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Recycled Water Strategic Plan 2024 Update

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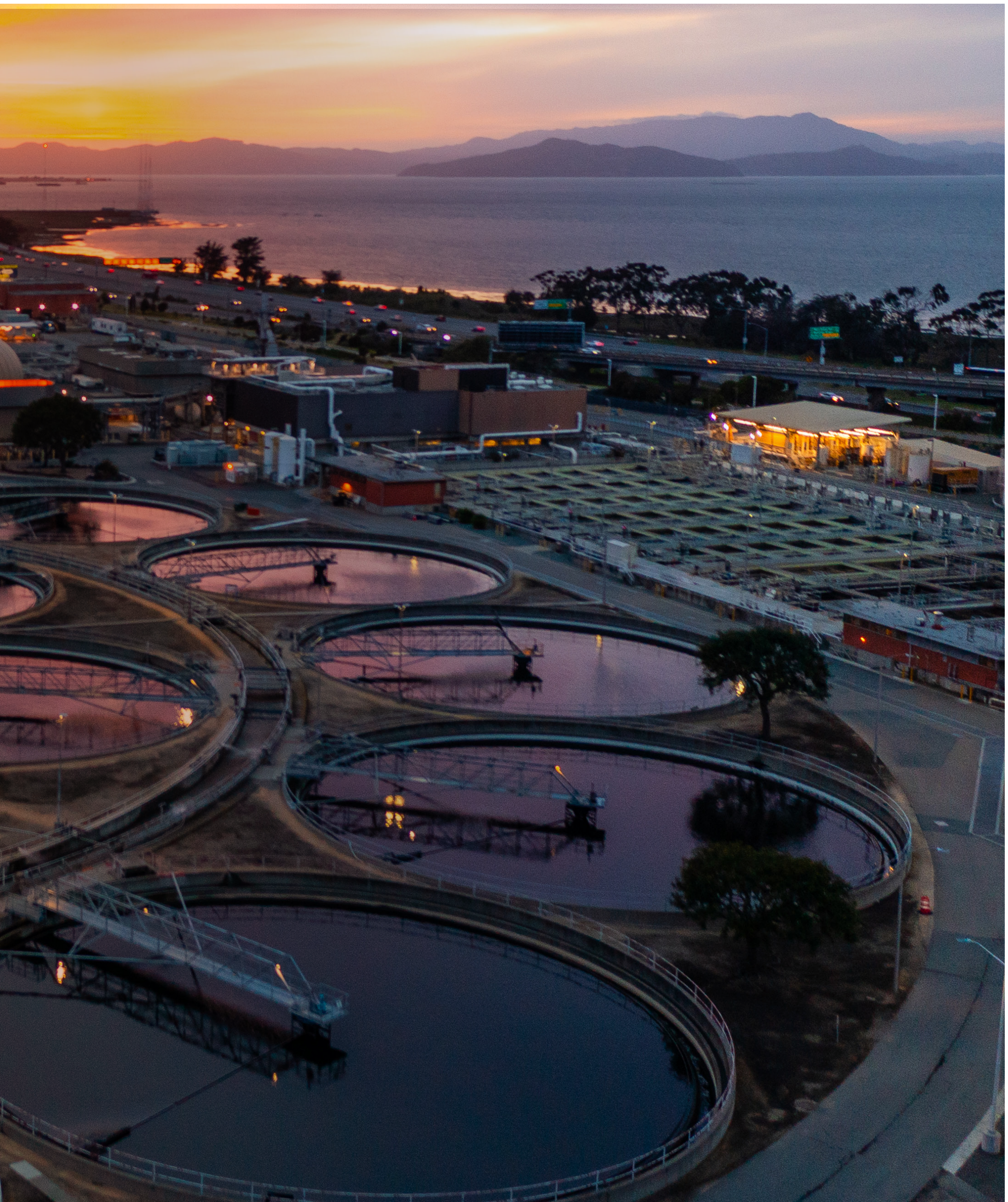

FINAL

Recycled Water Strategic Plan 2024 Update

Prepared for
East Bay Municipal Utility District
June 2025

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AACE	Association for the Advancement of Cost Engineering
AL	action level
ADWF	average dry weather flow
AF	acre-foot/feet
AFY	acre-feet per year
AOP	advanced oxidation process
AWPF	advanced water purification facility
AWTO	Advanced Water Treatment Operator
BAC	biologically activated carbon
BACWA	Bay Area Clean Water Agencies
BAF	biological active filtration
BC	Brown and Caldwell
CCMRP	Climate Change Monitoring and Response Plan
CCR	California Code of Regulations
CDPH	California Department of Public Health
CEC	constituent of emerging concern
Central San	Central Contra Costa Sanitary District
CIP	Clean in place
CIWQS	California Integrated Water Quality System Project
CO_2	carbon dioxide
CO&P	contractor overhead and profit
COC	cycles of concentration
DBP	disinfection byproduct
DDW	Division of Drinking Water
Delta	Sacramento-San Joaquin River Delta
DERWA	DSRSD/EBMUD Recycled Water Authority
DiPRRA	Direct Potable Reuse Responsible Agency
District	East Bay Municipal Utility District
DPR	direct potable reuse
DSRSD	Dublin San Ramon Services District
DWPR	Desalination and Water Purification Research Program
DWR	California Department of Water Resources
EBDA	East Bay Dischargers Authority
EBMUD	East Bay Municipal Utility District
EBRWP	East Bayshore Recycled Water Project
EIR	Environmental Impact Report
EPA	U.S. Environmental Protection Agency
ESCP	Enhanced Source Control Program
FAT	full advanced treatment
FEMA	Federal Emergency Management Agency
GC	golf complex
GWR	groundwater recharge
IAP	Independent Advisory Panel
IPR	indirect potable reuse
kg/d	kilograms per day
LAVWMA	Livermore-Amador Valley Water Management Agency
LOX	liquid oxygen
LRV	log reduction value
LSWRP	Large Scale Water Recycling Program
MCDA	multiple criteria decision analysis
MCL	maximum contaminant level
MF	microfiltration
mg/L	milligrams per liter
mgd	million gallons per day
MOU	memorandum of understanding
NaOCl	sodium hypochlorite
NL	notification level
NOFO	Notice of Funding Opportunity
NPDES	National Pollution Discharge Elimination System
NPR	non-potable reuse
NRWRP	North Richmond Water Recycling Plant
NWRI	National Water Research Institute
O&M	operations and maintenance
OLSD	Oro Loma Sanitary District

P3	public-private partnership
Pilot Study	East Bayshore Recycled Water Project Water Quality Improvements Pilot Study
RARE	Richmond Advanced Recycled Expansion
RO	reverse osmosis
ROC	reverse osmosis concentrate
RREC	Rodeo Renewed Energy Complex
RWA	raw water augmentation
RWMP	Recycled Water Master Plan
RWQCB	Regional Water Quality Control Board
RWSP	Recycled Water Strategic Plan Update 2024
RWTF	recycled water treatment facility
SD-1	Special District No. 1 (WWTP)
SLWRF	San Leandro Water Reclamation Facility
SRVRWP	San Ramon Valley Recycled Water Program
SWA	surface water augmentation
SWRCB	State Water Resources Control Board
SWRF	satellite water recycling facility
TDH	total dynamic head
TDS	total dissolved solids
TIN	total inorganic nitrogen
TMF	technical, managerial, and financial
TOC	total organic carbon
TWA	treated water augmentation
UCB	University of California, Berkeley
UF	ultrafiltration
USBR	U.S. Bureau of Reclamation
USL	Upper San Leandro
UV	ultraviolet
V/G/C	virus, *Giardia, Cryptosporidium*
WCW	West County Wastewater
WDR	waste discharge requirements
WIFIA	Water Infrastructure Finance and Innovation Act
WIIN	Water Infrastructure Improvements for the Nation
WPCP	Water Pollution Control Plant
WRFP	Water Recycling Funding Program
WRP	waste reclamation plant
WSMP 2040	Water Supply Management Plan 2040
WTP	water treatment plant
WWTP	wastewater treatment plant

Executive Summary

The East Bay Municipal Utility District (District or EBMUD) has been actively engaged in recycling water since the early 1970s (service area shown in Figure ES-1). The District's current set of recycled water projects have the capacity to produce approximately 9 million gallons per day (mgd) of recycled water, which is used for irrigation, cooling towers, and industrial boilers. Recycled water use is a critical element of the District's water supply portfolio and stretches the District's limited, high-quality drinking water supply, as any demand met with recycled or non-potable water reduces the demand for potable water supply. As demands change and future supplies become more uncertain due to climate change, the District continues to explore opportunities to develop locally controlled, drought-resilient supplies through recycled water. Today, the District continues to plan, develop, and implement recycled water projects throughout the water service area to reduce demand on drinking water supplies and steadily progress toward meeting a new goal of serving 20-mgd of recycled water by 2050.

Purpose and Approach

The District developed its first comprehensive recycled water study in 1991 through the development of the Water Reclamation Master Plan. Since then, the District has continued to explore opportunities to grow its recycled water program through the development of various planning studies, including the 2012 Water Supply Management Plan 2040, which set a recycled water goal of 20-mgd by 2040, and the 2019 Recycled Water Master Plan (RWMP), which identified potential projects that could be implemented to meet the 20-mgd recycled water goal. While the 2019 RWMP identified a potential path toward meeting the proposed 20-mgd goal, it also highlighted a level of uncertainty regarding the potential for some of the District's anticipated recycled water projects to fully meet its recycled water supply projections. The purpose of this Recycled Water Strategic Plan 2024 Update (RWSP) is to evaluate the District's existing recycled water portfolio and reassess opportunities for both non-potable and potable reuse. This reassessment considers factors such as climate change, wastewater supply availability, changes in the regulatory landscape, and an updated market assessment.

The RWSP update reassessed the 20-mgd by 2040 reuse goal to account for updated demand forecasts and incorporate flexibility to address changing conditions. The update considered findings and opportunities from other recent studies, including the EBMUD and Central Contra Costa Sanitary District (Central San) Recycled Water Project Concept Evaluation Report, the Dublin San Ramon Services District (DSRSD)-EBMUD Recycled Water Authority (DERWA) Recycled Water Supply and Operations Plan Update, the East Bayshore Recycled Water Project Water Quality Improvements Pilot Study, and the East Bayshore Recycled Water Project Expansion: Alternatives Study. This report describes efforts to identify and assess opportunities for both non-potable and potable reuse and includes an updated assessment of the water reuse market, development of a revised non-potable recycled water project list, and evaluation of these projects based on feasibility and affordability. It also includes a review and assessment of new and previously identified opportunities for potable reuse, considering updated conditions and emerging technologies.

Figure ES-1. EBMUD Service Boundary

Assessment of District's Existing Recycled Water Program

The District's existing reuse goal aims to implement several non-potable reuse (NPR) projects by 2040. It has built infrastructure capable of supplying more than 9 mgd of recycled water for irrigation, commercial, and industrial uses. The existing projects are summarized below.

- **San Ramon Valley Recycled Water Program (SRVRWP)** – DSRSD and the District created the SRVRWP in 1995 through a joint powers authority referred to as DERWA. The recycled water is sourced from DSRSD's wastewater treatment plant (WWTP). The SRVRWP currently provides approximately 0.8 mgd of recycled water for irrigation to District customers. The completion of Phase 2 will bring the District's use capability to 1.0 mgd.
- **East Bayshore Recycled Water Project (EBRWP)** – The EBRWP began recycled water delivery in 2008 and currently supplies recycled water primarily for landscape irrigation in Oakland and Emeryville. The recycled water is sourced from the District's main WWTP, also known as Special District No. 1 (SD-1). The current project capability is 0.2 mgd.
- **San Leandro Water Reclamation Facility (SLWRF) –** The SLWRF was constructed in 1998 to provide secondary-treated and disinfected recycled water produced for irrigation purposes. The annual average recycled water capacity of the SLWRF is 0.2 mgd. However, key recycled water customers have not used the supply since 2015.
- **North Richmond Water Recycling Plant (NRWRP)** – The NRWRP was built in 1996 and currently supplies tertiary recycled water for cooling towers at the Chevron Richmond Refinery. The recycled water is sourced from the West County Wastewater (WCW) secondary effluent. NRWRP has an installed capacity of 4 mgd but typically produces about 2 mgd.
- **Richmond Advanced Recycled Expansion (RARE) Project –** The RARE Project, constructed in 2010, supplies high-purity recycled water for boilers at the Chevron Richmond Refinery. The recycled water is sourced from the WCW secondary effluent. RARE can produce up to 3.5 mgd but could easily expand to 4 mgd by retrofitting existing facilities.

Actual recycled water use over the last decade has averaged approximately 6.2 mgd, which is well below the system's current 9.2 mgd capability. The capacities and actual use of each project in 2023 are summarized in Table ES-1, and the projects are shown on Figure ES-2.

Table ES-1. Existing Recycled Water Project Capacities and Actual Use

Project	Use	Capacity (mgd)	2013-2023 Average Use (mgd)	2023 Actual Use (mgd)
SRVRWP (Phase 1 and 2)	Landscape Irrigation	1.3	0.77	0.85
EBRWP Phase 1A	Landscape Irrigation	0.2	0.15	0.14
SLWRF	Golf Course and Landscape Irrigation	0.2	0.06	0
NRWRP/Chevron Cooling	Chevron Refinery Cooling Towers	4.0	2.45	1.71
RARE/Chevron Boilers	Chevron Refinery Boiler Makeup	3.5	2.81	3.3
Total		9.2	6.2	6.0

Figure ES-2. District Recycled Water Projects

Based on the opportunities evaluation from the 2019 RWMP, the recommended plan was to continue progress to meet the District's goal of 20-mgd by 2040 with the highest-ranking, lowest-cost opportunities. The recommended projects, which together totaled 11 mgd, included expansion of the EBRWP and SRVRWP, Chevron/Richmond, and Phillips 66.

Changing Conditions Since 2019 RWMP

Since the completion of the 2019 RWMP, the District has seen reduced recycled water demands, changes in the refinery industry, increased conservation efforts, and decreased wastewater flows which have all contributed to the uncertainties and challenges of continuing to grow and expand the District's recycled water program. In addition, climate variability, characterized by rising sea and groundwater levels, changing weather patterns, droughts, and increased coastal flooding, has the potential to impact existing water supplies through variations in the timing, amount, and form of precipitation, as well as affecting the quality of surface runoff and subsequent water demands. These trends could present challenges to existing NPR projects and any future water reuse initiatives in the region. As future supplies become more uncertain due to climate variability, changing industrial demands, and increased water conservation, the District will continue to explore opportunities to develop locally controlled, drought-resilient supplies, such as recycled water. Continued regional collaboration efforts and long-term planning will enable adaptation with cost-effective solutions that protect District assets and future investments, including the expansion of the District's water reuse program.

Non-potable Reuse Opportunities

The RWSP update considered NPR opportunities that had been previously identified and evaluated as part of the 2019 RWMP. Recycled water demand updates were coordinated with the District to reflect new or updated conditions. To produce relevant and viable reuse opportunities, the District also secured critical input from local stakeholders and considered findings from recent studies that provided valuable context and a wealth of data. The District leveraged this feedback and knowledge to identify reuse opportunities that offer the highest value. Based on limited recycled water demands, competing uses for the same wastewater source, and technical feasibility issues as presented in the 2019 RWMP and/or the EBMUD Central San Recycled Water Project Concept Evaluation Report, many of the alternatives were screened out as not viable for further consideration. Ultimately, the following opportunities were advanced for further consideration in the RWSP:

- **SRVRWP Phase 3 and 5 –** Phases 3 and 5 would build on the District's successful partnership with DSRSD by extending distribution system infrastructure and securing additional supplies to serve landscape irrigation customers in San Ramon, Danville, and the Blackhawk Country Club. Phase 3 would consist of an additional 3 miles of pipe and the new R3000 Pump Station along the Dougherty Road corridor. Phase 5 would encompass an additional 2.8 miles of pipe. Both phases would require customer retrofits for landscape irrigation.
- **EBRWP Expansion –** The District completed the East Bayshore Recycled Water Project Expansion Alternatives Study in April 2024. Based on findings from that study, the preferred EBRWP Expansion adds an additional 0.7 mgd of capacity and conveys recycled water to portions of Alameda, Emeryville, and Oakland—requiring approximately 8.3 miles of new recycled water pipeline ranging in size from 6 to 16 inches.
- **SLWRF Expansion –** The project includes rehabilitating the existing San Leandro recycled water pump station and lining the existing 3 miles of distribution pipelines.

- **Chevron/Richmond Refinery Recycled Water –** The District identified seven potential alternative approaches for the expansion of RARE. Based on the evaluation of these alternatives, the Partial RARE Expansion via the North Interceptor Diversion at Pt. Isabel is the recommended Chevron/Richmond Refinery Recycled Water Project. This alternative involves diverting the raw waste stream from the North Interceptor wet well at the District's Point Isabel Wet Weather Facility and conveying the raw waste stream to WCW water pollution control plant (WPCP) for treatment prior to supplying RARE. The additional supply from the North Interceptor would require a treatment expansion at RARE from 3.5 mgd to 4.2 mgd.
- **Phillips 66/Rodeo Renewed Energy Complex (RREC) Recycled Water –** The proposed project would include treatment facilities, a new pump station, and a new pipeline. The treatment facilities include membrane filtration, a biological aerated filter, reverse osmosis, and ultraviolet disinfection. A new Rodeo pump station would convey the secondary effluent from the Pinole Hercules WPCP and the Rodeo WWTP to the Phillips 66 Refinery fence line through the new pipeline. An existing pipeline would be used to convey treated effluent beyond the fence line to new treatment facilities on the refinery site.

Relevant yield and cost information, including capital, annual operation and maintenance (O&M), and unit costs for the NPR opportunities evaluated are presented in Table ES-2.

Table ES-2. Non-potable Reuse Opportunities Cost Summary

Project	Capital Costs ($ millions)	Annual O&M ($ million/yr)	Annual Demand		Unit Costs ($/AF)			
			(AFY)	(mgd)	Treatment	Distribution	Total	Dry Year
SRVRWP Phase 3	$32.3	$0.73	638	0.57	$1,000	$2,700	$3,700	$12,200
SRVRWP Phase 5	$26.6	$0.62	540	0.48	$1,000	$2,700	$3,700	$12,200
EBRWP Expansion[a]	$54.9	$0.53	785	0.7	-	$4,200	$4,200	$13,900
SLWRF Expansion Project	$13.3	$0.2	25-50	0.02-0.04	$0	$18,000 to $36,100	$18,000 to 36,100	$59,400 to $119,100
Chevron/Richmond Refinery Recycled Water Project	$91.0	$1.73	1,590	1.42	$500	$3,500	$4,000	$13,200
Phillips 66 Refinery/RREC	$40.6	$2.69	3,136	2.8	$1,300	$200	$1,500	$5,000

AF = acre-feet; AFY = acre-feet per year

a. The District has approximately $25 million in federal funding they plan to use to help implement this project. This funding is anticipated to reduce annualized total costs to approximately $3,500 per AF.

Evaluation Process of Non-potable Reuse Opportunities

The NPR projects presented in Table ES-2 were assessed through a multiple-criteria decision analysis (MCDA) framework based on relative benefit and cost. The framework consisted of three primary steps:

- **Benefits evaluation:** benefits evaluated using criteria and weightings that were discussed and confirmed with District staff. Evaluation criteria are framed as benefits (i.e., the higher the score, the greater the benefit) and result in an aggregate “relative benefit” score for each opportunity.
- **Cost estimate development:** preliminary capital, O&M, and unit costs were developed for each opportunity.
- **Cost/Benefit comparison:** considered costs and benefits together to facilitate decision making and understand the tradeoffs among NPR opportunities.

The relative benefit evaluation considered qualitative factors such as social, environmental, complexity, and risk. The cost evaluation considered capital costs that reflect construction, and unit costs that reflect operating costs over the project’s 30-year service life. Both the benefit and value criteria and financial considerations that factored in the evaluation of these projects are presented on Figure ES-3.

Benefit and Value Criteria → **Financial Considerations**

Environmental and Social Objectives

Distribution of Benefits
What regions/populations are serviced by the new supply and how are the benefits distributed?

Environmental Challenges
Would the project impact environmentally sensitive areas, like streams and wetlands?

Chemical and Energy Use
How many chemicals and how much energy would the project require?

Wastewater Discharge
Would the project reduce nutrient discharge to San Francisco Bay?

Complexity and Risk

Long-term Operational Viability
Would the project be challenging for EBMUD staff to manage, operate, maintain, and staff in the future?

Design and Construction
Does the project have difficult engineering or construction obstacles?

Regulatory
Would the project’s construction and operation require numerous permits, easements, etc.?

Institutional
How much time, challenges, and requirements are needed with internal and external partners to implement the project?

Cost

Unit Cost
How much will the project cost per acre-foot of water delivered to the community?

Capital Costs
How much would the project cost to develop?

Operating Costs
What ongoing chemical, labor, maintenance, and electrical costs are required to keep the project operational?

Figure ES-3. RWSP Update Evaluation Criteria

The results of the NPR projects evaluation are presented on Figure ES-4. The figure shows the relative benefit scores vs. estimated unit costs for each opportunity to help identify the best-value options. Optimal results are closest to the top-right corner of the chart (highest benefit and lowest cost). Centralized projects like the SRVRWP scored highest in the benefits assessment (y-axis) due to existing commitments and partnerships, despite needing supplemental supplies. In contrast, projects like the Chevron/Richmond Refinery Recycled Water Project scored lower because of their complexities, required coordination with multiple agencies, new infrastructure, and minimal recycled water yield increase for the District. With the inclusion of costs, it became evident that the SRVRWP, EBRWP Expansion, and Phillips 66/Rodeo Renewed projects were among the most cost effective and are consistent with what was observed in the 2019 RWMP where these same projects were deemed to be among the most appealing from both a benefit and cost standpoint.

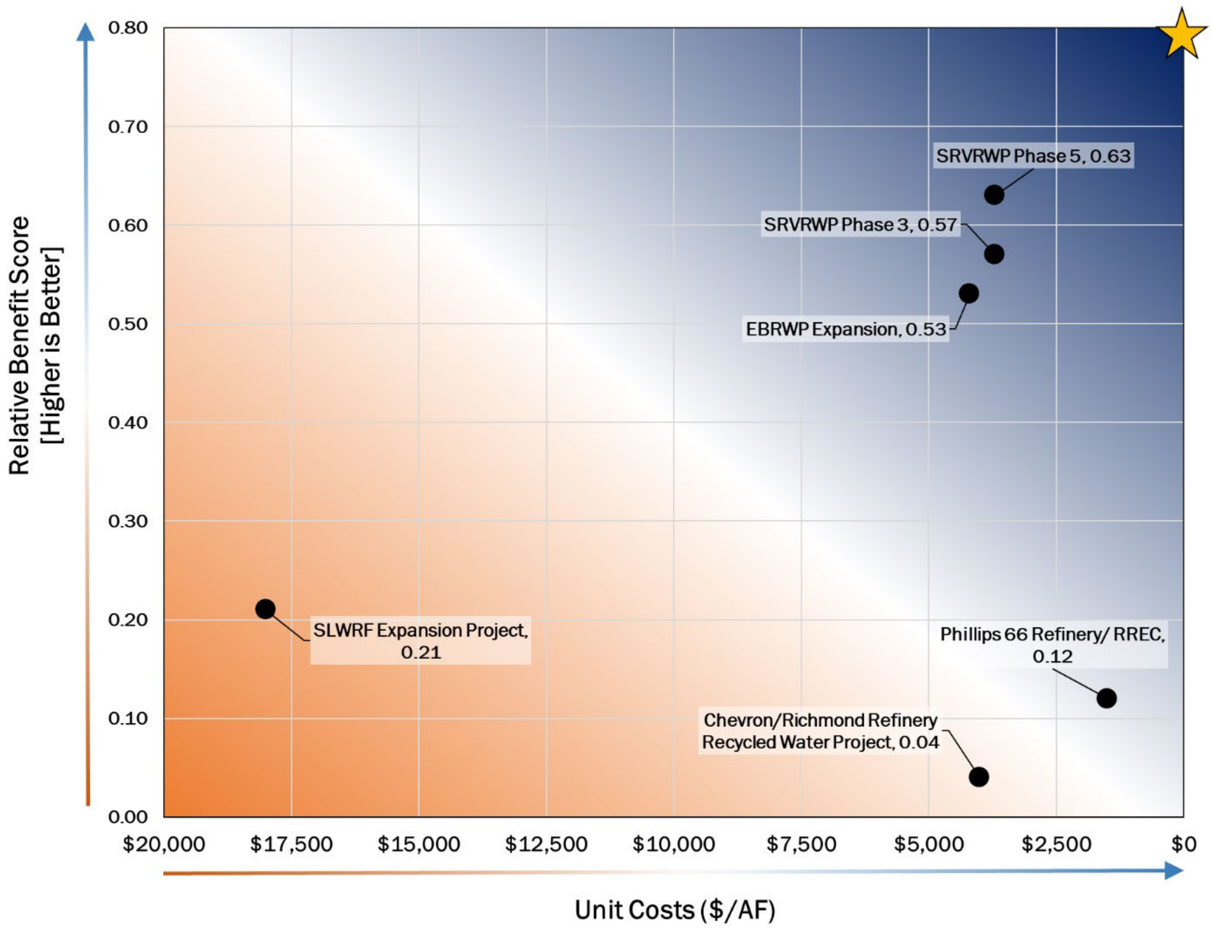

Figure ES-4. Aggregate Relative Benefit Scores vs. Unit Costs for NPR Projects

Recommended Non-potable Reuse Projects

The District has been making steady progress toward reaching its recycled water goal of 20-mgd by 2040. However, the increase in water conservation efforts, reduced recycled water demands, availability and quality of wastewater flows, and the uncertainty surrounding the long-term viability of previously identified projects suggests that reaching this goal by solely relying on the implementation of NPR projects may no longer be advisable/feasible. Based on the results of this evaluation, it is recommended that the District shift its efforts toward a tiered reuse goal that is anchored to specific triggers but that provide the flexibility to adapt to ever-changing conditions. As an initial step, it is recommended the District keep its reuse goal at 20-mgd but extend the timeline to 2050. The District should also focus on implementing projects that provide the highest value and flexibility and have the greatest likelihood of being implemented. To that end, the recommended District-led projects include the SRVRWP Phase 3 and 5 projects, EBRWP Expansion, and Phillips 66/RREC, totaling 4.55 mgd, as shown in Table E-3. When added to the existing suite of projects, it would bring the District's total recycled water program capability to 13.75 mgd.

Table ES-3. Recommended Non-potable Reuse Projects

Project	Unit Cost ($/AF)	Demand (AFY)	Demand (mgd)
SRVRWP Phase 3	$3,700	638	0.57
SRVRWP Phase 5	$3,700	540	0.48
EBRWP Expansion[a]	$4,200	785	0.7
Phillips 66 Refinery/RREC	$1,500	3,136	2.80
Total		5,099	4.55

a. The District has approximately $25 million in federal funding they plan to use to help implement this project. This funding is anticipated to reduce annualized total costs to approximately $3,500 per AF.

Also, while not featured in Table ES-3, the District anticipates that the Chevron Refinery will make an additional 0.5-mgd influent flow available from the refinery effluent by 2030, which would increase the recycled water production of RARE. It is important to note that this recommended list of NPR projects does not account for the implementation of any customer-led satellite projects, such as those currently being explored by the University of California Berkeley, the Moraga, Diablo, and Sequoyah county clubs, and the Rossmoor Community. The District remains supportive of these customer-led efforts that would contribute toward the District's water reuse goals.

Figure ES-5 shows the geographic location of each of the proposed projects.

Figure ES-5. Recommended Near-Term NPR Projects

Potable Reuse Opportunities

As part of the RWSP update, new and previously identified potable reuse opportunities were reviewed and assessed considering updated conditions and emerging technologies. California's potable reuse regulations distinguish between indirect potable reuse (IPR) and direct potable reuse (DPR). IPR projects include the presence of a significant environmental buffer like an aquifer for groundwater recharge (GWR) or a surface water reservoir for surface water augmentation (SWA). DPR projects don't require the presence of an environmental buffer, but as a result are subject to more rigorous treatment, monitoring, reporting, and other requirements. California distinguishes two forms of DPR: raw water augmentation (RWA) and treated water augmentation (TWA). Descriptions of the different types of potable reuse and how they fit into California's potable reuse regulations are depicted on Figure ES-6.

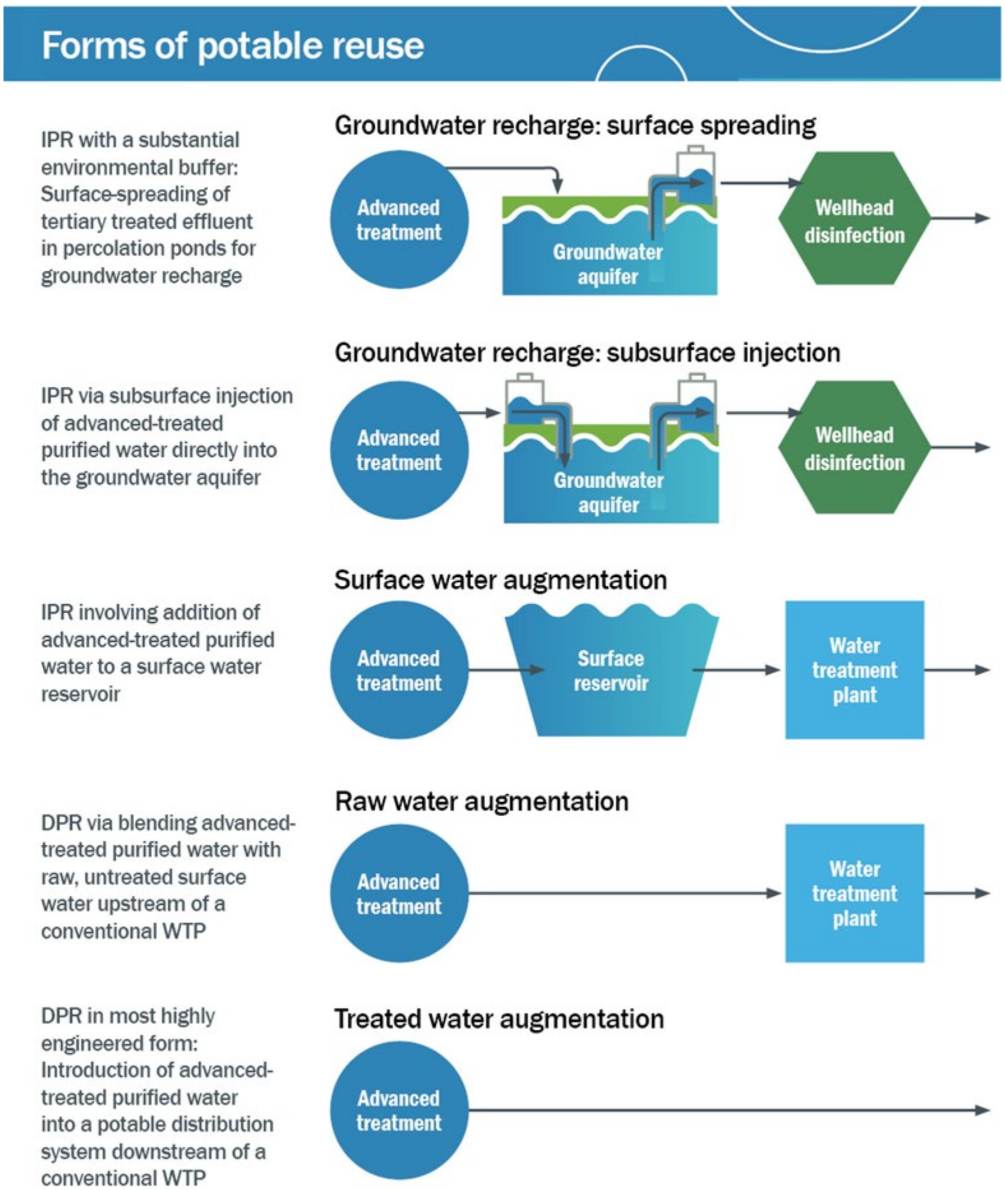

Figure ES-6. Forms of Potable Reuse Covered by California Regulations

Evaluation Process of Potable Reuse Opportunities

The 2019 RWMP developed and evaluated 36 potable reuse opportunities, considering treated wastewater sources within or immediately adjacent to the District's water service area and all forms of potable reuse (i.e., GWR, SWA, RWA, and TWA). The RWMP also assessed infrastructure (e.g., pipelines and pumps) needs to convey the purified water from the new advanced water purification facilities (AWPF) to their anticipated delivery point. As part of the RWSP, these potable reuse opportunities were reassessed to reflect the changes in reuse conditions, and evaluation criteria were updated to create a refined list of potable reuse alternatives. Findings from the EBMUD and Central San Recycled Water Project Concept Evaluation Report were also incorporated as part of this process.

The evaluation of the potable reuse opportunities used the same MCDA framework that was used to assess the NPR projects. Figure ES-7 presents the relative benefit score of each potable reuse opportunity plotted against its respective 2019 RWMP relative unit cost. Costs from the 2019 RWMP were not modified or escalated for this initial reassessment process to avoid any potential comparison between costs presented in this section and costs tabulated for the five potable reuse alternatives that were carried forward for further development. Costs were simply normalized at this stage to provide a relative reflection of cost per AF of yield within the group of options (100 to 1 scale; the larger the number the more expensive the unit cost of the opportunity). It is also important to note that Figure ES-7 includes only potable reuse opportunities with a benefit score above the median score of 0.30, plotted as a means of focusing on those opportunities that showed the most promise.

Figure ES-7 includes 20 total projects: two projects from the Richmond WPCP, one project from the WCW WPCP, two projects from the Oro Loma WPCP, five projects from Central San, nine projects from EBMUD's SD-1 WWTP, and one project from the satellite-based treatment alternatives. Opportunities closest to the upper right quadrant present the most favorable combination of costs and alignment with the evaluation criteria. The results show that those opportunities with the potential for greater benefit disbursement tended to score highest. This included many of the District SD-1 and Central-San-specific projects, whereas opportunities like the ones associated with less production capacity did not score as high since these projects tended to be more localized but still involved many of the same complexities as their counterparts.

Note that the following nomenclature is used to discuss potable reuse opportunities throughout this section: XX-YYY-##, where XX represents the effluent source, YYY represents the reuse type (for SWA opportunities, this will be delivery point), and ## represents the production rate.

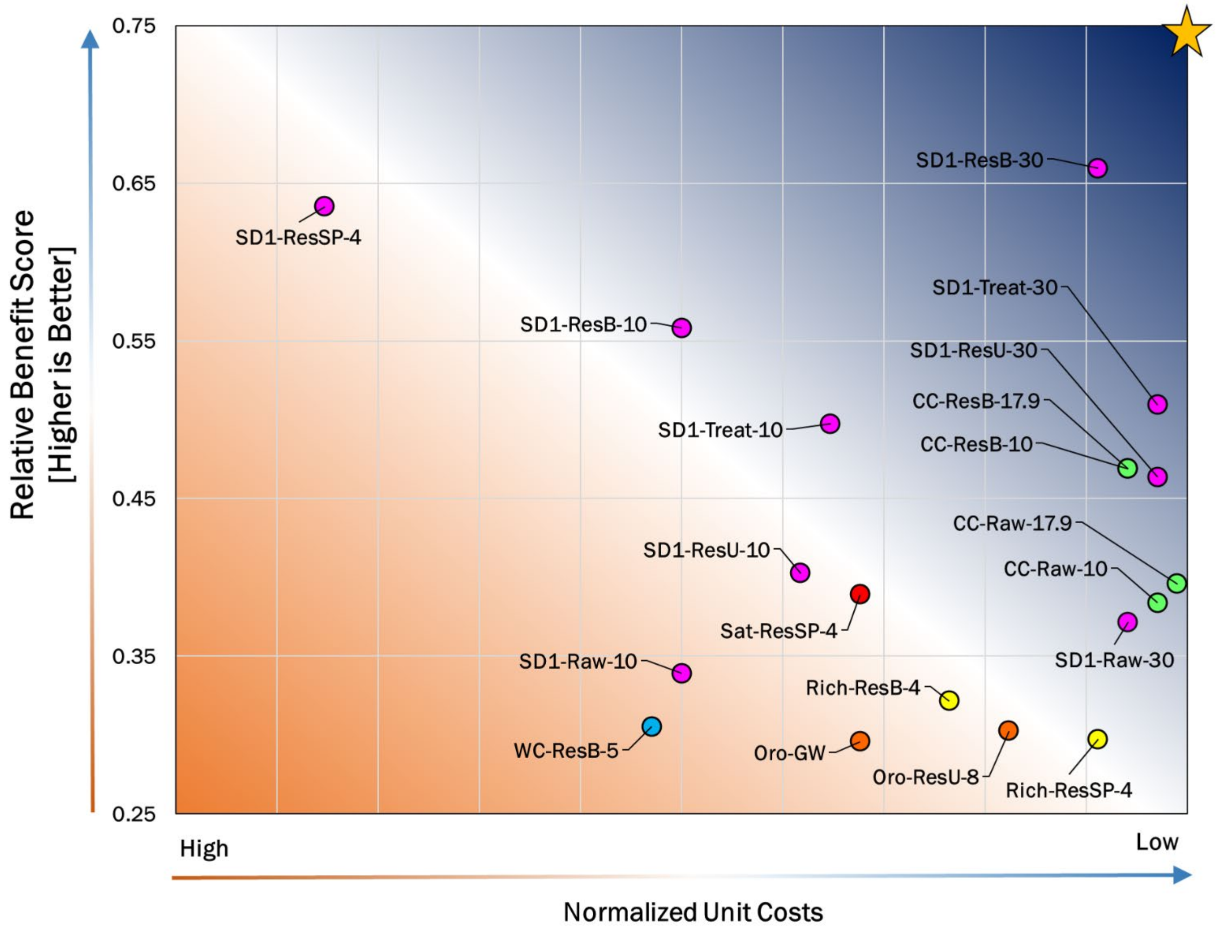

Figure ES-7. Aggregate Relative Benefit Scores for Potable Reuse Opportunities vs. Normalized Unit Costs

Neither CC-ResLV-17.9 or CC-Raw WCK-17.9 alternative is shown, since 2019 normalized unit costs for these are not available. Color designations: Blue = WCW-WPCP-based alternatives; green = Central-San-based alternatives; orange = Oro Loma-WPCP-based alternatives; pink = EBMUD-based alternatives; yellow = Richmond-WPCP-based alternatives; red = satellite-treatment-based alternatives.

Following the reassessment of potable reuse alternatives and discussions with District staff, five opportunities were selected for further development, as shown in Table ES-4). These are SWA and TWA options at SD-1, RWA and SWA projects with Central San, and a smaller SWA option with Oro Loma. It should be noted that the District and Central San's Recycled Water Project Concept Evaluation Report had recommended an RWA project concept involving Central San effluent and the Walnut Creek Water Treatment Plant (WTP) (i.e., CC-Raw WCK-17.9) for further assessment as part of this RWSP update; however, the District opted instead to pursue the SWA at Briones Reservoir concept (i.e., SD1-ResB-30) due to its greater benefits potential.

Table ES-4. Highest Ranking Potable Reuse Opportunities						
Name	Reuse Type	Source	Delivery Point	Production Rate (mgd)	Yield (AFY)	Normalized 2019 RWMP Unit Costs[a]
Oro Loma WPCP-based Alternatives						
Oro-ResU-8	SWA	Oro Loma WPCP	Upper San Leandro Reservoir	8.0	8,961	18
Central San WWTP-based Alternatives						
CC-Raw-17.9	RWA	Central San WWTP	Mokelumne Aqueduct	17.9	20,051	1
CC-ResB-17.9	SWA	Central San WWTP	Briones Reservoir	17.9	20,051	6
EBMUD Main WWTP (SD-1)-based Alternatives						
SD1-ResB-30	SWA	SD-1 WWTP	Briones Reservoir	30.0	33,604	9
SD1-Treat-30	TWA	SD-1 WWTP	Claremont Center	30.0	33,604	3

a. *Unit costs for potable reuse alternatives from 2019 RWMP were normalized using a "min-max normalization" approach.*

Recommended Potable Reuse Opportunities

Site layouts, treatment and conveyance needs, key considerations, and planning-level cost estimates for the five recommended potable reuse alternatives were identified and developed as part of the RWSP update. Each project presents its own unique combination of benefits and challenges that must be carefully considered prior to inclusion in the District's water supply portfolio.

- **SWA at Briones Reservoir from SD-1 (SD1-ResB-30) –** Uses available effluent from the District's SD-1 WWTP and a new AWPF located adjacent to the existing SD-1 WWTP in Oakland. Purified water would be conveyed to the Briones Reservoir through a new pump station and 13-mile-long,42-inch pipeline. Once in the reservoir, the purified water may be drafted back through the Briones Aqueduct and continue to the Orinda Water Treatment Plant (WTP) for treatment and distribution.
- **TWA through the District's Claremont Center (SD1-Treat-30) –** Involves constructing a new AWPF that would purify available effluent from the SD-1 WWTP and convey it to the Claremont Center for distribution. The Claremont Center is part of the District's existing water distribution system and currently receives water from the Orinda WTP via a 3.4-mile underground tunnel. The treated water is then distributed throughout the western portion of the District's service area (Oakland and Berkeley). This project requires the least pipeline infrastructure investment (4.6 miles of 42-inch pipe) relative to the other similarly sized projects originating at the SD-1 WWTP.
- **SWA at Briones Reservoir from Central San WWTP (CC-ResB-17.9) –** Involves augmenting Briones Reservoir with purified water produced at a new AWPF using available effluent from Central San. The facility would produce up to 17.9 mgd of purified water that would be conveyed approximately 11 miles to Briones Reservoir using a new pump station and 30-inch pipeline. The new AWPF would be constructed near the existing Central San WWTP in Martinez. This project would require a high degree of coordination between the District and Central San.

- **RWA at Mokelumne Aqueducts (CC-Raw-17.9) –** Involves constructing a new raw water augmentation AWPF near the existing Central San WWTP. Purified water would be conveyed via a new 30-inch pipeline approximately 3.5 miles to the Mokelumne Aqueducts near Mallard Reservoir. The purified water would be blended with raw water in the aqueducts prior to delivery to the WTPs.
- **SWA at Upper San Leandro Reservoir (Oro-ResU-8) –** This project would augment the Upper San Leandro Reservoir with purified water produced at a new AWPF. The facility would produce up to 8 mgd of purified water that would be conveyed approximately 11.6 miles to Upper San Leandro using a new pump station and 24-inch pipeline. The new AWPF would be constructed near the existing Oro Loma Sanitary District WWTP in San Lorenzo, which would supply the new facility's feed flow. This alternative was chosen for further evaluation to assess the feasibility of a purified water project within the southern portion of the District's water service area. However, it is unlikely that this specific concept, or a similar variation, will proceed due to its lower overall distribution of benefits and relatively higher unit costs.

Relevant yield and cost information including capital, annual O&M, and unit costs for the recommended potable reuse projects are presented in Table ES-5. Figure E-8 shows the geographic location of each of the recommended potable reuse projects.

Table ES-5. Summary of Recommended Potable Reuse Projects

Project	Yield (mgd)	Yield (AFY)	Capital Cost ($ millions)	O&M Cost ($ millions)	Unit Cost ($/AF)	Dry-year Unit Cost ($/AF)
SWA at Briones Reservoir from SD-1 (SD1-ResB-30)	30	33,600	$1,343	$60.5	$3,800	$12,500
TWA through the District's Claremont Center (SD1-Treat-30)	30	33,600	$982	$66.6	$3,500	$11,600
SWA at Briones Reservoir from Central San (CC-ResB-17.9)	17.9	20,000	$742	$37.3	$3,700	$12,200
RWA at Mokelumne Aqueducts (CC-Raw-17.9)	17.9	20,000	$656	$40.5	$3,700	$12,200
SWA at Upper San Leandro Reservoir (Oro-ResU-8)	8	8,960	$640	$16.5	$5,500	$18,200

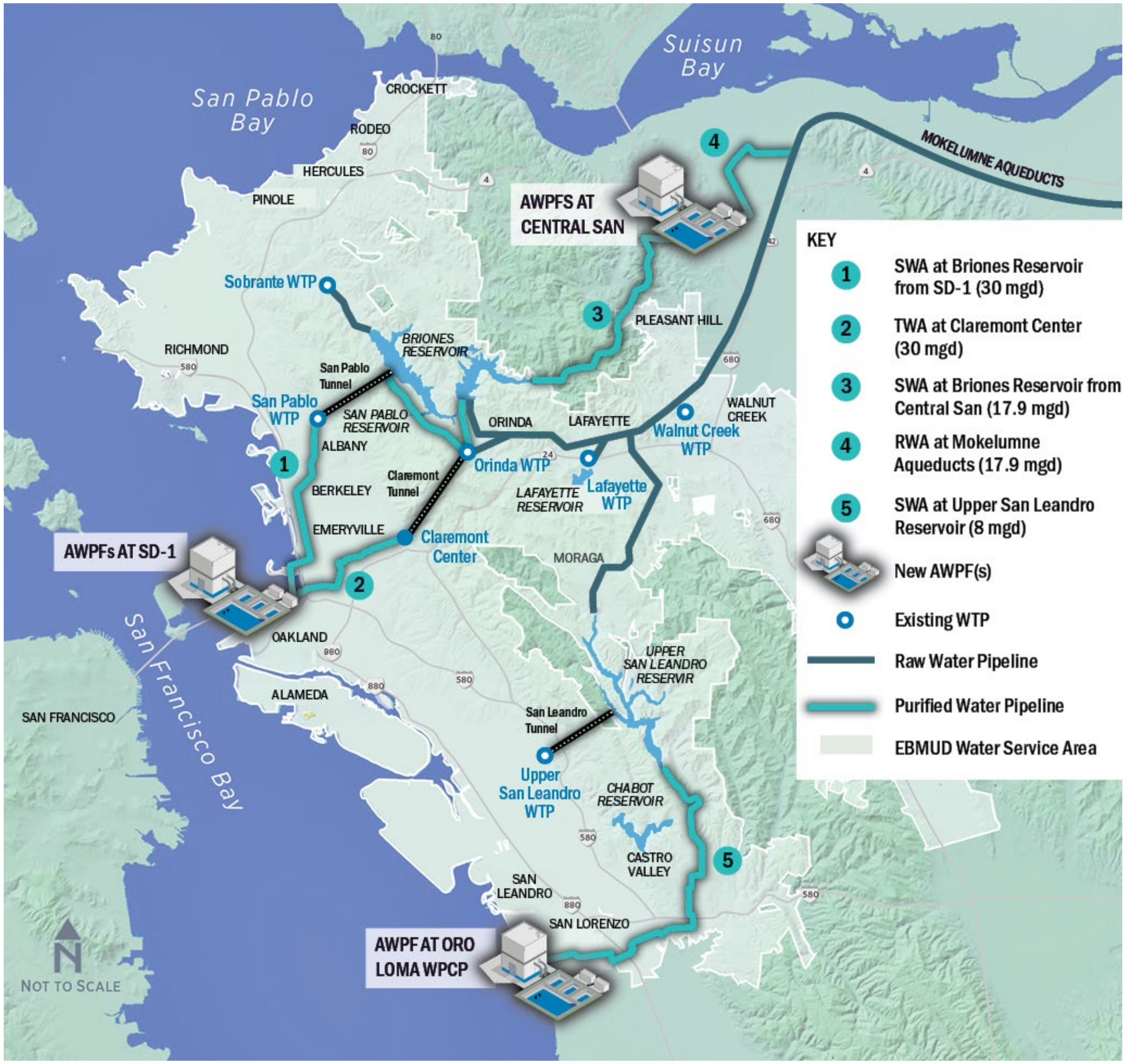

Figure ES-8. Recommended Potable Reuse Opportunities

Potable Reuse Next Steps

Potable reuse can be complex, time-consuming, and costly when compared to more traditional water supply alternatives. Given the large upfront capital costs and the current availability of alternate water supplies for the District, potable reuse is not recommended for current implementation and will be further considered following future evaluations of water supply needs. In the near term, the District's aim should remain with growing its NPR system, focusing on projects that provide the highest value, provide flexibility, and have the greatest likelihood of being implemented. The District should also work on implementing an outreach and education campaign to educate its customer base in case a potable reuse project is pursued in the future. Purified water may become a needed option in the next 10 to 20 years depending on the District's demand for water, availability of existing supplies, and improved clarity with regard to the type of secondary wastewater treatment upgrades that are planned for nutrient removal. Should the District choose to move forward with one of these options, a more detailed evaluation of these alternatives is recommended to help refine some of the assumptions that were used for this analysis, including:

- **Economics:** refine project concepts and costs to understand financial implications.
- **Environmental considerations:** analyze environmental impacts, energy use, greenhouse gas emissions, and regulatory considerations.
- **Governance considerations and Partnerships:** develop agreements for project elements, roles, responsibilities, and compliance documentation.
- **Residuals management:** evaluate site-specific reverse osmosis concentrate management options, costs, and permitting complexity.
- **Water supply integration, operations, and maintenance:** perform in-depth analyses of water supply integration, contracts, models, seasonal variation, blending, energy use, and permit requirements.

Implementation Plan

The suite of NPR projects recommended for implementation offered several benefits over their counterparts. Benefits included the presence of existing commitments and established partnerships that aligned the projects well with District objectives. Figure ES-9 shows the proposed phasing timeline for the recommended projects, which was based on discussions with District staff and accounts for project-specific considerations and implementation needs. Ultimately, the implementation timing will depend on wastewater supply availability, institutional agreements, customer outreach, cost effectiveness, and funding opportunities.

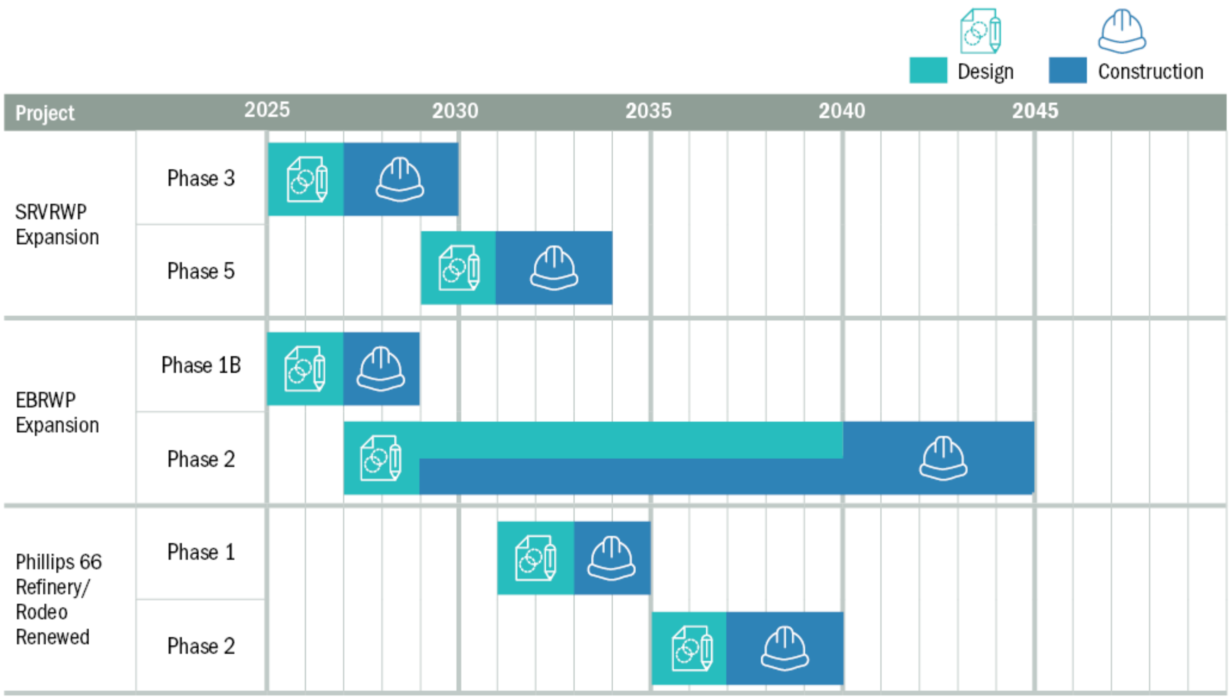

Figure ES-9. Implementation Timeline of Recommended Projects

The District has made steady progress toward its 20-mgd reuse goal. Implementing the three recommended NPR projects and the expected additional 0.5-mgd influent flow from the Chevron Refinery to boost the recycled water production of RARE will help the District move closer to this target. However, even with these new projects, the total recycled water deliveries are expected to fall short of the 20-mgd goal. Figure ES-10 shows the projected recycled water deliveries for the RWSP planning horizon (2025-2050), estimating that total planned recycled water deliveries for 2050 will be approximately 13 mgd. Even though this delivery schedule does not account for implementation of any customer-led satellite projects, it is unlikely that implementation of some or all of these projects will generate enough demand to bridge the gap needed to get to 20-mgd. It is unlikely the District will reach the full 20-mgd goal if relying solely on NPR projects.

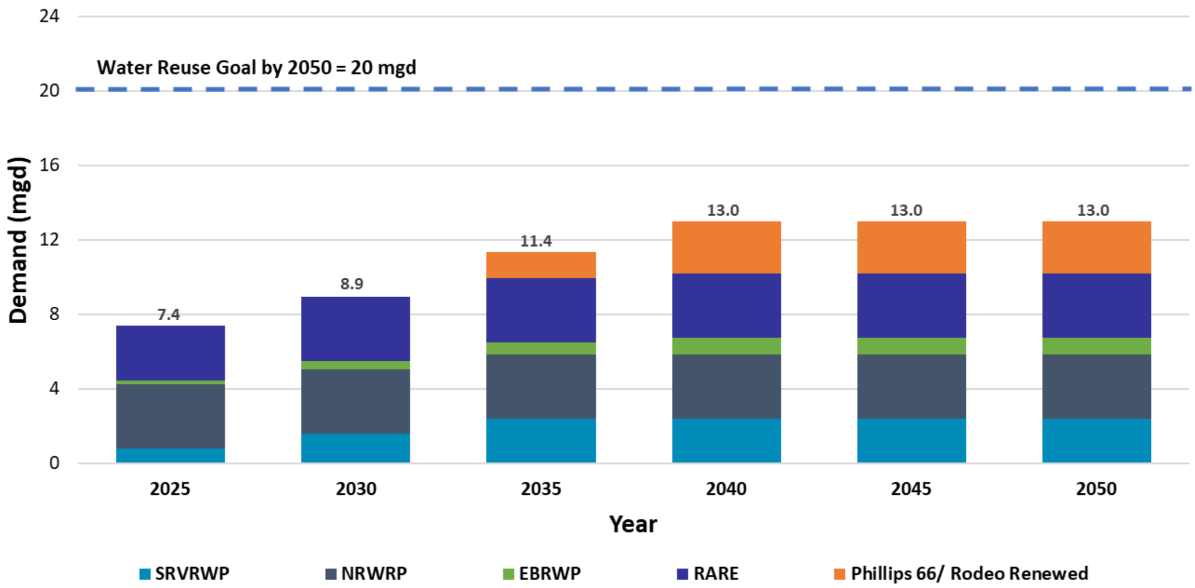

Figure ES-10. Planned Non-Potable Recycled Water Demand

While this report identified several promising purified water opportunities, moving forward with any one of them in the near term is not necessary to meet water supply needs. Currently, the District can meet its potable water demand with existing supplies. A purified water project will become more appealing when the District's need for water supply increases. The District should continue to follow developments in the potable reuse arena and work on executing an outreach and education campaign as detailed in Appendix D to inform its customer base and internal and external stakeholders in the event a potable reuse project is considered in the future. Moving forward, the District will continue to evaluate the need for purified water as part of future studies and assessments. Key studies include:

- **Urban Water Management Plan:** this plan is updated every 5 years; it assesses water supply and demand over 30 years and outlines actions to address future uncertainties.
- **Water Needs Analysis:** this study is a thorough assessment of the District's water needs, accounting for changes in demand, supply availability, and climate variability impacts.
- **Water Supply Management Program Update:** this program-level effort estimates the District's water supply needs over a 30-year horizon and proposes a diverse portfolio of policy initiatives and projects to ensure that those needs can be met in dry years.

Ultimately, the District is committed to meeting the 20-mgd goal of recycled water by 2050, but more importantly is dedicated to selecting the right projects that best serve the needs of the community and integrate into the system efficiently and effectively.

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Section 1

Introduction

The East Bay Municipal Utility District (District or EBMUD) is a public utility that supplies high-quality drinking water, generates renewable energy, and provides wastewater treatment and pollution prevention services that protect the San Francisco Bay. The District's customer base includes more than 1.4 million East Bay customers within a service area that spans more than 332 square miles in Alameda and Contra Costa counties, extending from Crockett in the north, southward to San Lorenzo, eastward from San Francisco Bay to Walnut Creek, and south through the San Ramon Valley, as shown on Figure 1-1.

Figure 1-1. EBMUD Service Boundary

Source: EBMUD UWMP (2020a)

The District understands that a reliable supply of clean water is necessary for the environmental, economic, and social well-being of the region. Over the years, the District has made significant investments to manage water demands and develop water supplies and infrastructure to meet the region's water needs. As demands continue to grow and future supplies become more uncertain due to climate change, the District intends to continue exploring opportunities to develop locally controlled, drought-resilient supplies such as recycled water.

Recycled water use is a critical element of the District's water supply portfolio and stretches the District's limited, high-quality drinking water supply, as any demand met with recycled or non-potable water reduces the demand for potable water supply. Recycled water use not only helps increase water supply reliability and lessen the effect of extreme rationing during droughts, but also provides the following benefits:

- Helps delay or eliminate the need for more potable water facilities
- Sustains the economy with increased water supply reliability
- Protects the San Francisco Bay by reducing treated wastewater discharges
- Safeguards community and private investments in parks and landscaping with a drought-resistant water supply
- Contributes to a green and healthy environment

The District initiated water recycling programs that reduce demand on drinking water supplies in the early 1970s. It has been recycling water for landscape irrigation and in-plant processes at its main wastewater treatment plant (WWTP) since 1971 and began its first golf course recycled water irrigation project in 1984. The District currently has approximately 9 million gallons per day (mgd) of recycled water capability in place. Recycled water use includes irrigation, cooling towers, and industrial boilers.

1.1 Project Purpose

The District developed its first comprehensive recycled water study in 1991 through the development of the Water Reclamation Master Plan. Its goals were to identify potential water reuse opportunities, develop and rank feasible projects, and provide recommendations for implementing high-priority projects. Since then, the District has continued to explore opportunities to grow its recycled water program through the development of various planning studies, including:

- The 2012 Water Supply Management Plan 2040 (WSMP 2040), which set a recycled water goal of 20-mgd by 2040
- The 2019 Recycled Water Master Plan (RWMP), which identified potential projects that could be implemented to meet the 20-mgd recycled water goal.

While the 2019 RWMP identified a potential path toward meeting the proposed 20-mgd goal, it also highlighted a level of uncertainty regarding the potential for some of the District's anticipated recycled water projects to fully meet their recycled water supply projections. The purpose of the Recycled Water Strategic Plan 2024 Update (RWSP) is to evaluate the District's existing recycled water portfolio and reassess opportunities for both non-potable and potable reuse considering factors such as climate change, wastewater supply availability, changes in the regulatory landscape, and an updated market assessment.

1.2 Project Approach

As part of this RWSP update, the 20-mgd reuse goal was re-assessed to account for updated demand forecasts and to incorporate flexibility to address ever-changing conditions. The RWSP also references and considered findings and opportunities identified from other recently completed studies, including:

- The EBMUD and Central Contra Costa Sanitary District (Central San) Recycled Water Project Concept Evaluation Report
- The Dublin San Ramon Services District (DSRSD)-EBMUD Recycled Water Authority (DERWA) Recycled Water Supply and Operations Plan Update
- East Bayshore Recycled Water Project Water Quality Improvements Pilot Study
- East Bayshore Recycled Water Project Expansion: Alternatives Study

This report describes the efforts to identify and assess opportunities for both non-potable and potable reuse. It builds on the work and assessments that were developed in the 2019 RWMP, includes an updated assessment of the District's water reuse market, development of a revised non-potable recycled water project list, and evaluation of these non-potable reuse (NPR) projects through a prioritization and assessment methodology based on feasibility and affordability. The report also summarizes the review and assessment of new and previously identified opportunities for potable reuse considering updated conditions and emerging technologies. Five of the potable reuse alternatives that showed promise for future implementation were further developed. The potable reuse assessment also includes a discussion on the importance of public outreach and engagement as a precursor to any potable reuse project. Throughout the RWSP update process, the project team worked closely with District staff to review and update past information, refine and evaluate both non-potable and potable reuse opportunities, and prepare recommendations.

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Section 2

Assessment of the District's Existing Recycled Water Program

This section summarizes the District's existing recycled water program and future opportunities identified as part of the 2019 RWMP. It also includes an overview of available wastewater effluent flows for new potential non-potable and potable reuse opportunities. The wastewater flows assessment includes a discussion around the potential impacts from ongoing nutrient reduction efforts and the effects of water conservation.

2.1 Existing and Planned Recycled Water Opportunities

The District has been recycling water for non-potable uses within its water service area since 1971 and would like to continue to plan, develop, and implement recycled water projects throughout the water service area to offset potable water demands. This section evaluates the District's existing NPR projects and identifies any planned NPR projects.

2.1.1 Existing and Planned Recycled Water Opportunities

The District's current recycled water goal is based on implementing a variety of NPR projects through 2040. The District has built infrastructure with the capability to provide more than 9 mgd of recycled water for irrigation, commercial, and industrial uses, as summarized in this section and shown on Figure 2-1.

- **San Ramon Valley Recycled Water Program (SRVRWP)** –DSRSD and the District created the SRVRWP in 1995 through a joint powers authority referred to as DERWA. The recycled water is sourced from DSRSD's wastewater treatment plant (WWTP). The SRVRWP currently provides approximately 0.8 mgd of recycled water for irrigation to District customers. The completion of Phase 2 will bring the District's use capability to 1.0 mgd.
- **East Bayshore Recycled Water Project (EBRWP)** – The EBRWP began recycled water delivery in 2008 and currently supplies recycled water primarily for landscape irrigation in Oakland and Emeryville. The recycled water is sourced from the District's main WWTP, also known as Special District No. 1 (SD-1). The current project capacity is 0.2 mgd.
- **San Leandro Water Reclamation Facility (SLWRF)** – The SLWRF was constructed in 1998 to provide secondary-treated and disinfected recycled water produced for irrigation purposes. The annual average recycled water capacity of the SLWRF is 0.2 mgd. However, key recycled water customers have not used the supply since 2015.
- **North Richmond Water Recycling Plant (NRWRP)** – The NRWRP was built in 1996 and currently supplies tertiary recycled water for cooling towers at the Chevron Richmond Refinery. The recycled water is sourced from West County Wastewater (WCW) secondary effluent. NRWRP has an installed capacity of 4 mgd but typically produces about 2 mgd.

- **Richmond Advanced Recycled Expansion (RARE) Project –** The RARE Project, constructed in 2010, supplies high-purity recycled water for boilers at the Chevron Richmond Refinery. The recycled water is sourced from WCW secondary effluent. RARE can produce up to 3.5 mgd but could easily expand to 4 mgd by retrofitting existing facilities.

Figure 2-1. EBMUD Existing Recycled Water Projects

Figure 2-2 shows the annual recycled water consumption for the existing recycled water projects dating back to 2013. Actual recycled water use over the last decade has averaged approximately 6.2 mgd, which is well below the system's current 9.2-mgd capability. Table 2-1 highlights the existing capacity of each of the District's recycled water projects and the actual recycled water use in 2023. Capacities shown are average annual production capacities.

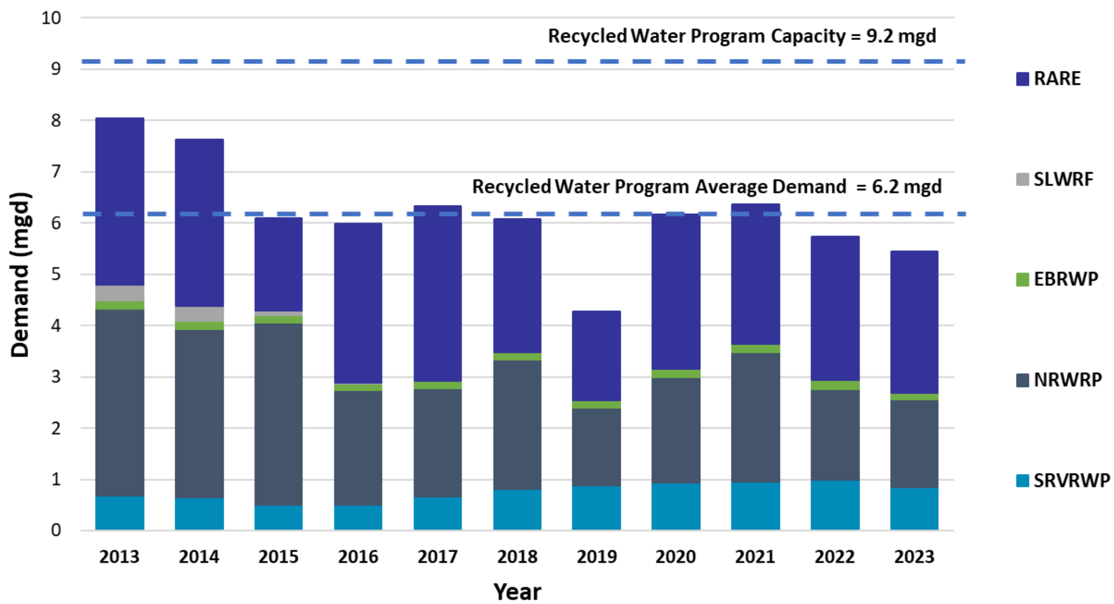


Figure 2-2. Recycled Water Deliveries

Table 2-1. Existing Recycled Water Project Capability and Actual Use

Project	Use	Existing Capability (mgd)	2013-2023 Average Use (mgd)	2023 Actual Use (mgd)
SRVRWP (Phases 1 and 2)	Landscape Irrigation	1.3	0.77	0.85
EBRWP Phase 1A	Landscape Irrigation	0.2	0.15	0.14
SLWRF	Golf Course and Landscape Irrigation	0.2	0.06	0
NRWRP/Chevron Cooling	Chevron Refinery Cooling Towers	4.0	2.45	1.71
RARE/Chevron Boilers	Chevron Refinery Boiler Makeup	3.5	2.81	3.3
Total		9.2	6.2	6.0

2.1.2 Planned Projects from the 2019 RWMP

Based on the opportunities evaluation from the 2019 RWMP, the recommended plan was to continue progress to meet the District's goal of 20-mgd by 2040 with the highest-ranking, lowest-cost opportunities, looking at both project unit costs and total capital outlay. The recommended projects from the 2019 RWMP included expansion of the EBRWP and SRVRWP, Chevron/Richmond, and Phillips 66, totaling 11 mgd. Diablo Country Club was also included since the project was expected to go forward under a self-financing model. Table 2-2 summarizes the recommended NPR projects from the 2019 RWMP that are further evaluated as part of the RWSP update. Figure 2-3 from the 2019 RWMP shows the planned implementation schedule.

Table 2-2. Recommended Non-potable Reuse Projects from 2019 RWMP		
Project	2019 Project Yield (AFY)	2019 Project Yield (mgd)
Diablo Country Club	250	0.2
SRVRWP – Phase 3	800	0.7
SRVRWP – Phase 4	300	0.3
SRVRWP – Phase 5	300	0.3
East Bayshore – Phase 2[a]	2,900	2.6
Richmond WPCP/Chevron Cooling and Boilers	4,300	3.8
P66 Rodeo Refinery	4,100	3.7
Total	12,950	11.6

a. *This phase includes all facilities in Phase 1A and Phase 1B plus expansion to University of California Berkeley (UCB), City of Albany, and City of Alameda.*

AFY = acre-feet per year

WPCP = water pollution control plant

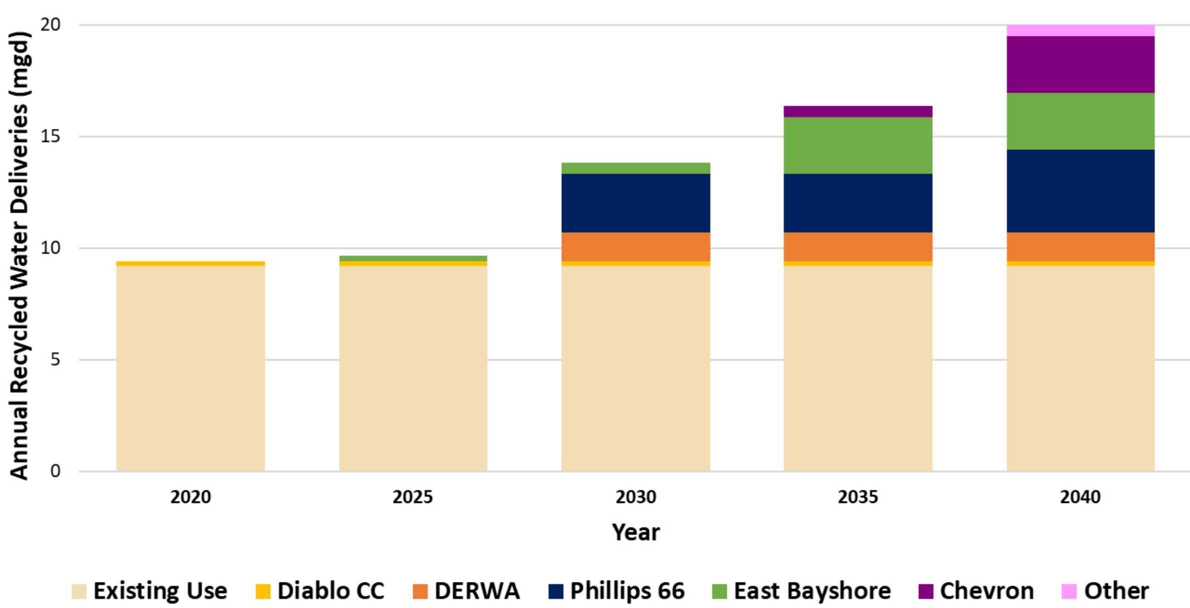


Figure 2-3. RWMP 2019 Planned Recycled Water Capacity Implementation Schedule

Source: Adapted from 2019 RWMP (Woodard & Curran, 2019a)

2.2 Available Wastewater for Reuse Opportunities

Several agencies within the District's potable water service area collect and treat wastewater. These agencies and the locations of their wastewater treatment facilities are highlighted on Figure 2-4. Much of the treated effluent generated at these wastewater facilities is currently discharged to either the San Francisco, Suisun, or San Pablo bays through pipelines or outfalls. This is treated effluent that could potentially be used to supply new potable and NPR projects.

Figure 2-4. EBMUD Water Service Area and Sources of Wastewater Effluent for Reuse

2.2.1 Wastewater Sources and Availability

The District and several other agencies provide wastewater collection and treatment within the District's water service area. The estimated firm supply of secondary effluent available is presented in Table 2-3 for each of the viable WWTPs. Available effluent is shown as average dry weather flow (ADWF), or the lowest consecutive 3-month average during the year. Note that values presented in Table 2-3 are from 2021 (unless stated otherwise), which was California's second driest year on record. In most instances, these wastewater flows are considerably lower than those listed in the District's 2012 Water Supply Management Plan 2040 Appendix D, TM 4, "*Future Recycled Water Potential Analysis*" (EBMUD, 2012) due to increased water conservation and water use efficiency and/or reductions in groundwater infiltration over the last decade.

Table 2-3. Sources of Secondary Effluent for Reuse				
Wastewater Supply Source	Permitted ADWF Treatment Capacity (mgd)	2021 ADWF Discharged to Bay (mgd)	Estimated Supply Available for Reuse (mgd)	Effluent Disposal Method
EBMUD Main WWTP (SD-1)[a]	120	42.4	37.4	SF Bay
San Leandro WPCP[b,c,d]	7.6	4.3	1.7	San Francisco (SF) Bay via EBDA outfall
Central San WWTP[a]	53.8	28.7	25.0	Suisun Bay
DSRSD WWTP[e,f,g]	17	3.5	0 (summer)	SF Bay via LAVWMA/EBDA
Livermore WRP[f,g]	8.5	3.6	0 (summer)	SF Bay via LAVWMA/EBDA
WCW WCPC[a]	12.5	5.8	0 (summer)	SF Bay via joint WCW/Richmond outfall
Pinole/Hercules WPCP[a]	4.1	2.1	2.1	San Pablo Bay via Joint Outfall
Richmond WPCP[e]	16	Included with WCW, above	4.5	SF Bay via joint WCW/Richmond outfall
Oro Loma WPCP[b]	20	11.2	11.2	SF Bay via EBDA outfall
Crockett Community Services District Water Treatment Facility (C&H Sugar Company)[g]	1.8	0.8	0.8	Carquinez Strait
Rodeo WPCF[a]	1.14	0.5	0.5	San Pablo Bay via Joint Outfall

a. *2022 Bay Area Clean Water Agencies (BACWA) Nutrient Watershed Permit Group Annual Report.*

b. *EBDA National Pollution Discharge Elimination System (NPDES) Permit for Common Outfall. Order No. R2-2022-0023, NPDES No. CA0037869. San Francisco Bay Regional Water Quality Control Board (RWQCB), 2022.*

c. *City of San Leandro Recycled Water Market Assessment Study. Prepared by Carollo Engineers for City of San Leandro. Draft, January 2016b.*

d. *EBMUD Water Supply Management Program 2040 Plan, Appendix D. April 2012.*

e. *DSRSD NPDES Permit. Order No. R2-2022-0024, NPDES No. CA0037613. San Francisco Bay Regional Water Quality Control Board, 2017.*

f. *ADWF flow rates are from 2020. DSRSD flows include a small flow of reverse osmosis concentrate (ROC) from Zone 7, averaging 0.34 mgd between 2018 and 2020.*

g. *CIWQS. Available at http://www.waterboards.ca.gov/water_issues/programs/ciwqs/*

Currently, some portion of wastewater effluent from these facilities is recycled for existing NPR projects. These commitments, summarized below, were subtracted out to estimate the firm daily supply available on a year-round basis. The values represent peak month demands (approximately double the average annual demand), unless specified, for each potential flow source.

