Encina Wastewater Authority

Serving North San Diego County

Encina Wastewater Authority

WATER REUSE FEASIBILITY STUDY

Final Report | July 2018

WOODARD & CURRAN

Prepared by Woodard & Curran

In Association with:

Carollo Engineers | Trussell Technologies Inc.

Ken Weinberg Water Resources Consulting, LLC | Michael R. Welch, Ph.D., P.E.

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ENCINA WASTEWATER AUTHORITY

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Prepared by:

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List of Abbreviations

AADF	annual average daily flow
AF	acre-feet
AFY	acre-feet per year
AOP	advanced oxidation process
AWT	advanced water treatment
AWTF	advanced water treatment facility
BAF	biologically activated filtration
CEQA	California Environmental Quality Act
CDP	Carlsbad Desalination Plant
DDW	State Water Resources Control Board Division of Drinking Water
DPR	direct potable reuse
EWA	Encina Wastewater Authority
EWPCF	Encina Water Pollution Control Facility
FAT	full advanced treatment
gpd	gallons per day
gpm	gallons per minute
GWA	Groundwater augmentation
HGL	hydraulic grade line
HP	horsepower
IPR	indirect potable reuse
IRWM	Integrated Regional Water Management
LF	Linear feet
LRP	Local Resources Program
LWSIP	Local Water Supply Incentive Program
LWSD	Local Water Supply Development
mgd	million gallons per day
mg/L	milligram per liter
MF	microfiltration
MWD	Metropolitan Water District
NDN	nitrification/denitrification
NPDES	National Pollutant Discharge Elimination System
NPR	non-potable reuse
NSDRC	North San Diego Reuse Coalition
O_3	ozone
O&M	operations and maintenance
OMWD	Olivenhain Municipal Water District
psi	pounds per square inch
RRT	response retention time
RO	reverse osmosis
ROWD	Report of Waste Discharge
RWA	raw water augmentation
RWQCB	Regional Water Quality Control Board
SDCWA	San Diego County Water Authority
SDWD	San Dieguito Water District
SEJPA	San Elijo Joint Powers Authority
SFID	Santa Fe Irrigation District
SRF	State Revolving Fund
SWA	surface water augmentation
SWRCB	State Water Resources Control Board
TDWA	treated drinking water augmentation
TM	technical memorandum
UF	ultrafiltration
UV	ultraviolet irradiation
VWD	Vallecitos Water District
WDR	Waste Discharge Requirements
WIIN	Water Infrastructure Improvements for the Nation
WRF	Water Reclamation Facility
WRFP	Water Recycling Funding Program
WRR	water recycling requirements
WTP	water treatment plant
WWTP	wastewater treatment plant

Executive Summary

ES-1 Introduction

As required by Encina Wastewater Authority's (EWA) 2020 Business Plan, this Water Reuse Feasibility Study (Study) identifies a path to maximize beneficial reuse of effluent from the Encina Water Pollution Control Facility (EWPCF)—which by 2040 is projected to reach an average of approximately 31 million gallons per day (mgd). Ultimately, the Study serves to advance EWA's mission of resource recovery and contributing to sustaining and enhancing the region's water resources.

A series of technical and regulatory issues were analyzed, and alternative project concepts were developed during the Study. The analysis is documented in a series of technical memoranda (TM):

- TM 1 – Background of Potable Reuse in California
- TM 2 – Portfolio of Options
- TM 3 – Preferred Project Identification
- TM 4 – Phasing of Preferred Project
- TM 5 – Funding Opportunities
- TM 6 – Stakeholder Involvement Plan

This Executive Summary provides an overview of the water reuse opportunities for EWA, identifies the Preferred Project along with a recommended approach and schedule for implementation that will help EWA chart a path forward. The complete TMs referenced above are attached to this Executive Summary, which together constitute the Study's final report.

ES-2 Background of Potable Reuse in California (TM 1)

Non-potable reuse (NPR) can be a vital component of a diverse water supply portfolio. In Southern California, non-potable reuse systems often serve to offset imported water by providing recycled water for irrigation demands. This is an important function, particularly in semi-arid San Diego County where approximately 84 percent of the water supply is imported from hundreds of miles away via the State Water Project and the Colorado River Aqueduct[1]. However, NPR does have limitations compared to potable water reuse. These include the fact that non-potable water has limited applications due to its quality; the cost of constructing, operating, and maintaining dedicated "purple pipe" infrastructure in parallel with potable water infrastructure; and the limited ability to maximize use given the seasonal nature of irrigation demands.

Indirect Potable Reuse (IPR) is the incorporation of recycled water into the drinking water supply system after storage in an environmental buffer, such as an aquifer or reservoir, and, in some cases, additional treatment steps. The two primary types of IPR are Groundwater Augmentation (GWA) and Surface Water Augmentation (SWA)[2]. There are currently several State regulations that govern IPR.

The State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW) has specific regulations for Groundwater Replenishment Reuse Projects (GRRPs) included in Title 22. These were last revised in July 2015. There are currently two types of regulated GRRPs: surface application and subsurface application. For surface application, additional treatment can be provided through percolation and dilution of the recycled water with groundwater in the groundwater basin. Subsurface application (injection) of

[1] Source: SDCWA 2016, http://www.sdcwa.org/san-diego-county-water-sources, Accessed 11/8/16.
[2] The terms "surface water augmentation" and "reservoir water augmentation" may be used interchangeably.

recycled water directly into the groundwater basin requires full advanced treatment that includes reverse osmosis (RO) and an advanced oxidation process (AOP).

Regulations for SWA were adopted by SWRCB on March 6, 2018. The new regulations set requirements for the quality of treated recycled water that can be added to a surface water reservoir that is used as a source of drinking water. The regulations also specify the percentage of recycled water that can be added and how long it must reside there before being treated again at a surface water treatment facility and provided as drinking water.

DDW is also developing regulations for Direct Potable Reuse (DPR). DPR is differentiated from IPR based on the absence of an environmental buffer. SWRCB defines DPR as the planned introduction of recycled water either directly into a public water system (Treated Drinking Water Augmentation [TDWA]), or into a raw water supply immediately upstream of a water treatment plant (Raw Water Augmentation [RWA]). No uniform regulations have been established within the State of California or nationally for DPR. However, AB 574 requires SWRCB to establish a framework for the regulation of DPR projects by June 1, 2018 and to adopt uniform water recycling criteria for RWA by 2023. SWRCB published a Draft Proposed Framework for Regulating Direct Potable Reuse in California in April 2018. The two DPR facilities globally that are currently operating (one in Windhoek, Namibia and the other in Big Spring, Texas) have site-specific permits and treatment requirements set forth by regional regulatory agencies.

The following considerations can facilitate the determination of timing and feasibility of various reuse options for EWA:

- There is significant experience with successful non-potable water reuse projects in North San Diego County, which are expected to expand over the next 10 to 20 years and continue providing a well-recognized valuable resource to the community.
- Final regulations allow for confident implementation of IPR projects, supported by decades of successful groundwater recharge project operations in California.
- DPR has been determined to be feasible in California by DDW. Regulations related to RWA are expected by 2023 after further research, expert consultation, and public engagement to ensure the regulations protect public health while increasing drinking water supplies. No timeframe has been established for development of regulations related to TDWA.
- Nationally, there are several established and very successful IPR projects. Some of these projects have been in operation for over 40 years.

ES-3 Stakeholder Involvement Plan (TM 6)

A stakeholder involvement plan was developed early in the project to identify stakeholder activities to be carried throughout the Study. The plan is presented in TM 6. At this stage, EWA has taken a leadership role by developing this Water Reuse Feasibility Study; however, EWA’s role for future work will need to be carefully defined. Although EWA would likely be the producer of recycled water, local water purveyors and others will ultimately control the end beneficial use. Developing the roles and responsibilities of EWA in a large-scale beneficial reuse project is critical to the formation of a business case and structure to implement a project.

The initial outreach activity was directed at EWA Member Agencies through a letter from EWA’s General Manager to each individual Member Agency. The North San Diego Water Reuse Coalition (NSDWRC) was a convenient stakeholder group to approach next because it was already an established structure that included most of the northern San Diego County retail water agencies. In addition, the City of San Diego and San Diego County Water Authority (SDCWA) were included due to their ownership in some of the facilities being considered in the Reuse Study Options.

Several presentations were made to the various stakeholder groups throughout the Study to:

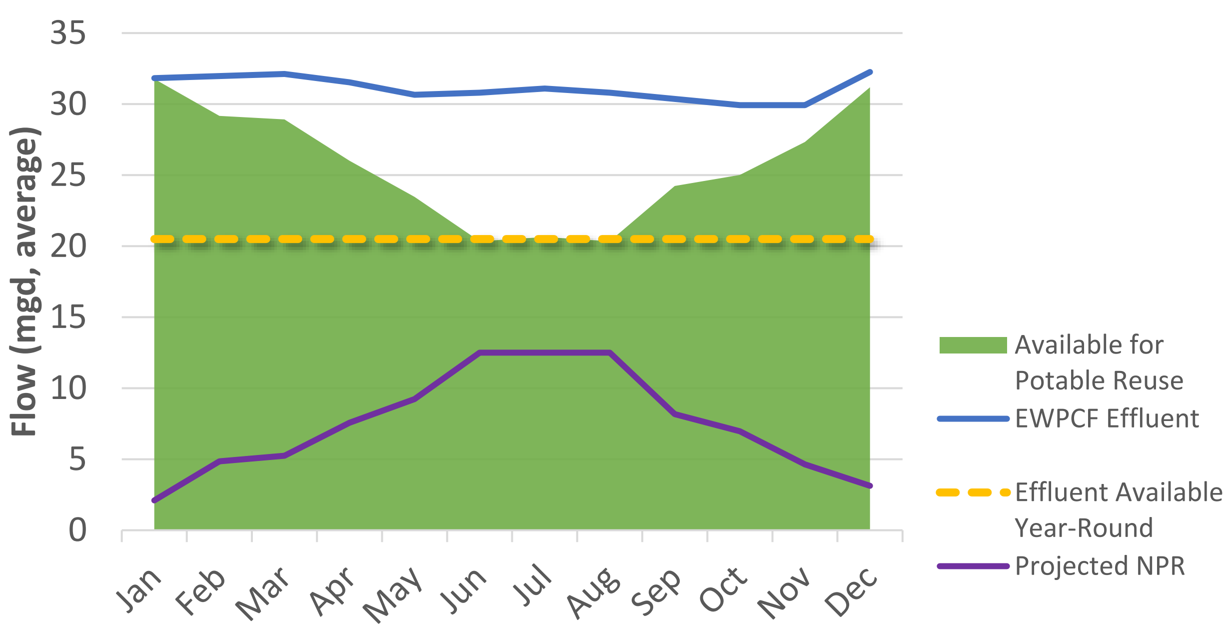
- Obtain feedback from the local water purveyors to develop the best alternatives possible,
- Build on work done by NSDWRC,
- Discuss options for cost responsibility assumptions, ownership of facilities, and permit responsibilities, and
- Seek a consensus through group discussion on the initial screening criteria and the highest ranked alternatives.

ES-4 Portfolio of Options (TM 2)

An update of the future flow projections to the EWPCF was performed as part of the EWPCF Process Master Plan (EWA 2016). This update was deemed necessary because of the significant drop in wastewater flows during the 2011-2016 drought. This analysis resulted in a range of estimated flows by 2040 between 26 mgd and 31 mgd, revised down from previous projections of 40.5 mgd.

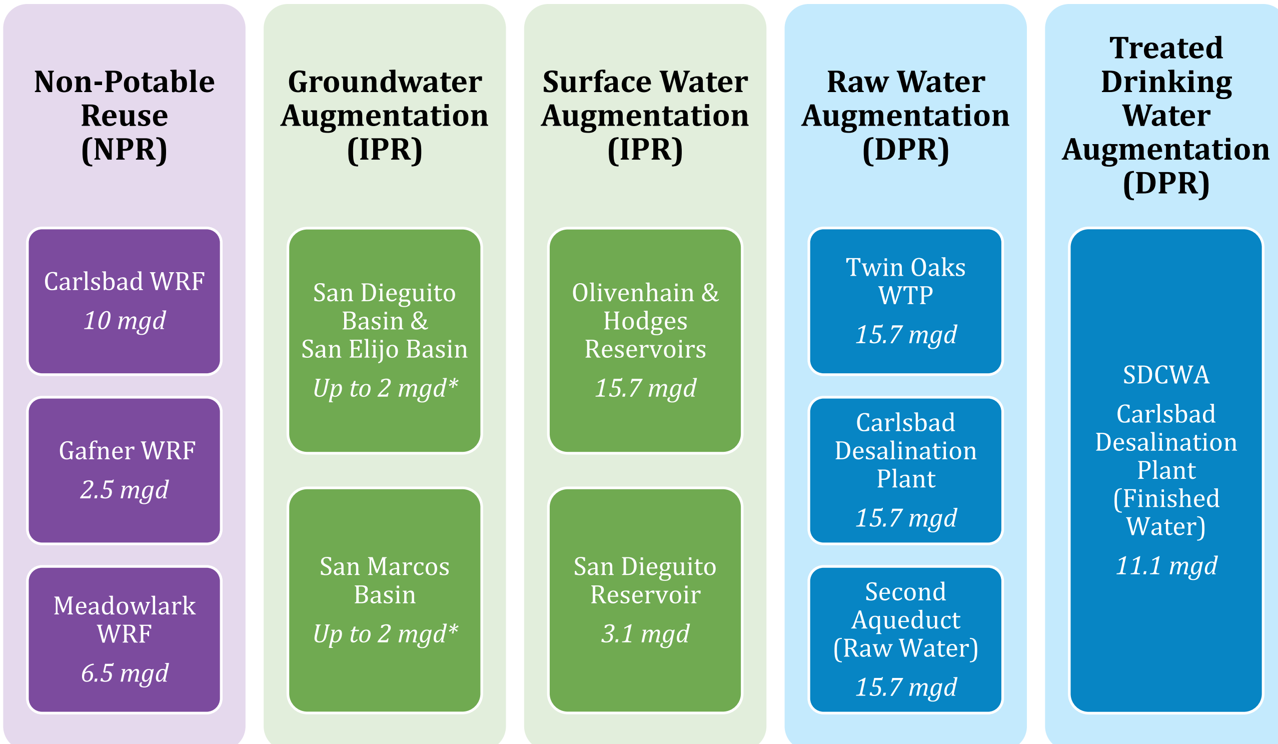
Any new reuse project being considered by EWA must be compatible with other current and planned reuse efforts being undertaken by the EWA Member Agencies. Based on a survey of these agencies, demand of EWPCF effluent for NPR is projected to be as high as 12.5 mgd by 2040, as shown in Figure ES-1**.** This projection includes 10 mgd to supply the City of Carlsbad's Water Reclamation Facility (WRF) and 2.5 mgd to supply Leucadia Wastewater District's Gafner WRF. Assuming reverse osmosis (RO) would be part of the treatment train for all potable reuse projects, approximately 20 mgd is estimated to be available for year-round potable reuse after accounting for projected NPR and RO concentrate losses.

Figure ES-1: Projected 2040 Monthly Flows and Potential for Potable Reuse



TM 2 presents a wide range of opportunities for potable reuse projects within the North San Diego County region. Each potential receptor of EWPCF effluent was categorized by form of reuse—including NPR, GWA, SWA, RWA, and TDWA (Figure ES-2**)**. The initial estimates of potential potable reuse flows account for reserving a baseline of 12.5 mgd for NPR by EWA Member Agencies. The existing regional water and wastewater facilities that may be involved in options for reuse are shown in Figure ES-3.

Figure ES-2: Reuse Opportunities using EWPCF Effluent and Potential Flows



Note: Flows denoted with an asterisk (*) require further evaluation (beyond the scope of this Study) to confirm reuse flows.

Based on the various potable reuse opportunities described in TM 2, nine options were identified as EWA's Portfolio of Options for this Reuse Study, summarized in Table ES-1**,** by combining opportunities considering peak demand requirements. A qualitative set of criteria was developed to allow for an initial screening of the nine options in EWA's Portfolio of Options prior to embarking on a more detailed quantitative evaluation to include capital and operating costs. For each criterion, a weighting factor was assigned and scoring levels were selected based on the expected range and relative impact on project feasibility. The nine options were then screened based on the criteria identified. The five criteria consisted of the following:

- Anticipated regulatory and permitting effort;
- Treatment and engineered storage requirements;
- Operational considerations;
- Conveyance infrastructure needed; and,
- Stakeholder input and potential institutional challenges.

Based on the results from the screening evaluation, the following were identified as the three most favorable options that were carried forward for further analysis to determine the preferred project:

1. Option F: San Dieguito Reservoir (SWA) and CDP Product Water (TDWA) (Ranked 3rd)
2. Option G: San Dieguito Reservoir (SWA) and Second Aqueduct (RWA) (Ranked 1st)
3. Option H: Second Aqueduct (RWA) and San Marcos Basin (GWA) (Ranked 2nd)

Figure ES-3: Regional Context for Reuse Project and Potential Receptors of EWPCF Effluent

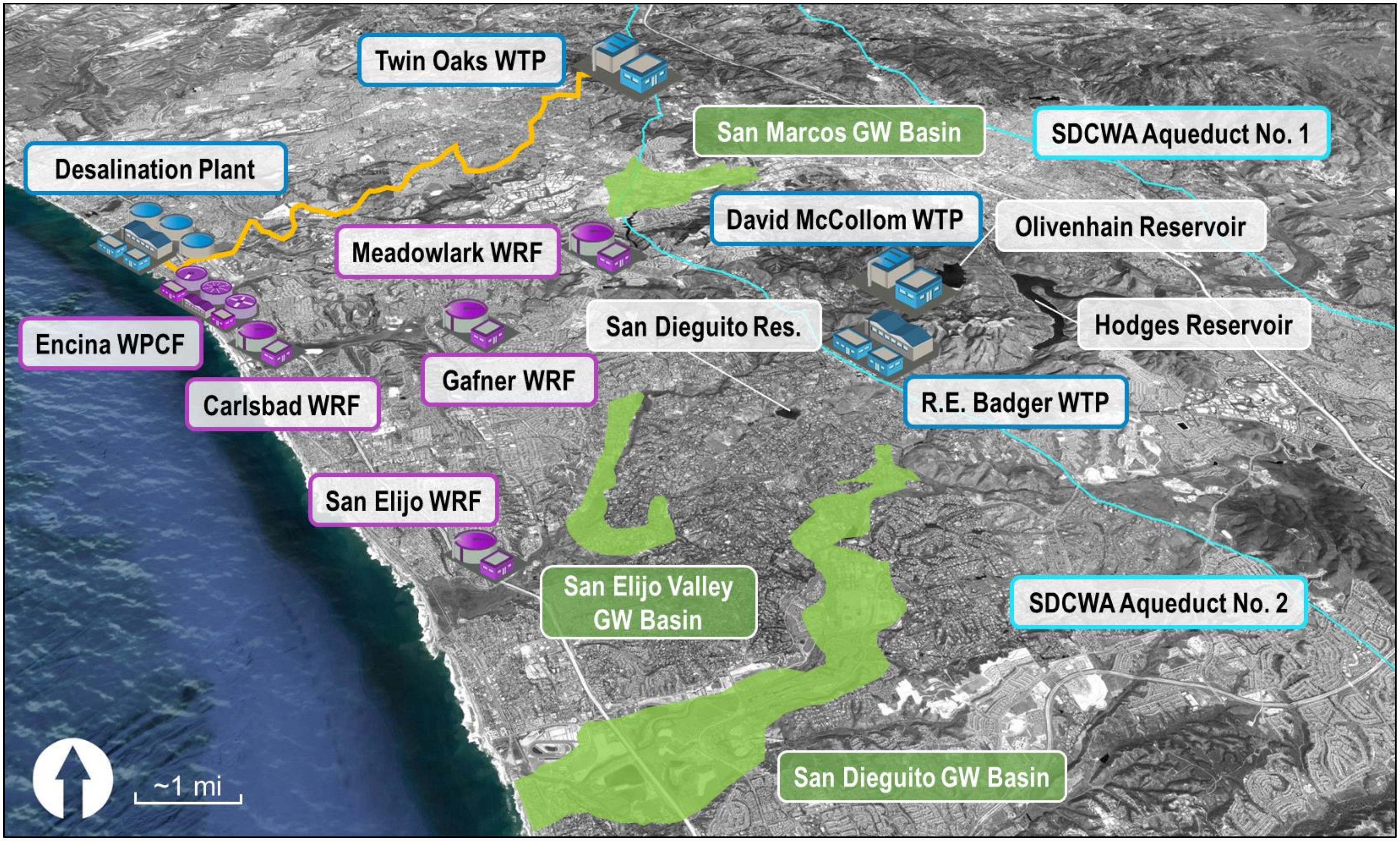


Table ES-1: Portfolio of Options Summary

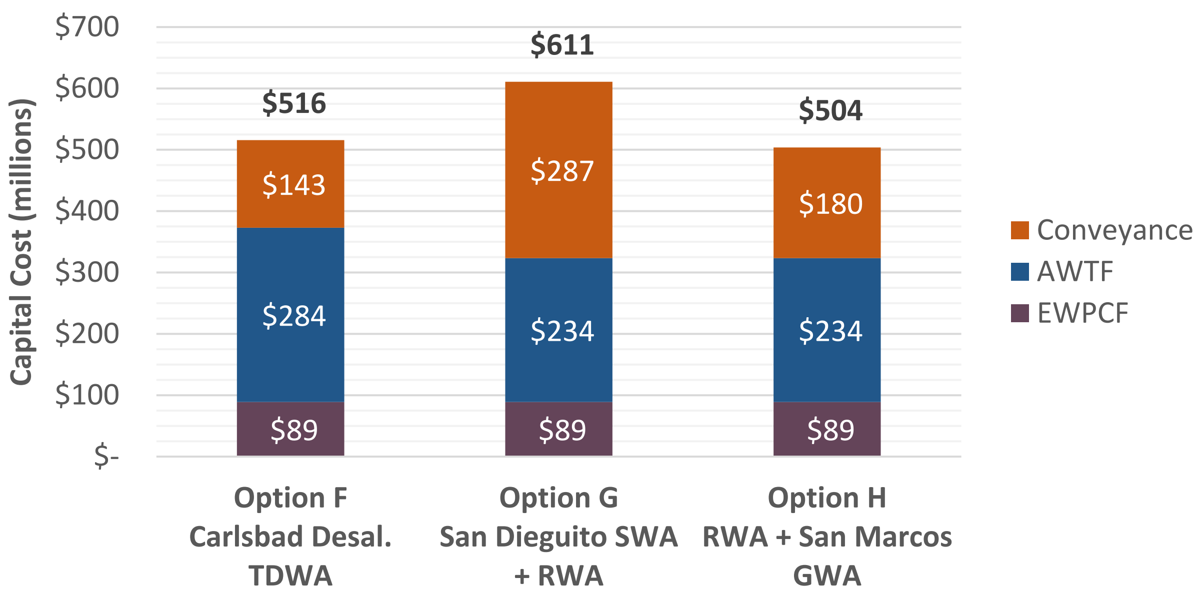
Option ID	Option Description	Projected 2040 Peak Production (mgd)								Total Potable Reuse (mgd)	Total Reuse (mgd)
		NPR	IPR			DPR		Ocean Disposal			
		Recycled Water	Ground-water	Large Res.	Small Res.	Source Water	Treated Water	SE	Brine		
A	Carlsbad Desalination Plant (CDP) Influent	12.5	-	-	-	11.1	-	0	7.4	11.1	23.6
B	CDP Product Water	12.5	-	-	-	-	15.7	0	2.8	15.7	28.2
C	Olivenhain Reservoir	12.5	-	15.7	-	-	-	0	2.8	15.7	28.2
D	San Dieguito Reservoir + Olivenhain Reservoir	12.5	2.0	10.6	3.1	-	-	0	2.8	15.7	28.2
E	San Dieguito Reservoir + CDP Influent	12.5	2.0	-	3.1	7.5	-	0	5.9	12.6	25.1
F	San Dieguito Reservoir + CDP Product Water	12.5	2.0	-	3.1	-	10.6	0	2.8	15.7	28.2
G	San Dieguito Reservoir + 2nd Aqueduct (Raw)	12.5	2.0	-	3.1	10.6	-	0	2.8	15.7	28.2
H	Second Aqueduct (Raw) + San Marcos Basin	12.5	2.0	-	-	13.7	-	0	2.8	15.7	28.2
I	Twin Oaks WTP Influent + San Marcos Basin	12.5	2.0	-	-	13.7	-	0	2.8	15.7	28.2

ES-5 Preferred Project Identification (TM 3)

In TM3, the three highest ranked project options are evaluated based on unit cost and non-cost factors including potential implications to EWPCF operations, advanced treatment requirements, anticipated timeframe for regulatory acceptance, project implementation timeline, and expected stakeholder support. The capital costs for the three options are summarized under three main categories and are shown on Figure ES-4:

- **EWPCF Treatment Improvements:** consisting primarily of primary effluent flow equalization, aeration basin retrofits for nitrification-denitrification, increased secondary clarifier capacity, and addition of tertiary filtration.
- **Advanced Water Treatment Facility (AWTF):** development of a new treatment facility on EWA's South Parcel to provide a level of treatment based on current and/or expected regulations that is protective of human health and can be achieved with available technologies.
    - **Option G for SWA** would require an AWTF providing full advanced treatment (FAT) consisting of membrane filtration (MF/UF), reverse osmosis (RO), and an ultraviolet light/advanced oxidation step (UV/ AOP).
    - In addition to an AWTF providing FAT, **Option H** and **Option G for RWA** would also require ozonation (O_3) with BAF as pretreatment before UF to provide further pathogen removal and enhanced water quality.
    - In addition to an AWTF providing FAT with O_3/BAF, **Option F for TDWA** would require further treatment by a tailored Water Treatment Plant (WTP) consisting of an Engineered Storage Buffer (ESB) with chlorination (Cl_2) and a high-flux UF system. This treatment train is anticipated to be required for integration with the potable water system.
- Conveyance Concepts: based on a preliminary hydraulic evaluation, the approximate conveyance pipe sizes, pressure requirements, pumping requirements, and alignment options were determined to convey the advanced treated water from the proposed AWTF to the receptor(s) associated with each option.

Figure ES-4: Capital Cost Summary for Options F, G, and H

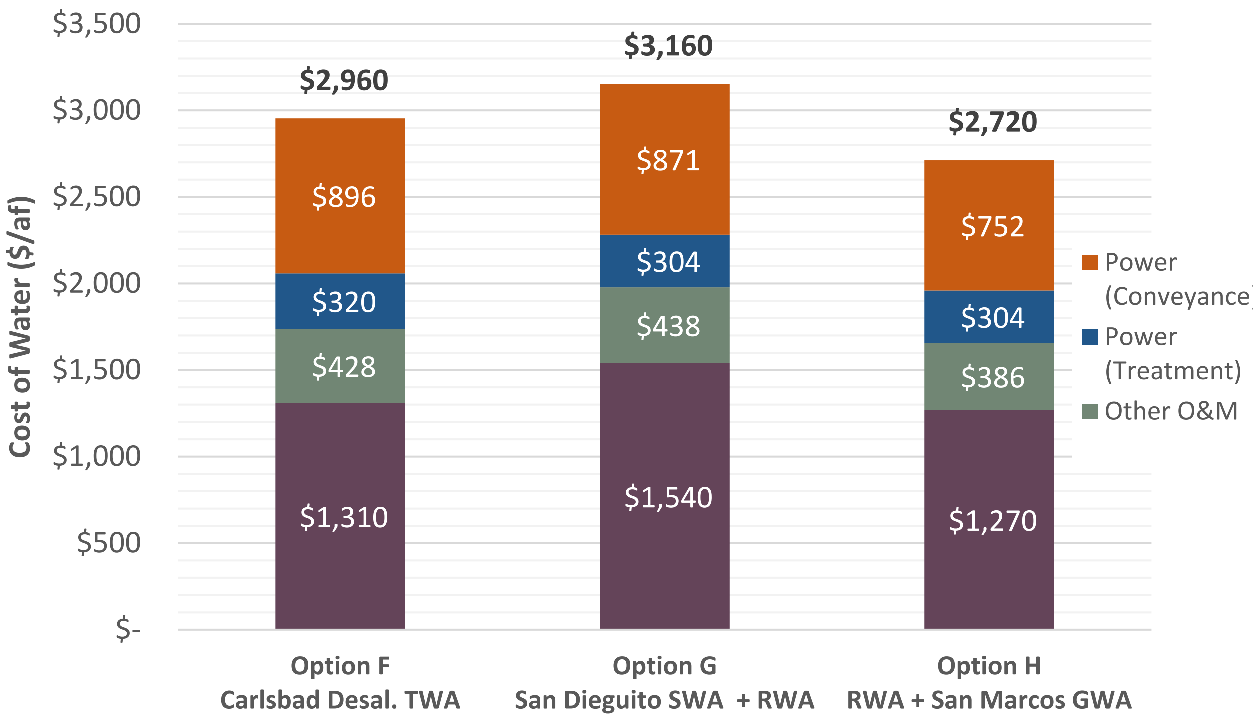


The annual O&M costs are summarized for the three options under the following categories:

- Power for treatment (including both the incremental power requirements at the EWPCF and the requirements for the AWTF)
- Power for conveyance (pumping)
- Other O&M costs: this includes equipment rehabilitation/replacement, consumables (across all improved and new facilities), and labor for the AWTF and the conveyance system (pipeline and pump station maintenance)

Unit costs for water produced were developed for each option, including O&M costs plus annualized capital costs, to assist with identification of the preferred project option (see Figure ES-5**)**.

Figure ES-5: Unit Cost Summary for Options F, G, and H



Note: Annualized capital costs assume 100% financing at a 2.0% annual interest rate over a 30-year term.

In evaluating the relative merits of the three options, the following criteria were considered in selecting the preferred option (as summarized in Table ES-2):

- Unit Cost of water
- Likely timeframe for regulatory acceptance and project implementation
- Complexity of operations and compliance
- Anticipated stakeholder support

Table ES-2: Summary of Key Considerations for EWA's Potable Reuse Options

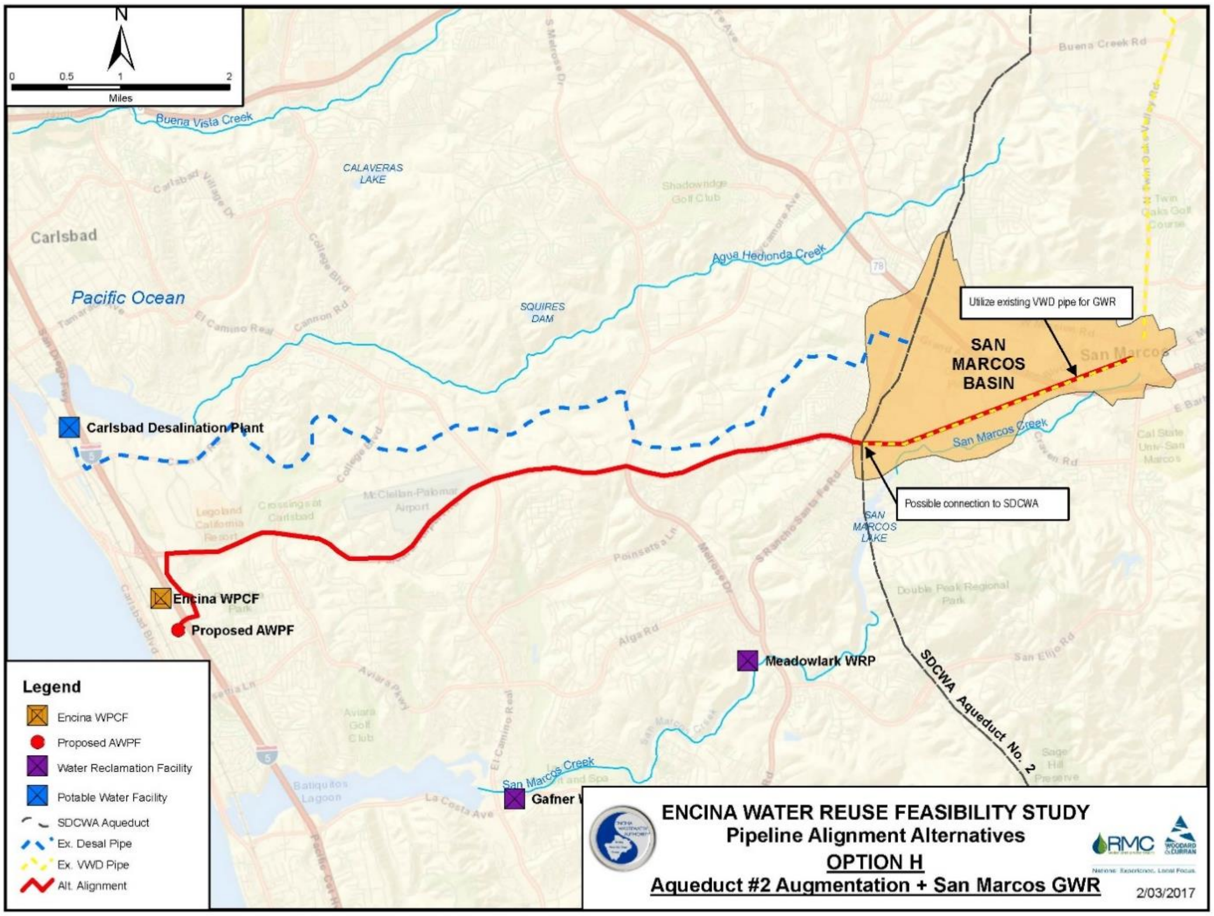
	Option F: Carlsbad Desal, TDWA	Option G: San Dieguito SWA + RWA	Option H: RWA + San Marcos GWA
Cost of Water (at 20.5 mgd influent)	\$2,960/af	\$3,160/af	\$2,720/af
Time to Implement	15-20+ years	10-15 years	10+ years
Regulatory Considerations	Timeframe uncertain	Expected by 2023	Expected by 2023
Complexity of Operations & Compliance	AWTF + ESB + Blending & Pumping at CDP	AWTF + Up to three forms of potable reuse (reservoir + groundwater + raw water)	AWTF + Up to two forms of potable reuse (raw water + groundwater)
Key Stakeholders	SDCWA, Poseidon	SEJPA, SDWD, SFID, OMWD, SDCWA	Vallecitos, SDCWA

Based on the considerations identified in Table ES-2**,** Option H was selected as the Preferred Project for further refinement under this Study. Relative advantages include lower cost of water than Options F and G, an earlier timeframe for implementation considering the regulatory requirements and coordination required with other key stakeholders, and simpler operations. EWPCF tertiary effluent would undergo advanced water treatment to produce water suitable for RWA. The facilities required for the RWA portion of the Preferred Project would include:

- Upgrades to the EWPCF, including primary effluent flow equalization, conversion of the secondary process to nitrification-denitrification and tertiary filters for the flow directed to the AWTF.
- AWTF (FAT with O_3 + BAF) that produces up to 16 mgd of advanced treated recycled water
- Pump station and conveyance pipeline to the SDCWA Second Aqueduct, Pipeline No. 5.

If, under Option H, Vallecitos Water District (VWD) pursues GWA in the San Marcos groundwater basin (within its service area), additional facilities required include two groundwater injection wells, conveyance pipeline to the injection wells, and two groundwater extraction wells with wellhead treatment (note that costs for these facilities are included in Figure ES-5 above). Because the GWA project facilities would be downstream of the connection point to the SDCWA Aqueduct (see conceptual alignment in Figure ES-6 below), the water for GWA would be treated to the same standards as for RWA.

Figure ES-6: Conceptual Pipeline Alignment for Option H



ES-6 Project Phasing (TM 4)

TM 4 presents the approach to phasing the implementation of the Preferred Project. This TM provides the initial recommendations for the secondary improvements and advanced treatment facilities, evaluation of AWTF size and future expansion capability, and a framework implementation plan and schedule.

The recommended phased approach consists of improvements to the EWPCF and construction of a new 16 mgd AWTF for potable reuse, using the treatment train shown in Figure ES-7. This would require a total area of approximately 286,100 ft^2 (6.6 acres) for the AWTF alone, in addition to the other facilities shown on Figure ES-8. A future expansion phase could increase the production to 25 mgd depending on flows available, with the AWTF footprint increasing to approximately 8.9 acres. Therefore, it is recommended to reserve adequate space on EWA's South Parcel to accommodate the expanded footprint within the 22.9 acres currently available.

Figure ES-7: Proposed AWTF Treatment Train for RWA

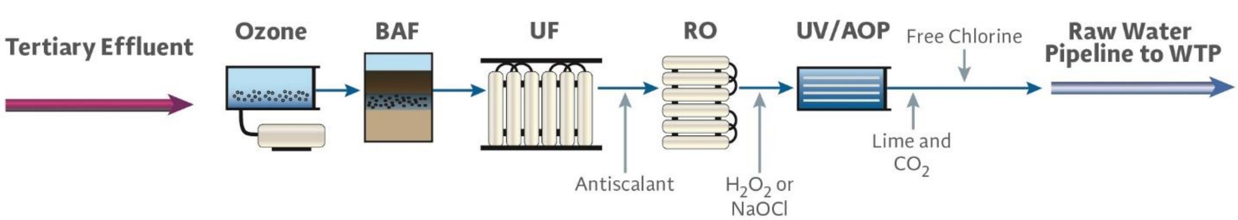


Figure ES-8: EWRFS Project Treatment Facilities Footprint (16 mgd RWA)

1. CIP
2. LOX
3. Maintenance Building
4. Administrative Building
5. Electrical Rooms
6. UV System
7. CO_2
8. Lime
9. Chemical Feed System/Storage
10. Electrical Building

Excluding the GWA aspect, the initial phase of the Preferred Project at 16 mgd product water (20.5 mgd influent, minus brine losses) has a capital cost of $481m and annual operations and maintenance cost of $22m. The Preferred Project's annualized cost over 30 years equates to $2,450/AF, as summarized in Table ES-3.

Table ES-3: Cost Summary for Option H at 16 mgd

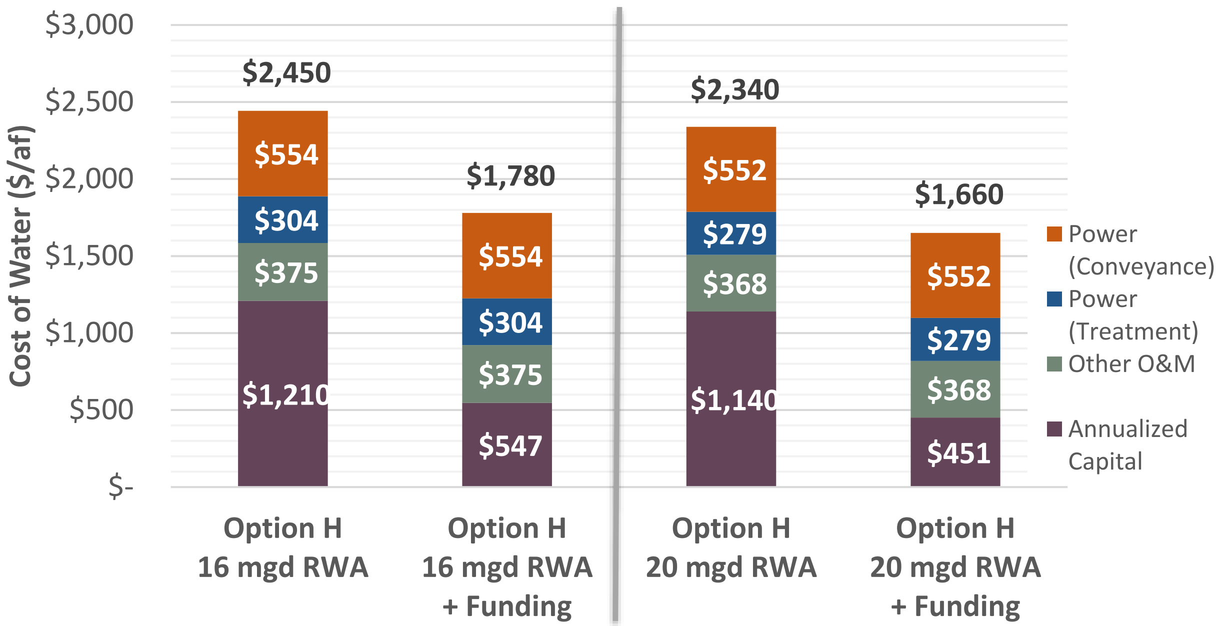
Option H: RWA to Second Aqueduct (16 mgd)	Cost	Notes
EWPCF Secondary Improvements	$89,000,000	at 31 mgd flow rate
Advanced Treatment (FAT + O3/BAF)	$234,400,000	at 20.5 mgd influent rate
Conveyance - East	$157,000,000	at 20.5 mgd influent rate
Total Capital Cost	**$480,400,000**	
Annual O&M Costs		
Power - Treatment (EWPCF + AWTF)	$5,403,000	24/7/365 operations
Power - Conveyance	$9,864,000	24/7/365 operations
Equipment Rehabilitation/Replace, Consumables	$5,537,000	All new facilities (incl. EWCPF)
Labor	$1,134,000	AWTF + Conveyance
Total Annual O&M Cost	**$21,938,000**	
Cost of Water		
Annualized Capital Cost	$21,450,000	2.0% rate, 30-yr term
Total Annual Cost	**$43,388,000**	for first 30 years
Annual Yield	**17,800**	acre-feet
Unit Cost of Water	**$2,450**	per acre-foot

Unit Cost of Water Sensitivity Analysis

The unit cost of water for Option H were initially developed based on reserving 12.5 mgd year-round for NPR by EWA Member Agencies, assumes there is no outside funding and it includes the VWD GWA project facilities. A sensitivity analysis (Figure ES-9) of the unit costs, excluding the GWA project facilities (i.e., RWA project only), was developed considering the following:

- Amount of water reserved for NPR water reduced to 8.0 mgd (more likely), resulting in an increased RWA project yield of 20 mgd (vs. 16 mgd baseline)
- Inclusion or exclusion of potential funding opportunities, including 20 percent outside funding and production incentives (local rebates) that would reimburse the participating agencies $500 per acre-foot for the first 25 years of operation.

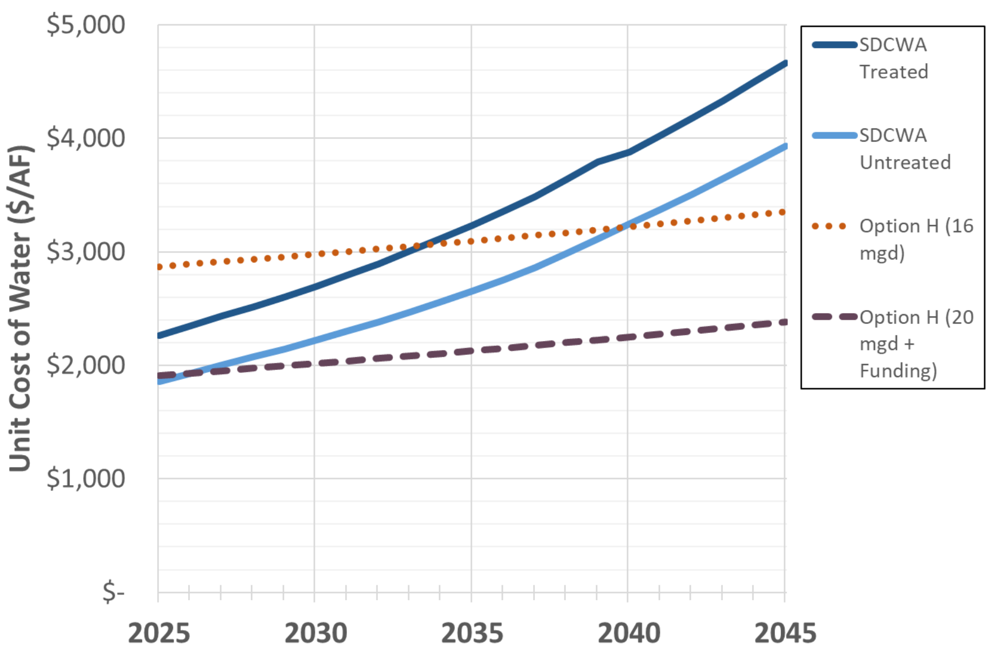
Figure ES-9: Sensitivity of Unit Costs with Increased Water for RWA and Outside Funding[1]



Note: Costs shown are based on Option H excluding GWA by VWD.

The anticipated cost of untreated (raw) water purchased from the SDCWA between 2025 and 2045 is shown in comparison with the projected range of costs for Option H on Figure ES-10. The range of costs for Option H as shown are with capital costs inflated at 2.5 percent per year and O&M cost escalated at 1.5 percent annually. As can be seen from Figure ES-10, the projected cost of water derived from Option H would match the cost of untreated SDCWA water by 2040 or earlier depending on flow available and level of outside funding.

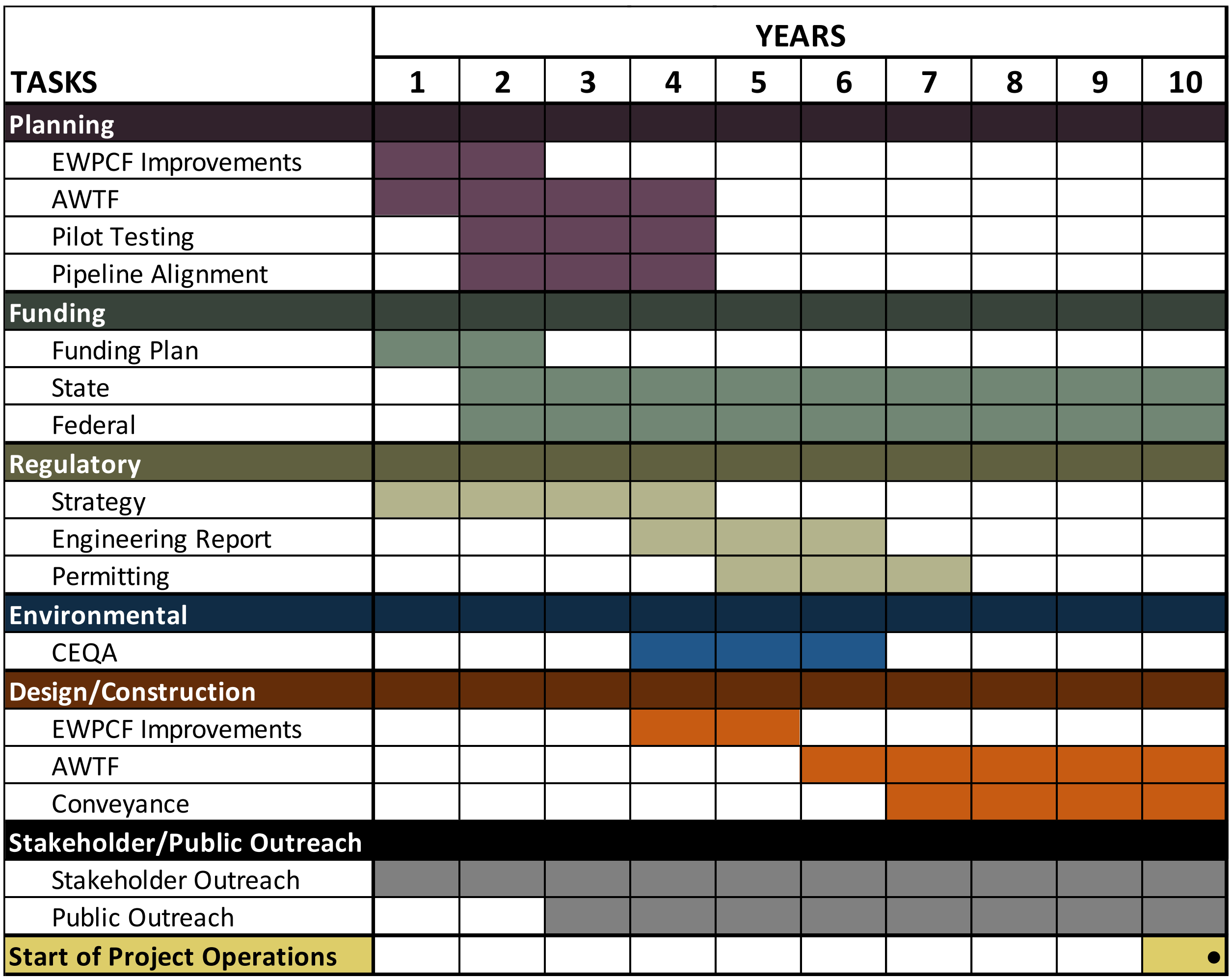
Figure ES-10: Comparative Cost of Water for Option H and Regionally Available Alternatives



Implementation Schedule

Additional planning, pilot studies, environmental review, public outreach and regulatory coordination are needed to refine the selected Preferred Project concept and verify economics. In addition, regulations related to RWA are not expected until at least 2023 after further research is completed. By laying out an implementation schedule for the initial phase of the Preferred Project, it was estimated that steady progress toward implementation would require approximately 10 years until the start of project operations (Figure ES-11).

Figure ES-11: Implementation Schedule for EWA's Potable Reuse Project (Phase 1)



ES-7 Funding Opportunities (TM 5)

TM 5 identifies local, state, and federal funding opportunities for the Project, including funding program objectives, eligibility criteria, cost share requirements, and activities that could be funded based on funding programs that existing today. It is likely that in the future additional funding programs may be available. Five of the funding programs described in TM 5 were determined to be the most applicable to EWA's water reuse project and were ranked as shown in Table ES-4.

Table ES-4: Funding Program Ranking

Rank	Program	Explanation
1	**SWRCB Water Recycling Funding Program (WRFP)**	WRFP planning grant funds are currently available and could support development of a Feasibility Study with up to $75,000 at a 50% match.
2	**San Diego Integrated Regional Water Management (IRWM) Program**	IRWM funding is a strong option because the competition occurs at the regional scale, where local water agency partners can be an advocate for the EWA Project. Planning activities can be paired with other “shovel-ready” capital projects to secure grant funding (using the capital project costs as match) or phased to allow for work to proceed in stages.
3	**USBR Water Infrastructure Improvements for the Nation (WIIN) Program**	WIIN funding could be used to fund planning, design, and/or construction of all potential project components. Construction activities can be phased to pursue construction of different components of the Project in each 2-year funding cycle until the $20 million grant is achieved.
4	**SWRCB Clean Water State Revolving Fund (SRF) Loan Program**	EWA and partnering agencies would likely qualify for low-interest financing through the Clean Water SRF Program, which would cover construction activities up to the full project cost. Extensive application materials are necessary, including completion of CEQA and all permits.
5	**MWD Local Resources Program (LRP) / SDCWA Local Water Supply Incentive Program (WSIP)**	The LRP and LWSIP are likely to become available to SDCWA member agencies again; however, the timeline or availability of funds is uncertain. Further, these funds only apply to the cost of delivered water, so they may only be awarded after all construction and start-up activities are complete.

Several water supply agencies within the region have capitalized on multiple grant and loan programs. In the near-term, pursuit of the SWRCB’s Water Recycling Funding Program and the San Diego Integrated Regional Water Management Program grants could provide funding for further planning activities. In the long-term, the Federal Water Infrastructure Improvements for the Nation, State Revolving Fund Program, and MWD’s Local Resource Program / SDCWA’s Local Water Supply Development funding should be pursued if available. To increase the chances of receiving funding for any future phases of EWA’s water reuse project, it is recommended that EWA and any partnering agencies pursue all funding options available.

ES-8 Conclusions and Next Steps

EWA’s wastewater flows and facilities represent a unique opportunity and a centralized location for large-scale production of recycled water that could capture economies of scale to the benefit of the region. EWA’s experience in water treatment and water quality may well make it suitable to take on the responsibility for the AWTF required for potable reuse. The presence and available capacity of a deep ocean outfall is conducive to siting the AWTF near the EWPCF for disposal of reject streams.

Demand for non-potable reuse in the region is not projected to be sufficient to fully utilize the available effluent at the EWCPF, especially considering the seasonal nature of irrigation demands. Therefore, potable reuse would be necessary to minimize discharges of EWPCF effluent to the Pacific Ocean. Although the cost of water estimated for EWA’s RWA option is higher than current SDCWA untreated water rates (like other recycled water projects being implemented in the region), SDCWA’s costs are projected to rise over time and EWA’s RWA project may become cost-competitive by the time it could begin delivering water in the mid to late 2020s.

Because the production of a new water supply by EWA is not required to comply with its NPDES permit or any other state or federal requirement, the cost of the RWA option beyond wastewater treatment and disposal would be the responsibility of water purveyors. As such, future planning and implementation activities should be pursued on a cost share basis with participating local and regional water suppliers. However, it should be noted that the draft Amendment to the Recycled Water Policy released by the SWRCB on May 9, 2018 identified the following:

- Goal: Increase the use of recycled water from 714,000 afy in 2015 to 1.5 million afy by 2020 and to 2.5 million by 2030.
- Goal: Minimize the direct discharge of treated municipal wastewater to […] ocean waters, except where necessary to maintain beneficial uses. Under this goal, treated municipal wastewater does not include brine discharges from recycled water facilities or desalination facilities.
- The State Water Board will evaluate progress toward these goals and revise the goals or establish mandates as necessary.

As reflected by the RWA project Implementation Schedule (Figure ES-11), the activities identified during the initial phases of the project are focused on:

- Identifying the potential impacts on the EWPCF.
- Refining the design criteria for the AWTF and pilot testing.
- Strategizing the approach to defining the regulatory requirements for RWA.
- Developing a funding plan to maximize the opportunities for outside funding.
- Determining a likely corridor for the conveyance pipeline to the SDCWA raw water pipeline.

If EWA’s Board of Directors authorizes staff to continue planning and permitting activities beyond this Study, future stakeholder outreach should focus on developing a formal partnership with the water purveyor(s) that would use the purified raw water produced from EWPCF effluent. The cost of the initial activities identified in the implementation schedule could be shared by local and regional water purveyors interested in continuing to refine the costs and partnering on the project.

Defining EWA’s role after the Feasibility Study will be key to any implementation plan of wider reuse of EWA’s valuable water resources. EWA should invite continued discussions with its potential partners (retail water agencies), and the next steps could also involve significant policy and financial deliberations by its Board and Member Agencies.

Attachment 1 - TM1: Background of Potable Reuse in California

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Technical Memorandum No. 1

EWA Water Reuse Feasibility Study

Subject: **Background of Potable Reuse in California**

Prepared for: Encina Wastewater Authority

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Date: July 2018 (Draft issued: November 2016)

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1 Introduction

1.1 Feasibility Study Background

As required by the Encina Wastewater Authority (EWA) 2020 Business Plan, this Water Reuse Feasibility Study (Study) identifies a path to maximize beneficial reuse of effluent from the Encina Water Pollution Control Facility (EWPCF)—which by 2040 is projected to reach an average of approximately 31 million gallons per day (mgd).

Within the context of potable reuse in California, the Study's focus was on developing of a broad portfolio of options for reuse projects using EWPCF effluent; screening the portfolio down to a short list for feasibility evaluation and conceptual cost analysis; identifying a preferred reuse project and phasing approach for implementation; determining applicability and timing of potential funding opportunities; preparing a stakeholder involvement plan; and coordinating with EWA's Member Agencies and other stakeholders to engage with the Study development and recommendations. Ultimately, the Study is intended to serve to advance EWA's mission of resource recovery and contribute to sustaining and enhancing the region's water environment.

1.2 Objectives

The purpose of this Technical Memorandum (TM) is to present a brief background on non-potable water reuse and potable water reuse in California, review select potable water reuse projects nationally, and provide regional context for the portfolio of water reuse options to be developed in this Study. The TM is organized as summarized below:

- **Water Reuse Regulatory Setting:** For each form of water reuse, this section provides a summary of the regulatory status in California.
- **Non-Potable Water Reuse in North San Diego County:** this section presents a summary of recycled water facilities operating in the region and their plans for expansion, with particular focus on the facilities that currently utilize EWPCF effluent.
- **Potable Water Reuse Case Studies:** a summary of indirect potable reuse (IPR) and direct potable reuse (DPR) projects in California and elsewhere that are in operation or advanced planning stages—where possible, focusing on projects in the region that may be most relevant to EWA.
- **Conclusions:** the final section presents conclusions regarding the feasibility of the various forms of water reuse, along with a discussion of challenges and lessons learned from other successful water reuse projects that can be applied to EWA's Study.

2 Water Reuse Regulatory Setting

2.1 Non-Potable Reuse

Non-potable reuse (NPR) can be a vital component of a diverse water supply portfolio. In Southern California, non-potable reuse systems often serve to offset imported water by providing recycled water for irrigation demands. This is an important function, particularly in semi-arid San Diego County where approximately 84 percent of the water supply is imported from hundreds of miles away via the State Water Project and the Colorado River Aqueduct[1]. However, NPR does have limitations compared to potable water reuse. These include the fact that non-potable water has limited applications due to its quality; the cost of constructing, operating, and maintaining dedicated "purple pipe" infrastructure in parallel with potable water infrastructure; and the limited ability to maximize use given the seasonal nature of irrigation demands.

In California, Title 22 Code of Regulations related to recycled water establishes the treatment requirements for recycled water and the approved uses based on the level of treatment. Title 22 defines four classifications of recycled water, which are determined by the level of treatment process, virus removal achieved, total coliform (TC) bacteria, and turbidity levels. The four classifications of non-potable recycled water that are currently permitted by the State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW) under Title 22 §60304 are summarized in Table 1 (SWRCB DDW, 2015).

Table 2-1: California Recycled Water Classifications

Treatment Level	Approved Uses	Total Coliform (TC) Standard (median)
Disinfected Tertiary Recycled Water	Spray Irrigation of Food Crops Landscape Irrigation(1) Non-restricted Recreational Impoundment	2.2 MPN/100 mL(4)
Disinfected Secondary-2.2 Recycled Water	Surface Irrigation of Food Crops Restricted Recreational Impoundment	2.2 MPN/100 mL
Disinfected Secondary-23 Recycled Water	Pasture for Milking Animals Landscape Irrigation(2) Landscape Impoundment	23 MPN/100 mL
Undisinfected Secondary Recycled Water	Surface Irrigation of Orchards and Vineyards(3) Fodder and Fiber Crops and Pasture for non-Milking Animals	N/A

Footnotes:

(1) Includes unrestricted access golf courses, parks, playgrounds, school yards, and other landscaped areas with similar access.
(2) Includes restricted access golf courses, cemeteries, freeway landscapes, and landscapes with similar public access restrictions.
(3) No fruit is harvested that has come in contact with irrigation water or the ground.
(4) In addition to the TC requirements, disinfected tertiary recycled water must also meet the following criteria:
    a. Filtered such that this water does not exceed: an average of 2 NTU within a 24-hour period; 5 NTU more than 5 percent of the time within a 24-hour period; and 10 NTU at any time (Title 22 §60301.320).
    b. Disinfected by one of the two following methods:
        - Chlorine disinfection with a minimum product of chlorine residual (C) and contact time (t), or Ct, of 450 mg-min/L with a modal contact time of at least 90 minutes, or
        - An alternative disinfection process, that, when combined with the filtration process, has been demonstrated to inactivate and/or remove 5-log virus (Title 22 §60301.230).

[1] Source: SDCWA 2016, http://www.sdcwa.org/san-diego-county-water-sources, Accessed 11/8/16.

2.2 Indirect Potable Reuse

Indirect Potable Reuse (IPR) is the incorporation of tertiary or advanced treated recycled water into the water supply system after storage in an environmental buffer such as an aquifer or a reservoir. There are currently several State regulations that govern the use of IPR, as described in the following sections.

2.2.1 Groundwater Augmentation

DDW has promulgated regulations for Groundwater Replenishment Reuse Projects (GRRPs) in Title 22, which were last revised in July 2015. There are currently two types of regulated GRRPs: surface and subsurface application. General requirements for groundwater augmentation (GWA) are listed in Table 2.

Table 2-2: Criteria for Potable Reuse via Groundwater Augmentation

Selected Parameters	Criteria
Pathogenic Microorganisms	
Enteric virus	12-log reduction
Giardia cyst	10-log reduction
Cryptosporidium oocyst	10-log reduction
Chemicals	
Total Organic Carbon (TOC)	Maximum 0.25 mg/L in 95% of samples within first 20 weeks Maximum 0.5 mg/L in 20-week running average
1,4-Dioxane	0.5-log reduction in the advanced oxidation process (2)
Total Nitrogen (TN)	10 mg/L maximum

Notes:
(1) Log reductions are from the point of raw wastewater to the point of finished water for drinking.
(2) Requirement for 1,4-dioxane removal applies to subsurface application (i.e., injection) projects only.

Surface Application (Spreading)

For surface application, additional treatment is provided through percolation and dilution of the recycled water with groundwater in the groundwater basin. Surface spreading projects can use tertiary recycled water if treatment through the soil ("soil aquifer treatment") is shown to be sufficient. Regulations establish that surface application projects can use up to 20 percent of recycled water initially and 80 percent of other acceptable dilution water, as long as the specific recycled water contribution of TOC in the blended water is below the values listed in Table 2. Per the regulations, "acceptable dilution water" is a water that meets drinking water standards. If only tertiary water is used, the recharge water should remain in the groundwater basin for a minimum of six months to meet the retention time target based on tracer tests or conservative hydraulic modeling.

Subsurface Application (Injection)

Subsurface application (injection) of recycled water directly into the groundwater basin requires full advanced treatment that includes reverse osmosis (RO) and an advanced oxidation process (AOP). Under these conditions, no dilution water is required. Additionally, a minimum of two months of subsurface travel time is required before extraction for potable use. These two months provides "Response Retention Time" (RRT), which provides time to monitor water quality and respond to water quality concerns.

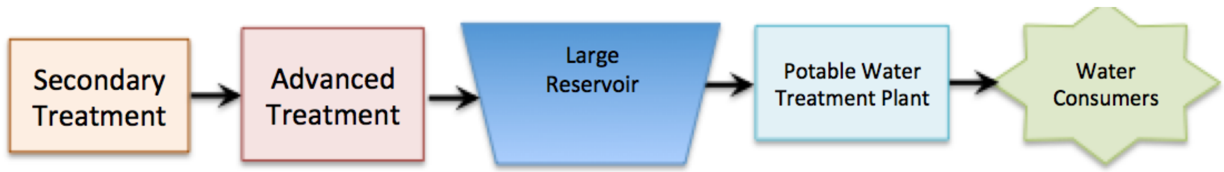
Direct injection projects have less room for innovation on the treatment train due to the close connectivity between the injected water and the extraction wells. Cost savings have been realized by using alternative

AOP systems, including the City of Los Angeles' new (12 mgd) ultraviolet light (UV) AOP that uses sodium hypochlorite (NaOCl) instead of hydrogen peroxide (H_2O_2) as the oxidant.

