PREPARED FOR:

PALMDALE WATER DISTRICT

PURE WATER
ANTELOPE VALLEY
A Palmdale Water Project

Final Report

Program Priorities and Implementation Plan

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1.0 Introduction

Stantec was retained by the Palmdale Water District (PWD) to provide program management services for its regional water augmentation program, referred to as Pure Water Antelope Valley (Pure Water AV) or Program. Using advanced treatment processes including microfiltration, reverse osmosis (RO), and ultraviolet light with advanced oxidation, Pure Water AV will further purify tertiary treated (Title 22) wastewater to produce water that will meet all applicable state and federal drinking water standards and regulations. This purified water will be injected into the local groundwater aquifer, thereby supplementing PWD's existing water supplies. Pure Water AV is intended to provide safe and reliable drinking water for Antelope Valley.

As part of the program management services contract, several planning studies have been completed to better define the Pure Water AV Program. This document provides a summary of major project components and identifies drivers, risks, and critical milestones necessary to fully implement the Program, based on current, available information. The findings and conclusions within this document may updated as additional information on the program becomes available.

1.1 Program Background and Drivers

PWD has been providing water service to its customers since 1918 when the Palmdale Irrigation District was formed. Due to extensive agricultural use, the Antelope Valley groundwater basin has been in an overdraft condition since the 1930s, resulting in land subsidence. In 1973, Palmdale Irrigation District changed its name to Palmdale Water District (PWD). In 2012, the Palmdale Recycled Water Authority (PRWA), comprised of members from the City of Palmdale and PWD, was established to manage recycled water that is generated and used within the Palmdale area for landscape irrigation. PRWA manages the distribution of recycled water, designing and constructing support facilities and financing efforts.

PWD has conducted a number of studies that date back to as early as the 1990s to evaluate the water resources necessary to meet future water demands. Concepts evaluated to date include using recycled water for landscape irrigation, discharging into existing sand and gravel pits where the recycled water would replenish the groundwater basin naturally, and groundwater recharge (GWR) through the use of recharge basins (i.e., Palmdale Regional Groundwater Recharge and Recovery Project). Based on the Littlerock Creek Groundwater Recharge and Recovery Project Feasibility Study (Kennedy Jenks, 2015), the average infiltration rate was expected to be 9.4 feet per day (fpd) in the northern region and 12 fpd in the southern region for the proposed sites. A series of subsequent pilot studies showed less than half of the original estimated recharge volume was realized, which challenged the feasibility of this alternative and prompted PWD to investigate other sources and approaches to augment existing water supplies.

1.2 Study Background and Objectives

Following the pilot studies for surface spreading, PWD hired Stantec to conduct a feasibility study on other potable reuse alternatives including indirect and direct potable reuse. The study concluded that indirect potable reuse by groundwater augmentation via direct injection is the most economical alternative for potable reuse and can be implemented based on existing regulations. The objective of this report is to define the Program and describe strategies for its successful implementation.

1.3 Study Area

PWD is located within the City of Palmdale, in Los Angeles County, CA. PWD provides service to an area of approximately 40 square miles to the City of Palmdale and unincorporated areas in Los Angeles County as shown in Figure 1-1. The service area is located in the Antelope Valley Groundwater Basin (AVGB) within the Lahontan Region. Covering parts of Kern, Los Angeles, and San Bernardino counties, the AVGB is located at the western end of the Mojave Desert in southern California. It is topographically closed with respect to surface water outlets and was formed by alluvial deposits filling a structural depression resulting from tectonic activity in the area. The AVGB is bounded on the northwest by the Tehachapi Mountains and the Garlock Fault Zone on the north and east by a series of low hills, ridges, and buttes, and on the south by the San Gabriel Mountains and the San Andreas Fault Zone. Groundwater flow is confined to the AVGB, except at the far northeastern end, where a small amount of groundwater flows into the Fremont Valley Basin. Figure 1-2 shows a regional map of the AVGB.

The entire PWD service area is designated as a large, disadvantaged community by the California State Water Resources Control Board (SWRCB), with a calculated median household income of $55,129. According to the Census Bureau, 15.8% of Palmdale residents live below the federal poverty line, 80% identify as people of color, and 47% speak a language other than English at home. The Environmental Protection Agency (EPA) Environmental Justice indices show Palmdale as above the US 90th percentile for multiple pollutants and above the US 80th percentile for multiple socioeconomic characteristics.

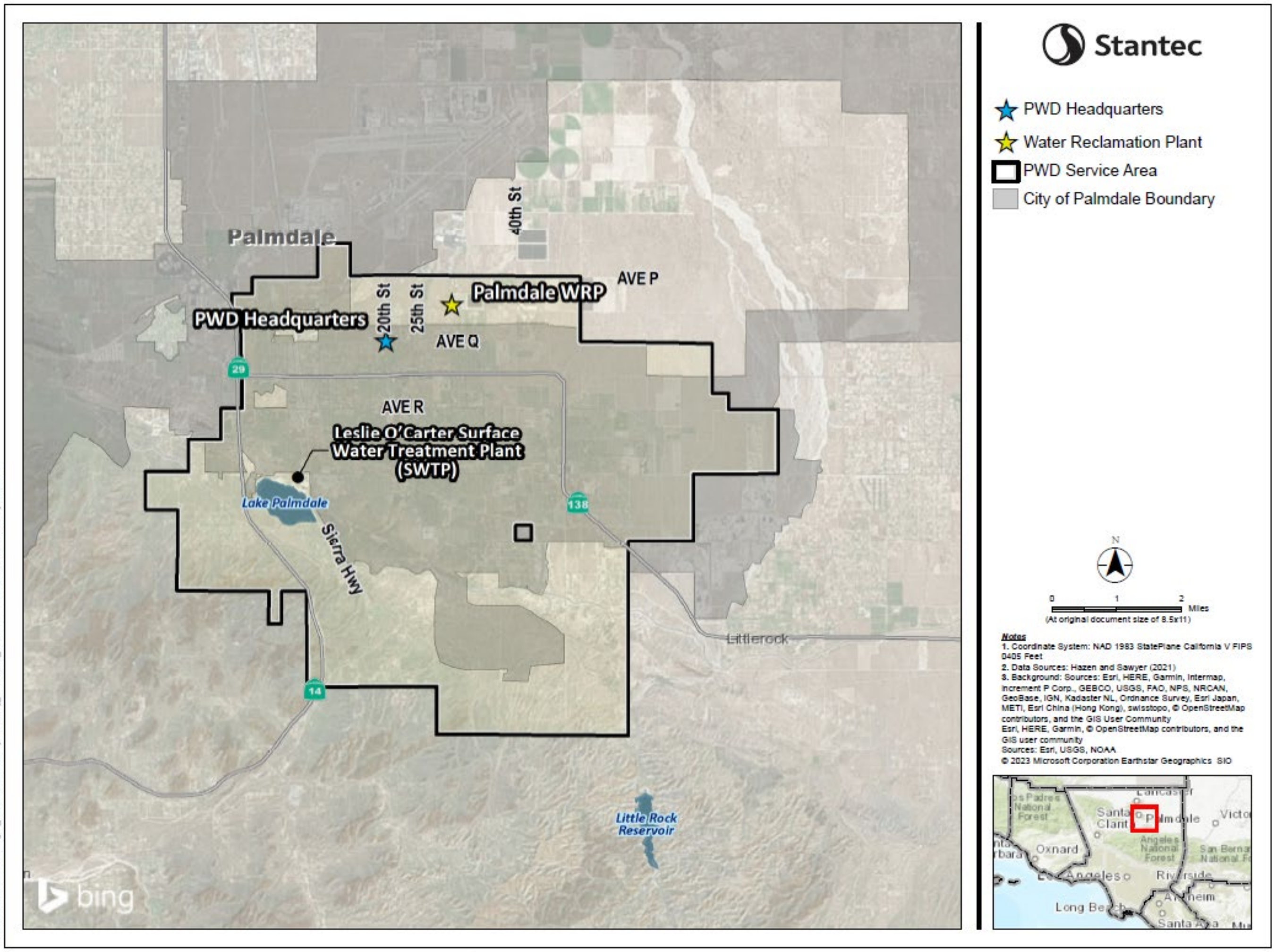

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Figure 1-1. Pure Water Antelope Valley Program Area

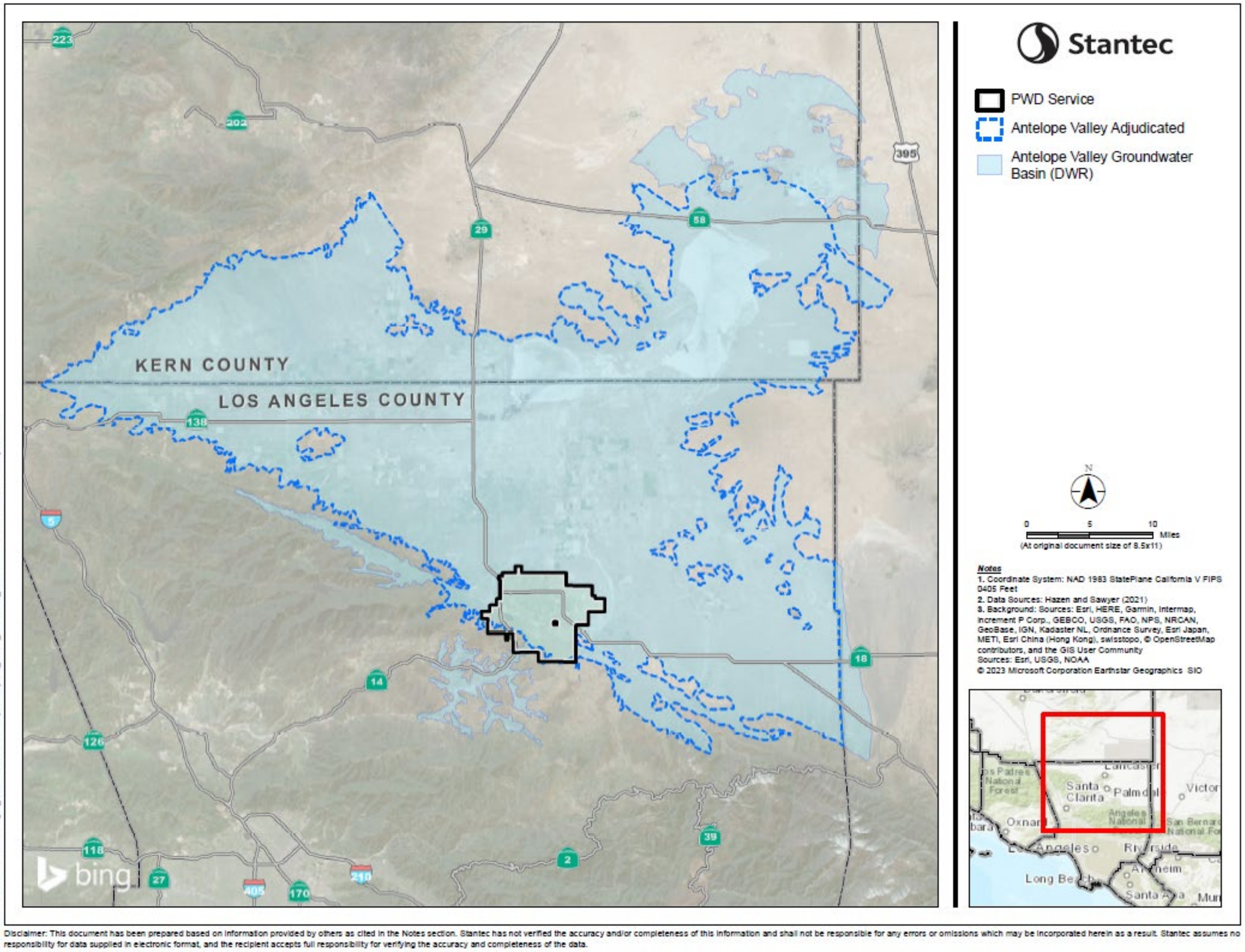


Figure 1-2. Antelope Valley Groundwater Basin

1.4 Report Structure and Content

- **Section 1 –** Introduction: Provides the Program background and drivers as well as study background and objectives.
- **Section 2 –** Study Approach: Describes the overall approach to the initial planning efforts of the Program.
- **Section 3 –** Program Components and Locations: Describes key project components including the advanced water purification facility, conveyance infrastructure and groundwater injections wells.
- **Section 4 –** Funding Strategy: Provides an overview of the potential funding sources and associated funding requirements recommended for the Program.
- **Section 5 –** Project Component Packaging and Delivery Methods: Provides recommendations for the delivery of Program components.
- **Section 6 –** Economic Impact Assessment: Provides an overview of the economic impacts of the Program on the surrounding communities.
- **Section 7 –** Regulatory Approval Approach: Describes the actions that will be taken to achieve regulatory approval along with continuous regulatory engagement.
- **Section 8 –** Public Outreach Strategy: Describes the overall public outreach approach of the Program.
- **Section 9 –** Environmental Studies and Permit Requirements: Provides an overview of the anticipated environmental and permitting requirements for the Program.
- **Section 10 –** Cost Estimates: Provides a summary of the estimated capital cost, the estimated operation and maintenance cost, and net present value analysis.
- **Section 11 –** Master Program Schedule: Provides an overview of the Program schedule components.

1.5 Acknowledgements

This document and its content were developed in close collaboration with PWD staff. We would like to thank them for their guidance, participation, and contributions including meeting attendance, document review, response to questions, and data inquiries throughout the development of this document.

2.0 Plan Approach

The Program Priorities and Implementation Plan (PPIP) is meant to be the framework to guide the implementation of the Pure Water AV Program in a cost-effective manner, using an expedited schedule, all while producing high-quality deliverables for the Program. Prior to project implementation, a multi-step approach was developed, as shown in **Figure 2-1**, to evaluate major project components, define project objectives, and provide a comprehensive implementation plan to PWD. The following subsections describe the approach used for each major task undertaken in developing the PPIP. Details on the results and recommendations from each task are provided in subsequent sections.

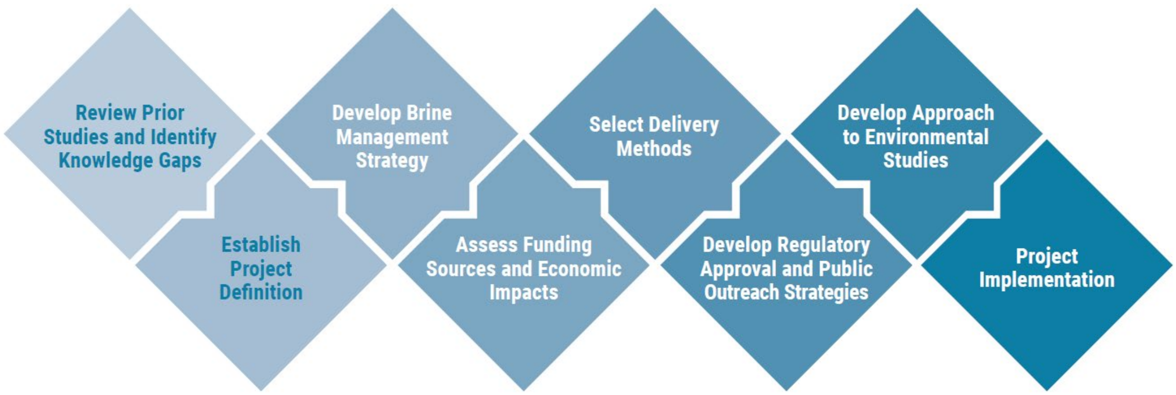


Figure 2-1. Program Priorities and Implementation Plan Approach

2.1 Review Prior Studies and Identify Knowledge Gaps

PWD has been planning for the use of recycled water within its service area for over twelve years. Significant progress towards implementing expanded use of recycled water has been made through various planning efforts including planning studies, environmental impact assessments and feasibility studies. PWD provided data and reports, including regulatory documents, master plans, environmental reports, groundwater modeling projects, existing and future wells characterization, plans and process information for the Los Angeles County Sanitation District (LACSD) 20 Palmdale Water Reclamation Plant (PWRP), as well as annual operating budgets and other financial information. The timeline for major studies and/or milestones that led to the Pure Water AV Program are shown in **Figure 2-2**.