- **SD-1:** The District's SD-1 facility serves an area that spans approximately 88 square miles within Alameda and Contra Costa counties. It treats domestic, commercial, and industrial wastewater for the cities of Alameda, Albany, Berkeley, Emeryville, Oakland and Piedmont, and for the Stege Sanitary District, which includes El Cerrito, Kensington and parts of Richmond. Currently, 5 mgd is reserved for the EBRWP facility and in-plant uses.
- **City of San Leandro WPCP:** This facility treats domestic, commercial, and industrial wastewater from the City of San Leandro. 0.6 mgd is reserved for the Monarch Bay Golf Club, and up to 2 mgd is reserved for future users of the SLWRF Expansion Project (discussed in Section 3.2.3). This is a conservative assumption, given that the SLWRF is not currently operational as noted in Section 2.1.1.

- **Central San WWTP:** Central San's service area comprises 147 square miles that include the cities of Danville, Lafayette, Moraga, Orinda, Pleasant Hill, Walnut Creek, portions of Martinez and San Ramon, and several unincorporated communities in Alamo and Pacheco. Existing effluent commitments are 3.7 mgd based on 1.1 mgd for in-plant use, 1.2 mgd for irrigation in Zone 1, and 0.5 mgd for serving the Shell Refinery (Central San, 2016). This total also accounts for the temporary agreement Central San and DERWA executed in 2019 to divert approximately 0.7 mgd of Central San's raw wastewater upstream of the San Ramon Pumping Station. Both Central San and DERWA are currently exploring a long-term agreement with the potential to increase the diversion amount to 2.7 mgd. The Concord Naval Weapons Station demand was not included, as the project will also produce additional wastewater supplies.
- **DSRSD and Livermore Waste Reclamation Plants (WRP):** These two plants send treated secondary effluent to the Livermore-Amador Valley Water Management Agency (LAVWMA) pipeline, which connects to the East Bay Dischargers Authority (EBDA) deep water outfall (located in the District's water service area). The DSRSD WWTP treats wastewater from the Cities of Dublin and Pleasanton, and a small, southern portion of San Ramon while the Livermore WRP treats wastewater from the City of Livermore. During the summer irrigation season, very little flow is directed to the LAVWMA pipeline as most of the available effluent is delivered to recycled water customers. Up to 15.9 mgd is available in the winter (December through April), with 10.4 mgd from the DSRSD WWTP and 5.5 mgd from the Livermore WRP (California Integrated Water Quality System Project [CIWQS], 2020).
- **WCW WPCP:** WCW collects and treats wastewater from the City of San Pablo, Tara Hills, Richmond (northern subdivisions), East Richmond Heights, the City of Pinole (designated sectors), El Sobrante, Rollingwood, Bayview and parts of the unincorporated county. Most of the flow from this plant currently goes to the NRWRP and RARE Project to supply the Chevron Richmond Refinery. If flows from the WCW WPCP were to be used for potable reuse, it is assumed that no flow would go to RARE. For this reason, the potable reuse alternatives involving WCW effluent are assumed to be a substitute for RARE in the event that the refinery is no longer operational. The potable reuse assessment is further discussed in Section 4 of this report.

No recycled water commitments were subtracted from the available supply for the Pinole/Hercules, Richmond, or Oro Loma WPCPs, or from Crockett Community Services District Water Treatment Facility.

In addition to the wastewater facilities included in the previously shown Table 2-3, the EBDA disposal system also runs through a portion of the District's service area. However, the EBDA outfall was not considered a viable source of effluent for two key reasons:

- EBDA conveys comingled wastewater from numerous agencies and would therefore require some of the assumed secondary treatment upgrades at multiple WWTPs to accommodate advanced treatment for potable reuse (see Section 2.2.2)
- EBDA conveys the ROC from Zone 7's demineralization plant, which can contain high TDS levels and many potential contaminants that may be harmful to irrigated soils.

2.2.2 Water Quality Considerations

Water quality considerations for both non-potable and potable reuse opportunities are presented in the following subsections. Additional water quality considerations and requirements for potable reuse projects are presented in Section 4 of this report.

2.2.2.1 Non-potable Reuse

For the NPR opportunities assessed as part of this study, two primary end uses were identified: landscape irrigation, and cooling tower makeup water and/or boiler feed water. In the absence of specific customer recycled water quality objectives, it is assumed that recycled water would need to meet the water quality objectives shown in Table 2-4. There are specific objectives for both landscape irrigation and cooling tower makeup. These objectives were established for the EBRWP facility, which assume tertiary treatment and disinfection to meet the California Code of Regulations (CCR), Title 22, regulations for non-potable unrestricted reuse (Brown and Caldwell [BC], 2017). Unless otherwise noted, project costs for additional treatment in this study assume that the water quality objectives can be met without additional treatment for salt removal.

Table 2-4. Non-potable Reuse Water Quality Objectives[a]

Parameter	Irrigation		Light Industrial
	Grasses	Sensitive Species	Cooling Towers, assuming 3.5 COC[b]
Ammonia, mg-N/L	NA	NA	0.6
Chloride, mg/L	<350	100	<71
TDS, mg/L	<1,670	1,000 to 2,000	<430
Sodium Adsorption Ratio	<9	3	NA
Boron, mg/L	2.0 to 4.0	0.5 to 1.0	NA

a. EBRWP Water Quality Improvements Study. Draft Technical Memorandum. October 2017 (BC, 2017).
b. EBRWP. Draft Recycled Water Quality Guidelines Summary for Cooling Towers. July 2016 (EBMUD, 2016).
COC = cycles of concentration mg/L = milligrams per liter
mg-N/L = milligrams nitrogen per liter

Also shown in Table 2-4, the principal recycled water quality constituents of concern for landscape irrigation are total dissolved solids (TDS), chloride, sodium, and boron. The sodium adsorption ratio is also a concern for irrigation. Recycled water quality criteria vary and are dependent on the landscape vegetation type and irrigation method (drip or sprinkler). The projects described in Section 3 assume, unless noted otherwise, that the focus for landscape irrigation is non-salt-sensitive species.

The water quality requirements for cooling tower makeup water vary depending on the tower's age and materials of construction, and the level of pretreatment currently performed on the circulation water. In most cases, the main sources of concern in industrial cooling tower applications are related to fouling, scaling, and corrosion. COCs are also established based on the makeup water quality and treatment. The COCs are equal to the ratio of circulating cooling water concentrations to fresh makeup water concentrations. Since recycled water generally has higher mineral and nutrient levels compared to potable water, fewer COCs are recommended. The District previously established water quality objectives based on 3.5 cycles (EBMUD, 2016) for light industrial/commercial applications. With heavy industrial customers, such as refineries, water quality objectives were established based on discussions with the industrial customer base. Existing industrial/cooling tower customers currently using potable water would likely need additional treatment to reduce ammonia, metals, and salt concentration, similar to the facilities delivering recycled water to the Chevron Richmond Refinery.

2.2.2.2 Potable Reuse

A higher-quality feed water is needed for the advanced treatment required for potable reuse opportunities. Since the wastewater facilities considered in the RWSP update provide mostly secondary treatment without significant levels of nitrification or denitrification, it was assumed that additional treatment in the form of longer solids residence time and partial removal of nitrogen (nitrification/denitrification) would be required. The National Water Research Institute's Expert Panel Preliminary Findings and Recommendations on Draft DPR Criteria (National Weather Research Institute [NWRI], 2022) recommends a stable and high-quality nitrified water (0 to 2 mg/L ammonium residual) prior to introduction into an advanced water purification facility (AWPF). The biological treatment process should have a sufficient mean cell residence time to nitrify in cold weather.

2.2.3 Nutrient Discharges to the Bay

The San Francisco Bay RWQCB issued a tentative order regulating nutrients in discharges from municipal wastewater treatment facilities to San Francisco Bay (Nutrients Watershed Permit (ca.gov)). The San Francisco Nutrients Watershed Permit was adopted unanimously at the July 10, 2024, RWQCB board meeting. Previous permits issued in 2014 and 2019 did not limit nutrient discharges because, at that time, nutrients had not been shown to harm San Francisco Bay. In July and August 2022, however, a significant harmful algae bloom occurred, and thousands of fish died, including sturgeon, leopard sharks, striped bass, and smaller fish. The draft permit proposes significant nutrient controls to protect San Francisco Bay. The draft permit provides 10 years to comply with proposed nutrient control since it is anticipated that necessary improvements will take years to complete.

Starting on October 1, 2034, the tentative order includes an aggregate mass load limit for total inorganic nitrogen (TIN) for all dischargers of 26,700 kilograms per day (kg/d) for average discharges in the dry season (May 1 through September 30). If the aggregate mass loading limit is not met, individual final effluent TIN loading limitations apply for each discharger. Individual plant limitations are based on the concentration that, when the various flows are considered, results in loads summing to the total aggregate average load of 26,700 kg/day, assuming 2022 dry season discharge flows. This concentration is 20.5 mg/L TIN in 2022 dry season flows. The permit also includes interim discharge limits for each WWTP from October 1, 2024, through September 30, 2034. Table 2-5 summarizes past discharges and individual WWTP limitations.

Table 2-5. TIN Discharge Summary

Discharger	11-year Average Dry Season TIN Discharge (kg/d)[a]	11-year Maximum Dry Season TIN Discharge (kg/d)[a]	Interim TIN Limit (kg/d)[b,c]	Final TIN Limit (kg/d) [b,d]
EBMUD Main WWTP (SD-1)	9,170	10,200	11,000	3,300
Central San WWTP[a]	3,630	3,900	4,300	2,300
West County Agency (includes WCW and City of Richmond and Richmond Municipal Sewer District)	774	1,040	1,100	1,100
Pinole-Hercules WPCP	292	369	460	190
EBDA (includes cities of Hayward, San Leandro, and Livermore; Oro Loma Sanitary District [OLSD]; Castro Valley Sanitary District; Union Sanitary District; LAVWMA; DSRSD)	7,400	8,080	9,000	4,200
Aggregate Mass Load	47,200	50,600	NA	26,700

a. *BACWA Nutrient Reduction Study 2023 Group Annual Report, February 1, 2024.*
b. *Tentative Order, San Francisco Bay Nutrients Watershed Permit, April 2024.*
c. *Compliance with interim limitations to be determined seasonally for each discharger based on discharges from May 1 to September 30.*
d. *Starting October 1, 2034, compliance with final limitations shall be determined seasonally based on discharges from May 1 through September 30. If the sum of all the individual dischargers' TIN mass loads is greater than the aggregate mass load limit, the dischargers whose TIN mass loads exceed their individual limitations will be in violation.*

As noted previously, most of the wastewater dischargers shown in Table 2-5 are being considered in this RWSP update as potential sources of effluent currently providing secondary treatment without significant nitrification or denitrification. Strategies to comply with the final TIN limits include:

- Seasonal nitrification and denitrification, with transition to and from operation in non-nitrifying mode during the wet season.
- Year-round nitrification and denitrification, with effluent total nitrogen concentrations around 15 mg/L, similar to what was called "Level 2" treatment in the BACWA Nutrient Reduction Study (BACWA, 2018).
- Treatment of anaerobic digestion dewatering recycles to remove nitrogen.
- Natural systems to remove nitrogen.

Another option to help comply with final TIN limits includes the increase of water reuse to reduce discharge flows and loadings. BACWA recently conducted the "Regional Evaluation of Potential Nutrient Discharge Reduction by Water Recycling" (BACWA, 2023) in which they noted that collective recycled water use by BAWCA member agencies currently diverts just under 10 percent of the annual flow and 5 percent of the annual TIN loads from San Francisco Bay. The report found that recycled water projects already in place or currently budgeted have the potential to divert 4,100 kg/d of TIN from the Bay during the dry season (May 1 to September 30). Including planned and conceptual projects (which include potable reuse projects), dry season TIN diversion could increase to 5,300 kg/d for the 37 agencies included in the BACWA study.

For this RWSP update, NPDES permit requirements were assumed to drive upgrades for nutrient removal; therefore, costs related to nutrient removal are not included in the capital cost estimates for each alternative. "Level 2" nitrogen removal upgrades are assumed for the potable reuse alternatives because it corresponds to a sufficiently long solids residence time (more than 5 days, preferably 7 to 10 days in dry weather), which is known to result in improved effluent quality suitable for advanced treatment and containing fewer trace pollutants (i.e., constituents of emerging concern [CEC]). Lower nitrogen is also a benefit when there is an environmental buffer (groundwater or surface water reservoir). However, it is important to note that the anticipated requirements do not require year-round nitrogen removal upgrades, and some facilities are considering a seasonal nitrification and denitrification strategy to comply with permit requirements. For plants that meet nitrogen limits using a seasonal nitrification and denitrification strategy, additional improvements may be needed to produce high-quality effluent year-round for potable reuse.

2.2.4 Effects of Water Conservation

The District has seen reduced water demands and wastewater flows since the recycled water goals presented in the WSMP 2040 were established. Water conservation can impact proposed recycled water projects in two ways: first by reducing demand projections and second by reducing recycled water supplies. District staff have noted decreased wastewater flows, reduced recycled water demands, increased conservation, and refinery industry change and uncertainty as challenges to the District's current recycled water program (EBMUD, 2024a).

California has been working toward conservation goals that are expected to reduce urban water use by more than 400,000 acre-feet (AF) by 2030, helping California adapt to the water supply impacts brought on by climate change. The State's "Make Conservation a California Way of Life" regulation was adopted July 3, 2024, and is expected to further reduce outdoor water use (impacting some non-potable project demands) and reduce indoor water use (reducing flows to WWTPs).

2.3 Climate Change Considerations

The effects of climate change, characterized by rising sea and groundwater levels, changing weather patterns, droughts, and increased coastal flooding are expected to affect the District's raw water and wastewater assets, which in turn could impact existing and future reuse opportunities. The District has a Climate Change Monitoring and Response Plan (CCMRP) in place to guide planning efforts related to future water supply, water quality, and infrastructure. This plan and other related studies also support water and wastewater infrastructure investment decisions.

2.3.1 Water Supply Considerations

As part of the CCMRP, the District conducted several assessments to identify potential impacts to water supply and demand, water quality and the environment, flood control management, infrastructure, and energy. The assessments concluded that:

- In terms of water supply, decreased runoff and changes in runoff timing could impact carryover storage. Water demand and usage may rise due to a warmer climate, which could lead to more-frequent rationing because of water supply shortages.
- Water quality could decline as warmer air temperatures alter spring runoff timing and increase peak runoff. Managing cold-water pool levels in Camanche and Pardee reservoirs would become more challenging with more-frequent dry years and warming rivers and reservoirs. Any temperature variations in the river could adversely affect fisheries.
- With regards to District water supply infrastructure, rising sea levels could increase storm surge flood events, which would pose challenges for flood control management due to altered runoff timing and elevated peak runoff. Sea level rise could damage infrastructure in the Sacramento-San Joaquin River Delta (Delta) and nearshore areas; one primary concern for the District includes the potential inundation of the Mokelumne Aqueducts from levee failure or overtopping in the Delta. Climate changes could also negatively impact hydropower generation due to altered runoff timing and patterns, and difficulties in managing cold-water pools. High air temperatures could reduce the transmitting capacity of electricity transmission lines, and there is an increased probability of wildfire exposure for some major transmission lines.

The District's water supply vulnerability to climate change was also assessed as part of the Water Supply Management Program 2040 (EBMUD, 2012) in which three major climate change scenarios (increased demand, earlier runoff in the springtime, and decreased annual precipitation) and their potential impacts to storage, customer shortage, flood control release volumes, and rationing were evaluated. The study found that the District's water supply system is most susceptible to reduced annual precipitation due to climate change. Reduced annual precipitation would cause a significant increase in customer shortage (16 to 51 percent), increase in rationing frequencies (4 to 6 percent on average), and a decrease in storage (12 to 24 percent).

2.3.2 Wastewater Considerations

The common location of wastewater infrastructure in low-lying, coastal areas, makes them particularly vulnerable as the climate changes, sea levels rise, and rainfall runoff volumes and intensity increase. As most of the District's facilities are near San Francisco Bay, the District has been proactive in working to understand, mitigate, and adapt to climate-change risks. As part of its Wastewater Climate Change Plan (EBMUD, 2020b), the District conducted a vulnerability assessment. The study revealed that both sea and groundwater levels are projected to increase, and the local climate is likely to experience a range of changes, including rising temperatures, intensified rainfall, shorter rainy seasons, and a possible increase in overall local rainfall. The combination of higher temperatures coinciding with more-infrequent rainfall could result in more-frequent droughts and corresponding water conservation measures. This in turn could lead to a reduction in indoor water use that results in lower flows to the wastewater collection system and the typical associated increase in concentrations of target constituents. This could present issues to existing NPR projects and any future water reuse projects for the region.

Although no significant impacts to the District's wastewater infrastructure within the 30-year planning horizon (i.e., by 2050) are anticipated, the District still intends on adapting various strategies to mitigate any adverse effects over the long term. The District anticipates working with neighboring jurisdictions, regulators, and stakeholders to address sea level rise along San Francisco Bay's shore. Since the District is not responsible for the shoreline features or infrastructure, a joint effort is needed to confirm that a solution for another agency does not have unintended impacts for the District, such as worsened flooding. The District also intends to consider accommodations for sea level rise during the design phase of each new project, including water reuse projects, that focus on the most vulnerable facilities. Actions include elevating critical equipment above projected flood levels, requiring waterproof materials in areas at risk of flooding, and the ability to route flows around compromised system components.

Ultimately, the effects of climate change are happening at a pace that allows the District time to prepare for, monitor, and respond. Continuing regional collaboration efforts and long-term planning work will allow adaptation with cost-effective solutions that will protect District assets and future investments, including the expansion of the District's water reuse program.

Section 3

Non-potable Reuse Opportunities

The District has been recycling water for non-potable uses within its water service area since 1971. The District would like to continue to plan, develop, and implement recycled water projects throughout the water service area to offset potable water demands. This section provides an update to the District's existing NPR projects, identifies new NPR projects, and provides an initial screening and prioritization of projects to further evaluate.

Note there have been no regulatory changes to the Title 22 NPR regulations since the 2019 RWMP. However, Senate Bill (SB) 31, which was introduced to State Legislature for consideration in February 2025, seeks to update the CCR and expand the allowable uses of recycled water throughout the state.

3.1 Revised Customer Base

Table 3-1 summarizes the NPR projects considered in this RWSP update. The table includes projects that were identified and previously evaluated as part of the 2019 RWMP, as well as new opportunities. Recycled water demand updates were coordinated with the District to reflect new or updated conditions. For example, some customers in recent years have implemented water conservation measures or are using stormwater runoff or groundwater for irrigation in lieu of potable water. In cases where potential customers are currently using non-potable water, the recycled water demands were adjusted to reflect actual demands. Refer to each updated project description for additional details in the next section. For projects with no documented updates, refer to the 2019 RWMP for their relevant project descriptions.

Table 3-1. Updated Market Assessment of NPR Projects							
Project	2019 Demand (AFY)	2024 Demand (AFY)	2024 Demand (mgd)	Changed between 2019 and 2024?	Moved Past Screening in 2019?	Recommended Project in 2019?	Notes
NPR opportunities included in 2019 RWMP							
Central San Regional/Refinery Water Exchange Project	22,400	5,600	5.0	Yes	Yes	No	--
Chevron Refinery/Richmond WPCP	4,300	See redefined Chevron/Richmond Refinery Recycled Water Project below		Yes	Yes	Yes	This alternative was redefined as part of the District *East Bayshore Recycled Water Project Expansion: Alternatives Study* and re-evaluated as part of the RWSP update. The evaluation process is included in Appendix B. This alternative was ultimately screened out from further consideration.
Contra Costa Pipeline in Canal Right-of-Way	900	--	--	No	Yes	No	--
SRVRWP Phase 3. Danville East	800	638	0.57	Yes	Yes	Yes	Reduced demands due to conservation measures; no facility changes.
SRVRWP Phase 4. Blackhawk East	300	0	0	Yes	Yes	Yes	Removed Phase 4 from project; associated demands combined with Phase 5.
SRVRWP Phase 5. Blackhawk West	300	540	0.48	Yes	Yes	Yes	Reduced demands due to water efficiency measures; no facility changes.
Diablo Country Club	250	250	0.2	No	Yes	Yes	--
East Bayshore Phase 1A	300	See redefined East Bayshore Recycled Water Project Expansion below		Yes	Yes	Yes	Project was redefined and re-evaluated as part of the District *East Bayshore Recycled Water Project Expansion: Alternatives Study.*
East Bayshore Phase 1B	1,064			Yes	Yes	Yes	
East Bayshore Phase 2	2,867			Yes	Yes	Yes	
Lamorinda/Reliez Valley Recycled Water Project	100	--	--	Yes	No	--	Project was redefined and grouped as part of Lamorinda Recycled Water Project. It was also evaluated as part of the District and Central San *Recycled Water Project Concept Evaluation Report.*
Moraga Area Expansion	250	245	0.21	No	Yes	No	Project was redefined and grouped as part of Lamorinda Recycled Water Project. It was also evaluated as part of the District and Central San

Table 3-1. Updated Market Assessment of NPR Projects							
Project	2019 Demand (AFY)	2024 Demand (AFY)	2024 Demand (mgd)	Changed between 2019 and 2024?	Moved Past Screening in 2019?	Recommended Project in 2019?	Notes
							Recycled Water Project Concept Evaluation Report.
Moraga Country Club	180	174	0.15	No	Yes	No	--
Oakland Hills	350	0	0	Yes	Yes	No	Project was redefined and added as a new project; see Sequoyah Country Club below.
Phillips 66 Refinery/Rodeo Renewed	Up to 4,144	3,136	2.8	Yes	Yes	Yes	Demands reduced due to refinery converting to renewable diesel.
Rossmoor Country Club	90	255	0.23	Yes	No	--	--
SLWRF Expansion Project	0	25 to 50	0.02 to 0.04	Yes	No	--	Rehabilitation of existing distribution facilities.
UCB Global Campus Richmond Project	1,040	0	0	Yes	No	--	UCB is no longer developing its Global Campus.
UCB Main Campus, Berkeley	900	419	0.37	Yes	Yes	No	--
New NPR opportunities for 2024 RWSP							
East Bayshore Recycled Water Project Expansion	--	785	0.70	--	--	--	The proposed expansion was redefined as part of the District *East Bayshore Recycled Water Project Expansion: Alternatives Study.* This new concept was not considered in the 2019 RWMP.
Lamorinda Recycled Water Project	--	862	0.77	--	--	--	New project not considered in 2019 RWMP. It was redefined and evaluated as part of the District and Central San *Recycled Water Project Concept Evaluation Report.*
Chevron/Richmond Refinery Recycled Water Project	--	1,590	1.4	--	--	--	Various alternatives were considered and evaluated. The evaluation process is included in Appendix B. The proposed project was identified as part of the District East Bayshore *Recycled Water Project Expansion: Alternatives Study.* This new concept was not considered in the 2019 RWMP.
Sequoyah Country Club	--	112	0.1	--	--	--	New project not considered in 2019 RWMP.

Based on limited recycled water demands, competing uses for the same wastewater source, and technical feasibility issues as presented in the 2019 RWMP and/or the EBMUD Central San Recycled Water Project Concept Evaluation Report, the following alternatives were screened out as not viable for further consideration:

- Chevron Refinery Process Water or WWTP Effluent
- Moraga Area Expansion
- Reliez Valley Recycled Water Project
- UCB's Global Campus Richmond Project
- Central San Regional/Refinery Water Exchange Project
- Lamorinda Recycled Water Project
- Contra Costa Pipeline in Canal Right-of-Way

Although previous studies screened the following satellite projects as not viable for further consideration, the District is still supportive of self-financed satellite projects within its service area, and the following are further documented in this RWSP update:

- Rossmoor Country Club Satellite Recycled Water Project
- Moraga Country Club
- Oakland Hills
- UCB, Main Campus

In addition, project updates for the SLWRF Expansion Project are documented and further evaluated in this update.

3.2 Assessment and Update of New and Previously Identified Non-potable Reuse Opportunities

This section summarizes the updates to the NPR opportunities evaluated in the 2019 RWMP as well as the new opportunities identified since the 2019 RWMP update. Project descriptions include annual average demands, project facilities (new or updates), and project costs.

Appendix A includes the methods for reviewing and updating costs for opportunities developed as part of previous work, as well as methods for developing costs for new opportunities for both capital and operations and maintenance (O&M) costs. Whenever possible, the raw construction costs were extracted and updated to March 2024 dollars using Engineering News-Record's 20-city average construction cost index ratios. The soft costs and allowances defined in Appendix A were then applied to the raw construction costs to estimate capital costs. Note that outside funding was not considered; therefore, costs presented may not reflect actual costs to the District.

The following sections include new or updated project descriptions for the following projects:

- SRVRWP
- EBRWP Expansion
- SLWRF Expansion Project
- Chevron/Richmond Refinery Recycled Water Project
- Phillips 66/Rodeo Renewed Energy Complex (RREC) Recycled Water
- Satellite Water Recycling Facility Projects
- UCB Main Campus, Berkeley

These projects are shown in Figure 3-1 below.

Figure 3-1. Non-potable Reuse Opportunities – Regional Overview Map

3.2.1 San Ramon Valley Recycled Water Program

DSRSD and the District developed the SRVRWP in 1995 through a joint powers authority referred to as DERWA. DERWA was established to supply recycled water through the operation of a water recycling treatment facility at the DSRSD WWTP and a distribution system (e.g., storage, pump stations, and pipelines). The planned build-out capacity of the SRVRWP was 5.7 mgd of recycled water for distribution to DSRSD and the District's service areas for landscape irrigation. Facility operation started in February 2006 and currently supplies recycled water to DSRSD and District customers in parts of Dublin, the Dougherty Valley, and San Ramon. In 2014, the City of Pleasanton entered into agreements with DERWA to provide recycled water to customers within the City of Pleasanton's service area. DERWA completed expansion of its recycled water treatment plant (WTP) to increase treatment capacity from 9.7 mgd to 16.2 mgd to meet future recycled water demands in 2019.

The project has historically been planned, designed, and constructed in a series of numbered phases; Phase 1 is complete, and Phase 2 is nearing completion pending final connection of the Crow Canyon Country Club. Table 3-2 summarizes the existing and projected demands of each phase, and Figure 3-2 shows the phased pipeline alignments. Due to effective water system conservation measures and irrigation efficiency projects implemented since the 2019 RWMP, the recycled water demands for the remaining Phases 3 and 5 have decreased from 1.25 mgd to 1.05 mgd (1,400 AFY to 1,178 AFY). In sum, Phases 1 through 5 will serve an annual average of 2.47 mgd (2,765 AFY) of recycled water to District irrigation customers in parts of Blackhawk, Danville, and San Ramon.

Table 3-2. SRVRWP Project Status

Phase	Description	Average Annual Demand (AFY)	Average Annual Demand (mgd)	Maximum Day Demand (mgd)	Anticipated Connection Year
1 and 2 (Complete)	Phase 1 includes the area northward from the DSRSD treatment plant, along the Iron Horse Trail south of Bollinger Canyon Road, servicing 32 sites. Phase 2 includes the area north of Bollinger Canyon Road eastward to Dougherty Valley Road and north to Crow Canyon Boulevard, serving 42 sites including Bridges Golf Course, Canyon Lakes Golf Course and the Bishop Ranch business park. Service in Crow Canyon Golf Course is expected to be connected in the future.	1,233	1.1	2.75	2022
2 (New Development)	New development within the Phase 2 area, expected by 2025; recycled water infrastructure is already in place, making these customers ready to connect.	18	0.02	0.04	2025
3	Includes many small customers; these phases require constructing new infrastructure	638	0.57	1.41	2030
5	Phase 5 includes the portions of the Blackhawk community and golf course. This phase requires DERWA supplemental supply.	540	0.48	1.21	2035
Additional Infill	Additional future infill anticipated	336	0.3	0.77	2035
Total		2,765	2.47	6.18	-

Source: Based on discussions with District staff and the Recycled Water Supply Management Plan DERWA, Table A-4 (BC, 2024)

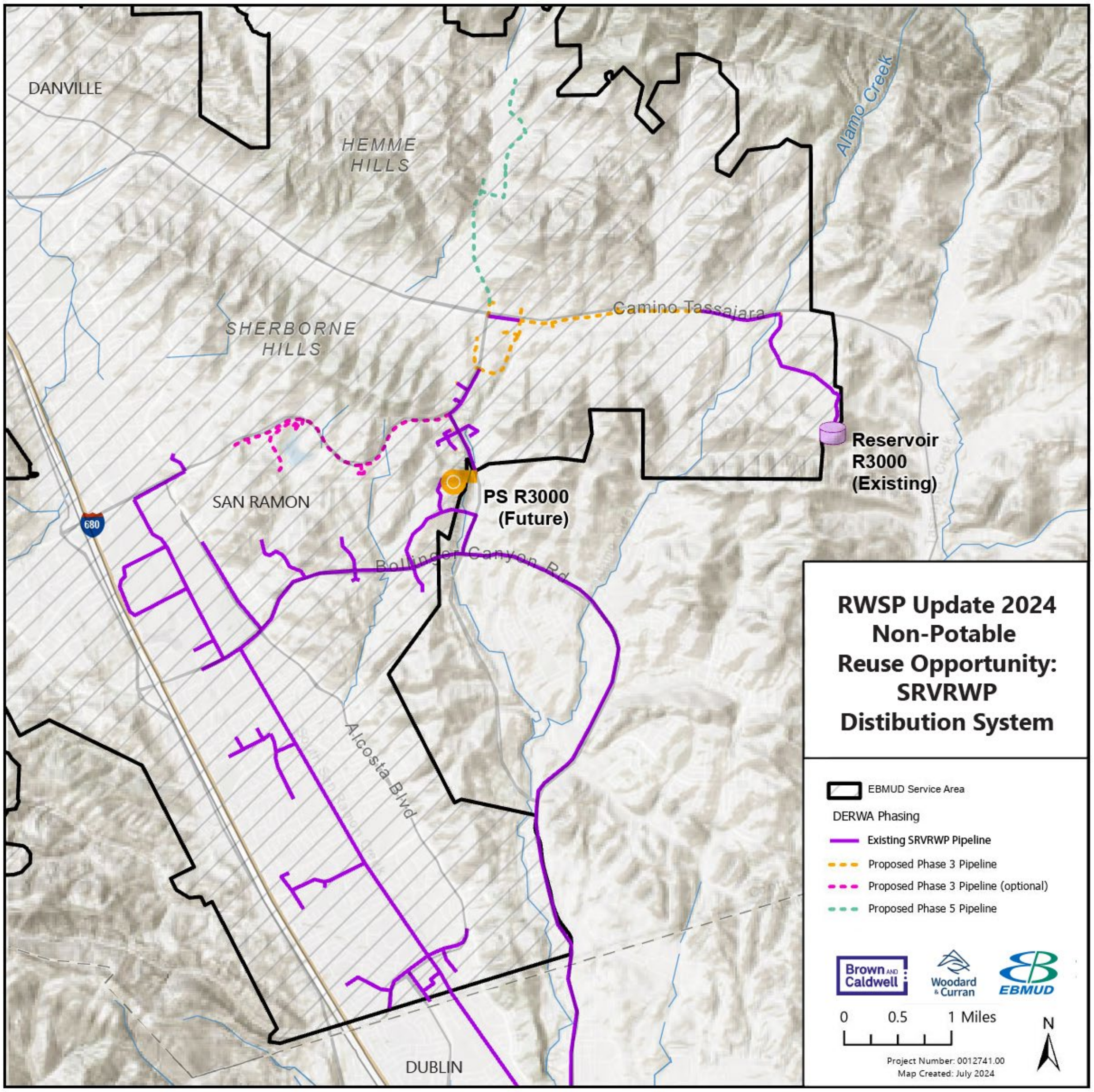


Figure 3-2. SRVRWP Distribution System

DERWA experiences peak month supply shortfalls during the summer seasons that require supplementation with potable water. The DERWA Board approved a connection moratorium in 2020. The connection moratorium requires that no new connections beyond approved Phase 2 customers be allowed until new supplemental supplies are secured.

In 2019, DERWA approved a temporary supplemental supply agreement with Central San, the wastewater agency to the north of DSRSD, to divert approximately 0.7 mgd of wastewater from Central San's collection system to DSRSD's collection system. This temporary diversion project was completed in late 2020 and operated during summer 2021 to help meet peak summer day demands. DERWA remains interested in exploring the potential for a long-term arrangement with Central San. In 2022, the District entered into a Memorandum of Understanding (MOU) with Central San to prepare a feasibility evaluation of recycled water partnership opportunities, including the potential for potable reuse and long-term diversion of a portion of Central San's wastewater upstream of the San Ramon Pumping Station to DERWA. In 2024, DERWA completed a Recycled Water Supply Management Plan that evaluated supplemental supply alternative and demand management strategies that would allow the connection moratorium to be lifted and the partner agencies, including the District, to expand its recycled water system. The evaluation found that a combination of demand management, wastewater from neighboring agencies (Central San or City of Livermore) were feasible options for mitigating the supply shortage. DERWA is proceeding with negotiating a long-term agreement with Central San. Plans for secure supplemental supplies are anticipated to be in place by 2026.

Table 3-3 summarizes the District's share of capital and O&M costs associated with this multi-phase project. These are the costs to operate the defined project phase and do not include the costs to operate the existing system.

Table 3-3. District's Share of SRVRWP Project Costs

Phase	Capital Cost ($ millions)	O&M ($ million/yr)	Annual Demand (AFY)	Annual Demand (mgd)	Annualized Total Cost ($/AF)
Phase 3					
Treatment/Supplemental Supply	-	$0.63	-	-	$1,000
Distribution (3 miles of pipe and a pump station)	$32.3	$0.10	-	-	$2,700
Total	$32.3	$0.73	638	0.57	$3,700
Phase 5					
Treatment/Supplemental Supply	-	$0.54	-	-	$1,000
Distribution (2.8 miles of pipe)	$26.6	$0.08	-	-	$2,700
Total	$26.6	$0.62	540	0.48	$3,700

3.2.2 East Bayshore Recycled Water Project Expansion

The EBRWP, located at SD-1, is a phased-project that started operation in 2008. The EBRWP recycled water treatment facility (RWTF) includes a 2.5-mgd max day microfiltration (MF) WTP, 1.5-million-gallon storage tank, and 3.6-mgd distribution pumping plant located on the north side of SD-1 in Oakland. Approximately 8.4 miles of existing recycled water pipelines currently distribute water to 52 landscape irrigation customers in Oakland and Emeryville with an existing demand of 0.18 mgd. The EBRWP uses MF and chlorine disinfection to produce recycled water that meets Title 22 requirements for use as landscape irrigation and industrial and commercial applications; however, due to its high salinity and ammonia concentrations, the recycled water is not suitable for industrial applications and is used only for landscape irrigation.

The District began the EBRWP Water Quality Improvements Pilot Study (Pilot Study) in 2020 to identify alternatives to improve EBRWP recycled water quality to provide more opportunities to use recycled water for industrial and commercial purposes. Preliminary results of the Pilot Study indicate that improvements could be achieved by treating EBRWP effluent with reverse osmosis (RO) and breakpoint chlorination. The proposed treatment upgrades would be located at the existing RWTF site. Figure 3-3 shows the treatment process train for these improvements.

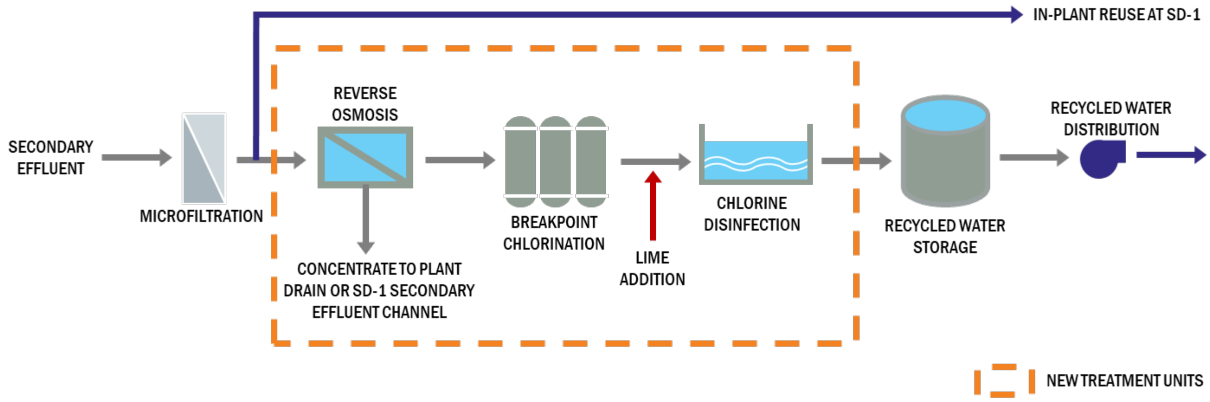


Figure 3-3. EBRWP RWTF with Proposed RO and Breakpoint Chlorination

Source: EBMUD Water Supply Improvements Division

Future proposed expansion areas of the EBRWP are grouped into phases that correspond to geographical locations. Table 3-4 provides a description and expected future average annual demand (AAD) for each demand area shown on Figure 3-4. Existing East Bayshore customers are included in Phase 1A and have a current AAD of 0.18 mgd.

Table 3-4. Proposed EBRWP Phases and Demands

Phase	Description	Total AAD (mgd)
Phase 1A	Existing and future customers in Oakland, Emeryville; no new pipelines needed	0.22
Phase 1B	Expansion to Berkeley and Albany	0.23
Phase 2	Expansion to Alameda, new customers in Oakland and Emeryville requiring new pipelines	0.46
UCB	Expansion to UC Berkeley and Channing Way customers	0.38
Total		1.5

Source: EBMUD Water Supply Improvements Division

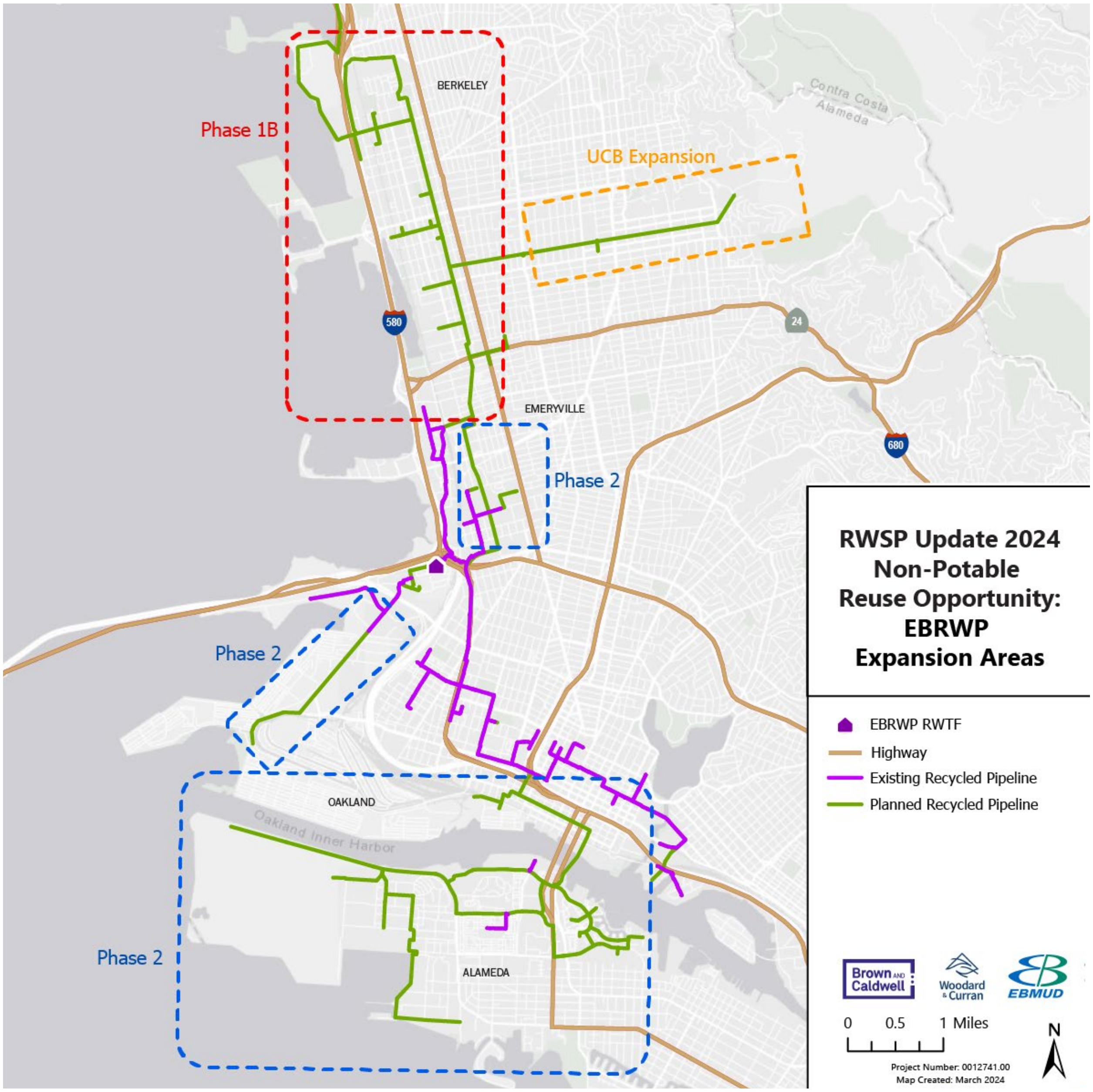


Figure 3-4. EBRWP Expansion Areas

The District completed the EBRWP Expansion Alternatives Study in April 2024. The alternative analysis reviewed options to expand the EBRWP to supply an average annual demand of 2.6 mgd of recycled water to help meet the District's overall recycled water goal of 20-mgd. The study supports the Pilot Study and includes a hydraulic analysis and review of infrastructure required to implement the Pilot Study recommendations. Alternatives included options that did and did not require capacity increases to the RWTF. The alternatives considered various expansion options to the cities of Alameda, Oakland, Emeryville, Berkeley, Albany, and Richmond, and the UCB campus. The study also evaluated alternative source water opportunities from the North Interceptor and the potential for supplementing recycled water to the Chevron Refinery in Richmond.

As a result of the alternative evaluation, the preferred EBRWP Expansion includes serving the irrigation customers included in Phase 1A and Phase 2, which would convey recycled water to portions of Oakland, Emeryville, and Alameda. The project would not include Phase 1B to Berkeley and Albany or an extension to the UCB campus. The EBRWP Expansion would require approximately 8.3 miles of new recycled water pipeline, ranging in size from 6 to 16 inches.

The project could be implemented in a phased approach in which southward expansion to Alameda and Oakland and eastward into Emeryville would be prioritized due to their larger recycled water demands. Further expansion northward from Emeryville to Albany could be implemented in the future but would require additional treatment to improve water quality and pumping capacity at the RWTF. Treatment improvements include the addition of RO and breakpoint chlorination as recommended by the preliminary results of the Pilot Study.

Results of the Pilot Study indicate that the required treatment costs to reduce ammonia and TDS are not feasible at this time. Corrosion control measures are recommended to be in place to prevent damage to the distribution system. Point-of-use water quality improvements would be recommended at the customer site if necessary. Table 3-5 summarizes the costs associated with the proposed EBRWP Expansion Project and do not include treatment upgrade costs.

Table 3-5. East Bayshore Recycled Water Project Expansion Costs

East Bayshore Expansion Project	Capital Cost ($ million)	O&M ($ million/yr)	Annual Demand (AFY)	Annual Demand (mgd)	Annualized Total Cost[a] ($/AF)
Treatment Upgrades	-	-	-	-	-
Distribution	$54.9	$0.53	-	-	$4,200
Total	$54.9	$0.53	785	0.7	$4,200

a. *The District has approximately $25 million in federal funding they plan to use to help implement this project. This funding is anticipated to reduce annualized total costs to approximately $3,500 per AF.*

3.2.3 San Leandro Water Reclamation Facility Expansion Project

Since 1988, the SLWRF has been providing secondary-treated and disinfected recycled water produced by the City of San Leandro's WPCP to customers for irrigation purposes. The District constructed facilities to convey recycled water to the Chuck Corica Golf Complex (GC) and roadway medians along Harbor Bay Parkway in Alameda and to the Metropolitan Golf Links in Oakland. The Monarch Bay Golf Club in San Leandro is also a recycled water customer, but it is supplied directly by the City of San Leandro. The SLWRF has the capacity to supply up to 0.4 mgd of recycled water to customers; however, the recycled water facility has not been in operation in recent years due to low recycled water demands along the existing recycled distribution system.

Recently, the Chuck Corica GC met with the District to express its interest in diversifying its water supply portfolio for sustainability by supplementing its stormwater and groundwater supplies by using recycled water for irrigation. The Chuck Corica GC estimates its potential recycled water demand to be between 25 and 50 AFY. The District coordinated with the cities of Alameda and San Leandro and the Port of Oakland to determine additional suitable demands; however, anticipated demands were low or would require additional treatment.

The proposed SLWRF Expansion Project was considered but ultimately not recommended to move forward for implementation in the 2019 RWMP. However, because of the renewed interest in the SLWRF recycled water supply, it is being reevaluated as part of the RWSP update. The proposed SLWRF Expansion Project includes rehabilitating the existing San Leandro recycled water pump station and lining the existing 3 miles of distribution pipelines. The anticipated costs for the project are summarized in Table 3-6. The existing SLWRF and distribution facilities are shown on Figure 3-5.

Table 3-6. SLWRF Expansion Project Costs

Component	Capital Cost ($ millions)	O&M ($ millions/yr)	Annual Demand (AFY)	Annual Demand (mgd)	Annualized Total Cost ($/AF)
Treatment	-	-	-	-	-
Distribution (Rehabilitation of 3 miles of pipes, and pump upgrades)	$13.3	$0.23	-	-	$18,000 to 36,100
Total	$13.3	$0.23	25-50	0.02 to 0.04	$18,000 to 36,100

Figure 3-5. SLWRF Expansion Project

3.2.4 Chevron/Richmond Refinery Recycled Water Project

Since 1996, the District has delivered recycled water to the Chevron Richmond Refinery. The District currently operates two treatment plants: the RARE Project and NRWRP, both supplied primarily by secondary-treated effluent produced by the WCW WPCP. The RARE Project supplies high-purity recycled water for the high-pressure boilers. The NRWRP supplies tertiary recycled water for the refinery's cooling towers. Operational changes at Chevron have impacted the refinery's future use of recycled water.

Chevron recently received a new Bay Area Air Quality Management District permit that reduced the TDS and conductivity limit for one of its largest new cooling towers. The new air quality permit has subsequently reduced recycled water use from NRWRP and increased potable water consumption for the last year (2023). This reduction of recycled water use from NRWRP is expected to be long term due to the water quality of NRWRP's effluent. In addition, legislative actions such as California Governor Newsom's Executive Order N-79-20 (zero emission passenger cars/light trucks by 2030) may have impacts to the refinery industry, its operations, and water demands. This report assumes that cooling tower demand from NRWRP will be limited to 4.0 mgd.

The RARE Project has a capacity of 3.5 mgd, but the facility can be expanded to 4.0 mgd by installing additional MF modules. Additional wastewater supply would be required to produce 4.0 mgd. Chevron plans to provide an additional 0.5 mgd of supply to RARE from on-site refinery effluent. It is assumed this project would be completed by 2030 y Chevron at no cost to the District.

The District is interested in exploring expanded uses of recycled water at the refinery; however, additional water supply would be needed. Given the limitations of WCW's effluent supply, the District has identified three potential sources of additional supply to RARE:

- The District's EBRWP RWTF
- Wastewater diversion at the District's North Interceptor at Point Isabel Wet Weather Facility (Pt. Isabel)
- The City of Richmond's WPCP treated effluent

The District has identified seven potential alternative approaches for the RARE Expansion Project comprised of different combinations of each supply source. The alternative evaluation to determine the preferred Chevron/ Richmond Refinery Recycled Water Project alternative is provided in Appendix B.

As a result of the alternative evaluation, the Partial RARE Expansion via the North Interceptor Diversion at Pt. Isabel is the recommended Chevron/Richmond Refinery Recycled Water Project. The recommended project includes diverting the raw waste stream from the North Interceptor wet well at the District's Pt. Isabel Wet Weather Facility and conveying the raw waste stream to WCW WPCP for treatment prior to supplying RARE. As shown on Figure 3-6, the additional supply from the North Interceptor would require a treatment expansion at RARE from 3.5 mgd to 4.2 mgd.

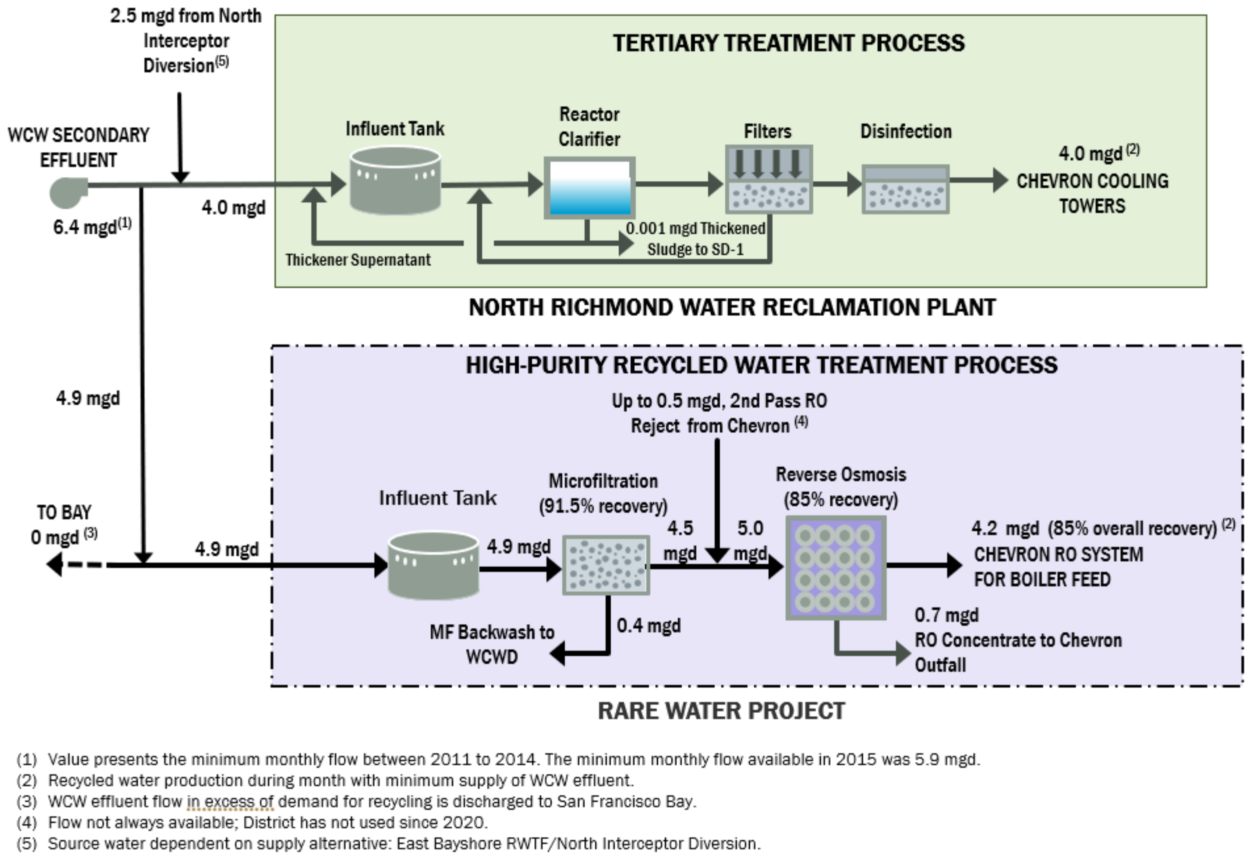


Figure 3-6. Chevron/Richmond Refinery Water Balance for Proposed Project

(RARE Expansion Project via diversion at Pt. Isabel to WCW WPCP)

Table 3-7 summarizes the current operational flows to RARE and the NRWRP, the proposed flows for the proposed project, the proposed flows once the Chevron refinery effluent is available to the District in 2030, and the expected yield from NRWRP to the cooling towers.

Table 3-7. Flow Summary for Chevron/Richmond Refinery Recycled Water Project

Alternative	RARE Treatment Capacity (mgd)	Average Influent Flow to RARE (mgd)	Average Yield from RARE (mgd)	Average Yield from RARE (AFY)	Yield Increase from Current RARE Operations (mgd)	Yield Increase from Current RARE Operations (AFY)	Average Yield from NRWRP (mgd)	Average Yield from NRWRP (AFY)
Current Operations (3-year average)	3.5	3.0	2.75	3,080	--	--	2.0	2,242
Current Operations (3-year average) with Chevron Effluent	3.5	3.5	3.15	3,528	0.5	560	2.0	2,242
Proposed Project	4.2	4.9	4.17	4,670	1.42	1,590	4.0	4,480

The existing pump station at Pt. Isabel could be re-configured to transmit the raw wastewater from Pt. Isabel to the WCW WPCP. A total of 8.3 miles of new 16-inch pipe from Pt. Isabel to WCW WPCP is required to convey the additional supply as part of the proposed project, as shown on Figure 3-7. Additional storage and pumping would be required at Pt. Isabel as part of this Chevron/Richmond Refinery project.

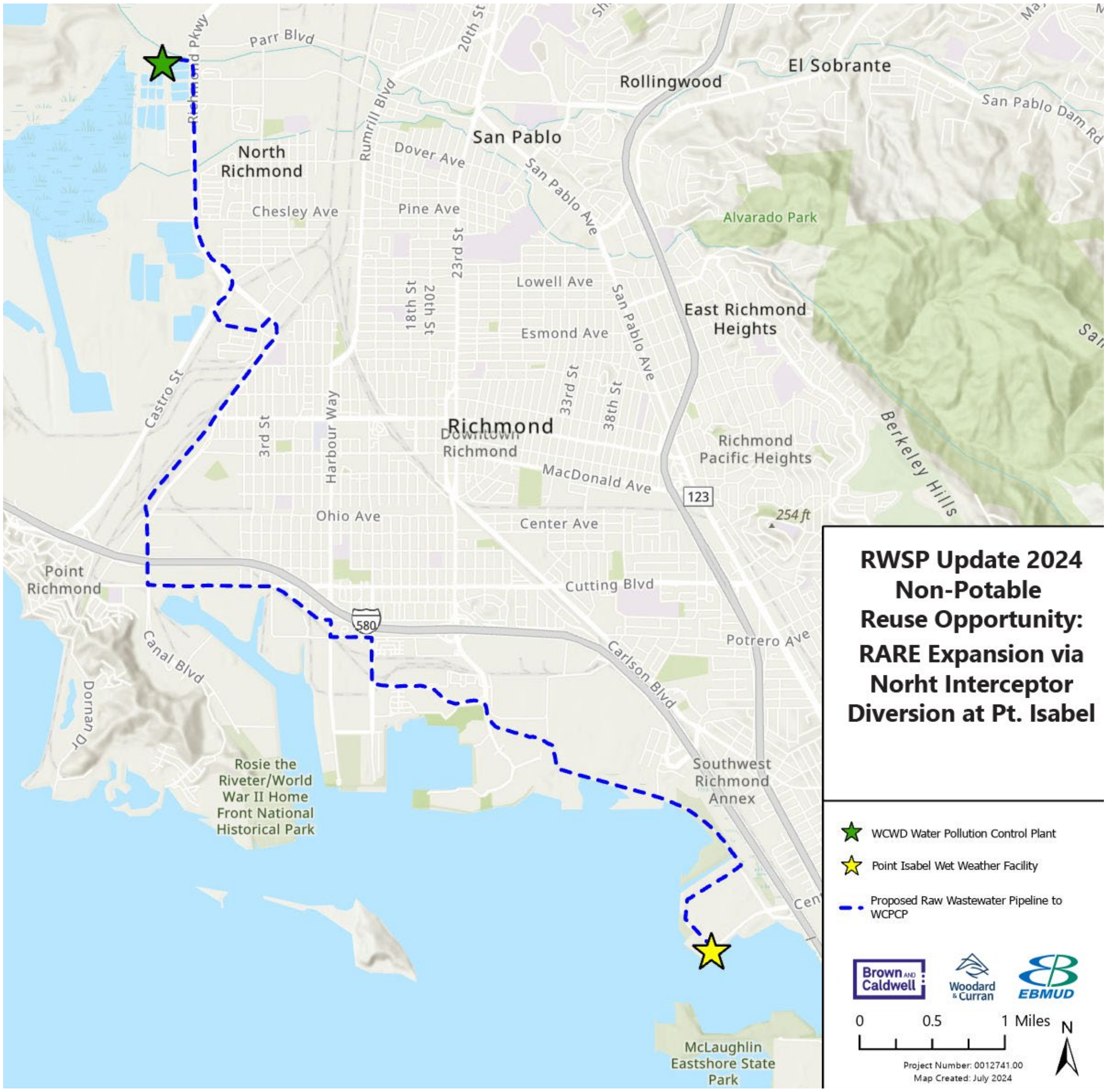


Figure 3-7. RARE Expansion Project via Diversion at Pt. Isabel to WCW WPCP

Table 3-8 summarizes the costs associated with the proposed Chevron/Richmond Refinery Recycled Water Project.

Table 3-8. Chevron/ Richmond Refinery Recycled Water Project Cost Summary					
Project	Capital Cost ($ million)	O&M ($ million/yr)	Annual Demand (AFY)	Annual Demand (mgd)	Annualized Total Cost ($/AF)
Treatment[a]	$2.20	$0.63	-	-	$500
Distribution	$88.8	$1.10	-	-	$3,500
Total	$91.0	$1.73	1,590	1.42	$4,000

a. Treatment cost does not include cost of treating additional flows at WCW WPCP.

3.2.5 Phillips 66/Rodeo Renewed Energy Complex Recycled Water Project

In 2005, the District and Phillips 66 executed an MOU to evaluate the feasibility of providing recycled water to its refinery in Rodeo. A 2007 feasibility study identified alternatives and costs for the treatment and use of recycled water at the refinery (BC, 2007). Final effluent from the Pinole-Hercules WPCP and the Rodeo Sanitary District WWTP would be conveyed to a pump station located at the Rodeo WWTP and pumped to a new advanced recycled water treatment facility located at the Phillips 66 facility, as shown on Figure 3-8.

Figure 3-8. RREC Recycled Water Project

The Phillips 66 Refinery transitioned from refining crude oil to producing renewable fuels at the end of 2024. The RREC has an anticipated recycled water demand for boiler feed and cooling tower uses of approximately 2.8 mgd. Phillips 66 plans to refine and optimize initial operations of the RREC in 2025. Phillips 66 plans to complete a water balance and feasibility study to evaluate the potential for on-site reuse within its facility (i.e., recycling condensate, process water, and/or wastewater). It is estimated that approximately 1.4 mgd of condensate, process, or wastewater may be available for on-site reuse.

The RREC Recycled Water Project assumes an ultimate recycled water demand of up to 2.8 mgd. The combined 10-year average supply of treated effluent from the Pinole-Hercules WPCP and the Rodeo WWTP is approximately 3.1 mgd (BACWA, 2023) and is assumed to be sufficient for the new recycled water demands. Secondary effluent would be conveyed from the Pinole Hercules WPCP and the Rodeo WWTP to a new Rodeo pump station and through a new pipeline that would deliver the secondary effluent to the refinery fence line. The pump station and pipeline would be sized for an ultimate capacity of 2.8 mgd. Phase 1 includes up to 1.4 mgd of recycled water produced onsite from the refinery effluent. It is assumed that this portion of the project would be fully funded by Phillips 66.

Phase 2 would produce up to 2.8 mgd of recycled water for boiler feed and/or cooling tower make-up water from a new treatment facility sourced from Pinole Hercules WPCP and the Rodeo WWTP secondary effluent. The proportion of boiler feed and/or cooling tower make-up water is unknown at this time, but it is assumed to be approximately 40 percent boiler feed and 60 percent cooling tower make-up. An existing tank will be used for effluent equalization prior to treatment. The treatment process for the high purity recycled water project would consist of MF, RO, and ultraviolet (UV) disinfection. A portion of the MF filtrate would be treated via RO, and another portion would be conveyed to a biological active filtration (BAF) unit to remove ammonia to meet water quality requirement for cooling towers. Effluent from the BAF unit would be disinfected with an inline UV system to meet Title 22 requirements.

Table 3-9 summarizes the costs associated with the RREC Project.

Table 3-9. Rodeo Renewed Energy Complex Project Costs

Alternative	Capital Cost ($ million)	O&M ($ million/yr)	Annual Demand (AFY)	Annual Demand (mgd)	Annualized Total Cost ($/AF)
Treatment (MF/RO/BAF/UV)	$27.4	$2.43	-	-	$1,300
Distribution (0.7 miles of pipelines, pump station)	$8.16	$0.26	-	-	$200
Total	$40.6	$2.69	3,136	2.8	$1,500

3.2.6 Satellite Water Recycling Facility Projects

Satellite water recycling facilities (SWRF) divert raw wastewater from a nearby sewer pipeline and treat it locally or on site to meet Title 22 standards required for a specific project. SWRFs can serve large water users that are located far from a centralized wastewater treatment facility. As part of the 2019 RWMP and the EBMUD and Central San Recycled Water Project Concept Evaluation Report, the District identified several potential SWRF projects that could provide recycled water to irrigate golf courses at Rossmoor, Moraga Country Club, Diablo Country Club, and Sequoyah Country Club within the overlapping District and Central San service area, as shown on Figure 3-9. These large irrigation customers are subject to the District's tiered demand reduction system for drought conditions; therefore, cutbacks to their irrigation supplies may impact the golf courses' sustainability and operations. Installing satellite facilities could help customers mitigate those effects. These facilities would operate independently, such that one or all four could be implemented if desired by the individual customers. Evaluation of a SRWF at UC Berkeley is included in a separate analysis in Section 3.2.7.

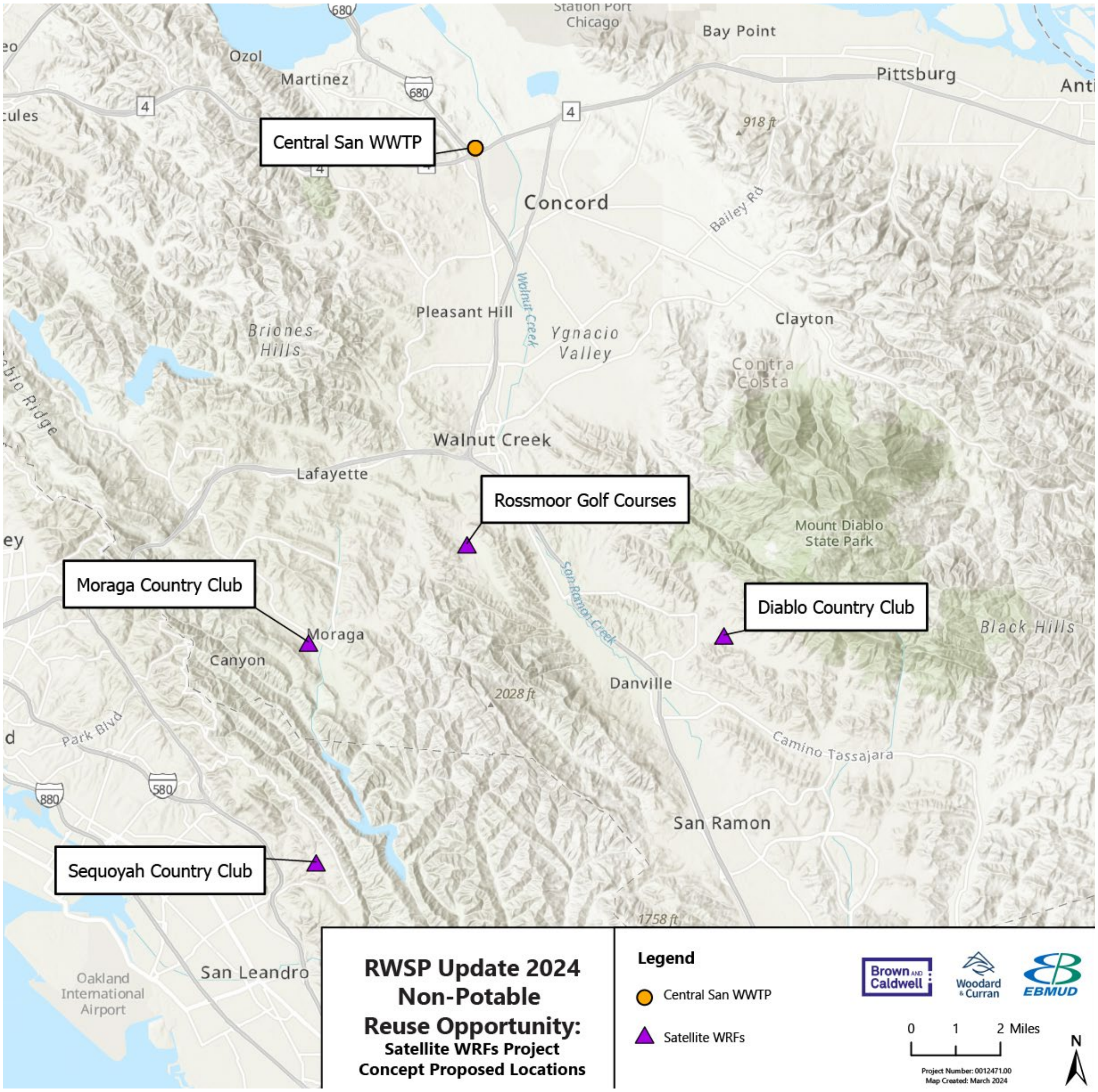


Figure 3-9. SWRF Project Concept Proposed Locations

Estimated recycled water irrigation demands are summarized in Table 3-10 for the four golf course customers. The estimated total demand is 791 AFY.

Table 3-10. Estimated Golf Course Irrigation Demands

Potential Recycled Water Customers	Annual Demand (AF)	Average Day Demand (mgd)
Rossmoor Golf Courses	255	0.23
Moraga Country Club	174	0.16
Diablo Country Club	250	0.22
Sequoyah Country Club[a]	112	0.10
Total	791	0.71

a. Sequoyah Country Club was originally included within the Oakland Hills Project in the 2019 RWMP.

Source water for the Sequoyah Country Club would be diverted from a low point in the existing local sewers (i.e., Mountain Boulevard in Oakland) and conveyed to the new SWRF. For all the other SWRFs, source water would be intercepted from a nearby location within the Central San sewer collection system and conveyed to the SWRF located at each customer site for recycling. The proposed treatment processes for the new SWRFs would include membrane bioreactors (MBR) followed by UV disinfection to produce tertiary disinfected recycled water suitable for golf course irrigation. Fine screening would be implemented upstream of the MBR to prevent filter clogging. The process waste from each SWRF would be discharged back to the sewer, while the recycled water would be stored either in existing golf course ponds or new recycled water storage tanks.

The SWRFs were assumed to operate 24 hours per day and were sized to meet the maximum day demand (average day demand times two). It was assumed that potable water could be used as an emergency backup supply such that a fully redundant treatment train was not included for the facilities. Equalization for influent wastewater flows was not included but would need to be verified as projects are further developed.

Table 3-11 summarizes the anticipated demand and SWRF sizing. Figure 3-10 shows a conceptual diagram of the proposed SWRF treatment train.

Table 3-11. Planning Criteria for SWRF Project Concept

Component	Units	Moraga Country Club	Rossmoor Golf Course	Diablo Country Club	Sequoyah Country Club
Satellite Treatment Facility	mgd	0.4	0.5	0.4	0.1
Sewer Diversion Pump	mgd	0.4	0.5	0.4	0.1
Sewer Force Main	LF	4,500	4,450	5,700	2,680
Waste Disposal Pipe	LF	100	4,450	1,200	2,680
Waste Disposal Pump	mgd	0.4	0.5	0.4	0.1
Recycled Water Pipe	LF	500	550	2,100	2,225

LF = linear feet

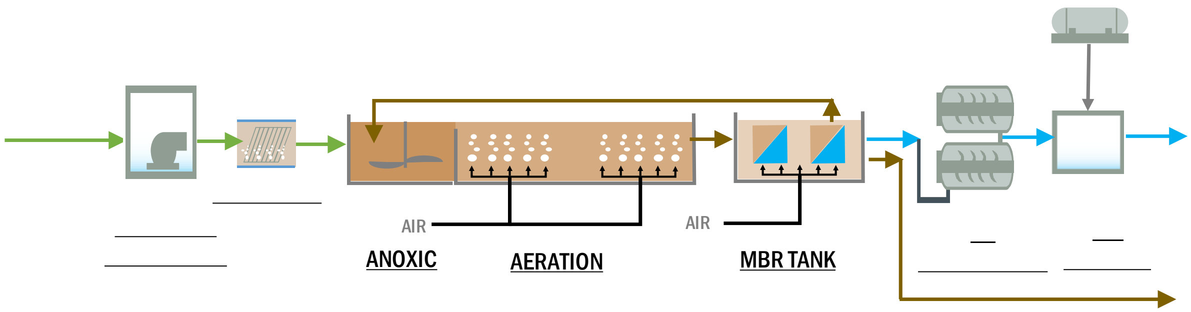


Figure 3-10. Conceptual Satellite Treatment Train Schematic

Note: Raw wastewater would be diverted from sanitary sewer system. Excess sludge would be discharged to the sewer downstream of influent diversion point.

Over the last decade, the various country clubs and golf courses have all initiated planning and feasibility efforts to look at alternative water supplies such as SWRFs to meet their irrigation demands. However, no project has moved forward into the design phase. At this time, the District remains supportive of customer-led efforts to develop, self-finance, permit, and operate these satellite facilities, but capital costs for these self-financed projects within the District service area were not developed for the RWSP.

3.2.7 UCB Main Campus

In 2005, the District completed a study to determine the feasibility of constructing a satellite demonstration project at two alternative service area locations within UCB (EBMUD, 2005). Based on the study results, a small-scale demonstration recycled water facility was recommended to be installed at the Berkeley campus. The intent was to help determine if a larger-scale project would be feasible in the future. Due to issues related to siting and unexpected construction costs, the District and UCB jointly decided in 2006 to stop pursuing the small-scale demonstration project.

UCB published its Resilient Water Plan in 2023, which was developed to provide a comprehensive approach to water sustainability and resilience. The plan includes long-term sustainability goals and actions taken to date to reduce on-site campus water use. Key goals of the plan include:

- Lowering potable water use through comprehensive conservation and efficiency measures for buildings, mechanical systems, and campus grounds.
- Evaluating water reclamation and reuse facilities to reduce potable water use through increased use of non-potable water for campus cooling systems, landscape irrigation, and toilet flushing.

UCB actions taken to date to reduce water demands include:

- Installing a co-generation plant dry low-emission turbine project in spring 2021 estimated to save 25 million gallons of water each year.
- Implementing smart irrigation throughout 90 percent of Campus Park, which improves the ability to monitor leaks.
- Reducing the amount of irrigated lawn on campus, which included converting 3.5 acres of turf to drought-tolerant plantings in 2019.

The non-potable demands identified in the UCB Resilient Water Plan include both existing systems and future campus demands. Primary non-potable demands include irrigation, toilet flushing in dual-plumbed buildings, and cooling towers. Figure 3-11 summarizes the updated non-potable demands for the UCB Campus Park, estimated at 0.57 mgd by 2036. Because both the irrigation and cooling tower demands peak in summer months, the demand for non-potable water exceeds the available wastewater supply on campus throughout most of the summer and fall. Using only the available campus wastewater supply, the projected annual reuse supply would be 0.37 mgd (414 AFY), or 68 percent of the total annual non-potable demand.

