# Palmdale Regional Groundwater Recharge and Recovery Project

## Draft Planning Report

Water Recycling Agreement No. D15-05003

Water Recycling Funding Program WRFP No. 3616-010

State of California Division of Financial Assistance

PALMDALE WATER DISTRICT

JUNE 2016

## Preface and Engineer's Stamp

Utilizing recycled water from the Palmdale Tertiary Treatment Wastewater Plant for use in the Palmdale Water District's service area has been implemented by providing recycled water to construction contractors and to McAdams Park in the City of Palmdale. Around year 2012, the District began to consider the use of recycled water as an essential component of its long range water supply portfolio when it undertook planning on the large scale Littlerock Creek Groundwater and Recharge Project. The study resulted in a Preliminary Feasibility Report of February 2015 in which ten alternatives were developed. Following that report, the name of the project was changed to the Palmdale Regional Groundwater Recharge and Recovery Project (PRGRRG). The rationale for the name change was that it better represents the long term interest of the District in being a regional partner in groundwater recharge in the Antelope Valley.

In this planning report reference is made to the Littlerock Creek Groundwater Recharge and Recovery Project and other reports. Since the completion of the Littlerock Creek recharge project, the District has completed the following reports –

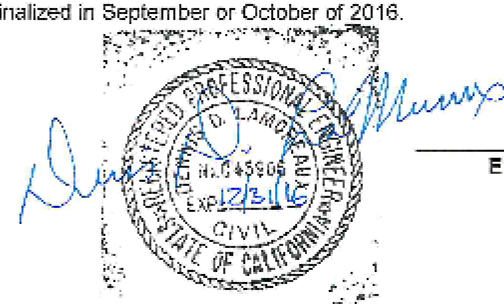
- November 2015, Engineering Report (Preliminary Design) on Preferred Alternative
- November 2015, 30% Plan and Specs Preferred Alternative
- November 25, 2015 Draft EIR/EIS Alternatives and Preferred Alternative

The Preferred Alternative described in the above reports has a construction cost in the range of $104 million dollars. Due to the size of the project and the urgent need to address short term water supply needs, the project was divided into smaller phases. Phase 1a would be constructed to meet PWD water demands to the year 2038 with costs in the $55 million range. Phase 1b would be constructed to meet PWD demands in the time period of 2039 to 2056 at a cost of $28 million. Phase 2 would be constructed to meet water demands to serve the build out population for the service area of the PWD that take place from 2059 to 2068 with an estimated cost of $21 million.

The PRGRRP project would deliver water from LA County Sanitation District No. 20 Palmdale Tertiary Treated Wastewater Plant and blend it with the District's State Water Project Table A water entitlement and recharge it into the Antelope Valley groundwater aquifer through recharge basins. The project would use 6,500 acre-feet of recycled water. This would allow the District to more efficiently use its SWP water. Long term the project would extract 10,800 acre-feet of water from the groundwater basin contributing to the District's long-term water supply reliability.

The Title 22 Engineering Report was completed in February 2016 for Phase 1a and submitted to the SWRCB DDW for review. The Final EIR/EIS is expected to be filed mid-to-late summer of 2016.

The District is presently in discussions with the LA County Sanitation District No. 20 to formalize an agreement to transfer the water rights for the recycled water to the District. The agreement is expected to be finalized in September or October of 2016.




**Engineer's Stamp**

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**Engineer's Stamp**

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2. Attachment B - Littlerock Creek Recharge Feasibility Report February 2015
3. Attachment C – Bartle and Wells Water Rate Study 2014
4. Attachment D - Approval Letter for Salt Nutrient Management Plan 2014
5. T1 Engineering Report (Preliminary Design) November 2015
6. T4 Title 22 Engineering Report February 2016
7. T9 Plan and Specs – 30% Design November 2015
8. Draft EIR/NEPA November 2015 (uploaded to FAAST – November 2015)

## 1.0 Location

The Palmdale Water District (District) is located in the Antelope Valley of Los Angeles County about 60 miles north of the city of Los Angeles. The District was organized in 1918 and now provides service to an area of approximately 40 square miles, including the majority of the City of Palmdale as well as substantial adjacent areas outside the City limits.

## 2.0 Status of Project and Work Completed

- Preliminary Feasibility Report on Alternatives and Design completed February 2015
- Final Feasibility Study completed November 2015
- Design to 30% level completed November 2015
- The Draft EIR/EIS was filed on November 25, 2015
- Title 22 Engineering Report – draft completed in February 2016 and submitted to State Water Quality Control Board for Review
- Final EIR/EIS will filed in July/August 2016
- Permitting will start in late summer 2016
- Final Design will start in late summer/early fall 2016

## 3.0 Project Overview

The Palmdale Regional Groundwater Recharge and Recovery Project (PRGRRP, or Project) is a groundwater banking program with surface recharge of imported water and recycled water, as well as recovery facilities to help meet future water demands and improve water supply reliability for the District. The Project will deliver raw water from the East Branch of the California Aqueduct (State Water Project [SWP] Water) and blend it with recycled water from LA County Sanitation District No. 20 Palmdale Tertiary Treated Wastewater Plant before recharging it to the groundwater basin in Antelope Valley. The recharge capacity of the Project is estimated to be approximately 52,000 acre-feet per year (AF/yr). This recharge capacity is greater than the maximum extraction capacity to allow high levels of recharge in wet years when SWP water is readily available.

## 4.0 Project Has Evolved Over Time

*Note: Palmdale Water District is seeking grant and construction funding for only Phase 1a*.

The project is proposed to be developed in the following three phases to meet Title 22 requirements, align with PWD's future water demands and spread capital infrastructure investments over time. Phases 1a would be constructed to meet PWD water demands to the year 2038, Phase 1b would be constructed to meet PWD demands in the time period of 2039 to 2058, and Phase 2 would be constructed to meet water demands to serve the build out population for the service area of the PWD that take place from 2059 to 2068.

- **Phase 1a** will include construction of facilities over the first 20 years to initially meet a recycled water content (RWC) of 20 percent and demonstrate the ability of the project to meet Title 22 requirements. Phase 1a facilities include construction of conveyance pipelines from the source waters to two recharge basins, four recovery wells and a well collection pipeline that connects to PWDs potable water distribution system.

- **Phase 1b** will expand facilities to meet PWD's water demands for the 20 years following Phase 1a. Phase 1b facilities include construction of a third recharge basin, up to four additional recovery wells, a water storage tank to meet chlorine contact time requirements, and the distribution site facility including an electrical room, control room, chlorine generation, and a Potable Water Pump Station (PWPS) to send flows back to the PWD potable water distribution system.

- **Phase 2** will build-out Project facilities to meet PWD's water demand through ultimate demand or can be constructed to accompany partner agencies. Phase 2 includes construction of all remaining facilities including the fourth recharge basin, up to eight additional recovery wells, If partner agencies participate in the recharge project, a Return Water Pump Station (RWPS) that would bypass the storage tank to pump non-chlorinated return water to the East Branch of the California Aqueduct would be constructed.

Phase 1a would use 3,600 acre-feet of recycled water and Phase 1b and 2 would use another 2,900 acre-feet of recycled water for a total of 6,500 acre-feet of recycled water.

## 5.0 Source of Recycled Water

LA County Sanitation Districts No. 14 and No. 20 (LACSD) respectively owns and operates the Lancaster and Palmdale Wastewater Treatment Plant and has jurisdiction over the water to be recycled as part of the Recycled Water Line Phase 2 project. Currently, the tertiary treated effluent water is provided by the LACSD for irrigation of fodder crops on land leased by the LACSD from the City of Los Angeles Department of Airports.

## 6.0 Water Supply

Water supply for the project area comes from three primary sources: groundwater, Littlerock Dam Reservoir, and imported water from the State Water Project (SWP). In addition, a small amount of water is supplied to western edges of Palmdale City by LA County Waterworks No. 40. Groundwater is obtained from the Antelope Valley Groundwater Basin via 25 active wells scattered throughout the service area. Local surface water supply is provided from Littlerock Dam Reservoir. This water is transferred from the reservoir to Lake Palmdale for treatment and distribution. PWD's imported water is provided by the SWP and is conveyed to Lake Palmdale which acts as a forebay for the PWD's 35 million gallon per day (mgd) Leslie O. Carter water treatment plant. Lake Palmdale can store approximately 4,250 AF of SWP and diversions from Littlerock Dam Reservoir water.

The PWD and Littlerock Creek Irrigation District currently hold a joint diversion right of 5,500 AFY from Littlerock Dam Reservoir. Littlerock Creek Irrigation District is entitled to purchase from the PWD, in any one calendar year, 1,000 acre-feet of water or 25 percent of the yield from Littlerock Dam Reservoir, whichever is less. The PWD has a SWP Table A maximum annual allocation of 21,300 AF. The PWD does not currently have a groundwater entitlement from the Antelope Valley Groundwater Basin. Table ES-1 summarizes the PWD's water entitlements.

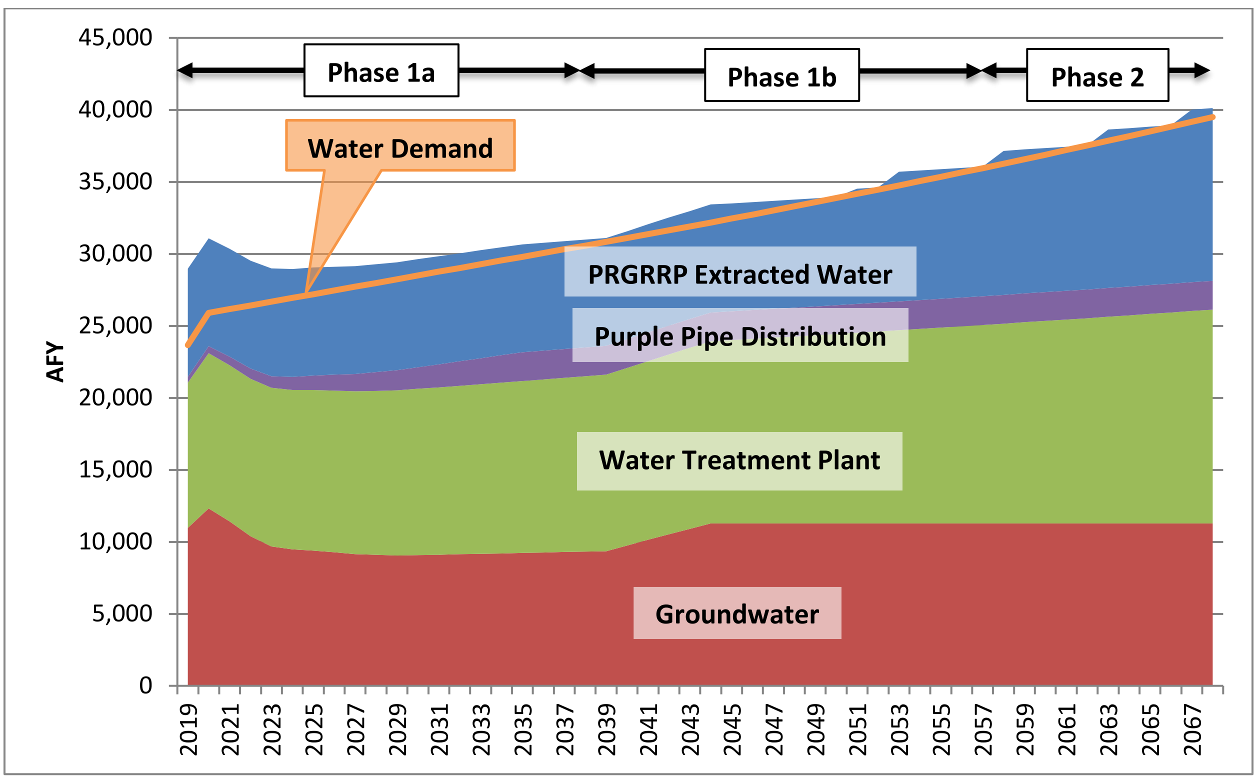
***Table ES-1 Palmdale Water District's Water Entitlements***

| Sources | Entitlements - AFY |
|---|---|
| **Groundwater** | N/A 1/ |
| **Littlerock Dam Reservoir** | 5,500 |
| **SWP** | 21,300 |
| **Totals** | **26,800** |
| 1/ Adjudication of the groundwater basin is expected to set an entitlement of 7,200 acre-feet per year. | |

## 7.0 Projected Water Demand For Recycled Water

The PWD is taking proactive steps towards expanding the use of non-potable water to meet a variety of non-potable and indirect potable uses. One of the District's goals is to utilize any available recycled water for groundwater replenishment as part of the optimal blend of supply alternatives to address future needs. Figure ES-1 displays in graphical form the long-term use of recycled water and its ability to stretch local water supplies for maximum efficiency. In essence, all of the available water in the District's service area will be used to meet the ultimate water demand at build-out for the City of Palmdale.

**Figure ES-1 Demand for Recycled Water**



## 8.0 Palmdale Water Reclamation Plant No. 20

The LA County Sanitation District No. 20 owns and operates the Palmdale Water Reclamation Plant which is located in LA County near 39300 30th Street East in the city of Palmdale. The plant currently occupies 286 acres east of the Antelope Valley (14) Freeway. It was placed in operation in September 1953.

The Palmdale Wastewater Treatment Plant is a tertiary treatment plant with a solids processing facility. The plant currently provides primary, secondary, and tertiary treatment for on average, 9 million gallons per day in and around the city of Palmdale. The plant serves a population of approximately 110,000 of Palmdale's residents. The remaining population of 40,000 is serviced by the LA County Sanitation District's No. 14 Lancaster Wastewater Treatment Plant. Effluent is currently reused for irrigation of trees and fodder crops on lands leased from the City of Los Angeles Department of Airports' property and also for parks in the city of Palmdale.

## 9.0 Palmdale Wastewater Plant Effluent Quality

The quality of the tertiary-treated recycled water produced at the Palmdale Wastewater Recycling Plant (WRP) is subject to Waste Discharge Requirements as expressed in the Lahontan Regional Water Quality Control Board Order R6V-2011-0012. Palmdale WRP consistently meets all of its effluent discharge requirements, with no waste discharge requirements (WDR) violations in the years 2011 through 2015.

The tertiary effluent produced at the Palmdale WRP meets Title 22 definitions of "filtered wastewater" and "disinfected tertiary recycled water" all Division of Drinking Water (DDW) standards for unrestricted access uses.

## 10.0 Compliance With Salt And Nutrient Management Plan

A Salt and Nutrient Management Plant (SNMP) was developed for the Antelope Valley Groundwater Basin in an effort to manage salts, nutrients and other constituents to ensure the beneficial uses of the groundwater basin are protected. Water quality management goals were established for seven chemical constituents based on protecting the groundwater basin for use as agricultural supply and municipal supply and based on consistency with the Regional Water Quality Control Board (RWQCB) Basin Plan.

Table ES-2 compares the Water Quality Management Goals for the Antelope Valley to the tertiary-treated recycled water quality at Palmdale WRP. For two constituents, boron and fluoride, no concentration data is currently available in the Recycled Water, and therefore no quality comparison is possible. Concentrations of constituents in Palmdale WRP are less than the respective SNMP management goal for all constituents with the exception of total dissolved solids. While total dissolved solids concentrations are higher in recycled water than in the lowest tier management goal for this constituent, groundwater TDS concentrations for the greater Antelope Valley are projected to remain below the management goal in the future for all planned recycled water and recharge projects. In general, recycled water use is not expected to affect present or future beneficial uses to beyond the 25 year planning period evaluated in the 2014 SNMP.

***Table ES-2: SNMP Water Quality Management Goals and Recycled Water Quality***

| Constituent | Units | SNMP Water Quality Management Goal | Palmdale WRP Tertiary-treated Effluent Average [(a)] |
|---|---|---|---|
| Arsenic | µg/L | 10 | <1 |
| Boron | mg/L | 0.7-1 [(b)] | NA [(c)] |
| Chloride | mg/L | 238-250-500 [(b)] | 150 |
| Fluoride | mg/L | 1-2 [(b)] | NA [(c)] |
| Nitrate | mg/L as N | 10 | 2.8 |
| Total Chromium | µg/L | 50 | 0.6 |
| Total Dissolved Solids | mg/L | 450-500-1000 [(b)] | 489 |

Notes:
NA = Not Analyzed, mg/L = milligrams per liter, µg/L = micrograms per liter
(a) Average of data from January 2012 through December 2014.
(b) Basin and sub-basin goals are based on baseline groundwater quality.
(c) At the time of preparation, no data is available on the effluent concentration of this constituent.

## 11.0 Cost Estimates for Phases

Funding under the Proposition 1 Water Recycling Program is being sought for only Phase 1a of the long range water recycling program of the Palmdale Water District. The costs for each Phase are present in Table ES-3.

**Table ES-3 Costs by Phase for Palmdale Water District's Long-Range Water Recycling Program**

| Infrastructure | Phase 1a | Phase 1b | Phase 2 | Total |
|---|---|---|---|---|
| Well Drilling (4/4/8) | $2,735,000 | $2,735,000 | $5,470,000 | $10,940,000 |
| Well Equipping, Site Work, & Buildings (4/4/8) | $3,027,500 | $3,027,500 | $6,055,000 | $12,110,000 |
| Recharge Site (2/1/1) | $5,000,000 | $2,084,500 | $2,084,500 | $9,169,000 |
| Pipelines | $36,400,000 | $3,300,000 | $170,000 | $39,870,000 |
| Distribution Site (Incl Phase 1a Chlorine Equip) | $1,000,000 | $13,080,000 | $4,300,000 | $18,380,000 |
| **Subtotal** | **$48,160,000** | **$24,230,000** | **$18,080,000** | **$90,470,000** |
| Design & Construction Management (15%) | $7,220,000 | $3,630,000 | $2,710,000 | $13,570,000 |
| **Total** | **$55,380,000** | **$27,860,000** | **$20,790,000** | **$104,040,000** |

## 12.0 Economic Analysis Summary

A summary table of the results of the economic analysis is presented below in Table ES-4.

Since funding is only being sought for Phase 1a, an economic analysis for Phase 1b and 2 are not presented. However, an analysis of the completed project at buildout has been included. A summary table of the results of the economic analysis is presented below.

***Table ES-4 Comparison of Alternatives Using Net Present Value***

| Alternative | Phase 1a (2019-2038) | Complete Project |
|---|---|---|
| **Annual Cost/AF** | **$835** | **$974** |
| **NPV** | **$697 M** | **$951 M** |
| **NPV/AF** | **$3,018** | **$2,934** |
| **Water Delivery (AF)** | **7,500** | **10,800** |

## 13.0 Phase 1a and State Water Management Objectives

The Department of Water Resources through the California Water Plan has developed the following six broad objectives for evaluating water management plans.

- Reduce Water Demand – could reduce water transfers from the Bay-Delta area.
- Improve operation efficiency and transfer of water – would contribute toward the goal of 100% water efficiency in Antelope Valley by recycling water.
- Increase water supply – would increase near-term water supply by 7,500 acre-feet and contribute toward long-term increase in local supply of 10,800 acre-feet.
- Improve water quality – project would neither improve or impair local water quality.
- Practice resource stewardship – project would facilitate prudent stewardship over local water supplies.
- Improve flood management – project would neither improve or impair flood management

## 14.0 Phase 1a and Palmdale Water District Objectives

Objectives of the Palmdale Water District include but is not limited to the following:

- Long term water supply reliability

- Environmental Sustainability
- Amount of financing required
- Cost effectiveness

*Long Term Water Supply Reliability* - This Phase 1a of the PRGRRP will provide 3,600 acre-feet of recycled water supply per year. Over the long term, the implementation of the Phases 1b and 2 will provide an additional reliable recycled water supply of approximately 2,900 acre-feet from the Palmdale Wastewater Plant. With the addition of 6,500 acre-feet of recycled water and the increased efficiency of using SWP the long-term reliable water supply would be increased by 10,800 acre-feet annually.

*Environmental Sustainability* **-** The project would not directly affect the environment of the Palmdale Water District Service area. However, it could have beneficial effects on the environmental issues in the Bay-Delta by reducing demands on transfer of water from that area.

*Amount of Financing Required* - The total project cost of $55,000,000 would be supported by a $15,000,000 and State Revolving Fund (SRF) loan interest loan of $40,000,000 at a 1.7% interest rate and 30-year loan period. This will require an annual repayment of $1,700,000 per year.

*Cost Effectiveness* **-** When all of the revenues generated by the sale of recycled water, meter fees and other items, the Palmdale Water District estimates that revenues would be $1,980 per acre-foot. This would generate annual revenues of $7,100,000 per year. This yields a benefit cost ratio in of 4.2 to 1.0 (computed by dividing $7,100,000 in benefits by $1,700,000 in annual costs) meaning the project is cost effective.

## 15.0 Regulatory And Permitting

### 15.1 Title 22

The Title 22 Engineering Report was completed in February 2016 and submitted to SWRCB DDW for review. The permit for the indirect potable reuse of recycled water will be managed by the Lahontan RWQCB, which requires the submission of a Report of Waste Discharge for discharging recycled water for ground water recharge via surface spreading. The Title 22 Engineering Report will support the Report of Waste Discharge by demonstrating how the project complies with the Title 22 Groundwater Replenishment Using Recycled Water Regulations adopted on June 18, 2014. Approval of the Title 22 Engineering Report must be obtained from both DDW and RWQCB, with the RWQCB the permitting agency.

### 15.2 CEQA/NEPA

CEQA requires every project proposed in the State of California to be examined for potential effects on the environment. An Draft Environmental Impact Report (EIR) for the PRGRRP was completed and filed on November 25, 2015. The report included additional analysis to satisfy the requirements of the Environmental Protection Agency. The document was uploaded to FAAST in November 2015. For each topic evaluated in detail in the EIR, the discussion included a description of baseline conditions, significance criteria, impact analysis, and measures (as applicable) to avoid, minimize, or mitigate impacts on the environment to less than significant levels.

## 16.0 Construction Financing Plan

This Executive Summary section summaries the financing plan for Phase 1 of the Palmdale Regional Groundwater Recharge and Recovery Project (PRGRRP). The project is seeking grant funding of 35% with a limitation of $15,000,000 and a low interest construction loan of the balance of $40,380,000 at 1.7%.

**Table ES-5 – Source and Timing of Required Funding for Phase 1a**

| **Funding Needs and Source of Funding** | **Funding Requirement By Years** | | |
|---|---|---|---|
| | **2016** | **2017** | **2018** |
| **Funding Needs** | | | |
| — Design/Construction Management | $1,220,000 | $4,000,000 | $2,000,000 |
| — Construction | - | $30,000,000 | $18,160,000 |
| *Subtotal* | $1,220,000 | $34,000,000 | $20,160,000 |
| **Prop 1 – Water Recycling** | | | |
| — Grant Portion (limited to $15,000,000) | $427,000 | $11,900,000 | $2,673,000 |
| — SRF Loan | $793,000 | $22,100,000 | $17,487,000 |
| *Subtotal* | $1,220,000 | $34,000,000 | $20,160,000 |

Using the State Water Resources Control Board set of procedures for economic analysis, the following values were computed. It is noted that for these calculations, the project cost of $55,000,000 was used in which the grant funding of has been included in project cost for analysis purposes.

**Table ES-6 - Effect of Potential Users to Fail to Use Recycled Water for Phase 1a (Note: annual cost/AF and NPV are based on using the SRWCB economic spreadsheet model)**

| | **Assume Different Amounts of Recycled Water Sold** | | | |
|---|---|---|---|---|
| Percent Water Sold | 100% | 90% | 80% | 75% |
| Amount of Water Sold | 7,500 AF | 6,750 AF | 6,000 AF | 5,625 AF |
| Total Project Cost | $55M | $55 M | $55 M | $55 M |
| Annual Cost/AF | $835AF | $886/AF | $950/AF | $988/AF |
| NPV | $679 M | $605 M | $531 M | $495M |
| NPV/AF | $3,018/AF | $2,987/AF | $2,949/AF | $2,926/AF |

# CHAPTER 1

# PROJECT SETTING

This Chapter provides background information for the Palmdale Regional Groundwater Recharge and Recovery Project. Grant and construction financing is being sought for only Phase 1a of the project with a construction cost of $48 million and design and construction management fees of $7,000,000 for a total project cost of $55 million.

## 1.1 Introduction

The Palmdale Regional Groundwater Recharge and Recovery Project (PRGRRP) is a groundwater banking program with surface recharge of imported water and recycled water, as well as recovery facilities to help meet future water demands and improve water supply reliability for the District. The Project will deliver raw water from the East Branch of the California Aqueduct (State Water Project [SWP] Water) to new recharge basins located in LA County near the northeastern portion of City of Palmdale. The recharge capacity of the Project is estimated to be approximately 52,000 acre-feet per year (AF/yr). This recharge capacity is greater than the maximum extraction capacity to allow high levels of recharge in wet years when SWP water is readily available. See Figure 1-1 for general location of the project.

The project will be developed in three Phases.

- **Phase 1a** will include construction of facilities over the first 20 years to initially meet a recycled water content (RWC) of 20 percent and demonstrate the ability of the project to meet Title 22 requirements. Phase 1a facilities include construction of conveyance pipelines from the source waters to two recharge basins, four recovery wells and a well collection pipeline that connects to PWDs potable water distribution system.

- **Phase 1b** will expand facilities to meet PWD's water demands for the 20 years following Phase 1a. Phase 1b facilities include construction of a third recharge basin, up to four additional recovery wells, a water storage tank to meet chlorine contact time requirements, and the distribution site facility including an electrical room, control room, chlorine generation, and a Potable Water Pump Station (PWPS) to send flows back to the PWD potable water distribution system.

- **Phase 2** will build-out Project facilities to meet PWD's water demand through ultimate demand or can be constructed to accompany partner agencies. Phase 2 includes construction of all remaining facilities including the fourth recharge basin, up to eight additional recovery wells, If partner agencies participate in the recharge project, a Return Water Pump Station (RWPS) that would bypass the storage tank to pump non-chlorinated return water to the East Branch of the California Aqueduct would be constructed.

The District is the applicant seeking funding through the State Water Resources Control Board (SWRCB) Recycled Funding Program for the PRGRRP. This document provides the project report required by the SWRCB.


**Figure 1-1 – Project Location Map**

## 1.2 Background

The District provides service to an area of approximately 40 square miles, including the majority of the City of Palmdale as well as adjacent areas outside the City limits. Currently, the District's water needs are met through three sources:

- Imported water from the SWP via the East Branch of the California Aqueduct and treated at the Leslie O. Carter Water Treatment Plant (LOCWTP);
- Surface water from Littlerock Dam Reservoir treated at the LOCWTP; and
- Groundwater from 22 active wells located in the Lancaster and Pearland sub-basins.

The District's current water delivery system provided approximately 23,000 AF/yr each year in 2013 and 2014. Based on District water demand projections, demand is projected to be 31,100 AF/yr by 2040 and is anticipated to reach 44,600 AF/yr under build-out conditions, after 2080. Given existing water supply conditions, deficits are anticipated to likely occur starting in 2021. As a result, new water supply options are being sought to continue meeting District demands.
At the beginning of 2015, the District undertook a feasibility study to evaluate the use of recycled water for groundwater banking, storage, and extraction to meet future municipal water demands and improve water supply reliability. Detailed analysis of water demands and supply indicates that the PRGRRP alone (in combination with incremental increases in SWP Table A water) can meet all of the District's future water supply needs.

The proposed PRGRRP delivers raw imported water from the East Branch of the California Aqueduct to new spreading basins. Tertiary treated wastewater from the Los Angeles County Sanitation District (LACSD) No. 20 Palmdale Water Reclamation Plant (PWRP) is used as the recycled water component of the Project. The District currently has a small recycled water program that only serves one customer (McAdam Park). Therefore, after the available amount of recycled water is allocated to McAdam Park, the proposed City of Palmdale Hybrid Power Plant (PHPP), and a proposed irrigation supply to east Palmdale, there is a substantial surplus available for groundwater replenishment. It is anticipated that the recycled water supply demand for groundwater replenishment will grow from about 3,600 AF/yr in 2020 to 6,500 AF/yr at buildout. The SWP water and recycled water will be blended together and then recharged to the groundwater aquifer. Blending of recycled water with another high quality water source is a requirement of the SWRCB.

## 1.3 Recycled Water Project Objectives

The Palmdale Water District desires to use recycled water to offset potable water demand and diversify the region's water supply options. The City's and PWD's service areas receives approximately 51 percent of its potable supply from imported surface water delivered by the State Water Project, 38 percent from groundwater, and 11 percent from local surface supplies stored in Littlerock Dam.

Developing recycled water use in the service area would accomplish a number of benefits. These include:

- Reduce dependence on the State Water Project (SWP) and groundwater supplies;

- Improve water supply reliability; and
- Preserve and extend potable water supplies

## 1.4 Description Of Entities And Service Area Boundaries

### 1.4.1 Los Angeles County Sanitation District No 20

LA County Sanitation Districts No. 14 and No. 20 (LACSD) respectively owns and operates the Lancaster and Palmdale Wastewater Treatment Plant and has jurisdiction over the water to be recycled as part of the PRGRRP project. Currently, the tertiary treated effluent water is provided by the LACSD for irrigation of fodder crops on land leased by the LACSD from the City of Los Angeles Department of Airports. The approximate location of the wastewater disposal area is shown on Figure 1-2.

LACSD has completed upgrades and expansions at the Palmdale Wastewater Treatment Plant that has resulted in commensurate increases in the availability of recycled water in the future. It is estimated that 18,100 acre-feet/year of tertiary-treated recycled water would be available by the build-out phase of the project.

### 1.4.2 Service Area(s)

Figure 1-2 shows location of the LACSD No. 20 Palmdale Wastewater Treatment Plant which will be the source of recycled water for the PRGRRP. The entity using the PRGRRP water will be the Palmdale Water District. Although not included as part of this water recycling project, other water entities include the Littlerock Creek Irrigation District and the Antelope Valley – East Kern (AVEK) water agency, and the cities of Rosamond and Lancaster. The general geographic relationship of the municipalities and water districts are shown on Figure 1-2.

The proposed project would be located within the Palmdale Water District's service area, which encompasses 46 square miles and includes a portion of the City of Palmdale and unincorporated Los Angeles County within the boundaries of Palmdale Water District. The project location is approximately 60 miles north of Los Angeles and 95 miles southeast of the City of Bakersfield, at an elevation approximately 2,600 feet above mean sea level.

The Palmdale Water District service area is located along the southwestern perimeter of the Antelope Valley. The Antelope Valley is a 2,400-square mile triangular basin bounded on the northwest by the Tehachapi Mountains, on the southwest by the San Gabriel Mountains, and on the east by a series of buttes and hills that roughly parallel the Los Angeles/San Bernardino County Line. The service area is located in a high desert climate, characterized by hot dry summers and cool wet winters.

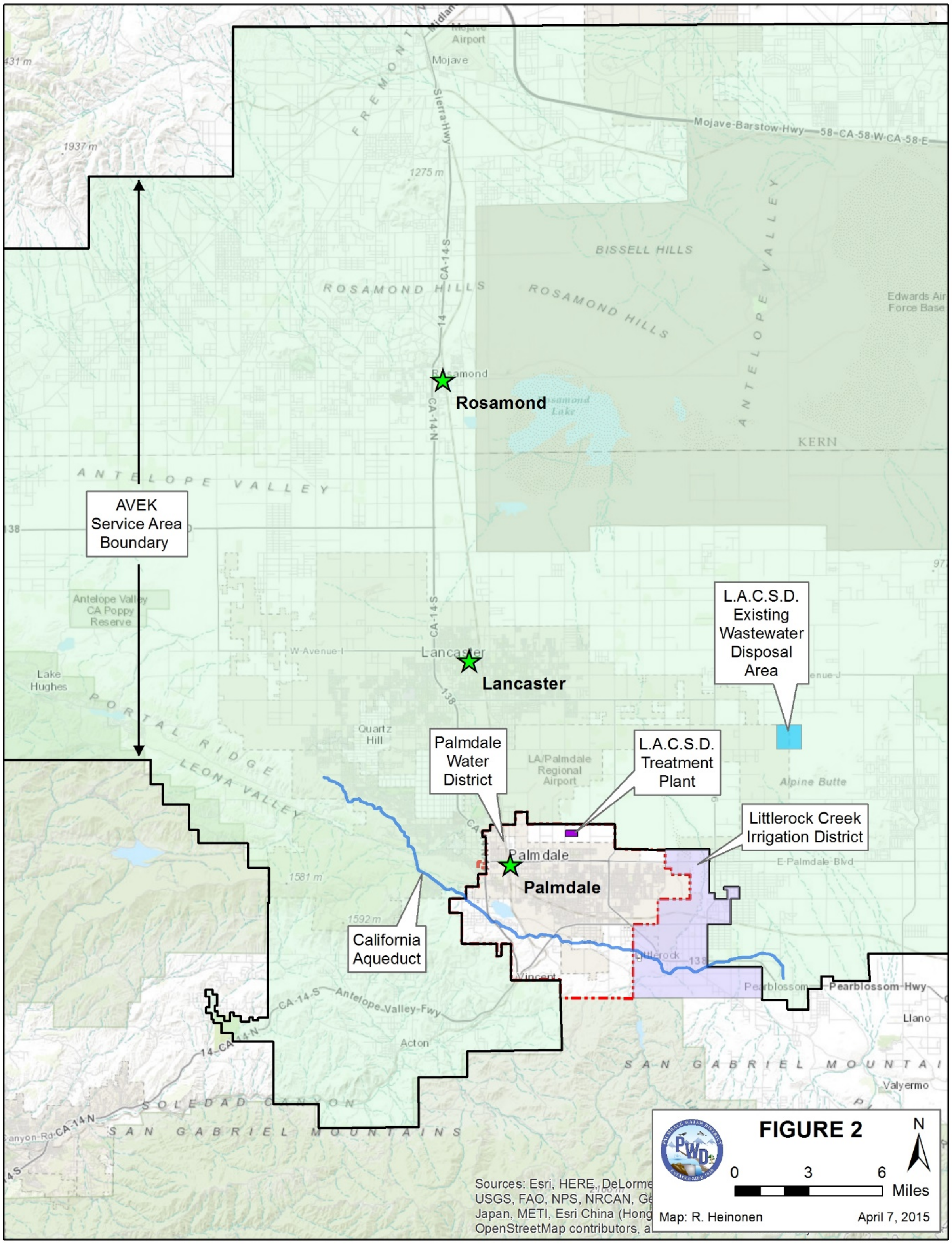



**Figure 1-2 Location of Wastewater Plant and Existing Disposal Area**

## 1.5 Population Projections

Population projections for City of Palmdale were obtained from Southern California Association of Governments.

| | Yr-2008 | Yr-2013 | Yr-2020 | Yr-2035 |
|---|---|---|---|---|
| City of Palmdale | 149,200 | 157,161 | 179,300 | 206,100 |

Irrigated land in Antelope Valley has resulted in little change in increase or decrease in agriculture production.