2.2.2 Surface Water Augmentation

State Bill 918 required DDW to develop and promulgate regulations for surface water augmentation (SWA), which were adopted on March 6, 2018. SWA projects are similar to GRRPs in that they also use an environmental buffer in between treatment and distribution; however, for SWA, the buffer is provided by a reservoir ahead of an existing surface water treatment plant. The following discussion is based on early drafts of the regulations (released in 2015) made available as a result of the dialogue between the Expert Panel and DDW. Key elements of the SWA regulations include pathogen and chemical control at the advanced water treatment facility (AWTF) and retention time and dilution requirements in the reservoir.

Figure 2-1: SWA Project Schematic Process Flow Diagram



The following are key requirements for SWA:

1. **Advanced Treatment -** The SWA regulations require full advanced treatment of the recycled water prior to delivery to the surface water reservoir. An advanced treatment train for SWA must include reverse osmosis (RO) and oxidation that achieves at least 0.5-log reduction of 1,4-dioxane.

2. **Dilution Requirement -** The SWA regulations stipulate dilution requirements for recycled water discharged into the reservoir. The basis of these requirements is that *any 24-hour input of recycled water* to the reservoir must be mixed such that water withdrawn for use as drinking water will never contain more than 1% of this input (or 10% with an additional log of pathogen treatment). The intent of this requirement is to provide a buffer against off-specification water that enters the reservoir; pathogen concentrations will be reduced by 2 logs, either through 100:1 dilution or 10:1 dilution with 1-log treatment (see pathogenic microorganism control requirements discussion below for log removal requirements).

   To demonstrate compliance with this requirement, the regulations require hydrodynamic modeling that verifies the ability of the reservoir to meet this requirement under all conditions, as well as completion of a tracer study with added tracer prior to the end of the first six months of operation. The achievable dilution of a 24-hour input can be estimated using a simplifying assumption of complete mixing in the reservoir. Under this assumption, dilution is related to the theoretical retention time (τ) and the duration of the input (Δt):

   $$\text{dilution factor} = \tau / \Delta t$$

3. **Retention Time -** The SWA regulations continue to incorporate the concept of retention time, albeit taking into account the differences in hydrodynamics between an aquifer and a reservoir. The regulations currently available stipulate that a reservoir used for SWA must have a minimum theoretical retention time (τ) of 180 days, to be measured on a monthly basis as follows:

   $$\tau = \frac{V_{total}}{Q_{out}} \geq 180\ days$$

   where V_{total} is the volume in the reservoir at the end of the month and Q_{out} is the total outflow from the reservoir during that month. The regulations include a permitting pathway for projects where the V/Q is at least 60 days (i.e., within the "gap" between SWA and DPR—which is expected to include projects with V/Q of less than 60 days).

4. **Pathogenic Microorganism Control -** The treatment requirements in the SWA regulations look very similar to those for a GRRP, particularly with regard to pathogenic microorganism control. If at least a 100:1 dilution is achieved in the reservoir, then the log removals for enteric virus, *Cryptosporidium*, and *Giardia* are the same as in the GRRP regulations. If less than 100:1 but at least 10:1 is dilution achieved in the reservoir, then an additional 1-log of pathogen treatment is required by an additional process. If there is less than 10:1 dilution available in the reservoir, then the project will likely be considered immediately upstream of a drinking water treatment plant and will be defined as DPR (see Section 0 below for more details). Table 3 illustrates the required removal criteria for enteric virus, *Cryptosporidium*, and *Giardia*.

Table 2-3: SWA Pathogenic Microorganism Control

Dilution	Enteric Virus Removal	*Cryptosporidium* Removal	*Giardia* Removal
Dilution ≥ 100:1	12-log	10-log	10-log
100:1 ≥ Dilution ≥ 10:1	13-log	11-log	11-log
Dilution < 10:1	*Not classified as surface water augmentation*		

GRRPs have the benefit of receiving log removal credit from the retention time underground, whereas SWA projects do not. Instead, SWA projects allow treatment credits from the conventional drinking water treatment plant downstream of the reservoir. The original surface water treatment rule (SWTR) promulgated by the U.S. Environmental Protection Agency (EPA 1989), required the surface water treatment plant to provide treatment to remove 4-log virus and 3-log *Giardia*. This rule has since been updated to include 2-log *Cryptosporidium* removal as well. SWA projects can combine the treatment credit achieved prior to the reservoir and at the conventional drinking water treatment plant to achieve the required pathogen reductions.

A primary goal in the design of the treatment train will be to design an overall system that has enough credit to achieve the required log removals in the SWA regulations.

5. **Regulated Contaminant Limits -** As with the GRRP regulations, the recycled water must meet all current regulatory limits. The inclusion of a RO system will ordinarily keep the product water quality well below any current regulatory limits; however, it is possible that the San Diego Regional Water Quality Control Board (RWQCB) may require strict nutrient limits for environmental reasons, lowering the total nitrogen discharged.

Water Code section 13561 defines Direct Potable Reuse (DPR) as "the planned introduction of recycled water either directly into a public water system, as defined in Health and Safety Code section 116275, or into a raw water supply immediately upstream of a water treatment plant." This definition provides a potential "gap" between SWA and DPR, as certain projects may use a reservoir that is too small to qualify for the SWA regulations. The adopted SWA regulations address this via an alternatives clause that can allow for a reduced minimum theoretical retention time of less than 180 days, but no less than 60 days.

2.3 Direct Potable Reuse

DPR projects are differentiated from IPR based on the absence of an environmental buffer. SWRCB defines DPR as the planned introduction of recycled water either directly into a public water system (Treated Drinking Water Augmentation [TDWA]), or into a raw water supply immediately upstream of a water treatment plant (Raw Water Augmentation [RWA]). No uniform regulations have been established within the State of California or nationally for DPR. However, AB 574 requires SWRCB to establish a framework for the regulation of DPR projects by June 1, 2018 and to adopt uniform water recycling criteria for RWA by 2023. SWRCB published a Proposed Framework for Regulating DPR in California in April 2018. The two DPR facilities globally that are currently operating (one in Windhoek, Namibia and the other in Big Spring, Texas) have site-specific permits and treatment requirements set forth by regional regulatory agencies.

2.3.1 Feasibility of DPR Regulations in California

Senate Bill (SB) 918 directed SWRCB to investigate the feasibility of developing uniform water recycling criteria for DPR, convene an Expert Panel to study the technical and scientific issues, and provide a final report to the California State Legislature by December 31, 2016. SB 322 further required that the SWRCB convene an Advisory Group comprised of utility stakeholders to advise SWRCB and its Expert Panel on the development of the feasibility report. SB 322 also amended the scope of the Expert Panel to include identification of research gaps that should be filled to support the development of uniform water recycling criteria for DPR. The SWRCB DDW released a draft report on the feasibility of DPR in California on September 8, 2016.

Summary of SWRCB Draft Report

In general, SWRCB found that regulations for DPR projects are attainable and that a common framework across the various forms of DPR will help avoid discontinuities in the risk assessment and management approach. The SWRCB clearly indicated that further quantification of reliability is necessary to develop criteria for DPR. The SWRCB stated that the process for developing criteria for DPR can be initiated as projects move forward, with a parallel analysis of the knowledge gaps.

The SWRCB outlines recommendations that must be addressed to successfully adopt uniform water recycling criteria for DPR that are protective of public health. These recommendations were derived in large part from the Expert Panel report, and are briefly summarized as follows:

Concurrent Uniform Criteria Development

- Develop uniform water recycling criteria for DPR concurrently with the six Expert Panel research recommendations to inform the development of criteria.

Targeted monitoring for source control and final water quality

- To continue to improve on source control and final water quality monitoring, carry out an ongoing literature review to identify new compounds that may pose health risks from short term exposures, particularly to fetuses and children.

Use of QMRA for DPR

- Implement a probabilistic method (Quantitative Microbial Risk Assessment, QMRA) to confirm the necessary removal values for viruses, Cryptosporidium and Giardia, based on a literature review and new pathogen data collected, and apply this method to evaluate the performance and reliability of DPR treatment trains.

Pathogen Monitoring in Raw Wastewater

- Require monitoring of pathogens in raw wastewater to develop better empirical data on concentrations and variability.

Outbreak Monitoring

- Investigate the feasibility of collecting raw wastewater pathogen concentration data associated with community outbreaks of disease, and implement where possible.

Control of Chemical Peaks

- Identify suitable options for final treatment processes that can provide some “averaging” with respect to potential chemical peaks, particularly for chemicals that have the potential to persist through advanced water treatment.

Identification of Unknown Contaminants

- Develop more comprehensive analytical methods to identify unknown contaminants, particularly low molecular weight compounds in wastewater that may not be removed by advanced treatment and are not detectable with existing monitoring approaches.

Addressing Knowledge Gaps

- Convene technical workgroups to address the knowledge gaps regarding resiliency to assist in developing uniform water recycling criteria for DPR.

DPR Research Initiative

- SWRCB will continue to work with WE&RF on its DPR Research initiative. SWRCB will serve as an advisor to prioritize projects and serve in its Project Advisory Committees.

Partnering Approach to Research

- The SWRCB will partner with other relevant agencies within CalEPA, university research centers, and water and wastewater research foundations to develop research projects that will advance knowledge relevant to DPR.

The SWRCB also adopted the Expert Panel and Advisory Group recommendations for non-treatment barriers, including the following:

1. Advanced training and certification of operators for potable reuse treatment facilities
2. Optimizing wastewater treatment plant performance
3. Enhancing source control/ pretreatment programs
4. Technical, managerial, and financial (TMF) capacity to ensure the success and safety of the project

The Expert Panel report, which is included as an appendix to the SWRCB report, includes the following specific findings:

- It "is technically feasible to develop uniform water recycling criteria for DPR in California, and that those criteria could incorporate a level of public health protection as good as or better than what is currently provided by conventional drinking water supplies and IPR."
- Increasing the reliability of mechanical systems and treatment plant performance will address the absence of an environmental buffer and the level of protection that it provides in IPR projects. Several reliability features should be incorporated into DPR projects:
    - Providing multiple, independent barriers
    - Ensuring the independent barriers represent a diverse set of processes
    - Using parallel independent treatment trains
    - Providing diversion of inadequately-treated water
    - Providing a final treatment step to attenuate any remaining short-term chemical peaks
    - Incorporating frequent monitoring of surrogate parameters at each step to ensure treatment processes are performing properly
    - Developing and implementing rigorous response protocols, such as a formal Hazard Analysis Critical Control Point (HACCP) system

Key Findings

The SWRCB made several statements in the draft report that could have implications to the path forward for DPR projects in California:

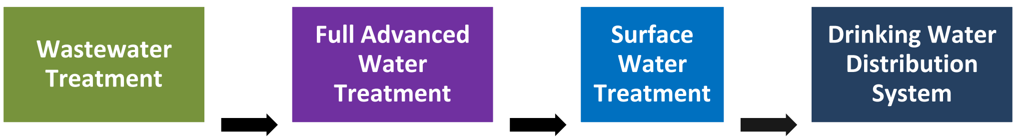
1. **Timing:** the SWRCB plans to further address knowledge gaps related to reliability prior to finalizing uniform water recycling criteria for DPR. This indicates that any planned DPR projects may need to seek site-specific approval from the SWRCB in the absence of a State-wide framework.
2. **Framework for criteria:** each form of DPR will have its own unique set of criteria that are possibly captured within a common framework to avoid discontinuities in the risk assessment. Thus, how a DPR project is defined could have implications to permitting requirements. The DDW acknowledges at least three forms of DPR:

a) **Small Reservoir Augmentation:** a project delivering recycled water to a surface water reservoir, with the reservoir providing some benefits, but not the full complement of benefits provided by SWA. This could include a relatively small reservoir that provides less than 60 days of "V/Q" retention time.

Figure 2-2: Small Reservoir DPR

b) **Raw Water Augmentation (RWA)**: a project delivering recycled water directly to a surface water treatment plant or a surface water reservoir that does not provide benefits.

Figure 2-3: RWA



c) **Treated Drinking Water Augmentation (TDWA):** a project delivering finished water directly to a public water system's distribution system. The advanced water treatment facility would also be permitted under the Surface Water Treatment Rule (SWTR) as a drinking water plant.

Figure 2-4: TDWA ("Flange-to-Flange" DPR)

3. **Raw water pathogen monitoring, including during outbreaks and recommendation to consider incorporating QMRA.** The SWRCB approach on establishing pathogen log inactivation / removal requirements will directly impact treatment requirements and costs. The language in the draft report suggests that rather than setting uniform values as with the groundwater replenishment requirements, the log inactivation / removal requirements could be based on site-specific raw water pathogen concentrations, or a more robust set of raw water pathogen concentrations for California that encompasses outbreak data. Those site-specific or worst-case raw water pathogen data would be used to calculate the required log removal / inactivation requirements to achieve a target finished water quality, potentially derived from QMRA. Depending on the database of raw water pathogen data, this approach could result in similar or more stringent requirements for log inactivation / removal than those established for IPR using injection into the groundwater aquifer as an environmental buffer.
4. **Monitoring and control of ongoing projects.** The Expert Panel suggests that a new formal process be established by the SWRCB to administer periodic review of treatment performance data of permitted potable reuse projects. This proposed process is not unlike the process for ongoing monitoring and review of surface water treatment plant operation through surface water monthly

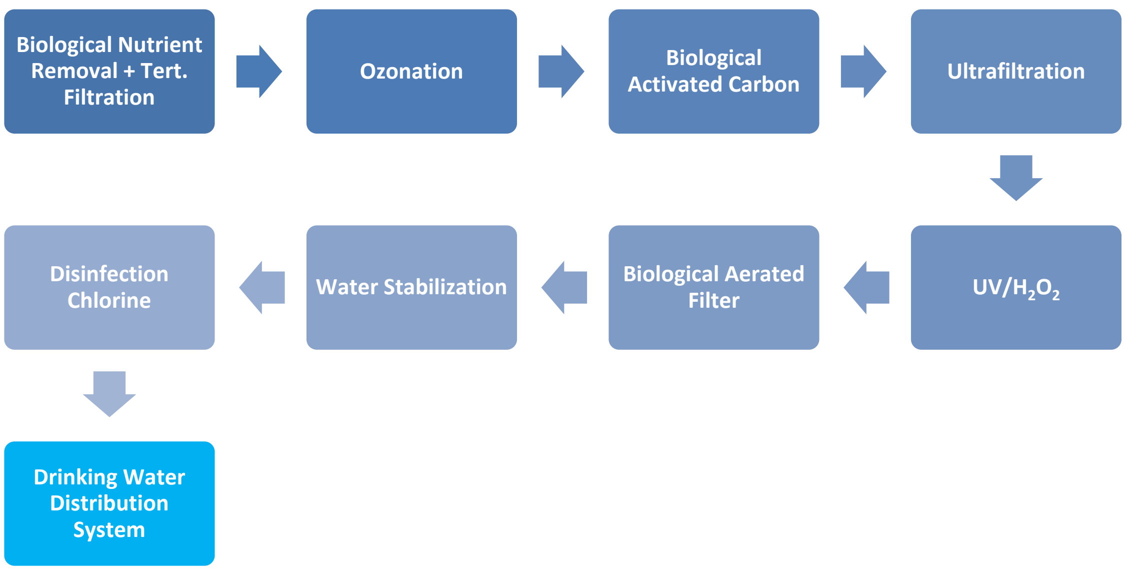
operating reports (SWMORs), annual reports (e.g., consumer confidence reports), and California DDW inspections. The SWRCB also indicates a plan to review the state of the science on chemicals of emerging concern every five years.

5. **Start-up and commissioning.** The Expert Panel cautioned that the introduction of DPR water into a public water system be staged to demonstrate reliability before contribution is increased. This language, if adopted by the SWRCB, has potential implications on the approach for starting up new DPR facilities.

6. **Approach to fill knowledge gaps and incorporate new research findings.** Outcomes of ongoing research and future blue-ribbon panel discussions will influence the criteria for DPR and should be carefully tracked by any DPR project planning to ensure that the facility design reflects any updated requirements that are expected to be incorporated in the DPR regulations.

7. **DPR projects without reverse osmosis (RO) treatment.** The Expert Panel recommended that the SWRCB consider proposals for DPR projects that do not employ RO. While RO provides a robust barrier for protozoa, viruses, nitrate, nitrite, TDS, and multiple metals and chemical micro-constituents, it produces a concentrate stream of up to 20% or more of the raw water production rate that requires disposal with environmental implications. The SWRCB's approach to establishing criteria for alternatives to RO will have significant ramifications for the feasibility of DPR projects that may be unable to readily manage RO concentrate or have other drivers that make RO unattractive. Figure 5 shows an example of a DPR treatment train without RO as a process, taken from the Expert Panel report.

Figure 2-5: DPR Treatment Train Example without RO



8. **Provision of a final treatment step to "average" out any chemical peaks.** The Expert Panel recommendation for research to identify suitable options for final treatment processes that can provide some "averaging" with respect to chemical peaks, and any resulting incorporation of that language in the criteria, will have important implications to the design, cost, and operation of DPR projects. This point should be carefully considered:

    a) If the Expert Panel is concerned with chemicals that pose a chronic health impacts, "averaging" may or may not result in a health benefit.

b) Large storage volumes following chlorine disinfection can result in a risk tradeoff of increased formation of halogenated disinfection by-products (DBPs).

c) Alternate approaches to "averaging" can result in the same desired benefit. For example, if the motivation for "averaging" is to reduce peak concentrations in organic chemical concentrations, a granular activated carbon (GAC) or biologically-active carbon (BAC) polishing step can further reduce concentrations of these chemicals, rather than simply averaging. If the motivation for "averaging" is in part to provide additional time to detect and respond to off-specification water, Salveson et al. (2016) outlines several recommended approaches to provide that engineered buffer.

9. **Consideration and incorporation of non-treatment barriers.** The Expert Panel and the SWRCB recommend incorporation of non-treatment barriers, including: optimization of wastewater treatment plant operation (WWTP), source control, technical, managerial and financial capacity (TMF), and operator training and certification. The SWRCB approach to incorporating these non-treatment barriers in any uniform water recycling criteria for DPR could have implications to:

   - WWTP capital improvement projects (CIP) and operational costs;
   - Pre-treatment program requirements for monitoring, management, and local limits;
   - Industrial discharge options and costs;
   - Water utility investment in technical, managerial, and financial capacity; and
   - Staffing and training costs for operation of a new DPR facility.

   Generally, these non-treatment factors reflect best practices for DPR and are recommended within the potable reuse industry. However, their potential adoption within State criteria for DPR projects highlights the importance of planning in advance to ensure that they are addressed as part of a comprehensive DPR project requiring State of California approval.

10. **Research on low molecular weight organics.** One of the SWRCB recommendations is that research be conducted to develop more comprehensive methods to identify low molecular weight unknown compounds for DPR, including non-targeted analysis as a screening tool. How the SWRCB proceeds with this may impact monitoring requirements at a minimum for DPR projects, but could also affect treatment requirements and incorporation of processes that address low molecular weight compounds. Low molecular weight compounds are perhaps the most challenging to remove through established treatment processes (e.g., membrane filtration, membrane desalination, advanced oxidation, granular activated carbon adsorption, biologically active filtration, and chemical disinfection). Requirements to mitigate these compounds could include source control strategies as one of the more effective approaches to reduce concentrations in DPR projects.

3 Non-Potable Water Reuse in North San Diego County

Recycled water serves as an important local water resource to Southern California, including the North San Diego County area. Information is provided below on the facilities that receive flows from EWPCF and/or may be part of the portfolio of options to be developed in this Study. In addition, plans for expansion to the facilities are also identified based upon the efforts of the North San Diego Water Reuse Coalition (NSDWRC). This information is summarized in Table 3-1 below.

Table 3-1: Recycled Water Projections

Recycled Water (RW) Production Facility	Planned Tertiary Treatment Capacity (mgd)			Projected Peak Summer Demand, Max. Month (mgd)		
	2015	2025	2040	2015	2025	2040
Carlsbad WRF	4.0	7.0	7.0	4.0	8.0	10.0
Gafner WRF	1.0	2.5	3.7	0.5	1.0	2.5
Meadowlark WRF	5.0	5.0	7.0	4.0	5.0	6.5
San Elijo WRF	3.0	3.5	3.5	3.0	3.5	3.5

3.1 Carlsbad Water Reclamation Facility

The Carlsbad Municipal Water District (MWD) recycled water system includes the 7.0 mgd Carlsbad Water Reclamation Facility (CWRF) operated by EWA, 79 miles of pipeline, three booster pumping stations, three storage tanks, three pressure regulating systems, and two supply sources with pump stations. Secondary effluent flows from EWPCF are currently sent to CWRF where they are treated to tertiary levels and recycled. By 2040, the projected peak summer recycled water demand for the City of Carlsbad is expected to be 10 mgd. The City of Carlsbad's treatment capacity ownership at EWPCF is 10.26 mgd out of the total 40.51 mgd liquid capacity (as of the Phase V expansion).

3.2 Leucadia Wastewater District Gafner Water Reclamation Facility

Leucadia Wastewater District (LWWD) wholesales recycled water to the City of Carlsbad for use at the Omni La Costa Resort and Spa. LWWD owns and operates the Forest R. Gafner WRF, which has a 1 mgd capacity to treat water to tertiary levels. Secondary effluent is provided to Gafner WRF from EWPCF. In the short-term, Gafner WRF could be expanded to provide up to an additional 1.5 mgd of recycled water, increasing its total capacity to 2.5 mgd by 2025. By 2040, the Gafner WRF's capacity could be increased to 3.7 mgd for recycled water depending on demands. This expansion would allow LWWD to meet additional recycled water demands identified through NSDWRC planning efforts. LWWD's treatment capacity ownership at EWPCF is 7.11 mgd out of the total 40.51 mgd liquid capacity (as of the Phase V expansion).

3.3 Vallecitos Water District Meadowlark Water Reclamation Facility

Vallecitos Water District (VWD) provides water, wastewater, and reclamation services to San Marcos, the community of Lake San Marcos, parts of the cities of Carlsbad, Escondido and Vista, and other unincorporated areas in north San Diego County, but does not currently retail recycled water to any customers. VWD owns and operates the 5 mgd Meadowlark WRF and wholesales recycled water to other agencies (Carlsbad MWD and Olivenhain MWD). However, wastewater flows currently limit production of recycled water to just under 4 mgd on an average daily basis. Projections show that the average daily flow will increase to approximately 4.5 mgd in the future. To meet short-term potable reuse demands, VWD is considering improvements to Meadowlark WRF to provide 1.0 mgd of advanced treatment capacity, which may be used for a groundwater replenishment reuse project in the San Marcos Basin. VWD's treatment capacity ownership at EWPCF is 7.67 mgd out of the total 40.51 mgd liquid capacity (as of the Phase V expansion); however, VWD has requested to increase their ownership to 10.06 mgd in the future.

3.4 San Elijo Water Reclamation Facility

San Elijo Joint Powers Authority (JPA) owns and operates San Elijo WRF and approximately 19 miles of recycled water distribution pipelines and two covered reservoirs. San Elijo WRF is a tertiary treatment facility that has a design capacity of 5.25 mgd through secondary treatment and a disinfected tertiary treatment capacity of 3.02 mgd. Secondary-treated wastewater that is not treated to tertiary levels is discharged to the ocean through the San Elijo Ocean Outfall. The tertiary treatment train at San Elijo WRF includes microfiltration and reverse osmosis processes. To meet increased recycled water demands, San Elijo JPA anticipates the need to increase its tertiary treatment capacity by 0.5 mgd (from 3.0 to 3.5 mgd) by approximately 2025.

4 Potable Water Reuse Case Studies

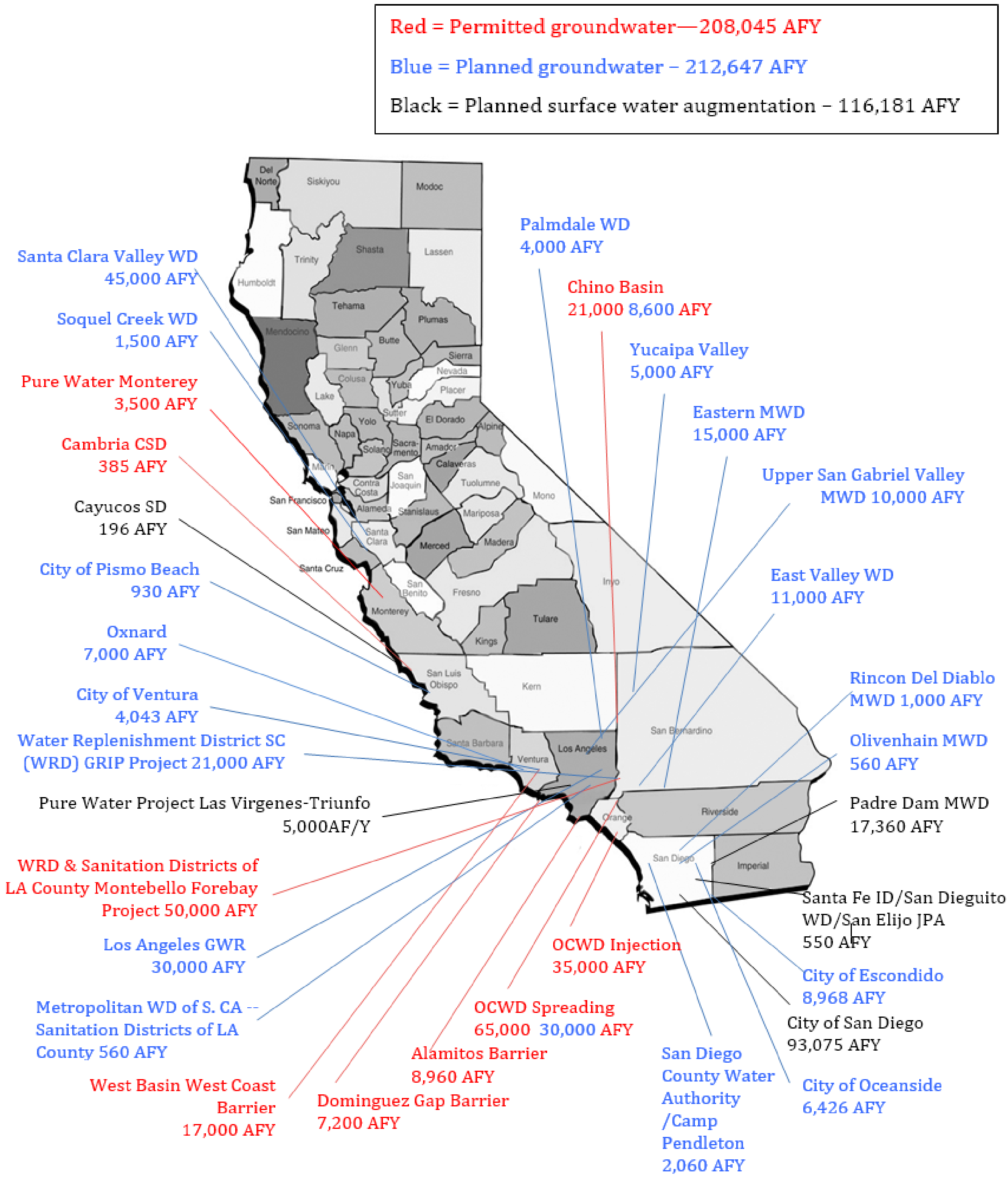
A summary of the potable reuse projects in California that were operational as of late 2106 is provided in Table 4-1. Brief descriptions of the Groundwater Replenishment System, Montebello Forebay Groundwater Recharge Project, and the Terminal Island Advanced Water Purification Facility are provided in the following sections.

Table 4-1: Operational Potable Reuse Projects in California (as of 2016)

Agency	Project Name	Facility Start-up	Potable Reuse Type	Current Treatment	Current Capacity (mgd)
LACSD, WRD, LACDPW	Montebello Forebay Groundwater Recharge Project	1962	Spreading	Tertiary (biological, GMF, disinfection)	50
Orange County Water District	Groundwater Replenishment System	1978	Spreading, Injection	Purification (biological, MF, RO, UV/H_2O_2)	100
West Basin Municipal Water District	West Coast Basin Seawater Intrusion Barrier	1992	Injection	Purification (biological, MF, RO, UV/H_2O_2)	17.5
Inland Empire Utilities Agency	Chino Basin	2005	Spreading	Tertiary (biological, GMF, disinfection)	19
Water Replenishment District	Alamitos Barrier	2005	Injection	Purification (biological, MF, RO, UV/H_2O_2)	10
Los Angeles Bureau of Sanitation	Dominguez Gap Seawater Intrusion Barrier (Terminal Island AWPF)	2006	Injection	Purification (biological, MF, RO, disinfection)	12
Cambria Community Services District	Sustainable Water Facility at the San Simeon Well Field and Percolation Pond System	2015	Injection	Purification (biological, MF, RO, disinfection)	0.5
				TOTAL	**208**

In addition to these operational projects, the map shown in Figure 4-1 also includes the planned potable reuse projects in California as of July 2018. Notably, three of the five planned SWA projects shown are located in San Diego County.

Figure 4-1: Existing and Planned Potable Reuse Projects in California



Source: (WateReuse California, July 2018)

4.1 Existing Indirect Potable Water Reuse in California

4.1.1 Groundwater Replenishment System

The Orange County Water District's (OCWD) Groundwater Replenishment System (GWRS) is the world's largest potable water reuse project, producing 100 mgd of purified water that is injected into the local groundwater basin. Since starting up in the late 1970s, this project has injected more than 188 billion gallons of purified water into the groundwater basin, later to be extracted for potable water use. Currently, OCWD is pursuing a final expansion of the GWRS to a total production to 130 mgd.

Figure 4-2: GWRS RO Membranes

4.1.2 Montebello Forebay Groundwater Recharge

The Water Replenishment District (WRD) and the Los Angeles County Sanitation Districts (LACSD) are partners in the Montebello Forebay Groundwater Recharge Project Tertiary recycled water is recharged into the local groundwater basin via spreading. Over the last 30+ years, more than 1.45 million acre-feet of reclaimed water has been placed into spreading basins and percolated down into the aquifer, later to be extracted for potable water use.

Figure 4-3: Rio Hondo Spreading Grounds, located off-channel

4.1.3 Terminal Island Advanced Water Purification Facility

The LA Sanitation (LASAN) Terminal Island Advanced Water Purification Facilities (AWPF) provides highly-purified water to recharge the Dominguez Gap Barrier. Currently the facility is undergoing an expansion that will increase the plant's capacity from 6 to 12 mgd and will add UV/AOP (UV plus sodium hypochlorite) for disinfection. The project's expansion will allow Terminal Island AWPF to continue supplying water to the Dominguez Gap Barrier, as well as to supply reclaimed water to various Los Angeles Harbor area industrial users and replenish the evaporation losses at Machado Lake.

Figure 4-4: City of Los Angeles Terminal Island AWPF RO Train

4.2 Planned Direct Potable Water Reuse Projects in California

Within California, multiple agencies are eager to move ahead with direct potable reuse projects. Two notable examples described below are the San Diego Pure Water program and the VenturaWaterPure DPR Demonstration Facility.

4.2.1 San Diego Pure Water

As part of its 2015 Point Loma WWTP National Pollutant Discharge Elimination System (NPDES) permit approval application, the City of San Diego worked with environmental stakeholders to develop a potable reuse strategy to reduce ocean discharges. This effort resulted in the development of a phased approach for the San Diego Pure Water Program that is intended to ultimately produce approximately 83 mgd of purified water by 2035. The initial phase of the Program will produce up to 30 mgd of purified water from the City's North County Water Reclamation Plant (NCWRP) to augment Miramar Reservoir.

Based on interactions with the independent advisory panel (IAP) and the Division of Drinking Water (DDW), the City of San Diego has developed an enhanced treatment train concept to ensure reliability of the purified water discharged to Miramar Reservoir. In a related effort, a Prop. 84 state-funded project, led by the WateReuse Research Foundation, has been on-going at NCWRP with a 1 mgd demonstration facility to quantify the reliability of the following potential DPR treatment train:

Ozone → Biologically Activated Carbon → Microfiltration and Ultrafiltration → RO → UV AOP

As part of its first phase of the Pure Water Program, the City is moving forward with the design of this treatment train for augmenting Miramar Reservoir. Additionally, the project includes conveyance and discharge of the advanced treated water to Miramar Reservoir, as well as consideration of the integration of this new supply into the Miramar drinking water treatment plant, a Surface Water Treatment Rule compliant drinking water filtration plant that will then further treat this recycled water prior to distribution to consumers.

The Miramar Reservoir is relatively small and has a retention time of approximately two months. According to early drafts of the SWA regulations, this reduced retention time would have been within the 'gap' between DPR and SWA. Through significant coordination between the City of San Diego and DDW (e.g., via weekly meetings through key project development phases), a Draft Engineering Report for the North City Pure Water Project was submitted in June 2018 with the project defined as SWA and having at least 60 days of retention time in the reservoir. This was in line with the Expert Panel's recommendation to allow "gap" projects within the SWA regulations via an alternatives clause.

Figure 4-5: San Diego Pure Water Demonstration Facility

4.2.2 VenturaWaterPure

The goal of the City of Ventura and Ventura Water's VenturaWaterPure demonstration facility was to document the high quality of purified reclaimed water through extensive water quality testing, and to understand the impact of blending this purified water with the conventional finished potable water. Additionally, this demonstration facility provided an educational opportunity for the community.

The VenturaWaterPure demonstration facility was designed to have multiple barriers for both pathogens and trace pollutants in excess of the treatment required for subsurface (injection) GWA and the anticipated requirements for DPR. The ~20 gallon per minute process train took filtered secondary effluent from the Ventura Water Reclamation Facility and treated it through pasteurization, UF, RO, and a UV light advanced oxidation process using hydrogen peroxide (Figure 4-6). In addition, the RO system was tested with an online control system using fluorescent tracers to demonstrate a minimum of 3-log removal credit for virus.

Moving forward, a granular activated carbon (GAC) process may be added after RO for an additional barrier to trace pollutants, and an engineered storage buffer may be added to the treatment train after the UV AOP to allow for appropriate system monitoring and water quality assurance.

Figure 4-6: City of Ventura DPR Demonstration Facility

4.3 Existing Potable Reuse Projects Outside of California

Potable water reuse projects have been successfully implemented nationally using a broad range of treatment and monitoring technology. Three examples of IPR and DPR projects across the United States are reviewed here.

4.3.1 IPR – SWA in Gwinnett County, Georgia

Gwinnett County Georgia is responsible for the advanced treatment of wastewater prior to discharge into Lake Lanier. The latest treatment process modifications to the F. Wayne Hill Water Resources Center were completed in 2005, allowing the advanced treatment of secondary effluent at up to 150 mgd using microfiltration, pre-ozone, biofiltration, and post-ozone. Water from Lake Lanier is then treated at a conventional water treatment plant and distributed to customers throughout Gwinnett County.

Figure 4-7: Lake Lanier, Georgia

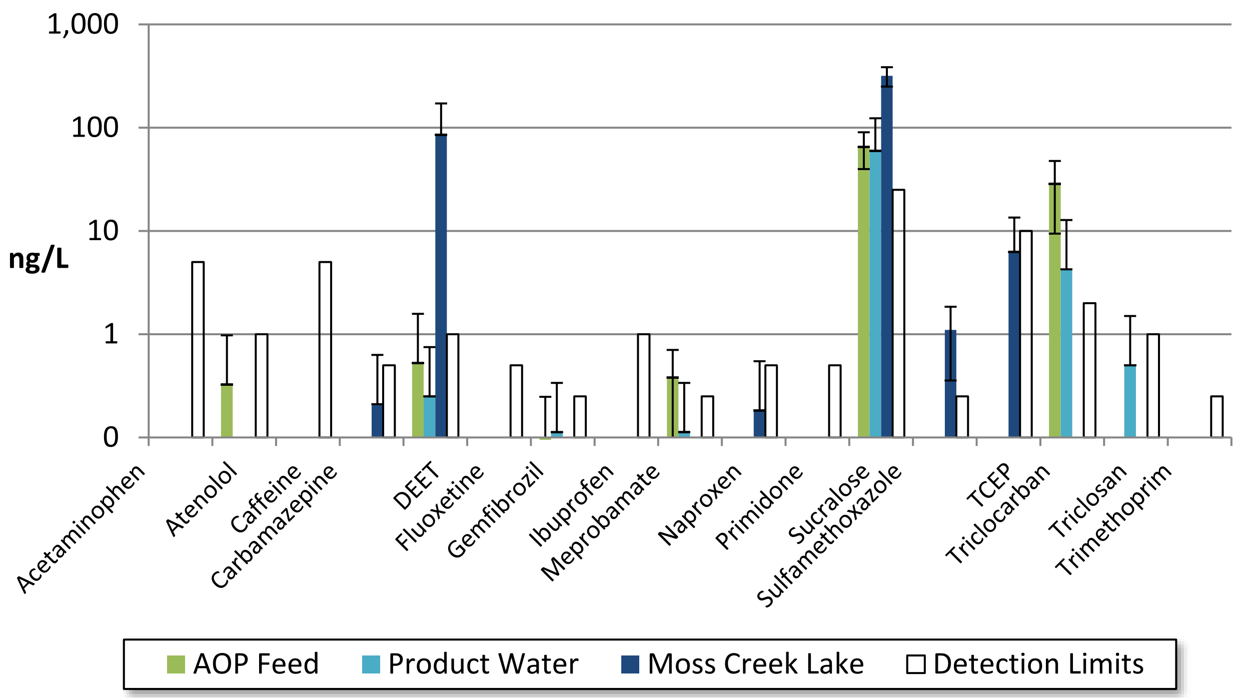
4.3.2 DPR in Big Spring, Texas

The Colorado River Municipal Water District (CRMWD) is a regional water agency in Texas, serving the cities of Big Springs, Odessa, Snyder, and others, with a current combined population of about 500,000. Extreme drought in Texas led the CRMWD to construct the Raw Water Production Facility (RWPF) in Big Spring, Texas. The RWPF started operating in May 2013, with a production capacity of 2 mgd. The RWPF uses the same advanced treatment processes as OCWD's GRWS: MF, RO, and UV advanced oxidation. After purification, the water from the RWPF is fed into a raw water supply line which blends with other raw water (up to 50 percent) and is then subjected to treatment at a standard water treatment plant (media filtration and chlorine disinfection). The City of Big Spring's surface water treatment plant (SWTP) is the first downstream user to withdraw from the pipeline. The cities of Snyder, Odessa, Stanton, and Midland also operate SWTPs that take water downstream of that pipeline.

Figure 4-8: Colorado River Municipal Water District's Raw Water Production Facility

A two-year, third-party evaluation of the water quality produced at this facility was recently completed. Water quality was tested across the treatment train at four major sample events, with test parameters including enteric virus, Giardia, Cryptosporidium, bacterial indicators, a large suite of CECs (pharmaceuticals, personal care products, consumer chemicals, flame retardants, steroid hormones, perfluorinated alkyl substances, conventional and emerging disinfection byproducts) and many other constituents. The study concluded that the product water met public health standards and was fit to drink without the additional treatment that occurs at the downstream conventional water treatment plants. The product water was found to generally be of a better quality than the conventional water supply from Moss Creek Lake, which has served the CRMWD's customers for many decades (Figure 14).

Figure 4-9: CEC Comparison between DPR Product Water and Existing Source (Moss Creek Lake)



4.3.3 DPR High Purity Water Project Demonstration Facility, Oregon

Clean Water Services (CWS) is a water resources management utility in Washington County, Oregon. CWS has Oregon's largest water reuse program and is exploring further options to address water needs within the Tualatin River Watershed. As part of their water reuse program, CWS funded, designed and constructed a High Purity Water Project DPR Demonstration Facility to purify municipal disinfected secondary effluent to various levels which would be sufficient for use in a variety of purposes, including semiconductor processing, agriculture and food crops, product manufacturing, and human consumption. The end goal was not to immediately produce a purified water for potable use, but to elevate the discussion of water in Oregon and to allow for a future potable reuse project.

Included in the overall process design were the following advanced water treatment technologies, which, when combined, provided robust pathogen and pollutant treatment:

Ultrafiltration → RO → UV / AOP → Granular Activated Carbon

These processes were used in series to purify disinfected secondary effluent from CWS's Forest Grove Facility (FGF). The testing demonstrated that the FGF effluent provides a very high-quality water absent of trace pollutants and/or pathogens. As a result, the purified water was deemed suitable for potable use, public consumption was confirmed, and a single use DPR permit was obtained from the Oregon Department of Environmental Quality. As a public outreach tool, annual Sustainable Water Challenge/Pure Water Brew competitions have been held since 2014, in which local brewers enter their beers made with the high purity water produced by the advanced treatment system (Figure 4-10).

Figure 4-10: Potable Reuse Safety Demonstration Using Understandable Methods (Beer)

5 Conclusions

As EWA considers opportunities for increasing the reuse of its secondary effluent, the following considerations drawn from the discussion in this TM can facilitate the determination of timing and feasibility of various reuse options:

- There is significant experience with successful non-potable water reuse projects in North San Diego County, which are expected to expand over the next 10-20 years and continue providing a well-recognized valuable resource to the community.
- Final regulations allow for confident implementation of indirect potable water reuse (IPR) projects using groundwater recharge, supported by decades of successful project operations in California.
- Regulations for IPR surface water augmentation (SWA) projects were finalized in 2018, and earlier drafts provided sufficient information to move forward with planning for these types of projects.
- Direct potable water reuse (DPR) has now been determined to be feasible in California by DDW. Regulations related to RWA are expected by 2023 after further research, expert consultation, and public engagement to ensure the regulations protect public health while increasing drinking water supplies. No timeframe has been established for development of regulations related to TDWA.
- Nationally, there are several established and very successful IPR projects, both groundwater recharge and SWA. Some of these projects have been in operation for over 40 years.
- The most watched potable water reuse project in the U.S. is the CRMWD facility in Big Spring Texas, where they have been now performing DPR successfully for over three years.
- In the San Diego region, it is expected that the San Diego Pure Water project and the East San Diego County surface water augmentation project will be one of the pioneers in advancing potable reuse regulations and public acceptance.

Considering the context of water reuse in California and elsewhere presented in this TM, subsequent TMs under this Study explore the feasibility of NPR, IPR, and DPR options to allow EWA flexibility to move forward with one or more options as the regulatory landscape evolves over time.

6 References

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Attachment 2 - TM2: Portfolio of Options

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Technical Memorandum No. 2

EWA Water Reuse Feasibility Study

Subject: **Portfolio of Options**

Prepared for: Encina Wastewater Authority

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Reviewed by: Scott Goldman, P.E., BCEE | Woodard & Curran

Date: July 2018 (Draft issued: July 2017)

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Appendices

1 Introduction

1.1 Feasibility Study Background

As required by Encina Wastewater Authority's (EWA) 2020 Business Plan, this Water Reuse Feasibility Study (Study) will identify a path to maximize beneficial reuse of effluent from the Encina Water Pollution Control Facility (EWPCF)—which by 2040 is projected to reach an average of approximately 31 million gallons per day (mgd).

This Study will focus on developing a portfolio of options for potential reuse projects; identify and analyze a short list of options; develop an approach to phasing of the preferred water reuse project; identify funding opportunities; develop a stakeholder involvement plan; and coordinate with EWA member agencies and other stakeholders to engage with the Study development and recommendations. Ultimately, the Study will serve to advance EWA's mission of resource recovery and contribute to sustaining and enhancing the region's water environment.

1.2 Objectives

The purpose of this Technical Memorandum (TM) is to define EWA's portfolio of potential water reuse options, perform a qualitative evaluation of each option, and define a shortlist of options to be analyzed in further detail under subsequent TMs in this Study. This TM is organized as follows:

- Project Feasibility Requirements
- Wastewater Flow Projections
- Treated Effluent Available for Additional Reuse
- Potential Types of Reuse Projects and Receptors of Advanced Treated Water
- Development of Options
- Qualitative Evaluation of Options
- Conclusions

2 Project Feasibility Requirements

2.1 General Requirements

In general, a water reuse project is considered feasible when it meets the following overall requirements[1]:

- Technical: project must be technically feasible, produce high quality water, and achieve sustainable local supply.
- Regulatory: project must be feasible to permit, protect public health, provide multiple treatment barriers, and use enhanced monitoring.
- Socioeconomic: project must be accepted by the public, supported by stakeholders, and funded adequately for capital investments and ongoing operations.

2.2 EWA-Specific Requirements

In addition to generally accepted feasibility requirements, a reuse project must make sense for EWA and fit within its core functions. As a model of excellence and innovation, EWA is committed to sound planning

[1] Adapted from WateReuse DPR Framework Summary Report.

and investment, protecting public health and the Pacific Ocean, and efficiency and fiscal responsibility. From EWA's perspective, for a reuse project to be feasible, it must satisfy the following specific requirements:

1. **Maximize use of available EWPCF effluent year-round:** the reuse project must be large enough to achieve economies of scale, to significantly reduce EWA's ocean discharges, and to noticeably advance the sustainability of water resource management in the region.
2. **Project cost neutrality (or better) for EWA:** the reuse project must ensure fiscal responsibility to EWA's Member Agencies and must generate sufficient revenue to offset any costs incurred that extend beyond EWA's core functions. To do this, the reuse water must be produced and delivered at a competitive cost of water with respect to alternatives for the region.
3. **Maximize benefits for EWA Member Agencies and Service Area:** the reuse project must ensure that existing and projected recycled water demands for EWA's Member Agencies will continue to be met, and that new reuse projects within EWA's service area will be prioritized if possible.
4. **Centralized Advanced Treatment:** any potable reuse project will require advanced treatment of effluent from the EWPCF. For the purposes of this study, it is assumed that any new advanced treatment facilities will be located on existing EWA property because this provides the most synergies with existing operations and staff and is consistent with the planned uses for the 28 acres available at EWA's South Parcel. Consideration will also be given to locating the advanced treatment of EWPCF flows at the San Elijo JPA's Water Reclamation Plant (SEJPA WRP) because there has been interest expressed by that agency. Other wastewater facilities in North San Diego County have been excluded, such as the Oceanside San Luis Rey Wastewater Treatment Plant (SLR) and the Escondido Hale Avenue Resource Recovery Facility (HARRF), because those facilities have sufficient wastewater and no interest was expressed by those agencies.
5. **Maintain EWPCF Sewershed Intact:** No consideration was given to diversion of wastewater into or out of the existing EWA service area. For example, diversion of wastewater away from the EWPCF and towards the SEJPA WRF was not considered. In addition, diversion of wastewater to an upstream scalping WRP was also not considered in this study. While these options might be viable concepts, it is expected that they could only be feasible at a small scale and not maximize the use of the available local water resources. Therefore, only effluent conveyed from the EWPCF, or advanced treated water from any new EWA facilities, were considered in the development of the reuse options.

3 Wastewater Flow Projections

3.1 Phase V Flow Projections

The Phase V Expansion, completed in 2008, was the last major expansion of the EWPCF. Prior to the Phase V Expansion, EWA spent a great deal of time working with the Member Agencies to project future wastewater flows and loadings. The results of this effort is a Phase V design influent flow of 40.5 mgd, and a corresponding solids loading equivalent flow of 43.3 mgd. The difference between the two capacities is a result of the solids loading from the upstream Meadowlark WRF, which only has a liquid treatment train. The breakdown of Phase V EWPCF liquid ownership and existing flow contributions from each Member Agency is shown in Table 3-1.

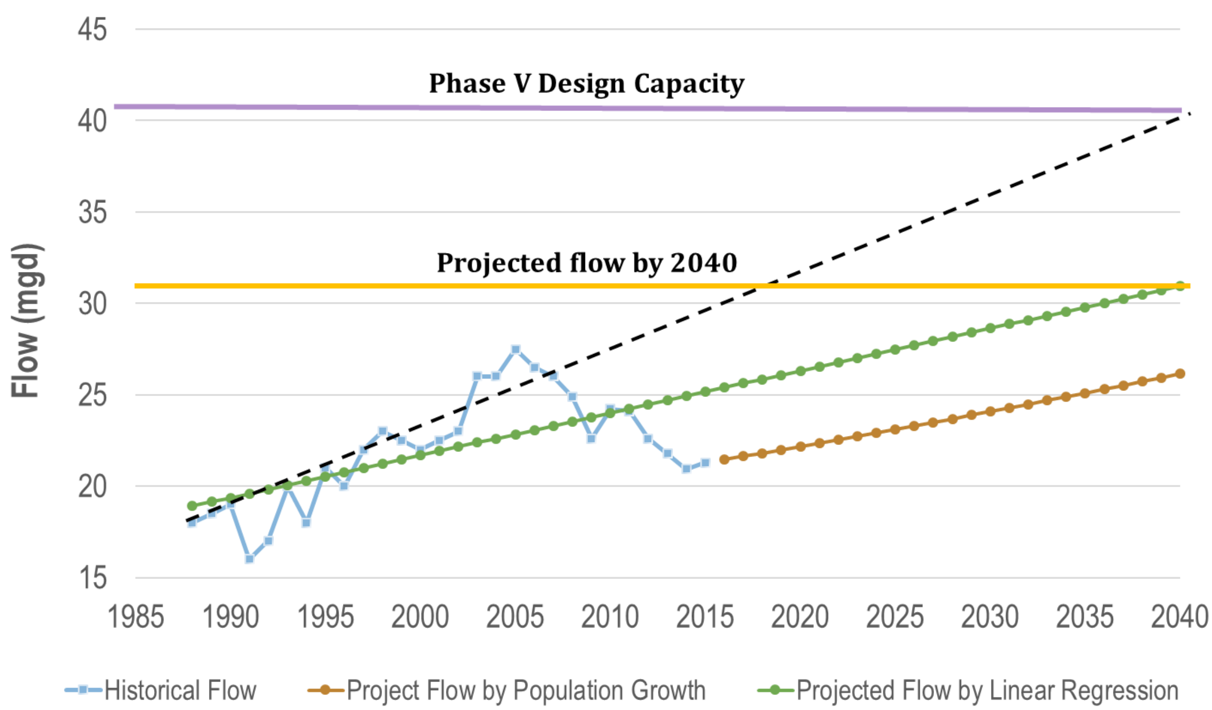
Table 3-1: EWPCF Liquid Ownership and Existing Flow Contribution by Member Agency

Agency	Phase V Ownership		2017 Average Flows	
	(mgd)	(percent)	(mgd)	(percent)
Vista	10.67	26.3%	5.88	24.5%
Carlsbad	10.26	25.3%	6.30	26.6%
Buena	3.00	7.4%	1.77	6.7%
Vallecitos	7.67	18.9%	3.51	21.8%
Leucadia	7.11	17.6%	3.82	16.4%
Encinitas	1.80	4.4%	0.97	4.0%
Total	**40.51**		**22.25**	

3.2 Updated EWPCF Flow Projections

A recent update of the future flow projections to the EWPCF was performed as part of the EWPCF Process Master Plan (EWA 2016). This update was deemed necessary because of the significant drop in wastewater flows during the 2011-2017 drought. Population projections were obtained from the San Diego Association of Governments (SANDAG). An updated unit wastewater generation rate and annual growth rate was estimated based SANDAG data. This analysis resulted in a range of estimated flows by 2040 between 26 mgd and 31 mgd, which is significantly less than the Phase V design capacity (see Figure 3-1).

Figure 3-1: EWPCF Flow Projections to 2040.



Source: EWA 2016.

A projected annual average daily flow (AADF) of 31.0 mgd by 2040 will be used for this Reuse Study. Using the higher end of the range of flows assumes that water conservation efforts during the recent drought may decrease if drought conditions subside in the future, leading to a resumption of a flow growth trend.

4 Treated Effluent Available for Additional Reuse

Any new reuse project being considered by EWA must be compatible with other current and planned reuse efforts being undertaken in the region. As an early coordination step, each of the EWA Member Agencies were contacted to provide input on projected demands. Copies of the letters that were sent to each Member Agency and their responses are provided in Appendix A – EWA Member Agency Correspondence. It is assumed that the EWA Member Agencies have determined the maximum amount of cost effective non-potable reuse within the region, and that a new EWA reuse project will involve some type of potable reuse.

4.1 Member Agency Recycled Water Demand Projections

Based on the responses received, EWA's Member Agency projections to 2040 include a total of approximately 12.5 mgd of non-potable recycled water demand to be supplied from the EWPCF, as shown in Table 4-1. This projection includes 10 mgd to supply the City of Carlsbad's WRF and 2.5 mgd to supply Leucadia Wastewater District's Gafner WRF. It should be noted that Vallecitos Water District's Meadowlark WRF obtains its source flow from wastewater diversion upstream of the EWPCF, and thus is already accounted for in the flow projections for the EWPCF and does not require additional EWPCF effluent.

Table 4-1: EWA Member Agency Recycled Water Projections to 2040

Recycled Water Production Facility	Planned Tertiary Treatment Capacity (mgd)			Projected Peak Summer Demand, Max. Month (mgd)		
	2015	2025	2040	2015	2025	2040
Carlsbad WRF	4.0	7.0	10.0	4.0	8.0	10.0
Gafner WRF	1.0	2.5	3.7	0.5	1.0	2.5
Meadowlark WRF	5.0	5.0	7.0	4.0	5.0	6.5
TOTAL (sourced by EWPCF effluent)	**5.0**	**9.5**	**13.7**	**4.5**	**9.0**	**12.5**

The options developed as part of this Study will allocate flow from the EWPCF to meet the Member Agency's 2040 projection of 12.5 mgd of recycled water demands. The remaining flow will be considered available flow for new potable reuse projects.

4.2 Available EWPCF Effluent for Potable Reuse

Based on the projections to 2040 for EWPCF flows and EWA Member Agency recycled water demands, it is anticipated that the summertime minimum flow available for potable reuse will be 20.5 mgd. The summertime minimum was selected to allow the project to operate at capacity year-round, which will increase the potential to identify a cost effective and feasible project. Assuming typical recovery values for a conventional full advanced treatment train (i.e., microfiltration with 90% recovery and reverse osmosis with 85% recovery), this would result in approximately 15.7 mgd of advanced treated water year-round and approximately 2.8mgd of brine for disposal (as shown on Figure 4-1 and Figure 4-2). Note that this also assumes that the microfiltration backwash can be added to the nonpotable reuse supply.

Figure 4-1: Projected 2040 Monthly Flows and Potential for Potable Reuse

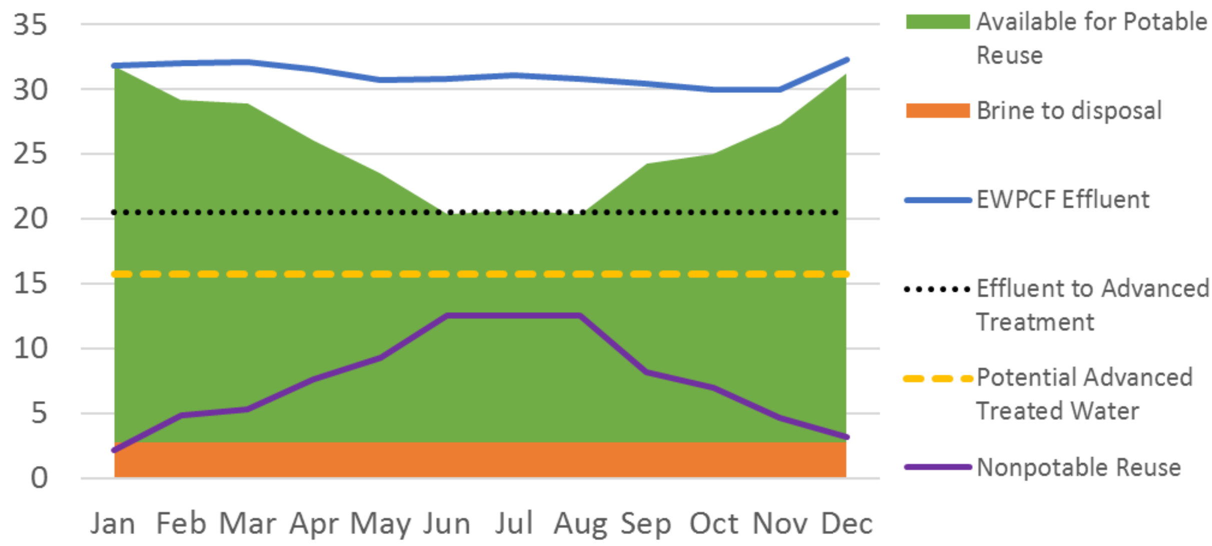
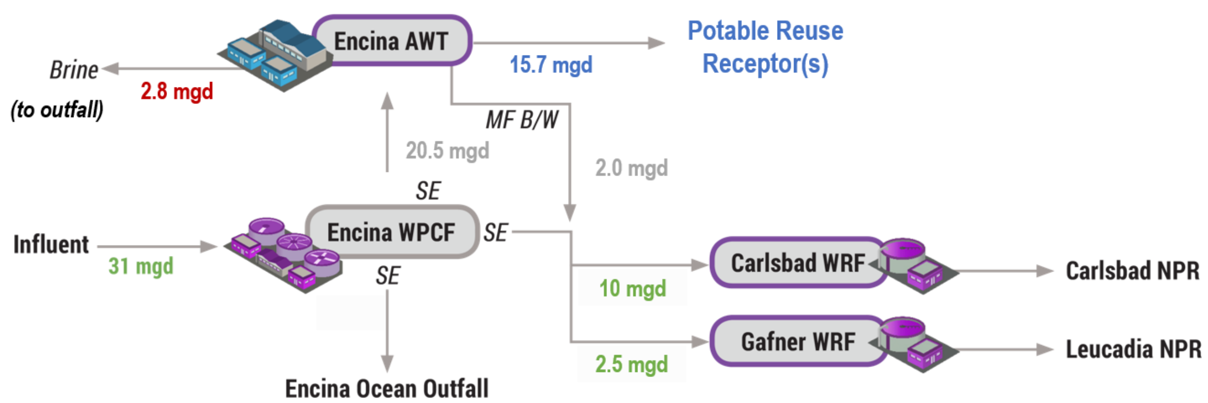


Figure 4-2: Proposed 2040 Peak Summer Flow Schematic



5 Potential Types of Reuse and Receptors of Advanced Treated Water

This section presents the wide range of opportunities for potable reuse projects within the North San Diego County region. These are categorized by the potable reuse regulatory framework that would be applicable for a potential project using EWPCF effluent.

5.1 Groundwater Augmentation Opportunities

5.1.1 San Elijo and San Dieguito Basins

The San Dieguito Valley groundwater basin lies beneath Osuna Valley and San Dieguito Valley in San Diego County. The basin is naturally recharged by percolation in the San Dieguito River, underflow from Hodges Dam, percolation from the valley, and underflow from the La Jolla Group Sediments. The groundwater storage capacity for the basin is estimated to be approximately 50,000 acre-feet. Salinity concentrations range from up to 3,000 mg/L of total dissolved solids (TDS) in the upper and middle portions of the basin, to as high as 10,000 mg/L in the lower portion of the basin. The basin primarily overlays the Olivenhain Municipal Water District (OMWD) service area, as well as part of the SFID/SDWD service area.

The San Elijo Valley groundwater basin underlies two valleys with Escondido Creek intermittently flowing through the upper valley and discharging into the San Elijo Lagoon. The basin's natural recharge source is primarily percolation in Escondido Creek, with additional smaller recharge contributed by direct precipitation, underflow from surrounding marine sedimentary units, and percolation of urban runoff. Groundwater storage capacity for the basin is estimated to be 8,500 acre-feet. This is a narrow and shallow basin, with average TDS of 1,550 mg/L. Deeper formations have higher TDS of up to 5,000 mg/L.

OMWD is studying the San Elijo/San Dieguito Valley basins for siting of a brackish groundwater desalter facility near San Elijo Lagoon that could produce up to 1-2 mgd. For San Elijo Valley Basin in particular, a recent study determined that the feasibility for a groundwater desalter was low due to the thin alluvium and number of private wells located within the basin (OMWD 2015).

Therefore, for the purposes of this Reuse Study, the San Dieguito Basin will be considered as a potential location for groundwater augmentation with up to 1 mgd of advanced treated recycled water from the EWPCF.

5.1.2 San Marcos Basin

The San Marcos Valley groundwater basin lies beneath San Marcos Valley in northwestern San Diego County, spanning 3.3 square miles. The basin is recharged predominantly by rainfall percolation in the valley and ephemeral stream flow. TDS levels range between 500 and 750 mg/L, and groundwater quality is better in the northern part of the basin than in the south (DWR 2003).

Vallecitos Water District has previously studied the San Marcos Valley Groundwater Basin for possible development. It was estimated in a study done by Todd Engineers in 2005 that the recharge capacity of the San Marcos Basin is about 4,600 AFY. Development of groundwater in the San Marcos area is constrained by limited storage, relatively low well yields and poor water quality. Nonetheless, for purposes of this reuse study the San Marcos Basin will be considered as a potential location for groundwater augmentation with up to 1 mgd of advanced treated recycled water from the EWPCF.

5.1.3 Mission Basin

The City of Oceanside is investigating the Mission groundwater basin, which runs along the San Luis Rey River, for groundwater augmentation opportunities using highly treated water from the San Luis Rey WRF.

The goal is to improve groundwater quality, and thereby also improve the water produced by the Mission Basin Groundwater Purification Facility (a brackish groundwater desalter), which currently has a capacity of 6.2 mgd and provides 15% of the City of Oceanside's water supply. Although this is the largest coastal basin in the region, it is expected to be fully utilized by the City of Oceanside and therefore will be excluded from the EWA reuse study's portfolio of options.

5.2 Reservoir Augmentation Opportunities

5.2.1 Hodges and Olivenhain Reservoirs

Hodges Reservoir was created in 1918 with the construction of Hodges Dam on San Dieguito Creek. The reservoir and dam are owned by the City of San Diego (since 1925). Hodges Reservoir has a storage capacity of approximately 30,000 acre-feet, and services the San Dieguito Water District and Santa Fe Irrigation District. A 21 cfs pipeline carries water from Hodges to the San Dieguito Reservoir, as discussed in Section 5.2.2 below. In addition, Hodges Dam has historically discharged water from its spillway during large storm events, which has contributed to groundwater recharge in the San Dieguito basin.

Olivenhain Reservoir is owned by the SDCWA and has a storage capacity of 24,000 acre-feet. A 600 cfs pump station serves to lift water from Hodges to Olivenhain, with a maximum total design head (TDH) of 800 feet. Energy recovery facilities are used to capture the hydraulic energy when transferring water from Olivenhain to Hodges. Thus, water is typically moved between the two reservoirs daily to optimize energy usage in the region. Olivenhain Reservoir can also be filled directly from the Second Aqueduct.