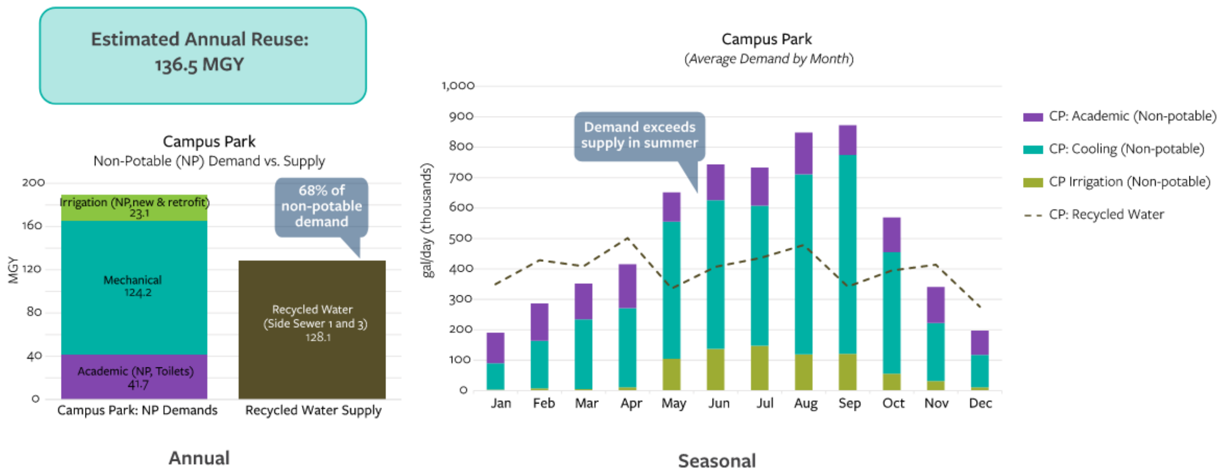


Figure 3-11. UCB Campus Park Water Recycling Facility Project Water Balance

Source: Adapted from 2023 UCB Resilient Water Plan

Figure 3-12 shows the non-potable demand locations throughout the UCB Campus Park and the proposed non-potable water distribution system that would be required. The District evaluated the potential to service UCB with recycled water from the EBRWP as part of the East Bayshore Recycled Water Project Expansion: Alternatives Study. It was found that the additional treatment capacity and distribution infrastructure required, including a new pump station, storage tank and approximately 2 miles of pipeline, made the project infeasible. It was recommended that UCB continue plans to move forward with the proposed project to divert raw wastewater from the existing local sewers to the new SWRF located at UCB.

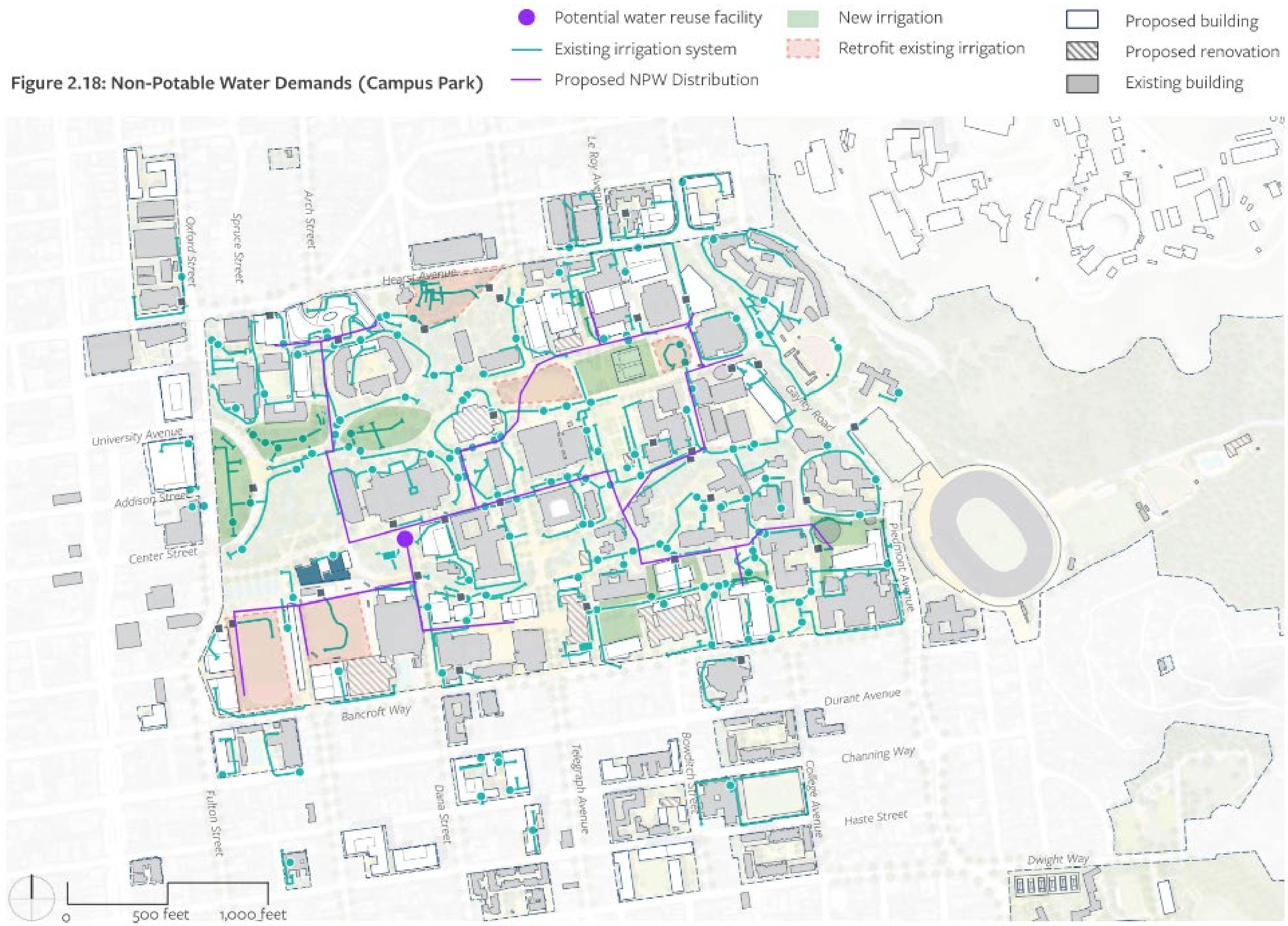


Figure 3-12. UCB Campus Park Project

Source: 2023 UCB Resilient Water Plan

Agreements between the District and UCB would need to be developed. Similar to the other satellite water recycling facility projects, the District would be interested in having UCB self-finance construction of the SWRF in lieu of paying the standard water rate. O&M responsibilities for the treatment and sewer line diversion facilities would need to be discussed.

3.3 Summary of Non-potable Reuse Opportunities

This section summarizes the District's NPR opportunities. This includes both District-led opportunities and those being developed/assessed by other entities.

3.3.1 Summary of District-led Non-potable Reuse Opportunities

Table 3-12 summarizes the updated non-potable market assessment for EBMUD-led opportunities still in consideration.

Table 3-12. District-led NPR Opportunities – Summary of 2024 Demands

Project	2019 Demand (AFY)	2019 Demand (mgd)	2024 Demand (AFY)	2024 Demand (mgd)
SRVRWP Phase 3	800	0.7	638	0.57
SRVRWP Phase 5	300	0.6	540	0.48
EBRWP Expansion	4,231	3.8	785	0.7
SLWRF Expansion Project	0	0	25-50	0.02-0.04
Chevron/ Richmond Refinery Recycled Water Project	4,300	3.8	1,590	1.42
Phillips 66 Refinery/RREC	4,100	3.7	3,136	2.80
Total	13,775	12.6	6,739	6.01

3.3.2 Non-potable Reuse Opportunities Led by Others

Over the last decade, the Rossmoor golf course, Moraga Country Club, Diablo Country Club, Sequoyah Country Club, and the UCB campus have all initiated planning and feasibility efforts to look at alternative water supplies such as SWRFs to meet their golf course irrigation demands. At this time, the District remains supportive of customer-led efforts to develop, self-finance, permit, and operate these satellite facilities.

Table 3-13 summarizes the updated non-potable market assessment for projects led by others.

Table 3-13. NPR Opportunities Led by Others – Summary of Projected Demands

Project	2019 Demand (AFY)	2019 Demand (mgd)	2024 Demand (AFY)	2024 Demand (mgd)
Rossmoor Country Club	90	0.08	255	0.23
Moraga Country Club	180	0.16	174	0.16
Diablo Country Club	250	0.22	250	0.22
Sequoyah Country Club	135	0.12	112	0.10
UCB Main Campus	900	0.80	419	0.37
Total	1,555	1.39	1,210	1.08

3.4 Evaluation of Non-potable Reuse Opportunities

The District-led NPR opportunities identified previously in Table 3-12 were evaluated through a multiple criteria decision analysis (MCDA) framework based on relative benefit and cost. Figure 3-13 outlines the decision-support process.

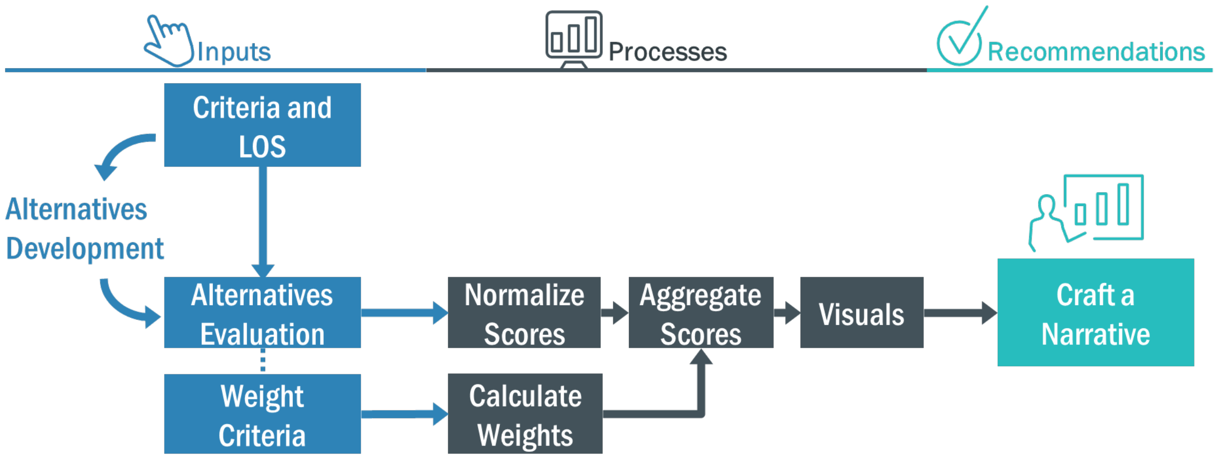


Figure 3-13. Decision-Support Process Flow Diagram

LOS = levels of service

The framework consisted of three primary steps:

- **Benefits evaluation:** benefits evaluated using criteria and weightings that were discussed and confirmed with District staff. Evaluation criteria are framed as benefits (i.e., the higher the score, the greater the benefit) and result in an aggregate "relative benefit" score for each opportunity.
- **Cost estimate development:** preliminary capital, O&M, and unit costs were developed for each opportunity.
- **Cost/Benefit comparison:** considered costs and benefits together to facilitate decision making and understand the tradeoffs among NPR opportunities.

This process helped compare and prioritize the NPR opportunities to inform next steps.

3.4.1 Benefits Evaluation for Non-potable Reuse Opportunities

Decision criteria were identified to differentiate and prioritize the NPR opportunities, these are presented in Table 3-14. Non-monetary criteria are critical to project success and require a defensible, repeatable approach that makes use of project information available at the time. The evaluation criteria and corresponding weighting factors shown in Table 3-14 were used to conduct the evaluation. The criteria used for this analysis was largely based on the criteria used in the 2019 RWMP, revised with District input, to reflect updated conditions and drivers.

Weighting evaluation criteria allows decision makers to emphasize the relative importance of some criteria over others (higher weight indicates greater relative importance). District staff reviewed and confirmed the weighting scheme presented in Table 3-14. This weighting scheme emphasizes the District's focus on the long-term viability of projects, as well as on distribution of benefits and regulatory complexity.

Table 3-14. RWSP Update Evaluation Criteria		
Criteria	**Description**	**Weighting Factor**
Environmental and Social Objectives		
Distribution of Benefits	What regions/populations are serviced by this new supply and how are the benefits distributed? Evaluation of public perception issues and degree of outreach and education needed.	15%
Environmental Challenges	Evaluation of potential environmental challenges during construction or operations of the alternative.	10%
Chemical and Energy Use	Chemical and energy use during operations.	10%
Wastewater Discharge	Assessment of reduced nutrient discharges.	10%
Complexity and Risk		
Institutional	Evaluation of the time, challenges, and requirements to implement the project either internally or in coordination with external partners.	10%
Regulatory	Assessment of the time, challenges, and requirements to implement the project from a regulatory permitting perspective prior to construction, as well as ongoing as part of operations.	15%
Design and Construction	Evaluation of the time, challenges, and requirements to design and construct the project.	10%
Long-term Operational Viability	Alternative complexity/how challenging it will be for District staff to manage any new processes or operations, maintenance, and staffing. Assessment of long-term flexibility of investments and potential for stranded assets.	20%
Total:		100%

To develop a relative evaluation of the opportunities with respect to how effectively each met the evaluation criteria, a scoring rubric was developed and is presented in Table 3-15. The NPR opportunities from Table 3-12 were scored from 1 to 5, with a high score indicating a high response to the criterion and a low score indicating a low response to the criterion (5 = most favorable, 1 = least favorable). The rubric includes a brief description of the metrics used to score each alternative.

The scores for each NPR opportunity are shown in Table 3-16, including notable considerations that factored into the assigned scores. These scores were normalized (i.e., converted to a scale of 0 to 1 for each criterion to facilitate a relative comparison) by determining the percentile of a selected opportunity's benefits compared to other opportunities for each qualitative criterion (Marler and Arora, 2004; Cinelli et al., 2020). This approach allowed differentiation of relative opportunity performance, which highlights benefits across each of the NPR opportunities. Normalized scores were multiplied by their component weighting factor and summed to develop an overall relative benefit score. This orients the analysis such that maximum normalized scores are associated with maximum benefit.

Table 3-15. Scoring Rubric for Non-Potable Reuse Opportunities Evaluation Criteria

Criteria	(Most Favorable)	Scoring Rubric			(Least Favorable)
	5	4	3	2	1
Distribution of Benefits	Project benefits many types of customers and/or the potable water use offset provides increased reliability for a significant portion of District service area		Project benefits some customers and/or the potable water use offset provides increased reliability for some of the District's service area.		Project does not significantly impact District supply reliability aside from one to two (likely private) customers
Environmental Challenges	Project operations and/or construction will have limited environmental impacts or challenges (locations or operations not near sensitive habitats, protected species)		Project operations and/or construction will have some environmental impacts (may include locations or operations near streams, wetlands, or other habitat)		Project operations and/or construction will have significant environmental impacts (may include significant locations or operations near streams, wetlands, or other habitat)
Chemical and Energy Use	Project operation will require low energy and chemical use for treatment and conveyance		Project operation will require "average" chemicals and energy for treatment and conveyance		Project operation will require significant chemicals and energy for treatment and conveyance
Wastewater Discharge	Project provides denitrification or serves a large irrigation customer (>2 mgd)		Project provides partial denitrification or serves an irrigation customer		Project provides no denitrification and does not serve an irrigation customer
Institutional	Project does not require any coordination with partner agencies	Project does not require any coordination with partner agencies but requires extensive internal coordination among departments	Project requires coordination with one external partner agency	Project requires coordination with two to three external partner agencies	Project requires coordination with four or more external partner agencies
Regulatory	Project requires limited number of permits, easements, documentation, etc., which results in less coordination effort with state agencies and local stakeholders and minimal required annual monitoring/permitting		Project requires some permits, easements, documentation, etc., that results in some effort to coordinate with state agencies and local stakeholders, and minimal required annual monitoring/permitting		Project requires many permits, easements, documentation, etc., that result in significant effort to coordinate with state agencies and local stakeholders, and significant required annual monitoring/permitting
Design and Construction	Project includes limited number of unique facilities, facility siting concerns, or other special circumstances such as trenchless crossings		Project includes some unique facilities, facility siting concerns, or other special circumstances such as trenchless crossings.		Project includes many unique facilities, facility siting concerns, or other special circumstances such as trenchless crossings
Long-term Operational Viability	Project will require limited change to existing District operations (changes are limited to the expansion of an existing treatment facility)		Project will require limited change to existing District operations (changes are limited to some changes to a treatment facility and/or distribution)		Project will require operation of a new, independent facility and conveyance system

Table 3-16. Scoring of Non-potable Reuse Opportunities												
			Environmental and Social Objectives				Complexity and Risk					
Name	2024 Demand (mgd)	Recommended in 2019 RWMP	Distribution of Benefits	Environmental Challenges	Chemical and Energy Use	Wastewater Discharge	Institutional	Regulatory	Design and Construction	Long-term Operational Viability	Final Composite Score	Key Considerations
SRVRWP Phase 3	0.57	Yes	4	5	5	3	4	5	4	5	0.57	• Expansion of a committed project with an established partnership with DSRSD • Program Environmental Impact Report (EIR) is certified • Need to resolve potential supply limitations
SRVRWP Phase 5	0.48	Yes	4	5	5	3	4	5	5	5	0.63	• Expansion of a committed project with an established partnership with DSRSD • Program EIR is certified • Need to resolve potential supply limitations
EBRWP Expansion	0.7	Yes	5	4	5	4	5	4	4	4	0.53	• Expansion of a committed project with adequate supply to meet existing demands • Requires expansion of distribution system and pumping facilities at EBWRF • No major treatment upgrades are needed to move forward • Would likely require an Addendum or Supplemental EIR
SLWRF Expansion Project	0.04	No	2	3	5	3	4	4	4	4	0.21	• Limited increase in yield • Requires expansion of existing distribution system • San Leandro is an established District project partner
Chevron/ Richmond Refinery Recycled Water Project	1.42	No	1	3	3	3	4	3	3	4	0.04	• Limited increase in yield • Requires minor upgrades/modifications at Pt. Isabel and construction of pipeline to convey flows • Capacity is limited to available flows in North Interceptor (2.5 mgd) • May result in adverse effects to SD-1 water quality • Limited expansion of a committed project • Chevron is an established District project partner • Requires an EIR
Phillips 66 Refinery/RREC	2.8	Yes	3	4	4	1	3	3	3	4	0.12	• MOU in place between Phillips 66 and EBMUD • Project is in planning phase; technically feasible but uncertainty remains on long-term demands • District is exploring funding options

Figure 3-14 presents the relative benefit scores. Each colored bar represents the benefit score for an individual criterion (shown in legend); opportunities with longer bars (i.e., toward the top of the figure) generally offer greater benefits.

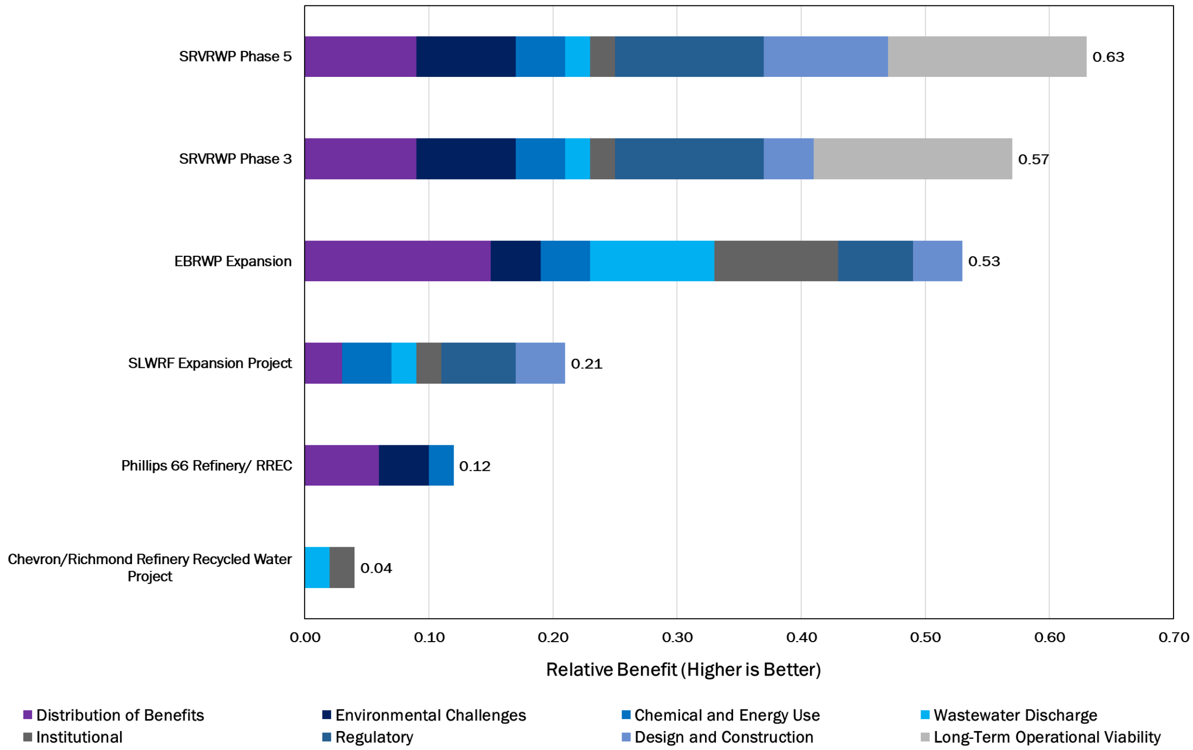


Figure 3-14. Aggregated Relative Benefit Scores Representing Alternative Non-monetary Benefits

In reviewing the results of the relative benefits assessment, centralized opportunities like the SRVRWP projects tended to score the highest. While projects like these still have issues that need to be resolved (e.g., the SRVRWP projects still need to secure supplemental supplies), the presence of existing commitments and established partnerships make for projects well-aligned with District objectives.

Other projects such as the Chevron/Richmond Refinery Recycled Water Project did not score as high due to their implementation complexities. These opportunities would require coordination with multiple agencies, could call for extensive amounts of new infrastructure (e.g., treatment upgrades, distribution systems), pose challenging construction conditions, and result in only a minimal increase in the District's recycled water yield.

3.4.2 Non-potable Reuse Opportunities Cost Summary

Cost estimates for the assessed NPR opportunities in terms of capital, O&M, and unit costs (levelized for annual yield and based on a 30-year life cycle) are summarized in Table 3-17. The table also includes an estimation of each opportunity's dry year unit costs. While the District has adequate supply from the Mokelumne River to meet water demands in most years (7 out of 10), dry year unit costs for each project were estimated for comparison against other District supplemental supply options that are implemented only in dry years. To estimate dry year unit costs, capital and O&M costs were held constant, while project life-cycle yield was reduced to 30 percent to reflect an assumed need for supplemental supply in 3 out of every 10 years.

Table 3-17. Non-potable Reuse Opportunities Cost Summary

Project	Capital Costs ($ millions)	Annual O&M ($ million/yr)	Annual Demand		Unit Costs ($/AF)			
			(AFY)	(mgd)	Treatment	Distribution	Total	Dry Year
SRVRWP Phase 3	$32.3	$0.73	638	0.57	$1,000	$2,700	$3,700	$12,200
SRVRWP Phase 5	$26.6	$0.62	540	0.48	$1,000	$2,700	$3,700	$12,200
EBRWP Expansion[a]	$54.9	$0.53	785	0.7	-	$4,200	$4,200	$13,900
SLWRF Expansion Project	$13.3	$0.2	25-50	0.02-0.04	$0	$18,000 to $36,100	$18,000 to $36,100	$59,400 to $119,100
Chevron/ Richmond Refinery Recycled Water Project	$91.0	$1.73	1,590	1.42	$500	$3,500	$4,000	$13,200
Phillips 66 Refinery/RREC	$40.6	$2.69	3,136	2.8	$1,300	$200	$1,500	$5,000

a. *The District has approximately $25 million in federal funding they plan to use to help implement this project. This funding is anticipated to reduce annualized total costs to approximately $3,500 per AF.*

Details on the capital costs, O&M, and associated markups/contingencies for NPR projects are provided in Appendix A.

For ease of comparison, Figure 3-15 through Figure 3-18 visually depict the range of estimated costs in terms of capital, O&M, and unit costs (for both normal year and dry year) of the NPR opportunities. The cost estimates represent an Association for the Advancement of Cost Engineering International (AACE) Class 5 planning-level estimate with an accuracy range of -50 percent/+100 percent.

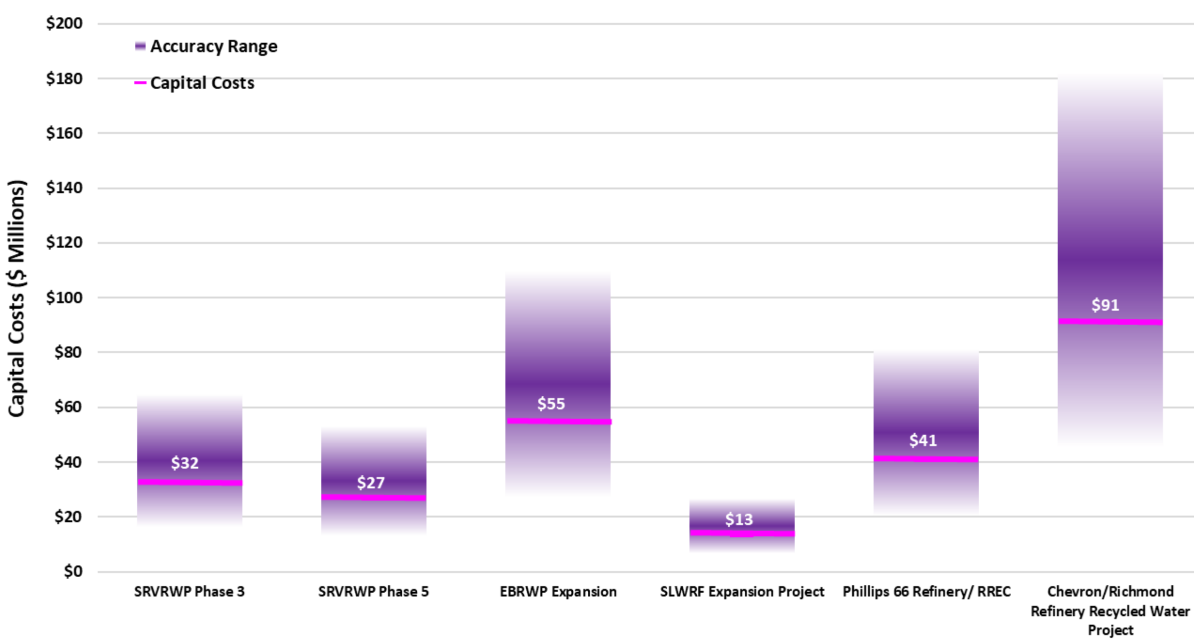


Figure 3-15. Ranges of Estimated Capital Cost with AACE Class 5 Level of Accuracy

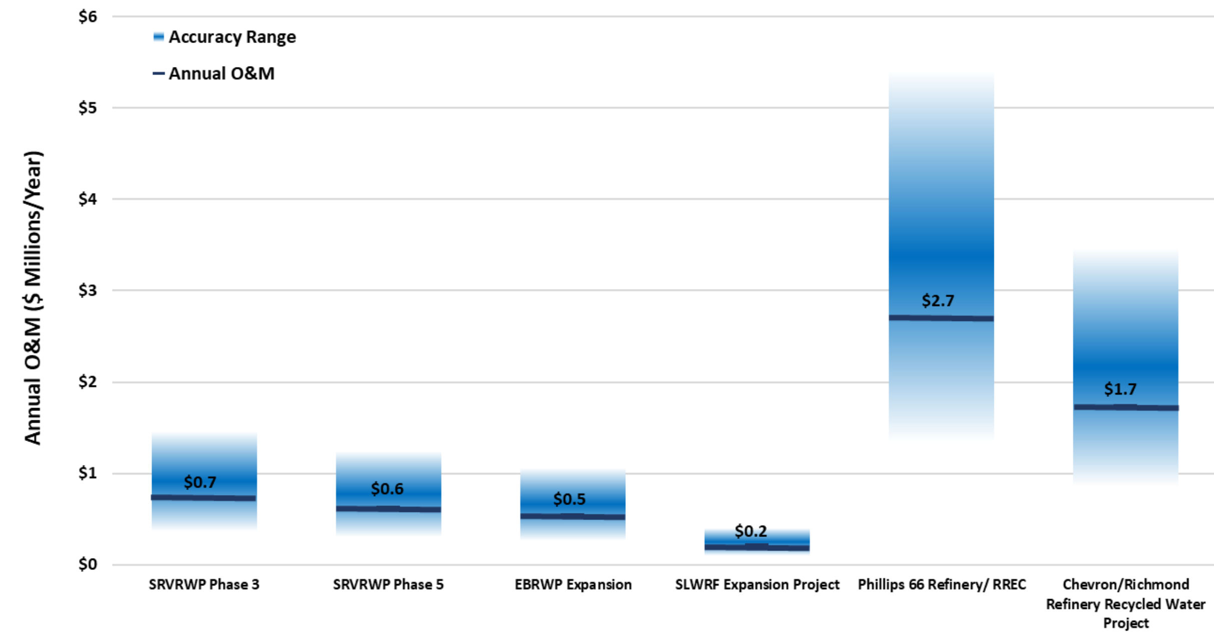


Figure 3-16. Ranges of Estimated Annual O&M Costs with AACE Class 5 Level of Accuracy

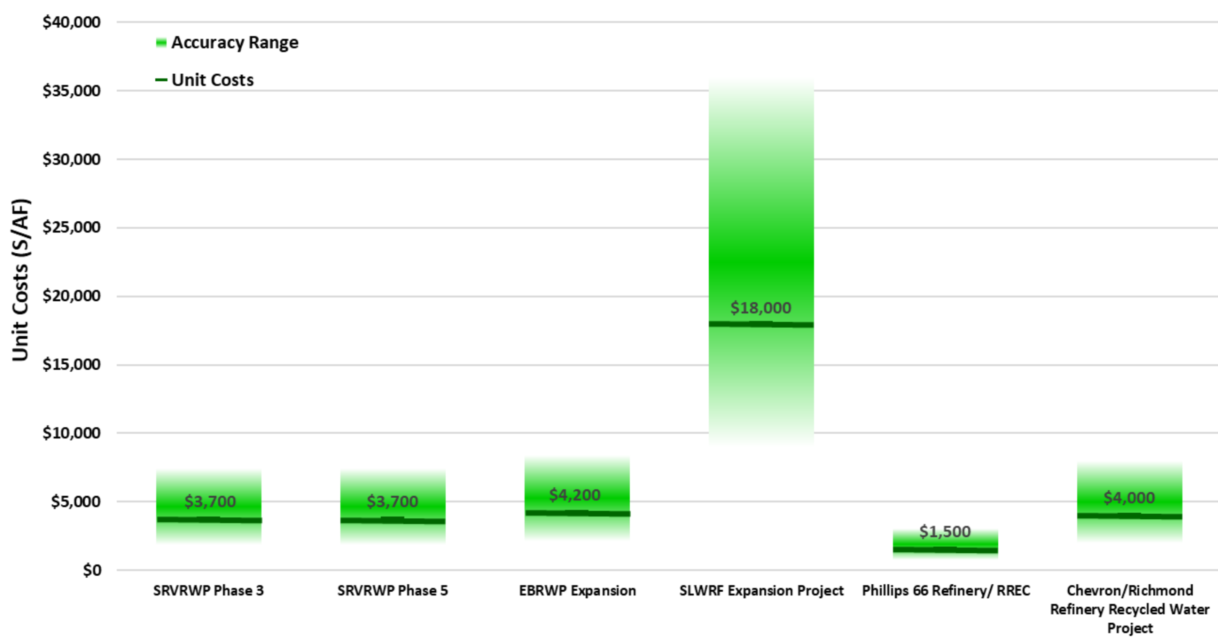


Figure 3-17. Levelized Unit Costs with AACE Class 5 Level of Accuracy

30-year life cycle

The District has approximately $25 million in federal funding they plan to use to help implement this project. This funding is anticipated to reduce annualized total costs to approximately $3,500 per AF.

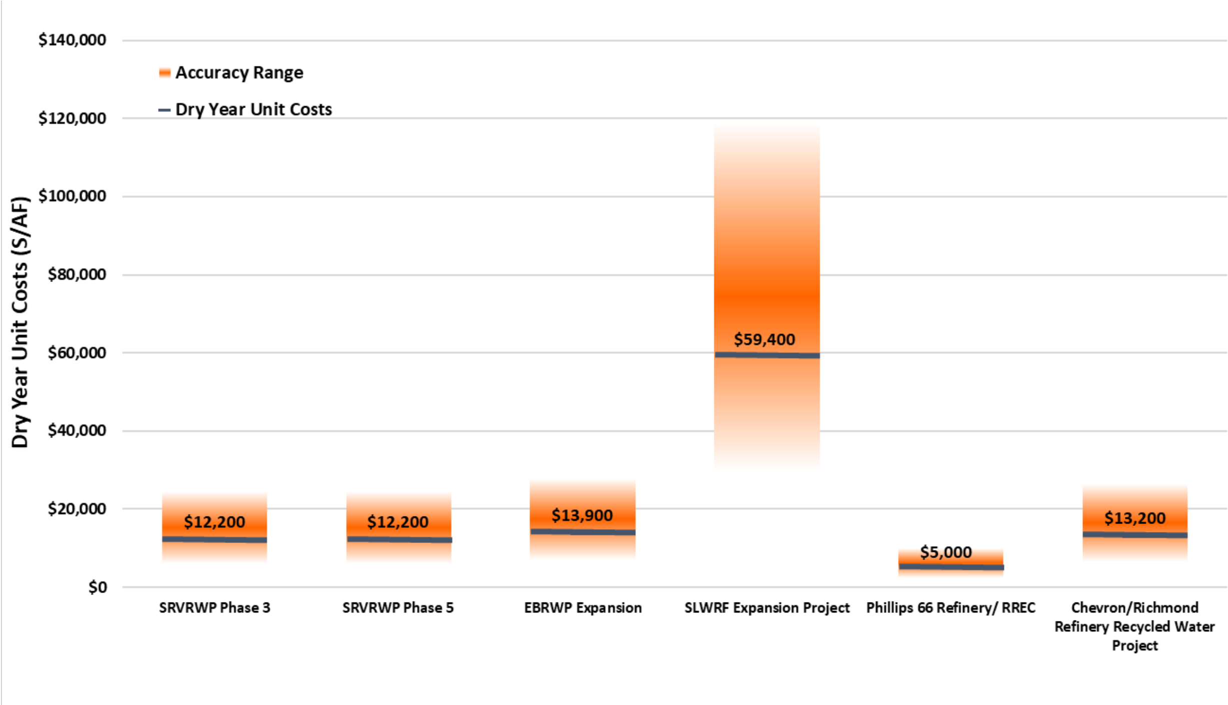


Figure 3-18. Levelized Dry Year Unit Costs with AACE Class 5 Level of Accuracy

30-year life cycle

3.4.3 Comparison of Benefits and Costs for Non-potable Reuse Opportunities

While aggregate non-monetary benefit characterization aids in identifying what the best opportunities are on their surface, it does not account for cost. Considering costs in addition to benefits adds another dimension to the evaluation and helps further distinguish opportunities. Figure 3-19 shows the relative benefit scores vs. estimated unit costs for each opportunity to help identify which opportunities provide the best value. Optimal results are closest to the top-right corner of the chart (highest benefit and lowest cost).

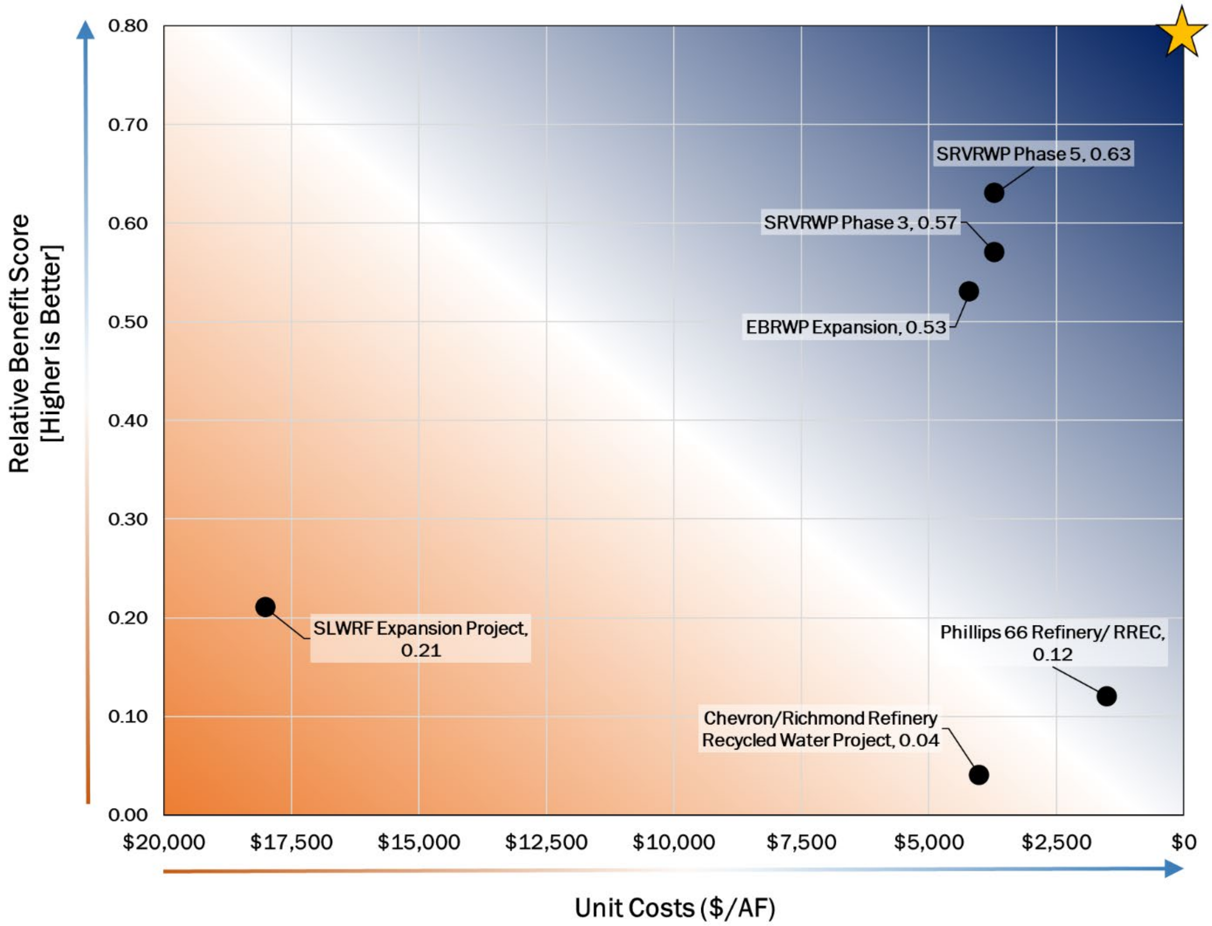


Figure 3-19. Aggregate Relative Benefit Scores vs. Unit Costs

In reviewing the results presented on Figure 3-19, it is evident that the SRVRWP, EBRWP Expansion, and Phillips 66/RREC projects are among the most cost effective. These projects align well with the District's evaluation criteria as evidenced by their relative benefit scores, and they offer comparatively lower costs. This trend is consistent with what was observed in the 2019 RWMP where these same projects were deemed to be among the most appealing from both a benefit and cost standpoint.

3.4.4 Non-potable Reuse Opportunities Overall Summary

The District has been making steady progress toward reaching its recycled water goal of 20-mgd by 2040; however, the increase in water conservation efforts, reduced recycled water demands, availability and quality of wastewater flows, and the uncertainty surrounding the long-term viability of previously identified projects suggests that reaching this goal by solely relying on the implementation of NPR projects may no longer be advisable/feasible. While NPR projects that could help the District reach the 20-mgd goal have been identified as part of this and other previously completed planning efforts, many potential projects have implementation challenges and institutional complexities, and are cost prohibitive. Based on the results of this evaluation, it is recommended that the District shift its efforts toward a tiered reuse goal that is anchored to specific triggers to build flexibility to ever-changing conditions.

As an initial step, it is recommended the District keep its reuse goal at 20-mgd but extend the timeline to 2050. The District should also focus on implementing projects that provide the highest value and flexibility and have the greatest likelihood of being implemented. To that end, the recommended District-led projects include the SRVRWP Phase 3 and 5 projects, EBRWP Expansion, and Phillips 66/RREC, totaling 4.55 mgd, as shown in Table 3-18. When added to the existing suite of projects, it would bring the District's total recycled water program capacity to 13.75 mgd.

Table 3-18. Recommended Non-potable reuse Projects

Project	Unit Cost ($/AF)	Demand (AFY)	Demand (mgd)
SRVRWP Phase 3	$3,700	638	0.57
SRVRWP Phase 5	$3,700	540	0.48
EBRWP Expansion[a]	$4,200	785	0.7
Phillips 66 Refinery/RREC	$1,500	3,136	2.80
Total		5,099	4.55

a. *The District has approximately $25 million in federal funding they plan to use to help implement this project. This funding is anticipated to reduce annualized total costs to approximately $3,500 per AF.*

Also, while not listed above, the District anticipates that the Chevron Refinery will make an additional 0.5-mgd influent flow available from the refinery effluent by 2030 to allow an increase in the recycled water production of RARE.

Figure 3-20 shows the geographic location of each of the proposed projects. These projects offer several benefits over the other opportunities that were evaluated. Both the SRVRWP and EBRWP Expansion projects would continue to help build on existing NPR projects and offer the District some flexibility in how to move forward with future phases. Although not evaluated as a phased project in this update, the EBRWP Expansion Project could potentially be implemented as a first phase, with the potential to pick up additional customers once the EBWRF treatment upgrades are completed. SRVRWP also offers some of this flexibility as well. Even though these are relatively smaller projects, implementation can be sequenced based on the availability of wastewater supply and funding. Conversely, the Phillips 66 Refinery/RREC Project is included as a recommended project because it would deliver a significant amount of recycled water (up to 2.8 mgd) to a single customer, with comparatively few pipelines required due to the short distance between the sources of wastewater and the Phillips 66 Refinery.

It is also important to note that this recommended list of projects does not account for the implementation of customer-led satellite projects, such as those currently being explored by UCB, the Moraga, Diablo, and Sequoyah country clubs and the Rossmoor Community. The District should remain supportive of these customer-led efforts to develop, self-finance, permit, and operate these satellite-type projects that would contribute to the District's water reuse goals. Implementation of these SWRF projects could provide up to 1.08 mgd of additional recycled water deliveries.

A detailed implementation and phasing strategy is included in Section 6 of this report.

Figure 3-20. Recommended Near-Term Non-Potable Reuse Projects

Section 4

Potable Reuse Opportunities

This section presents a brief history and overview of water reuse policy in California. It also presents the reassessment of the potable reuse alternatives that were identified in the 2019 RWMP and recommends five opportunities for further development. A summary of key issues to consider is also included as the District explores the possibility of potentially integrating potable reuse into its water supply portfolio.

4.1 Overview of Potable Reuse Regulatory Framework in California

Potable reuse applications exist along a spectrum based on the type of system and planned use. Under California potable reuse regulations, indirect potable reuse (IPR) projects include a significant environmental buffer as defined in the regulations. For example, an aquifer for groundwater recharge (GWR) must have a minimum underground retention time of 2 months, and a surface water reservoir for surface water augmentation (SWA) must have a minimum theoretical retention time of 60 days. The direct potable reuse (DPR) regulations apply to any project that does not fit within the definitions of the different types of IPR projects. California distinguishes two forms of DPR: raw water augmentation (RWA) and treated water augmentation (TWA). Since a DPR project does not include a significant environmental buffer as defined by the regulations, there is less time to detect and respond to treatment failures prior to off-specification water reaching a drinking water distribution system. Regulators have compensated for this difference by including more rigorous treatment, monitoring, reporting, and other requirements. Figure 4-1 depicts the different types of potable reuse and how they fit into California's potable reuse regulations.

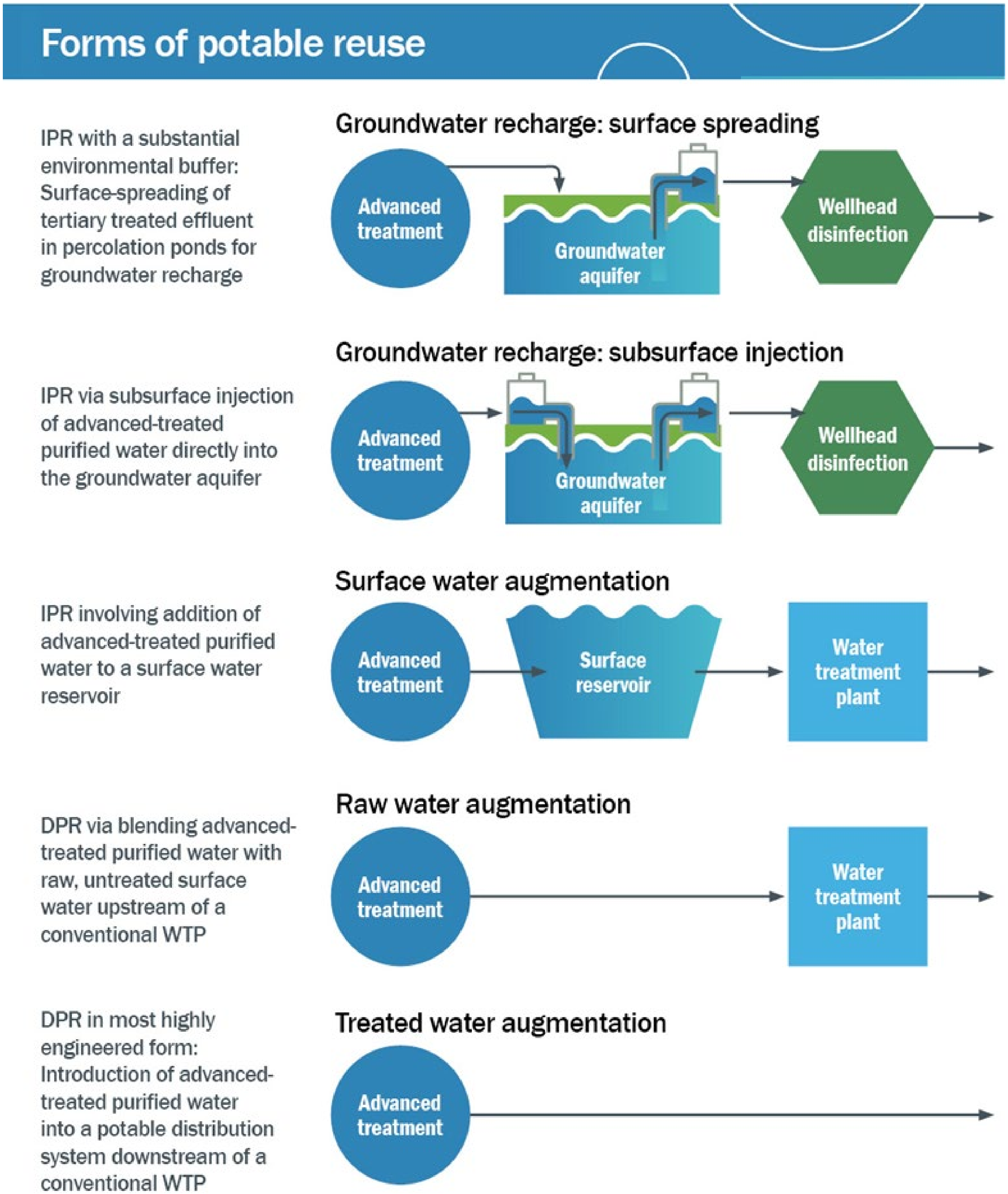


Figure 4-1. Forms of Potable Reuse Covered by California Regulations

The regulation of water reuse in California falls under the jurisdiction of the State Water Resources Control Board (SWRCB). Within the SWRCB, two departments are responsible for protecting public health and the environment with respect to water: the Division of Drinking Water (DDW), and the RWQCBs. DDW helps regulate public drinking water systems and is responsible for developing regulations for recycled water and reviewing recycled water projects. The RWQCBs develop and enforce water quality objectives and implementation plans to protect the beneficial uses of the State's waters, and write the permits for recycled water projects. The overriding regulatory criteria governing wastewater reuse are found in Title 22, Division 4, Section 60301, et seq. Title 22 has long-established water quality requirements for NPR. These criteria were revised in 2014 and 2018 to adopt uniform IPR recycling criteria for GWR and SWA, respectively.

Efforts to establish regulations for DPR projects were initiated in 2010 with SB 918. SB 918 directed the California Department of Public Health (CDPH), now DDW, to investigate the feasibility of developing uniform water recycling criteria for DPR and to report its findings to the State Legislature by December 2016. In addition, SB 918 mandated that an expert panel be convened to advise DDW on scientific and technical matters regarding DPR feasibility. The expert panel released its final report in August 2016, concluding that it was feasible to develop uniform criteria for DPR.

Assembly Bill (AB) 574, which was signed into law in October 2017, required that the SWRCB develop uniform water recycling criteria for RWA by December 2023. Subsequently, DDW stated its intent to regulate both RWA and TWA under one set of uniform criteria. On December 19, 2023, SWRCB unanimously adopted the final DPR regulations, which do not explicitly differentiate between RWA and TWA. The criteria are among the most rigorous and robust potable reuse regulations and requirements in the nation. Many of the DPR requirements are informed by recommendations contained in SWRCB and Expert Panel reports. DPR regulations were approved by the Office of Administrative Law on August 6, 2024 and became effective October 1, 2024.

4.1.1 Regulatory Structure and Compliance

Water reuse regulations are focused on making wastewater safe for public use and consumption. Reuse facilities are subject to public health protection criteria, and environmental discharge criteria. Public health protection criteria generally include requirements for treatment, monitoring, and effluent water quality for the designated end use (e.g., landscape irrigation and GWR). Environmental discharge criteria consist of water quality requirements to protect surface water and groundwater quality for all designated beneficial uses. The sources of the criteria relevant to the District, as well as requirements for project implementation for the different types of water reuse, are summarized on Figure 4-2.

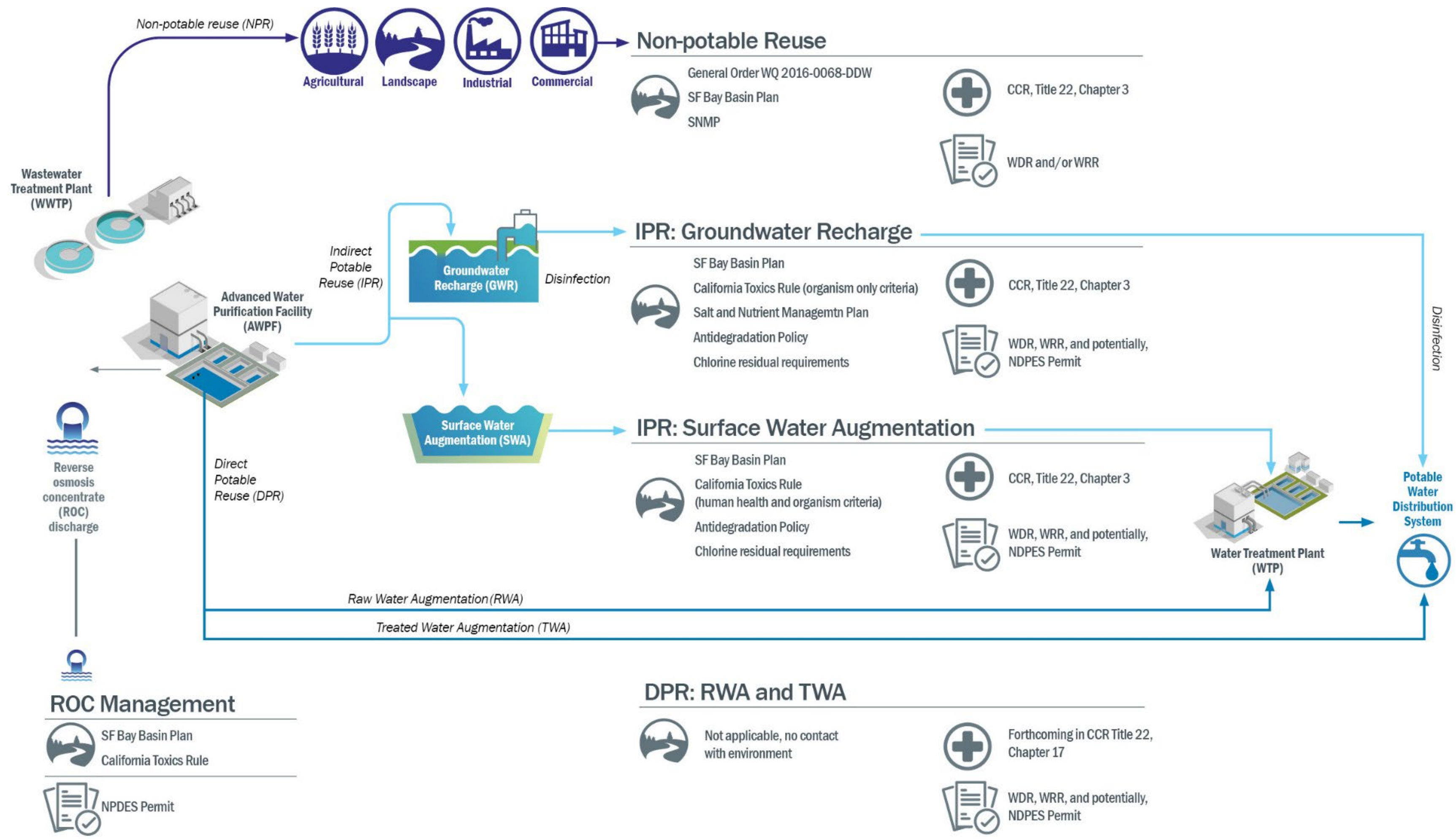


Figure 4-2. California Potable Reuse Regulatory Compliance Landscape

SNMP = salt and nutrient management plan; WDR = waste discharge requirement; WRR = water reclamation requirements

The SWRCB develops the criteria for public health protection, which are encapsulated in CCR Title 22. Specific criteria for each form of potable reuse are discussed in more detail in the following sections. Typically, these criteria are enforced through the use of waste discharge requirements (WDR), water reclamation requirements, or other appropriate RWQCB-issued permits. These permits specify requirements for treatment, monitoring, reporting, effluent water quality, and any other elements of the water recycling criteria that are relevant for a given application. The RWQCBs generally require projects to receive SWRCB approval of a Title 22 Engineering Report to obtain a discharge permit. This report outlines how the system will reliably meet recycling water rules.

The criteria for environmental discharge can significantly differ based on the specific discharge and reuse type. In the East Bay, discharges are subject to the provisions of the Water Quality Control Plan for the San Francisco Bay Basin (SF Bay Basin Plan). These and other relevant provisions are discussed in detail in subsequent sections. In all instances, the criteria are designed to safeguard receiving waters, such as aquifers and reservoirs, to ensure water quality maintenance for all beneficial uses. Environmental discharge criteria are enforced through a permit, with the permit type depending on the receiving water. Discharges to aquifers, which are not considered Waters of the United States, are governed by RWQCB-issued WDRs. Discharges to reservoirs, on the other hand, require a permit under the NPDES program, which would also be issued by the RWQCB, along with WDRs specific to any state water quality policies and regulations.

The following sections summarize the regulatory requirements for the various forms of potable reuse. While containing many prescriptive requirements, the regulations do incorporate a certain degree of flexibility. This flexibility has been and can be used to pursue novel approaches that offer advantages in terms of project size and overall cost.

4.1.2 Groundwater Recharge Regulatory Requirements

GWR has been around for years, most notably by the Groundwater Replenishment System in Orange County and the Montebello Forebay Project in Los Angeles County. GWR regulations were officially enacted in June 2014 and identify two forms of GWR: surface application (CCR Title 22, Chapter 3, Article 5.1), and subsurface application (CCR Title 22, Chapter 3, Article 5.2). Surface spreading and well injection are the commonly used terms for surface application and subsurface application, respectively. For a project to be permitted under the GWR regulations, a minimum of 2 months of underground retention time is required before extraction for potable use to provide time to monitor water quality and respond to concerns before the water reaches consumers.

Surface spreading requires that secondary effluent receive a minimum of tertiary filtration and disinfection before the water is applied to a spreading basin where it can percolate into the aquifer (CDPH, 2014). For well injection, the regulations require full advanced treatment (FAT) of RO and an advanced oxidation process (AOP) that removes at least 0.5 logs of 1,4-dioxane. Due to space constraints and local hydrogeology, the 2019 RWMP only considered alternatives with subsurface application via injection wells. This assumption was carried forward in this RWSP update.

Requirements for pathogen control include 12-log reduction of enteric virus, 10-log reduction of *Giardia cysts*, and 10-log reduction of *Cryptosporidium oocysts*. These “12/10/10” requirements must be met using a multiple-barrier approach, i.e., for each type of pathogen, a minimum of three treatment processes must be used, with each providing at least 1.0-log, but credited with no more than 6.0-logs, of pathogen removal credit. For treatment processes used to meet pathogen requirements, projects must validate unit process performance and demonstrate their effectiveness via ongoing monitoring of a surrogate parameter.

Underground retention time may be credited with a maximum of 1-log per month for virus reduction. During project planning, the regulations give partial log-reduction credit of 0.5-log per month for numerical modeling or 0.25-log per month for analytical modeling. The underground retention time estimated during project planning must be verified by a tracer study that is initiated within 3 months of project start-up. This tracer study can use an added tracer study to receive full credit for virus reduction (1-log per month) or an intrinsic tracer to receive partial credit for virus reduction (0.67-log per month).

For both surface and subsurface applications of purified water to drinking water aquifers, DDW requires low levels of total organic carbon (TOC) at 0.5 mg/L and total nitrogen at 10 mg/L. Depending on project specifics, the TOC limit can be achieved through one or more of the following strategies: above ground treatment, soil aquifer treatment (SAT), and dilution.

Select GWR criteria are summarized in Table 4-1.

Table 4-1. Summary of Select Groundwater Recharge Criteria

Parameter	Surface Application	Subsurface Application
Minimum Treatment	Tertiary Filtration + Disinfection	Full Advanced Treatment
Minimum Retention Time	2 months	
Virus	≥12-log reduction	
Giardia	≥10-log reduction	
Cryptosporidium	≥10-log reduction	
Safe Drinking Water Act Contaminants	Meets all maximum contaminant levels (MCL)	
Total Nitrogen	≤10 mg/L	
TOC	≤0.5 mg/L (after SAT and dilution)	≤0.5 mg/L

Beyond the aforementioned topics, the regulations specify requirements for a number of additional elements. Table 4-2 summarizes the requirements in each article of the relevant regulation.

Table 4-2. Summary of Additional Criteria for Groundwater Recharge

CCR Requirement	Description
General requirements (§60320.100 and §60320.200)	Describes compliance report that must accompany all projects showing ability to meet regulation requirements; specifies requirements for alternative water supplies, and aquifer water quality and hydrogeological characterization, including zone of controlled drinking water well construction; demonstration of technical, managerial, and financial (TMF) capabilities; approvals needed to re-start a project that has been suspended
Public hearing (§60320.102 and §60320.202)	Required for the initial permit and whenever there is a proposal to increase the maximum recycled municipal wastewater contribution
Laboratory analysis (§60320.104 and §60320.204)	Must be performed by certified labs approved by DDW using DDW-approved drinking water methods
Operations plan (§60320.122 and §60320.222)	Operation Optimization Plan must be submitted to DDW prior to startup that identifies and describes O&M, monitoring, and analytical methods for the groundwater replenishment reuse project to meet requirements of the groundwater replenishment regulations
Reporting (§60320.128 and §60320.228)	Annual report must be submitted to DDW within 6 months of the end of each calendar year; engineering reports must be updated at least once every 5 years

4.1.3 Surface Water Augmentation Regulatory Requirements

SWA refers to the intentional introduction of purified water into a surface water reservoir that serves as a source of domestic drinking water supply. Final SWA regulations became effective October 1, 2018, with the City of San Diego's Pure Water San Diego Program's North City Project gaining approval of the State's first SWA permit in May 2020. Many of the requirements for SWA projects are similar to those required under the GWR regulations. The following discussion provides an overview of the provisions most relevant to agencies considering implementing an SWA project.

In SWA, the reservoir itself plays an important role in public health protection. The first benefit of the reservoir is to provide dilution, which mitigates contamination by reducing the concentration of potential compounds present in the purified water. The dilution and mixing criteria in the SWA regulations require that water withdrawn from a reservoir contain no more than either of the following:

- 1 percent, by volume, of purified water (100-fold dilution) that was delivered to the reservoir during any 24-hour period
- 10 percent, by volume, of purified water (10-fold dilution) having been subjected to additional treatment producing no less than an additional 1-log reduction of enteric virus, *Giardia cysts*, and *Cryptosporidium oocysts* removal or inactivation credit

Pathogen log reduction requirements are dependent on both the dilution and theoretical retention time achieved in the reservoir. The SWA regulations allow pathogen credits to be earned at both a WWTP and AWPF prior to a reservoir, as well as through subsequent treatment at a drinking WTP. Post-reservoir treatment at a WTP is required to comply with the U.S. Environmental Protection Agency's (EPA) Surface Water Treatment Rules (i.e., achieving a minimum 4/3/2 log reduction of virus, *Giardia,* and *Cryptosporidium* [V/G/C], respectively). The remaining credits must be achieved at a WWTP and AWPF, with the regulations specifying two levels of treatment based on the degree of dilution provided by the reservoir:

- For projects achieving a minimum 100-fold dilution of the purified water, the total amount of treatment required from a log reduction values (LRV) standpoint is 12/10/10 for V/G/C. This translates to a minimum of 8/7/8 being achieved through a WWTP and AWPF (assuming the WTP will provide 4/3/2). Treatment must be provided by at least two treatment processes, each achieving at least 1-log reduction, with no more than 6-log credit awarded for any one process.
- For projects achieving a minimum 10-fold dilution of the purified water, an additional 1-log pathogen reduction through treatment is required prior to the reservoir. In other words, the WWTP and AWPF must provide a minimum of 9/8/9 for an overall total log removal requirement of 13/11/11. Treatment must be provided by at least three separate treatment processes, each achieving at least 1-log reduction, with no more than 6-log credit awarded for any one process.

In addition to dilution, the project's theoretical retention time also impacts the degree of treatment required. Additional treatment is required whenever a project proposes a minimum theoretical retention time of less than 120 days. The regulations require "no less than 1-log reduction" beyond what would otherwise be required based on the treatment and dilution provided. Table 4-3 summarizes the treatment requirements for SWA projects depending on the dilution and theoretical retention time in the reservoir. Table 4-4 shows additional requirements for SWA specified by the regulations.

Table 4-3. Summary of Treatment, Dilution, and Theoretical Retention Time Criteria for SWA

Dilution	Volume/Flow (days)	Minimum Log Removal Credit (V/G/C)		Number of Treatment Processes	Additional Considerations
		WWTP/AWPF	Total		
100:1	≥180	8/7/8	12/10/10	2	--
	<180–120	8/7/8	12/10/10		SWRCB approval
	<120–60	9/8/9	13/11/11		SWRCB approval
10:1	≥180	9/8/9	13/11/11	3	--
	<180–120	9/8/9	13/11/11		SWRCB approval
	<120–60	10/9/10	14/12/12		SWRCB approval

Table 4-4. Summary of Additional Criteria for Surface Water Augmentation

CCR Requirement	Description
Chapter 3. Article 5.3. Indirect Potable Reuse: Surface Water Augmentation	
General Requirements (§60320.301)	Includes development of a joint plan between water recycling agency and public water system; demonstration of TMF capability; compliance
Advanced Treatment Criteria (§60320.302)	Requirements for FAT, process monitoring, demonstration testing, reporting
Lab Analyses (§60320.304)	Laboratory requirements for analysis of chemicals, both with and without MCLs
Wastewater Source Control (§60320.306)	Requirements for source control program
Pathogenic Microorganism Control (§60320.308)	Requirements for V/G/C removal through the advanced treatment process; options for alternative levels of treatment; responses to failures
Regulated Contaminants and Physical Characteristics Control (§60320.312)	Requirements for monitoring various groups of regulated chemical contaminants; response to exceedances; monitoring
Additional Chemical and Contaminant Monitoring (§60320.320)	Requirements for additional chemical testing and reporting, including notification levels (NL) and other contaminants of concern
Surface Water Source Augmentation Project (SWSAP) Operation Plan (§60320.322)	Identifies plan requirements, including O&M, analytical methods, monitoring, reporting, and ongoing training
Augmented Reservoir Monitoring (§60320.326)	Identifies monitoring requirements at the reservoir, including sampling locations and frequency
Reporting (§60320.328)	Includes results of monitoring, an operations summary, and responses to failure events
Alternatives (§60320.330)	Permits use of alternatives that provide equivalent or better protection of public health; requirements for approval of alternatives
Chapter 17. Article 9. Indirect Potable Reuse: Surface Water Augmentation	
General Requirements and Definitions (§64668.10)	Includes definitions, permit requirements, and other elements related to Article 5.3, Chapter 3; requirements for reservoir
Public Hearings (§64668.20)	Requirements for public interaction, including meetings, Web-accessible information, and customer notifications
SWSAP Augmented Reservoir Requirements (§64668.30)	Requirements for reservoir as approved surface water supply; retention time requirements; tracer study and modeling requirements; dilution requirements

Beyond adhering to CCR Title 22 recycling criteria, any District SWA project will need an NPDES permit to discharge into surface water because the District's reservoirs are named water bodies with beneficial uses listed in the Water Quality Control Plan for the San Francisco Bay Basin (SF Bay RWQCB, 2017). This may result in additional requirements related to aquatic life protection, including strict limits on residual chlorine in the purified water added to a reservoir and nutrient limits intended to prevent reservoir eutrophication (i.e., high nitrogen and phosphorus).

4.1.4 DPR Regulatory Requirements

The DPR regulations (adopted August 6, 2024, effective October 1, 2024) build on the public health protection requirements for IPR (i.e., GWR and SWA) and incorporate new elements to account for:

- The loss of an environmental buffer (e.g., an aquifer or surface water reservoir).
- New information on pathogen concentrations.
- Safety factors for unknown or undetected chemical constituents.

All DPR projects must have a Direct Potable Reuse Responsible Agency (DiPRRA) responsible for SWRCB coordination and DPR criteria compliance. The DiPRRA will be required to develop several plans that are not required for GWR and SWA projects. These plans are intended to provide extensive documentation of the public health protection elements of a project and describe how any issues or failures will be addressed and mitigated. Compliance reporting to the SWRCB will be required monthly. While the DiPRRA must be a public water agency, each project may elect to include other partner agencies, such as those providing wastewater treatment/collection or other relevant entities.

Operation of a DPR project will be subject to an intensive monitoring and oversight effort. Therefore, the regulations stipulate that the DiPRRA must have a chief operator who possess grade T5 drinking water treatment certification overseeing the entire treatment train that is used to satisfy the DPR regulations, and at least one shift operator who possesses grade T3 water treatment operator certification. In addition, the chief operator and shift operators at treatment facilities used to satisfy chemical control requirements of the regulations (CCR Section 64669.50) must be an Advanced Water Treatment Operator (AWTO) grade AWT5 and grade AWT3, respectively. Either the chief or shift operator must be present on site at all times if a treatment facility is used to satisfy the pathogen control requirements (CCR Section 64669.45) and/or the chemical control requirements (CCR Section 64669.50). After 12 months of operation, the DiPRRA can apply for a waiver to the requirement to always have a chief or shift operator on site.

The DiPRRA is also responsible for:

- Establishing a comprehensive wastewater source control program that includes a monitoring program to provide early warning of potential issues.
- Establishing a source control committee.
- Establishing a community outbreak surveillance program.
- An expansion of the local limits program to identify and limit contaminants in wastewater.

From a treatment standpoint, the DPR regulations build on the FAT train required for GWR and SWA by adding two new barriers: ozone and biologically activated carbon (ozone/BAC). When combined with RO and AOP, these new treatment processes are expected to provide further protection against CECs. The regulations require that ozone/BAC occur before RO unless it can be demonstrated to DDW and an independent advisory panel (IAP) that an alternative treatment process is as protective of public health as ozone/BAC. Requirements for pathogen control include 20-log reduction of enteric virus, 14-log reduction of *Giardia cysts*, and 15-log reduction of *Cryptosporidium oocysts*. These requirements must be met using a multiple-barrier approach, i.e., for each type of pathogen, a minimum of four treatment processes must be used, with each providing at least 1.0-log, but credited with no more than 6.0-logs, of pathogen removal credit. Table 4-5 summarizes DPR criteria.

Table 4-5. Summary of DPR Criteria

Parameter	Criteria
Minimum Treatment[a]	Ozone/BAC + RO + AOP are required, in that order
Virus	≥20-log reduction
Giardia	≥14-log reduction
Cryptosporidium	≥15-log reduction
Safe Drinking Water Act Contaminants	Meets all MCLs
TOC	≤ 0.5 mg/L

a. The alternative treatment clause does allow for some flexibility in treatment process selection, but any proposed treatment alternative needs to be reviewed and approved by an IAP.

The DPR regulations encompass a broad range of obligations, including treatment requirements, monitoring protocols, source control, reporting, and more. The structure is largely akin to what has been established for IPR (i.e., GWR and SWA), but several of the stipulations have been tightened and new aspects have been added. Table 4-6 summarizes the key regulatory requirements for DPR and how those compare to the requirements previously established for GWR and SWA.

<table>
<tr><th colspan="4">Table 4-6. Comparison of Regulatory Requirements for IPR and DPR Projects</th></tr>
<tr><th rowspan="2">Requirement</th><th colspan="2">IPR</th><th>DPR</th></tr>
<tr><th>GWR</th><th>SWA</th><th>RWA and TWA</th></tr>
<tr><td>Organizational Structure</td><td>Main entity is the project sponsor
Requires an IAP for review of proposed alternative</td><td>Includes both the wastewater agency and public water agency
Requires a Joint Plan
Requires IAP review of the proposed alternative and the reservoir's hydraulic characterization</td><td>Requires establishment of a DiPRRA
Requires a Joint Plan
Requires IAP review of various project elements, including the Enhanced Source Control Program (ESCP), water safety plans, TMF capacity, and water quality data</td></tr>
<tr><td>Wastewater Source Control</td><td colspan="2">Requires industrial pretreatment and pollutant source control program, including:
Assessment of the fate of site-specific chemicals through the wastewater and recycled water treatment systems
Monitoring and investigation of chemical sources
Outreach program to minimize discharge of chemicals into the feed water</td><td>Requires:
ESCP
All elements of source control as needed for IPR
Quantitative evaluation of chemicals discharged to collection system
Early warning program with online monitoring that indicates an increase in chemical contamination
Coordination with pretreatment program for notification of discharges above allowable limits
Tracking of local public health surveillance programs to determine when community outbreaks of disease occur
Establishment of a source control committee</td></tr>
<tr><td>Feedwater Monitoring</td><td colspan="2">No specific requirements</td><td>Prior to operation, 24 months of monthly monitoring to characterize the quality of wastewater to be used and treated by the DPR project to produce purified water
This includes contaminants with an MCL, priority pollutants, NLs, a specific list of solvents, disinfection byproducts (DBP), and DBP precursors</td></tr>
<tr><td>Pathogen Control</td><td>≥12-log virus
≥10-log Giardia
≥10-log Cryptosporidium</td><td>12 to 14-log virus
10 to 12-log Giardia
10 to 12-log Cryptosporidium</td><td>≥20-log virus
≥14-log Giardia
≥15-log Cryptosporidium
Pathogen removal can be as low as 16/10/11 for up to 10% of the time an AWPF is operating during a month
At least four treatment units should provide no less than 1-log removal
Three different mechanisms of control, including UV disinfection, membrane physical separation, and chemical inactivation, must be provided for each pathogen
Regulations include crediting flexibility for continuous blending with another water source, continuous mixing in a reservoir, and/or retention in a groundwater basin</td></tr>
<tr><td>Treatment Requirements</td><td colspan="2">RO + AOP is required</td><td>Ozone/BAC + RO + AOP are required, in that order
Ozone/BAC is not required if a continuous blending process reduces the percentage of purified water to 10 percent or less of the total flow</td></tr>
</table>

Table 4-6. Comparison of Regulatory Requirements for IPR and DPR Projects

<table>
<tr><th rowspan="2">Requirement</th><th colspan="2">IPR</th><th>DPR</th></tr>
<tr><th>GWR</th><th>SWA</th><th>RWA and TWA</th></tr>
<tr><td>Chemical Control</td><td colspan="2">• Maximum TOC contribution by purified water is limited to 0.5 mg/L
• Must meet all current drinking water standards (i.e., MCLs, DBPs, and action levels [AL]) and provide quarterly monitoring</td><td>• Maximum TOC contribution by purified water is limited to 0.5 mg/L with more-stringent TOC thresholds with response actions for the RO system
• Must meet all current drinking water standards (i.e., MCLs, DBPs, and ALs) and provide monthly monitoring
• Ability to attenuate a 1-hour chemical spike
• Continuous monitoring of nitrate and nitrite downstream of RO treatment</td></tr>
<tr><td>Additional Monitoring</td><td>• Quarterly sampling in purified water for priority pollutants, unregulated chemicals, and NLs</td><td>• Quarterly sampling in purified water for priority pollutants, unregulated chemicals, and NLs
• 24 months of monthly sampling for secondary MCLs, TOC, nitrogen, and others at multiple locations in the reservoir to be augmented
• Additional monthly monitoring for at least the first 24 months of operations</td><td>• Monthly and quarterly monitoring required in feed water, directly after oxidation process, and of purified water
  • All MCLs, secondary MCLs, NLs, priority toxic pollutants, ALs, DBPs, DBP precursors, and specific solvents are to be monitored monthly
  • Chemicals known to cause cancer or reproductive issues are to be monitored quarterly for at least 3 years
• Weekly monitoring of nitrate, nitrite, perchlorate, and lead in the purified water only</td></tr>
<tr><td>Environmental Buffer</td><td>• A minimum of 2 months of underground retention time</td><td>• Minimum reservoir retention time of 180 days with the potential to reduce to 60 days with additional pathogen control
• Minimum reservoir dilution of 10:1 with 1-log reduction value of pathogen treatment added if dilution is less than 100:1</td><td>• No environmental buffer</td></tr>
<tr><td>Response Time</td><td>• A minimum of 2 months of underground retention time</td><td>• No specific requirements</td><td>• System must be designed to meet certain response time requirements to ensure diversion and/or shutoff can occur in event of a failure to meet pathogen and/or chemical control requirements
• If a failure is identified, system must divert or shut off before 10% of off-specification water reaches diversion or shutoff point</td></tr>
<tr><td>Operator Requirements</td><td colspan="2">• No specific requirements</td><td>• T5 chief and T3 shift operator must oversee entire DPR treatment train
• AWTO certification is required for any facility providing chemical control:
  • AWT5 for chief operators
  • AWT3 for shift operators
• 24/7 staffing requirement for any facility providing either chemical or pathogen control</td></tr>
</table>

Table 4-6. Comparison of Regulatory Requirements for IPR and DPR Projects			
Requirement	IPR		DPR
	GWR	SWA	RWA and TWA
Documentation	• Engineering Report • Operations Optimization Plan	• Joint Plan • Engineering Report • Operations Plan • Plan to address impacts to WTP and distribution system	• Joint Plan • Water Safety Plan • Engineering Report • Operations Plan • Pathogen and Chemical Control Point Monitoring and Response Plan • Monitoring Plan • Corrosion Control and Stabilization Plan • Consumer Confidence Report • Annual Climate Change Report
Reporting Frequency	• Annual compliance reporting		• Monthly compliance reporting

4.2 Previously Identified Potable Reuse Opportunities

The 2019 RWMP developed and evaluated a list of 36 potable reuse opportunities. The opportunities considered available sources of treated municipal wastewater within or immediately adjacent to the District's water service area, considered all forms of potable reuse (i.e., GWR, SWA, RWA, and TWA), and assessed infrastructure (e.g., pipelines and pumps) needs to convey the purified water from the new AWPFs to their anticipated delivery point. As part of this effort, seven treatment trains were developed based on the combination of wastewater source and reuse type for each opportunity. At a minimum, all treatment trains developed included FAT.