The increase in residential land use is evident from the population growth in the Antelope Valley. With significantly lower home prices than in southern Los Angeles County, the Antelope Valley housing market has seen an increase as people chose to commute to the Los Angeles area.

Industrial land use in the Antelope Valley consists primarily of manufacturing for the aerospace industry and mining. Edwards Air Force Base and the U.S. Air Force Flight Production Center (Plant 42) provide a strong aviation and military presence. Mining of borate in the northern areas and salt extract, rock, gravel and sand in the southern areas contribute to the Antelope Valley's industrial land uses. Figure 1-3 shows the land uses for the Palmdale area.

## 1.6 Disadvantage Community

The Department of Water Resources (DWR) has developed a web-based application to assist local agencies and other interested parties in evaluating Economically Distressed Area (EDA) status throughout the State, using the definition specified under the Water Quality, Supply, and Infrastructure Improvement Act of 2014 (Proposition 1) Economically Distressed Area Instructions.

Using the DWR's web based tool, it was determined that the blocks and census tracts to be served by the PRGRRP are designated as disadvantaged community status (see Figure 1-4). Prior to completion of the final project report, the PWD plans to explore further using Median Household Income statistics to see if the District can quality for consideration under the category of Disadvantage Community.

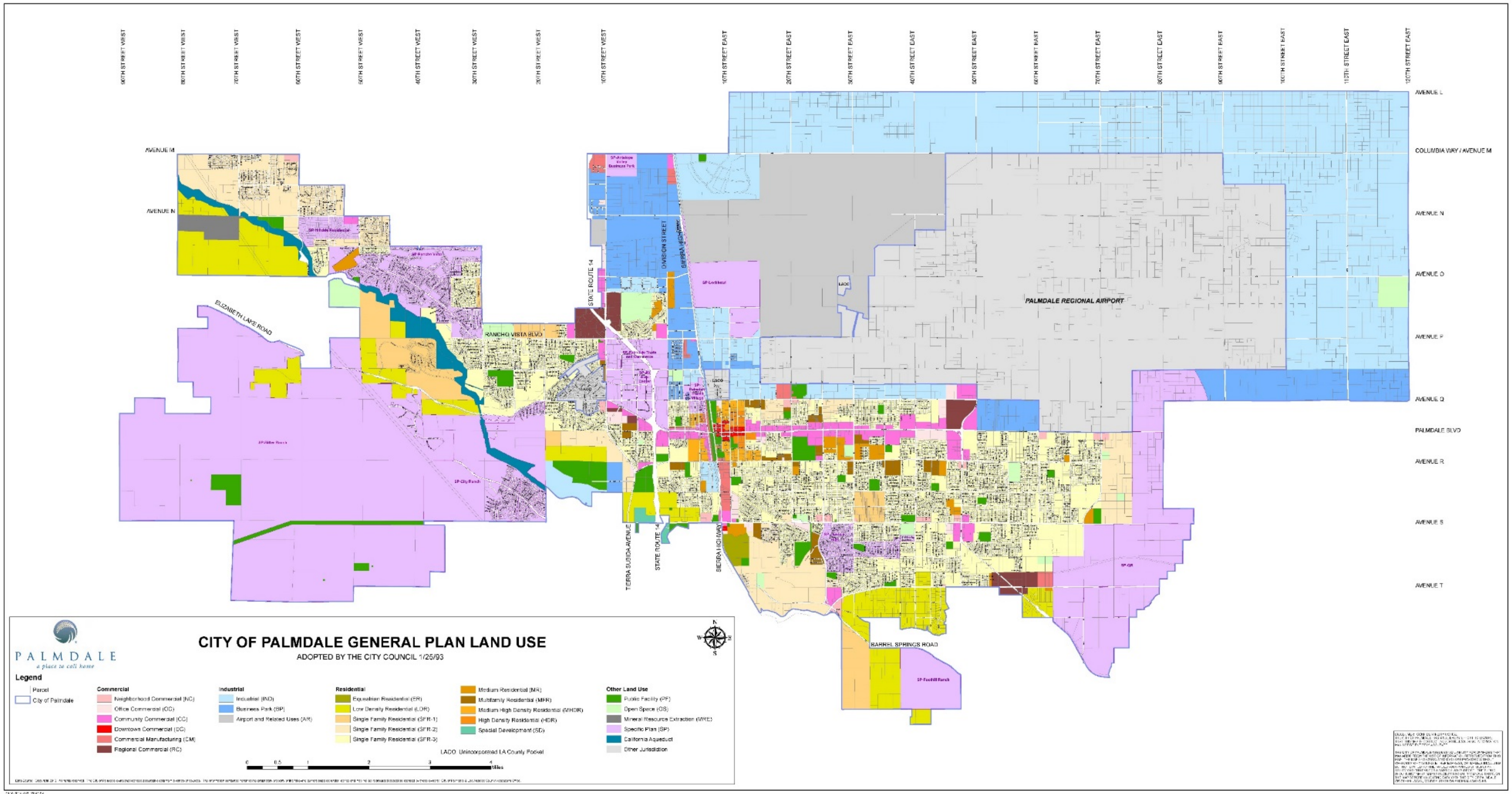



**Figure 1-3 City of Palmdale Land Use Map**

# CHAPTER 2

# STUDY AREA CHARACTERISTICS

This section provides a summary of the physical characteristics of the District's service area and water supplies.

## 2.1 Hydrologic Features

### 2..1.1 Climate

The District's service area is located in a high desert climate, characterized by hot dry summers and cool wet winters. The average annual rainfall is 7.9 inches per year that occurs mostly during winter from December to March. There is little precipitation during the summer from June to September.

### 2.1.2 Soils and Topography

The service area lies in a broad alluvial-filled valley. In general, soils within the Antelope Valley are derived from downslope migration of loess and alluvial materials, mainly from granitic rock sources originating along the eastern slopes of the Tehachapi and San Gabriel Mountains. The soil in the service area consists of alluvial deposits that have been derived from erosion of the mountains that border the alluvial plain. These deposits are composed of sands, silty sands and gravels which are moderately permeable. The soils are level, well-drained, moderately to highly alkaline and contain areas that are saline affected. Due to the dry climate, soils do not contain significant amounts of organic matter and have a low intrinsic fertility. However, the predominant soils that are found in the area are generally suitable for agricultural production and there are areas of historical and current agricultural production within the area and in the nearby vicinity. In these areas, where agricultural practices have led to tilling of plant residues back into the soil, the organic content of the soils has increased over time.

### 2.1.3 Surface Hydrology

The Antelope Valley is a closed basin. Surface water from the surrounding hills and from the valley floor flow primarily toward three dry lakes on the Edwards Air Force Base: Rosamond Lake, Buckhorn Lake and Rogers Lake. Surface water flows are carried by ephemeral streams. The most hydrologically significant streams begin in the San Gabriel Mountains in the southwestern edge of the Valley and include, from east to west, Big Rock Creek, Littlerock Creek and Amargosa Creek. Except during the largest rainfall events of a season, surface water generally flows toward the Antelope Valley from the surrounding mountains and quickly percolates into the stream bed and recharges the groundwater basin. Surface water flows that reach the dry lakes are generally lost to evaporation. It appears that little percolation occurs in the Antelope Valley other than near the base of the surrounding mountains due to impermeable layers of clay overlying the groundwater basin. The U.S. Geological Survey (USGS) estimates that nearly 1.4 million AF of surface water in the Antelope Valley is lost to evapotranspiration each year.

Littlerock Creek is the only developed surface water supply in the Antelope Valley. The Littlerock Reservoir, jointly owned by the District and Littlerock Creek Irrigation District (LCID), collects runoff from the San Gabriel Mountains. The 1992 design capacity of the reservoir was 3,500 AF.

Due to sediment accumulation the reservoir currently has a useable storage capacity of 3,037 AF. The District is in the planning stages of a project that would remove the accumulated sediment and restore the storage in the reservoir to its 1992 design capacity. Historically, water stored in the Littlerock Reservoir has been used directly for agricultural uses within LCID's service area and for municipal and industrial uses within District's service area following treatment at Leslie O. Carter water purification plant owned and operated by the District.

## 2.2 Groundwater Supplies

Groundwater pumping currently makes up a significant proportion of the water supply portfolio, accounting for 40 percent of supplies during a normal year. The groundwater supply comes from the Antelope Valley Groundwater Basin where there are 25 active wells currently drawing from the aquifer. This water is treated with chlorine disinfection and pumped directly into the District's potable distribution system. Since 1999, the District has produced on average 9,706 AF of groundwater per year. The availability of groundwater supply for the service area does not vary throughout the course of a year.

### 2.2.1 Groundwater Sub-basins

The USGS has identified a series of sub-basins in the Antelope Valley Groundwater Basin. The District overlies the Lancaster, Buttes, and Pearland groundwater sub-basins as shown in Figure 2-1. The boundaries between the three sub-basins are determined by discontinuity or by steepening of the groundwater surface as measured in wells, rather than by surface evidence of faults. The groundwater transfer from the Pearland and Buttes sub-basins to the Lancaster sub-basin is slowed across these boundaries. The total amount of water transferred between these three sub-basins is unknown.

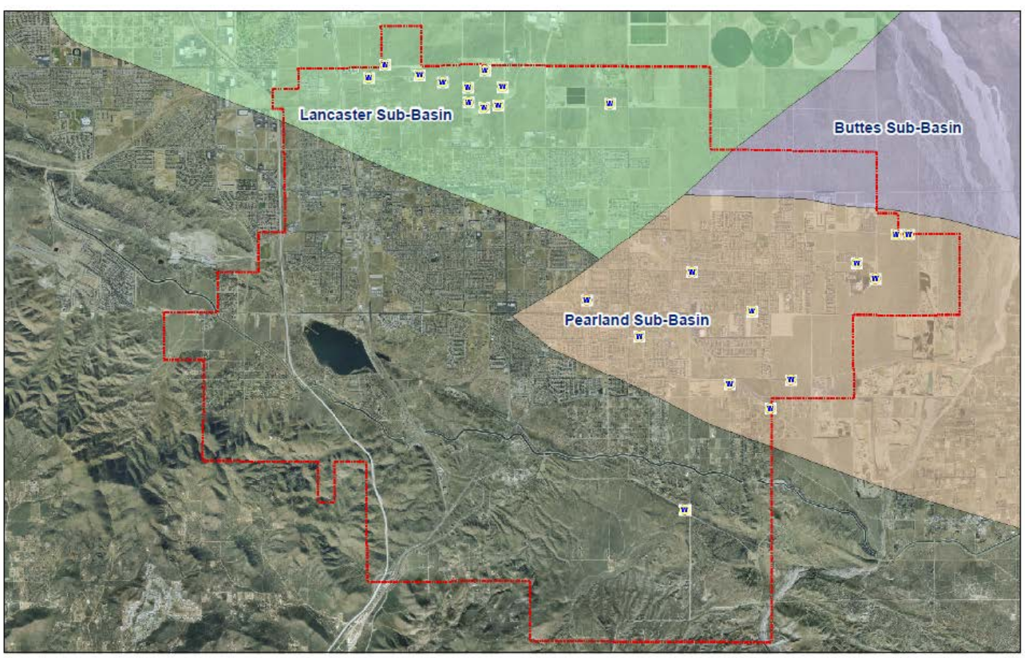



**Figure 2-1 Groundwater sub-basins in Antelope Valley**

**Lancaster Sub-basin -** The Lancaster sub-basin is located in the center of the Antelope Valley groundwater basin with its southern-most portions lying within the service area. It is bounded by bedrock to the south and by the Buttes and Pearland sub-basins to the east. Alluvium in this sub-basin reaches a thickness of about 1,100 feet in the northern portion of the service area. Two aquifer zones occur in this sub-basin. The principal (upper) aquifer is confined and is several hundred feet thick within the District service area. The District operates 12 wells in the Lancaster sub-basin, with a pumping capability of approximately 12,500 gallons per minute. This is approximately 75 percent of the District's total annual groundwater production and approximately 30 percent of the District's total water demand.

**Buttes Sub-basin -** The Buttes sub-basin is located southeast of the Lancaster sub-basin. A small portion underlies the District's service area. The District does not currently have any wells or pump water from this sub-basin. The aquifer zone consists of approximately 150 feet of saturated alluvial deposits.

**Pearland Sub-basin -** The Pearland sub-basin is also located southeast of the Lancaster sub-basin. This sub-basin is bounded on the south by bedrock, on the north by a fault separating it from Buttes sub-basin and on the West by the basin boundary. The northern most portion of the sub-basin lies within the District service area. A single aquifer zone occurs within the Pearland sub-basin and consists of approximately 250 feet of saturated alluvial deposits. The District operates 10 wells in the Pearland sub-basin, with a pumping capability of 3,500 gallons per minute. This accounts for approximately 20 percent of the District's groundwater production and 10 percent of the District's total water demand.

**San Andreas Rift Zone -** The San Andreas rift zone has two general groundwater-bearing areas. These areas generally lie east and west of the intersection of Pearblossom Highway and Barrel Springs Road. The area to the east is a narrow valley, with poor groundwater production potential. The area to the west is a broader valley with more extensive groundwater-bearing deposits. The District has four wells in the San Andreas rift zone, two in the western area and 2 in the eastern area. Currently, the District operates three of these wells pumping approximately 150 AF each year. This amount equals approximately two percent of the total annual groundwater production.

The depth to water along the San Andreas rift zone is generally about 25 feet below the ground surface, with a seasonal groundwater level fluctuation of 15 feet. Over the long term, groundwater levels in sediments within the fault zone have remained relatively stable, suggesting that the groundwater-bearing sediments have not been overdrawn.

### 2.2.2 Historical Groundwater Pumping

The historical groundwater pumped from the Antelope Valley Groundwater Basin by the Palmdale Water District is shown in Figure 2-2. The groundwater supplies accounted for 33 to 41 percent of water supplies between 2006 and 2010. Future pumping in the Antelope Valley Groundwater Basin is expected to decrease due to likely adjudication and then remain at a constant level of 7,200 AF. Given the District's efforts to diversify its water supply portfolio in the next several years, groundwater levels are expected to be managed. Projected groundwater supplies will consist of a combination of native groundwater, imported replenishment, and other banked supplies.

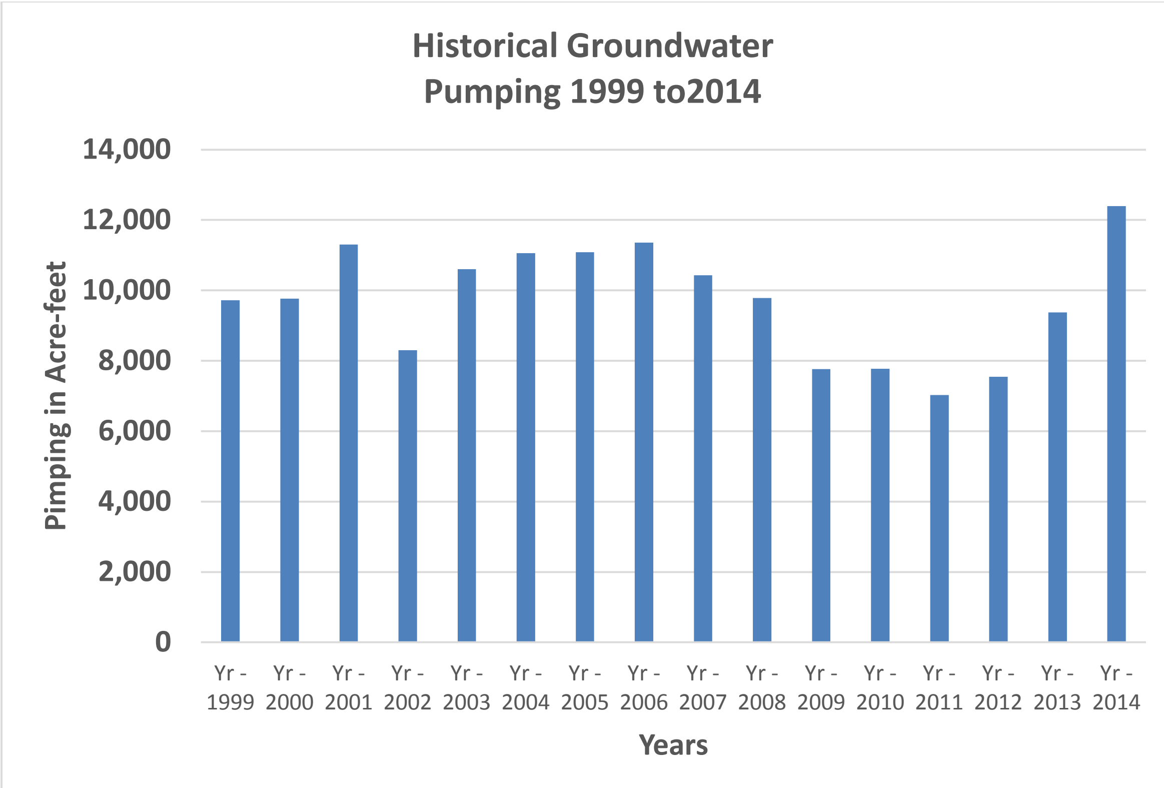



**Figure 1-2 Palmdale Water District Historical Groundwater Pumping**

## 2.3 Local Surface Water – Littlerock Creek Dam

Littlerock Dam Reservoir was built in 1922. This reservoir constitutes the District's local surface water supply source and is located in the hills southwest of the city of Palmdale. Recent renovations to Littlerock Dam Reservoir have increased its storage capacity to 3,500 AF, or 1.1 billion gallons of water.

Littlerock Dam reservoir is fed by natural run-off from snow packs in the local San Gabriel Mountains and from rainfall. The principal tributary streams are Littlerock and Big Rock Creeks, which flow north from the San Gabriel Mountains along the southern District boundary. Numerous intermittent streams also flow into the service area, however run-off is meager. The Littlerock Dam Reservoir intercepts flows from the Littlerock and Santiago Canyons. Runoff from the 65 square mile watershed in the Angeles National Forest to the reservoir is seasonal and varies widely from year to year.

The water is transferred from Littlerock Dam Reservoir to Palmdale Lake. Although Littlerock Creek flows mainly during winter and spring months, this influx is buffered somewhat by Littlerock Dam Reservoir, allowing this water to be available throughout the year.

### 2.3.1 Local Surface Water Entitlements

Since 1922, the District has shared water from this source with Littlerock Creek Irrigation District. The District and LCID jointly hold long-standing water rights to divert 5,500 AF/yr from Littlerock Creek flows. Per an agreement between the two districts, the first 13 cubic feet per second (cfs) of creek flows is available to LCID. Any flow above 13 cfs is shared between the two districts with 75 percent going to the District and 25 percent to LCID. Each of the districts is entitled to 50 percent of the reservoir's storage capacity. On average, the District has diverted approximately 4,000 per year from Littlerock Dam Reservoir. After losses in the 7 mile ditch from the Littlerock Dam to Palmdale Lake, the District's yield of the 4,000 AF is 2,791 AF.

In 1992, during renegotiations of the District's agreement, a plan to rehabilitate the existing dam was implemented. The plan involved reinforcing the original multiple-arch construction with a roller-compacted concrete buttress, raising the dam by 12 feet to increase capacity, providing recreational facilities around the reservoir, and replacing the historic wooden trestle between the creek and the reservoir with an underground siphon. The entire project was completed by the end of 1995. This agreement gives the District the authority to manage the reservoir. LCID granted ownership of its water rights to the District for the fifty-year term of the agreement in lieu of contributing financial resources for the rehabilitation work. Littlerock Creek Irrigation District is currently entitled to purchase from the District, in any one calendar year, 1,000 AF of water or 25 percent of the yield from Littlerock Dam Reservoir, whichever is less.

### 2.3.2 Historical Littlerock Creek Water Deliveries

The District's historical and current production from Littlerock Dam Reservoir is shown Figure 2-3. Historically the District local surface water production accounts for approximately 9 to 15 percent of its water supplies.

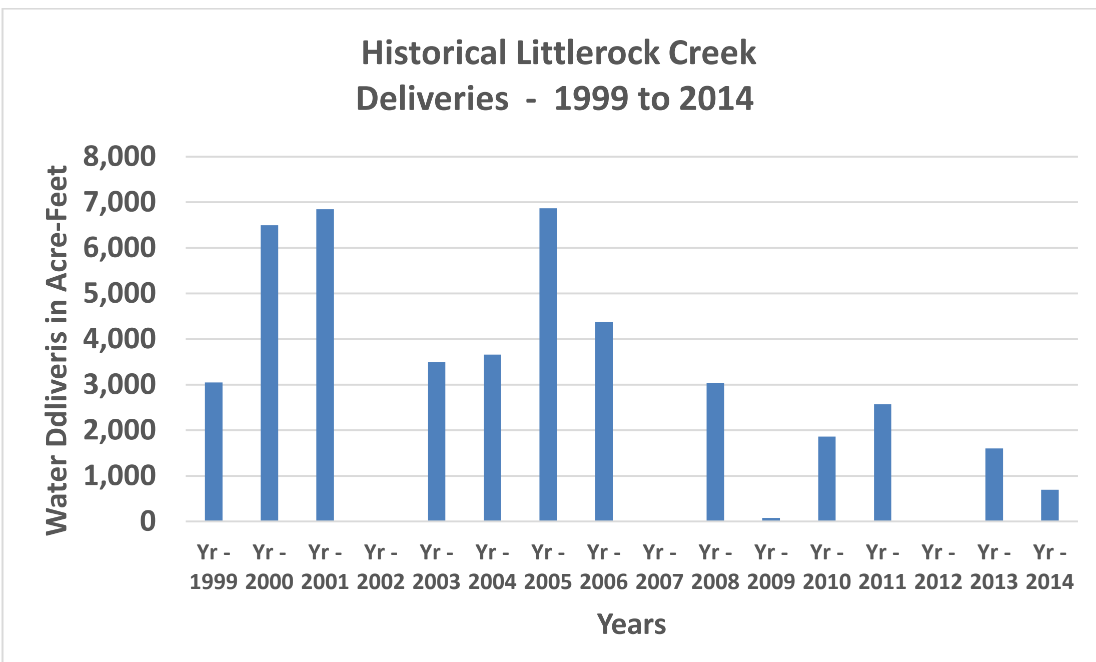



**Figure 2-3 Historical Littlerock Creek Water Deliveries**

## 2.4 Imported State Water Project Water

Imported water from the SWP is the current primary source of water supply to the District, providing approximately 50 percent of the District's water supply. The main transport structure of the SWP is the California Aqueduct, which conveys water from Northern California to Southern California. The aqueduct is a concrete-lined water delivery structure that is about 450 miles in length. This facility is managed by California Department of Water Resources (DWR).

### 2.4.1 Imported Water Entitlements

The District is one of 29 contracting agencies entitled to receive Table A water from the SWP. The District has been able to take delivery of SWP water since 1985 from the East branch of the California Aqueduct, which passes through the service area. The District receives its entitlement via a 30 cfs connection on the East Branch, where SWP water is conveyed to Lake Palmdale via a 30-inch diameter pipeline. Lake Palmdale acts as a forebay for the District's 35 million gallon per day (mgd) water treatment plant and stores SWP water and diversions from Littlerock Dam Reservoir water.

The District is contractually entitled to receive a Table A amount of 21,300 AF per year of SWP water. Availability of SWP water varies from year to year and depends on precipitation, regulatory restrictions, legislative restrictions, and operational conditions. Availability is greatly reduced during dry years. Over the last decade, the District has received on average 58% percent of its 21,300 AF contractual amount.

### 2.4.2 Article 21 Water

Article 21 water (defined in Article 21 of the water supply contracts, formerly called "Interruptible water") is offered only periodically, usually in wet hydrologic years, when excess flows are available in the Delta. The estimated range of monthly Article 21 water availability for the District is a relatively small amount of about 300 to 430 AF/yr over the next 20 years on an average basis.

### 2.4.3 Historical State Water Project Deliveries

The District's historical and current SWP deliveries are shown in Figure 2-4. Historically, imported water accounts for approximately 44 to 50 percent of the District's water supply.

### 2.4.4 Imported Water Opportunities

The District may increase its current Table A Amount through either short-term or permanent transfer of a portion of some other contractors' Table A Amounts. Selected contractors may have Table A Amounts in excess of their service area demands for a time, but may not wish to permanently transfer portions of that Table A Amount. In these cases, arrangement can be made for purchase of the excess water for a predetermined time as agreed upon.

The District has entered into a long-term purchase agreement of the Table A allocations with the County of Butte, another SWP contactor. The term of the agreement is ten years, and the District pays all SWP costs, including capital and operation and maintenance (O&M), as well as the variable power costs to deliver the water to its service area.

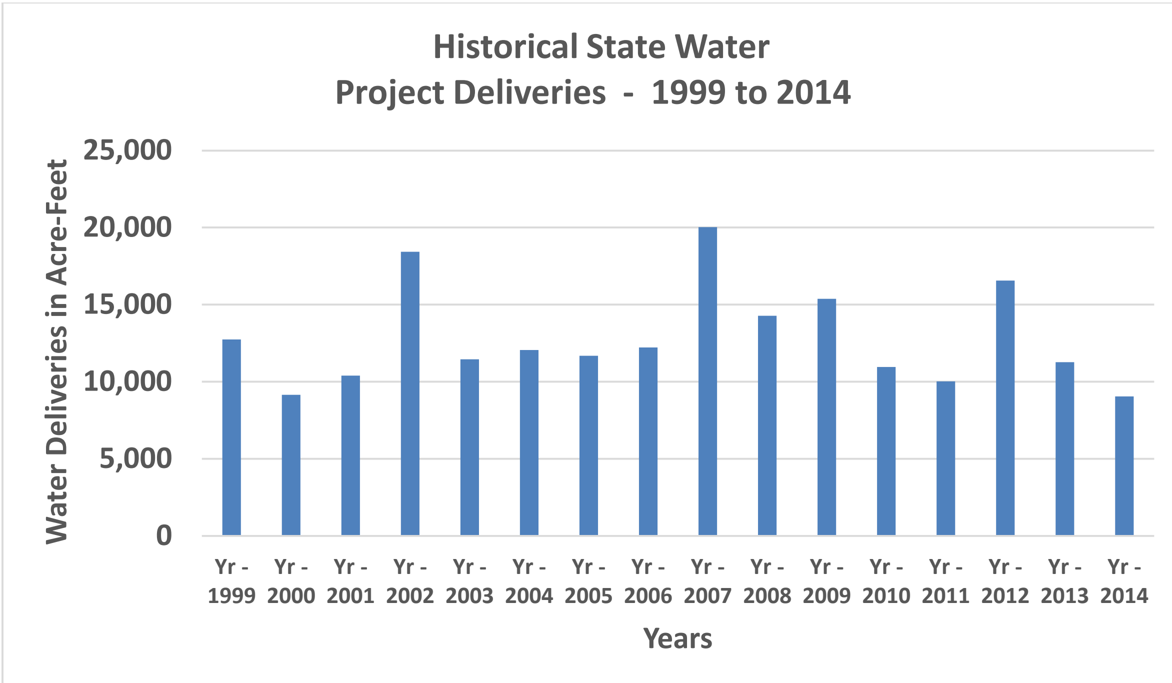



**Figure 2-4 Historical State Water Project Deliveries to Palmdale Water District**

Contractors (or their member agencies) may hold contractual SWP Table A in excess of their demands. Due to the high annual fixed costs of SWP Table A, these agencies may wish to sell this excess to another contractor. As such, Table A would be subject to the SWP annual allocation and SWP delivery and reliability constraints.

#### 2.4.4.1 Other Imported Water Opportunities

SWP contractors have several options for water that is allocated to them: use it, store it for later use, or transfer it to another contractor. Each long-term water contract describes several types of SWP water that are available to SWP contractors to supplement Table A allocations and Article 21 water: carryover water, turnback pool water, multi-year pool water, and SWP exchanges. Regardless of hydrologic conditions, Table A allocation water is given first priority for delivery over other types of SWP water. Historically, SWP water deliveries to the District since 1996 have ranged from approximately 9,000 AFY to 21,500 AFY, with an average value of approximately 12,300 AF/yr.

Carryover Water is Table A water that is allocated to a contractor and approved for delivery to that contractor in a given year, but is not used by the end of the year. Since 1996, the District has recalled up to 5,300 AF/yr of its carryover water. However, once implemented, the Palmdale Regional Groundwater Recharge and Recovery Project (PRGRRP) will act as a water savings account for the District, and it is anticipated that the District will no longer need to use SWP facilities to store its excess Table A allocated water.

Turnback Pools are a mechanism by which contractors with excess Table A allocations in a given hydrologic year may sell that excess water to other contractors. Since 1996, the District has only purchased a total of about 750 AF from turnback pools in order to supplement its water supplies, mostly during peak demand months of summer. However, upon implementation of the PRGRRP, the District should purchase and store this type of water (prior to April 1) if and when the water is offered at a lower price than Table A Amount, particularly during wet years when supply to the pools is high and retail demands are lower than normal.

Multi-Year Pool is a new program, which has been proposed by the SWP contractors and initiated by DWR, to improve management of limited SWP Table A supplies. The initial term of a demonstration multi-year pool will be two years (to distinguish it from the turnback pool and to not conflict with SWP water supply contract terms).

SWP Exchanges are included in provisions of the water supply contracts, providing for exchanges of SWP water (as well as non-SWP water). The District has entered into annual exchanges with one or more other SWP contractors, as needed, to bolster its annual Table A allocation in a given water year. These exchanges are highly dependent on hydrology, contractor demands, and the availability of Table A water. Exchanges can be "balanced" (i.e., one acre-foot to the buyer, exchanged for one acre-foot payable to the seller in a future year), or "unbalanced" (in which the buyer receives one acre-foot but agrees to pay a higher amount of water to the seller in a future year, often 1.5 to 2 AF). Because exchanges have flexible terms and can be affected quickly, they are becoming more common among SWP contractors.

## 2.5 Recycled Water

The District currently has a small recycled water program that only serves one customer within its service area (McAdam Park). The District is taking proactive steps towards expanding the use of non-potable water to meet a variety of non-potable and indirect potable uses through the formation of a Joint Powers Authority (JPA) with City of Palmdale. One of the District's goals is to utilize any available recycled water for groundwater recharge as part of the optimal blend of supply alternatives to address future needs. The recycled water can be supplied to the District from the LA County Sanitation District's No. 20 (LACSD) Palmdale Wastewater Treatment Plant (PWTP), which currently produces about 10,000 AF/yr of Title 22 recycled water.

Effluent from the PWTP is currently reused for irrigation of trees and fodder crops on City of Los Angeles Department of Airports (LAWA) property at agronomic rates and also for parks in the City of Palmdale. LACSD also has recycled water seasonal storage ponds located on 120th Street, between Avenue L and Avenue M. Recycled water is conveyed to the storage ponds via a transmission main along Avenue N that could also be utilized to convey recycled water to recharge basin alternatives. Prior to the plant's treatment process upgrade to full tertiary treatment in 2012, this site has discharged secondary effluent by land spreading, allowing it to percolate and evaporate, causing adverse impacts to groundwater quality (i.e., elevated nitrate levels), and creating a nitrate plume.

To project future supplies, it was assumed that recycled water from the PWRP would grow linearly at the same rate as potable demands; approximately 0.9 percent per annum on an average basis in the 2015-2040 period. This projection results in an estimated total recycled water supply of about 12,500 AF/yr by 2040, which is a lower number than the projections presented in the Palmdale Water District Recycled Water Facilities Master Plan (RMC, 2010). An initial 3.5 percent annual growth rate of potable water demands was estimated assuming that 2010 Urban Water Management Plan projections would delay by five years in order to account for slow economic recovery. The annual growth rate of potable water demands has since been revised and estimated to be 0.9 percent.

Based on these assumptions, it is estimated that the total recycled water supply from the PWRP will grow to about 12,500 AF/yr by 2040 and 18,100 AF/yr by buildout. It is anticipated that the recycled water use for landscape irrigation will not exceed 2,000 AF/yr at buildout. In addition, approximately 400 AF/yr of recycled water is planned for use at the proposed Palmdale Power Plant. Figure 2-5 presents projections of recycled water supply availability for the Project through 2040.

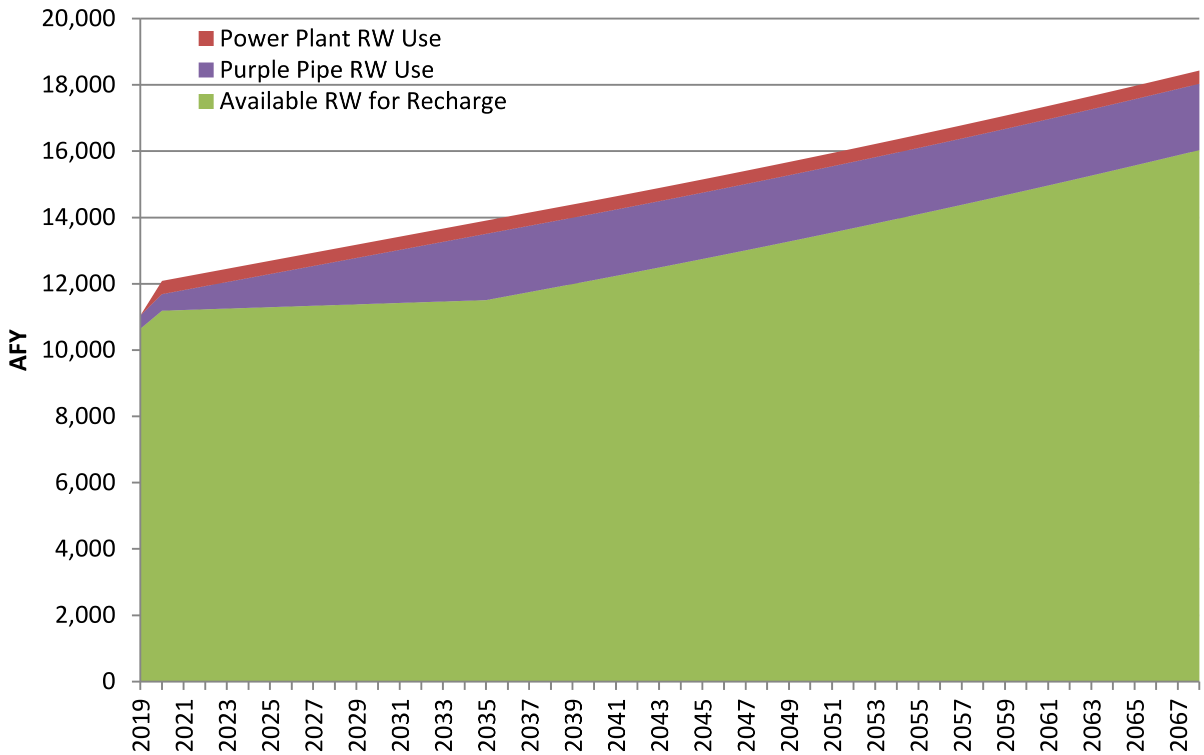



**Figure 2-5 Recycled Water Quantity from Palmdale Wastewater Plant**

## 2.6 Water Quality

### 2.6.1 Groundwater

Groundwater quality is excellent within the principal aquifer but degrades toward the northern portion of the dry lakes areas. Considered to be generally suitable for domestic, agricultural, and industrial uses, the water in the principal aquifer has a total dissolved solids (TDS) concentration ranging from 200 to 800 milligrams per liter (mg/L). The deep aquifer typically has a higher TDS level. Hardness ranges from 50 to 200 mg/L and high fluoride, boron, and nitrates are a problem in some areas of the basin. The groundwater in the basin is used for agricultural, municipal and industrial uses.