To assess data gaps between the existing information available versus the information necessary for full Program implementation, data made available and previously prepared reports provided by PWD were reviewed and summarized into a Rapid Program Readiness Assessment Technical Memorandum (TM) (**Appendix A.1**). The assessment was used to evaluate and identify additional studies, data and/or analyses needed to supplement the existing studies. The findings and data gaps of these prior work efforts are discussed in more detail within this report. The workplan developed for the Pure Water AV Program is anticipated to fill the major data gaps and thereby pave the way for successful implementation of the Program.

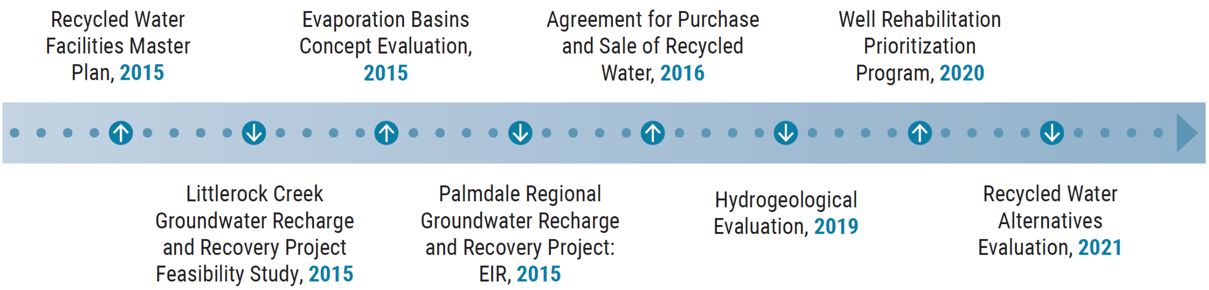


Figure 2-2. Important Milestones Leading to Pure Water AV

2.2 Establish Project Definition

The tertiary effluent characteristics and available flow, treatment capacity and process configuration, as well as location of treatment, conveyance, and injection well infrastructure, have to be established to define the project to a point where subsequent tasks can occur. As part of this effort, the available tertiary effluent flow and characteristics from the PWRP were reviewed to confirm the capacity of the full-scale advanced water purification facility (AWPF).

To determine the process configuration and treatment/conveyance infrastructure, potable reuse alternatives for the Program were also evaluated and the most suitable alternative was recommended. Defining the process configuration also helps develop the Program cost as well as funding and regulatory approval strategies.

Additionally, preliminary siting of major project components was undertaken with the intent of minimizing the project footprint, assessing procurement/use feasibility, and estimating the cost of land acquisition, as well as examining the potential to reduce conveyance costs. Additional consideration in the analysis was to select a site for the full-scale AWPF that would not restrict future expansion. Based on this analysis, the full-scale Pure Water AV AWPF will be located approximately 1,100 ft north of the intersection of 25th Street E and Avenue Q, approximately 0.5 miles from PWD headquarters.

2.3 Develop Brine Management Strategy

Reverse osmosis is a key treatment component of the AWPF and is important for salinity management and for its ability to reject pathogens and trace constituents. However, RO treatment generates a continuous brine (waste) stream for disposal, which is a planning consideration for inland systems where ocean disposal of the brine is not available. Given that Pure Water AV is located in an arid inland region, brine management is a key issue for the overall cost, conceptual viability, and operability of the project. An evaluation of brine management options to provide a cost-effective strategy for Pure Water AV was conducted and summarized in **Appendix A.4**. From this analysis, the use of brine evaporation ponds was recommended.

To reduce the footprint and the cost of constructing evaporation ponds, it is important to minimize, to the extent reasonable, the generated brine volume. Thus, selecting the highest practical RO recovery is an important strategy to reduce brine (**Figure 2-3**). This impacts the overall facility's footprint, cost of construction, and annual operations and maintenance. The chemistry of the RO concentrate was also considered, such as saturation levels of common scaling compounds, including silica, calcium carbonate and calcium phosphate, which were analyzed using scaling models. The results were first used to establish a minimum target RO recovery as a baseline. High recovery targets using advanced secondary RO systems, such as closed-circuit desalination RO (CCRO) and flow reversal RO (FRRO), were evaluated to perform a cost-benefit analysis and compare with the baseline scenario. Passive evaporation ponds were designed per the outcome of the analysis to accommodate the projected brine discharge with different recovery scenarios. Cost of the alternatives was analyzed to determine optimal mix of high-recovery RO systems and brine disposal concepts. To better define the process feasibility, design criteria, and system costs for the full-scale facilities, the Pure Water AV demonstration plant will test high-recovery RO systems in connection with brine management.

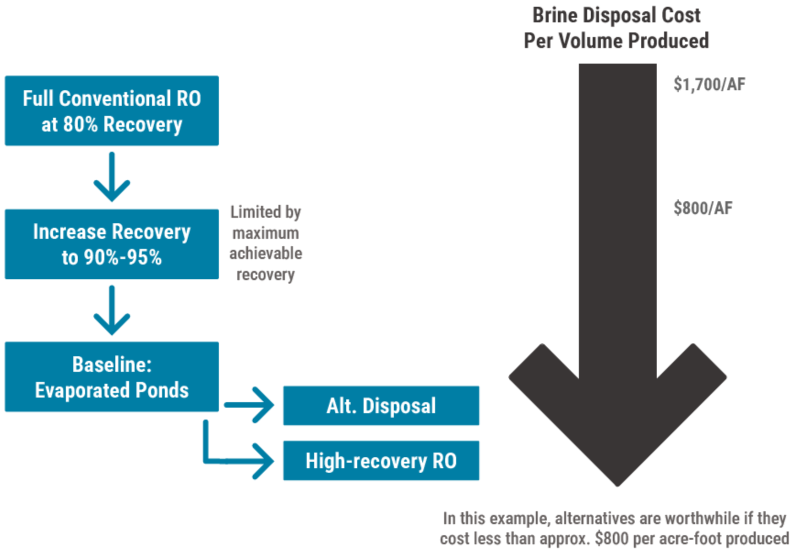


Figure 2-3. Approach to Analyze Brine Management Alternatives

The demonstration plant will also evaluate another brine management solution provided by Capture6, which is a novel technology for carbon dioxide removal via direct air capture (DAC). It utilizes RO brine to generate a solvent to extract carbon dioxide from the atmosphere. In aqueous form, the carbon dioxide is converted to carbonate which makes it stable for long-term storage. Such conversion also allows precise calculation of carbon dioxide removed, which is important to secure federal and corporate incentives for carbon removal. By realizing the ancillary benefit of DAC, additional treatment of the brine through the Capture6 process may become viable and would eliminate the need for evaporation ponds. Through data collected from testing and operations of Capture6's technology, PWD will determine the final strategy for brine management of the full-scale AWPF.

2.4 Assess Funding Sources and Requirements

The implementation costs for Pure Water AV Program are substantial and include a significant construction cost component. There are, however, a number of relevant and available federal, state, and local funding programs that have the potential to provide assistance with funding. The initial steps in developing a funding strategy are to identify funding opportunities available, evaluate for relevance to the Pure Water AV Program, and assess for likelihood of procurement success. Based on the identified funding sources, a preliminary strategy for phasing the Pure Water AV Program and schedule for application preparation, submission, and compliance has been developed to target funding opportunities well suited for the Program, as detailed in Section 4.0. As more funding programs are identified, this assessment process is sufficiently flexible to allow for updating with future funding opportunities.

2.5 Select Delivery Methods and Packaging for Program Components

A key consideration for the Pure Water AV Program is the program component delivery method assessment, which considers the complexity, time constraints and risk of each Program component and identifies a suitable approach for Program implementation. The project delivery methods available and utilized in the water/wastewater marketplace range from traditional Design-Bid-Build (DBB) to Alternative Project Delivery (APD) methods such as Design-Build (DB), Progressive Design-Build (PDB), and Construction Management at Risk (CMAR). The project delivery method selected for a particular project is dependent upon a number of factors, such as legality of the delivery method for the entity in question, the goals of the project, the project schedule, and cost.

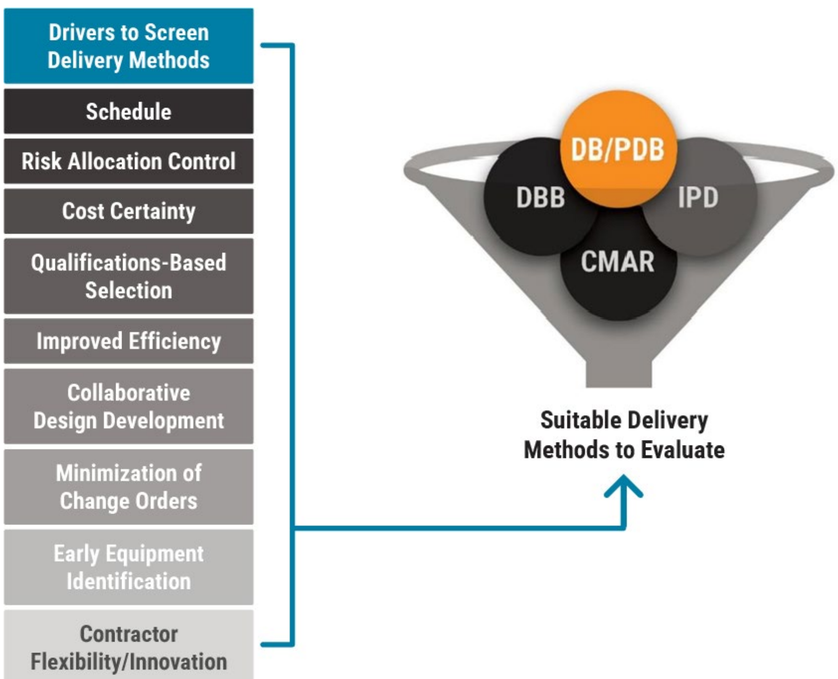


Figure 2-4. Drivers for Delivery Method Selection

A workshop was held on June 14, 2022 with PWD staff to discuss the key project drivers and selection criteria, merits of different delivery methods, and assist PWD in selecting methods for each Program component. A summary of the recommendations based on the outcome of the workshop is provided in **Section 5.0**.

2.6 Assess Economic Impact of the Program

An economic impact analysis is utilized to capture the multiplier effects resulting from the direct impact of a project (such as investment in materials, jobs, etc.), and to estimate the indirect impacts (on industries supporting the project) and induced impacts (due to the increased economic activity) of a project. The inputs for such an analysis include construction costs, estimated fulltime equivalent employees, operations costs, and approximate salaries for jobs created during different phases of a project's life cycle. The economic impact assessment for the Pure Water AV Program will give PWD and its stakeholders insight into the overall economic effects of the Program on the surrounding communities to better understand added benefits of the project.

2.7 Develop Regulatory Approval Strategy

Identifying permitting requirements and obtaining timely regulatory approvals are key for successful Program implementation. These approvals have to be coordinated with appropriate deadlines for funding applications. Preparing an initial permitting matrix will help identify a list of required permits throughout the duration of the project along with continuous regulatory engagement, as major project facilities become operational. Major known regulatory approvals include waste discharge requirements, brine discharge permit, and Title 22 Engineering report.

2.8 Initiate Groundwater Modeling Efforts

Groundwater modeling is a key component for the Pure Water AV Program to better understand groundwater flow directions and gradients. Information developed will be used to confirm travel times and provide confidence in the use of groundwater recharge by direct injection. Existing general groundwater models that adequately represent the project area without significant modification were not available for this effort. Thus, a project-specific groundwater flow, particle track and solute transport model was required to reproduce groundwater flow conditions, injected water flow directions, dilution rates, and travel times to nearby pumping wells. This information was used to evaluate alternate injection wellfield and monitoring network designs that meet regulatory requirements. Groundwater modeling work began immediately after the start of the project and will continue through the pilot testing for groundwater injection and groundwater monitoring phase, while utilizing the data from the field to update the model concurrently.

To obtain regulatory approval for groundwater injection, the response retention time must be two months at minimum. Starting at two months, for each month of retention time underground, one log removal value (LRV) of virus can be granted to the project, thus potentially obtaining from two to six LRVs. The regulations require that travel time needs to be adjusted based on the accuracy of the method used to estimate groundwater injection. For example, the use of Darcy's law to estimate travel time, qualifies for 25% response time credit. Similarly, numerical groundwater flow and transport models can receive a 50% travel time credit. The later methodology was applied for the Pure Water AV Program to evaluate the injection sites and maximize the time credit. Site-specific data was used to evaluate the feasibility of direct injection for the Pure Water AV Program and estimate the minimum travel time from the injection well sites to the potable water extraction wells.

2.9 Develop Public Outreach Strategy

Building on PWD's existing outreach activities and leveraging the prior efforts for the groundwater recharge and recovery efforts, a new public outreach strategy was developed to assist the Program in moving towards successful implementation by gaining stakeholder and public acceptance. Public outreach activities will include a programmatic communications plan and talking points, content for the dedicated Pure Water AV website, newsletter and social media, in-person tour development and support, virtual tours, and community meetings.

2.10 Strategize Approach to Environmental Studies and Clearances

It is critical to identify all environmental documentation, permits, and clearances required prior to project implementation and the strategy for their procurement. This will assist with identifying the appropriate California Environmental Quality Act (CEQA) processes for the project along with initial studies including air quality, biological resources, cultural resources, noise, water resources, traffic, and Cortese list (i.e., Hazardous Waste and Substances Sites List). Documenting environmental investigations, including field surveys, provides a focus on environmental issues that may present a fatal flaw to successful regulatory permitting or that could become major schedule constraints.

3.0 Potable Reuse Alternatives

The regulatory framework governing potable reuse was assessed to determine requirements that specifically pertain to the alternative scenarios under consideration for PWD in terms of both indirect and direct potable reuse applications (IPR/DPR). After analyzing the benefits and drawbacks for each potable reuse alternative, a final recommendation was made (**Appendix A.3**).

From the IPR alternatives analyzed, only GWR by direct injection and surface water augmentation (SWA) were judged viable. DPR regulations are under development in California and are expected to be formalized by the end of 2023. As such, the two forms of DPR, (1) raw water augmentation (RWA) and (2) treated water augmentation (TWA) were evaluated. The alternatives considered in this analysis are illustrated in **Figure 3-1**.