As part of the RWSP, these opportunities were reassessed to reflect the changes in reuse conditions and evaluation criteria was updated to create a refined list of alternatives that may be best suited to help the District achieve its reuse goals. This section summarizes the approach used to conduct this updated assessment and the resultant list of five potable reuse alternatives that were carried forward for further development.

The following nomenclature will be used to discuss potable reuse opportunities throughout this section: XX-YYY-##, where XX represents the effluent source, YYY represents the reuse type (for SWA opportunities this will be delivery point), and ## represents the production rate. As an example, the Oro-ResU-8 opportunity refers to an alternative that receives source flow from the Oro Loma WPCP, is an SWA opportunity that would deliver purified water to the USL Reservoir and produce 8 mgd of purified water.

4.2.1 Reassessment of Previously Identified Potable Reuse Opportunities

As an initial step in the reassessment process, both the approach and assumptions used to develop the 2019 RWMP list of opportunities were reviewed and reaffirmed for most of the projects, apart from the Central San opportunities. Findings from the District and Central San Recycled Water Project Concept Evaluation Report resulted in:

- The addition of two Central-San-specific opportunities (CC-ResLV-17.9 and CC-Raw WCK-17.9).
- The update of the maximum projected yield for two of the Central-San-specific opportunities that had been previously identified (CC-Raw-17.9 and CC-ResB-17.9 production rates were previously both at 19 mgd but have now been revised to 17.9 mgd).

Costs from the 2019 RWMP were not modified or escalated for this initial reassessment process to avoid any potential comparison between costs presented in this section and costs tabulated for the five potable reuse alternatives that are carried forward for further development. The opportunities that are carried forward will undergo a more detailed evaluation to develop a refined set of cost estimates and should not be compared to the initial set of potable reuse cost estimates that were developed as part of the 2019 RWMP. For that reason, costs were simply normalized at this stage to provide a relative reflection of cost per AF of yield within the group of options (100 to 1 scale; the larger the number the more expensive the unit cost of the opportunity). Table 4-7 presents the updated opportunities list.

Table 4-7. Potable Reuse Opportunities						
Name	Reuse Type	Source	Delivery Point	Production Rate (mgd)	Yield (AFY)	Normalized 2019 RWMP Unit Costs[a]
San Leandro WPCP-based opportunities						
SL-Raw-1	RWA	San Leandro WPCP	Upper San Leandro (USL) WTP	1.4	1,568	41
SL-ResU-1	SWA	San Leandro WPCP	USL Reservoir	1.4	1,568	62
SL-Chabot-1	SWA	San Leandro WPCP	Lake Chabot	1.4	1,568	100
SL-Treat-1	TWA	San Leandro WPCP	Dunsmuir Reservoir	1.4	1,568	50
Pinole WPCP-based opportunities[b]						
Pin-Raw-2	RWA	Pinole WPCP	Sobrante WTP	1.7	1,904	26
Pin-ResB-2	SWA	Pinole WPCP	Briones Reservoir	1.7	1,904	32
Pin-ResSP-2	SWA	Pinole WPCP	San Pablo Reservoir	1.7	1,904	18
Pin-Treat-2	TWA	Pinole WPCP	Maloney Reservoir	1.7	1,904	29
Richmond WPCP-based opportunities						
Rich-Raw-4	RWA	Richmond WPCP	Sobrante WTP	3.6	4,033	24
Rich-ResB-4	SWA	Richmond WPCP	Briones Reservoir	3.6	4,033	24
Rich-ResSP-4	SWA	Richmond WPCP	San Pablo Reservoir	3.6	4,033	9
Rich-Treat-4	TWA	Richmond WPCP	Wildcat Aqueduct	3.6	4,033	9
WCW WPCP Based opportunities[c]						
WC-Raw-5	RWA	WCW WPCP	Sobrante WTP	4.7	5,265	24
WC-ResB-5	SWA	WCW WPCP	Briones Reservoir	4.7	5,265	53
WC-ResSP-5	SWA	WCW WPCP	San Pablo Reservoir	4.7	5,265	41
WC-Treat-5	TWA	WCW WPCP	Wildcat Aqueduct	4.7	5,265	15
Oro Loma WPCP-based opportunities						
Oro-GW	GWR	Oro Loma WPCP	Injection Wells	8.0	8,961	32
Oro-Raw-8	RWA	Oro Loma WPCP	USL WTP	8.0	8,961	12
Oro-ResU-8	SWA	Oro Loma WPCP	USL Reservoir	8.0	8,961	18
Oro-Chabot-8	SWA	Oro Loma WPCP	Lake Chabot	8.0	8,961	3
Oro-Treat-8	TWA	Oro Loma WPCP	South Reservoir	8.0	8,961	12
Central San WWTP-based opportunities						
CC-Raw-17.9	RWA	Central San WWTP	Mokelumne Aqueduct	17.9	20,051	1
CC-Raw-10	RWA	Central San WWTP	Mokelumne Aqueduct	10.0	11,201	3
CC-ResB-17.9	SWA	Central San WWTP	Briones Reservoir	17.9	20,051	6
CC-ResB-10	SWA	Central San WWTP	Briones Reservoir	10.0	11,201	6
CC-ResLV-17.9[d]	SWA	Central San WWTP	Los Vaqueros Reservoir	17.9	20,051	N/A
CC-Raw WCK-17.9[d]	RWA	Central San WWTP	Walnut Creek WTP	17.9	20,051	N/A

Table 4-7. Potable Reuse Opportunities

Name	Reuse Type	Source	Delivery Point	Production Rate (mgd)	Yield (AFY)	Normalized 2019 RWMP Unit Costs[a]
EBMUD Main WWTP (SD-1)-based opportunities						
SD1-Raw-30	RWA	SD-1 WWTP	Orinda WTP	30.0	33,604	6
SD1-Raw-10	RWA	SD-1 WWTP	Orinda WTP	10.0	11,201	50
SD1-ResU-30	TWA	SD-1 WWTP	USL Reservoir	30.0	33,604	3
SD1-ResB-30	TWA	SD-1 WWTP	Briones Reservoir	30.0	33,604	9
SD1-ResSP-4	TWA	SD-1 WWTP	San Pablo Reservoir	4.0	4,481	85
SD1-ResU-10	TWA	SD-1 WWTP	USL Reservoir	10.0	11,201	38
SD1-ResB-10	TWA	SD-1 WWTP	Briones Reservoir	10.0	11,201	50
SD1-Treat-30	TWA	SD-1 WWTP	Claremont Center	30.0	33,604	3
SD1-Treat-10	TWA	SD-1 WWTP	Claremont Center	10.0	11,201	35
Satellite Treatment opportunities						
LA-Chabot-10	SWA	LAVWMA Castro Valley	Lake Chabot	10.0	11,201	53
Sat-ResSP-4	SWA	Satellite – Pt. Isabel	San Pablo Reservoir	4.0	4,481	32

a. *Unit costs for the potable reuse alternatives from the 2019 RWMP were normalized using a "min-max normalization" approach.*
b. *These alternatives are mutually exclusive with the Phillips 66 Refinery/RREC Recycled Water Project.*
c. *These alternatives are mutually exclusive with the Chevron/Richmond Refinery Recycled Water Project.*
d. *These opportunities were not part of the 2019 RWMP; they are new concepts that were identified as part of the District and Central San Recycled Water Project Concept Evaluation Report.*

The reassessment of the potable reuse opportunities largely followed the MCDA process that was used to assess the NPR opportunities in Section 3.3. The evaluation criteria and corresponding weighting factors from Table 3-14 in Section 3.4.1 were used to conduct the evaluation. To compare the opportunities relative to how effectively each met the evaluation criteria, a potable-reuse-specific scoring rubric was developed. The potable reuse opportunities from Table 4-7 were scored from 1 to 5, with a high score indicating a high response to the criterion and a low score indicating a low response to the criterion (5 = most favorable, 1 = least favorable). The rubric includes a brief description of the metrics used to score each alternative. Details pertaining to the potable reuse rubric, opportunity scoring, and considerations that factored into the assigned scores are included in Appendix C of this report.

Figure 4-3 and Figure 4-4 present graphically the results of the relative benefits evaluation. The graphics group all potable reuse opportunities by wastewater source and present the final composite relative benefit score of each opportunity. As discussed previously, each colored bar represents the benefit score for an individual criterion (shown in legend); opportunities with longer bars (i.e., toward the top of the figure) generally offer greater benefits. The results show that those opportunities with the potential for greater benefit disbursement tended to score highest. This included many of the District SD-1 and Central-San-specific projects, whereas opportunities like the ones specific to the San Leandro WPCP and Pinole WPCP did not score as high since these projects tended to be more localized but still involved many of the same complexities as their counterparts.

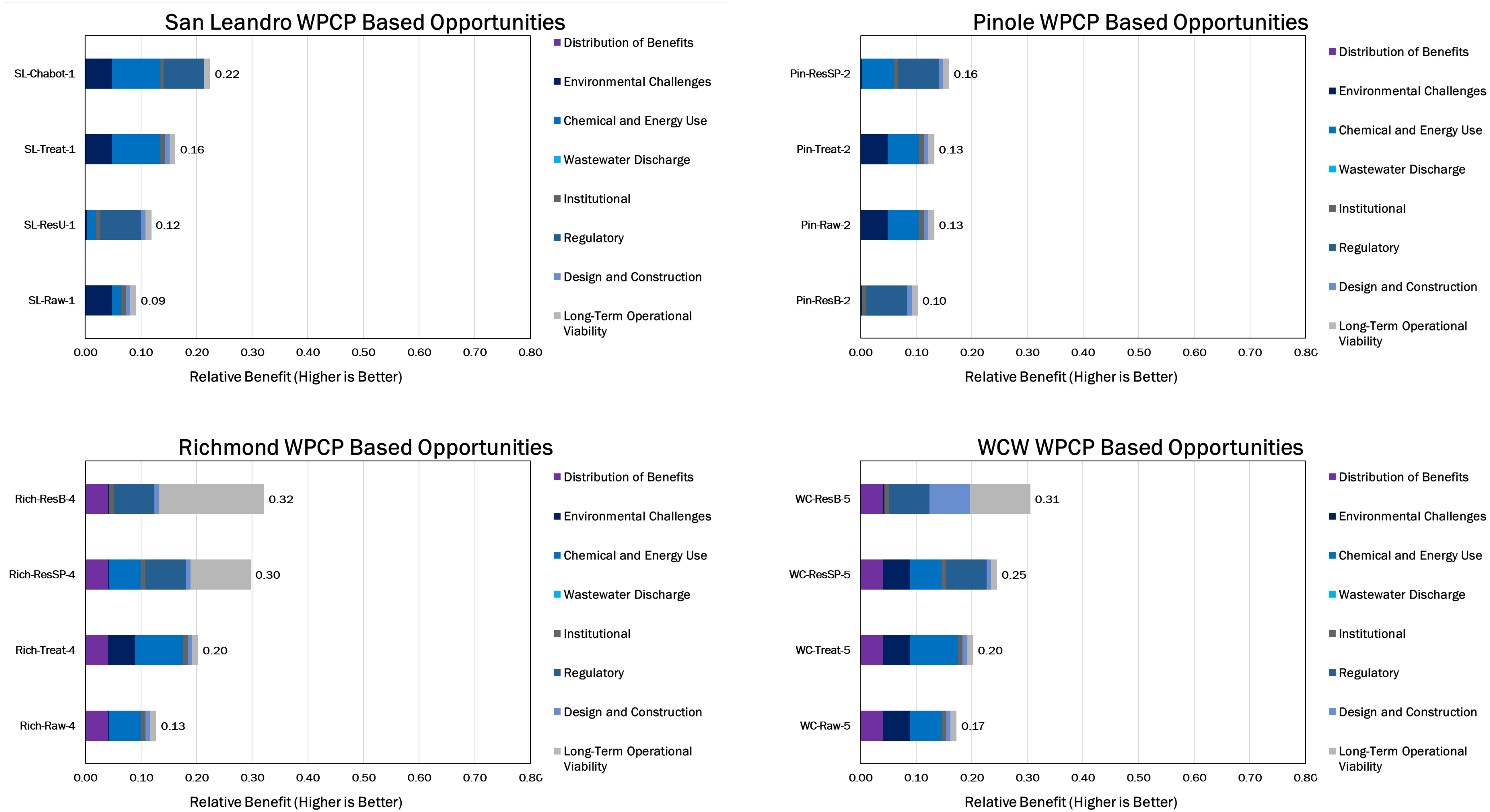
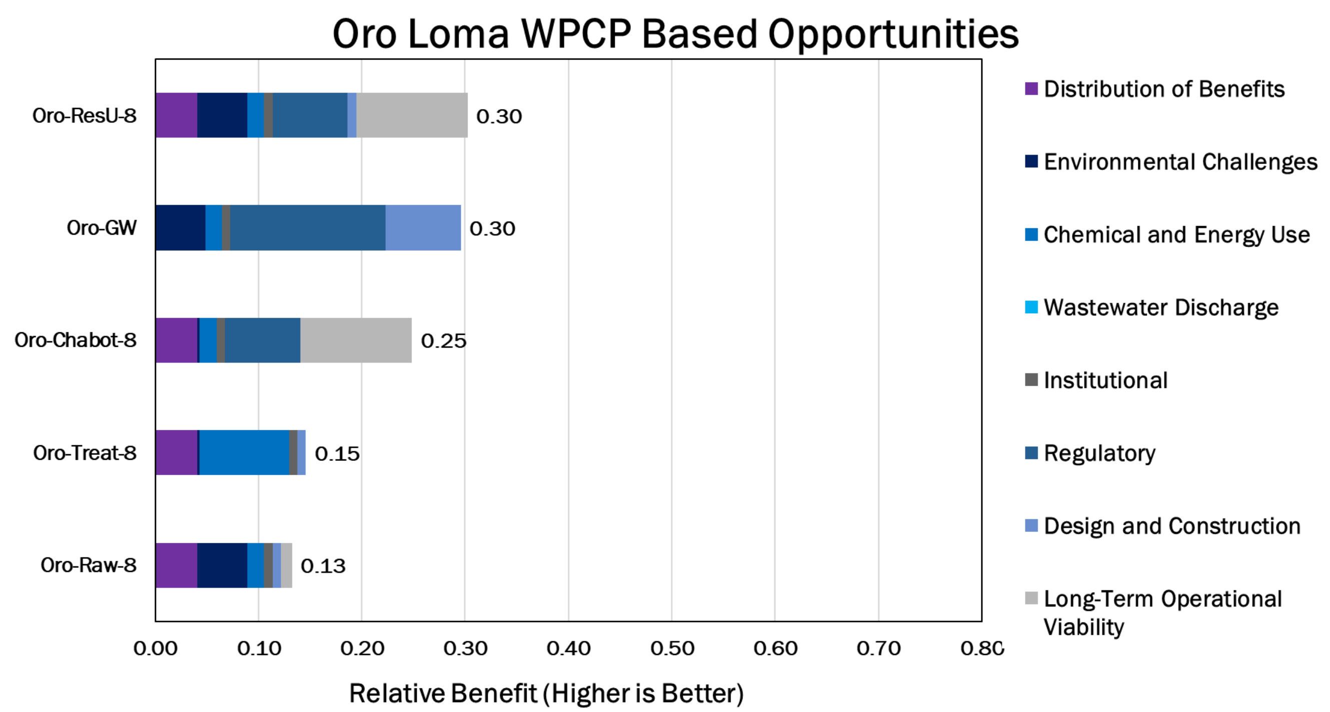
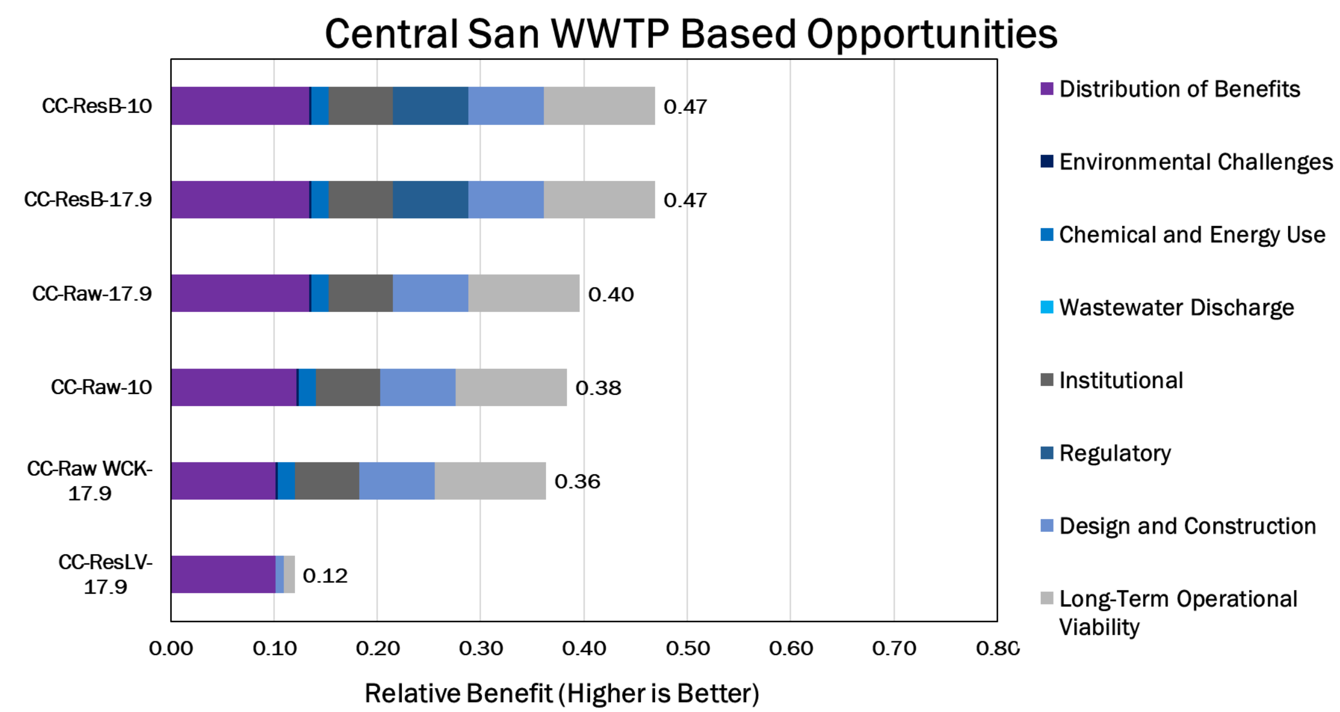
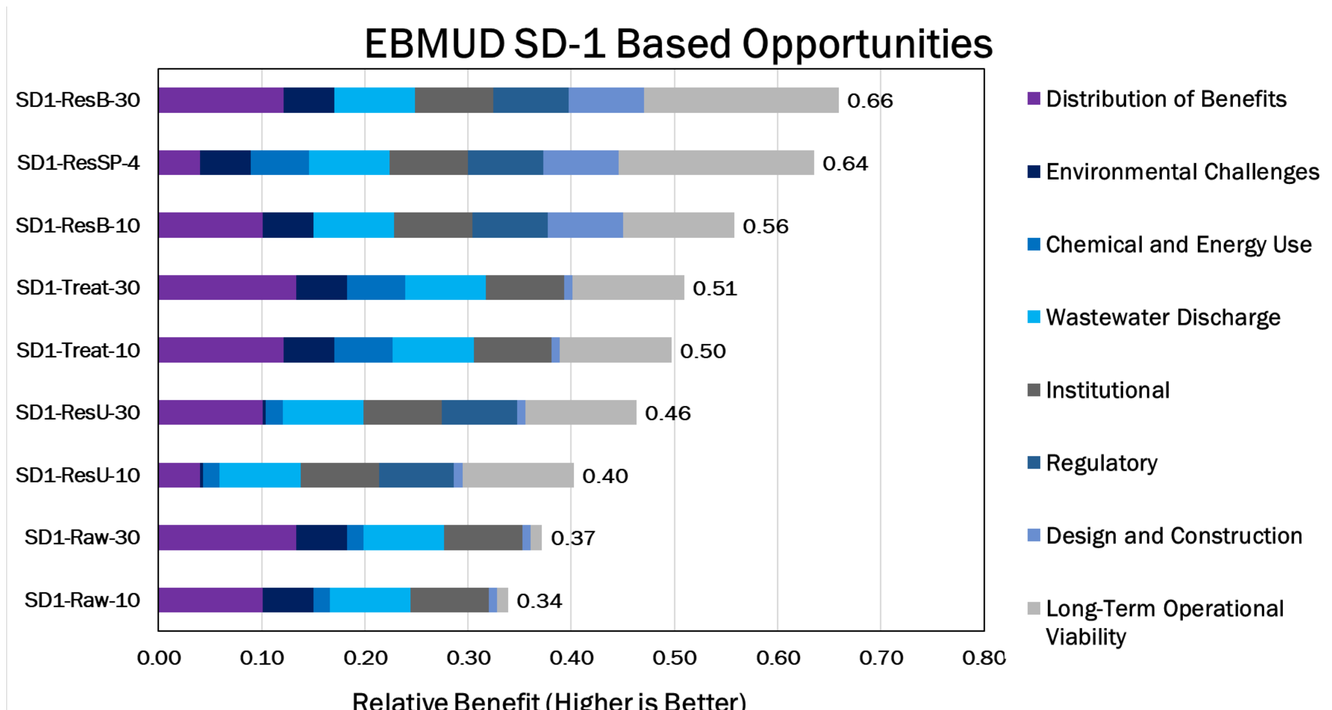


Figure 4-3. Aggregated Relative Benefit Scores of Potable Reuse Opportunities







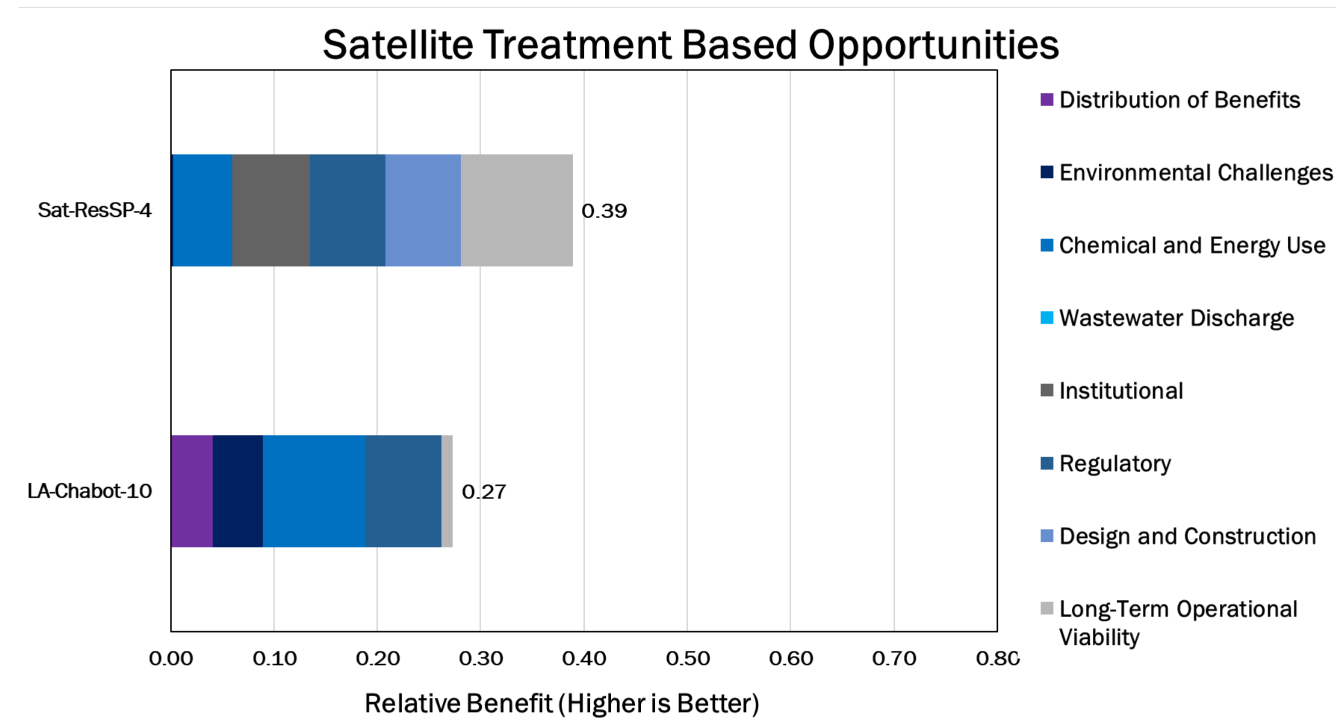


Figure 4-4. Aggregated Relative Benefit Scores of Potable Reuse Opportunities (continued).

4.2.2 Applying Relative Costs to the Benefits Analysis

While the collective characterization of non-financial benefits helps identify the most promising opportunities ostensibly, it doesn't consider the project cost. Incorporating costs alongside benefits introduces an extra layer to the assessment and helps further differentiate the opportunities. Figure 4-5 presents the relative benefit score of each potable reuse opportunity plotted against its respective 2019 RWMP normalized relative unit cost. Note that only potable reuse opportunities with a benefit score above the median score of 0.30 were plotted as a means of focusing the assessment on those opportunities that showed most promise. Twenty projects evaluated had a benefit score above the median score of 0.30 including: two projects from the Richmond WPCP, one project from the WCW WPCP, two projects from the Oro Loma WPCP, five projects from Central San, nine projects from EBMUD's SD-1 WWTP, and one project from the satellite-based treatment alternatives. Opportunities closest to the upper right quadrant present the most favorable combination of costs and alignment with the evaluation criteria.

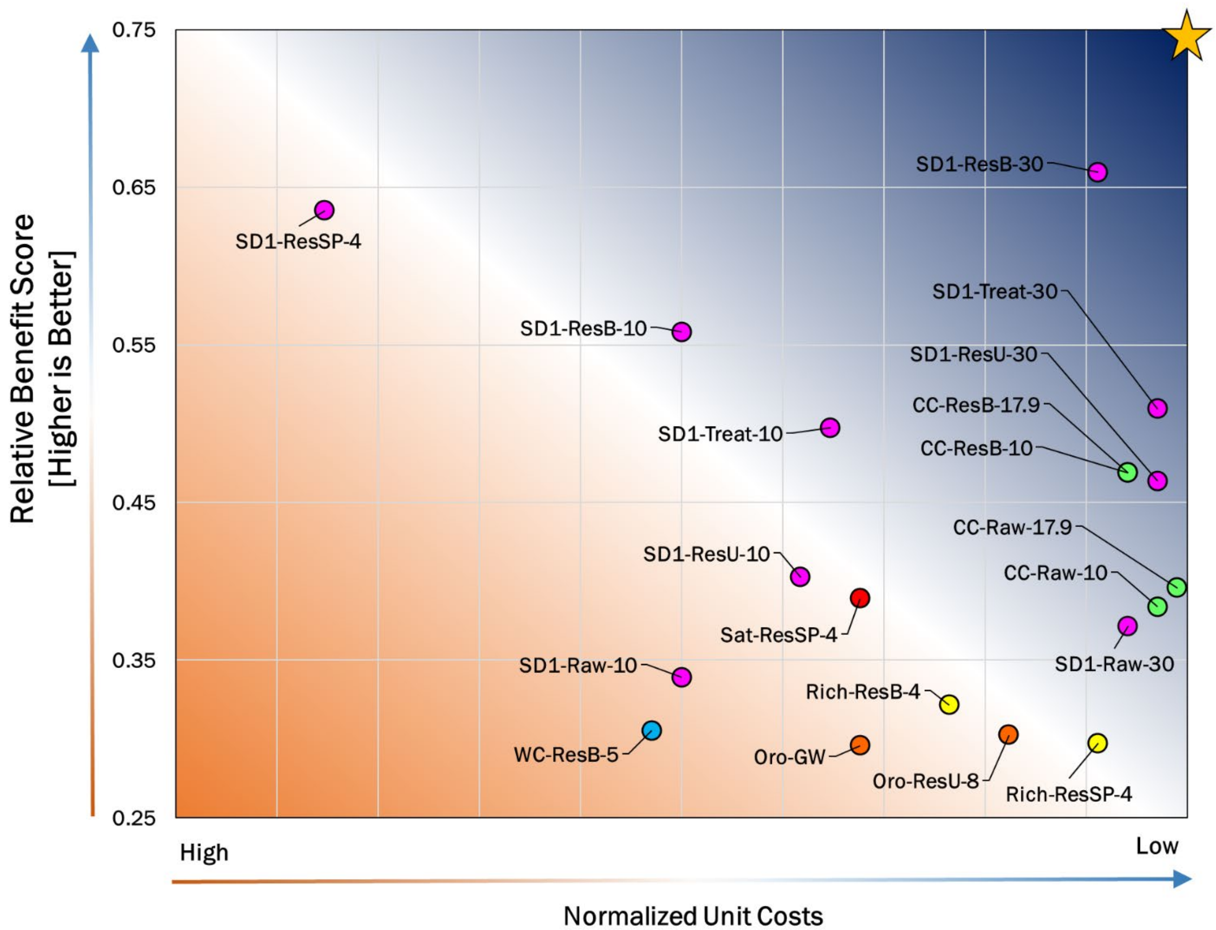


Figure 4-5. Aggregate Relative Benefit Scores for Potable Reuse Opportunities vs. Normalized Unit Costs

Neither CC-ResLV-17.9 nor CC-Raw WCK-17.9 alternatives are shown in the graph since 2019 normalized unit costs for these opportunities are not available.

Color designations: Blue = WCW-WPCP-based alternatives; green = Central-San-based alternatives; orange = Oro Loma-WPCP-based alternatives; pink = EBMUD-based alternatives; yellow = Richmond-WPCP-based alternatives; red = satellite-treatment-based alternatives.

4.2.3 Recommended Potable Reuse Alternatives

Based on the results of the potable reuse alternatives reassessment and discussions with District staff, the five opportunities in Table 4-8 were carried forward for further development. The selection of these projects allowed the District to further evaluate an SWA and TWA option at SD-1; RWA and SWA projects with Central San; and a smaller, more-southern-based SWA option with Oro Loma. It should be noted that the District and Central San's Recycled Water Project Concept Evaluation Report had recommended an RWA project concept that involved Central San effluent and the Walnut Creek WTP (i.e., CC-Raw WCK-17.9) for further assessment as part of this RWSP update. However, after careful consideration, the District opted to instead move forward with the SWA at Briones Reservoir concept (i.e., SD1-ResB-30) as it offered a greater distribution of benefits potential.

Site layouts, treatment, and conveyance needs; key considerations; and planning-level cost estimates for these five alternatives are presented in Section 5 of this TM.

Table 4-8. Highest Ranking Potable Reuse Opportunities

Name	Reuse Type	Source	Delivery Point	Production Rate (mgd)	Yield (AFY)	Normalized 2019 RWMP Unit Costs[a]
Oro Loma WPCP-based opportunities						
Oro-ResU-8	SWA	Oro Loma WPCP	USL Reservoir	8.0	8,961	18
Central San WWTP based opportunities						
CC-Raw-17.9	RWA	Central San WWTP	Mokelumne Aqueduct	17.9	20,051	1
CC-ResB-17.9	SWA	Central San WWTP	Briones Reservoir	17.9	20,051	6
EBMUD Main WWTP (SD-1)-based opportunities						
SD1-ResB-30	SWA	SD-1 WWTP	Briones Reservoir	30.0	33,604	9
SD1-Treat-30	TWA	SD-1 WWTP	Claremont Center	30.0	33,604	3

a. *Unit costs for the potable reuse alternatives from the 2019 RWMP were normalized using a "min-max normalization" approach (100 to 1 scale; the larger the number the more expensive the unit cost of the opportunity).*

Section 5

Recommended Potable Reuse Projects

This section presents additional details on the potable reuse alternatives that were recommended in Section 4 for further advancement. This includes a discussion on treatment needs, considerations for delivery points, and a summary of each alternative that includes facility layouts, project-specific considerations, and cost summaries. This section also discusses ROC management and public outreach and education needs.

5.1 Proposed Treatment

Potable reuse treatment requirements are a function of source water quality, existing WWTP processes, intended use of product water, regulatory requirements, and local/regional requirements and settings. Included below are general descriptions of the various treatment unit processes used by the proposed AWPFs, their primary treatment objectives, and key process variables for monitoring compliance and performance verification. Many of these treatment technologies have been documented in both demonstration and full-scale applications through years of research and performance monitoring.

- **Secondary Treatment.** For this update, it was assumed that the feed water for the new AWPFs will align with year-round “Level 2” nutrient removal requirements as identified in Section 2.2.3. Costs for these nutrient removal improvements are not included in the cost estimates developed for the alternatives presented in this section as it was assumed the improvements would be driven by NPDES permit stipulations.
- **Ozone-BAC.** Ozone is a chemical oxidation and disinfection process that (1) oxidizes organic matter for ready biodegradation by microorganisms in the BAC, and (2) provides targeted LRV credits. BAC is a biological process that metabolizes the organic matter in ozone effluent to increase organic carbon removal and will remove some trace organic chemicals. In the proposed RWA and TWA treatment trains, ozone and BAC function as a combined treatment process that helps address two of the priority topics for DPR in California—control of chemical peaks and low-molecular weight compounds, e.g., certain disinfection byproducts. A contactor provides the necessary residence time for ozonation, and the ozone residual is monitored at multiple points along the contactor vessel. Each residual monitoring point can be used to verify performance. BAC is typically designed using granular activated carbon (GAC) media because GAC has a larger surface area on which to attract microorganisms to the particle surfaces. BAC does not provide pathogen reduction or reduce salinity. Performance can be monitored via TOC analyzers on the filtrate.
- **Membrane Filtration.** Membrane filtration refers to low-pressure membrane processes, including MF and ultrafiltration (UF). MF and UF operate primarily by size exclusion: MF membranes, which are included in the proposed treatment trains, have an effective pore size ranging from 0.1 to 10 micrometers. Membrane filtration removes particles larger than the membrane’s effective pore size, including *Giardia cysts* and *Cryptosporidium oocysts*, but is relatively ineffective at removing viruses and does not remove dissolved organic compounds or salinity. It is typically

used as a pretreatment process that protects downstream RO performance and integrity by removing some protozoa and particles that may damage RO membranes. Membrane integrity can be verified using continuous turbidity measurements and daily pressure decay tests (PDT). LRV credit is limited by the PDT resolution such that credits for 4-log removal of *Cryptosporidium* and *Giardia* can be acquired.

- **RO.** RO involves pushing water at high pressure through a semi-permeable membrane, thereby removing dissolved organic compounds and ions, including most CECs, from the water. RO is used to remove pathogens, TDS, and many chemical constituents. When the integrity of the RO membrane is sound, it is understood to remove essentially all pathogens from the permeate (unlike MF/UF membranes, RO does not have an integrity test). RO creates a residual stream (concentrate) that is typically 15 to 20 percent of the feed stream volume. Parameters used for monitoring RO performance include conductivity and TOC. TOC removal is often used to approximate pathogen removal, but regulations limit LRV credit to 2-logs for V/G/C when monitoring using TOC.
- **UV/AOP.** UV/AOP uses high-intensity UV light combined with an oxidant such as chlorine or hydrogen peroxide to provide advanced disinfection as a final polishing step following RO. Sodium hypochlorite is used as the oxidant in this analysis. UV is highly effective for disinfection, providing up to 6-log inactivation of V/G/C. The UV doses used for UV/AOP are significantly greater than the dose required in most drinking water applications. A typical dose for UV/AOP is at least 800 to 900 millijoules per square centimeter (mJ/cm2), but the required dose is only 100 mJ/cm2 for disinfected tertiary recycled water and less than 40 mJ/cm2 for typical drinking water applications (for *Giardia* and *Cryptosporidium* removal credit). The key parameters for verifying UV/AOP system performance are UV intensity, flow rate, UV transmittance (UVT) at 254 nanometers, and chemical dosing rate. RO permeate typically has a UVT between 96 and 98 percent and is strongly influenced by the chloramine concentration.
- **Product Water Stabilization.** RO permeate is highly corrosive and must be stabilized to prevent pipe corrosion downstream of the RO treatment. Lime addition increases the pH (thus increasing the alkalinity) and adds calcium to the water to stabilize the water and minimize corrosivity. The amount of lime needed, as well as the entire post-treatment strategy, is determined using various corrosivity indices, such as the Langelier Saturation Index or Aggressiveness Index, and would be informed by corrosion control studies.
- **Chlorine Disinfection.** Chlorine disinfection provides additional protection against microbes and viruses, as well as a residual for distribution. It is used to provide additional LRV credits for both RWA and TWA (i.e., 6-log removal for viruses and 1-log removal for *Giardia*). Dose and contact time may be based on the EPA guidance for drinking water disinfection. Free chlorine disinfection can achieve additional LRV credits for viruses and *Giardia,* but it is ineffective for *Cryptosporidium*. Chlorine can also provide residual disinfectant to control biofilm growth in the distribution system. For RWA and TWA, free chorine disinfection would be implemented in the pipeline between the AWPF and the respective delivery points that would provide sufficient detention time for disinfection to occur. Additionally, an 8-hour clearwell provides emergency storage in the event of process interruptions.

5.1.1 Surface Water Augmentation

The overall pathogen requirements for SWA depend on the level of dilution offered by the reservoir being augmented. For reservoirs that provide a 100:1 dilution and a retention time of at least 4 months, Title 22 regulations require a 12/10/10-log reduction of V/G/C. To meet these LRVs, the AWPFs must provide 8/7/8-log reductions of V/G/C, with the WTPs providing the remaining 4/3/2. If, however, the reservoirs provide only 10:1 dilution or if they offer less than 4 months of retention time, an additional log reduction will be required, for a total of 13/11/11. In this dilution scenario, the AWPF would need to provide 9/8/9 LRVs for V/G/C. Considering the uncertainty of the dilution and retention time provided by the Briones and USL reservoirs, it was conservatively assumed that an AWPF providing 9/8/9 would be appropriate for both scenarios. Table 5-1 summarizes treatment goals and default pathogen reduction credits granted for each FAT unit process.

Table 5-1. SWA Treatment Train Pathogen Control

Unit processes	Microbiological log removal credits			Organic matter removal		Salinity
	Viruses	*Giardia*	*Cryptosporidium*	TOC	CECs[a]	
Assumed credits						
MF	0	4	4	No	No	No
RO	1.5	1.5	1.5	Yes	Yes	Yes
UV/AOP	6	6	6	No	Yes	No
Chlorine disinfection	6	1	0	No	No	No
WTP Credits[b]	4	3	2	--	--	--
Total	13.5	15.5	13.5	--	--	--
Required credits						
Required	13	11	11	Yes	Yes[c]	No[d]

a. *Each unit process targets certain CECs, but not all CECs will be removed equally by any one process.*

b. *Assumed the WTPs would provide 4/3/2-log reductions of V/G/C.*

c. *Not all CECs require specific removal rates. The requirements can vary based on known or perceived human health risk and are informed by site-specific water quality monitoring and current and proposed regulations. Typical removal rates range from 70% to more than 99%, depending on unit processes.*

d. *Managing salinity is a long-term sustainability issue that must be considered in the treatment process selection. Not every system will require salinity removal.*

The process flow diagram for the SWA alternatives is shown on Figure 5-1. This treatment train is composed of MF, RO treatment, and UV/AOP and should help protect reservoir water quality, limit nutrient loading, and guard against potential impacts from trace organic contaminants such as per- and polyfluoroalkyl substances (PFAS).

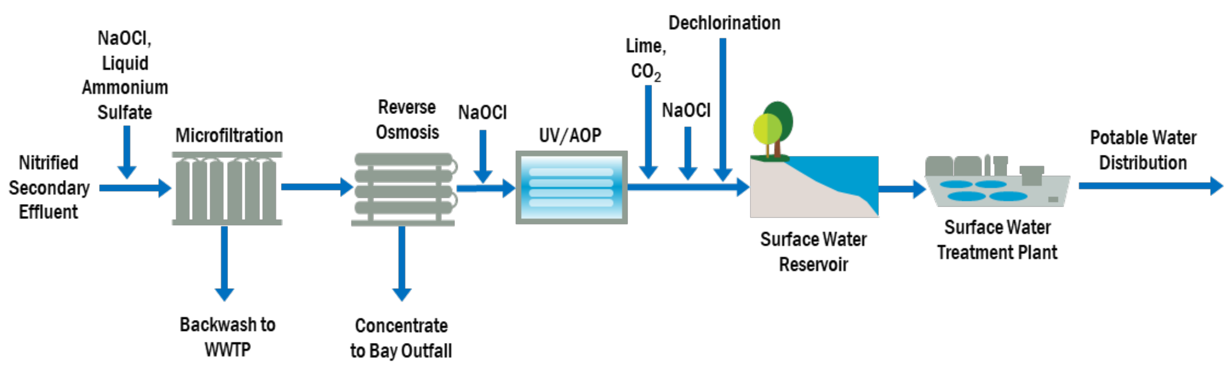


Figure 5-1. AWPF Process Flow Diagram for SWA

NaOCl = sodium hypochlorite; CO_2 = carbon dioxide

5.1.2 Raw Water and Treated Water Augmentation

The newly adopted DPR regulations call for a more robust treatment train to comply with stricter requirements for both pathogen and chemical control. Based on an assessment of these newly adopted requirements, a FAT process train with the addition of ozone-BAC pretreatment, low-dose UV between the MF and RO processes, and free chlorine disinfection is proposed. Table 5-2 provides default credits and demonstrates the level of pathogen treatment applicable to each treatment process. LRV redundancy will be beneficial for operating AWPFs and maintaining a high degree of system availability (i.e., online reliability).

Table 5-2. RWA and TWA Treatment Train Pathogen Control

Unit processes	Microbiological log removal credits			Control of chemical compounds				Salinity[b]
	Viruses	*Giardia*	*Crypto-sporidium*	TOC	CECs[a]	Chemical Peaks	Low Molecular-weight Compounds	
Assumed credits								
Ozone/BAC	6	6	1	Yes	Yes	Yes	Yes	No
MF	0	4	4	No	No	No	No	No
Low-dose UV	1	5	5	No	Yes	Yes	Yes	No
RO	1.5	1.5	1.5	Yes	Yes	Yes	Some[c]	Yes
UV/AOP	6	6	6	No	Yes[d]	Yes[d]	Yes[d]	No
Chlorine disinfection	6	1	0	No	No	No	No	No
Total	20.5	23.5	17.5	--	--	--	--	--
Required credits								
Required	20	14	15	Yes	Yes[a]	Yes	Yes	No[b]

a. *Not all CECs require specific removal rates. Requirements can vary based on known or perceived human health risk. Typical removal rates range from 70% to more than 99%.*
b. *Managing salinity is a long-term sustainability issue that must be considered in the treatment process selection. Not every system will require salinity removal.*
c. *RO is typically less effective for control of low-molecular-weight organic compounds that are uncharged and polar.*
d. *UV/AOP will provide some treatment for chemical peaks of constituents amenable to treatment by the process (e.g. 1,4-dioxane).*

The treatment processes for the RWA and TWA AWPFs were selected considering both pathogen and chemical treatment in terms of microbiological log removal, chemical compound control, and salinity reduction, as shown on Figure 5-2. The DPR regulations also included requirements to address two topics of concern for chemical control:

- Attenuation of chemical peaks (i.e., high concentrations of chemicals that may be released into the treatment process, as from an industrial spill), including both known and unknown compounds
- Increased removal of low-molecular-weight compounds, including both known and unknown compounds that have been observed to pass through FAT trains

The selected TWA treatment train is believed adequate to safeguard against these two DPR chemical control issues, but these items would need to be further assessed through modeling to confirm both items are adequately addressed.

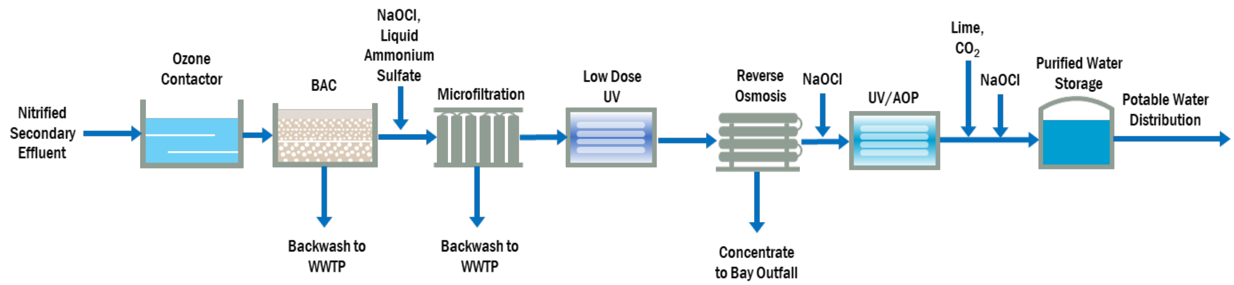


Figure 5-2. AWPF Process Flow Diagram for RWA and TWA

5.1.3 RO Concentrate Management

For projects that use RO, ROC stream management is an important part of the permitting process. As an RO system rejects 95 to 99 percent of dissolved salts, this concentrate stream contains high levels of TDS that must be properly managed. ROC management strategies vary depending on the AWPF location. Table 5-3 summarizes some of these strategies. As part of the RWSP, it was assumed that all the potable reuse concepts presented later in Section 5.2 would dispose of their respective ROC through an existing deep-water Bay outfall. A more detailed evaluation will need to be conducted to determine which strategy might work best given the characteristics of each proposed AWPF concepts.

Table 5-3. ROC Management Strategies

Strategy	Description	Considerations
Discharge through an Outfall	Discharge through an existing or new outfall is a potential strategy. The benefit is that it avoids impacts on downstream collection systems and WWTP processes; however, the viability of this strategy depends on the impact of concentrate flow on pollutant concentrations or toxicity limits specified in an existing outfall's NPDES permit.	Anticipated water quality concerns for ROC disposal through existing outfalls include nutrients, TOC, TDS, and trace metals like copper and nickel. Metals are of particular concern because they typically have concentration-based limits. As wastewater effluents are diverted for water reuse, the available dilution volume to reduce the concentrations of these contaminants goes down, which makes NPDES compliance potentially challenging. A new outfall could be a regional concentrate disposal solution; however, similar to using an existing outfall, it would require obtaining an NPDES permit and ensuring compliance with the SF Bay Basin Plan.
Deep Well Injection	ROC would be injected into a deep confined aquifer under pressure, and the injection zone would be selected to prevent impacts to any drinking water aquifers (or any other beneficial uses).	Option is viable only in areas with favorable hydrogeological conditions. For permitting, California has primacy for Class II – oil- and gas-related wells; all other injection wells are regulated by the EPA and must be registered through the federal Underground Injection Control program.
Evaporation Ponds	Evaporation ponds, either with or without mechanical enhancement tend to be easy to operate and help divert ROC from the San Francisco Bay.	Evaporation ponds typically require large areas of land which, depending on the location, might present some challenges. For permitting requirements, development of an evaporation pond would be included in an NPDES or WDR permit application. Any existing NPDES or WDR permits would be subject to RWQCB revision and re-approval.

Table 5-3. ROC Management Strategies		
Strategy	**Description**	**Considerations**
Engineered Wetlands and Treatment Cells	ROC could be managed and treated through engineered wetlands. Engineered fresh and brackish water wetlands could reduce the concentrations of nutrients and trace contaminants in ROC. Wetlands designated as "treatment" wetlands would be permitted as part of the overall wastewater treatment process.	If necessary, additional pretreatment of open-water treatment cells could be applied to further reduce pollutant loading; however, permitting for treatment cells could be challenging, as coordination would be needed with the U.S. Army Corps of Engineers, RWQCB, U.S. Fish and Wildlife Service, California Department of Fish and Wildlife, and the San Francisco Bay Conservation and Development Commission. Treated ROC from treatment cells and engineered wetlands would have to be conveyed to another location for ultimate disposal; however, this management strategy could potentially be combined with another disposal option, e.g., the ROC could be treated via engineered wetland before being discharged through an outfall. The wetland would reduce ROC pollutant concentrations and toxicity, potentially maintaining effluent concentrations below NPDES permit limits.
Sanitary Sewer Discharge	This option discharges into an existing sanitary sewer system for treatment at a WWTP. This would require coordination with the managing utility (e.g., Central San or OLSD), which may include acquiring an industrial discharge permit. Multiple costs are associated with this strategy, including those of a new sanitary sewer/treatment plant connection and the potential increase in unit treatment costs due to increased 5-day biochemical oxygen demand (BOD) and TSS concentrations of the wastewater influent.	Potential downstream impacts to the collection system or WWTP need to be considered. High sulfate or chloride levels could cause corrosion within the pipeline, and ROC may need to be discharged in locations with sufficient flow to provide needed dilution. Pollutant increases could also impact downstream WWTP operations, particularly increases in nutrients and trace metals. These WWTP influent concentration increases can also translate to increased concentrations in the effluent, which could challenge NPDES permit limits (e.g., by contributing to toxicity in the receiving water) or impact downstream advanced water treatment facilities. For example, increases in TDS could impact downstream potable RO systems and create a positive feedback loop.

5.2 Potable Reuse Alternatives Summary

This section summarizes the planning-level facilities for the five potable reuse options identified in Section 4, including treatment facilities, conveyance/distribution facilities (e.g., pipelines and pump stations), and conceptual cost estimates. The cost estimates are based on vendor quotes specific to the proposed facilities, historical construction estimates, historical costs, and professional experience with similar projects. These details will need to be further refined and optimized in future studies. It is important to note that these estimated costs do not consider impacts of external funding, and therefore, may not necessarily represent the costs to the District. Additional detailed information to supplement this section can be found in this report's attachments. The proposed potable reuse alternatives are:

- SWA at Briones Reservoir from SD-1 (SD1-ResB-30)
- TWA through the District's Claremont Center (SD1-Treat-30)
- SWA at Briones Reservoir from Central San (CC-ResB-17.9)
- RWA at Mokelumne Aqueducts (CC-Raw-17.9)
- SWA at Upper San Leandro Reservoir (Oro-ResU-8)

5.2.1 Surface Water Augmentation at Briones Reservoir from SD-1 (SD1-ResB-30)

This alternative is centered on using available effluent from the District's SD-1 WWTP and a new AWPF located adjacent to the existing SD-1 WWTP in Oakland. This area is owned by the District but is currently leased to outside entities. Purified water produced from this new AWPF would be conveyed to the Briones Reservoir. The Briones Reservoir was created in 1964 with the construction of Briones Dam on Bear Creek. With a storage capacity of 60,500 AF, it is the largest among the five District-managed terminal reservoirs. It is given the highest priority for filling among the terminal reservoirs as it contains almost half of the reservoirs' total standby storage and is at an elevation high enough to supply all District WTPs.

5.2.1.1 Facilities Summary

The proposed project would produce up to 30 mgd of purified water at a new AWPF constructed next to the existing SD-1 WWTP. The purified water would be conveyed to the Briones Reservoir through a new pump station and 14.7-mile-long, 42-inch steel pipeline to the Briones Reservoir, as shown on Figure 5-3. The proposed project would leverage the San Pablo Tunnel, which was assumed would be rehabilitated and reused to serve as part of the pipeline alignment. The proposed 14.7-mile pipeline from the AWPF to Briones Reservoir is expected to traverse through highly urbanized settings with significant utilities and temporary community disruption. Once in the reservoir, the purified water may be drafted back to the Briones and Orinda Distribution Centers through the Briones Aqueduct and continue to the Orinda WTP for treatment and eventual distribution within the District's West of Hills distribution system.

The layout for this AWPF is shown on Figure 5-4. The total footprint for the proposed facilities would be approximately 250,000 square feet. Treatment processes would be as described in Section 5.1.1. It was assumed that all treatment equipment for MF, RO, and UV/AOP are within a single process building to provide weather protection. For site planning, representative equipment layouts were arranged within the building to allow efficient O&M access. The process building also includes space for staff and facilities to support AWPF O&M. Ancillary facilities, post-treatment areas, chemical storage, water storage, and pumping facilities are assumed to be outside or under canopies. Key facilities are highlighted in Table 5-3.

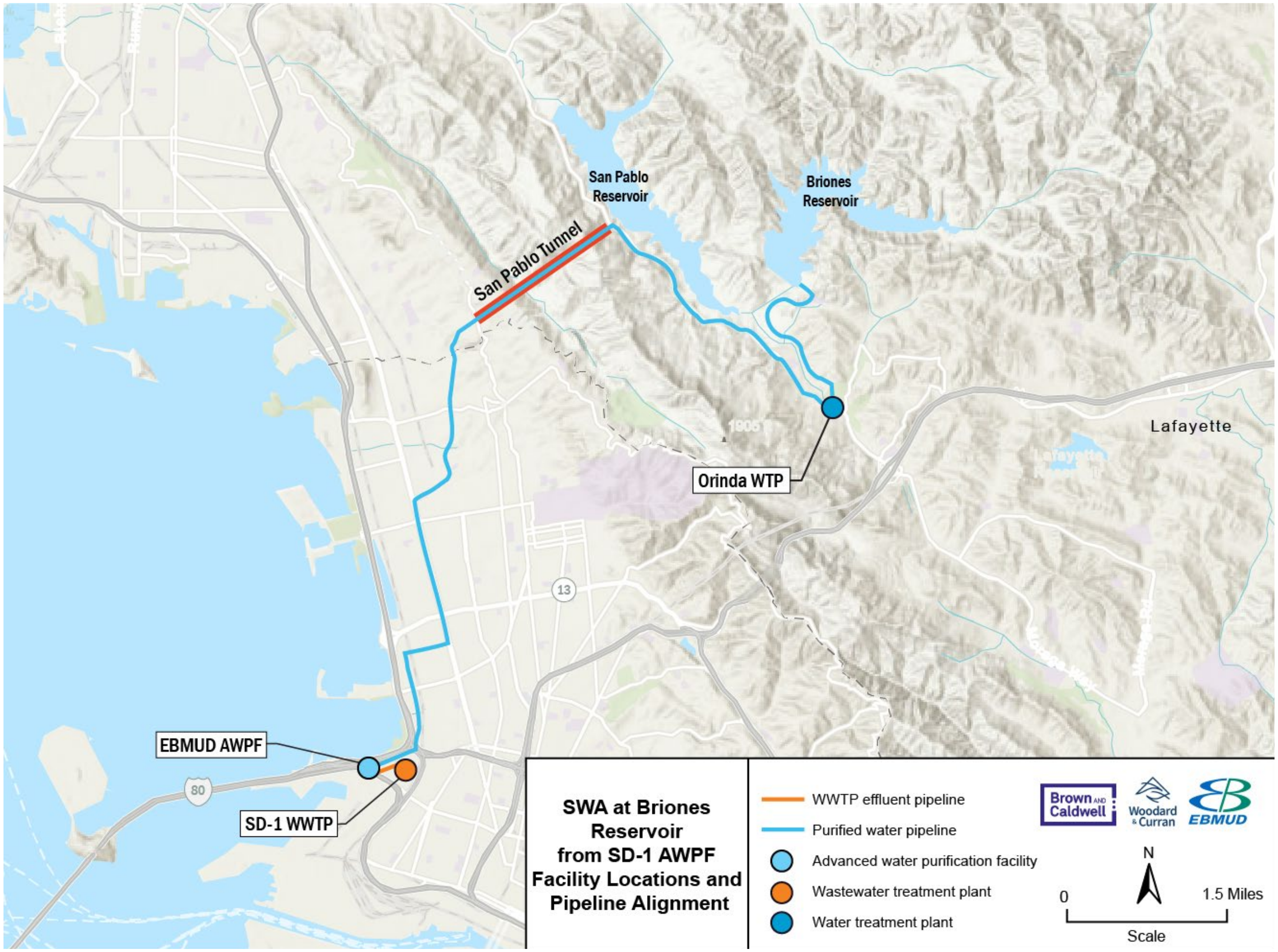


Figure 5-3. Purified Water from EBMUD 30-mgd AWPF to Briones Reservoir

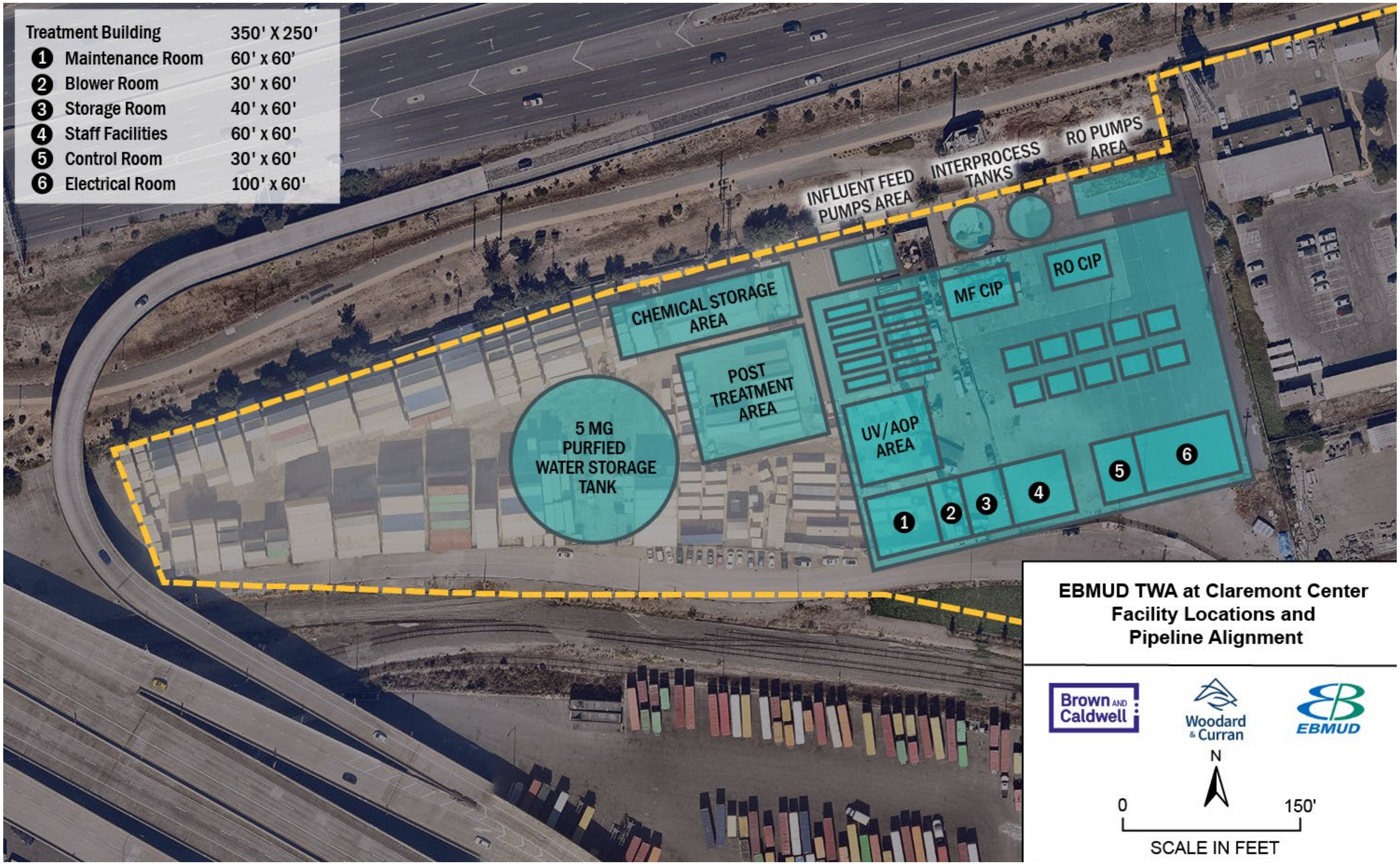


Figure 5-4. Site Layout for SWA EBMUD 30-mgd AWPF

CIP = clean-in-place

Table 5-3. SWA at Briones Reservoir from SD-1 Facilities Summary				
Element	**Criteria**	**Quantity**	**Unit**	**Notes**
EBMUD AWPF for SWA	Capacity	30	mgd	30-mgd AWPF for SWA at Briones Reservoir
Annual yield				
Annual yield	Yield	33,600	AFY	Based on purified water production capacity
Pump stations				
Pump Station 1	Flow	27,360	gpm[a]	Effluent from SD-1 WWTP to EBMUD AWPF
	TDH	40	ft	
Pump Station 2	Flow	20,833	gpm[a]	Purified water from EBMUD AWPF to Briones Reservoir
	TDH	740	ft	
Effluent and conveyance pipelines				
Pipeline 1	Diameter	48	inch	Effluent from SD-1 WWTP to EBMUD AWPF
	Length	620	ft	
Pipeline 2	Diameter	42	inch	Purified water from EBMUD AWPF to Briones Reservoir
	Length	77,400	ft	
ROC management				
ROC management pipeline	Diameter	24	inch	ROC disposal to SD-1 WWTP outfall
	Length	620	ft	
ROC management pump station	Flow	6,600	gpm[a]	ROC disposal to SD-1 WWTP outfall
	TDH	40	ft	

a. 1 gpm = 0.00144 mgd
TDH = total dynamic head

5.2.1.2 Project Considerations

Both SWA and GWR projects benefit from an established set of regulations with clear precedents to help navigate through potential challenges. As it pertains to SWA, California already has one project permitted under the 2018 regulations (City of San Diego's North City Pure Water Project) and two others that are currently being developed (East County Advanced Water Purification and Pure Water Las Virgenes). Based on gathered insights from these projects, key District considerations are:

- **Chemical Control.** The proposed FAT train plus dilution in the reservoir should facilitate adherence to SWA's chemical control requirements. Beyond the public health mandates in the SWA regulations, SWA projects typically need to meet environmental discharge requirements through NPDES permits, which can impose stricter limits than the IPR regulations. Specifically, SWA projects may have more-stringent nutrient control limits to manage eutrophication in the reservoir while also complying with the California Toxics Rule (CTR). The CTR includes rigorous requirements for constituents such as trihalomethanes and N-nitrosodimethylamine (NDMA). These strict environmental discharge limits prompt SWA projects to be designed to maintain high levels of nutrient control at the WWTP.
- **Operations.** Water in the Briones and Orinda Distribution Centers spills into San Pablo Reservoir, which continues into the Sobrante WTP. Historically, Briones has not spilled water directly into San Pablo Reservoir, and although facilities exist for this purpose they are primarily designed for emergencies. For the purposes of this update, it was assumed both reservoirs and their connected downstream WTPs would be impacted by regulatory and operational requirements, since both could receive this water.

- **Reservoir Requirements.** The 2019 RWMP surmised that the Briones Reservoir could accommodate up to 58 mgd of purified water under current SWA regulations, which is well above the 30-mgd amount being assessed as part of this update. The augmentation volume assessment also noted that while the 58-mgd alternative was limited by the residence time requirement, the dilution requirement is still relevant since the actual dilution could be considerably smaller than the predicted dilution achieved due to potential reservoir short-circuiting and stratification. Should the District look to move forward with this alternative, the project would require hydrodynamic modeling and tracer studies to confirm the actual level of dilution that could be reliably attained.
- **Source Control.** SWA projects like this one typically demand improvements to existing source control programs due to the increased range of chemicals that need to be evaluated and managed. Several source control programs exist for SWA to use as references.
- **TMF.** Purified water discharged into the Briones Reservoir has the potential to spill over into the San Pablo Reservoir. The District would likely need to work closely with DDW to identify how to best permit an SWA project with the potential to impact multiple reservoirs and consequently multiple WTPs (i.e., Orinda and Sobrante WTPs).
- **Other Project Challenges.** Constructing a new AWPF at the SD-1 WWTP may present some challenges due to space constraints. The District will need to carefully consider how a new AWPF might fit with other planned facilities and/or plant expansions. The proposed alternative also makes use of the San Pablo Tunnel, which had previously been used to convey water from the San Pablo Reservoir to the San Pablo WTP. Prior to its use, it is assumed that the full length of the tunnel (17,600 feet) would need to be rehabilitated.

5.2.1.3 Cost Overview

Table 5-4 presents the estimated capital and annual O&M costs for the SWA at Briones Reservoir from the SD-1 AWPF options. Detailed cost information is provided in Appendix A.

Table 5-4. Estimated Cost Summary from SWA at Briones Reservoir from SD-1[a]

Element	Cost ($2024, in millions)	
	Capital	Annual O&M
AWPF (EBMUD property 30 mgd)	$255	$52.2
Conveyance Infrastructure: • Effluent pipeline (SD-1 WWTP to EBMUD AWPF) • Pump stations (EBMUD AWPF, purified water, waste disposal) • Purified pipeline (EBMUD AWPF to Briones Reservoir) • Waste disposal pipeline (ROC management) • Pipeline easements	$330	$8.2
Raw Construction Subtotal (includes CO&P, sales tax)	$730	--
Total Construction Cost (includes construction contingency and mobilization)	$1,020	--
Total Project Cost (includes planning/environmental, design, project administration and construction management)	$1,343	$60.5
Unit Costs ($/AF)	$3,800	
Dry-year Unit Costs ($/AF)	$12,500	

a. Values are rounded up to the nearest $5 million for capital costs and $100,000 for annual O&M costs
CO&P = contractor overhead and profit

5.2.2 Treated Water Augmentation through the District's Claremont Center (SD1-Treat-30)

This alternative involves constructing a new AWPF that would purify available effluent from the SD-1 WWTP and convey it to the Claremont Center for distribution. The Claremont Center, located at the foot of the Claremont Hills, is part of the District's existing water distribution system and currently receives water from the Orinda WTP via a 3.4-mile underground tunnel. The treated water is then distributed throughout the western portion of the District's service area (primarily in Oakland and Berkeley). This alternative offers an appealing DPR concept because it would allow the District to maximize blending and distribution of the purified water within the distribution system while minimizing negative impacts on system hydraulics. This alternative also requires the least amount of pipeline infrastructure investment relative to the other similarly sized project concepts originating at the SD-1 WWTP.

5.2.2.1 Facilities Summary

The proposed TWA AWPF would be very similar to the facility proposed under the SWA option but would incorporate additional disinfection (ozone, low-dose UV) and filtration (BAC) processes to the multi-process treatment train to account for the additional pathogen and chemical control requirements for DPR, as described in Section 5.1.2. Purified water from the new AWPF would be conveyed approximately 4.6 miles via a 42-inch steel pipeline to the Claremont Center for distribution, as shown on Figure 5-5.

The layout for the TWA AWPF is very similar to the one developed for the SWA alternative, shown on Figure 5-6. The total footprint for the proposed facilities would be approximately 276,000 square feet. It was assumed that all the treatment equipment for ozone generation/destruct, MF, low-dose UV, RO, and UV/AOP are housed within a single process building, while ancillary facilities, post-treatment areas, chemical storage, and pumping facilities would be located on outdoor concrete pads. The ozone contactors, BAC filters, and liquid oxygen (LOX) facilities are also accounted for in the proposed layout. Ensuring adequate systems are in place to protect against treatment and water quality issues that could lead to the distribution of off-spec (or potentially off-spec) water will be critical. To help mitigate some of these concerns, the TWA AWPF design includes a baffled clearwell that should provide:

- The ability to respond to upstream performance and water quality issues.
- Hydraulic buffering to manage demands in the distribution system.
- A location to divert off-spec water upstream of distribution.

Table 5-5 summarizes project facilities and key design criteria.