The San Diego County Water Authority (SDCWA) Emergency and Carryover Storage Project consists of a system of reservoirs, pipelines, and pump stations designed to provide water to the San Diego service area in an event of an interruption of imported water deliveries (e.g., due to a major earthquake). The project connects the City of San Diego's Hodges Reservoir and SDCWA's Olivenhain Reservoir to store up to 20,000 acre-feet of water in Hodges for emergency use.

Due to water quality concerns in Hodges Reservoir, water from Olivenhain Reservoir must meet DDW conditions for the blended water quality at the point of connection to the Second Aqueduct raw water pipeline no. 5, which can restrict the allowable flow from Olivenhain Reservoir. Based on input from the SDCWA and the City of San Diego, for purposes of this Reuse Study, reservoir augmentation is only considered for the Olivenhain Reservoir. Hodges and Olivenhain function as a single reservoir and all water must be conveyed through the Olivenhain reservoir to be distributed to the region. The potential that Hodges could be full for months at a time eliminated it as a potential receptor of advanced treated water. The reservoir system is considered large enough to receive all the available advanced treated water from the EWPCF.

5.2.2 San Dieguito Reservoir

The San Dieguito Reservoir is jointly owned by SFID and SDWD and serves as a raw water storage reservoir and pretreatment facility for the R.E. Badger Water Filtration Plant (WFP). The reservoir storage capacity has decreased over time due to decayed plant material build up, solids sent from the Badger WFP, and sediments from urban and storm water runoff. The current capacity of the reservoir is approximately 800 acre-feet. Based on recent analysis (Trussell, 2015), an existing 30-inch low-pressure pipeline from SEWRF to the San Dieguito Reservoir could be rehabilitated and used to convey up to 5 mgd or 3,472 gallons per minute (gpm).

The Badger WFP is jointly owned by SFID and SDWD. The plant can treat local water supplied from Lake Hodges, which is conveyed through the San Dieguito Reservoir for pretreatment, or raw water directly from the SDCWA Second Aqueduct. The plant was first constructed in 1970 and upgraded in 1993 for a total treatment capacity of 40 mgd.

A study performed for SFID, SDWD and SEJPA identified the potential for up to 4 mgd of reservoir augmentation could be implemented based on the anticipated regulations (Trussell 2016). However, based upon the expected requirements for surface water augmentation projects, it is anticipated that a maximum of approximately 3.1 mgd could be accommodated. For purposes of this Reuse Study, the San Dieguito Reservoir will be considered for Reservoir Augmentation up to 3.1 mgd.

5.2.3 Additional Reservoirs in the Region

Although other reservoirs in the region have been considered in past studies for potable reuse opportunities (e.g., Lake Wohlford, Lake Dixon), these are not considered feasible for a project using EWPCF effluent.

5.3 Raw Water Augmentation

5.3.1 SDCWA Aqueduct System

SDCWA provides both raw and treated water to serve its member agencies using large-diameter pipelines that are grouped in two north-south aqueduct alignments (see Figure 5-1 below; for additional detail, see Appendix B – SDCWA Water System Planning Schematic):

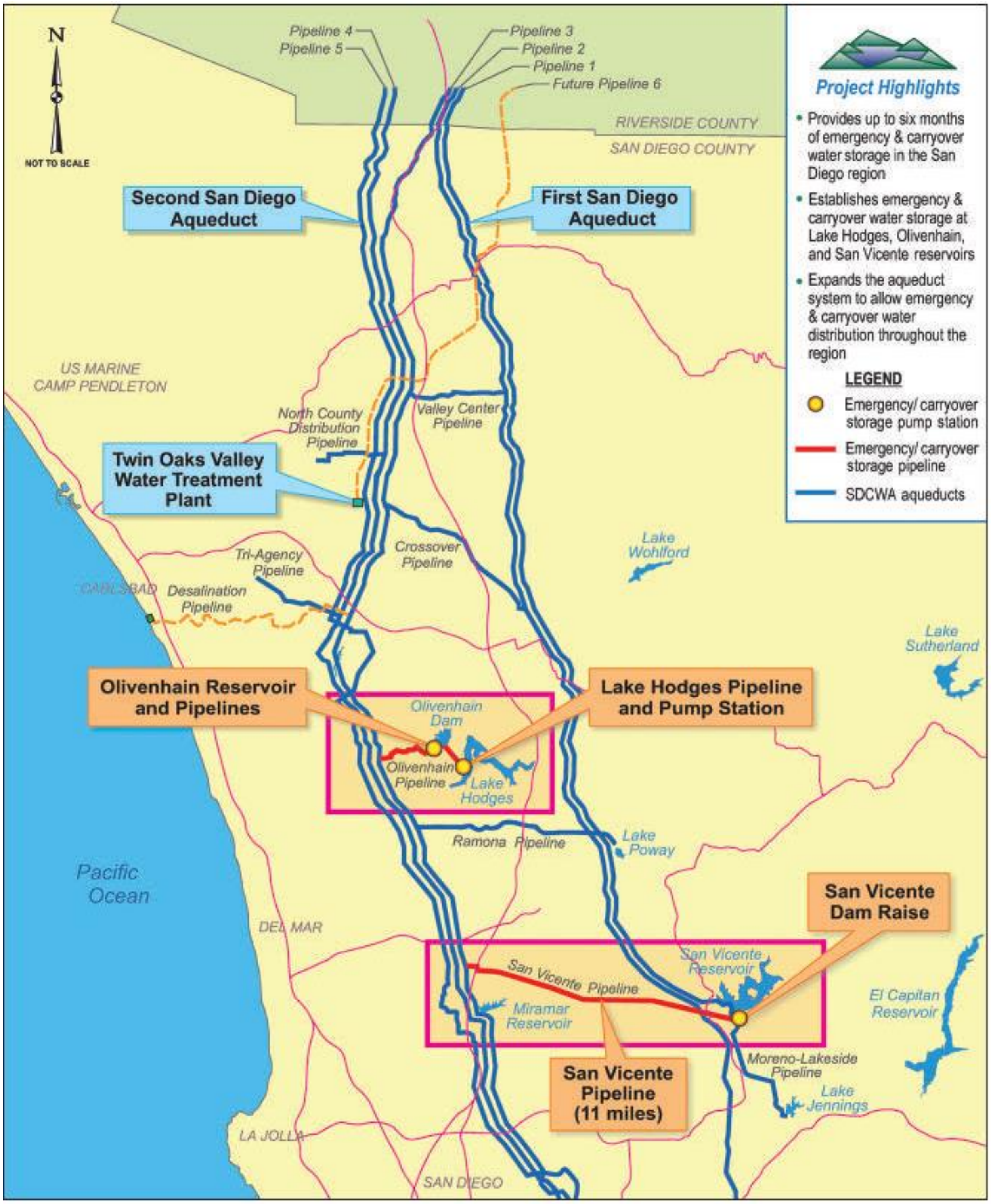
- First Aqueduct consists of the 48-inch diameter Pipelines 1 and 2, which are operated as a single unit. The northern portion of the First Aqueduct serves to deliver 180 cubic feet per second (cfs) of treated water from Metropolitan Water District's (MWD) R.A. Skinner Water Treatment Plant (WTP). At the connection point with the Crossover Pipeline, the First Aqueduct is refilled with raw water and provides 190 cfs to various agencies, terminating at the San Vicente Reservoir.
- Second Aqueduct consists of three high pressure (400 psi) pipelines, identified as Pipelines 3, 4, and 5, which are operated independently. All three pipelines run from the MWD Delivery Point, six miles south of the county boundary, to the Twin Oaks Valley WTP, and continue south to a point where the Second Aqueduct crosses Interstate 15 in the Mira Mesa area. Their design characteristics are summarized below:
    - Pipeline 3: 72-inch diameter, 280 cfs, terminates at the Lower Otay Reservoir
    - Pipeline 4: 90-inch diameter, 470 cfs, terminates at the Lower Otay Reservoir
    - Pipeline 5: 96-inch diameter, 500 cfs, terminates just north of I-15

Pipelines 3, 4, and 5 operate differently between different reaches of the aqueduct, as summarized below:

- Pipeline 3 conveys treated water in the reach from the Twin Oaks Valley Diversion Structure to the Interstate 15 (south of the Miramar Vent). North of San Marcos, 5.5 miles of Pipeline 3 have been re-purposed to convey water from the Carlsbad Desalination Plant to the Twin Oaks Valley Diversion Structure. South of San Marcos, Pipeline 3 continues as a gravity flow treated water pipeline at 200 cfs until it reaches its connection with the Ramona Pipeline.
- Pipeline 4 conveys treated water from its initial MWD delivery point to the Miramar Vent; south of the Miramar Vent, it branches off to provide treated water to South County, and also interconnects with Pipeline 3 to provide raw water.
- Pipeline 5 is used for raw water only. It conveys 636 cfs of raw water to the R.E. Badger and David C. McCollom WTPs.

For purposes of this Study, Pipeline 5 will be considered an option for raw water augmentation up to the full amount of advanced treated water that is available from EWPCF. It is assumed that sufficient blend water would be available within Pipeline 5 based on SDCWA's current operations.

Figure 5-1: Regional Map of SDCWA Aqueduct System and Emergency Storage Project



Source: Civil Engineering Magazine, November 2016.

5.3.2 Twin Oaks Valley Water Treatment Plant

The Twin Oaks Valley WTP was completed in 2008 as the first treatment plant built by SDCWA. The plant is located adjacent to SDCWA's Second Aqueduct north of San Marcos, with a treated water capacity of 100 mgd. The Twin Oaks Valley WTP primarily treats raw imported water delivered from the State Water Project or Colorado River. In addition, the Twin Oaks WTP is one of the locations where SDCWA can blend and distribute the desalinated product water from the Carlsbad Desalination Plant throughout the region.

For purposes of this reuse study, Twin Oaks Valley will not be considered an option for raw water augmentation using advanced treated water that is available from EWPCF. The distance to the Twin Oaks Valley WTP is further than the raw water aqueducts and offers little to no advantage over the pipeline.

5.3.3 Carlsbad Desalination Plant

Poseidon Water owns the Claude "Bud" Lewis Carlsbad Desalination Plant (CDP), a 54 mgd desalination plant adjacent to the Encina Power Station in Carlsbad. Potable water produced at the CDP is delivered to the SDCWA at the property boundary of the treatment facility. SDCWA has responsibility for distribution of the potable water, which is first pumped from the desalination pump station into the desalinated water conveyance pipeline. From there, the desalinated water can be delivered to Pipelines 3, 4, and/or the Tri-Agency Pipeline (serving Vallecitos Water District, Vista Irrigation District, and Carlsbad Municipal Water District, as well as the City of Oceanside).

For purposes of this reuse study, the CDP will be considered an option for raw water augmentation up to the full amount of advanced treated water that is available from EWPCF. For raw water augmentation, this would involve blending the advanced treated water from the EWPCF with the ocean water prior to the desalination treatment step.

5.4 Treated Water Augmentation

5.4.1 SDCWA Desalinated Water Pipeline

The Carlsbad desalinated water conveyance pipeline is considered an east-west branch of the Second Aqueduct. It is 10 miles long and has a 54-inch diameter. Since the CDP started operations in late 2015, an average of approximately 50 mgd has been supplied to the SDCWA and its Member Agencies. Additional pipeline capacity is available up to a total of approximately 83 mgd.

At the location where the desalinated water pipeline ties into the Second Aqueduct, the minimum HGL in Pipelines 3 and 4 is approximately 979 ft (equal to the invert elevation of the San Marcos Vents).

For purposes of this reuse study, the SDCWA Desalinated Water pipeline will be considered an option for treated water augmentation using advanced treated water that is available from EWPCF.

5.4.2 SDCWA Second Aqueduct Pipelines 3-4

For purposes of this Reuse Study, the Second Aqueduct treated water pipelines in the vicinity of the EWPCF (Pipelines 3 and 4) will not be considered an option for treated water augmentation because the distance from the EWPCF to Pipeline 3 is further than that to the Desalination Pipeline and is not expected to offer any significant advantage.

6 Development of Options

Based on the various potable reuse opportunities described in the previous section, the following nine options were identified as EWA's Portfolio of Options for this Reuse Study. Note that all options include the baseline assumption of reserving 12.5 mgd for nonpotable reuse by EWA Member Agencies. Brine losses are also accounted for, depending on whether the reverse osmosis treatment step includes seawater (assumed 60% recovery and 40% brine) or not (assumed 85% recovery and 15% brine).

A. Carlsbad Desalination Plant (CDP) Influent

- 11.1 mgd of potable reuse through raw water augmentation of the CDP source water

B. CDP Product Water

- 15.7 mgd potable reuse through treated water augmentation of the CDP finished water

C. Olivenhain Reservoir

- 15.7 mgd potable reuse through reservoir augmentation of the Olivenhain Reservoir

D. San Dieguito Reservoir and Olivenhain Reservoir

- 15.7 mgd potable reuse through the following:
  - Groundwater augmentation of the San Dieguito Valley groundwater basin (up to 2 mgd)
  - Reservoir augmentation of the San Dieguito Reservoir (up to 3.1 mgd)
  - Reservoir augmentation of the Olivenhain Reservoir (9.7 mgd to 15.7 mgd)

E. San Dieguito Reservoir and CDP Influent

- 12.6 mgd potable reuse through the following:
  - Groundwater augmentation of the San Dieguito Valley groundwater basin (up to 2 mgd)
  - Reservoir augmentation of the San Dieguito Reservoir (up to 3.1 mgd)
  - Raw water augmentation of the CDP source water (7.5 mgd to 12.6 mgd)

F. San Dieguito Reservoir and CDP Product Water

- 15.7 mgd potable reuse through the following:
  - Groundwater augmentation of the San Dieguito Valley groundwater basin (up to 2 mgd)
  - Reservoir augmentation of the San Dieguito Reservoir (up to 3.1 mgd)
  - Treated water augmentation of the CDP finished water (9.7 to 15.7 mgd)

G. San Dieguito Reservoir and Second Aqueduct

- 15.7 mgd potable reuse through the following:
  - Groundwater augmentation of the San Dieguito Valley groundwater basin (up to 2 mgd)
  - Reservoir augmentation of the San Dieguito Reservoir (up to 3.1 mgd)
  - Raw water augmentation of the Second Aqueduct, Pipeline No. 5 (9.7 to 13.7 mgd)

H. Second Aqueduct and San Marcos Basin

- 15.7 mgd potable reuse through the following:
  - Groundwater augmentation of the San Marcos groundwater basin (up to 2 mgd)
  - Raw water augmentation of the Second Aqueduct, Pipeline No. 5 (13.7 to 15.7 mgd)

I. Twin Oaks WTP Influent and San Marcos Basin

- 15.7 mgd potable reuse through the following:
  - Groundwater augmentation of the San Marcos groundwater basin (up to 2 mgd)
  - Raw water augmentation of the Twin Oaks WTP source water (13.7 to 15.7 mgd)

Table 6-1 summarizes the portfolio of options and the associated 2040 peak summer production.

Table 6-1: Portfolio of Options Summary

Option ID	Option Description	Projected 2040 Peak Production (mgd)								Total Potable Reuse (mgd)	Total Reuse (mgd)
		NPR	IPR			DPR		Ocean Disposal			
		Recycled Water	Ground-water	Large Res.	Small Res.	Source Water	Treated Water	SE	Brine		
A	**Carlsbad Desalination Plant (CDP) Influent**	12.5	-	-	-	11.1	-	0	7.4	**11.1**	**23.6**
B	**CDP Product Water**	12.5	-	-	-	-	15.7	0	2.8	**15.7**	**28.2**
C	**Olivenhain Reservoir**	12.5	-	15.7	-	-	-	0	2.8	**15.7**	**28.2**
D	**San Dieguito Reservoir + Olivenhain Reservoir**	12.5	2.0	10.6	3.1	-	-	0	2.8	**15.7**	**28.2**
E	**San Dieguito Reservoir + CDP Influent**	12.5	2.0	-	3.1	7.5	-	0	5.9	**12.6**	**25.1**
F	**San Dieguito Reservoir + CDP Product Water**	12.5	2.0	-	3.1	-	10.6	0	2.8	**15.7**	**28.2**
G	**San Dieguito Reservoir + 2nd Aqueduct (Raw)**	12.5	2.0	-	3.1	10.6	-	0	2.8	**15.7**	**28.2**
H	**Second Aqueduct (Raw) + San Marcos Basin**	12.5	2.0	-	-	13.7	-	0	2.8	**15.7**	**28.2**
I	**Twin Oaks WTP Influent + San Marcos Basin**	12.5	2.0	-	-	13.7	-	0	2.8	**15.7**	**28.2**

Footnotes
1. Assumed available secondary effluent flow from EWPCF: 31.0 mgd
2. Assumed secondary effluent sent to AWPF as source water: 20.5 mgd
3. Assumed recovery from MF process: 90%
4. Assumed recovery from AWT RO process: 85%
5. Assumed recovery from seawater desalination process: 60%
6. Assume that all potable reuse options require MF and RO (at AWT or at desalination plant), and assume that MF backwash can be recovered for NPR.

7 Qualitative Evaluation of Options

7.1 Scoring and Ranking Methodology

A set of criteria was developed to allow for an initial screening of each option in EWA's Portfolio of Options prior to embarking on a more detailed evaluation of the top preferred options, which will include capital and operating cost analyses. For each criterion, a weighting factor was assigned and scoring levels were selected based on the expected range and relative impact on project feasibility. The weighting and scoring methodology is summarized as follows:

1. Assign a Weighting Factor to each Criterion (on a scale of 1-10), where a higher weight means higher impact on project feasibility.
2. Define Scoring Levels within each Criterion (on a scale of 0-4), where a higher score means the project is more feasible.
3. Select appropriate scoring for each option across all criteria.
4. Multiply scores by their associated weighting factors to obtain Option total score.
5. Rank Options by total score.

For options with multiple potable reuse types (e.g., Option E contains both DPR and IPR), points are allocated to each project based on the criteria and are weighted by flow.

7.2 Feasibility Screening Criteria

The five feasibility screening criteria used are shown in Table 7-1 below, along with key considerations and associated weighting and scoring.

Table 7-1: Feasibility Screening Criteria with Weighting Factors and Scoring Levels

Screening Criteria	Weight	Score	Description of Scoring Levels
Regulatory Certainty and Permitting Effort			
Considerations: -Status of regulations in California and expected future requirements. -Ease of approval and precedents to follow.	6	4	IPR (groundwater or surface water)
		3	DPR - Source Water (for SWTP)
		2	N/A
		1	DPR - Source Water (for desalination)
		0	DPR - Treated Water (flange-to-flange)
Treatment and Engineered Storage			
Considerations: -Knowledge of advanced treatment and engineered storage requirements. -Operational complexity and potential impacts to EWPCF.	5	4	FAT for IPR (groundwater or surface water)
		3	FAT for DPR (source water augmentation)
		2	N/A
		1	FAT for DPR (treated water augmentation)
		0	FAT for DPR (for desalination)
Operations			
Considerations: -Regional demand for raw/treated water (considering seasonality). -Integration with reservoir operations and groundwater management. -Brine management and disposal for desalination.	5	4	No seasonal limitations
		3	Seasonal limitations (e.g., demand for treated water)
		2	Wet-weather limitations (e.g., reservoir freeboard)
		1	Integration with desalination facilities & increased brine disposal
		0	Groundwater recharge facilities/operations

Screening Criteria	Weight	Score	Description of Scoring Levels
Conveyance Infrastructure			
Considerations: -Pipeline length, alignment constraints, pumping facilities, pumping requirements.	**10**	**4** **3** **2** **1** **0**	<5 miles 5-15 miles | <500 ft ΔHGL 5-15 miles | >500 ft ΔHGL >15 miles | <500 ft ΔHGL >15 miles | >500 ft ΔHGL
Stakeholders and Institutional Challenges			
Considerations: -Benefits to EWA member agencies. -Institutional challenges related to quantity and type of stakeholders. -Public acceptance of regional IPR/DPR option.	**3**	**4** **3** **2** **1** **0**	EWA Member Agencies only EWA + 1 stakeholder group EWA + 2 stakeholder groups EWA + 3 stakeholder groups EWA + 4 stakeholder groups

7.3 Results of Options Screening

Based upon the methodology described above, each of the nine options within EWA's Portfolio of Options was scored. This led to the ranking of options by score, as shown in Table 7-2.

Table 7-2: Scoring and Ranking of Potable Reuse Options

				Portfolio of Options Scoring								
				CDP Influent	CDP Product Water	Olivenhain Reservoir	San Dieguito Res. + Olivenhain Res.	San Dieguito Res. + CDP Influent	San Dieguito Res. + CDP Product Water	San Dieguito Res. + 2nd Aqueduct (Raw)	Second Aqueduct (Raw) + San Marcos	Twin Oaks WTP Influent + San Marcos
Screening Criteria	**Weight**	**Score**	**Description of Scoring Levels**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**
Regulatory Certainty and Permitting Effort	**6**	**4** **3** **2** **1** **0**	IPR (groundwater or surface water) DPR - Source Water (for SWTP) N/A DPR - Source Water (for desalination) DPR - Treated Water (flange-to-flange)	1	0	4	4	2.2	1.3	3.3	3.1	3.1
Treatment and Engineered Storage	**5**	**4** **3** **2** **1** **0**	FAT for IPR (groundwater or surface water) FAT for DPR (source water augmentation) N/A FAT for DPR (treated water augmentation) FAT for DPR (for desalination)	0	1	4	4	1.6	2.0	3.3	3.1	3.1
Operations	**5**	**4** **3** **2** **1** **0**	No seasonal limitations Seasonal limitations (e.g., demand for treated water) Wet-weather limitations (e.g., reservoir freeboard) Integration with desalination facilities & increased brine disposal Groundwater recharge facilities/operations	1	3	2	2.1	1.6	2.8	3.5	3.5	2.6
Conveyance Infrastructure	**10**	**4** **3** **2** **1** **0**	<5 miles 5-15 miles | <500 ft ΔHGL 5-15 miles | >500 ft ΔHGL >15 miles | <500 ft ΔHGL >15 miles | >500 ft ΔHGL	4	4	0	1.0	3.6	3.7	2.6	2.0	0.4
Stakeholders and Institutional Challenges	**3**	**4** **3** **2** **1** **0**	EWA Member Agencies only EWA + 1 stakeholder group EWA + 2 stakeholder groups EWA + 3 stakeholder groups EWA + 4 stakeholder groups	2	3	2	1	1	2	2	3	3
		Total Weighted Score		**57**	**69**	**60**	**67**	**68**	**74**	**87**	**81**	**60**
		Rank		**9**	**4**	**8**	**6**	**5**	**3**	**1**	**2**	**7**

Footnote

1. For options with multiple potable reuse types, points are allocated to each project based on the criteria and are weighted by flow.

8 Conclusions

Based on the results from the screening evaluation, the following are the three most favorable options that will be carried into TM3 for further analysis to determine feasibility and identify the preferred project:

1. Option F: San Dieguito Reservoir and CDP Product Water
2. Option G: San Dieguito Reservoir and Second Aqueduct (Raw Water Pipeline 5)
3. Option H: Second Aqueduct (Raw Water Pipeline 5) and San Marcos Basin

Table 8-1 summarizes key aspects of each of these options, including the projected flows considered for each of the potable reuse receptors selected for this Reuse Study (as described in Section 5 above).

Table 8-1. Most Favorable Options for Further Analysis

Potable Reuse Receptor	Key Stakeholders	Form of Potable Reuse	Option F	Option G	Option H
San Dieguito Groundwater Basin	Olivenhain MWD	Groundwater Augmentation	***2 mgd***	***2 mgd***	-
San Marcos Groundwater Basin	Vallecitos WD	Groundwater Augmentation	-	-	**2 mgd**
San Dieguito Reservoir	SEJPA/ SFID/ SDWD	Surface Water Augmentation	***3.1 mgd***	***3.1 mgd***	-
Olivenhain and Hodges Reservoirs	SDCWA, City of San Diego	Surface Water Augmentation	-	-	-
Second Aqueduct (Pipeline 5)	SDCWA	Raw Water Augmentation	-	**10.6 mgd**	**13.7 mgd**
Carlsbad Desalination Plant Finished Water	SDCWA	Treated Water Augmentation	**9.7 mgd**	-	-
Twin Oaks Valley WTP	SDCWA	Raw Water Augmentation	-	-	-
Carlsbad Desalination Plant Influent	Poseidon, SDCWA	Raw Water Augmentation	-	-	-
		Potential Phase 1 Potable Reuse **TOTAL POTABLE REUSE**	*5.1 mgd* **15.7 mgd**	*5.1 mgd* **15.7 mgd**	*N/A* **15.7 mgd**

9 References

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Appendix A – EWA Member Agency Correspondence

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ENCINA WASTEWATER AUTHORITY

ENCINA WASTEWATER AUTHORITY

A Public Agency

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October 28, 2016

Mr. Elmer Alex
Principal Engineer/Engineering Department/Utilities
City of Vista/Buena Sanitation District
200 Civic Center Drive
Vista, CA 92084

Subject: Confirmation of Water Reuse Projections for Use in Encina Water Reuse Feasibility Study

Dear Mr. Alex:

As you know, Encina Wastewater Authority (EWA) has begun a Water Reuse Feasibility Study (Study) to identify a path to maximize beneficial reuse of effluent from the Encina Water Pollution Control Facility (EWPCF). A key aspect of the Study will be to coordinate with EWA's Member Agencies and other stakeholders to ensure that the ultimate reuse project using EWPCF effluent is compatible with other current and planned reuse efforts in the region. As an early coordination step, EWA is requesting comments from its Member Agencies on the projected demands presented below. We note that there will be additional coordination and stakeholder engagement activities over the course of the Study, which is expected to be completed by mid-2017.

RECYCLED WATER (NON-POTABLE REUSE)

There are three Water Reclamation Facilities (WRFs) that are owned and/or operated by EWA's Member Agencies; a brief description of each one and a summary of known planning[1] is provided below:

- The Carlsbad WRF has a current capacity of 7 mgd (following completion of the recent expansion), which matches its distribution system capacity. It receives secondary effluent from EWPCF and treats it to tertiary levels for recycling. Recently, the City informed EWA that they may further expand their capacity to 10 mgd by 2040.
- Leucadia Wastewater District's Gafner WRF has a current capacity of 1 mgd and plans to expand to 2.5 mgd by 2025. It receives secondary effluent from EWPCF and treats it to tertiary levels for recycling. To increase capacity to 3.7 mgd, a pipeline must be constructed to connect to the adjacent recycled water distribution systems of Carlsbad MWD and Olivenhain MWD.
- Vallecitos Water District's Meadowlark WRF has a current tertiary treatment capacity of 5 mgd, although wastewater flow availability currently limits production of recycled water to just under 4 mgd on an average daily basis. It receives wastewater flows that are diverted prior to reaching

[1]Documents reviewed include: North San Diego Water Reuse Coalition's 2015 Regional Recycled Water Project Program Environmental Impact Report, as amended; and the Member Agencies' 2015 Urban Water Master Plans.

EWPCF, and returns solids to EWPCF for treatment. Plans to expand capacity to 7 mgd also include potential for incorporating advanced treatment for a potable reuse project.

The current and projected WRF treatment capacity information is presented along with current and projected peak summer recycled water demands in Table 1. Based on this information, together with the projections for EWPCF flows developed in EWA's Process Master Plan[2], the Study will explore the feasibility of additional water reuse options for the balance of the EWPCF flow *after* meeting the projected peak summer demands for the Member Agencies' WRFs.

Table 1. Recycled water projections and planned allocation of EWPCF flows.

Recycled Water (RW) Production Facility	Tertiary Treatment Capacity (mgd)			Peak Summer Demand Max. Month (mgd)		
	2015	2025	2040	2015	2025	2040
Carlsbad WRF	4.0	7.0	7.0	4.0	8.0	10.0
Gafner WRF	1.0	2.5	3.7	0.5	1.0	2.5
Meadowlark WRF	5.0	5.0	7.0	4.0	5.0	6.5
TOTAL	**10.0**	**14.5**	**17.7**	**8.5**	**14.0**	**19.0**

EWA Water Reuse Feasibility Study	Flow (mgd)		
	2015	2025	2040
Annual Average Influent Flow to EWPCF	20.3	25.1	31.1
EWPCF Flows Reserved for RW Production in Summer	4.5	9.0	12.5
Available for Additional Reuse	**15.8**	**16.1**	**18.6**

POTABLE REUSE (INDIRECT AND/OR DIRECT)

Based on the work of the North San Diego Water Reuse Coalition, we understand that the following potable reuse project is being considered by EWA Member Agencies:

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[2] Carollo Engineers, EWPCF Process Master Plan Technical Memorandum No. 1 – Flows and Loadings, May 2016.

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envisioned that up to 1 mgd could be delivered as a short-term indirect potable reuse project under the forthcoming surface water augmentation regulations. By 2025, this could potentially be increased up to 4 mgd.

If you have any comments on the information presented in this letter or any questions regarding EWA's Study, please call me at (760) 438-3941 or email me at mikes@encinajpa.com.

Sincerely,

Michael F. Steinlicht
General Manager

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From: Brian Smith [mailto:BSmith@vidwater.org]
Sent: Thursday, November 3, 2016 7:08 AM
To: 'mikes@encinajpa.com'
Cc: 'ealex@ci.vista.ca.us'; Scott Goldman; Don Smith; Randy Whitmann
Subject: FW: Confirmation of Water Reuse Projections

Mike,

I am Brian Smith, Director of Engineering at the Vista Irrigation District. I am responding to an email you sent to Don Smith at our office.

We do not have any immediate plans for any reuse or recycled water projects. All potential recycled projects for our District are included in the North San Diego Water Reuse Coalition's Facilities Plan.

If you have any questions or need additional information please feel free to contact Randy Whitman or myself.

Sincerely,

Brian Smith
Director of Engineering
Vista Irrigation District
1391 Engineer St.
Vista, CA 92081
(760) 597-3113
bsmith@vidwater.org

From: Mike Steinlicht [mailto:mikes@encinajpa.com]
Sent: Monday, October 31, 2016 8:16 AM
To: Don Smith
Cc: Scott Goldman; Nathan Chase; 'Elmer Alex (ealex@ci.vista.ca.us)'
Subject: Confirmation of Water Reuse Projections

Good Morning Don,

Attached is a request for confirmation of water reuse projections for the City of Vista and the Buena Sanitation District. As we move forward with this water reuse feasibility study we want to make sure we capture all potential water reuse for each of EWA's member agencies and key stakeholders to ensure compatibility and alignment. Thanks in advance for your help!

Hard copy to follow.

Best,

Mike

Michael F. Steinlicht
General Manager
Encina Wastewater Authority

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October 28, 2016

Mr. Paul J. Bushee
General Manager
Leucadia Wastewater District
1960 La Costa Avenue
Carlsbad, CA 92009

Subject: Confirmation of Water Reuse Projections for Use in Encina Water Reuse Feasibility Study

Dear Mr. Bushee:

As you know, Encina Wastewater Authority (EWA) has begun a Water Reuse Feasibility Study (Study) to identify a path to maximize beneficial reuse of effluent from the Encina Water Pollution Control Facility (EWPCF). A key aspect of the Study will be to coordinate with EWA's Member Agencies and other stakeholders to ensure that the ultimate reuse project using EWPCF effluent is compatible with other current and planned reuse efforts in the region. As an early coordination step, EWA is requesting comments from its Member Agencies on the projected demands presented below. We note that there will be additional coordination and stakeholder engagement activities over the course of the Study, which is expected to be completed by mid-2017.

RECYCLED WATER (NON-POTABLE REUSE)

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The current and projected WRF treatment capacity information is presented along with current and projected peak summer recycled water demands in Table 1. Based on this information, together with the projections for EWPCF flows developed in EWA's Process Master Plan[2], the Study will explore the feasibility of additional water reuse options for the balance of the EWPCF flow *after* meeting the projected peak summer demands for the Member Agencies' WRFs.

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TOTAL	**10.0**	**14.5**	**17.7**	**8.5**	**14.0**	**19.0**

EWA Water Reuse Feasibility Study	Flow (mgd)		
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If you have any comments on the information presented in this letter or any questions regarding EWA's Study, please call me at (760) 438-3941 or email me at mikes@encinajpa.com.

Sincerely,

Michael Steinlicht

Michael F. Steinlicht
General Manager

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From: Paul Bushee <PBushee@lwwd.org>
Sent: Monday, October 31, 2016 9:37 AM
To: Mike Steinlicht
Cc: Scott Goldman; Nathan Chase
Subject: RE: Confirmation of Water Reuse Projections

Mike:

Thanks for forwarding the information. All the flow numbers look accurate for LWD. I don't this would impact EWA's study, but the only discrepancy I could see was that we would have to build a pump station and pipeline to OMWD or Carlsbad if we increase our capacity to 2.5 mgd in 2025.

Thanks,

Paul

Paul J. Bushee
General Manager
Leucadia Wastewater District
1960 La Costa Avenue
Carlsbad, CA 92009
Ph: (760) 753-0155
Fax: (760) 753-3094
Email: pbushee@lwwd.org
Web: www.lwwd.org

From: Mike Steinlicht [mailto:mikes@encinajpa.com]
Sent: Friday, October 28, 2016 11:01 AM
To: Paul Bushee <PBushee@lwwd.org>
Cc: Scott Goldman <sgoldman@rmcwater.com>; Nathan Chase <nchase@rmcwater.com>
Subject: Confirmation of Water Reuse Projections

Good Morning Paul,

Attached is a request for confirmation of water reuse projections for the Leucadia Wastewater District. As we move forward with this water reuse feasibility study we want to make sure we capture all potential water reuse for each of EWA's member agencies to ensure compatibility and alignment. Thanks in advance for your help!

Hard copy to follow.

Best,

Mike

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October 28, 2016

Mr. Terry L. Smith
Engineering Manager
City of Carlsbad Public Works, Utilities Division – Engineering
5950 El Camino Real
Carlsbad, CA 92008-8802

Subject: Confirmation of Water Reuse Projections for Use in Encina Water Reuse Feasibility Study

Dear Mr. Smith:

As you know, Encina Wastewater Authority (EWA) has begun a Water Reuse Feasibility Study (Study) to identify a path to maximize beneficial reuse of effluent from the Encina Water Pollution Control Facility (EWPCF). A key aspect of the Study will be to coordinate with EWA's Member Agencies and other stakeholders to ensure that the ultimate reuse project using EWPCF effluent is compatible with other current and planned reuse efforts in the region. As an early coordination step, EWA is requesting comments from its Member Agencies on the projected demands presented below. We note that there will be additional coordination and stakeholder engagement activities over the course of the Study, which is expected to be completed by mid-2017.

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Sincerely,

Michael F. Steinlicht
General Manager

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From: Terry Smith <Terry.Smith@carlsbadca.gov>
Sent: Tuesday, November 22, 2016 12:48 PM
To: Mike Steinlicht
Cc: Scott Goldman; Nathan Chase; Wendy Chambers
Subject: RE: Confirmation of Water Reuse Projections

Mike,
I have reviewed the attached letter and agree with the projections you have shown for the City of Carlsbad. I have no additional comments.

Thanks,

Terry L. Smith, PE
Engineering Manager / District Engineer

City of Carlsbad

Public Works – Utilities Engineering
City of Carlsbad
5950 El Camino Real
Carlsbad, CA 92008
www.carlsbadca.gov

Direct Line 760.603.7354
Terry.Smith@carlsbadca.gov

From: Mike Steinlicht [mailto:mikes@encinajpa.com]
Sent: Friday, October 28, 2016 11:01 AM
To: Terry Smith <Terry.Smith@carlsbadca.gov>; Wendy Chambers <Wendy.Chambers@carlsbadca.gov>
Cc: Scott Goldman <sgoldman@rmcwater.com>; Nathan Chase <nchase@rmcwater.com>
Subject: Confirmation of Water Reuse Projections

Good Morning Terry, Wendy,

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October 28, 2016

Mr. Tom Scaglione
Interim General Manager
Vallecitos Water District
201 Vallecitos De Oro
San Marcos, CA 92069

Subject: Confirmation of Water Reuse Projections for Use in Encina Water Reuse Feasibility Study

Dear Mr. Scaglione:

As you know, Encina Wastewater Authority (EWA) has begun a Water Reuse Feasibility Study (Study) to identify a path to maximize beneficial reuse of effluent from the Encina Water Pollution Control Facility (EWPCF). A key aspect of the Study will be to coordinate with EWA's Member Agencies and other stakeholders to ensure that the ultimate reuse project using EWPCF effluent is compatible with other current and planned reuse efforts in the region. As an early coordination step, EWA is requesting comments from its Member Agencies on the projected demands presented below. We note that there will be additional coordination and stakeholder engagement activities over the course of the Study, which is expected to be completed by mid-2017.

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Sincerely,

Michael F. Steinlicht

Michael F. Steinlicht
General Manager

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October 28, 2016

Mr. Glenn Pruim
Director of Public Works
City of Encinitas
505 South Vulcan Avenue
Encinitas, CA 92024

Subject: **Confirmation of Water Reuse Projections for Use in Encina Water Reuse Feasibility Study**

Dear Mr. Pruim:

As you know, Encina Wastewater Authority (EWA) has begun a Water Reuse Feasibility Study (Study) to identify a path to maximize beneficial reuse of effluent from the Encina Water Pollution Control Facility (EWPCF). A key aspect of the Study will be to coordinate with EWA's Member Agencies and other stakeholders to ensure that the ultimate reuse project using EWPCF effluent is compatible with other current and planned reuse efforts in the region. As an early coordination step, EWA is requesting comments from its Member Agencies on the projected demands presented below. We note that there will be additional coordination and stakeholder engagement activities over the course of the Study, which is expected to be completed by mid-2017.

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POTABLE REUSE (INDIRECT AND/OR DIRECT)

Based on the work of the North San Diego Water Reuse Coalition, we understand that the following potable reuse project is being considered by EWA Member Agencies:

- Vallecitos Water District is studying the San Marcos Valley Groundwater Basin for a possible indirect potable reuse groundwater replenishment project. The basin lies beneath San Marcos Valley in northwestern San Diego County, spanning 3.3 square miles. The basin is recharged predominantly by rainfall percolation in the valley and ephemeral stream flow, and has an estimated recharge capacity of 4,600 AFY. By 2025, approximately 1,100 AFY (approximately 1 mgd) of purified water to recharge the basin could come from the Meadowlark WRF, which currently treats water to tertiary levels. By 2035, this could be increased to 2,200 AFY (approximately 2 mgd). The total amount of water produced will likely be greater given that activities such as conjunctive use (groundwater and untreated surface water) may be implemented.

Also, we note that EWA's Study will take into consideration the Potable Water Reuse Feasibility Study completed earlier this year by Santa Fe Irrigation District, San Elijo Joint Powers Authority, and San Dieguito Water District. We understand that this study presents a regional potable reuse project concept for delivering advanced treated water from the San Elijo WRF to the San Dieguito Reservoir. It is

[2] Carollo Engineers, EWPCF Process Master Plan Technical Memorandum No. 1 – Flows and Loadings, May 2016.

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Serving North San Diego County

envisioned that up to 1 mgd could be delivered as a short-term indirect potable reuse project under the forthcoming surface water augmentation regulations. By 2025, this could potentially be increased up to 4 mgd.

If you have any comments on the information presented in this letter or any questions regarding EWA's Study, please call me at (760) 438-3941 or email me at mikes@encinajpa.com.

Sincerely,

Michael Steinlicht

Michael F. Steinlicht
General Manager

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Appendix B – SDCWA Water System Planning Schematic

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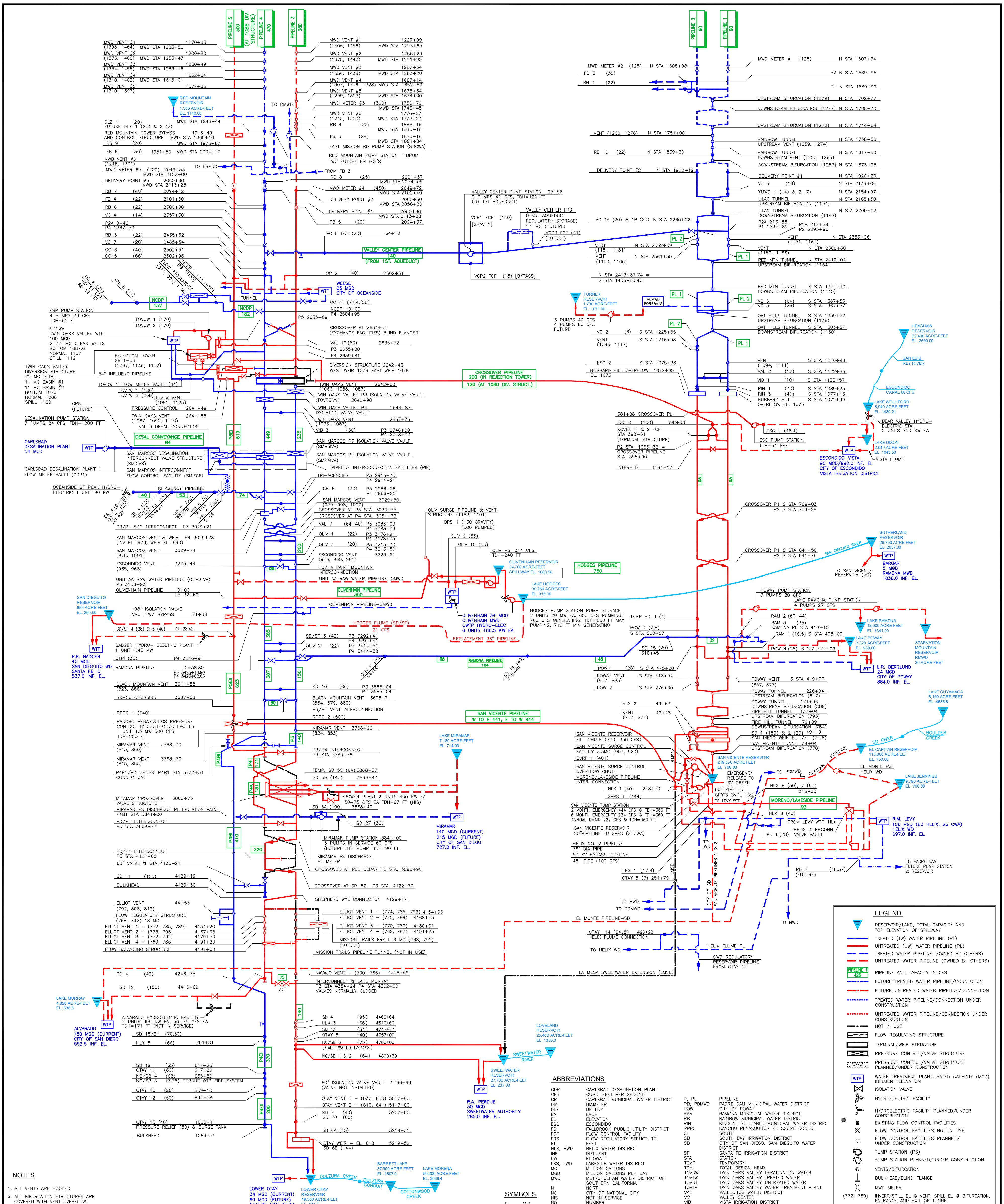

NOTES

1. ALL VENTS ARE HOODED.
2. ALL BIFURCATION STRUCTURES ARE COVERED WITH VENT OVERFLOW.
3. THIS SCHEMATIC WAS PREPARED BY SAN DIEGO COUNTY WATER AUTHORITY FOR ITS OWN USE AND IS FOR GENERAL INFOMATION ONLY. THIS SCHEMATIC IS UPDATED AT IRREGULAR INTERVALS AND MAY NOT SHOW CURRENT STATUS AND SHOULD NOT BE USED FOR DESIGN PURPOSES. NO WARRANTY IS EXPRESSED OR IMPLIED TO OTHERS AS TO THE CORRECTNESS OR CONTENT OF THE INFORMATION SHOWN HEREIN.

SYMBOLS

&	AND
@	AT
=	EQUAL
"	INCHES
#	NUMBER
+	PLUS

ABBREVIATIONS

CDP	CARLSBAD DESALINATION PLANT
CFS	CUBIC FEET PER SECOND
CR	CARLSBAD MUNICIPAL WATER DISTRICT
DIA	DIAMETER
DLZ	DE LUZ
EA	EACH
EL	ELEVATION
ESC	ESCONDIDO
FB	FALLBROOK PUBLIC UTILITY DISTRICT
FCF	FLOW CONTROL FACILITY
FRS	FLOW REGULATORY STRUCTURE
FT	FEET
HLX, HWD	HELIX WATER DISTRICT
INF	INFLUENT
KW	KILOWATT
LKS, LWD	LAKESIDE WATER DISTRICT
MG	MILLION GALLONS
MGD	MILLION GALLONS PER DAY
MWD	METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA
N	NORTH
NC	CITY OF NATIONAL CITY
NIS	NOT IN SERVICE
NO	NUMBER
OC	CITY OF OCEANSIDE
OLIV	OLIVENHAIN MUNICIPAL WATER DISTRICT
OPS	OLIVENHAIN PUMP STATION
OTP	OLIVENHAIN WATER TREATMENT PLANT
OTAY, OWD	OTAY WATER DISTRICT
P, PL	PIPELINE
PD, PDMWD	PADRE DAM MUNICIPAL WATER DISTRICT
POW	CITY OF POWAY
RAM	RAMONA MUNICIPAL WATER DISTRICT
RB	RAINBOW MUNICIPAL WATER DISTRICT
RIN	RINCON DEL DIABLO MUNICIPAL WATER DISTRICT
RPPC	RANCHO PENASQUITOS PRESSURE CONROL
S	SOUTH
SB	SOUTH BAY IRRIGATION DISTRICT
SD	CITY OF SAN DIEGO, SAN DIEGUITO WATER DISTRICT
SF	SANTA FE IRRIGATION DISTRICT
STA	STATION
TEMP	TEMPORARY
TDH	TOTAL DESIGN HEAD
TOVDW	TWIN OAKS VALLEY DESALINATION WATER
TOVTW	TWIN OAKS VALLEY TREATED WATER
TOVUT	TWIN OAKS VALLEY UNTREATED WATER
TOVTP	TWIN OAKS VALLEY WATER TREATMENT PLANT
VAL	VALLECITOS WATER DISTRICT
VC	VALLEY CENTER
VID	VISTA IRRIGATION DISTRICT
VV	VALVE VAULT
W/	WITH
WD	WATER DISTRICT
WTP	WATER TREATMENT PLANT
YMWD	YUIMA MUNICIPAL WATER DISTRICT

LEGEND

- RESERVOIR/LAKE, TOTAL CAPACITY AND TOP ELEVATION OF SPILLWAY
- TREATED (TW) WATER PIPELINE (PL)
- UNTREATED (UW) WATER PIPELINE (PL)
- TREATED WATER PIPELINE (OWNED BY OTHERS)
- UNTREATED WATER PIPELINE (OWNED BY OTHERS)
- PIPELINE 1 426 — PIPELINE AND CAPACITY IN CFS
- FUTURE TREATED WATER PIPELINE/CONNECTION
- FUTURE UNTREATED WATER PIPELINE/CONNECTION
- TREATED WATER PIPELINE/CONNECTION UNDER CONSTRUCTION
- UNTREATED WATER PIPELINE/CONNECTION UNDER CONSTRUCTION
- NOT IN USE
- FLOW REGULATING STRUCTURE
- TERMINAL/WEIR STRUCTURE
- PRESSURE CONTROL/VALVE STRUCTURE
- PRESSURE CONTROL/VALVE STRUCTURE PLANNED/UNDER CONSTRUCTION
- WTP — WATER TREATMENT PLANT, RATED CAPACITY (MGD), INFLUENT ELEVATION
- ISOLATION VALVE
- HYDROELECTRIC FACILITY
- HYDROELECTRIC FACILITY PLANNED/UNDER CONSTRUCTION
- EXISTING FLOW CONTROL FACILITIES
- FLOW CONTROL FACILITIES NOT IN USE
- FLOW CONTROL FACILITIES PLANNED/UNDER CONSTRUCTION
- PUMP STATION (PS)
- PUMP STATION PLANNED/UNDER CONSTRUCTION
- VENTS/BIFURCATION
- BULKHEAD/BLIND FLANGE
- MWD METER
- (772, 789) INVERT/SPILL EL @ VENT, SPILL EL @ BIFURCATION, ENTRANCE AND EXIT OF TUNNEL
- (774, 785, 792) INVERT/OVERFLOW/SPILL EL @ VENT FOR OVERFLOW VENT TYPE
- (20) CUBIC FEET PER SECOND (METER CAPACITY)
- (20–15) METER MAX– METER RECALIBRATED

San Diego County Water Authority

CAPITAL IMPROVEMENT PROGRAM

WATER SYSTEM PLANNING SCHEMATIC

AQUEDUCTS, FLOW CONTROL FACILITIES AND GRADIENT CONTROL STRUCTURES

STATUS: AS OF DECEMBER 2016

W:\ACAD\AutoCAD\Water System Planning Schematics\WSPS_2016.DWG
BY: KKS – REV: 12–15–2016
PRINT DATE: 2016

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Attachment 3 - TM3: Preferred Project Identification

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Technical Memorandum No. 3

EWA Water Reuse Feasibility Study

Subject: **Preferred Project Identification**

Prepared For: Encina Wastewater Authority

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Date: July 2018 (Draft: January 2018)

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1 Introduction

1.1 Feasibility Study Background

As required by Encina Wastewater Authority's (EWA) 2020 Business Plan, this Water Reuse Feasibility Study (Study) will identify a path to maximize beneficial reuse of effluent from the Encina Water Pollution Control Facility (EWPCF)—which by 2040 is projected to reach an average annual daily flow of approximately 31 million gallons per day (mgd).

The Study will focus on developing a portfolio of options for potential reuse projects; analyze a shortlist of options (focus of this technical memorandum (TM)); develop an approach to phasing of the preferred water reuse project; identify funding opportunities; develop a stakeholder involvement plan; and coordinate with EWA member agencies and other potential stakeholders. Ultimately, the Study will serve to advance EWA's mission of resource recovery and contribute to sustaining and enhancing the region's water resources.

1.1.1 Preferred Options for Analysis

Through prior work on this Study, three preferred options have been identified for further analysis. Each option includes improvements to the EWPCF and construction of a new Advanced Water Treatment Facility (AWTF) to produce approximately 16 mgd of advanced treated water (or purified water) for potable reuse. Additional details on each option are presented in this TM. The options are listed below, along with the associated designation that will be used throughout this TM:

- **Option F:** 15.8 mgd of potable reuse through the following:
  - Groundwater augmentation in the San Dieguito Valley groundwater basin (up to 2 mgd)
  - Surface water augmentation in the San Dieguito Reservoir (up to 3.1 mgd)
  - Treated drinking water augmentation introduced at the Carlsbad Desalination Plant finished water pump station (ranging from 10.7 to 15.8 mgd)
- **Option G:** 16.0 mgd of potable reuse through the following:
  - Groundwater augmentation in the San Dieguito Valley groundwater basin (up to 2 mgd)
  - Surface water augmentation in the San Dieguito Reservoir (up to 3.1 mgd)
  - Raw water augmentation in the Second Aqueduct, Pipeline No. 5 (ranging from 10.9 to 14 mgd)
- **Option H:** 16.0 mgd of potable reuse through the following:
  - Groundwater augmentation in the San Marcos groundwater basin (up to 2 mgd)
  - Raw water augmentation in the Second Aqueduct, Pipeline No. 5 (ranging from14 to 16 mgd)

1.2 Objectives

This TM includes conceptual analysis leading to a preliminary opinion of probable construction costs and annual operational costs for each of the three preferred options at the projected 2040 flow levels (as described in TM2). The analysis includes estimation of the unit cost of water produced (i.e., dollars per acre-foot) to allow for comparison of existing and planned water resources expected to be available in the region. The TM is organized as summarized below:

- **Wastewater Treatment Plant Improvements:** With a goal of providing improved source water to a future AWTF, this section examines raw wastewater source control and improvements to the existing EWPCF secondary treatment process. Key outcomes include expected AWTF source water quality and quantity.

- **Purified Water Receptor Integration Concepts:** For the surface water augmentation option, a concept will be presented for diffusing the purified water into the reservoir and meeting the anticipated regulatory requirements for dilution and retention time. For the groundwater augmentation option, a concept will be presented for injection wells and extraction wells to meet anticipated retention time requirements. For the treated drinking water augmentation option, a concept will be presented for engineered storage and blending facilities to combine the purified water with the desalination plant effluent.
- **Advanced Water Treatment Concepts:** To meet the requirements for potable reuse in California, an AWTF will need to be constructed to deliver purified water to the specific receptor(s) in each option. This section will present potential treatment trains tailored to each form of potable reuse contemplated in the top options, as well as conceptual facility layouts for the AWTF options.
- **Conveyance Concepts**: Various pipeline alignment routes were considered for conveying purified water from the AWTF to the proposed receptor(s). This section will present conceptual pipeline alignments and pump station requirements for each option.
- **Permitting Considerations and Brine Disposal:** Based on the proposed modifications to the EWPCF, the proposed AWTF, and the proposed forms of potable reuse, this section outlines the associated considerations for permitting based on available information. Furthermore, permitting requirements are outlined for disposal of RO concentrate (brine) generated at the proposed AWTF via the Encina Ocean Outfall.
- **Conceptual Cost Analysis:** For each option, a feasibility-level Opinion of Probable Construction Costs is provided. In turn, operational cost rates are added to each option to develop a cost of water that can be compared across options, as well as to other water sources in the region.
- **Conclusions:** Based on the analysis in this TM and feedback from stakeholders, a recommendation is provided to carry forward in the Study regarding project phasing analysis and funding opportunity identification.

2 Wastewater Treatment Plant Improvements

2.1 EWPCF Treatment Upgrades

No changes to the EWPCF treatment are expected to be required by current regulations to provide secondary effluent to source non-potable reuse projects with EWA's Member Agencies. However, current best practice suggests that the source water for an AWTF should include biological nutrient removal (e.g., nitrification-denitrification [NDN]) and tertiary filtration. These modifications may also be required by future potable reuse regulations. The following aspects of the EWPCF treatment upgrades and how they pertain to potable reuse will be addressed in this section:

- Source control and industrial pretreatment
- Primary effluent flow equalization
- Conversion of secondary process to NDN
- Tertiary filters
- Management of sludge dewatering sidestreams

2.1.1 Source Control and Industrial Pretreatment

Effective source control and industrial pretreatment management programs are important for maintaining consistent feed water quality for potable reuse. Source control and industrial pretreatment will help minimize concentrations of chemicals of concern and illegal dumping events that can cause wastewater treatment upsets.

EWA maintains a robust source control program in which they permit and monitor all industrial users in the sewershed. The most recent data from their source control program is from 2015, at which time EWA had 59 permitted industrial users, four of which were considered significant. As of the end of 2015, EWA had no incidents of "upset, interference or pass-through" attributed to industrial users and industrial users were contributing only 0.84% of the average daily influent flow (Encina Wastewater Authority 2017). All regular sampling at both the ocean outfall and in receiving waters showed that EWA's effluent quality met or exceeded compliance standards.

In addition to the regulation of industrial users, EWA also implements a range of best management practices (BMPs) aimed at reducing the level of pollutants entering the system. The BMP program involves working with non-significant industrial users to identify specific pollution prevention strategies and follow-up sampling and inspection to ensure the effectiveness of the program. Since its inception in 1999, the BMP program has reduced the level of pollutants entering the treatment plant and has resulted in a decrease of non-significant industrial user permits, including a decrease from 304 to 35 by the end of the second year of the program (Encina Wastewater Authority 2017). Increased wastewater flows to EWA's service area are expected to result from increased residential development and should have little to no effect on the level of industrial sources in the sewershed. If new industrial users enter the sewershed, EWA is well-equipped to ensure that proper industrial source control and pretreatment is implemented to safeguard the influent flows to the treatment plants.

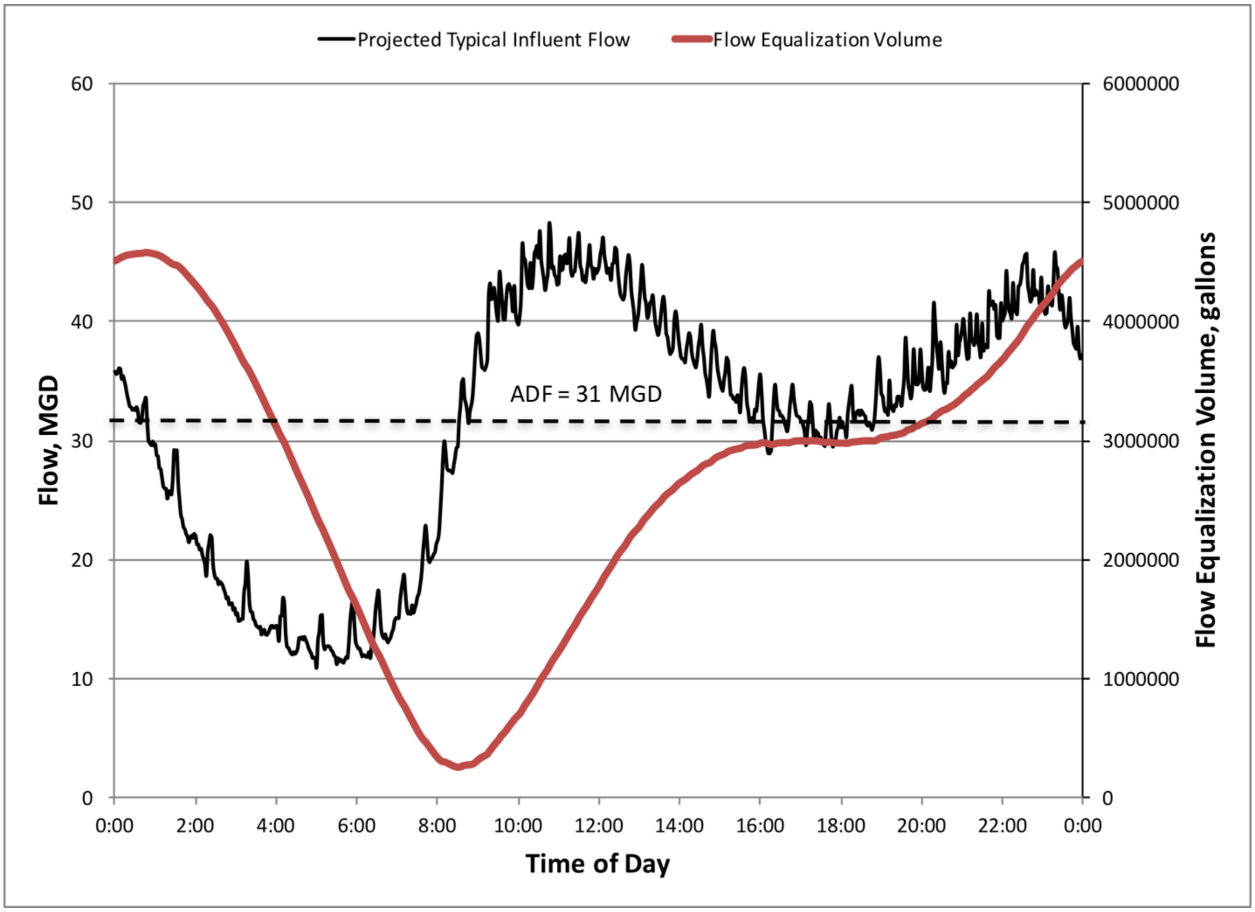
2.1.2 Primary Effluent Flow Equalization

Primary effluent flow equalization stabilizes the organic and nitrogen load to the biological treatment process, making the biological treatment, as well as each subsequent treatment step, easier to operate and manage. The constant flow allows the processes to become more stable and reliable. It also allows for more appropriate sizing of subsequent treatment processes, including membrane processes at the AWTF, preventing over-design due to sizing for peak flows.

Currently, EWPCF utilizes Aeration Basin No. 4 for primary flow equalization; however, this required modifications to the basin and addition of manual controls. Converting the EWPCF to an NDN facility will require additional aeration basin volume; thus, Basin No. 4 is likely to be needed for its original purpose in the future.

A flow equalization simulation was performed to estimate the volume required to equalize an average daily flow of 31 mgd assuming a typical diurnal flow pattern (Figure 2-1). Based on the simulation, approximately 4.5 MG of equalization volume is required. A 20% safety factor was assumed resulting in a total volume of 5.4 MG. Based on this analysis, two new 2.7 MG circular tanks are assumed to provide primary flow equalization.

Figure 2-1: Projected EWPCF Diurnal Flow Curve and Flow Equalization Volume



2.1.3 Conversion of Secondary Treatment to NDN

Currently, EWPCF operates in a non-nitrifying mode which has the primary goals of reducing the biochemical oxygen demand (BOD), total suspended solids (TSS) and turbidity of the secondary effluent for ocean discharge. However, as mentioned, biological nutrient removal such as nitrification-denitrification (NDN) is recommended for waters used as source waters for an AWTF. Running the EWPCF as an NDN facility, specifically using the Modified Ludzack-Ettinger Process (MLE), will lead to more consistent and better water quality with respect to BOD, TSS, turbidity, TOC and contaminants of emerging concern (CECs). It will also reduce the downstream capital costs of filtration at the AWTF and reduce fouling of the membranes. Typically, MLE requires greater aeration basin capacity than non-nitrifying facilities. However, EWPCF currently uses only two of four aeration basins and can potentially accommodate MLE in the existing aeration basins so recent water quality data and biological modeling was utilized to evaluate MLE at EWPCF.

The strength of the influent wastewater to the EWPCF has increased in recent years due to drought and water conservation efforts. Table 2-1 presents and compares average influent and primary effluent strength from 2011-2012 and 2016.

Table 2-1: Average Influent and Primary Effluent Strength for 2011 - 2012 and 2016

Parameter	Units	2011-2012	2016	Percent Change
Influent Flow	mgd	23.2	21.0	-11%
Influent TSS	mg/L	299	380	21%
Influent BOD	mg/L	288	406	29%
Primary Effluent TSS	mg/L	71	57	-25%
Primary Effluent BOD	mg/L	159	203	22%
TSS Removal	%	76	85	11%
BOD Removal	%	44	50	12%

As shown in Table 2-1, the average influent TSS and BOD have increased by 21% and 29%, respectively, since the sampling in 2011-2012. The primary effluent BOD also increased similarly (by 22%), but the primary effluent TSS decreased. Though TSS removal was already quite high during the first sampling (76% removal), it increased to 85% removal in 2016 leading to a decrease of 25% in primary effluent TSS. Therefore, although influent TSS increased 21% from 2011-2012 to 2016, primary effluent TSS decreased by 25% over this same interval. This could be explained by chemical enhancement of the primary sedimentation, or perhaps by increases in chemical dosing or hydraulic residence time.