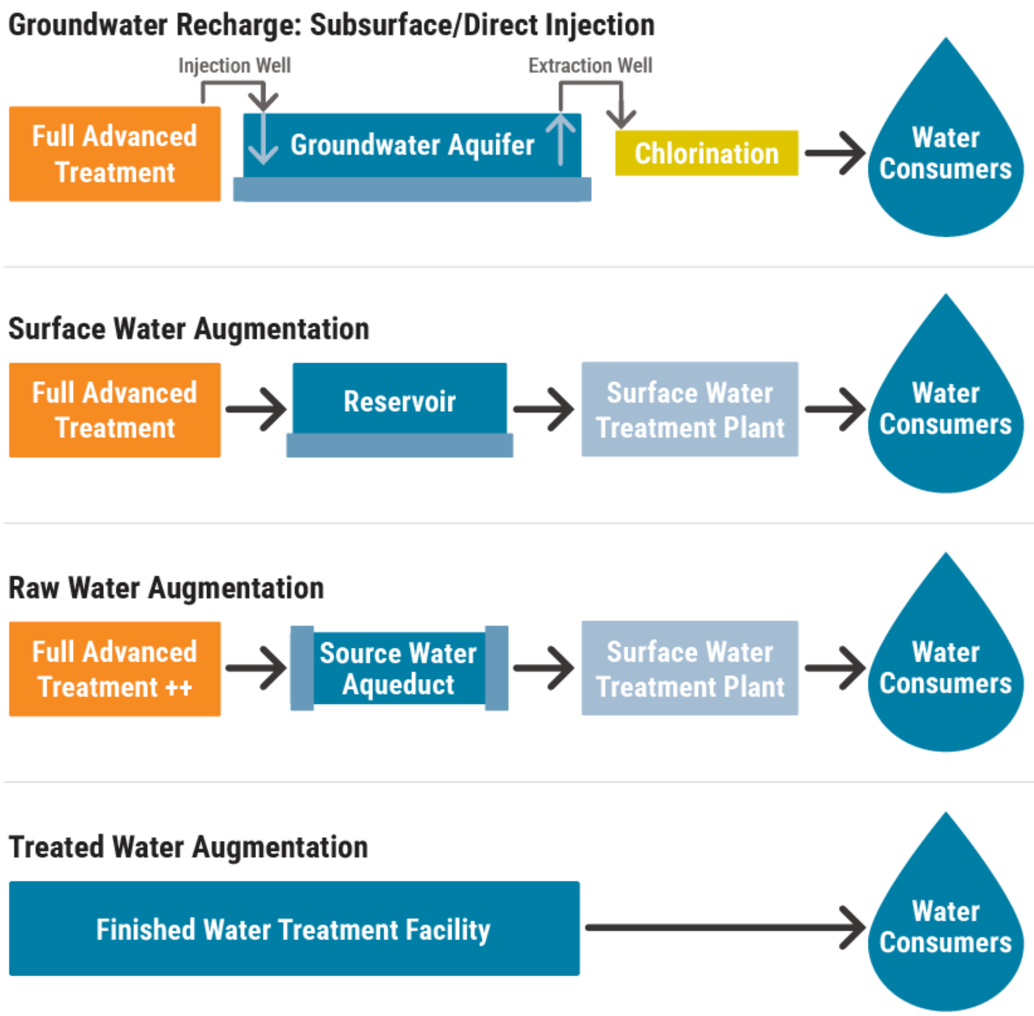


Figure 3-1. Evaluated Potable Reuse Alternatives

The benefits and challenges for all potable reuse alternatives considered in the analysis are summarized in **Table 3-1** below.

Table 3-1. Potable Reuse Alternatives – Advantages and Challenges

Criteria	GWR via subsurface injection	SWA	DPR (RWA/TWA)
Advantages	• Increases groundwater supply for drinking water use • Lower costs (capital, O&M) • Small footprint • Less treatment processes, less complexity • Well established statewide	• Increases surface water supply for drinking water • Small footprint • Relatively new to the state, but current projects are actively pursuing this alternative • Potential capital costs comparable to GWR via direct injection, but more stringent regulations may require additional planning effort (e.g., CTR compliance)	• Adds additional source of water supply, increases drought resiliency • Can be used when IPR alternative(s) cannot meet the dilution and/or retention time requirements (RWA) • Can add a source of water directly into the distribution system (TWA)
Challenges	• Studies and modeling required to determine if groundwater flow and hydrogeology parameters are adequate to meet retention time and dilution requirements • Must meet BPOs limits	• Modeling required to determine if reservoir volume and flows are adequate to meet required dilution • Studies and modeling required to determine if hydrology parameters are adequate to meet retention time requirements • AWPF treated water must comply with CTR, unless a mixing zone (dilution factor) is studied and approved by the RWQCB	• Most expensive alternative (capital, O&M, permitting, monitoring, reporting, etc.) • Largest treatment footprint • Most treatment processes, increases operational complexity • New to the state (regulations have not been finalized, no permitted projects) • More intensive, broad, and higher frequency monitoring required • Requires higher degree of inter-agency coordination, technical, financial, and management capacity (more efforts for source control, sewershed monitoring, faster response to failure) • More frequent reporting (monthly versus annually)

Key:
AWPF = advanced water purification facility
CTR = California Toxics Rule
DPR = direct potable reuse
GWR = groundwater recharge
IPR = indirect potable reuse
O&M = operations and maintenance
RWA = raw water augmentation
RWQCB = Regional Water Quality Control Board
SWA = surface water augmentation
TWA = treated water augmentation

From the alternatives presented herein and based on an evaluation of the advantages and challenges described above, GWR via direct injection provides the most straightforward and economical implementation of potable reuse. In a GWR application, retention time of water in the ground provides additional treatment, pathogen abatement, chemical dilution, and an environmental buffer to reduce the treatment infrastructure. Because of its simplicity compared to the other potable reuse options and the number of similar projects implemented in the State of California, the permitting process for GWR via direct injection is straightforward. This IPR application has been regulated for almost a decade and this approach is well established in California, with many water utilities employing it.

Overall, any potable reuse project will decrease PWD's reliance on water imported from other institutions and associated infrastructure. In the case of GWR, the project will add a reliable source of water to the public while also potentially working as storage to offset long-term drought or water supply variations. This will diversify the region's long-term water supply source and increase PWD's groundwater pumping rights. Additionally, the safe yield of the AVGB may be increased if the stored groundwater is not fully utilized each year, although this is not guaranteed. GWR via direct injection would be subject to routine monitoring and reduction requirements to meet Title 22 California Code of Regulations (CCR) mandates and Salt and Nutrient Management Plan (SNMP) limits, which will improve the water quality by providing highly purified water.

Using GWR via direct injection, the AWPF facility, using the planned processes, will meet all Title 22 water quality goals based on the current PWRP tertiary effluent water quality. The only factor that could affect this alternative's implementation is the theoretical retention time that the aquifer provides. However, preliminary results of the groundwater modeling indicate that groundwater injection is a viable option, as discussed further in **Section 4.4**. Additional data gathering and modeling may be performed to increase the confidence of the model and the resulting travel and retention times.

4.0 Program Components

The following section summarizes the components of the Pure Water AV Program, including:

- Tertiary effluent source water from the PWRP
- The full-scale AWPF
- Conveyance lines including tertiary effluent to the AWPF, product water from the AWPF to the injection wells, and RO brine to the brine ponds
- Injection wells located adjacent to the AWPF
- Brine ponds

An overview map of the major Program components is presented in **Figure 4-1**.

Figure 4-1 Pure Water AV Program Components

4.1 Source Water

The Pure Water AV Program includes the design of a 4.75 MGD AWPF, where the product water will be used for groundwater recharge via direct injection into the AVGB. The feed water to the AWPF will be disinfected tertiary effluent from the PWRP. This section provides a summary of the tertiary effluent flow, water quality, treatment design implications, and contractual arrangements and commitments, all of which can be found in more detail in **Appendix A.2**.

4.1.1 Contractual Arrangements/Commitments

PWD has an agreement with LACSD for the sale and purchase of up 4.75 MGD (5,325 AFY [acre feet per year]) of recycled water from PWRP, of which 3.6 MGD (4,000 AFY) is currently allocated for groundwater recharge and 1.2 MGD (1,325 AFY) for non-potable (purple pipe) reuse (LACSD/PWD, 2016). The agreement states that PWD may request a permanent increase to the allotment of recycled water if additional permanent supplies of recycled water become available at the PWRP. In addition, PWD must meet certain milestones toward completion of the recharge project to continue to receive its recharge allotment. The LACSD/PWD agreement was amended in 2019 to grant a two-year extension in reaching the milestones for the intended recharge use and non-potable projects. The intended recharge use defined in the document was groundwater recharge with a blend of recycled water and imported water from the SWP, while the non-potable project referred to direct reuse of recycled water for irrigation. The implementation of the Pure Water AV Program will require an amendment to the agreement to account for changes, such as milestones and method for recycled water use.

Per the agreement amended in 2019, water quality provided by LACSD must conform to disinfected tertiary recycled water Title 22 regulations. The PWRP uses a nitrification/denitrification process to reduce total nitrogen levels in the recycled water. The agreement outlines there is no minimum mandatory volume of recycled water that PWD must take from PWRP but to maintain the allotment established under the agreement, PWD must pay a minimum payment each year. This minimum payment was detailed in the agreement in terms of equivalent AFY for each year of the contract. PWD and LACSD are currently updating the agreement to address the minimum water quality requirements expected for the Pure Water AV Program.

4.1.2 Tertiary Effluent Location

The wastewater generated from the City of Palmdale's service area is collected and treated by LACSD's 14 and 20 districts. Wastewater conveyance is provided via gravity flow, through a network of 104 miles of trunk sewers (Carollo, 2015). The collected wastewater is treated in two water reclamation facilities: the PWRP and the Lancaster Water Reclamation Plant (LWRP). Although a portion of the City of Palmdale's generated wastewater is treated at the LWRP, the first phase of implementation of the Pure Water AV Program will be only using feed water from PWRP and the focus of this PPIP is PWD's service area. Future expansion of the Program may consider additional water from LWRP, subject to future agreements between the agencies that have jurisdiction over the recycled water.

PWRP, operated by LACSD District No. 20, provides primary, secondary, and tertiary treatment for wastewater with a maximum daily design capacity of 12 MGD. The plant is located at 39300 30th Street

East, Palmdale, California, 93550, northeast from PWD's headquarters (**Figure 4-2**). LACSD adds chloramines to tertiary effluent from the PWRP for disinfection and control of biogrowth in the recycled water distribution system.

The City of Palmdale and PWD established the PRWA through a joint agreement to manage recycled water that is generated within the Palmdale area. The joint powers authority manages non-potable reuse projects for a recycled water distribution system for landscape irrigation within the Palmdale area. **Figure 4-2** shows the existing PRWA recycled water system, which also includes a Recycled Water Backbone System. This conveyance system is in development with a portion of the system having already been constructed by the City of Lancaster, the City of Palmdale, and Los Angeles County Waterworks District No. 40. After full implementation, the system can move recycled water between the LWRP and PWRP and could be utilized to facilitate expansion of the Pure Water AV Program, if agreements are reached between the agencies.

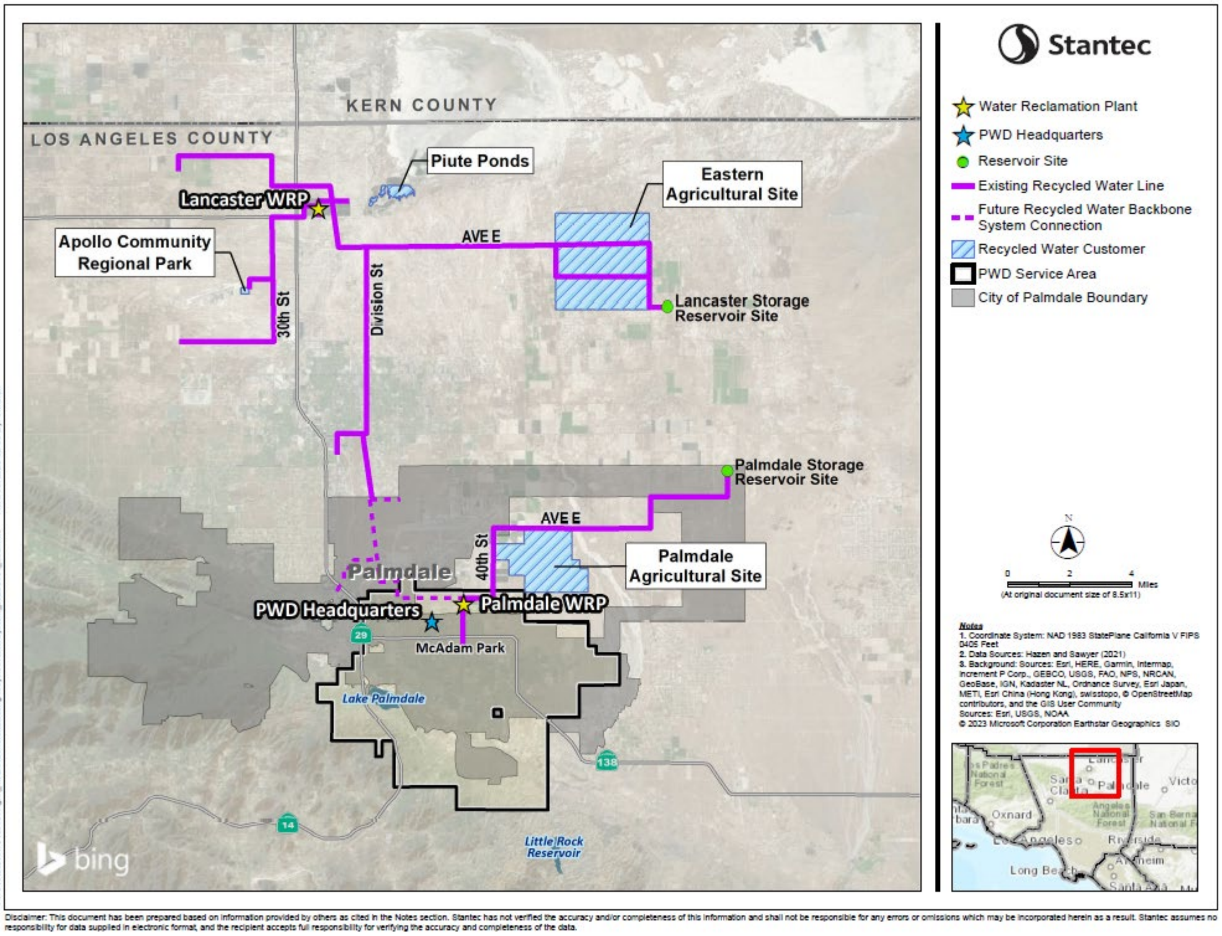


Figure 4-2. Existing PRWA Recycled Water System

4.1.3 Variability in Tertiary Effluent Flows and Equalization Needs

The PWRP has a design capacity of 12 MGD, however the average tertiary effluent flow produced is 8.3 MGD. Several treatment processes at the AWPF require a near-constant feed flow. Therefore, the flow data from 2017 to 2021 was assessed to determine if PWRP can consistently provide at least 4.75 MGD of feed water to the AWPF and if not, what equalization volume would be needed to maintain a constant feed flow to the AWPF.

