required in the future; there are no inexpensive solutions to local water reliability issues. Changes in consumer behavior or landscaping might be necessary from the public in order to meet State efficiency goals and maintain a high level of reliability. Meaningful input and support from customers will be necessary in order to succeed at ensuring water supply reliability for the Tri-Valley. Retailer staff and the Zone 7 Board affirmed that regular outreach and general discussion of reliability with the public will be important steps toward achieving public support for reliability projects.

11.2 Schedule of Recommendations and Next Steps

The recommendations above will be implemented over the next few years, and beyond, as shown in the schedule below (Figure 11-1). While continued pursuit of various water supply and storage projects are recommended, the results of other recommended actions (i.e., any policy revisions and/or changes in demand projections) could affect the ultimate selection of projects to implement. The WSE will be updated again within the next couple of years as the projects are developed further and demands are refined, and Zone 7 makes decisions about continued participation in existing projects or pursuit of new ones. Information from the demand and conservation studies, and from the next WSE Update, will be incorporated into the 2020 Urban Water Management Plan to be completed by mid-2021.

Figure 11-1: Schedule of recommendations