An emerging contaminant of concern is arsenic. In California, there are 763 sources in 404 water systems in 45 counties that show arsenic levels greater than the new federal drinking water standard (California Department of Health Services, May 2005). Arsenic is a naturally occurring inorganic contaminant often found in groundwater, occasionally found in surface water. Anthropogenic sources of arsenic include agricultural, industrial and mining activities. Arsenic can be toxic in high concentrations. Arsenic is considered a carcinogen when accounting for lifetime exposures.

There has been a drinking water regulation for arsenic since 1975, which included a Maximum Contaminant Level (MCL), of 0.05 mg/L (50 ppb). In 2001, US EPA revised the drinking water regulation for arsenic to include an MCL of 0.010 mg/L (10 parts-per-billion), effective nationwide (including California) 23 January 2006.

### 2.6.2 Surface Water

Littlerock Reservoir is the only developed surface water source in the Antelope Valley. This reservoir collects runoff from the San Gabriel Mountains. Surface water from the reservoir is generally of very high quality. The reservoir water is ultimately treated by the District's Leslie O. Carter water treatment plant.

## 2.7 Land Use

Historically, land uses within the Antelope Valley have focused primarily on agriculture. However, the area is in transition as the predominant land use shifts from agricultural uses to residential and industrial uses. Agricultural land use has decreased from 73,000 acres in the early 1950s to 12,854 acres in 1993 (USGS 1994). DWR predicts that agricultural land use will continue to decrease to approximately 900 acres in 2020 (USGS 1994). It should be noted that DWR did not take into account approximately 5,500 acres for carrot production that was developed in the Antelope Valley between 1995 and 2000. In addition, the LACSDs' proposed farming operations in Lancaster and Palmdale presently utilize 4,600 and 5,100 acres, respectively, to dispose of effluent from the wastewater treatment plants.

Historically, crops grown in the Antelope Valley have included alfalfa, wheat, barley and other livestock feed crops. In recent years, onions, turf and orchards have become more prominent. Broken down by the various types of crops, acreages in mid-1990's were 6,124 acres for alfalfa, 955 acres for pasture and turf, 835 acres for grain, 32 acres for field crops, 2,645 acres for truck crops and 2,263 acres for deciduous trees. Since the mid-1990's some of the agricultural lands have urbanized but the addition of approximately 5,000 acres of irrigated land for carrot production in irrigated land in Antelope Valley has resulted in little change in increase or decrease in agriculture production.

The increase in residential land use is evident from the population growth in the Antelope Valley. With significantly lower home prices than in Southern Los Angeles County, the Antelope Valley housing market has seen an increase as people chose to commute to the Los Angeles area.

Industrial land use in the Antelope Valley consists primarily of manufacturing for the aerospace industry and mining. Edwards Air Force Base and the U.S. Air Force Flight Production Center (Plant 42) provide a strong aviation and military presence. Mining of borate in the northern areas and salt extract, rock, gravel and sand in the southern areas contribute to the Antelope Valley's industrial land uses. Figure 2-6 shows the land uses for the Palmdale area.

## 2.8 Population Projections

According to the District's Draft Water Master Plan (MWH 2014), which is based on Southern California Association of Governments data, it is estimated that the population within the City of Palmdale will reach approximately 166,800 by 2015, and 215,000 by 2040. The same document projects the population for the District itself; increasing from 122,000 persons in 2015, to 157,300 in 2040.

## 2.9 Beneficial Uses

The Antelope Valley is located in Region 6 (Lahontan) of the nine Regional Water Quality Control Board (RWQCB) regions. The Water Quality Control Plan (Basin Plan) for the Lahontan Region identifies the beneficial uses of waters of the Antelope Valley. The Lahontan Basin Plan describes beneficial uses and water quality objectives for surface water and groundwater within the study area. Effluent limitations and discharge prohibitions are included in the Lahontan Basin Plan. The most recent update of the entire Lahontan Basin Plan was adopted by the Regional Board on March 31, 1995. Several amendments have been added since this 1995 plan date.

The beneficial uses for the Antelope Valley's surface waters are: municipal and domestic water supply, agricultural water supply, industrial service supply, groundwater recharge, freshwater replenishment, water contact recreation, non-contact water recreation, commercial and sport fishing, wildlife habitat, warm fresh water habitat, cold freshwater habitat, inland saline water, spawning, reproduction and development, water quality enhancement and flood peak attenuation/flood water storage.

Existing and potential beneficial uses applicable to groundwater in the region include municipal and domestic water supply, agricultural water supply, industrial service supply and fresh water replenishment.

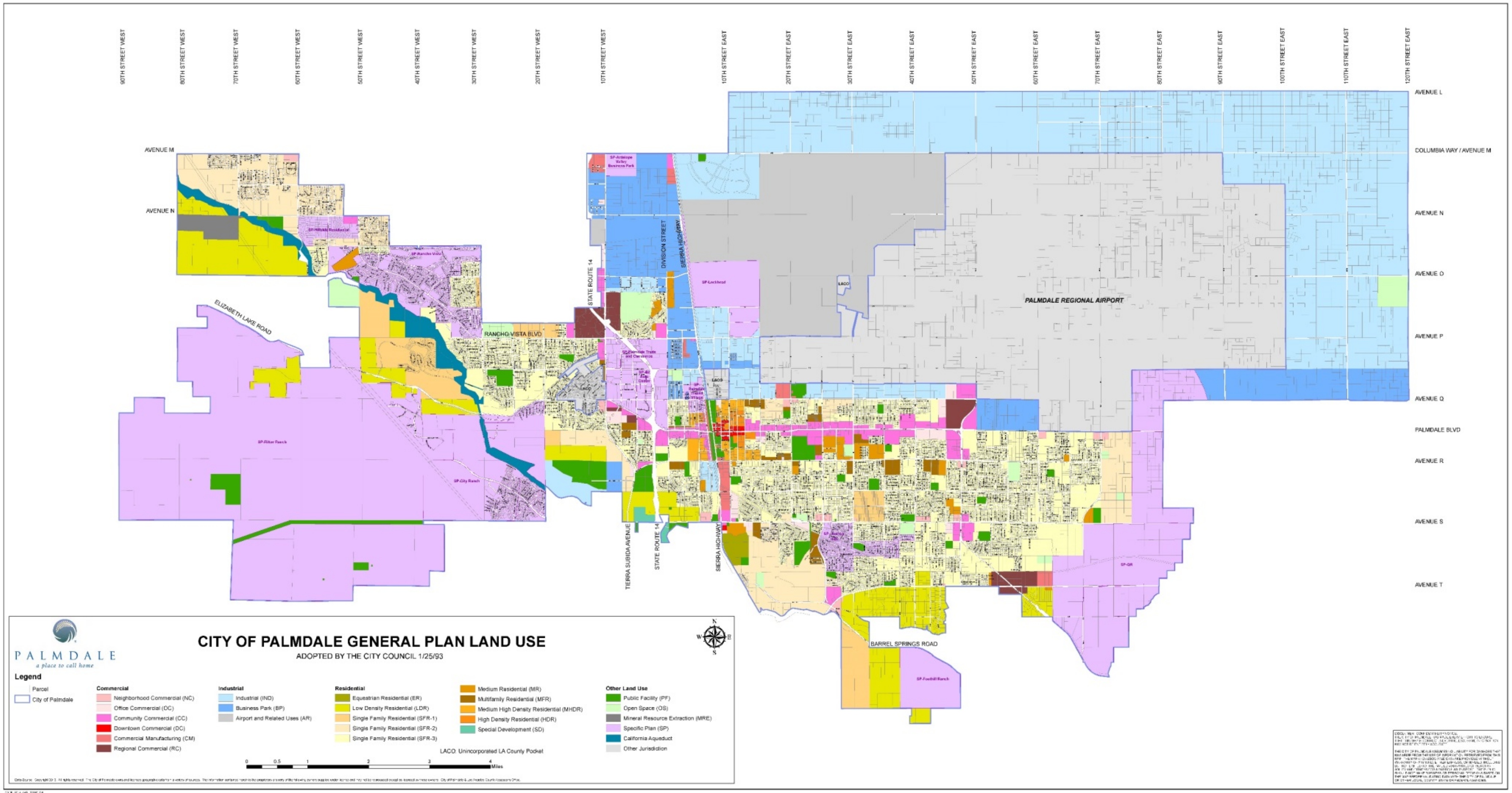



Figure 2-6 Land Use City of Palmdale, California

# WATER SUPPLY CHARACTERISTICS AND FACILITIES

This section provides a summary of the Palmdale Water District's water supplies and facilities.

## 3.1 Water Supply

The District currently receives water from three sources: groundwater, Littlerock Dam Reservoir, and imported water from the SWP. Groundwater is obtained from the Antelope Valley Groundwater Basin via 22 active wells scattered throughout the District. The District's local surface water supply is from Littlerock Dam Reservoir. This water is transferred from the reservoir to Lake Palmdale for treatment and distribution. The District's imported water is provided by the SWP and is conveyed to Lake Palmdale which acts as a forebay for the District's 35-mgd Leslie O. Carter Water Treatment Plant. Lake Palmdale can store approximately 4,250 AF of SWP and Littlerock Dam Reservoir water. The District is currently in the process of developing the use of non-potable water to offset potable water demand and to diversify its water supply options. Additionally, the District is developing new sources of supply via groundwater banking and anticipated new supplies from transfer and exchange opportunities.

## 3.2 Water Rates

The District's water supply sources have various costs depending on the water supply and the treatment technology utilized. Costs vary by the location served as some areas have greater distribution and pumping costs. The current customer base is primarily Single Family Residential with a number of Multi Family Residential, Irrigation, and Commercial-Industrial customers. A "Fire Service" class covers compound meters utilized by Commercial-Industrial customers, and an "Other" customer class primarily consists of construction meters.

The District's most recent water rate study was conducted in 2014 by Bartle Wells Associates (Attachment C in FAAST PIN # 30947); the previous was prepared in 2009 by Raftelis Financial Consultants, Inc. During the 2009 study the District worked with Raftelis to implement a water budget rate structure. The budget structure establishes a level of "efficient usage" for individual customers defined by each customer's class. Usage above the "efficient usage" tier is charged a progressively higher rate based on conservation costs and the costs of purchasing supplemental supply, with tier breakpoints determined by a percentage of each individual customer's water budget. The percentage of the water budget that determines tier breakpoints is the same for all customer classes.

The District completed a Proposition 218 process in September 2014 that included water rate increase caps and changes to the water rate system for the next five years. The approved water rate plan capped annual rate increases at 5.5 percent through 2019. It also changed the prior water rate structure in several ways including a new low usage tier to further encourage and reward water conservation, standardized monthly water meter charges for water meters 1-inch and smaller, provided for additional variance adjustments, the use of a long term average for setting the water quality charge, and a broader use of historic usage in determining water allocations. The District's 2015 Budget incorporates all the rate structure changes and a 2.5 percent rate change. The structural changes actually represent a 2 percent revenue decrease in 2015.

Therefore, the projected revenue change is only a 0.5 percent increase. The use of this type of water rate structure and the refinements adopted by the District still remain unique in the Antelope Valley.

The District also as a result of the 2014 water rate study implemented a drought surcharge. Revenue that is lost during mandatory cutbacks is revenue the District still requires to cover its costs whether or not water is available from the State or elsewhere. Not all fixed costs are recovered from the District's fixed charges, and the District relies upon estimated use to recover its fixed costs, which is not available during times of drought. Additionally, there are additional costs to the District during drought and mandatory cutbacks, including, but not limited to, enforcement of State mandated restrictions on customers and additional reporting to the State.

A drought surcharge is recommended based on Board Resolution No. 09-04, which calls for 3 stages of mandatory cutbacks of 20 percent 30 percent and 40 percent of water deliveries. The rate was developed by estimating the amount of variable revenue lost from lower water sales at each stage of drought, and subtracting the reduction in estimated purchased water costs from the State Water Project to determine lost revenues. The lost revenue was divided by the amount of "nonessential" usage, or usage above the new Tier 1, to develop a per CCF drought rate for each stage.

The District also has established a Reserve Policy (Resolution No. 13-13) recognizing the need to ensure that the District will have sufficient funding available to meet its operating, emergency capital, and debt service obligations. The updated policy simplifies the reserve level and funds goals and designations. The main designations are now: 1) Capital Improvement Fund; 2) Bond Proceeds Fund; 3) Rate Stabilization Fund; 4) Dam Self Insurance; 5) O&M Operating Reserve; 6) O&M Emergency Reserve, and 7) Unrestricted Reserves. Based on this policy, the minimum reserve level goal for the District is $16.2 million.

Lastly, the District's Capital Improvement Program (CIP) provides a long-range look at investment in infrastructure through capital investment and financial planning. It is intended to provide a comprehensive view of the new capital facilities and improvements to existing capital facilities required in the future to successfully carry out the District's mission. The CIP establishes a specific list of projects to be completed for capital replacements and improvements, and preventive maintenance.

## 3.3 Major Water Supply Facilities and Capacity

### 3.3.1 Capacity of Present Facilities

The following is a brief description of the capacities of each of the District's major water supply facilities. See Figure 3-1 for a schematic of facilities.

**Littlerock Dam Reservoir** - Littlerock Dam Reservoir constitutes the District's local surface water supply source. Recent renovations to Littlerock Dam Reservoir have increased its storage capacity to 3,500 AF, or 1.1 billion gallons of water.

Although Littlerock Creek flows mainly during winter and spring months, water is available throughout the year as a result of Littlerock Dam Reservoir. Since 1922, the District has shared water from this source with LCID. Both districts jointly hold water rights to divert 5,500 AF/yr from Littlerock Creek flows.

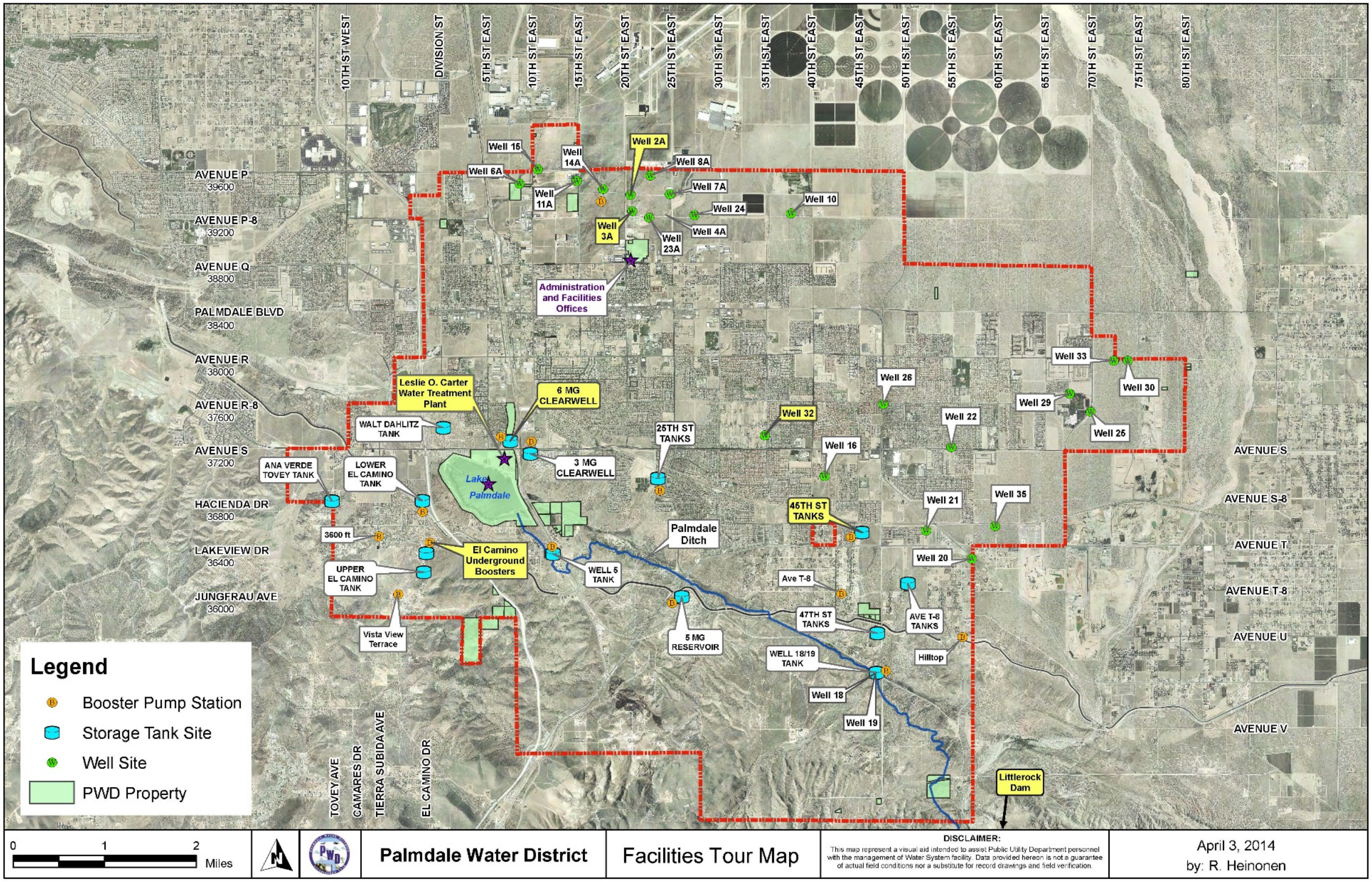



**Figure 3-1 Palmdale Water District Water Delivery Facilities**

**Groundwater** - The District operates 12 wells in the Lancaster sub-basin, with a pumping capability of approximately 12,500 gallons per minute. This is approximately 75 percent of the District's total annual groundwater production. The District operates 10 wells in the Pearland sub-basin, with a pumping capability of 3,500 gallons per minute. This accounts for approximately 20 percent of the District's groundwater production. Currently, the District operates three of four wells in the San Andreas rift zone pumping approximately 150 AF/yr. This amount equals approximately two percent of the total annual groundwater production.

Future pumping in the Antelope Valley Groundwater Basin is expected to decrease due to the on-going adjudication process. It is anticipated that future pumping rights will be restricted to 60 percent of existing pumping, which will cap the District's groundwater pumping rights to 7,200 AFY.

**State Water Project** - The District has been able to take delivery of SWP water since 1985 from the East branch of the California Aqueduct, which passes through the service area. The District receives its deliveries from a 30 cfs connection on the East Branch, where SWP water is conveyed to Lake Palmdale via a 30-inch diameter pipeline. Lake Palmdale acts as a forebay for the District's 35 mgd water treatment plant and stores SWP water and diversions from Littlerock Dam Reservoir water. The District is contractually entitled to receive a Table A amount of 21,300 AF/yr of SWP water.

**Lake Palmdale** - Lake Palmdale can store approximately 4,250 AF of SWP and Littlerock Dam Reservoir water.

**Leslie O. Carter Water Treatment Plant** - The Leslie O. Carter Water Treatment Plant (LOCWTP) is a conventional potable water treatment plant that has a current capacity of 35 mgd. Recent upgrades have improved nearly every phase of the treatment process, most notably the addition of granular activated carbon (GAC) contactors.

**LACSD Palmdale Water Treatment Facility** - The PWRP, owned by LACSD, was constructed in the City of Palmdale in 1953 with an initial treatment capacity of 0.75 mgd. The PWRP is located at 39300 30th Street East in the City of Palmdale and currently occupies 286 acres east of the Antelope Valley (14) Freeway.

The PWRP is a tertiary treatment plant with a solids processing facility, providing primary, secondary, and tertiary treatment. The plant serves a population of approximately 150,000 people in and around the City of Palmdale. In 2012, the PWRP was expanded to reach its current treatment capacity of 15 mgd.

The LACSD PWRP currently produces an average of about 10,000 AF/yr of Title 22 recycled water. Based on population growth assumptions, it is estimated that the total recycled water supply from the Palmdale WRP will grow to about 12,500 AF/yr by 2040 and 18,100 AF/yr by buildout. Effluent is reused for irrigation of trees and fodder crops on City of Los Angeles Department of Airports (LAWA) property and also for parks in the City of Palmdale.

## 3.4 Water Supply Analysis and Capital Improvements

### 3.4.1 Water Supply Reliability

The reliability of water supply within the PWD's service area is a composite of the reliability of each source of supply. Table 3-1 summarizes the factors that impact each resource's water supply reliability. Although not all shortages can be prevented, the District's overall goal is to further diversify the area's recycled water supply portfolio in an effort to improve the immediate, near- and long-term reliability of water supplies.

Table 3-1: Factors Resulting in Inconsistency of Water Supply

| WATER SUPPLY SOURCES | SPECIFIC SOURCE NAME, IF ANY | LIMITATION QUANTIFICATION | LEGAL | ENVIRON-MENTAL | WATER QUALITY | CLIMATIC |
|---|---|---|---|---|---|---|
| **Groundwater** | Antelope Valley Groundwater Basin | Limited by well production capacity | X | | X | |
| **Imported Water** | SWP (California Aqueduct) | Limited by Table A maximum amount and hydrologic conditions | X | X | X | X |
| **Local Surface Water** | Littlerock Creek and Dam Reservoir | Limited by Allocation | | | | X |

#### 3.4.1.1 Factors Affecting Groundwater Reliability

Groundwater is traditionally considered a highly reliable supply since it is not immediately susceptible to changes in climate and surface flows. However, the Antelope Valley Groundwater Basin is in overdraft and a court adjudication was approved in December 2015. This adjudication will limit and possibly decrease the allowable annual extraction of groundwater, as described further below.

#### 3.4.1.2 Factors Affecting Imported Water Reliability

Imported water comes from the SWP. The factors affecting the reliability of imported water supplies from the SWP include legal, environmental, water quality, and climatic.

In consideration of these factors, the State of California in its 2015 State Water Project Delivery Capability Report made projections to year 2033 relating to the projected amount of water that would be available from the SWP. These percentages are shown in Table 3-2 below and used in determining water use trends described below.

Table 3-2: Percentage of Available SWP under Average, Wet, and Dry Periods

| Water Condition | Percent Available | Water Condition | Percent Available |
|---|---|---|---|
| Long Term Average | 62% | Long Term Average | 62% |
| Single Dry Year | 11% | Single Wet Year | 98% |
| 2 year – Dry Period | 28% | 2 year – Wet Period | 95% |
| 4 year – Dry Period | 33% | 4 year – Wet Period | 86% |
| 6 year – Dry Period | 29% | 6 year – Wet Period | 83% |
| Source of Data: DWR 2015 Final Delivery Capability Report | | | |

#### 3.4.1.3 Factors Affecting Local Surface Water Reliability

A certain amount of water supply from Littlerock Dam Reservoir water is expected to be available each year. This amount is estimated at 50 percent of the average available historical yield (8,000 AF) such that 4,000 AF is available in all years. Annual climatic changes can impact the reliability of Littlerock Dam Reservoir water in amounts above 4,000 AF.

The available water supply from Littlerock Dam is projected to follow average, dry and wet cycles similar to the water available from the SWP. The State of California completed a new water forecast in 2015 that projected water supplies from the SWP for various climatic scenarios to determine the percentages of water available.

### 3.4.2 Planned Capital Improvements

The District's CIP establishes a specific list of projects to be completed for capital replacements and improvements, and preventive maintenance. These are projects that are developed as part of the District's Master Plan to meet future growth requirements within its service boundaries. These projects are usually offset by capital improvement fees paid for by developers and typically are building new developments that expand the current installed service area. These fees are for offsite improvements such as the development's fair share cost of wells, reservoirs, transmission mains, treatment plant capacity, and other necessary facilities, as well as to pay for water supply acquisitions and projects associated with new water supplies necessitated by new development. The fees are collected at rates established by the Board of Directors based upon specific engineering studies. The rates charged are based on a project's equivalent capacity unit (ECU) basis. These funds are restricted to the design and construction of capital facilities for water delivery, and as otherwise provided in the District's Resolution No. 13-12 and the District's Rules and Regulations (PWD, 2014).

## 3.5 Groundwater Management

The Antelope Valley Groundwater Basin has over the last 17 years been in the process of adjudication, which will eventually limit and possibly decrease the allowable annual extraction of groundwater. The Court approved the adjudication in December 2015 with a finding that the basin is in an overdraft condition and the District agrees with that finding. The Court ruling eliminates, over time, the long-term overdraft, either by reduction of pumping or the purchase of replacement water.

Adjudication of the Antelope Valley groundwater basin is expected to take effect in 2016. It is anticipated that this will limit the District to annual pumping of 7,200 AF. The District expects groundwater pumping to be consistent in average (normal), dry, and wet years.

The District has not adopted a groundwater management plan, and no regional groundwater management plan currently exists for the basin. However, it is expected that the adjudication will result in a court-ordered physical solution, which will include a groundwater management plan.

## 3.6 Water Use Trends and Future Demands

### 3.6.1 Overview of Water Use

The District provides potable water service to its residential, commercial, industrial, and institutional customers within its service area, and serves supplemental water to several customers outside its primary service area in accordance with agreements made with the Antelope Valley East Kern Water Agency (AVEK). The highest annual water use was experienced in 2007 at a total of 28,151 AF. The District plans to meet approximately 60 percent of its projected average demand from surface water sources and approximately 40 percent from groundwater sources.

### 3.6.2 Sales to Other Water Agencies

The District and the LCID jointly hold long-standing water rights to divert 5,500 AF per year from Littlerock Creek. The District manages Littlerock Dam Reservoir. LCID is entitled to purchase from the District, in one calendar year, up to 1,000 AF of water or 25 percent of the yield from Littlerock Dam Reservoir, whichever is less.

### 3.6.3 Total Projected Water Deliveries

Table 3-3 presents a summary of the District's total water demands. The water demand projections were obtained from the District's Potable Water Master Plan (currently in revision) demand projections, which are based on population projections and expected land use build-out. The values presented below are from the draft master plan.

Table 3-3: Existing and Planned Water Supplies

| Year | Annual Average Demand (AF/yr) |
|---|---|
| 2015 | 24,809 |
| 2020 | 25,900 |
| 2025 | 27,200 |
| 2030 | 28,500 |
| 2035 | 29,800 |
| 2040 | 31,100 |
| 2045 | 32,457 |
| 2050 | 33,873 |
| 2055 | 35,350 |
| 2060 | 36,892 |
| 2065 | 38,502 |
| 2070 | 40,181 |
| 2075 | 41,934 |
| 2080 | 43,764 |
| *Buildout* | *44,600* |

## 3.7 Quality of Water Supplies

The potable water provided by the District meets the State and Federal drinking water regulations for primary and secondary drinking water standards. More detail about water quality within the service area is summarized in Chapters 4, 5 and 9.

## 3.8 Sources of Additional Water and Plans for New Facilities

Due to current and anticipated growth, as well as increasing uncertainty of the District's ability to meet local water demands with imported water and groundwater, the District is taking proactive steps towards expanding the use of non-potable water to meet a variety of non-potable and indirect potable uses. The District has been actively working with Los Angeles County Waterworks, City of Palmdale, City of Lancaster, and Los Angeles County Sanitation Districts (LACSD) to develop a regional recycled water system.

The District developed a Recycled Water Facilities Plan as part of the first non-potable reuse phase for the Antelope Valley Recycled Water Project Facilities Planning Report. The Antelope Valley WPFP Report provides alternatives for construction of a new distribution system that would deliver recycled water from the PWRP to some of the District's municipal and industrial customers.

Future WRP capacity will be expanded as needed to treat increased wastewater flow.

Figure 3-2 displays in graphical form the long-term use of recycled water and its ability to stretch local water supplies for maximum efficiency. In essence, all of the available water in the District's service area will be used to meet the ultimate water demand at build-out for the City of Palmdale.

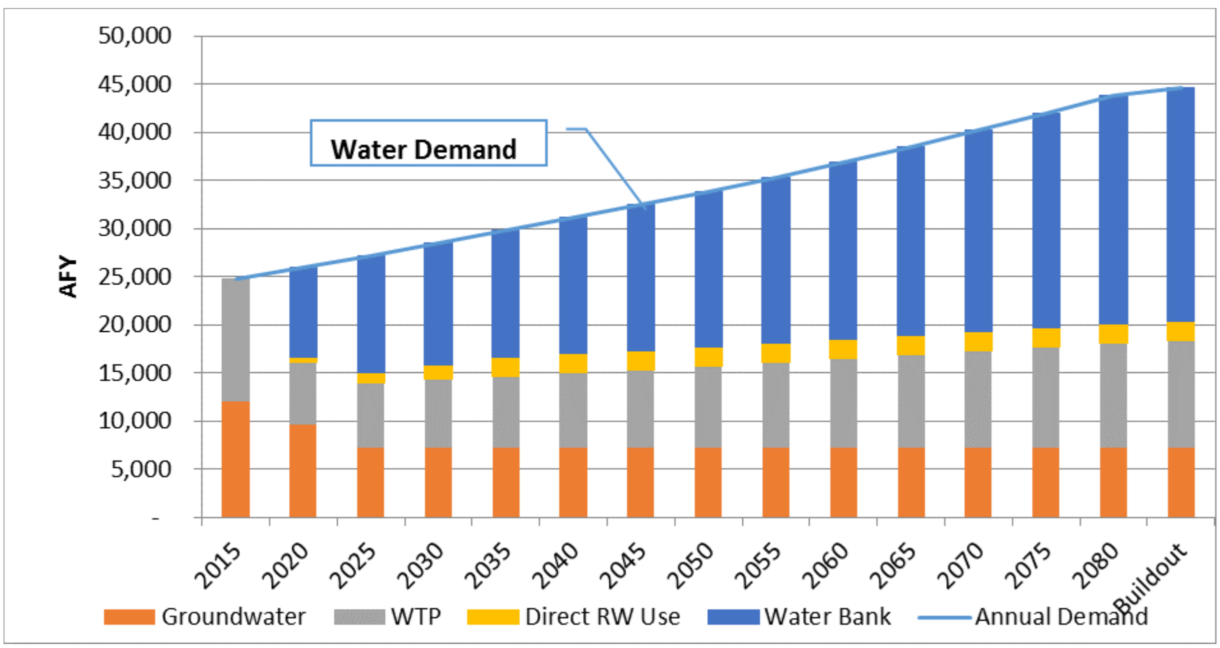



**Figure 3-2 Long term use of recycled water**

## 3.9 Climate Change

### 3.9.1 Identification of Vulnerabilities

Understanding the potential impacts and affects that climate change is projected to have on the PWD service area and Antelope Valley Region allows an informed vulnerability assessment to be conducted for the Regions' water resources. A climate change vulnerability assessment helps to assess the Regions water resource sensitivity to climate change, prioritize climate change vulnerabilities, and to ultimately guide decisions as to what strategies and projects would most effectively adapt to and mitigate against climate change. The California Department of Water Resources (DWR) has recommended that Regions use the Climate Change Handbook for Regional Planning. This handbook was developed by the U.S. Environmental Protection Agency, DWR, U.S. Army Corps of Engineers, and the Resource Legacy Fund as resource for methodologies to determine and prioritize regional vulnerabilities. The Climate Change Handbook provided specific questions that help to identify key indicators of potential vulnerability, including:

- Currently observable climate change impacts (climate sensitivity)
- Presence of particularly climate-sensitive features, such as specific habitats and flood control infrastructure (internal exposure)
- Resiliency of a region's resources (adaptive capacity)

An exercise was undertaken to answer vulnerability issues for the Region by taking questions from the Climate Change Handbook and associated the answers with potential water management issues/vulnerabilities. See Table 4-4 for the completed vulnerability question worksheet. Included in the analysis are qualitative vulnerability questions framed to help assess resource sensitivity to climate change and prioritization of climate change vulnerabilities within a region. Answers to vulnerability questions are given for the Region with local examples provided as justification for the answer. Vulnerability issues are then prioritized.

### 3.9.2 Prioritization of Vulnerabilities

The vulnerability issues identified in the climate change analysis discussed above were reviewed and then refined to better articulate the vulnerability issues of the Region and PWD's service area. The revised vulnerability issues were then prioritized into three tiers based upon the perceived risk and importance of the issue. Those vulnerabilities posing the greatest risk of occurrence and resulting in the greatest impacts upon occurrence were ranked as the highest priority.

The list of prioritized vulnerabilities developed are presented in Table 3-4. Note that the vulnerability issues shown in Table 3- 5 do not exactly match those in Table 3-4 since refinements and edits were made to the vulnerabilities during the prioritization process.

**Table 3 – 4 Climate Change Vulnerability**

| Priority Level | Category and Vulnerability Issue |
|---|---|
| **High** | Water Demand/Supply: Limited ability to meet summer demand and decrease in seasonal reliability<br>Flooding: Increases in flash flooding, with particular attention paid to the balance of flood control with habitat and lakebed needs such as Edwards Air Force Base<br>Water Supply: Lack of groundwater storage to buffer drought<br>Water Supply: Decrease in imported State Water Project water<br>Water Supply: Invasive species can reduce supply available<br>Ecosystem and Habitat: Increased impacts to water dependent species and decrease in environmental flows<br>Water Quality: Increased constituent concentrations in groundwater |
| **Medium** | Water Supply: Decrease in local surface supply<br>Water Quality: Increased erosion and sedimentation<br>Water Supply: Sensitivity due to higher drought potential<br>Ecosystem and Habitat: Decrease in available necessary habitat |
| **Low** | Water Demand: Industrial demand would increase<br>Water Demand: Crop demand would increase per acre<br>Water Demand: Habitat demand would be impacted<br>Flooding: Increases in inland flooding |

The justifications as to why the following vulnerability issues were classified as High Priority are provided below:

- *Limited ability to meet summer demand and decrease in seasonal reliability*: The Antelope Valley Region has high irrigation and landscaping demands during the summer months. Increases in temperature due to climate change would likely increase this already high demand, as well as decrease water supplies available.