Overall, increases in influent TSS and BOD are dampened by primary sedimentation and do not affect secondary processes as much as influent concentrations would suggest. Influent ammonia is not measured but would follow the same trends as TSS and BOD, though ammonia would not be removed by primary sedimentation. While increased ammonia concentrations do not impact conventional treatment, they are a significant factor in NDN. Limited data is available on nitrogen in influent or primary effluent flows, so additional sampling and profiling of the influent and primary effluent should be performed to further develop the conversion to NDN.

Modeling of the EWPCF was conducted using GPS-X, a dynamic wastewater treatment simulator. The model was calibrated using 2016 operational data as it is most representative of recent wastewater strength. Table 2-2 presents the average historical conditions (January - December 2016) and the calibrated model results. Once the model was calibrated to closely simulate the average conditions, it was used to simulate NDN conditions at 2040 design flows, peak flows, and peak concentrations and sludge volume index (SVI) assuming primary flow equalization and steady state conditions.

Table 2-2: Modeling Results Summary

Parameters [a]	Units	Existing Average Conditions (2016)	Calibrated Model Results	NDN Modeling Results				Typical Design Values	
				Current Flow	Projected 2040 Flow	Peak Flow [c]	Peak Conc. & SVI [c, d]	Conventional	NDN
Flow	mgd	21.0	21.0	21.0	31.0	40.3	31.0	--	
Primary Clarifiers									
Primary Clarifiers in Operation	No.	6	6	6	9	10	9	--	
Primary Overflow Rate	gpd/sf	1094	1094	1094	1076	1259	1076	800 – 1000	
Primary Detention Time	hours	1.5	1.5	1.5	1.5	1.3	1.5	1.5 – 2.5	
Primary Effluent TSS	mg/L	57	57	57	57	57	70	--	
Primary Effluent BOD	mg/L	203	203	203	203	203	226	--	
Primary Effluent TKN	mg/L	46	46	46	46	46	50	--	
Aeration Basins (Bioreactors)									
Aeration Basins Online	No.	2	2	3	3	4	4	--	
Active Bioreactor Volume	MG	4.68	4.68	7.02	7.02	9.36	9.36	--	
Anaerobic/Anoxic Volume	%	17	17	33	33	33	33	20 - 40	
Bioreactor Detention Time	hours	5.3	5.3	8.0	5.4	5.6	7.2	2.5 – 5.0	5.0 – 12
SRT	days	1.88	1.88	8.0	8.0	8.0	8.0	<2.5	>8
Mixed Liquor Recycle Flow	mgd	0	0	100	120	120	120	0	2Q – 4Q
RAS Flow [g]	%Q	37	37	75	75	75	100	50 – 100	
MLSS	mg/L	1413	1415	2960	4313	4140	3940	1000 – 2500	2500 - 5000
Alpha factor [e]	--	--	0.6	0.4-0.6	0.4-0.6	0.4-0.6	0.4-0.6	0.4 – 0.6	
SOTE [f]	%	--	16	16	16	16	16	30	
Dissolved Oxygen (Zones 3&6)	mg/L	1.4/1.8	1.4/1.8	1.4/1.8	1.4/1.8	1.4/1.8	1.4/1.8	2	
OUR (1st Aerobic Zone)	$mgO_2/(L.h)$	NA	39	61	91	87	74	<100	
Total Airflow	scfm	10213	8465	29600	43300	55900	47000	--	

Table 2-2: Modeling Results Summary (Continued)

Parameters [a]	Units	Existing Average Conditions (2016)	Calibrated Model Results	NDN Modeling Results				Typical Design Values	
				Current Flow	Projected 2040 Flow	Peak Flow [c]	Peak Conc. & SVI [c, d]	Conventional	NDN
Secondary Clarifiers									
Secondary Clarifiers in Service	No.	5	5	5	7	8	8	--	
SVI	mL/g	150	150	150	150	150	180	--	
WAS Rate	mgd	0.74	0.74	0.39	0.38	0.51	0.66	--	
WAS Concentration	mg/L	4992	4764	6736	9903	9690	7700	--	
2° Overflow Rate	gpd/sf	485	485	476	505	575	440	400 – 700	
2° Solids Loading Rate	lb/(sf.d)	7.8	7.8	21.0	32.2	35.5	29.4	<35	
2° BOD	mg/L	--	5.7	5.0	6.0	6.0	5.0	--	
2° TSS	mg/L	7.56	9.00	9.00	12.00	12.00	10.00	--	
2° Ammonia	mg/L	33.7	34.0	0.2	0.2	0.2	0.2	>30	<1
2° Nitrite + Nitrate	mg/L	0	0	15.0	15.0	14.3	14.3	0	<10
2° TKN	mg/L	--	35.4	1.5	1.7	1.7	1.5	>30	<5

Footnotes:

a. SRT = solids retention time, RAS = return activated sludge, MLSS = mixed liquor suspended solids, OUR = oxygen uptake rate, WAS = waste activated sludge
b. Peak flow is assuming a peaking factor of 1.3
c. Peak conditions assume 4th aeration basin is in service and 8th clarifier is equipped and operational
d. Peak concentrations/SVI assume 90th percentile primary effluent BOD, TSS and TKN concentrations and SVI from 2016
e. Alpha factor based on low concentration MLSS and assumed to be lower for higher MLSS concentration; tapered through the aeration basin for NDN scenarios
f. SOTE calibrated to target approximate total aeration airflow assuming some of the existing airflow used for channel mixing
g. Higher RAS rate required for peak concentration/SVI condition to keep secondary clarifier blankets low

The NDN model results for the 2040 projected flows show that NDN with the MLE process is possible with the existing tanks/footprint at EWPCF; however, there is limited redundancy as three of four aeration basins and seven of eight secondary clarifiers are in use at that condition. To ensure that current tankage could handle peak storm events or other challenging circumstances (e.g., peak concentrations and reduced sludge settleability), additional scenarios were modeled. The NDN model results at peak flows show that existing tankage can treat up to 40.3 mgd, though all four aeration basins and all eight secondary clarifiers would be in use. This is also the case for the peak concentration and SVI condition, for which the 90^{th} percentile primary effluent BOD, TSS, TKN and SVI values from 2016 were used as model inputs. There is a significant increase in aeration demand and associated energy requirements for all NDN scenarios, which is described in more detail in Section 2.3 below. The solids loading rate to the secondary clarifiers appears to be the most limiting factor for all NDN conditions, and due to the lack of redundancy at 2040 peak conditions, two additional secondary clarifiers are recommended.

The biological modeling results for NDN at the projected 2040 flow are compared to the current operating conditions of the City of San Diego's North City Water Reclamation Plant (WRP) in Table 2-3. North City WRP is designed to treat and reclaim up to 30 mgd of wastewater, though it currently receives only 15.4 mgd of influent flow. Recycled water produced at the North City WRP supplements the water supply of the northern region of the City of San Diego, used primarily for industrial and agricultural purposes. The North City WRP is an NDN facility that has been running successfully since 1996 and is similar in many ways to the proposed EWPCF at 2040 design flows utilizing MLE.

Table 2-3: Aeration Basin Retrofit

Parameter	Encina WPCF (2040)	North City WRP [a]
Influent Flow	31.0 mgd	15.4 mgd
Aeration Basins		
Duty/Total Number of Units	3/4	3/7
Sludge Retention Time (SRT)	8 days	10 days
Mixed Liquor Suspended Solids (MLSS)	4,313 mg/L	4,500 mg/L
Hydraulic Retention Time (HRT)	5.4 hours	5.1 hours
Secondary Clarifiers		
Duty/Total Number of Units	7/8	8/14
Overflow Rate	505 gpd/sf	538 gpd/sf
Solids Loading Rate	32.2 lbs/sf-d	33.6 lbs/sf-d

Footnotes:

a) Based on operational data from July 1, 2016 through February 22, 2017.

Table 2-3 shows clear similarities between the estimated operational parameters for the EWPCF running as an MLE facility and those employed at the North City WRP. EWPCF is closer to its full treatment capacity than the North City WRP, but the similarity in operations suggests that the designs for the EWPCF with MLE at 2040 flows are reasonable and yield results similar to the well-functioning North City WRP.

It is important to note that there are other treatment options available for achieving nutrient removal, such as the use of a membrane bioreactor (MBR) in the secondary treatment process or using the secondary effluent as source water for an MBR. Retrofitting the EWPCF with an MBR system would be a major capital investment and would also carry high operating expenditures, including additional energy for air scouring, chemicals for membrane cleans, and routine membrane replacements every 5-7 years. An MBR treating a non-nitrified secondary effluent will also require a supplemental carbon source, such as methanol, for denitrification. Based on the increased associated cost, MBR was not assessed in this Reuse Study.

2.1.4 Tertiary Filters

Filtration is recommended to reduce the particulate matter in the secondary effluent prior to the AWTF. Lower particulate levels will help improve the effectiveness of downstream membrane treatment processes and reduce the maintenance requirements for the online meters. The filters will also provide a significant buffer to any process upsets in the upstream wastewater treatment plant and redundancy of treatment processes, which is ideal for potable reuse schemes.

Six granular media filters, each with a surface area of 440 ft^2, are assumed to filter the 19 mgd of secondary effluent to be treated by the AWTF. A waste wash water equalization basin is also required to equalize the granular media filter and membrane filtration backwash flows. The filtrate from the tertiary filters will feed the AWTF and does not need to adhere to Title 22 filtration requirements, so these filters can exceed 5 gpm/ft^2. The predicted flow rate through all six filters is 5 gpm/ft^2, increasing to 7.50 gpm/ft^2 with two filters offline.

2.1.5 Management of Sludge Dewatering Sidestreams

The dewatering of digested sludge results in liquid sidestreams that contain high concentrations of (1) nutrients (ammonia and phosphorus), (2) polymers and organic components that are known precursors of NDMA (a carcinogenic disinfection byproduct known to breach RO systems), and (3) recalcitrant organics that behave as strong membrane foulants. Currently, EWPCF treats sludge dewatering sidestreams in the plant with the rest of their water. It is critical to manage and dilute these sidestreams effectively to ensure reliable nitrification, minimize NDMA formation, provide consistent treatment, and protect the downstream membranes.

The best option for the management of sludge dewatering streams at EWPCF is to have separate treatment for the sidestreams (e.g., a membrane bioreactor), and discharge the effluent into the ocean at the Encina Ocean Outfall. This option will need to be assessed further to ensure that EWPCF can still meet their ocean-discharge permits with the inclusion of these sidestreams. With this configuration, the treated effluent from the sidestreams is not recycled through the treatment plant, which is ideal for both maintaining consistent conditions for the biological processes and for improving effluent quality.

Alternatively, the sidestreams can be returned to primary flow equalization basins. By returning the sludge dewatering sidestreams to primary flow equalization basins, these concentrated liquid streams are diluted and slowly brought back into the biological treatment process when the BOD and ammonia load are lowest.

2.2 Preliminary Layout of Improvements

The modifications to the EWPCF and the proposed AWTF could be sited in the area south of the treatment plant designated for expansion (except for the additional secondary clarifiers, which could fit in the current EWPCF footprint) (Figure 2-2). Refer to Table 2-4 for the dimensions of the proposed facilities.

Figure 2-2: Preliminary site layout for new facilities at EWPCF

Table 2-4: Dimensions of Proposed Facilities

Description	Dimensions (ft)
Primary Flow EQ Tanks (2)	140 (dia.)
Tertiary Filters (6)	20 x 22 x 7 (L x W x D)
Waste Wash Water Basin	40 x 40 x 25 (L x W x D)
Tertiary Filter Perimeter	200 x 100 (L x W)

2.3 Conceptual Costs for EWPCF Improvements

2.3.1 Capital Costs

Preliminary cost estimates were performed for the following EWPCF treatment improvements:

- Primary effluent flow equalization
- Conversion of the secondary process to MLE
- Tertiary filters

Estimates for sidestream treatment of the centrifuge centrate are not included in this preliminary cost estimate associated with the EWPCF but should be further evaluated.

Primary effluent flow equalization assumes two concrete storage tanks, piping, a pump, flow meter, and control valve. The costs of excavation and installation are included in the estimate as well.

Conversion of the secondary process to MLE will require the following modifications:

- Internal mixed liquor recycle (IMLR)
  - Pumps
  - Piping
- Anoxic Zones
  - Baffling
  - Mixing
  - Scum and Foam Removal
- Aeration
  - Larger blowers
  - Larger air piping
  - Additional fine bubble diffusers
- Clarification
  - Two additional secondary clarifiers

The preliminary cost estimate (see Appendix A) assumes that NDN will take place in the existing aeration basins with the retrofits listed above. Larger air piping, new blowers, and enhanced mixing make up the bulk of the estimated additional capital associated with the aeration basin retrofit for MLE. It is assumed that the existing blower building is adequate for accommodating the new blowers. If the existing aeration piping is large enough for the anticipated airflow rates for nitrification, then the additional capital associated with MLE could be considerably less than what is shown in Appendix A. Installation costs for this equipment are listed separately.

Two additional circular secondary clarifiers are assumed with the same dimensions as the existing secondary clarifiers. This cost estimate includes the cost of two new secondary clarifier structures and the equipment for three clarifiers (i.e., to also equip the existing Secondary Clarifier No. 8 that is currently unequipped). The costs of equipment, excavation and installation for the new clarifiers are included in the estimate for the structures, while the equipment cost for the unequipped existing clarifier is listed as its own line item. Installation for the unequipped secondary clarifier equipment is listed separately, in combination with the installation of the aeration basin retrofit.

Six granular media filters are assumed with surface areas of 440 ft^2, as well as a waste wash water equalization tank with a capacity of 264,000 gal. The waste wash water tank was sized to hold three backwash volumes (estimated as 200 gal/sf filter surface area); this is a conservative sizing approach that should also be sufficient to accommodate backwash water from membrane processes at the AWTF as well. The cost estimates for the tertiary filters include excavation, piping and installation.

2.3.2 O&M Costs

The operations and maintenance (O&M) costs associated with NDN are also higher than non-nitrified treatment. The cost increases over "status quo" EWPCF operating conditions are presented in Table 2-5 (based upon a rate of $0.15 per kWh), and are also included in Appendix A.

Table 2-5: Preliminary Estimate of Increase in O&M Cost with NDN

O&M Item	Difference in Cost
Power	
Aeration Blowers	$2,013,000
IMLR Pumps	$122,000
Anoxic Zone Mixers	$47,000
Subtotal Power Costs	**$2,182,000**
Equipment	
Equipment Rehabilitation and Replacement	$71,500
Estimated Annual O&M Increase	**$2,254,000**

The O&M cost estimates assume that EWPCF is running at the design flow of 31 mgd. The difference in O&M costs scale with flow should EWPCF not operate at the design condition. The principal driver for the increase in O&M costs is the power demand associated with the increased aeration demand for nitrification. It was assumed that no additional labor would be required over EWA's baseline operations and that there would be no increase in chemical costs as additional coagulant/polymer is not expected to be necessary.

3 Advanced Water Treatment Concepts

3.1 Overview

In implementing potable reuse at the EWPCF, protection of public health requires adequate treatment to remove pathogens and chemicals, a system of multiple barriers for reliability and redundancy, systematic monitoring to ensure compliance, proper operation and maintenance, careful source control, and qualified operator training. Combining treatment processes into a series of multiple barriers provides effective pathogen and chemical pollutant reduction.

While the pathogen and chemical pollutant removal goals are the same for all types of potable reuse, the actual combination of treatment processes can vary, depending on the end use. The major concerns of using treated wastewater as a feed source for purification are the presence of pathogens and trace-level constituents in secondary effluent (Rose et at., 2004, Olivieri et al., 2007, and Trussell et al., 2015).

Additional processes beyond secondary or tertiary treatment, defined as Advanced Water Treatment, are used to produce advanced treated water (ATW) (Tchobanoglous et al., 2015). ATW must protect human health, as well as surface water quality and groundwater quality, depending upon the use of the water. To serve as a new water source, ATW must meet federal, state, and local regulations. A description of the regulatory requirements and a review of water reuse projects in California and Nationally is provided in this Study's TM1: "Background of Potable Reuse in California".

From a risk reduction standpoint, minimization of both chronic and acute risk to consumers is the goal of advanced treatment. From a public health perspective, potable water reuse depends on the combined performance of various processes to remove pathogens and pollutants. These processes can only produce water reliably if the overall treatment train is robust, redundant, and resilient (known as the "4 Rs", Pecson et al., 2015).

Each treatment process operates within a performance range, often normally or close to normally distributed. This means that, for a small percentage of time, the performance of that process may be below or above the expected value. From a treatment train perspective, should the low level of performance (equating to lesser water quality) for one key process occur at the same time as the low level of performance for another key process, there may be an increased risk to public health. This risk is minimized through coupling reliability and redundancy. To make processes redundant, treatment processes are designed with multiple barriers to provide effective pathogen and chemical pollutant reduction. While the pathogen removal and chemical pollutant goal is the same for all types of potable reuse, the types and combinations of treatment processes can vary based on the source water, end use, and other project-specific factors.

3.2 Treatment Technologies

Potable reuse treatment technologies have been documented in both demonstration and full-scale applications through years of research and performance monitoring. This section summarizes accepted treatment technologies that would be appropriate for producing ATW from EWPCF effluent.

3.2.1 Ozonation with Biologically Active Filtration

Ozonation (O_3) with biologically active filtration (BAF) is a treatment combination used to break down organic matter and trace pollutants into smaller molecules through chemical oxidation by ozone, so that the biofilm developed in the biofilter can more readily biodegrade the oxidized organic matter. O_3/BAF can be installed ahead of microfiltration (MF) or ultrafiltration (UF) membranes, enhancing their operation. There are three primary benefits of O_3/BAF treatment:

- reduction of TOC, both the bulk TOC and trace pollutants,
- reduction of pathogens, and
- removal of nutrients (e.g., ammonia removal through nitrification).

Results from two recent O_3/BAF demonstration projects for potable water reuse are summarized in this section.

Pilot at Reno-Stead Water Reclamation Plant, Las Vegas, NV

An O_3/BAF demonstration project was completed as part of WRRF Project 11-02, and documented by Trussell et al. (2015). The O_3/BAF pilot plant used an O_3 system from MiPro, advanced oxidation pilot system from Xylem, and the BAF from Leopold Biofiltration. The O_3/BAF was studied on a very high quality secondary effluent, with and without microfiltration as pretreatment. Feed TOC was approximately 5 mg/L. TOC removal percentages were higher for MF filtered water (29-40 %, average 34 %) compared to secondary effluent (26-33 %, average 30%). Substantial destruction and degradation of trace pollutants (e.g., hormones and pharmaceuticals) was seen as part of this study.

Pilot at Santa Clara Valley Water District

An O_3/BAF demonstration project was completed at the Santa Clara Valley Water District (SCVWD) (2015) using the same O_3/BAF pilot plant as in Trussell et al. (2015). Two water qualities were used with the O_3/BAF setup (tertiary recycled water and secondary effluent) at O_3/TOC values of <1, and with BAF empty bed contact times (EBCTs) of 20 to 30 minutes, based on Trussell et al. (2015). The goal of testing the different operational scenarios was to maximize TOC reduction, destroy or reduce trace organic constituents, and destroy pathogens, all while minimizing the construction cost of a future O_3/BAF system.

Influent water quality plays an important role in O_3 demand and O_3 dosing costs. A stable influent water quality lessens operational effort with a streamlined dosing system for both O_3 and BAF. Overall, the TOC removal for this study's O_3/BAF pilot was approximately 20% when treating blended tertiary recycled water, and 25 % when treating secondary effluent. The effluent TOC from the O_3/BAF pilot ranged from 2 to 7 mg/L. Reduced performance on the tertiary recycled water was potentially due to the variability in feed water quality, particularly due to the changing chlorine concentration and type (free or combined). Periodic breakthrough of chlorine to the BAF could hinder the biological activity within the BAF. O_3/BAF showed good reduction of ammonia through BAF (from ~1 mg/L to below detection [0.1 mg/L]), but nitrate levels, as expected, remained high (~11 to 15 mg/L as nitrate-N). The BAF would need to be run in an entirely different mode to provide denitrification.

Disinfection byproduct formation, particularly bromate, chlorate, and NDMA, is also a concern due to the use of O_3, and thus was measured through the O_3/BAF process at SCVWD (2015). O_3 was shown to form bromate, for which BAF was an effective removal technology. Higher O_3/TOC ratios resulted in higher bromate formation, as expected. In all tested cases, the O_3/BAF finished water bromate concentration was less than the MCL. Chlorate levels were low in the feed to the O_3/BAF, with no measurable increase by ozonation or decrease through BAF. The O_3/BAF finished water chlorate concentration for all tests was less than the notification level of 800 µg/L (NL). Consistent with other work, ozonation increases NDMA formation, and BAF reduces NDMA concentrations. The key to meeting NDMA targets (such as 10 ng/L) is to minimize NDMA levels upstream of ozonation (e.g., by separating sludge dewatering centrate sidestream flows as described in Section 2.1.5 above).

Overall Performance for Pathogen Reduction: No log removal credit is obtained by BAF, though the U.S. Environmental Protection Agency's (USEPA) Long Term 2 Enhanced Surface Water Treatment Rule could be used to obtain pathogen credit based upon filtered effluent turbidity values (USEPA, 2006). However, log removal credit can be achieved by ozonation. Assuming a temperature of 15 ºC or higher, Giardia is reduced by 3 log at a CT of 0.95 mg/min/L. At the same temperature, 4-log reduction of virus occurs at a CT of 0.6 mg/min/L. A 5-log virus disinfection approval for O_3 disinfection is based upon a minimum CT of 1.0 mg/min/L. Trussell et al. (2015) documented similar virus kill. Both projects consistently demonstrated 7+ log reduction of seeded MS2. Such log reduction of MS2 is conservatively equivalent to 5-log reduction of poliovirus (Tchobanoglous et al., 2015).

3.2.2 Membrane Filtration - Microfiltration/ Ultrafiltration

Microfiltration (MF) and Ultrafiltration (UF) are both types of physical filtration processes. Membranes used for MF applications have a pore size that ranges from 0.1 to 10 µm, while UF membrane pore sizes are smaller, in the range of 0.001 to 0.1 µm. MF/UF is a robust technology that has proved to be effective to remove *Giardia* oocysts and *Cryptosporidium* cysts, algae, and some bacterial species. However, MF is not an effective barrier to viruses. On the other hand, UF have proven to be effective in removing viruses. MF/UF processes have not been shown to remove a significant amount of chemical pollutants. A primary function of the MF/UF system in a potable reuse treatment train is to provide adequate pretreatment for sustainable operation of the RO process.

Recent DPR demonstration testing with Clean Water Services (CWS) (Oregon) indicates that a well-functioning UF membrane (0.01 µm nominal pore size in this case) can attain 4.7-log reduction of seeded virus (CWS, 2014) without chemical use (such as alum or polymer) ahead of the membrane. Equivalent or greater reduction of protozoa can be assumed based upon this data, and is directly supported by NSF (2012). Furthermore, MF or UF membrane integrity testing (MIT) confirms system performance and demonstrates how MIT data can be used to track and ensure continued membrane performance (CWS, 2014).

Overall Performance for Pathogen Reduction: Both MF and UF membranes can be relied upon for 4+ log reduction of protozoa. System performance monitoring (to provide regulators confidence in the removal credit) is accomplished by precise and accurate filtrate turbidity monitoring coupled with daily pressure hold tests and MIT. Innovative methods to track MF or UF performance includes the use of bench-scale particle counting and the use of adenosine triphosphate (ATP) to daily verify bacteria removal. ATP provides a near real-time microbial monitoring tool that could allow better diagnosis and mitigation of threats as compared to the more conventional MIT and turbidity monitoring.

3.2.3 Reverse Osmosis (RO)

The RO process in a potable reuse treatment train provides for removal of salt (measured as TDS and electrical conductivity (EC)), organics (measured as total organic carbon (TOC)), and pathogens. RO removes ~95 percent of incoming salt. Depending on the feed water quality, RO permeate can have a total dissolved solids (TDS) concentration lower than 50 mg/L. Along with salt and TOC removal, RO removes trace level pollutants as hormones, pharmaceuticals, and personal care products.

Studies have found virus removal by RO to be from 3 to >6-log (Reardon et al., 2005, NRMMC/EPHC/NHMRC 2008, CWS 2014). Equal or greater removal is expected for protozoa based upon size differences (protozoa being much larger than virus). However, the log removal value for RO pathogen rejection is not governed by the ability of an intact membrane to reject pathogens; it is governed by the ability to monitor process integrity (Reardon et al., 2005 and Schäfer et al., 2005). The monitoring tools currently used, EC meters and TOC meters, can measure 99 percent or less removal of both parameters through the RO process. Recently, the DDW granted 1.5-log reduction credit for all pathogens for RO (WRD, 2013), based upon a requirement to continuously monitor TOC reduction across RO. The Orange County Water District currently attains 2-log pathogen credit using online TOC meters.

Alternative technologies, such as online fluorescent dye monitoring, have been shown to have higher accuracy in assessing membrane efficiency (Steinle-Darling et al., 2016, Kitis et al., 2003, Henderson et al., 2009, Pype et al., 2013). The proprietary Trasar® fluorescent dye (Nalco) is stable over a range of temperature and is not impacted by pH in the range of 4 to 10. At 600 g/mol, this compound is larger than the openings in the RO membrane, but smaller than the size of any target pathogen, making the Trasar technology a potentially valuable tool for RO system performance monitoring.

The Trasar technology's efficiency to detect any flaw in a RO membrane was tested as part of the Ventura Water Pure demonstration testing. The test included monitoring the removal of seeded virus MS2, EC, and Trasar for different RO operational conditions, including "normal" operation, a cut O-ring condition, and two chlorine oxidized RO membranes. The performance was tracked across both the first stage of RO and for the entire RO. Results from this research demonstrate the ability to conservatively monitor 3 to >4-log removal of virus using Trasar, compared to ~1.5-log removal of other monitoring surrogates (Steinle-Darling et al., 2016).

Overall Performance for Pathogen Reduction: RO provides a robust removal for all pathogens and substantial removal of trace level chemical pollutants. For the purposes of this Study, we are assuming 1.5-log reduction for all pathogens, with an increase to 3.0-log reduction if the Trasar technology is used. California DDW has stated that they are willing to approve the Trasar technology once a utility applies for credit.

3.2.4 Advanced Oxidation Process (AOP)

In the event of pathogens passing through RO, the AOP process provides additional disinfection and removal of trace organics. An ultraviolet irradiation (UV) dose of 235 mJ/cm^2 will result in 6+ log reductions of all target pathogens (USEPA 2006; Hijnen et al., 2006, Rochelle et al., 2005), including Cryptosporidium, Giardia, and adenovirus. Potable water reuse UV AOP systems will commonly operate at UV doses greater than 900 mJ/cm^2; thus, higher reductions are theoretically possible, but DDW allows only a maximum of 6-log reduction credits per any one treatment technology (CDPH, 2014).

Adding an oxidant before a high UV dose results in the generation of hydroxyl radicals during treatment, providing an advanced oxidation process (AOP). The UV AOP provides destruction of a range of pollutants that may pass through RO. Either Hydrogen peroxide (H_2O_2) or sodium hypochlorite (NaOCl) can be used as an oxidant for this application. H_2O_2 is a more common oxidant than NaOCl for UV AOP applications. Both the NaOCl and H_2O_2 UV AOPs are controlled by oxidant dose and UV dose (UV intensity, UV transmittance, or power). However, the NaOCL UV process is also controlled by the influent pH to the UV reactor and is sensitive to ammonia residual through the RO process, which has a high NaOCl demand, thereby requiring a higher oxidant dose. Free chlorine concentration and pH should be closely monitored to ensure the UV AOP design dose is met.

DDW requires the UV AOP to provide at least 0.5-log reduction of 1,4-dioxane, a conservative surrogate for destruction of trace pollutants (CDPH, 2014). Additionally, NDMA, with a DDW notification level (NL) of 10 ng/L, can pass through RO at low concentrations (typically 20 to 100 ng/L), requiring destruction by UV photolysis (Sharpless and Linden, 2003). Therefore, it is common to set the UV dose at 900 mJ/cm^2 or higher. This high UV dose photolyzes NDMA as well as many other smaller chemicals that may have passed through the RO train. NDMA is particularly photolabile.

Overall Performance for Pathogen Reduction: UV/AOP reliably provides at least 6-log disinfection of both protozoa and virus. The same system will reduce NDMA to <10 ng/L and destroy at least 0.5-log of 1,4-dioxane, thus also reducing other trace level pollutants. Online dose monitoring systems, using real time inputs of UV, UV intensity, flow, and oxidant dosing, is recommended for continuous confidence in UV AOP performance.

3.2.5 High-Flux Water Treatment Plant

To meet the anticipated regulations for direct potable reuse (following the Quirk Bill), in particular for “treated drinking water augmentation”, a separate water treatment plant consisting of engineered storage buffer (ESB), chlorination, and a high-flux UF system will be used to treat the purified water produced by the AWTF. The UF system will be able to achieve high fluxes (~120 gfd) due to the high quality of the water.

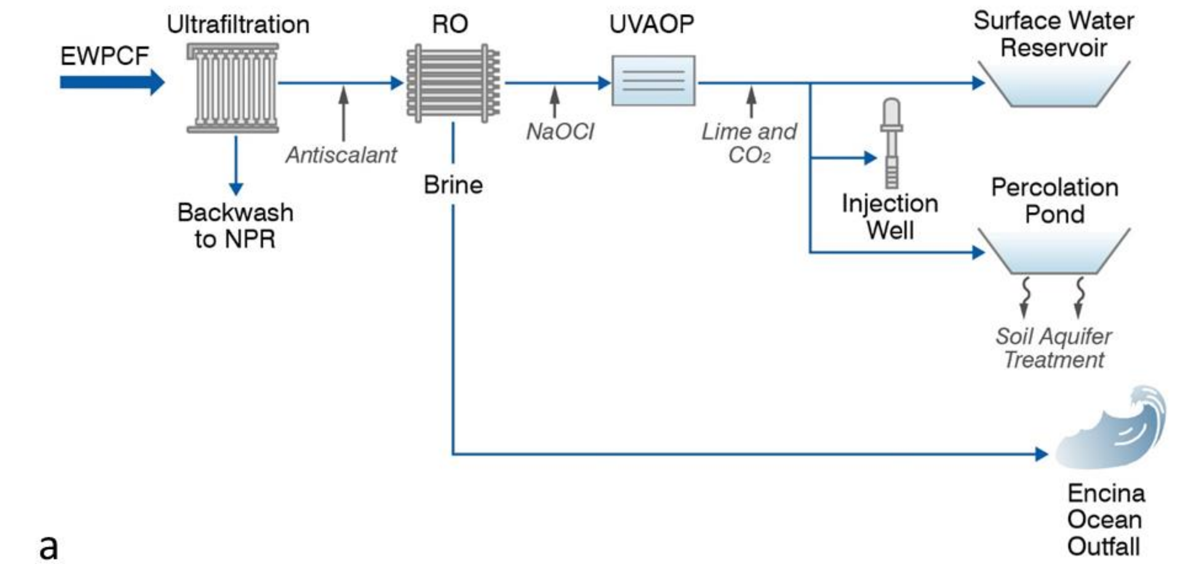
For this case, the ESB has been designed to have a residence time of two (2) hours. This time will provide response time to identify treatment and monitoring system failures and implement appropriate corrective actions. Should the hold time of two hours pass without an “override” by the responsible operator (i.e., indicating successful resolution of any problems and return to required treatment quality), the “off-spec” water would be diverted to waste, followed by continued diversion until all issues are remedied.

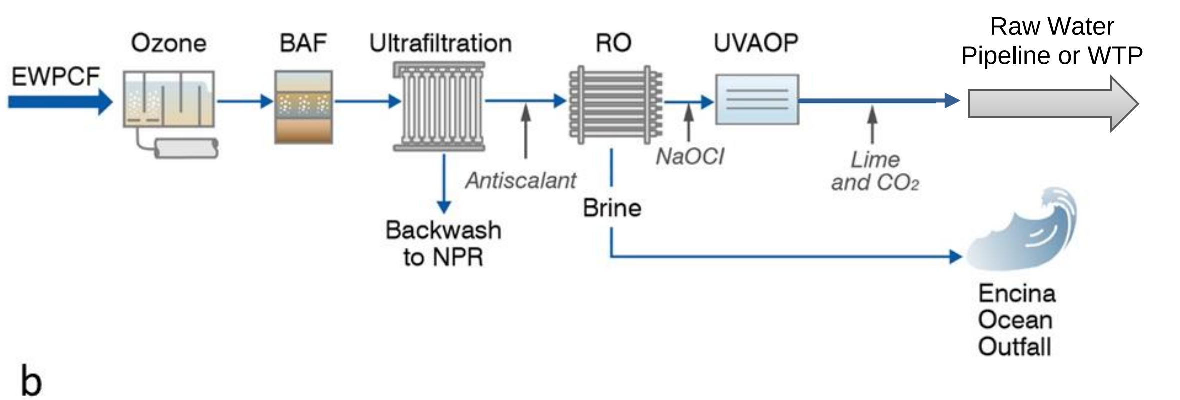
3.3 Proposed Treatment Trains

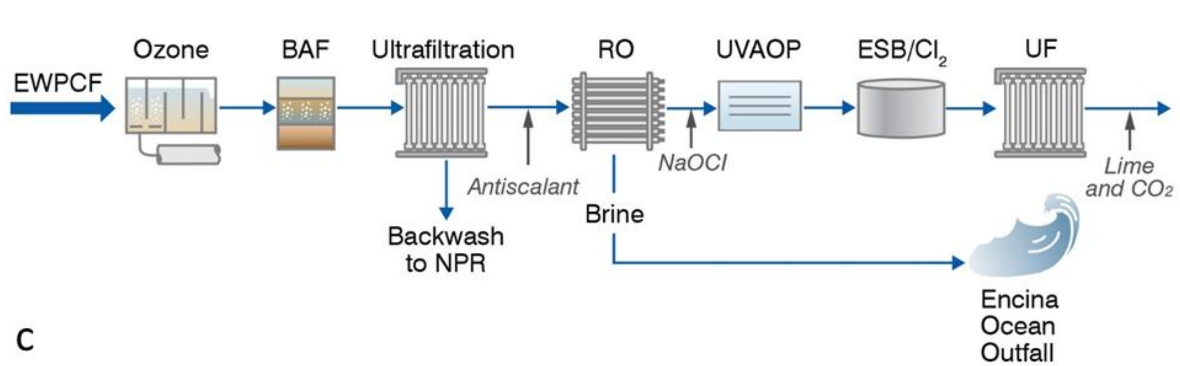
The proposed treatment trains for this Study’s Options combine the available technologies for advanced water treatment of pathogens and pollutants in accordance with current California state regulations for potable water reuse through groundwater injection and surface water augmentation. The proposed treatment trains (Figure 3-1 below) include RO for reduction of salts as well as the removal of pollutants and pathogens. The brine from the RO process will be disposed via the Encina Ocean Outfall. Backwash water for the MF/UF will be directed to the Carlsbad Water Reclamation Facility (CWRF) to augment non-potable reuse supplies.

a. **Full Advanced Treatment (FAT) AWTF**: this widely accepted treatment train includes membrane filtration (MF/UF), reverse osmosis (RO), and an ultraviolet light/advanced oxidation step (UV/NaOCl AOP). NaOCl as an oxidant for AOP presents benefits such as increased disinfection due to the presence of free chlorine, lower chemical cost, and operator familiarity. An additional benefit of the UV/NaOCl AOP is a more efficient generation of hydroxyl radicals at a low pH (<6), because RO permeate is typically in this pH range and can be readily controlled within this range. This treatment train is tailored to groundwater and surface water (reservoir) augmentation projects.
b. **FAT with O_3/BAF AWTF:** this treatment train adds ozonation (O_3) with biologically active filtration (BAF) as pretreatment before MF/UF. These additional treatment steps provide further pathogen removal and enhanced water quality, improving the performance of downstream technologies. This treatment train is anticipated to be appropriate for raw water augmentation projects, based on currently available information (DDW regulations are pending).
c. **FAT with O_3/BAF AWTF plus WTP:** in addition to the FAT with O_3/BAF advanced treatment train, an additional barrier and treatment would be provided by a tailored Water Treatment Plant (WTP) consisting of an Engineered Storage Buffer (ESB) with chlorination (Cl_2) and a high-flux UF system. This treatment train is anticipated to be appropriate for integration with the potable water system, based on currently available information (DDW regulations are pending).

Figure 3-1: Advanced Treatment Train Options.







3.4 Unit Process Monitoring

The performance of each treatment process is measured by log reduction of pathogens and removal of chemical compounds. Because a system of multiple barriers is added up to meet the total log reduction criteria established by regulations, it is important to understand the log reductions that occur across each process. The log reduction credit (LRC) of each process is subject to the ability to accurately monitor system performance, either online or periodically. In California, the potable reuse goals (from source to drinking water) to meet regulatory criteria are defined in Table 3-1, better known as the 12/10/10 rule.

Table 3-1: Potable Reuse Pathogen Reduction Requirements (from source water to potable water).

Applicable Potable Reuse Form	Virus	*Giardia*	*Crypto.*
Groundwater Augmentation Surface Water Augmentation (standard: Dilution ≥ 100:1)	12	10	10
Surface Water Augmentation (reduced dilution: 100:1 ≥ Dilution ≥ 10:1)	13	11	11
Raw Water and Treated Drinking Water Augmentation*	14+	12+	12+

Footnotes:
* It is expected that the State will increase several LRC for raw water augmentation and treated drinking water augmentation projects. This increase does not imply an increase in health protection, but rather risk minimization to mitigate the potential of process failure without an environmental buffer.

3.4.1 Expected Performance of Proposed Treatment Trains

The anticipated total performance of a proposed treatment train will depend upon the coupled treatment processes, which in turn depends upon the planned type of potable water reuse. Tables 3-2 through 3-5 summarize the treatment performance for the proposed treatment trains described in Section 3.3 above.

Table 3-2: Expected Performance of Treatment Train "a" for Groundwater Augmentation.

Parameter	Primary/Secondary Treatment	UF[1]	RO[2]	UV/AOP[3]	Underground Travel Time[4]	Total Credits	Goal
Virus (log)	1.9	0	1.5	6	2.6	12.0	12
Giardia cysts (log)	0.8	4	1.5	6	0	12.3	10
Crypto. oocysts (log)	1.2	4	1.5	6	0	12.7	10
1,4-dioxane				X			0.5-log by AOP
NDMA			X	X			<10 ng/L
Turbidity		X					<0.2 NTU
TOC			X				<0.5 mg/L
Drinking Water MCLs	X		X	X			Varies

Footnotes:
1. Although UF can achieve greater than 2 LRC for virus, no regulatory credit is expected to be granted.
2. Online TOC monitoring can conservatively obtain 1.5 LRC.
3. Assumes NaOCl as oxidant can achieve comparable results to H_2O_2 as oxidant for 6 LRC.
4. DDW regulations set a minimum time of 2 months. Virus removal can be correlated with time at 1-log removal per month. For this example, 2.6 months is needed to obtain the full credit. Alternatively, Trasar® technology could be used for the RO process to demonstrate 3 LRC instead of 1.5 LRC with online TOC monitoring.

Table 3-3: Expected Performance of Treatment Train "a" for Surface Water Augmentation.

Parameter	Primary/Secondary Treatment	UF	RO[1]	UV/AOP[2]	WTP	Total Credits	Goal[3]
Virus (log)	1.9	0	1.5	6	4	13.4	13
Giardia cysts (log)	0.8	4	1.5	6	3	15.3	11
Crypto. oocysts (log)	1.2	4	1.5	6	3	15.7	11
1,4-dioxane				X	X		0.5-log by AOP
NDMA			X	X			<10 ng/L
Turbidity		X			X		<0.2 NTU
TOC			X		X		<0.5 mg/L
Drinking Water MCLs	X		X	X	X		Varies

Footnotes:

1. Online TOC monitoring can conservatively obtain 1.5 LRC.
2. Assumes NaOCl as oxidant can achieve comparable results to H_2O_2 as oxidant for 6 LRC.
3. Assumes reduced dilution credit requirements.

Table 3-4: Expected Performance of Treatment Train "b" for Raw Water Augmentation.

Parameter	Primary/ Secondary Treatment	O_3	BAF	UF	RO[1]	UV/AOP[2]	WTP	Total Credits	Goal
Virus (log)	1.9	5	0	0	3.0	6	4	19.9	14+
Giardia cysts (log)	0.8	3	0	4	3.0	6	3	19.8	12+
Crypto. oocysts (log)	1.2	0	0	4	3.0	6	3	17.2	12+
1,4-dioxane						X	X		0.5-log by AOP
NDMA			X		X	X			<10 ng/L
Turbidity			X	X			X		<0.2 NTU
TOC		X	X		X		X		<0.5 mg/L
Drinking Water MCLs	X	X	X		X	X	X		Varies

Footnotes:

1. Use of Trasar® technology for 3 LRC.
2. Assumes NaOCl as oxidant can achieve comparable results to H_2O_2 as oxidant for 6 LRC.

Table 3-5: Expected Performance of Treatment Train "c" for Treated Drinking Water Augmentation.

Parameter	Primary/ Secondary Treatment	O_3	BAF	UF	RO[1]	UV/AOP[2]	ESB/ Cl_2	UF	Total Credits	Goal
Virus (log)	1.9	5	0	0	3.0	6	6	1	22.9	14+
Giardia cysts (log)	0.8	3	0	4	3.0	6	3	4	23.8	12+
Crypto. oocysts (log)	1.2	0	0	4	3.0	6	0	4	18.2	12+
1,4-dioxane						X		X		0.5-log by AOP
NDMA			X		X	X				<10 ng/L
Turbidity			X	X				X		<0.2 NTU
TOC		X	X		X			X		<0.5 mg/L
Drinking Water MCLs	X	X	X		X	X		X		Varies

Footnotes:

1. Use of Trasar® technology for 3 LRC.
2. Assumes NaOCl as oxidant can achieve comparable results to H_2O_2 as oxidant for 6 LRC.

3.4.2 Critical Control Points

Operation, maintenance, and monitoring of each the processes used in advanced water treatment is of critical importance to ensure that the finished water is protective of public health. End-of-pipe compliance monitoring and performance-based monitoring are used to ensure that the AWTF continuously and reliably meets the regularity criteria. The benefit of a performance-based monitoring approach is to identify and implement Critical Control Points (CCPs) where hazards to human health risks can be reduced, prevented, or eliminated (Mosher et al., 2016).

NWRI defines a CCP as "a point in advanced water treatment where control can be applied to an individual unit process to reduce, prevent, or eliminate process failure and where monitoring is conducted to confirm that the control point is functioning correctly. The goal is to reduce the risk from pathogen and chemical constituents." (Tchobanoglous, 2015).

The CCP is intended to effectively monitor process performance, and hence relies upon the consistency of the monitoring system. Monitoring system failures can be gradual (sensor drift), slight (sensor bias), result in a loss in sensitivity, false positives, and false negatives, and even result in outright failure. Table 3-5 shows examples of CCPs for an AWTF and the corresponding monitoring requirements (Tchobanoglous, et al., 2015).

Table 3-6: CCPs for an AWTF.

CCP	Monitoring Tool
O_3 / BAF	Online ozone dose, empty bed contact time (EBCT); control dose based on the ozone-to-TOC ratio and ozone CT.
MF / UF	Daily pressure decay testing (PDT). Values in accordance with membrane supplier recommendations and validation to demonstrate membrane integrity
RO	Online EC or online TOC or online fluorescence. Log reduction of EC or TOC or fluorescence across the RO process to demonstrate a minimum level of pathogen removal.
UV-AOP	Intensity sensors. Following USEPA 2006 or other methods, online intensity monitoring demonstrates disinfection dose delivery.

Footnote: Adapted from Tchobanoglous et al., 2015 and Mosher et al., 2016

3.5 Facility Planning and Conceptual Layouts

The purification systems described here are intended to receive effluent from the EWPCF's proposed tertiary filters. It is assumed that the existing Secondary Effluent Equalization Pumps (SEEPs) capacity could be used to pump EWPCF effluent to the potential future AWT site, and thus there would be no added cost or engineering required for this effort. The UF and RO recoveries are estimated at 93% and 85%[1], respectively. The UV/AOP process uses sodium hypochlorite (NaOCl) as oxidant. The process is designed for an available EWPCF effluent flow of 20.5 mgd.

The conceptual facility layouts are intended to accommodate the additional staff required to operate the facility (including administration offices, maintenance shops, and vehicle access and parking), as well as accommodating public tour groups (including additional parking area and a large meeting room). Furthermore, the conceptual layouts have been configured to avoid conflicts with other planned uses for the South Parcel, including future Interstate 5 expansion, widening and re-alignment of Avenida Encinas, and additional secondary flow equalization facilities.

3.5.1 AWTF for Groundwater and Surface Water Augmentation

The preliminary design parameters used for the conceptual design of the AWTF for potable reuse via groundwater augmentation and surface water augmentation are shown in Table 3-7 through Table 3-9.

Table 3-7: UF System Design Parameters

System Component	Design Value	Unit
UF Feed Tank		
Number of tanks	1	
Volume for operational equalization, minimum	130,000	gal
Total residence time, minimum	11.5	min
Total water volume	163,000	gal
UF Feed Pump		
Pump type	Vertical Turbine	
Number of duty pumps	4	

[1] These estimated recoveries can be refined in the future with additional analysis of EWPCF water quality and specific treatment equipment.

System Component	Design Value	Unit
Number of standby pumps	1	
Capacity per pump	5.1	mgd
Drive type	VFD	
Automatic Strainer		
Manufacturer/model	Amiad Omega, SP Kinney: AF, Eaton 2596, Fluid Engineering Model 723, or equal	
Type	Auto-backwash strainer	
Design flow	20.5	mgd
Clean head loss, minimum	<1	psi
Duty units	4	
Standby units	1	
Excess capacity required	25	%
Capacity per strainer	6.41	mgd
Screen pore size, minimum	3	µm
Strainer recovery	99.93	%
Automatic strainer backwash residuals estimates		
Backwash average waste flow	3,000 - 33,000	gpd
Backwash duration per unit, per cycle	25 - 120	sec
Backwash volume per unity, per backwash cycle	148 - 800	gal
Backwash flow rate per unit, instantaneous	180 - 740	gpm
UF		
Manufacturer	Toray	
Model Number	HFU-2020N	
Membrane nominal pore size	0.01 µm	
Membrane area	775	ft^2
System rated capacity (filtrate flow)	19.1	mgd
Feed flow	20.5	mgd
UF Recovery (assumed)	93	%
Number of total racks	10	
Number of membrane modules per rack, installed	86	
Number of membrane modules per rack, total available	96	
Design flux, maximum instantaneous (N-2)	38.4	gfd
Backwash water supply	UF filtrate	
Backwash type	Reverse flow with air scour	
Backwash interval	24	min
Design NaOCl Maintenance Cleaning (MC) frequency	2x/week	

System Component	Design Value	Unit
Design Citric Acid ($C_6H_8O_7$) (MC) frequency	1/month	
Design Cleaning In Place (CIP) frequency	1/month	
Direct Integrity Testing (DIT) method	Daily PDTs	
Indirect integrity testing method	Continuous filtrate turbidity monitoring	
UF Backwash Pumps		
Pump type	Horizontal Centrifugal	
Number of duty pumps	1	
Number of standby pumps	1	
Flow rate, each pump	2,800	gpm
Total Dynamic Head (TDH)	100	ft
UF Backwash Flow Rates		
Cycle length between backwashes (duration of permeate production)	24	min
Total backwash cycle duration	3.17	min
Backwash flux	54.8	gfd
Backwash flow rate per module	29.5	gpm
Modules per rack, total	96	
Backwash flow rate, per rack (maximum instantaneous)	2,830	gpm
UF Backwash Residuals Estimates		
Backwash cycles per day (system)	424	
Backwash waste volume per cycle per rack	8,884	gal
Daily average residuals	1.4	mgd
UF Air Scour Blowers		
Blower Type	Positive-displacement lobe, or hybrid rotary lobe	
Number of sets	2	
Number of blowers on duty	1	
Number of blowers on standby	1	
Blower capacity, each	665	cfm
Blower pressure	15	psi
Blower motor power, each	60	hp
UF CIP/MC Cleaning procedures		
Typical duration, each rack, each clean	27-90	min
Design Frequency	NaOCl: 2x/week $C_6H_8O_7$: 1/month	

System Component	Design Value	Unit
Make-up water	UF filtrate	
Solution temperature, typical	100	˚F
CIP/MC System		
CIP/MC systems, total	2	
CIP fill pumps on duty	1	
CIP fill pumps on standby	1	
CIP fill pump flow rate, each	500	gpm
CIP fill pump TDH	38	ft
CIP fill pump motor power, each	7.5	hp
MC fill pumps on duty	1	
MC fill pumps on standby	1	
MC fill pump flow rate, each	500	gpm
MC fill pump TDH	20	ft
MC fill pump motor power, each	5	hp
CIP tanks per system	2	
CIP tank volume, each	6,000	gal
CIP pumps on duty	1	
CIP pumps on standby	1	
CIP pump flow rate, each	1,235	gpm
CIP pump TDH	97	ft
CIP pump motor power, each	50	hp
Neutralization System		
Neutralization systems	2	
Neutralization tanks per system	1	
Neutralization tank volume, each	15,000	gal
Pumps on duty	1	
Pumps on stand-by	1	
Neutralization/drain pump TDH	43	ft
Neutralization/drain pump flow rate, each pump	500	gpm
Neutralization/drain pump motor power, each pump	10	hp
Time to drain neutralization tank	30	min
UF CIP/MC Residuals Estimates		
Average CIP waste flow	6,300	gpd
CIP duration, total	4 to 6	hr
CIP chemical solutions, per CIP	1. Chlorine 2. $C_6H_8O_7$	

System Component	Design Value	Unit
CIP waste volume per CIP chemical solution	11,100	gal
CIP waste volume per CIP total	22,200	gal
Average MC waste flow	35,500	gpd
MC duration, total	Up to 90	min
MC waste volume per MC, total	11,100	gal
CIP/MC waste flow from neutralization tanks to drain, total	1,000	gpm
Average MC waste flow	35,500	gpd
UF compressed air system *(for pneumatic valves and the integrity testing system)*		
Compressors duty	1	
Compressors standby	1	
Compressor type	Rotary screw compressor	
Compressor size, each	15	kW
Air receivers duty	1	
Air receivers standby	1	
Air receiver pressure rating	200	psi
Air receiver operating pressure	100-150	psi

Table 3-8: RO System Design Parameters

System Component	Design Value	Unit
RO Feed Tank		
Number of tanks	1	
Available volume for operational equalization	8,000	gal
Residence time, minimum	15	min
Volume required for minimum residence time	198,600	gal
Cartridge Filters		
On duty	3	
On standby	1	
Flow per vessel	4,413	gpm
Vessel configuration	Horizontal	
Vessel pressure rating	150	psi
Cartridges per vessel	32	
Cartridge rating	5	um
Cartridge material	Polypropylene	
Cartridge diameter	6	in
Cartridge length	40	in
RO System Flow Stream pH and Chemical Doses		

System Component	Design Value	Unit
pH Ranges		
UF filtrate	6.7 - 7.7	
RO feed (dosed)	6.2 - 6.7	
RO permeate (typical)	4.8 - 5.7	
RO concentrate	7.0 - 7.5	
Chemical Dosing		
Antiscalant	1.0 - 5.0	mg/L
H_2SO_4	10 - 100	mg/L
RO Trains		
RO Feed	19.1	mgd
RO Permeate	16.2	mgd
Duty	7	
Standby	1	
RO feed pump flow	1890	gpm
RO feed pressure	100-225	psi
RO recovery (assumed)	85%	
RO Stages	3	
1st Stage Pressure Vessels	46	Pressure Vessels
Elements Per Vessel	6	
2nd Stage Pressure Vessels	23	Pressure Vessels
Elements Per Vessel	6	
3rd Stage Pressure Vessels	11	Pressure Vessels
Elements Per Vessel	6	
Elements per train	480	
Total Elements	3,360	
Membrane	Hydranautics	ESPA2-LD
RO CIP System		
CIP tanks on duty	1	
CIP tanks on standby	1	
CIP tank volume	7,000	gal
CIP tank diameter	12	ft
CIP tank total height	10	ft
Heaters per CIP tank	2	
CIP heat power	200	kW
Target CIP solution temperature	45	°C
CIP solution heating time	2	hr
Target CIP solution pH	2 or 11.5	
Recirculation rate: Stage 1	1,060	gpm (two halves)
Recirculation rate: Stage 2	1,060	gpm

System Component	Design Value	Unit
CIP pumps on duty	1	
CIP pumps on standby	0	
CIP pump flow rate	1,060	gpm
CIP pump pressure	60	psi

Table 3-9: UV/AOP Design Parameters

System Component	Design Value	Unit
UV/AOP	TrojanUV	
Reactors on duty	3	
Reactors on standby	1	
Oxidant type	HOCl	
Flow, design	15.7	mgd
Flow capacity per duty train	5.2	mgd
Minimum electrical energy delivered (EED)	0.2	kWh/kgal
Design EED	0.2	kWh/kgal
Minimum UV dose	920	mJ/cm^2
Maximum operating pressure	30	psi
Head loss at full flow	4	in
Minimum UVT	96	%
Oxidant Dosing		
Oxidant Dosing	Free chlorine (HOCl)	
Oxidant dose, design	2	mg/L as Cl_2
Oxidant dosing system, minimum	2	mg/L as Cl_2
Oxidant dosing system, maximum	5	mg/L as Cl_2
Chemical Addition	NaOCl	
Strength of solution	12.5	%
Product Water Tank HRT	**Volume (gal)**	**HRT at Full Capacity (min)**
CO2 injection box	40,000	3.6
Lime injection box: 2 boxes on line	22,000	2.0
Lime injection ox: 1 box off line	11,000	1.0
Pump wet well	35,000	3.1
CO_2 Storage		
Storage time: worst-case conditions	4	days
Tanks	2	
CO_2 transfer efficiency	95	%
CO_2 dose: max	90	mg/L

System Component	Design Value	Unit
CO_2 feed rate: max (actual)	26,886	lb/d
Net capacity: max conditions, per tank	24	metric ton
Lime Silo		
Diameter	12	ft
Height	30	ft
Storage capacity per tank	3,393	ft^3
Design total storage capacity	6,786	ft^3

FAT AWTF Footprint

The total footprint of the proposed AWTF is approximately 226,300 ft^2 (5.2 acres). The total area is based on the footprint provided by the equipment manufacturers and includes the area for the administration building, electrical room, electrical building, roadway, and parking (Table 3-10). Figure 3-2 shows the tentative location of the AWTF on EWA's South Parcel.

Table 3-10: FAT AWTF Footprint.

Process	Footprint (ft^2)[2]
UF Trains	16,000
RO Trains	18,000
CIP System	2,000
UV System	3,600
Electrical Rooms	5,000
Electrical Building	9,000
Chemical Feed System /Storage	11,300
CO_2 Dosing System	2,000
Lime Dosing System	3,000
Product Water Tank	14,700
Pump Station	8,100
Administration Building[1]	14,000
Parking	40,600
Roadway	79,000
Total Footprint	**226,300**

Footnotes:
1. The administration building area includes offices, conference rooms, exhibit space, maintenance shops/ storage, control room, water quality laboratory, lunchroom, restrooms, showers, and miscellaneous storage space.
2. Rounded to the nearest 100.

Figure 3-2: Representative Layout of the FAT AWTF on EWA's South Parcel.

3.5.2 AWTF for Raw Water Augmentation

The assumed preliminary design parameters used for the conceptual design of the AWTF including O_3/BAF + FAT are shown in Table 3-11. The O_3/BAF provides favorable conditions to design the UF with a higher flux. For the UV/AOP process, the design uses sodium hypochlorite (NaOCl).

Table 3-11. Ozone Design Parameters.

System Component	Design Value	Unit
Liquid Oxygen (LOX) System		
LOX Tanks	2	
Tank volume (each)	10,000	gal
Vaporizers	3	
Vaporizer capacity (each)	27,500	scfh
Number of Gaseous Oxygen (GOX) Particulate Filters	1	
Number of Stand-by GOX Particulate Filters	1	
Minimum GOX Filter Capacity	400	scfm
Ozone Generators		
Ozone dose, design	14	mg/L
Ozone dose, minimum	5	mg/L
Flow, design	20.5	mgd
Number of duty ozone generators	2	
Number of standby ozone generators	1	
Minimum generator capacity (each)	1,200	lb/d
O_3 Gas Concentration range at design dose	7 - 12	%
Oxygen supply	LOX System	
Power Requirements	4.5	kWh/lb O_3
Maximum feed gas dew point	-65	°C
Cooling Water System		
Open-Loop cooling water pumps, duty	2	
Open-Loop cooling water pumps, Standby	1	
Closed-Loop Cooling Water Pumps, Duty	2	
Closed-Loop Cooling Water Pumps, Standby	1	
Number of duty heat exchangers	1	
Number of standby heat exchangers	1	
Source of open-loop cooling water	UF filtrate	
Open-loop flow per pump	250	gpm
Motor horsepower per open-loop pump	20	hp
Source of closed-loop makeup water	Stabilized RO product water	
Max temperature of open-loop supply	86	F
Max temperature rise across open loop	7.5	F

System Component	Design Value	Unit
Minimum heat transfer efficiency	90	%
Pressure differential between loops	5	psi
Ozone Side Stream Injection System		
Injection Type	Side stream	
Number of duty skids	4	
Number of standby skids	2	
Number of injectors per skid	1	
Number of pumps per skid	1	
Pump capacity	1,200	gpm
Pump Pressure	80	psi
Number of injection nozzles per flash reactor	6	
Minimum 3 transfer efficiency	90%	
Ozone Contactors		
Type of ozone contactor	Serpentine, vertically stacked	
Number of ozone contactors	2	
Flow, design	20.5	mgd
Flow, design (per contactor)	10.25	mgd
Design HRT	9.65	min
T12/HRT	0.79	
Effective HRT (T10)	7.6	min
Design CT (@ 20°C)	3.8	mg-min/L
Sodium Bisulfite Quenching System		
Injection Point	Ozone Contactors	
Design HRT for quenching ozone residual in ozone contactors	1.2	min
Concentration	25	% by weight
Maximum dose, design	3	mg/L
Ozone Off-Gas Destruct System		
Number of duty destruct units	2	
Number of standby destruct units	1	
Type of destruct units	Thermal Catalytic	
Maximum ozone concentration in destruct	0.1	ppm
Minimum pressure at basin headspace	-4	inches

Table 3-12: BAC Design Parameter

System Component	Design Value	Unit
Number of duty filters	5	
Number of standby filters	1	
Media depth	10	ft
Feed flow, design	20.5	mgd
Filtrate flow, design	20.2	mgd
Filtrate flow, design (per filter)	4.0	mgd
Water Recovery	98.5%	
Filter surface area (per filter)	750	ft^2
Backwash frequency per filter	2	per week
Backwash water supply source	UF feed tank	
Backwash flux	10 - 25	gpm/ft^2
Backwash flow rate	12.4 - 24.8	mgd
Backwash time	10	min
Backwash volume per filter	173,000	gal
EBCT	14	min
Air scour rate	4	cfm/ft^2
Air scour flow rate	3,000	scfm
Air scour duration	6	min
Hydraulic pause duration	5	min
Filter Media Bed Design Criteria		
Media Product	8 x 16 mesh granulated activated carbon	
Media Type	Virgin bituminous coal-based GAC	
Effective size	1.3 to 1.5 mm	
Uniformity coefficient, maximum	1.4	
Media bed length-to-diameter ratio	2,177	
Predicted clean bed head loss	1.8 to 2.1	ft
BAC System Backwash Equipment		
Number of backwash pumps, duty	2	
Number of backwash pumps, standby	1	
Backwash pump flow, each	9,375	gpm
Backwash pump pressure	37	psi
Backwash pump power	125	hp
Backwash pump type	Horizontal split case	
Number of air scour blowers, duty	1	
Number of air scour blowers, standby	1	
Air scour blower flow, each	3,000	scfm
Air scour blower backpressure	9.1	psi

System Component	Design Value	Unit
Air scour blower power	200	hp
Air scour blower type	Positive displacement	

Table 3-13: UF Design Parameter

System Component	Design Value	Unit
UF Feed Tank		
Number of tanks	1	
Available volume for operational equalization, minimum	130,000	gal
Total residence time, minimum	11.5	min
Total water volume (including submergence)	163,000	gal
UF Feed Pump		
Pump type	Vertical Turbine	
Number of duty pumps	4	
Number of standby pumps	1	
Capacity per pump	5.0	mgd
Drive type	VFD	
Automatic Strainer		
Manufacturer/model	Amiad Omega, SP Kinney: AF, Eaton 2596, Fluid Engineering Model 723, or equal	
Type	Auto-backwash strainer	
Design flow	20.2	mgd
Clean head loss, minimum	<1	psi
Duty units	4	
Standby units	1	
Excess capacity required	25	%
Capacity per strainer	6.31	mgd
Screen pore size, minimum	3	µm
Strainer recovery	99.93	%
Automatic strainer backwash residuals estimates		
Backwash average waste flow	3,000 - 33,000	gpd
Backwash duration per unit, per cycle	25-120	sec
Backwash volume per unity, per backwash cycle	148-800	gal
Backwash flow rate per unit, instantaneous	180 - 740	gpm
UF		

System Component	Design Value	Unit
Manufacturer	Toray	
Model Number	HFU-2020N	
Membrane nominal pore size	0.01 µm	
Membrane area	775 ft^2	
System rated capacity (filtrate flow)	18.8	mgd
Feed flow	20.2	mgd
Assumed Recovery	93	%
Number of total racks	8	
Number of membrane modules per rack, installed	86	
Number of membrane modules per rack, total available	96	
Design flux, instantaneous (N-2)	50.5	gfd
Backwash water supply	UF filtrate	
Backwash type	Reverse flow with air scour	
Backwash interval	24	min
Design NaOCl EFM frequency	2x/week	
Design $C_6H_8O_7$ EFM frequency	1/month	
Design CIP frequency	1/month	
DIT method	Daily PDTs	
Indirect integrity testing method	Continuous filtrate turbidity monitoring	
UF Backwash Pumps		
Pump type	Horizontal Centrifugal	
Number of duty pumps	1	
Number of standby pumps	1	
Flow rate, each pump	2,800	gpm
TDH	100	ft
UF Backwash Flow Rates	Toray	
Cycle length between backwashes (duration of permeate production)	24	min
Total backwash cycle duration	3.2	min
Backwash flux	54.8	gfd
Backwash flow rate per module	29.5	gpm
Modules per rack, total	95	
Backwash flow rate, per rack (maximum instantaneous)	2,800	gpm
UF Backwash Residuals Estimates		
Backwash cycles per day	424	

System Component	Design Value	Unit
Backwash waste volume per cycle per rack	8,884	gal
Average backwash waste flow	1.4	mgd
UF Air Scour Blowers		
Blower Type	Positive-displacement lobe, or hybrid rotary lobe	
Number of sets	2	
Number of blowers on duty	1	
Number of blowers on standby	1	
Blower capacity, each	665	cfm
Blower pressure	15	psi
Blower motor power, each	60	hp
UF CIP/EFM Cleaning procedures	MC	
Typical duration, each rack, each clean	27-90	min
Design Frequency	NaOCl: 2x/week, $C_6H_8O_7$: 1/month	
Make-up water	UF filtrate	
Solution temperature, typical	100°F	
CIP/EFM System		
CIP/EFM systems, total	2	
CIP fill pumps on duty	1	
CIP fill pumps on standby	1	
CIP fill pump flow rate, each	500	gpm
CIP fill pump TDH	38	ft
CIP fill pump motor power, each	7.5	hp
EFM fill pumps on duty	1	
EFM fill pumps on standby	1	
EFM fill pump flow rate, each	500	gpm
EFM fill pump TDH	20	ft
EFM fill pump motor power, each	5	hp
CIP tanks per system	2	
CIP tank volume, each	6,000	gal
CIP pumps on duty	1	
CIP pumps on standby	1	
CIP pump flow rate, each	1,235	gpm
CIP pump TDH	97	ft
CIP pump motor power, each	50	hp
Neutralization System		

System Component	Design Value	Unit
Neutralization systems	2	
Neutralization tanks per system	1	
Neutralization tank volume, each	15,000	gal
Pumps on duty	1	
Pumps on standby	1	
Neutralization/drain pump TDH	43	ft
Neutralization/drain pump flow rate, each pump	500	gpm
Neutralization/drain pump motor power, each pump	10	hp
Time to drain neutralization tank	30	min
UF CIP/EFM Residuals Estimates		
Average CIP waste flow	6,300	gpd
CIP duration, total	4 to 6	hr
CIP chemical solutions, per CIP	1. Chlorine 2. Citric Acid ($C_6H_8O_7$)	
CIP waste volume per CIP chemical solution	11,100	gal
CIP waste volume per CIP total	22,200	gal
Average MC waste flow	35,500	gpd
MC duration, total	Up to 90	min
MC waste volume per clean, total	11,100	gal
CIP/MC waste flow from neutralization tanks to drain, total	1,000	gpm
UF compressed air system		
Compressors duty	1	
Compressors standby	1	
Compressor type	Rotary screw compressor	
Compressor size, each	15	kW
Air receivers duty	1	
Air receivers standby	1	
Air receiver pressure rating	200	psi
Air receiver operating pressure	100 - 150	psi

Table 3-14: RO Design Parameters.