The assessment used hourly effluent flow data for one week in September for each year from 2017 to 2021. As shown in **Figure 4-3**, results indicate that the diurnal pattern of PWRP's effluent flow is very stable, ranging from 7.1 MGD to 9.2 MGD, and averaging 8.3 MGD. Therefore, there is sufficient minimum tertiary effluent available throughout the day to sustain treatment of 4.75 MGD of tertiary effluent at the AWPF.

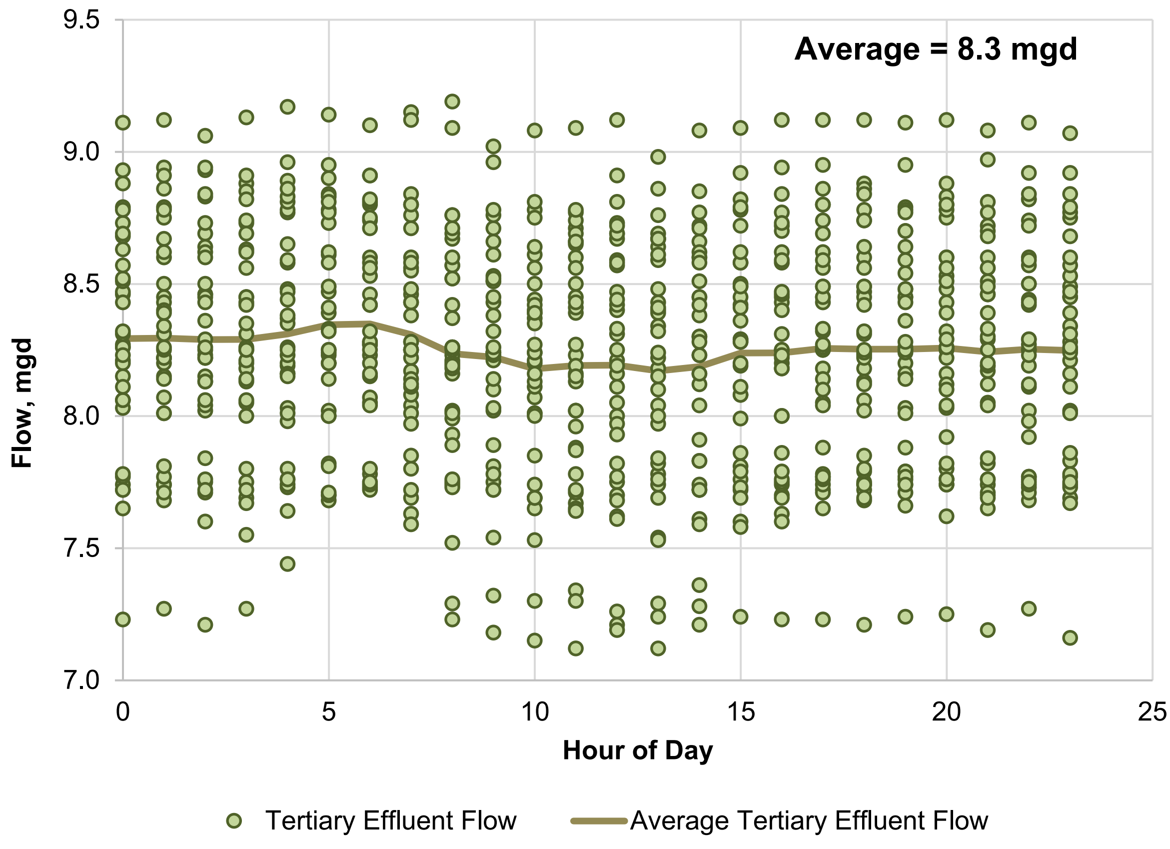


Figure 4-3. Diurnal Pattern of the PWRP Effluent Flows with One-Week Hourly Data from September of 2017, 2018, 2019, 2020, and 2021

Further assessment of hourly flows throughout the year is recommended, but if the trend from this analysis is consistent for other months, it may be possible to convey tertiary effluent to the AWPF directly from the PWRP without equalization at the AWPF.

Seasonal flow variability was assessed using PWRP's daily tertiary effluent flowrates from 2017-2021. Based on this information, the probability plot shown in **Figure 4-4** was prepared to show the flows available for groundwater injection. As illustrated, the historical daily tertiary effluent flow in the past five years was at least 5 MGD 99.8% of the time. Therefore, the plant is expected to be able to consistently provide a flow of 4.75 MGD of tertiary water to the AWPF.

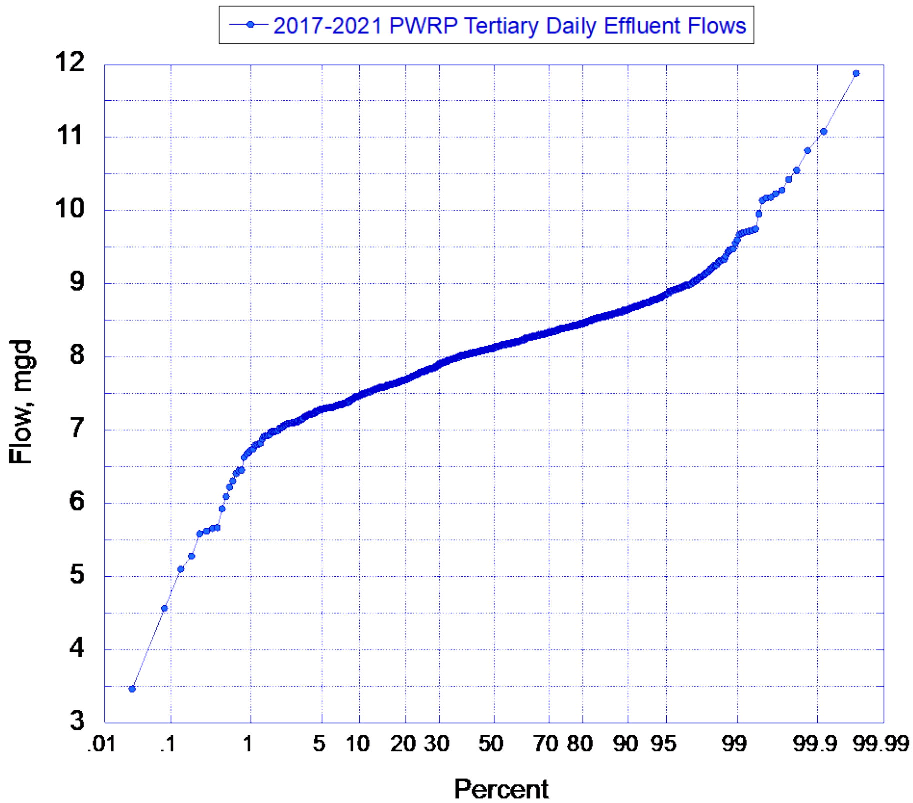


Figure 4-4. Seasonal Variability Probability of the PWRP Tertiary Effluent Flows Minus City of Palmdale Recycled Water Flows

4.1.4 Tertiary Effluent Water Quality and Treatment Design Implications

The PWRP tertiary effluent water quality impacts the design and performance of the downstream AWPF. Various key water quality parameters were analyzed in relation to the proposed AWPF treatment processes to provide a good understanding of the effects these processes may have in reducing contaminant concentrations and the impacts that the water contaminants may have on system performance.

In California, indirect potable reuse projects must meet the regulatory requirements and monitor contaminants at frequencies listed in Articles 5.1, 5.2 and 5.3 of the Water Recycling Criteria, Title 22, Division 4, Chapter 3 of the California Code of Regulations (Title 22 CCR). Indirect potable reuse regulatory requirements include the SNMP, EPA, and State of California drinking water primary and secondary maximum contaminant levels (MCLs) and action levels (ALs), as well as California's notification levels (NLs). In addition, the final effluent must meet the water quality objectives (WQOs) prescribed in AVGB's SNMP for groundwater.

PWRP's tertiary effluent's water quality was analyzed in relation to these drinking water and potable reuse standards to better understand the influent water quality to the AWPF and its ability to meet these limits in the final effluent. A few constituents were identified as possible challenges for the implementation of the AWPF, either due to their concentrations found in the PWRP tertiary effluent, or to the lack of existing data from the tertiary effluent. These compounds are listed in **Table 4-1** along with possible solutions for implementation at the AWPF.

Table 4-1. Potentially Challenging Compounds for the Implementation at the AWPF

Compound	Reason for Possible Challenge to AWPF Implementation	Possible Solution
NDMA	Low limit (CTR), NL	Source control at PWRP; high UV doses
Chlorine residuals	High variability in concentrations	Impacts operational logic in the AWPF to stabilize chlorine residuals in the AWPF'S feed water

Key:
AWPF = advanced water purification facility
CTR = California Toxics Rule
NDMA = N-nitrosodimethylamine
NL = notification level
PWRP = Palmdale Water Reclamation Plant
UV = ultraviolet

4.2 Advanced Water Purification Facility

The Pure Water AV AWPF will be designed to treat 4.75 MGD of disinfected tertiary effluent from PWRP. After treatment, approximately 4.25 MGD of purified product water will be used for GWR via direct injection. The following subsections summarize the process train, preliminary design criteria, and phasing of the planned AWPF.

4.2.1 Process Train and Preliminary Design Criteria

The treatment train of the Pure Water AV AWPF will consist of membrane filtration (MF), RO and advanced oxidation process (UV/AOP), as shown in **Figure 4-5**. The feedwater to the MF system will be dosed with chloramines to control biofouling on the MF and RO membranes. Following the chloramines addition, the flow will be filtered through Automatic Backwashing Strainers (ABS) to remove any large particles present in the feed water that may damage the MF membranes. The MF process will polish the feed water (tertiary effluent from PWRP) as a pretreatment step for the RO process by removal of virtually all solids. It will also provide pathogen removal credits of four logs for both *Cryptosporidium* and *Giardia*. Credits are not granted for virus removal through MF treatment. The integrity of the membranes will be assessed to establish LRV credits based on daily pressure decay tests (PDT) and continuous turbidity monitoring from individual MF units.

In a conventional RO system, MF filtrate (i.e., RO feed water) is pressurized by a high-pressure RO feed pump and fed to the RO vessels, which contain the membranes. The feed flow passes through the first stage, where the concentrate flow is separated from the permeate. The concentrate from Stage 1 is used as the feed flow for Stage 2. The permeate streams are typically combined and the resultant concentrate flow is only produced from the final stage. Higher recoveries can be achieved by adding a third stage. Because the feed water to each subsequent phase is the concentrate from the prior stage, later stages have increased salinity levels in the feedwater and may require more frequent membrane replacement due to more frequent cleanings associated with higher scaling potential of the feedwater.

In California, use of RO process is mandatory for GWR via direct injection. It provides removal of dissolved constituents – including inorganic salts, total organic carbon (TOC), nitrate, metals, and trace organic contaminants – while also serving as a barrier for pathogens. Depending on the feed concentrations, typically 1.5-2.0 log credits each for virus, *Giardia*, and *Cryptosporidium* are provided when using online conductivity and/or TOC as surrogates.

Percent recovery for RO systems contemplated is important in that higher recoveries increase product water volumes and reduce the volume of brine to be disposed of. Conventional RO technology can typically achieve up to 90% recovery, beyond which some form of novel secondary RO system is required. Based on PWRP's tertiary effluent water quality, recoveries between 92-96% may be achievable with adequate pH adjustment and anti-scalant dosing, with a maximum theoretical recovery of around 94% based on scaling model. Achieving a recovery of greater than 90% would require a high recovery RO system that uses novel flow patterns (e.g., Closed Circuit RO, CCRO or Pulse-Flow RO, PFRO). A High Efficiency RO (HERO)-type process with much more extensive pre-conditioning is required to reach recoveries greater than 96%.

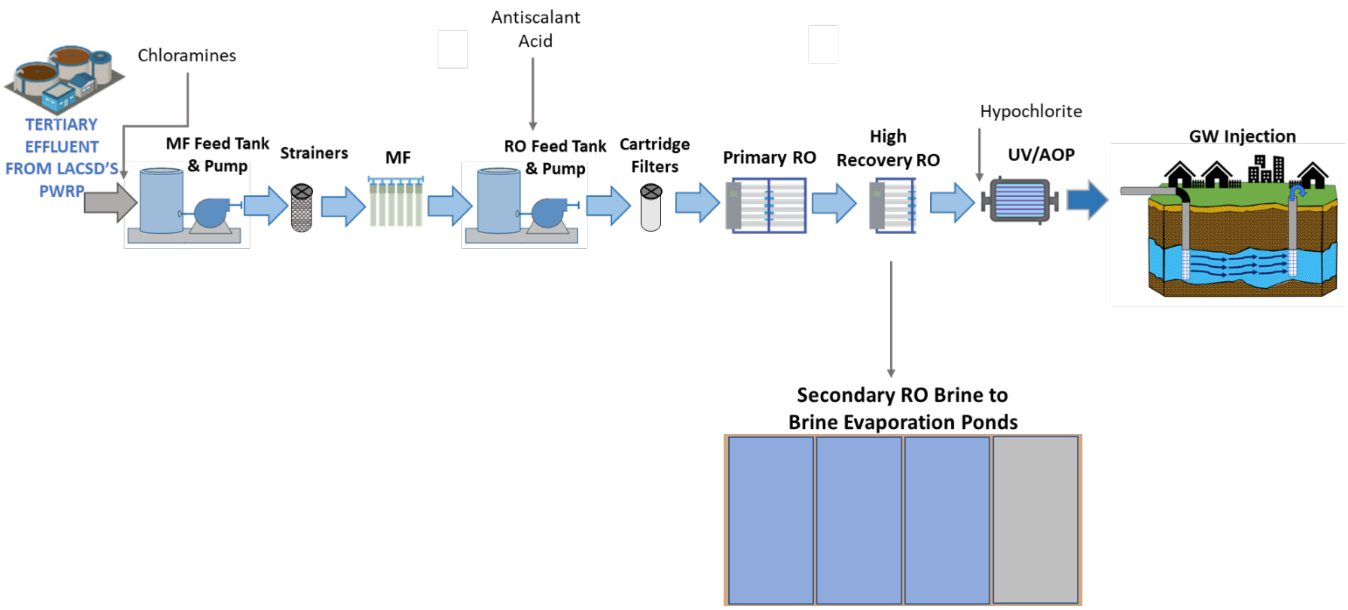


Figure 4-5. Process Flow Diagram of the Pure Water AV AWPF

For the Pure Water AV AWPF, a conventional 2-stage RO will be used as the primary RO system. To increase the recovery, either a third stage will be added or a high-recovery system such as CCRO or PFRO will be deployed to treat the brine from the second stage of the primary RO system. The preferred pathway will be identified after testing at the demonstration facility (described in **Section 7.1**).