- *Increases in flash flooding, with particular attention paid to the balance of flood control with habitat and lakebed needs which Edwards Air Force base depends on*. Flooding is common in the Region, particularly in the foothill areas. The projected increase in storm intensity will likely increase the occurrence and intensity of flash flooding. This increase will need to be managed carefully in light of habitats that depend on these seasonal flash floods and the needs of the Air Force base.

- *Lack of groundwater storage to buffer drought*: Groundwater levels are a long standing issue in the Region. The Region is limited in terms of the groundwater stored from year to year, and has issues with groundwater quality in some areas. Should a prolonged drought occur, this resource may not be available to buffer supply needs during additional drought years.

- *Decrease in imported supply*: The Region is heavily dependent upon imported water supplies which are very susceptible to the impacts of climate change given their reliance on seasonal snowpack. The Region could not be solely dependent upon local resources to sustain the current economy, so some imported water must be secured. The supply is highly vulnerable at its source given the dependence upon the stability of the California Bay Delta levee system. Climate change impacts to this area from higher sea level rise and higher storm surges could be catastrophic to the water supply.

- *Invasive species can reduce supply available:* Invasive species are becoming more common in the Region, and may increase with the projected changes to temperature and precipitation. Certain invasive species, such as Tamarisk and Arundo, may reduce the water supply available for species native to the area.

- *Increased impacts to water dependent species and decrease in environmental flows*: A number of water dependent species are present in the Region that require certain stream flows to maintain habitats, such as those species dependent on the Piute Ponds. The projected changes to local temperature and precipitation may impact these environmental flows, and impact water dependent species, particularly since these species have limited opportunity for migration.

- *Increase constituent concentrations*: Decreases in stream flows may reduce the ability for these streams to dilute water quality constituents. Should stream flows decrease due to increases in temperature and decreases in annual precipitation, the water quality of local streams may be impacted. In addition, the projected increase in wildfires in the surrounding mountains may lead to increased erosion and sedimentation in local streams.

Table 3-5 Climate Change Vulnerability Prioritization Results

(Source: Antelope Valley Integrated Water Resource Management Plan – 2013)

| VULNERABILITY | Y/N | JUSTIFICATION | VULNERABILITY ISSUE | COMMENTS |
|---|---|---|---|---|
| **WATER DEMAND** | | | | |
| Are there major industries that require cooling/process water in your planning region? | Y | Thermal solar power generation, Edwards Air Force Base (not significant), Palmdale Power, landfills and recycling plants | Industrial demand would increase | Renewables |
| Are crops grown in your region climate-sensitive? Would shifts in daily heat patterns, such as how long heat lingers before night-time cooling, be prohibitive for some crops? | Y | Major crops: ornamental trees, turf, alfalfa, nuts, carrots. | Crop demand would increase | Maintain some crops |
| Do groundwater supplies in your region lack resiliency after drought events? | Y | Groundwater levels area long-standing issue | Lack of groundwater storage to buffer droughts | — Issue is already a major concern, The issue would increase exponentially.<br>— Over pumping of groundwater basin<br>— Need increased water storage to meet needs<br>— Groundwater recharge is slow and Antelope Valley already is overdrawn so capacity is reduced. |
| Are water use curtailment measures effective in your region? | N | Not yet saturated | Limited ability to conserve further | No comment |
| Does water use vary by more than 50% seasonally in parts of your region? | Y | Higher demand in summer: agriculture , indoor/outdoor varies | Limited ability to meet summer demand | — State Water Project Supplies are uncertain<br>— Aggravates overall issue |
| Are some instream flow requirements in your region either currently insufficient to support aquatic life or occasionally unmet? | Y | Aquatic plants, freshwater shrimp | Habitat demand would be impacted | No comment |
| **WATER SUPPLY** | | | | |
| Does a portion of the water supply in your region come from snowmelt? | Y | Local surface supply comes from snowmelt | Decrease in surface supplies | — Water supply is already limited.<br>— Decrease in natural water supplies from snowpack and diverted water will increase dependency and expense of SWP imported water |
| Does part of your region rely on water diverted from the Delta, imported water from the Colorado River, or imported from other climate-sensitive systems outside you region? | Y | Large portion of supply comes from imported SWP water. | Decrease in imported supply | — Impact of species/habitats by capture of runoff<br>— Vulnerability in storage/more rain, then snow (timing)<br>— SWP vulnerability<br>— Dependency of Antelope Valley on imported water. |
| Would your region have difficulty in storing carryover supply surpluses from year to year? | Y | Potential for groundwater recharge, have not yet met potential for groundwater recharge | Decrease in seasonal reliability | No comment |
| Does part of your region rely on coastal aquifers? Has salt intrusion been a problem in the past? | N | | Decrease in groundwater supply | No comment |
| Has your region face a drought in the past during which it failed to meet local water demands? | Y | Demand management plans have been effective in the past | Sensitivity due to higher drought potential | — See this as a fundamental issue<br>— More frequent and prolonged droughts<br>— With increased potential for drought, the competition for water would be a concern |
| Does your region have invasive species management issues at your facilities, along conveyance structures, or in habitat areas? | Y | Tamarisk, Cottonwoods | Invasive plants can reduce supply | No comment |

Table 3-5 Climate Change Vulnerabilities Prioritization Results (continued)

| VULNERABILITY | Y/N | JUSTIFICATION | VULNERABILITY ISSUE | COMMENTS |
|---|---|---|---|---|
| WATER **QUALITY** | | | | |
| Are increased wildfires a threat in your region? If so, does your region include reservoirs with fire-susceptible vegetation nearby which could pose a water quality concern from increased erosion? | Y | Fire in the San Gabriel mountains could cause sedimentation in the Little Rock Creek Reservoir | Increased erosion and sedimentation | — Resulting from fires and flash floods<br>— Limited water quantity makes quality even more important |
| Does part of your region rely on surface water bodies with current water quality issues related to eutrophication, such as low dissolved oxygen or algal blooms? Are there other water quality constituents potentially exacerbated by climate change? | N | Little Rock Creek Reservoir and Lake Palmdale do not have eutrophication issues. | Poor water quality in surface waters | No Comment |
| Are seasonal low flows decreasing for some water bodies in your region? If so, are the reduced low flows limiting the water bodies' assimilative capacity? | N | Contaminant levels are low in areas with transport potential to drinking water bodies. | Increased constituent concentrations | No Comment |
| Are there beneficial uses designated for some water bodies in your region that cannot always be met due to water quality issues? | N | Reservoirs are primarily for drinking water | Decrease in recreational opportunity | No Comment |
| Does part of your region currently observe water quality shifts during rain events that impact treatment facility operation? | N | Bulk of water is either imported or groundwater | Increase in treatment needs and costs | No Comment |
| **SEA LEVEL RISE** | | | | |
| Has coastal erosion already been observed in your region? | N | n/a | n/a | No Comment |
| Are there coastal structures, such as levees or breakwaters in your region? | N | n/a | n/a | No Comment |
| Is there significant coastal infrastructure, such as residences, recreation, water and wastewater treatment, tourism and transportation at less than six feet above mean sea level in your region? | N | n/a | n/a | No Comment |
| Is there land subsidence in the coastal areas of your region? | N | n/a | n/a | No Comment |
| Are there climate sensitive low lying coastal habitats in your region? | N | n/a | n/a | No Comment |
| Are there areas in your region that currently flood during extreme high tides or storm surges? | N | n/a | n/a | No Comment |
| Do tidal gauges along the coastal parts of your region show an increase over the past several decades? | N | n/a | n/a | No Comment |
| **HYDROPOWER** | | | | |
| Is hydropower a source of electricity in your region? | N | n/a | n/a | No Comment |
| Are energy needs in your region expected to increase in the future? IF so, are there future plans for hydropower generation facilities or conditions for hydropower generation in your region? | N | n/a | | |

Table 3-5 Climate Change Vulnerabilities Prioritization Results (continued)

| VULNERABILITY | Y/N | JUSTIFICATION | VULNERABILITY ISSUE | COMMENTS |
|---|---|---|---|---|
| **FLOODING** | | | | |
| Does critical infrastructure in your region lie within the 200 year floodplain? | Y | Water reclamation plants are in the 100-yr to 500-yr floodplain. | Increase in inland flooding | No comment |
| Does aging critical flood protection infrastructure exist? | Y | Aging local flood protection infrastructure exists in the region. | Increase in inland flooding | No comment |
| Have flood control facilities, such as impoundment structures, been insufficient in the past? | Y | There are areas in the region that flood regularly | Increase in inland flooding | No comment |
| Are wildfires a concern in parts of your region? | Y | Flash flooding has been an issue in the past | Increase in flash flooding | — Increase in extreme weather events though decrease in frequency<br>— Historical occurrences<br>— Development in flood plain<br>— Need to avoid development in flash flooding channels/areas to increase availability of flows to habitat and Edwards Air Force base<br>— Great potential for damages |
| **ECOSYSTEM AND HABITAT** | | | | |
| Does your region include inland or coastal aquatic habitats vulnerable to erosion/sedimentation issues? | Y | Erosion and sedimentation in Little Rock and Big Rock Creek | Increased impacts to water dependent species | — Stressors to water dependent habitat<br>— Potential conflicts among users of water supply |
| Does your region include aquatic habitats which rely on seasonal freshwater flow patterns? | Y | Local Piute ponds, ephemeral streambeds, all sub-watersheds in the desert are critical. | | |
| Do climate sensitive fauna or flora populations live in your region? | Y | Evapotranspiration may affect habitat | | |
| Do estuaries, coastal dunes, wetlands, marshes, or exposed beaches exist in your region? Is so, are coastal storms possible/frequent in your region? | N | Region does not have coastal storms | Decease in habitat protection against coastal storms. | |
| Do endangered or threatened species exist in your region? Are changes in species distribution already being observed in parts of your region? | Y | Desert tortoise, burrowing owl, Mojave ground squirrel | Decrease in available necessary habitat | — There are already several factors in play. With anticipated climate change issues, the issue will likely be exacerbated<br>— Many climate sensitive and endangered species with limited opportunity for irrigation |
| Does the region rely on aquatic or water dependent habitats for recreation or other economic activities? | Y | Duck hunting in Piute ponds, bird watching and canoeing | | |
| Are these areas of fragmented estuarine, aquatic, or wetland wildlife habitats within your region? Are there movement corridors for species to naturally migrate: Are there infrastructure projects planned that might preclude species movement? | Y | Limited planning in ecological areas – Littlerock Creek, Big Rock Creek, Broad Canyon Wash, Elizabeth Lake – “choke point” | | |
| Does your region include one or more of the habitats described in the Endangered Species Coalition’s Top 10 habitats vulnerable to climate change? | Y | The “Southwest Deserts”, which include the Mojave Desert, is on the Top 10 Habitats | | |
| Are there rivers in your region with quantified environmental flow requirements or known water quality/quantity stressors to aquatic life? | Y | Freshwater shrimp and Mariposa Lily require a certain quantity of flow | Decrease in environmental flows. | No comment |

# CHAPTER 4

# WASTEWATER CHARACTERISTICS AND FACILITIES

This section describes the wastewater collection and treatment facilities in the District's service area, which will produce the recycled water for the project.

## 4.1 Wastewater Entities

Wastewater collection and treatment in and around the District's service area is provided by LACSD No. 20, which owns and operates the Palmdale Wastewater Recycling Plant (PWRP). The approximate location of the PWRP and LACSD wastewater disposal area is shown on Figure 4-1.

The PWRP is a tertiary treatment plant with a solids processing facility, providing primary, secondary, and tertiary treatment. The plant serves a population of approximately 110,000 people in and around the City of Palmdale. Collection is provided through a network of trunk sewers, which are designed to provide wastewater conveyance via gravity flow. The wastewater flows from the remaining population of Palmdale population of 40,000 is transported to the Lancaster Wastewater Treatment Plant.

In 2012, the plant was expanded, increasing capacity from then 9 mgd to its current capacity of 12 mgd. Construction work included of nine final sedimentation tanks, six aeration tanks, chlorine contact tank, one digester with cleaning bed and pump stations, six tertiary filters, two dissolved air flotation units, RAS pump station, four chemical facilities, six Title 22 cloth disk filters, generator building, air compressor building, boiler house, four switchboard buildings, operations and lab building, and associated pipelines, grading, paving and site improvements. Figure 4-2 is a schematic representing the treatment processes for the PWRP.

On average, the PWRP produces about 10,000 AF/yr of Title 22 recycled water and is anticipated to reach about 12,500 AF/yr by 2040 and 18,100 AF/yr by buildout. Effluent is currently reused for irrigation of trees and fodder crops on lands leased from the City of Los Angeles Department of Airports' property and also for parks in the city of Palmdale.

Figure 4-3 provides an overview of the existing and designed facilities providing recycled water to the District's service area and the proposed phasing.

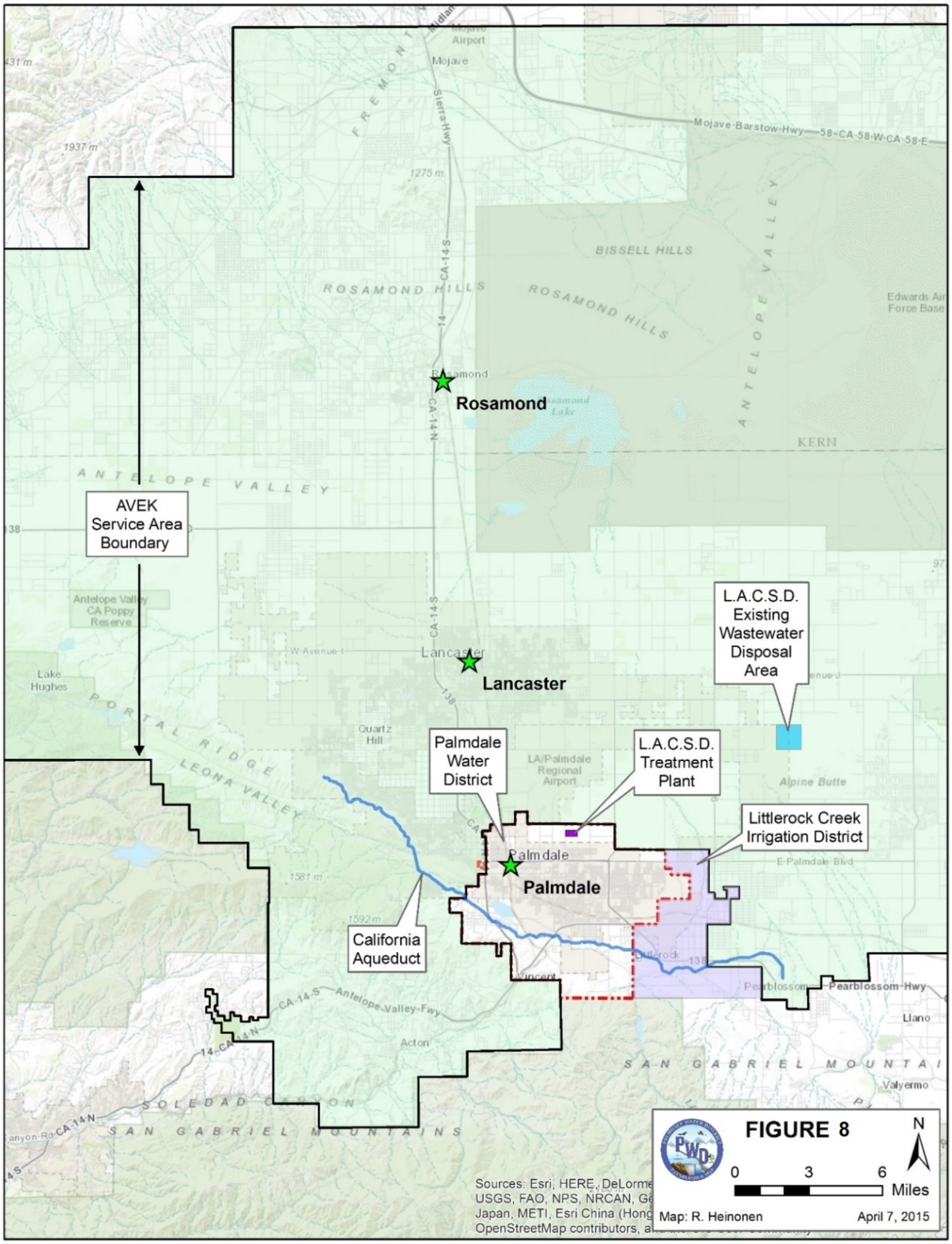



**Figure Location of LACSD Existing Wastewater Disposal Site 4-1**

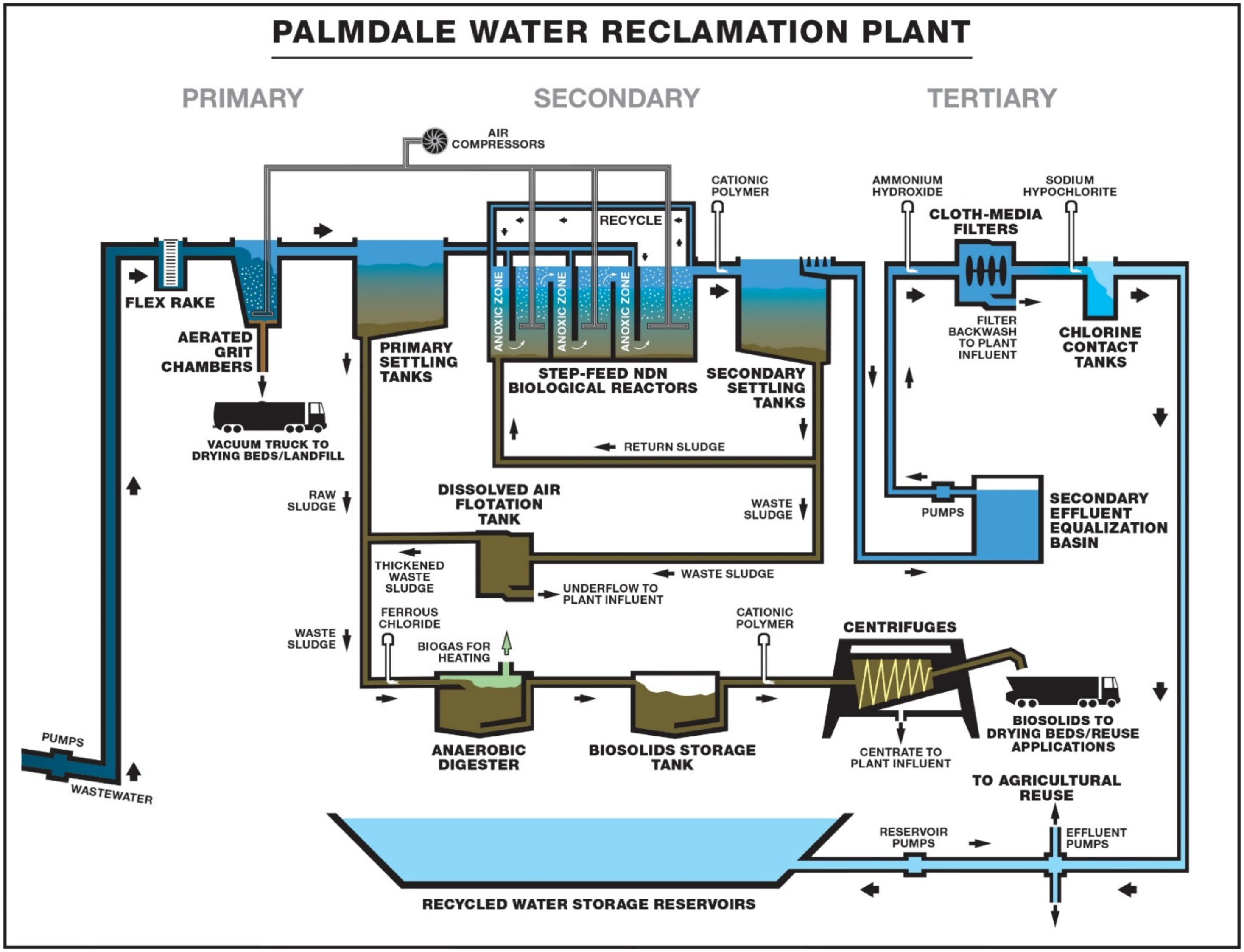



**Figure 4-2 Schematic of LACSD Palmdale Tertiary Treated Wastewater Plant**

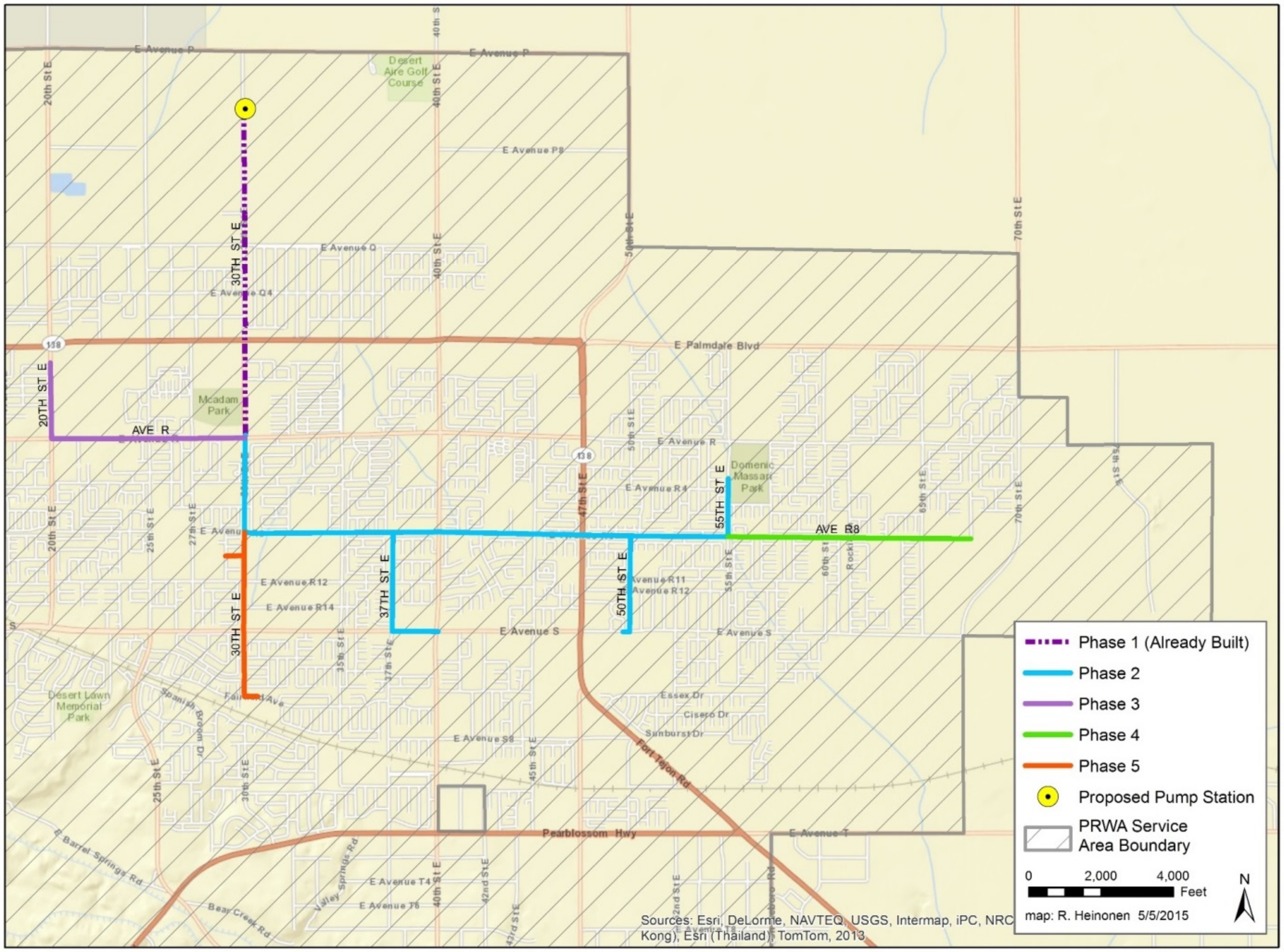



**Figure 4-3 Palmdale Recycled Water Authority Proposed Direct Use Water Recycling**

### 4.1.1 Wastewater Flows

Average monthly flows from the PWRP for the year 2014 are presented in Table 4-1.

**Table 4-1: P**almdale Water Reclamation Plant (Flows 2014)

| | Influent | | Tertiary Recycled Water Plant Effluent | |
|---|---|---|---|---|
| | Monthly Mean | Total | Monthly Mean | Total |
| Month | MGD | MG | MGD | MG |
| January | 9.0 | 277.6 | 8.3 | 257.1 |
| February | 9.1 | 253.3 | 8.2 | 230.4 |
| March | 9.0 | 278.6 | 8.2 | 253.4 |
| April | 9.0 | 271.2 | 8.3 | 249.5 |
| May | 9.2 | 283.9 | 8.3 | 256.7 |
| June | 9.2 | 274.5 | 8.2 | 246.2 |
| July | 9.3 | 288.6 | 8.5 | 262.7 |
| August | 9.3 | 289.1 | 8.3 | 257.4 |
| September | 9.7 | 289.8 | 8.7 | 261.8 |
| October | 9.3 | 287.4 | 8.2 | 253.8 |
| November | 9.1 | 272.3 | 8.1 | 243.6 |
| December | 9.3 | 286.7 | 8.2 | 254.0 |
| Mean | 9.2 | 279.4 | 8.3 | 252.2 |
| Max | 9.7 | 279.4 | 8.7 | 262.7 |
| Min | 9.0 | 253.3 | 8.1 | 230.4 |
| Total MG | | 3353 | | 3,026.7 |
| Total Acre-feet (AF) | | 10289 | | 9288 |

## 4.2 Existing System Analysis

The City of Palmdale (City) and the District have been involved in planning for the use of recycled water within and around the City boundaries and the District's service area. In the fall of 2012, a mutual joint exercise of powers agreement was executed wherein the Palmdale Recycled Water Authority (PRWA or Authority) was established in order to manage recycled water that is generated and used within the District's service area. PRWA is proposing to implement the Recycled Water Facilities Plan, which includes construction and operation of distribution pipelines and one new pump station at the PWRP. The proposed project would distribute disinfected tertiary recycled water for beneficial end uses that include irrigation and groundwater recharge in the PRWA service area.

A Recycled Water Backbone System has been proposed for the Antelope Valley that would connect the Lancaster WRP and PWRP, allowing recycled water from both plants to be used throughout the region. Portions of the Recycled Water Backbone System have already been constructed by the City of Lancaster, City of Palmdale, and Waterworks No. 40. Additionally the City of Palmdale has partnered with Waterworks No. 40 to design and construct a portion of the

Recycled Water Backbone System that will complete the connection of the LWRP (Lancaster Water Reclamation Plant) and PWRP and serve the proposed Palmdale Power Plant, and the Antelope Valley Country Club. The portions of the Recycled Water Backbone System that have been designed or constructed are all located outside of the service area of the PRWA. The primary benefit to the PRWA of these portions is the potential ability to move recycled water between the Lancaster WRP and PWRP. However, the majority of the tertiary treated water that will be used in the PRWA service area will originate at PWRP.

Prior to the agreement to create PRWA, the City constructed a recycled water transmission line to deliver recycled water from Palmdale WRP to McAdam Park for irrigation. The City has an existing agreement with the LACSD for 2,000 AF/yr of recycled water to provide to customers throughout the City's service area.

### 4.2.1 Palmdale WRP Design Criteria

Table 4-2 presents the design criteria for the PWRP, at a capacity of 15 mgd and above. As shown in the table, process units of the WRP include a conventional activated sludge process (CAS) with nitrification/denitrification (NDN), tertiary, and disinfection facilities, and. Specifically, the proposed Stage V upgrade includes primary effluent equalization basins, CAS aeration tanks, CAS sedimentation tanks, Dissolved Air Flotation (DAF) tanks, digested solids transfer pumps, centrifuges, a truck loading station, supernatant pumps, tertiary filters, chlorine contact tanks, a chlorination station, return and waste activated sludge pump stations, an emergency generator, a control building, a laboratory building, chemical addition stations, odor control stations, and associated piping and appurtenant structures. The existing PWRP headworks and primary treatment facilities will remain in service, but the existing 12.0 mgd-capacity oxidation ponds will be decommissioned.

Table 4-2: Summary of Design Criteria for the Palmdale water Reclamation Plant [a,b]

| UNIT PROCESS | DESIGN CRITERIA | PWRP | | | |
|---|---|---|---|---|---|
| | | EXISTING FACILITIES | Stage V | Stage VI | 2025 FACILITIES |
| Anaerobic Digestion | Primary & WAS Design Flow | 67,000 gpd | +46,000 gpd | + 56,000 gpd | 169,000 gpd |
| Tanks | Total Number of Digesters No. of 1st Stage Digesters Capacity, each | 4c | + 2 | +1 | 7d |
| | | 3 | 5 | 6 | 6 |
| | Detention Time | 3 @ 618,240 gal | 3 @ 618,240 gal | 3 @ 618,240 gal | 3 @ 618,240 gal |
| | No. of Storage Digesters | | 2 @ 1,222,261 gal | 2 @ 1,222,261 gal | 2 @ 1,222,261 gal |
| | Capacity, each | 27.7 days (0 o/s) | 27.2 days (1 o/s) | 25.4 days (1 o/s) | 25.4 days (1 o/s) |
| | Detention Time | 1 | 1 | 1 | 1 |
| | | 1 @ 618,240 gal | 1 @ 618,240 gal | 1 @ 618,240 gal | 1 @ 618,240 gal |
| | | 9.2 days | 4.9 days | 3.3 days | 3.3 days |
| | Number | 2 | 1 | 1 | 4 |

| UNIT PROCESS | DESIGN CRITERIA | PWRP EXISTING FACILITIES | Stage V | Stage VI | 2025 FACILITIES |
|---|---|---|---|---|---|
| Digester | Capacity, each | 1 @ 280 gpm | -- | -- | 1 @ 280 gpm |
| Cleanout Pumps | | 1 @ 440 gpm | 440 gpm | 440 gpm | 3 @ 440 gpm |
| Digested Biosolids transfer | Number | -- | 2 | 1 | 3 |
| Pumps | Capacity, each | -- | 250 gpm | 250 gpm | 250 gpm |
| Ferrous Chloride | Number of Pumps | 2 | -- | 1 | 3 |
| Station | Capacity, each | 1 @ 111 gph | -- | 1 @ 111 gph | 2 @ 111 gph |
| | | 1 @ 39.5 gph | -- | -- | 1 @ 39.5 gph |
| | Tank Capacity | 5,375 gal | -- | -- | 5,375 gal |
| Centrifuges | Number | -- | 2 | 1 | 3 |
| w/screens | Capacity, each | -- | 250 gpm | 250 gpm | 250 gpm |
| Truck Loading Station | Number | -- | 1 | -- | 1 |
| Biosolids Drying Beds | Number | 13 | -- | -- | -- |
| | Dimensions (feet) | 180 x 50 x 3 | -- | -- | -- |
| Drying Beds Supernatant | Number | 2 | -- | -- | -- |
| Pumps | Capacity, each | 900 gpm | -- | -- | -- |
| Secondary Effluent | Capacity | -- | +1.8 MG | -- | 1.8 MG |
| Equalization Basins | Dimensions (feet) | -- | 155 x 155 x 10 | -- | 155 x 155 x 10 |
| Tertiary Filters | Number | -- | 6 | 2 | 8 |
| | Capacity, each | -- | 5 gpm/sf | 5 gpm/sf | 5 gpm/sf |
| Chlorine Contact Tanks | Number | -- | 4 | 1 | 5 |
| | Capacity, each | -- | 533,000 gal | 533,000 gal | 533,000 gal |
| | HRT @ Avg. Flow (1 o/s) | -- | 2.6 hours | 2.3 hours | 2.3 hours |
| Chlorination Stations | Number of Stations | -- | 1 | 1 | 2 |
| | Total Capacity | -- | 15.0 mgd | 7.4 mgd | 22.4 mgd |
| Plant Effluent Pump | Number of Pumps | -- | 4 | 2 | 6 |
| Station | Capacity, each | -- | 6,500 gpm | 6,500 gpm | 6,500 gpm |
| | Maximum Station Flow | -- | 18,700 gpm | 28,000 gpm | 28,000 gpm |
| Plant Effluent Force Main | Diameter | -- | 36 inches | -- | 36 inches |
| | Length | -- | 9.0 miles | -- | 9.0 miles |
| Storage | Number | -- | 4 | 2 | 6 |
| Reservoirs | Total Wetted Surface Area Average Capacity, each Average Water Depth, each | -- | 280 acres | 140 acres | 420 acres |
| | Average Freeboard, each | -- | 385 MG | 385 MG | 385 MG |
| | | -- | 18 feet | 18 feet | 18 feet |
| | | -- | 3 feet | 3 feet | 3 feet |
| Agricultural Recycled | Number of Pumps | -- | 6 | 3 | 9 |
| Water | Capacity, each | -- | 8,000 gpm | 8,000 gpm | 8,000 gpm |
| Pump Station | Maximum Station Flow | -- | 38,900 gpm | 58,400 gpm | 58,400 gpm |

| UNIT PROCESS | DESIGN CRITERIA | PWRP | | | |
|---|---|---|---|---|---|
| | | EXISTING FACILITIES | Stage V | Stage VI | 2025 FACILITIES |
| Agricultural Recycled | Diameter | -- | 36 inches | 36 inches | 36 inches |
| Water Force Main | Length | -- | +1 miles | +6 mile | 7 miles |
| Agricultural Recycled | Number | -- | 1 | -- | 1 |
| Water Storage Tank | Total Capacity | -- | 1 MG | -- | 1 MG |
| Agricultural Reuse | Total Farmed Area | 2,067[e] acres | +670 acres | +3,440[f] acres | 4,110 acres |
| Operations | Total Land Area | 2,680 acres | +840 acres | +4,300[f] acres | 5,140 acres |
| Anaerobic Digestion Tanks | Primary & WAS Design Flow | 67,000 gpd | +46,000 gpd | + 56,000 gpd | 169,000 gpd |
| | Total Number of Digesters No. of 1st Stage Digesters Capacity, each | 4[c] | + 2 | +1 | 7[d] |
| | | 3 | 5 | 6 | 6 |
| | | 3 @ 618,240 gal | 3 @ 618,240 gal | 3 @ 618,240 gal | 3 @ 618,240 gal |
| | | | 2 @ 1,222,261 gal | 2 @ 1,222,261 gal | 2 @ 1,222,261 gal |
| | Detention Time | 27.7 days (0 o/s) | 27.2 days (1 o/s) | 25.4 days (1 o/s) | 25.4 days (1 o/s) |
| | No. of Storage Digesters | 1 | 1 | 1 | 1 |
| | Capacity, each | 1 @ 618,240 gal | 1 @ 618,240 gal | 1 @ 618,240 gal | 1 @ 618,240 gal |
| | Detention Time | 9.2 days | 4.9 days | 3.3 days | 3.3 days |
| Digester Cleanout Pumps | Number | 2 | 1 | 1 | 4 |
| | Capacity, each | 1 @ 280 gpm | -- | -- | 1 @ 280 gpm |
| | | 1 @ 440 gpm | 440 gpm | 440 gpm | 3 @ 440 gpm |
| Digested Biosolids transfer | Number | -- | 2 | 1 | 3 |
| Pumps | Capacity, each | -- | 250 gpm | 250 gpm | 250 gpm |
| Ferrous Chloride | Number of Pumps | 2 | -- | 1 | 3 |
| Station | Capacity, each | 1 @ 111 gph | -- | 1 @ 111 gph | 2 @ 111 gph |
| | | 1 @ 39.5 gph | -- | -- | 1 @ 39.5 gph |
| | Tank Capacity | 5,375 gal | -- | -- | 5,375 gal |
| Centrifuges w/screens | Number | -- | 2 | 1 | 3 |
| | Capacity, each | -- | 250 gpm | 250 gpm | 250 gpm |
| Truck Loading Station | Number | -- | 1 | -- | 1 |
| Biosolids Drying Beds | Number | 13 | -- | -- | -- |
| | Dimensions (feet) | 180 x 50 x 3 | -- | -- | -- |
| Drying Beds Supernatant | Number | 2 | -- | -- | -- |
| Pumps | Capacity, each | 900 gpm | -- | -- | -- |
| Secondary Effluent | Capacity | -- | +1.8 MG | -- | 1.8 MG |
| Equalization Basins | Dimensions (feet) | -- | 155 x 155 x 10 | -- | 155 x 155 x 10 |

| UNIT PROCESS | DESIGN CRITERIA | PWRP | | | |
|---|---|---|---|---|---|
| | | EXISTING FACILITIES | Stage V | Stage VI | 2025 FACILITIES |
| Tertiary Filters | Number | -- | 6 | 2 | 8 |
| | Capacity, each | -- | 5 gpm/sf | 5 gpm/sf | 5 gpm/sf |
| Chlorine Contact Tanks | Number | -- | 4 | 1 | 5 |
| | Capacity, each | -- | 533,000 gal | 533,000 gal | 533,000 gal |
| | HRT @ Avg. Flow (1 o/s) | -- | 2.6 hours | 2.3 hours | 2.3 hours |
| Chlorination Stations | Number of Stations | -- | 1 | 1 | 2 |
| | Total Capacity | -- | 15.0 mgd | 7.4 mgd | 22.4 mgd |
| Plant Effluent Pump | Number of Pumps | -- | 4 | 2 | 6 |
| Station | Capacity, each | -- | 6,500 gpm | 6,500 gpm | 6,500 gpm |
| | Maximum Station Flow | -- | 18,700 gpm | 28,000 gpm | 28,000 gpm |
| Plant Effluent Force Main | Diameter | -- | 36 inches | -- | 36 inches |
| | Length | -- | 9.0 miles | -- | 9.0 miles |
| Storage | Number | -- | 4 | 2 | 6 |
| Reservoirs | Total Wetted Surface Area Average Capacity, each Average Water Depth, each | -- | 280 acres | 140 acres | 420 acres |
| | Average Freeboard, each | -- | 385 MG | 385 MG | 385 MG |
| | | -- | 18 feet | 18 feet | 18 feet |
| | | -- | 3 feet | 3 feet | 3 feet |
| Agricultural Recycled | Number of Pumps | -- | 6 | 3 | 9 |
| Water | Capacity, each | -- | 8,000 gpm | 8,000 gpm | 8,000 gpm |
| Pump Station | Maximum Station Flow | -- | 38,900 gpm | 58,400 gpm | 58,400 gpm |
| Agricultural Recycled | Diameter | -- | 36 inches | 36 inches | 36 inches |
| Water Force Main | Length | -- | +1 miles | +6 mile | 7 miles |
| Agricultural Recycled | Number | -- | 1 | -- | 1 |
| Water Storage Tank | Total Capacity | -- | 1 MG | -- | 1 MG |
| Agricultural Reuse | Total Farmed Area | 2,067[e] acres | +670 acres | +3,440[f] acres | 4,110 acres |
| Operations | Total Land Area | 2,680 acres | +840 acres | +4,300[f] acres | 5,140 acres |