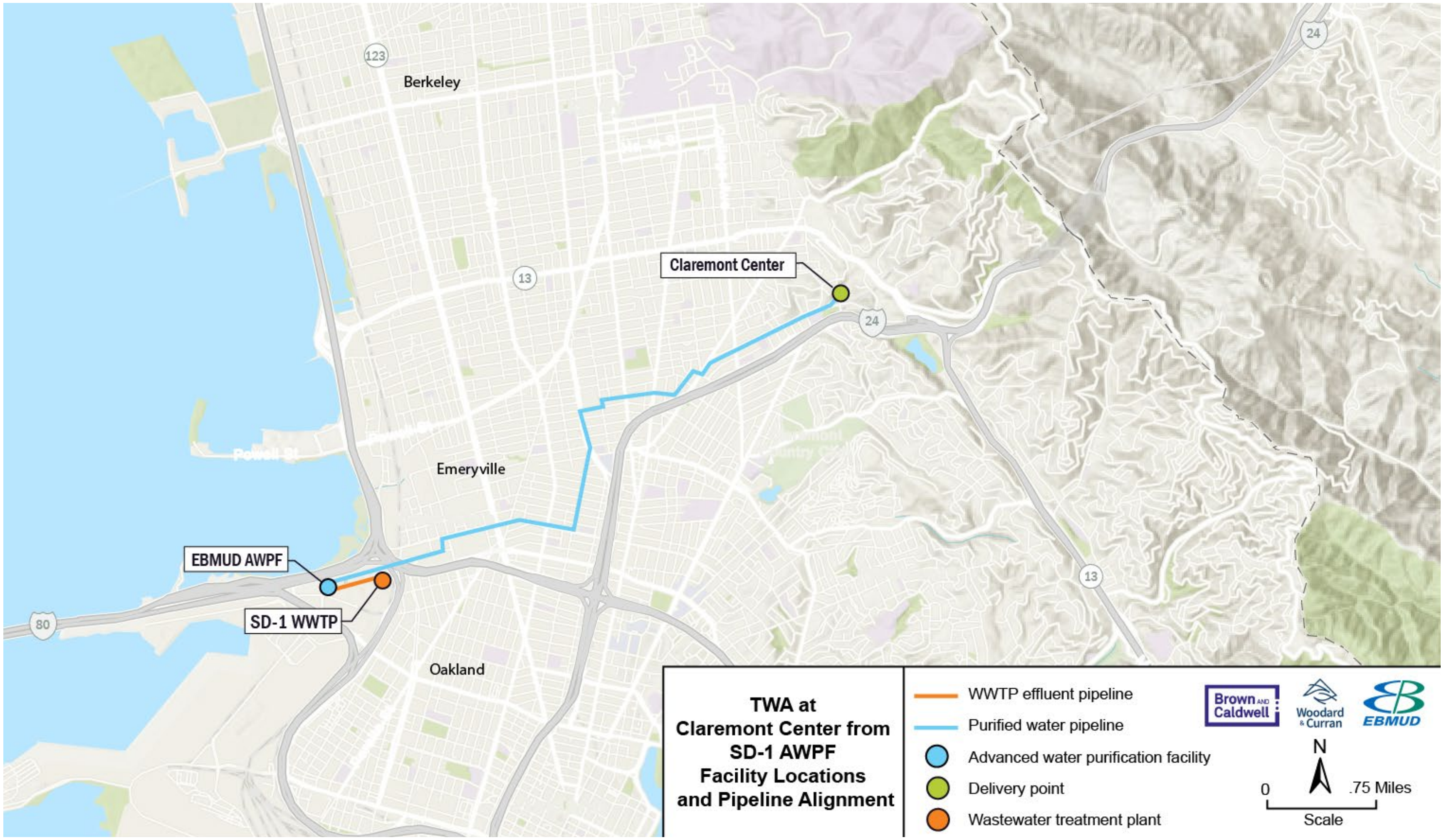


Figure 5-5. Purified Water from EBMUD 30-mgd AWPF to Claremont Center

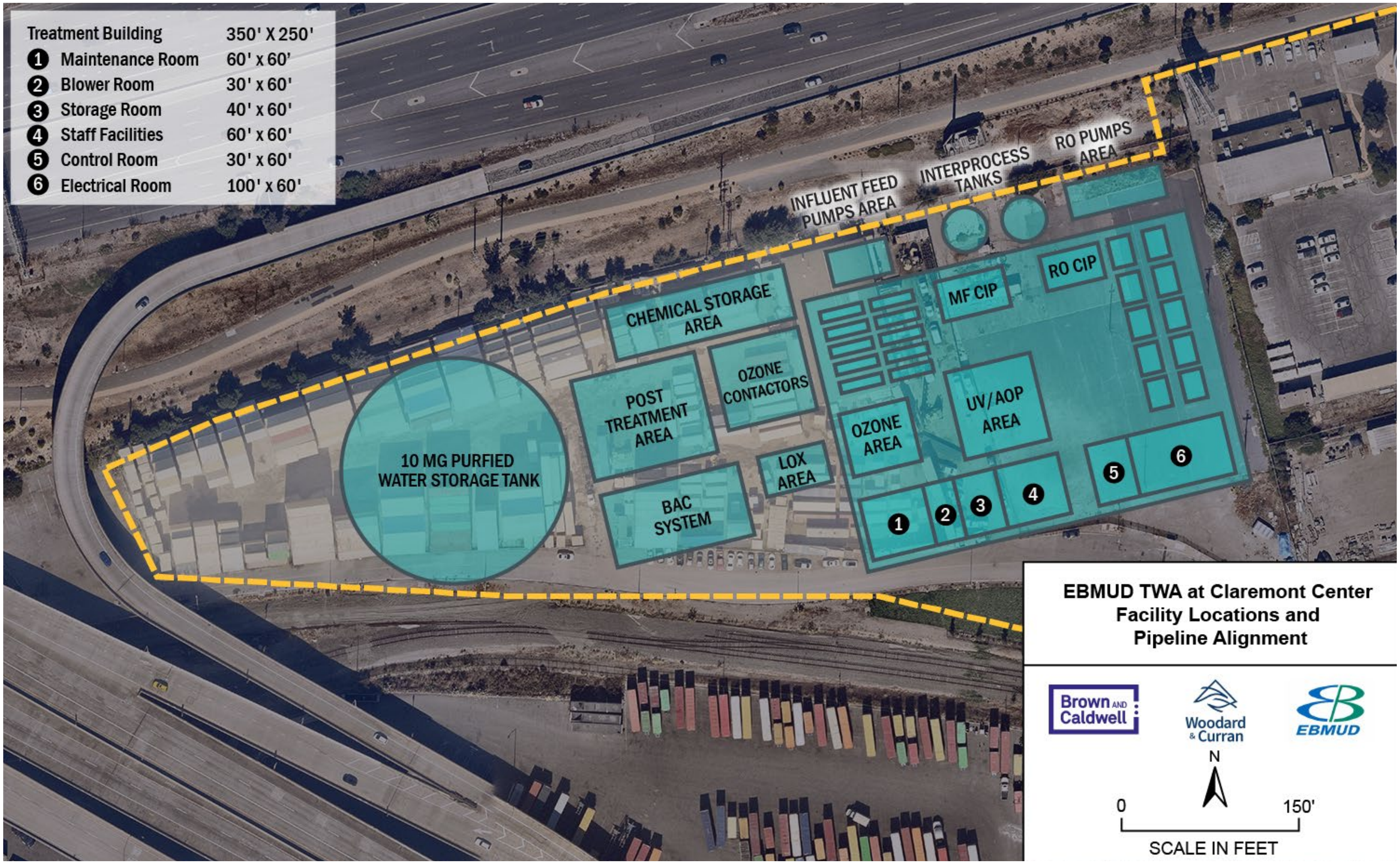


Figure 5-6. Site Layout for TWA EBMUD 30-mgd AWPF

LOX = liquid oxygen system

Table 5-5. TWA at Claremont Center Facilities Summary				
Element	Criteria	Quantity	Unit	Notes
EBMUD AWPF for TWA	Capacity	30	mgd	30-mgd AWMP for TWA at Claremont Center
Annual yield				
Annual yield	Yield	33,600	AFY	Based on purified water production capacity
Pump stations				
Pump Station 1	Flow	27,360	gpm[a]	Effluent from SD-1 WWTP to EBMUD AWPF
	TDH	40	ft	
Pump Station 2	Flow	20,833	gpm[a]	Purified water from EBMUD AWPF to Claremont Center
	TDH	380	ft	
Effluent and conveyance pipelines				
Pipeline 1	Diameter	48	inch	Effluent from SD-1 WWTP to EBMUD AWPF
	Length	620	ft	
Pipeline 2	Diameter	42	inch	Purified water from EBMUD AWPF to Claremont Center
	Length	24,600	ft	
ROC management pipeline				
ROC management pipeline	Diameter	24	inch	ROC disposal to SD-1 WWTP outfall
	Length	620	ft	
ROC management pump station	Flow	6,600	gpm[a]	ROC disposal to SD-1 WWTP outfall
	TDH	40	ft	

a. 1 gpm = 0.00144 mgd

5.2.2.2 Project Considerations

While DPR projects do not benefit from a long-standing set of regulations with clear permitting precedents, recent work by the NWRI and other agencies with projects that are making steady progress toward implementation provide valuable insight into the key items agencies must consider when pursuing a DPR project. The items below highlight some of the key elements that must be considered for a potential TWA project:

- **AWPF Operations.** The DPR regulations increase the on-site staffing requirements (for facilities providing either chemical or pathogen control) and baseline certification needs of staff at facilities included in the proposed project (WWTP, AWPF, and WTP). An AWT5 or AWT3 operator must always be on site unless an approved operations plan allows for some degree of remote operations. The regulations also require that a T5 chief and T3 shift operator be present to oversee operation of the entire DPR treatment train. Currently, California has only a few AWTP Grade 5-certified operators. To ensure adequate operator capacity is available, additional investment in operator training and certification will be needed.
- **Chemical Control and Monitoring.** DPR systems must be quick to respond to any detected issues or failures. Since DPR projects lack an environmental buffer, a greater emphasis on chemical control is required. Online monitoring and data processing systems must be maintained to a high degree of accuracy and precision to carefully track system performance.
- **Enhanced Source Control.** DPR projects will need to adhere to an ESCP that extends beyond local limits and industry-specific monitoring and include regulated and unregulated chemical testing across the new AWPF, the SD-1 WWTP, and the collection system. A successful ESCP aims to minimize adverse impacts on industries while proactively working with them to gain a

comprehensive understanding of the waste streams they release and how to manage these streams effectively to facilitate consistent production of purified water. The effectiveness of an ESCP hinges on robust collaboration and swift response between the WWTP and the AWPF to changing conditions.

- **Managing Chemical Peaks.** DDW has offered limited direction on its expectations for projects to fulfill the requirement of diluting a 1-hour chemical peak. This dilution could be achieved through various methods, including use of a primary or secondary equalization basin during the recirculation of flows in the activated sludge process or in a purified water tank. Currently, there are no proposed TWA projects that have a clear plan to meet this requirement.
- **Treatment Requirements.** To meet the DPR regulations, a robust treatment train is required for the new AWPF. Each unit process will need to be validated and operated in a specific manner to gain the required LRV credits. To verify unit process performance and regulation adherence, a substantial amount of data will need to be collected, analyzed, and synthesized for monthly compliance reporting.
- **TMF.** DPR regulations significantly expand the necessary TMF capacity for DPR projects. The SWRCB will evaluate a DiPRRA's (e.g., EBMUD) TMF capacity across multiple domains, including funding continuity, interagency agreements, staffing, and operator certification. Compliance will require documentation through an extensive suite of reports, programs, and plans beyond those currently required for IPR projects.
- **Other Project Challenges.** As noted previously, constructing a new AWPF at the SD-1 WWTP may present some challenges due to space constraints. The inclusion of an engineered storage buffer, like the one included in this alternative, can help provide additional time to respond to issues but requires space and infrastructure. The District will need to carefully consider how a new AWPF might fit with other planned facilities and/or future plant expansions.

5.2.2.3 Cost Overview

Table 5-6 presents the estimated capital and annual O&M costs for the TWA through the District's Claremont Center. Detailed cost information is provided in Appendix A.

Table 5-6. Estimated Cost Summary from TWA through District's Claremont Center[a]

Element	Cost ($2024, in millions)	
	Capital	Annual O&M
AWPF (EBMUD property 30 mgd)	$345	$63.1
Conveyance Infrastructure • Effluent pipeline (SD-1 WWTP to EBMUD AWPF) • Pump stations (EBMUD AWPF, purified water, waste disposal) • Purified pipeline (EBMUD AWPF to Claremont Center) • Waste disposal pipeline (ROC management) • Pipeline easements	$85	$3.5
Raw Construction Subtotal (includes CO&P, sales tax)	$530	--
Total Construction Cost (includes construction contingency and mobilization)	$745	--
Total Project Cost (includes planning/environmental, design, project administration and construction management)	$982	$66.6
Unit Costs ($/AF)	$3,500	
Dry-year Unit Costs ($/AF)	$11,600	

a. *Values are rounded up to the nearest $5 million for capital costs and $100,000 for annual O&M costs.*

5.2.3 Surface Water Augmentation at Briones Reservoir from Central San WWTP (CC-ResB-17.9)

This SWA concept is similar to SD1-ResB-30 presented previously in Section 5.2.1 in that it involves augmenting Briones Reservoir with purified water produced at a new AWPF. Available effluent for this new facility, however, would be supplied from the Central San WWTP. The new AWPF would be constructed near the existing Central San WWTP in Martinez.

5.2.3.1 Facilities Summary

The new AWPF could be constructed on unused buffer land adjacent to the Central San WWTP on the southeast side, known as the former Kiewit Property. The facility would produce up to 17.9 mgd of purified water that would be conveyed approximately 11 miles to Briones Reservoir using a new pump station and 30-inch pipeline, as shown on Figure 5-7. The proposed pipeline alignment would follow Highway 4 before cutting southwest through the Briones Hills on its way to the east end of the Briones Reservoir. Like the other SWA alternative involving the Briones Reservoir, it is assumed that once in the reservoir the purified water could be drawn out and treated using existing facilities prior to distribution within the District's West of Hills distribution system.

The proposed layout of the new AWPF is presented on Figure 5-8. This site offers significantly more space for a new plant. The total footprint for the proposed facilities would be approximately 230,000 square feet. The process building for this new plant is assumed to house all of the treatment equipment for the MF, RO, and UV/AOP. The building would also include interior space for a control room, laboratory, and other office-type amenities. Ancillary facilities, post-treatment areas, chemical storage, and pumping facilities are assumed to be outside or under canopies. Table 5-7 summarizes the project facilities and key design criteria.

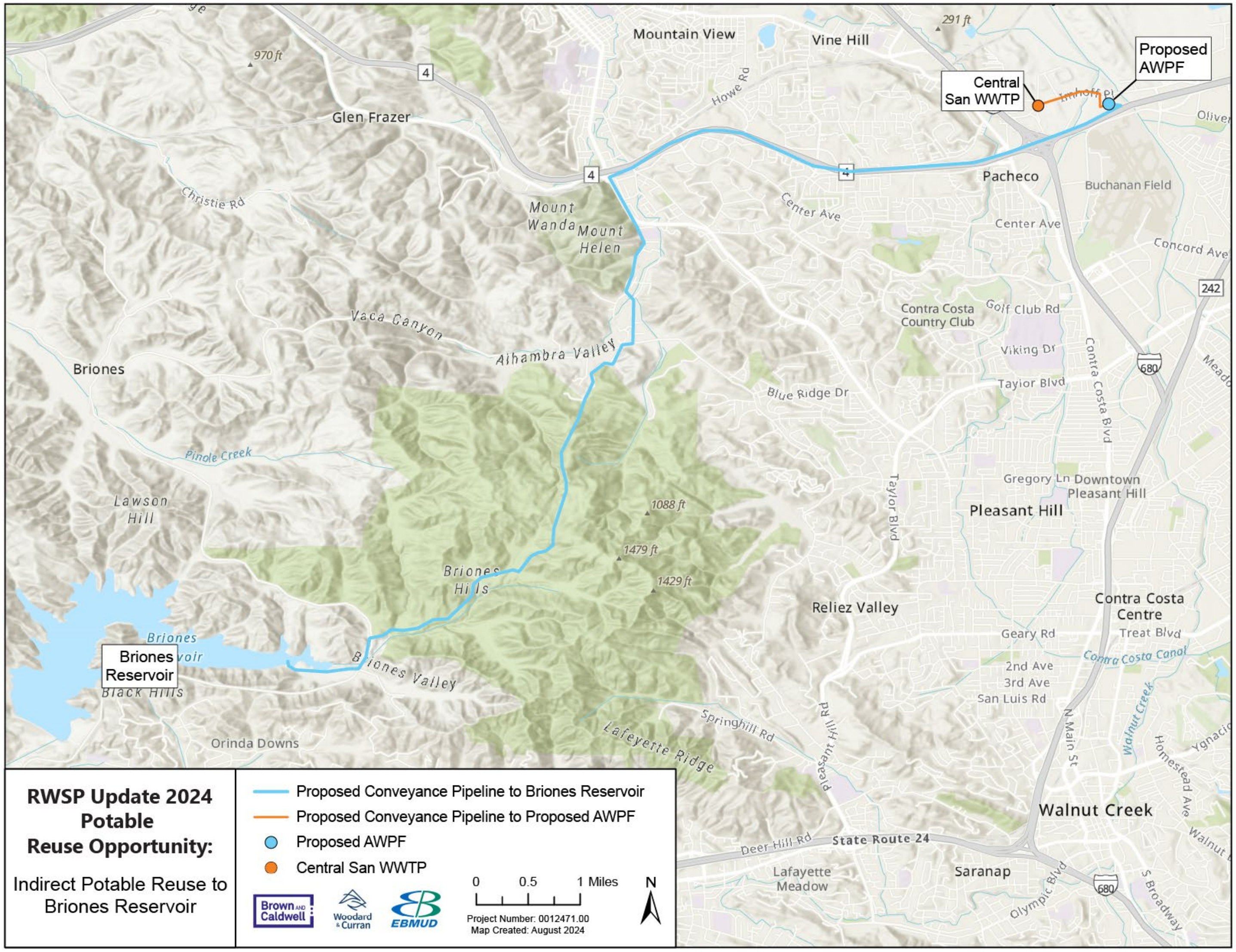


Figure 5-7. Purified Water from EBMUD 17.9 mgd AWPF to Briones Reservoir

Source: Adapted from EBMUD-Central San Recycled Water Project Concept Evaluation Report, 2024

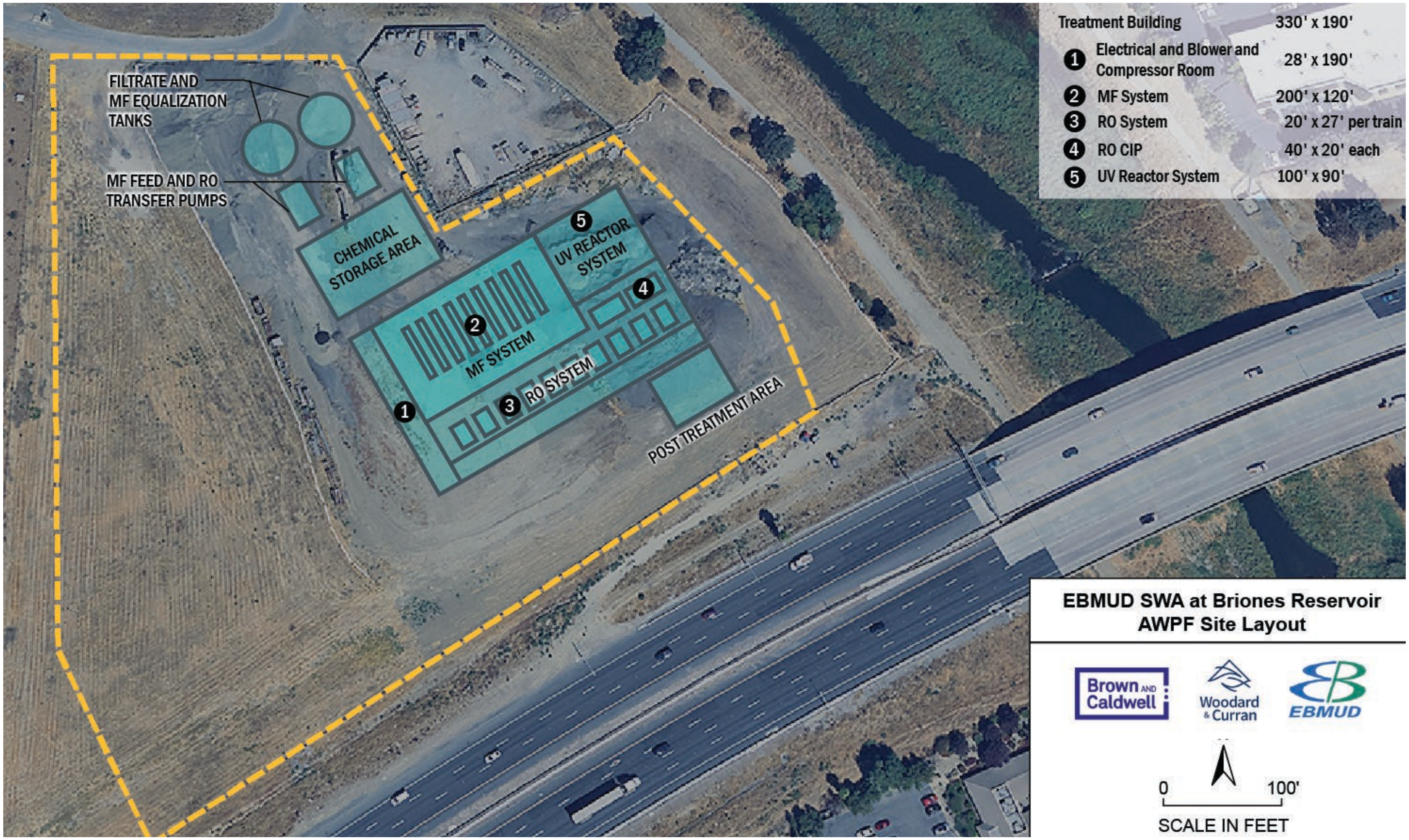


Figure 5-8. Site Layout for SWA EBMUD 17.9-mgd AWPF

Source: Adapted from EBMUD- Central San Recycled Water Project Concept Evaluation Report, 2024

Table 5-7. SWA at Briones Reservoir from Central San Facilities Summary				
Element	Criteria	Quantity	Unit	Notes
EBMUD AWPF for SWA	Capacity	17.9	mgd	17.9-mgd AWPF for SWA at Briones Reservoir
Annual yield				
Annual yield	Yield	20,000	AFY	Based on purified water production capacity
Pump stations				
Pump Station 1	Flow	16,320	gpm[a]	Effluent from Central San WWTP to EBMUD AWPF
	TDH	50	ft	
Pump Station 2	Flow	12,400	gpm[a]	Purified water from EBMUD AWPF to Briones Reservoir
	TDH	780	ft	
Effluent and conveyance pipelines				
Pipeline 1	Diameter	36	inch	Effluent from Central San WWTP to EBMUD AWPF
	Length	2,200	ft	
Pipeline 2	Diameter	30	inch	Purified water from EBMUD AWPF to Briones Reservoir
	Length	56,850	ft	
ROC management pipeline				
ROC management pipeline	Diameter	20	inch	ROC disposal to Central San WWTP
	Length	2,200	ft	
ROC management pump station	Flow	3,610	gpm[a]	ROC disposal to Central San WWTP
	TDH	50	ft	

a. 1 gpm = 0.00144 mgd

5.2.3.2 Project Considerations

This SWA concept shares many of the same key considerations that were flagged for the SWA project discussed previously in Section 5.2.1. An item unique to this project concept is:

- **TMF and Interagency Coordination.** Because this version of the SWA at Briones Reservoir project will involve both the District and Central San a higher degree of coordination will be required. Both agencies will need to work in tandem to develop a Joint Plan that addresses several items, including corrective actions in the event of an off-specification water episode, procedures for notifying relevant stakeholders, and operational changes that affect reservoir water quality. As the wastewater management agency participating in the SWA project, the District would be reliant on Central San to maintain an industrial pretreatment program and a source control program that adheres to IPR regulations.

5.2.3.3 Cost Overview

Table 5-8 presents the estimated capital and annual O&M costs for the SWA at Briones Reservoir from the District AWPF. Detailed cost information is provided in Appendix A.

Table 5-8. Estimated Cost Summary from SWA at Briones Reservoir from Central San[a]

Element	Cost ($2024, in millions)	
	Capital	Annual O&M
AWPF (Central San property 17.9 mgd)	$155	$31.2
Conveyance Infrastructure • Effluent pipeline (Central San WWTP to EBMUD AWPF) • Pump stations (EBMUD AWPF, purified water, waste disposal) • Purified pipeline (EBMUD AWPF to Briones Reservoir) • Waste disposal pipeline (ROC management) • Pipeline easements	$175	$6.2
Raw Construction Subtotal (includes CO&P, sales tax)	$400	--
Total Construction Cost (includes construction contingency and mobilization)	$560	--
Total Project Cost (includes planning/environmental, design, project administration and construction management)	$742	$37.3
Unit Costs ($/AF)	$3,700	
Dry-year Unit Costs ($/AF)	$12,200	

a. *Values are rounded up to the nearest $5 million for capital costs and $100,000 for annual O&M costs*

5.2.4 Raw Water Augmentation at Mokelumne Aqueducts (CC-Raw-17.9)

Approximately 90 percent of the District's source water comes from the Mokelumne River and is delivered to the District's service area via the Mokelumne Aqueducts. The aqueducts traverse through the Central San service area very close to the Central San WWTP. The three aqueducts have a total capacity of approximately 200 mgd, conveyed via gravity flow, or 325 mgd when pumping at the District's Walnut Creek pumping plants. The purified water would be blended with raw water in the aqueducts prior to delivery to the WTPs for additional treatment. The initial DPR concept was identified in the 2016 Central San Wholesale Study and updated as part of the 2019 RWMP and the EBMUD-Central San Recycled Water Project Concept Evaluation Report.

5.2.4.1 Facilities Summary

A new DPR AWPF could be constructed on unused buffer land adjacent to the Central San WWTP on the southeast side, known as the former Kiewit Property. Up to 17.9 mgd of purified water would be conveyed via a new 30-inch pipeline approximately 3.5 miles to the Mokelumne Aqueducts near Mallard Reservoir, as shown on Figure 5-9. The Mokelumne Aqueducts transport water to EBMUD's Walnut Creek, Lafayette, and Orinda WTPs as well as EBMUD's Briones, San Pablo, and USL surface water reservoirs. As such, purified water could be added directly to the Mokelumne Aqueducts and used at any of EBMUD's WTPs. This concept includes installation of connections to both Mokelumne Aqueduct 2 and 3 to provide operational flexibility to EBMUD water supply and treatment operations.

The layout for the DPR AWPF is shown on Figure 5-10. The total footprint for the proposed facilities would be approximately 330,000 square feet. It was assumed that all the process equipment for ozone generation/destruct, MF, low-dose UV, RO, and UV/AOP are within a single treatment building that also includes space for a control room, break room, offices, lab space, restroom, and other various spaces needed within the building for personnel. The MF feed and filtrate equalization tanks, the transfer pumps associated with those tanks, and the chemical storage and post-treatment areas will be located on outdoor concrete pads. A LOX facility would be constructed as a concrete slab-on-grade to house the LOX storage tank and vaporizers. An outdoor ozone contactor is included in the layout, along with an outdoor BAC filter tank. Table 5-9 summarizes key project facilities.

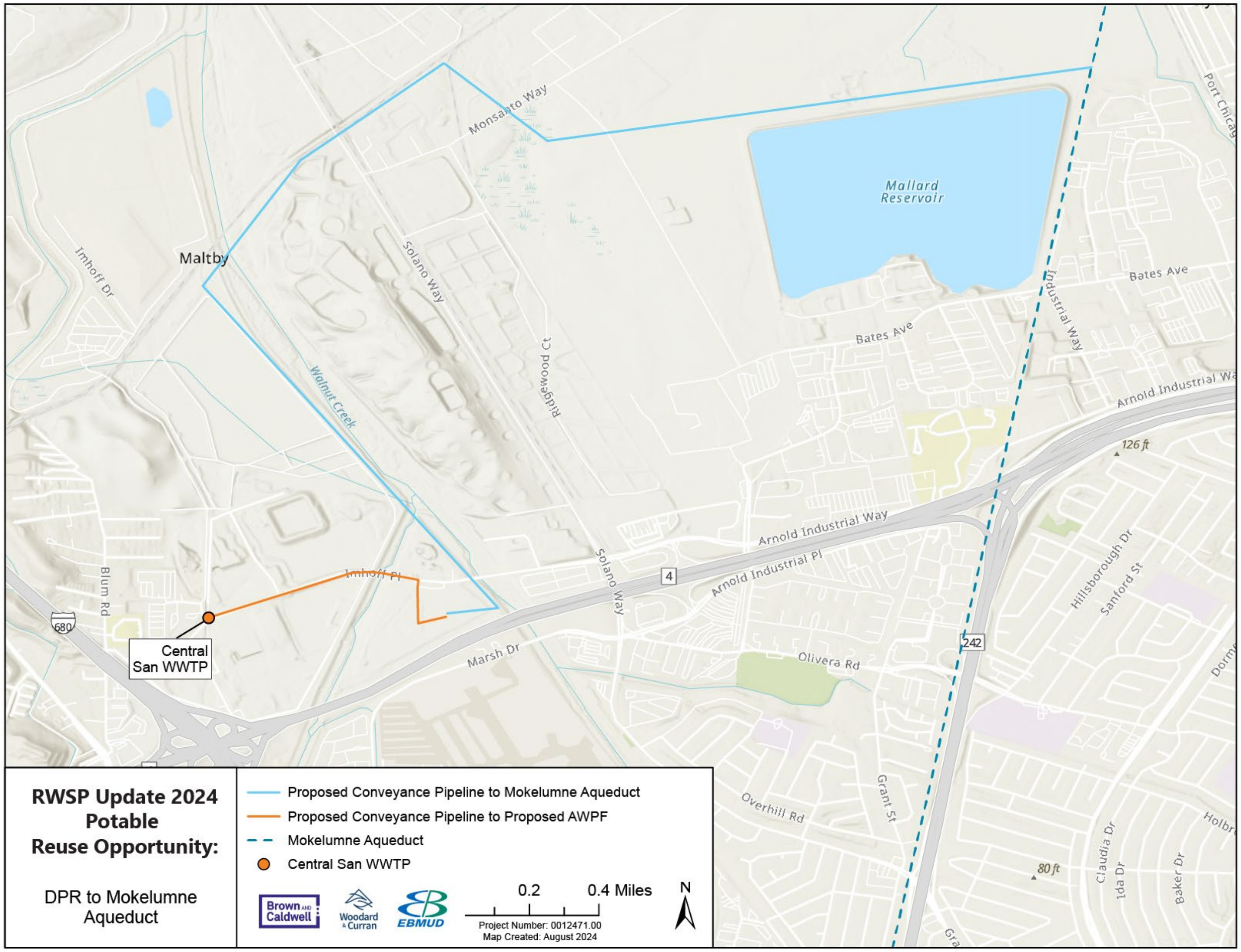


Figure 5-9. Purified Water from EBMUD 17.9 mgd AWPF to Mokelumne Aqueducts

Source: Adapted from EBMUD-Central San Recycled Water Project Concept Evaluation Report, 2024

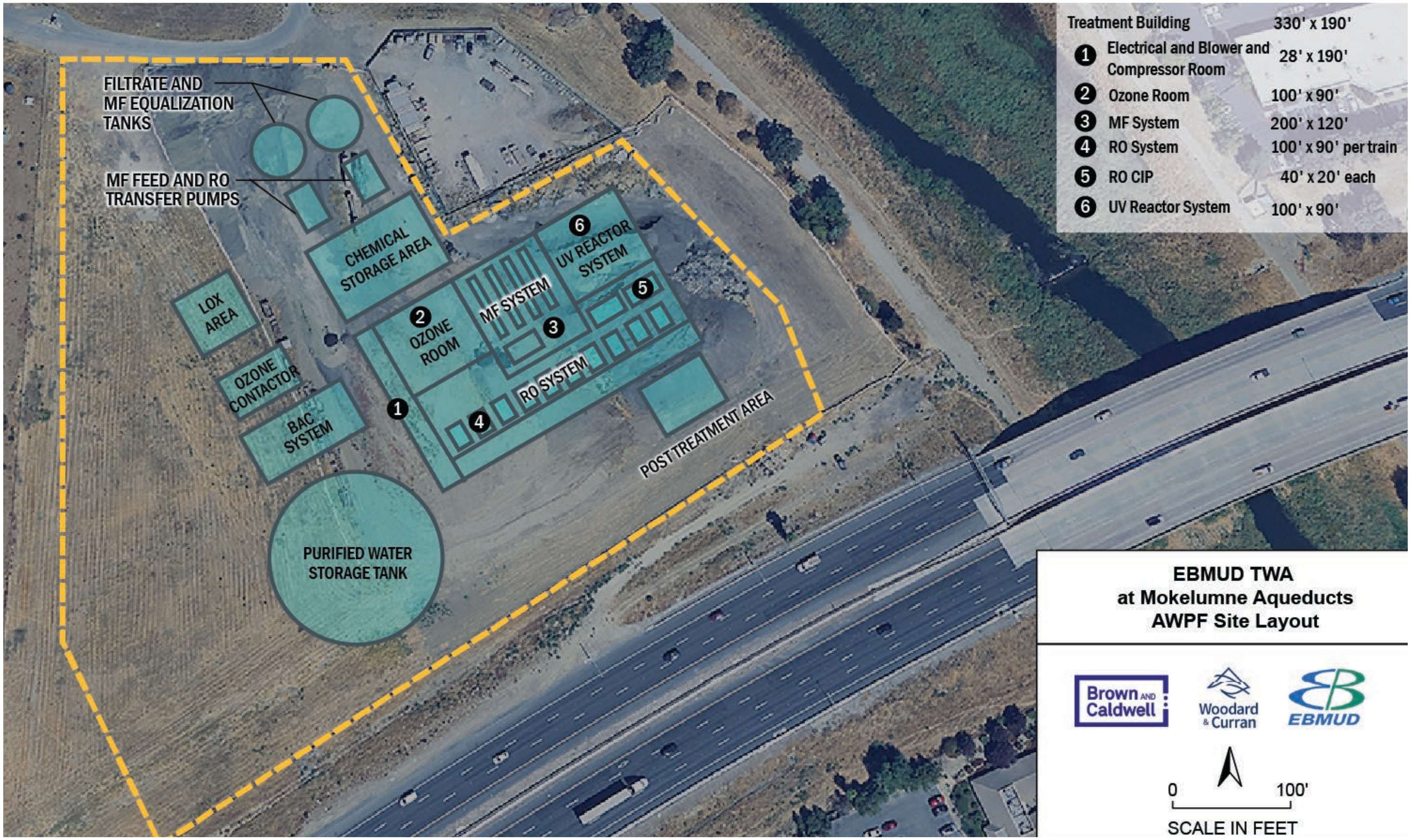


Figure 5-10. Site Layout for RWA EBMUD 17.9-mgd AWPF

Source: Adapted from EBMUD-Central San Recycled Water Project Concept Evaluation Report, 2024

Table 5-9. RWA at Mokelumne Aqueducts Facilities Summary				
Element	**Criteria**	**Quantity**	**Unit**	**Notes**
EBMUD AWPF for RWA	Capacity	17.9	mgd	17.9-mgd AWPF for potable reuse
Annual yield				
Annual yield	Yield	20,000	AFY	Based on purified water production capacity
Pump stations				
Pump Station 1	Flow	16,320	gpm[a]	Effluent from Central San WWTP to EBMUD AWPF
	TDH	50	ft	
Pump Station 2	Flow	12,400	gpm[a]	Purified water from EBMUD AWPF to Mokelumne aqueducts
	TDH	600	ft	
Effluent and conveyance pipelines				
Pipeline 1	Diameter	36	inch	Effluent from Central San WWTP to EBMUD AWPF
	Length	2,200	ft	
Pipeline 2	Diameter	30	inch	Purified water from EBMUD AWPF to Mokelumne aqueducts
	Length	16,700	ft	
ROC management				
ROC management pipeline	Diameter	20	inch	ROC disposal to Central San WWTP
	Length	2,200	ft	
ROC management pump station	Flow	3,920	gpm[a]	ROC disposal to Central San WWTP
	TDH	50	ft	

a. 1 gpm = 0.00144 mgd

5.2.4.2 Project Considerations

This RWA alternative shares many of the same challenges that were discussed previously as part of the TWA option in Section 5.2.2. Items unique to this project concept are:

- **Pathogen Control.** RWA projects may rely on pathogen credits obtained at downstream WTPs to meet the 20/14/15-log requirements for V/G/C. Given that several WTPs will be implicated in the RWA project discharging into the Mokelumne Aqueducts, it may be advantageous to meet the minimum pathogen requirements at the AWPF and use any additional credit at the WTPs as further redundancy. AWPF treatment trains can be designed to meet all pathogen requirements, which would make compliance with this requirement relatively straightforward. Blending with other source water(s) feeding the WTP may also provide pathogen LRV credits.
- **Chemical Control.** The DPR regulations put greater emphasis on chemical control than IPR due to the absence of the environmental buffer. Several elements contribute to the control of chemicals, including pretreatment with ozone/BAC. Assuming projects provide the minimum level of treatment coupled with enhanced source control and extensive monitoring, compliance with the chemical control can be achieved.

- **TMF and Interagency Coordination.** The Mokelumne Aqueduct project would have a higher degree of complexity due to the involvement of multiple WTPs receiving the purified effluent as raw water sources. All of the participating WTPs would be required to be included in the Joint Plan (along with Central San), amend their permits, and update their operations plans. This project concept would also require the District to work closely with Central San to identify corrective actions in the event of an off-specification water episode and procedures for notifying relevant stakeholders. The District would also be reliant on Central San to maintain an industrial pretreatment program and a source control program that adheres to DPR regulations.
- **Regulatory and Permitting Considerations.** Because there have been no DPR permitting discussions in Northern California at the time of this RWSP, DDW and RWQCB staff may be less experienced than their colleagues in Southern California where several projects (including San Diego's Central Area Pure Water Project, Metropolitan Water District of Southern California/Los Angeles County Sanitation Districts' Pure Water SoCal, and LA Sanitation & Environment/LA Department of Water and Power's Hyperion 2035/Operation Next) have already engaged regulators.
- **Other Project Challenges.** Augmentation of the Mokelumne Aqueducts may also result in the discharge of purified water into the Briones, USL, and San Pablo reservoirs. Whether or not the project would require NPDES permit(s) in line with SWA requirements remains unclear; additional discussion with DDW would be required to clarify this point. Requiring NPDES permits would add to the project's complexity.

5.2.4.3 Cost Overview

The total RWA through Mokelumne Aqueduct project costs, including annual O&M costs are presented in Table 5-10. The total project costs are estimated to be $656 million, with an annual O&M cost of approximately $40 million per year for 20,000 AFY of purified water.

Table 5-10. Estimated Cost Summary from RWA at Mokelumne Aqueducts[a]

Element	Cost ($2024, in millions)	
	Capital	Annual O&M
AWPF (Central San Property 17.9 mgd)	$215	$37.4
Conveyance Infrastructure Effluent pipeline (Central San WWTP to EBMUD AWPF) Pump stations (EBMUD AWPF, purified water, waste disposal) Purified pipeline (EBMUD AWPF to Mokelumne aqueducts) Waste disposal pipeline (ROC management) Pipeline easements	$75	$3.1
Raw Construction Subtotal (includes CO&P, sales tax)	$355	--
Total Construction Cost (includes construction contingency and mobilization)	$500	--
Total Project Cost (includes planning/environmental, design, project administration and construction management)	$656	$40.5
Unit Costs ($/AF)	$3,700	
Dry-year Unit Costs ($/AF)	$12,200	

a. *Values are rounded up to the nearest $5 million for capital costs and $100,000 for annual O&M costs*

5.2.5 Surface Water Augmentation at Upper San Leandro Reservoir (Oro-ResU-8)

The USL Reservoir is being considered as a potential delivery point of purified water produced from a new AWPF. Treated secondary effluent from the Oro Loma WPCP would be used as feed flow for this new facility. The USL Reservoir, created in 1929 with the construction of the earthen San Leandro Dam on San Leandro Creek, has storage capacity of 38,000 AF (EBMUD, 2014b).

This alternative was chosen for further evaluation to assess the feasibility of a purified water project within the southern portion of the District's water service area. However, it is unlikely that this specific concept, or a similar variation, will proceed due to its lower overall distribution of benefits and relatively higher unit costs.

5.2.5.1 Facilities Summary

This alternative includes a FAT facility for SWA constructed at the OLSD WPCP or nearby property and conveying water to the closest potable water reservoir, i.e., the District's USL Reservoir. The blended water would then be treated at the USL WTP and distributed to District customers.

Purified water would be conveyed via a 24-inch pipeline approximately 11.6 miles to the lower reach of the USL Reservoir, as shown on Figure 5-11; this configuration is consistent with previous studies. As shown on Figure 5-11, the USL WTP intake is in the middle of the reservoir, and preliminary alignments were routed to the southern reach of the reservoir to allow for maximum possible retention time. Reservoir modeling and additional analysis is needed to investigate reservoir mixing and refine the recycled water outfall locations to confirm the 6-month retention time is met, per SWA regulations.

The layout for the IPR AWPF is shown on Figure 5-12. The total footprint for the proposed facilities would be approximately 160,000 sq ft. It was assumed that all the treatment equipment for MF, RO, and UV/AOP are within a single process building that also includes space for a control room, break room, offices, lab space, restroom, and other various spaces needed within the building for personnel. The MF feed and filtrate equalization tanks, the transfer pumps associated with those tanks, and the chemical storage and post-treatment areas will be located on outdoor concrete pads. Table 5-11 summarizes key project facilities.

Figure 5-11. Purified Water from OLSD AWPF to USL Reservoir

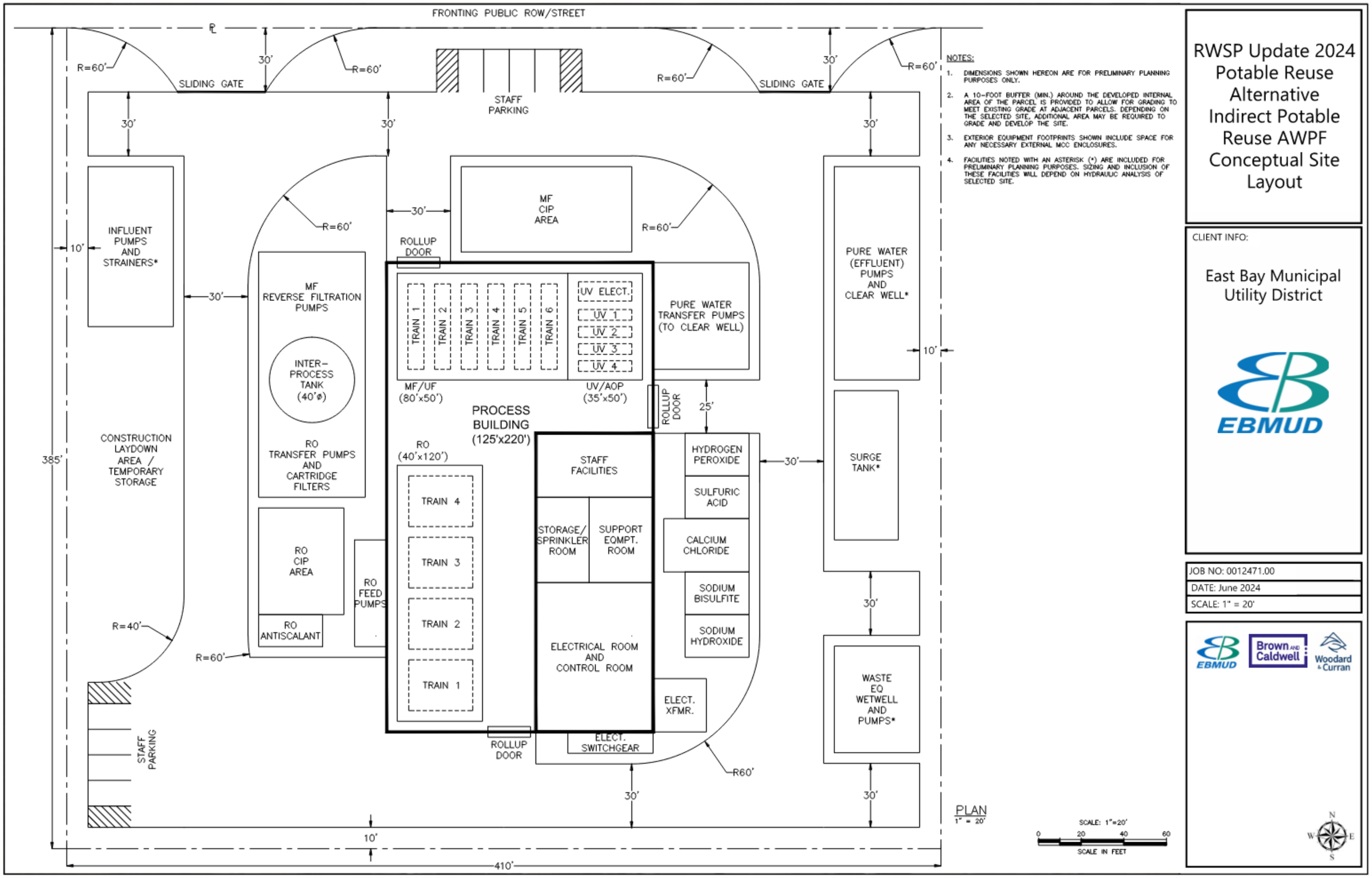


Figure 5-12. Conceptual SWA Oro Loma AWPF Site Layout

(Generic location)

Table 5-11. SWA at USL Reservoir Facilities Summary				
Element	Criteria	Quantity	Unit	Notes
EBMUD AWPF	Capacity	8	mgd	8-mgd AWPF for potable reuse
Annual yield				
Annual yield	Upper bound	8,900	AFY	Based on purified water production capacity
Pump stations				
Pump Station 1	Flow	7,300	gpm[a]	Effluent from OLSD WWTP to EBMUD AWPF
	TDH	30	ft	
Pump Station 2	Flow	5,540	gpm[a]	Purified water from EBMUD AWPF to USL Reservoir
	TDH	796	ft	
Effluent and conveyance pipelines				
Pipeline 1	Diameter	24	inch	Effluent from OLSD WWTP to AWPF (assumed at nearby property)
	Length	1,500	ft	
Pipeline 2	Diameter	24	inch	Purified water from AWPF to USL Reservoir
	Length	11.6	miles	
ROC management				
ROC management pipeline	Diameter	12	inch	ROC disposal to OLSD WWTP
	Length	1,500	ft	
ROC management pump station	Flow	1,750	gpm[a]	ROC disposal to OLSD WWTP
	TDH	36	ft	

a. 1 gpm = 0.00144 mgd

5.2.5.2 Project Considerations

The SWA at the USL Reservoir presents many of the same challenges that were identified for the two previously discussed SWA options involving the Briones Reservoir. This section highlights only key items that are specific to this project.

- **Environmental Habitat.** USL Reservoir is home to native rainbow trout, whose migration was blocked by construction of the dam. Rainbow trout in the reservoir are a rare un-hybridized population. Due to their presence, USL Reservoir is considered more environmentally sensitive than other reservoir augmentation alternatives.
- **Reservoir Requirements.** USL Reservoir supplies water directly to the USL WTP. The amount of purified water that can be feasibly added to the USL Reservoir is limited by the USL WTP capacity and SWA regulatory limits. USL Reservoir is located directly upstream from the USL WTP. Based on the assessment conducted as part of the 2019 RWMP, the maximum amount of water that USL WTP can accept is 4,200 AF per month. The maximum amount of purified water that USL Reservoir can accept in every month before violating SWA regulations is 3,520 AF per month. This regulatory limit is higher in other months, depending on the amount of storage in the reservoir at the time of the measurement and the monthly flow to USL WTP.
- **TMF.** Purified water discharged into the USL Reservoir would primarily impact the USL WTP. This reduces complexity compared to other options by limiting the number of impacted WTPs. However, USL Reservoir can spill into San Leandro Creek, which flows to the adjacent Chabot Reservoir, which also serves as a District emergency supply. It is unclear how DDW would permit an SWA project that impacts multiple reservoirs; communication with DDW would be required to gain clarity on the requirements.

- **Waste Streams from AWPF.** Treated wastewater from the Oro Loma WPCP is currently transported to the EBDA system for final dechlorination and discharge to the EBDA common outfall, or for beneficial reuse at a local golf course. EBDA is a Joint Powers Agency consisting of the City of Hayward, City of San Leandro, OLSD, Union Sanitary District, and Castro Valley Sanitary District. Disposal of any new waste streams, including ROC, through the EBDA common outfall would need to be assessed and discussed with the EBDA partners.
- **Other Permitting Challenges.** In addition to the considerations described, this project would have increased complexity due to the long pipeline that would be needed to connect the AWPF to the USL Reservoir, which traverses through multiple jurisdictions. Furthermore, DDW and SWRCB staff in Northern California do not have experience with SWA, so additional interactions may be needed to inform them of the permitting experience of the existing projects in Southern California.
- **Other Project Considerations.** A firm location for the new AWPF has not been identified. The District would need to work closely with OLSD to acquire land and/or easements to construct the new facility. If advanced forward, the benefit of supplying water to USL is that it offers the potential for multi-year storage of purified water by the District for future use. which provides added resiliency. However, the water supply yield for the District may be less than the amount of purified water produced, depending on potential yield constraints; USL WTP is currently a seasonal WTP for the District.

5.2.5.3 Cost Overview

Table 5-12 summarizes the total USL Reservoir project costs, including annual O&M costs. The total project costs are estimated to be $640 million, with an annual O&M cost of approximately $16 million per year for 8,900 AFY of purified water.

Table 5-12. Estimated Cost Summary SWA at USL Reservoir[a]

Element	Cost ($2024, in millions)	
	Capital	Annual O&M
AWPF (OLSD 8 mgd)	$160	$12.9
Conveyance Infrastructure Effluent pipeline (OLSD WWTP to AWPF) Pump station (OLSD WWTP, purified water) Purified pipeline (AWPF to USL Reservoir) Pipeline easements	$120	$3.7
Raw Construction Subtotal (Includes CO&P, sales tax)	$350	--
Total Construction Cost (includes construction contingency and mobilization)	$485	--
Total Project Cost (includes planning/environmental, design, project administration and construction management)	$640	$16.5
Unit Costs ($/AF)	$5,500	
Dry-year Unit Costs ($/AF)	$18,200	

a. *Values are rounded up to the nearest $5 million for capital costs and $100,000 for annual O&M costs*

5.2.6 Cost Summary of Potable Reuse Alternatives

Table 5-13 summarizes the yield and cost information for the potable reuse alternatives that were further developed as part of this section.

Table 5-13. Summary of Recommended Potable Reuse Projects

Project	Yield (mgd)	Yield (AFY)	Capital Cost ($ millions)	O&M Cost ($ millions)	Unit Cost ($/AF)	Dry Year Unit Cost ($/AF)
SWA at Briones Reservoir from SD-1 (SD1-ResB-30)	30	33,600	$1,343	$60.5	$3,800	$12,500
TWA through the District's Claremont Center (SD1-Treat-30)	30	33,600	$982	$66.6	$3,500	$11,600
SWA at Briones Reservoir from Central San (CC-ResB-17.9)	17.9	20,000	$742	$37.3	$3,700	$12,200
RWA at Mokelumne Aqueducts (CC-Raw-17.9)	17.9	20,000	$656	$40.5	$3,700	$12,200
SWA at Upper San Leandro Reservoir (Oro-ResU-8)	8	8,960	$640	$16.5	$5,500	$18,200

For ease of comparison, Figure 5-13 through Figure 5-16 visually depict the range of estimated costs in terms of capital, O&M, and unit costs (for both normal year and dry year) of the potable reuse opportunities.

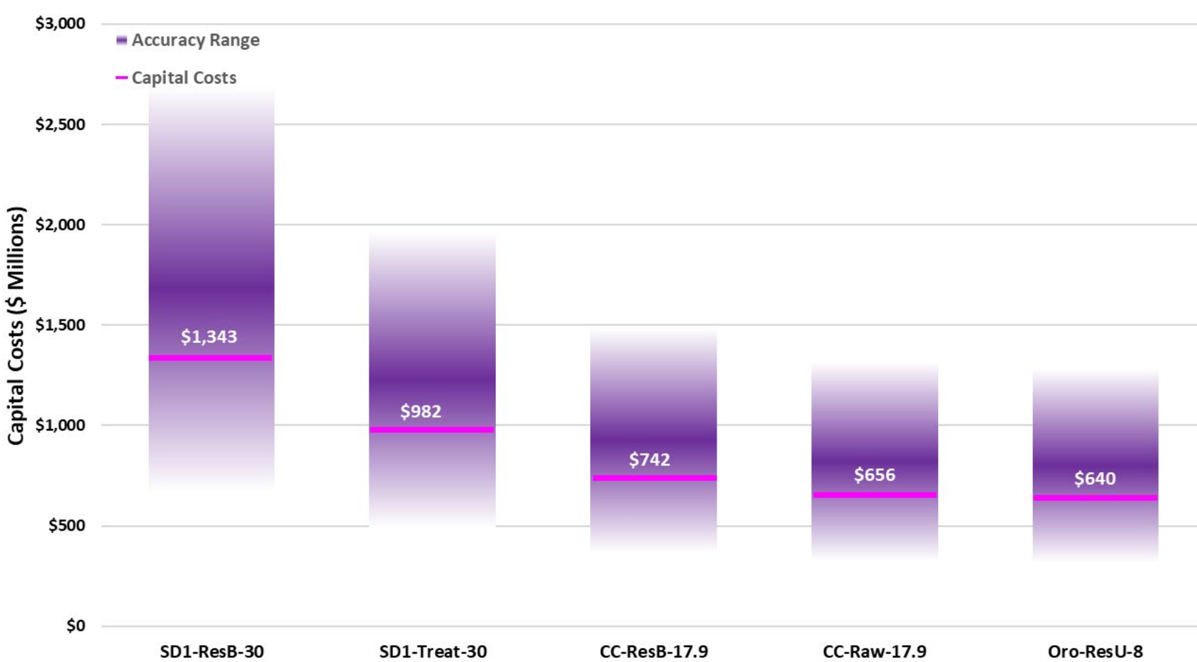


Figure 5-13. Ranges of Estimated Capital Costs with AACE Class-5-level of Accuracy

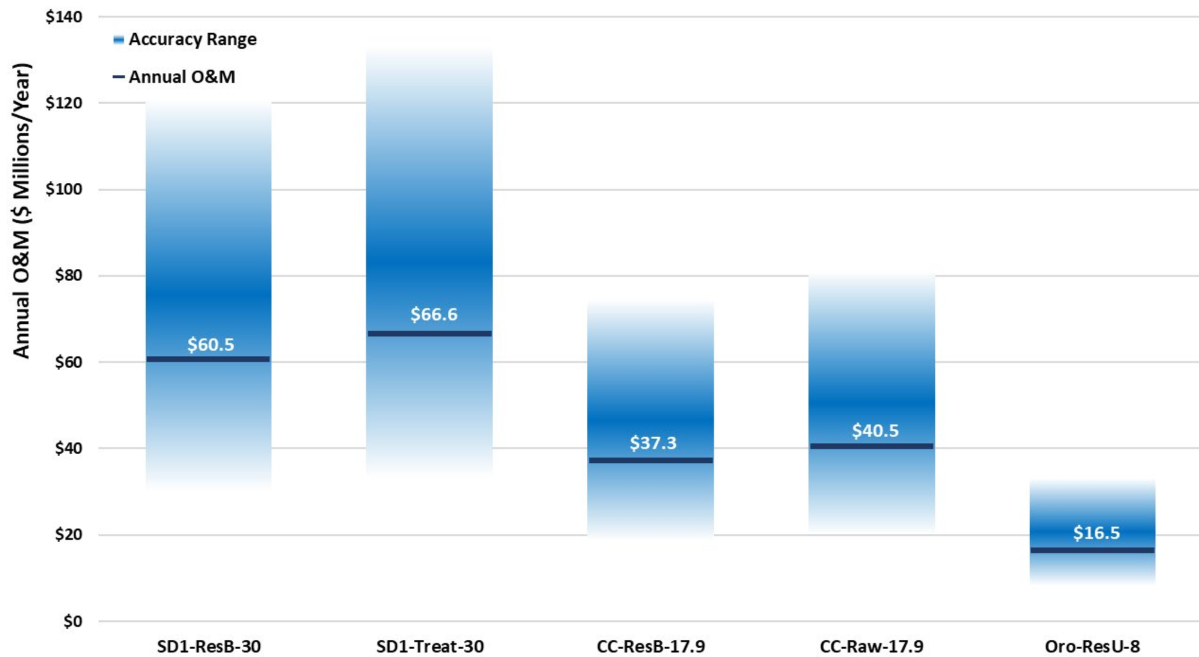


Figure 5-14. Ranges of Estimated Annual O&M Costs with AACE Class-5-level of Accuracy

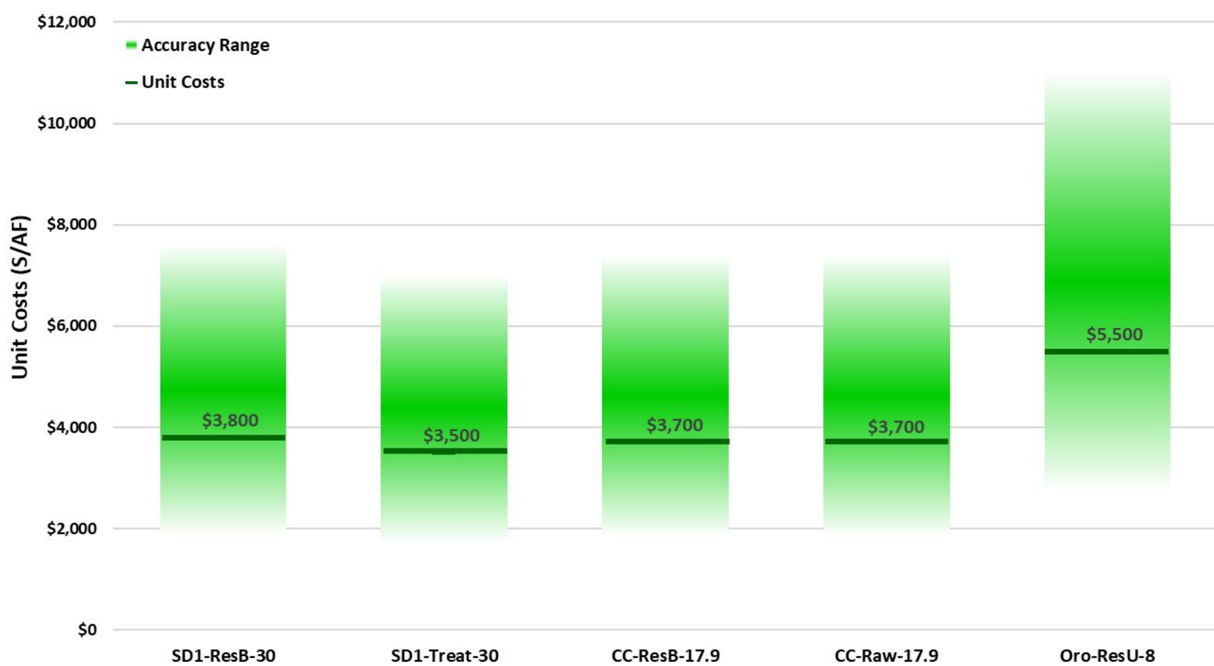


Figure 5-15. Levelized Unit Costs with AACE Class-5-level of Accuracy (30-year life cycle)

Figure 5-16. Levelized Dry-year Unit Costs with AACE Class-5-level of Accuracy (30-year life cycle)

5.3 Public Outreach and Education

Public awareness, understanding, and support is integral to the success of any potable reuse project. These elements often pose a more significant obstacle to a project's implementation than the technical aspects. These roadblocks, however, can be overcome through effective public outreach, which requires meticulous planning, cohesion among project partners, a commitment to clear and consistent communication, and diligent follow-through.

Although not entirely mainstream, potable reuse is a proven approach that yields a safe, dependable, drought-resilient, and high-quality source of drinking water. Over the past decade, water suppliers, industry professional associations, and research organizations have made significant investments in comprehensive research portfolios for potable reuse to confirm public health protection and inform regulatory measures. As an agency starts to consider a potable reuse project, community confidence, understanding, acceptance, and support, as well as stakeholder involvement, become essential. However, the general public often lacks knowledge about the specifics of their water supply, the systems in place to bring drinking water to their businesses and homes, and the mechanisms employed to ensure that the quality of their finished water protects public health. Common issues raised by the public include concerns about no-growth, the impact on rates, and a general apprehension about the concept of potable reuse. Gaining an early understanding of whether the public supports or opposes a project is a key part of the decision-making process. The District should strive to identify potential concerns in the service area at an early stage so they can be addressed directly. Initiating and maintaining an extensive public engagement campaign is critical.

As part of this RWSP update, a District-specific outreach roadmap was developed that outlines the steps needed to help with outreach and education around the potential implementation of a future potable reuse project. The outreach roadmap is included in Appendix D.

5.4 Next Steps for Potable Reuse

Potable reuse can be complex, time-consuming, and costly when compared to more traditional water supply alternatives. Given the large upfront capital costs and the current availability of alternate water supplies for the District, potable reuse is not recommended for current implementation and will be further considered following future evaluations of water supply needs. In the near term, the District's aim should remain with growing its NPR system, focusing on projects that provide the highest value, provide flexibility, and have the greatest likelihood of being implemented. The District should continue to closely follow potable reuse developments and work on implementing an outreach and education campaign as noted in Section 5.3 to educate its customer base in case a potable reuse project is pursued in the future.

5.4.1 Future Evaluations

While not recommended for current implementation, potable reuse may be a needed option in the next 10 to 20 years depending on the District's demand for water, availability of existing supplies, and improved clarity with regards to the type of secondary wastewater treatment upgrades that are planned for nutrient removal. Should the District choose to move forward with one of these options, a more detailed evaluation of these alternatives is recommended to help refine some of the assumptions that were used for this analysis, including:

- **Economics:** As the alternatives are better defined, the project concept(s) and associated capital and O&M costs will need to be refined and priced in more detail (e.g., at a Class 4 level, rather than a Class 5). A more robust economic assessment, to better refine the unit cost (e.g., cost per AF) of these potential projects, should be completed to better understand the financial burden of implementing one of these projects.
- **Environmental benefits, impacts, and permitting:** A more detailed analysis of potential environmental impacts, including energy and greenhouse gas emissions, along with permitting and regulatory considerations (e.g., NPDES permits and California Environmental Quality Act [CEQA] compliance) and ROC management, is recommended. Any additional effluent flow requirements (e.g., for discharge or blending) would be considered at this stage.
- **Governance considerations and potential partnership arrangements:** Some of the alternatives in this assessment involve project elements that require new or extended agreements, such as ownership and operation of a joint AWPF. Roles and responsibilities of potential potable reuse producer(s) and retailer(s) will need to be further developed, along with potential new agreements. As mentioned, the DPR regulations significantly increase required TMF capacity for DPR projects. Compliance will require documentation through an extensive suite of reports, programs, and plans beyond those currently required for IPR.
- **Residuals management:** As stated previously in Section 5.1.3, each potential AWPF is anticipated to consist of a process train that will yield a series of residual streams that will need to be managed, especially as it pertains to ROC. While a set of potential strategies was included in this analysis, a more informed evaluation is needed to help identify site-specific ROC management options, costs, and permitting complexity.

- **Water supply integration, operations, and maintenance:** The potable reuse projects assessed in this section would benefit from a more in-depth water supply integration analysis that would evaluate existing contracts, water supply models, infrastructure parameters, seasonal variation, blending requirements, energy use, and permit requirements. This evaluation would consider estimated utilization rates and impacts of proposed alternatives on the regional water cycle. Also included would be a water quality evaluation to better understand the quality of water from each source and to refine the treatment train and costs. Based on IPR and DPR regulations, O&M procedures will need to be carefully assessed and developed. Any potable reuse facility will require a high degree of monitoring (i.e., frequency, locations, and range of contaminants) and more stringent operational control (e.g., automatic diversions and shutdowns) to prevent distribution of water does not comply with requirements. This is especially true for DPR.

Implementing any of the alternatives will not be a linear process. The District will likely need to work on multiple implementation steps simultaneously, and the interdependency of some of those steps adds complexity. In addition to the items listed above, the District will likely need to initiate a more focused potable reuse public outreach and engagement effort informed by the alternative to be implemented, planned project location, and rate impacts.

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Section 6

Implementation Plan

The RWSP update was developed to evaluate the District's existing recycled water portfolio and identify, assess, and prioritize additional water reuse opportunities to meet the 20-mgd goal. After an extensive and collaborative evaluation process, it was recommended the District move forward with a list of NPR projects that includes the continued expansion and implementation of the SRVRWP (Phase 3 and 5) and EBRWP, and the delivery of effluent to support the implementation of the Phillips 66/Rodeo Renewed project. This section presents considerations and implementation needs for the recommended projects, includes a phasing schedule, identifies funding opportunities to help facilitate implementation, and provides an overview of District next steps. Also, while not explicitly discussed below, the District anticipates the Chevron Refinery will make an additional 0.5 mgd influent flow available by 2030 to allow an increase in the recycled water production of RARE. The District intends to work with Chevron Refinery staff to facilitate this process.

6.1 Considerations and Implementation Needs

The suite of NPR projects that were recommended for implementation were selected because they offered several benefits over their counterparts, including the presence of existing commitments and established partnerships that aligned them well with District objectives; however, these projects also carry certain risks that must be carefully considered and resolved to facilitate implementation. Addressing these challenges at the earliest opportunity possible not only reduces risk but also enables greater clarity and efficiency in the path forward.

6.1.1 San Ramon Valley Recycled Water Program – Phase 3 and 5 Expansion

The Phase 3 and 5 expansions of the SRVRWP builds on a well-established landscape irrigation program. Phase 1 is complete, and Phase 2 is nearing completion pending the final connection of the Crow Canyon Country Club. Portions of the Phase 3 recycled water pipeline and the R3000 recycled water reservoir are already constructed; however, further expansion of the SRVRWP will require supplemental supplies to meet peak summer demands due to reduced wastewater flows from increased water use efficiency and conservation. Recently, peak season demand exceeded supply, which prompted a moratorium on new recycled water connections. Without additional sources of supply and/or other significant changes, the amount of wastewater available will be insufficient to meet the Phase 3 and 5 demands.

As noted in Section 3.2.1, DERWA completed the Recycled Water Supply Management Plan in 2024 that evaluated supplemental supply alternatives and demand management strategies that would allow the connection moratorium to be lifted and the partner agencies, including the District, to expand its recycled water system. As an outcome of the evaluation, DERWA is now working with Central San to negotiate a long-term agreement to supplement existing supplies with raw wastewater from Central San. This new agreement is anticipated to be in place by 2026. The District will move forward with the design and construction of Phase 3 and 5 once these supplemental supplies are secured. Phase 3 would consist of an additional 3 miles of pipe and a new R3000 pump station along the Dougherty Road corridor. Phase 5 would encompass an additional 2.8 miles of pipe. Both phases would require customer retrofits for landscape irrigation.

6.1.2 East Bayshore Recycled Water Project Expansion

The recommended EBRWP Expansion alternative will look to add an additional 0.7 mgd of capacity and convey recycled water to portions of Alameda, Emeryville, and Oakland—requiring approximately 8.3 miles of new recycled water pipeline ranging in size from 6 to 16 inches. The project will be implemented in phases, with the initial phase focused on expanding the distribution system into Emeryville and Oakland and the latter phase expanding into Alameda. The proposed expansion alternative is being recommended for implementation because it offers the District some flexibility in how to move forward with future phases, and implementation can be sequenced based on the recycled water demands and funding.

It's important to note that without treatment upgrades to the EBRWP RWTF to reduce ammonia and TDS, the expansion will need to remain focused on landscape customers. Existing water quality is not ideal for irrigating sensitive plant species and is not suitable for industrial use or ventilation and cooling systems. Results of the East Bayshore Water Quality Improvements Pilot Study indicated that the treatment improvements needed were not cost effective at this time. Additionally, treatment plant capacity would need to be increased to further expand the recycled water distribution system to other areas outside of Oakland, Emeryville and Alameda. As a result, the District should focus near-term efforts on customer outreach and implement strategies to maximize existing assets while also exploring funding opportunities to help offset projects costs for future phases of the project.

6.1.3 Phillips 66/Rodeo Renewed Energy Complex Recycled Water Project

The Phillips 66/RREC Recycled Water Project assumes an ultimate water demand of up to 2.8 mgd. The potential to deliver a significant amount of recycled water to a single customer, with comparatively few pipelines required due to the short distance between the sources of wastewater and the Phillips 66 Refinery, make the project very appealing. As currently envisioned, the project would be implemented in two phases. Phase 1 includes up to 1.4 mgd of recycled water produced on site from the refinery effluent. Phase 2 would come online soon thereafter but would require the construction of a new treatment facility that would be sourced with secondary effluent from the Pinole Hercules WPCP and the Rodeo WWTP.

The project, however, is not without its challenges. Implementation could be complex due to the involvement of four public agencies and one private entity, with agreements needed to divide responsibilities for operating and maintaining the pump station, pipeline, and treatment facilities. The treatment facility would be located on Phillips 66 Refinery property. Waste streams also need to be carefully considered. Waste streams from the new recycled water treatment facility, including filter backwash and RO concentrate, would be discharged to the San Francisco Bay through the refinery's permitted outfall (NPDES Permit No. CA 0005053, Order No. R2-2016-0044). The MF/BAF backwash would be sent to the refinery's sewer system and processed at the refinery's wastewater treatment plant before being discharged to the refinery's deep-water outfall (Discharge Point No. 002). While the refinery's existing NPDES permit outlines a procedure for adjusting concentration-based and mass-based effluent limits to account for the use of recycled water (which may have higher pollutant concentrations compared to other sources), the permit might require further modification to address loading from reject waste streams. As a result, the refinery may need to conduct additional monitoring, testing, and evaluations to ensure permit compliance, particularly concerning effluent toxicity.

6.2 Proposed Phasing of Recommended Projects

The proposed phasing timeline for the recommended projects is presented in Table 6-1 and depicted graphically on Figure 6-1. The schedule was based on discussions with District staff and accounts for the considerations and implementation needs that were summarized in the previous section.

Table 6-1. Phasing Timeline of Recommended Projects

Project	Project Phase	Design Period	Construction Period	Year Online
SRVRWP Expansion	Phase 3	2025–2027	2027–2030	2030
	Phase 5	2030–2032	2032–2035	2035
EBRWP Expansion	Phase 1B	2025–2027	2027–2029	2029
	Phase 2	2027–2040	2029–2045	2045
Phillips 66 Refinery/RREC	Phase 1	2031–2033	2033–2035	2035
	Phase 2	2035–2037	2037–2040	2040

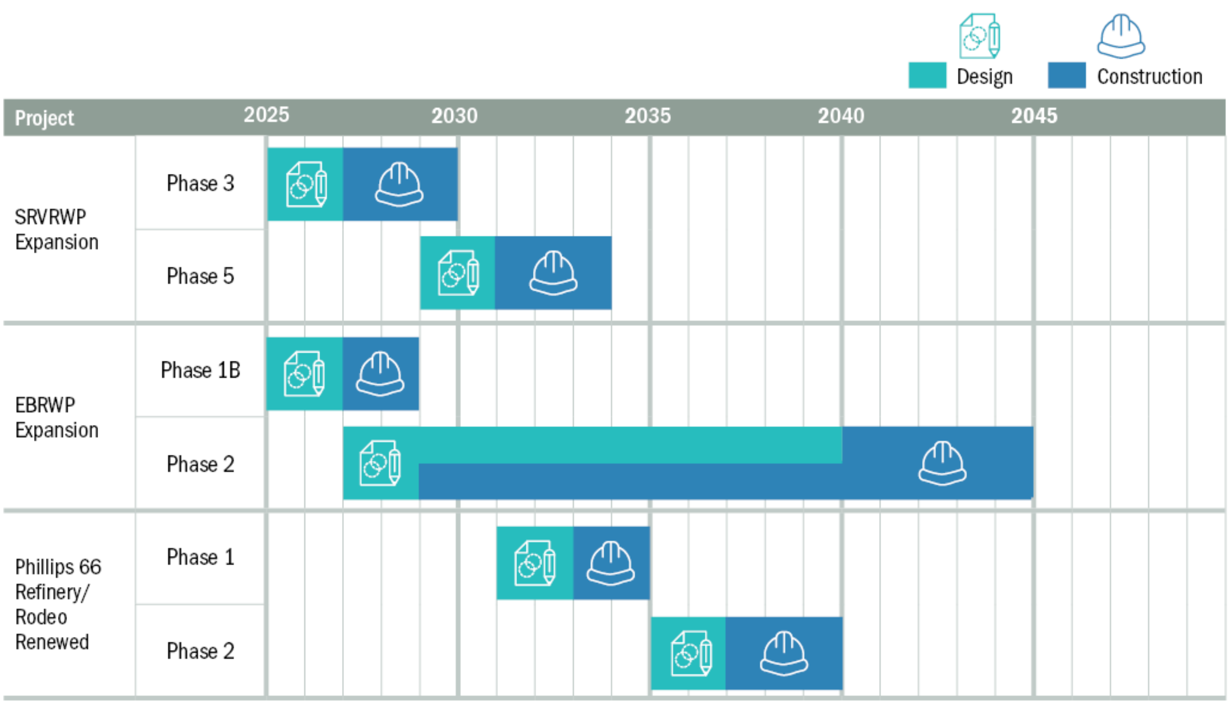

Figure 6-1. Implementation Timeline of Recommended Projects

SRVRWP – Phases 3 and 5. It is expected that Phase 3 of the SRVRWP would be among the first projects the District would look to advance, followed by the design and construction of Phase 5. The implementation of both projects is contingent on the procurement of supplemental wastewater supplies. Both projects build on a well-established landscape irrigation program that leverages existing infrastructure and should continue to be a high priority as long as funding and source supply is available.

EBRWP Expansion. In the near term, the District would also look to advance the EBRWP Expansion project as it leverages existing infrastructure, particularly distribution system backbone pipelines in Oakland. The Phase 1B customers in Oakland and Emeryville would be prioritized, with the intent of having deliveries to those customers online by 2029. The Phase 2 expansion into Alameda would likely be carried out progressively based on recycled water demands and funding availability.

Phillips 66 Refinery/RREC. The Phillips 66/RREC Recycled Water Project would be implemented in two phases. Phases 1 and 2 are expected to be online by 2035 and 2040, respectively. In the near term, the District will work with the refinery and partner agencies to firm up water demand, water quality requirements, as well as any needed arrangements to facilitate implementation, including operational agreements related to the pump station, pipelines, and treatment facilities.

6.3 Funding Opportunities

Funding is often a major barrier to project implementation. Identifying viable state, federal, and local funding sources (like grants and loans) is crucial to advancing some of these reuse projects. There are several state, federal, and local funding sources that are potentially available (i.e., current grants and loan opportunities). Funding eligibility and other requirements, such as local cost-share for grants and repayment terms for loans, are important considerations. Additionally, grant funding is competitive and therefore less certain. Alternative funding mechanisms, such as public-private partnerships (P3), should also be considered as potential pathways.

Like any other water project, costs associated with the recommended set of reuse projects identified in this RWSP update have three components—capital costs for initial construction, O&M costs, and repair and replacement costs for ongoing implementation once initial construction is complete. Some funding sources can be used only for capital expenditures, while others have broader applicability.

6.3.1 Grants and Loans

Table 6-2 summarizes currently available federal and state funding sources that could potentially be used to help finance some of the reuse projects. Many of the referenced programs tend to evolve with time, and current information is typically most efficiently found on websites (refer to the embedded hyperlinks in Table 6-2).

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

- Grant applications must demonstrate the ability to construct, operate, and maintain the project without grant funding.
- Grant award or funding authorization is not a promise of grant reimbursement.
  - Most grants are reimbursements and not up-front cash, which means a funding source must be available for project construction.
  - Grant reimbursements are subject to annual budget and appropriations processes. As such, disbursement of grant funds is not guaranteed to follow an established schedule.

- It may take several years after project completion to receive reimbursements, especially in difficult economic times.
- Most grants require a minimum cost share by the project sponsor.
- Federal grants typically require investment of additional resources.

Despite the competitive nature of grants, securing external funding can help minimize ratepayer impacts and the rising cost of water services, which is particularly important when considering affordability issues in low-income disadvantaged communities.

6.3.2 Public Private Partnerships

In recent years, public agencies have considered P3s and other forms of private sector financial involvement as viable methods to enhance service quality and efficiency. When effectively designed and implemented within a balanced regulatory framework, P3s can significantly increase the efficiency and sustainability of public service provision. P3s encompass private financing and involve the sharing of a project’s risks and rewards beyond the construction phase between public and private partners. In these projects, the private partner is generally accountable for a facility’s financing, design, construction, and O&M. In exchange, the private partner will typically receive a fee for the water from the public partner(s).

California's Infrastructure Finance Act (IFA; published in California Government Code Section 5956) allows local governments to use private investment capital for “fee-producing infrastructure facilities” paid for by those benefiting from the facility. It applies to cities, counties, special districts, joint power authorities, and other public entities. The government agency can grant ownership or leasing rights for up to 35 years. P3 projects can offer unique benefits and provide funding for expensive infrastructure and operational costs that make these projects economically feasible. Private partners are often incentivized to complete projects quickly, as payment is often contingent on meeting predetermined performance requirements.

While P3s can offer many direct and indirect benefits, they also present challenges. These arrangements can be complex and require significant legal and technical input. Agencies may lose some control of their water systems to private entities. Additionally, the public may have concerns about privatizing infrastructure and losing public control over these assets. Though most agreements address these issues, they can still pose challenges for public agencies pursuing projects on a P3 basis.