System Component	Design Value	Unit
RO Feed Tank		
Number of tanks	1	
Available volume for operational equalization, minimum	8,000	gal
Residence time, minimum	15	min
Available volume required for minimum residence time	220,000	gal
Total water volume (including submergence)	235,000	gal
Total residence time	18.4	min
Cartridge Filters	Main	
On duty	3	
On standby	1	
Flow per vessel	4,246	gpm
Vessel configuration	Horizontal	
Vessel pressure rating	150	psi
Cartridges per vessel	32	
Cartridge rating	5	µm
Cartridge material	Polypropylene	
Cartridge diameter	6	in
Cartridge length	40	in
RO System Flow Stream pH and Chemical Doses		
pH Ranges		
UF filtrate	6.7 - 7.7	
RO feed (dosed)	6.2 - 6.7	
RO permeate (typical)	4.8 - 5.7	
RO concentrate	7.0 - 7.5	
Chemical Dosing		
Antiscalant	1.0 - 5.0	mg/L
H_2SO_4	10 - 100	mg/L
RO Trains		
RO Feed	18.3	mgd
RO Permeate	15.6	mgd
On duty	7	
On standby	1	
RO feed pump flow	1,820	gpm
RO feed pressure	100 - 225	psi

System Component	Design Value	Unit
RO recovery	85%	
RO CIP System		
CIP tanks on duty	1	
CIP tanks on standby	1	
CIP tank volume	7,000	gal
CIP tank diameter	12	ft
CIP tank total height	10	ft
Heaters per CIP tank	2	
CIP heat power	200	kW
Target CIP solution temperature	45	°C
CIP solution heating time	2	hr
Target CIP solution pH	2 or 11.5	
Recirculation rate: Stage 1	3,600	gpm
Recirculation rate: Stage 2	1,800	gpm
CIP pumps on duty	2	
CIP pumps on standby	1	
CIP pump flow rate	900	gpm
CIP pump pressure	60	psi

Table 3-15: UV/AOP Design Parameters

System Component	Design Value	Unit
Reactors on duty	3	
Reactors on standby	1	
Oxidant type	HOCl	
Flow, design	15.6	mgd
Flow capacity per duty train	5.20	mgd
Minimum EED	0.2	kWh/kgal
Design EED	0.22	kWh/kgal
Minimum UV dose	850	mJ/cm^2
Maximum operating pressure	30	psi
Head loss at full flow	4	in
Minimum UVT	96	%
Oxidant Dosing		
Oxidant Dosing	Free chlorine (HOCl)	
Oxidant dose, design	2	mg/L as Cl_2
Oxidant dosing system, minimum	2	mg/L as Cl_2
Oxidant dosing system, maximum	5	mg/L as Cl_2
Chemical Addition	NaOCl	

System Component	Design Value	Unit
Strength of solution	6.9	%
Product Water Tank HRT	**Volume (gal)**	**HRT at Full Capacity (min)**
CO_2 injection box	40,000	3.7
Lime injection box: 2 boxes on line	22,000	2.0
Lime injection ox: 1 box off line	11,000	1.0
Pump wet well	35,000	3.2
CO_2 Storage		
Storage time: worst-case conditions	4	days
Tanks	2	
CO_2 transfer efficiency	95	%
CO_2 dose: max	90	mg/L
CO2 feed rate: max (actual)	26,886	lb/d
Net capacity: max conditions, per tank	24	metric ton
Lime Silo		
Diameter	12	ft
Height	30	ft
Storage capacity per tank	3,393	ft^3
Design total storage capacity	6,786	ft^3

FAT+O_3/BAF AWTF Footprint

The assumed AWTF for this option will require a total area of approximately 286,100 ft^2 (6.6 acres). Table 3-16 summarizes the individual footprint for the equipment requirement for each process and administration and electrical building, roadway, and parking. Figure 3-3 shows the tentative location of the AWTF on EWA's South Parcel.

Table 3-16: Footprint of FAT + O_3/BAF AWTF

Process	Footprint (ft^2)
LOX System	2,000
Ozone System	6,400
BAC Filters	15,000
UF Trains	16,000
RO Trains	18,000
CIP System	2,000
UV System	3,600
Electrical Rooms	5,000
Electrical Building	9,000
Product Water Tank	14,700
CO_2 Dosing System	2,000
Lime Dosing System	3,000
Chemical Storage	11,300
Pump Station	12,100
Admin. / Maint. Building[1]	14,000
Parking	27,000
Roadway/	125,000
Total	**286,100**

Footnotes:

1. The administration building area includes offices, conference rooms, exhibit space, maintenance shops and storage, control room, water quality laboratory, lunch room, restrooms, showers, and of miscellaneous storage space.
2. Rounded to the nearest 100.

Figure 3-3: Representative Layout of the O_3/BAF + FAT AWTF on EWA's South Parcel (Far View).

3.5.3 WTP for Treated Drinking Water Augmentation

The purified water from the O_3/BAF + FAT treatment facility would be sent to an ESB + Cl_2. The assumed residence time is thirty minutes before being treated by UF system. Due to the highly-treated feed water quality, the UF would be able to operate at a higher flux (120 gfd). Table 3-17 provides a summary of the design criteria for the ESB and the UF system.

Table 3-17. Design Criteria for ESB-Cl_2 + UF System

System Component	Design Value	Unit
Oxidant Dose		
Oxidant dose, design	2	mg/L as Cl_2
Oxidant dosing system, minimum	2	mg/L as Cl_2
Oxidant dosing system, maximum	6	mg/L as Cl_2
Effluent Chlorine Residual	3	mg/L as Cl_2
Chemical Addition	NaOCl	
Strength of solution	12.5	%
Engineered Storage Buffer		
Retention Time	2	hours
Volume per tank	173,708	ft^3
Tank Water Height	40	ft
Diameter of tank	74	ft
Number of tanks	3	(fill, hold, draw)
Length of ESB area	253	ft
Width of ESB area	94	ft
Ammonia Dosing System		
Ratio NH_3-N:Cl_2	1:5	
Dose	1	mg/L
Loading	130	lb/day
Aqua Ammonia Concentration	19	%
UF		
Membrane area / module	775	ft^2
System rated capacity (filtrate flow)	15.44	mgd
Feed flow	15.59	mgd
Assumed Recovery	99	%
Number of racks	6	
Number of membrane modules per rack, installed	28	
Number of membrane modules per rack, total available	37	
Design flux, instantaneous	120	gfd

FAT+O_3/BAF AWTF plus WTP Footprint

The assumed AWTF for this option will require a total area of approximately 324,400 ft^2 (7.4 acres). Table 3-18 summarizes the individual footprint for the equipment requirement for each process and administration and electrical building, roadway, and parking. Figure 3-4 shows the tentative location of the AWTF on EWA's South Parcel.

Table 3-18: O_3/BAF + FAT + WTP for Treated Drinking Water Augmentation Footprint

Process	Footprint (ft^2)
LOX System	2,000
Ozone System	6,400
BAC Filters	15,000
UF Trains	16,000
RO Trains	18,000
CIP System	2,000
UV System	3,600
Engineered Storage Buffer	15,600
High-Flux UF	800
Electrical Rooms	5,000
Electrical Building	9,000
CO_2 Dosing System	2,000
Lime Dosing System	3,000
Chemical Storage	11,300
Product Water Tank	14,700
Pump Station	14,000
Admin. / Maint. Building[1]	14,000
Parking	27,000
Roadway	145,000
Total	**324,400**

Footnotes:

1. The administration building area includes offices, conference rooms, exhibit space, maintenance shops and storage, control room, water quality laboratory, lunch room, restrooms, showers, and of miscellaneous storage space.
2. Rounded to the nearest 100.

Figure 3-4: Representative Layout of the O_3/BAF + FAT + WTP on EWA's South Parcel (Far View).

3.5.4 Future AWTF Expansion Footprint

A future expansion of the FAT+O_3/BAF AWTF from 16 mgd to 25 mgd was evaluated for space planning purposes. This option will require a total area of approximately 389,600 ft^2 (8.9 acres). Table 3-19 summarizes the individual footprint for the equipment requirement for each process and administration and electrical building, roadway, and parking. Figure 3-5 shows the tentative location of the AWTF on EWA's South Parcel.

Table 3-19. Footprint of FAT + O_3/BAF AWTF at 25 mgd

Process	Footprint (ft^2)
LOX System	3,100
Ozone System	7,200
BAC Filters	17,000
UF Trains	19,000
RO Trains	28,200
CIP System	3,600
UV System	5,600
Electrical Rooms	5,000
Product Water Tank	22,900
CO_2 Dosing System	2,000
Lime Dosing System	3,000
Chemical Feed System/Storage	11,300
Electrical Building	9,000
Pump Station	21,000
Admin./ Maint. Building[1]	23,000
Parking	68,200
Roadway	140,500
Total	**389,600**

Footnotes:
1. The administration building area includes offices, conference rooms, exhibit space, maintenance shops and storage, control room, water quality laboratory, lunch room, restrooms, showers, and of miscellaneous storage space.
2. Rounded to the nearest 100.

Figure 3-5: Representative Layout of the O_3/BAF + FAT AWTF Expansion (25 mgd) on EWA's South Parcel.

3.6 Conceptual Costs for Advanced Treatment

3.6.1 Capital Costs

Based on the conceptual design assumptions listed above, a Class 4 Budget Estimate was performed. This conceptual cost estimate includes all the components of the advanced water treatment plant (i.e., UF, RO, AOP, and additional equipment including pumps, administrative building, brine disposal, engineering, taxes, shipping, and site work. This estimate does not include the estimated costs and any footprint needed for finished water conveyance or integration with the potable reuse receptor, which is discussed in Sections 4 and 5 below. The cost estimate also does not include potential brine treatment; however, it does include a pressurized brine pipeline from the AWTF to the Encina Ocean Outfall (connection assumed to be made immediately upstream of the final secondary effluent sampling station).

The AWTF cost estimates are provided in Appendix A and are summarized as follows:

- FAT AWTF: capital cost of $164,000,000.
- FAT with O_3/BAF: capital cost of $235,000,000.
- FAT with O_3/BAF and WTP: capital cost of $284,000,000.

3.6.2 O&M Costs

Operation and maintenance (O&M) costs include power cost (at $0.15 per kWh), chemical costs, and replacements of consumables (membranes, filter media, UV lamps and ballasts, RO cartridge filters, and RO membrane elements). Maintenance costs are included for each of the systems in the treatment train, product water conditioning, chemical system and electrical equipment. Annual labor costs were based on four full-time employees (FTEs) operating the facility working 2080 hours per employee per year for the FAT AWTF, six FTEs for the FAT with O_3/BAF AWTF, and seven FTEs for the FAT with O_3/BAF and WTP AWTF.

The O&M costs are provided in Appendix A and are summarized as follows:

- FAT AWTF: O&M cost of $7,000,000.
- FAT with O_3/BAF: O&M cost of $8,600,000.
- FAT with O_3/BAF and WTP: O&M cost of $9,900,000.

4 Conveyance Concepts

4.1 Introduction

The purpose of this section is to develop the concepts for conveyance within the three proposed options to be further evaluated as part of this report:

- Option F - Carlsbad Desalination Plant product water pump station (North)
- Option G - San Dieguito Reservoir, Groundwater Basin and SDCWA Second Aqueduct Augmentation (South)
- Option H - San Marcos Groundwater Basin and SDCWA Second Aqueduct Augmentation (East)

For each option, a preliminary hydraulic evaluation was conducted to determine approximate pipe size, pressure requirements, pumping requirements, and a preliminary opinion of construction costs. A summary of each Option's hydraulics is provided in Figure 4-1.

4.1.1 Pipeline Alignment Assumptions

Conveyance alignments were selected with input from stakeholders and are based on the shortest right-of-way corridors from the proposed Encina Advanced Water Treatment Facility (AWTF) to the San Diego County Water Authority (SDCWA) aqueduct and did not consider utilities and other constructability constraints nor environmental impacts. Pipeline routes within existing easements, such as overhead electrical transmission easements, were not considered. A detailed alignment evaluation should be conducted if the project moves forward as part of a preliminary design phase.

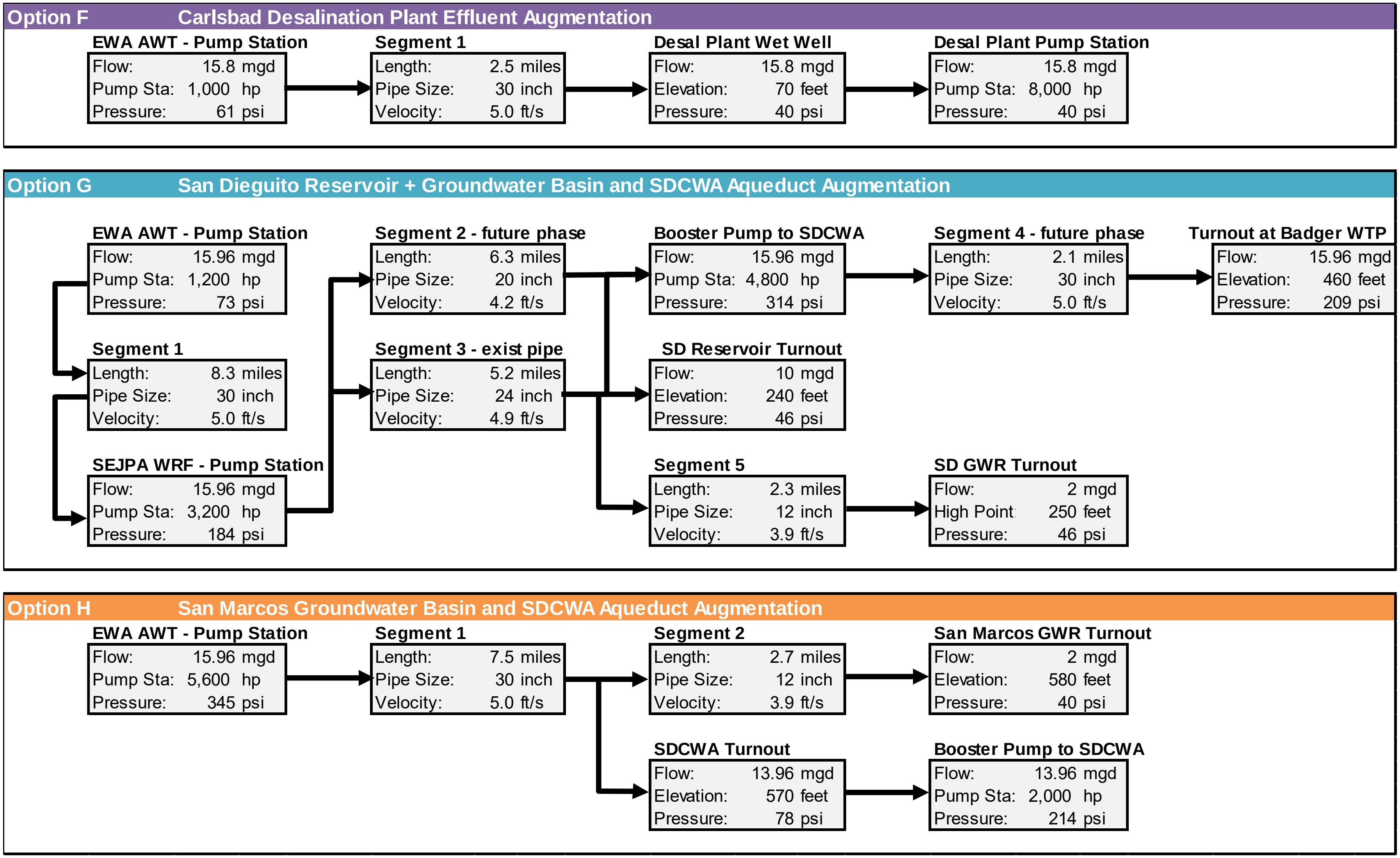
4.1.2 Hydraulic Requirement Assumptions

Due to changes in elevation and the high pressure requirements, multiple pump stations are assumed for this analysis to avoid pressures greater than 400 psi throughout miles of pipeline. It is assumed that for each SDCWA turnout, a smaller booster station can be constructed to adequately meet the pressure requirements.

A spreadsheet model and calculations were used to select pipe diameter, determine pumping requirements, and pressure requirements. Flow velocity and pumping horsepower requirements were calculated for each option and its segments.

- Nominal pipe diameter is used as the interior pipe diameter in the hydraulic calculations. Variance in internal diameter based on pipe material were not considered.
- Elevation of the proposed conveyance pump station at the AWTF is estimated to be 55 feet above mean sea level (MSL). Elevation and requirements of intermediate booster stations and discharge elevations are noted below by Option.
- Headloss calculations are based on Hazen-Williams equation with a friction factor (C-value) of 130 for new pipe.
- Pumping efficiency is estimated to be 80%.

Figure 4-1: Pumping Requirements Summary



4.2 Option F – North

Option F will provide a maximum flow of 15.8 mgd from the proposed AWTF to the Carlsbad Desalination Plant clearwell immediately upstream of the existing booster station for treated drinking water augmentation. Pressure required at the clearwell air-gap is assumed to be 40 psi. The existing Desalination Plant Pump Station will boost pressure to 533 psi to meet SDCWA requirements. The elevation of the Desalination Plant is approximately 70 feet above MSL.

The clearwell at the Desalination Plant may be undersized and may be unable to accept additional flow. Therefore, Option F includes additional costs for clearwell construction/expansion to allow for blending and addition of baffling to provide mixing of the AWTF effluent with the desalinated product water.

Phasing Options:

- Option F1: full 15.8 mgd to a new clearwell at the Carlsbad Desalination Plant for integration with the desalinated product water and distribution to the SDCWA potable water system via the desalinated water pipeline. Project will include a new clearwell sized to provide 30 minutes of storage capacity along with a new pump station to booster pressure to 533 psi to match existing system pressure.
- Option F2: first phase of 5.1 mgd conveyed to the south for surface water augmentation at the San Dieguito Reservoir (3.1 mgd) and groundwater augmentation in the San Dieguito Basin (2 mgd). As a second phase, the remaining 10.7 mgd would be integrated with the desalinated product water for treated drinking water augmentation as in Option F1 above. The pump station at the desalination plant could be scaled down to match the 10.7 mgd flow, or could be kept at 15.8 mgd as in Option F1 to allow flexibility of operations in determining which receptor to send the AWTF product water to.

For the purposes of this section, Option F is assumed to consist only of Option F1, as the first phase of Option F2 is discussed under Section 4.3 below. See Table 4-1 for this Option's hydraulics summary. See Table 4-2 for this Option's pumping requirements.

Table 4-1: Pipeline Velocity and Headloss – Option F

Pipe Segment	Flow	Length	Pipe Diameter	Flow Velocity	Pipe Headloss
Option F – Carlsbad Desalination Plant Augmentation					
1-Backbone to Desal Plant turnout	15.8 mgd	2.6 miles	30 in.	4.98 ft/s	34 ft

Table 4-2: Pumping Requirements – Option F

Option	HGL	Static Head	TDH	Hydraulic Horsepower [1]	Est. Total Station Horsepower [2]
Option F – Carlsbad Desalination Plant Augmentation					
Pump at EWA AWTF	196 ft	15 ft	141 ft	500 hp	1,000 hp
Pump at Desal Plant Wet Well	1300 ft	15 ft	1245 ft	4,000 hp	8,000 hp

Footnotes:

1) Hydraulic horsepower is the minimum actual motor horsepower for a single pump required to move the water rounded up to the nearest 100 hp to meet the pumping requirements.
2) Total station horsepower is total motor horsepower and will depend on the number of pumps installed. A reasonable estimate of total station horsepower considering standard motor sizes and standby pumps is twice the hydraulic horsepower. For cost estimating purposes, two (2) duty pumps are assumed and one (1) standby pump.

Length of pipeline from the proposed AWTF to the connection point to the Desalination Plant clearwell is estimated to be 2.5 miles. This will provide approximately 45 minutes of travel time from the AWTF to the Desalination Plant clearwell. Alignment crosses the I-5 Freeway via trenchless construction, then follows Paseo del Norte to Cannon Road before crossing back across the I-5 Freeway via trenchless construction to Avenida Encinas into the Desalination Plant property.

See Figure 4-2 for Option F proposed alignment. See Figure 4-3 for Option F proposed HGL.

Figure 4-2: Option F - Carlsbad Desalination Plant Augmentation Alignment

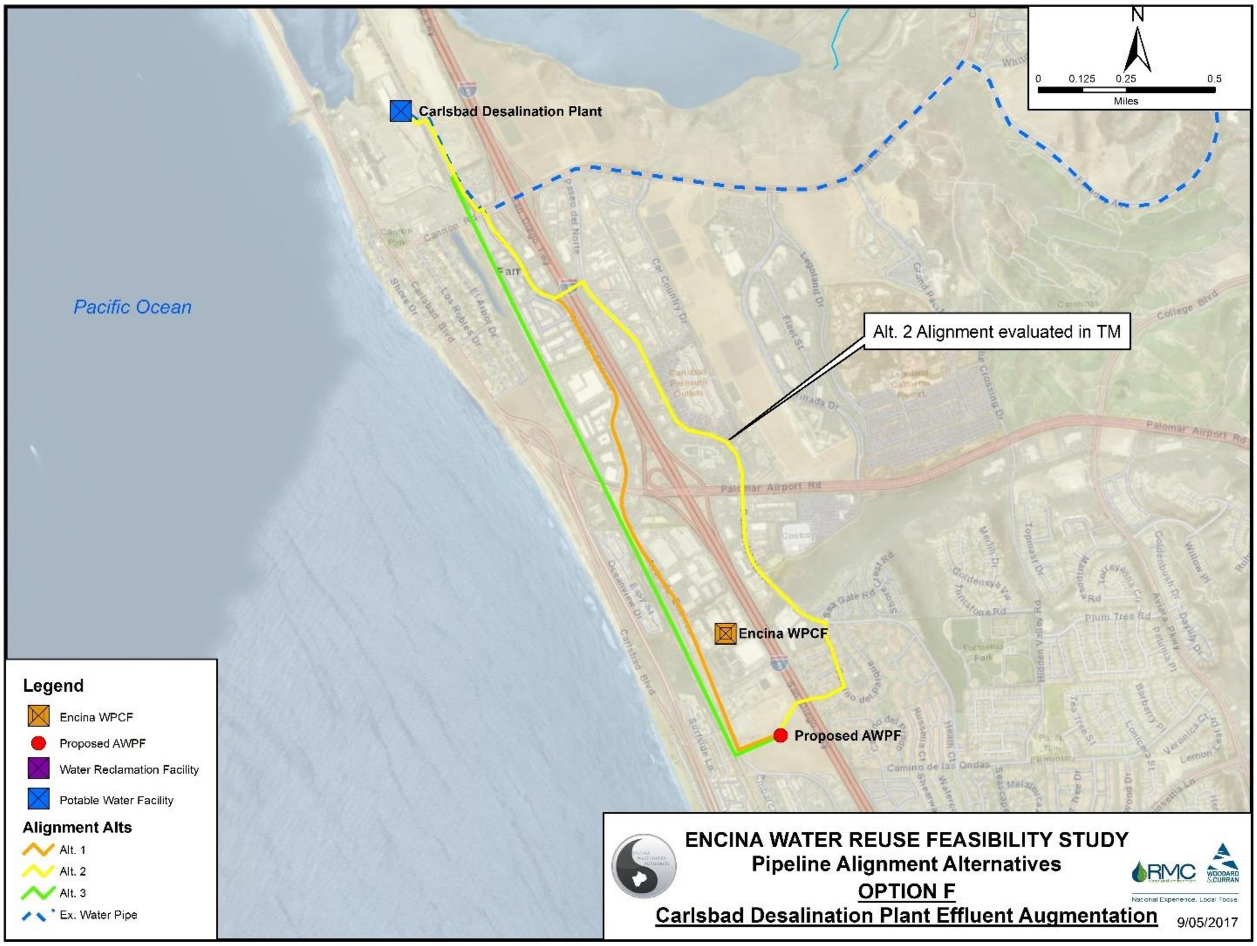
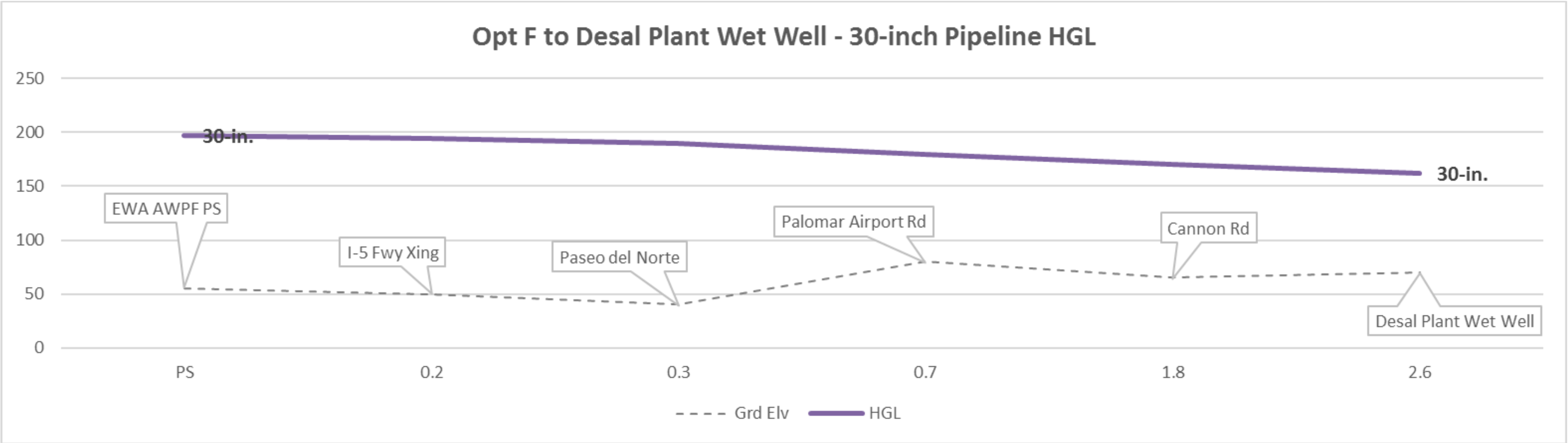


Figure 4-3: Option F - Carlsbad Desalination Plant Augmentation HGL



4.3 Option G – South

Option G will provide a maximum flow of 15.96 mgd from EWA AWTF to San Elijo Joint Power Authority (SEJPA). A new pump station will be constructed at SEJPA to convey flows: 3.1 mgd will be discharged to San Dieguito Reservoir for surface water augmentation, 2 mgd to San Dieguito Groundwater Basin for groundwater injection, and 10.86 mgd to SDCWA Second Aqueduct for raw water augmentation.

An additional Pump Station will boost pressure from San Dieguito Reservoir turnout to the SDCWA turnout to 208 psi to meet SDCWA requirements. Elevation of the SDCWA Second Aqueduct at the connection location is approximately 670 feet above MSL. Elevation of the proposed discharge facility at San Dieguito Reservoir is approximately 250 feet above MSL. Elevation of the proposed discharge facility at GWR is approximately 100 feet above MSL.

Phasing Options:

- Option G1: First phase of 5.1 mgd conveyed to the south for surface water augmentation at the San Dieguito Reservoir (3.1 mgd) and groundwater augmentation in the San Dieguito Basin (2 mgd).
- Option G2: Second phase of up to 15.96 mgd to the Second Aqueduct for raw water augmentation. This would then form part of the supply for the Badger WFP, so surface water augmentation at the San Dieguito Reservoir would no longer be required as in the first phase. Note that groundwater augmentation in the San Dieguito Basin would continue at approximately 2 mgd; however, since the water would be conveyed via the same pipeline, it would need to be at a quality suitable for raw water augmentation.

See **Table 4-3** for pipeline Option G hydraulics summary. See **Table 4-4** for Option G Pumping Requirements.

Table 4-3: Pipeline Velocity and Headloss – Option G

Pipe Segment	Flow	Length	Pipe Diameter [1]	Flow Velocity	Pipe Headloss
Option G – San Dieguito Reservoir, Groundwater Basin & SDCWA Augmentation					
1-Backbone to SEJPA WRF	15.96 mgd	8.3 mi.	30 in.	5.0 ft/s	110 ft
2-New Pipe to SD Reservoir	5.96 mgd	6.3 mi.	20 in.	4.2/ft/s	97 ft
3-Existing pipe to SD Reservoir	10.0 mgd	5.2 mi.	24 in.	4.9 ft/s	100 ft
4-Backbone to Badger WTP	15.96 mgd	2.1mi.	30 in.	5.0 ft/s	33 ft
5-Lateral to GWR at Via de la Valle	2.0 mgd	2.3 mi.	12 in.	3.9 ft/s	57 ft

Table 4-4: Pumping Requirements – Option G

Option	HGL	Static Head	TDH	Hydraulic Horsepower [1]	Est. Total Station Horsepower [2]
Option G – San Dieguito Reservoir, Groundwater Basin & SDCWA Augmentation					
Pump at EWA AWTF	223 ft	-35 ft	168 ft	600 hp	1,200 hp
Pump at SEJPA WRF	444 ft	220 ft	424 ft	1,600 hp	3,200 hp
Pump at SD Reservoir	928 ft	210 ft	679 ft	2,400 hp	4,800 hp

Footnotes:

1) Hydraulic horsepower is the minimum actual motor horsepower for a single pump required to move the water rounded up to the nearest 100 hp to meet the pumping requirements.
2) Total station horsepower is total motor horsepower and will depend on the number of pumps installed. A reasonable estimate of total station horsepower considering standard motor sizes and standby pumps is twice the hydraulic horsepower. For cost estimating purposes, two (2) duty pumps are assumed and one (1) standby pump.

Segment 1 Pipeline alignment is 8.3 miles traveling south from EWA AWTF along Avenida Encinas to San Batiquitos Lagoon which will be crossed via trenchless methods to La Costa Avenue. Alignment will continue south along Vulcan Avenue, San Elijo Avenue, and Manchester Avenue to SEJPA WRF.

Segment 2 Pipeline alignment is 6.3 miles traveling east from SEJPA WRF along Manchester Avenue to Encinitas Boulevard to El Mirlo to Via de Fortuna to El Montevideo ending at San Dieguito Reservoir.

Segment 3 Pipeline alignment is 5.2 miles utilizing the existing abandoned 30-inch San Dieguito Water District pipeline from SEJPA WRF ending at San Dieguito Reservoir. Segment 4 Pipeline alignment is 2.1 miles traveling east from San Dieguito Reservoir along El Camino del Norte to Aliso Canyon Road ending at Badger WTP.

Segment 4 Pipeline alignment is 2.3 miles traveling south from San Dieguito Reservoir along El Montevideo to Paseo Delicias to Via de la Valle ending at proposed injection wells in the San Dieguito Groundwater Basin.

See Figure 4-4 for Option G proposed alignment. See Figure 4-5 for Option G proposed HGL.

Figure 4-4: Option G Alignment Analysis

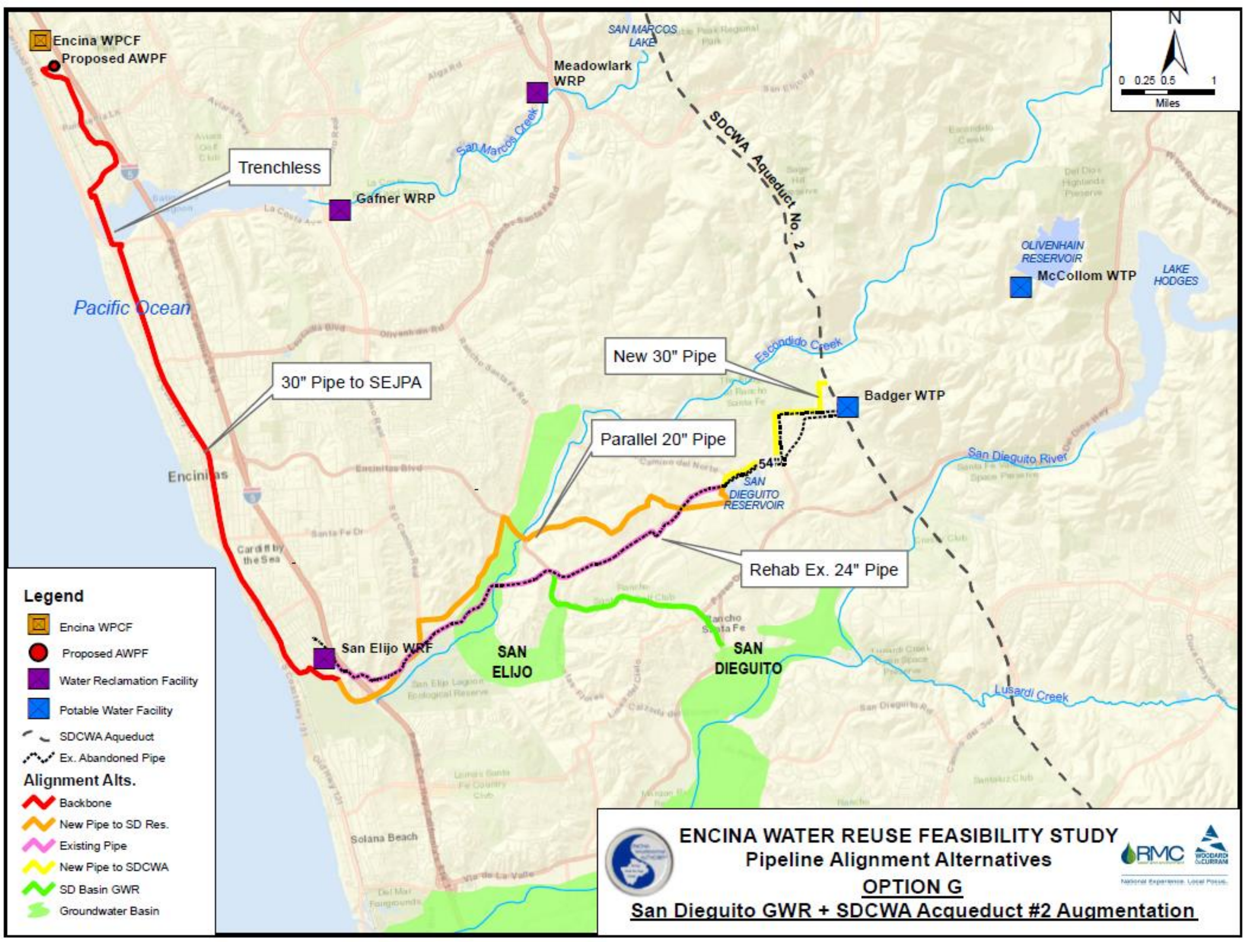
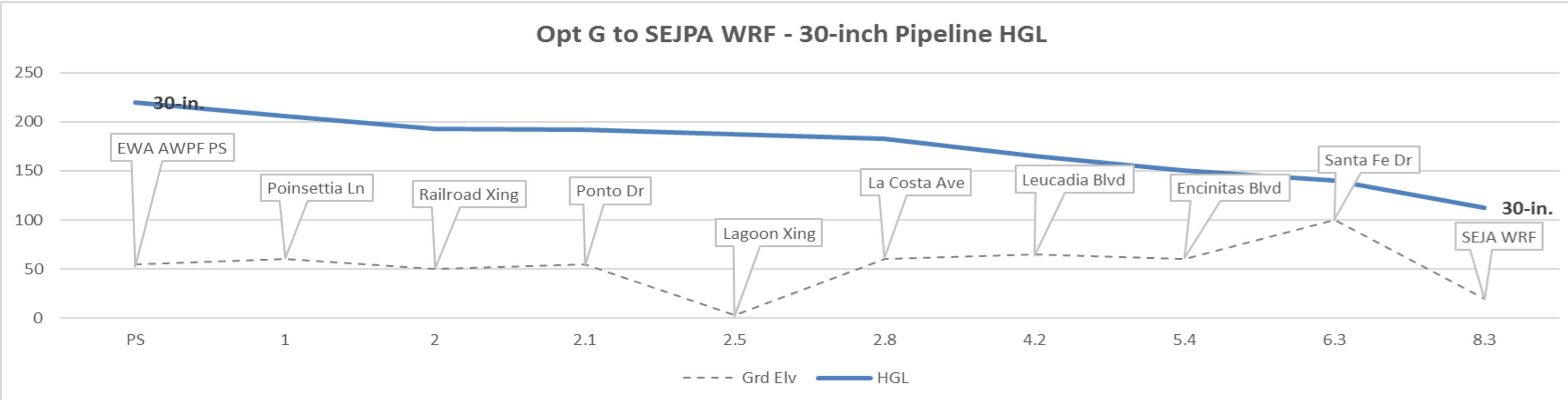
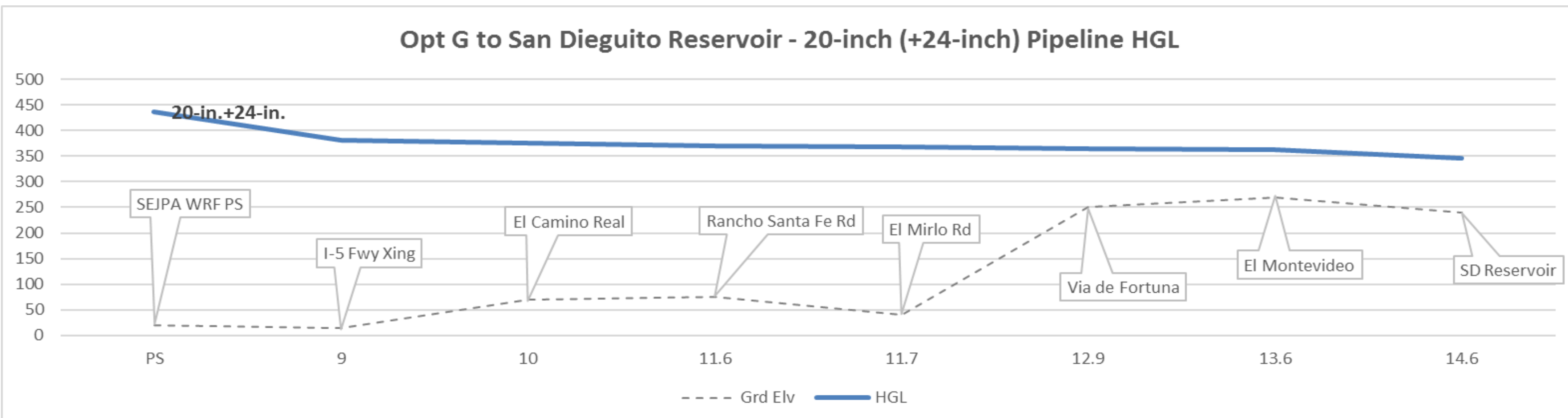
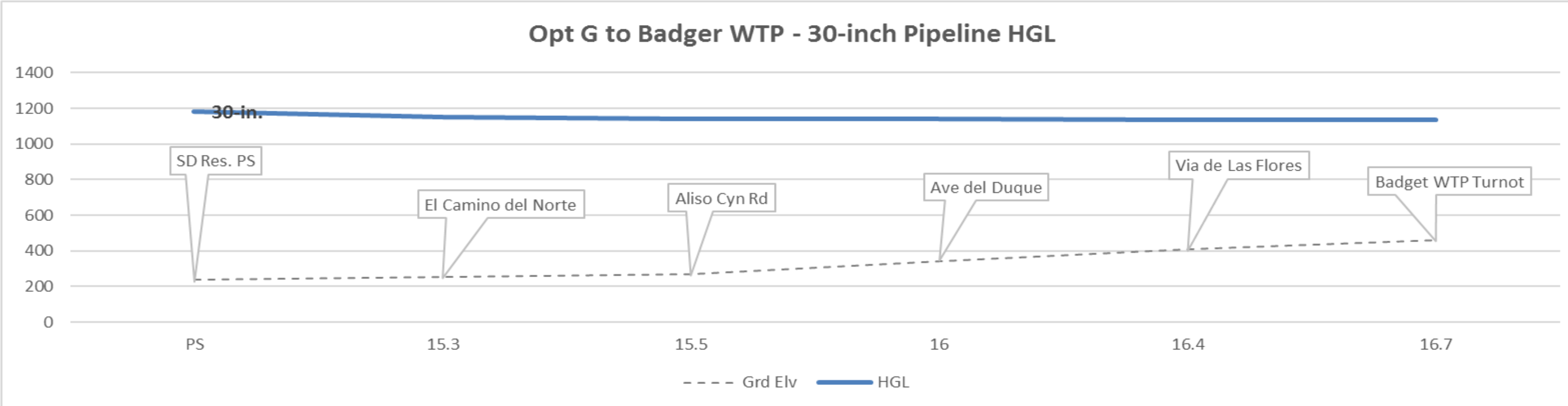


Figure 4-5: Option G - San Dieguito Reservoir, Groundwater Basin & SDCWA Second Aqueduct Augmentation HGLs






Opt G to Badger WTP - 30-inch Pipeline HGL
1400
1200
1000
800
600
400
200
0
30-in.
SD Res. PS
El Camino del Norte
Aliso Cyn Rd
Ave del Duque
Via de Las Flores
Badget WTP Turnot
PS
15.3
15.5
16
16.4
16.7
Grd Elv
HGL

4.4 Option H - East

Option H will provide a maximum flow of 15.96 mgd from the AWTF to SDCWA Second Aqueduct for raw water augmentation. There is potential for up to 2 mgd to be diverted via a branch off the main proposed pipeline to the San Marcos Groundwater Basin for groundwater injection. Thus, all water produced at the proposed AWTF would need to be at a quality suitable for raw water augmentation.

An additional Pump Station will boost pressure at SDCWA turnout to 208 psi to meet SDCWA requirements. Elevation of the discharge at SDCWA is approximately 570 feet above MSL. Elevation of the discharge at GWR turnout is approximately 580 feet above MSL.

See **Table 4-5** for pipeline Option H hydraulics summary. See **Table 4-6** for Option H Pumping Requirements.

Table 4-5: Pipeline Velocity and Headloss – Option H

Pipe Segment	Flow	Length	Pipe Diameter [1]	Flow Velocity	Pipe Headloss
Option H – San Marcos Groundwater Basin & SDCWA Augmentation					
1-Backbone to SDCWA	15.96 mgd	7.5 mi.	30 in.	5.0 ft/s	101 ft
2-Existing Pipe to GWR	2.0 mgd	2.7 mi.	12 in.	3.9/ft/s	78 ft

Table 4-6: Pumping Requirements – Option H

Option	HGL	Static Head	TDH	Hydraulic Horsepower [1]	Est. Total Station Horsepower [2]
Option H – San Marcos Groundwater Basin & SDCWA Augmentation					
Pump at EWA AWTF	848 ft	515 ft	796 ft	2,800 hp	5,600 hp
Pump at Turnout	883 ft	10 ft	493 ft	1,000 hp	2,000 hp

Footnotes:

1) Hydraulic horsepower is the minimum actual motor horsepower for a single pump required to move the water rounded up to the nearest 100 hp to meet the pumping requirements.
2) Total station horsepower is total motor horsepower and will depend on the number of pumps installed. A reasonable estimate of total station horsepower considering standard motor sizes and standby pumps is twice the hydraulic horsepower. For cost estimating purposes, two (2) duty pumps are assumed and one (1) standby pump.

Length of pipeline from EWA AWTF to the connection point to the SDCWA turnout is estimated to be 7.5 miles. Alignment crosses the I-5 Freeway via trenchless construction, then follows Paseo del Norte to Palomar Airport Road to San Marcos Boulevard ending at Rancho Santa Fe Road with a new SDCWA turnout with booster station.

Segment 2 Pipeline alignment is 2.7 miles utilizing existing abandoned 12-inch Vallecitos Water District pipeline along San Marcos Boulevard to Twin Oaks Valley Road ending at new proposed injection wells in the San Marcos Groundwater Basin.

See Figure 4-6 for Option H proposed alignment. See Figure 4-7 for Option H proposed HGL.

Figure 4-6: Option H Alignment.

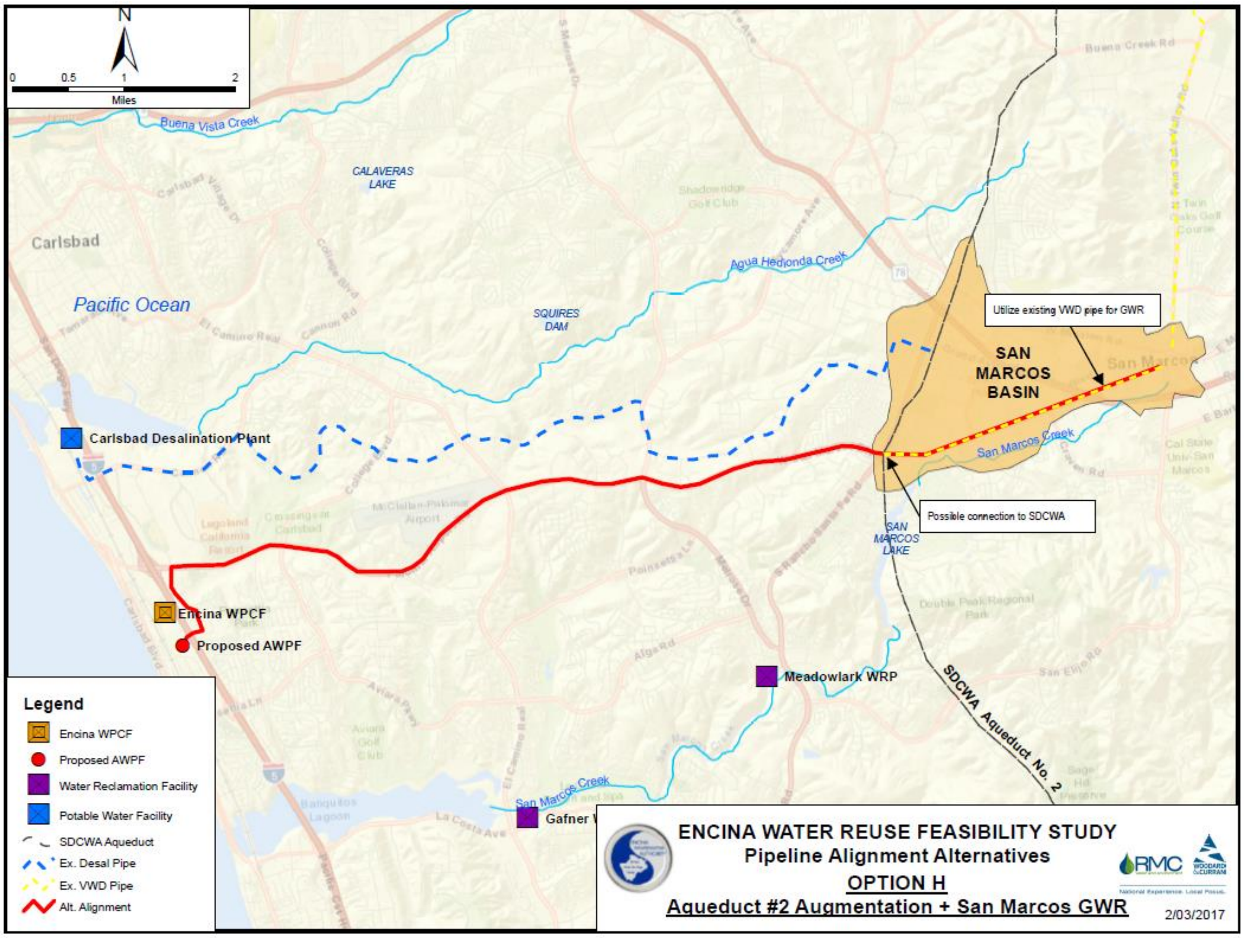
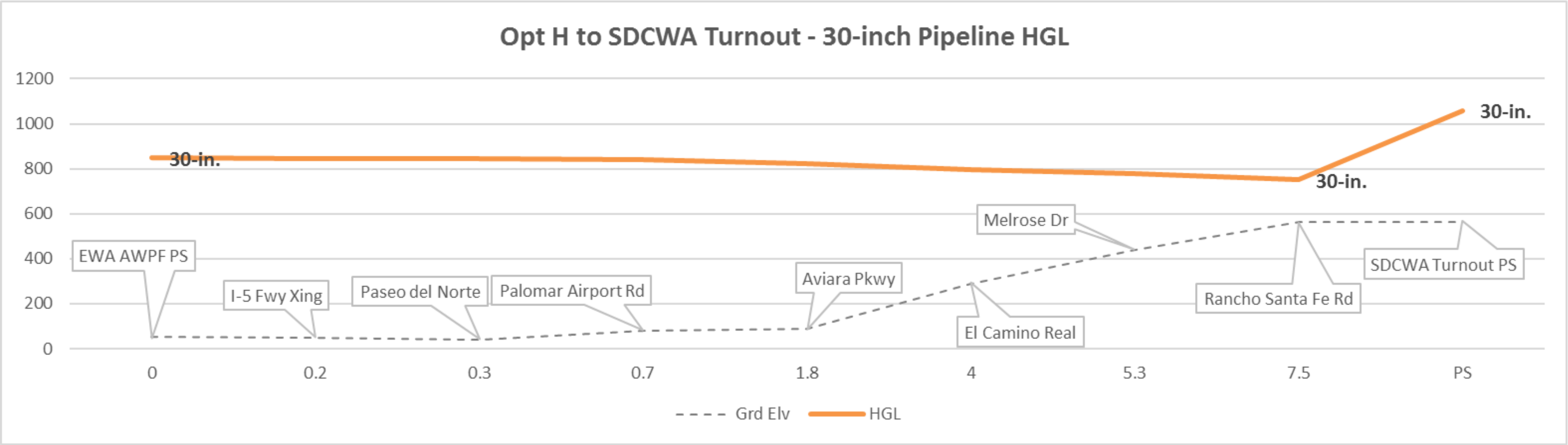


Figure 4-7: Option H - San Marcos Groundwater Basin & SDCWA Aqueduct #2 Augmentation HGL



4.5 Conceptual Costs for Conveyance

An opinion of probable construction cost was developed based on the concept presented in this TM. The cost estimate is a Class IV estimate. **Table 4-7** provides a summary of the preliminary capital and O&M cost estimates for the conveyance system for each Option at the full product water flows. Detailed conveyance construction cost estimates are provided Appendix A.

Table 4-7: Conveyance & Receptor Integration Costs by Option

Option	Capital Cost		O&M Costs
	Conveyance (Pipe + Pump)	Receptor Integration	
F - Carlsbad Desalination Plant Effluent Augmentation	$39,000,000	$104,000,000	$17,100,000
G - San Dieguito Reservoir + Groundwater Basin and SDCWA Augmentation	$254,000,000	$33,000,000	$18,800,000
H - San Marcos Groundwater Basin and SDCWA Augmentation	$159,000,000	$21,000,000	$15,200,000

4.5.1 Capital Costs

Each potable water reuse option will require receptor integration according to the form of potable reuse: Treated Drinking Water Augmentation (TDWA), Groundwater Augmentation (GWA), and Surface Water Augmentation (SWA). The following summarizes the key capital cost assumptions for receptor integration for each project concept in addition to conveyance pipelines and pumping:

- Option F – Carlsbad Desalination Plant Effluent:
  - Project includes construction of a 350,000-gallon clearwell at the Desalination Plant to allow for blending and addition of baffling to provide mixing of the AWTF effluent with the desalinated product water. Assumes 30 minutes of clearwell storage. Includes 8,000 hp pump station to match desalination plant effluent pressure requirements.
- Option G – San Dieguito Reservoir + Groundwater Basin and SDCWA Augmentation:
  - For surface water augmentation, project includes turnout with dechlorination to Reservoir; costs for surface water treatment are not included.
  - For groundwater augmentation, project includes construction of two groundwater injection wells, two extraction wells, and expansion costs for pre-treatment and RO treatment. Expansion costs for brine disposal and product water conveyance are assumed to be included in the planned groundwater desalination plant.
  - For raw water augmentation, project includes pumping to meet turnout requirements; treatment costs are not included.
- Option H – San Marcos Groundwater Basin and SDCWA Augmentation:
  - For groundwater augmentation, project includes construction of two groundwater injection wells and two groundwater extraction wells with wellhead treatment. Assumes RO treatment is not required as TDS levels in basin are less than 750 ppm.
  - For raw water augmentation, project includes pumping to meet turnout requirements; treatment costs at downstream water plants are not included.

4.5.2 O&M Costs

O&M costs assumes $0.15/kWh for pumping costs and 1% of pipeline construction costs for conveyance infrastructure maintenance. Pumping power is based on total motor horsepower for the pump station.

- Option F – Carlsbad Desalination Plant Effluent:
  - Project includes 1,000 hp pump station at the AWTF, and a new 8,000 hp pump station at the desalination plant.
  - Project includes 2.5 miles of piping to be maintained.
- Option G – San Dieguito Reservoir + Groundwater Basin and SDCWA Augmentation:
  - Project includes 800 hp pump station at the AWTF, 3,200 hp pump station at SEJPA, and a 4,800 hp pump station at the Badger WTP.
  - Expansion of the groundwater desalination facility from 1 to 3 mgd, 2 injection wells, and 2 additional extraction wells.
  - Project includes 29.1 miles of piping to be maintained.
- Option H – San Marcos Groundwater Basin and SDCWA Augmentation:
  - Project includes 5,600 hp pump station at the AWTF and a 2,000 hp pump station at the SDCWA turnout.
  - 2 groundwater injection wells and 2 extraction wells.
  - Project includes 10.3 miles of piping to be maintained.

5 Purified Water Receptor Integration Concepts

5.1 Groundwater Augmentation

5.1.1 San Dieguito Basin Recharge (Option G) and San Marcos Basin Recharge (Option H)

Reliability in potable reuse can be achieved in a number of ways. At one extreme, strategies can rely heavily on the *prevention* of failures, namely, through the provision of redundancy in treatment. Alternatively, reliability can be achieved by creating systems that are capable of consistently *responding* to failures, i.e., halting the distribution of off-spec water before it reaches consumers. In both cases, public health is maintained by protecting consumers from contaminants. Most potable reuse systems utilize a combination of these two strategies—failure prevention and failure response. Groundwater recharge, for example, requires both (1) treatment and (2) the retention and passage of water through the environment. The retention in the aquifer provides some additional treatment—e.g., 1-log of virus reduction credit per month in the ground (see TM 1)—but also a significant period of time during which a project sponsor could detect and respond to any upstream treatment excursion or failure. The degree to which these two components are used—treatment and retention time—can be balanced in different ways. For this reason, the degree of treatment is integral in determining the requirements for the aquifer.

Analyzing the groundwater recharge portions of Options G and H, the FAT treatment train provides sufficient treatment to meet the 10-log protozoa requirements, but alone cannot fully achieve the 12-log requirement for viruses (refer to Table 3-2). Accordingly, the groundwater recharge system will need to rely on additional treatment in the aquifer to complete the 12-log requirement. This treatment train provides the opportunity to engage in both groundwater spreading and injection. While spreading is allowable from the standpoint of regulations, it is likely infeasible due to the large footprint necessary for spreading basins and the density of development in the areas of the San Dieguito and the San Marcos Basins. For the groundwater augmentation option, it is assumed that groundwater injection will be pursued. Furthermore, because the treatment train alone cannot achieve the pathogen reduction credits, it is assumed that the water will have a minimum 6-month residence time in the groundwater basin. This assumption allows the project to comply with the 12-log virus requirement and is in line with the retention times provided by the majority of the existing, permitted groundwater recharge projects. Hydraulic modeling is necessary to ensure that a 6-month residence time is reasonable for the 2 mgd intended for injection in both the San Dieguito and San Marcos Basins.

Assuming there will be no phasing of the AWTF treatment train, the FAT treatment train will not be sufficient as all three remaining options include either raw or treated drinking water augmentation and these DPR elements will require more stringent treatment than the FAT treatment train provides. For this scenario, we will assume the FAT treatment train with O_3/BAF addition will be implemented for the purposes of analysis. Most of the same requirements discussed above will still apply, however the residence time in the aquifer will no longer be needed for the purposes of achieving sufficient virus LRC. Referring to Table 3-4, LRC of 15.9, 16.8, and 14.2 are expected for virus, Cryptosporidium, and Giardia, respectively, for the FAT treatment train with O_3/BAF addition, irrespective of retention time in the aquifer (excluding the addition of a WTP after the AWTF). To permit this portion of the project as an IPR project, a 2-month residence time in the aquifer will still be necessary. Again, hydraulic modeling is necessary to determine if a 2-month residence time is reasonable for the 2 mgd intended for injection.

Assuming that the water will be injected into the aquifer, the following facilities/equipment are necessary:

- Pipeline from AWTF to groundwater basin (as described in Section 4 - Conveyance Concepts)
- Pump stations

- Injection wells and associated buildings
- Extraction wells
- Treatment facilities, which are expected to include RO treatment, as necessary, and disinfection
- Monitoring wells

5.2 Surface Water Augmentation

5.2.1 San Dieguito Reservoir Discharge and Blending (Options F + G)

To assess surface water augmentation (SWA) projects, the most important components of the draft regulations pertain to (1) the retention time of the advanced treated water in the reservoir and (2) the dilution and mixing therein. The retention time in the reservoir is calculated as the theoretical hydraulic residence time on a monthly basis as follows:

$$\frac{V_{end}}{Q} \geq 6\ months$$

Where:

V_{end}= volume in the reservoir at the end of the month

Q = total outflow (withdrawals + overflow)

Assuming a 6-month V/Q, the San Dieguito Reservoir can only accommodate ~1 mgd of flow from the AWTF[2]. However, while 6 months is the current minimum theoretical residence time in the reservoir for SWA projects in draft regulations, it is likely that projects with residence times as low as 2 months will be permitted, given additional treatment and redundancy. If 2-month residence time is used as the lower bookend, the reservoir can accommodate ~3.1 mgd of advanced treated water[1]. This analysis assumes that the advanced treated water is the only input to the reservoir, which is not currently the case.

In addition, the SWA project must meet dilution and mixing requirements. Currently, there are two pathways to meet the mixing and dilution requirements based on the degree of treatment provided: 100:1 dilution in the reservoir and LRC of 12/10/10 for virus, Giardia, and Cryptosporidium, or 10:1 dilution and provision of an additional 1-log removal of all three regulated pathogens (thus, final LRC of 13/11/11). For this analysis, we will assume that a minimum dilution of 10:1 will be achieved, thus requiring the additional 1-log removal credit. Reservoir characterization, modeling, and tracer tests will be essential to determine the extent of mixing and dilution in the reservoir. Numerous data inputs will be necessary for the modeling team, including meteorological, water quality, and flow data. The most recent bathymetry evaluation was completed 7 years ago and demonstrated the presence of significant solids build-up within the reservoir (Anderson 2010). Updated bathymetry may be necessary given the high solids deposition rate (0.5 inches per year). This would also be necessary following any future dredging and removal of solids from the reservoir. The modeling results will provide important information to understand the mixing and dilution in the reservoir, and the need for any engineered solutions to improve these characteristics. Tracer studies to validate the model will also be necessary, per the draft requirements.

The log removal credits for a 2-month residence time project with 10:1 dilution will be at least 13/11/11, if not significantly higher. LRC gained at the drinking water treatment plant downstream of the reservoir count toward this 13/11/11 goal. Assuming the drinking water treatment plant provides the typical 4/3/2 log reductions, the AWTF would only be required to achieve LRC of 9/8/9 for an overall LRC of 13/11/11.

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[2] Capacity calculated using the following storage volume equation derived in (Anderson, 2010): Volume (acre-ft) = -54.2 + 10.807*H – 0.7045*H^2 + 0.01498*H^3

It is important to note that the only current project pursuing a 2-month retention time (the City of San Diego's Miramar Lake SWA project) is providing AWTF LRC of >20/>20/16, i.e., values in great excess of 13/11/11.