(a) *The planned facilities were designed using peaking factors of 1.8 for sanitary flow and 2.5 for storm flow.*
(b) *Plant capacity data in the third column of Table 7-1 under the Existing Facilities heading is based on primary treatment capacity at the PWRP. However, under the Stage V, Stage VI, and 2025 Facilities headings, plant capacity is based on tertiary treatment capacity.*
(c) *Existing digesters 1 and 2 have been abandoned and are not included in criteria.*
(d) *One digester is assumed to be out of service at any given time.*
(e) *This number represents the maximum acreage available for development of agricultural reuse operations at the EMS.*
(f) *Assumes that the existing agricultural reuse acreage is no longer available when the LAWA lease expires in 2022.*

## 4.3 Effluent Water Quality

Table 4-3 presents water quality data of the PWRP's tertiary effluent for 2013.

Table 4-3: Year 2013 Palmdale Wastewater Treatment Facility Effluent Water Quality

| Ammonia Nitrogen (mg/L) [a] | Nitrate Nitrogen (mg/L) [a] | Nitrite Nitrogen (mg/L) [a] | Total Nitrogen (mg/L) [a] | Chloride (mg/L) [a] | TDS [a] | TOC [b] |
|---|---|---|---|---|---|---|
| 4.0 - 6.3 | 2.17 - 2.68 | 0.162 - 0.178 | 8.97 - 10.5 | 178 | 500-560 | 5.34 |

(a) Data from the PWRP Water Recycling Monitoring Report - First Quarter 2013
(b) Data from the PWRP Monthly Monitoring Report – July 2013

Groundwater recharge regulation states that the water quality of discharged waters must be of higher quality than the maximum allowable groundwater basin contaminant load, as presented in the Antelope Valley Salt and Nutrient Management Plan. Current PWRP tertiary effluent water quality, presented in Table 4-3 meets this requirement.

## 4.4 Additional Treatment Facilities

The PWRP tertiary effluent water quality currently meets Title 22 tertiary requirements. Making recycled water supplies available for reuse rather would help eliminate land application and related groundwater contamination.

## 4.5 Existing Recycled Water Users

The City of Palmdale currently owns a recycled water transmission line to deliver recycled water from the Palmdale WRP to McAdam's Park for irrigation. The balance of recycled water is utilized for agriculture irrigation at agronomic rates.

The PRWA plans on providing up to 2,000 AF/yr of recycled water to landscape irrigation customers in the future. The proposed Palmdale Power Plant will use 400 AF/yr of recycled water. The PRRGRP and other recycled water projects will eventually utilize all of the remaining recycled water at buildout. There will be a transition period over the first few years of the project, where there will be recycled water utilized for both agricultural irrigation and the project. Eventually, agricultural irrigation will not utilize recycled water when the project is fully operational.

## 4.6 Rights to Treated Effluent

Presently the water rights to wastewater from the PWRP are held by LACSD No. 20. In a public meeting in the summer of 2015 in Lancaster, LACSD and LA County Waterworks stated they would transfer the rights of wastewater effluent to water recycling projects being planned by the PRWA and the District.

# TREATMENT REQUIREMENTS FOR DISCHARGE AND REUSE

This Chapter describes the treatment and health requirements for use of recycled water with the project.

## 5.1 Required Water Quality and Treatment for Reuse

The primary regulation governing recycled water use is the California Water Code of Regulations, Title 22. The treatment requirement for this project would be tertiary treated recycled water, unrestricted use. Recycled water requirements in the State of California are administered by the SWRCB Division of Drinking Water (DDW) and individual RWQCBs. The District is located in the South Lahontan Region (Region 6).

The SWRCB establishes general policies governing the permitting of recycled water projects consistent with its role of protecting water quality and sustaining water supplies. The SWRCB also exercises general oversight over recycled water projects, including review of RWQCB permitting practices. The DDW regulates the treatment, quality and use of recycled water, as well as the proper separation of recycled water and drinking water systems. Further, DDW’s Recycled Water Unit develops water recycling criteria and regulations, evaluates water recycling projects and makes recommendations to RWQCBs about public health implications, and maintains an Alternative Treatment Technology Report for recycled water. The RWQCB is charged with protection of surface and groundwater resources and with the issuance of permits that implement DDW recommendations.

The recycled water supply from the LACSD No. 20 PWRP meets Title 22 tertiary requirements. The present disposal for the wastewater effluent is for use on fodder agricultural crops in the Antelope Valley.

### 5.1.1 Title 22 Requirements for Irrigation Using Recycled Water

Title 22 stipulates the levels of treatment for different non-potable uses of recycled water, permissible types of reuse, and minimum recycled water quality requirements. Routine monitoring is required to ensure that he intended quality is consistently being produced.

The following text is taken from Title 22, Article 3. Uses of Recycled Water, §60304. Use of recycled water for irrigation.

> “(a) Recycled water used for the surface irrigation of the following shall be a disinfected tertiary recycled water, except that for filtration pursuant to Section 60301.320(a) coagulation need not be used as part of the treatment process provided that the filter effluent turbidity does not exceed 2 NTU, the turbidity of the influent to the filters is continuously measured, the influent turbidity does not exceed 5 NTU for more than 15 minutes and never exceeds 10 NTU, and that there is the capability to automatically activate chemical addition or divert the wastewater should the filter influent turbidity exceed 5 NTU for more than 15 minutes:
>
> (1) Food crops, including all edible root crops, where the recycled water comes into contact with the edible portion of the crop,

(2) Parks and playgrounds,
(3) School yards,
(4) Residential landscaping,
(5) Unrestricted access golf courses, and
(6) Any other irrigation use not specified in this section and not prohibited by other sections of the California Code of Regulations.

(b) Recycled water used for the surface irrigation of food crops where the edible portion is produced above ground and not contacted by the recycled water shall be at least disinfected secondary-2.2 recycled water.

(c) Recycled water used for the surface irrigation of the following shall be at least disinfected secondary-23 recycled water:
(1) Cemeteries,
(2) Freeway landscaping,
(3) Restricted access golf courses,
(4) Ornamental nursery stock and sod farms where access by the general public is not restricted,
(5) Pasture for animals producing milk for human consumption, and
(6) Any nonedible vegetation where access is controlled so that the irrigated area cannot be used as if it were part of a park, playground or school yard
(d) Recycled wastewater used for the surface irrigation of the following shall be at least undisinfected secondary recycled water:
(1) Orchards where the recycled water does not come into contact with the edible portion of the crop,
(2) Vineyards where the recycled water does not come into contact with the edible portion of the crop,
(3) Non food-bearing trees (Christmas tree farms are included in this category provided no irrigation with recycled water occurs for a period of 14 days prior to harvesting or allowing access by the general public),
(4) Fodder and fiber crops and pasture for animals not producing milk for human consumption,
(5) Seed crops not eaten by humans,
(6) Food crops that must undergo commercial pathogen-destroying processing before being consumed by humans, and
(7) Ornamental nursery stock and sod farms provided no irrigation with recycled water occurs for a period of 14 days prior to harvesting, retail sale, or allowing access by the general public.

(e) No recycled water used for irrigation, or soil that has been irrigated with recycled water, shall come into contact with the edible portion of food crops eaten raw by humans unless the recycled water complies with subsection (a)."

Figure 5-1 summarizes the Title 22 requirements for non-potable use of recycled water.

## TITLE 22, CALIFORNIA CODE OF REGULATIONS
## DIVISION 4, CHAPTER 3, WATER RECYCLING CRITERIA

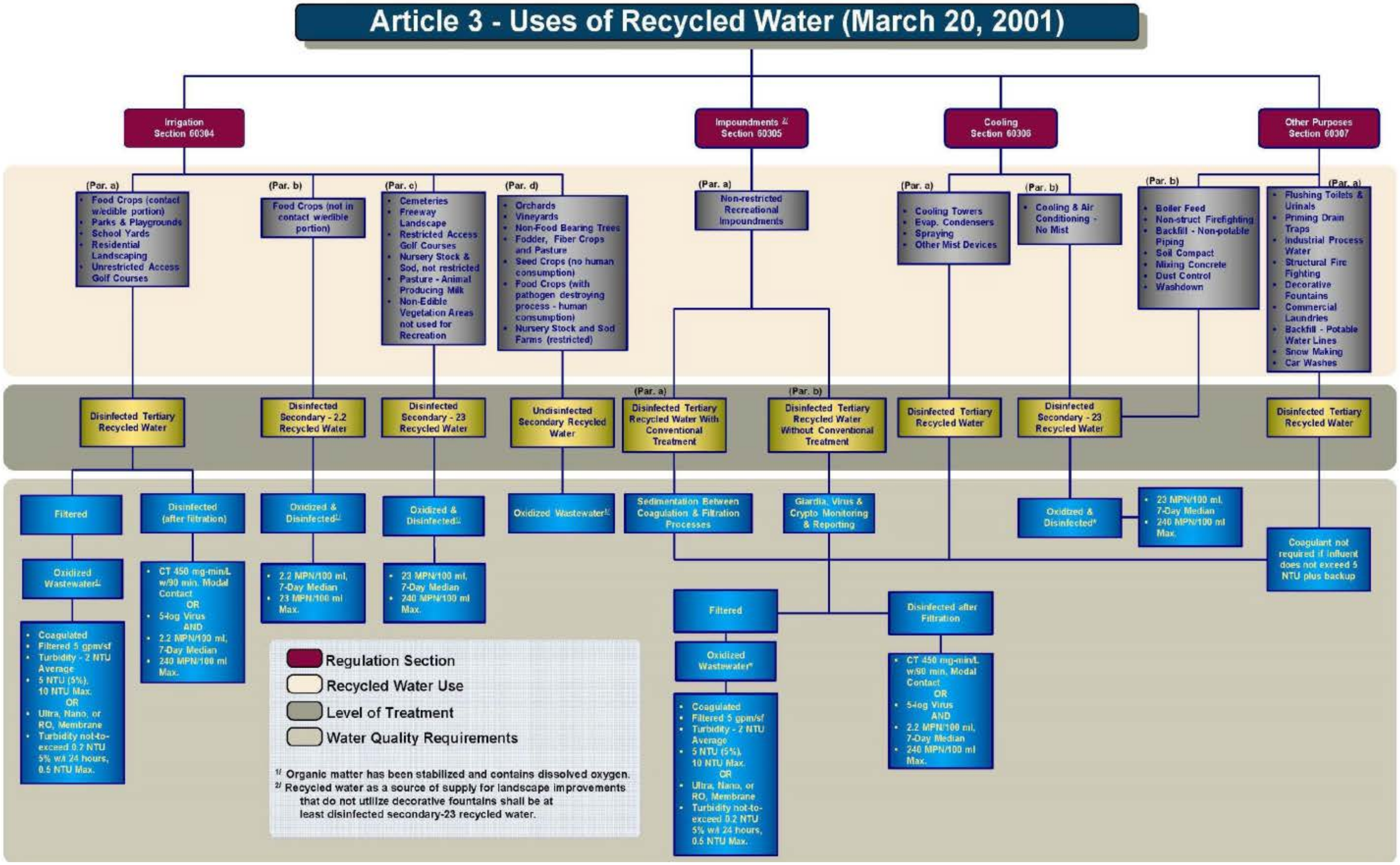



**Figure 5-1 Schematic of Title 22 Process**

In addition to recycled water uses and treatment requirements, Title 22 addresses water quality monitoring, use area requirements, preparation of an engineering report prior to production or use of recycled water, general treatment design requirements, reliability requirements, and alternative methods of treatment. Recycled water quality monitoring for disinfected tertiary recycled water includes daily sampling for total coliform and continuous sampling for turbidity using a continuous turbidity meter and recorder following filtration. Use area requirements dictate recycled water application distance requirements from water supply wells (i.e., buffer zone), irrigation run-off control and overspray guidelines, and signage requirements. Treatment facility reliability features include guidelines for establishing operational and reliability measures and operator certification requirements.

### 5.1.2 Title 17 Requirements for Recycled Water

In addition to Title 22 requirements for non-potable water reuse, DDW reviews and approves final plans for cross connection control and pipeline separations in accordance with Title 17, and inspects distribution systems prior to operation. The focus of Title 17 is protection of potable water supplies through control of cross connections with non-potable water supplies such as recycled water. Title 17 specifies the minimum backflow protection required on the potable water system for situations in which there is potential for contamination to the potable water supply.

The following section is extracted from Title 17 Code of Regulations, Article 2. Protection of Water System, §7604:

> "The type of protection that shall be provided to prevent backflow into the public water supply shall be commensurate with the degree of hazard that exists on the consumer's premises. The type of protective device that may be required (listed in an increasing level of protection) includes: Double check Valve Assembly-- (DC), Reduced Pressure Principle Backflow Prevention Device--(RP) and an Air gap Separation--(AG). The water user may choose a higher level of protection than required by the water supplier. The minimum types of backflow protection required to protect the public water supply, at the water user's connection to premises with various degrees of hazard, are given in [the following table]."

Table 5-1: Minimum Types of Backflow Prevention

| **Degree of Hazard** | **Minimum Type of Backflow Prevention** |
|---|---|
| (c) Recycled water | |
| (1) Premises where the public water system is used to | AG |
| (2) Premises where recycled water is used, other than as allowed in paragraph (3), and there is no interconnection with the potable water system. | RP |

| Degree of Hazard | Minimum Type of Backflow Prevention |
| --- | --- |
| (3) Residences using recycled water for landscape irrigation as part of an approved dual plumbed use area established pursuant to sections 60313 through 60316 unless the recycled water supplier obtains approval of the local public water supplier, or the Department if the water supplier is also the supplier of the recycled water, to utilize an alternative backflow protection plan that includes an annual inspection and annual shutdown test of the recycled water and potable water systems pursuant to subsection 60316(a). | DC |

Details on the approval, construction, location, and testing and maintenance of required backflow preventers are outlined in Title 17 Code of Regulations, Article 2.

In addition, under the California Health and Safety Code, it is required that all recycled water pipes installed above or below the ground are required to be colored purple or distinctively wrapped with purple tape.

## 5.2 General Permit for Recycled Water Use

In June 2014, the SWRCB adopted General Waste Discharge Requirements for Recycled Water Use (Order WQ 2014-0090-DWQ – Corrected) which covers non-potable uses of recycled water (SWRCB 2014). The intent of the order is to streamline the permitting process and delegate the responsibility of administrating water recycling programs to an Administrator to the fullest extent possible. The document serves as a statewide General Order authorizing the use of recycled water for all Title 22 non-potable uses. Groundwater replenishment activities (potable reuse) and disposal of treated wastewater are specifically excluded. Recycled water producers that are already covered under existing orders (as in the case with the Palmdale WRP) may elect to either (i) continue or expand coverage under existing orders, or (ii) apply for coverage under this General Order.

The General Order includes certain requirements and prohibitions and specifies that recycled water production, distribution, and use comply with applicable Title 22 and Title 17 requirements. Compliance with the General Order does not relieve producers or distributors from the obligation to comply with applicable Waste Discharge Requirements (WDRs) for discharges from wastewater treatment plants.

## 5.3 Potable Reuse Requirements for Groundwater Recharge

Potable reuse involves the use of high quality recycled water for augmenting a drinking water source. Potable reuse may be classified into two types: indirect potable reuse (IPR) and direct potable reuse (DPR). IPR is the purposeful introduction of highly treated recycled water into an untreated drinking water supply source (i.e., a groundwater aquifer or surface water body) that serves as a natural buffer. In DPR, the water is introduced immediately upstream of a drinking water treatment plant or directly into the potable water supply distribution system, i.e., no natural buffer.

Regulations for IPR using groundwater replenishment became effective on June 18, 2014 and were added to the Title 22 Code of Regulations (Division 4, Chapter 3, Articles 5.1 and 5.2). These regulations define a “Groundwater Replenishment Reuse Project” (or GRRP) as a “project involving the planned use of recycled municipal wastewater that is operated for the purpose of replenishing a groundwater basin designated in the Water Quality Control Plan for use as a source of municipal and domestic water supply.”

Table 5-2 summarizes the water quality and treatment requirements of the GRRP regulations (Trussell et al. 2013; CDPH 2014). Full advanced treatment (FAT) is required in the case of groundwater replenishment via injection (subsurface application), and is not required in the case of groundwater replenishment via surface spreading, which is the replenishment mechanism utilized for this project.

A key aspect of the GRRP regulations is that the recharge water (recycled water) must receive treatment that achieves at least 12-log enteric virus reduction, 10-log Giardia cyst reduction, and 10-log Cryptosporidium oocyst reduction, referred to as the 12-10-10 log removal. A 10-log removal corresponds to 99.99999999% removal and 12-log removal corresponds to 99.9999999999% removal. For groundwater recharge using surface spreading, the 10-log removal requirements for Giardia and Cryptosporidium can be waived for disinfected tertiary effluents (per Title 22) that achieve at least six months of storage underground (CDPH 2014; Gerrity et al. 2013), as indicated in Table 5-2. The water quality requirements prior to recharge are the same for spreading or injection (per Table 5-2) except for TOC, which depends on the Recycled Water Contribution (RWC) in the case of spreading Figure 5-2.

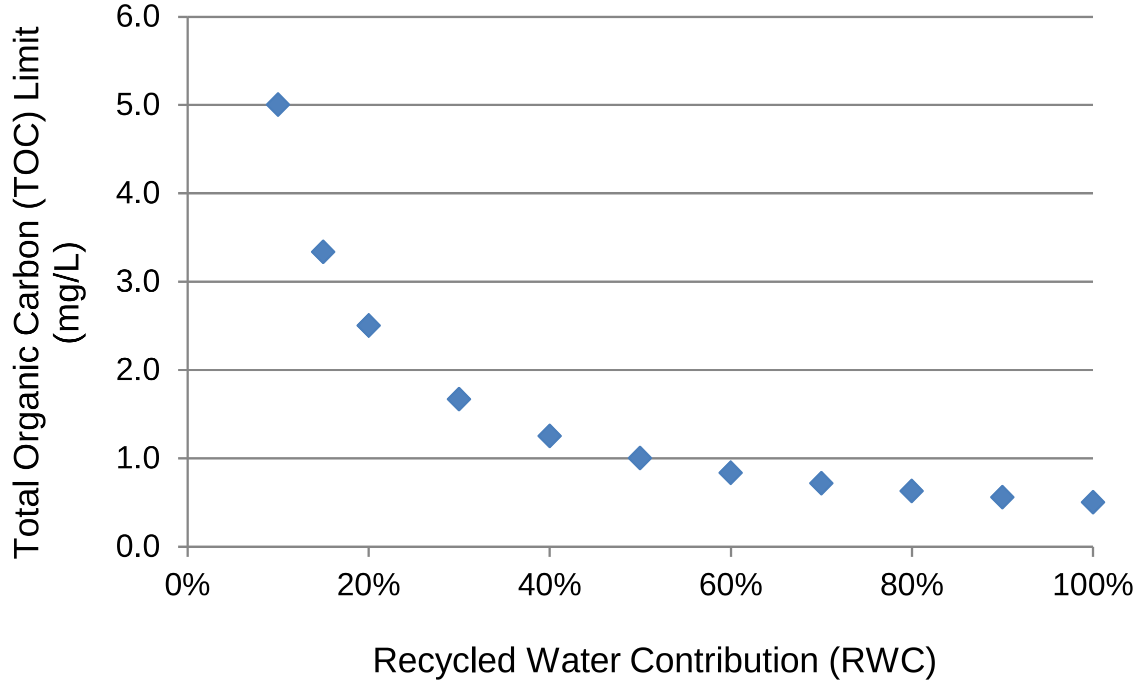



**Figure 5-2 Relationship between RWC and TOC**

Table 5-2: Summary of SWRCB DDW Regulations for Indirect Potable Reuse via Groundwater Recharge

| **Treatment Requirements** | **Water Quality Requirements** |
|---|---|
| Spreading (i.e., surface application)<br>• Oxidation<br>• Filtration<br>• Disinfection<br>• Soil aquifer treatment<br>Injection with FAT (i.e., subsurface application)<br>• Oxidation<br>• Reverse Osmosis<br>• Advanced Oxidation Process (AOP) | ≥ 12-log virus reduction*<br>≥ 10-log *Giardia* cyst reduction**<br>≥ 10-log *Cryptosporidium* oocyst reduction**<br>Drinking water MCLs (except for nitrogen)<br>≤ 10 mg/L total nitrogen<br>Action levels for lead and copper<br>TOC ≤ 0.5 mg/L for injection<br>TOC ≤ 0.5/RWC for spreading<br>*(Water quality requirements are applicable prior to recharge except where noted * and **)* |
| **Underground Retention Time** | |
| • Minimum 2-month retention time underground | |
| **Pathogen Log Reduction Credits for Underground Retention** | |
| • *For spreading, or injection with Full Advanced Treatment (FAT), 1-log virus reduction credit automatically given per month of subsurface retention (less credit may be given depending on whether a tracer study or lesser method has been used to estimate retention time)<br>• **For spreading, 10-log *Giardia* reduction and 10-log *Cryptosporidium* reduction credit given to disinfected tertiary effluents with at least 6 months retention time underground | |
| **Recycled Water Contribution (RWC) / Diluent Water Requirements** | |
| • For spreading, initial maximum RWC ≤ 20%. Over time the RWC can be increased if certain requirements are met.<br>• For injection with FAT, up to 100% RWC | |
| **Other Selected Requirements** | |
| • Treatment train shall consist of at least 3 separate treatment processes to achieve the required pathogenic (microorganism) control<br>• For each pathogen (i.e., virus, *Giardia*, or *Cryptosporidium*), a separate treatment process may be credited with no more than 6-log reduction, with at least 3 processes each being credited with no less than 1.0-log reduction | |

Definitions for required treatment are presented in the regulations (CDPH 2014). There are additional regulatory requirements not shown in Table 5-2, such as reporting and monitoring requirements. The following list summarizes the major reports, actions, and studies required by the GRRP regulations to implement a groundwater replenishment project. The language below is in a summary form. The precise requirements and conditions are found in the regulations.

Prior to groundwater replenishment:

- Prepare engineering report with hydrogeological assessment

- Prepare a map of the GRRP site with drinking water well and monitoring well locations

- Site and construct at least two monitoring wells down gradient of the GRRP

- Obtain DDW approval of a plan to provide an alternative drinking water supply or treatment for all users of a drinking water well that has been compromised as a result of the GRRP's operations

- Conduct background water quality monitoring for the potentially affected aquifer (total nitrogen, regulated contaminants and physical characteristics, TOC, Priority Toxic Pollutants from 40 CFR Section 131.38, any additional contaminants specified by DDW)

- For surface spreading (i.e., no FAT), prior to initial operation and at five-year intervals thereafter, conduct study to determine occurrence of indicator compounds[1] (i.e., trace organic compounds [TOrCs]) in the recycled water

- Demonstrate that all treatment processes have been installed and can be operated to achieve their intended function

- Validate each of the treatment processes used to meet the 12-10-10 log requirements by submitting a report for DDW review or by using an approved challenge test

- Prepare Operation Optimization Plan that includes operations, maintenance, analytical methods, and monitoring necessary to meet the GRRP requirements, including ongoing monitoring to verify performance of treatment processes used to meet the 12-10-10 log requirements, and submit to regulator for approval

- Hold public hearing prior to initial permit and any time an increase in maximum RWC is proposed

- Develop a method for determining the volume of diluent water to be credited

- Conduct a tracer study to determine underground retention time (must be initiated prior to the end of the third month of operation)

During groundwater replenishment (ongoing):

- Ensure that the recycled water is from a wastewater management agency that maintains a source control program

- Ongoing monitoring to verify performance of treatment processes used to meet the 12-10-10 log requirements

- Ongoing weekly, quarterly, or annual monitoring (depending on the water quality parameter) for water quality parameters including primary and secondary drinking water

[1] The GRRP regulations define "Indicator Compound" as an individual chemical in a GRRP's municipal wastewater that represents the physical, chemical, and biodegradable characteristics of a specific family of trace organic chemicals (TOrCs); is present in concentrations that provide information relative to the environmental fate and transport of those chemicals; may be used to monitor the efficiency of TOrCs removal by treatment processes; and provides an indication of treatment process failure.

MCLs, Priority Toxic Pollutants, chemicals having California Notification Levels (NLs), indicator compounds, etc. according to the Operation Optimization Plan

- For surface spreading (i.e., no FAT), prior to initial operation and at five-year intervals thereafter, conduct study to determine occurrence of indicator compounds in the recycled water. Evaluate the soil aquifer treatment (SAT) process through ongoing monitoring of removal of indicator compounds, with a target of 90% reduction. For injection, continuously monitor the selected indicator and/or surrogate compounds during full-scale operation of the oxidation process.

- Ensure diluent water, if used, does not exceed primary MCLs or secondary MCL upper limits and NLs and implement water quality monitoring plan

- Ongoing determination of the recycled water contribution

- Annual reporting to the DDW and RWQCB

- Update Engineering Report every five years

## 5.4 Health Related Water Qualities

The required health-related water qualities and treatment requirements are covered under Title 22 Requirements for Irrigation Using Recycled Water, and Title 17 Requirements for Recycled Water, described above.

Drinking water standards are called maximum contaminant levels (MCLs). MCLs are found in Title 22 of the California Code of Regulations and they address public health concerns. Esthetics, such as taste and odor are addressed by secondary MCLs.

Recycled water recharge requires permitting through the Regional Water Quality Control Board (RWQCB) and coordination with the extraction for potable use requirements from the California State Water Quality Control Board Division of Drinking Water (DDW) (formerly California Department of Public Health [CDPH]). The recycled water replenishment regulations adopted on June 18, 2014 identify the requirements and approval process, which can be lengthy and complex. Regulations require that any recycled water recharged be blended with a diluent source of supply. While blending does not have to physically occur at the time of recharge, the replenishment area must be essentially the same for both recycled water and diluent supply for proper blending. It is anticipated that the initial blending requirement will be 80 percent diluent with 20 percent recycled water. With successful water quality testing and monitoring, it is anticipated that the blending percentage diluent water will decrease, allowing for a greater recharge rate for recycled water.

## 5.5 Wastewater Discharge Requirements

The PWRP currently operates under Order No. R6V-2011-0012 adopted by the Lahontan RWQCB on March 9, 2011, formerly under Order No. 6-00-57 and its amendments. The adopted order specifies WDRs and water recycling requirements (WRRs) for the PWRP. The Lahontan RWQCB has not issued updated WDRs for the PWRP.

The RWQCB also adopted Cleanup and Abatement Order No. R6V-2003-056 (CAO) and Cease and Desist Orders No. R6V-2004-039 (CDO) and CDO No. R6V-2004-0039-A01 in November 2003, October 2004 and November 2007, respectively. The CAO requires LA County Sanitation District No. 20 and LA World Airports to clean up and abate the elevated nitrate levels identified in the groundwater beneath the land application sites.

The CDO and amendment required LACSD No. 20 to cease discharges of nitrogen to the groundwater in violation of its WDRs. In 2011, Board Order No. R6V-2011-0046 was adopted, rescinding the CDO and amended CDO after requirements had been fulfilled. LACSD constructed facilities to store and manage its wastewater and was able to demonstrate that its application of recycled water to land did not exceed the water and nutrient agronomic rates.

Specific discharge requirements are defined by the surface water quality and groundwater quality objectives in the Lahontan Basin Plan. Waste discharge requirements and water quality criteria of applicable Palmdale WRP orders (as mentioned above) implement and are consistent with the Basin Plan and the Recycled Water Policy and related criteria, as stated in these Orders.

If the existing surface or groundwater background water quality is better than the prescribed objective, the RWQCB will enforce an Anti-Degradation Policy to prevent degradation due to the use of recycled water. The recently adopted General Waste Discharge Requirements for Recycled Water Use (SWRCB 2014) reiterates the Anti-Degradation Policy and states the following:

“This General Order regulates discharges to groundwater basins throughout the state. There is not sufficient data to determine which groundwater basins are high quality waters for the various constituents that may be associated with recycled water. To the extent use of recycled water may result in a discharge to a groundwater basin that contains high quality water, this General Order authorizes limited degradation consistent with the Anti-degradation Policy as described in the findings below. Further, Salt and Nutrient Management Plans, developed in accordance with the Recycled Water Policy, will require analysis on an ongoing basis to evaluate inputs to the basin, the salt and nutrient mass balance, and the available assimilative capacity.”

## 5.6 Compliance with Anticipated Recycled Water Quality Requirements

Recycled Water must achieve compliance with primary and secondary drinking water maximum contaminant levels (MCLs) prior to surface application. Water quality comparisons with notification levels (NLs) may be determined based on concentrations of chemicals in the recharge water after surface application if the fraction of Recycled Water in the Recharge Water is equal to or greater than the average fraction of Recycled Water in the Recharge Water applied over the quarter. The recycled water produced at the Palmdale WRP is of relatively high quality and is suitable for use for groundwater replenishment via surface spreading. Palmdale WRP recycled water meets or exceeds the requirements for water quality for the majority of chemicals with primary or secondary drinking water MCLs.

### 5.6.1 Recycled Water Quality with Respect to Landscape Irrigation

LA County Sanitation District No. 20 has completed a Title 22 Engineering Report that was approved on January 11, 2012 by the Lahontan Region Water Quality Control Board as Board Order No. R6V-2012-002 and WDID No. 6B190901008. The Order is included as Appendix B. The Order approves the use of recycled water from the Palmdale Tertiary Treated Wastewater for use on outdoor landscaping and other closely related outdoor watering activities. Table 5-3 presents the water quality of the Palmdale WRP recycled water with respect to irrigation water requirements.