The CCRO process relies on the use of a recirculation loop that decouples cross-flow velocity from the flow rate through the system. In a recirculation loop, feedwater enters the system during the closed-circuit desalination mode, producing permeate and recirculating concentrate. As more product water is produced and brine is recirculated, the brine concentration increases. When the recovery set point is achieved, the system transitions to plug-flow desalination mode, and the brine is purged from the system. Due to the continuous recirculation, the CCRO is not limited by minimum cross-flow velocity, and recovery can theoretically be maximized up to the solubility limit. Based on scaling models around 94% recovery can be achieved through a CCRO system for the Pure Water AV AWPF. However, the CCRO process is energy-intensive and requires more frequent membrane cleanings than conventional RO, thereby resulting in high operations and maintenance cost.

The last treatment process prior to product water stabilization is UV/AOP. In California, the use of the AOP process is mandatory for GWR via direct injection. During this process, an oxidant is injected into the water; common oxidants are sodium hypochlorite and hydrogen peroxide. The water is then irradiated with a high dose of UV light. The combination of oxidant and UV light results in the formation of hydroxyl radicals. UV/AOP (as opposed to ozone based AOP processes) is commonly employed in potable reuse applications due to its ability to photolyze certain compounds, most specifically NDMA. In addition, the UV/AOP process has a high efficiency in inactivating pathogens, including *Cryptosporidium, Giardia*, and viruses. Finally, the AOP process oxidizes many types of harmful contaminants present in the water, including alkenes and aromatics, due to the creation of hydroxyl radicals. The full-scale AWPF will utilize UV/AOP with free chlorine as an oxidant. After the three main treatment processes, the product water will be stabilized through calcite contactors that add alkalinity and calcium hardness as the water passes through them. Carbon dioxide (CO_2) may also be added upfront of the contactors to aid calcite dissolution into the water. Alternatively, other acids can also be used.

4.2.2 Capacity and Phasing

The first step in the Pure Water AV program is to build the Demonstration Facility that has a capacity of approximately 200 gpm. The demonstration facility is expected to come online in 2025. The Demonstration Facility will not be a production facility. It will provide valuable insight into the design and construction of the full-scale facilities. Phase-1 of the full-scale facilities will be rated to treat approximately 4.75 MGD and is anticipated to come online by 2030 (**Figure 4-6**).

Figure 4-6. Summary of Capacity and Phasing

There are various opportunities to expand treatment capacity if additional sources of influent water become available through agreements with other agencies. One such opportunity could be with the City of Palmdale who has an agreement with LACSD for 1.8 MGD of recycled water (Recycled Water Facilities Master Plan, 2015) that was transferred to PRWA for use in urban irrigation and construction. If an agreement is reached between the City of Palmdale and PWD, some of this water could be treated at the Pure Water AV AWPF to expand the groundwater recharge program. In addition, future agreements with LACSD to purchase tertiary effluent from LWRP may also lead to further expansion of Pure Water AV by up to 5 MGD, for a total Phase-2 capacity of up to 10 MGD. Consideration of this future scenario would also require expansion of the recycled backbone conveyance system to connect LWRP with the existing PWD recycled water system.

4.3 Conveyance Infrastructure

As shown in **Figure 4-1**, three major conveyance pipelines are required for the full-scale Pure Water AV Program. These include:

+ **Source Water to the AWPF** - Approximately 7,700 linear feet (LF) of 18-inch diameter pipe will convey tertiary feed water from the PWRP to the new AWPF, which will be located on an undeveloped 15-acre parcel just east of PWD headquarters. The existing temporary recycled water pump station at PWRP will need to be replaced to convey the source water to both the recycled water system and to the new full-scale facility. A new recycled water pump station is required and. There is an opportunity to reduce the required length of the new pipeline by utilizing the existing 24-inch recycled water pipeline currently used to deliver treated water for irrigation. However, further analyses are required to assess the condition and spare capacity of this pipeline.
+ **Product Water from the AWPF** – Advanced treated water from the AWPF will be conveyed by approximately 500 LF of 16-inch diameter pipeline to two new injection wells, located at the AWPF site. This pipeline will be within the site boundaries of the AWPF.
+ **RO Brine to Evaporation Ponds** – The brine produced from the RO process at the AWPF will need to be conveyed to the evaporation ponds located northeast of the AWPF. Although the pressure in the RO brine line is expected to be high enough to convey the brine without any additional pumps, this assumption will be confirmed during the conceptual design of the

full-scale AWPF. Approximately 17,000 LF of 6-inch diameter pipeline will be required to convey up to 0.45 MGD of brine flow. PVC piping is a preferred material for this smaller-diameter pipe as it is smooth and chemically inert, which helps mitigate issues with precipitate formation and pipe corrosion, respectively. Additional details on anticipated brine volume and characteristics can be found in the brine management strategy TM (**Appendix A.4**).

4.4 Injection Wells

Product water from the AWPF will be injected into the groundwater basin using injection wells. Groundwater modeling was conducted using available data to assess the travel times and feasibility of groundwater recharge via direct/subsurface injection.

First, a local scale hydrogeologic conceptual model (HCM) was developed using hydrogeologic data and information from the other Antelope Valley numerical groundwater models. The HCM informed a preliminary assessment of injection feasibility and confirmed that the underground retention times were favorable compared to Title 22 IPR regulatory requirements. For a subsurface groundwater augmentation IPR project, Title 22 Regulations require injected treated water to have an underground retention time of at least two months. Analytical estimates receive a 25 percent retention time credit, and numerical model estimates receive a 50 percent retention time credit.

A numerical groundwater flow and particle tracking model was then developed primarily to estimate underground retention times of purified water in the saturated zone between the injection and extraction wells. The model was also used to confirm injection feasibility and evaluate conceptual injection well and monitor well locations. A conservative analysis was conducted to develop reasonable estimates of the shortest underground retention times. Key assumptions include: (1) injection wells would be located within the boundaries of the new AWPF site, and (2) future pumping rates in the six closest PWD pumping wells would be increased to extract all purified water. **Figure 4-7** presents the results from the groundwater modeling. Using a simulated injection rate of 1,750 gallons per minute (GPM) and two injection wells (total of 5 MGD) on the AWPF property, the model results indicate favorable simulated (two years) and credited (one year) underground retention times compared to Title 22 IPR regulations. Credited underground retention time reflects the 50 percent reduction applied to results from a numerical groundwater flow model. Title 22 IPR regulations require a minimum two-month underground retention time and also allow for up to six months of log virus reduction credit. The model results of one year credited underground retention time exceeds the two-month requirement and exceeds the six months to qualify for the maximum log virus reduction credit.

Model results also indicate that operating injection wells on the treatment facility properties would result in manageable groundwater level rise, indicating that these locations are conceptually feasible. Title 22 IPR regulations also require monitoring of purified water flow in at least two monitor wells to demonstrate effective underground treatment and ensure a safe water supply. Model results indicate that one of these monitor wells could be located on the full-scale treatment facility property and one would be located between the injection and pumping wells.

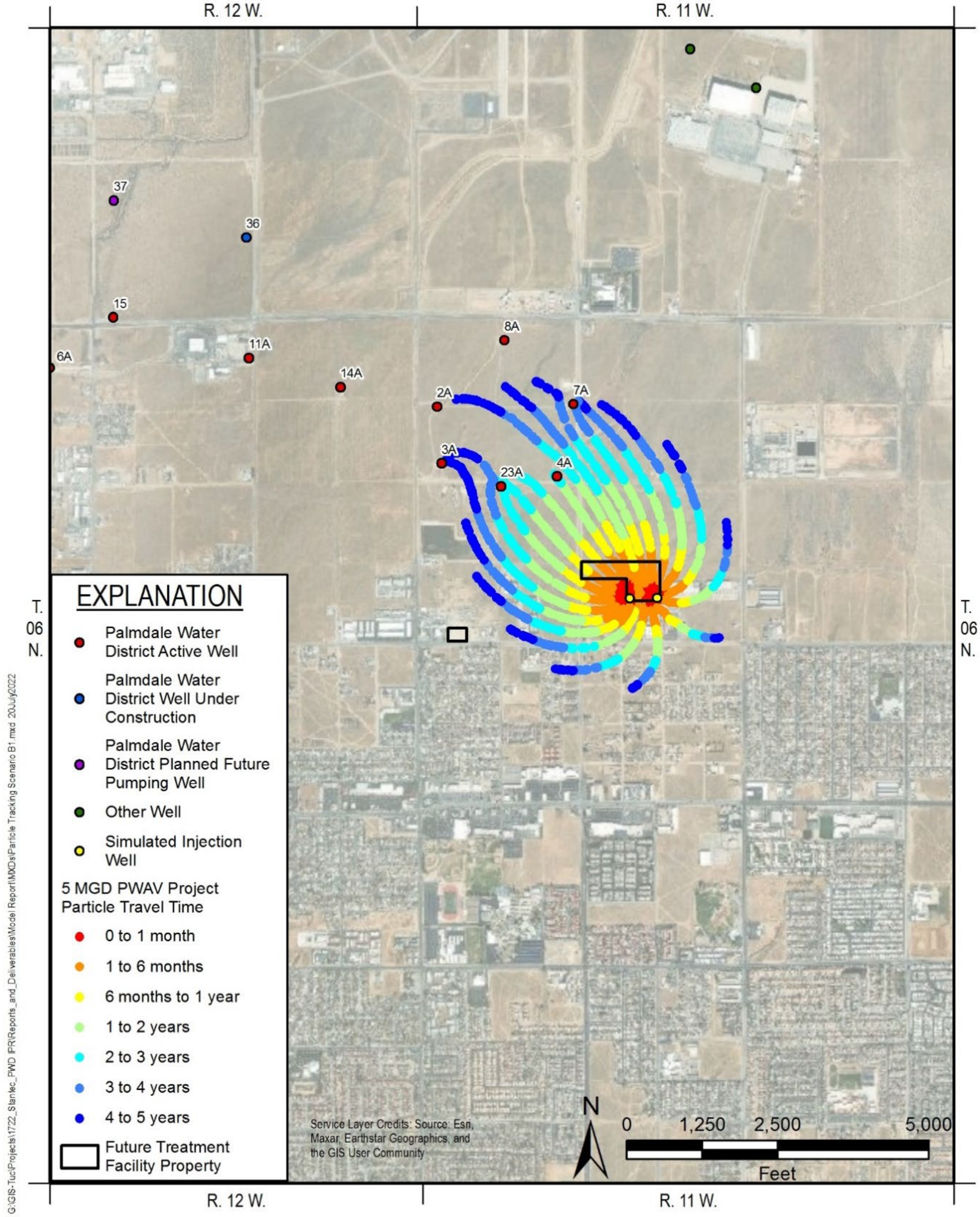


Figure 4-7. Groundwater Particle Travel Time

The results of the conservative modeling analysis indicate favorable underground retention times compared to Title 22 IPR regulations. Based on the particle travel time presented in **Figure 4-7**, the shortest simulated and credited travel time was 2.1 years and one year, respectively. Model results also indicate that operating injection wells on the treatment facility property would result in manageable groundwater level rise, indicating that the assumed location is conceptually feasible. The construction of the injection wells will include drilling wells, and installation of well screens, injection pumps and equipment. Title 22 IPR regulations also require monitoring of purified water flow in at least two monitoring wells to demonstrate effective underground treatment and ensure a safe water supply. Model results indicate that one of these monitoring wells could be located on the full-scale treatment facility property and one would be located between the injection and extraction wells.

Although results were generally favorable, important data gaps that reduce model confidence include: (1) uncertainty on the presence of preferential rapid flow paths between the injection and pumping wells, (2) injection capacity of wells located on the full-scale and demonstration facility properties, and (3) uncertainty on effective porosity. To improve model confidence, supplemental hydrogeologic characterization in the project area is recommended. Refer to **Appendix A.8** for more details about the groundwater modeling study.

5.0 Funding Strategy

A comprehensive funding plan assessment was developed, which considered federal and state funding opportunities, in addition to exploring alternative financing mechanisms to supplement state and federal funding, using bonds, public-public partnerships, and public-private partnerships. The funding sources are anticipated to include grants and low-interest loans across federal, state, and local levels. The full funding plan report for the Program is attached in Appendix D. The assessment showed that combining multiple complementary funding programs can be optimized to match the Pure Water AV Program Schedule, as some funding opportunities are better suited for funding different phases of the project. A funding strategy for phasing the proposed project is provided in **Table 5-1**. Application preparation, submission, and compliance varies by funding program. State and federal funding is vital to the viability of this project. For all of these programs, PWD will work with individual funding entities to coordinate different sources and thereby avoid overlap or duplicate in terms of activities, costs, or commitment of key personnel. The full funding plan report for the Program is attached in **Appendix A.5**.

Projects receiving funding and financing assistance from government sources must comply with relevant laws and regulations, including environmental compliance requirements, labor regulations, and other compliance requirements. Federal requirements differ from state requirements and may occasionally conflict. Complying has cost implications for the funding recipient and in certain instances, funding made available through a program does not justify the level of effort associated with compliance systems and activities.

There are three areas of funding compliance for PWD to consider:

1. Funding eligibility
2. Representations and warranties priorly included in grant or loan agreements
3. Project implementation compliance and reporting

Table 5-1. Funding Strategy by Project Phase

Program	Phase: Planning	Phase: Design	Phase: Construction	Status	Maximum cost coverage
CA Prop 1 IRWM Round 2 DAC			•	**Awarded** $450K awarded for demonstration facility conservation garden	50% of costs, up to 100% for DACs. No award maximum.
CA Prop 1 IRWM Round 2 Implementation			•	**Awarded** $587K offered by IRWM region in 2/2023 for demonstration facility influent pipeline	50% of costs, up to 100% for DACs. No award maximum.
USBR Title XVI Desalination and Recycling- Planning	•	•		**Awarded** $715K awarded in 9/2023 for planning and design activities of the full-scale facility occurring between 10/2023-10/2025.	50% of planning and design costs as federal cost share, up to $1M.
CA SGC Community Resilience Centers [Demonstration Facility]		•	•	**Submitted** $10.0M requested for construction of demonstration facility and transition to community resilience center	100% of costs, up to $10.0M
CA OPR ICARP Regional Resilience [Demonstration Facility]			•	**Submitted** $3.0M requested for construction of demonstration facility and transition to community resilience center	100% of costs, up to $3.0M
CA DWR Urban Community Drought Relief		•	•	**Submitted, Not Awarded** $13.1M requested for demonstration facility, submitted 12/2022.	75% for non-DACs, 100% for DACs. Requested 76% cost coverage. No award maximum.
CA DWR Urban Community Drought Relief		•	•	**Submitted, Not Awarded** $11.4M requested for extraction well 36/37, submitted 12/2022.	75% for non-DACs, 100% for DACs. Requested 87% cost coverage. No award maximum.
USBR WaterSMART Drought Resiliency Projects		•	•	**Submitted, Not Awarded** $5.0M requested for extraction well 36/37, submitted 6/2022. Application will be resubmitted in 10/2023.	50% of costs as federal cost share, up to $5M.