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Table 6-2. Federal and State Grant and Loan Funding Programs

Program	Administrative Agency	Type of Funding	Overview	Available Funding	Website	Considerations
Federal Opportunities						
Water Infrastructure Finance and Innovation Act (WIFIA)	EPA	Loan	Federal credit assistance program intended to accelerate investment in critical water infrastructure. Program can provide planning/design and planning/design/construction loans.	• $6.5B available for FY24	Water Infrastructure Finance and Innovation Act (WIFIA) | US EPA	• Potential low-interest loan mechanism that provides planning/design and/or planning/design/construction funding as long as costs meet the minimum threshold of $20M. • Potential opportunity to package other CIP projects together.
Large-scale Water Recycling Program (LSWRP)	U.S. Bureau of Reclamation (USBR)	Grant	Established under the Bipartisan Infrastructure Law (BIL), the LSWRP will provide $450M through FY26 for large-scale recycled water projects in Reclamation states. Large-scale recycled water projects (those with a project cost >$500M) will play an important role in helping communities develop local, drought-resistant sources of water supply by turning currently unusable water sources into a new source of water supply that is less vulnerable to drought and climate change.	• $180M available for FY23–24, of which $179M was awarded under the first round of awards. • USBR has made available an additional $129M (FY 25 appropriations) for the second and third round of the FY23–24 Notice of Funding Opportunity (NOFO). • USBR anticipates a new NOFO in early-mid 2025 with the remaining appropriations.	Large-Scale Water Recycling Program | Bureau of Reclamation	• Program authorization per BIL expires November 2026, at which time USBR will likely not be able to award money or execute new agreements. However, if Congress continues to award appropriations, USBR will put out money or a new authorization will be approved. • Total federal funding provided would need to be <80% of the total project cost.
WaterSMART Title XVI Authorized Water Reclamation and Reuse Projects	USBR	Grant	The Title XVI Authorized Projects program provides financial and technical assistance to local water agencies for the planning, design, and construction of water reclamation and reuse projects. Title XVI projects develop and supplement urban and irrigation water supplies through water reuse, thereby improving efficiency, providing flexibility during water shortages, and diversifying the water supply. These projects provide growing communities with new sources of clean water, which increases water management flexibility and makes water supplies more reliable.	• $60M available for FY23. • Maximum award 25% of total eligible cost or up to $20M per approved project.	Water Recycling and Desalination | Bureau of Reclamation	• Should see if District has any existing Title XVI authorizations that may help facilitate project implementation.
WaterSMART Title XVI Water Infrastructure Improvements for the Nation (WIIN) Act Water Reclamation and Reuse Projects	USBR	Grant	The Title XVI WIIN program provides financial and technical assistance to local water agencies that have submitted completed feasibility studies to USBR for the planning, design, and construction of water reclamation and reuse projects. WIIN projects develop and supplement urban and irrigation water supplies through water reuse, thereby improving efficiency, providing flexibility during water shortages, and diversifying the water supply. These projects provide growing communities with new sources of clean water, which increases water management flexibility and makes water supplies more reliable.	• $179M available for FY23/FY24 • Maximum award of 25% of total eligible costs up to $30M per applicant.	Water Recycling and Desalination | Bureau of Reclamation	• If a project defined under Title XVI and an LSWRP project receives $30M in grant funding, it would no longer be able to use the Title XVI WIIN authorization as the cap will have been reached. The overall project description needs to be strategically crafted to optimize receipt of funding from both pots (if possible).
WaterSMART: Water Recycling and Desalination Planning	USBR	Grant	Funding for potential new Title XVI projects, desalination construction projects and large-scale recycling projects	• FY 24 NOFO made $30M in funding available.	Desalination | Bureau of Reclamation	• Potential funding mechanism for reuse projects.
Congressionally Directed Spending Requests/Community Project Funding	U.S. Congress	Directed Appropriation	Congressionally directed spending is a mechanism by which members of Congress can request funding for specific projects in their home state that have been submitted for consideration by state and local government entities and nonprofits. Members of Congress can request direct funding for specific entities and projects in their districts to serve the public good.	• Average funding awarded in FY 2021 ranged from $3M to $5M, but can be higher.	About | House Committee on Appropriations - Republicans	• Congressionally directed spending requests for distinct phases or steps of the project or larger Congressional authorizations for the project should be investigated further with the District's Government Affairs and Congressional Representatives.
Midsize and Large Drinking Water System Infrastructure Resilience and Sustainability Program	EPA	Grants	The program assists medium- and large-sized public water systems with protecting drinking water sources from natural hazards, extreme weather events, and cybersecurity threats.	• $5M/year anticipated for FY22 to FY26.	Midsize and Large Drinking Water System Infrastructure Resilience and Sustainability Program | US EPA	

Table 6-2. Federal and State Grant and Loan Funding Programs

Program	Administrative Agency	Type of Funding	Overview	Available Funding	Website	Considerations
WaterSMART Drought Resiliency Projects	USBR	Grant	Program supports a proactive approach to drought by helping water managers develop and update comprehensive drought plans and implement projects that will build long-term resiliency to drought.	• FY 25 Funding Opportunity will allocate up to $40M in FY 24/25 appropriations plus some funding from IRA appropriations. USBR expects to fund 25 to 40 awards.	Drought Resiliency Projects | Drought Response Program	• Program could be pursued by potential partners or for elements not critical to an overall project (but providing drought mitigation). Projects with Title XVI/WIIN/LSWRP funding cannot pursue drought grants.
Building Resilient Infrastructure and Communities (BRIC) Grant	Federal Emergency Management Agency (FEMA)/California Office of Emergency Services	Grant	Helps states, local communities, tribes, and territories undertake hazard mitigation projects that reduce the risks these entities face from disasters and natural hazards. BRIC program guiding principles are: • Supporting communities through capability- and capacity-building • Encouraging and enabling innovation • Promoting partnerships • Enabling large projects • Maintaining flexibility • Providing consistency	• FY23 – FEMA will distribute up to $1B through State/Territory Allocation. • Up to $50M per applicant.	Building Resilient Infrastructure and Communities | FEMA.gov	• Requires projects be identified in an adopted Local Hazard Mitigation Plan. • Phased projects are allowed for complex projects for which FEMA provides funding to sub-applicants first for planning/design and then subsequently construction. • FEMA approvals process may deter projects from being delivered using alternative delivery methods.
Desalination and Water Purification Research (DWPR)	USBR	Grant	DWPR works with USBR researchers and partners to develop innovative, cost-effective, and technologically efficient ways to desalinate and treat water. Objectives include developing improved methods of desalination, increasing energy-efficient water treatment processes, and reducing the costs and environmental impacts of treating impaired waters, including but not limited to seawater, inland brackish groundwater, municipal wastewater, and waters produced from oil and gas extraction activities.	• $1.9M was available for FY24. • The maximum award is $300k.	Desalination and Water Purification Research Program | Research and Development Office	• Level of effort to develop proposal vs funding availability consideration.
DWPR: Pitch to Pilot Program	USBR	Grant	DWPR works with USBR researchers and partners to develop innovative, cost-effective, and technologically efficient ways to desalinate and treat water. The DWPR program works to address the need to reduce the costs, energy requirements, and environmental impacts of treating impaired and unusable water.	• $1.5M is available for FY25. • The maximum award is $300k.	DWPR Pitch-to-Pilot Research Reports | Research and Development Office	• Pilot program must be greater than 1 gpm.
Science and Technology Program	USBR	Grant	The Science and Technology Program is a USBR-wide competitive, merit-based applied research and development program. The program focuses on innovative solutions for water and power challenges in the Western United States for USBR water and facility managers and the stakeholders they serve.	• FY24 total funding available was $3.3M spread over 35 projects.	Science and Technology | Research and Development Office	• Some current competitions may be of interest, including More Water Less Concentrate.
State Opportunities						
Proposition 4: Parks, Environment, Energy, and Water Bond Measure (2024) (SB 867) (PENDING)	Various Agencies will disburse funds if the Bond Measure Passes	Bond monies are anticipated to be distributed as grants and loans through various state programs	Proposition 4 allows the state to sell a $10 billion bond for natural resources and climate activities. Much of the bond money would be used for loans and grants to local governments, Native American tribes, not-for-profit organizations, and businesses. Some bond money also would be available for state agencies to spend on state-run activities.	• $386M would be appropriated to the SWRCB for grants and projects related to water reuse and recycling.	Proposition 4 [Ballot]	• SWRCB is anticipated to receive funding for recycled water projects (language requires a set aside for Large Scale Recycle Water Projects).
Water Recycling Funding Program (WRFP) - Construction	SWRCB	Loan and Grant	WRFP provides funding for water recycling projects that offset or augment state or local fresh water supplies in California, and water recycling research.	• $50M cap between EPA's Clean Water State Revolving Fund (CWSRF) and WRFP. • Water recycling construction loans are capped at $50M. • Construction grants have a maximum award of $2M. • SWRCB anticipates that for FY24-25 it will have a total of $6.4M for construction grants and $57.7M for construction loans.	Water Recycling Funding Program (WRFP) | California State Water Resources Control Board	• Total program funding is capped at $50M currently per Intended Use Plan. • Requires packaging of project elements into distinct projects in order to seek multiple rounds or loans.

Table 6-2. Federal and State Grant and Loan Funding Programs

Program	Administrative Agency	Type of Funding	Overview	Available Funding	Website	Considerations
Drinking Water State Revolving Fund	SWRCB	Loan	DWSRF program helps public water systems finance the cost of drinking water infrastructure projects needed to achieve or maintain compliance with Safe Drinking Water Act requirements.	• Maximum loan of $50M per project, up to $100M per entity per funding cycle.	Drinking Water State Revolving Fund | California State Water Resources Control Board	• Total program funding is capped at $50M currently per Intended Use Plan. • Would require packaging of project elements into distinct projects in order to seek multiple rounds or loans.
State-directed Appropriations	CA State Legislature	Direct Appropriation	State-directed Appropriation is a mechanism by which the State Legislature can direct funding to specific projects in the state that have been advocated for by entities and that serve the public good.	• Varies (Metropolitan Water District received a $80M state grant)	Welcome to Committee on Appropriations | California State Assembly	• Opportunities for State Grant directed to the District with Government Affairs and Legislative Representatives support.
WRFP – Planning	SWRCB	Grant	Planning grant that encourages local public agencies to investigate the feasibility of recycling wastewater and assists them with completing planning for water recycling projects by supplementing local funds.	• $3M total funding available. $75k to $150k per award.	Water Recycling Funding Program (WRFP) | California State Water Resources Control Board	• SWRCB had enough funding to award 5 to 6 planning grants in FY 2024.
Clean Water State Revolving Fund (CLSRF)	SWRCB	Loan	The CWSRF program offers low-cost financing for a wide variety of water quality projects. The goal is to maintain abundant clean water for human uses and environmental protection to sustain California's future.	• $50M cap	Clean Water State Revolving Fund | California State Water Resources Control Board	• Program cannot fund demonstration facilities as there is no tangible off-site offset of potable water use. • Currently the program is capped at $50M per project.
Sustainable Groundwater Management Program (SGMA) Program	California Department of Water Resources (DWR)	Grant	Program provides funding to groundwater sustainability agencies and other responsible entities under SGMA to promote healthy and sustainable groundwater basins, to reduce and eliminate undesirable effects, and to promote projects that provide multiple benefits while also improving groundwater supply and quality.	• Funding Round 2 awarded $187M in September 2023. • Round 2 grant awards were between $1M and $20M.	Sustainable Groundwater Management Act (SGMA)	• Only one funding award per groundwater basin.
California Infrastructure State Revolving Fund	California Infrastructure and Economic Development Bank (IBank)	Loan	Program provides low-cost, direct financing to local governments as well as nonprofits sponsored by public agencies for a wide variety of public infrastructure and economic expansion projects that improve and sustain communities.	• Loan amounts are available between $1M and $65M.	Infrastructure Loans | California Infrastructure and Economic Development Bank (IBank)	• Depending on interest rate, potential funding mechanism but limited capacity (smaller than WIFIA).
Integrated Regional Water Management (IRWM) Grant Program	DWR	Grant	Funding is intended to improve regional water self-reliance security and adapt to the effects on water supply arising out of climate change. Specifically, the purpose is to help water infrastructure adapt to climate change; provide incentives for water agencies throughout each watershed to collaborate in managing the region's water resources and set regional priorities for water infrastructure; and improve regional water self-reliance, while reducing reliance on the Delta.	• $65M was available for the San Francisco Funding Area during Round 2. Funding appropriations for the program have been fully used at this time. Pending future appropriations.	IRWM Grant Programs	• Unless additional appropriations are provided, the IRWM program is not anticipated to release any more NOFOs.
Urban Community Drought Relief Funding	DWR	Grant	DWR is offering financial assistance to address drought impacts.	• $175M was available in the latest NOFO. • Minimum award amount of $3M. • Funding limits have not yet been determined.	2022 Urban Community Drought Relief Funding	• Total program funding is small in comparison to overall recycled water projects; could perhaps provide a grant source for groundwater wells or small aspects of the recycled water project to be pursued by project partners.

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6.4 Conclusions and Next Steps

The District has been making steady progress toward its 20-mgd reuse goal. The implementation of the three recommended NPR projects and the anticipated additional 0.5-mgd influent flow from the Chevron Refinery to increase the recycled water production of RARE will help the District move closer to that goal. However, the total recycled water deliveries are still expected to fall short of the 20-mgd goal by 2050. Figure 6-2 presents the projected recycled water deliveries for the RWSP planning horizon (2025–2050) and projects that the total planned 2050 recycled water deliveries will add up to approximately 13 mgd. While this delivery schedule does not account for the implementation of any customer-led satellite projects, such as those currently being explored by UCB, the Rossmoor Community, and the Moraga, Diablo, and Sequoyah country clubs, it is unlikely that the implementation of some or all of these projects will generate enough demand to bridge the gap needed to reach 20-mgd by 2050. It is unlikely the District will reach the full 20-mgd goal if relying solely on NPR projects.

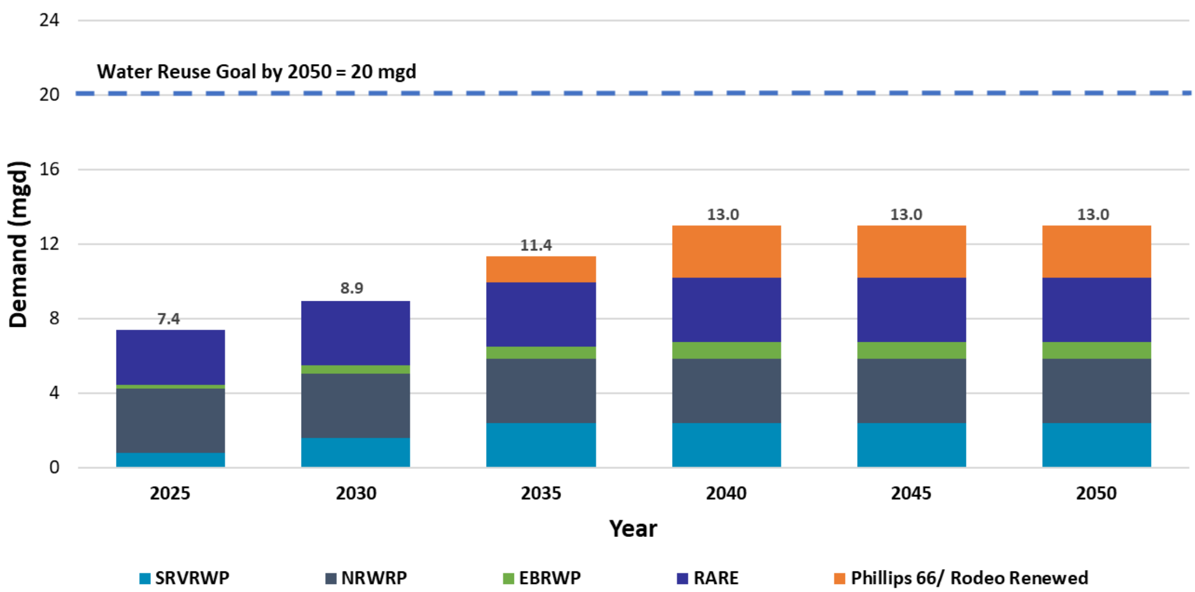

Figure 6-2. Planned Non-Potable Recycled Water Demand

While other NPR projects that could help the District reach its 20-mgd goal have been identified as part of this report and other previous planning efforts, those projects have implementation challenges and institutional complexities and are cost prohibitive. To reach the full 20-mgd goal, the District may need to consider adding purified water to its long-term water supply portfolio.

While this report identified several promising purified water opportunities, moving forward with any one of them in the near term is not necessary to meet the District's existing water supply needs. As previously noted, implementing a potable reuse project can be costly when compared to more traditional water supply alternatives and requires a significant time investment due to the inherent complexities that characterize these opportunities. A potable reuse project also can't be viewed as a supplementary water supply option used exclusively during dry periods; it is only cost effective when implemented as a large-scale project that operates consistently throughout all years. Currently, the District can meet its potable water demand with existing supplies. A purified water project will become more appealing when the District's need for water supply increases; however, it is advised that the District continue to follow developments in the potable reuse arena and to work on executing an outreach and education campaign as detailed in Appendix D to inform its customer base in the event a potable reuse project is considered in the future. Moving forward, the District will continue to evaluate the need for purified water as part of future studies and assessments. Key studies include:

- **Urban Water Management Plan:** This plan is updated every 5 years; it assesses water supply and demand over 30 years and outlines actions to address future uncertainties.
- **Water Needs Analysis:** This study is a thorough assessment of the District's water needs accounting for changes in demand, supply availability, and climate variability impacts.
- **Water Supply Management Program Update:** This program-level effort estimates the District's water supply needs over a 30-year horizon and proposes a diverse portfolio of policy initiatives and projects to ensure that those needs can be met in dry years.

Ultimately, the District is committed to meeting the 20-mgd goal, but more importantly is dedicated to selecting the right projects that best serve the needs of the community and integrate into the system efficiently and effectively.

Section 7

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Woodard & Curran, 2022b. Lamorinda Recycled Water Supply Alternatives Evaluation. Central San.

West Yost Associates, 2017. Oakland Hills Alternative Water Supply Feasibility Study. Completed by West Yost Associates and Whitley Burchett & Associates for EBMUD, April 2017.

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Appendix A: Basis for Cost Estimate

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Appendix A

Basis for Cost Estimate

This document summarizes the approach used to develop the estimated capital and operation and maintenance (O&M) costs for the non-potable and potable reuse opportunities included in the Recycled Water Strategic Plan 2024 Update (RWSP). The basis of cost documents the capital, O&M, and life-cycle costs to evaluate and compare the reuse opportunities.

A.1 Previous Studies

The East Bay Municipal Utility District (District or EBMUD) has developed many relevant studies and plans that are now serving as a foundation for the RWSP. While past studies are invaluable in many respects, the basis of costs often varies between projects as a function of scope, cost estimating approach, level of detail, and available cost data. Cost estimates should provide a common basis to enable meaningful comparisons among project opportunities.

The RWSP includes the assessment of both non-potable and potable reuse project opportunities. Most of the non-potable project descriptions are based on work that was developed as part of the District's 2019 Recycled Water Master Plan (RWMP). Cost estimates for these projects have been reviewed for any major errors or omissions to the facilities or the unit costs. Once any necessary corrections were made, the raw construction costs were extracted and escalated to March 2024 dollars (unless otherwise specified). The soft costs and allowances defined in this document were then applied to the raw construction costs, resulting in a capital cost estimate for use in the RWSP. Variations from this approach are highlighted for each project as needed in Section 3 of the main report.

Cost estimates developed for the potable reuse project opportunities use an approach similar to the one used in the recently completed *EBMUD-Central San Recycled Water Project Concept Evaluation Report* which are based on the team's material and labor databases, historical project data, current vendor and material cost information, and other cost benchmarks specific to the project locale. This methodology helps support comparison of costs and life-cycle assessment. O&M costs are based on recent estimates of the District's facilities, estimated lab hours, equipment power needs, and chemical and other consumable demands.

A.2 Class of Estimate

The cost estimates developed for the RWSP align with the Association for the Advancement of Cost Engineering (AACE) International's criteria for Class 5 estimates. Expected accuracy for Class 5 estimates typically ranges from -50 percent to +100 percent. The expected accuracy range of the Class 5 estimates is similar to the "Preliminary" or "Conceptual" category as defined in the District's Engineering Standard Practice (ESP) 020.3, which has an expected accuracy range of -30% to +50% (EBMUD, 2008b).

A.3 Development of Capital Costs

As is customary practice in a planning-level design, reference documents and available information lacked some details, resulting in the estimator's use of the following assumptions:

- Contractor markup is based on conventionally accepted values and adjusted for project-area economic factors.
- Major equipment costs are based on other similar facility costs and vendor-supplied price quotes obtained by Brown and Caldwell and Woodard & Curran engineers. Cost curves provided by the District were also utilized to estimate costs of various items including pipes, pump stations and storage tanks.
- Bulk material quantities are based on manual quantity take-offs.
- Sufficient electrical power is available to feed equipment specified in the preliminary designs. The local power company will supply power and transformers suitable for the potential facilities.
- Soils are of adequate nature to support the structures.

Capital costs consist of:

- Raw construction costs for new treatment and conveyance facilities for non-potable and potable reuse opportunities.
- Markups, including contractor overhead and profit, sales tax, equipment installation cost, mobilization, and contingency.
- Implementation costs, including change orders, engineering services for design and construction, and construction management (CM). Legal and administrative costs associated with implementation also are incorporated.

The capital cost estimate assumes a design-bid-build implementation approach.

A.3.1 Raw Construction Costs

Capital cost estimates rely on estimated construction costs and unit costs developed using RSMeans, vendor quotes, and equipment pricing furnished by either an engineering team or an estimator. The estimate includes equipment and construction-related labor costs and anticipated productivity adjustments to labor. Based on the level of detail available, percentage-based allowances are used for some elements.

Construction cost factors were used to develop and escalate unit costs when required to reflect the current bid environment, industry trends, and project location. Two factors are incorporated into some of the unit costs:

- **Engineering News Record's (ENR) Construction Cost Index (CCI) –** Since the rate of construction cost inflation varies by geographic region, the ENR CCI converts historic cost information to current dollar values. The City of Oakland is not one of the cities that is indexed within the ENR CCI. As such, the ENR CCI 20 Cities Average was applied to adjust unit cost and other cost estimates established at a different point in time to a common cost basis. Where applicable, RWSP estimated construction costs were indexed to a March 2024 ENR CCI 20 Cities Average of 13,532.01.

- **RSMeans Location Factor –** The unit costs presented in RSMeans represent the national average across the United States and Canada. A location factor, also referred to as a city cost index, is applied to account for variations in regional costs such as labor, equipment rental, raw materials, and freight. It represents a weighted average of both materials and labor costs across all divisions of construction. The Oakland, California location factor listed in RS Means is used for this Project, which has a corresponding location factor of 151.5 (RS Means 2024). This location factor represents a weighted average of both materials and labor cost across all divisions of construction. The location factor may be used to adjust cost estimates from other geographic areas (for example, to adjust capital cost estimates for potable reuse treatment trains in Southern California).

Preliminary design criteria and advanced water purification facility (AWPF) layouts provided the basis for estimating AWPF construction costs. The consultant team collected proposals from equipment manufacturers for treatment process systems such as RO and UV system. Other resources tapped for AWPF estimates included unit costs from past construction projects and industry estimating resources, such as RSMeans 2024. If cost data were not available, an estimate was made based on engineering judgment and best information available.

A.3.2 Contractor and Other Markups

Markups are conventionally accepted values and adjusted for the local economy. The following factors apply to facilities estimates:

- **Contingency –** Contingency is incorporated to provide flexibility to address costs related to unforeseen future and circumstances that are possible but cannot be predicted with certainty, such as fluctuations in the economy. Based on industry standard, the level of project definition and complexity, and local factors, construction contingency can range from 10 to 50 percent. This estimate incorporates a 25 percent contingency for non-potable reuse projects and 35 percent for potable reuse projects, selected using engineering judgment.
- **Mobilization/Demobilization –** This involves the process of establishing resources at a project site that are to be used over the course of the project, such as temporary office trailers, temporary utilities, and other equipment rental. Mobilization also includes insurance, bonding, administrative submittals, and regulatory permitting like stormwater pollution prevention plans. Demobilization involves removing temporary facilities, trailer(s), and the final move off the construction site. For this project, mobilization/demobilization is estimated as 5 percent of the sum of raw construction cost.
- **Contractor Overhead and Profit –** Contractor overhead and profit costs consist of standard expenses for a business to remain operational, including staff resources (e.g., salaries, fringe time, benefits), outsourced labor (e.g., accountant, legal, information technology), office costs, tools, equipment/vehicles, training, and insurance. A factor of 15 percent is used based on engineering judgment and past experiences. Overhead and profit is not applied to consumables (e.g., UF/RO replacement membranes or chemicals).
- **Sales Tax –** Sales tax applies to half the subtotal of construction costs. For this estimate, sales tax was estimated at 9 percent.
- **Equipment Installation –** Equipment installation costs consist of relevant labor, equipment delivery, sizing, foundation, and material costs associated with making equipment fully functional. Based on engineering judgment and past experiences, a 50 percent markup on total equipment cost is used as an estimate.

Table A-1 presents percentage factors based on raw construction costs and contingency.

Table A-1. Contractor and Other Markups		
Item	Markup (%)	Applied to
Equipment installation cost (for AWPFs only, as applicable)	50%	Raw construction costs
Contractor Overhead and Profit	15%	
Sales tax on materials (applied to half the construction cost subtotal)	9%	
Contingency	25% to 35%	Raw construction subtotal
Mobilization/Demobilization	5%	

A.3.3 Implementation Costs

Implementation costs are estimated as a percentage of the total construction cost (including contingency, tax, and general contractor overhead and profit). Implementation costs support environmental documentation and permits, engineering design, and CM. The following factors apply to facilities estimates:

- **Owner's Reserve for Change Orders –** Change orders may be a result of the Owner's direction to implement additional work, differing field conditions that require additional work, or an error in the project contract documents. District standard practice does not include a change order allowance for this level of cost estimate, so these were not included as a line item in RWMP Update cost estimates.
- **Environmental Documentation and Permits –** Costs associated with developing environmental studies and acquiring any permits necessary to construct a project.
- **Engineering Services (design) –** Engineering services include field investigations, such as surveys, geotechnical reports, and hazard materials investigations, preliminary and final design, contract document development, preparation of detailed cost estimations, and project scheduling.
- **Construction Management –** CM includes planning, coordinating, and providing monitoring and controlling of a construction project.

Table A-2 summarizes the implementation cost factors that have been adopted for this estimate. Legal and administration costs are not included as a separate percentage but are accounted for in each of the percentages.

Table A-2. Implementation Cost Factors	
Element	Percentage[a]
Owner's reserve for change orders	0%
Environmental Documentation and Permits	5%
Design Cost	15%
Construction management	12%

a. *Legal and administrative costs for the project are incorporated into the percentage for each element.*

A.4 Construction Component Costs

This section introduces the costing methods and assumptions for the RWSP Update non-potable and potable reuse opportunities and principal cost components.

A.4.1 Site Work

Site work includes all work related to the civil construction of the reuse opportunities such as excavation, off haul and disposal, grading, paving, shoring dewatering and backfill. Assumptions regarding site work are described within each project type (pipeline, pump station, etc.) in the following sections.

A.4.2 Advanced Water Purification Facilities

The AWPFs represent a substantial portion of the proposed potable reuse opportunities costs. The facilities planning included the development of preliminary process design and site layouts that form the basis for estimating quantities and cost. Process and ancillary equipment and installation represent a substantial portion of the raw construction cost for AWPFs. Costs for equipment are based on three sources: scaled costs from previous studies, equipment vendor budget proposals customized to influent water quality, desired effluent water quality, and facility plans, and unit costs based on those developed for other projects, including the Santa Clara Valley Water District, Sacramento Regional County Sanitation District, and others (Table A-3).

Table A-3. Annual AWPF Treatment O&M Costs

Treatment Process	Capital ($/mgd)
Ozone	$780,000
Biologically activated carbon	$630,000
Microfiltration	$590,000
Reverse osmosis	$890,000
Advanced oxidation and disinfection	$270,000
Chemicals (storage and use)	$150,000
Sitework/Piping/Structures	$3,720,000

Note that in instances where equipment costs from vendor proposals were utilized in the cost estimates, a 50 percent markup for process equipment, such as the RO system and UV reactors, was added to account for equipment installation costs.

A.4.3 Pipelines

Pipeline capital costs were developed using unit costs from two District provided cost curves (Figure A-1 and Figure A-2) and engineering judgement based on past construction projects. The allowances described in Section A.3.2 for the contractor overhead, sales tax and contingency were added to the estimates as were the implementation markups listed in Section A.3.3. Note that pipe material was not defined at this time as that determination will depend on a more detailed site assessment.

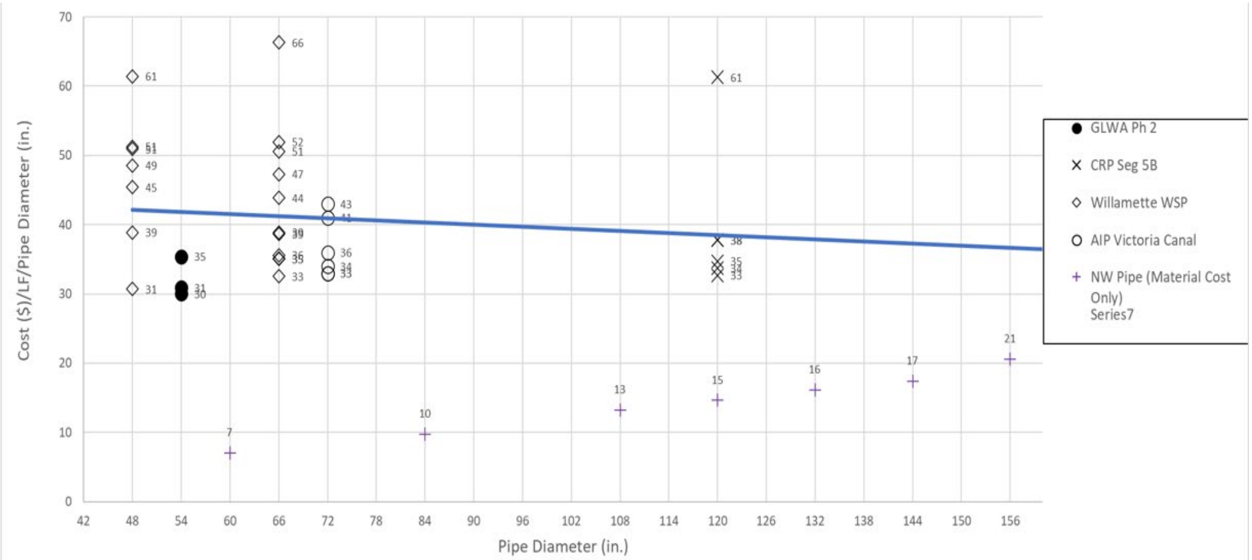

Figure A-1. Pipeline unit costs

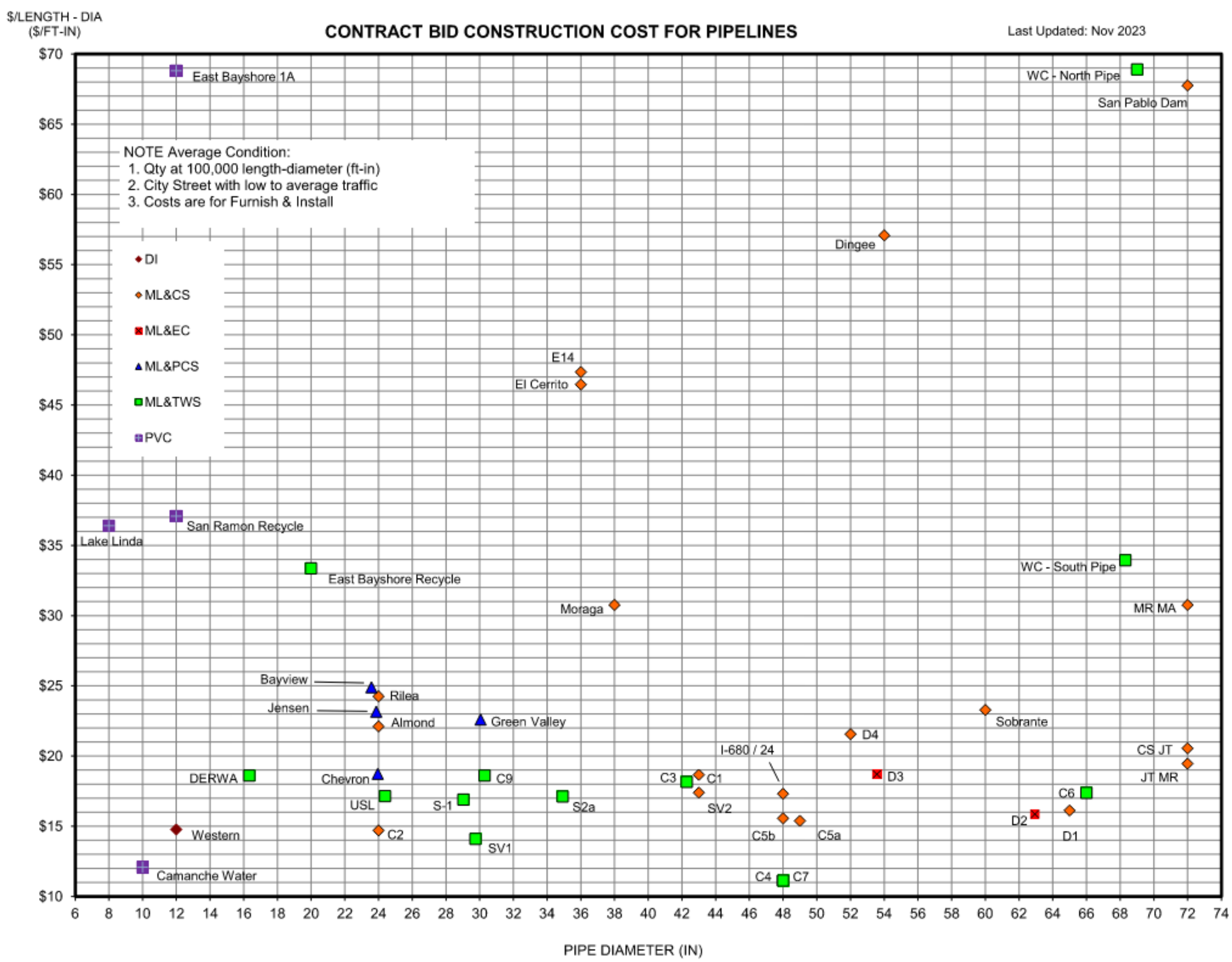

Figure A-2. Pipeline construction costs (with Bid markups)

The number and length of trenchless crossings required for each project alternative was estimated by using ArcGIS to assess the number of streams, California Highways, railroads, and Bay Area Rapid Transit (BART) right of ways that were intersected by the preliminary pipeline alignments. Unless otherwise specified, the costs of trenchless pipeline construction were assumed to be $3,500 per linear foot. In addition to the included trenchless crossings, tunneled lengths were estimated for those alternatives which would either take advantage of the existing San Pablo Tunnel or necessitate a new tunnel due to routing challenges through the coastal hills. For alternatives involving the San Pablo Tunnel, it was assumed that the entire tunnel length of 17,600 feet would undergo rehabilitation. The costs for the rehabilitation of the San Pablo Tunnel and or the implementation of a new tunnel were assumed to be $4,375 per linear foot. This cost was based on an escalated estimate that was previously developed as part the District's *San Pablo Tunnel - Full Seismic Retrofit* report. Note that the updated unit cost also includes an additional 25% contingency.

A.4.4 Pump Stations

Pump station costs can vary depending on the hydraulic requirements, type of pumps, pump station arrangement, surge control systems, and other project characteristics. For this RWSP update, the capital costs for pump stations were derived using the construction cost curve provided by the District (Figure A-3). The cost estimates shown below were marked up using the implementation cost allowances outlined in Section A.3.

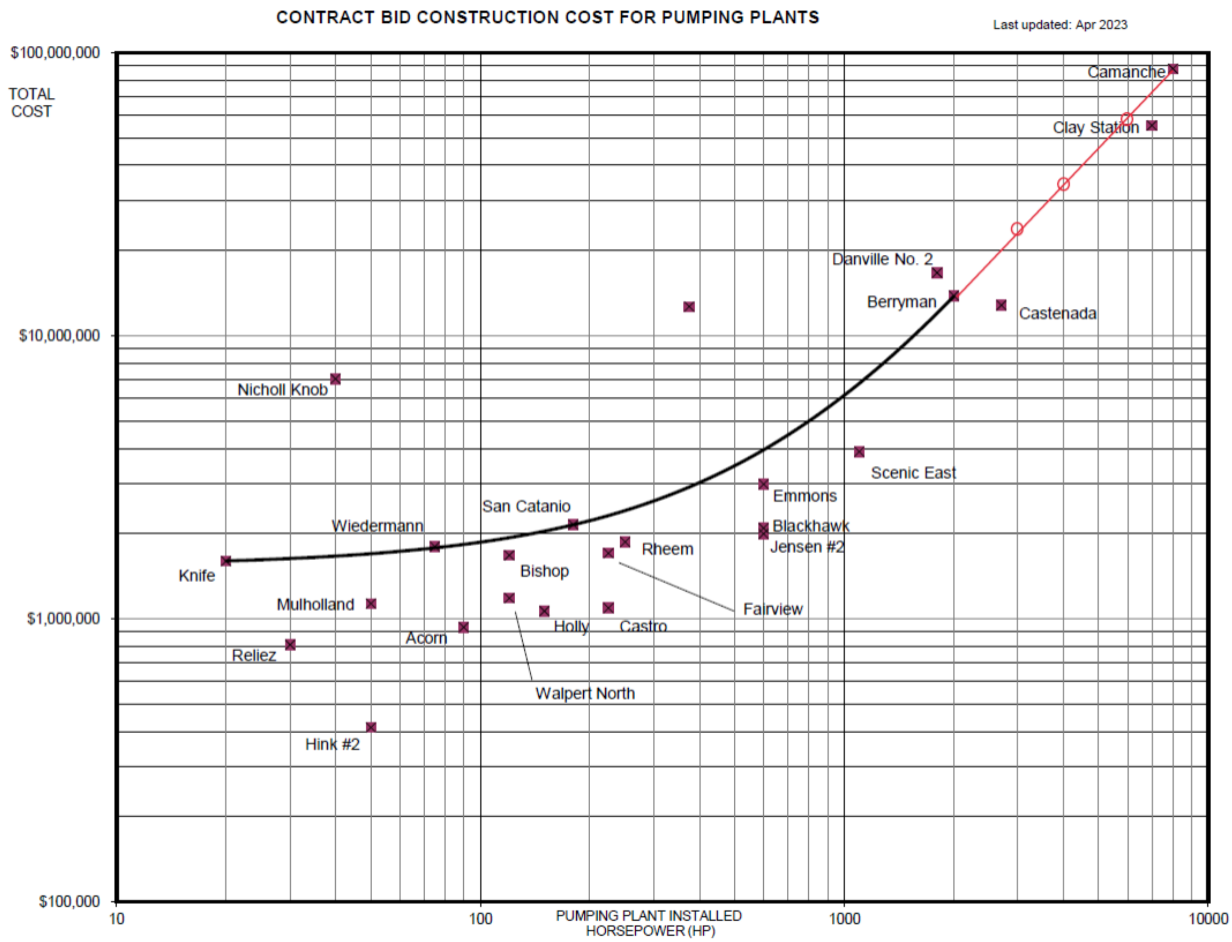

Figure A-3. Pump station construction costs (with Bid markups)

A.4.5 Storage Tanks

For the RWSP update, storage tank costs were estimated using the two construction cost curves (welded steel and pre-stressed concrete) provided by the District and cost information gathered from tank vendors. The welded steel storage tank curve (Figure A-4) includes the costs of site work and piping. The pre-stressed concrete tank curve (Figure A-5) does not include site work, piping, contractor overhead, sales tax or estimating contingency. The cost of the storage tanks was based on the generated cost from the two curves and the vendor estimates gathered for the desired tank size. The allowances described in Section A.3.2 for the contractor overhead, sales tax and contingency were added to the estimates as were the implementation markups listed in Section A.3.3. Note that tank material was not defined at this time as that determination will depend on a more detailed site assessment.

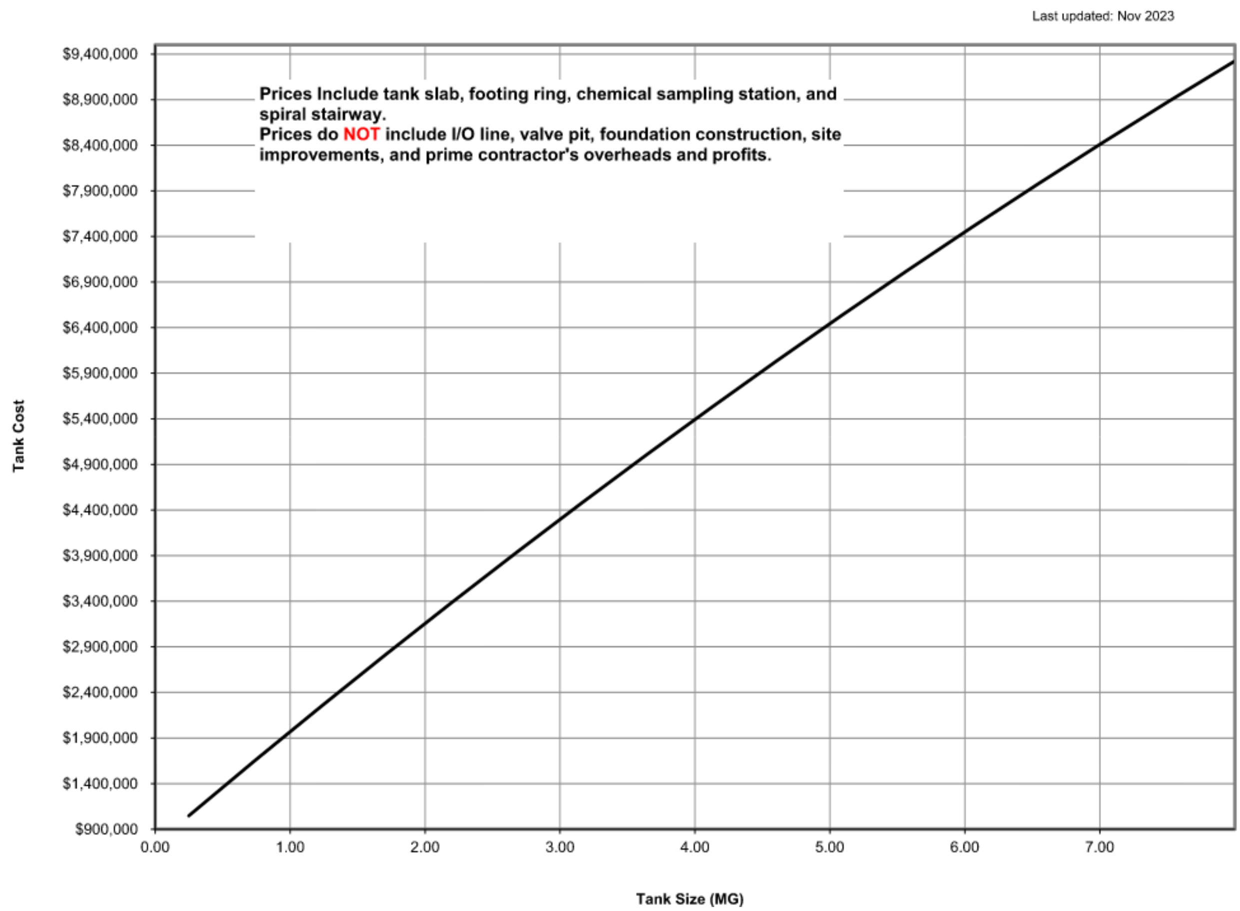

Figure A-4. Welded steel storage tank construction costs (with Bid markups)

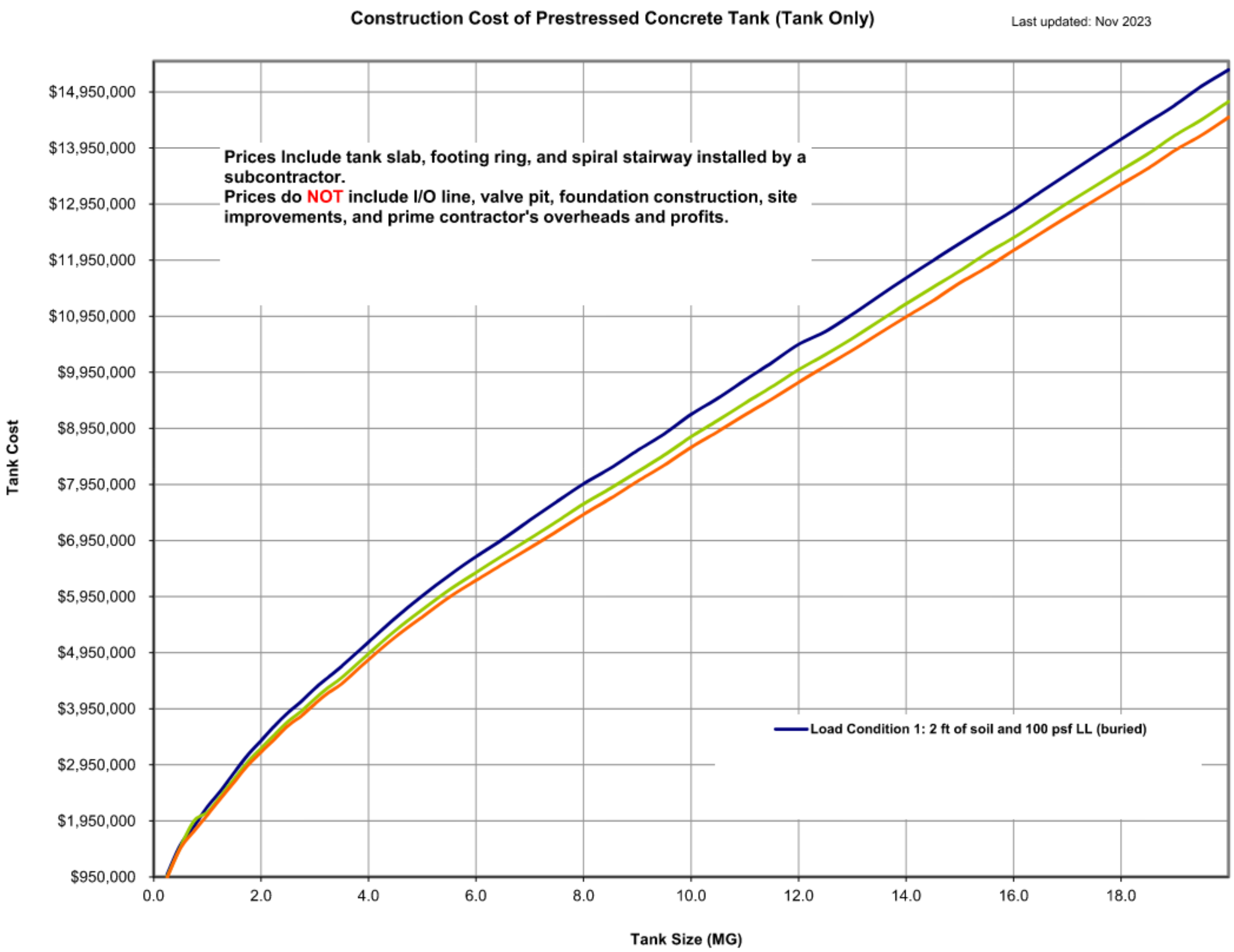

Figure A-5. Pre-stressed concrete storage tank construction costs

A.4.6 Non-Potable Treatment

Costs for non-potable treatment trains are based on the District's 2019 RWMP and other previous study information, where available (adjusted to March 2024 dollars, unless otherwise specified).

A.5 Operation and Maintenance Costs

O&M costs were derived from experience on similar projects and standard engineering methods. There is the potential for future increases in O&M unit costs, such as energy and labor costs, that are not accounted for in the O&M cost estimates but will be accounted for in the life-cycle cost development. The three components used to develop annual O&M costs were:

- **Labor –** Labor costs associated with the system O&M is calculated on an hourly basis. Where applicable, it was assumed that the maximum number of working hours per year is 2,080 hours. The average hourly cost of O&M personnel, which includes all wages and benefits to the operator, is estimated at $170.
- **Maintenance –** Maintenance costs were estimated as a percent of total constructions costs for both pipelines and pump stations.
- **Electricity –** The unit cost of electricity used was $0.22/kWh and was based on the average electricity billing rate of new Pacific Gas and Electric customers. All power-intensive equipment

for the reuse opportunities (such as pumps, blowers, and ultraviolet [UV] disinfection lamps) were included in the electricity estimate. Equipment and systems that consume significantly less energy (such as lighting, chemical dosing systems, and valve actuators) are assumed to be negligible and were not included.

A.5.1 AWPF O&M

The assumed O&M unit costs for the various treatment processes (including electricity and consumables) are presented in Table A-4. In addition to O&M costs for all the treatment processes, it was assumed that labor requirements for O&M at the facilities would be approximately one full-time employee per million gallon per day (mgd) (or 2,080 hours/mgd) at an hourly rate of $170.

Table A-4. Annual AWPF Treatment O&M Costs

Treatment Process	Annual O&M ($/mgd)
Ozone	$76,900
Biologically activated carbon	$146,600
Microfiltration	$372,400
Reverse osmosis	$559,900
Advanced oxidation and disinfection	$54,100
Chemicals (storage and use)	$144,200

A.5.2 Pipelines O&M

Pipelines require a minimal amount of operational labor resources, as most of the operations occur at the pump station or at the discharge point (i.e., reservoir or storage tank). Therefore, it is assumed that there are no operational labor requirements for pipelines. Pipelines would require regularly scheduled maintenance that may include the exercising of valves, appurtenance inspections (including customer turnouts), and flushing procedures at dead ends. It is estimated that it would require 2 percent of the construction cost for annual maintenance. No consumables or electrical needs are identified specific to pipelines.

A.5.3 Pump Stations O&M

Pump station O&M consists of labor, maintenance, and power:

- **Labor –**The annual labor requirements of a pump station mainly depend on the amount of equipment at the pump station, as well as the level of automation that is implemented at the pump station. Other minor factors, such as pump station location, contingency measures, and age of pump station, would also affect the labor demands. Operators are expected to regularly tend to the pump stations to operate valves, start and stop pumps, and examine flow data. Routine maintenance may include the inspection of equipment, exercising of valves, and servicing instrumentation. Estimates for operation and maintenance labor requirements are tabulated below in Table A-5.
- **Maintenance –** Pump station maintenance was estimated as 5 percent each of the construction costs associated with the pump station.
- **Electricity –** Pump station electricity consumption is estimated by evaluating the total flow, total dynamic head, and an assumed 80 percent pump efficiency.

Table A-5. Annual Labor Requirements for Various Pump Station Sizes			
Pump Station Capacity (gpm)	Annual Operator Hours	Annual Maintenance Hours	Total Annual O&M Hours
0 to 2,500	400	100	500
2,500 and up	800	200	1,000

A.5.4 Storage Tanks O&M

The annual O&M requirements of a storage tank are estimated at 1 percent of storage tank construction costs. No consumables or electrical needs are identified specifically to storage tanks.

A.5.6 Non-Potable Treatment O&M

O&M costs for non-potable treatment was based on previous study information, where available (adjusted to March 2024 dollars, unless otherwise specified).

A.6 Life-Cycle Costs

Life-cycle costs are calculated over a 30-year period of analysis using a 3 percent real discount rate (net of inflation). The discount rate reflects the time value of money, indicating that any future costs (or benefits) must be discounted by an appropriate rate for comparing alternatives based on a common point in time. Discount rates used by the utilities are typically the same as the borrowing rates expected over the next several years. While there is no consensus on a single borrowing rate, much of the industry data suggests that a rate of approximately 3 percent would be appropriate and justified.

All reuse opportunities costs (i.e., capital and O&M and replacement) were combined and brought back to their present value so that the project costs could be represented by a single number, the net present value. The annual costs were developed by including the annualized capital costs and annual O&M costs. The annual costs were then divided by the projected per year water benefits to obtain the project's unit cost on a per acre foot (AF) of water delivered basis ($/AF). Financing costs for loan or bond repayment are not included in the annualized total costs, but financing options are discussed as part of the RWSP implementation.

A.7 References

EBMUD, 2010b. *Life Cycle Cost Analysis – Engineering Standard Practice 20.1.* Effective August 26, 2008.

EBMUD, 2011b. *Average Useful Life of Water Facilities – Engineering Standard Practice 462.1.* Effective May 26, 2011.

EBMUD, 2018. *San Pablo Tunnel - Full Seismic Retrofit*, Cost estimate by District staff based on March 9, 2006 Northern Pipeline cost estimates.

SD-1 Surface Water Augmentation to Briones Reservoir (SD1-ResB-30)

Preliminary Cost Estimate
June 2024

Item	Size	Units	Unit Cost	Units	Quantity	Cost
Capital Costs						
AWPF Treatment						
Ozone						$ -
BAC						$ -
MF System			$31,500,000	each	1	$ 31,500,000
Low dose UV						$ -
Interprocess Tank			$275,000	each	2	$ 550,000
RO System					37.5	$ 31,320,630
Advanced Oxidation and Disinfection					30.0	$ 3,219,000
Chemicals (Storage and Feed Systems)			$150,000	per MGD	30.0	$ 4,500,000
Sitework/Piping/Structures			$3,720,000	per MGD	30.0	$ 111,600,000
Storage Tank	5.0	MG	$6,100,000	each	1	$ 6,100,000
New Primary Service and Electrical Building			$271.58	per SF	87,500	$ 23,763,557
Mechanical Allowance			10%	of equipment costs	71,089,630	$ 7,109,000
Electrical Allowance			30%	of equipment costs	71,089,630	$ 21,326,900
I&C Allowance			20%	of equipment costs	71,089,630	$ 14,217,900
			Treatment Subtotal			$ 255,206,987
Conveyance						
Secondary Effluent from SD-1 WWTP	48	inch	$42	per in-dia/LF	620	$ 1,249,900
Secondary Effluent Pump Station	625	hp	$1,500,000	each	1	$ 1,500,000
Waste Disposal to SD-1 ocean outfall	24	inch	$50	per in-dia/LF	620	$ 744,000
Waste Disposal Pump Station	120	hp	$1,000,000	each	1	$ 1,000,000
Product Water to Briones Reservoir	42	inch	$45	per in-dia/LF	77,400	$ 146,286,000
Product Water Pump Station	6,000	hp	$72,963,446	each	1	$ 80,000,000
San Pablo Tunnel Rehabilitation			$4,375	each	17,600	$ 80,000,000
Trenchless Crossings (Microtunnel jack and receive)			$769,000	each	4	$ 10,000,000
Microtunnel Pipe			$3,500	LF	2,400	$ 10,000,000
			Conveyance Subtotal			$ 330,779,900
Contractor Overhead & Profit					15%	$ 87,898,000
Sales Tax					9%	$ 52,738,800
			Raw Construction Subtotal			$ 726,624,000
Construction Contingency						
Estimation Contingency					35%	$ 254,318,400
Mobilization					5%	$ 36,331,200
			Total Construction Cost			**$ 1,017,274,000**
Implementation Costs						
Planning/ Environmental					5%	$ 50,863,700
Design Cost					15%	$ 152,591,100
Project Administration and Construction Management Cost					12%	$ 122,072,900
			Total Project Cost			**$ 1,342,802,000**
Annualized Project Cost						$ 68,509,000
Annual O&M Cost						$ 60,507,000
Annualized Capital Cost						**$ 129,016,000**
			Annual Yield	AFY	33,600	
Cost per AF					per AF	$ 3,800
					dry year	$ 12,500

Annual Operations and Maintenance Cost						
Pipe Maintenance			2.0%	of Construction cost	$158,279,900	$ 3,165,600
Pumping Energy			$0.22	per kWh	1,710,802	$ 376,400
Pump Maintenance			5%	of Construction cost	$82,500,000	$ 4,125,000
Pump Labor			$170	hrs	3,000	$ 510,000
Storage			1.0%	of Construction cost	$6,650,000	$ 66,500
Treatment						
Ozone						$ -
BAC						$ -
MF System			$372,400	per MGD	39.5	$ 14,709,800
Low dose UV						$ -
RO System			$559,900	per MGD	37.5	$ 20,996,300
Advanced Oxidation and Disinfection			$54,100	per MGD	30.0	$ 1,623,000
Chemicals (Storage and Feed Systems)			$144,200	per MGD	30.0	$ 4,326,000
Labor	30.0	MGD	$170	hrs/MGD	2,080	$ 10,608,000
					Total	$ 60,507,000

SD-1 Treated Water Augmentation to Claremont Center (SD1-Treat-30)

Preliminary Cost Estimate
June 2024

Item	Size	Units	Unit Cost	Units	Quantity		Cost
Capital Costs							
AWPF Treatment							
Ozone			$780,000	per MGD	39.4	$	30,732,000
BAC			$630,000	per MGD	39.4	$	24,822,000
MF System			$27,000,000	each	1	$	27,000,000
Low dose UV			$1,714,500	each	1	$	1,714,500
Interprocess Tank			$275,000	each	2	$	550,000
RO System			$31,320,630	each	1	$	31,320,630
Advanced Oxidation and Disinfection			$3,219,000	each	1	$	3,219,000
Chemicals (Storage and Feed Systems)			$150,000	per MGD	30.0	$	4,500,000
Sitework/Piping/Structures			$3,720,000	per MGD	30.0	$	111,600,000
Storage Tank	10.0	MG	$9,600,000	each	1		$9,600,000
New Primary Service and Electrical Building			$271.58	per SF	87,500	$	23,763,557
Mechanical Allowance			10%	of equipment costs	123,858,130	$	12,385,800
Electrical Allowance			30%	of equipment costs	123,858,130	$	37,157,400
I&C Allowance			20%	of equipment costs	123,858,130	$	24,771,600
			Treatment Subtotal			$	343,136,487
Conveyance							
Secondary Effluent from SD-1 WWTP	48	inch	$42	per in-dia/LF	620	$	1,249,900
Secondary Effluent Pump Station	625	hp	$1,500,000	each	1	$	1,500,000
Waste Disposal to SD-1 ocean outfall	24	inch	$50	per in-dia/LF	620	$	744,000
Waste Disposal Pump Station	120	hp	$1,000,000	each	1	$	1,000,000
Product Water to Claremont Center	42	inch	$45	per in-dia/LF	23,000	$	43,470,000
Product Water Pump Station	3,600	hp	$29,388,055	each	1	$	30,000,000
Trenchless Crossings (Microtunnel jack and receive)			$769,000	each	3	$	2,307,000
Microtunnel Pipe			$3,500	LF	1,500	$	5,250,000
			Conveyance Subtotal			$	85,520,900
Contractor Overhead & Profit					15%	$	64,298,600
Sales Tax					9%	$	38,579,200
			Raw Construction Subtotal			$	531,535,000
Construction Contingency							
Estimation Contingency					35%	$	186,037,300
Mobilization					5%	$	26,576,800
			Total Construction Cost			**$**	**744,149,000**
Implementation Costs							
Planning/ Environmental					5%	$	37,207,500
Design Cost					15%	$	111,622,400
Project Administration and Construction Management Cost					12%	$	89,297,900
			Total Project Cost			**$**	**982,277,000**
Annualized Project Cost				annualized 30 years, 3.0% interest		$	50,115,000
Annual O&M Cost						$	66,592,000
Annualized Capital Cost						**$**	**116,707,000**
			Annual Yield	AFY	33,600		
Cost per AF					per AF	$	3,500
					dry year	$	11,600

Annual Operations and Maintenance Cost	Size	Units	Unit Cost	Units	Quantity		Cost
Pipe Maintenance			2.0%	of Construction cost	$50,713,900	$	1,014,300
Pumping Energy			$0.22	per kWh	1,102,066	$	242,500
Pump Maintenance			5%	of Construction cost	$32,500,000	$	1,625,000
Pump Labor			$170	hrs	3,000	$	510,000
Storage			1.0%	of Construction cost	$10,150,000	$	101,500
Treatment							
Ozone			$76,900	per MGD	39.4	$	3,029,900
BAC			$146,600	per MGD	39.4	$	5,776,000
MF System			$372,400	per MGD	39.5	$	14,709,800
Low dose UV			$54,100	per MGD	37.5	$	2,028,800
RO System			$559,900	per MGD	37.5	$	20,996,300
Advanced Oxidation and Disinfection			$54,100	per MGD	30.0	$	1,623,000
Chemicals (Storage and Feed Systems)			$144,200	per MGD	30.0	$	4,326,000
Labor	30.0	MGD	$170	hrs/MGD	2,080	$	10,608,000
					Total	$	66,592,000

Central San Surface Water Augmentation to Briones Reservoir (CC-ResB-17.9)

Preliminary Cost Estimate
June 2024

Item	Size	Units	Unit Cost	Units	Quantity	Cost	
Capital Costs							
AWPF Treatment							
Ozone						$	-
BAF						$	-
MF System			$590,000	per MGD	23.5	$	13,865,000
Low dose UV						$	-
Interprocess Tank			$943,492	each	1	$	943,500
RO System			$890,000	per MGD	22.3	$	19,847,000
Advanced Oxidation and Disinfection			$270,000	per MGD	17.9	$	4,833,000
Chemicals (Storage and Feed Systems)			$150,000	per MGD	17.9	$	2,685,000
Sitework/Piping/Structures			$3,720,000	per MGD	17.9	$	66,588,000
Storage Tank						$	-
New Primary Service and Electrical Building			$19,664,361	LS	1	$	19,664,400
Mechanical Allowance			10%	of equipment costs	42,173,500	$	4,217,350
Electrical Allowance			30%	of equipment costs	42,173,500	$	12,652,050
I&C Allowance			20%	of equipment costs	42,173,500	$	8,434,700
			Treatment Subtotal			$	153,730,000
Conveyance							
Secondary Effluent from Central San WWTP	36	inch	$50	per in-dia/LF	2,200	$	3,960,000
Secondary Effluent Pump Station	600	hp	$4,000,000	each	1	$	4,000,000
Waste Disposal to Central San WWTP	20	inch	$50	per in-dia/LF	2,200	$	2,200,000
Waste Disposal Pump Station	150	hp	$2,000,000	each	1	$	2,000,000
Product Water to Briones Reservoir	30	inch	$50	per in-dia/LF	53,550	$	80,325,000
Product Water Pump Station	6,600	hp	$60,000,000	each	1	$	60,000,000
Trenchless Crossings (Microtunnel jack and receive)			$769,000	each	8	$	6,152,000
Microtunnel Pipe			$3,500	LF	3,300	$	11,550,000
			Conveyance Subtotal			$	170,187,000
Contractor Overhead & Profit					15%	$	48,587,600
Sales Tax					9%	$	29,152,500
			Raw Construction Subtotal			$	401,657,000
Construction Contingency							
Estimation Contingency					35%	$	140,580,000
Mobilization					5%	$	20,082,900
			Total Construction Cost			**$**	**562,320,000**
Implementation Costs							
Planning/ Environmental					5%	$	28,116,000
Design Cost					15%	$	84,348,000
Project Administration and Construction Management Cost					12%	$	67,478,400
			Total Project Cost			**$**	**742,262,000**
Annualized Project Cost						$	37,870,000
Annual O&M Cost						$	37,293,000
Annualized Capital Cost						**$**	**75,163,000**
			Annual Yield	AFY	20,048		
Cost per AF					per AF	$	3,700
					dry year	$	12,200

Annual Operations and Maintenance Cost							
Pipe Maintenance			2.0%	of Construction cost	$98,035,000	$	1,960,700
Pumping Energy			$0.22	per kWh	1,864,254	$	410,100
Pump Maintenance			5%	of Construction cost	$66,000,000	$	3,300,000
Pump Labor			$170	hrs	3,000	$	510,000
Storage			1.0%	of Construction cost	$943,500	$	9,435
Treatment							
Ozone						$	-
BAF						$	-
MF System			$372,400	per MGD	23.5	$	8,751,400
Low dose UV						$	-
RO System			$559,900	per MGD	22.3	$	12,485,800
Advanced Oxidation and Disinfection			$54,100	per MGD	17.9	$	968,400
Chemicals (Storage and Feed Systems)			$144,200	per MGD	17.9	$	2,581,200
Labor	17.9	MGD	$170	hrs/MGD	2,080	$	6,315,300
					Total	$	37,293,000

Central San Raw Water Augmentation to Mokelumne Aqueducts (CC-Raw-17.9)

Preliminary Cost Estimate
June 2024

Item	Size	Units	Unit Cost	Units	Quantity	Cost	
Capital Costs							
AWPF Treatment							
Ozone			$780,000	per MGD	23.5	$	18,330,000
BAF			$630,000	per MGD	23.5	$	14,805,000
MF System			$590,000	per MGD	23.0	$	13,587,700
Low dose UV			$1,019,556	each	1	$	1,019,600
Interprocess Tank			$950,000	each	1	$	950,000
RO System			$890,000	per MGD	22.3	$	19,881,800
Advanced Oxidation and Disinfection			$270,000	per MGD	17.9	$	4,833,000
Chemicals (Storage and Feed Systems)			$150,000	per MGD	17.9	$	2,685,000
Sitework/Piping/Structures			$3,720,000	per MGD	17.9	$	66,588,000
Storage Tank			$5,100,000	each	1	$	5,100,000
New Primary Service and Electrical Building			$19,800,000	LS	1	$	19,800,000
Mechanical Allowance			10%	of equipment costs	76,092,100	$	7,609,200
Electrical Allowance			30%	of equipment costs	76,092,100	$	22,827,600
I&C Allowance			20%	of equipment costs	76,092,100	$	15,218,400
			Treatment Subtotal			$	213,235,300
Conveyance							
Secondary Effluent from Central San WWTP	36	inch	$50	per in-dia/LF	2,200	$	3,960,000
Secondary Effluent Pump Station	600	hp	$4,000,000	each	1	$	4,000,000
Waste Disposal to Central San WWTP	20	inch	$50	per in-dia/LF	2,200	$	2,200,000
Waste Disposal Pump Station	150	hp	$2,000,000	each	1	$	2,000,000
Product Water to Briones Reservoir	30	inch	$50	per in-dia/LF	16,700	$	25,050,000
Product Water Pump Station	3,000	hp	$25,000,000	each	1	$	25,000,000
Trenchless Crossings (Microtunnel jack and receive)			$771,600	each	3	$	2,315,000
Microtunnel Pipe			$3,500	LF	2,500	$	8,750,000
			Conveyance Subtotal			$	73,275,000
Contractor Overhead & Profit					15%	$	42,976,500
Sales Tax					9%	$	25,785,900
			Raw Construction Subtotal			$	355,273,000
Construction Contingency							
Estimation Contingency					35%	$	124,345,600
Mobilization					5%	$	17,763,700
			Total Construction Cost			**$**	**497,382,000**
Implementation Costs							
Planning/ Environmental					5%	$	24,869,100
Design Cost					15%	$	74,607,300
Project Administration and Construction Management Cost					12%	$	59,685,800
			Total Project Cost			**$**	**656,544,000**
Annualized Project Cost						$	33,496,000
Annual O&M Cost						$	40,539,000
Annualized Capital Cost						**$**	**74,035,000**
			Annual Yield	AFY	20,048		
Cost per AF					per AF	$	3,700
					dry year	$	12,200

Annual Operations and Maintenance Cost							
Pipe Maintenance			2.0%	of Construction cost	$39,960,000	$	799,200
Pumping Energy			$0.22	per kWh	951,150	$	209,300
Pump Maintenance			5%	of Construction cost	$31,000,000	$	1,550,000
Pump Labor			$170	hrs	3,000	$	510,000
Storage			1.0%	of Construction cost	$6,050,000	$	60,500
Treatment							
Ozone			$76,900	per MGD	23.5	$	1,807,200
BAF			$146,600	per MGD	23.5	$	3,445,100
MF System			$372,400	per MGD	23.0	$	8,576,400
Low dose UV			$54,100	per MGD	22.3	$	1,208,500
RO System			$559,900	per MGD	22.3	$	12,507,700
Advanced Oxidation and Disinfection			$54,100	per MGD	17.9	$	968,400
Chemicals (Storage and Feed Systems)			$144,200	per MGD	17.9	$	2,581,200
Labor	17.9	MGD	$170	hrs/MGD	2,080	$	6,315,300
					Total	$	40,539,000

Oro Loma Surface Water Augmentation at Upper San Leandro Reservoir (Oro-ResU-8)

Preliminary Cost Estimate
June 2024

Item	Size	Units	Unit Cost	Units	Quantity	Cost
Capital Costs						
AWPF Treatment						
Influent Storage	1.8	MG	$2,000,000	LS	1	$ 2,000,000
Ozone						$ -
BAF						$ -
MF System			$590,000	per MGD	10.5	$ 6,195,000
Interprocess Tank			$400,000	each	1	$ 400,000
RO System			$890,000	per MGD	8.0	$ 7,102,200
Advanced Oxidation and Disinfection			$270,000	per MGD	8.0	$ 2,154,600
Chemicals (Storage and Feed Systems)			$150,000	per MGD	8.0	$ 1,197,000
Sitework/Piping/Structures			$3,720,000	per MGD	8.0	$ 29,685,600
Storage Tank						$ -
New Primary Service and Electrical Building			$19,800,000	LS	1	$ 19,800,000
Mechanical Allowance			10%	of equipment costs	17,048,800	$ 1,704,880
Electrical Allowance			30%	of equipment costs	17,048,800	$ 5,114,640
I&C Allowance			20%	of equipment costs	17,048,800	$ 3,409,760
Land Acquisition			$500	per SF	160,000	$ 80,000,000
			Treatment Subtotal			$ 158,763,680
Conveyance						
Secondary Effluent from Central San WWTP	24	inch	$50	per in-dia/LF	1,500	$ 1,800,000
Secondary Effluent Pump Station	200	hp	$2,200,000	each	1	$ 2,200,000
Waste Disposal to Central San WWTP	12	inch	$50	per in-dia/LF	1,500	$ 900,000
Waste Disposal Pump Station	50	hp	$1,800,000	each	1	$ 1,800,000
Product Water to Briones Reservoir	24	inch	$62	per in-dia/LF	61,250	$ 91,140,000
Product Water Pump Station	2,500	hp	$18,000,000	each	1	$ 18,000,000
Trenchless Crossings (Microtunnel jack and receive)			$771,600	each	3	$ 2,315,000
Microtunnel Pipe			$3,500	LF	750	$ 2,625,000
			Conveyance Subtotal			$ 120,780,000
Contractor Overhead & Profit					15%	$ 41,931,600
Sales Tax					9%	$ 25,158,900
			Raw Construction Subtotal			$ 346,634,000
Construction Contingency						
Estimation Contingency					35%	$ 121,321,900
Mobilization					5%	$ 17,331,700
			Total Construction Cost			**$ 485,288,000**
Implementation Costs						
Planning/ Environmental					5%	$ 24,264,400
Design Cost					15%	$ 72,793,200
Project Administration and Construction Management Cost					12%	$ 58,234,600
			Total Project Cost			**$ 640,580,000**
Annualized Project Cost						$ 32,682,000
Annual O&M Cost						$ 16,480,000
Annualized Capital Cost						**$ 49,162,000**
			Annual Yield	AFY	8,938	
Cost per AF					per AF	$ 5,500
					dry year	$ 18,200

Annual Operations and Maintenance Cost						
Pipe Maintenance			2.0%	of Construction cost	$96,465,000	$ 1,929,300
Pumping Energy			$0.22	per kWh	697,510	$ 153,500
Pump Maintenance			5%	of Construction cost	$22,000,000	$ 1,100,000
Pump Labor			$170	hrs	3,000	$ 510,000
Storage			1.0%	of Construction cost	$400,000	$ 4,000
Treatment						
Ozone						$ -
BAF						$ -
MF System			$372,400	per MGD	10.5	$ 3,910,200
Low dose UV						$ -
RO System			$559,900	per MGD	8.0	$ 4,468,000
Advanced Oxidation and Disinfection			$54,100	per MGD	8.0	$ 431,700
Chemicals (Storage and Feed Systems)			$144,200	per MGD	8.0	$ 1,150,700
Labor	8.0	MGD	$170	hrs/MGD	2,080	$ 2,821,700
					Total	$ 16,480,000

SRVRWP Phase 3

Preliminary Cost Estimate
October 2024

Item	Size	Units	Unit Cost	Units	Quantity	Cost	
Capital Costs							
Treatment							
SRVRWP Treatment/Supplemental Supply (EBMUD Share)				LS		$	-
Pipeline							
SRVRWP Distribution	16	in	$62	in/dia-LF	15840	$	15,713,280
Pump Station							
Pump Station R3000	200	hp	$2,100,000	LS	1	$	2,100,000
			Subtotal			$	17,813,000
Contractor Overhead & Profit					15%	$	2,672,000
Sales Tax					9%	$	801,600
			Raw Construction Subtotal				$21,287,000
Construction Contingency							
Estimation Contingency					25%	$	5,322,000
Mobilization					5%	$	1,330,000
			Total Construction Cost			**$**	**24,465,000**
Implementation Costs							
Planning/ Environmental					5%	$	1,223,000
Design Cost					15%	$	3,670,000
Project Administration and Construction Management Cost					12%	$	2,936,000
			Total Project Cost			**$**	**32,294,000**
Annualized Project Cost				annualized 30 years, 3.0% interest		$	1,648,000
Annual O&M Cost						$	734,000
Total Annualized Cost						**$**	**2,382,000**
			Annual Yield	AFY	638		
Cost per AF					per AF	$	3,700
					dry year	$	12,200