***Table 5-3: Quality of Recycled Water from the Palmdale WRP with Respect to Irrigation Water Quality***

| Constituent | Units | Irrigation Water Quality Management Goal | Palmdale WRP Tertiary-treated Effluent Average [(a)] |
|---|---|---|---|
| **Salt Content** | | | |
| Total Dissolved Solids (TDS) | mg/L | 1000 | 520 |
| **Cations and Anions** | | | |
| Calcium | mg/L | 300 | 44.6 |
| Magnesium | mg/L | 60 | 10 |
| Sodium | mg/L | 300 | 136 |
| Chloride | mg/L | 250 | 150 |
| Carbonate | mg/L | 2 | 1/ |
| Bicarbonate | mg/L | 400 | 1 |
| Sulfate | mg/L | 500 | 91.5 |
| **Nutrients** | | | |
| Nitrate | mg/L | 10 | 2.98 |
| Ammonium | mg/L | 5 | 2.6 |
| Phosphate | mg/L | 2 | 1/ |
| Potassium | mg/L | 2 | 1/ |
| **Miscellaneous** | | | |
| Arsenic | µg/L | 10 | <1 |
| Boron | mg/L | 0.7-1 | Not analyzed |
| Fluoride | mg/L | 1-2 | Not analyzed |
| Total Chromium | µg/L | 50 | 0.6 |

1/ Monitoring of these elements is not required for recycled water. These elements combined with other elements to form Calcium Carbonate, Calcium Phosphate and Potassium Carbonate and contribute to Total Dissolved Solids (TDS). Although not measured, their concentrations is inherent in monitoring of TDS.

### 5.6.2 Recycled Water Quality with Respect to Primary Drinking Water MCLs

Although this Phase 2 Water Line project no longer includes a groundwater recharge component, a Title 22 Engineering Report for the Palmdale Regional Groundwater Recharge and Recovery Project has been submitted to the Lahontan Region Water Quality Control Board for their review and subsequent approval. The following information from that report applies to drinking water.

Table 5-4, Table 5-5 and Table 5-6 present the water quality of the Palmdale WRP recycled water with respect to primary drinking water requirements, as well as copper and lead. Palmdale WRP recycled water quality data included in this analysis is from the years 2011 to 2015. For all inorganic chemicals (including copper and lead), organic chemicals, and disinfection byproducts for which tertiary effluent data exists, the Palmdale WRP recycled water is lower than the respective MCL.

### 5.6.3 Recycled Water Quality with Respect to Secondary Drinking Water MCLs

Table 5-7 presents the water quality of the Palmdale WRP recycled water with respect to secondary drinking water requirements. Palmdale WRP Recycled Water quality data is from the years 2011 to 2015. The tertiary effluent concentrations of aluminum, color, iron, manganese, odor and thiobencarb have not been determined at this time. The following discussion applies to those constituents for which tertiary effluent water data exists. For those constituents with a fixed consumer acceptance MCL, Palmdale WRP recycled water is below the MCL.

For those constituents for which no fixed consumer acceptance contaminant level has been established a range of contaminant level are provided. The Recommended Contaminant Levels is desirable for a higher degree of consumer acceptance; however, the Upper Contaminant Level is acceptable if it is not reasonable or feasible to provide water at the Recommended Contaminant Level. Palmdale WRP recycled water is below the Recommended Contaminant Level for chloride and sulfate and below the Upper Contaminant Level for total dissolved solids.

*Table 5-4: Quality of Recycled Water from the Palmdale WRP with Respect to Primary Drinking Water Maximum Contaminant Levels (MCLs) for Inorganic Chemicals and Radionuclides*

| Constituent | Units | MCL | Palmdale WRP Average [(a)] | Palmdale WRP Maximum (Since Dec. 2011) |
|---|---|---|---|---|
| **Inorganics** | | | | |
| Aluminum | µg/L | 1000 | NA | NA |
| Antimony | µg/L | 6 | <0.5 | <0.5 |
| Arsenic | µg/L | 10 | <1 | <1 |
| Asbestos | MFL | 7 | NA | NA |
| Barium | µg/L | 1000 | NA | NA |
| Beryllium | µg/L | 4 | <0.25 | <0.25 |
| Cadmium | µg/L | 5 | <0.2 | <0.2 |
| Chromium, Total | µg/L | 50 | 0.7 | 1.27 |
| Chromium, Hexavalent | µg/L | 10 | <0.05 | <0.05 |
| Cyanide | µg/L | 150 | NA | <5.0 |
| Fluoride | mg/L | 2 | NA | NA |
| Mercury (inorganic) | µg/L | 2 | 0.00075 | 0.00097 |
| Nickel | µg/L | 100 | 1.1 | 1.3 |
| Nitrate (as N) | mg-N/L | 10 | 2.8 | 8.46 |
| Nitrite (as N) | mg-N/L | 1 | 0.108 | 0.679 |
| Nitrate + Nitrite | mg-N/L | 10 | ** | 8.497 |
| Perchlorate | µg/L | 6 | NA | NA |
| **Copper and Lead [(b)]** | | | | |
| Copper | µg/L | 1300 | 1.9 | 2.8 |
| Lead | µg/L | 15 | <0.25 | <0.25 |
| **Radionuclides** | | | | |
| Gross alpha particle activity | pCi/L | 15 | NA | NA |
| Gross beta particle activity | mrem/yr | 4 | NA | NA |
| Radium-226 + Radium-228 | pCi/L | 5 | NA | NA |
| Strontium-90 | pCi/L | 8 | NA | NA |
| Tritium | pCi/L | 20,000 | NA | NA |
| Uranium | pCi/L | 20 | NA | NA |

Notes:
MCL = Maximum Contaminant Level, NA = Not Analyzed, mg/L = milligrams per liter, µg/L = micrograms per liter, MFL = million fibers per liter; for fibers >10 microns long, pCi/L = picocuries per liter, mrem/yr = roentgen equivalent in man per year, ** Data unavailable

(a) Annual average tertiary effluent concentration from January 2012 through December 2015.

(b) Values referred to as MCLs for lead and copper are not actually MCLs; instead, they are called "Action Levels" under the lead and copper rule, 22 CCR §64672.3

*Table 5-5 Maximum Contaminant Levels (MCLs) for Organic Chemicals*

| Constituent | Units | MCL | Palmdale WRP Average [(a)] | Palmdale WRP Maximum (Since Dec. 2011) |
|---|---|---|---|---|
| **Volatile Organic Chemicals (VOCs)** | | | | |
| Benzene | µg/L | 1 | <0.5 | <0.5 |
| Carbon tetrachloride | µg/L | 0.5 | <0.5 | <0.5 |
| 1,2-Dichlorobenzene | µg/L | 600 | <0.5 | <0.5 |
| 1,4-Dichlorobenzene (p-DCB) | µg/L | 5 | <0.5 | <0.5 |
| 1,1-Dichloroethane (1,1-DCA) | µg/L | 5 | <0.5 | <0.5 |
| 1,2-Dichloroethane (1,2-DCA) | µg/L | 0.5 | <0.5 | <0.5 |
| 1,1-Dichloroethylene (1,1-DCE) | µg/L | 6 | <0.5 | <0.5 |
| cis-1,2-Dichloroethylene | µg/L | 6 | NA | <0.5 |
| trans-1,2-Dichloroethylene | µg/L | 10 | <0.5 | <0.5 |
| Dichloromethane (Methylene chloride) | µg/L | 5 | <0.5 | <0.5 |
| 1,2-Dichloropropane | µg/L | 5 | <0.5 | <0.5 |
| 1,3-Dichloropropene | µg/L | 0.5 | <0.5 | <0.5 |
| Ethylbenzene | µg/L | 300 | <0.5 | <0.5 |
| Methyl tertiary butyl ether (MTBE) | µg/L | 13 | <0.5 | <0.5 |
| Monochlorobenzene | µg/L | 70 | <0.5 | <0.5 |
| Styrene | µg/L | 100 | NA | NA |
| 1,1,2,2-Tetrachloroethane | µg/L | 1 | <0.5 | <0.5 |
| Tetrachloroethylene (PCE) | µg/L | 5 | <0.5 | <0.5 |
| Toluene | µg/L | 150 | <0.5 | <0.5 |
| 1,2,4-Trichlorobenzene | µg/L | 5 | <5 | <5 |
| 1,1,1-Trichloroethane (1,1,1-TCA) | µg/L | 200 | <0.5 | <0.5 |
| 1,1,2-Trichloroethane (1,1,2-TCA) | µg/L | 5 | <0.5 | <0.5 |
| Trichloroethylene (TCE) | µg/L | 5 | <0.5 | <0.5 |
| Trichlorofluoromethane (Freon 11) | µg/L | 150 | NA | <1.0 |
| 1,1,2-Trichloro-1,2,2-Trifluoroethane (Freon 113) | µg/L | 1200 | NA | NA |
| Vinyl chloride | µg/L | 0.5 | <0.5 | <0.5 |
| Xylenes | µg/L | 1750 | NA | NA |
| **Non-Volatile Synthetic Organic Chemicals (SOCs)** | | | | |
| Alachlor | µg/L | 2 | NA | NA |
| Atrazine | µg/L | 1 | NA | NA |
| Bentazon | µg/L | 18 | NA | NA |
| Benzo(a)pyrene | µg/L | 0.2 | <0.02 | <0.02 |

| Constituent | Units | MCL | Palmdale WRP Average [a] | Palmdale WRP Maximum (Since Dec. 2011) |
|---|---|---|---|---|
| Carbofuran | µg/L | 18 | NA | NA |
| Chlordane | µg/L | 0.1 | <0.05 | <0.05 |
| Dalapon | µg/L | 200 | NA | NA |
| | | | | |
| 1,2-Dibromo-3-chloropropane (DBCP) | µg/L | 0.2 | NA | NA |
| 2,4-Dichlorophenoxyacetic acid (2,4-D) | µg/L | 70 | NA | NA |
| Di(2-ethylhexyl)adipate | µg/L | 400 | NA | NA |
| Di(2-ethylhexyl)phthalate (DEHP) | µg/L | 4 | <2 | <2 |
| Dinoseb | µg/L | 7 | NA | NA |
| Diquat | µg/L | 20 | NA | NA |
| Endrin | µg/L | 2 | <0.01 | <0.01 |
| Endothal | µg/L | 100 | NA | NA |
| Ethylene dibromide (EDB) | µg/L | 0.05 | NA | NA |
| Glyphosate | µg/L | 700 | NA | NA |
| Heptachlor | µg/L | 0.01 | <0.01 | <0.01 |
| Heptachlor epoxide | µg/L | 0.01 | <0.01 | <0.01 |
| Hexachlorobenzene | µg/L | 1 | <1 | <1 |
| Hexachlorocyclopentadiene | µg/L | 50 | <5 | <5 |
| Lindane | µg/L | 0.2 | <0.01 | <0.01 |
| Methoxychlor | µg/L | 30 | NA | NA |
| Molinate | µg/L | 20 | NA | NA |
| Oxamyl | µg/L | 50 | NA | NA |
| Pentachlorophenol | µg/L | 1 | <1 | <1 |
| Picloram | µg/L | 500 | NA | NA |
| Polychlorinated biphenyls (PCBs) | µg/L | 0.5 | NA | NA |
| Simazine | µg/L | 4 | NA | NA |
| 2,4,5-TP (Silvex) | µg/L | 50 | NA | NA |
| 2,3,7,8-TCDD (dioxin) | µg/L | 0.00003 | NA | <0.000012 |
| Thiobencarb | µg/L | 70 | NA | NA |
| Toxaphene | µg/L | 3 | <0.5 | <0.5 |

Notes:
MCL = Maximum Contaminant Level, NA = Not Analyzed, µg/L = micrograms per liter
(a) Annual average tertiary effluent concentration from January 2012 through December 2015.

*Table 5-6: Quality of Recycled Water from the Palmdale WRP with Respect to Primary Drinking Water Maximum Contaminant Levels (MCLs) for Disinfection Byproducts*

| Constituent | Units | MCL | Palmdale WRP Average [(a)] | Palmdale WRP Maximum (Since Dec. 2011) |
|---|---|---|---|---|
| Total Trihalomethanes | µg/L | 80 | 4.5 | 11.6 |
| Bromodichloromethane | µg/L | -- | 0.7 | 1.4 |
| Bromoform | µg/L | -- | <0.5 | 1.3 |
| Chloroform | µg/L | -- | 3.9 | 10.2 |
| Dibromochloromethane | µg/L | -- | <0.5 | <0.5 |
| Haloacetic Acids (five) (HAA5) | µg/L | 60 | 208 | 43 |
| Monochloroacetic Acid | µg/L | -- | 2.3 | 3.4 |
| Dichloroacetic Adic | µg/L | -- | 14 | 31 |
| Trichloroacetic Acid | µg/L | -- | 4.4 | 11 |
| Monobromoacetic Acid | µg/L | -- | 2.0 | 5.4 |
| Dibromoacetic Acid | µg/L | -- | 1.0 | 1.1 |
| Bromate | mg/L | 0.01 | NA | NA |
| Chlorite | mg/L | 1 | NA | NA |

Notes: MCL = Maximum Contaminant Level, NA = Not Analyzed, mg/L = milligrams per liter, µg/L = micrograms per liter
(a) Annual average tertiary effluent concentration from January 2012 through December 2015.

*Table 5-7: Quality of Recycled Water from the Palmdale WRP with Respect to Secondary Drinking Water Maximum Contaminant Levels (MCLs)*

| Constituent | Units | MCL (Recommended-Upper-Short Term) | Palmdale WRP Average[(a) (a)] | Palmdale WRP Maximum (Since Dec. 2011) |
|---|---|---|---|---|
| **Consumer Acceptance Contaminant Levels** | | | | |
| Aluminum | mg/L | 0.2 | NA | NA |
| Color | Units | 15 | NA | NA |
| Copper | mg/L | 1 | 0.002 | 0.0028 |
| Foaming Agents (MBAS) | mg/L | 0.5 | 0.06 | 0.17 |
| Iron | mg/L | 0.3 | NA | NA |
| Manganese | mg/L | 0.05 | NA | NA |
| Methyl-*tert*-butyl ether | mg/L | 0.005 | <0.0005 | <0.0005 |
| Odor—Threshold | Units | 3 | NA | NA |
| Silver | mg/L | 0.1 | <0.0002 | <0.0002 |
| Thiobencarb | mg/L | 0.001 | NA | NA |
| Turbidity | Units | 5 | 0.7 [(b)] | 2.4 |
| Zinc | mg/L | 5 | 0.089 | 0.120 |
| **Consumer Acceptance Contaminant Level Ranges** | | | | |
| Total Dissolved Solids | mg/L | (500-1000-1500) | 489 | 553 |
| Chloride | mg/L | (250-500-600) | 150 | 178 |
| Sulfate | mg/L | (250-500-600) | 75 | 96.6 |

Notes:
MCL = Maximum Contaminant Level, NA = Not Analyzed, mg/L = milligrams per liter
(a) Average of data from January 2012 through December 2014..
(b) Data shown is the average value for January through September of 2015

### 5.6.4 Recycled Water Quality with Respect to Notification Levels

The tertiary effluent concentrations of constituents with notification levels have not been determined at this time with the exception of naphthalene, N-nitrosodimethylamine (NDMA) and N-nitrosodi-n-propylamine (NDPA). Table 5-8 presents the water quality of the Palmdale WRP recycled water with respect to notification levels for these constituents. Palmdale WRP Recycled Water quality data is from the years 2011 to 2015.

Palmdale WRP recycled water concentrations of naphthalene and N-nitrosodiethylamine (NDEA) are below the notification level for this chemical. Concentrations of two other nitrosamines have also been analyzed in the Recycled Water. Method detection limits for N-nitrosodi-n-propylamine (NDPA) were not sufficiently low to determine if the water quality was below the notification level in a majority of samples; however, a recent sampling campaign with a lower detection limit of 2 ng/L of NDPA did not detect the presence of this chemical. The average concentration of N-nitrosodimethylamine (NDMA) in the Recycled Water was 3.2 µg/L (average is 1.05 µg/L), two orders of magnitude greater than the notification level for this chemical. The maximum concentration of NDMA detected in the recycled water since 2011is 3200 ng/L.

***Table 5-8: Quality of Recycled Water from the Palmdale WRP with Respect to Notification Levels***

| Constituent | Units | NL | Palmdale WRP Average [(a)] | Palmdale WRP Maximum (Since Dec. 2011) |
|---|---|---|---|---|
| Naphthalene | µg/L | 17 | <1 | <1 |
| N-Nitrosodiethylamine (NDEA) | µg/L | 0.01 | NA | 0.00059 [(b)] |
| N-Nitrosodimethylamine (NDMA) | µg/L | 0.01 | 1.05 | 3.2 |
| N-Nitrosodi-n-propylamine (NDPA) | µg/L | 0.01 | <5 | <5, <0.002 [(c)] |

Notes:

NL = Notification Level, NA = Not Analyzed, mg/L = milligrams per liter, µg/L = micrograms per liter

(a) Annual average tertiary effluent concentration from January 2012 through December 2015.

(b) Based on a single sample.

(c) The typical method detection limit for NDPA is 5 µg/LL. One sample has been analyzed with a lower detection limit, returning a result of 0.002 µg/L.

#### 5.6.5 Proposed Reductions of N-nitrosodimethylamine (NDMA) and Other Nitrosamines

The LACSD will look into examining how plant operations at the Palmdale WRP may be modified to reduce NDMA concentrations in the tertiary effluent produced at the WRP. NDMA reduction efforts at other LACSD plants have resulted in running annual average NDMA concentrations ranging from 100 to 600 ng/L. Palmdale WRP may have factors impacting NDMA levels that result in better or worse performance that that achieved at other LACSD plants; however, assuming NDMA effluent levels between 100 and 600 ng/L at the Palmdale WRP requires that between 90% and 98.5% of NDMA removal be accomplished within the PRGRRP.

### 5.6.6 Compliance with Salt and Nutrient Management Plan

A Salt and Nutrient Management Plant (SNMP) was developed for the Antelope Valley Groundwater Basin in an effort to manage salts, nutrients and other constituents to ensure the beneficial uses of the groundwater basin are protected. Water quality management goals were established for seven chemical constituents based on protecting the groundwater basin for use as agricultural supply and municipal supply and based on consistency with the RWQCB Basin Plan. See Appendix C for approval of Salt Nutrient Plan.

Table 5-9 compares the Water Quality Management Goals for the Antelope Valley to the tertiary-treated recycled water quality at Palmdale WRP. For two constituents, boron and fluoride, no concentration data is currently available in the Recycled Water, and therefore no quality comparison is possible. Concentrations of constituents in Palmdale WRP are less than the respective SNMP management goal for all constituents with the exception of total dissolved solids. While total dissolved solids concentrations are higher in recycled water than in the lowest tier management goal for this constituent, groundwater TDS concentrations for the greater Antelope Valley are projected to remain below the management goal in the future for all planned recycled water and recharge projects. In general, recycled water use is not expected to affect present or future beneficial uses to beyond the 25 year planning period evaluated in the 2014 SNMP.

***Table 5-9: SNMP Water Quality Management Goals and Recycled Water Quality***

| Constituent | Units | SNMP Water Quality Management Goal | Palmdale WRP Tertiary-treated Effluent Average [(a)] |
|---|---|---|---|
| Arsenic | µg/L | 10 | <1 |
| Boron | mg/L | 0.7-1 [(b)] | NA [(c)] |
| Chloride | mg/L | 238-250-500 [(b)] | 150 |
| Fluoride | mg/L | 1-2 [(b)] | NA [(c)] |
| Nitrate | mg/L as N | 10 | 2.8 |
| Total Chromium | µg/L | 50 | 0.6 |
| Total Dissolved Solids | mg/L | 450-500-1000 [(b)] | 489 |

Notes:
NA = Not Analyzed, mg/L = milligrams per liter, µg/L = micrograms per liter
(c) Average of data from January 2012 through December 2014.
(d) Basin and sub-basin goals are based on baseline groundwater quality.
(c) At the time of preparation, no data is available on the effluent concentration of this constituent.

# RECYCLED WATER MARKET

This Chapter describes the recycled water market for the project. The market for the project is considered to be the District's service area since the project will create a potable water supply through the use of recycled water with surface spreading groundwater recharge and recovery.

## 6.1 Present and Future Source of Water and Quantity of Use

All of the current and future users of the recycled water rely on existing sources of potable water, which include local groundwater, local surface water and imported water from the State Water Project via the California Aqueduct. Future sources of water for the District's service area will come from recycled water from the Palmdale Regional Groundwater Recharge and Recovery Project (PRGRRP).

Increasing recycled water use will enable the District to augment existing water supplies and be able to meet growing future needs. As shown in Figure 6-1 and Table 6-1, water demands are projected to exceed water supplies by 21,403 AF/yr without recycled water to augment existing sources. Recycled water is expected to make up for the future water supply shortfall.

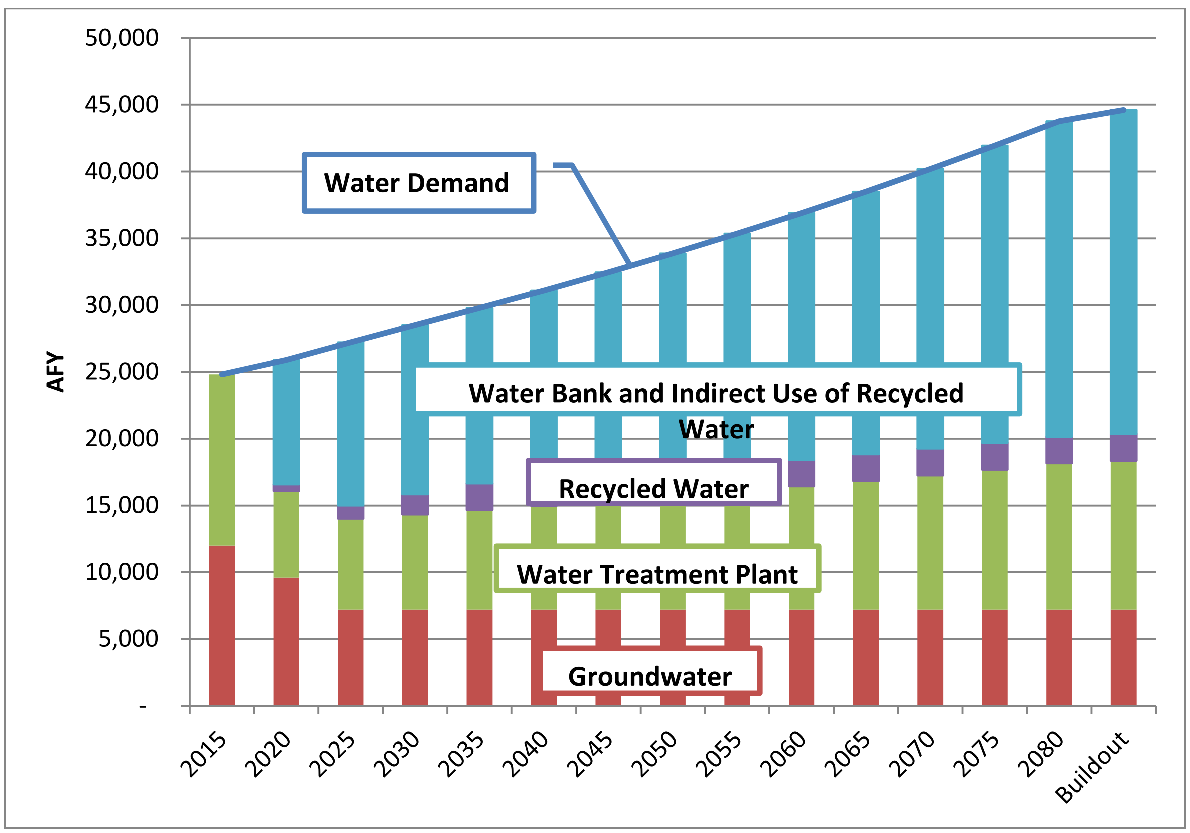



**Figure 6-1 Water Demand from Various Source in Palmdale Water District Service Area**

**Table 6-1** **Projected Water Supply and Demand for Recycled Water at Build-Out Conditions for Palmdale City**

| | | WET YEARS | | | | | DRY YEARS | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Average Year | Single Wet Year | Multiple Wet Years 2 years | 4 years | 6 years | 10 years | Single Dry Year | Multiple Dry Years 2 years | 4 years | 6 years | 10 years |
| **Groundwater** | 7,200 | 7,200 | 7,200 | 7,200 | 7,200 | 7,200 | 7,200 | 7,200 | 7,200 | 7,200 | 7,200 |
| **State Water Project** | | | | | | | | | | | |
| Table A - Entitlement | 21,300 | 21,300 | 21,300 | 21,300 | 21,300 | 21,300 | 21,300 | 21,300 | 21,300 | 21,300 | 21,300 |
| Percentage of Table A Available | 58% | 98% | 95% | 82% | 79% | 72% | 11% | 24% | 31% | 26% | 30% |
| Projected Tabe A Water Supply | 12,354 | 20,874 | 20,235 | 17,466 | 16,827 | 15,336 | 2,343 | 5,112 | 6,603 | 5,538 | 6,390 |
| **Local Surface (Littlerock Dam)** | | | | | | | | | | | |
| Water Diversion Rights | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 | 4,000 |
| Projected Local Littlerock Supply | 2,791 | 3,920 | 3,800 | 3,280 | 3,160 | 2,880 | 440 | 960 | 1,240 | 1,040 | 1,200 |
| **Projected Future Water Supply Without Water Recycling** | 22,345 | 31,994 | 31,235 | 27,946 | 27,187 | 25,416 | 9,983 | 13,272 | 15,043 | 13,778 | 14,790 |
| **Total Demand at Build-Out** | 44,600 | 44,600 | 44,600 | 44,600 | 44,600 | 44,600 | 44,600 | 44,600 | 44,600 | 44,600 | 44,600 |
| **Required Additional Supplies (Recycled Water)** | | | | | | | | | | | |
| Direct Reuse (Recycled Line Phase 2) | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 |
| Direct Reuse (Recycled Line Phases 3, 4, and 5) | 700 | 700 | 700 | 700 | 700 | 700 | 700 | 700 | 700 | 700 | 700 |
| Palmdale Regional Groundwater Recharge & Recovery | 20,755 | 11,106 | 11,865 | 15,154 | 15,913 | 17,684 | 33,117 | 29,828 | 28,057 | 29,322 | 28310 |

## 6.2 Market Assessment Procedures

The goals of a market assessment are to identify potential customers within a given area. Land use, historic demands, available supply, implementation challenges, installation, and utilization are all considered in developing a customer base.

There are three groups of customers in the District's service area for which indirect recycled water demand exists. The first is residential homes for both indoor and outdoor use. The second group is denoted as Schools, Parks, and Others, and contains the high demand irrigation customers in the service area. This set of customers is primarily drawn from the two previous master plans (PWD, 2010 and City of Palmdale, 2009). The third group, Landscape Maintenance Districts (LMDs), is comprised of common landscaped areas irrigated off of a single connection in residential areas.

The District's service area is shown on Figure 6-2. The District serves a population of 115,000 of the 150,000 residents in the City of Palmdale and parts of Unincorporated Los Angeles County. The location of the potential customers is shown on Figure 6-3.

The project is intended to provide an additional source of potable water supply to existing customers of the District. The recycled water would be blended with imported water from the California Aqueduct in new recharge basins and allowed to percolate to the groundwater basin. Recovery wells would extract the water for use by the District's customers. Demands for the recycled water, as a potable supply, are detailed in the Draft Water Master Plan, the approved 2010 Urban Water Management Plan and the recently completed 2015 Draft Urban Water Management Plan.

## 6.3 Wastewater Disposal Methods

Currently, the vast majority of the recycled water produced at the Palmdale Tertiary Treated Wastewater Plant is applied at agronomic rates for agricultural irrigation. One municipal irrigation customer, McAdam Park, is served in the City of Palmdale. In the future, it is anticipated that the majority of the recycled water will be utilized by the proposed PRGRRP project, with 2,000 AFY set aside for landscape irrigation through the Palmdale Recycled Water Authority and 400 AFY set aside for the proposed Palmdale Power Plant. Agricultural irrigation will no longer receive recycled water. However, it is anticipated that agricultural irrigation will continue to receive recycled water until the proposed project, recycled water distribution system, and Palmdale Power Plant are built and fully operational.

## 6.4 Other Topics From Water Recycling Guidelines

### 6.4.1 Estimated Internal Capital Investment Required

Capital investment required is discussed in Chapter 13 on "Construction Financing and Program Revenues".

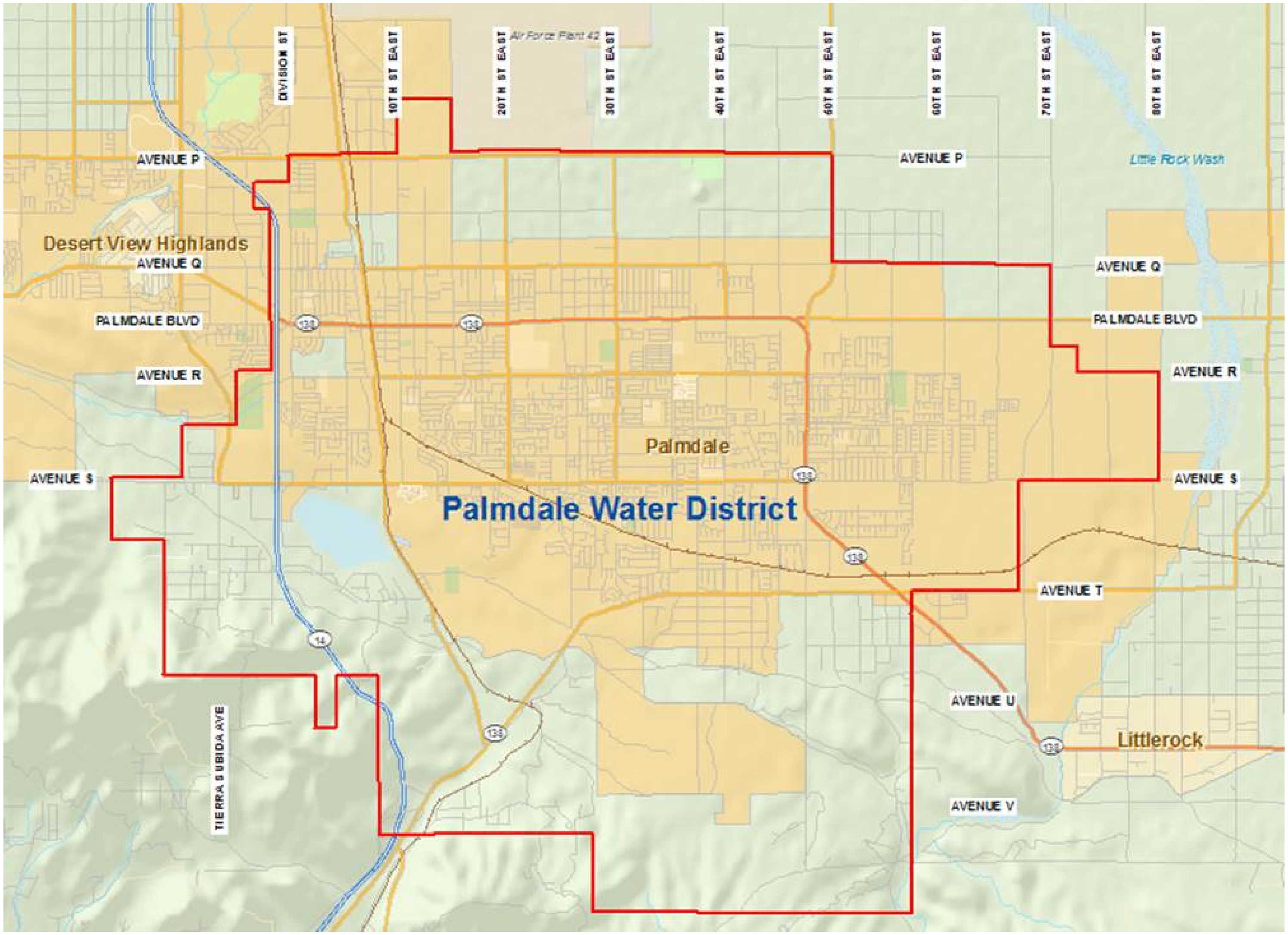



**Figure 6-2 Palmdale Water District Service Area**

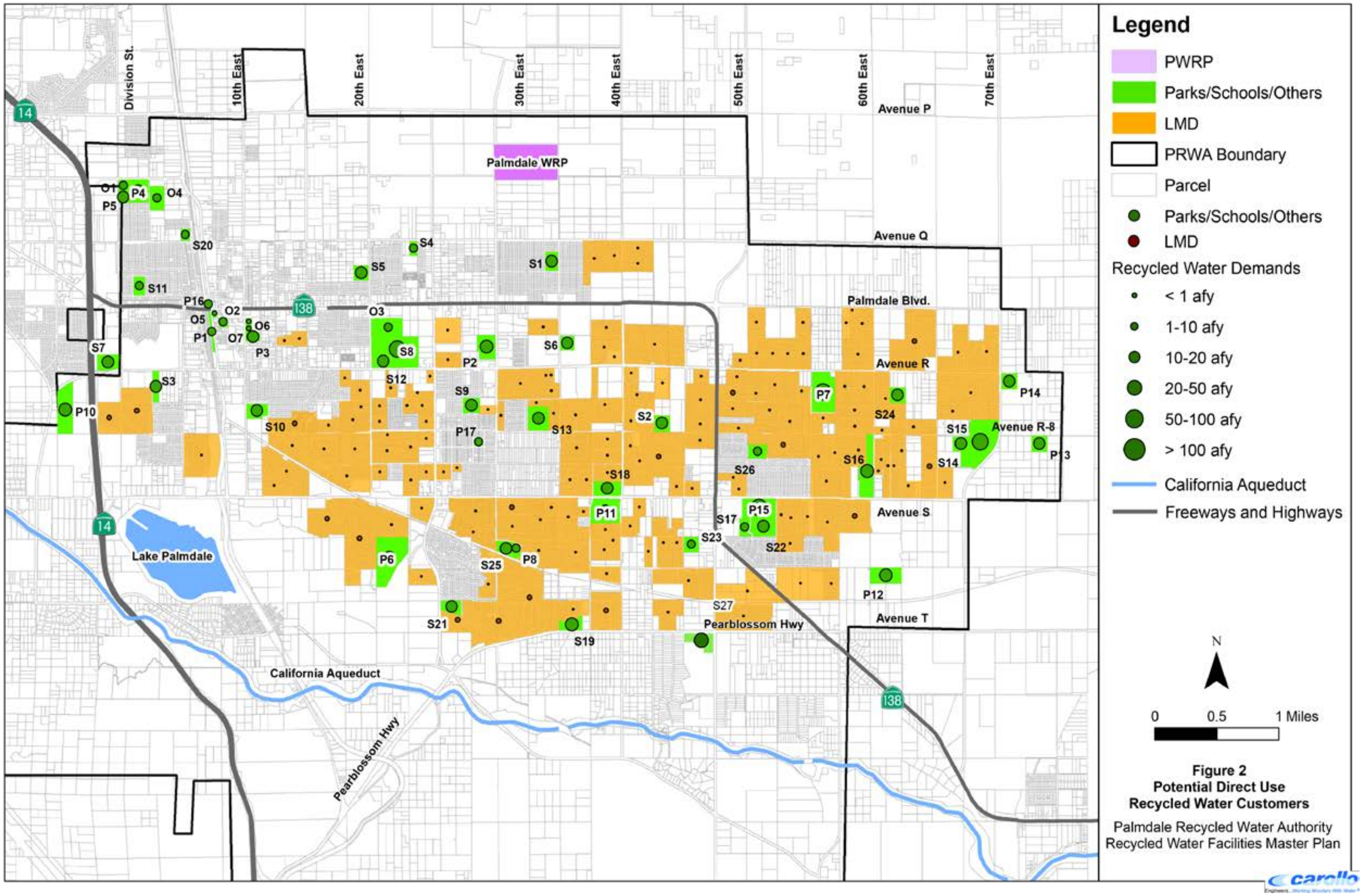



**Figure 6-3 Potential Customers for Outdoor Use**

### 6.4.2 Needed Water Cost Savings

The users for the proposed PRGRRP project would benefit from the recycled water in that it would be at a lower cost than providing treatment and infrastructure for potable water. The delivery of the recycled water would be by the Palmdale Water District.