For these reasons, it is likely that FAT treatment alone will not be sufficient for a 2-month project, even if the project provides more than 9-logs (9.4-logs) of removal for virus (refer to Table 3-2). The proposed train for a 2-month SWA project is therefore assumed to be equivalent to the one used by the City of San Diego, namely, FAT treatment train with O_3/BAF pre-treatment. Referring to Table 3-4, LRC of 15.9, 16.8, and 14.2 are expected for virus, Cryptosporidium, and Giardia, respectively, for the FAT treatment train with O_3/BAF addition (without an additional WTP after the AWTF). This treatment train provides a high degree of redundancy beyond 13/11/11.

As mentioned above, additional reservoir characterization is necessary to determine whether these V/Q and dilution values are feasible in the San Dieguito Reservoir. The operation of the reservoir will also need to be modified in a variety of ways to maximize its potable reuse capacity and to comply with regulations. One significant assumption made in the V/Q calculations was that the only influent to the reservoir will be advanced treated water; all other existing inflows, including flows from Lake Hodges, filter backwash water from the Badger Water Filtration Plant, storm water runoff, and urban runoff, will need to be redirected. In addition, it is likely that the reservoir will need to be specifically engineered to meet the dilution requirement of 10:1. Engineering solutions likely to be relevant in the San Dieguito reservoir include optimizing placement of the influent site relative to the extraction site, as well the implementation of equipment that increases mixing in the reservoir to maximize dilution. The reservoir is currently operated using a diffused aeration system, which facilitates a well-mixed, oxic state in the bulk water. Additional equipment necessary for the implementation of a SWA project in San Dieguito reservoir could include the following:

- Diffusers
- Additional aeration equipment
- Floating baffles

5.3 Raw Water and Treated Drinking Water Augmentation

There are select examples of blending purified water with raw or finished water (e.g., Big Spring TX DPR blending with raw surface water, CDP blending of purified water with other finished water). A recent project funded by Water Research Foundation (WRF 4536) provides recommendations and guidance for the appropriate use of blending as part of a DPR project, including evaluations of treatment, impact of different water qualities, and corrosion control issues, impact on engineered storage, blending location, and blending percentages (WRRF-13-15). There are key issues that should be addressed including (i) aesthetics; (ii) regulated and emerging contaminants; (iii) microbiology; (iv) corrosion; and (v) location of blending (WRRF- 13-15).

Aesthetics

Aesthetics challenges arises when blending water from multiple sources. Blending water from multiple sources might cause changes in taste, odor color, turbidity, formation of scum, lack of lathering with soap if hardness changes, etc. (Peet et al., 2001). Taste issues may be particularly important in RO-treated recycled waters that lack hardness, alkalinity, and minerals. Bench or pilot-scale testing must be used to evaluate the effects of blending because most of these parameters cannot be evaluated by the law of mixtures or chemical theory. Maintaining the aesthetic quality of the water is a key issue when blending water, because some consumers will relate the aesthetics of the water to its safety. With that said, stabilized purified water (after chemical addition of minerals and pH adjustment) is consistently served to tour visitors at the Orange County Water District, with high marks for flavor. The Big Spring TX DPR facility has been blending ~50% purified water (similar treatment to OCWD) with other surface waters, followed by a water treatment plant, and has not experienced aesthetic challenges.

Regulated and Emerging Contaminants

Recycled water may contain more chemicals than conventional water supplies, depending upon the level of recycled water treatment and the origin of existing raw water supplies. Of critical importance are those pollutants that may present health risks, including regulated inorganic, radiologic, industrial, and pesticide contaminants (Tchobanoglous et al., 2011). NWRI (2013) lists a number of chemicals of potential health concerns that may be present in wastewater, including non-regulated contaminants, such as pharmaceuticals, hormones, and consumer chemicals. Trussell et al. (2013) has determined the level of both pathogen reduction and pollutant reduction needed for safe implementation of both IPR and DPR treatment, and the use of UF/RO/UV AOP was proven to provide more than sufficient treatment. Other health and risk evaluations have shown that such levels of purification provide a water quality that is equal or greater in quality compared to conventional water supplies in the United States (NRC, 2012).

Disinfection byproducts remain an important item of water quality focus. NDMA and tri-halomethanes are formed and destroyed in the purification process and can be properly managed to maintain concentrations below regulated values. At the point of blending, the formation of these and other DBPs should be examined through bench-scale studies to best understand the impact of disinfectant residuals, blending concentrations, and TOC impacts (WRRF - 13-15).

Microbiology

Microorganisms that may remain in treated recycled water represent a threat to water quality. NRC (2006) identified the high risks associated with regrowth in premise plumbing and the Centers for Disease Control has acknowledged that opportunistic pathogens (OPs), such as Legionella, Pseudomonas, and Mycobacterium, proliferating in building plumbing systems are now the primary source of waterborne disease outbreaks (and a majority of associated deaths) in the U.S. (CDC, 2011; Brunkard et al., 2011). Concerns are also emerging regarding the potential to spread antibiotic resistance genes (ARGs) via microbial re-growth in water reuse systems, a topic that is of concern to policy makers in the U.S. and world-wide (Fahrenfeld et al., 2013; Pruden, 2013; Wellington et al., 2013). Addressing knowledge gaps related to opportunistic pathogens and antibiotic resistance will help to advance water reuse system design, including water treatment and distribution, in order to minimize potential risks of emerging microbiological constituents of concern. Regrowth of OPs, bacteria with ARGs, microbes influencing corrosion (MIC) and indicator organisms such as heterotrophic plate counts (HPCs) is a function of many parameters including disinfectant residual, type of disinfectant, temperature, nutrient concentrations, turbidity, pH, and alkalinity.

As it pertains to this evaluation, WRF 4536 is documenting the relative improvement in blended water quality as a result of the use of purified water for blending (Salveson et al., in progress). Results clearly document that higher percentages of purified water reduce the levels of microorganisms in the blended water within the simulated distribution systems; a clear improvement in water quality.

Corrosion

Increased corrosiveness or aggressiveness of water following blending is another concerning issue. This corrosion can be directly linked to corrosive water quality (e.g., RO permeate), or can be the result of microbiologically induced corrosion. Microbial activity during stagnation has been linked to rapid loss of disinfectant (Zhang and Edwards, 2009; Nguyen et al., 2012), contamination of potable water with high levels of copper, lead and iron (McNeill and Edwards, 2001; Edwards et al., 2000; Zhang et al., 2009), microbial corrosion failures (Videla, 1996) and aesthetic problems (taste and odor) of potable water (NRC, 2006). The corrosion influencing parameters that are most relevant to recycled waters are temperature, pH, alkalinity, dissolved inorganic carbon, oxidants, total dissolved solids, calcium hardness, chloride, sulfate, hydrogen sulfide, and natural organic carbon (Vik et al., 1996).

As it pertains to this evaluation, the purified water will be stabilized and a chloramine residual will be maintained prior to blending with other raw or finished water, minimizing the corrosion impacts.

Location of Blending

Another important aspect of blending water of different quality pertains to the location of blending. Blending water of different quality may locally disrupt the natural "ecology" of the receiving environment. Because of this, blending in a storage reservoir or within a treatment plant will have a different impact compared to blending in the distribution system, as measured by biofilm detachment, or disruption of passive protective scale layers. Depending on water quality, blending recycled water upstream of a WTP may result in positive or negative impacts on the existing treatment processes. The State of California Division of Drinking Water has expressed this very concern related to DPR integration. In other cases, blending upstream of a water treatment plant can be expected to improve treated water quality, as in the case of blending purified water, resulting in decreased total organic carbon, potentially leading to more stable disinfectant residuals and reduced microbial growth feeding into a water treatment plant.

Pertaining to this project, the primary concern is the blending of purified water with other finished water, which could result in a localized change to pipeline biofilms.

5.3.1 Second Aqueduct Raw Water Augmentation (Options G-H)

As part of another effort, the San Diego County Water Authority (SDCWA) considered the effects on water quality of delivering water directly from the Carlsbad Desalination Plant (CDP) to the south and into the SDCWA's aqueduct. A chemical injection facility was proposed at the San Marcos connection point to assure water quality. It should be noted that this is not a normal operation mode and water from the desalination plant is typically routed to the Twin Oaks Valley Water Treatment Plant (TOVWTP). The chemical injection facility would inject sodium hypochlorite (11% - 14% solution) at a rate of 700 gal/day and aqueous ammonia (17% - 20% solution) at a rate of 350 gal/day (SDCWA, 2006). In the fourth addendum of the environmental impact report, additional modifications were made to ensure the desalinated product water can be safely and reliably integrated into the distribution system.

The proposed Encina AWT facilities, as described previously, will use sodium hypochlorite as part of the UV/AOP, leaving a free chlorine residual of 2 to 3 mg/L. The aqueous ammonia dosing station would likely be installed at the new AWTF to combine with the free chlorine to create a stable chloramine residual. The AWTF also will stabilize the purified water with a lime solution and neutralize the pH, making the new water less aggressive. Overall, it is unlikely that any further chemical addition facilities will be needed at the SDCWA blending location.

5.3.2 Carlsbad Desalination Plant Treated Drkinking Water Augmentation (Option F)

SDCWA has experience blending water from the CDP with their other supplies. The desalinated water must meet primary and secondary drinking water standards and does not differ significantly from the water quality of the other sources of product water in the distribution. However, certain measures are taken to prevent any possible effects on the water quality, aesthetics, and distribution system. The desalinated water is chemically conditioned prior to delivery. The post-treatment stabilization for the RO product water includes a combination of lime with carbon dioxide. Additionally, the desalinated water is then disinfected using chloramines and blended with potable water, also disinfected with chloramines, from the Metropolitan Water District. The blending of the desalinated water and the potable water does not result in any measurable impacts related to water quality. Finally, the effects on the distribution system were considered, because the existing water supply is delivered via gravity flow and delivering water from the desalination plant will require continuous pumping to reach delivery points. This issue was addressed by modeling the potential effects and providing design features to minimize this effect by including surge control facilities to avoid damage to water delivery facilities (SDCWA, 2014).

Pertaining to this project, blending of purified water (that has also been chemically stabilized) with other water supplies in the region, such as with the CDP finished water, is not expected to have negative effects on the combined finished water.

6 Permitting Considerations and Brine Disposal

6.1 Permitting Overview

Although a variety of permits and approvals would be required for a potable reuse project (including demonstration of CEQA compliance, construction-related permits, land use and/or coastal permits, air quality permits, etc.), this TM focuses on the Regional Water Quality Control Board (RWQCB) and State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW) permitting issues that warrant early feasibility evaluation.

The RWQCB regulates the treatment, reclamation, and discharge of wastewater or recycled water through federal NPDES (National Pollutant Discharge Elimination System) permits and State of California Waste Discharge Requirements (WDRs). NPDES permits regulate discharges to federal surface waters[3] pursuant to requirements established within the federal Clean Water Act. In California, NPDES permits are issued by the RWQCB under authority delegated by the U.S. Environmental Protection Agency (EPA). NPDES permits are valid for up to five years, after which renewal of the permit is required. WDRs are issued by the RWQCB to regulate discharges to state waters[4] pursuant to provisions of the State of California Porter-Cologne Water Quality Act.[5] WDRs do not have an expiration date, but may be replaced or updated by the RWQCB at any time.

NPDES permits and WDRs for proposed facilities would implement applicable federal and state water quality plans and policies, including:

- The *Water Quality Plan for the San Diego Basin* (Basin Plan), which is applicable to all discharges to ground and surface waters.[6]
- The *Water Quality Control Plan, Ocean Waters of California* (Ocean Plan), which is applicable to all discharges to marine waters.[7]

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3 Federal surface waters include inland surface waters and wetlands, estuaries, bays, and the Pacific Ocean. NPDES permits regulate discharges to federal surface waters or tributaries to such surface waters.

4 State waters include both federal surface waters and groundwaters. NPDES permits issued by the RWQCB for discharges to federal surface waters also double as WDRs, as the NPDES permits combine both federal and state requirements into a single permit. Individual WDRs are issued for discharges to groundwater, as groundwater discharges are regulated under state law but not federal law.

5 The Porter-Cologne Water Quality Act (as amended in 2017) preceded implementation of the federal Clean Water Act, and includes the following portions of the *California Water Code*: Division 1, Sections 100-540; Division 2, Sections 1000-5976, and Division 7, Sections 13000-16104.

6 The Basin Plan designates beneficial uses of ground and surface waters within the San Diego Region, and establishes water quality objectives to protect the beneficial uses on a watershed-by-watershed basis. The Basin Plan also establishes implementation policies for protecting beneficial uses and achieving the water quality objectives.

7 The Ocean Plan establishes effluent and receiving water standards applicable for all discharges to State-regulated waters of the Pacific Ocean (i.e., waters within three nautical miles of the shore). The Ocean Plan also establishes requirements and implementation policies applicable to ocean discharges.

- The California Toxics Rule (CTR), which is applicable to all discharges to federal inland surface waters, enclosed bays, and estuaries.[8]

DDW acts as a consulting agency to the RWQCB, and the RWQCB incorporates all applicable DDW recycled water, source water, discharge, and receiving water requirements within the NPDES permits or WDRs that are issued by the RWQCB to discharging agencies. In addition, DDW also implements drinking water standards and potable reuse requirements in the water supply permits issued by DDW to potable water supply agencies.

6.1.1 RWQCB Permit Application Process

Dischargers must submit a Report of Waste Discharge (RWD) to the RWQCB in application for NPDES permits or WDRs. The RWD consists of applicable permit applications forms; descriptions of proposed facilities (including descriptive text, tables and figures); demonstrations of compliance with applicable water quality plans and policies; and demonstrations of compliance with applicable environmental regulations. The RWQCB is empowered to request any information, data, or studies needed to support RWQCB assessment potential discharge compliance or impacts of the discharge. The RWQCB endeavors to notify dischargers within 30 days of submission of the RWD as to whether the RWD is complete or if supplemental information is required.

RWDs must be received by the RWQCB no later than 180 days in advance of the proposed discharge, but RWQCB action on the submitted application may be delayed by RWQCB staff priorities and workloads. It is advantageous to submit the RWD as soon as CEQA compliance is certified in order to eliminate uncertainty on final RWQCB effluent concentration limits.[9] In recent years, RWQCB workloads have been such that processing of NPDES permits typically takes the entire 180-day period (or more). Processing of WDRs, on the other hand, is often completed in significantly less time.

6.1.2 Required Permits for Reuse Options

Table 6-1 summarizes required RWQCB and DDW permits that would be required for reuse options considered within TM3. As shown in Table 6-1, RWQCB permits required to implement the TM3 options may include:

- WDRs to regulate the treatment and use of recycled water to recharge the San Dieguito Valley Groundwater Basin (Option F and G) or the San Marcos Basin (Option H),
- a NPDES permit to regulate the discharge of purified water to San Dieguito Reservoir (Options F and G).

In addition, modification of the existing Encina Ocean Outfall (EOO) NPDES permit would be required to allow the discharge of AWTF waste brine to the EOO[10]. Modification of the EOO NPDES permit would also be required to address any significant changes to Encina Water Pollution Control Facility (EWPCF) onsite facilities that support implementation of any of the regional reuse options.

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8 The California Toxics Rule (CTR) is established by EPA within Title 40, Section 131.38 of the *Code of Federal Regulations* (CFR). The CTR establishes state-wide water quality standards for all discharges to inland surface waters, enclosed bays, and estuaries.

9 The RWD can be submitted to the RWQCB prior to completing CEQA (and, if applicable, National Environmental Protection Act) certification, but the RWQCB typically does not process the application until after completion of the CEQA process. Regardless of the sequence of completion, information presented in the RWD must be consistent with information presented within the CEQA documents.

10 Note that the EOO is used to discharge RO waste brine from the Carlsbad Water Reclamation Facility when the RO system is in operation (e.g., to reduce salinity of the recycled water produced).

Finally, modification of existing DDW water supply permits would be required for any water agency that makes use of source water derived from EWA recycled water sources (e.g., groundwater augmentation, surface water augmentation).

Table 6-1: Anticipated RWQCB and DDW Permits for TM3 Reuse Options.

Option	Activity	Type of Required Permit		
		RWQCB NPDES Permit[11]	RWQCB WDRs[12]	DDW Water Supply Permit
F	Groundwater augmentation (up to 2 mgd) in San Dieguito Valley Groundwater Basin		●	● [13, 15]
	Surface water augmentation (up to 3.1 mgd) in San Dieguito Reservoir	● [14]		
	Treated drinking water augmentation (10.7 to 15.8 mgd) with Desalination Plant finished water	See note[15]	See note[12]	
	Brine discharge to Encina Ocean Outfall	● [16]		
G	Groundwater augmentation (up to 2 mgd) in San Dieguito Valley Groundwater Basin		●	● [13, 15]
	Surface water augmentation (up to 3.1 mgd) in San Dieguito Reservoir	● [14]		
	Raw water augmentation (10.9 to 14 mgd) in the Second Aqueduct Pipeline No. 5	See note[12]	See note[12]	
	Brine discharge to Encina Ocean Outfall	● [13]		
H	Groundwater augmentation (up to 2 mgd) in San Marcos Basin		●	● [12, 15]
	Raw water augmentation (14 to 16 mgd) in Second Aqueduct Pipeline No. 5	See note[12]	See note[12]	
	Brine discharge to Encina Ocean Outfall	● [16]		

[11] The RWQCB would adopt the NPDES permit pursuant to authority delegated by EPA. The NPDES permit would implement applicable state and federal water quality plans, policies, and standards. The treating/discharging agency would be the NPDES permittee.

[12] WDRs would be adopted by the RWQCB pursuant to the State of California Porter-Cologne Water Quality Act. The WDRs would implement applicable state water quality plans, policies, and standards. The treating/discharging agency would be the NPDES permittee.

[13] Modification of existing DDW water supply permits would be required for any agency issued to the Santa Fe Irrigation District (operator of San Dieguito Reservoir) would be required.

[14] NPDES permit would address the treatment and discharge of purified water to San Dieguito Reservoir, and would implement applicable Basin Plan water quality standards for the reservoir as well as statewide water quality standards established by the EPA California Toxics Rule.

[15] Regulations governing direct potable reuse (DPR) have not been developed, but Senate Bill 918 directs the SWRCB to convene an expert panel and investigate the feasibility of developing uniform water recycling criteria for DPR projects. As documented in TM1, the SWRCB in a draft report released in 2016 determined that "it is technically feasible to develop uniform water recycling criteria for DPR in California, and that those criteria could incorporate a level of public health protection as good as or better than what is currently provided by conventional drinking water supplies and IPR."

[16] Modification of the existing Encina Wastewater Authority NPDES permit (NPDES CA0107395) would be required to address the discharge of brine to the EOO. The brine discharge NPDES modifications would implement applicable Ocean Plan water quality standards.

6.1.3 DPR Permitting Issues

As noted in Table 6-1, DPR regulations are not currently in place that would allow the use of purified water to augment either (1) treated supplies in the CDP product water pipeline, or (2) raw water supplies in the SDCWA Second Aqueduct Pipeline No. 5. As a result, it is uncertain how these treated or raw water augmentation discharges would be regulated. Because directing purified recycled water to the Carlsbad Desalination Project product water pipeline would not involve a discharge to federal surface waters, however, it is probable that the RWQCB and DDW would regulate purified water treatment operations through the following:

- RWQCB issuance of WDRs to recycled water agencies that incorporate applicable DDW-mandated DPR requirements, and
- requirements established by DDW within water supply permits issued to water purveying agencies.

Because raw water augmentation would allow for discharge to imported water storage reservoirs, it is probable that raw water augmentation to the SDCWA Second Aqueduct would be regulated through the following:

- RWQCB issuance of a NPDES permit to the recycled water (discharging) agency that incorporates applicable DDW-mandated DPR requirements, and
- requirements established by DDW within the water supply permits issued to water purveying agencies.

6.2 Groundwater Augmentation

As shown in Table 6-1, groundwater recharge within the San Dieguito Valley Groundwater Basin (Options F and G) or San Marcos Basin (Option H) would be regulated by RWQCB issuance of WDRs that implement applicable DDW groundwater recharge regulations and RWQCB groundwater quality objectives established within the Basin Plan. DDW regulations governing the use of recycled water for recharging potable groundwater basins are established in Title 22, Division 4, Chapter 3 of the *California Code of Regulations* (CCR). As detailed within TM1, DDW groundwater recharge regulations establish requirements governing, in part:

- source control,
- level of treatment, recharge methods, and pathogen removal,
- diluent (dilution) water and recycled water contribution,
- recycled water (underground) retention times,
- restrictions on the construction of new groundwater wells within the restricted zone,
- tracer and treatment performance studies, and
- monitoring.

DDW acts as a consulting agency within the RWQCB permitting process, and the RWQCB will implement DDW-mandated requirements[17] directly into the WDRs governing the recycled water treatment and groundwater recharge operations. As noted, DDW will also implement the groundwater recharge regulations within the Water Supply Permits issued to each applicable water agency that would derive potable supply from the affected groundwater basin.

In addition to implementing the DDW recycled water groundwater recharge requirements established within Title 22, WDRs issued by the RWQCB would implement applicable prohibitions, requirements, and

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[17] See TM1 for a summary of DDW groundwater recharge regulations and requirements.

water quality objectives established within the Basin Plan. Table 6-2 summarizes Basin Plan groundwater quality objectives for mineral constituents for the San Dieguito Valley Groundwater Basin (Option F and G) and the San Marcos Basin (Option H). Purified recycled water that complies with DDW treatment requirements should readily comply with applicable Basin Plan groundwater quality objectives.

In addition to the objectives for mineral constituents listed in Table 6-2, the Basin Plan also applies DDW primary drinking water Maximum Contaminant Levels (MCLs) directly to groundwaters of the San Dieguito Valley and San Marcos Basin. As a result, WDRs issued by the RWQCB will likely prohibit recycled water used for groundwater recharge from exceeding the potable water MCLs. The DDW water supply permit, on the other hand, will apply the MCLs to the finished blended potable water supply.

Table 6-2: Basin Plan Groundwater Quality Objectives.

Constituent	Basin Plan Groundwater Quality Objective (mg/L)[18]	
	San Dieguito Valley Groundwater Basin	San Marcos Basin
Total dissolved solids, TDS	1500	1000
Chloride	500	400
Sulfate	500	500
Nitrate (as NO_3)	45	45
Iron	0.85	0.3
Manganese	0.15	0.05
Boron	0.75	0.75
Fluoride	1.0	1.0

6.3 Surface Water Augmentation

The use of recycled water for surface water augmentation of San Dieguito Reservoir (Options F and G) would be regulated by RWQCB issuance of a NPDES permit to the recycled water treatment and discharging agency. The NPDES permit would implement applicable DDW potable reuse regulations as well as applicable state and regional surface water quality objectives.

As discussed in TM1, DDW has issued uniform regulations governing the use of recycled water for augmenting supplies within surface water reservoirs that serve as a source of raw water supply to potable water treatment plants. Initial draft surface water augmentation regulations were distributed by DDW for public comment in mid-2017.[19] As summarized in TM1, the draft DDW potable reuse regulations address requirements for:

- source control,
- advanced treatment and pathogen removal,

[18] Basin Plan groundwater quality objective not to be exceeded more than 10 percent of the time. It is probable that the RWQCB will establish effluent concentration limits for groundwater recharge projects at the listed objective.

[19] Draft proposed regulations released by DDW in 2017 (dated October 12, 2016) include revisions to the following sections of Title 22, Division 4 of the *California Code of Regulations*: Chapter 3, Article 1 (Section 60301); Chapter 3, Article 5.3 (Section 60320); and Article 9 (Section 64668).

- reservoir dilution,
- reservoir retention,
- reservoir modeling and tracer studies,
- emergency and operations plans to ensure reliability, and
- ongoing performance monitoring.

DDW potable reuse regulations will be incorporated in the NPDES permit issued by the RWQCB to the recycled water treatment agency as well as the water supply permit issued by DDW to the reservoir operator. Additionally, the NPDES permit that regulates the discharge of purified water to San Dieguito Reservoir would establish purified water concentration standards that implement:

- state and federal water quality standards[20] for San Dieguito Reservoir that are established by the RWQCB within the Basin Plan, and
- state-wide standards for inland surface waters that have been imposed by EPA within the California Toxics Rule (CTR).[21]

The Basin Plan establishes surface water quality standards within the San Diego Region on a watershed-by-watershed basis. Basin Plan water quality standards for San Dieguito Reservoir watershed are established for:

- mineral constituents such as total dissolved solids, chloride, sulfate, manganese, iron, boron, and fluoride,
- nutrient constituents (total nitrogen and total phosphorus), and
- toxic constituents for which state and federal primary drinking water standards have been established.

6.3.1 Basin Plan Standards

Table 6-3 summarizes Basin Plan surface water quality objectives for mineral constituents for San Dieguito Reservoir. Because the purified water used for surface water augmentation would be required (per DDW regulations) to undergo full reverse osmosis treatment, compliance with the Basin Plan mineral standards is not projected to represent a compliance concern.

The Basin Plan establishes a narrative objective that concentrations of nitrogen and phosphorus, by themselves or in combination with any other nutrient, shall be maintained at levels below those that stimulate algae and emergent plant growth. As shown in Table 6-3, the Basin Plan also establishes numerical concentration objectives for total phosphorus. While Basin Plan concentration objectives for total phosphorus are stringent, phosphorus is readily removed through advanced treatment and compliance with the Basin Plan standard for total phosphorus should not represent a compliance concern for the level of treatment mandated under proposed DDW surface water augmentation regulations.

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20 Basin Plan water quality objectives for surface waters have been adopted by EPA as federal water quality standards that are subject to requirements and enforcement provisions of the federal Clean Water Act.

21 CTR regulations were promulgated by EPA within 40 CFR 131.38. (EPA, 2000).

Table 6-3: Basin Plan Surface Water Quality Objectives for San Dieguito Reservoir

Constituent	Basin Plan Surface Water Quality Objective (mg/L)[22] San Dieguito Reservoir
Total dissolved solids, TDS	500
Chloride	250
Sulfate	250
Iron	0.3
Manganese	0.05
Boron	0.75
Fluoride	1.0
Total Phosphorus	0.025[23]
Total Nitrogen	See Note[24,25]

Total nitrogen, on the other hand, is not completely removed through advanced treatment and would represents a significant compliance concern for a surface water augmentation project at San Dieguito Reservoir. The Basin Plan requires that "natural" N:P ratios are to be identified and upheld, and that in the absence of data, a N:P ratio of 10:1 is to be used. Applying a 10:1 N:P ratio to the 0.025 mg/L Basin Plan standard for total phosphorus would result in a total nitrogen concentration limit of 0.25 mg/L – a value that cannot readily be achieved even with 100 percent reverse osmosis treatment.

To address this issue, after initial review of two local surface water augmentation projects[26], the RWQCB has tentatively agreed to a surface water augmentation regulatory concept under which purified water discharges to imported water reservoirs could be regulated through:

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[22] Basin Plan groundwater surface water quality objective not to be exceeded more than 10 percent of the time. It is probable that the RWQCB will establish NPDES effluent concentration limits for surface water augmentation discharges at the listed objective.

[23] Threshold total phosphorus (P) shall not exceed 0.05 mg/L in any stream at the point where it enters any standing body of water, nor 0.025 mg/L in any standing body of water.

[24] The Basin Plan does not establish analogous concentration values for total nitrogen, but requires that natural ratios of nitrogen to phosphorus (N:P) are to be identified through monitoring and upheld. In the absence of data, the Basin Plan specifies that a N:P ratio of 10:1 is to be used. If applied to San Dieguito Reservoir, such a 10:1 N:P ratio would translate to a total nitrogen standard of 0.5 mg/L in discharges to standing bodies of water, and a nitrogen standard of 0.25 mg/L within the ambient reservoir water.

[25] In indirect potable reuse (IPR) projects proposed by the City of San Diego for Miramar Reservoir and by the Padre Dam Municipal Water District and Helix Water District for Lake Jennings, the RWQCB has indicated a willingness to consider imposing total nitrogen standards on the order of 2 mg/L for purified recycled water discharges to these reservoirs. The basis for this consideration is that "natural" N:P ratios do not exist in reservoirs that are dominated by imported water or by IPR water. Instead, N:P ratios are dependent on the source and quality of the imported water supply. Consequently, operators of such reservoirs can manage and maintain N:P ratios at sufficiently high values to ensure that phosphorus remains the limiting nutrient and the limited phosphorus concentrations prevent adverse biostimulation effects.

[26] The City of San Diego has proposed the use of purified recycled water for supplying Miramar Reservoir, and the Padre Dam Municipal Water District and Helix Water District have proposed the use of purified recycled

- recycled water treatment to ensure compliance with the Basin Plan 0.025 mg/L total phosphorus objective, and
- ensuring that phosphorus-limited conditions (e.g. maintaining a high N:P ratio) are maintained within the reservoir to prevent biostimulation.

Additional study will be required to determine if the tentative nutrient compliance proposed for Miramar Reservoir and Lake Jennings is workable at San Dieguito Reservoir. It is probable that this approach will only be feasible if purified water completely replaces Lake Hodges water as the source of supply within San Dieguito Reservoir.[27]

6.3.2 Application of Drinking Water Standards

In addition to establishing standards for mineral constituents, the Basin Plan imposes state and federal primary drinking water standards on raw waters stored in San Dieguito Reservoir. As a result, while DDW applies the drinking water standards to the final potable supply, the RWQCB applies the state and federal primary drinking water concentration standards to the untreated source water waters within the watershed.

6.3.3 California Toxics Rule

EPA in 2000 promulgated the California Toxics Rule (CTR) which established state-wide water quality standards for inland surface waters of California.[28] CTR standards have been established for toxic inorganic and toxic organic constituents for the protection of aquatic habitat and for the protection of public health. The CTR standards also incorporate national standards for toxic chemicals established by EPA within the National Toxics Rule (NTR).[29]

Table 6-4 presents CTR standards for the protection of aquatic habitat that would be applicable to San Dieguito Reservoir. Table 6-5 presents CTR standards for the protection of public health. Since San Dieguito Reservoir is closed to public access and fishing, only the CTR standards for the consumption of water would apply to the reservoir.

As shown in Table 6-4 and Table 6-5, CTR standards for some toxic constituents are more stringent than corresponding drinking water standards. As a result, the CTR concentration limits (rather than drinking water limits) would govern purified water treatment and production for these constituents.

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water for supplying Lake Jennings. The RWQCB has tentatively provided verbal agreement with a phosphorus-limited approach for the Miramar Reservoir and Lake Jennings surface water augmentation projects that would allow for total nitrogen effluent standards on the order of 2 mg/L. The RWQCB to date, however, has not formally committed in writing to any particular tentative NPDES permit limits for these projects.

[27] Lake Hodges receives significant nutrient contributions from its watershed, and it may not be possible to manage or properly control nutrient concentrations in San Dieguito Reservoir if Lake Hodges supply continues to be introduced in San Dieguito Reservoir. On the other hand, if the Lake Hodges supply is 100 percent replaced by purified recycled water (e.g. no Lake Hodges water to San Dieguito), management of nutrient conditions within San Dieguito Reservoir will be greatly simplified and it is probable that the RWQCB would entertain total nitrogen standards on the order of 2 mg/L – standards that would be consistent with those being considered by the RWQCB for proposed potable reuse projects at Miramar Reservoir and Lake Jennings.

[28] Title 40, Section 131.38 of the *Code of Federal Regulations* (40 CFR 131.38). (EPA, 2000)

[29] NTR standards are promulgated by EPA within 40 CFR 131.36. (EPA, 1993)

It should be noted that CTR standards apply to ambient receiving waters, and SWRCB implementation policies allow the RWQCB to apply the CTR standards outside designated mixing zones.[30] As a result, where appropriate dilution and mixing documentation is provided, the RWQCB may consider dilution credits in establishing CTR-based NPDES effluent concentration standards.

Table 6-4: California Toxic Rule Standards for the Protection of Aquatic Habitat

Constituent	Concentration (µg/l) Standard for Protection of Aquatic Habitat[31]		Constituent	Concentration (µg/l) Standard for Protection of Aquatic Habitat[28]	
	CMC[32]	CCC[33]		CMC[29]	CCC[30]
TOXIC INORGANIC CONSTITUENTS			**CHLORINATED PESTICIDES**		
Antimony	NS	NS	Aldrin	3.0	NS
Arsenic	340	150	gamma BHC (Lindane)	0.95	NS
Cadmium	4.3[34]	2.2[31]	Chlordane	2.4	0.0043
Chromium III	550[31]	180[31]	4,4'-DDT	1.1	0.001
Chromium VI	16	11	4,4'-DDD	NS	NS
Copper	13[31]	9[31]	4,4'-DDE	NS	NS
Lead	65[31]	2.5[31]	Dieldrin	0.24	0.056
Mercury	1.4	0.77	alpha Endosulfan	0.22	0.056
Nickel	470	52	beta Endosulfan	0.22	0.056
Selenium	NS	5.0	Endosulfan Sulfate	NS	NS
Silver	3.4[31]	NS	Endrin	0.086	0.036
Thallium	NS	NS	Endrin Aldehyde	NS	NS
Zinc	120[31]	120[31]	Heptachlor	0.52	0.0038
Cyanide	22	5.2	Heptachlor Epoxide	0.52	0.0038
ACID EXTRACTABLE COMPOUNDS			PCBs	NS	0.014
Pentachlorophenol	19	15	Toxaphene	0.73	0.0002

Footnotes:

1. NS indicates that no standard has been established for the listed constituent.

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30 The SWRCB established CTR implementation policies within *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California*. (SWRCB, 2005)

31 *California Toxics Rule* (40 CFR 131.38) per EPA (2000). CTR numeric criteria for protection of aquatic habitat. Standards are applicable to all freshwater surface waters of the San Diego Region. All values rounded to two significant figures. Discharge concentration standards established in the NPDES permit adopted by the RWQCB may take into account potential mixing zone dilution credits allowed by the RWQCB.

32 CMC is the criteria maximum concentration, the highest concentration to which aquatic life can be exposed for a short period of time without deleterious effect

33 CCC is the criteria continuous concentration, the highest concentration to which aquatic life can be exposed for 4 days without deleterious effect.

34 CMC and CCC water quality criteria for cadmium, chromium III, copper, lead, silver, and zinc are dependent on receiving water hardness. (CTR limits become more stringent with lower hardness, and less stringent with higher hardness concentrations.) The above values are based on a receiving water hardness of 100 mg/L.

Table 6-5: California Toxics Rule Standards for the Protection of Human Health

Constituent	Concentration (µg/l) Standard Protection of Human Health (Monthly Average)[35]		Constituent	Concentration (µg/l) Standard Protection of Human Health (Monthly Average)[32]	
	Consumption of Water[36]	Consumption of Water plus Organisms[37]		Consumption of Water[33]	Consumption of Water plus Organisms[34]
TOXIC INORGANIC CONSTITUENTS			**ACID EXTRACTABLE COMPOUNDS**		
Antimony	4300	14	2-chlorophenol	400	120
Mercury	1300	NS	2,4-dichlorophenol	790	93
Copper	0.051	0.05	2,4-dimethylphenol	2300	540
Nickel	4600	610	2-methyl 4,6 dinitrophenol	765	13.4
Thallium	6.3	1.7	2,4-dinitrophenol	14,000	70
Cyanide	220,000	700	Pentachlorophenol	8.2	0.28
VOLATILE ORGANIC COMPOUNDS			Phenol	4,600,000	21,000
Acrolein	780	320	2,4,6-trichlorophenol	6.5	2.1
Acrylonitrile	0.66	0.059	**BASE NEUTRAL COMPOUNDS**		
Benzene	71	1.2	Acenaphthene	2700	1200
Bromoform	360	4.3	Anthracene	110,000	9600
Carbon tetrachloride	4.4	0.25	Benzidene	0.00054	0.00012
Chlorobenzene	21,000	680	Benzo (a) anthracene	0.049	0.0044
Chlorodibromom ethane	34	0.41	Benzo (a) pyrene	0.049	0.0044
Dichlorobromom ethane	46	0.56	Benzo (b) fluoranthene	0.049	0.0044
1,2-dichloroethane	99	0.38	Benzo (k) fluoranthene	0.049	0.0044
1,1-dichloroethylene	3.2	0.057	Bis (2-chloroethoxy) ether	1.4	0.031
1,2-dichloropropane	39	0.52	Bis (2-chloroisopropyl) ether	170,000	1400
1,3-dichloropropene	1700	10	Bis (2-ethylhexyl) phthalate	5.9	1.8

California Toxics Rule (40 CFR 131.38) per EPA (2000). All values rounded to two significant figures. Standards are applicable to all freshwater surface waters of the San Diego Region.

35 *California Toxics Rule* (40 CFR 131.38) per EPA (2000). All values rounded to two significant figures. The above standards are for ambient surface waters. Actual discharge concentration standards will be established in the NPDES permit adopted by the RWQCB, and may take into account potential mixing zone dilution credits allowed by the RWQCB.

36 CTR criteria for the consumption of water. Standard applicable to San Dieguito Reservoir.

37 CTR criteria for the consumption of water plus organisms. Standards applicable to potable water reservoirs that allow fishing.

Constituent	Concentration (µg/l) Standard Protection of Human Health (Monthly Average)[35] Consumption of Water[36]	Consumption of Water plus Organisms[37]	Constituent	Concentration (µg/l) Standard Protection of Human Health (Monthly Average)[32] Consumption of Water[33]	Consumption of Water plus Organisms[34]
Ethylbenzene	29,000	3100	Butyl benzyl phthalate	5200	3000
Methyl bromide	4000	48	2-chloronaphthalene	4300	1700
Methylene chloride	1600	4.7	Chrysene	0.049	0.0044
1,1,2,2-tetrachloroethane	11	0.17	Dibenzo (a,h) anthracene	0.049	0.0044
Tetrachloroethylene	8.85	0.8	1,2-dichlorobenzene	17,000	2700
Toluene	200,000	6,800	1,3-dichlorobenzene	2600	400
1,2 trans-dichloroethylene	140,000	700	1,4-dichlorobenzene	2600	400
1,1,2-trichloroethane	42	0.60	3,3-dichlorobenzidene	0.077	0.04
Trichloroethylene	81	2.7	Diethyl phthalate	120,000	23,000
Vinyl chloride	525	2.0	Dimethyl phthalate	2,900,000	313,000
CHLORINATED PESTICIDES			Di-n-octyl phthalate	12,000	2700
Aldrin	0.00014	0.00013	2,4-dinitrotoluene	9.1	0.11
alpha BHC	0.013	0.0039	1,2-diphenylhydrazine	0.54	0.04
beta BHC	0.046	0.014	Fluoranthene	370	300
gamma BHC (Lindane)	0.063	0.019	Fluorene	14,000	1300
Chlordane	0.00059	0.00057	Hexachlorobenzene	0.00077	0.00075
4,4'-DDT	0.00059	0.00059	Hexachlorobutadiene	50	0.44
4,4'-DDD	0.00059	0.00059	Hexachlorocyclopentadiene	17,000	240
4,4'-DDE	0.00084	0.00083	Hexachloroethane	8.9	1.9
Dieldrin	0.00014	0.00014	Ideno 1,2,3-cd Pyrene	0.049	0.0044
alpha Endosulfan	240	110	Isophorone	600	8.4
beta Endosulfan	240	110	Nitrobenzene	1900	17
Endosulfan Sulfate	240	110	N-nitrosodimethylamine	8.1	0.00069
Endrin	0.81	0.76	N-nitrosodi-n-propylamine	1.4	0.005
Endrin Aldehyde	0.81	0.76	N-nitrosodiphenylamine	16	5.0
Heptachlor	0.00021	0.00021	Pyrene	11,000	960

Constituent	Concentration (µg/l) Standard Protection of Human Health (Monthly Average)[35]		Constituent	Concentration (µg/l) Standard Protection of Human Health (Monthly Average)[32]	
	Consumption of Water[36]	Consumption of Water plus Organisms[37]		Consumption of Water[33]	Consumption of Water plus Organisms[34]
Heptachlor Epoxide	0.00011	0.00010	1,2,4-trichlorobenzene	940	260
PCBs	0.00017	0.00017	**DIOXANS AND DIFURANS**		
Toxaphene	0.00075	0.00073	2,3,7,8-TCDD	1.4E-08	1.3E-08

Footnotes:

1. NS indicates that no standard has been promulgated for the listed constituent and category.

6.3.4 Chlorine Policy

The CTR does not establish a standard for chlorine residual, but EPA has established national criteria for chlorine residual concentrations to protect freshwater aquatic life.[38] The SWRCB in 2006 proposed that the EPA criteria be established as a statewide standard, but to date the draft chlorine residual standards have not been implemented.[39] The draft statewide chlorine standards currently being considered by the SWRCB would require that dischargers reduce chlorine residual in discharges to receiving waters to as close to zero as practicable. Pending approval of statewide standards for chlorine residual, the SWRCB has implemented the EPA criteria maximum concentration (CMC) water quality criteria (see Table 6-6 below) in the current statewide NPDES permit governing discharges to surface waters from drinking water systems.[40] It is anticipated that such a standard would also be applied to any surface water augmentation discharge to San Dieguito Reservoir.

[38] National water quality criteria for total chlorine published by EPA. (EPA, 2017)

[39] See *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California.* (SWRCB, 2006)

[40] SWRCB General Order No. WQ 2014-0194-DWQ. (SWRCB, 2014)

Table 6-6: Recommended Criteria for Chlorine for the Protection of Freshwater Aquatic Life

Parameter	National Recommended Water Quality Criteria[41] (concentration in µg/L)	
	CMC[42]	CCC[43]
Chlorine Residual	19[44]	11

6.4 Raw Water Augmentation

Options G and H involve the potential use of purified recycled water for augmenting untreated water supplies in Pipeline No. 5 of the SDCWA Second Aqueduct. Pipeline No. 5 provides supply to potable water treatment plants and reservoirs operated by the Olivenhain Municipal Water District, Santa Fe Irrigation District/San Dieguito Water District, City of San Diego, and Sweetwater Authority.

6.4.1 DDW Regulation

As noted in TM1, DDW has not developed uniform regulations governing the use of purified recycled water for augmenting aqueduct supplies. It is probable, however, that such regulations (when developed) would include additional treatment and monitoring requirements that would ensure the aqueduct discharge scenario provides a degree of public health protection that is at least as protective as current water supply operations and proposed DDW indirect potable reuse regulations.[45]

6.4.2 Probable RWQCB Regulation

Because aqueduct water from Pipeline No. 5 may be discharged to and stored in reservoirs, the RWQCB would likely regulate the discharge of purified recycled water to the Second Aqueduct through issuance of a NPDES permit that implements (1) applicable DDW requirements, and (2) surface water standards for applicable terminal reservoirs. The same Basin Plan standards that are applicable to San Dieguito Reservoir (see Table 6-3) are also applicable to each of the terminal reservoirs for Pipeline No. 5 (e.g., Olivenhain Reservoir, Miramar Reservoir, San Vicente Reservoir, Sweetwater Reservoir).

Fishing is allowed in City of San Diego and Sweetwater Authority reservoirs that receive supply from Pipeline No. 5. As a result, CTR human health standards for the consumption of water plus organisms (see Table 6-5) would be applicable for any purified recycled water flow discharged to the Second Aqueduct. In addition to Basin Plan and CTR standards, any NPDES permit governing aqueduct augmentation would, of course, incorporate all applicable DDW regulations or requirements governing augmentation of Second Aqueduct flows.

41 National recommended water quality criteria per EPA (2017) for the protection of aquatic freshwater life.

42 CMC is the criteria maximum concentration, the highest concentration to which aquatic life can be exposed for a short period of time without deleterious effect.

43 CCC is the criteria continuous concentration, the highest concentration to which aquatic life can be exposed for 4 days without deleterious effect.

44 This 19 µg/l criterion has been established as a NPDES effluent concentration limit in the SWRCB general NPDES permit (Order WQ 2014-0194-DWQ) that regulates discharges of potable water to surface waters. (SWRCB, 2014)

45 See TM1 for a summary of issues and probable regulatory approaches associated with direct potable reuse.

6.5 Brine Disposal

Each of the reuse options considered herein involve discharging waste brine to the EOO. Modification of the EOO NPDES permit would be required to:

- address changes in facilities descriptions within the findings and Fact Sheet of the existing EMWPF NPDES permit,[46]
- establish requirements for the discharge of waste brine to the EEO, and
- address changes in initial dilution created by the brine discharge.

NPDES permit effluent limitations in the EOO NPDES permit implement receiving water standards and technology-based effluent standards that are established in the Ocean Plan, including receiving water standards (Ocean Plan Table 1 standards) and technology-based standards (Ocean Plan Table 2 standards).[47]

6.5.1 Ocean Plan Technology-Based Standards

In part, Table 2 of the Ocean Plan includes technology-based standards for:

- Grease and oil (30-day average limit of 25 mg/L; daily maximum limit of 75 mg/L),
- Settleable solids (30-day average of 1.0 milliliters per liter; daily maximum of 1.5 ml/l),
- Turbidity (30-day average limit of 75 NTU; daily maximum limit of 225 NTU), and
- pH (pH to be maintained between 6.0 and 9.0 units at all time)

Ocean Plan Table 2 effluent standards apply to each individual discharge stream to the EOO, and the Ocean Plan Table 2 standards would be imposed as NPDES effluent concentration standards for any brine discharge to the EEO.

6.5.2 Ocean Plan Receiving Water Standards and Initial Dilution Implications

Ocean Plan Table 1 receiving water standards apply to the combined discharge from the EOO. Ocean Plan Table 1 standards apply to receiving waters beyond designated zones of initial dilution, and the Table 1 standards are to be achieved after completion of the initial dilution process. The Ocean Plan specifies that NPDES effluent limits for regulated constituents within Table 1 be established on the basis of the following equation: $C_e = C_o + D_m \cdot (C_o - C_s)$

Where C_e = NPDES effluent concentration standard for the Ocean Plan Table 1 constituent,
C_o = Ocean Plan Table 1 receiving water concentration standard,
D_m = minimum probable initial dilution assigned by the RWQCB, and
C_s = ambient ocean water concentration.

The RWQCB currently assigns an initial dilution of 144:1 to the EOO on the basis of plume buoyancy and dilution modeling completed by the SWRCB.[48] Implementation of the reuse options considered herein will increase the salinity of the EEO discharge, as EWPCF wastewater discharges to the EOO will be reduced

46 The EEO discharge (including discharges from the EWPCF, the Meadowlark Water Reclamation Plant, the Shadowridge Water Reclamation Plant, and the Carlsbad Water Recycling Facility) is currently regulated by RWQCB Order No. R9-2011-0009 (NPDES CA0107395). NPDES CA0107395 was set to expire on June 1, 2016, but the permit has been administratively continued by the RWQCB, and RWQCB action on the Encina Wastewater Authority application for renewal of the NPDES permit is pending.

47 See Tables 1 and 2 of the *Water Quality Control Plan, Ocean Waters of California* (SWRCB, 2015).

48 See Section II.B of the Fact Sheet (Attachment F) to Order No. R9-2011-0019 (NPDES CA0107395).

while the waste brine flows to the EOO will be increased. Dilution modeling will be required to assess how the increased brine flows to the EOO will affect the assigned initial dilution, but it is possible that increased brine contributions within the EOO would reduce the discharge plume buoyancy to the point where the assigned initial may be significantly reduced.

Such a reduction in the assigned initial dilution should not affect EOO compliance with most constituents, as the EOO currently complies with Ocean Plan-based NPDES requirements for individual toxic organic and inorganic constituents by a comfortable margin. A reduction in the assigned initial dilution, however, may potentially affect compliance with the Ocean Plan Table 1 receiving water standard for chronic toxicity. Additional analysis will be required to (1) assess the impact of increased brine on EOO initial dilution, and (2) evaluate how this reduction in initial dilution may affect compliance with the Ocean Plan receiving water standard for chronic toxicity.

A brine discharge to the EOO under Options F, G or H would contain salinity concentrations well below ambient ocean salinity levels. Such a brine discharge would not be subject to 2016 Ocean Plan Amendments that address brine discharges from seawater desalination facilities.

An engineering report describing the proposed facilities and potable reuse operations will be required.

7 Conceptual Cost Analysis

7.1 Cost Opinion Methodology

7.1.1 Cost Classification

An opinion of probable construction cost (OPCC) for each option was developed as a Class 4 opinion, which is expected to be within a +50% to -30% accuracy range under a competitive bidding environment.[49] Cost opinions were developed relying heavily on historical bid-based and cost-based methods to develop raw construction costs. From the raw construction costs, several construction cost factors were applied to develop opinions of total construction costs, followed by implementation factors to develop opinions of total capital costs.

7.1.2 Construction Cost Allowances

From the raw construction cost subtotal, the construction cost factors listed below are applied to develop an opinion of total construction costs.

- **Construction contingency of 25%** – The construction contingency is defined as unknown costs due to lack of detailed engineering during the preliminary design phase that are estimated as a percentage of defined project costs (i.e., raw construction cost subtotal). As the level of project definition and understanding increases and the level of unknown decreases, the construction contingency typically decreases. For this Study, a construction contingency of 25% was applied to the raw construction cost estimates. This is also intended to include Owner's reserve for change orders, which 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.
- **Tax on Materials = 8%, applied to 50% of construction subtotal** – A Class 4 estimate uses installed unit cost metrics that include both raw materials and installation (i.e., labor and equipment) costs. Therefore, tax on materials was estimated as 8.0% (local tax) and applied to 50% of the construction cost subtotal.
- **Shipping rate = 15% applied to 40% of the construction cost subtotal** – A Class 4 estimate uses installed unit cost metrics that include both raw materials and installation (i.e., labor and equipment) costs. Therefore, shipping costs for equipment delivery were estimated as 15% and applied to 40% of the construction cost subtotal.
- **Overhead and Profit = 15%** – Overhead and profit (O&P) represents the general contractor's operating costs and estimated profit levels. The O&P factor typically varies between 10% and 25%, depending on the size of the project and market conditions, with larger projects typically having lower O&P factors. An O&P factor of 15% was applied to the construction cost subtotal.

At this conceptual feasibility study stage, costs not considered include but are not limited to additional planning, administration, legal, and property acquisition.

7.1.3 Implementation Cost Allowances

To generate the opinions of total capital costs for the project, implementation costs such as design, environmental review, construction management, engineering services during construction, and other administrative costs associated with the project are included. Implementation costs are typically estimated

[49] As defined by the Association for the Advancement of Cost Engineering International (AACE International).

as a percentage of total construction cost, including all allowances described in Section 7.1.2 above. The implementation allowances used are summarized below.

- **Environmental Documentation and Permits = 5%** – Environmental documentation and permits involves producing environmental studies and acquiring any permits necessary to construct a project. A factor of 5% was applied to the total construction cost for environmental documentation and permits.
- **Engineering Services = 10%** – Engineering services include field investigations (e.g., surveys, geotechnical reports, hazard materials investigations), preliminary and final design, contract document development (i.e. plans and specifications), preparation of detailed cost estimates, and project scheduling. An engineering services factor of 10% was applied to the total construction cost.
- **Construction Management = 5%** – Costs for construction management, including inspection, can vary greatly with project size and complexity and whether the Owner performs this work with in-house staff or through a consultant. A construction management factor of 5% was applied to the total construction cost.
- **Engineering Services During Construction = 5%** – Engineering services during construction (ESDC) typically include submittal and request for information (RFI) reviews, design clarifications, and startup support services. An ESDC factor of 5% was applied to the total construction cost.

7.1.4 Capital Financing Assumptions

Financing assumptions used to annualize capital costs are:

- Capital costs would be 100% financed
- Annual interest rate: 2.0%
- Term of Financing: 30 years
- Discount Rate: 0%

Over the last 10 years, the General Obligation (GO) Bond interest rate has varied from 1.7% to 3.0% and may increase. Actual project financing will vary based on the current market conditions and the type of loan secured. For the purposes of the analysis in this TM, no consideration was given to any grants or special loans that may be awarded to EWA for this Project.

7.1.5 Operations and Maintenance (O&M) Costs

Operations and maintenance (O&M) requirements were derived from experience on similar projects and standard engineering methods. The three components used to develop annual O&M costs were:

- **Labor** – Labor costs associated with new treatment and conveyance facilities O&M are calculated on an hourly basis, with 2080 hours per year assumed to be one full-time equivalent (FTE). The required labor hours are estimated based on experience with prior projects and other current systems in operation. The average hourly cost of an O&M personnel, including overhead, is estimated to be $75.
- **Power** – The unit cost of electricity used is $0.15/kWh. Any offsets available from power produced at the EWPCF were not considered.
- **Equipment Rehabilitation/Replacement and Consumables** - Consumables are major component of operation expenditures and include resources that are intended and expected to be used up relatively quickly. Example of consumables include chemicals, gaskets, and potable water.

Where specific consumable line items could not be quantified, consumable costs were estimated as 1% of the raw construction cost.

7.2 Costs by Option

This section presents the cost opinions for each of the three main Options evaluated. The capital costs are summarized under three categories:

- EWPCF Secondary Improvements
- AWTF
- Conveyance

The annual O&M costs are summarized under the following categories:

- Power for treatment (including both the incremental power requirements at the EWPCF and the requirements for the AWTF)
- Power for conveyance (pumping)
- Other O&M costs: this includes equipment rehabilitation/replacement and consumables (across all improved and new facilities), and labor for the AWTF and the conveyance system (pipeline maintenance)

The total capital costs are annualized using the financing assumptions presented in Section 7.1.4 above and combined with the O&M costs to develop a cost of water per acre-foot produced. An overview of the OPCCs and costs of water for the three Options are provided in Figures 7-1 and 7-2; cost summary tables are provided in Tables 7-1 through 7-5. Detailed cost tables for the components of each option are provided in Appendix A.

Figure 7-1: Capital Cost Summary for Options F, G, and H.

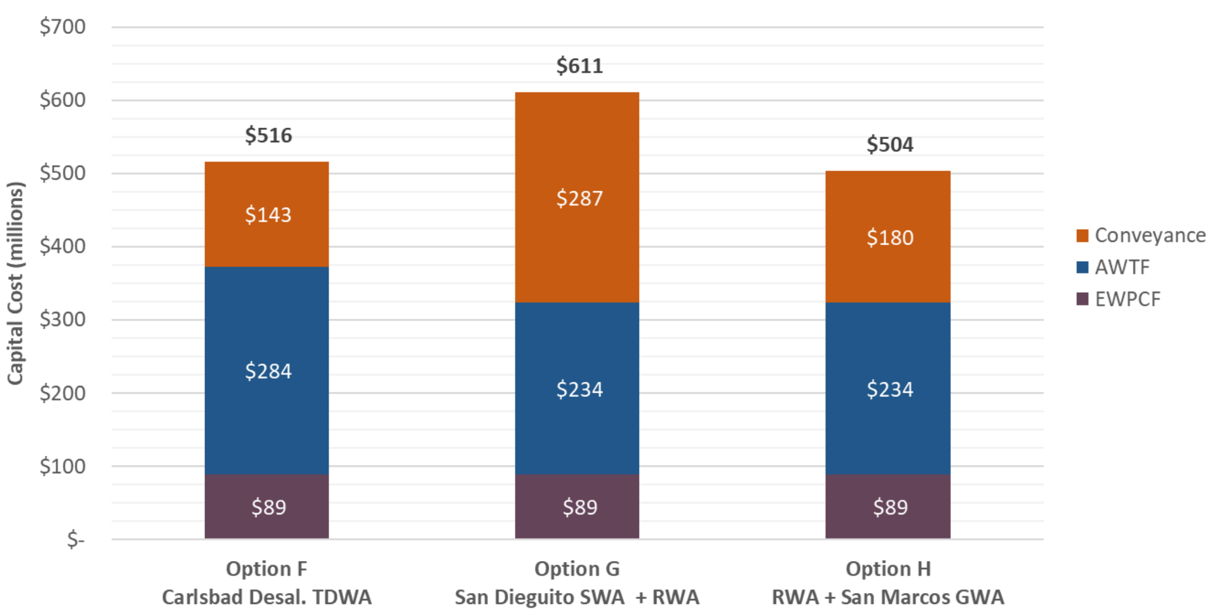

Figure 7-2: Cost of Water Summary for Options F, G, and H.

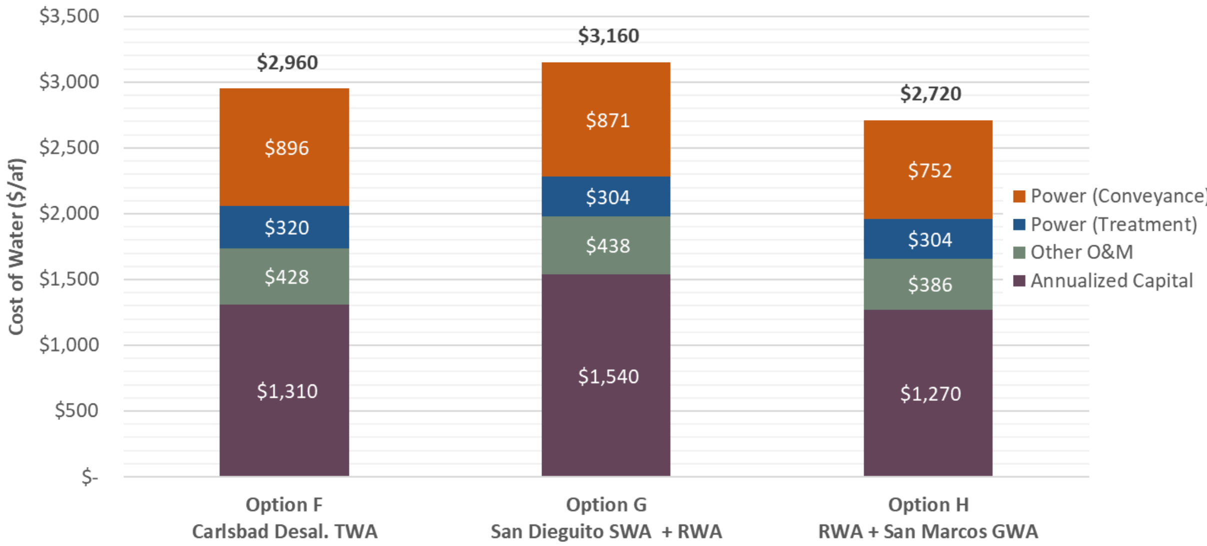

Table 7-1: Cost Summary for Option F.

Option F: Carlsbad Desalination Plant	Cost	Notes
EWPCF Secondary Improvements	$89,000,000	at 31 mgd flow rate
Advanced Water Treatment Facility (FAT+O3/BAF+WTP)	$283,900,000	at 20.5 mgd influent rate
Conveyance - North	$142,800,000	at 20.5 mgd influent rate
Total Capital Cost	**$515,700,000**	
Annual O&M Costs		
Power - Treatment (EWPCF + AWTF)	$5,671,000	24/7/365 operations
Power - Conveyance	$15,853,000	24/7/365 operations
Equipment Rehabilitation/Replace, Consumables	$6,309,000	All new facilities (incl. EWCPF)
Labor	$1,270,000	AWTF + Conveyance
Total Annual O&M Cost	**$29,110,000**	
Cost of Water		
Annualized Capital Cost	$23,026,000	2.0% rate, 30-yr term
Total Annual Cost	**$52,136,000**	for first 30 years
Annual Yield	**17,700**	acre-feet
Unit Cost - Capital	$1,310	per acre-foot
Unit Cost - O&M	$1,650	per acre-foot
Unit Cost of Water	**$2,960**	per acre-foot

Table 7-2: Cost Summary for Option G.

Option G: San Dieguito Groundwater Basin and SDCWA Second Aqueduct (All Phases)	Cost	Notes
EWPCF Secondary Improvements	$89,000,000	at 31 mgd flow rate
Advanced Treatment (FAT + O3/BAF)	$234,400,000	at 20.5 mgd influent rate
Conveyance - South	$287,400,000	at 20.5 mgd influent rate
Total Capital Cost	**$610,800,000**	
Annual O&M Costs		
Power - Treatment (EWPCF + AWTF)	$5,403,000	24/7/365 operations
Power - Conveyance	$15,501,000	24/7/365 operations
Equipment Rehabilitation/Replace, Consumables	$6,580,000	All new facilities (incl. EWCPF)
Labor	$1,221,000	AWTF + Conveyance
Total Annual O&M Cost	**$28,705,000**	
Cost of Water		
Annualized Capital Cost	$27,273,000	2.0% rate, 30-yr term
Total Annual Cost	**$55,978,000**	for first 30 years
Annual Yield	**17,800**	acre-feet
Unit Cost - Capital	$1,540	per acre-foot
Unit Cost - O&M	$1,620	per acre-foot
Unit Cost of Water	**$3,160**	per acre-foot

Table 7-3: Cost Summary for Option H.

Option H1: SDCWA Second Aqueduct and San Marcos Groundwater Basin	Cost	Notes
EWPCF Secondary Improvements	$89,000,000	at 31 mgd flow rate
Advanced Treatment (FAT + O3/BAF)	$234,400,000	at 20.5 mgd influent rate
Conveyance - East	$180,400,000	at 20.5 mgd influent rate
Total Capital Cost	**$503,800,000**	
Annual O&M Costs		
Power - Treatment (EWPCF + AWTF)	$5,403,000	24/7/365 operations
Power - Conveyance	$13,387,000	24/7/365 operations
Equipment Rehabilitation/Replace, Consumables	$5,724,000	All new facilities (incl. EWCPF)
Labor	$1,144,000	AWTF + Conveyance
Total Annual O&M Cost	**$25,658,000**	
Cost of Water		
Annualized Capital Cost	$22,495,000	2.0% rate, 30-yr term
Total Annual Cost	**$48,153,000**	for first 30 years
Annual Yield	**17,800**	acre-feet
Unit Cost - Capital	$1,270	per acre-foot
Unit Cost - O&M	$1,450	per acre-foot
Unit Cost of Water	**$2,720**	per acre-foot

7.2.1 Comparison to Projected Cost of Water for Other Water Sources

To provide context for the cost of water developed for this Study's Options, information on the costs of other sources of water available in the region and in the State of California is provided below (California Public Utilities Commission [CPUC] 2016):

- SDCWA treated water costs are expected to reach $3,880/af by 2040.
- Conservation programs can provide substantial incentives for water savings, such as the CPUC unaccounted for water (UFW) incentive mechanism that provides $2,019/af.
- Planning for other recent potable reuse projects in California, such as San Diego Pure Water and Monterey Pure Water, have projected costs in the $2,000 to $5,000 per af range.
- Desalinated product water provided to SDCWA member agencies cost up to $2,367/af in 2016.

8 Conclusions

In evaluating the relative merits of the three options presented in this TM, the following criteria were used:

- Cost of water
- Likely timeframe for regulatory acceptance and project implementation
- Complexity of operations and compliance
- Expected demand and stakeholder support

Key information for each of these criteria is presented in Table 8-1, based on each option at the full projected 2040 flows for the EWPCF (i.e., 20.5 mgd influent to the AWTF).