Program	Phase: Planning	Phase: Design	Phase: Construction	Status	Maximum cost coverage
US EPA WIFIA Loan	•	•	•	**In Progress** Letter of interest accepted 12/2022, invited to apply. PWD will submit a request for a loan for 49% of project costs in Fall 2023.	49% of planning, design, and construction costs as low-interest loan, allows up to 80% federal cost share. No maximum loan amount.
US EPA Climate Pollution Reduction Grant			•	**In Progress** PWD intends to collaborate with the County to submit an application for this program in April 2024.	100% of implementation costs, with awards ranging from $2.0M - $500.0 M
CA SWB Water Recycling Funding Program Construction			•	**Forecasted** PWD intends to request $15.0M for construction of full-scale facility in FY24 after full-scale design has begun.	35% of construction costs, up to $15M.
USBR Title XVI Reuse & Recycling Construction			•	**Forecasted** PWD intends to request $30.0M for construction of full-scale facility in FY24.	25% of construction costs as federal share, up to $30M.
US FEMA Building Resilient Infrastructure and Communities			•	**Forecasted** PWD intends to request up to $50.0M for construction of full-scale facility in FY23.	90% of costs as federal cost share, up to $50M
Revenue Bonds	As Needed			**Forecasted** PWD intends to issue revenue bonds to finance as needed.	N/A
CA Clean Water State Revolving Fund Loan	N/A			**Ineligible** PWD is unable to qualify for SRF loan funds due to existing bond coverage requirements.	N/A

Key:
CA = California
DAC = Disadvantaged Community
DWR = Department of Water Resources
FEMA = Federal Emergency Management Agency
EPA = Environmental Protection Agency
IRWM = Integrated Regional Water Management
K = Thousands of Dollars
M = Millions of Dollars
OPR ICARP = Office of Planning and Research Integrated Climate Adaptation and Resiliency Program
SGC = Strategic Growth Council
SRF = State Revolving Fund
USBR = US Bureau of Reclamation
WIFIA = Water Infrastructure Finance and Innovation Act

6.0 Program Component Packaging and Delivery Methods

The selection of the delivery methods for the different major Program components was based on PWD's key priorities and drivers as well as PWD's contractual requirements and constraints. PWD's contractual requirements are described in **Section 4.1.1**. This section provides an overview of the implementation phasing of the Program components as well as a description of the recommended delivery method and timeline for the design packages. For more details, refer to the Delivery Methods Assessment TM in **Appendix A.6**.

Based upon the nature of the new facilities planned, and in consultation with PWD staff, it was recommended to deliver the Pure Water AV Program in four separate packages including:

1. Demonstration Facility
2. Conveyance Pipelines (tertiary effluent, AWPF product water, and RO brine)
3. Injection Wells
4. AWPF and Brine Ponds

The following four delivery methods were evaluated for the Pure Water AV Program using key criteria identified by PWD staff:

1. Conventional Design-Bid-Build;
2. Construction Manager at Risk;
3. Fixed-price Design Build; and
4. Progressive Design-Build.

The delivery methods were analyzed in relation to project risk allocation, owner involvement, and major equipment procurement. PWD staff identified cost certainty as the most important criterion for PWD to minimize rate changes to customers and maintain a level of integrity for its stakeholders. **Table 6-1** below lists the recommended delivery methods for each of the Program packages, as well as the reasoning behind the selection. Construction schedule details are included in the Master Program Schedule presented in **Section 11**.

There are statutory legal requirements to consider in the selection of any project delivery method. PWD, as an independent special district formed under the California Water Code Division 11 has the authority to establish its own rules and regulations. Per PWD's rules and regulations, its Board may authorize to establish new contract mechanisms for different procurement and delivery methods.

Table 6-1. Program Packages' Recommended Delivery Methods

Program Package	Delivery Method	Details
1. Demonstration Facility	DBB	The demonstration facility consists of pre-packed OEM vendor systems. Due to the relatively straightforward nature of the facility, it is recommended to deliver this package using DBB.
2. Conveyance Pipelines	DBB	Because of their routine approach to design and construction, this package's components did not drive the schedule. Therefore, design and construction can be staged. DBB is recommended as the appropriate delivery method.
3. Injection Wells	DBB	Similar to conveyance pipelines, injection well designs are also straightforward and because staging of design and construction is not expected to impact the schedule, DBB was selected as the appropriate delivery method.
4. AWPF and Brine Ponds	PDB	Because of the complexity surrounding the AWPF, an early start of the construction activities is crucial to maintain the overall Program schedule. Additionally, it is important for PWD to obtain a cost estimate at different design levels and adjust the design accordingly to meet the construction cost. Based on this, PDB is recommended for the delivery of this package.

Key:
AWPF = advanced water purification facility
DBB = design bid build
OEM = original equipment manufacturer
PDB = progressive design build
PWD = Palmdale Water District

7.0 Economic Impact Assessment

The potential economic impacts of the Pure Water AV Program include direct impacts (such as investment in materials, jobs, etc.), indirect impacts (on industries supporting the project) and induced impacts (due to the increased economic activity) arising from the construction and operation of the final facilities. An economic impact analysis was conducted to measure these impacts. The inputs for the analysis included construction costs, estimated full-time equivalent employees and approximate salaries for jobs created during different phases of the Program. The analysis accounts for the construction period and ongoing operations through the projected life of 20+ years. The economic analysis for the Pure Water AV Program focused on the effects the new facilities may have to Los Angeles County's economy, with a particular emphasis on the following economic indicators: output, value added/gross domestic product, labor income, and jobs. For the full analysis, refer to **Appendix A.7**. The overall economic impacts of the Project could total about $79.8 million annually during the anticipated 3-year construction period, and $9.3 million annually once the facilities are operational. The regional economic multiplier from the construction phase of the Program is 0.78, and 0.69 for the operations phase. This means that for every $1 spent during construction on the project, an additional $0.78 could be generated in the Los Angeles County economy. For every $1 spent during the operational life of the Pure Water AV Program, $0.69 could be generated in the Los Angeles County economy. During the construction phase, about 269 construction-related support and induced jobs are expected to be created, bringing economic benefits to the community through labor income and economic output from onsite construction as well as supply chain services and induced jobs. Operation of the facilities will require approximately four full-time jobs annually over the estimated 50-year life of the Program. In addition to these direct jobs, indirect and induced jobs related to operations and maintenance (O&M) services could create 19 additional jobs, earning approximately $1.3 million more in labor income within Los Angeles County per year (in 2022 dollars).

8.0 Regulatory Approval Approach

The production and use of recycled water is supervised by state and local regulatory agencies, including Lahontan Regional Water Quality Control Board (RWQCB), the State Water Resources Control Board Division of Drinking Water (DDW), and the Department of Environmental Health (DEH). The Pure Water AV Program will pursue a groundwater recharge permit and a waste discharge permit from the RWQCB, pursuant to the applicable compliance requirements. The key activities for regulatory approval are provided in the following section.

8.1 Demonstration Testing

One of the key Program features that will be instrumental in attaining regulatory approval is the Pure Water AV Demonstration Facility (Demonstration Facility). Data from monitoring and testing at this facility will be used to procure regulatory acceptance by engaging regulators and generating at the Demonstration Facility the required data for validation and permitting. In addition, this facility will be used to optimize the full-scale design, provide a training ground for PWD operators, and promote public outreach.

The Demonstration Facility will be located adjacent to PWD's headquarters and will utilize tertiary treated water from PWRP, which will be fed from a tertiary recycled water pipeline. At a minimum, the facility will employ a treatment train consisting of MF, primary RO, high recovery RO, and UV/AOP, with the objective of achieving the treatment level required by groundwater recharge via direct injection. A process flow diagram for the Demonstration Facility is presented in **Figure 8-1** below.

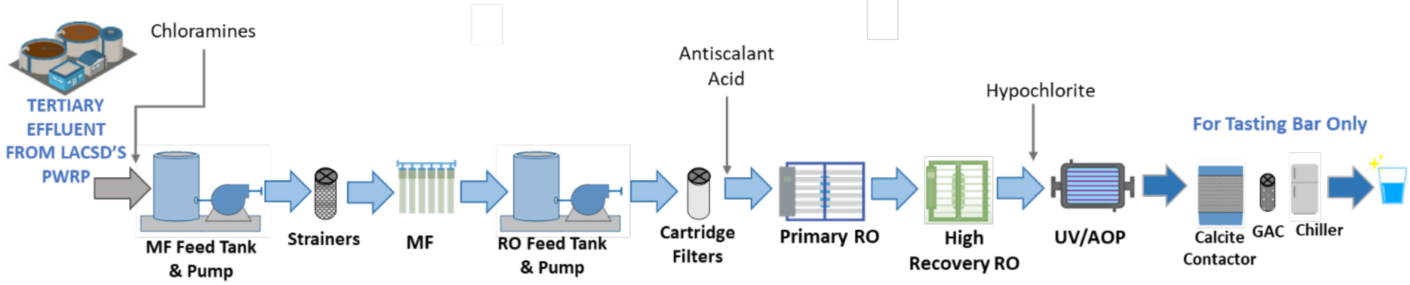


Figure 8-1. Demonstration Facility Process Flow Diagram

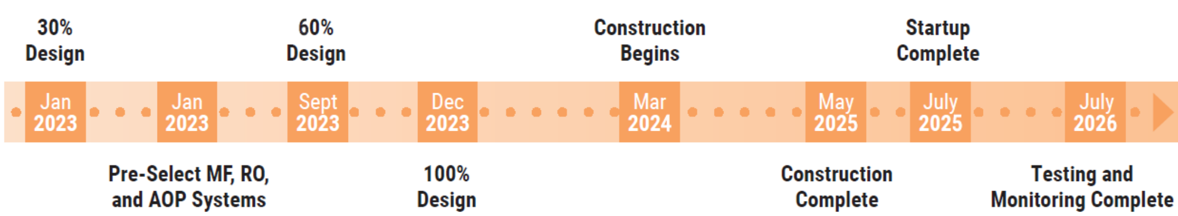
The design is intended to promote public engagement by adopting an open design. 3D renderings for the Demonstration Facility are presented in **Figure 8-2**.

Figure 8-2. Demonstration Facility 3D Rendering (Left – Conservation Garden, Right – Front of Facility)

Major objectives of the Demonstration Facility include the following:

- Demonstrate that the treatment train can meet regulatory requirements regarding both chemical and pathogen constituents.
- Inform and optimize the treatment processes for the full-scale design.
- Test recoveries for different RO technologies.
- Engage the public via tours, educational opportunities, and public events.
- Facilitate operator training of advanced treatment processes.

The Conceptual Design Report (**Appendix A.9**) was developed for the Demonstration Facility and includes a detailed description of the facility, the project delivery method, applicable regulations, water quality information, process description, control strategies, design guidelines, a cost estimate, and information pertaining to public outreach. After completion of testing to guide full-scale design, PWD plans to continue operating the facility and use it as a learning center for public outreach and a training center for water and conservation education. The schedule of the design, construction, and startup of the Demonstration Facility is illustrated in **Figure 8-3**.



Key:
AOP = advanced oxidation process
MF = membrane filtration
RO = reverse osmosis

Figure 8-3. Demonstration Facility Timeline

Extensive testing and water quality monitoring will be performed at the Demonstration Facility to assess regulatory compliance, operations and treatment performance, and to inform design criteria for the full-scale facility. The results from these sampling events will also be compared to other reuse facilities. Once all systems are optimized, special tests will be performed at the Demonstration Facility to investigate compliance with potable reuse regulations. It is anticipated that testing and monitoring of the Demonstration Facility will require up to twelve months, as shown in **Table 8-1**. The initial three months will be used for baseline testing to establish baseline conditions, while the remaining nine months will be designated for optimization of key operational parameters.

Table 8-1. Testing and Monitoring Schedule for the Demonstration Facility

Task	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
MF												
• Phase 1: Low flux	■	■	■	■								
• Phase 2: Medium flux					■	■	■	■				
• Phase 3: High flux									■	■	■	■
Primary RO												
• Baseline Testing	■	■										
• Normal Operations			■	■	■	■	■	■	■	■	■	■
Secondary Conventional RO												
• Baseline Testing	■	■										
• Recovery Evaluation/Optimization Testing			■	■	■	■	■	■	■	■	■	■
Secondary CCRO												
• Baseline Testing: Overall Recovery	■	■										
• Recovery Evaluation/Optimization Testing: Overall Recovery			■	■	■	■	■	■	■	■	■	■
UV/AOP												
• Routine Testing	■	■	■	■	■	■	■	■	■	■	■	■
• Phase 1: Verify UV Dose			■									
• Phase 2: Determine optimized UV dose and free chlorine dose setpoints						■						
Routine Monitoring	■	■	■	■	■	■	■	■	■	■	■	■

8.2 Independent Advisory Panel and Regulatory Engagement

An Independent Advisory Panel (IAP) has been engaged under the framework of the National Water Research Institute (NWRI), which includes a team of academics and industry experts with relevant water augmentation experience. The IAP will evaluate the technical, scientific, and regulatory aspects of the Demonstration facility, approve the test plan, and provide input during demonstration testing and ultimately, the Pure Water AV Program. The following workshops and meetings are scheduled to better inform and prepare the IAP.

1. **Introductory Meeting**: present an overview of the project and determine what information the IAP needs in advance of Workshop 1. The introductory meeting was conducted on December 21, 2022.
2. **Workshop 1**: present the project alternatives, groundwater modeling results, demonstration facility, and associated test plan to the IAP. Workshop 1 was conducted on March 2, 2023.
3. **Update Meeting**: solicit input on technical and/or regulatory hurdles midway through the demonstration testing. This meeting will be scheduled in accordance with demonstration testing.
4. **Workshop 2**: Review the preliminary results of the demonstration facility and final groundwater modeling results. Workshop 2 will be scheduled once results from the demonstration facility are available.

Direction and recommendations received from the IAP in each of the meetings/workshops will be incorporated into the project as appropriate.

Additionally, PWD has hired an independent consultant to review the testing results and project costs and the performance data from the Capture6 demonstration facility. Using the data from the independent consultant, a separate IAP will provide recommendations on the full scale Capture6 carbon removal technology. The IAP will primarily assist PWD to assess the technical feasibility of integrating Capture6's technology into Pure Water AV and review the economic viability of the carbon capture portion of the project. The following workshops and meetings are scheduled to better inform and prepare the IAP for review of the Capture6 facility.

1. **Introductory Meeting**: present an overview of the project and determine what information the IAP needs in advance of Workshop 1. The introductory meeting will be conducted on October 17th, 2023.
2. **Workshop 1**: Review conceptual design of Capture6's demonstration facility and framework of testing and monitoring plan. This meeting will be scheduled within the fourth quarter of 2023.
3. **Update Meeting**: solicit input on performance data midway through the brine management demonstration testing. This meeting will be scheduled in accordance with the brine management demonstration testing.
4. **Workshop 2**: Review operational and water quality performance data from the demonstration facility. Workshop 2 will be scheduled after results from the brine management demonstration facility are available.

8.3 Title 22 Engineering Report

The Title 22 Engineering Report describes how the final, full-scale facility will comply with the California Code of Regulations, Title 22 requirements. The Title 22 Engineering Report must be approved by the DDW. At a minimum, the engineering report shall: identify all project participants, describe applicable rules and regulations, describe the source wastewater, describe the recycled water treatment processes and operations, present plant reliability features, describe all supplemental water supplies, present the proposed monitoring and reporting program, and present a contingency plan to prevent discharge of off-specification water.