Since the users would benefit from a reduction in their water costs by using indirect recycled water, none of the proposed users are likely to reject the opportunity to use recycled water.

### 6.4.3 Desire to Use Recycled Water

The Palmdale Water District will enter into a user agreement to use the recycled water. User agreement is being negotiated with LA County Sanitation District No. 20. The agreement is expected to be finalized in September or October 2016.

### 6.4.4 Date of Possible Initial Use of Recycled Water

The date of initial use of recycled water is projected to begin at the conclusion of construction in early fall of 2018. The recycled water supply 6,500 acre-feet from the LA County Sanitation District No. 20 Palmdale Wastewater Treatment Plant will be for indirect use by the Palmdale Regional Groundwater Recharge and Recovery project and would be used starting with completion of construction and used in all subsequent years.

**WATER RECYCLING FUNDING PROGRAM**
**Palmdale Water District**
**Palmdale Regional Groundwater Recharge and Recovery Site**
**WRFP NO. 3616-010**

| Map ID No. | User Site/Address | City | Use Site Owner | Use Type | Estimated Usage (AFY)[1] | Type of Use[2] | User Status Existing or Future[3] | Projected Connection Date (Months)[4] | User Assurance Type[5] | Retrofit Required Yes/No | Current Fresh Water Supplier | Phase |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2029 East Avenue Q | Palmdale, CA | Palmdale Water District | Indirect recycled water | 6,500 | Indirect Potable and outdoor watering | Future | 9/1/2018 | Water District | No | Yes | 1a |
| | | | | Total | 6,500 | | | | | | | |

### 6.4.5 Present and Future Source of Water and Quantity of Use

All of the current and future users of the recycled water rely on existing sources of potable water, which include local groundwater, local surface water and imported water from the State Water Project. Future sources of water for the Palmdale Water District service area will come from recycled water from the Palmdale Wastewater Treatment Plant.

### 6.4.6 Quality and Reliability Needs

All of the potential users are customers who require water quality and quantity sufficient to meet the needs of landscaping. The recycled water, treated to a tertiary level and provided by LA County Sanitation District No. 20 Palmdale Wastewater Treatment Plant, will be of sufficient quality to meet the potential users' needs for landscape watering.

Recycled water is a highly reliable source of water because wastewater is being continually produced. It is expected that the recycled water facilities will be sufficiently reliable to meet the needs of landscaping. Landscape is expected to be able to tolerate short duration outages with limited impact.

# CHAPTER 7

# PROJECT ALTERNATIVES DEVELOPMENT, ANALYSIS, AND SCREENING OF ALTERNATIVES

This Chapter describes the alternatives analysis that was conducted for the proposed project. The analysis was completed as part of the *Littlerock Creek Groundwater Recharge and Recovery Project Final Report* (Feasibility Study), completed in February 2015 by Kennedy/Jenks Consultants. Included as Attachment C in FAAST, PIN # 30947.

## 7.1 Planning and Design Assumptions

This section describes the assumptions utilized for the project alternatives analysis.

### 7.1.1 Projected Water Demands

The District serves a combination of residential, commercial, and industrial users, with essentially no agriculture. Their current system provided approximately 23,000 AF/yr in 2013 and 2014. Table 7-1 provides a water demand projection for PWD's service area, based on a preliminary draft version of the District's Water Master Plan, which is currently being updated. A land use analysis indicates that demand will be 44,600 AF/yr under buildout conditions. By 2040, demand is projected to be 31,100 AF/yr. For the 50-year financial analysis of the PRGRRP from 2018 through 2067, the demand in 2067 is projected to be 39,160 AF/yr.

Table 7-1: Projected Retail Demands

| **Year** | **Annual Average Demand (AF/yr)** |
|---|---|
| 2015 | 24,809 |
| 2020 | 25,900 |
| 2025 | 27,200 |
| 2030 | 28,500 |
| 2035 | 29,800 |
| 2040 | 31,100 |
| 2045 | 32,457 |
| 2050 | 33,873 |
| 2055 | 35,350 |
| 2060 | 36,892 |
| 2065 | 38,502 |
| 2070 | 40,181 |
| 2075 | 41,934 |
| 2080 | 43,764 |
| *Buildout* | *44,600* |

### 7.1.2 Feasibility Study

Since the District requires additional water to meet increased future demands and decreased future supplies, a study was retained to analyze groundwater banking opportunities and how recycled water from the PWRP could be utilized. Currently all the wastewater from the PWRP is applied for agricultural use at one location at agronomic rates in the amount of approximately 10,000 AF/yr. To best utilize the recycled water within the existing infrastructure constraints of the District, an indirect potable reuse project is proposed. Recycled water from the PWRP is recharged along with water from the East Branch of the SWP, which serves as diluent water to the recycled water. The recharge water is to be spread on the ground surface to allow for groundwater infiltration. Extraction wells, which are spaced radially around the recharge basins, will extract the water and disinfect it for distribution to the District's distribution system.

In February, 2015, the District completed the Feasibility Study for the PRGRRP. The Feasibility Study considered indirect potable reuse at ten sites, known as Alternatives, near Palmdale, California. Two Alternatives were selected and further refined into four alternatives. From the four refined Alternatives, one was selected (Alternative 10C) around which the Preliminary Design Report was drafted and finalized in November, 2015.

The Preliminary Design or Engineering Report is included in FAAST as Attachment 1 and Plans and Specifications are included in FAAST as Attachment T9.(search PIN 30947 in FAAST)

### 7.1.3 Operational Scenarios

Prior to evaluating project alternatives, water operational scenarios must first be considered to determine the water supply quantity. In order to ensure the most effective ratio of recycled water and diluent water for the size of the water bank, four operational scenarios (1, 2A, 2B, and 3) were defined. Scenarios 1 and 3 apply to all the alternatives; Scenario 2A is applicable to Alternatives 3 through 10; and Scenario 2B is applicable to Alternatives 1 and 2. Each scenario is described below:

- Recycled Water Blending Scenario 1 – Low Water Treatment Plant (WTP) Utilization: This scenario assumes minimal surface water allocation for treatment at the District's water treatment plant, with surface water treatment remaining constant at about 4,000 AF/yr over the project's life cycle. This minimal flow is intended to maintain granular activated carbon (GAC) filters at the treatment plant. The remaining surface water would be stored in the water bank through surface spreading and recovered using new wells.

- Recycled Water Blending Scenario 2A – Moderate WTP Utilization with Recycled Water for Groundwater Recharge: This scenario assumes that the treatment plant would serve only 25 percent of the total retail demands every year. The remaining available surface water would be delivered to the water bank for both recovery and banking, with banked water available in dry years. Scenario 2A assumes groundwater recharge through a combination of surface and recycled water.

- Recycled Water Blending Scenario 2B – Moderate WTP Utilization without Recycled Water for Groundwater Recharge: This scenario is the same as 2A, but assumes local surface water supply only for recharge.

- Recycled Water Blending Scenario 3 – High WTP utilization: This scenario assumes that the majority of surface water would be treated at the District's water treatment plant. It also assumes that the water treatment plant's utilization will grow from about 25 percent of total retail demands in the beginning of project's life cycle (2018) to about 65 percent by the end of project's 50-year financial evaluation (2067). The remaining surface water and available recycled water would be stored in the water bank and recovered using new wells.

With an initial recycled water contribution (RWC) of 20 percent, increasing to 30 percent after 5 years, 40 percent after 8 years, and 50 percent after 11 years, it was determined that Scenario 2A defines an optimum utilization of recycled water and project capacity. Through this scenario, the WTP serves 25 percent of demands with the water bank serving 45.4 percent, 51.5 percent, and 54.4 percent of the water demand in 2040, 2067, and at buildout, respectively.

### 7.1.4 Facility Sizing

Scenarios 2A and 2B offer an optimization by providing sufficient diluent supply to maximize the recycled water content after the first five years of the project and utilizing existing supply facilities for average base supply as well as maximum day demand (MDD) peaking, without over-sizing the PRGRRP extraction wells, collection pipelines, distribution pump station, and distribution transmission pipeline. Under Scenario 2, the recovery wells are sized to meet annual average demand and not MDD. Preliminary sizing for PRGRRP facilities was developed based on Scenario 2. The design criteria and accompanying assumptions are as follows:

- Turnout Capacity for Recharge: 50 cfs
- Diluent Pipe Size: 30-inch
    - Assumes a maximum allowed velocity (by gravity) of 10 feet per second (fps)
- Recycled Water Turnout: 20-inch
    - Assumes a maximum velocity 8 fps.
- Combined Raw/Recycled Pipeline, where applicable: 36-inch
    - Based on maximum velocity of 8 fps
- Net Recharge Area: 60 acres
    - Assumes an average long-term percolation rate of 3 feet per day (fpd) and includes 75 percent spare basin capacity for wet-dry rotation and maintenance.
- Gross Recharge Site: 160 acres minimum (175 acres for Alternatives 6, 7, 8, and 9)
    - Includes 50 percent more surface area to account for access roads and berms and a 300-ft setback all around the recharge basins.
    - Alternatives 6, 7, 8, and 9 straddle the Buttes and Lancaster sub-basins, and require additional land to separate the two sets of recharge basins.
- Number of Recovery Wells by Buildout:
    - 33 for Alternative 1
    - 32 for Alternative 2
    - 29 for Alternatives 3, 4, 5
    - 22 for Alternative 6

- 21 for Alternatives 7, 8, 9
- 16 for Alternative 10
- Assumes summer peaking is met through 22 currently active groundwater wells and supply from the LOCWTP

- Recovery Well Capacity:
  - 500 gpm for Pearland sub-basin
  - 600 gpm for Buttes sub-basin
  - 1,200 gpm for Lancaster sub-basin

### 7.1.5 Cost Basis

For each alternative described in this report, facility, water purchase, and O&M costs are provided. The costs are developed based on the cost assumptions presented in Table 7-2. The cost estimates for the preliminary alternatives do not include capital costs for the distribution system pump station, reservoir, or disinfection facilities.

Table 7-2: Cost Assumptions

| Item | Value | Unit |
|---|---|---|
| 50-cfs turnout | $500,000 | $/ea |
| Pipelines | $10 | $/in/LF |
| Recharge Basins | $100,000 | $/acre |
| Recharge Basin Land Acquisition | $8,000 | $/acre |
| Recovery Wells | $1,200,000 | $/well |
| Pump Stations | $2,000 | $/hp |
| Reservoir (Steel Tank) | $0.75 | $/gal |
| Chlorination Facility | $250,000 | ea |
| Chemical Cost | $0.88 | $/AF |
| Power | $0.12 | $/kWh |
| O&M Cost - Wells (% of Construction Cost) | 1% | % |
| O&M Cost - Pumps/Tanks/Chemicals (% of Construction Cost) | 2% | % |
| O&M Cost - Recharge Basins (% of Construction Cost) | 1% | % |
| SWP Water | $4,500 | $/AF/yr |
| SWP Purchase Cost | $250 | $/AF/yr |
| Recycled Water Purchase Cost | $100 | $/AF/yr |
| Water Delivery/Purchase Cost Escalation | 3% | % |
| Phase I Planning Horizon | 2018 – 2040 | years |
| Total Project Planning Horizon | 2018 – 2067 | years |
| Discount Rate | 5% | % |
| Inflation Rate | 3% | % |
| Contingency (% of Construction Cost) | 20% | % |
| Engineering & Admin Cost (% of Construction Cost + Contingency) | 20% | % |

(a) All costs are shown in 2015 dollars.
(b) ea = each; LF = linear foot; hp = horsepower; gal = gallons; kWh = kilowatt hour

Total cost is the present and future funding requirement for the implementation of an alternative. It is estimated as the sum of construction, property acquisition, construction contingency (twenty percent), and other soft costs such as engineering, management, legal, and environmental. In addition, the future costs of purchasing additional SWP Table A water rights is included in the net present costs of the total costs.

Unit water cost is an estimate of the cost of the projected water resource developed through each alternative compared to the total costs of the alternative over the life of the project. The total costs include capital and annual O&M costs. The unit water cost of an alternative is measured as the ratio of combined amortized capital cost and annual O&M costs in dollars per year ($/yr) over the estimated yield of the alternative in AF/yr. The unit water cost is therefore identified in dollars per acre-foot ($/AF).

### 7.1.6 Evaluation Criteria

The evaluation criteria utilized for the project alternatives analysis is provided as Table 7-3.

Table 7-3: Evaluation Criteria

| Criteria | Description |
|---|---|
| Total Cost | The total net present cost of an alternative over the study period of 50 years (2018 – 2067) |
| Unit Water Cost | An estimate of the cost of the projected water resource compared to the total costs of the alternative over the life of the project |
| Recharge and Recovery Capacity | (1) The recharge rate at which the basin can infiltrate water and (2) the capacity of planned recovery wells |
| Recovery Water Quality | The ability of an alternative to meet water quality standards, primarily based on the alternative's distance from the existing nitrate plume |
| Environmental Sensitivity | Potential sensitivity regarding biological and cultural resources in each project area |
| Implementation Risk and Uncertainty | The unintended consequences of implementation of various alternatives |
| Property Acquisition[a] | The ease at which property may be acquired, whether by a private or public owner |
| Institutional Issues[b] | The complexity of obtaining project support of public agencies and/or private entities, either directly or indirectly involved in the project, and the consequences on the project's implementation and/or schedule |
| Public Acceptance[c] | The likely support versus opposition of the public associated with each alternative |

(a) Property acquisitions from public entities such as LACSD's Effluent Management (EM) area are easier to acquire as opposed to a private entity. Furthermore, land ownership is considered more preferable than leasing.
(b) Institutional issues are more likely to occur the closer the proximity to Air Force Plant 42, specifically within a 5-mile radius as according to the provisions described in the FAA's 2007 WAAC.
(c) Due to the use of recycled water in all four alternatives, the public's reaction to recycled water use is not considered a differentiator as with the original alternatives with and without recycled water; however, local resistance to property acquisition and project location may be a differentiator.

### 7.1.7 Planning Period

The total planning period extends from 2018 to 2067, with Phase 1 of the project planned for 2018 through 2040.

## 7.2 Preliminary Project Alternatives

This section describes the 10 preliminary alternatives. A water supply scenario, Scenario 2A, is utilized for sizing infrastructure. This scenario was found to provide an optimal utilization of recycled water and project capacity. The water supply scenario 2A assumes that the District's Leslie O. Carter Water Treatment Plant would serve 25 percent of the total retail demands every year. The remaining available surface water would be stored in the water bank. Scenario 2A also assumes groundwater recharge through a combination of surface and recycled water.

Table 7-4 provides a summary of the preliminary facility sizing for the major recharge and conveyance components based on water supply scenario 2A.

Table 7-4: Summary of Preliminary Facility Sizing

| | **Scenario 2A** |
|---|---|
| Turnout Capacity[(a)] (cfs) | 50 |
| Raw Water Pipe Size[(b)] (inch) | 30 |
| Recycled Water Pipe Size[(c)] (inch) | 20 |
| Combined Raw/Recycled Water Pipe Size[(c)] (inch) | 36 |
| Net Recharge Area[(d)] (acre) | 60 |
| Gross Recharge Site[(e)] (acre) | 160 - 175 |
| Number of Recovery Wells at Buildout[(f)] | 16 - 33 |

Notes:
(a) The proposed turnout capacity is sized to accommodate 100% surface water allotment under buildout conditions.
(b) The raw water pipeline was sized assuming a maximum allowed velocity of 10 ft/s.
(c) The recycled water and combined pipelines were sized assuming a maximum allowed velocity of 8 ft/s.
(d) The net recharge areas were estimated assuming an average long-term percolation rate of 3 fpd and includes 75 percent redundancy.
(e) The gross recharge areas include 50 percent more surface area to account for access roads and berms and a 300-ft setback all around the recharge basins.
(f) The number of recovery wells is based on the assumed well capacities for each sub-basin, as discussed in the previous section.

A description of each of the ten alternatives and their infrastructure needs is presented in this section. The location of proposed recharge sites and pipelines for each alternative is shown on Figure 7-1.

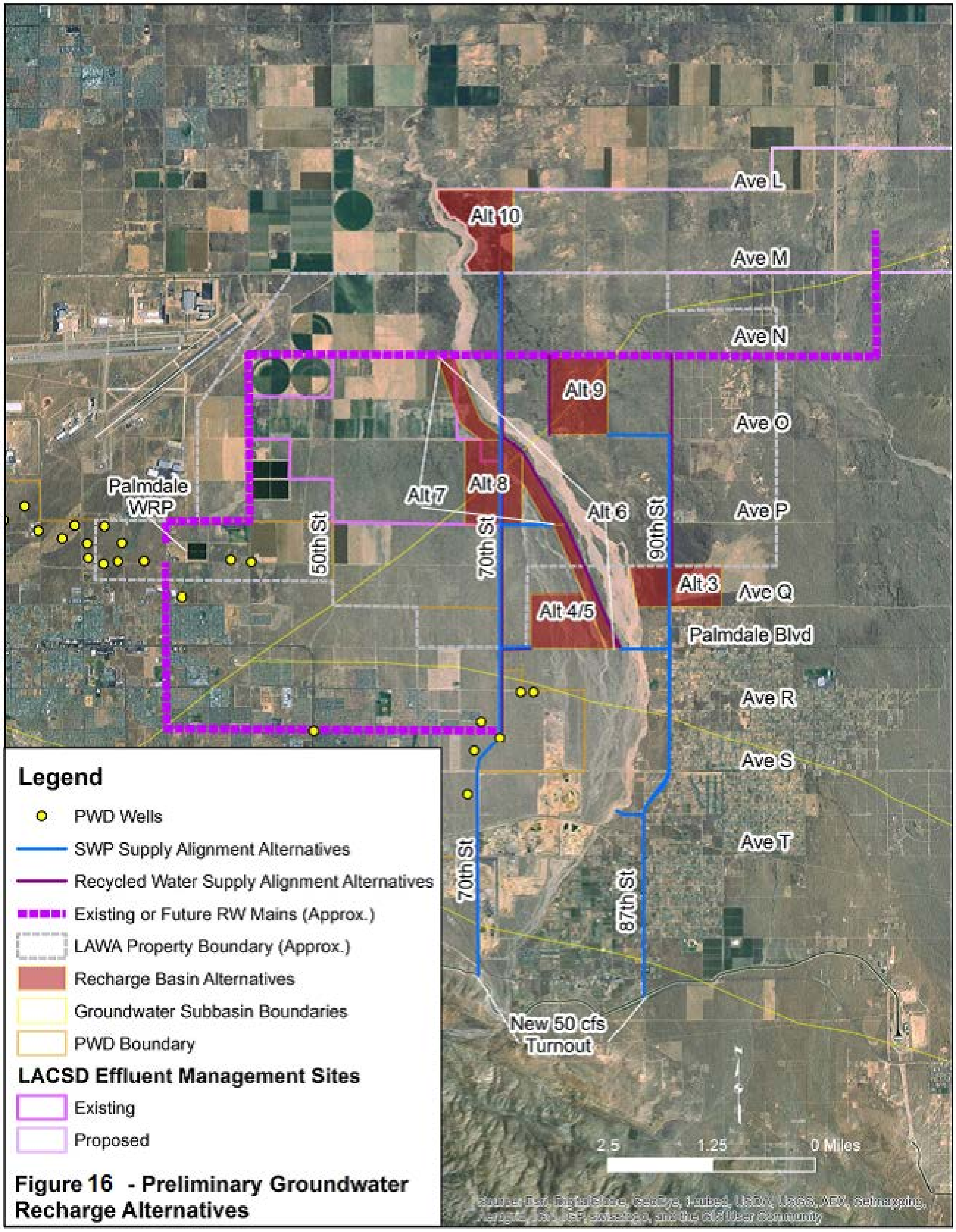



**Figure 7-1 – Preliminary Alternatives**

Generalizations regarding the alternatives include:

- Alternatives 1 and 2 assume run-of the river for recharge, with Alternative 1 delivering imported water directly from the East Branch. Alternative 2 would utilize a pipeline to deliver from the East Branch to a point in the Creek about half-way to Palmdale Boulevard; thus, avoiding most of the quarries.

- Alternatives 3 through 10 assume pipeline delivery of imported water from the East Branch directly to constructed recharge basins, with no water in or from the creek.

- The recharge basins for Alternatives 3 and 9 are proposed on the east side of the creek, and would be served from a new turnout along 87$^{th}$ Street and pipeline continuing north in 90$^{th}$ Street.

- The recharge basins for Alternatives 4, 5, 6, 7, 8 are proposed on the west side of the creek, and would be served from a new turnout (and pipeline) along 70$^{th}$ Street.

- The recharge basin for Alternative 10 is proposed east of the creek, but unlike Alternatives 3 and 9, would be served from 70$^{th}$ Street due to the northwesterly alignment of the creek.

- Alternatives 7, 8, and 9 are within the limits of the Los Angeles World Airport (LAWA) 17,000-acre property that was acquired in the 1960s for a regional airport that was never constructed. Alternative 6 is mostly within LAWA property. Alternatives 3, 4, and 5 are south of the LAWA property, and Alternative 10 is north of the LAWA property. Alternative 10 is located within an area designated by LA County Sanitation District (LACSD) for a future Effluent Management Site.

- Two of the ten alternatives (Alternatives 1 and 2) do not utilize recycled water.

- Seven of the eight alternatives designed to receive recycled water would be supplied from LACSD's existing 48-inch diameter transmission pipeline along Avenue N.

- One alternative (Alternative 5) was designated to receive recycled water from a proposed 24-inch pressurized recycled water distribution system water main along Avenue R.

- The eight alternatives with constructed recharge basins were first evaluated with linear rows of extraction wells on the down gradient side: west, north, or a combination of west and north. Extraction wells are located in a radial pattern around the recharge basins for the final four refined alternatives. A well-to-basin setback distance of 2,500 feet was modeled to achieve a minimum groundwater travel time of 12 months for groundwater replenishment with recycled water.

### 7.2.1 Alternative 1 Run-of-River Recharge within Pearland Sub-basin

Alternative 1 assumes that surface water from the East Branch of the California Aqueduct would be released directly in the creek for groundwater recharge. This alternative is not intended to change the contribution of local surface runoff. Characteristics, constraints, or benefits are described below.

**SWP Turnout:** A new 50-cfs turnout to supply the water bank would be constructed near 72nd Street where Littlerock Creek meets the California Aqueduct.

**Groundwater Basin(s):** The majority of the released water would be recharged initially within the Pearland sub-basin due to the porous nature of the creek bed. However, it is anticipated that with continued recharge, the upper creek bed would become saturated, and the released water would enter the Buttes sub-basin.

**Recharge Site:** This alternative assumes in-stream recharge. Therefore, no recharge basins would need to be constructed.

**Raw Water Conveyance:** Because the creek bed is used to convey water, no raw water pipeline would be required.

**Recycled Water Conveyance:** Recycled water could not be recharged in this alternative because regulations require that recycled and diluent water recharge must occur in the same area for proper blending. This requirement could not be met in this alternative because the extent of recharge within the creek cannot be controlled.

**Recovery Wells:** To meet buildout demands, 33 wells (22 wells in the Pearland sub-basin and 11 wells in the Buttes sub-basin) would need to be constructed.

**Land Acquisition:** Land acquisition would not be required for recharge basins.

**Other Project Constraints:** No encroachment into LAWA property is anticipated. However, the proximity of the creek to local quarries and the potential for lateral seepage into quarry pits, which could adversely influence quarry operations, could pose an implementation hurdle.

**Other Project Benefits:** Due to minimal construction requirements and lack of recycled water recharge, the implementation timeframe for this alternative would be relatively short with minimal capital costs.

**Costs:** Table 7-5: presents the cost estimate for Alternative 1. Net present costs are the sum of the present value of all costs over a select period of interest and time. Net present costs are provided for Phase I, which is from 2018 to 2040, and the total project planning horizon, which is from 2018 to 2067.

Table 7-5: Alternative 1 Cost Estimate

| | Phase I Net Present Costs | Total Net Present Costs |
|---|---|---|
| Turnout | $790,000 | $790,000 |
| Recharge Pipelines | $0 | $0 |
| Recharge Basin Construction | $0 | $0 |
| Recharge Basin Land Acquisition | $0 | $0 |
| Recovery Wells | $35,880,000 | $52,860,000 |
| Well Collection Pipelines | $7,130,000 | $7,130,000 |
| Distribution Pipelines | $9,120,000 | $9,120,000 |
| ***Facilities Subtotal*** | ***$52,920,000*** | ***$69,900,000*** |
| | | |
| ***SWP Table A Water Purchase*** | ***$65,050,000*** | ***$104,910,000*** |
| | | |
| SWP Water Purchase | $62,920,000 | $129,270,000 |
| Recycled Water Purchase | $0 | $0 |
| ***Water Purchase Subtotal*** | ***$62,920,000*** | ***$129,270,000*** |
| | | |
| Power Costs | $23,190,000 | $47,640,000 |
| O&M Costs | $5,160,000 | $11,910,000 |
| ***O&M Subtotal*** | ***$28,350,000*** | ***$59,550,000*** |
| | | |
| **Grand Total** | **$209,240,000** | **$363,630,000** |
| **Unit Water Cost ($/AF)** | **$1,304** | **$1,352** |

(a) Notes:
(a) Net present costs are shown.
(b) Construction costs are fully burdened with contingency and engineering & administration costs.
(c) Phase I = 2018 – 2040; Total Project = 2018 – 2067.
(d) The cost estimate does not include costs for the distribution system pump station, reservoir, or disinfection facilities.

### 7.2.2 Alternative 2 – Run-of-River Recharge within Pearland and Buttes Sub-basins (Run-of-river and Pipeline Conveyance Combination)

To avoid interference with quarry operations, an alternative was developed to introduce the SWP water into the creek at a location downstream of the quarries. The water would be conveyed from a new aqueduct turnout via 2.5 miles of 36-inch diameter pipeline along 87$^{th}$ Street with an outlet along East Avenue S-8. This alternative assumes a combination of pipeline and run-of river conveyance. Characteristics, constraints, or benefits are described below. This alternative is not intended to change the contribution of local surface runoff.

**SWP Turnout:** A new 50-cfs turnout to supply the water bank would be constructed at 87$^{th}$ Street.

**Groundwater Basin(s):** This alternative bypasses approximately half of the Pearland sub-basin. Therefore, the likelihood of recharging the Buttes sub-basin in addition to the Pearland sub-basin would be higher compared to Alternative 1. It is still unlikely that the released water would reach as far as the Lancaster sub-basin.

**Recharge Site:** This alternative also assumes in-stream recharge; therefore, no recharge basin would need to be constructed.

**Raw Water Conveyance:** Approximately 2.5 miles of 36-inch diameter pipeline would be constructed from the turnout and along 87$^{th}$ Street to the creek via East Avenue S-8.

**Recycled Water Conveyance:** Same as Alternative 1.

**Recovery Wells:** To meet future demands at buildout, 32 wells (12 wells in the Pearland sub-basin and 20 wells in the Buttes sub-basin) would need to be constructed.

**Land Acquisition:** Because recharge basins are not needed, land acquisition would not be required.

**Other Project Constraints:** This alternative minimizes interference with the existing quarries. However, if the quarries are further expanded along the creek to the north, then the potential for lateral seepage may still pose a challenge.

**Other Project Benefits:** Due to minimal construction requirements and the absence of recycled water recharge, the implementation timeframe for this alternative would be relatively short with minimal capital costs.

**Costs:** Table 7-6 presents the cost estimate for Alternative 2. Net present costs are provided for Phase I, which is from 2018 to 2040, and the total project planning horizon, which is from 2018 to 2067.

Table 7-6: Alternative 2 Cost Estimate

| | Phase I Net Present Costs | Total Net Present Costs |
|---|---|---|
| Turnout | $790,000 | $790,000 |
| Recharge Pipelines | $5,660,000 | $5,660,000 |
| Recharge Basin Construction | $0 | $0 |
| Recharge Basin Land Acquisition | $0 | $0 |
| Recovery Wells | $33,990,000 | $50,970,000 |
| Well Collection Pipelines | $6,910,000 | $6,910,000 |
| Distribution Pipelines | $9,120,000 | $9,120,000 |
| ***Facilities Subtotal*** | ***$56,470,000*** | ***$73,450,000*** |
| | | |
| ***SWP Table A Water Purchase*** | ***$65,050,000*** | ***$104,910,000*** |
| | | |
| SWP Water Purchase | $62,920,000 | $129,270,000 |
| Recycled Water Purchase | $0 | $0 |
| ***Water Purchase Subtotal*** | ***$62,920,000*** | ***$129,270,000*** |
| | | |
| Power Costs | $23,190,000 | $47,640,000 |
| O&M Costs | $4,890,000 | $11,430,000 |
| ***O&M Subtotal*** | ***$28,080,000*** | ***$59,070,000*** |
| | | |
| **Grand Total** | **$212,520,000** | **$366,700,000** |
| **Unit Water Cost ($/AF)** | **$1,325** | **$1,364** |

(a) Notes:
(a) Net present costs are shown.
(b) Construction costs are fully burdened with contingency and engineering & administration costs.
(c) Phase I = 2018 – 2040; Total Project = 2018 – 2067.
(d) The cost estimate does not include costs for the distribution system pump station, reservoir, or disinfection facilities.

### 7.2.3 Alternative 3 – Off-stream Recharge within the Buttes Sub-basin Only (East of Littlerock Creek)

This alternative assumes recharge within constructed basins outside the creek. The net or effective recharge area is estimated at 60-acres with redundancy. The gross recharge area, inclusive of berms, streets, and 300-feet of setback all around the basins, is 160 acres. The recharge site is located adjacent to and east of the creek just outside LAWA property. The recycled water would be supplied from the north via LACSD's existing 48-inch diameter pipeline along Avenue N, and the raw water supply would be conveyed to the basins from the south along 87$^{th}$ and 90$^{th}$ Streets. Characteristics, constraints, or benefits are described below.

**SWP Turnout:** A new 50-cfs SWP turnout to supply the water bank would be constructed at 87$^{th}$ Street.

**Groundwater Basin(s):** The recharge basins are entirely located within Buttes sub-basin.

**Recharge Site:** The site is located adjacent to and east of the creek, just south of LAWA property.

**Raw Water Conveyance:** Approximately 4.7 miles of 30-inch diameter pipeline would be constructed from the turnout and along 87$^{th}$ and 90$^{th}$ Streets to the recharge site, just north of Palmdale Boulevard.

**Recycled Water Conveyance:** Approximately 2.5 miles of 24-inch diameter pipeline would be constructed from LACSD's existing recycled water pipeline in Avenue N to the recharge site along 90$^{th}$ Street.

**Recovery Wells:** To meet future demands at buildout, an additional 29 wells would need to be constructed within the Buttes sub-basin.

**Land Acquisition:** The proposed recharge site is located outside LAWA, and land acquisition would be required.

**Other Project Constraints:** This alternative has several technical, institutional, and private entity related implementation hurdles. Proximity of the proposed recharge site to the existing developments south of Avenue Q and the need to tie-in to the existing recycled water pipeline owned and operated by LACSD are among those hurdles. Moreover, the proposed recharge basins are entirely located within the Buttes sub-basin, which has the least amount of readily-available information on aquifer transmissivity and hydrogeologic characteristics.

**Other Project Benefits:** Unlike Alternatives 1 and 2, this alternative allows for recycled water recharge.

**Costs:** Table 7-7 presents the cost estimate for Alternative 3. Net present costs are provided for Phase I, which is from 2018 to 2040, and the total project planning horizon, which is from 2018 to 2067.

Table 7-7: Alternative 3 Cost Estimate

| | Phase I Net Present Costs | Total Net Present Costs |
|---|---|---|
| Turnout | $790,000 | $790,000 |
| Recharge Pipelines | $15,340,000 | $15,340,000 |
| Recharge Basin Construction | $9,000,000 | $9,000,000 |
| Recharge Basin Land Acquisition | $1,550,000 | $1,550,000 |
| Recovery Wells | $30,210,000 | $45,980,000 |
| Well Collection Pipelines | $6,260,000 | $6,260,000 |
| Distribution Pipelines | $5,560,000 | $5,560,000 |
| ***Facilities Subtotal*** | ***$68,710,000*** | ***$84,480,000*** |
| | | |
| ***SWP Table A Water Purchase*** | ***$0*** | ***$25,590,000*** |
| SWP Water Purchase | $46,840,000 | $88,630,000 |
| Recycled Water Purchase | $9,560,000 | $21,530,000 |
| ***Water Purchase Subtotal*** | ***$56,400,000*** | ***$110,160,000*** |
| | | |
| Power Costs | $23,190,000 | $47,640,000 |
| O&M Costs | $5,640,000 | $12,560,000 |
| ***O&M Subtotal*** | ***$28,830,000*** | ***$60,200,000*** |
| | | |
| **Grand Total** | **$153,940,000** | **$280,430,000** |
| **Unit Water Cost ($/AF)** | **$960** | **$1,043** |

(a) Notes:
(a) Net present costs are shown.
(b) Construction costs are fully burdened with contingency and engineering & administration costs.
(c) Phase I = 2018 – 2040; Total Project = 2018 – 2067.
(d) The cost estimate does not include costs for the distribution system pump station, reservoir, or disinfection facilities.