Table 8-1: Summary of Key Considerations for EWA's Potable Reuse Options.

	Option F Carlsbad Desal. Plant	Option G San Dieguito + 2nd Aqueduct	Option H 2nd Aqueduct + San Marcos
Cost of Water (at 20.5 mgd influent)	$2,960/af	$3,160/af	$2,720/af
Time to Implement	15-20+ years	10-15 years	10-15 years
Regulatory Considerations	Timeframe uncertain	Legislation pending	Legislation pending
Complexity of Operations & Compliance	AWTF "c" Blending & Pumping at CDP	AWTF "b" Up to three forms of potable reuse (reservoir + groundwater + raw water)	AWTF "b" Up to two forms of potable reuse (raw water + groundwater)
Key Stakeholders	SDCWA Poseidon	SEJPA, SDWD, SFID, OMWD, SDCWA	SDCWA Vallecitos WD

Based on these criteria, it is recommended that **Option H** be carried forward for further phasing analysis under TM4 and funding analysis under TM5. A potential implementation schedule for the various components of Option H (i.e., EWPCF improvements, AWTF, and conveyance/receptor integration infrastructure) will also be provided under TM4.

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Appendix A – Conceptual Cost Analysis Tables

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Project: Encina Water Reuse Feasibility Study

Element: EWPCF Improvements

Date: 1/25/2018
Project Number: 0305-059
Prepared By: Trussell Technologies, Inc.
Reviewed by: RMC / Woodard & Curran

Cost Opinion Type: Planning (Class IV)

Item	Description	Size	Units	Quantity	Unit	Unit Cost		Total Cost
Primary Effluent Flow Equalization							**$**	**7,900,000**
	Flow EQ Basin			2	EA	$2,700,000	$	5,400,000
	Primary Effluent Pipe			1	LS	$1,500,000	$	1,500,000
	Pump Station/ Modulating Valve			1	LS	$1,000,000	$	1,000,000
Item	**Description**	**Size**	**Units**	**Quantity**	**Unit**	**Unit Cost**		**Total Cost**
Aeration Basins (4)							**$**	**8,620,000**
	Baffling			12	EA	$50,000	$	600,000
	Blower Upgrades			1	LS	$2,800,000	$	2,800,000
	Anoxic Zone Mixers			1	LS	$960,000	$	960,000
	Fine Bubble Aeration Equipment			1	LS	$2,000,000	$	2,000,000
	Internal Mixed Liquor Pumps			1	LS	$460,000	$	460,000
	Piping/Basin Modifications for IMLR			1	LS	$100,000	$	100,000
	Scum and Foam Control			1	LS	$500,000	$	500,000
	Demo of Existing Aeration Equipment			1	LS	$100,000	$	100,000
	Air Piping/Valves/ DO Control			1	LS	$1,100,000	$	1,100,000
Item	**Description**	**Size**	**Units**	**Quantity**	**Unit**	**Unit Cost**		**Total Cost**
Secondary Clarifiers							**$**	**7,000,000**
	Circular Clarifier, New			2	EA	$1,500,000	$	3,000,000
	Retaining Wall			1	LS	$1,000,000	$	1,000,000
	Equipping Existing Clarifier No. 7			1	LS	$500,000	$	500,000
	Secondary Effluent Pump Station			1	LS	$1,500,000	$	1,500,000
	Piping/Valving			1	LS	$1,000,000	$	1,000,000
Item	**Description**	**Size**	**Units**	**Quantity**	**Unit**	**Unit Cost**		**Total Cost**
Tertiary Filters							**$**	**19,300,000**
	Gravity Filter Housing and Underdrain			6	EA	$1,333,333	$	8,000,000
	Piping/Valving			1	LS	$5,000,000	$	5,000,000
	Filter Media			1	LS	$1,200,000	$	1,200,000
	Backwash Pump Station			1	LS	$2,000,000	$	2,000,000
	Air Scour Wash			1	LS	$2,800,000	$	2,800,000
	Waste Wash Water Equalization Tank			1	LS	$300,000	$	300,000

Project: Encina Water Reuse Feasibility Study

Element: EWPCF Improvements

Date: 1/25/2018
Project Number: 0305-059
Prepared By: Trussell Technologies, Inc.
Reviewed by: RMC / Woodard & Curran

Cost Opinion Type: Planning (Class IV)

Equipment Installation				**$**	**2,736,000**
Installation of Aeration Basin and Clarifier Equipment	1	LS	$2,736,000	$	2,736,000

Cost Summary

EWPCF Improvements			**Subtotal**
Primary Effluent Flow Equalization		$	7,900,000
Aeration Basins (4)		$	8,620,000
Secondary Clarifiers		$	7,000,000
Tertiary Filters		$	19,300,000
Equipment Installation		$	2,736,000
Raw Construction Subtotal		**$**	**45,556,000**
Construction Contingency	25%	$	11,389,000
Construction Cost Subtotal		**$**	**56,945,000**
Tax on Materials	8.00%	$	2,278,000
Shipping	15%	$	3,417,000
General Contractor Overhead and Profit	15%	$	8,542,000
Estimated Total Construction Cost		**$**	**71,182,000**
Environmental Documentation and Permits	5%	$	3,560,000
Engineering Services (Design)	10%	$	7,119,000
Construction Management	5%	$	3,560,000
Engineering Services During Construction	5%	$	3,560,000
Total Capital Cost		**$**	**89,000,000**

O&M Costs								**Subtotal**
Power								
Aeration Blowers	1,143	hp	13,420,000	kWh	$	0.15	$	2,013,000
IMLR Pumps	69	hp	810,667	kWh	$	0.15	$	122,000
Anoxic Zone Mixers	27	hp	313,333	kWh	$	0.15	$	47,000
Equipment								
Equipment Rehabilitation and Replacement							$	71,500
Total Annual O&M Cost							**$**	**2,254,000**

Project: Encina Water Reuse Feasibility Study

Element: 16 mgd AWTF "a" (FAT)

Date: 1/25/2018
Project Number: 0305-059
Prepared By: Carollo Engineers, Inc.
Reviewed by: RMC / Woodard & Curran

Cost Opinion Type: Planning (Class IV)

Item	Description	Size	Units	Quantity	Unit	Unit Cost		Total Cost
Treatment Unit Operations and Buildings							**$**	**57,372,000**
	Ultrafiltration System			1	LS	$9,225,000	$	9,225,000
	Reverse Osmosis System			1	LS	$10,978,000	$	10,978,000
	Ultraviolet/ Advanced Oxidation Process System			1	LS	$2,050,000	$	2,050,000
	Product Water Tank			1	LS	$1,047,000	$	1,047,000
	Carbon Dioxide System			1	LS	$854,000	$	854,000
	Lime System			1	LS	$1,719,000	$	1,719,000
	Chemical System			1	LS	$2,543,000	$	2,543,000
	Feed Pipeline + Pump Station			1	LS	$1,527,000	$	1,527,000
	Brine Pipeline + Pump Station			1	LS	$1,561,000	$	1,561,000
	Yard Piping			1	LS	$3,608,000	$	3,608,000
	Process Building			39,600	SF	$350	$	13,860,000
	Admin. and Maintenance Building			14,000	SF	$350	$	4,900,000
	Electrical Building and Electrical Rooms			14,000	SF	$250	$	3,500,000

Item	Description	Size	Units	Quantity	Unit	Unit Cost		Total Cost
Factored Costs							**$**	**26,339,000**
	Site work	5%		1	LS	$2,868,600		$2,869,000
	Electrical & IC	30%		1	LS	$14,691,600		$14,692,000
	Mechanical	25%		1	LS	$8,778,000		$8,778,000

Cost Summary

Treatment				Subtotal
Treatment Unit Operations and Buildings			$	57,372,000
Factored Costs			$	26,339,000
	Raw Construction Subtotal		**$**	**83,711,000**
	Construction Contingency	25%	$	20,927,750
	Construction Cost Subtotal		**$**	**104,639,000**
	Tax on Materials	8.00%	$	4,186,000
	Shipping	15%	$	6,279,000
	General Contractor Overhead and Profit	15%	$	15,696,000
	Estimated Total Construction Cost		**$**	**130,800,000**
	Environmental Documentation and Permits	5%	$	6,540,000
	Engineering Services (Design)	10%	$	13,080,000
	Construction Management	5%	$	6,540,000
	Engineering Services During Construction	5%	$	6,540,000
	Total Capital Cost		**$**	**163,500,000**

O&M Costs	Subtotal
Power	

Project: Encina Water Reuse Feasibility Study

Element: 16 mgd AWTF "a" (FAT)

Date: 1/25/2018
Project Number: 0305-059
Prepared By: Carollo Engineers, Inc.
Reviewed by: RMC / Woodard & Curran

Cost Opinion Type: Planning (Class IV)

UF	152	hp	1,782,353	kWh	$	0.15	$	267,353
RO	864	hp	10,141,176	kWh	$	0.15	$	1,521,176
UV/AOP	100	hp	1,170,588	kWh	$	0.15	$	175,588
Product Water Conditioning	12	hp	135,294	kWh	$	0.15	$	20,294
Chemical Dosing Systems	5	hp	52,941	kWh	$	0.15	$	7,941
Building HVAC Systems	115	hp	1,347,059	kWh	$	0.15	$	202,059
Feed Pump Station	85	hp	1,000,000	kWh	$	0.15	$	150,000
Brine Pump Station	105	hp	1,235,294	kWh	$	0.15	$	185,294
Misc. Facility Power	10	kW	87,600	kWh	$	0.15	$	14,000
Chemicals								
UF Pretreatment and Cleaning							$	496,000
RO Pretreatment and Cleaning							$	565,000
UF							$	93,000
UV/AOP							$	98,000
RO							$	139,000
UV/AOP							$	43,000
Product Water Conditioning							$	3,000
Chemical Dosing Systems							$	22,000
Electrical Equipment							$	112,000
Product Water Conditioning							$	1,047,000
Pipeline Chlorination							$	73,000
Replacement of Consumables								
MF Modules							$	296,000
RO Cartidge Filters and Membrane Elements							$	536,000
UV Lamps and Ballasts							$	77,000
Maintenance								
Site Security							$	69,000
Landscaping							$	23,000
Janitorial Services							$	69,000
Hazardous Waste Clean-up							$	6,000
Labor								
O&M Labor							$	624,000
Total O&M Cost							$	7,000,000

Project: Encina Water Reuse Feasibility Study

Element: 16 mgd AWTF "b" (FAT + O_3/BAF)

Date: 1/25/2018
Project Number: 0305-059
Prepared By: Carollo Engineers, Inc.
Reviewed by: RMC / Woodard & Curran

Cost Opinion Type: Planning (Class IV)

Item	Description	Size	Units	Quantity	Unit	Unit Cost		Total Cost
O3/BAF+FAT							**$**	**80,418,000**
	LOX Feed Facility			1	LS	$1,429,000	$	1,429,000
	Ozone Generation Facility			1	LS	$5,504,000	$	5,504,000
	Ozone Contactors Facility			1	LS	$4,943,000	$	4,943,000
	Biologically Activated Carbon System			1	LS	$8,265,000	$	8,265,000
	Ultrafiltration System			1	LS	$9,225,000	$	9,225,000
	Reverse Osmosis System			1	LS	$10,978,000	$	10,978,000
	Ultraviolet/ Advanced Oxidation Process System			1	LS	$2,050,000	$	2,050,000
	Product Water Tank			1	LS	$1,047,000	$	1,047,000
	Carbon Dioxide System			1	LS	$854,000	$	854,000
	Lime System			1	LS	$1,719,000	$	1,719,000
	Chemical System			1	LS	$2,528,000	$	2,528,000
	Feed Pipeline + Pump Station			1	LS	$1,527,000	$	1,527,000
	Brine Pipeline + Pump Station			1	LS	$1,561,000	$	1,561,000
	Yard Piping			1	LS	$3,588,000	$	3,588,000
	Process Building			48,000	SF	$350	$	16,800,000
	Admin. and Maintenance Building			14,000	SF	$350	$	4,900,000
	Electrical Building			14,000	SF	$250	$	3,500,000

Item	Description	Size	Units	Quantity	Unit	Unit Cost		Total Cost
Factored Costs							**$**	**39,431,000**
	Site work	5%		1	LS	$4,020,900	$	4,021,000
	Electrical & IC	30%		1	LS	$21,605,400	$	21,605,000
	Mechanical	25%		1	LS	$13,804,500	$	13,805,000

Cost Summary

Treatment				Subtotal
O3/BAF+FAT			$	81,000,000
Factored Costs			$	39,431,000
Raw Construction Subtotal			**$**	**120,000,000**
	Construction Contingency	25%	$	30,000,000
Construction Cost Subtotal			**$**	**150,000,000**
	Tax on Materials	8.00%	$	6,000,000
	Shipping	15%	$	9,000,000
	General Contractor Overhead and Profit	15%	$	22,500,000
Estimated Total Construction Cost			**$**	**187,500,000**
	Environmental Documentation and Permits	5%	$	9,375,000
	Engineering Services (Design)	10%	$	18,750,000
	Construction Management	5%	$	9,375,000
	Engineering Services During Construction	5%	$	9,375,000
	Total Capital Cost		**$**	**234,400,000**

Project: Encina Water Reuse Feasibility Study

Element: 16 mgd AWTF "b" (FAT + O_3/BAF)

Date: 1/25/2018
Project Number: 0305-059
Prepared By: Carollo Engineers, Inc.
Reviewed by: RMC / Woodard & Curran

Cost Opinion Type: Planning (Class IV)

O&M Costs									Subtotal
Power	Ozone	381	hp	4,476,471	kWh	$	0.15	$	671,471
	BAC	4	hp	41,176	kWh	$	0.15	$	6,176
	MF	152	hp	1,782,353	kWh	$	0.15	$	267,353
	RO	864	hp	10,141,176	kWh	$	0.15	$	1,521,176
	UV/AOP	100	hp	1,170,588	kWh	$	0.15	$	175,588
	Product Water Conditioning	12	hp	135,294	kWh	$	0.15	$	20,294
	Chemical Dosing Systems	5	hp	52,941	kWh	$	0.15	$	7,941
	Building HVAC Systems	115	hp	1,347,059	kWh	$	0.15	$	202,059
	Feed Pump Station	85	hp	1,000,000	kWh	$	0.15	$	150,000
	Brine Pump Station	105	hp	1,235,294	kWh	$	0.15	$	185,294
	Misc. Facility Power	10	kW	87,600	kWh	$	0.15	$	14,000
Equipment Rehab/Replacement									
	BAF Filter Media Replacement							$	134,000
	MF Modules							$	296,000
	RO Cartidge Filters and Membrane Elements							$	536,000
	UV Lamps and Ballasts							$	77,000
	Ozone							$	77,000
Chemical									
	Ozone							$	364,000
	MF Pretreatment and Cleaning							$	496,000
	RO Pretreatment and Cleaning							$	565,000
	UV/AOP							$	98,000
	Product Water Conditioning							$	1,047,000
	Pipeline Chlorination							$	73,000
	BAF							$	34,000
	MF							$	93,000
	RO							$	139,000
	UV/AOP							$	43,000
	Product Water Conditioning							$	3,000
	Chemical Dosing Systems							$	22,000
	Electrical Equipment							$	112,000
Special Contracts									
	Site Security							$	69,000
	Landscaping							$	23,000
	Janitorial Services							$	69,000
	Hazardous Waste Clean-up							$	6,000
Labor								$	936,000
	Total O&M Cost							$	8,600,000

Project: Encina Water Reuse Feasibility Study

Element: 15.8 mgd AWTF "c" (FAT+O_3/BAF + WTP)

Date: 1/25/2018
Project Number: 0305-059
Prepared By: Carollo Engineers, Inc.
Reviewed by: RMC / Woodard & Curran

Cost Opinion Type: Planning (Class IV)

Item	Description	Size	Units	Quantity	Unit	Unit Cost		Total Cost
O3/BAF+FAT+ WTP							**$**	**96,382,000**
	LOX Feed Facility			1	LS	$1,429,000	$	1,429,000
	Ozone Generation Facility			1	LS	$5,504,000	$	5,504,000
	Ozone Contactors Facility			1	LS	$4,943,000	$	4,943,000
	Biologically Activated Carbon System			1	LS	$8,265,000	$	8,265,000
	Ultrafiltration System			1	LS	$9,225,000	$	9,225,000
	Reverse Osmosis System			1	LS	$10,978,000	$	10,978,000
	Ultraviolet/ Advanced Oxidation Process System			1	LS	$2,050,000	$	2,050,000
	Engineered Storage Buffer			1	LS	$1,625,000	$	1,625,000
	Chlorine Dosing System			1	LS	$493,000	$	493,000
	Aqua Ammonia Dosing System			1	LS	$311,000	$	311,000
	Ultrafiltration System			1	LS	$13,255,000	$	13,255,000
	Product Water Tank			1	LS	$1,047,000	$	1,047,000
	Carbon Dioxide System			1	LS	$854,000	$	854,000
	Lime System			1	LS	$1,719,000	$	1,719,000
	Chemical System			1	LS	$2,528,000	$	2,528,000
	Feed Pipeline + Pump Station			1	LS	$1,527,000	$	1,527,000
	Brine Pipeline + Pump Station			1	LS	$1,561,000	$	1,561,000
	Yard Piping			1	LS	$3,588,000	$	3,588,000
	Process Building			48,800	SF	$350	$	17,080,000
	Admin. and Maintenance Building			14,000	SF	$350	$	4,900,000
	Electrical Building			14,000	SF	$250	$	3,500,000

Item	Description	Size	Units	Quantity	Unit	Unit Cost		Total Cost
Factored Costs							**$**	**48,940,000**
	Site work	5%		1	LS	$4,819,100	$	4,819,000
	Electrical & IC	30%		1	LS	$26,394,600	$	26,395,000
	Mechanical	25%		1	LS	$17,725,500	$	17,726,000

Cost Summary

Treatment			Subtotal
O3/BAF+FAT+ WTP		$	96,382,000
Factored Costs		$	48,940,000
Raw Construction Subtotal		**$**	**145,322,000**
Construction Contingency	25%	$	36,330,500
Construction Cost Subtotal		**$**	**181,653,000**
Tax on Materials	8.00%	$	7,267,000
Shipping	15%	$	10,900,000
General Contractor Overhead and Profit	15%	$	27,248,000
Estimated Total Construction Cost		**$**	**227,068,000**
Environmental Documentation and Permits	5%	$	11,354,000
Engineering Services (Design)	10%	$	22,707,000
Construction Management	5%	$	11,354,000
Engineering Services During Construction	5%	$	11,354,000
Total Capital Cost		**$**	**283,900,000**

O&M Costs									Subtotal
Power	Ozone	381	hp	4,476,471	kWh	$	0.15	$	671,471
	BAC	4	hp	41,176	kWh	$	0.15	$	6,176
	UF (FAT)	152	hp	1,782,353	kWh	$	0.15	$	267,353
	RO	864	hp	10,141,176	kWh	$	0.15	$	1,521,176
	UV/AOP	100	hp	1,170,588	kWh	$	0.15	$	175,588
	UF (WTP)	152	hp	1,782,353	kWh	$	0.15	$	267,353
	Product Water Conditioning	12	hp	135,294	kWh	$	0.15	$	20,294
	Chemical Dosing Systems	5	hp	52,941	kWh	$	0.15	$	7,941
	Building HVAC Systems	115	hp	1,347,059	kWh	$	0.15	$	202,059
	Feed Pump Station	85	hp	1,000,000	kWh	$	0.15	$	150,000
	Brine Pump Station	105	hp	1,235,294	kWh	$	0.15	$	185,294
	Misc. Facility Power	10	kW	87,600	kWh	$	0.15	$	14,000
Chemical									
	Ozone							$	364,000
	MF Pretreatment and Cleaning							$	496,000
	RO Pretreatment and Cleaning							$	565,000
	UV/AOP							$	98,000
	UF Pretreatment and Cleaning							$	496,000
	Product Water Conditioning							$	1,047,000
	Pipeline Chlorination							$	73,000
Equipment Rehab/Replacement									
	BAF Filter Media Replacement							$	134,000
	UF Modules (FAT)							$	296,000
	RO Cartidge Filtera and Membrane Elements							$	536,000
	UV Lamps and Ballasts							$	77,000
	UF Modules (WTP)							$	296,000
	Ozone							$	77,000
	BAF							$	34,000
	UF (FAT)							$	93,000
	RO							$	139,000
	UV/AOP							$	43,000
	UF (WTP)							$	93,000
	Product Water Conditioning							$	3,000
	Chemical Dosing Systems							$	22,000
	Electrical Equipment							$	112,000
Special Contracts									
	Site Security							$	69,000
	Landscaping							$	23,000
	Janitorial Services							$	69,000
	Hazardous Waste Clean-up							$	6,000
Labor								$	1,092,000
	Total O&M Cost							$	9,900,000

Project: Encina Water Reuse Feasibility Study

Element: Option F Conveyance (North)

Date: 1/25/2018
Project Number: 0305-059
Prepared By: K. Erickson
Reviewed by: N. Chase

Cost Opinion Type: Planning (Class IV)

Item	Description	Size	Units	Quantity	Unit	Unit Cost		Total Cost
Option F: Carlsbad Desalination Plant							**$**	**73,100,000**
	Pump Station			1,000	hp	$6,500	$	6,500,000
	Segment 1 Pipe	30 inch	15.8 mgd	13,200	LF	$750	$	9,900,000
	Trenchless Freeway		2	500	LF	$2,000	$	2,000,000
	Trenchless Palomar Airport Road		1	500	LF	$2,000	$	1,000,000
	Trenchless Railroad		1	200	LF	$2,000	$	400,000
	Discharge Appurt at Desal plant wet well			1	LS	$250,000	$	250,000
	New Clearwell with Baffling at Desal Plant			350,000	gallon	$3.00	$	1,050,000
	Pump Station at Desal Plant wet well			8,000	hp	$6,500	$	52,000,000

Cost Summary

Conveyance			Subtotal
Option F: Carlsbad Desalination Plant		$	73,100,000
Raw Construction Subtotal		**$**	**73,100,000**
Construction Contingency	25%	$	18,275,000
Construction Cost Subtotal		**$**	**91,375,000**
Tax on Materials	8.00%	$	3,655,000
Shipping	15%	$	5,483,000
General Contractor Overhead and Profit	15%	$	13,707,000
Opinion of Total Construction Cost		**$**	**114,220,000**
Environmental Documentation and Permits	5%	$	5,711,000
Engineering Services (Design)	10%	$	11,422,000
Construction Management	5%	$	5,711,000
Engineering Services During Construction	5%	$	5,711,000
Total Capital Cost		**$**	**142,800,000**

O&M Costs								Subtotal
Pumping Power	9,000	hp	105,683,646	kWh	$	0.15	$	15,853,000
Pipeline O&M Labor	1	hr/yr/100 LF	14,400	LF	$	75.00	$	11,000
Conveyance Infrastructure Rehabilitation/Replacement	1%						$	1,143,000
Total O&M Cost							$	17,007,000

Project: Encina Water Reuse Feasibility Study

Element: Option G Conveyance (South)

Date: 1/25/2018
Project Number: 0305-059
Prepared By: K. Erickson
Reviewed by: N. Chase

Cost Opinion Type: Planning (Class IV)

Item	Description	Size	Units	Quantity	Unit	Unit Cost		Total Cost
Option G: San Dieguito Groundwater Basin and Aqueduct #2 (All Phases)							**$**	**147,112,000**
	Pump Station EWA			800	hp	$6,500	$	5,200,000
	Segment 1 Pipe	30 inches		43,824	LF	$750	$	32,868,000
	Trenchless Lagoon Crossing			3,600	LF	$2,000	$	7,200,000
	Pump Station SEJPA PS			3,200	hp	$6,500	$	20,800,000
	Segment 2 Pipe	20 inches		33,264	LF	$500	$	16,632,000
	Trenchless Freeway			500	LF	$2,000	$	1,000,000
	Segment 3 Pipe Existing	24 inches		27,456	LF	$0	$	-
	Segment 3 Pipe Slip Line	24 inches		23,250	LF	$120	$	2,790,000
	Segment 3 Pipe Open Cut	24 inches		2,200	LF	$180	$	396,000
	Discharge Structure to San Dieguito Res. (incl. dechlorination)		3.1 mgd	1	LS	$2,000,000	$	2,000,000
	Pump Station to Badger WTP			4,800	hp	$6,500	$	31,200,000
	Segment 4 Pipe	30 inches		11,088	LF	$750	$	8,316,000
	Segment 5 Pipe	12 inches		12,144	LF	$300	$	3,643,000
	GW Desalter (ext. wells, desal, brine, product conveyance)		1.0 mgd	1	MG	--	$	-
	GWR Injection Wells in San Dieguito Basin		2.0 mgd	2	MG	$1,000,000	$	2,000,000
	GW Desalter expansion - Extraction Wells		2.0 mgd	2	MG	$1,033,333	$	2,067,000
	GW Desalter expansion - pre+RO treatment		2.0 mgd	2	MG	$5,500,000	$	11,000,000
	GW Desalter expansion - Brine Disposal		--			--	$	-
	GW Desalter expansion - Product Water Conveyance		--			--	$	-

Project: Encina Water Reuse Feasibility Study

Element: Option G Conveyance (South)

Date: 1/25/2018
Project Number: 0305-059
Prepared By: K. Erickson
Reviewed by: N. Chase

Cost Opinion Type: Planning (Class IV)

Cost Summary

Conveyance			Subtotal
Option G: San Dieguito Groundwater Basin and Aqueduct #2 (All Phases)		$	147,112,000
Raw Construction Subtotal		**$**	**147,112,000**
Construction Contingency	25%	$	36,778,000
Construction Cost Subtotal		**$**	**183,890,000**
Tax on Materials	8.00%	$	7,356,000
Shipping	15%	$	11,034,000
General Contractor Overhead and Profit	15%	$	27,584,000
Estimated Total Construction Cost		**$**	**229,864,000**
Environmental Documentation and Permits	5%	$	11,494,000
Engineering Services (Design)	10%	$	22,987,000
Construction Management	5%	$	11,494,000
Engineering Services During Construction	5%	$	11,494,000
Total Capital Cost		**$**	**287,400,000**

O&M Costs (All Phases)								Subtotal
Pumping Power	8,800	hp	103,335,121	kWh	$	0.15	$	15,501,000
Treatment Power	400	hp	4,697,051	kWh	$	0.17	$	799,000
Pipeline O&M Labor	1	hr/yr/100 LF	157,326	LF	$	75.00	$	118,000
Conveyance Infrastructure Rehabilitation/Replacement	1%						$	2,299,000
Total O&M Cost							**$**	**18,717,000**

Project: Encina Water Reuse Feasibility Study

Element: Option H Conveyance (East)

Date: 1/25/2018
Project Number: 0305-059
Prepared By: K. Erickson
Reviewed by: N. Chase

Cost Opinion Type: Planning (Class IV)

Item	Description	Size	Units	Quantity	Unit	Unit Cost		Total Cost
Option H1: SDCWA Second Aqueduct and San Marcos Groundwater Basin							**$**	**92,343,000**
	Pump Station EWA			5,600	hp	$6,500	$	36,400,000
	Segment 1 Pipe	30 inches		39,600	LF	$750	$	29,700,000
	Trenchless Freeway			500	LF	$2,000	$	1,000,000
	Pump Station to SDCWA turnout			2,000	hp	$6,500	$	13,000,000
	Discharge Appurt at SDCWA turnout			1	LS	$250,000	$	250,000
	Segment 2 Pipe Existing	12 inches		14,256	LF	$0	$	-
	Segment 2 Pipe Slip Line	12 inches		14,256	LF	$100	$	1,426,000
	GWR Injection Wells in San Marcos Basin			2	MG	$1,000,000	$	2,000,000
	GW Desalter expansion - Extraction Wells			2	MG	$1,033,333	$	2,067,000
	GW Desalter expansion - wellhead treatment			2	MG	$3,250,000	$	6,500,000
	GW Desalter expansion - Product Water Conveyance			--		--	$	-

Cost Summary

Conveyance			Subtotal
Option H1: SDCWA Second Aqueduct and San Marcos Groundwater Basin		$	92,343,000
Raw Construction Subtotal		**$**	**92,343,000**
Construction Contingency	25%	$	23,085,750
Construction Cost Subtotal		**$**	**115,429,000**
Tax on Materials	8.00%	$	4,618,000
Shipping	15%	$	6,926,000
General Contractor Overhead and Profit	15%	$	17,315,000
Estimated Total Construction Cost		**$**	**144,288,000**
Environmental Documentation and Permits	5%	$	7,215,000
Engineering Services (Design)	10%	$	14,429,000
Construction Management	5%	$	7,215,000
Engineering Services During Construction	5%	$	7,215,000
Total Capital Cost		**$**	**180,400,000**

O&M Costs								Subtotal
Pumping Power	7,600	hp	89,243,968	kWh	$	0.15	$	13,387,000
Treatment Power	150	hp	1,761,394	kWh	$	0.15	$	265,000
Pipeline O&M Labor	1	hr/yr/100 LF	54,356	LF	$	75.00	$	41,000
Conveyance Infrastructure Rehabilitation/Replacement	1%						$	1,443,000
Total O&M Cost							**$**	**15,136,000**

Attachment 4 - TM4: Phasing of Preferred Project

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Technical Memorandum No. 4

EWA Water Reuse Feasibility Study

Subject: **Phasing of Preferred Project**

Prepared For: Encina Wastewater Authority

Prepared by: Nathan Chase, P.E., Martha de Maria y Campos | Woodard & Curran

Reviewed by: Scott Goldman, P.E. | Woodard & Curran

Date: July 2018 (Draft: July 2018)

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1 Introduction

1.1 Feasibility Study Background

As required by Encina Wastewater Authority's (EWA) 2020 Business Plan, this Water Reuse Feasibility Study (Study) will identify a path to maximize beneficial reuse of effluent from the Encina Water Pollution Control Facility (EWPCF)—which by 2040 is projected to reach an average of approximately 31 million gallons per day (mgd).

This Study will focus on developing a portfolio of options for potential reuse projects; identify and analyze a short list of options; develop an approach to phasing of the preferred water reuse project—the focus of this technical memorandum (TM); identify funding opportunities; develop a stakeholder involvement plan; and coordinate with EWA member agencies and other stakeholders to engage with the Study development and recommendations. Ultimately, the Study will serve to advance EWA's mission of resource recovery and contribute to sustaining and enhancing the region's water resources.

1.2 Objectives

This TM presents a phasing approach to implementing Option H, which was identified under TM3 as the preferred water reuse project for EWA. Option H primarily consists of raw water augmentation (RWA) into the San Diego County Water Authority's (SDCWA) Second Aqueduct, Pipeline No. 5.

As presented in TM3, Option H may also include groundwater augmentation (GWA) into the San Marcos groundwater basin, which is within the Vallecitos Water District's service area. However, the feasibility of the smaller (~2 mgd) GWA aspect of Option H is dependent on:

- Moving forward with the larger (~16 mgd) RWA Project to deliver advanced treated water to the Second Aqueduct in the vicinity of the San Marcos basin; and,
- Further investigation of the suitability of the San Marcos Basin for GWA.

If the GWA component of the Project is pursued, it is expected that the planning, design, permitting, regulatory coordination, and other activities would be initiated and led by Vallecitos Water District. Therefore, additional detail on the GWA aspect of Option H is excluded from this TM. Furthermore, given the long history of GWA projects in California, the pathway to a GWA project in the San Marcos basin is better understood and would require less early planning than the core RWA aspect of Option H.

This TM is organized as summarized below:

- Initial Phase for Secondary and Advanced Treatment Facilities
- Evaluation of Advanced Water Treatment Facility (AWTF) Size and Phased Expansion
- Framework Implementation Plan and Schedule
- Conclusions

2 Initial Phase for Secondary and Advanced Treatment Facilities

A comprehensive and efficient approach to ensuring that water quality requirements and goals are met for EWA's water reuse project includes changes to the existing secondary treatment provided at the EWPCF to provide higher quality source water for the proposed AWTF. This is discussed in detail in TM3. Major capital investments recommended include the following:

- Primary effluent flow equalization, including addition of new tankage and associated conveyance infrastructure.
- Conversion of the secondary treatment process to biological nutrient removal, including retrofits to the aeration basins to implement a nitrification – denitrification (NDN) process, such as the Modified Ludzack-Ettinger (MLE) process.
- Tertiary filtration (e.g., addition of granular media filters).

Based on the improved treated effluent quality characteristics from the EWPCF, it is expected that pilot testing and/or a demonstration study for the proposed AWTF treatment train will be required to confirm expected performance and satisfy stakeholders (including project partners, regulators, and the public).

This section presents a step-by-step framework for the initial phase of improvements to the EWPCF and the AWTF facilities proposed for the preferred option for EWA's water reuse project.

2.1 EWPCF Improvements

The following steps are recommended for the first phase of EWPCF improvements:

1. Identify method to produce nitrified effluent from the EWPCF, including the following:
   - Timeframe and cost for full nitrification to inform pilot studies
   - Determine if nitrification in only a portion of the EWPCF is practical (e.g., one aeration basin)
   - Determine approach to separating a side stream of primary effluent to run a pilot-scale NDN treatment train
2. Identify location and approach to achieve primary equalization, evaluating the following:
   - Use of the existing primary equalization provided by Aeration Basin No. 4 (and implications for approach to NDN)
   - Conversion of the East secondary equalization basin (and implications for peak wet weather flow management)
   - Construction of new primary equalization basin, considering siting and conveyance requirements
   - Management of waste side streams (e.g., re-routing ahead of primary treatment and/or separating from treatment train serving the AWTF)
3. Use a treatment process model/simulator to estimate projected secondary treatment performance for the EWPCF and key water quality parameters for the influent to the AWTF.
4. Develop a preliminary design for the conversion to NDN treatment, including the following retrofits to existing aeration basins and EWPCF systems:
   - Baffle walls
   - Mixers
   - Mixed liquor return pumps
   - Blower and aeration system requirements

- Scum and foam control

5. Identify location of the two additional secondary clarifiers required for the increased flows at the plant.
6. Identify the location and requirements for tertiary filtration including the following:
   - Type of filters
   - Approach to disposal of backwash (location of return, equalization, etc.)

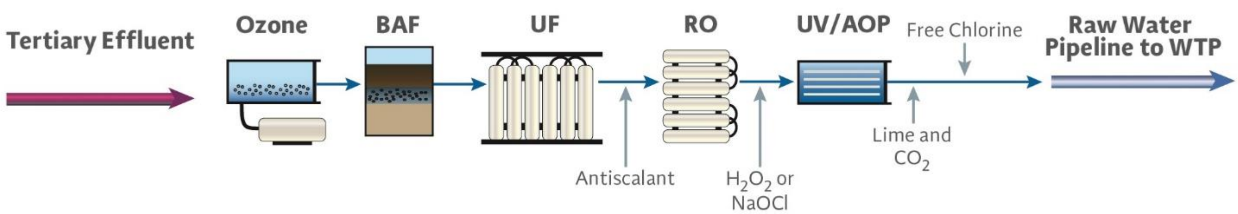
2.2 AWTF Pilot/Demonstration Study

A critically important part of the Project planning process is to determine the extent of a pilot or demonstration study for the advanced purification technologies using effluent (treated wastewater) from EWPCF. Typically, a pilot study is conducted over a shorter duration and at a smaller scale than a demonstration study, while the facilities for a demonstration study are often intended for stakeholder interaction and remain in use until a full-scale facility is near completion.

At a minimum, a pilot study is recommended as the initial phase to evaluate the effectiveness of the proposed AWTF processes on the EWPCF secondary effluent, support public outreach, and test alternative advanced oxidation processes. The piloting/demonstration phase would serve to test and develop design criteria for the following AWT technologies, shown in Figure 2-1:

- Ozonation with biofiltration (O_3/BAF)
- Ultrafiltration (UF)
- Reverse osmosis (RO)
- Advanced oxidation process (AOP) using ultraviolet (UV) light
- Stabilization (lime/CO_2)
- Chemical dosing (e.g., free chlorine)

Figure 2-1: Proposed AWTF Treatment Train for RWA.



2.2.1 Test Plan Objectives

Prior to testing, a pilot/demonstration study plan should be prepared to determine the following requirements:

- Location and options for pumping secondary effluent from EWPCF to pilot treatment train.
- Evaluate potential locations for the treatment train to be tested, considering process equipment footprint, site access (for equipment setup and operations, deliveries, facility tours, etc.), availability of electrical supply and SCADA connections, discharge of product water and reject water, etc. Locations to be considered include the existing EWPCF, EWA's South Parcel, and/or the Carlsbad WRF site.
- Identify critical control points and monitoring strategies.

- Review and determine timing requirements and approximate costs for pilot/demonstration studies. It may be beneficial to conduct pilot tests in phases for separate testing of the different treatment technologies that are proposed in the advanced water treatment train.

2.2.2 Operating Conditions and Performance

The pilot/demonstration plant would evaluate various operating conditions to aid in process optimization and to determine recommended design criteria for a future treatment facility. Key conditions to evaluate include:

- O_3/BAF performance in reduction of TOC, pathogens, and nutrients
- MF/UF performance with acceptable intervals between chemical cleanings (e.g., at least 30 days) by testing different operating conditions for flux, chemically enhanced backwash frequency, and disinfection method
- RO performance with acceptable intervals between chemical cleanings (e.g., at least 180 days) by testing different operating conditions for flux, recovery, membrane configuration, and membrane type. RO testing could also be used for the following:
    - Determine if a 2-stage or 3-stage RO configuration provides more efficient, reliable performance at an 85 percent hydraulic recovery rate.
    - Determine whether operation at a high flux rate (e.g., greater than 12 gfd) provides an advantage or is a detriment to membrane fouling.
    - Verify performance of alternative monitoring technologies such as online fluorescent dye monitoring (e.g., Trasar®)
- UV AOP approach, including the following:
    - Verify the performance of sodium hypochlorite (NaOCl) as an oxidant for the UV AOP.
    - Evaluate the effectiveness of the UV AOP to destroy trace organic compounds not completely removed by RO.
    - Determine UV AOP effectiveness at destroying NDMA and other CECs, meeting the minimum requirement of 1.2-log NDMA reduction and 0.5-log 1,4-dioxane reduction.

Baseline operating conditions for testing could be chosen based on operational information at existing AWTFs. By optimizing these operating conditions through multiple testing runs, a more efficient and effective treatment process can be designed for the future AWTF. The pilot/demonstration testing should also confirm that the proposed treatment train can reliably meet the Project water quality goals, remove constituents of emerging concern (CECs), and perform comparably to other operational AWTFs.

3 Evaluation of AWTF Size and Phased Expansion

To achieve sufficient economies of scale and ensure the cost of water produced is reasonable, it is anticipated that the initial project would produce approximately 16 mgd of advanced treated water. A second phase expansion could potentially increase the production to 20 mgd based on the projected 2040 EWPCF flows, while still allowing for peak summer NPR production of 8 mgd at the facilities that rely on EWPCF effluent (i.e., Carlsbad WRF and Gafner WRF). An additional expansion to 25 mgd production may be possible if wastewater flows reach the liquid capacity of the EWCPF or if NPR demands decrease in the future.

3.1 EWA Facilities Footprint Analysis

The AWTF for the preferred option at 16 mgd of production is estimated to require a total area of approximately 290,000 ft^2 (6.6 acres). Figure 3-1 shows the footprint of the assumed improvements to the EWPCF, the AWTF sized for 16 mgd of production for RWA, and the RO concentrate (brine) disposal connection to the Encina Ocean Outfall. If the AWTF were expanded to 25 mgd of production, the space required would increase to approximately 390,000 ft^2 (8.9 acres), which could still be sited within the 22.8-acre footprint currently available at EWA's South Parcel.

3.2 Conveyance and SDCWA System Integration

To accommodate the potential future increased flow to 20 or 25 mgd versus the "baseline" 16 mgd, the pipeline to the SDCWA Second Aqueduct would need to be upsized from a 30-inch to a 36-inch, along with increased pumping capacity at the pump station sited at the AWTF and at the booster pump station required to match the pressure in the SDCWA raw water pipeline.

Activities to determine the requirements for integration with the SDCWA system may include the following:

- Identify potential corridors for a 36-inch pipeline to convey up to 25 mgd maximizing use of public right-of-way.
- Obtain utility information for selected potential alignments.
- Identify potential locations to connect to the Aqueduct and the SDCWA requirements.
- Perform preliminary hydraulic analysis to determine pump station(s) needs.
- Identify preferred alignment, size of corridor, easement requirements, etc.
- Update preliminary costs for conveyance of raw water to the Aqueduct.
- Summarize results in a Technical Memorandum.

Figure 3-1: Project Treatment Facilities Footprint Layout (16 mgd RWA)

1. CIP
2. LOX
3. Maintenance Building
4. Administrative Building
5. Electrical Rooms
6. UV System
7. CO_2
8. Lime
9. Chemical Feed System/Storage
10. Electrical Building

3.3 Sensitivity Analysis of Conceptual Costs

Following the same methodology as outlined in TM3, a sensitivity analysis of the conceptual costs was developed to consider the potential impact of increased availability of flow and/or outside funding sources. For the purposes of the sensitivity analysis, the following phases and variants of Option H are presented:

- Phase 1: 20.5 mgd influent (16 mgd product water, for RWA only)
- Phase 2: 25.5 mgd influent (20 mgd product water, for RWA only)

A cost summary for each option is provided in Table 3-1 and Table 3-2, respectively.

Table 3-1: Cost Summary for Option H, Phase 1

Option H: RWA to Second Aqueduct (16 mgd)	Cost	Notes
EWPCF Secondary Improvements	$89,000,000	at 31 mgd flow rate
Advanced Treatment (FAT + O3/BAF)	$234,400,000	at 20.5 mgd influent rate
Conveyance - East	$157,000,000	at 20.5 mgd influent rate
Total Capital Cost	**$480,400,000**	
Annual O&M Costs		
Power - Treatment (EWPCF + AWTF)	$5,403,000	24/7/365 operations
Power - Conveyance	$9,864,000	24/7/365 operations
Equipment Rehabilitation/Replace, Consumables	$5,537,000	All new facilities (incl. EWCPF)
Labor	$1,134,000	AWTF + Conveyance
Total Annual O&M Cost	**$21,938,000**	
Cost of Water		
Annualized Capital Cost	$21,450,000	2.0% rate, 30-yr term
Total Annual Cost	**$43,388,000**	for first 30 years
Annual Yield	**17,800**	acre-feet
Unit Cost of Water	**$2,450**	per acre-foot

Table 3-2: Cost Summary for Option H, Phase 2

Option H4: SDCWA Second Aqueduct; Reduced NPR	Cost	Notes
EWPCF Secondary Improvements	$89,000,000	at 31 mgd flow rate
Advanced Treatment (FAT + O3/BAF)	$281,511,221	at 25.5 mgd influent rate
Conveyance - East	$191,900,000	at 25.5 mgd influent rate
Total Capital Cost	**$562,411,221**	
Annual O&M Costs		
Power - Treatment (EWPCF + AWTF)	$6,189,000	24/7/365 operations
Power - Conveyance	$12,252,000	24/7/365 operations
Equipment Rehabilitation/Replace, Consumables	$6,843,000	All new facilities (incl. EWCPF)
Labor	$1,330,732	AWTF + Conveyance
Total Annual O&M Cost	**$26,615,000**	
Cost of Water		
Annualized Capital Cost	$25,112,000	2.0% rate, 30-yr term
Total Annual Cost	**$51,727,000**	for first 30 years
Annual Yield	**22,200**	acre-feet
Unit Cost of Water	**$2,340**	per acre-foot

A summary of the capital costs for each of the two phases for Option H is provided in Figure 3-2, representing the difference in costs for the AWTF and conveyance. The required investment in EWPCF improvements would be the same regardless of AWTF production.

Figure 3-2: Capital Cost Summary for Option H Phasing

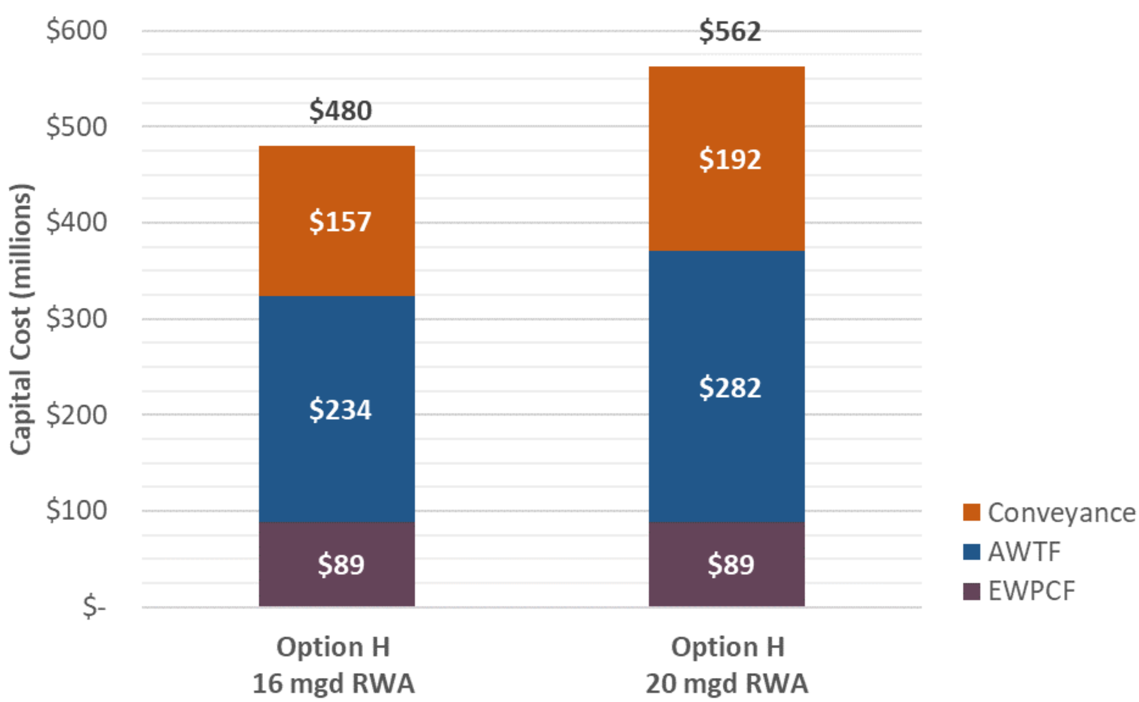
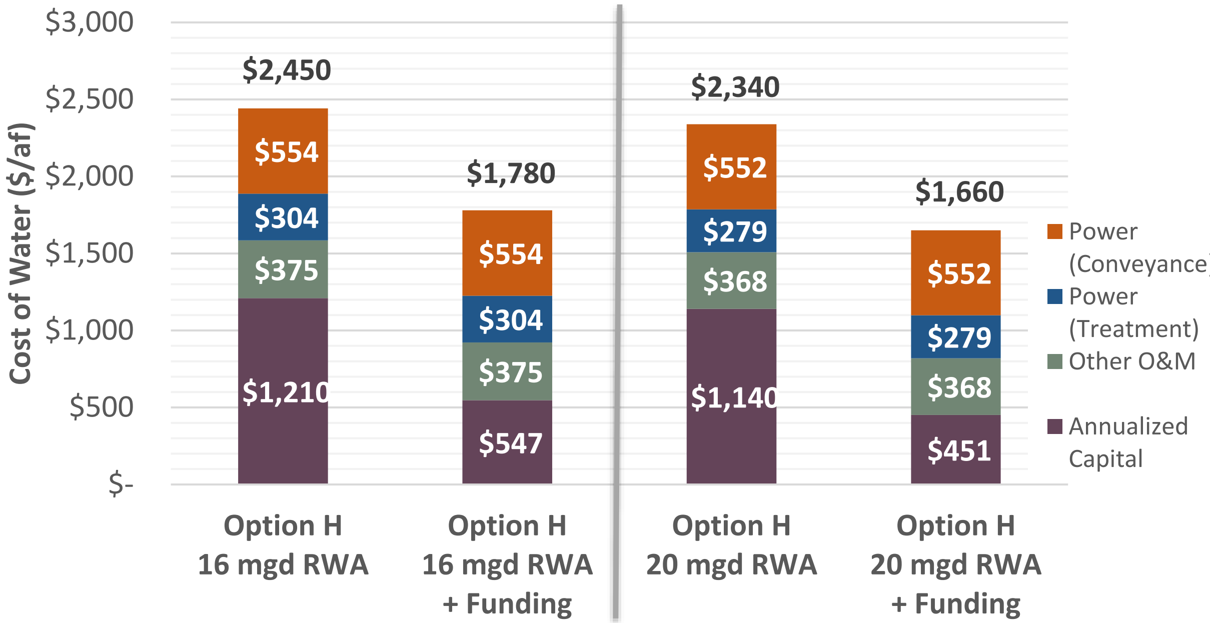


Figure 3-3 compares the cost of water for each phase with and without outside funding over the assumed 30-year financing period. The outside funding scenario assumes that grant funding would be obtained to offset 20% of the capital costs, and that production incentives (local rebates) would reimburse the participating agencies $500 per acre-foot for the first 25 years of operation.

Figure 3-3: Cost of Water Summary for Option H Phasing



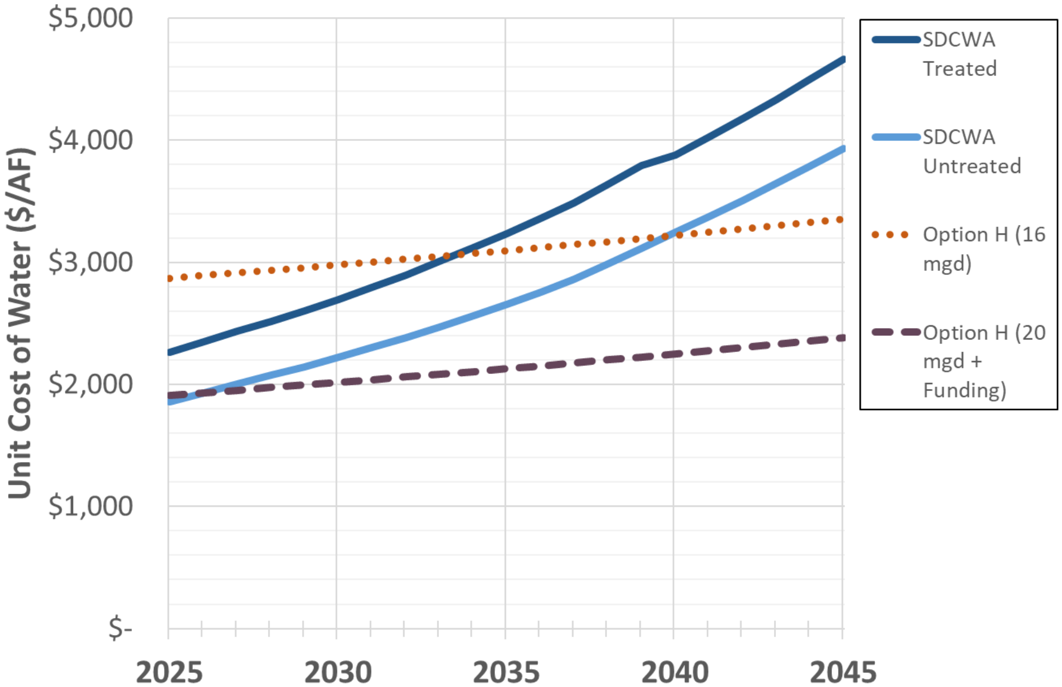
3.4 Comparison of EWA Water Costs to Regional Alternatives

To evaluate the competitiveness of EWA's Option H project, its associated costs to produce and deliver advanced treated water for RWA were compared with the rates projected for SDCWA—the main water wholesaler in the North San Diego County region. Although both untreated (raw) and treated rates for SDCWA were reviewed, EWA's RWA product water would be directly comparable to the raw water rates.

The SDCWA projected rate increases for the 2025-2045 period were based on a 10-year projection prepared by SDCWA for the period 2017-2027. Projections of water rates after 2027 were developed by Helix Water District and Padre Dam Municipal Water District in their financial analysis of a potential East San Diego County surface water augmentation project and presented publicly on several occasions.

Note that the projections do not reflect the current status of litigation between SDCWA and MWD which is pending a final ruling by a trial court following the 2017 Court of Appeals decision. These projections also do not reflect MWD's recent decision to finance approximately two thirds of the cost of the $15 Billion California WaterFix twin tunnels Bay Delta Conveyance Project. This represents a significant increase from the previous 26% MWD cost responsibility included in the rate projections shown in Figure 3-4 and is expected to result in higher SDCWA water rates than anticipated. The water rates that are shown are in comparison with the projected range of costs for EWA's Option H on Figure 3-4. The range of costs for Option H as shown are with capital costs inflated at 2.5 percent per year and O&M cost escalated at 1.5 percent annually.

Figure 3-4: Comparative Cost of Water for EWA's Option H and SDCWA Projected Costs



By identifying the points of intersection between the costs of water for EWA's Option H and raw water provided by SDCWA, Figure 3-4 shows that EWA's project could be cost-competitive as early as 2025 or as late as 2040, depending on flow available and level of outside funding. As previously noted, the projections for SDCWA rates do not reflect the final decision in the SDCWA—MWD rate litigation and exclude any additional cost increases associated with implementing the California WaterFix project, which may accelerate the timeframe within which EWA's project would become more cost-competitive.

4 Implementation Plan and Schedule

Additional planning, pilot studies, environmental review, public outreach and regulatory discussion are needed to refine the selected potable reuse project concept and verify economics. In addition, regulations related to RWA are not expected until at least 2023 after further research is completed. To move the project beyond this Study phase, additional work is required to address the following:

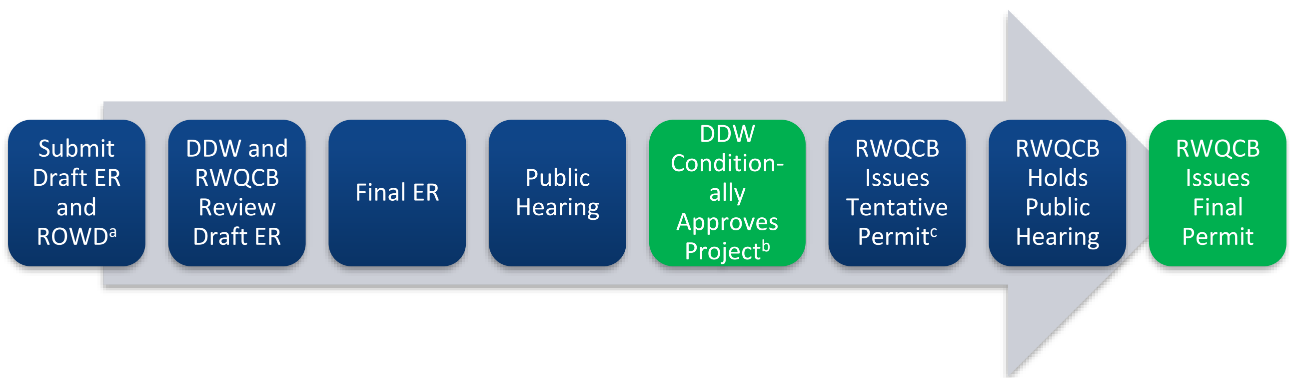
- Regulatory Activities
- Environmental Documentation
- Source Water Analysis
- Engineering, Design, and Construction
- Funding Plan and Applications
- Stakeholder/Public Outreach

The following sections present a summary of the activities under each category for the Preferred Project.

4.1 Regulatory Activities

As a first step, details of the regulatory strategy for the Preferred Project would be identified. Regulatory oversight of potable reuse projects is carried out by DDW and the San Diego RWQCB. The general responsibilities of each agency through the regulatory approval process are illustrated in Figure 4-1:

Figure 4-1: Regulatory Approval Process Steps.



Footnotes:
[a] ER – Engineering Report; ROWD – Report of Waste Discharge.
[b] Conditional approval may include conditions recommended by DDW for the RWQCB to include in the permit.
[c] The CEQA documentation must be certified before the tentative permit is released for public comment.

Engineering Report. As part of the DDW approval process, a draft Engineering Report must be submitted to DDW and RWQCB. The purpose of the engineering report is to describe how the Project would comply with the Title 22 Criteria, the Basin Plan, and SWRCB Plans and Policies. The report would include the following types of information:

- Project purpose and goals
- Project participants (agencies or entities that would be in involved in the design, treatment, distribution, construction, and O&M of the facilities)
- Applicable rules and regulations

- Project facilities, including location, general design criteria for the treatment processes, reliability features, etc.
- EWA's industrial pretreatment/source control program
- Chemical quality of the source water (EWPCF raw wastewater)
- How compliance with the Title 22 Criteria pathogen control requirements would be achieved
- The quality of the recycled water and how it meets Title 22 Criteria
- The proposed monitoring program
- A contingency plan

The development of the draft Engineering Report and supporting technical studies is anticipated to take approximately two and half years, with an additional six months to finalize the report (e.g., addressing DDW and RWQCB comments and revising the text). The actual time necessary for finalizing the report may be shorter or longer depending on the progress of other RWA projects in California, the availability of DDW to review the draft report, and resolution of regulatory comments on the draft report.

Public Hearing. Once the report is finalized, the lead agency would schedule a public hearing to receive comments on the project. DDW would attend the hearing. Following the public hearing, depending on the comments received, DDW would send a letter to the RWQCB that conditionally approves the project and recommends that the RWQCB issue a tentative permit. The approval letter may contain conditions that must be implemented (and included in the permit) prior to operation of the project. The time necessary to receive the conditional approval letter is a function of organizing the hearing, DDW availability to participate in the hearing and approve materials to be presented at the hearing, and the time for DDW to issue the approval letter. This overall process is estimated to take about three months.

RWQCB Permit – Waste Discharge and Water Recycling Requirements (WDR/WRR). A Report of Waste Discharge (ROWD) for the proposed recycled water use is submitted to the RWQCB to initiate the RWQCB permitting process. The ROWD must identify proposed treatment, discharge facilities and operations, and characterize potential impacts on water quality. The ROWD is typically submitted along with the draft Engineering Report. In addition, another ROWD would be required for the ocean outfall National Pollutant Discharge Elimination System (NPDES) permit revision to discharge the proposed RO brine to the Encina Ocean Outfall.

After DDW has issued its conditional approval letter and after the project's California Environmental Quality Act (CEQA) document is certified, the RWQCB would issue a tentative WDR/WRR. It is also possible to request that EWA be given the opportunity to review a pre-public draft of the permit to resolve any significant issues in advance of the public review period.

Ongoing Regulatory Coordination. It would be important to engage with DDW and RWQCB through project permitting and implementation beginning early in the process. The DDW process is characterized by ongoing consultation between the project proponent and DDW throughout the project planning, predesign, design, and construction phases. Consultation with the RWQCB should occur both before and after submittal of the ROWD. Pre-submittal consultation is directed toward ensuring that the ROWD is structured to adequately address all RWQCB issues and concerns. Post-submittal consultation may be directed toward addressing subsequent RWQCB questions or requests for additional information. The timing and manner of engagement (e.g., in-person meetings versus conference calls) should be worked out with the regulators based on their schedules and availability.

4.2 Environmental Documentation

All public projects in California must comply with CEQA. If a project is not exempt, CEQA provides for the preparation of an Initial Study (IS) to analyze whether the project would have a significant impact upon the environment. A Negative Declaration/Mitigated Negative Declaration (ND/MND) could be issued if the analysis in the IS determines that the project or action, as proposed or as proposed with specific mitigation measures, would not have a significant impact upon the environment. If the analysis in the IS determines that the project or action has the potential to result in a significant impact(s) to the environment, then an Environmental Impact Report (EIR) would need to be prepared to further address such impacts. It is anticipated that EWA will need to complete an EIR for the Preferred Project.

In addition to CEQA, a project is subject to National Environmental Policy Act (NEPA) if it is jointly carried out by a federal agency, requires a federal permit, entitlement, or authorization, requires federal funding, and/or occurs on federal land.

CEQA certification is required prior to RWQCB action to adopt the discharge permit. The RWQCB staff typically defers preparation of the tentative discharge permit until after full CEQA certification has been completed.

4.3 Source Water Analysis

Contaminants of Concern- Source Control Plan. An assessment will be required to determine the fate of DDW-specified contaminants through the wastewater and recycled water treatment systems. The constituents are those considered of importance based on industrial discharges to the wastewater system and the source control program inventory of contaminants. These contaminants may include pharmaceuticals, endocrine disruptors, and other wastewater indicator chemicals as specified by DDW based on the review of the Engineering Report. In addition, EWA's existing source control program should be reviewed and augmented as necessary to satisfy the Title 22 Criteria.

EWPCF Effluent Monitoring and Operations Analysis. Analysis of the EWPCF current operational procedures should be reviewed to determine their suitability to support the preferred project. Operational improvement and optimization opportunities should be identified to increase the reliability of the secondary treatment per the Title 22 Criteria.

4.4 Engineering, Design, and Construction Activities

The new facilities for Option H are summarized in **Table 4**. This section discusses the effort needed to develop and implement the capital improvement projects identified for the initial phase, including EWCPF improvements, construction of the AWTF, conveyance pump stations, pipelines, and conveyance of RO brine to the Encina Ocean Outfall (EOO).

Table 4-1: New Facilities Required for the Initial Phase of Option H

New Facility	Description	Quantity
EWPCF Improvements	• Primary Effluent Flow Equalization • Secondary Process Conversion to MLE • Tertiary Filtration	• 2 x 140-foot dia. tanks • 4 aeration basins (retrofits), 2 new secondary clarifiers • 6 tertiary filters
AWT Facility	• Treatment Facilities, including O_3/BAF, UF, RO, AOP with UV/NaOCl, and conditioning of product water • Appurtenant Facilities, including roadways, administration/maintenance buildings, electrical facilities, product water tank, and brine disposal to EOO.	• 16 mgd product water
Conveyance to SDCWA Aqueduct No. 2 and Integration with Pipeline No. 5	• AWT product pump station • Pipeline to RWA site • Booster pump station	• 3 pumps, 5,600 hp • 30 inch, 7.6 miles • 3 pumps, 2,000 hp

O_3 – ozone; BAF – biological activated filtration; UF – ultrafiltration; RO – reverse osmosis; UV – ultraviolet irradiation; NaOCl – sodium hypochlorite; hp – horsepower; LF – linear feet; psi – pounds per square inch

Preliminary Design. Detailed facilities plans would be prepared for all the new facilities identified for the project, including revised facilities layout for the AWTF, pipeline alignment evaluation, as well as revised capital and O&M cost estimates based on vendor quotes and proposals. During preliminary design, the concepts developed in this Study would be further refined, and assumptions would be updated, validated and documented. The conveyance pipeline alignments and booster pump station siting would be addressed as well. Alternative project delivery methods should be evaluated at this stage also (e.g., design-build vs. traditional design-bid-build).