Annual Operations and Maintenance Cost					
Pumping Energy	$0.22	per kWh	2,178	$	-
Pipe Maintenance	2%	of Construction cost		$	-
Pump Maintenance including R&R	5%	of Construction cost	2,100,000	$	105,000
Labor Costs	$170	per hour		$	-
Storage Maintenance	1%	of Construction cost		$	-
SRVRWP Treatment Cost	$994	per AF	638	$	634,172
SRVRWP Transmission Cost	$156	per AF	638	$	99,528
			Total	**$**	**734,000**

SRVRWP Phase 5

Preliminary Cost Estimate
October 2024

Item	Size	Units	Unit Cost	Units	Quantity	Cost	
Capital Costs							
Treatment							
SRVRWP Treatment/Supplemental Supply (EBMUD Share)				LS		$	-
Pipeline							
SRVRWP Distribution	16	in	$62	in/dia-LF	14784	$	14,665,728
Pump Station							
-				LS		$	-
			Subtotal			$	14,666,000
Contractor Overhead & Profit					15%	$	2,199,900
Sales Tax					9%	$	660,000
			Raw Construction Subtotal				$17,526,000
Construction Contingency							
Estimation Contingency					25%	$	4,382,000
Mobilization					5%	$	1,095,000
			Total Construction Cost			**$**	**20,143,000**
Implementation Costs							
Planning/ Environmental					5%	$	1,007,000
Design Cost					15%	$	3,021,000
Project Administration and Construction Management Cost					12%	$	2,417,000
			Total Project Cost			**$**	**26,588,000**
Annualized Project Cost				annualized 30 years, 3.0% interest		$	1,357,000
Annual O&M Cost						$	621,000
Total Annualized Cost						**$**	**1,978,000**
			Annual Yield	AFY	540		
Cost per AF					per AF	$	3,700
					dry year	$	12,200

Annual Operations and Maintenance Cost					
Pumping Energy	$0.22	per kWh	0	$	-
Pipe Maintenance	2%	of Construction cost		$	-
Pump Maintenance including R&R	5%	of Construction cost	0	$	-
Labor Costs	$0	per hour	0	$	-
Storage Maintenance	1%	of Construction cost		$	-
SRVRWP Treatment Cost	$994	per AF	540	$	536,760
SRVRWP Transmission Cost	$156	per AF	540	$	84,240
			Total	**$**	**621,000**

EBRWP Expansion

Preliminary Cost Estimate
October 2024

Item	Size	Units	Unit Cost	Units	Quantity	Cost	
Capital Costs							
East Bayshore Upgrades							
Treatment Quality Upgrades (RO with Breakpoint Chlorination)			$0	LS	1	$	-
Treatment Capacity Upgrades			$0	LS	1	$	-
Peak Hour Pumping Upgrades (+2.7 MGD)		hp	$0	LS	1	$	-
Pipeline							
Phase 1B		in	$62	in/dia-LF		$	-
Phase 2, Emeryville	6	in	$62	in/dia-LF	2,112	$	785,664
Phase 2, OARB (Oakland Army Base)	8	in	$62	in/dia-LF	7,920	$	3,928,320
Phase 2 OIH (Oakland Inner Harbor)							
6 inch pipeline	6	in	$62	in/dia-LF	1,570	$	584,040
8 inch pipeline	8	in	$62	in/dia-LF	1,130	$	560,480
12 inch pipeline	12	in	$62	in/dia-LF	1,200	$	892,800
Phase 2 Alameda East							
6 inch pipeline	6	in	$62	in/dia-LF	5,745	$	2,137,140
8 inch pipeline	8	in	$62	in/dia-LF	7,583	$	3,761,168
Phase 2 Alameda West and VA							
8 inch pipeline	8	in	$62	in/dia-LF	8,976	$	4,452,096
Alameda - 16" Estuary Pipeline							
16 inch pipeline	16	in	$62	in/dia-LF	4,604	$	4,567,168
16 inch slipline crossing	16	in	$100	in/dia-LF	3,055	$	4,888,000
			Subtotal			$	26,557,000
Contractor Overhead & Profit					15%	$	3,983,600
Sales Tax					9%	$	1,195,100
			Raw Construction Subtotal				$31,736,000
Construction Contingency							
Estimation Contingency					25%	$	7,934,000
Mobilization					5%	$	1,984,000
			Total Construction Cost			**$**	**41,654,000**
Implementation Costs							
Planning/ Environmental					5%	$	2,083,000
Design Cost					15%	$	6,248,000
Project Administration and Construction Management Cost					12%	$	4,998,000
			Total Project Cost			**$**	**54,983,000**
Annualized Project Cost					annualized 30 years, 3.0% interest	$	2,805,000
Annual O&M Cost						$	531,000
Total Annualized Cost						**$**	**3,336,000**
			Annual Yield	AFY	785		
Cost per AF					per AF	$	4,200
					dry year	$	13,900

Annual Operations and Maintenance Cost							
Pumping Energy	0	hp	$0.22	per kWh	0	$	-
Pipe Maintenance			2%	of Construction cost	$26,556,876	$	531,000
Pump Maintenance including R&R			5%	of Construction cost	$0	$	-
Storage Maintenance							
Treatment							
RO			$543,200	per MGD	0.0	$	-
Labor	0.0	MGD	$170	hrs/MGD	2,080	$	-
					Total	**$**	**531,000**

SLWRF Expansion Project

Preliminary Cost Estimate
October 2024

Item	Size	Units	Unit Cost	Units	Quantity	Cost	
Capital Costs - Distribution only							
Pipeline							
Pipeline Rehabilitation (lining)	16	in	$200	LF	15840	$	3,168,000
Pump Stations							
Pump Rehabilitation			$3,240,000	LS	1	$	3,240,000
			Subtotal			$	6,408,000
Contractor Overhead & Profit					15%	$	961,200
Sales Tax					9%	$	288,400
			Raw Construction Subtotal				$7,658,000
Construction Contingency							
Estimation Contingency					25%	$	1,915,000
Mobilization					5%	$	479,000
			Total Construction Cost			**$**	**10,052,000**
Implementation Costs							
Planning/ Environmental					5%	$	503,000
Design Cost					15%	$	1,508,000
Project Administration and Construction Management Cost					12%	$	1,206,000
			Total Project Cost			**$**	**13,269,000**
Annualized Project Cost					annualized 30 years, 3.0% interest	$	677,000
Annual O&M Cost						$	225,000
Total Annualized Cost						**$**	**902,000**
			Annual Yield	AFY	25		
Cost per AF					per AF	$	36,100
					dry year	$	119,100

Annual Operations and Maintenance Cost						
Pumping Energy	hp	$0.22	per kWh	0	$	-
Pipe Maintenance		2%	of Construction cost	3,168,000	$	63,000
Pump Maintenance including R&R		5%	of Construction cost	3,240,000	$	162,000
				Total	**$**	**225,000**

Chevron/Richmond Refinery Recycled Water Project

Preliminary Cost Estimate
October 2024

Item	Size	Units	Unit Cost	Units	Quantity	Cost	
Capital Costs - Distribution Only							
Treatment							
RARE MF/RO expansion from 3.5 to 4.2 mgd	0.7	MGD	$1,214,060	LS	1	$	1,214,000
Conveyance							
Pipeline Pt. Isabel to West County WPCP	16	in	$62	in/dia-LF	44352	$	43,997,184
Effluent Tank and Pumps			$5,000,000	LS	1	$	5,000,000
			Subtotal			$	50,211,000
Contractor Overhead & Profit					15%	$	7,531,700
Sales Tax					9%	$	2,259,500
			Raw Construction Subtotal				$60,002,000
Construction Contingency							
Estimation Contingency					25%	$	15,001,000
Mobilization					5%	$	3,750,000
			Total Construction Cost			**$**	**68,962,000**
Implementation Costs							
Planning/ Environmental					5%	$	3,448,000
Design Cost					15%	$	10,344,000
Project Administration and Construction Management Cost					12%	$	8,275,000
			Total Project Cost			**$**	**91,029,000**
Annualized Project Cost					annualized 30 years, 3.0% interest	$	4,644,000
Annual O&M Cost						$	1,730,000
Total Annualized Cost						**$**	**6,374,000**
			Annual Yield	AFY	1,590		
Cost per AF					per AF	$	4,000
					dry year	$	13,200

Annual Operations and Maintenance Cost							
Pumping Energy	150	hp	$0.22	per kWh	326,748	$	72,000
Pipe Maintenance			2%	of Construction cost	43,997,184	$	880,000
Pump Maintenance including R&R			5%	of Construction cost	2,500,000	$	125,000
Storage Maintenance			1%	of Construction cost	2,500,000	$	25,000
Treatment Maintenance							
RO			$543,200	per MGD	0.7	$	380,000
Labor	0.7	MGD	$170	hrs/MGD	2080	$	247,500
					Total	**$**	**1,730,000**

Phillips 66 Refinery/ Rodeo Renewed Energy Complex Recycled Water Project

Preliminary Cost Estimate
October 2024

Item	Size	Units	Unit Cost	Units	Quantity		Cost
Capital Costs							
Treatment							
MF	3.130612	MGD	$590,000	per MGD	1	$	1,847,061
RO	2.284	MGD	$890,000	per MGD	1	$	2,032,760
BAF	0.784	MGD	$630,000	per MGD	1	$	493,920
UV	2.59552	MGD	$270,000	per MGD	1	$	700,790
Chemicals (Storage and Feed Systems)	2.59552	MGD	$150,000	per MGD	1	$	389,328
Sitework/Piping/Structures	2.59552	MGD	$3,720,000	per MGD	1	$	9,655,334
Pipeline							
To Rodeo Renewed	12	in	$62	in/dia-LF	3565	$	2,652,360
Pump Stations							
Effluent to Rodeo Renewed	80	hp	$1,850,000	LS	1	$	1,850,000
			Subtotal			$	19,622,000
Contractor Overhead & Profit					15%	$	2,943,300
Sales Tax					9%	$	883,000
			Raw Construction Subtotal				$23,448,000
Construction Contingency							
Estimation Contingency					25%	$	5,862,000
Mobilization					5%	$	1,466,000
			Total Construction Cost			**$**	**30,776,000**
Implementation Costs							
Planning/ Environmental					5%	$	1,539,000
Design Cost					15%	$	4,616,000
Project Administration and Construction Management Cost					12%	$	3,693,000
			Total Project Cost			**$**	**40,624,000**
Annualized Project Cost					annualized 30 years, 3.0% interest	$	2,073,000
Annual O&M Cost						$	2,688,000
Total Annualized Cost						**$**	**4,761,000**
			Annual Yield	AFY	3,136		
Cost per AF					per AF	$	1,500
					dry year	$	5,000

Annual Operations and Maintenance Cost					
Pumping Energy	$0.22	per kWh	522,797	$	115,000
Pipe Maintenance	2%	of Construction cost	2,652,360	$	53,000
Pump Maintenance including R&R	5%	of Construction cost	1,850,000	$	93,000
Storage Maintenance	1%	of Construction cost		$	-
Treatment					
MF	$361,300	per MGD	3.1	$	1,131,000
RO	$543,200	per MGD	2.3	$	1,241,000
BAF	$52,500	per MGD	0.8	$	41,000
UV	2%	of Construction cost	700,790	$	14,000
			Total	**$**	**2,688,000**

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Appendix B: Chevron/ Richmond Refinery Recycled Water Project Alternatives Evaluation

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Appendix B

Chevron/Richmond Refinery Recycled Water Project Alternatives Evaluation

This document summarizes the various alternatives evaluated for the Chevron/Richmond Refinery Recycled Water Project included in the Recycled Water Strategic Plan 2024 Update (RWSP). Several of these alternatives were developed as part of the East Bayshore Recycled Water Project Expansion: Alternatives Study.

B.1 Chevron/Richmond Refinery Recycled Water Project

The East Bay Municipal Utility District (District or EBMUD) is interested in exploring an expansion of recycled water use at the Chevron Richmond Refinery, however additional water supply is needed as indicated in the 2019 Recycled Water Master Plan (RWMP). Given the deficit in West County Wastewater (WCW) effluent supply, the District has identified four potential sources of additional supply to Chevron: Chevron effluent, the District's East Bayshore Recycled Water Project (EBRWP), wastewater diversion at the District's North Interceptor at Pt. Isabel, and the City of Richmond's Water Pollution Control Plant (WPCP) treated effluent. The alternatives are also distinguished by the degree of treatment expansion. Amongst the alternatives being considered, there are alternatives that have the influent flows needed to accommodate the expansion of the Richmond Advanced Recycled Expansion (RARE) Project to 5 million gallons per day (mgd) and there are others that can only accommodate a treatment expansion to 4.2 mgd. The latter are referred to as "partial expansion" since the original intent of the RARE expansion was to increase production capacity of the facility to 5 mgd. Overall, the District has identified nine potential alternative approaches for the Chevron/ Richmond Refinery Recycled Water Project that comprise different combinations of each supply source as described in Table B-1.

Table B-1. Chevron/ Richmond Refinery Recycled Water Project Alternatives		
Alternative	Description	Annual Yield Increase (AFY)
Chevron Effluent to RARE	Assumes 0.5 mgd Chevron effluent is available to the District at no cost to supplement flows to RARE.	560
North Interceptor Diversion at Pt. Isabel to WCW WPCP, Untreated	Assumes supplemental flows to WCW WPCP via diversion of the North Interceptor at the Pt. Isabel Treatment Plant. New raw waste distribution pipeline totaling 8.3 miles to WCW WPCP. Additional pumping and storage facilities required at Pt. Isabel Treatment Plant.	560
Partial RARE Expansion via EBRWP to North Richmond Water Recycling Plant (NRWRP)	Assumes EBRWP expansion to the NRWRP. New distribution pipeline totaling 14.2 miles. Additional treatment required at the EBRWP recycled water treatment facility (RWTF). Additional pumping and storage facilities required at Pt. Isabel Treatment Plant. By supplying additional recycled water flows to the NRWRP, WCW supply is available for supplementing RARE flows. Assumes additional treatment expansion to 4.2 mgd at RARE.	1,590
Partial RARE Expansion via North Interceptor Diversion and New Treatment at Pt. Isabel to NRWRP	Assumes expansion to the NRWRP via diversion of the North Interceptor at Pt. Isabel. New distribution pipeline totaling 8.3 miles. Additional treatment, pumping and storage facilities required at Pt. Isabel Treatment Plant. By supplying additional recycled water flows to the NRWRP, WCW supply is available for supplementing RARE flows. Assumes additional treatment expansion to 4.2 mgd at RARE.	1,590
Partial RARE Expansion via North Interceptor Diversion at Pt. Isabel to WCW WPCP, Untreated	Assumes expansion to WCW WPCP via diversion of the North Interceptor at the Pt. Isabel Treatment Plant. New raw waste distribution pipeline totaling 8.3 miles to WCW WPCP. Additional pumping and storage facilities required at Pt. Isabel Treatment Plant. Assumes additional treatment expansion to 4.2 mgd at RARE.	1,590
RARE Expansion via Richmond WPCP Effluent	Assumes all necessary treatment improvements are implemented at the Richmond WPCP for water quality requirements at RARE as noted in the RWMP. New distribution pipeline totaling 2 miles. Assumes additional treatment expansion to 5 mgd at RARE.	2,520
RARE Expansion via EBRWP to NRWRP and Richmond WPCP Effluent	Assumes EBRWP expansion to the NRWRP. New distribution pipeline totaling 14.2 miles. Additional pumping and storage facilities required at Pt. Isabel Treatment Plant. By supplying additional recycled water flows to the NRWRP, WCW supply is available for supplementing RARE flows. Additionally, assumes all necessary treatment improvements are implemented at the Richmond WPCP for water quality requirements at RARE as noted in the RWMP, sending 1.0 mgd of effluent to RARE through a new 2-mile distribution pipeline. Assumes additional treatment expansion to 5 mgd at RARE.	2,520
RARE Expansion via North Interceptor Diversion and New Treatment at Pt. Isabel and Richmond WPCP Effluent	Assumes expansion to NRWRP via diversion of the North Interceptor at Pt. Isabel. New distribution pipeline totaling 8.3 miles. Additional treatment, pumping and storage facilities required at Pt. Isabel Treatment Plant. By supplying additional recycled water flows to the NRWRP, WCW supply is available for supplementing RARE flows. Additionally, assumes all necessary treatment improvements are implemented at the Richmond WPCP for water quality requirements at RARE as noted in the RWMP, sending 1.0 mgd of effluent to RARE through a new 2-mile distribution pipeline. Assumes additional treatment expansion to 5 mgd at RARE.	2,520
RARE Expansion via North Interceptor Diversion at Pt. Isabel to WCW WPCP and Richmond WPCP Effluent	Assumes expansion to North Richmond via diversion of the North Interceptor at the Pt. Isabel Treatment Plant. New raw waste distribution pipeline totaling 8.3 miles to WCW WPCP. Additional pumping and storage facilities required at Pt. Isabel Treatment Plant. Additionally, assumes all necessary treatment improvements are implemented at the Richmond WPCP for water quality requirements at RARE as noted in the RWMP, sending 1.0 mgd of effluent to RARE through a new 2-mile distribution pipeline. Assumes additional treatment expansion to 5 mgd at RARE.	2,520

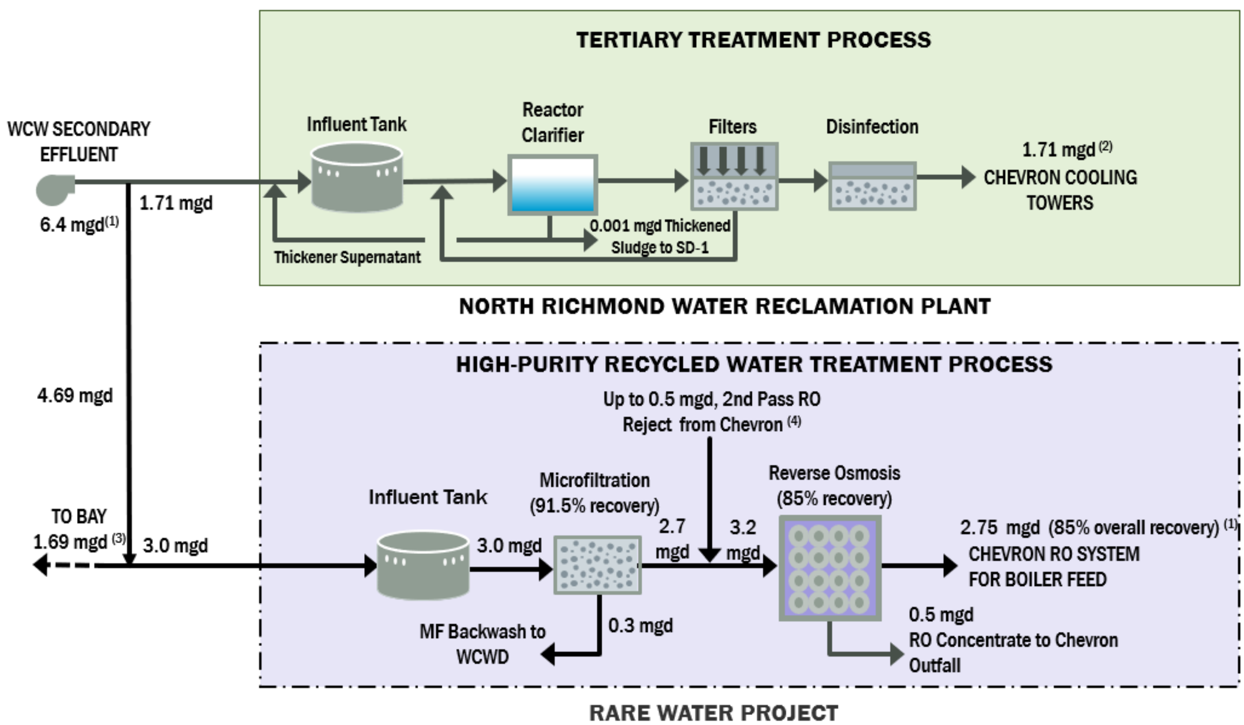
AFY = acre-feet per year

Table B-2 summarizes the current operational flows to RARE and the NRWRP, the proposed flows for the partial expansion of RARE, the proposed flows for the full expansion of RARE, and the expected yield from NRWRP to the cooling towers.

Table B-2. Flow Summary for Chevron/ Richmond Refinery Recycled Water Project

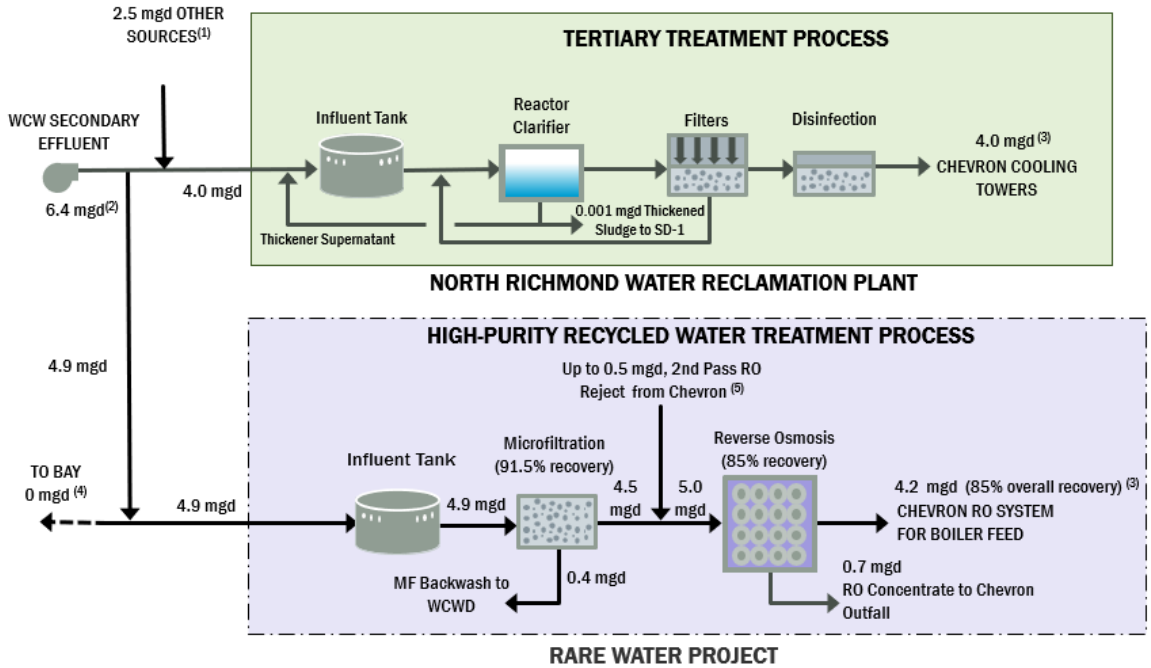
Alternative	RARE Treatment Capacity	Average Influent Flow to RARE	Average Yield from RARE		Increase in Yield from Current RARE Operations		Average Yield from NRWRP	
	mgd	mgd	mgd	AFY	mgd	AFY	mgd	AFY
Current (3-year average)	3.5	3.0	2.75	3,080	--	--	1.71	1,915
Partial RARE Expansions	4.2	4.9	4.17	4,670	1.42	1,590	4.0	4,480
Full RARE Expansions	5.0	5.9	5.0	5,600	2.25	2,520	4.0	4,480

Figure B-1 shows the water balance for current conditions, while Figures B-2 and B-3 show the water balance for the different RARE expansion alternatives.



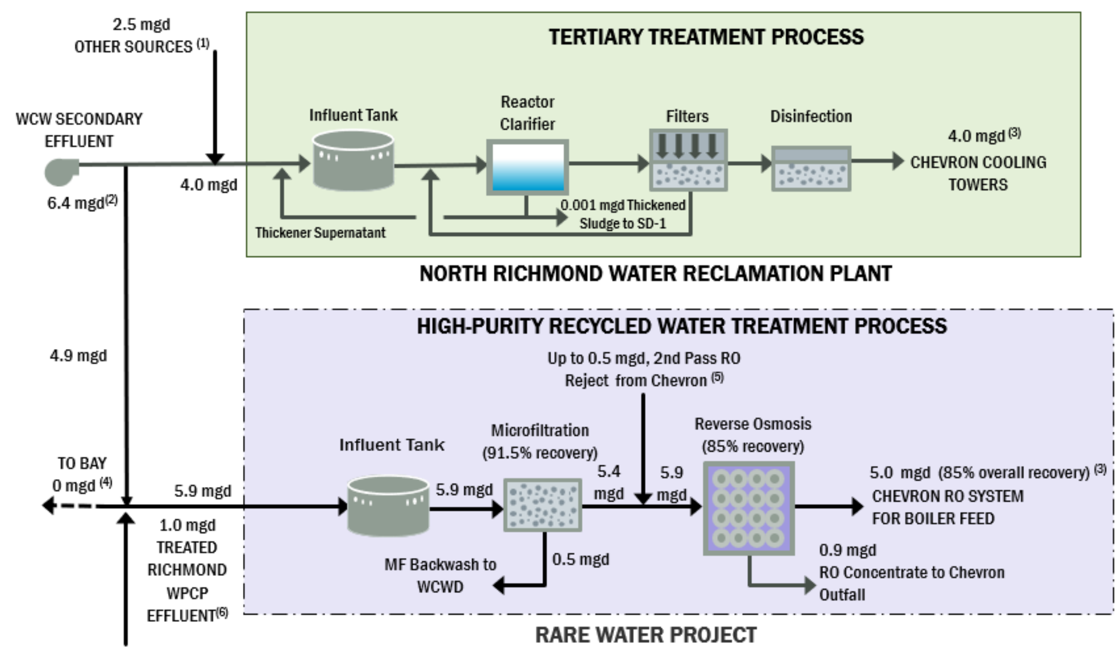
(1) Value presents the minimum monthly flow between 2011 to 2014. The minimum monthly flow available in 2015 was 5.9 mgd.
(2) Recycled water production during month with minimum supply of WCW effluent.
(3) WCW effluent flow in excess of demand for recycling is discharged to San Francisco Bay.
(4) Flow not always available, District has not used since 2020.

Figure B-1. Chevron /Richmond Refinery Water Balance at Current Conditions



(1) Source water dependent on supply alternative: East Bayshore RWTF/North Interceptor Diversion. If source water is untreated wastewater, it would need to go to WCW for treatment before being distributed to either NRWRP or RARE.
(2) Value presents the minimum monthly flow between 2011 to 2014. The minimum monthly flow available in 2015 was 5.9 mgd.
(3) Recycled water production during month with minimum supply of WCW effluent.
(4) WCW effluent flow in excess of demand for recycling is discharged to San Francisco Bay.
(5) Flow not always available; District has not used since 2020.

Figure B-2. Chevron/Richmond Refinery Water Balance for Partial RARE expansion

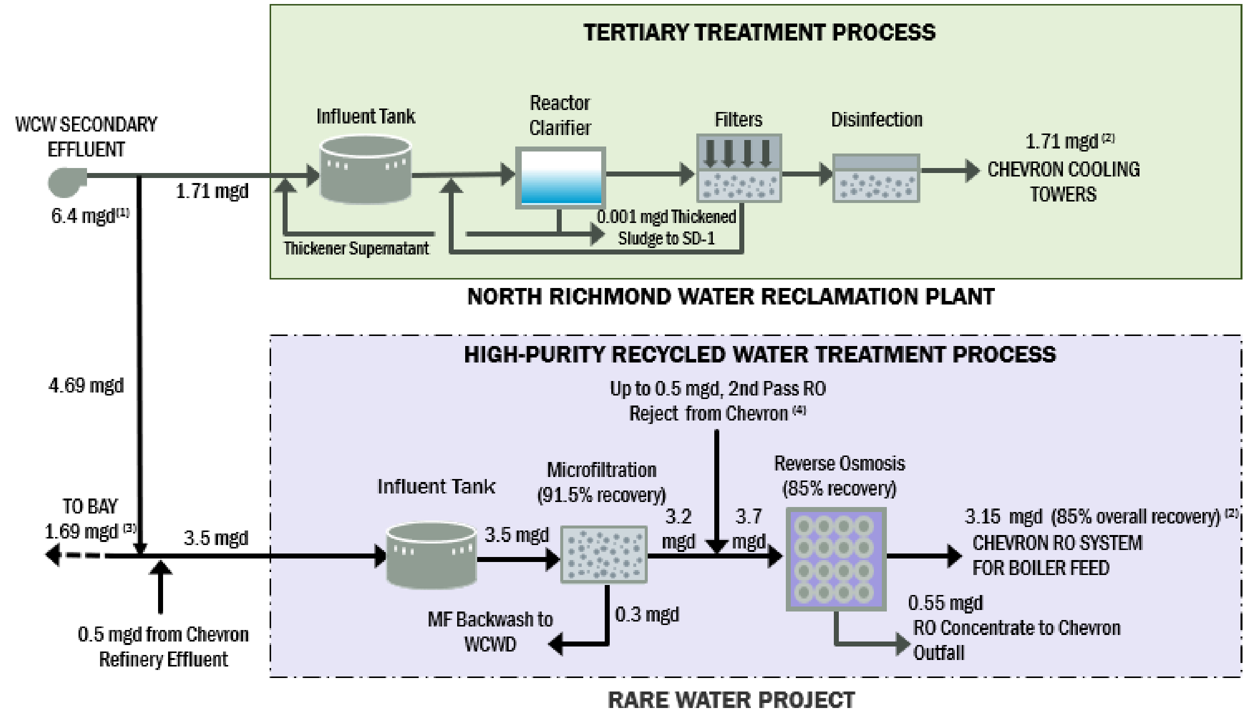


(1) Source water dependent on supply alternative: East Bayshore RWTF/ North Interceptor Diversion. If source water is untreated wastewater, it would need to go to WCW for treatment before being distributed to either NRWRP or RARE.
(2) Value presents the minimum monthly flow between 2011 to 2014. The minimum monthly flow available in 2015 was 5.9 mgd.
(3) Recycled water production during month with minimum supply of WCW effluent.
(4) WCW effluent flow in excess of demand for recycling is discharged to San Francisco Bay.
(5) Flow not always available, District has not used since 2020.
(6) Richmond WPCP effluent will be treated via MBR, RO and UV disinfection to meet the District's RARE influent water quality limits for TDS, ammonia and disinfection.

Figure B-3. Chevron RARE Water Balance for Full RARE expansion

B.1.1 Chevron Effluent to RARE or North Interceptor Diversion to WCW WPCP, Untreated

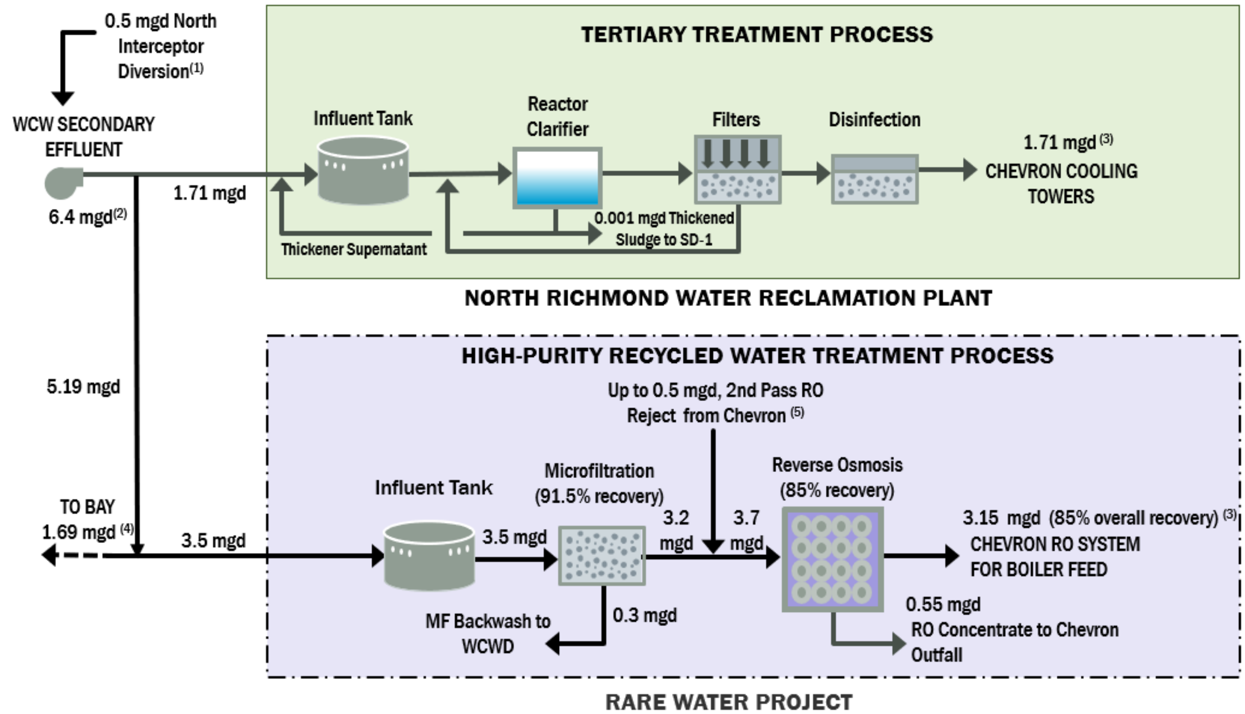
This alternative assumes 0.5 mgd Chevron effluent is available to the District at no cost to supply RARE as shown in Figure B-4.



(1) Value presents the minimum monthly flow between 2011 to 2014. The minimum monthly flow available in 2015 was 5.9 mgd.
(2) Recycled water production during month with minimum supply of WCW effluent.
(3) WCW effluent flow in excess of demand for recycling is discharged to San Francisco Bay.
(4) Flow not always available, District has not used since 2020.

Figure B-4. Chevron/Richmond Refinery Water Balance with Chevron Effluent

For cost comparison purposes, an additional alternative assumes 0.5 mgd of the raw waste stream from the North Interceptor wet well at Pt. Isabel would be diverted for additional supply to the NRWRP, freeing up supply from WCW's WPCP to RARE as shown in Figure B-5.



(1) Supply source from Pt. Isabel North Interceptor.
(2) Value presents the minimum monthly flow between 2011 to 2014. The minimum monthly flow available in 2015 was 5.9 mgd.
(3) Recycled water production during month with minimum supply of WCW effluent.
(4) WCW effluent flow in excess of demand for recycling is discharged to San Francisco Bay.
(5) Flow not always available, District has not used since 2020.

Figure B-5. Chevron/Richmond Refinery Water Balance with untreated wastewater via Diversion at Pt. Isabel to WCW WPCP

The existing pump station at Pt. Isabel could be re-configured to transmit the untreated wastewater from Pt. Isabel to WCW's WPCP, up to 0.5 mgd of raw wastewater would be conveyed from Pt. Isabel through approximately 8.3 miles of 6-inch pipeline to the WCW's WPCP for treatment and distribution to NRWRP and RARE, as shown on Figure B-6. This alternative requires a tie-in to the North Interceptor and repurposing the existing pumps and storage tank at Pt. Isabel.

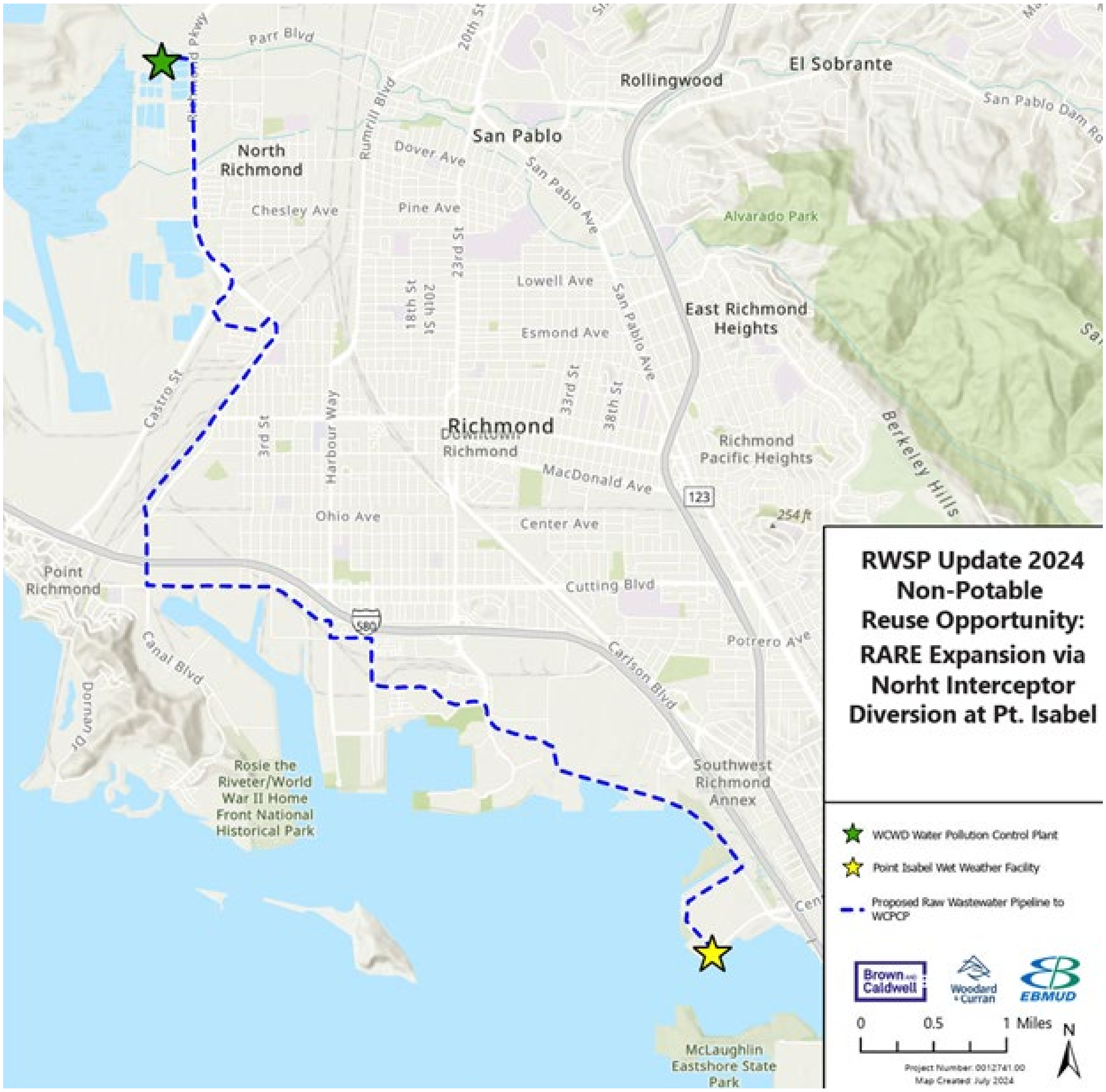


Figure B-6. RARE Expansion via Diversion at Pt. Isabel to WCW WPCP

B.1.2 Partial RARE Expansion via EBRWP Expansion to NRWRP

In conjunction with the EBRWP expansion to upgrade the RWTF to 2.5 mgd, this alternative would allow the RWTF to operate year-round and optimize the District's recycled water use. Existing customers (and potential future customers in Oakland, Emeryville, and Alameda) can continue to be served from EBRWP; any excess recycled water produced by the facility, up to 2.5 mgd, would then be conveyed to the NRWRP for use by Chevron. As shown on Figure B-7, up to 2.5 mgd of recycled water would be conveyed from EBRWP through approximately 14.2 miles of 16-inch pipeline to the NRWRP. By supplying additional flows from EBRWF to the NRWRP, flow from WCW's WPCP is then available for use at RARE. The alternative would require expanding the existing pump station at EBRWP and repurposing the existing pumps and storage tank at Pt. Isabel.

Figure B-7. RARE Expansion via EBRWP to NRWRP

B.1.3 Partial RARE Expansion via Diversion of North Interceptor and New Treatment at Pt. Isabel

The District has identified supply alternatives that would divert the raw waste stream from the North Interceptor wet well at Pt. Isabel for additional supply to the NRWRP, freeing up supply from WCW's WPCP to RARE.

One alternative includes treating the raw waste stream with new membrane bioreactor (MBR) and RO processes to produce 2.5 mgd of recycled water at Pt. Isabel. The existing pump station at Pt. Isabel could be re-configured to transmit the recycled water from Pt. Isabel to the NRWRP as shown in Figure B-8.

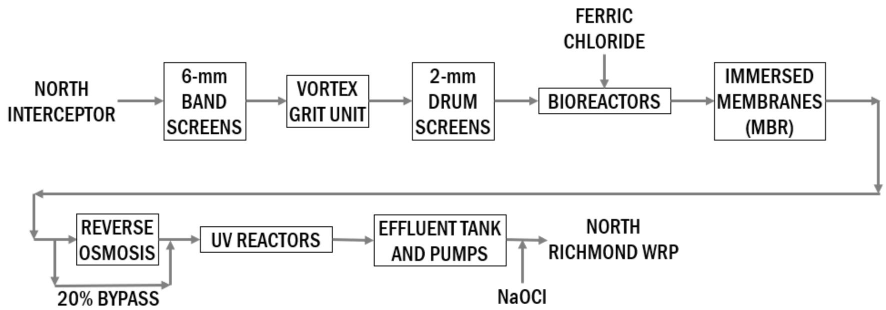


Figure B-8. North Interceptor Diversion with Advanced Treatment at Pt. Isabel

Up to 2.5 mgd of recycled water would be conveyed from Pt. Isabel through approximately 8.3 miles of 16-inch pipeline to the NRWRP, as shown on Figure B-9. This alternative requires a tie-in to the North Interceptor, a new MBR and RO treatment facility, and repurposing the existing pumps and storage tank at Pt. Isabel.

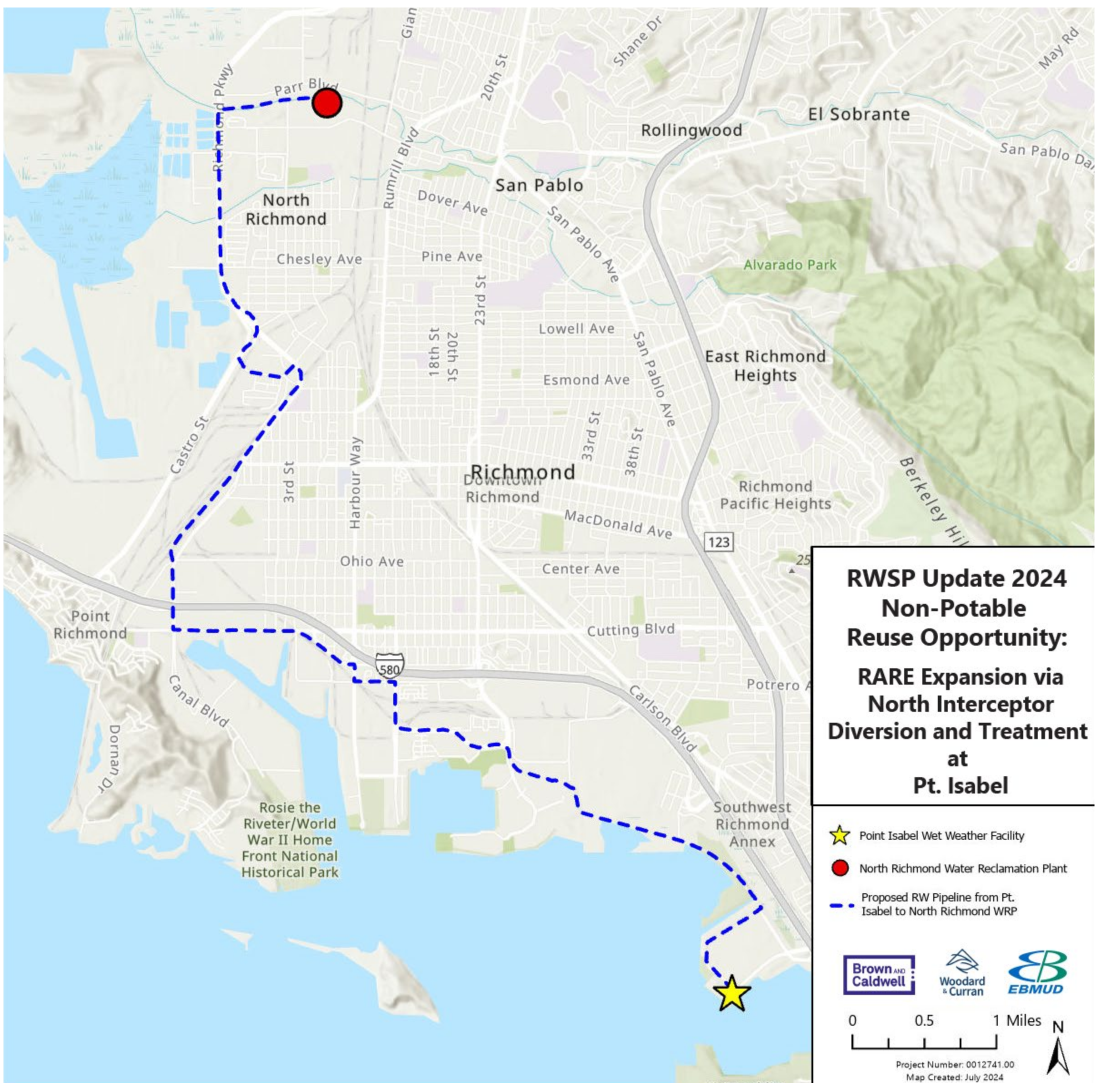


Figure B-9. RARE Expansion via Diversion and New Treatment at Pt. Isabel to NRWRP

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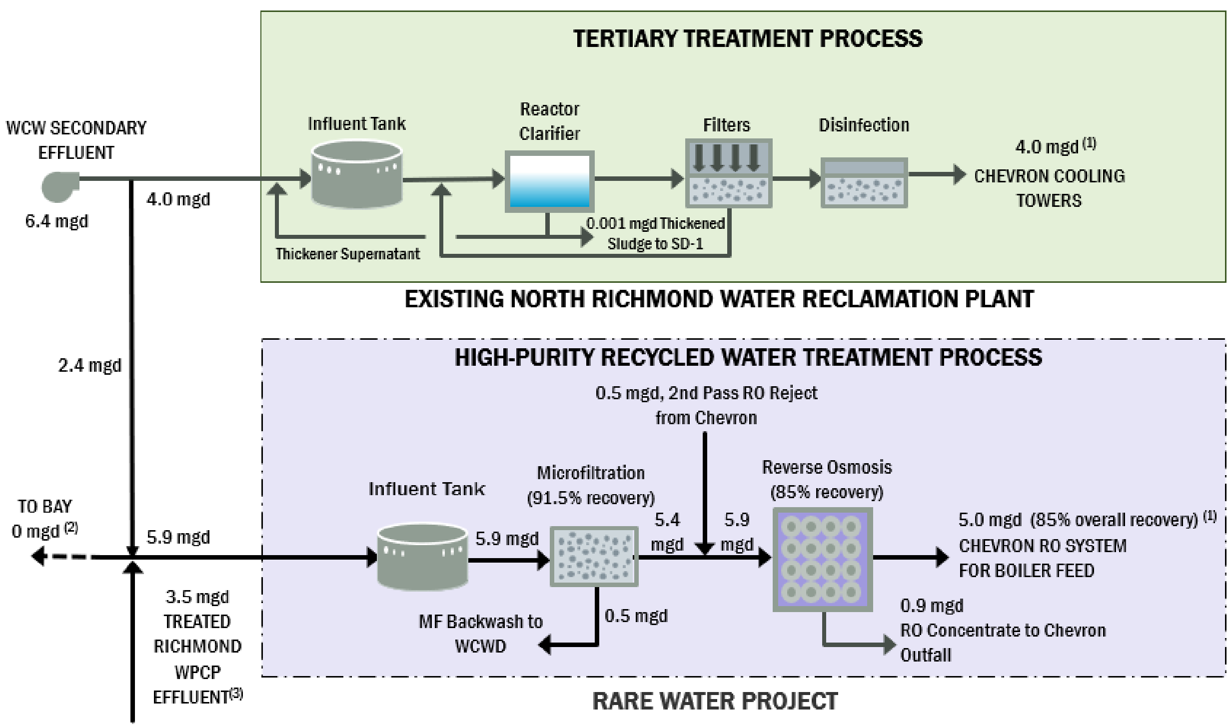
B.1.4 Partial RARE Expansion via Diversion of North Interceptor at Pt. Isabel

In addition to the treatment option at Pt. Isabel, the waste stream from the North Interceptor could be diverted and conveyed from Pt. Isabel to WCW's WPCP for treatment and distribution to NRWRP and RARE. The existing pump station at Pt. Isabel could be re-configured to transmit the untreated wastewater from Pt. Isabel to WCW's WPCP, up to 2.5 mgd of raw wastewater would be conveyed from Pt. Isabel through approximately 8.3 miles of 16-inch pipeline to the WCW's WPCP for treatment and distribution to NRWRP and RARE, as shown on Figure B-5. This alternative requires a tie-in to the North Interceptor and repurposing the existing pumps and storage tank at Pt. Isabel.

B.1.5 RARE Expansion via Richmond WPCP Effluent

Another potential source of recycled water for the RARE project is effluent from the City of Richmond WPCP. Per the 2016 Facility Plan, the projected 2040 average dry weather flow is 7.4 mgd (Carollo, 2016a). To use available Richmond WPCP effluent, treatment upgrades are required to meet the District's RARE influent water quality limits for salinity and ammonia. The 2016 Facility Plan analyzed alternatives for reducing both constituents and identified the need for a 5-mgd MBR followed by RO and ultraviolet disinfection (UV). A portion of the UV-disinfected effluent would be chlorinated to meet the District's chlorine residual requirement. A total of 3.5 mgd of the Richmond WPCP effluent would be sent to RARE as shown in the water balance on Figure B-10.



(1) Monthly average recycled water production during month with minimum supply of WCW effluent with additional supply from Richmond WPCP effluent.
(2) WCW and Richmond WPCP effluent flow in excess of demand for recycling is discharged to San Francisco Bay.
(3) Richmond WPCP effluent will be treated via MBR, RO and UV disinfection to meet the District's RARE influent water quality limits for TDS, ammonia and disinfection.

Figure B-10. Chevron RARE Water Balance with Richmond WPCP Effluent at Full Buildout

For this RWSP, it is assumed that the Richmond WPCP treated effluent meets the RARE feed requirements following MBR, RO, and UV treatment. The 3.5 mgd of treated wastewater would be conveyed through approximately 2.4 miles of 16-inch pipeline to RARE, as shown on Figure B-11. This project would allow the RARE facility to increase production by 1.5 mgd, therefore the costs associated with the RARE project expansion were also included.

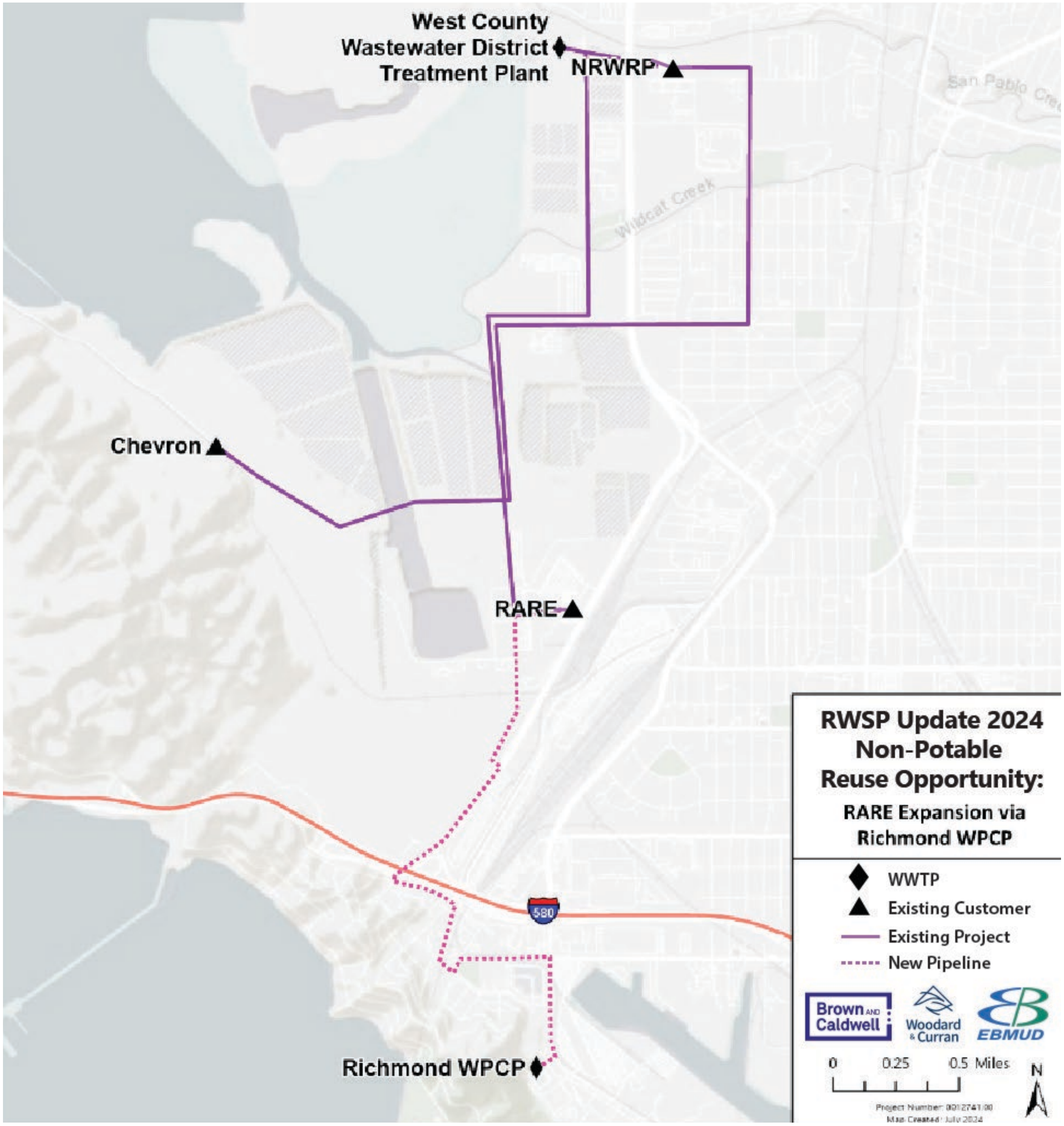


Figure B-11. Chevron RARE Expansion via Richmond WPCP Effluent

Source: EBMUD UWMP (2020a)

B.1.6 RARE Expansion via EBWRP Expansion to NRWRP and Richmond WPCP Effluent

This alternative combines the 2.5 mgd of supply from the EBWRP expansion with an additional 1.0 mgd of treated effluent from Richmond WPCP for a total additional supply of 3.5 mgd. As shown previously on Figure B-7, up to 2.5 mgd of recycled water would be conveyed from EBWRP through approximately 14.2 miles of 16-inch pipeline to the NRWRP for distribution to RARE. By supplying additional flows from EBRWF to the NRWRP, flow from WCW's WPCP is then available for use at RARE.

Additionally, as shown previously on Figure B-11, 1 mgd of treated wastewater would be conveyed through approximately 2.4 miles of 10-inch pipeline to RARE. This project would allow the RARE facility to increase production by 1.5 mgd, therefore, the costs associated with the RARE project expansion were also included.

B.1.7 RARE Expansion via Diversion of North Interceptor and New Treatment at Pt. Isabel and Richmond WPCP Effluent

This alternative combines the 2.5 mgd supply from the North Interceptor diversion and new treatment plant at Pt. Isabel with an additional 1 mgd of treated effluent from Richmond WPCP. As previously discussed, the existing pump station at Pt. Isabel could be re-configured to transmit the recycled water from Pt. Isabel to NRWRP. Up to 2.5 mgd of recycled water would be conveyed from Pt. Isabel through approximately 8.3 miles of 16-inch pipeline to the NRWRP, as shown previously on Figure B-9. By supplying additional flows to the NRWRP, flow from WCW's WPCP is then available for use at RARE.

Additionally, as shown previously on Figure B-11, 1 mgd of treated wastewater would be conveyed through approximately 2.4 miles of 10-inch pipeline to RARE. This project would allow the RARE facility to increase production by 1.5 mgd, therefore, the costs associated with the RARE project expansion were also included.

B.1.8 RARE Expansion via Diversion of North Interceptor at Pt. Isabel and Richmond WPCP Effluent

This alternative combines the 2.5 mgd supply from the North Interceptor diversion at Pt. Isabel with an additional 1 mgd of treated effluent from Richmond WPCP. As previously discussed, the existing pump station at Pt. Isabel could be re-configured to transmit the untreated wastewater from Pt. Isabel to WCW WPCP. Up to 2.5 mgd of raw wastewater would be conveyed from Pt. Isabel through approximately 8.3 miles of 16-inch pipeline to the WCW WPCP for treatment and distribution to RARE, as shown previously on Figure B-6.

Additionally, as shown previously on Figure B-11, 1 mgd of treated wastewater would be conveyed through approximately 2.4 miles of 10-inch pipeline to RARE. This project would allow the RARE facility to increase production by 1.5 mgd, therefore the costs associated with the RARE Water Project expansion were also included.

Table B-3 summarizes the costs associated with each of the alternatives for the Chevron/ Richmond Refinery Recycled Water Project.

Table B-3. Summary of Chevron/ Richmond Refinery Recycled Water Project Alternative Costs					
Alternative[a]	Capital Cost ($ millions)	O&M ($ million/yr)	Annual Demand (mgd)	Annual Demand (AFY)	Annualized Total Cost ($/AF)
North Interceptor Diversion to WCW WPCP, Untreated					
Treatment	-	-	-	-	-
Distribution	$44.5	$0.55	-	-	$5,000
Total	$44.5	$0.55	0.5	560	$5,000
Partial RARE Expansion via EBWRP to NRWRP					
Treatment	$97.8	$2.87	-	-	$4,900
Distribution	$164	$1.71	-	-	$6,300
Total	$262	$4.58	1.4	1,590	$11,300
Partial RARE Expansion via North Interceptor Diversion and New Treatment at Pt. Isabel					
Treatment	$194	$3.38	-	-	$8,300
Distribution	$88.8	$1.10	-	-	$3,500
Total	$283	$4.48	1.4	1,590	$11,800
Partial RARE Expansion via North Interceptor Diversion at Pt. Isabel to WCW WPCP, Untreated					
Treatment[b]	$2.20	$0.63	-	-	$500
Distribution	$88.8	$1.10	-	-	$3,500
Total	$91.0	$1.73	1.4	1,590	$4,000
RARE Expansion via Richmond WPCP Effluent					
Treatment[c]	$177	$4.89	-	-	$5,500
Distribution	$30.4	$0.53	-	-	$800
Total	$208	$5.42	2.3	2,520	$6,300
RARE Expansion via EBWRP to NRWRP and Richmond WPCP Effluent					
Treatment[b]	$150	$3.64	-	-	$4,500
Distribution	$184	$1.94	-	-	$4,500
Total	$334	$5.58	2.3	2,520	$9,000
RARE Expansion via North Interceptor Diversion and New Treatment at Pt. Isabel and Richmond WPCP Effluent					
Treatment[c]	$276	$3.64	-	-	$7,000
Distribution	$121	$1.55	-	-	$3,100
Total	$397	$5.19	2.3	2,520	$10,100
RARE Expansion via North Interceptor Diversion at Pt. Isabel to WCW WPCP, Untreated and Richmond WPCP Effluent					
Treatment[b,c]	$54.5	$1.40	-	-	$1,700
Distribution	$122	$1.57	-	-	$3,100
Total	$176	$2.97	2.3	2,520	$4,800

a. *The Chevron Effluent to RARE alternative is not included in this table as the District anticipates that Chevron will provide the 0.5 mgd of additional supply to RARE from the onsite refinery effluent at no cost to the District.*

b. *Treatment cost does not include cost of treating additional flows at WCW WPCP.*

c. *Treatment cost does not include cost of purchasing effluent from Richmond WPCP.*

B.2 Evaluation of Alternatives

The Chevron/ Richmond Refinery Recycled Water Project alternatives identified in Table B-3 were evaluated through a multiple criteria decision analysis (MCDA) framework based on relative benefit and cost. The decision-support process is outlined on Figure B-12.

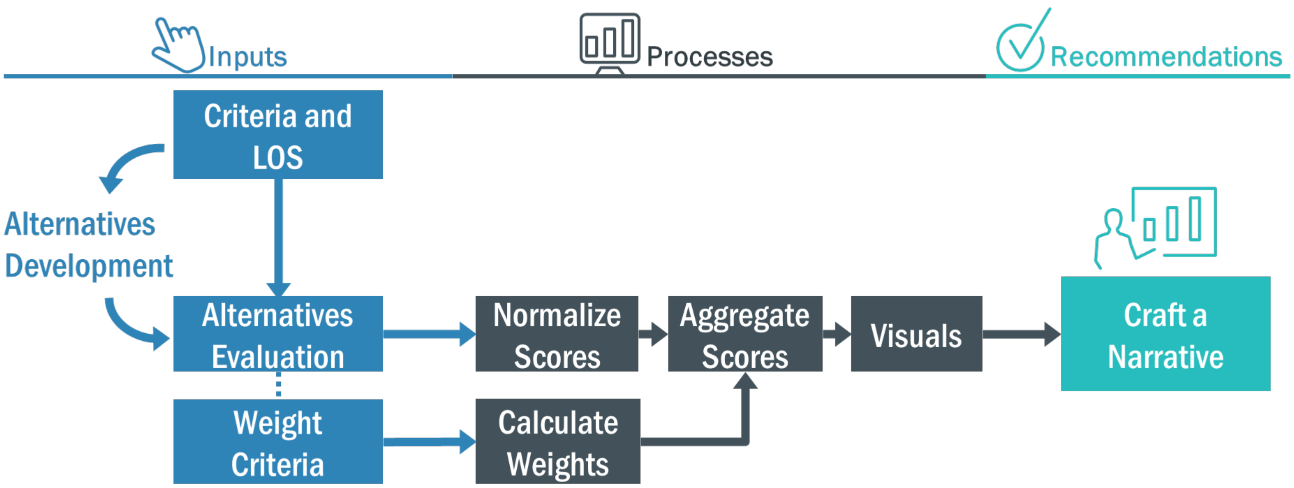


Figure B-12. Decision-support process flow diagram

The framework consisted of three primary steps:

- **Benefits evaluation:** benefits evaluated using criteria and weightings that were discussed and confirmed with District staff. Evaluation criteria are framed as benefits (i.e., the higher the score, the greater the benefit) and result in an aggregate "relative benefit" score for each opportunity.
- **Cost estimate development:** preliminary capital, O&M, and unit costs were developed for each opportunity.
- **Cost/Benefit comparison:** considered costs and benefits together to facilitate decision making and understand the tradeoffs among non-potable reuse opportunities.

This process helped compare and prioritize the Chevron/ Richmond Refinery Recycled Water Project alternatives to inform next steps. Note that the Chevron Effluent to RARE or North Interceptor Diversion to WCW WPCP, untreated effluent alternatives were not included in the following evaluation as the District anticipates that Chevron will provide an additional 0.5 mgd of supply to RARE from onsite refinery effluent by 2030 at no cost to the District.

B.2.1 Evaluation of Benefits

Decision criteria were identified to differentiate and prioritize the Chevron/ Richmond Refinery Recycled Water Project alternatives. Non-monetary criteria are critical to project success and require a defensible, repeatable approach that makes use of project information available at the time. The evaluation criteria and corresponding weighting factors shown in Table B-4 were used to conduct the evaluation. The criteria used for this analysis was largely based on the criteria used in the 2019 RWMP, revised with District input, to reflect updated conditions and drivers.

Weighting evaluation criteria allows decision makers to emphasize the relative importance of some criteria over others (higher weight indicates greater relative importance). District staff reviewed and confirmed the weighting scheme presented in Table B-4. This weighting scheme emphasizes the

District's focus on the long-term viability of projects as well as on the distribution of benefits, and regulatory complexity.

Table B-4. RWSP Update Evaluation Criteria

Criteria	Description	Weighting Factor
Environmental and Social Objectives		
Distribution of Benefits	What regions/populations are serviced by this new supply and how are the benefits distributed? Evaluation of public perception issues and degree of outreach and education needed.	15%
Environmental Challenges	Evaluation of potential environmental challenges during construction or operations of the alternative.	10%
Chemical and Energy Use	Chemical and energy use during operations.	10%
Wastewater Discharge	Assessment of reduced nutrient discharges.	10%
Complexity and Risk		
Institutional	Evaluation of the time, challenges, and requirements to implement the project either internally or in coordination with external partners.	10%
Regulatory	Assessment of the time, challenges, and requirements to implement the project from a regulatory permitting perspective prior to construction, as well as ongoing as part of operations.	15%
Design and Construction	Evaluation of the time, challenges, and requirements to design and construct the project.	10%
Long-term Operational Viability	Alternative complexity/how challenging it will be for District staff to manage any new processes or operations, maintenance, and staffing. Assessment of long-term flexibility of investments and potential for stranded assets.	20%
	Total:	100%

To develop a relative evaluation of the alternatives with respect to how effectively each one met the evaluation criteria, a scoring rubric was developed and is presented in Table B-5. The Chevron/ Richmond Refinery Recycled Water Project alternatives were scored from 1 to 5, with a high score indicating a high response to the criterion and a low score indicating a low response to the criterion (5 = most favorable, 1 = least favorable). The rubric includes a brief description of the metrics used to score each alternative.

The scores for each alternative are shown in Table B-6, along with some of the notable considerations that factored into the assigned scores. These scores were normalized (i.e., converted to a scale of 0 to 1 for each criterion to facilitate a relative comparison) by determining the percentile of a selected opportunity's benefits compared to other opportunities for each qualitative criterion (Marler and Arora, 2004; Cinelli et al., 2020). This approach allowed differentiation of relative opportunity performance, which highlights benefits across each of the non-potable reuse opportunities. Normalized scores were multiplied by their component weights and summed to develop an overall relative benefit score. This orients the analysis such that maximum normalized scores are associated with maximum benefit.

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Table B-5. Scoring Rubric for Non-Potable Reuse Opportunities Evaluation Criteria

Criteria	(Most Favorable)	Scoring Rubric			(Least Favorable)
	5	4	3	2	1
Distribution of Benefits	Project benefits many types of customers and/or the potable water use offset provides increased reliability for a significant portion of District service area		Project benefits some customers and/or the potable water use offset provides increased reliability for some of the District service area.		Project does not significantly impact the supply reliability for the District aside from one to two (likely private) customers
Environmental Challenges	Project operations and/or construction will have limited environmental impacts or challenges (locations or operations not near sensitive habitats, protected species)		Project operations and/or construction will have some environmental impacts (may include locations or operations near streams, wetlands, or other habitat).		Project operations and/or construction will have significant environmental impacts (may include significant locations or operations near streams, wetlands, or other habitat)
Chemical and Energy Use	Project operation will require low energy and chemical use for treatment and conveyance		Project operation will require "average" chemical and energy for treatment and conveyance		Project operation will require significant chemical and energy for treatment and conveyance
Wastewater Discharge	Project provides denitrification or serves a large irrigation customer (>2 mgd)		Project provides partial denitrification or serves an irrigation customer		Project provides no denitrification and does not serve an irrigation customer
Institutional	Project does not require any coordination with partner agencies	Project does not require any coordination with partner agencies but requires extensive internal coordination among departments.	Project requires coordination with one external partner agency	Project requires coordination with two to three external partner agencies	Project requires coordination with four or more external partner agencies
Regulatory	Project requires limited number of permits, easements, documentation, etc., which results in less coordination effort with state agencies and local stakeholders and minimal required annual monitoring/permitting		Project requires some permits, easements, documentation, etc., which results in some effort to coordinate with state agencies and local stakeholders, and minimal required annual monitoring/permitting.		Project requires many permits, easements, documentation, etc., which results in significant effort to coordinate with state agencies and local stakeholders, and significant required annual monitoring/permitting.
Design and Construction	Project includes limited number of unique facilities, facility siting concerns, or other special circumstances such as trenchless crossings.		Project includes some unique facilities, facility siting concerns, or other special circumstances such as trenchless crossings.		Project includes many unique facilities, facility siting concerns, or other special circumstances such as trenchless crossings
Long-term Operational Viability	Project will require limited change to existing District operations (changes are limited to the expansion of an existing treatment facility).		Project will require limited change to existing District operations (changes are limited to some changes to a treatment facility and/or distribution)		Project will require operation of a new, independent facility and conveyance system

Table 6. Scoring of Chevron/ Richmond Refinery Recycled Water Project Alternatives

Name	2024 Demand (mgd)	Recommended in 2019 RWMP	Environmental and Social Objectives				Complexity and Risk				Final Composite Score	Key Considerations
			Distribution of Benefits	Environmental Challenges	Chemical and Energy Use	Wastewater Discharge	Institutional	Regulatory	Design and Construction	Long-term Operational Viability		
Partial RARE Expansion via EBWRP to NRWRP (i.e., Partial RARE Expansion with East Bayshore Alt H)	1.42	N/A	1	3	2	3	4	3	3	3	0.07	• Limited increase in yield • Is mutually exclusive with some of the other EBRWF expansion alternatives being considered • Requires extensive number of new pipelines • Limited expansion of a committed project • Chevron is an established District project partner • Requires an EIR
Partial RARE Expansion via North Interceptor Diversion and New Treatment at Pt. Isabel (i.e., Partial RARE Expansion with East Bayshore Alt I)	1.42	N/A	1	3	2	3	4	3	2	3	0.03	• Limited increase in yield • Requires new treatment plant at Pt. Isabel as well as expenses related to pipelines, pumps, and storage • Capacity is limited to available flows in North Interceptor (2.5 mgd) • May result in adverse effects to water quality at SD-1 • Limited expansion of a committed project • Chevron is an established District project partner • Requires an EIR
Partial RARE Expansion via North Interceptor Diversion at Pt. Isabel to WCW WPCP, Untreated (i.e., Partial RARE Expansion with East Bayshore Alt J)	1.42	N/A	1	3	3	3	4	3	3	4	0.30	• Limited increase in yield • Requires minor upgrades/modifications at Pt. Isabel and construction of pipeline to convey flows • Capacity is limited to available flows in North Interceptor (2.5 mgd) • May result in adverse effects to SD-1 water quality • Limited expansion of a committed project • Chevron is an established District project partner • Requires an EIR
RARE Expansion via Richmond WPCP Effluent (i.e., RARE Expansion with Richmond WPCP)	2.25	Yes	3	4	2	1	3	3	3	4	0.34	• Expansion of a committed project • Chevron is an established District project partner • Requires partnership with City of Richmond • Requires treatment upgrades at City of Richmond WPCP and construction of conveyance system
RARE Expansion via EBWRP to NRWRP and Richmond WPCP Effluent (i.e., RARE Expansion with East Bayshore Alt H and Richmond WPCP)	2.25	N/A	3	3	2	3	4	3	3	3	0.14	• Expansion of a committed project • Chevron is an established District project partner • Requires partnership with the City of Richmond • Requires treatment upgrades at City of Richmond WPCP and construction of conveyance system • Is mutually exclusive with some of the other EBRWF expansion alternatives being considered • Requires extensive number of new pipelines to get water from EBWRF to the North Richmond area • Requires an EIR
RARE Expansion via North Interceptor Diversion and New Treatment at Pt. Isabel and Richmond WPCP Effluent (i.e., RARE Expansion with East Bayshore Alt I and Richmond WPCP)	2.25	N/A	3	3	2	3	4	3	2	3	0.11	• Expansion of a committed project • Chevron is an established District project partner • Requires partnership with City of Richmond • Requires treatment upgrades at City of Richmond WPCP and construction of conveyance system • Requires new treatment plant at Pt. Isabel as well as expenses related to pipelines, pumps, and storage • Capacity is limited to available flows in North Interceptor (2.5 mgd) • May result in adverse effects to SD-1 water quality • Requires an EIR

Table 6. Scoring of Chevron/ Richmond Refinery Recycled Water Project Alternatives												
			Environmental and Social Objectives				Complexity and Risk					
Name	2024 Demand (mgd)	Recommended in 2019 RWMP	Distribution of Benefits	Environmental Challenges	Chemical and Energy Use	Wastewater Discharge	Institutional	Regulatory	Design and Construction	Long-term Operational Viability	Final Composite Score	Key Considerations
RARE Expansion via North Interceptor Diversion at Pt. Isabel to WCW WPCP, Untreated and Richmond WPCP Effluent (i.e., RARE Expansion with East Bayshore Alt J and Richmond WPCP)	2.25	N/A	3	3	2	3	4	3	3	4	0.28	• Expansion of a committed project • Chevron is an established District project partner • Requires partnership with City of Richmond • Requires treatment upgrades at City of Richmond WPCP and construction of conveyance system • Requires minor upgrades/modifications at Pt. Isabel and construction of pipeline to convey flows • Capacity is limited to available flows in North Interceptor (2.5 mgd) • May result in adverse effects to SD-1 water quality • Requires an EIR

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Figure B-13 presents the relative benefit scores of the Chevron/ Richmond Refinery Recycled Water Project alternatives. Each colored bar represents the benefit score for an individual criterion (shown in legend); opportunities with longer bars (i.e., towards the top of the figure) generally offer greater benefits.