Development of the Draft Title 22 Engineering Report will begin near completion of the 60% full-scale design and is expected to take approximately 6 months to complete, including internal review. Once completed, the draft will be submitted to DDW to review and provide comments. The review and revision process is expected to take 3 to 6 months.

The Preliminary Final Title 22 Engineering Report will be prepared during the DDW review cycle as revisions are made in response to comments from DDW. The preliminary final report is expected to be submitted approximately 6 months after the submittal of the draft report. The submittal of the preliminary final report will be followed by a public hearing with DDW.

The Final Title 22 Engineering Report will be prepared and submitted to DDW after the public hearing, incorporating any additional feedback from the hearing. Once submitted, it may take 1 to 3 months to receive the Conditional Approval Letter from DDW.

8.4 Waste Discharge Requirements/Water Recycling Requirements (WDR/WRR) Permit

The Report of Waste Discharge (ROWD) package includes general information about the facility, the type of discharge, the location of the facility, and the reason for filing. Information about completion of CEQA requirements must be included, and any completed CEQA documents should be enclosed. A complete characterization of the discharge must be provided, which includes information about flows, discharge concentrations of constituents, best managements practices, and disposal methods, among others. The ROWD package will be prepared in parallel to the preparation of the Preliminary Final Title 22 Engineering Report to capture feedback from DDW. The timing of the submittal of the ROWD will be similar to that of the Preliminary Final Title 22 Engineering Report. The ROWD, along with the Conditional Approval Letter, will inform the RWQCB's preparation of the WDR/WRR permit. Once the draft WDR/WRR permit is received, there will be a courtesy review period, followed by a public comment period. The permit is expected to be adopted shortly after the end of the public comment period.

8.5 Operation Optimization Plan

The Operation Optimization Plan (OOP) describes the operations, maintenance, analytical methods, monitoring, and reporting necessary to meet the requirements set by Article 5.2 (Indirect Potable Reuse: Groundwater Replenishment – Subsurface Application) of the Title 22 regulations. The draft OOP must be submitted to and accepted by DDW and the RWQCB prior to operation of the facility. Preparation of the draft OOP may take 6 to 9 months, including internal review cycles and DDW review. An amended OOP may be requested by the regulatory agencies that incorporates feedback on the draft OOP as well as full-scale startup testing results. The final OOP is typically prepared and submitted within the first 90 days of operation.

Per the recycled water regulations, after the first year of operation, an updated OOP must be submitted within six months that incorporates any changes in operational procedures that were made to optimize treatment processes. The updated OOP is not included in this schedule.

8.6 Tracer Study Workplan

The Tracer Study Workplan will include details such as rationale for tracer selection, the tracer injection protocol, proposed sampling methods, and other sampling details. The Tracer Study Workplan may take approximately 3 months to prepare, including internal review and DDW review and approval. The tracer study should be initiated prior to the end of the third month of operation. A tracer study report should be prepared upon completion of the study.

8.7 UV/AOP Performance Test

UV/AOP performance testing must be completed during commissioning to demonstrate the system meets required treatment criteria (i.e., minimum 0.5-log removal of 1.4-dioxane). The test protocol should be completed and approved by DDW prior to the end of construction. Once performance testing is completed, a test report is prepared and submitted to DDW for approval. Typically, completion of the UV/AOP performance testing is shortly followed by the DDW inspection to receive approval for injection.

9.0 Public Outreach Strategy

Public outreach to communities that may receive the new purified recycled water and/or be impacted by the construction of the Program is a vital component for PWD. Therefore, a Public Outreach Plan (**Appendix A.10**) was prepared to assist PWD with informing the local communities about the Program, respectfully seek their input, and start building trusting relationships. The Public Outreach Plan is an audience-driven plan and "living" document, meaning that the outreach activities outlined are tailored to the various audiences that need to be informed about the Program, and such activities will be reviewed and revised on a periodic basis. It is essential that these efforts be broad, equitable, and inclusive, encompassing diverse audiences and ensuring all communities have access to Program information and opportunities for participation and involvement.

Water recycling agencies across the nation often face negative public opinion about potable reuse projects because the product water was once municipal wastewater. Linked to this are the existing concerns about the water quality of the public drinking water supply. A sense of mistrust can be highly prevalent in some communities, particularly in areas that have experienced systemic challenges with water service. Moreover, the communication of technical information may require audiences to learn new vocabulary and assimilate new information in short amounts of time. Different communication methods and networks may be required to promptly reach all the population groups.

Various opportunities to aid in building understanding, momentum, visibility, and support for the Pure Water AV Program include:

- The increased popularity of environmental awareness and support,
- Numerous successful potable reuse projects throughout California and the U.S., and
- Heightened public awareness of limited or constrained water supplies.

Additionally, PWD plans to approach outreach on a more local level and work directly within the communities to create the opportunity for more innovative and community-oriented strategies. Virtual engagement offers a different way of communication that can expand the outreach Program engagement through the development of additional tools that can serve virtual audiences. The already established relationships with key project stakeholders can also be utilized to connect to communities in a more collaborative approach. Utilizing these opportunities to better engage with the public contributes directly to the overall success of the Program.

The key messages and overarching themes for public outreach to help focus communication efforts and frame the conversation around the Pure Water AV Program are:

1. The Palmdale Water District has embarked on the Pure Water AV, which will use advanced technology to purify wastewater that has already been treated to levels consistent with pretreatment required by the advanced water treatment systems envisioned.
2. The purified water will be a local, reliable, and sustainable source that will help ensure water supply reliability for the region.

3. Once operational, PWD will be conducting testing at its 200 GPM Advanced Purification Demonstration Facility in 2025, which will provide data for a full-scale water purification plant and Program. The Demonstration Facility will also serve as a central component of the potable reuse outreach program by offering guided tours of the treatment process, tasting opportunities for tour participants, interactive educational displays, a native garden to provide examples of low water use landscaping, and a community room available for public functions.

10.0 Environmental Studies and Permit Requirements

As a discretionary action of a governmental agency that will have direct and reasonably foreseeable indirect impacts on the environment, Pure Water AV will be subject to review under CEQA. In compliance with CEQA (Public Resources Code Section 21000 et seq., and state CEQA Guidelines, Title 14 CCR Section 15000 et seq.), PWD will prepare an Initial Study (IS) to address the impacts of construction and operation of the Program. The IS will identify the site-specific impacts, evaluate their potential significance, and determine the appropriate document needed to comply with CEQA. If the information reviewed and contained in the IS supports a determination that the proposed project will not have a significant environmental impact with mitigation measures incorporated into the project, a Mitigated Negative Declaration (MND) will be the appropriate CEQA document. If potentially significant unmitigable impacts are identified, PWD will prepare an Environmental Impact Report to further evaluate project alternatives and additional mitigation measures. The CEQA process will include distribution of the environmental document for review and comment by relevant responsible, trustee, and interested agencies, Native American tribes, environmental organizations, and the public. It is assumed that the CEQA process will approximately follow the schedule shown in **Figure 10-1**.

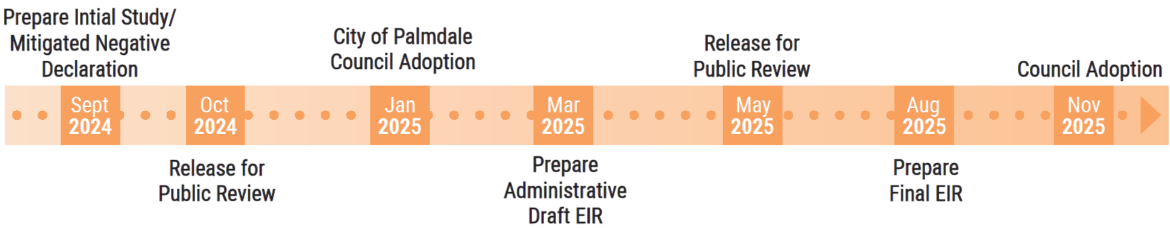


Figure 10-1. Proposed CEQA Process Schedule

In further compliance with CEQA and Assembly Bill 52 (AB52), PWD will consult with relevant California Native American tribes and consider tribal cultural resources potentially impacted by the project. By requiring consideration of tribal cultural resources early in the CEQA process, the legislature intended to ensure that local and tribal governments, public agencies, and project proponents will have information available early in the project planning process to identify and address potential adverse impacts to tribal cultural resources. PWD will outreach to the Native American Heritage Commission to obtain a tribal contact list. Individual letters to each tribe on the contact list will be sent to outline the proposed project and invite tribal representatives to consult with PWD.

Based on initial biological and cultural investigations of the project site, no significant cultural or biological resources were identified at the project site. The site is currently vacant and graded with a scattering of Joshua trees and drainages running through the area. More detailed investigations as described within this section will be completed once the project site has been officially procured and further details of the project are established, prior to ground disturbing activities.

In addition to the above-mentioned environmental studies, PWD will pursue and acquire the applicable permits for implementation of the Pure Water AV Program. **Table 10-1** summarizes the anticipated permits that will be pursued and respective stakeholders. This list may not be exhaustive of all applicable permits for the project, and a more detailed assessment will be developed during final design to identify all applicable permits and regulatory requirements.

Table 10-1. Potential Permit Requirements for Pure Water AV

Permit/Approval	Stakeholders
National Pollutant Discharge Elimination System (NPDES) and Construction Stormwater Pollution Prevention Plan (SWPPP) permit	State Water Resource Control Board (State Water Board)
Indirect Potable Reuse Permit	State Water Resources Control Board Division of Drinking Water (DDW)
Waste Discharge & Water Recycling Requirements / User Water Recycling Permit/ Title 22 Engineering Report / operations and optimization plan (OOP)	Lahontan RWQCB
Sewer Discharge Permit	Los Angeles County, LACSD
Cross Connection & Water Pollution Control Program Compliance	Los Angeles County Department of Public Health
Fire Protection System Permit/Plan Check	Los Angeles County Fire Department
Hazardous Materials Review/Field Inspection **Spill Prevention Control and Countermeasure Plan (SPCC)** **Certified Unified Program Agency (CUPA) Permit**	Los Angeles County Fire Department
Fire Protection System Permit/Plan Check	City of Palmdale
Easement Encroachment/Haul Route Permit	City of Palmdale
Offsite Utilities, Roadway, Street Use, and Landscape	City of Palmdale Public Works
Construction Permits • Demolition • Stockpile • After Hours Construction • Oversize Load • Right-Of-Way • Sign • Roadway Closure (Temp Traffic Control Plan) • Dewatering • Boring • Fugitive Dust Control	City of Palmdale CalTrans (for transportation permits of oversize/overweight vehicles on State Highway System)
Standard Urban Storm Water Mitigation Plan (SUSMP)	Los Angeles County Public Works
Flood Control Permit	Los Angeles County Department of Public Works Flood Control District
Dust Control Plan (depending on acreage and volume of earthwork) **Construction and operations permit**	Antelope Valley AQMD

Key:
AQMD = Air Quality Management District
OOP = Operations and Optimization Plan

11.0 Cost Estimates

The following section describes the preliminary cost assessment performed for the full-scale facilities of the Pure Water AV Program. Cost estimating details include the capital cost estimate, operation and maintenance cost estimate, and net present value analysis.

11.1 Capital Cost Estimate

The five major Program components considered in the capital cost estimate includes:

+ Conveyance Lines
+ The New AWPF
+ Groundwater Injection Wells
+ Brine Conveyance
+ Brine Evaporation Ponds

Each of these are briefly discussed in the following subsections:

+ **Conveyance**: Approximately 7,700 linear feet (LF) of 18-inch diameter pipe will be utilized to convey tertiary feed water from the PWRP to the new AWPF, currently located on an undeveloped 15-acre parcel just east of PWD headquarters.
+ **Treatment:** The AWPF will treat 4.75 mgd of tertiary effluent and will consist of MF, Primary RO, Secondary RO, and UV system along with ancillary facilities, such as break tanks, transfer pumps, chemical pump skids. Equipment for the AWPF will be housed in a pre-engineered metal building and a separate operations and laboratory building will also be constructed adjacent to the AWPF.
+ **Product Water Distribution:** Advanced treated purified product water from the AWPF will be conveyed by approximately 500 LF of 16-inch diameter pipelines to two new injection wells, located at the AWPF site.
+ **Disposal Conveyance:** The brine from the RO system will be conveyed by approximately 17,000 LF of 6-inch diameter pipelines to new evaporation ponds to facilitate brine disposal at a nearby location.
+ **Brine Evaporation Ponds:** Up to 113 acres of new evaporation ponds will be constructed to dispose RO brine.

After the required residence time (groundwater travel time) as stipulated by the DDW, groundwater will be extracted downgradient using existing municipal wells owned by PWD to supply potable water to the service area. **Table 11-1** provides a summary of the construction costs, which includes the following cost components:

- **Equipment –** includes process equipment and associated tanks or pumps.
- **Conveyance –** includes pipelines, pumps and injection wells.
- **Buildings –** includes pre-engineering buildings for equipment and storage and associated concrete foundations.
- **Brine Evaporation Ponds –** includes liners, ramps and flood control improvements.
- **Sitework and Installation –** includes demolition, earthwork, yard piping, installation and electrical and instrumentation and control (I&C) work.
- **Mobilization –** assumed at five percent of the construction subtotal.
- **Other Contract Costs –** includes five percent design contingency, 9.5 percent sales tax of equipment and materials, 30 percent contractor markups and overheads, and 25 percent construction contingencies.
- **Non-Contract Costs –** includes Engineering/ESDC/PM/CM costs, land acquisition and permitting.