Final Design. Following pilot/demonstration testing and any recommended equipment pre-selection, the design packages would be prepared for the AWT facilities. Design for conveyance pipeline and booster pump station could proceed independently of the AWTF design. After permitting is completed, the bid package would be prepared (assuming a design-bid-build approach).

Bidding/Contract Award, Construction, and Startup. Bidding and contract award would commence once the bid package is complete. Following construction, a startup period of approximately 6 to 12 months is anticipated, along with final approvals of the AWT facility and overall project.

4.5 Funding Applications

As described in TM5, the EWA Water Reuse Project would be eligible for funding from multiple federal, state, and regional programs. To ensure the project maximizes its chances of receiving funding, a Funding Plan could be prepared to confirm the potential funding sources and to identify the specific funding assistance activities. Funding assistance activities include researching, identifying, and applying for federal, state, and private foundation funding sources for utility-related projects including wastewater treatment plant facilities and recycled water projects. This would further require the development of grant applications tailored to specific projects in such a way as to make the projects more competitive for potential grant funding. The necessary supporting technical and financial information is important when identifying how much is needed in matching funds, including contributions from potential project partners. Funding assistance activities are expected be required throughout implementation of the preferred project.

Pursuit of the Water Recycling Funding Program (WRFP) and San Diego Integrated Regional Water Management (IRWM) Program grants could provide funding in the near-term, with Water Infrastructure Improvements for the Nation (WIIN), Clean Water State Revolving Fund (SRF) Program, and MWD Local

Resources Program / SDCWA Local Water Supply Incentive Program (LRP / LWSD) funding available in the longer term.

4.6 Stakeholder/Public Outreach

A public information program is an essential element for the Water Reuse Project because of the importance of educating and informing the public about the use of a new water supply and communicating that the overwhelming scientific evidence has shown that potable reuse is a safe, feasible solution. An effective public information program includes both outreach and participation, each serving different functions. Outreach is a way of disseminating or collecting information to educate the public; participation implies a means for stakeholders to actively engage in and influence a plan.

There is a track record of successful potable reuse projects that have the following characteristics in common:

- They are designed to improve water quality;
- They augment water supplies or prevent seawater intrusion versus being designed to dispose of wastewater;
- They maintain a database of historical water quality of treated effluent and conduct research to support success;
- They are managed by agencies with established experience and that have gained the confidence of regulatory authorities.

Thus, a public engagement program for the potential project should be initiated early in the planning process and incorporated into EWA's existing community relations program to reinforce the project purpose and need. Elements of an outreach program to be developed for EWA may include:

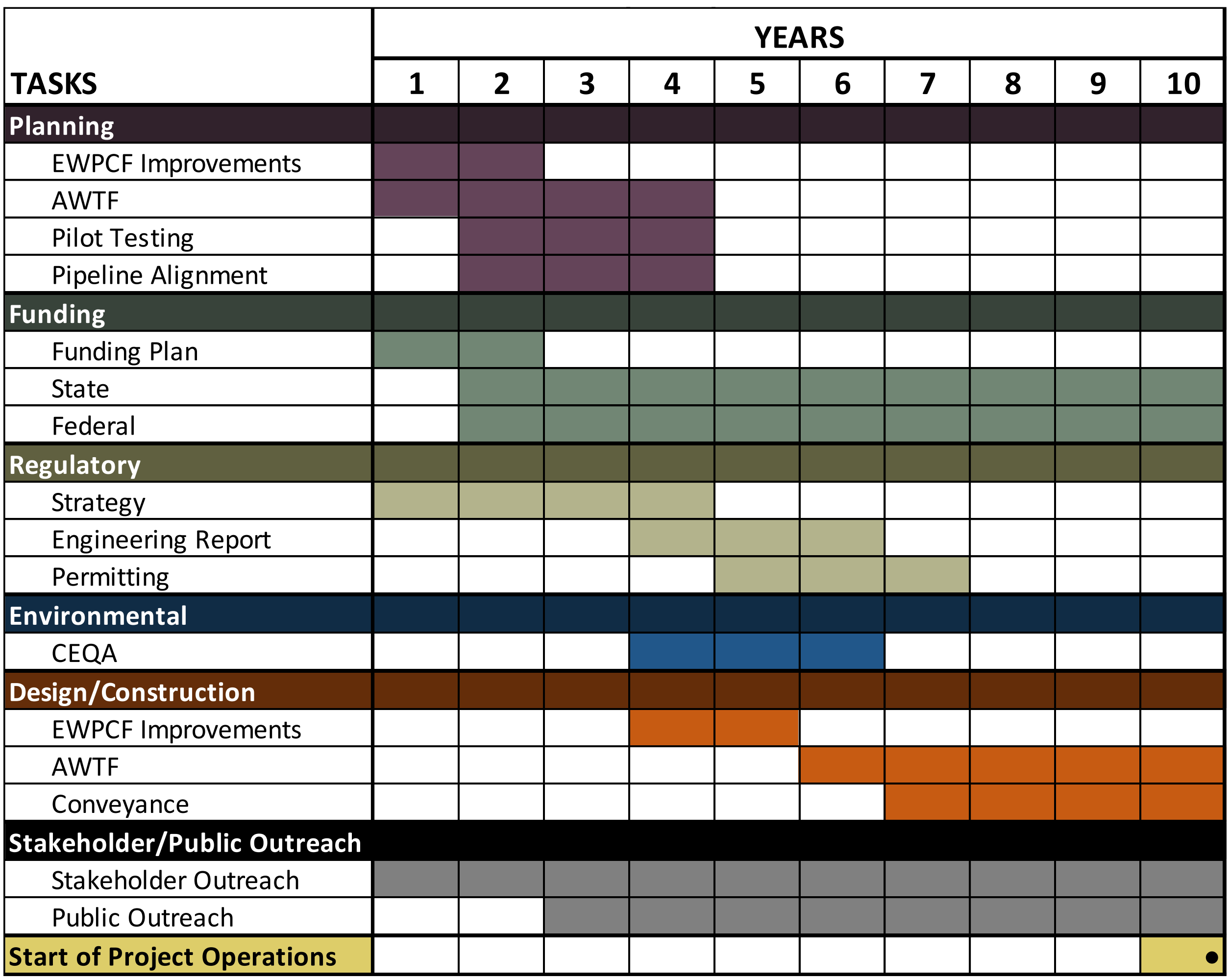
- **Planning Workshops.** To identify EWA's communication goal and objectives for the project, project challenges and opportunities, and key messages and audiences
- **Purpose and Need Statement**. Review EWA's reason for examining potable reuse and ensure that the purpose and need for the project are clearly stated. This could be the basis for key messages, informational materials, presentations and all other project communication.
- **Survey.** Conduct a baseline public opinion survey so that perceptions, awareness and knowledge about water supply needs and sources, recycled water and potable reuse can be measured at the very start of the project. Key messages could also be tested to determine if they help respondents understand the project more clearly.
- **Communication Plan.** Develop a strategic communication plan that includes: a situation analysis; project challenges and opportunities; EWA's communication goal and objectives; strategies or a list of how the goal and objectives would be accomplished; and outreach tactics, activities, and communication tools that carry out the strategies and meet the goal or objectives.
- **Informational Materials.** Develop a fact sheet and frequently asked questions document that can be posted on EWA's website and printed for distribution at appropriate locations, including EWA offices and at community presentations or events.
- **Website.** Evaluate the need for a separate project website or a page on EWA's existing website. Post all information about the potable reuse project on the website.
- **Community Advisory Group.** Consider establishing a community advisory group to work with EWA staff and the project team on an identified task related to the project. This task could be for the community advisory group to review the communication strategies and provide input on additional ways to expand outreach about the project in the service area.

4.7 Implementation Schedule

An overall implementation plan for the preferred project is shown schematically on Figure 4-2, which indicates an overall duration of approximately ten years before project startup. Although there are currently no permitted DPR projects in California (raw or treated drinking water augmentation), recent experience with surface water augmentation projects is proceeding on similar timeframes (such as San Diego Pure Water or the East County Advanced Water Purification Program) once a decision is made to proceed. Key phases of the EWA RWA project and interdependencies are summarized as follows:

- Initial work should focus on planning for the major capital improvements (including a pilot/demonstration phase) and developing the regulatory strategy for RWA.
- By the time the planning studies are completed, regulatory requirements for RWA projects should be better defined, allowing the project to move ahead with preparation of the Engineering Report.
- Environmental documentation should be done in parallel with the design and DDW coordination phases. CEQA certification is needed before RWQCB can issue the tentative permit.
- Construction of the project can begin after the RWQCB issues the final permit.
- Funding application and stakeholder/public outreach efforts will occur during the life of the project, though the public outreach activities are not expected to ramp up until the pilot/ demonstration facilities are operating.

Figure 4-2: Implementation Schedule for EWA's Potable Reuse Project (Phase 1)



5 Conclusions and Next Steps

EWA's wastewater flows and facilities represent a unique opportunity and a centralized location for large-scale production of recycled water that could capture economies of scale to the benefit of the region. EWA's experience in water treatment and water quality may well make it suitable to take on the responsibility for the AWTF required for potable reuse. The presence and available capacity of a deep ocean outfall is conducive to siting the AWTF near the EWPCF for disposal of reject streams.

Demand for non-potable reuse in the region is not projected to be sufficient to fully utilize the available effluent at the EWCPF, especially considering the seasonal nature of irrigation demands. Therefore, potable reuse would be necessary to minimize discharges of EWPCF effluent to the Pacific Ocean. Although the cost of water estimated for EWA's RWA option is higher than current SDCWA untreated water rates (like other recycled water projects being implemented in the region), SDCWA's costs are projected to rise over time and EWA's RWA Project may become cost-competitive by the time it could begin delivering water in the mid to late 2020s.

Because the production of a new water supply by EWA is not required to comply with its NPDES permit or any other state or federal requirement, the cost of the RWA Project beyond wastewater treatment and disposal would be the responsibility of water purveyors. As such, future planning and implementation activities should be pursued on a cost share basis with participating local and regional water suppliers. However, it should be noted that the draft Amendment to the Recycled Water Policy released by the SWRCB on May 9, 2018 identified the following:

- Goal: Increase the use of recycled water from 714,000 afy in 2015 to 1.5 million afy by 2020 and to 2.5 million by 2030.
- Goal: Minimize the direct discharge of treated municipal wastewater to […] ocean waters, except where necessary to maintain beneficial uses. Under this goal, treated municipal wastewater does not include brine discharges from recycled water facilities or desalination facilities.
- The State Water Board will evaluate progress toward these goals and revise the goals or establish mandates as necessary.

As shown on the RWA Project Implementation Schedule included in Section 4 above, the activities identified during the initial phases of the Project are focused on:

- Identifying the potential impacts on the EWPCF.
- Refining the design criteria for the AWTF and pilot testing.
- Strategizing the approach to defining the regulatory requirements for RWA.
- Developing a funding plan to maximize the opportunities for outside funding.
- Determining a likely corridor for the conveyance pipeline to the SDCWA raw water pipeline.

If EWA's Board of Directors authorizes staff to continue planning and permitting activities beyond this Study, future stakeholder outreach should focus on developing a formal partnership with the water purveyor(s) that would use the purified raw water produced from EWPCF effluent. The anticipated cost of recommended activities over the first two years is estimated to be approximately $800,000. This cost will likely be shared by local and regional water purveyors interested in continuing to refine the costs and partnering on the project.

Defining EWA's role after the Feasibility Study will be key to any implementation plan of wider reuse of EWA's valuable water resources. EWA should invite continued discussions with its potential partners (retail water agencies), and the next steps could also involve significant policy and financial deliberations by its Board and Member Agencies.

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Attachment 5 - TM5: Funding Opportunities

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Technical Memorandum No. 5

EWA Water Reuse Feasibility Study

Subject: **Funding Opportunities**

Prepared for: Encina Wastewater Authority

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Date: July 2018 (Draft Issued: October 2017)

Contents

List of Tables

1 Introduction and Background

1.1 Background

As required by Encina Wastewater Authority's (EWA) 2020 Business Plan, the Water Reuse Feasibility Study (Study) will identify a path to maximize beneficial reuse of effluent from the Encina Water Pollution Control Facility (EWPCF)—which by 2040 is projected to reach an average of approximately 31 million gallons per day (mgd).

The Study will focus on developing a portfolio of options for potential reuse; identify and analyze a short list of options; develop an approach to phasing of the preferred water reuse project; identify funding opportunities for projects; develop a stakeholder involvement plan; and coordinate with EWA Member Agencies and other stakeholders to engage with the Study development and recommendations. Ultimately, the Study will serve to advance EWA's mission of resource recovery and contribute to sustaining and enhancing the region's water environment.

1.2 Objectives

The purpose of this technical memorandum (TM) is to identify local, state, and federal funding opportunities for EWA's water reuse project. For each funding source, the TM explains the funding program objectives, eligibility criteria, cost share requirements, and activities that could be funded, thereby reducing the cost to local agencies and their retail water customers. The TM is organized as follows:

- **Regional Funding:** San Diego Integrated Regional Water Management (IRWM) Program, Metropolitan Water District of Southern California (MWD) Local Resources Program, and a potential San Diego County Water Authority (SDCWA) Local Water Supply Development Program.
- **State Funding:** Clean Water State Revolving Fund (SRF) Program, and Water Recycling Funding Program.
- **Federal Funding:** Title XVI Water Reclamation and Reuse Program, and Water Infrastructure Improvements for the Nation (WIIN) Program.
- **Conclusions:** Conclusions regarding the level of funding that could be available for project implementation, as well as recommendations for funding future phases of the project development process if EWA and any partnering agencies determine there is a feasible project to move forward with.

2 Regional Funding

2.1 San Diego IRWM Program

The Integrated Regional Water Management (IRWM) Grant Program is supported by bond funding through the California Department of Water Resources (DWR). This program funds competitive grants for multi-benefit projects that develop long-term water supply reliability, improve water quality, and protect natural resources. Funding is distributed regionally and applied for at the local level.

Proposition 1 provides $52.5 million for the San Diego Funding Area (which includes southern Orange and Riverside counties) for projects that help meet the long-term water needs of the State. Eligible grant applicants include public agencies, non-profit organizations, public utilities, federally-recognized Indian Tribes, state Indian Tribes listed on the Native American Heritage Commission's Tribal Consultation list, and mutual water companies.

The San Diego IRWM Program – managed by a Regional Water Management Group (RWMG) comprised of San Diego County Water Authority (SDCWA), County of San Diego, and City of San Diego – will receive $38.2 million for distribution to local water resource management projects. The application process occurs through the local program prior to and concurrent with each round of funding made available by DWR. One round of Proposition 1 funding has already been awarded locally, totaling $4.9 million, which leaves $33.3 million available for future rounds. The IRWM Grant Program will fund planning, design, environmental, and construction costs. The San Diego IRWM Program requires inclusion of public outreach and construction components in all funded projects.

Eligible project types for the IRWM Grant Program are announced with each solicitation, but generally include the following:

a. Water reuse and recycling for non-potable reuse and direct and indirect potable reuse.
b. Water-use efficiency and water conservation.
c. Local and regional surface and underground water storage, including groundwater aquifer cleanup or recharge projects.
d. Regional water conveyance facilities that improve integration of separate water systems.
e. Watershed protection, restoration, and management projects, including projects that reduce the risk of wildfire or improve water supply reliability.
f. Storm water resource management projects.
g. Conjunctive use of surface and groundwater storage facilities.
h. Water desalination projects.
i. Decision support tools to model regional water management strategies to account for climate change and other changes in regional demand and supply projections.
j. Improvement of water quality, including drinking water treatment and distribution, groundwater and aquifer remediation, matching water quality to use, wastewater treatment, water pollution prevention, and management of urban and agricultural runoff.

The San Diego IRWM Program application process typically begins approximately six months prior to DWR's deadline, with a local Call for Projects. One or more workshops are generally held before and during the Call for Projects for local project sponsors to identify opportunities to strengthen their project and receive assistance with submitting their project for consideration. Submitted applications are scored in accordance with the scoring criteria established by the Regional Advisory Committee (RAC) for that round of funding, and project scores are presented to stakeholders for comments. Following project scoring, a workgroup is selected from RAC members. The workgroup evaluates each project and conducts interviews with project sponsors, finally selecting a list of projects for that round of funding. The list of selected projects is then approved by the RAC. Once the project list is approved, the RWMG and consultants preparing the grant application coordinate directly with the project sponsors to obtain required information to prepare the application for submittal to DWR. To date, DWR has approved and fully awarded all of the San Diego IRWM Program's grant applications.

DWR anticipates two rounds of implementation funding for Proposition 1. Applications for the first round of funding are anticipated to be due to DWR in late 2018, and the second round is anticipated to occur in 2020. Funding availability for the two future rounds is uncertain, but estimated by the San Diego IRWM program to be $10-15 million in 2018 and $18-23 million in 2020. These grants require a minimum of 50% local cost share. Projects that score well in the San Diego IRWM Program are multi-benefit, have multiple (public and/or non-profit) partners, and have substantial public outreach components.

Evaluation for EWA Water Reuse Project

EWA's Water Reuse Project would be competitive under the San Diego IRWM Program because water reuse is a priority for the Region. The project would address multiple goals and objectives of the *San Diego IRWM Plan* including improving the reliability and sustainability of regional water supplies, protecting and enhancing water quality, watersheds and natural resources, and promoting and supporting sustainable integrated water resource management.[1]

EWA could become involved in the San Diego IRWM Program by attending RAC meetings as a member of the public, and potentially volunteering to sit on the RAC when the next set of seats become available at the end of 2018. EWA could also contribute projects during the Call for Projects for each round of funding, and attend public workshops associated with the funding opportunities. Participation in the San Diego IRWM Program is open to any entity involved in water management and would not have to be done through EWA's Member Agencies.

Proposition 1 funding via the IRWM Grant Program could be used for planning, design, and construction activities. However, projects must be "shovel-ready" to be eligible for the IRWM Grant Program. Although planning components can be included, the project must contain a construction component that will deliver physical benefits (e.g., result in recycled water deliveries) to be funded. EWA might consider phasing the construction components and beginning design and CEQA compliance on early construction components, so that those deliverables can be submitted with the application. EWA might also consider coupling the planning phase of the Water Reuse Project with one or more capital projects at the EWPCF so that the total package is "shovel-ready". All IRWM-funded projects must also contain a public/stakeholder outreach component that exceeds minimum regulatory (e.g., CEQA or Title 22) requirements.

The local process for the next round of Proposition 1 funding is anticipated to begin in early to mid-2018. The subsequent round of Proposition 1 funding is anticipated to occur in 2020. EWA should become engaged with the San Diego IRWM Program by end of 2017 to receive all relevant information for the next funding opportunity. There is no maximum award level (minimum is $500,000), but the largest award to date was $6 million and the average award was $1.5 million.

The San Diego IRWM Region project prioritization and selection process would dictate whether EWA's Project would be included in an application. Additional information is requested from projects selected for

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[1] Additional details on the *San Diego 2013 IRWM Plan*'s goals and 11 objectives can be found in Chapter 2 of the IRWM Plan, http://sdirwmp.org/pdf/SDIRWM_02_Vision_Objectives_Sep2013.pdf

inclusion in the Region's application, which is then used by the RWMG and its consultant team to develop the Region's application to DWR.

2.2 MWD Local Resources Program

The Metropolitan Water District of Southern California (MWD) has provided incentives for the development of local water supply projects since 1982. The Local Resources Program (LRP) began by providing up-front capital; after operation began, MWD would recover costs by selling its share of water to the participating agency. Since then, the LRP has evolved into a system in which MWD pays the agency for project water deliveries, essentially subsidizing the higher cost of water that water agencies may face when developing a recycled water or groundwater recovery project. Today, there are three payment options, consisting of the following:

1. Sliding scale incentives up to $340/AF over 25 years
2. Sliding scale incentives up to $475/AF over 15 years
3. Fixed incentive up to $305/AF over 25 years

The sliding scale incentives are calculated annually based on actual project unit cost exceeding MWD's prevailing water rate. The LRP is open to public and private water agencies within MWD's service area. Eligible projects are listed below, provided they include construction of new substantive treatment or distribution facilities:

a. Water recycling projects
b. Groundwater recovery projects
c. Seawater desalination projects

Since the program began, 78 water recycling projects and 25 groundwater recovery projects have been approved, for a total of 432,000 AFY expected production upon completion[2]. Not all funded projects are operating at full capacity. Total investment to date is approximately $571 million.

MWD is currently involved in on-going litigation with SDCWA over its rates. SDCWA has filed four lawsuits against MWD to date, in 2010, 2012, 2014, and 2016, claiming that MWD illegally charged SDCWA for transporting conserved Colorado River water through MWD's conveyance system. SDCWA also claimed that MWD's Rate Structure Integrity(RSI) provision which was included in LRP and water conservation funding agreements was unconstitutional. The RSI provision prevented agencies involved in litigation or legislation challenging MWD's rate structure from receiving LRP or conservation funding.

In June 2017, the State Court of Appeal issued its opinion on the 2010, 2012 and 2014 litigation and among other findings ruled that MWD's RSI language was unconstitutional and could not be used to bar SDCWA from LRP and conservation funding. MWD did not appeal that ruling to the California Supreme Court which in September 2017 denied SDCWA's petition for review on other issues and the appellate ruling became final. Now, SDCWA and its member agencies are once again able to receive LRP funding. Since that time, SDCWA member agencies began developing their applications for submittal to the LRP Program. SDCWA has pending litigation which it filed in 2016 that challenges MWD Water Stewardship Rate that funds LRP. The status of that lawsuit and its effect on future LRP agreements are unknown presently.

[2] MWD Board Report on MWD's Efforts to Encourage Local Resources Development, http://www.mwdh2o.com/PDF_About_Your_Water/2794_001.pdf

SDCWA Local Water Supply Development Program

SDCWA had its own water supply incentive program that was originally intended as a supplement to MWD's LRP based on financial need. Established in 1991, the program was originally called the Reclaimed Water Development Fund (RWDF) and was later changed to the Local Water Supply Development (LWSD) Program. The program provided agencies up to $100/AF of recycled water produced and beneficially reused within SDCWA's service area, which offset a demand for imported water. In 2005, the program was amended to eliminate the requirement that award of funding was contingent upon receiving MWD's LRP funding. In 2006 and 2008, the program was amended to allow eligible projects to include brackish and contaminated groundwater recovery projects and seawater desalination projects and the incentive amount was increased to up to $200/AF. In 2010, the LWSD Program ceased accepting new applications because it was believed there was no longer a financial need for SDCWA to provide its own incentive.

In November 2017, SDCWA initiated a Cost of Service Study (COSS) that will also examine the formulation of a new SDCWA local projects incentive program. This potential Local Water Supply Incentive Program (LWSIP) is expected to be consistent with SDCWA legal claims in their 2016 lawsuit. It is anticipated that the COSS and a proposal for a potential LWSIP will be completed by Spring 2018.

It is likely that, between MWD's LRP eligibility and SDCWA's evaluation of its own program, regional financial incentives would be available for the EWA Water Reuse Project that would reduce cost for local ratepayers.

Evaluation for EWA Water Reuse Project

Because applicants must be a member agency of SDCWA or be sponsored by a member agency, EWA would be required to partner with a member agency; or, more likely, the member agency that beneficially reuses the recycled water would apply on their own and EWA would remain solely in a wholesaler role. The terms of a Water Purchase Agreement between EWA and the end user of the supply would assign roles and responsibilities among the parties. It is reasonable to expect that responsibility for obtaining either MWD or SDCWA financial incentives is more properly the role of the water supply agency.

The LRP incentives apply to the cost of delivered water only, so they may be achieved only after all construction and start-up activities are complete. These programs do not provide financial support prior to operations such as during the planning, design, or construction phases. Currently, MWD has a target of annual water production under the LRP Program of 63,000 AFY. MWD has contracted for some portion of that target and may have to raise that target for the EWA Water Reuse Project. Continued uncertainty in imported water availability and comments by MWD staff indicate that relooking at that target which was adopted in 2009 is likely in the coming years.

3 State Funding

3.1 Clean Water SRF Program

The Clean Water State Revolving Fund (SRF) Program is administered by the State Water Resources Control Board's (SWRCB) Division of Financial Assistance. The SRF Program provides below-market rate financing to assist communities in preventing pollution of water resources. Repayments of loan principal and interest earnings are recycled back into SRF Program to finance new projects that allow the funds to "revolve" at the state level over time. Eligible applicants are any city, town, district or public body created under state law; Native American tribal governments or authorized Native American tribal organizations having jurisdiction over disposal of sewage, industrial waste or other waste; any designated management agency under Clean Water Act §208; and 501(c)(3)s and National Estuary Programs.

The Clean Water SRF Program will fund construction costs and associated soft costs (e.g., planning, design, administration) as estimated in the application. Following contract execution, budget values are refined based on the final construction bid for the project.

Eligible projects include, but are not limited to the following:

a. Publicly-owned treatment works
b. Nonpoint source projects
c. National estuary program projects
d. Decentralized wastewater treatment systems
e. Storm water projects
f. Water conservation
g. Watershed projects
h. Energy conservation
i. Water reuse projects
j. Security measures at publicly-owned treatment works
k. Technical assistance

Funds would be limited only by EWA's ability to borrow, and no match is required. Loan terms include 30-year amortization and low interest rates. Repayment begins one year after construction is complete. SWRCB can offer principal forgiveness (i.e., grants) to applicants if the project directly benefits a small, disadvantaged community (DAC).

The Clean Water SRF application process occurs at the state level. Four different application packages are submitted to the SWRCB – general information, technical, environmental, and financial security packages. The application preparation and review process takes 9-12 months, and loans are awarded based on readiness-to-proceed (e.g., CEQA-Plus [state and federal environmental compliance documentation] completed and approved by SWRCB). Applications are currently accepted on a rolling basis but may transition to a formal application window in the future.

Although early disbursement requests can cover soft costs only, generally it is preferable to be ready for the construction bid process by completion of the SRF application process. SWRCB staff require submittal of and conduct their own federal environmental consultations with U.S. Fish & Wildlife Agency and State Historic Preservation Office as part of the application review process. Additionally, any necessary Wastewater Change Petition must be completed prior to application approval.

It should be noted that the Clean Water SRF Program is currently oversubscribed. However, because it is a revolving fund (i.e., 50% of all repayments are available for future awards), the status of the SRF Program could improve by the time a financing agreement with the SWRCB would be executed for the EWA project.

Water Recycling Funding Program

The SWRCB administers the Water Recycling Funding Program (WRFP) concurrent with the SRF Program to promote the beneficial use of treated municipal wastewater to augment fresh water supplies. The WRFP provides technical and financial assistance in support of water recycling projects and research. Proposition 1 provided $625 million under the WRFP for planning and construction of water recycling projects, which is being administered through the Clean Water SRF. Applications are accepted on an ongoing basis.

Two categories of grants are offered, planning grants and construction grants, which are described below:

1. **Planning grants**: Planning studies for facilities to determine the feasibility of using recycled water to offset the use of fresh/potable water from state and/or local supplies are eligible. Pollution control studies, in which water recycling is an alternative to disposal, are not eligible. The facilities planning report must include analysis of all the essential components of the project and identify a recommended project.
    - A 50% match is required.
    - The maximum grant award is $75,000. Funding is still available in this category.
2. **Construction grants:** Eligible applicants for construction grants are local public agencies, non-profit organizations, public utilities, federally- and state-recognized Native American Tribes, mutual water companies, and JPAs. Financial and technical assistance is available for projects that offset or augment state fresh water supplies. Projects focused on system process efficiencies including, but not limited to, operations and maintenance (O&M) and process improvements not regulated by a waste discharge permit, are ineligible to receive funding.
    - A 50% match is required.
    - The maximum grant award is 35% of the total project cost or $15 million, whichever is less. However, SWRCB has reported that all of the WRFP construction funding has been allocated; construction grants are no longer available. Recent passage of Senate Bill 5 (California Drought, Water, Parks, Climate, Coastal Protection, and Outdoor Access for All Act of 2018) may provide additional funding for the WRFP, but it is uncertain at this time whether additional funding will be available under this program.

Evaluation for EWA Water Reuse Project

EWA and partnering agencies would likely qualify for planning grants and low-interest financing through the Clean Water SRF Program and WRFP. EWA could apply immediately for a WRFP planning grant, which would provide up to a $75,000 grant toward completion of a Feasibility Study, requiring a 50% match. JPAs are eligible entities for planning grants. EWA could utilize WRFP planning grant funds to expand this Study to meet SWRCB and USBR requirements, so that it complies with both Clean Water SRF and Title XVI/WIIN requirements.

Clean Water SRF would provide a low-interest loan (current interest rate is 1.7%) up to the full project cost. Additional construction grant funds could be obtained through the WRFP if additional funding becomes available. Clean Water SRF loans are approved on a first-come, first-serve basis following approval of submitted applications. Because the application review process takes 9-12 months, the status of the SRF Program is expected to improve by the time a construction application is ready for the EWA Project.

4 Federal Funding

4.1 Title XVI Water Reclamation and Reuse Program

The United States Bureau of Reclamation (USBR) WaterSMART: Title XVI Water Reclamation and Reuse Program (Title XVI Program) includes funding for the planning, design, and construction of water recycling and reuse projects, including prior costs. The purpose of the Title XVI Program is to develop and supplement urban and irrigation water supplies through water reuse, thereby improving efficiency, providing flexibility during water shortages, and diversifying water supply. A water reuse project is a project that reclaims and reuses municipal, industrial, domestic, or agricultural wastewater and naturally impaired groundwater and/or surface waters. Reclaimed water can be used for a variety of purposes such as environmental restoration, fish and wildlife, groundwater recharge, municipal, domestic, industrial, agricultural, power generation, or recreation.

To receive Title XVI funding for a construction project, the project must receive congressional authorization (which has not occurred in the last few years due to the congressional earmark ban). Once a project has congressional authorization, a Title XVI Feasibility Study must be submitted to USBR for review and approval. USBR will then provide a Determination of Feasibility, which provides eligibility to pursue the annual Funding Opportunity Announcements (FOAs). Both USBR and congressional approval are required to be eligible to pursue Title XVI funding. The federal share for a Title XVI project shall not exceed 25%, up to the value authorized by Congress.

A Title XVI application is submitted in response to the annual FOAs and is evaluated against all other applications received from the Western States. The application requires project information and response (limited to 75-pages) to a series of evaluation criterion questions related to water supply, environment and water quality, energy efficiency, economic benefits, disadvantaged communities, and watershed perspective.

Water Infrastructure Improvements for the Nation (WIIN) Program

The WIIN Program is a subset of the Title XVI Program, established for agencies that have not received congressional authorization under Title XVI. The purpose of the WIIN Program is to develop and supplement urban and irrigation water supplies through water reuse, thereby improving efficiency, providing flexibility during water shortages, and diversifying the water supply.

This program includes $50 million for Title XVI projects that have received a Determination of Feasibility (i.e., they have submitted and received approval of a Feasibility Study from USBR), but have not been congressionally authorized. The federal share for a WIIN project shall not exceed 25%, up to $20 million. The WIIN Program is being administered similarly to the Title XVI Program, and the FOA for the 2017 fiscal year (which offered $10 million for WIIN grants) was released on July 17, 2017. The next round of funding under the WIIN Program may be available as soon as Fall or Winter 2017.

The application process for WIIN grants is similar to the Title XVI Program, with comparable application requirements and evaluation criterion.

Evaluation for EWA Water Reuse Project

The USBR WIIN Program could be used to fund planning, design, and/or construction of all potential project components. Construction activities can be phased to pursue construction of different components of the Project in each 2-year funding cycle until the $20 million grant is achieved. USBR does not award the full $20 million at once. EWA can submit multiple applications under the annual FOAs, with a fraction of the $20 million grant received each time.

EWA would need to submit a Title XVI Feasibility Study to receive a Determination of Feasibility, after which the project would be eligible to apply for a WIIN grant. USBR does not expect to receive congressional authorizations for any new Title XVI projects – all future projects will now follow the WIIN process.

The FOA for this program is expected to be released annually in the Fall, with USBR moving toward a joint Title XVI/WIIN solicitation in the future. The Project would then be in direct competition with all other authorized and unauthorized projects. Projects that include a construction component score higher in the WIIN grant process. EWA might consider phasing the construction components and beginning design and CEQA compliance on early construction components, so that those deliverables can be submitted with each application.

5 Conclusions

5.1 Summary of Funding Opportunities for EWA's Reuse Project

Five of the funding programs described in this TM are most applicable to various components of EWA's water reuse project. Table 1 is a summary of the impact of each funding program on the potential cost of water produced by the EWA Project, based upon the conceptual cost opinions developed under TM4 for Option H[3]. For simplicity, all costs are shown in 2017 dollars.

Table 1: Funding Program Financial Benefit Example

Program	Assumption	Capital Cost	Cost of Water (incl. O&M)	% Reduction
Baseline *(No Funding Support)*	*Assumes financing with a 30-year loan at 2% interest rate*	*$480 million*	*$2,450/AF*	*N/A*
San Diego IRWM	Assumes $5 million grant award	$475 million	$2,440/AF	0.4%
SWRCB WRFP	Assumes $15 million grant award	$465 million	$2,410AF	1.6%
USBR WIIN Program	Assumes $20 million grant award	$460 million	$2,400/AF	2.0%
SWRCB Clean Water SRF Program	Assumes low interest loan for the full Project cost at 1.7% interest rate	*No change*	$2,400/AF	2.0%
MWD LRP / SDCWA LWSIP	Assumes $540/AF incentive (LRP: $340/AF for 25 years + LWSD: $200/SF for 25 years)	*No change*	$2,000/AF [4]	18.4%

For each of the funding programs described above, the projected capital cost and cost of water has been calculated assuming the stated award. If EWA were to secure financial benefits from all programs identified in Table 1, the overall projected reduction in the cost of water could be up to 24.5% based upon the following:

- $440 million total capital cost
- $1,850/AF cost of water

Several water supply agencies within the region have capitalized on multiple grant and loan programs in this way.

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[3] Note that the funding opportunities used in this example could apply to other EWA Reuse Project Options also.

[4] To facilitate comparison to the other programs, this assumes the incentive subsidies per acre-foot are in place for the first 25 years, and a return to the baseline non-subsidized cost for the remaining 5 years of the 30-year term loan.

As explained in **Table 2**, pursuit of WRFP and San Diego IRWM Program grants could provide funding in the near-term, with WIIN, SRF Program, and LRP / LWSD funding available in the longer term. The five programs are ranked as follows:

1. The WRFP ranks first because EWA could apply for a planning grant to support preparation of a Feasibility Study for the Water Reuse Project. Funding is available in the planning grant program.
2. The San Diego IRWM Program ranks second because it is the least competitive of the available programs and there is substantial funding available. However, EWA would need to be creative in developing a "Project" that meets the eligibility requirements, with some "shovel-ready" components.
3. The Title XVI WIIN Program is ranked third because it offers a larger grant maximum and the solicitations are expected to occur annually. However, the program is highly competitive, and a Title XVI Feasibility Study must be prepared to be eligible.
4. The Clean Water SRF Program ranks fourth because the program is currently oversubscribed, and it can take 9-12 months for the application review process to be complete. That said, it offers low interest rates that would be beneficial for such a large capital project and should be pursued once the Project is further along.
5. The LRP / LWSIP Programs are ranked last because of the uncertainty of their reinstatement and their timing after construction and start-up. These programs should be tracked and applied for when the Project is farther along, if funds are available.

Table 2: Funding Program Ranking

Rank	Program	Explanation
1	**SWRCB WRFP**	WRFP planning grant funds are currently available and could support development of a Feasibility Study with up to $75,000 at a 50% match.
2	**San Diego IRWM Program**	IRWM funding is a strong option because the competition occurs at the regional scale, where local water agency partners can be an advocate for the EWA Project. Planning activities can be paired with other "shovel-ready" capital projects to secure grant funding (using the capital project costs as match) or phased to allow for work to proceed in stages.
3	**USBR Water Infrastructure Improvements for the Nation (WIIN) Program**	WIIN funding could be used to fund planning, design, and/or construction of all potential project components. Construction activities can be phased to pursue construction of different components of the Project in each 2-year funding cycle until the $20 million grant is achieved.
4	**SWRCB Clean Water State Revolving Fund (SRF) Loan Program**	EWA and partnering agencies would likely qualify for low-interest financing through the Clean Water SRF Program, which would cover construction activities up to the full project cost. Extensive application materials are necessary, including completion of CEQA and all permits.
5	**MWD Local Resources Program / SDCWA Local Water Supply Incentive Program**	The LRP and LWSIP are likely to become available to SDCWA member agencies again; however, the timeline or availability of funds is uncertain. Further, these funds only apply to the cost of delivered water, so they may only be awarded after all construction and start-up activities are complete.

5.2 Recommended Next Steps

To increase the chances of receiving funding for any future phases of EWA's water reuse project, it is recommended that EWA and any partnering agencies pursue all funding options available. In the short term, the following actions should be considered to further refine the project and position EWA and any partners for existing and future funding opportunities:

- **Partner Agreements:** EWA should identify one or more water agency partners to begin pursuing funding opportunities for the initial phases of work. Development of one or more MOUs with partner agencies may help facilitate funding pursuits by outlining roles and responsibilities.
- **WRFP Planning Grant Application**: EWA could apply for WRFP planning grant funding to support preparation of complete Feasibility Studies that, in turn, could be used in applying for additional funding as described below.
- **Clean Water SRF/WRFP and Title XVI/WIIN Feasibility Studies:** EWA should develop additional content to supplement this Study to ensure it complies with the requirements for a Clean Water SRF/WRFP and Title XVI/WIIN Feasibility Study, which would enable the project proponents to submit applications for funding with SWRCB and USBR. WRFP planning grant funding could be secured to support this effort.
- **San Diego IRWM Grant Application**: EWA could develop a package of activities that includes planning for the Water Reuse Project, as well as other capital projects at the EWPCF. If this is pursued, EWA should become engaged in the IRWM Program through RAC and stakeholder meetings.
- **CEQA Environmental Review:** Due to the construction phasing that is allowed by the WIIN and San Diego IRWM Programs, EWA might consider preparing a Program Environmental Impact Report (EIR) that addresses all facilities that may be necessary for the Project. EWA would then complete project-level CEQA through either Supplements or Addendums to the Program EIR, depending on the level of anticipated impacts for each individual project component as those are moved forward into various funding programs.
- **Clean Water SRF Application:** As an initial step, EWA could prepare and submit General Information forms to get in the queue for the Clean Water SRF. This notifies SWRCB and others that the EWA Project will proceed and provides information about expected funding needs. In turn, this allows SWRCB to lobby for additional allocations from water bonds or the Legislature. If funds become available, this could ensure EWA is in a favorable position to obtain funding (e.g., for detailed facilities planning for a first phase of the Project).
- **Pilot Phase Funding:** Once a pilot phase scope of work is determined and the Title XVI/WIIN Feasibility Study is complete, EWA could prepare applications for WIIN and San Diego IRWM funding for full-scale pilot facilities that would produce advanced treated water for potable reuse as an initial phase of the ultimate project.
- **Funding Opportunity Tracking:** Ongoing tracking of funding opportunities that may emerge and be relevant to EWA's reuse project, including attending workshops and coordinating with funding agencies to determine eligibility and define requirements for application, is essential to be ready for each opportunity as it arises.

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Attachment 6 - TM6: Stakeholder Involvement Plan

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Technical Memorandum No. 6

EWA Water Reuse Feasibility Study

Subject:	**Stakeholder Involvement Plan**
Prepared for:	Encina Wastewater Authority
Prepared by:	Ken Weinberg | Ken Weinberg Water Resources Consulting, LLC Rosalyn Prickett | Woodard & Curran
Reviewed by:	Nathan Chase, P.E., Scott Goldman, P.E. | Woodard & Curran
Date:	July 2018 (Draft Issued: December 2016)

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1 Introduction and Background

1.1 Background

As required by Encina Wastewater Authority's (EWA's) 2020 Business Plan, this Water Reuse Feasibility Study (Study) will identify a path to maximize beneficial reuse of effluent from the Encina Water Pollution Control Facility (EWPCF)—which by 2040 is projected to reach an average of approximately 31 million gallons per day (mgd).

This Study focuses on development of a portfolio of options for potential reuse projects; identification and analysis of a short list of options; development of an approach to phasing of the preferred water reuse project; identification of funding opportunities; development of a stakeholder involvement plan—the focus of this technical memorandum (TM); and coordination with EWA member agencies and other stakeholders to engage with the Study development and recommendations. Ultimately, the Study will serve to advance EWA's mission of resource recovery and contribute to sustaining and enhancing the region's water environment.

1.2 Objectives

The purpose of this TM is to develop a stakeholder involvement plan that identifies the stakeholder activities to be completed as part of this Study and provides an overview of potential next steps for the ultimate water reuse project. The TM is organized as summarized below:

- **EWA as Water Wholesaler:** this section will define EWA's role as a water wholesaler and identify the goals for water pricing to ensure the ultimate project allows full cost recovery (at a minimum) to EWA.
- **Stakeholder Identification:** this section provides a listing of local and regional stakeholders along with key contacts. Stakeholders will depend on the options that are investigated, but as a minimum are anticipated to include EWA Member Agencies, the San Diego County Water Authority, and the North San Diego County Reuse Coalition.
- **Stakeholder Outreach:** this section provides the methodology and timing for conducting stakeholder workshops as part of this Study, as well as how the outcomes of the workshops will be captured and communicated.
- **Potential Next Steps:** the final section identifies potential stakeholder activities that may be required for the next stage of the water reuse project arising from this Study, including discussion of the anticipated role for EWA.

2 EWA's Role as Water Wholesaler

Although EWA is taking the lead at this stage by developing this Water Reuse Feasibility Study, its role as a project proponent needs to be well-defined prior to engaging stakeholders. EWA would likely be the producer of recycled water, while the local water purveyors and others will ultimately control the end beneficial use. Developing the roles and responsibilities of EWA in a large-scale beneficial reuse project is critical to the formation of a business case and structure to implement a project if it is found to be technically and financially feasible.

2.1 Existing Capabilities and Drivers for Increased Reuse

EWA facilities represent a unique centralized location for large-scale production of recycled water that could capture economies of scale to the benefit of the region. The regulatory standards for beneficial use of recycled water are continuously evolving and expanding the potential market for recycled water supplies. This expanding market of permitted uses requires the availability of increased and cost-effective production of recycled water that can meet Title 22 non-potable standards or undergo advanced treatment for potable reuse under existing Indirect Potable Reuse (IPR) regulations or under future Direct Potable Reuse (DPR) regulations.

EWA's mission and core competencies are centered on the collection, treatment, and disposal of wastewater. Although authorized by its Board of Directors to be involved in developing water resources and specifically recycling wastewater for beneficial uses, EWA is not in the business of the retail distribution of recycled water. That would be outside of EWA's jurisdiction as a joint powers authority (JPA) and would require an expansion of its historic role and core competencies. Also, under California anti-paralleling laws, EWA would have significant difficulty in distributing recycled water to potential customers without the permission and cooperation of local water purveyors.

EWA's experience in water treatment and water quality may well make it suitable to take on the responsibility for the Advanced Water Treatment (AWT) required for potable reuse. The presence and availability of a deep ocean outfall is conducive to siting the AWT facility near the EWPCF. In addition, a portion of the 28 acres available at EWA's South Parcel could be used as the site of the AWT facility, which would be consistent with the requirement of utilization for EWA-mission related purposes. This is a decision EWA should thoughtfully consider and it would still be consistent with a wholesaler role.

Given the constraints discussed above and its fiduciary responsibilities to wastewater ratepayers, the most appropriate role for EWA in maximizing beneficial reuse in North San Diego County and possibly throughout the region is as a wholesaler of recycled water. This role would be similar to certain characteristics of the San Diego County Water Authority (SDCWA) role as a wholesaler of imported water and desalinated seawater to retail water purveyors.

2.2 Financial Considerations

To facilitate engagement with external stakeholders on the concept of EWA as a recycled water wholesaler, this section identifies certain aspects and financial bottom lines of that role. While EWA's relationship with its (potential future) wholesale recycled water customers will function as a partnership, it is also a business arrangement and key business issues are best defined as early in the process as possible. It is important to articulate these business features to potential retail water purveyors or other wholesale customers as wider participation in a potential reuse program is discussed.

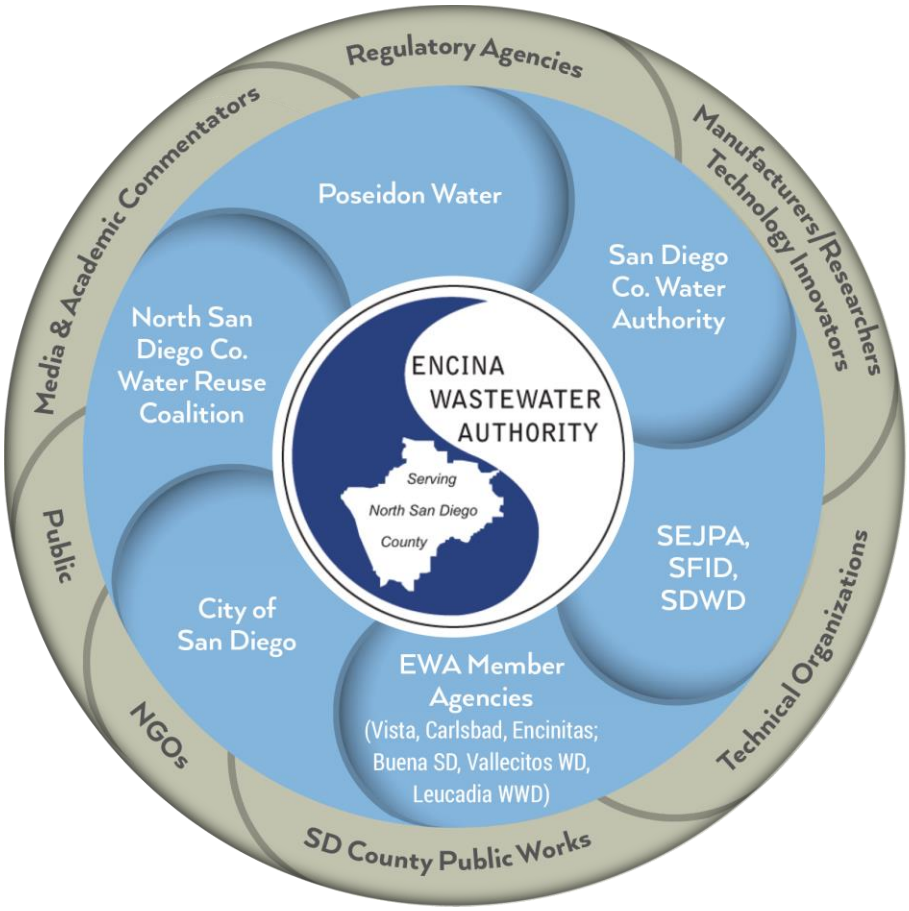
While at this early stage of feasibility analysis it may not be possible to identify all the aspects of a wholesale structure, it may be possible to develop a framework around the known bottom line positions, as well as acknowledging those deal points that EWA is open to discussing with the stakeholders concerning its role in the potential project. Aspects of a water reuse project to consider will include costs for planning, design, and construction of new facilities and improvements to existing facilities; ownership and operation of new facilities; permitting and compliance responsibilities; and financing and application for low interest loans, grants, and incentives.

EWA must consider its requirement to collect revenues for all its activities and note that the allocation of costs between wastewater ratepayers and water ratepayers will be a critical aspect of any cost responsibility and cost recovery structure. Currently, the clearest demarcation is defined by EWA's existing NPDES permit requirements. In the event those permit requirements change, or changes are made to State law limiting ocean outfall discharge volumes, additional cost allocation methods should be considered.

3 Stakeholder Identification

Through an initial stakeholder identification effort, Figure 3-1 below was developed to provide a comprehensive view of stakeholders that may be involved in the planning and implementation of potential EWA water reuse projects.

Figure 3-1: Stakeholder Diagram for EWA Water Reuse



Because EWA is at an early stage of feasibility planning and has not yet determined whether it is either cost-effective or within its organizational mission to implement a project, a focused stakeholder involvement plan is appropriate to engage only those stakeholders considered essential to the development of the Feasibility Study. Additionally, EWA's likely role as wholesale supplier of recycled water would suggest that it initially conduct a focused outreach to its potential wholesale customers and not the general public. It is the retail water purveyors that have the direct relationship with the public and input from the public will be vitally important at a future phase if a program or project advances beyond feasibility planning.

Another factor in using a targeted outreach is to avoid setting expectations among external stakeholders prior to EWA's Board of Directors (Board) determining how best to use the information arising from the Feasibility Study and deciding what, if any, future action should be taken to develop a water reuse project. As a wholesaler whose potential customers include several EWA Member Agencies, the decision on whether a project is technically and economically viable ultimately rests with both the Board and the water purveyor agencies.

3.1 Core Stakeholders for this Study

The proposed stakeholder outreach effort recognizes that neither EWA, its individual Member Agencies, nor the retail water purveyors have made any decision to move forward on what are the yet unknown results of the Study. These stakeholders are identified on the inner circle of Figure 3-1 and include both EWA Member Agencies and other entities that might be part of the projects identified in the Study's Portfolio of Options.

With the exception of the City of San Diego, the San Diego County Water Authority, San Dieguito Water District, and Poseidon Resources, these agencies are all members of the North San Diego Water Reuse Coalition (NSDWRC) and have conducted extensive planning on how to maximize the beneficial use of available recycled water supplies. This core group of stakeholders is very educated on the topic of non-potable and potable water reuse, and their expertise will allow informed discussions and decisions by all the parties to proceed expeditiously. Their participation is also critical because many of the NSDWRC partners have invested in their own recycled water treatment and conveyance facilities, and it will be important to ensure that those assets are not stranded in the future. Definition of the EWA wholesale market will need to make sure that existing demands and users are not double-counted.

3.2 Regulatory Agencies

Although beyond the scope of the current Feasibility Study, discussions with regulatory agencies will be an important part of any future stakeholder outreach. Informal discussions with regulatory agencies during the Feasibility Study may be beneficial to better evaluate the feasibility of the Options being considered as they are an important participant and source of critical information. Water reuse opportunities are constrained by the existing or anticipated regulatory environment, and the water purveyor(s) will be identified through determining the best means of complying with the regulatory scheme in a cost-effective manner.

In the event that additional studies and project development activities occur following the completion of the Feasibility Study, the San Diego Regional Water Quality Control (Regional Board) and the State Water Resources Control Board's Division of Drinking Water (DDW) should be considered major stakeholders to be engaged in those future technical discussions.

3.3 EWA Board of Directors

The EWA Board of Directors (Board) is also a primary stakeholder in this process as they are the final evaluators of the Study and whether EWA will move beyond the feasibility planning stage. Providing updates and opportunities for discussion of strategic and business issues during development of the Feasibility Study will help keep the Board engaged in the process. The Board's input will be critical to the results of the Study and key features of EWA' s relationship with the water purveyors.

Board involvement should be concurrent with the core stakeholder outreach activities and is expected to be accomplished through two Board workshops. It is recommended that a Board workshop be scheduled following each stakeholder workshop. In this way, the Study Team will be able to provide the Board with the input received from the stakeholder discussions regarding the progress of the Feasibility Study and related policy issues, along with the technical advancements of the Study. This approach will provide opportunities for the Board to give input into Study development and will familiarize the Board with the key policy issues prior to hearing the final results and EWA staff recommendations.

4 Stakeholder Outreach

4.1 Initial Outreach to Member Agencies

The initial outreach activity was directed at EWA Member Agencies through a letter from EWA's General Manager to each individual Member Agency informing them of the commencement of this Feasibility Study and requesting confirmation of current data relating to existing recycled water commitments, treatment capacity, peak demand estimates, and future plans for indirect potable or direct potable reuse (see Table 4-1). This information is critical to the development of the Portfolio of Options.

Table 4-1: Summary of Initial Outreach Letters Sent and Responses Received

Agency	Date of Letter from EWA	Date of Agency Response
City of Carlsbad	10/28/2016	11/22/2016
City of Encinitas	10/28/2016	N/A
Leucadia Wastewater District	10/28/2016	10/31/2016
Vallecitos Water District	10/28/2016	N/A
City of Vista / Buena Sanitation District	10/28/2016	10/28/2016
Vista Irrigation District	10/31/2016	11/3/2016

In addition to the letters, a presentation was made to the Member Agency Managers on November 1, 2016 to brief them on the Feasibility Study and discuss the initial Portfolio of Options, as well as the planned stakeholder activities.

4.2 Stakeholder Workshops

It is recommended that subsequent outreach to stakeholders will consist of the following:

- Two workshops, where collectively the local water purveyors will work with EWA staff and the Study Team to review the progress of the Feasibility Study and provide feedback on the initial recommendations.
- One-on-one technically-oriented meetings, as needed, where specific project alternatives will be refined in partnership with the potential water purveyor.

Because the NSDWRC is an established structure, it will provide a useful vehicle for advancing the goals of the Feasibility Study and integrating the local water retailers into the process. The NSDWRC meets regularly and their meetings present an ideal venue to hold workshops and achieve a high level of stakeholder participation.

Study Team members presented an overview of the Feasibility Study and the outreach approach to the NSDWRC at their November 7, 2016 meeting. It was agreed that the December monthly meeting would be used to conduct Workshop 1. Along with the NSDWRC, representatives of the City of San Diego and the SDCWA were also invited to attend the same meeting. At the current stage of analysis, the alternatives involving Poseidon are not considered to be favorable compared to other alternatives; therefore, Poseidon is not being considered for targeted outreach at this time.

4.2.1 Workshop 1: Portfolio of Options

The goals of Workshop 1 will include achieving stakeholders' familiarity with the Study Team, understanding EWA's desire to complete the Feasibility Study with input from the local water purveyors, provide an overview of technical approach to the Feasibility Study, and to present the technical details around the Portfolio of Options and the process used for selecting a "shortlist" for further consideration. Another goal of Workshop 1 is to begin the conversation of what a water reuse partnership between EWA and the water purveyors could look like. This will be the initial identification of a business structure.

The agenda for Workshop 1 will include the following:

- **Introduction of Feasibility Study and Historical/Regional Context**
  - Emphasize EWA's desire to obtain feedback from the local water purveyors to develop the best alternatives possible and to identify what if any next steps should be taken.
- **Overview of the Study's Technical Approach and Schedule**
  - Build on work done by NSDWRC
  - Process for identifying and screening reuse opportunities
  - Regulatory context and assumptions for potential project timing and phasing
- **Discussion of EWA's Role in Maximizing Reuse**
  - Indicating EWA's initial positions relative to how the business relationship can be structured.
  - Discussion of cost responsibility assumptions, ownership of facilities and permit responsibilities. EWA Member Agencies will be in attendance at the Workshop and will be representing their agency's wastewater and water supply interests, as applicable.
- **Discussion of the Study's Portfolio of Options and Ranking**
  - Describe the range of alternatives and potential timing of implementation.
  - Seek a consensus through group discussion on the initial screening criteria and the highest ranked alternatives.
- **Action Items, Next Steps, and Overview of Workshop 2**

4.2.2 Workshop 2: Best Option and Phasing

The purpose of Workshop 2 will be to present the Preferred Option of water reuse projects to potentially develop further for future consideration. Workshop 2 will begin with a review of what was accomplished in Workshop 1, including any updates to the Portfolio of Options, screening criteria, and ranking.

The Study Team will present its evaluation of the options and how it arrived at the Preferred Option and suggested phasing. As part of Workshop 2, the Study Team will review cost estimates, cost estimating methodology, and provide a financial analysis of the option's annual capital and operating costs. The financial analysis will also include identification of potential funding options that can reduce the cost to EWA and water purveyor ratepayers. It is important to note that the financial analysis will not include cost allocation approaches between wastewater and water agencies.

The agenda for Workshop 2 will include the following:

- **Portfolio of Options Screening Criteria Review**
- **Refinements to Preferred Option(s)**
- **Financial Analysis**
  - Overall Cost per acre-foot
- **Stakeholder Input Requests**

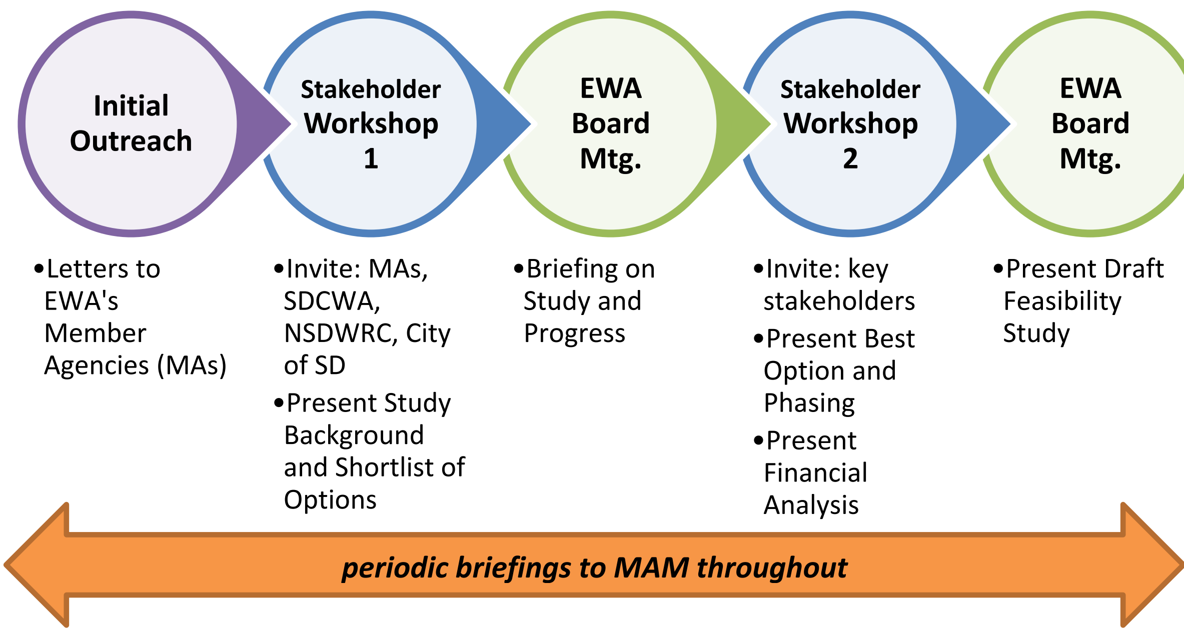
- Review of draft Feasibility Study results
- Encourage attendance at the EWA Board meeting where the Study will be presented to demonstrate their engagement and support

4.3 Timeline of Stakeholder Activities

Following completion of Workshop 2 and finalization of the Study's technical memoranda, the Study Team will prepare a final draft Feasibility Study for EWA review.

The final Feasibility Study and any recommendations should have the engagement and support of the retail water agencies. Ideally, presentation to the Board of the final Feasibility Study should include comment letters supporting the Feasibility Study and recommended next steps by one or more of the water agencies' General Managers. Figure 4-1 below depicts the sequence of stakeholder activities.

Figure 4-1: Timeline of Stakeholder Activities



Expressions of Support

Ahead of the EWA Board Meeting at which the Draft Feasibility Study was presented, a letter of support was received from the General Manager of Olivenhain Municipal Water District (OMWD (see Appendix A). At the meeting itself, the General Manager of San Elijo Joint Powers Authority (SEJPA) made a public comment in support of the Feasibility Study, thanking EWA's Board of Directors and staff for their leadership on this Study. Both OMWD and SEJPA are members of the NSDWRC.

5 Next Steps

In the event that the Board authorizes EWA staff to continue planning and permitting activities beyond the Feasibility Study, future stakeholder outreach should be focus on developing a formal partnership with the water purveyor(s). Defining EWA's role in the post-Feasibility Study timeframe will be key to any implementation plan of wider reuse of EWA's valuable water resources. It will invite continued discussions with its potential partners, the retail water agencies, and could involve significant policy and financial deliberations by its Board and Member Agencies.

5.1 Memorandum of Understanding

An early step in the future stakeholder process could be development of a Planning Memorandum of Understanding (MOU) between EWA and the participating water purveyor(s). The Planning MOU would focus on roles, responsibilities and potential cost sharing between EWA and the partner agencies for additional planning work. It could also identify joint stakeholder outreach activities for a potential project, which will include additional entities shown in

that were not formally engaged in the Study phase.

The Planning MOU would define the mutually agreeable next steps for project development. Some of the key aspects for EWA to consider in defining its future role in a Planning MOU could include:

- Willingness to cost-share with partnering agencies for the next round of studies to move projects forward with potential for EWA receiving reimbursement later.
- EWA can offer to fulfil an administrative role on project implementation, especially with regard to AWT and conveyance infrastructure, permitting and zoning, water treatment operations expertise, construction management, etc.
- Future regulatory changes may have a major impact on EWA's role (e.g., a bill by Senator Hertzberg mandating reduction in ocean discharges of treated wastewater). This may require a more active and phased approach to EWA's role that can be considered in future planning efforts.

Appendix A – Letter of Support

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OLIVENHAIN
Municipal Water District

April 24, 2018

Michael Steinlicht, General Manager
Encina Wastewater Authority
6200 Avenida Encinas
Carlsbad, CA 92011

Re: Support for Water Reuse Feasibility Study

Dear Mr. Steinlicht,

On behalf of Olivenhain Municipal Water District, I am writing to express our support for the Water Reuse Feasibility Study that explores the development of potable reuse options for Encina Wastewater Authority.

As Southern California's population continues to grow, the need for local sources of water is also increasing. Recycled water and potable reuse are emerging as logical solutions to safeguarding adequate water supplies regardless of weather conditions. The Water Reuse Feasibility Study outlines forward-thinking strategies to maximize the area's resources and improve local water supply reliability and drought resilience. Reclaiming wastewater for potable and non-potable uses is both an economical and sustainable choice in a region dependent on water imported from faraway sources.

OMWD appreciates that EWA has employed extensive outreach during the study process, keeping the community and stakeholders engaged every step of the way. In accordance with this level of outreach, we suggest that a presentation be given at the next San Diego County Water Authority General Managers' meeting once your board has considered this study.

EWA is uniquely suited to benefit water agency partners across the county thanks to its centralized location and experience in large-scale wastewater treatment. OMWD stands as a strong supporter of EWA's efforts to invest in future water supply reliability through water reuse, and offers its assistance in vetting this project.

If you or your staff have any questions about our assessment of the Water Reuse Feasibility Study, please do not hesitate to contact me at 760-753-6466 or kthorner@olivenhain.com.

Sincerely,

Kimberly A. Thorner

Kimberly A. Thorner
General Manager

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WOODARD
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