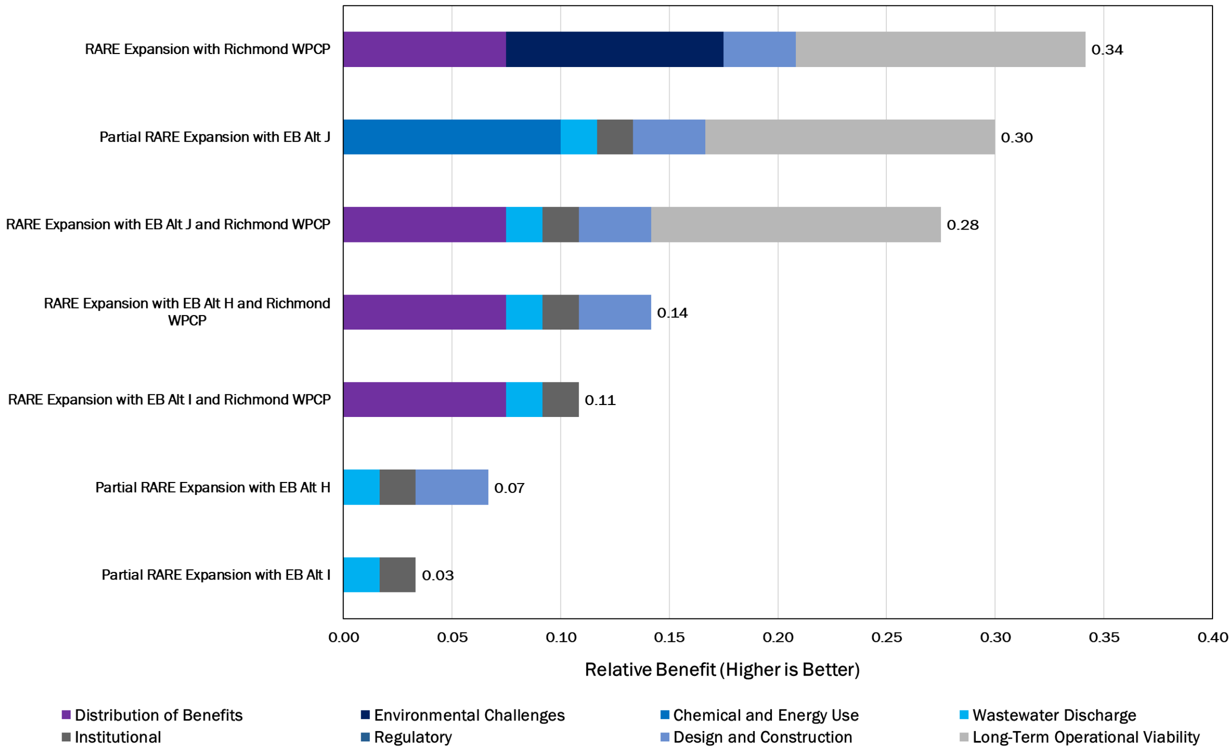

Figure B-13. Aggregated relative benefit scores representing alternative non-monetary benefits

In reviewing the results of the relative benefit assessment, we see that amongst the evaluated alternatives, the RARE expansion with effluent flow from the Richmond WPCP and the partial RARE expansion with East Bayshore Alternative J (i.e., Partial RARE Expansion via North Interceptor Diversion at Pt. Isabel to WCW WPCP) scored highest. Both alternatives offer long term operational viability benefits relative to their counterparts.

B.2.2 Comparison of Benefits and Costs for Alternatives

As part of this evaluation, costs were also considered to further distinguish the respective alternatives. Figure B-14 shows the relative benefit scores vs. estimated unit costs for each alternative to help identify which concepts provide the best value. Optimal results are closest to the top-right corner of the chart (highest benefit and lowest cost).

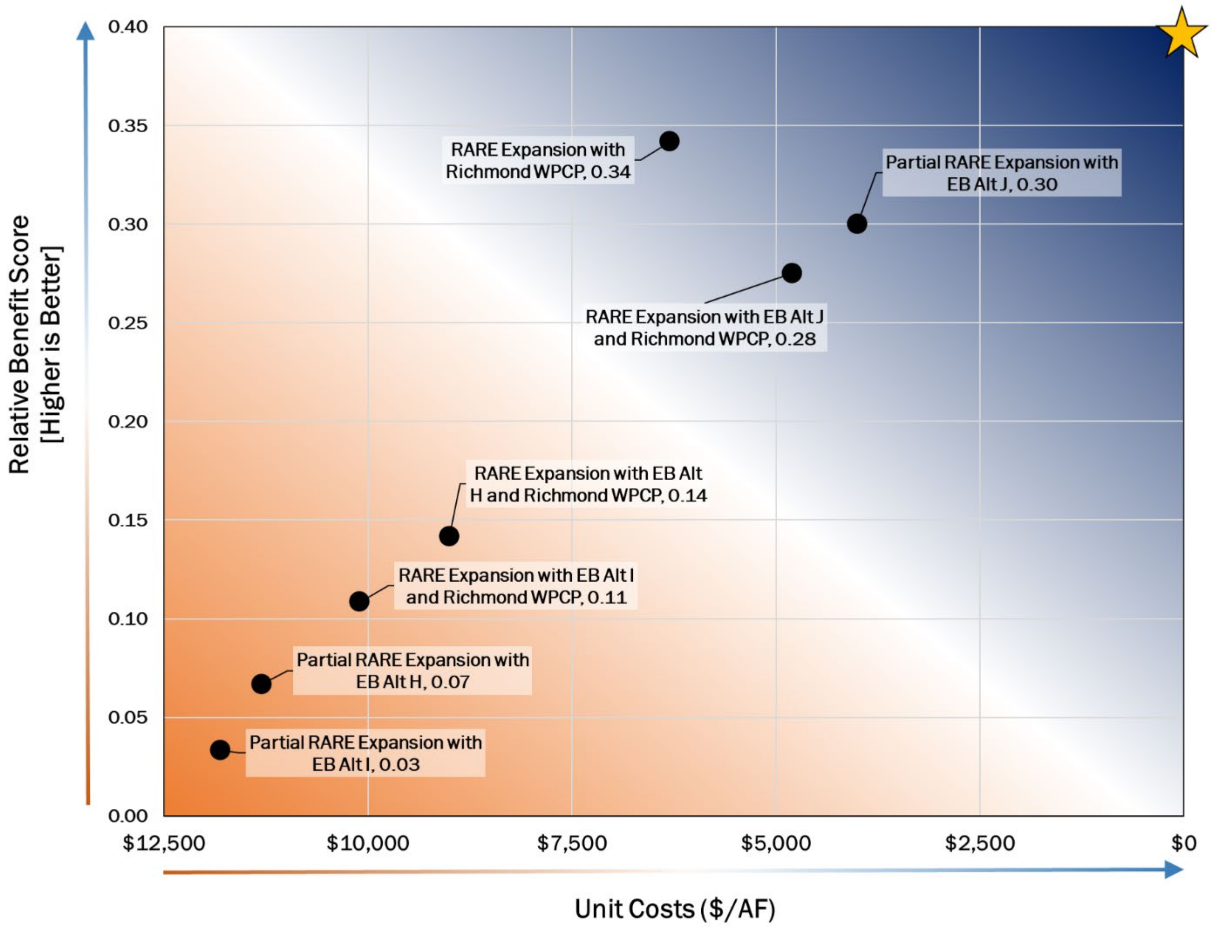

Figure B-14. Aggregate relative benefit scores vs. unit costs

In reviewing the results presented on Figure B-14, we see that the RARE Expansion with Richmond WPCP, the RARE Expansion with East Bayshore Alternative J and Richmond WPCP, and the Partial RARE Expansion with East Bayshore Alternative J are all clustered close together, providing the best value amongst its counterparts. Given that the Partial RARE Expansion with East Bayshore Alternative J (i.e., Partial RARE Expansion via North Interceptor Diversion at Pt. Isabel to WCW WPCP) appeared to have the lowest unit costs while also possessing the second highest benefit score, it was selected and carried forward for comparison to some of the other non-potable reuse opportunities that were assessed as part of the RWSP.

Appendix C: Reassessment of Previously Identified Potable Reuse Opportunities

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Appendix C

Reassessment of Previously Identified Potable Reuse Opportunities

This document summarizes the approach used to conduct the reassessment of previously identified potable reuse opportunities and the resultant list of five potable reuse opportunities that were carried forward for further development.

C.1 Background and Purpose

The 2019 Recycled Water Master Plan (RWMP) identified and evaluated a list of 36 potable reuse opportunities. Based on the evaluation, the opportunities listed in Table 1 ranked the highest using evaluation criteria developed to assess the projects and the respective unit costs of each opportunity. The list includes four East Bay Municipal Utility District (EBMUD, District) SD-1 Wastewater Treatment Plant (WWTP) opportunities, two Central Contra Costa Sanitary District (Central San) opportunities, and one Oro Loma Water Pollution Control Plant (WPCP) opportunity.

Table 1. 2019 RWMP Highest Ranking, Lowest Cost Potable Reuse Opportunities

Name	Description	Yield (AFY)	2019 RWMP Unit Cost ($/AF)
SD1-Treat-10	10 million gallons per day (mgd) treated water augmentation project involving EBMUD's SD-1 WWTP.	11,200	$3,400
SD1-Treat-30	30 mgd treated water augmentation project involving EBMUD's SD-1 WWTP.	33,600	$2,300
SD1-ResB-10	10 mgd surface water augmentation project involving Briones Reservoir and EBMUD's SD-1 WWTP.	11,200	$3,900
SD1-ResB-30	30 mgd surface water augmentation project involving Briones Reservoir and EBMUD's SD-1 WWTP.	33,600	$2,600
CC-Raw-19	19 mgd raw water augmentation project involving Central San's WWTP and the Mokelumne Aqueduct.	21,820	$2,200
CC-Raw-10	10 mgd raw water augmentation project involving Central San's WWTP and the Mokelumne Aqueduct.	11,200	$2,300
Oro-ResU-8	8 mgd surface water augmentation project involving Upper San Leandro Reservoir and Oro Loma's WPCP.	8,960	$2,800

AFY = acre-feet per year

As part of the Recycled Water Strategic Plan Update 2024 (RWSP), all 36 potable reuse opportunities were reassessed to reflect the changes in reuse conditions and updates to the evaluation criteria to create a refined list of five potable reuse alternatives that may be best suited to help the District achieve its reuse goals.

C.2 Potable Reuse Opportunity List

The potable reuse opportunities developed and evaluated as part of the 2019 RWMP considered all forms of potable reuse (i.e., groundwater recharge [GWR], surface water augmentation [SWA], raw water augmentation [RWA], and treated water augmentation [TWA]). As an initial step in the reassessment process, both the approach and assumptions used to develop the 2019 RWMP list of opportunities were reviewed and reaffirmed for most of the projects, apart from the Central San opportunities. Findings from the District and Central San Recycled Water Project Concept Evaluation Report resulted in the addition of two new Central San specific opportunities (CC-ResLV-17.9 and CC-Raw WCK-17.9) and the update of maximum projected yield to two of the Central San specific opportunities that had been previously identified (CC-Raw-17.9 and CC-ResB-17.9 production rates were previously both at 19 mgd but have now been revised to 17.9 mgd).

Costs from the 2019 RWMP were not modified or escalated for this initial reassessment process to avoid any potential comparison between costs presented in this initial reassessment and costs tabulated for the five potable reuse opportunities that are carried forward for further development. The opportunities that are carried forward will undergo a more detailed evaluation to develop a refined set of cost estimates and should not be compared to the initial set of potable reuse cost estimates that were developed as part of the 2019 RWMP. For that reason, costs were simply normalized at this stage to provide a relative reflection of cost per acre foot of yield within the group of options (100 to 1 scale; the larger the number the more expensive the unit cost of the opportunity). The updated opportunities list is presented in Table 2.

Table 2. Potable Reuse Opportunities

Name	Reuse Type	Source	Delivery Point	Production Rate (mgd)	Yield (AFY)	Normalized 2019 RWMP Unit Costs[a]
San Leandro WPCP Based Alternatives						
SL-Raw-1	RWA	San Leandro WPCP	Upper San Leandro (USL) WTP	1.4	1,568	41
SL-ResU-1	SWA	San Leandro WPCP	USL Reservoir	1.4	1,568	62
SL-Chabot-1	SWA	San Leandro WPCP	Lake Chabot	1.4	1,568	100
SL-Treat-1	TWA	San Leandro WPCP	Dunsmuir Reservoir	1.4	1,568	50
Pinole WPCP Based Alternatives						
Pin-Raw-2	RWA	Pinole WPCP	Sobrante WTP	1.7	1,904	26
Pin-ResB-2	SWA	Pinole WPCP	Briones Reservoir	1.7	1,904	32
Pin-ResSP-2	SWA	Pinole WPCP	San Pablo Reservoir	1.7	1,904	18
Pin-Treat-2	TWA	Pinole WPCP	Maloney Reservoir	1.7	1,904	29
Richmond WPCP Based Alternatives						
Rich-Raw-4	RWA	Richmond WPCP	Sobrante WTP	3.6	4,033	24
Rich-ResB-4	SWA	Richmond WPCP	Briones Reservoir	3.6	4,033	24
Rich-ResSP-4	SWA	Richmond WPCP	San Pablo Reservoir	3.6	4,033	9

Table 2. Potable Reuse Opportunities						
Name	Reuse Type	Source	Delivery Point	Production Rate (mgd)	Yield (AFY)	Normalized 2019 RWMP Unit Costs[a]
Rich-Treat-4	TWA	Richmond WPCP	Wildcat Aqueduct	3.6	4,033	9
WCW WPCP Based Alternatives						
WC-Raw-5	RWA	WCW WPCP	Sobrante WTP	4.7	5,265	24
WC-ResB-5	SWA	WCW WPCP	Briones Reservoir	4.7	5,265	53
WC-ResSP-5	SWA	WCW WPCP	San Pablo Reservoir	4.7	5,265	41
WC-Treat-5	TWA	WCW WPCP	Wildcat Aqueduct	4.7	5,265	15
Oro Loma WPCP Based Alternatives						
Oro-GW	GWR	Oro Loma WPCP	Injection Wells	8.0	8,961	32
Oro-Raw-8	RWA	Oro Loma WPCP	USL WTP	8.0	8,961	12
Oro-ResU-8	SWA	Oro Loma WPCP	USL Reservoir	8.0	8,961	18
Oro-Chabot-8	SWA	Oro Loma WPCP	Lake Chabot	8.0	8,961	3
Oro-Treat-8	TWA	Oro Loma WPCP	South Reservoir	8.0	8,961	12
Central San WWTP Based Alternatives						
CC-Raw-17.9	RWA	Central San WWTP	Mokelumne Aqueduct	17.9	20,051	1
CC-Raw-10	RWA	Central San WWTP	Mokelumne Aqueduct	10.0	11,201	3
CC-ResB-17.9	SWA	Central San WWTP	Briones Reservoir	17.9	20,051	6
CC-ResB-10	SWA	Central San WWTP	Briones Reservoir	10.0	11,201	6
CC-ResLV-17.9	SWA	Central San WWTP	Los Vaqueros Reservoir	17.9	20,051	N/A
CC-Raw WCK-17.9	RWA	Central San WWTP	Walnut Creek WTP	17.9	20,051	N/A
EBMUD Main WWTP (SD-1) Based Alternatives						
SD1-Raw-30	RWA	SD-1 WWTP	Orinda WTP	30.0	33,604	6
SD1-Raw-10	RWA	SD-1 WWTP	Orinda WTP	10.0	11,201	50
SD1-ResU-30	TWA	SD-1 WWTP	USL Reservoir	30.0	33,604	3
SD1-ResB-30	TWA	SD-1 WWTP	Briones Reservoir	30.0	33,604	9
SD1-ResSP-4	TWA	SD-1 WWTP	San Pablo Reservoir	4.0	4,481	85
SD1-ResU-10	TWA	SD-1 WWTP	USL Reservoir	10.0	11,201	38
SD1-ResB-10	TWA	SD-1 WWTP	Briones Reservoir	10.0	11,201	50
SD1-Treat-30	TWA	SD-1 WWTP	Claremont Center	30.0	33,604	3
SD1-Treat-10	TWA	SD-1 WWTP	Claremont Center	10.0	11,201	35
Satellite Treatment Alternatives						
LA-Chabot-10	SWA	LAVWMA Castro Valley	Lake Chabot	10.0	11,201	53
Sat-ResSP-4	SWA	Satellite - Point Isabel	San Pablo Reservoir	4.0	4,481	32

a. *Unit costs for the potable reuse alternatives from the 2019 RWMP were normalized using a "Min-Max Normalization" approach.*

C.3 Evaluation of Potable Reuse Opportunities

The potable reuse opportunities identified in Table 2 were evaluated through a multiple criteria decision analysis (MCDA) framework based on relative benefit and cost. The decision-support process is outlined on Figure 1.

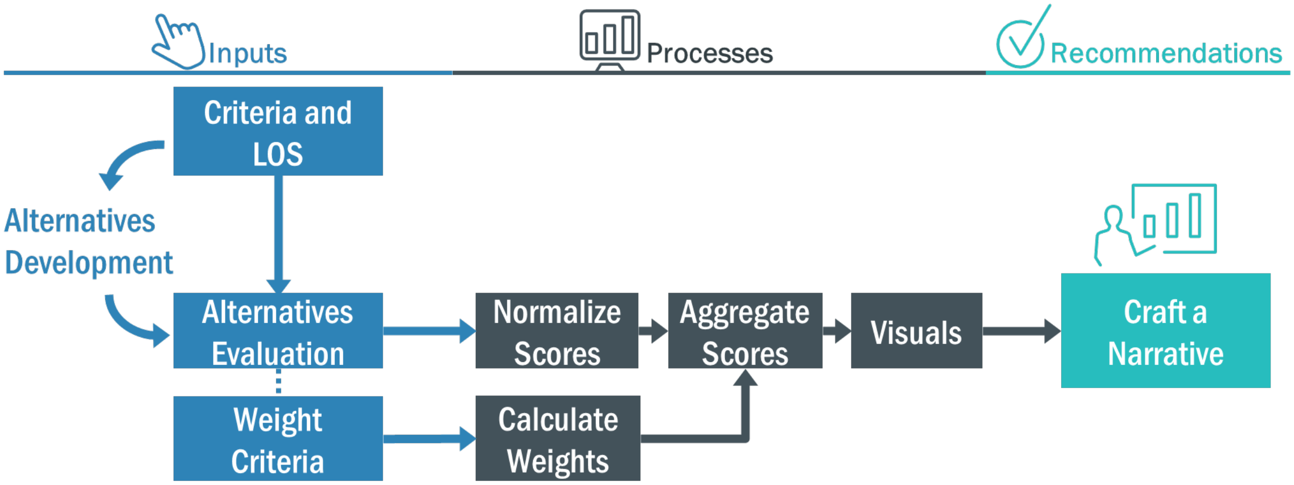

Figure 1. Decision-support process flow diagram

The framework consisted of three primary steps:

- **Benefits evaluation:** benefits evaluated using criteria and weightings that were discussed and confirmed with District staff. Evaluation criteria are framed as benefits (i.e., the higher the score, the greater the benefit) and result in an aggregate "relative benefit" score for each opportunity.
- **Cost estimate development:** preliminary capital, O&M, and unit costs were developed for each opportunity.
- **Cost/Benefit comparison:** considered costs and benefits together to facilitate decision making and understand the tradeoffs among non-potable reuse opportunities.

This process helped compare and prioritize the potable reuse opportunities to inform next steps.

C.3.1 Evaluation of Benefits for the Potable Reuse Opportunities

The evaluation criteria and corresponding weighting factors shown in Table 3 were used to conduct the screening analysis. The criteria and corresponding weighting scheme used for this analysis was largely based on the criteria that was used in the 2019 RWMP, revised with District input, to reflect updated conditions and drivers. The updated weighting scheme emphasizes the District's focus on the long-term viability of projects as well as on the distribution of benefits, and regulatory complexity.

Table 3. RWSP Update Evaluation Criteria		
Criteria	**Description**	**Weighting Factor**
Environmental and Social Objectives		
Distribution of Benefits	What regions/populations are serviced by this new supply and how are the benefits distributed? Evaluation of public perception issues and degree of outreach and education needed.	15%
Environmental Challenges	Evaluation of potential environmental challenges during construction or operations of the alternative.	10%
Chemical and Energy Use	Chemical and energy use during operations.	10%
Wastewater Discharge	Assessment of reduced nutrient discharges.	10%
Complexity and Risk		
Institutional	Evaluation of the time, challenges, and requirements to implement the project either internally or in coordination with external partners.	10%
Regulatory	Assessment of the time, challenges, and requirements to implement the project from a regulatory permitting perspective prior to construction, as well as ongoing as part of operations.	15%
Design and Construction	Evaluation of the time, challenges, and requirements to design and construct the project.	10%
Long-term Operational Viability	Alternative complexity/how challenging it will be for District staff to manage any new processes or operations, maintenance, and staffing. Assessment of long-term flexibility of investments and potential for stranded assets.	20%
	Total:	100%

To develop a relative evaluation of the alternatives with respect to how effectively each one met the evaluation criteria, a scoring rubric was developed and is presented in Table 4. The potable reuse alternatives were scored from 1 to 5, with a high score indicating a high response to the criterion and a low score indicating a low response to the criterion (5 = most favorable, 1 = least favorable). The rubric includes a brief description of the metrics used to score each alternative.

The scores for each alternative are shown in Table 5, along with some of the notable considerations that factored into the assigned scores. These scores were normalized (i.e., converted to a scale of 0 to 1 for each criterion to facilitate a relative comparison) by determining the percentile of a selected opportunity's benefits compared to other opportunities for each qualitative criterion (Marler and Arora, 2004; Cinelli et al., 2020). This approach allowed differentiation of relative opportunity performance, which highlights benefits across each of the potable reuse opportunities. Normalized scores were multiplied by their component weights and summed to develop an overall relative benefit score. This orients the analysis such that maximum normalized scores are associated with maximum benefit. The potable reuse opportunities with a composite total above the median score of 0.30 are highlighted in the table as those are rated most favorable based on the non-cost evaluation.

The results of the project evaluation are also presented graphically in Figures 3 and 4. The graphics group all potable reuse opportunities by wastewater source and present the final composite score of each opportunity. Each colored bar represents the benefit score for an individual criterion (shown in legend); opportunities with longer bars (i.e., towards the top of the figure) generally offer greater benefits.

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Table 4. Scoring Rubric for Potable Reuse Opportunities Evaluation Criteria					
Criteria	(Most Favorable)		Scoring Rubric		(Least Favorable)
	5	4	3	2	1
Distribution of Benefits	Project benefits entire service area.		Project benefits around half of the District service area.	Project benefits around 25% of the District service area.	Project benefits a small area (pressure zone) of the District service area.
Environmental Challenges	Pipeline alignment does not include any stream crossings. Project operations and/or construction will have some environmental impacts (may include some stretches of alignment near streams, wetlands, or another habitat).	Pipeline alignment includes 1 stream crossing	Pipeline alignment includes 2 or 3 stream crossings. Project operations and/or construction will have some environmental impacts (may include some stretches of alignment near streams, wetlands, or another habitat).	Pipeline alignment includes 4 stream crossing	Pipeline alignment includes 5+ stream crossings. Project operations and/or construction will have significant environmental impacts (may include significant stretches of alignment near streams, wetlands, or another habitat).
Chemical and Energy Use	Opportunity requires <200,000 kWh/MGD/year for pumping and will require low energy and chemical use for treatment and conveyance.		Opportunity requires 400,000-600,000 kWh/MGD/year for pumping and Project operation will require "average" chemical and energy for treatment and conveyance	Opportunity requires 600,000-800,000 kWh/MGD/year for pumping and project operation will require "above average" chemical and energy for treatment and conveyance	Opportunity requires >800,000 kWh/MGD/year for pumping and project operation will require significant chemical and energy for treatment and conveyance
Wastewater Discharge	Wastewater treatment train includes denitrification.		Wastewater treatment train includes denitrification, but volume of reuse could impact R2 program capability (SD1 only)		
Institutional	Opportunity does not require any coordination with partner agencies.	Opportunity does not require any coordination with partner agencies but requires extensive internal coordination between departments.	Opportunity requires coordination with 1 external partner agency.	Opportunity requires coordination with 2-3 external partner agencies.	Opportunity requires coordination with 4+ external partner agencies.
Regulatory	Opportunity does not require new WDR or NPDES (treated or raw water augmentation) and has sufficient dilution flows for RO concentrate management	Opportunity requires new WDR (groundwater augmentation)	Opportunity requires new NPDES (reservoir augmentation) or has limited ability for RO concentrate management		Opportunity requires new NPDES and has limited ability for RO concentrate management
Design and Construction	WWTP source has ample space for advanced treatment processes.	WWTP source has ample space for advanced treatment processes but tunneling to potable reuse target is required.	WWTP source has some space available for advanced treatment.	WWTP source has some space available for advanced treatment but tunneling to potable reuse target is required. Or WWTP source has no space currently available for advanced treatment processes	WWTP source has no space currently available for advanced treatment processes and tunneling to potable reuse target is required. Or no satellite site identified for advanced treatment.
Long-Term Operational Viability	Minimal operational impacts limited to administrative impacts. No impacts on existing operations	Minimal impacts to existing water and wastewater operations (groundwater and reservoir augmentation utilize existing raw water sources)	Minimal impacts to existing water and wastewater operations and significant impacts to hydraulics (including variable flowrate considerations) or requires MBR upgrade for secondary treatment.	Significant impacts to existing water and wastewater operations (raw water or treated water augmentation introduces new water source)	Significant impacts to existing water and wastewater operations and significant impacts to hydraulics or requires MBR upgrade for secondary treatment.

Table 5. Scoring of Potable Reuse Opportunities													
Name	Reuse Type	Delivery Point	Production Rate (MGD)	Environmental and Social Objectives				Complexity and Risk				Final Composite Score	Key Considerations
				Distribution of Benefits	Environmental Challenges	Chemical and Energy Use	Wastewater Discharge	Institutional	Regulatory	Design and Construction	Long-Term Operational Viability		
San Leandro WPCP Based Alternatives													
SL-Raw-1	RWA	Upper San Leandro WTP	1.4	1	4	2	4	3	1	2	2	0.10	• Minimal yield compared to other opportunities. • Upper San Leandro WTP supplies only the southwestern portion of the District's drinking water system. • Requires partnership with City of San Leandro. • RWA regulations were just adopted, complex permitting and reporting requirements. • San Leandro WWTP has limited space for a new AWPF.
SL-ResU-1	SWA	Upper San Leandro Reservoir	1.4	1	3	2	4	3	2	2	2	0.12	• Minimal yield compared to other opportunities. • Upper San Leandro Reservoir supplies only the southwestern portion of the District's drinking water system. • Requires partnership with City of San Leandro. • SWA regulations and permits are established. NPDES discharge permit are needed for reservoir augmentation. • San Leandro WWTP has limited space for a new AWPF.
SL-Chabot-1	SWA	Lake Chabot	1.4	1	4	4	4	2	2	1	2	0.22	• Minimal yield compared to other opportunities. • Supplies would be limited to the southwestern part of the District's drinking water system. • Requires partnership with City of San Leandro. • SWA regulations and permits are established. NPDES discharge permit are needed for reservoir augmentation. • Lake Chabot is not currently connected to any existing potable water distribution facilities or Upper San Leandro Reservoir.
SL-Treat-1	TWA	Dunsmuir Reservoir	1.4	1	4	4	4	3	1	2	2	0.17	• Minimal yield compared to other opportunities. • The treated water connection supplies only the southwestern portion of the District's drinking water system. • Requires partnership with City of San Leandro. • TWA regulations were just adopted, complex permitting and reporting requirements.
Pinole WPCP Based Alternatives													
Pin-Raw-2	RWA	Sobrante WTP	1.7	1	4	3	4	3	1	2	2	0.14	• Minimal yield compared to other opportunities. • Sobrante WTP supplies only the northwestern portion of the District's water system. • Requires partnership with Pinole and Hercules. • RWA regulations were just adopted, complex permitting and reporting requirements. • Pinole WPCP has limited space for a new AWPF. • Mutually exclusive with non-potable reuse options.
Pin-ResB-2	SWA	Briones Reservoir	1.7	1	3	1	4	3	2	2	2	0.10	• Minimal yield compared to other opportunities. • Briones Reservoir supplies the District's West of Hills distribution system. • Requires partnership with Pinole and Hercules. • SWA regulations and permits are established. NPDES discharge permit are needed for reservoir augmentation. • Pinole WPCP has limited space for a new AWPF. • Mutually exclusive with non-potable reuse options.
Pin-ResSP-2	SWA	San Pablo Reservoir	1.7	1	3	3	4	3	2	2	2	0.16	• Minimal yield compared to other opportunities. • San Pablo Reservoir supplies only the northwestern portion of the District's water system. • Requires partnership with Pinole and Hercules. • SWA regulations and permits are established. NPDES discharge permit are needed for reservoir augmentation. • Pinole WPCP has limited space for a new AWPF. • Mutually exclusive with non-potable reuse options.
Pin-Treat-2	TWA	Maloney Reservoir	1.7	1	4	3	4	3	1	2	2	0.14	• Minimal yield compared to other opportunities. • The treated water connection supplies only the northwestern portion of the District's drinking water system. • Requires partnership with Pinole and Hercules. • TWA regulations were just adopted, complex permitting and reporting requirements. • Pinole WPCP has limited space for a new AWPF. • Mutually exclusive with non-potable reuse options.

Table 5. Scoring of Potable Reuse Opportunities													
				Environmental and Social Objectives				Complexity and Risk					
Name	Reuse Type	Delivery Point	Production Rate (MGD)	Distribution of Benefits	Environmental Challenges	Chemical and Energy Use	Wastewater Discharge	Institutional	Regulatory	Design and Construction	Long-Term Operational Viability	Final Composite Score	Key Considerations
Richmond WPCP Based Alternatives													
Rich-Raw-4	RWA	Sobrante WTP	3.6	2	3	3	4	3	1	2	2	0.13	• Minimal yield compared to other opportunities. • Sobrante WTP supplies only the northwestern portion of the District's water system. • Requires partnership with City of Richmond. • RWA regulations were just adopted, complex permitting and reporting requirements. • Potentially mutually exclusive with some of the RARE expansion options. • Richmond WWTP has limited space for a new AWPF.
Rich-ResB-4	SWA	Briones Reservoir	3.6	2	3	1	4	3	2	2	4	0.32	• Minimal yield compared to other opportunities. • Briones Reservoir supplies the District's West of Hills distribution system. • Requires partnership with City of Richmond. • SWA regulations and permits are established. NPDES discharge permit are needed for reservoir augmentation. • Potentially mutually exclusive with some of the RARE expansion options. • Richmond WWTP has limited space for a new AWPF.
Rich-ResSP-4	SWA	San Pablo Reservoir	3.6	2	3	3	4	3	2	2	3	0.30	• Minimal yield compared to other opportunities. • San Pablo Reservoir supplies only the northwestern portion of the District's water system. • Requires partnership with City of Richmond. • SWA regulations and permits are established. NPDES discharge permit are needed for reservoir augmentation. • Potentially mutually exclusive with some of the RARE expansion options. • Richmond WWTP has limited space for a new AWPF.
Rich-Treat-4	TWA	Wildcat Aqueduct	3.6	2	4	4	4	3	1	2	2	0.21	• Minimal yield compared to other opportunities. • The treated water connection supplies only the northwestern portion of the District's drinking water system. • Requires partnership with City of Richmond. • TWA regulations were just adopted, complex permitting and reporting requirements. • Potentially mutually exclusive with some of the RARE expansion options. • Richmond WWTP has limited space for a new AWPF.
WCW WPCP Based Alternatives													
WC-Raw-5	RWA	Sobrante WTP	4.7	2	4	3	4	3	1	2	2	0.18	• Minimal yield compared to other opportunities. • Sobrante WTP supplies only the northwestern portion of the District's water system. • Requires partnership with the WCW WPCP. • RWA regulations were just adopted, complex permitting and reporting requirements. • Mutually exclusive with RARE expansion options.
WC-ResB-5	SWA	Briones Reservoir	4.7	2	3	1	4	3	2	3	3	0.31	• Minimal yield compared to other opportunities. • Briones Reservoir supplies the District's West of Hills distribution system. • Requires partnership with the WCW WPCP. • SWA regulations and permits are established. NPDES discharge permit are needed for reservoir augmentation. • Mutually exclusive with RARE expansion options.
WC-ResSP-5	SWA	San Pablo Reservoir	4.7	2	4	3	4	3	2	2	2	0.25	• Minimal yield compared to other opportunities. • San Pablo Reservoir supplies only the northwestern portion of the District's water system. • Requires partnership with the WCW WPCP. • SWA regulations and permits are established. NPDES discharge permit are needed for reservoir augmentation. • Mutually exclusive with RARE expansion options.
WC-Treat-5	TWA	Wildcat Aqueduct	4.7	2	4	4	4	3	1	2	2	0.21	• Minimal yield compared to other opportunities. • The treated water connection supplies only the northwestern portion of the District's drinking water system. • Requires partnership with the WCW WPCP. • TWA regulations were just adopted, complex permitting and reporting requirements. • Mutually exclusive with RARE expansion options.

Table 5. Scoring of Potable Reuse Opportunities

Name	Reuse Type	Delivery Point	Production Rate (MGD)	Environmental and Social Objectives				Complexity and Risk				Final Composite Score	Key Considerations
				Distribution of Benefits	Environmental Challenges	Chemical and Energy Use	Wastewater Discharge	Institutional	Regulatory	Design and Construction	Long-Term Operational Viability		
Oro Loma WPCP Based Alternatives													
Oro-GW	GWR	Injection Wells	8.0	1	4	2	4	3	3	3	1	0.30	• The wells supply only the southwestern portion of the District's drinking water system. • Requires partnership with Oro Loma WPCP. • GWR regulations and permits are well established. • Extensive public outreach likely required to integrate project into existing Bayside Wells operations.
Oro-Raw-8	RWA	USL WTP	8.0	2	4	2	4	3	1	2	2	0.14	• Upper San Leandro WTP supplies only the southwestern portion of the District's drinking water system. • Requires partnership with Oro Loma WPCP. • RWA regulations were just adopted, complex permitting and reporting requirements.
Oro-ResU-8	SWA	USL Reservoir	8.0	2	4	2	4	3	2	2	3	0.30	• Upper San Leandro Reservoir supplies only the southwestern portion of the District's drinking water system. • Requires partnership with Oro Loma WPCP. • SWA regulations and permits are established. NPDES discharge permit are needed for reservoir augmentation.
Oro-Chabot-8	SWA	Lake Chabot	8.0	2	3	2	4	3	2	1	3	0.25	• Supplies would be limited to the southwestern part of the District's drinking water system. • SWA regulations and permits are established. NPDES discharge permit are needed for reservoir augmentation. • Requires partnership with Oro Loma WPCP. • Lake Chabot is not currently connected to any existing potable water distribution facilities or Upper San Leandro Reservoir.
Oro-Treat-8	TWA	South Reservoir	8.0	2	3	4	4	3	1	2	1	0.15	• The treated water connection supplies only the southwestern portion of the District's drinking water system. • Requires partnership with Oro Loma WPCP. • TWA regulations were just adopted, complex permitting and reporting requirements.
Central San WWTP Based Alternatives													
CC-Raw-17.9	RWA	Mokelumne Aqueduct	17.9	5	3	2	4	4	1	3	3	0.40	• Mokelumne Aqueduct could convey supplies to the District's entire distribution system. • Requires partnership with Central San. • RWA regulations were just adopted, complex permitting and reporting requirements.
CC-Raw-10	RWA	Mokelumne Aqueduct	10.0	4	3	2	4	4	1	3	3	0.39	• Mokelumne Aqueduct could convey supplies to the District's entire distribution system. • Requires partnership with Central San. • RWA regulations were just adopted, complex permitting and reporting requirements.
CC-ResB-17.9	SWA	Briones Reservoir	17.9	5	3	2	4	4	2	3	3	0.47	• Briones Reservoir supplies the District's West of Hills distribution system. • Requires partnership with Central San. • SWA regulations and permits are established. NPDES discharge permit are needed for reservoir augmentation.
CC-ResB-10	SWA	Briones Reservoir	10.0	5	3	2	4	4	2	3	3	0.47	• Briones Reservoir supplies the District's West of Hills distribution system. • Requires partnership with Central San. • SWA regulations and permits are established. NPDES discharge permit are needed for reservoir augmentation.
CC-ResLV-17.9	SWA	Los Vaqueros Reservoir	17.9	3	1	1	4	1	2	2	2	0.12	• New supplies could be routed to the District's entire distribution system. • Institutionally complex, requires partnership with Central San, CCWD, USBR, and Los Vaqueros Reservoir partner agencies. • SWA regulations and permits are established. NPDES discharge permit are needed for reservoir augmentation.
CC-Raw WCK-17.9	RWA	Walnut Creek WTP	17.9	3	3	2	4	4	1	3	3	0.37	• Supplies would be limited to the District's Walnut Creek WTP distribution area. • Requires partnership with Central San. • RWA regulations were just adopted, complex permitting and reporting requirements.
EBMUD Main WWTP (SD-1) Based Alternatives													
SD1-Raw-30	RWA	Orinda WTP	30.0	5	4	2	5	5	1	2	2	0.38	• Orinda WTP supplies the District's West of Hills distribution system. • RWA regulations were just adopted, complex permitting and reporting requirements. • SD-1 WWTP has limited space for a new AWPF.
SD1-Raw-10	RWA	Orinda WTP	10.0	3	4	2	5	5	1	2	2	0.34	• Orinda WTP supplies the District's West of Hills distribution system. • RWA regulations were just adopted, complex permitting and reporting requirements. • SD-1 WWTP has limited space for a new AWPF.

Table 5. Scoring of Potable Reuse Opportunities

Name	Reuse Type	Delivery Point	Production Rate (MGD)	Environmental and Social Objectives				Complexity and Risk				Final Composite Score	Key Considerations
				Distribution of Benefits	Environmental Challenges	Chemical and Energy Use	Wastewater Discharge	Institutional	Regulatory	Design and Construction	Long-Term Operational Viability		
SD1-ResU-30	SWA	USL Reservoir	30.0	3	3	2	5	5	2	2	3	0.46	• Upper San Leandro Reservoir supplies only the southwestern portion of the District's drinking water system. • SWA regulations and permits are established. NPDES discharge permit are needed for reservoir augmentation. • SD-1 WWTP has limited space for a new AWPF.
SD1-ResB-30	SWA	Briones Reservoir	30.0	4	4	1	5	5	2	3	4	0.66	• Briones Reservoir supplies the District's West of Hills distribution system. • SWA regulations and permits are established. NPDES discharge permit are needed for reservoir augmentation. • SD-1 WWTP has limited space for a new AWPF.
SD1-ResSP-4	SWA	San Pablo Reservoir	4.0	2	4	3	5	5	2	3	4	0.64	• Minimal yield compared to other opportunities. • San Pablo Reservoir supplies only the northwestern portion of the District's water system. • SWA regulations and permits are established. NPDES discharge permit are needed for reservoir augmentation. • SD-1 WWTP has limited space for a new AWPF.
SD1-ResU-10	SWA	USL Reservoir	10.0	2	3	2	5	5	2	2	3	0.40	• Upper San Leandro Reservoir supplies only the southwestern portion of the District's drinking water system. • SWA regulations and permits are established. NPDES discharge permit are needed for reservoir augmentation. • SD-1 WWTP has limited space for a new AWPF.
SD1-ResB-10	SWA	Briones Reservoir	10.0	3	4	1	5	5	2	3	3	0.56	• Briones Reservoir supplies the District's West of Hills distribution system. • SWA regulations and permits are established. NPDES discharge permit are needed for reservoir augmentation. • SD-1 WWTP has limited space for a new AWPF.
SD1-Treat-30	TWA	Claremont Center	30.0	5	4	3	5	5	1	2	3	0.51	• The treated water connection supplies the District's West of Hill's distribution system. • TWA regulations were just adopted, complex permitting and reporting requirements. • SD-1 WWTP has limited space for a new AWPF.
SD1-Treat-10	TWA	Claremont Center	10.0	4	4	3	5	5	1	2	3	0.50	• The treated water connection supplies the District's West of Hill's distribution system. • TWA regulations were just adopted, complex permitting and reporting requirements. • SD-1 WWTP has limited space for a new AWPF.
Satellite Treatment Alternatives													
LA-Chabot-10	SWA	Lake Chabot	10.0	2	4	5	4	1	2	1	2	0.27	• Supplies would be limited to the southwestern part of the District's drinking water system. • Requires partnership with LAVWMA. • SWA regulations and permits are established. NPDES discharge permit are needed for reservoir augmentation. • LAVWMA has limited space for a new AWPF. • Lake Chabot is not currently connected to any existing potable water distribution facilities or Upper San Leandro Reservoir.
Sat-ResSP-4	SWA	San Pablo Reservoir	4.0	1	3	3	4	5	2	3	3	0.39	• Minimal yield compared to other opportunities. • San Pablo Reservoir supplies only the northwestern portion of the District's water system. • SWA regulations and permits are established. NPDES discharge permit are needed for reservoir augmentation.

Figure 2. Aggregated relative benefit scores of potable reuse alternatives.

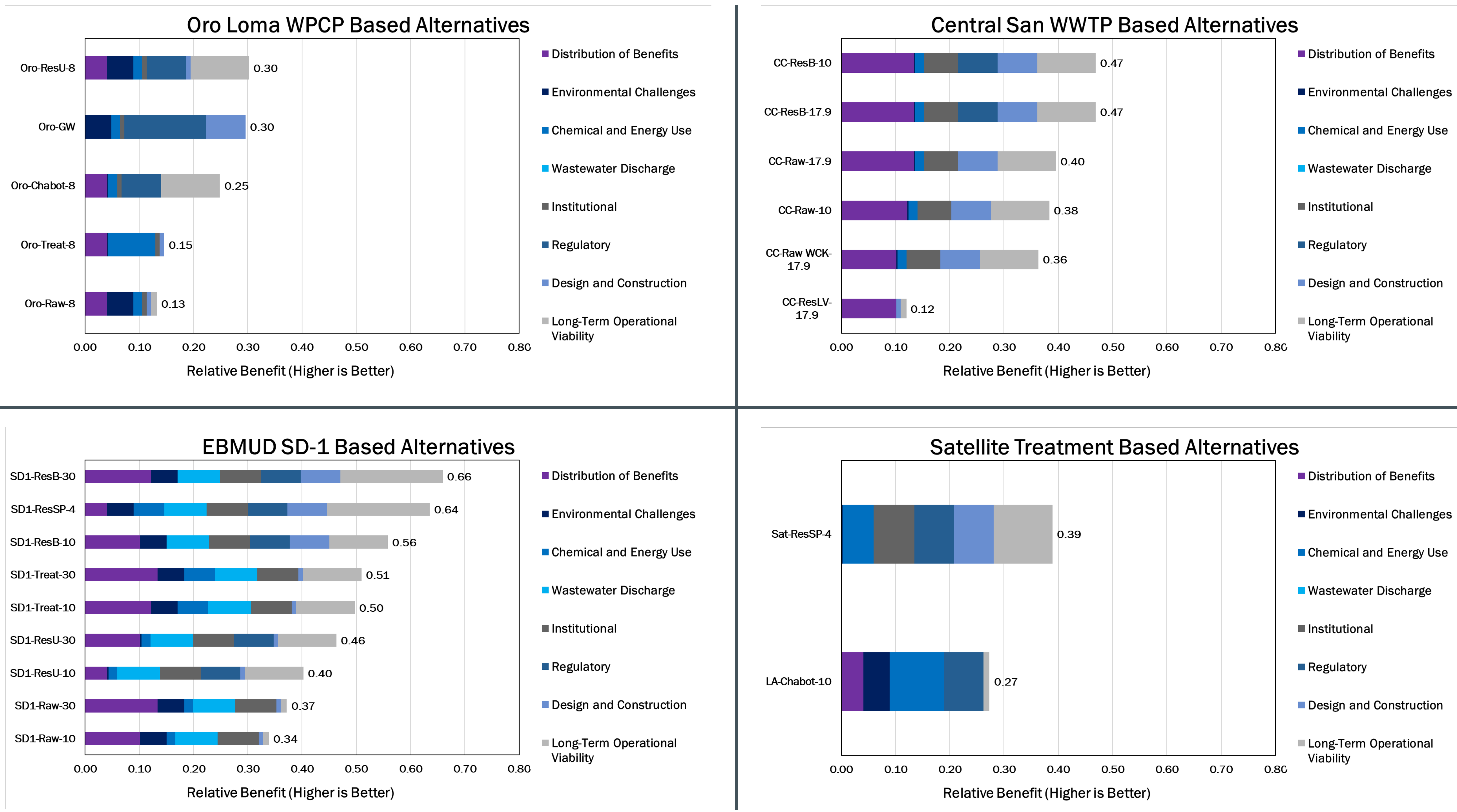

Figure 3. Aggregated relative benefit scores of potable reuse alternatives (continued).

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In reviewing the results of the relative benefits assessment, we see those opportunities with the potential for greater disbursement of benefits tended to score highest. This included many of the District SD-1 and Central San specific projects. Whereas opportunities like the ones specific to the San Leandro WPCP and Pinole WPCP didn't score as high since these projects tended to be more localized but still involved many of the same complexities as their counterparts. This trend holds when reviewing the revised ranking and comparing to the ranking from the 2019 RWMP. Table 6 shows the relative ranking of each potable reuse opportunity and how it differs from the rankings that were developed as part of the 2019 RWMP. From Table 6 we see that opportunities that are more localized (e.g., San Leandro WPCP) tended to drop in the relative rankings while those involving a greater reach in terms of distribution of new water supply tended to rise in the rankings (e.g., District specific opportunities).

Table 6. Change in Ranking of Potable Reuse Opportunities

Name	Reuse Type	Source	Delivery Point	RWSP Update Evaluation Ranking	2019 RWMP Evaluation Ranking	Change in Ranking
San Leandro WPCP Based Alternatives						
SL-Raw-1	Raw Water Augmentation	San Leandro WPCP	Upper San Leandro WTP	38	16	Down 22
SL-ResU-1	Surface Water Augmentation	San Leandro WPCP	Upper San Leandro Reservoir	36	10	Down 16
SL-Chabot-1	Surface Water Augmentation	San Leandro WPCP	Lake Chabot	24	30	Up 6
SL-Treat-1	Treated Water Augmentation	San Leandro WPCP	Dunsmuir Reservoir	28	14	Down 14
Pinole WPCP Based Alternatives						
Pin-Raw-2	Raw Water Augmentation	Pinol WPCP	Sobrante WTP	33	29	Down 4
Pin-ResB-2	Surface Water Augmentation	Pinol WPCP	Briones Reservoir	37	23	Down 14
Pin-ResSP-2	Surface Water Augmentation	Pinol WPCP	San Pablo Reservoir	29	24	Down 5
Pin-Treat-2	Treated Water Augmentation	Pinol WPCP	Maloney Reservoir	32	35	Up 3

Table 6. Change in Ranking of Potable Reuse Opportunities						
Name	Reuse Type	Source	Delivery Point	RWSP Update Evaluation Ranking	2019 RWMP Evaluation Ranking	Change in Ranking
Richmond WPCP Based Alternatives						
Rich-Raw-4	Raw Water Augmentation	Richmond WPCP	Sobrante WTP	34	33	Down 1
Rich-ResB-4	Surface Water Augmentation	Richmond WPCP	Briones Reservoir	16	25	Up 9
Rich-ResSP-4	Surface Water Augmentation	Richmond WPCP	San Pablo Reservoir	19	18	Down 1
Rich-Treat-4	Treated Water Augmentation	Richmond WPCP	Wildcat Aqueduct	26	26	No Change
WCW WPCP Based Alternatives						
WC-Raw-5	Raw Water Augmentation	WCW WPCP	Sobrante WTP	27	31	Up 4
WC-ResB-5	Surface Water Augmentation	WCW WPCP	Briones Reservoir	17	20	Up 3
WC-ResSP-5	Surface Water Augmentation	WCW WPCP	San Pablo Reservoir	23	17	Down 6
WC-Treat-5	Treated Water Augmentation	WCW WPCP	Wildcat Aqueduct	25	28	Up 3
Oro Loma WPCP Based Alternatives						
Oro-GW	Groundwater Recharge	Oro Loma WPCP	Injection Wells	20	15	Down 5
Oro-Raw-8	Raw Water Augmentation	Oro Loma WPCP	USL WTP	31	11	Down 20
Oro-ResU-8	Surface Water Augmentation	Oro Loma WPCP	USL Reservoir	18	6	Down 12
Oro-Chabot-8	Surface Water Augmentation	Oro Loma WPCP	Lake Chabot	22	21	Down 1

Table 6. Change in Ranking of Potable Reuse Opportunities						
Name	Reuse Type	Source	Delivery Point	RWSP Update Evaluation Ranking	2019 RWMP Evaluation Ranking	Change in Ranking
Oro-Treat-8	Treated Water Augmentation	Oro Loma WPCP	South Reservoir	30	22	Down 8
Central San WWTP Based Alternatives						
CC-Raw-17.9	RWA	CCCSD WWTP	Mokelumne Aqueduct	10	3	Down 7
CC-Raw-10	RWA	CCCSD WWTP	Mokelumne Aqueduct	12	1	Down 11
CC-ResB-17.9	SWA	CCCSD WWTP	Briones Reservoir	7	36	Up 29
CC-ResB-10	SWA	CCCSD WWTP	Briones Reservoir	6	32	Up 26
CC-ResLV-17.9	SWA	CCCSD WWTP	Los Vaqueros Reservoir	35	--	N/A
CC-Raw WCK-17.9	RWA	CCCSD WWTP	Walnut Creek WTP	14	--	N/A
EBMUD Main WWTP (SD-1) Based Alternatives						
SD1-Raw-30	RWA	SD1 WWTP	Orinda WTP	13	27	Up 14
SD1-Raw-10	RWA	SD1 WWTP	Orinda WTP	15	13	Down 2
SD1-ResU-30	SWA	SD1 WWTP	USL Reservoir	8	19	Up 11
SD1-ResB-30	SWA	SD1 WWTP	Briones Reservoir	1	8	Up 7
SD1-ResSP-4	SWA	SD1 WWTP	San Pablo Reservoir	2	2	No Change
SD1-ResU-10	SWA	SD1 WWTP	USL Reservoir	9	9	No Change
SD1-ResB-10	SWA	SD1 WWTP	Briones Reservoir	3	4	Up 1
SD1-Treat-30	TWA	SD1 WWTP	Claremont Center	4	7	Up 3

Table 6. Change in Ranking of Potable Reuse Opportunities						
Name	Reuse Type	Source	Delivery Point	RWSP Update Evaluation Ranking	2019 RWMP Evaluation Ranking	Change in Ranking
SD1-Treat-10	TWA	SD1 WWTP	Claremont Center	5	5	No Change
Satellite Treatment Alternatives						
LA-Chabot-10	SWA	LAVWMA Castro Valley	Lake Chabot	21	34	Up 13
Sat-ResSP-4	SWA	Satellite - Pt. Isabel	San Pablo Reservoir	11	12	Up 1

C.3.2 Applying Relative Costs to the Benefits Analysis

The final composite scores of the potable reuse opportunities with a composite total above the median score of 0.30 were plotted against their respective 2019 RWMP relative unit cost (Figure 4). The figure includes 20 total projects: two projects from the Richmond WPCP, one project from the WCWD WPCP, two projects from the Oro Loma WPCP, five projects from Central San, nine projects from EBMUD's SD-1 WWTP, and one project from the satellite-based treatment alternatives. Opportunities closest to the upper right quadrant present the most favorable combination of costs and alignment with the evaluation criteria.

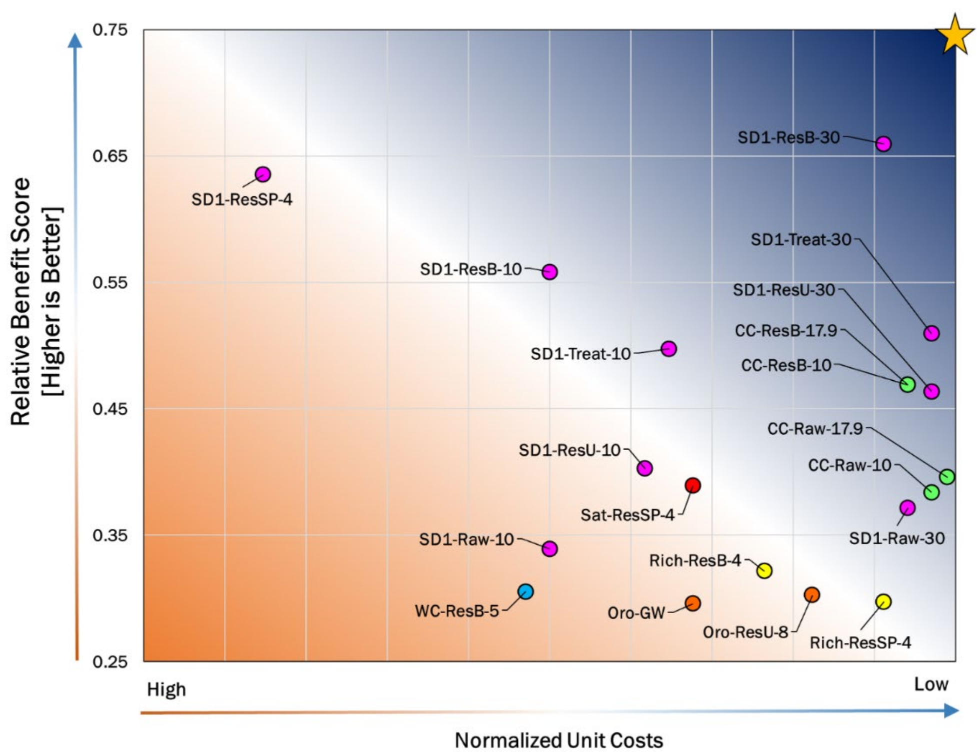

Figure 4. Aggregate relative benefit scores for potable reuse opportunities vs. normalized unit costs

Both the CC-ResLV-17.9 and CC-Raw WCK-17.9 alternatives are not shown in the graph since 2019 normalized unit costs for these opportunities are not available.
Color designations: Blue: WCWD-WPCP-based alternatives; green: Central-San-based alternatives; orange: Oro Loma-WPCP-based alternatives; pink: EBMUD-based alternatives; yellow: Richmond-WPCP-based alternatives; red: Satellite-Treatment-based alternatives.

C.4 Recommended Potable Reuse Alternatives

Based on the results of the potable reuse alternatives reassessment and discussions with District staff, the five opportunities in Table 7 were carried forward for further development. The selection of these projects allowed the District to further evaluate an SWA and TWA option at SD-1; RWA and SWA projects with Central San; and a smaller, more-southern-based SWA option with Oro Loma. Site layouts, treatment and conveyance needs, key considerations, and planning-level cost estimates for these five alternatives are presented in Section 5 of this Technical Memorandum.

Table 7. Highest Ranking Potable Reuse Opportunities

Name	Reuse Type	Source	Delivery Point	Production Rate (mgd)	Yield (AFY)	Normalized 2019 RWMP Unit Costs[a]
Oro-Loma-WPCP-based Alternatives						
Oro-ResU-8	SWA	Oro Loma WPCP	USL Reservoir	8.0	8,961	18
Central San WWTP Based Alternatives						
CC-Raw-17.9	RWA	Central San WWTP	Mokelumne Aqueduct	17.9	20,051	1
CC-ResB-17.9	SWA	Central San WWTP	Briones Reservoir	17.9	20,051	6
EBMUD Main WWTP (SD-1)-based Alternatives						
SD1-ResB-30	TWA	SD-1 WWTP	Briones Reservoir	30.0	33,604	9
SD1-Treat-30	TWA	SD-1 WWTP	Claremont Center	30.0	33,604	3

a. Unit costs for the potable reuse alternatives from the 2019 RWMP were normalized using a "Min-Max Normalization" approach.

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Appendix D: Potable Reuse Outreach Roadmap

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Public Outreach Roadmap for Potential EBMUD Potable Reuse Projects

Introduction

Recycled water use is a critical element of East Bay Municipal Utility District's (EBMUD or District) water supply management policies, as any demand met with recycled water reduces the demand for limited drinking water supplies. In addition to increasing water supply reliability and lessening the effect of extreme rationing during droughts, the use of recycled water:

- Delays or eliminates the need to construct more potable water facilities;
- Sustains the economy with increased water supply reliability;
- Protects San Francisco Bay by reducing treated wastewater discharges;
- Safeguards investments in parks and landscaping with a drought-resistant water supply;
- Contributes to a green and healthy environment.

Many districts and agencies in California have taken their recycled water programs to the next level and implemented potable reuse projects, also referenced as advanced purified water or just "purified water" throughout this document. Purified water uses multi-stage treatment to provide a safe, reliable, and sustainable drinking water supply. While potable reuse is not currently part of the District's Recycled Water Program, it is important for the Board and staff to keep up to date on regulatory requirements and trends in potable reuse locally and statewide. In the event that the District considers a purified water project, a roadmap for conducting a public outreach program will be useful to gain understanding and acceptance of the process and safety of producing purified water.

A key emphasis of this Public Outreach Roadmap for purified water will be to build on the education and outreach efforts the District has already developed for its successful Recycled Water Program. An effective public outreach effort is essential to inform and educate the District's Board, Staff and customers and generate support for a successful purified water project, if and when it may be needed. The District is not considering a purified water project at this time, but when that day comes, we want to make sure that our Board, staff, and customers are educated and comfortable with the idea of producing advanced purified water that will not diminish the quality of our existing drinking water.

> While potable reuse may sometimes further be defined as either **direct or indirect potable reuse**, these terms may be confusing to the public. It is recommended to further define potable reuse by describing how it augments the water supply, e.g., groundwater augmentation, reservoir augmentation, raw water augmentation and treated drinking water augmentation. As they are still sometimes used, definitions for indirect and direct potable reuse are provided below:
>
> **Indirect Potable Reuse (IPR)** involves blending purified recycled water with other environmental systems such as a river, reservoir, or groundwater basin, before the water is reused for drinking water.
>
> **Direct Potable Reuse (DPR)** involves putting purified recycled water directly into a potable water supply distribution system downstream of a drinking water plant or into the source water supply immediately upstream of the drinking water plant.

Background

EBMUD provides drinking water for 1.4 million customers in Alameda and Contra Costa counties. During the period 2009 through 2018, EBMUD produced, on average, about 175 MGD of potable water. EBMUD's Main Wastewater Treatment Plant protecting San Francisco Bay and serving 685,000 customers, discharges approximately 60 MGD of treated water to the Bay. EBMUD is one of only a handful of large water utilities in California that provide both drinking water and wastewater services to a large urban area. This provides increased opportunities to integrate recycled water into its source water portfolio, including the possibility of including potable reuse in the future.

EBMUD has been recycling water for irrigation and in-plant processes at its main wastewater treatment plant since 1971 and began its first golf course recycled water irrigation project in 1984. The Board of Directors created the Office of Water Recycling in 1988 to centralize and expand water recycling. The initial goal of the EBMUD Recycled Water was to expedite recycled water projects in response to the drought that lasted from 1987-1992. Today, the goal of the program continues to be the planning, development, and implementation of recycled water projects throughout EBMUD's water service area in order to reduce the demand on EBMUD's drinking water supplies. Purified water is a possible next step in the expansion of the District's Recycled Water Project that would augment the District's existing drinking water sources and create a more diversified water supply portfolio.

This Draft Public Outreach Roadmap provides a timeline and associated outreach and education tools to support and reinforce the District's existing recycled water education programs as it lays the groundwork for a potential purified water (potable reuse) project. Although the District Board is not recommending a purified water project at this time, staff is committed to keeping the Board educated and informed about current state water quality regulations and potable reuse projects within our region and statewide. This Draft Roadmap is based on effective practices other utilities have adopted in their approach and successful implementation of purified water projects.

Public Outreach Roadmap Strategy

An effective public outreach strategy is designed to engage identified audiences and stakeholders with clear, comprehensible information about a purified water project that EBMUD may consider in the future. This outreach strategy and recommended communication tools will effectively convey the purpose, benefits, and safety of a potential purified water project.

These communication tools are designed to foster understanding and support for any potential projects the Board may consider in the future. While the District is not currently planning a purified water project, the need to expand the Recycled Water Project to include purified water may arise due to worsening droughts and other effects of climate change or weather variability. A purified water project provides a drought-resilient water supply to mitigate these impacts.

Initial Potable Reuse Education and Outreach Plan

Public Outreach Goals

The primary goals of a purified water public outreach efforts are to:

- Engage identified audiences with clear, comprehensible information about a project and its purpose, benefits, and status.
- Foster understanding and support of a project (including alternatives).
- Provide a positive introduction to the concept of augmenting the water supply with advanced purified water.
- Be a trusted source of information. Build and sustain trust between District and the public.

Steps to prepare for public engagement

- Form a Project Communications Team
- Review literature / Study lessons learned from similar projects
- Educate elected officials, key staff, internal organization, and partner agencies
- Identify key stakeholders / Build email broadcast list and contact database
- Develop a project brand and draft key messages for testing
- Conduct interviews with key stakeholders
- Develop communication plan and outreach tools based on previous steps:
    - Informational materials and videos
    - Speakers' bureau and training
    - Web pages and social media
    - Media training
- Develop and maintain trust in the purified water process
- Tour existing facilities – Elected officials and key staff can listen and learn from others
- Opinion Leader Outreach – Builds strong relationships and involves third parties
- Independent Advisory Panel to examine project and share findings with the public
- Consider a demonstration site (Pilot Project and/or Educational Center)
- Consider conducting a baseline survey and focus groups to gauge progress

Preparing for public engagement

- **Form a Project Communications Team** – A Project Communications Team should be formed to bring together designated spokespersons (such as PIOs, governmental affairs personnel, and other designated spokespersons) from within the District. The team should identify a leader, who could be one of the spokespersons or an outreach communications consultant, to facilitate discussion and guide the team in implementing coordinated messaging. This team should develop project messaging and talking points, meet regularly to remain current on project status, identify and discuss potential outreach issues or concerns, and develop appropriate responses to outreach issues. The Project Communications Team should closely coordinate with the Project engineering and management teams in implementing a Public Outreach Plan.

- **Review literature / Study lessons learned from similar projects** – There are many communities in California and around the country that use purified water to augment drinking water and groundwater sources. A review of these projects will ensure that the District takes advantage of the literature and science already available. The Board and Staff should keep informed about the latest developments with State regulations for production of purified water and how they could affect a project. For example, in August 2024 the Office of Administrative Law approved the proposed Direct Potable Reuse regulations and filed the regulations with the Secretary of State. The regulations became effective on October 1, 2024. The adoption of the regulations followed years of research, investigation, and peer review by an expert panel.

- **Educate elected officials, key staff, and management teams** – Elected officials and management teams from each agency should be knowledgeable about a proposed project and understand its implications and benefits, be aligned in messaging, and be viewed by the public as a trusted source of information. Elected officials and management teams should visit existing purified water projects, taste advanced purified water, and meet the leaders of those projects.

- **Identify key stakeholders -** Identify key community leaders and groups and build a mailing database for distribution of e-mail or direct mail updates. Listen to these stakeholders and be responsive to concerns related to purified water project implementation. As the Project evolves, develop a contact manager database for stakeholders who potentially could be impacted within the Project construction areas.

- **Develop a project brand, and draft key messages for testing –** This is where the District develops the project story: Why is the project needed? Brand the project with a new title that is identifiable, easily understood, and creates positive public perception with cultural sensitivity. Develop key messages in terms understandable to a non-technical audience and avoid jargon. Key messages provide coordinated, consistent, effective communication about the role and importance of potable reuse (purified water) that can be uniformly used with a variety of stakeholders – from children to parents and health professionals to business interests. These are examples of three key messages, which are tested and proven:
    - Purified water provides a safe, reliable, and sustainable drinking water supply.
    - Using advanced purified water is good for the environment.
    - Purified water provides a locally controlled, drought-resilient water supply.

  Additional key messages the District could consider:
    - Purified water will be distributed to customers throughout the District – ensuring that all customers have equal access to high-quality drinking water.
    - Using purified water to augment the current drinking water supply prepares the District for the impacts of a changing climate, and the prospect of drastic water rationing during a prolonged drought.

- **Conduct interviews with key stakeholders –** Use in-depth interviews (ideally in one-on-one settings) to identify and clarify health concerns; identify and address concerns about reliability and the ability to stop production; and develop a public outreach framework and communication tools that address concerns in layperson terms that can be adapted by the District for a variety of audiences.

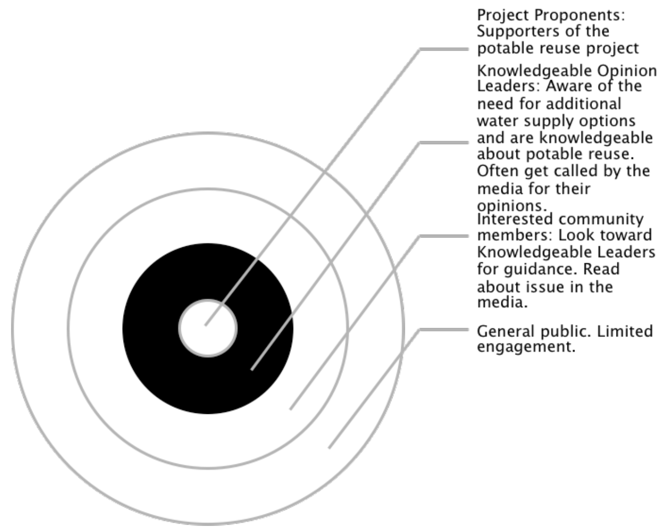
- **Develop communication plan and outreach tools based on interviews and messages –** All informational materials and outreach tools should be available in easy-to-understand language that highlights key messages that are appropriate for target audiences. All materials should be provided in print and electronic formats, and consider using QR codes and social medial platform strategies.
    - **Informational materials and videos** – A list of collateral materials could include: a purified water fact sheet and FAQs; a pocket brochure; bill inserts; posters and banners; materials for children; white papers; and template articles. Short videos can be produced for website use and social media.
    - **Speakers' bureau and training** – A speaker's bureau of staff and elected officials can be an effective tool for spreading the word about your project.
    - **Web pages and social media** – A vibrant website and the use of social media are indispensable public outreach tools. Consider a dedicated project page on the District website that is a one-stop source for all project information, including a clear and concise project description, environmental review documents, project FAQs, and where to go for more information about purified water (include links such as: https://watereuse.org/educate/types-of-reuse/potable-reuse/
    - **Media Training** – The media and reporters will often contact several different people in one organization when trying to get information to develop a story. However, only the District's project manager or spokespeople should speak to the media to ensure that accurate and consistent information is provided. Ensure that all staff that are responding to media requests have received media training. Remind staff to follow agency protocol to refer reporters to the spokespeople.

- **Develop and maintain trust in the Advanced Purification Process –** The District and its customers take pride in the existing Sierra Nevada water supply and regard it as a high-quality water source. Introducing a new water source could affect that perception. To address this challenge the District must develop and maintain trust in the quality of purified water. Trust can be earned if you:
    - Communicate in simple and meaningful terms how purified water is produced and how water quality is tested
    - Communicate that you are asking the tough questions and looking for answers
    - Share Emergency Response Plans for responding to water quality problems
    - Articulate Water Quality Risks – Define the water quality risks that need to be addressed in simple and meaningful terms. People who are paying attention won't accept the idea that there are no risks.

- **Tour existing facilities in the region** – Guided tours of existing purified water projects or education centers allow elected officials and key staff to listen and learn from others about their experiences implementing projects. Several projects in the South Bay and Monterey Bay areas could be toured in a one-day outing, including the ***Silicon Valley Advanced Water Purification Center, Pure Water Soquel***, and ***Pure Water Monterey*. For the past decade we have witnessed the value of demonstration sites for purified water projects. They are very effective in educating elected officials, community influencers and the general public and have a positive effect on views and perspectives on the use of advanced purified recycled water. These demonstration facilities have been instrumental in advancing support and acceptance of such projects.

- **Outreach to identify Opinion Leaders** – Opinion leaders influence attitudes, beliefs, motivations, and behaviors of others. They influence opinions by raising awareness, persuading others, establishing, or reinforcing norms, and leveraging resources. They usually have high visibility and a defined constituency. Opinion leader outreach builds strong relationships and garners third-party involvement in disseminating information to a broader network.

  Opinion leaders can include, but are not limited to:
  - Academic/education leaders
  - Business organizations
  - Civic groups
  - Environmental groups
  - Media
  - Medical, public health, and water quality experts
  - Multicultural and faith-based leaders and groups
  - State and local elected officials and their staffs



  The accompanying graphic illustrates the opinion leaders in relation to other community members. Opinion leaders spread viewpoints and information to other community members and should be made aware of the need to increase water supply sources and should be knowledgeable about purified water as an option.

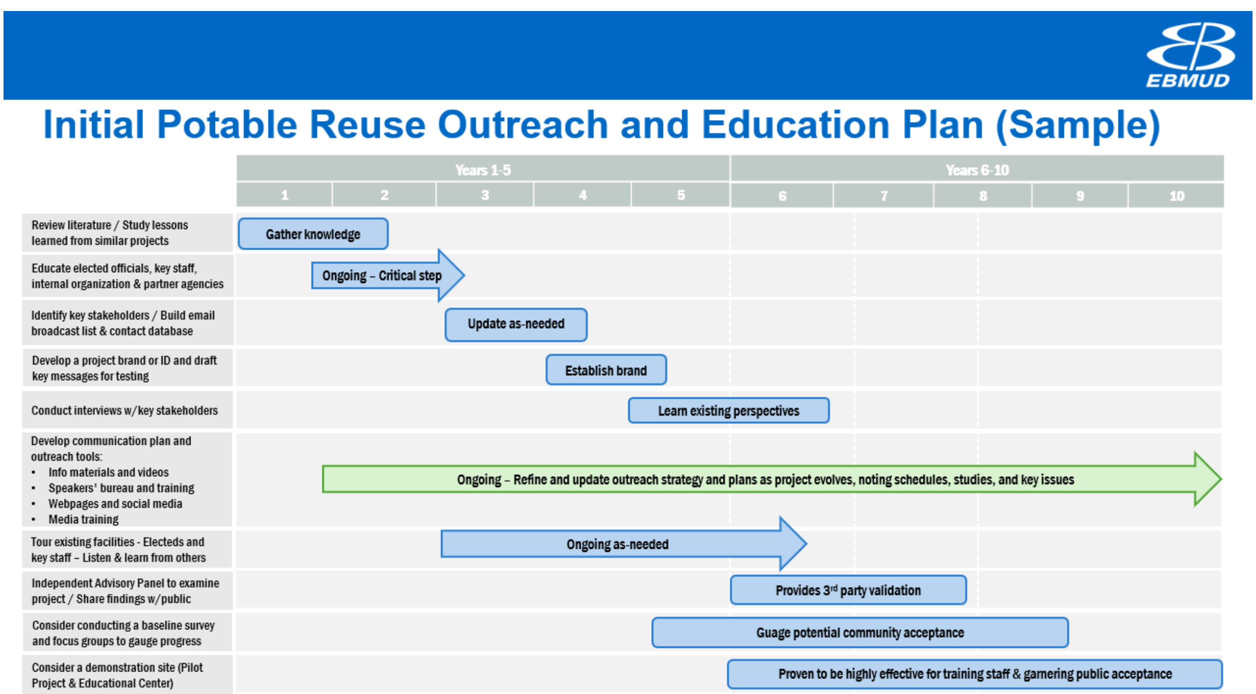
- **Utilize an Independent Expert Advisory Panel** – The District should consider utilizing a recognized third party to evaluate a project's viability and safety. Most of the recent potable reuse projects in the nation have used the National Water Research Institute (NWRI) to assemble independent advisory panels (IAP) of experts. These IAPs are tasked with reviewing the project and providing their scientific and technological opinions. These panels typically include experts in water quality, health, water reuse technology, and other related areas of expertise. The purpose of an IAP is to provide an independent viewpoint and, at times, may recommend project or process changes. Including an IAP review of the Project provides valuable credibility in the eyes of the public.

- **Consider a demonstration site/pilot project and mobile trailer** – The District should consider developing facilities where the public can see and learn about the purification process and taste the purified water. First-hand exposure to the process and tasting the water is a proven method in building confidence and community trust in the Project.
  - Plan for and develop a demonstration site (or pilot project) where people can see the purification treatment process and taste the purified water. This site also could be used to train operators and prepare them for operating the future purification facilities.

- Plan for and develop a mobile educational trailer. A mobile educational trailer will enable the District to go to where the public is and participate in various community events, schools, and public meetings.

- **Consider conducting a baseline survey and focus groups to gauge progress –** Conduct periodic surveys and focus groups to gauge how community perspectives about the Project and advanced purified water are evolving. Other ways to measure public outreach success are tracking:
    - Website visits
    - The number of people reached with the mobile educational trailer
    - News releases issued
    - Articles placed in newsletters/newspapers
    - Presentations made/community meetings conducted
    - Posts/engagements on social media (e.g., Facebook, Instagram, etc.)
    - Incoming inquiries about the Project
    - Customer surveys and personal interviews
    - Letters of support and testimonials received from local agencies and stakeholder groups
    - Visits to the demonstration sites or pilot facilities (once built)

- **A Public Outreach Plan is a living document –** This Plan should be considered a "living document" that is periodically reviewed and adjusted to adapt to the evolution and milestones of the Project and to the outreach needs of the communities involved. Outreach is dynamic and must evolve and adapt with the Project. Outreach efforts should remain cognizant of shifts in public opinion and align with project milestones. The outreach strategy must continue to be revisited and adapted to address concerns, maintain trust and build consensus among the various stakeholders. The messages, activities, and tools can be modified as the Project progresses.



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