Table 11-1. Construction Cost Summary

Parameter	Cost (2022$)	Notes
Equipment	$14,463,000	
Conveyance	$13,115,000	
Buildings	$20,825,000	
Brine Evaporation Ponds	$16,836,000	
Sitework and Installation	$15,808,000	
Subtotal	$81,047,000	
Mobilization	$4,060,000	5% of subtotal
Subtotal with Mobilization	$85,107,000	
Contract Cost Allowances	$36,050,000	includes design contingencies, sales tax, contractor markups and overheads
Contract Cost	$121,157,000	
Construction Contingencies	$30,290,000	25% of contract cost
Field Cost	$151,447,000	
Non-Contract Costs	$44,990,000	includes engineering, ESDC, PM, CM, land acquisition costs and permitting
TOTAL CONSTRUCTION COST	**$196,500,000**	

Key:
CM = construction management
ESDC = engineering services during construction
PM = project management

Detailed cost estimates are provided in **Appendix A.11**. All cost estimates are presented in 2022 dollars but once the project schedule is finalized, costs will be escalated to the midpoint of construction. The estimates were prepared in accordance with the criteria established by the Association for the Advancement of Cost Engineering (AACE) for a Class 5 cost estimate. According to AACE, Class 5 estimates are "generally prepared based on very limited information, and subsequently have wide accuracy ranges. Typical accuracy ranges for Class 5 estimates are -20 percent to -50 percent on the low side, and +30 percent to +100 percent on the high side, depending on the technological, geographical, and geological complexity of the project, appropriate reference information, and other risks."[1]

11.2 Operations and Maintenance Cost Estimate

The operation and maintenance costs include power, chemicals, and consumables for each treatment process at the AWPF, major equipment replacement, labor, brine disposal, tertiary effluent water purchase and contingency. **Table 11-2** provides a breakdown of the O&M costs. The cost components include:

+ **Power –** assumed at $0.18/kWh and included power demand for treatment equipment and conveyance based on pumping demand.
+ **Chemicals –** assumed for process chemicals including MF (sodium hypochlorite, citric acid, hydrochloric acid, sodium bisulfite, ammonium sulfate), RO (sulfuric acid, antiscalant, citric acid, caustic), UV/AOP (sodium hypochlorite), stabilization (lime, carbon dioxide) and residual disinfectant (sodium hypochlorite)
+ **Maintenance –** assumed at three percent of equipment costs
+ **Major Equipment Replacement –** estimated at five percent of equipment costs
+ **Labor –** estimated at $150/hr (based on experience from other AWPF facilities)
+ **Disposal –** brine ponds salt disposal costs assumed at $243/cubic yards (based on quotes from dredging companies and disposal rates for resource conservation and recovery act (RCRA waste)
+ **Surface water treatment –** estimated at $270/acre-feet (AF) (based on 5-year historical treatment cost data from PWD)
+ **Tertiary water purchase –** estimated at $150/AF (based on contract agreement with LACSD)
+ **Contingency –** assumed at 15 percent of O&M subtotal

[1] (2005) AACE International Recommended Practice No. 18R-97, Cost Estimate Classification System – As Applied In Engineering, Procurement, And Construction For The Process Industries, TCM Framework: 7.3 – Cost Estimating and Budgeting

Table 11-2. Operations and Maintenance Cost Summary

Parameter	Cost (2022$)	Notes
Power, $/yr	$753,000	
Chemicals, $/yr	$611,000	
Maintenance, $/yr	$592,000	
Major Equipment Replacement, $/yr	$561,000	5% of equipment cost
Labor, $/yr	$1,752,000	
Disposal, $/yr	$1,070,000	Salt disposal from ponds
O&M Subtotal	$5,339,000	
O&M Contingency	$801,000	15% of subtotal of O&M cost estimate
Water Purchase	$799,000	$150/AF: Based on agreement with LACSD
Total O&M Cost	**$6,140,000**	

Key:
LACSD = Los Angeles County Sanitation District
O&M = operations and maintenance

Detailed operations and maintenance cost estimates are provided in **Appendix A.11**.

11.3 Net Present Value

The net present value was calculated for a 25-year term and 5 percent interest rate, using 2022 dollars. This analysis showed NPV of $235,435,000, which translates to a unit cost for product water at $1,982/AF.

12.0 Risk and Mitigation Summary

The following potential risks and associated mitigation strategies that have been identified to date for the Pure Water AV Program are presented in **Table 12-1.** Potential risks, and recommended mitigation strategies associated with the program will be continually assessed throughout the project life cycle.

Table 12-1. Risk Assessment

Program Item	Risk	Mitigation
Financing	Financing rates are higher than anticipated.	Stantec is continually working with PWD to secure additional sources of funding as they become available to help finance Pure Water AV. Funding opportunities will continually be explored through construction of the program to minimize project costs and the impact to PWD rate payers.
Demonstration Facility Water Quality Results	Demonstration water quality results are less favorable than expected.	During demonstration testing, adjustments and optimizations will be made to each of the processes to confirm final water quality results are within acceptable regulatory limits. All water quality test results from the demonstration testing will be carefully reviewed by an independent advisory panel of experts (IAP). Recommendations from the IAP will be incorporated into the design of the full-scale facilities.
Brine Management Approach	Viability of Capture6 technology for brine management.	The Capture6 technology will be tested alongside the AWP demonstration facility to confirm its applicability and viability for full-scale brine management. The test results from the brine management demonstration testing will be reviewed by an independent consultant as well as an independent advisory panel. If the results and recommendations from the IAP are unfavorable, PWD will still move forward with the project using brine ponds for brine management
Injection Wells	Reduced groundwater modeling confidence due to uncertainty of travel times, injection capacity, and uncertainty of effective porosity	To date, groundwater modeling efforts have been based on desktop studies using available site hydrogeological data. To improve confidence in the model results, it is recommended to perform field studies to better inform the hydrogeological model. Field studies to include design and construction of a full-scale injection well, construction of monitoring wells, installation of data loggers on existing potable water extraction wells and tracer testing. Potable water would be utilized to test the capacity of the injection well and data collected would be reviewed by an independent advisory panel. Additional field testing will be completed as needed and the hydrogeological model will be updated.
Construction Costs	Construction costs may be higher than originally estimated.	Updated construction costs will be provided to PWD throughout the various stages of design to increase confidence in the final construction costs and allow PWD time to secure more funding if needed.
Environmental Permitting	Environmental issues may arise during initial investigations that result in more mitigation than expected.	It is assumed a Mitigated Negative Declaration (MND) will be the appropriate CEQA document. If potentially significant unmitigable impacts are identified, PWD will prepare an Environmental Impact Report to further evaluate project alternatives and additional mitigation measures. Cost and time impacts will be evaluated at that time.
Public Outreach	Limited public acceptance of the program.	PWD will continue public outreach efforts throughout the life of the project planning and construction. A Pure Water AV website has been set-up to keep the public and stakeholders up to date on program activities. Documents produced as part of the program will be available for public and stakeholder review on the Pure Water AV website. Public tours of the demonstration facility will be held and will provide an opportunity for public and stakeholder engagement and learning.

13.0 Master Program Schedule

The recommended project implementation schedule is presented in **Figure 12-1** and includes phases for engineering, procurement and bidding, construction, and commissioning activities for various project components. It is anticipated that preliminary design and CEQA tasks will be completed in 2024 and 2025, with design and construction of facilities to follow through 2029. The critical path schedule will consist of the AWPF construction and well drilling and equipping tasks, while other infrastructure design and construction will occur in parallel. Under this schedule, the treatment facility and conveyance infrastructure will be operational by mid-2029.

The current schedule is based on the use of brine ponds for brine disposal. As previously discussed, the Capture6 technology will be evaluated at the demonstration facility as an alternative brine management solution, which may eliminate the need for brine ponds. However, initial results from the demonstration facility will not be available until 2026. Waiting for these results to determine an optimum brine management strategy would extend the overall Program schedule by over one year, as presented in an alternative schedule (**Figure 12-2**).

These project schedules are a snapshot in time of what is known at the time of this report being written. The program schedule is driven by many factors including obtaining additional funding, permitting, demonstration performance results, design activities and constructions schedules. Both program schedules will be updated periodically as more data becomes available and until an optimum brine management strategy is selected.

Brine Management with Brine Ponds

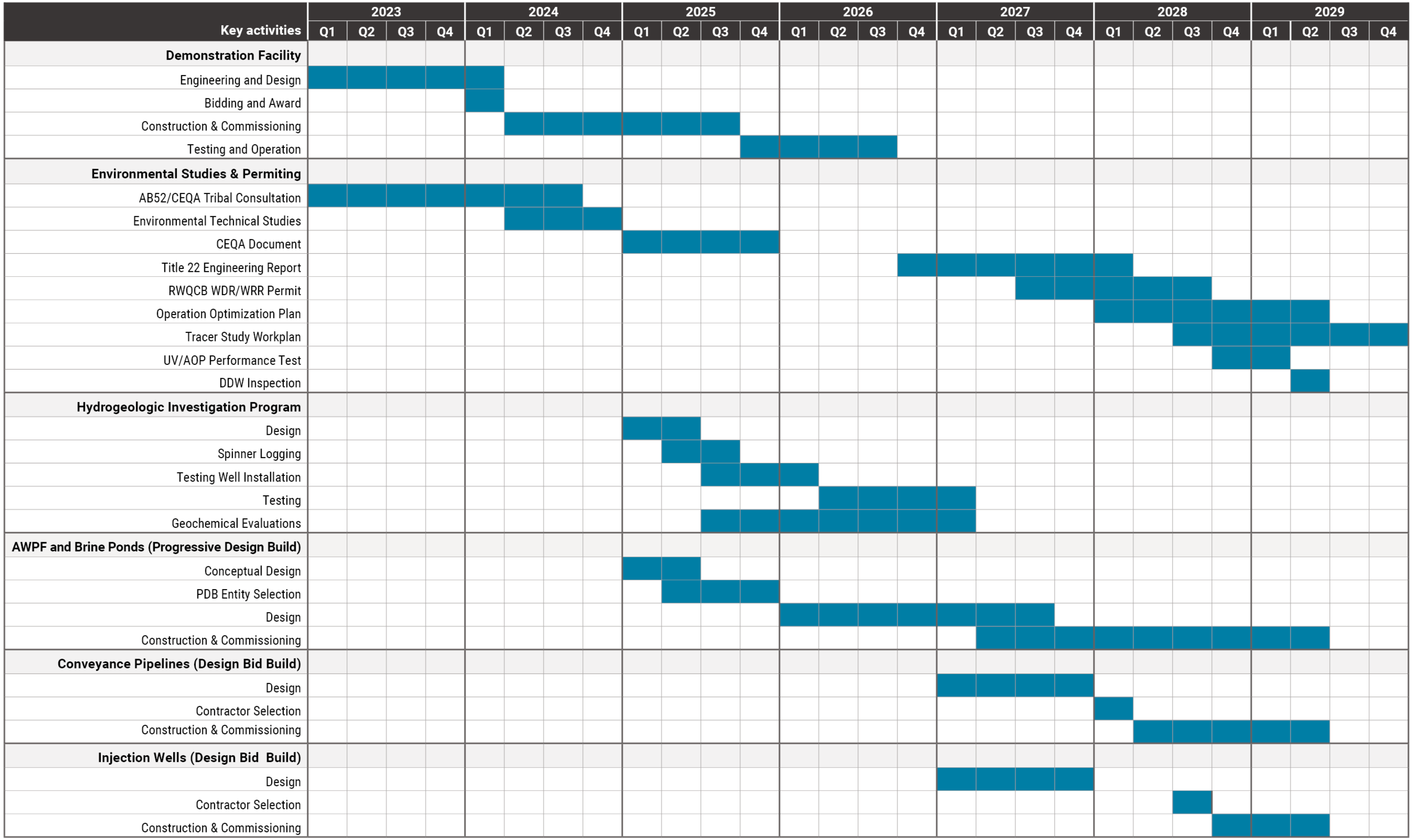


Figure 12-1. Pure Water Antelope Valley Baseline Implementation Schedule

Brine Management with Capture 6

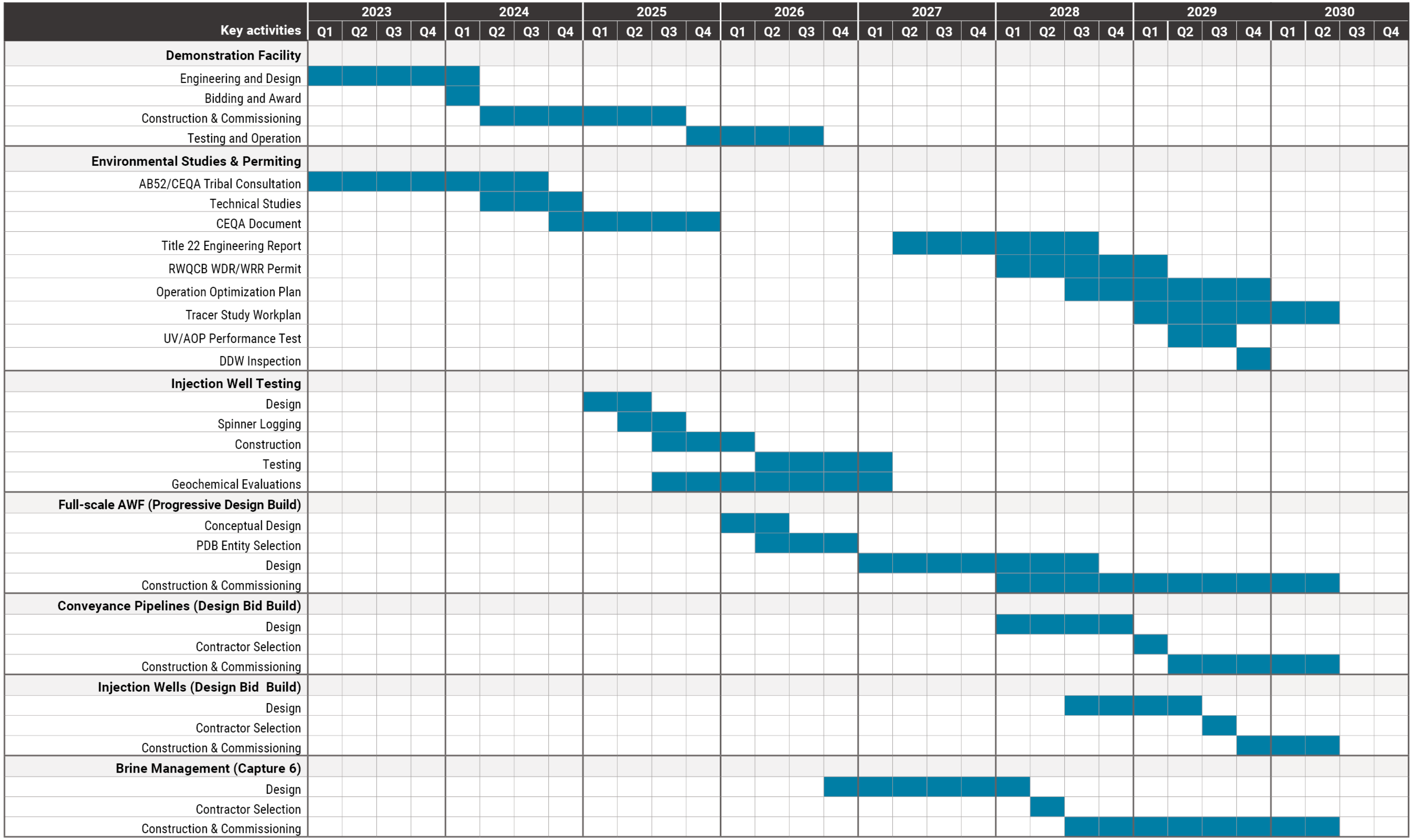


Figure 12-2. Pure Water Antelope Valley Extended Implementation Schedule

APPENDIX A.1

Rapid Program Readiness TM

APPENDIX A.2

Tertiary Water Requirements TM

APPENDIX A.3

Potable Reuse Alternatives Analysis TM

APPENDIX A.4

Brine Management Strategy TM

APPENDIX A.5

Funding Assessment TM

APPENDIX A.6

Delivery Methods Assessment TM

APPENDIX A.7

Economic Impact Assessment TM

APPENDIX A.8

Summary of Numerical Groundwater Model Results TM

APPENDIX A.9

Conceptual Design Report for Pure Water AV – Advanced Water Treatment Demonstration Facility

APPENDIX A.10

Public Outreach Plan TM

APPENDIX A.11

Project Construction Costs

Stantec

SUBMITTING WITH

Trussell

MONTGOMERY & ASSOCIATES Water Resource Consultants

K&A KATZ & ASSOCIATES

mwa architects