### 7.2.4 Alternatives 4/5 – Off-stream Recharge within the Buttes Sub-basin Only (West of Littlerock Creek)

Similar to Alternative 3, Alternatives 4 and 5 assume recharge within constructed recharge basins located outside the creek channel. The recharge site is located adjacent to and west of the creek just south of LAWA property and has the same size as Alternative 3. For Alternative 4, the recycled water would be supplied from the north via LACSD's existing 48-inch diameter pipeline along Avenue N; whereas for Alternative 5, the recycled water would be supplied from a future 24-inch diameter recycled water distribution pipeline that is currently being planned along East Avenue R-8 south of the proposed recharge site. The raw water supply would be conveyed from the south along 87th and 90th Streets, and a short distance along Palmdale Boulevard. Characteristics, constraints, or benefits are described below.

**SWP Turnout:** Same as Alternative 3.

**Groundwater Basin(s):** The recharge basins are entirely located within Buttes sub-basin.

**Recharge Site:** The 160-acre site is generally located adjacent to and west of the creek, north of Palmdale Boulevard and just outside LAWA property.

**Raw Water Conveyance:** Approximately 4.5 miles of 30-inch diameter pipeline would be constructed from the turnout, and then along 70$^{th}$ Street and Palmdale Boulevard to the proposed recharge site.

**Recycled Water Conveyance:** For Alternative 4, approximately 4 miles of 24-inch diameter pipeline would be constructed from LACSD's existing recycled water pipeline in Avenue N along 70$^{th}$ Street and the western edge of the creek to the south end of the proposed recharge site on Palmdale Boulevard. For Alternative 5, the recycled water would be diverted from the future recycled water transmission main along East Avenue R-8. Approximately 1.25 miles of 24-inch diameter pipeline would be constructed along 70$^{th}$ Street and Palmdale Boulevard.

**Recovery Wells:** Same as Alternative 3.

**Land Acquisition:** Similar to Alternative 3, the proposed recharge site is located outside LAWA, and land acquisition would be required.

**Other Project Constraints:** For Alternative 4, agreement with LACSD for recycled water conveyance may be an implementation constraint. The proposed recharge basins are entirely located within Buttes sub-basin, where limited information on aquifer transmissivity and hydrogeologic characteristics is available.

**Other Project Benefits:** Unlike Alternatives 1 and 2 and similar to Alternative 3, these alternatives allow for recycled water recharge.

**Costs:** Tables 7-8 and 7-9 presents the cost estimates for Alternatives 4 and 5, respectively. Net present costs are provided for Phase I, which is from 2018 to 2040, and the total project planning horizon, which is from 2018 to 2067.

Table 7-8: Alternative 4 Cost Estimate

| | Phase I Net Present Costs | Total Net Present Costs |
|---|---|---|
| Turnout | $790,000 | $790,000 |
| Recharge Pipelines | $17,230,000 | $17,230,000 |
| Recharge Basin Construction | $9,000,000 | $9,000,000 |
| Recharge Basin Land Acquisition | $1,550,000 | $1,550,000 |
| Recovery Wells | $30,210,000 | $45,980,000 |
| Well Collection Pipelines | $6,260,000 | $6,260,000 |
| Pump Station | $0 | $0 |
| Reservoir | $0 | $0 |
| Chlorination Facilities | $0 | $0 |
| Distribution Pipelines | $5,560,000 | $5,560,000 |
| ***Facilities Subtotal*** | ***$70,600,000*** | ***$86,370,000*** |
| | | |
| ***SWP Table A Water Purchase*** | ***$0*** | ***$25,590,000*** |
| | | |
| SWP Water Purchase | $46,840,000 | $88,630,000 |
| Recycled Water Purchase | $9,560,000 | $21,530,000 |
| ***Water Purchase Subtotal*** | ***$56,400,000*** | ***$110,160,000*** |
| | | |
| Power Costs | $23,190,000 | $47,640,000 |
| O&M Costs | $5,640,000 | $12,560,000 |
| ***O&M Subtotal*** | ***$28,830,000*** | ***$60,200,000*** |
| | | |
| **Grand Total** | **$155,830,000** | **$282,320,000** |
| **Unit Water Cost ($/AF)** | **$971** | **$1,050** |

(a) Notes:
(b) Net present costs are shown.
(c) Construction costs are fully burdened with contingency and engineering & administration costs.
(d) Phase I = 2018 – 2040; Total Project = 2018 – 2067.
(e) The cost estimate does not include costs for the distribution system pump station, reservoir, or disinfection facilities.

Table 7-9: Alternate 5 Cost Estimate

| | Phase I Net Present Costs | Total Net Present Costs |
|---|---|---|
| Turnout | $790,000 | $790,000 |
| Recharge Pipelines | $12,700,000 | $12,700,000 |
| Recharge Basin Construction | $9,000,000 | $9,000,000 |
| Recharge Basin Land Acquisition | $1,550,000 | $1,550,000 |
| Recovery Wells | $30,210,000 | $45,980,000 |
| Well Collection Pipelines | $6,260,000 | $6,260,000 |
| Distribution Pipelines | $5,560,000 | $5,560,000 |
| ***Facilities Subtotal*** | ***$66,070,000*** | ***$81,840,000*** |
| | | |
| ***SWP Table A Water Purchase*** | ***$0*** | ***$25,590,000*** |
| | | |
| SWP Water Purchase | $46,840,000 | $88,630,000 |
| Recycled Water Purchase | $9,560,000 | $21,530,000 |
| ***Water Purchase Subtotal*** | ***$54,400,000*** | ***$110,160,000*** |
| | | |
| Power Costs | $23,190,000 | $47,640,000 |
| O&M Costs | $5,640,000 | $12,560,000 |
| ***O&M Subtotal*** | ***$28,830,000*** | ***$60,200,000*** |
| | | |
| **Grand Total** | **$151,300,000** | **$277,790,000** |
| **Unit Water Cost ($/AF)** | **$943** | **$1,033** |

(a) Notes:
(b) Net present costs are shown.
(c) Construction costs are fully burdened with contingency and engineering & administration costs.
(d) Phase I = 2018 – 2040; Total Project = 2018 – 2067.
(e) The cost estimate does not include costs for the distribution system pump station, reservoir, or disinfection facilities.

### 7.2.5 Alternatives 6/7 – Off-stream Recharge within the Buttes and Lancaster Sub-basins (Along the Western Edge of Littlerock Creek)

The proposed recharged sites for Alternatives 6 and 7 are stretched alongside of the creek. For Alternative 6, the proposed recharge site extends for 4.25 miles along the western edge of the creek from Ave N to Palmdale Boulevard. Per this configuration, approximately half of the recharge site would be located in the Buttes sub-basin with the remaining half of the recharge area located within the Lancaster sub-basin. The proposed recharge site for Alternative 7 is shorter in length, extending for 2.5 miles along the western edge of the creek between Avenue N and Avenue P. Approximately one-third of the recharge area in this alternative is located in the Buttes sub-basin with the remaining two-thirds of the recharge area located within the Lancaster sub-basin. Both alternatives allow recycled water recharge from LACSD's existing 48-inch diameter pipeline along Avenue N. Characteristics, constraints, or benefits are described below.

**SWP Turnout:** A new 50-cfs turnout is proposed at the intersection of California Aqueduct and 87th Street for Alternative 6 and 70th Street for Alternative 7.

**Groundwater Basin(s):** For Alternative 6, two-thirds of the recharge site is located in Buttes sub-basin with the remaining one-third in Lancaster sub-basin. For Alternative 7, the recharge site is equally divided between the Buttes and Lancaster sub-basins.

**Recharge Site:** The proposed recharge sites are located along the western edge of the creek between Avenue N and Palmdale Boulevard (Alternative 6) and Avenue P (Alternative 7). The majority of recharge site for Alternative 6, and the entire site for Alternative 7, are within the LAWA property. Because of the inefficient shape and the need for a gap at the sub-basin boundary, the area required is estimated to be 175 acres compared to 160 acres for Alternatives 3, 4, 5, and 10.

**Raw Water Conveyance:** For Alternative 6, approximately 5 miles of 30-inch diameter pipeline would be constructed along 87th and 90th Streets from the new turnout location to the south end of the proposed recharge (north of Palmdale Boulevard). For Alternative 7, approx. 6.3 miles of 30-inch pipeline would be constructed along 70th Street and Avenue P. The pipeline would extend from the new turnout location on 70th Street to the south end of the proposed recharge site (north of Avenue P).

**Recycled Water Conveyance:** Both alternatives would receive recycled water from LACSD's existing transmission main along Avenue N. For Alternative 6, the 24-inch diameter recycled water pipeline would extend for about 4 miles from Avenue N south along 90th Street all the way to the south end of the proposed recharge site north of Palmdale Boulevard to allow gravity distribution to all recharge basins. The recycled water pipeline for Alternative 7 would extend 2.3 miles from Avenue N south along 90th Street to Avenue P.

**Recovery Wells:** For Alternative 6, at buildout 22 wells would be required (14 wells in Buttes sub-basin and 8 wells in Lancaster sub-basin). For Alternative 7, at buildout 21 well would be required (10 wells in Buttes sub-basin and 11 wells in Lancaster sub-basin).

**Land Acquisition:** Approximately three-quarters of the recharge site in Alternative 6 and the entire recharge site for Alternative 7 are within LAWA property and must be leased or its use established through other contracting means. The portion of Alternative 6 would require land acquisition. For both alternatives the lease or other contractual arrangement for long-term use of the LAWA property is estimated in this study to be equal to the 160 ac property acquisition for the non-LAWA alternatives.

**Other Project Constraints:** For both alternatives, agreements with LAWA and LACSD would be required. Furthermore, both recharge sites are within close proximity of the existing nitrate plume, which was created by the groundwater recharge of the secondary effluent from LACSD's Palmdale WRP without diluent and prior to the plant upgrade to tertiary treatment and nitrification/de-nitrification for nitrate reduction. Also, two-thirds of the proposed recharge site in Alternative 6, and half of the recharge site in Alternative 7, are located within Buttes sub-basin (sub-basin has little information on aquifer transmissivity and geologic characteristics).

**Other Project Benefits:** Both alternatives allow recharging of both the Buttes and Lancaster sub-basins.

**Costs:** Tables 7-10 and 7-11 presents the cost estimates for Alternatives 6 and 7, respectively. Net present costs are provided for Phase I, which is from 2018 to 2040, and the total project planning horizon, which is from 2018 to 2067.

Table 7-10: Alternative 6 Cost Estimate

| | **Phase I Net Present Costs** | **Total Net Present Costs** |
|---|---|---|
| Turnout | $790,000 | $790,000 |
| Recharge Pipelines | $19,070,000 | $19,070,000 |
| Recharge Basin Construction | $9,000,000 | $9,000,000 |
| Recharge Basin Land Acquisition | $1,550,000 | $1,550,000 |
| Recovery Wells | $22,660,000 | $34,790,000 |
| Well Collection Pipelines | $4,750,000 | $4,750,000 |
| Distribution Pipelines | $4,610,000 | $4,610,000 |
| ***Facilities Subtotal*** | ***$62,430,000*** | ***$74,560,000*** |
| | | |
| ***SWP Table A Water Purchase*** | ***$0*** | ***$25,590,000*** |
| | | |
| SWP Water Purchase | $46,840,000 | $88,630,000 |
| Recycled Water Purchase | $9,560,000 | $21,530,000 |
| ***Water Purchase Subtotal*** | ***$56,400,000*** | ***$110,160,000*** |
| | | |
| Power Costs | $23,190,000 | $47,640,000 |
| O&M Costs | $4,550,000 | $10,040,000 |
| ***O&M Subtotal*** | ***$27,740,000*** | ***$57,680,000*** |
| | | |
| **Grand Total** | **$146,570,000** | **$267,990,000** |
| **Unit Water Cost ($/AF)** | **$914** | **$996** |

(a) Notes:
(b) Net present costs are shown.
(c) Construction costs are fully burdened with contingency and engineering & administration costs.
(d) Phase I = 2018 – 2040; Total Project = 2018 – 2067.
(e) The cost estimate does not include costs for the distribution system pump station, reservoir, or disinfection facilities.

Table 7-11: Alternative 7 Cost Estimate

| | Phase I Net Present Costs | Total Net Present Costs |
|---|---|---|
| Turnout | $790,000 | $790,000 |
| Recharge Pipelines | $19,450,000 | $19,450,000 |
| Recharge Basin Construction | $9,000,000 | $9,000,000 |
| Recharge Basin Land Acquisition | $1,550,000 | $1,550,000 |
| Recovery Wells | $22,660,000 | $33,580,000 |
| Well Collection Pipelines | $5,670,000 | $5,670,000 |
| Distribution Pipelines | $4,610,000 | $4,610,000 |
| ***Facilities Subtotal*** | ***$63,730,000*** | ***$74,650,000*** |
| | | |
| ***SWP Table A Water Purchase*** | ***$0*** | ***$25,590,000*** |
| | | |
| SWP Water Purchase | $46,840,000 | $88,630,000 |
| Recycled Water Purchase | $9,560,000 | $21,530,000 |
| ***Water Purchase Subtotal*** | ***$56,400,000*** | ***$110,160,000*** |
| | | |
| Power Costs | $23,190,000 | $47,640,000 |
| O&M Costs | $4,550,000 | $9,840,000 |
| ***O&M Subtotal*** | ***$27,740,000*** | ***$57,480,000*** |
| | | |
| **Grand Total** | **$147,870,000** | **$267,880,000** |
| **Unit Water Cost ($/AF)** | **$922** | **$996** |

(a) Notes:
(b) Net present costs are shown.
(c) Construction costs are fully burdened with contingency and engineering & administration costs.
(d) Phase I = 2018 – 2040; Total Project = 2018 – 2067.
(e) The cost estimate does not include costs for the distribution system pump station, reservoir, or disinfection facilities.

### 7.2.6 Alternative 8 – Off-stream Recharge within the Buttes and Lancaster Sub-basins (West of Littlerock Creek between Avenue P and Avenue O)

Similar to Alternative 7, this Alternative 8 has one-third of the recharge area located in the Buttes sub-basin and two-thirds of the recharge area located in the Lancaster sub-basin west of Littlerock Creek. The proposed recharge site is located within LAWA property south of Avenue O, north of Avenue P, and east of 65$^{th}$ Street East. The diluent supply would be conveyed from a new turnout through 5.5 miles of 30-inch diameter pipeline along 70$^{th}$ Street. The recycled water would be supplied from LACSD's existing 48-inch diameter pipeline along Avenue N through 2 miles of 24-inch diameter pipeline along 70$^{th}$ Street. Characteristics, constraints, or benefits are described below.

**SWP Turnout:** A new 50-cfs turnout would need to be constructed at the intersection of California Aqueduct and 70$^{th}$ Street.

**Groundwater Basin(s):** This alternative recharges both the Lancaster and Buttes sub-basins equally.

**Recharge Site:** The proposed recharge site is located within LAWA property south of Avenue O, north of Avenue P, and east of 65th Street East.

**Raw Water Conveyance:** The raw water supply is proposed to be conveyed from the new turnout through 5.5 miles of 30-inch diameter pipeline along 70th Street.

**Recycled Water Conveyance:** The recycled water is proposed to be supplied from LACSD's existing pipeline along Avenue N through 2 miles of 24-inch diameter pipeline along 70th Street.

**Recovery Wells:** Same as Alternative 7.

**Land Acquisition:** The entire 175-acre recharge site is located within LAWA property and must be leased or otherwise be acquired. The long-term use of the LAWA property is estimated in this study to be equal to the 160-acre property acquisition for the non-LAWA alternatives.

**Other Project Constraints:** Same as Alternatives 6 and 7.

**Other Project Benefits:** Same as Alternatives 6 and 7.

**Costs:** Table 7-12 presents the cost estimate for Alternative 8. Net present costs are provided for Phase I, which is from 2018 to 2040, and the total project planning horizon, which is from 2018 to 2067.

Table 7-12: Alternative 8 Cost Estimate

| | Phase I Net Present Costs | Total Net Present Costs |
|---|---|---|
| Turnout | $790,000 | $790,000 |
| Recharge Pipelines | $17,030,000 | $17,030,000 |
| Recharge Basin Construction | $9,000,000 | $9,000,000 |
| Recharge Basin Land Acquisition | $1,550,000 | $1,550,000 |
| Recovery Wells | $22,660,000 | $33,580,000 |
| Well Collection Pipelines | $5,670,000 | $5,670,000 |
| Distribution Pipelines | $4,610,000 | $4,610,000 |
| ***Facilities Subtotal*** | ***$61,310,000*** | ***$72,230,000*** |
| | | |
| ***SWP Table A Water Purchase*** | ***$0*** | ***$25,590,000*** |
| | | |
| SWP Water Purchase | $46,840,000 | $88,630,000 |
| Recycled Water Purchase | $9,560,000 | $21,530,000 |
| ***Water Purchase Subtotal*** | ***$56,400,000*** | ***$110,160,000*** |
| | | |
| Power Costs | $23,190,000 | $47,640,000 |
| O&M Costs | $4,550,000 | $9,840,000 |
| ***O&M Subtotal*** | ***$27,740,000*** | ***$57,480,000*** |
| | | |
| **Grand Total** | **$145,450,000** | **$265,460,000** |
| **Unit Water Cost ($/AF)** | **$907** | **$987** |

(a) Notes:
(a) Net present costs are shown.
(b) Construction costs are fully burdened with contingency and engineering & administration costs.
(c) Phase I = 2018 – 2040; Total Project = 2018 – 2067.
(d) The cost estimate does not include costs for the distribution system pump station, reservoir, or disinfection facilities.

### 7.2.7 Alternative 9 – Off-stream Recharge within the Buttes and Lancaster Sub-basins (East of Littlerock Creek between Avenue N and Avenue O)

Similar to Alternatives 7 and 8, Alternative 9 has one-third of the recharge area located in the Buttes sub-basin and two-thirds of the recharge area located in the Lancaster sub-basin, but to the east of Littlerock Creek. The proposed recharge site is located within LAWA property south of Avenue N, north of Avenue O, and to the east of the creek. The raw water supply would be conveyed from a new turnout through 7.7 miles of 30-inch diameter pipeline along 87$^{th}$ and 90$^{th}$ Streets. The recycled water would be supplied from LACSD's existing 48-inch diameter pipeline in Avenue N. Even though the proposed recharge site is located just south of Avenue N, approximately 1.0 mile of recycled water pipeline would be needed to distribute recycled water to the southern portion of the site. Characteristics, constraints, or benefits are described below.

**SWP Turnout:** A new 50-cfs turnout would need to be constructed at the intersection of California Aqueduct and 87$^{th}$ Street.

**Groundwater Basin(s):** This alternative recharges both the Lancaster and Buttes sub-basins equally.

**Recharge Site:** The proposed recharge site is located within LAWA property south of Avenue N, north of Avenue O, and to the east of Littlerock Creek.

**Raw Water Conveyance:** The raw water supply is proposed to be conveyed from the new turnout through 7.7 miles of 30-inch diameter pipeline along 87th Street, 90th Street, and Avenue O.

**Recycled Water Conveyance:** The recycled water is proposed to be supplied from LACSD's existing pipeline along Avenue N through 1.0 mile of 24-inch diameter pipeline along either the western or eastern edge of the recharge site.

**Recovery Wells:** Same as Alternatives 7 and 8.

**Land Acquisition:** The entire 175-acre recharge site is located within LAWA property and must be leased or otherwise be acquired. The long-term use of the LAWA property is estimated in this study to be equal to the 160-acre property acquisition for the non-LAWA alternatives.

**Other Project Constraints:** Agreements with LAWA and LACSD must be achieved. Moreover, half of the recharge site is located within Buttes sub-basin (sub-basin has little information on aquifer transmissivity and hydrogeologic characteristics).

**Other Project Benefits:** Same as Alternatives 6, 7, and 8.

**Costs:** Table 7-13 presents the cost estimate for Alternative 9. Net present costs are provided for Phase I, which is from 2018 to 2040, and the total project planning horizon, which is from 2018 to 2067.

Table 7-13: Alternative 9 Cost Estimate

| | Phase I Net Present Costs | Total Net Present Costs |
|---|---|---|
| Turnout | $790,000 | $790,000 |
| Recharge Pipelines | $19,120,000 | $19,120,000 |
| Recharge Basin Construction | $9,000,000 | $9,000,000 |
| Recharge Basin Land Acquisition | $1,550,000 | $1,550,000 |
| Recovery Wells | $22,660,000 | $33,580,000 |
| Well Collection Pipelines | $5,670,000 | $5,670,000 |
| Distribution Pipelines | $7,900,000 | $7,900,000 |
| ***Facilities Subtotal*** | ***$66,690,000*** | ***$77,610,000*** |
| | | |
| ***SWP Table A Water Purchase*** | ***$0*** | ***$25,590,000*** |
| | | |
| SWP Water Purchase | $46,840,000 | $88,630,000 |
| Recycled Water Purchase | $9,560,000 | $21,530,000 |
| ***Water Purchase Subtotal*** | ***$56,400,000*** | ***$110,160,000*** |
| | | |
| Power Costs | $23,190,000 | $47,640,000 |
| O&M Costs | $4,550,000 | $9,840,000 |
| ***O&M Subtotal*** | ***$27,740,000*** | ***$57,480,000*** |
| | | |
| **Grand Total** | **$150,830,000** | **$270,840,000** |
| **Unit Water Cost ($/AF)** | **$940** | **$1,007** |

(a) Notes:
(b) Net present costs are shown.
(c) Construction costs are fully burdened with contingency and engineering & administration costs.
(d) Phase I = 2018 – 2040; Total Project = 2018 – 2067.
(e) The cost estimate does not include costs for the distribution system pump station, reservoir, or disinfection facilities.

### 7.2.8 Alternative 10 – Off-stream Recharge within the Lancaster Sub-basin (Within LACSD Effluent Management Site North of Avenue M)

The proposed recharge site in Alternative 10 is located entirely in Lancaster sub-basin, outside LAWA property and within LACSD's Effluent Management Site, just east of Littlerock Creek between Avenue M and Avenue L. The raw water supply would be conveyed from a new turnout through 8.7 miles of 30-inch diameter pipeline along 70th Street. The recycled water would be supplied from LACSD's existing pipeline along Avenue N through 1.0 mile of 24-inch diameter pipeline along 70th Street to the north. Characteristics, constraints, or benefits are described below.

**SWP Turnout:** A new 50-cfs turnout would need to be constructed at the intersection of the California Aqueduct and 70th Street.

**Groundwater Basin(s):** This alternative recharges the Lancaster sub-basin only.

**Recharge Site:** The proposed recharge site is located outside LAWA property, within LACSD's Effluent Management Site, north of Avenue M, south of Avenue L, and just east of Littlerock Creek.

**Raw Water Conveyance:** The raw water supply would be conveyed from a new turnout through 8.7 miles of 30-inch diameter pipeline along 70$^{th}$ Street.

**Recycled Water Conveyance:** The recycled water would be supplied from LACSD's existing pipeline in Avenue N through 1.0 mile of 24-inch diameter pipeline along 70$^{th}$ Street to the north.

**Recovery Wells:** To meet future demands at buildout, 16 wells in Lancaster sub-basin would need to be constructed. The recovery wells for this alternative are much further away from the Disrict's distribution system than the recovery wells for the other alternatives.

**Land Acquisition:** The proposed recharge site is located within LACSD's future Effluent Management Site. Currently, LACSD disposes of the majority of its recycled water through leased agricultural property not exceeding agronomic irrigation rates. As of 2014, LACSD has only acquired about 1 percent of the land within the proposed Alternative 10 site. The cost for the 160-acre property acquisition is estimated using the assumed unit cost. LACSD currently disposes of water to an individual land owner.

**Other Project Constraints:** The alternative does not provide an opportunity to recharge the Buttes or Pearland sub-basins. Agreement with LACSD must be achieved for both recycled water use and land acquisition. Furthermore, the site with a linear row of wells on the west and north could pull in elevated nitrate levels from the existing nitrate plume; model results indicate at extraction levels exceeding the direct needs of PWD may see interference from the nitrate plume.

**Other Project Benefits:** The Lancaster sub-basin is best understood, and has the highest aquifer transmissivity and best hydrogeologic characteristics for recharge and recovery when compared to Buttes or Pearland sub-basins. As such, Alternative 10 requires the fewest wells to meet the District's water demands.

**Costs:** Table 7-14 presents the cost estimate for Alternative 10. Net present costs are provided for Phase I, which is from 2018 to 2040, and the total project planning horizon, which is from 2018 to 2067.

Table 7-14: Alternative 10 Cost Estimate

| | Phase I Net Present Costs | Total Net Present Costs |
|---|---|---|
| Turnout | $790,000 | $790,000 |
| Recharge Pipelines | $23,580,000 | $23,580,000 |
| Recharge Basin Construction | $9,000,000 | $9,000,000 |
| Recharge Basin Land Acquisition | $1,550,000 | $1,550,000 |
| Recovery Wells | $15,110,000 | $24,810,000 |
| Well Collection Pipelines | $5,180,000 | $5,180,000 |
| Distribution Pipelines | $17,860,000 | $17,860,000 |
| ***Facilities Subtotal*** | ***$73,070,000*** | ***$82,760,000*** |
| | | |
| ***SWP Table A Water Purchase*** | ***$0*** | ***$25,590,000*** |
| | | |
| SWP Water Purchase | $46,840,000 | $88,630,000 |
| Recycled Water Purchase | $9,560,000 | $21,530,000 |
| ***Water Purchase Subtotal*** | ***$56,400,000*** | ***$110,160,000*** |
| | | |
| Power Costs | $23,190,000 | $47,640,000 |
| O&M Costs | $3,460,000 | $7,720,000 |
| ***O&M Subtotal*** | ***$26,650,000*** | ***$55,360,000*** |
| | | |
| **Grand Total** | **$156,120,000** | **$273,880,000** |
| **Unit Water Cost ($/AF)** | **$973** | **$1,018** |

## 7.3 Preliminary Alternatives Evaluation

The scoring and ranking of the ten preliminary alternatives was performed in a matrix. This matrix includes a list of the ten economic and non-economic criteria, weight of each criteria, scores for each alternative, weighted scores for each alternative, total weighted score for each alternative, rank of each alternative, and comments on the scoring.

The ten preliminary alternatives were ranked from the most favorable to the least favorable based on the total weighted score of each alternative. A higher total weighted score indicated the alternative was more favorable, and a lower total weighted score indicated the alternative was less favorable. The greater the total weighted score, the more favorable an alternative was deemed. The most favorable alternative received a ranking of 1 and the least favorable alternative received a ranking of 10. The alternatives ranking matrix is presented in Table 7-15 and summarized in 6. Alternative 10 is the most favorable alternative, followed by Alternative 9, then a group of near-equal scores for Alternatives 3, 4, and 5; then a second group of near-equal scores for Alternatives 6, 7, and 8; with Alternatives 1 and 2 the least favorable alternatives.

## TABLE 7-15 Ranking Matrix

**Table 7-15: Littlerock Creek Groundwater Recharge and Recovery Project**
**Ten Preliminary Alternatives Scoring and Ranking**

| | | | Alternative 1 - Run-of-River Recharge within Pearland Basin | | | Alternative 2 - Run-of-River Recharge within Pearland and Buttes Basins | | | Alternative 3 - Off-stream Recharge within the Buttes Basin (East of Littlerock Creek) | | | Alternative 4 - Off-stream Recharge within the Buttes Basin (West of Littlerock Creek) | | | Alternative 5 - Off-stream Recharge within the Buttes Basin (West of Littlerock Creek) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Criteria | Weight | Scoring | Score | Weighted Score | Comment | Score | Weighted Score | Comment | Score | Weighted Score | Comment | Score | Weighted Score | Comment | Score | Weighted Score | Comment |
| Capital Cost | 15% | 1 - 5 (Best) | 3.65 | 0.5 | $363,630,000 | 3.62 | 0.5 | $366,700,000 | 4.73 | 0.7 | $280,430,000 | 4.70 | 0.7 | $282,320,000 | 4.78 | 0.7 | $277,790,000 |
| Unit Water Cost | 15% | 1 - 5 (Best) | 3.65 | 0.5 | $1,352 | 3.62 | 0.5 | $1,364 | 4.73 | 0.7 | $1,043 | 4.70 | 0.7 | $1,050 | 4.78 | 0.7 | $1,033 |
| Recharge and Recovery Capacity | 10% | 1 - 5 (Best) | 2.22 | 0.2 | Pearland and Buttes Basin | 2.36 | 0.2 | Buttes and Pearland Basin | 2.50 | 0.3 | Buttes Basin | 2.50 | 0.3 | Buttes Basin | 2.50 | 0.3 | Buttes Basin |
| Recovery Water Quality | 10% | 1 - 5 (Best) | 3.5 | 0.4 | | 3.5 | 0.4 | | 5 | 0.5 | | 5 | 0.5 | | 5 | 0.5 | |
| Environmental Impact | 10% | 1 - 5 (Best) | 2 | 0.2 | Relatively high biological constraints, moderate to high cultural constraints | 2 | 0.2 | Relatively high biological constraints, moderate to high cultural constraints | 4 | 0.4 | Relatively low biological constraints, moderate to high cultural constraints | 3 | 0.3 | Largely unconstrained biologically, moderate to high cultural constraints | 3 | 0.3 | Largely unconstrained biologically, moderate to high cultural constraints |
| Implementation Risk and Uncertainty | 10% | 1 - 5 (Best) | 2 | 0.2 | Near existing creek/quarry operations | 2 | 0.2 | Least known about Buttes basin, potential to be near future creek/quarry operations | 2 | 0.2 | Least known about Buttes basin, adjacent to existing development | 2 | 0.2 | Least known about Buttes basin | 2 | 0.2 | Least known about Buttes basin |
| Institutional and Private Entity Issues | 10% | 1 - 5 (Best) | 2 | 0.2 | Outside LAWA, quarry operations | 3 | 0.3 | Outside LAWA, potential future quarry operations | 3 | 0.3 | Outside LAWA, proximity to existing development | 3 | 0.3 | Outside LAWA, Air Force buffer zone | 3 | 0.3 | Outside LAWA, Air Force buffer zone |
| Recycled Water Recharge Compatibility | 10% | 1 - 5 (Best) | 1 | 0.1 | Not RW compatible | 1 | 0.1 | Not RW compatible | 5 | 0.5 | RW compatible | 5 | 0.5 | RW compatible | 5 | 0.5 | RW compatible |
| Regulatory and Permitting Issues | 5% | 1 - 5 (Best) | 2 | 0.1 | USACE and CDFW | 2 | 0.1 | USACE and CDFW | 1 | 0.1 | RWQCB and CDPH | 1 | 0.1 | RWQCB and CDPH | 1 | 0.1 | RWQCB and CDPH |
| Public Acceptance | 5% | 1 - 5 (Best) | 4 | 0.2 | No RW, recharge in creek | 4 | 0.2 | No RW, recharge in creek | 2 | 0.1 | RW, recharge near creek, near existing development | 3 | 0.2 | RW, recharge near creek | 3 | 0.2 | RW, recharge near creek |
| **Total** | **100%** | **5** | | **2.67** | | | **2.77** | | | **3.72** | | | **3.66** | | | **3.68** | |
| **Rank** | | | | **10** | | | **9** | | | **3** | | | **5** | | | **4** | |

| | Alternative 6 - Off-stream Recharge within the Buttes and Lancaster Basins (Along the Western Edge of Littlerock Creek) | | | Alternative 7 - Off-stream Recharge within the Buttes and Lancaster Basins (Along the Western Edge of Littlerock Creek) | | | Alternative 8 - Off-stream Recharge within the Buttes and Lancaster Basins (West of Littlerock Creek between Avenues P and O) | | | Alternative 9 - Off-stream Recharge within the Buttes and Lancaster Basins (East of Littlerock Creek between Avenues N and O) | | | Alternative 10 - Off-stream Recharge within the Lancaster Basin (Within LACSD Effluent Management Site North of Avenue M) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Criteria | Score | Weighted Score | Comment | Score | Weighted Score | Comment | Score | Weighted Score | Comment | Score | Weighted Score | Comment | Score | Weighted Score | Comment |
| Capital Cost | 4.95 | 0.7 | $267,990,000 | 4.95 | 0.7 | $267,880,000 | 5.00 | 0.8 | $265,460,000 | 4.90 | 0.7 | $270,840,000 | 4.85 | 0.7 | $273,880,000 |
| Unit Water Cost | 4.95 | 0.7 | $996 | 4.95 | 0.7 | $996 | 5.00 | 0.8 | $987 | 4.90 | 0.7 | $1,007 | 4.85 | 0.7 | $1,018 |
| Recharge and Recovery Capacity | 3.75 | 0.4 | Buttes and Lancaster Basins | 4.18 | 0.4 | Lancaster and Buttes Basins | 4.18 | 0.4 | Lancaster and Buttes Basins | 4.18 | 0.4 | Lancaster and Buttes Basins | 5.00 | 0.5 | Lancaster Basin |
| Recovery Water Quality | 3 | 0.3 | Impact from Plume | 3 | 0.3 | Impact from Plume | 3 | 0.3 | Impact from Plume | 5 | 0.5 | | 4 | 0.4 | Impact from Plume |
| Environmental Impact | 2 | 0.2 | Relatively high biological constraints, moderate to high cultural constraints | 2 | 0.2 | Relatively high biological constraints, moderate to high cultural constraints | 3 | 0.3 | Largely unconstrained biologically, moderate to high cultural constraints | 3 | 0.3 | Largely unconstrained biologically, moderate to high cultural constraints | 4 | 0.4 | Relatively low biological constraints, moderate to high cultural constraints |
| Implementation Risk and Uncertainty | 2 | 0.2 | Least known about Buttes basin - portion within, Impact from Plume | 2 | 0.2 | Least known about Buttes basin - portion within, Impact from Plume | 2 | 0.2 | Least known about Buttes basin - portion within, Impact from Plume | 3 | 0.3 | Least known about Buttes basin - portion within | 4 | 0.4 | Impact from Plume |
| Institutional and Private Entity Issues | 2 | 0.2 | Portion in LAWA, Air Force buffer zone | 1 | 0.1 | LAWA, Air Force buffer zone | 1 | 0.1 | LAWA, Air Force buffer zone | 1 | 0.1 | LAWA, Air Force buffer zone | 3 | 0.3 | Outside LAWA, LACSD land acquisition, Air Force buffer zone |
| Recycled Water Recharge Compatibility | 5 | 0.5 | RW compatible | 5 | 0.5 | RW compatible | 5 | 0.5 | RW compatible | 5 | 0.5 | RW compatible | 5 | 0.5 | RW compatible |
| Regulatory and Permitting Issues | 1 | 0.1 | RWQCB and CDPH | 1 | 0.1 | RWQCB and CDPH | 1 | 0.1 | RWQCB and CDPH | 1 | 0.1 | RWQCB and CDPH | 1 | 0.1 | RWQCB and CDPH |
| Public Acceptance | 3 | 0.2 | RW, recharge near creek | 3 | 0.2 | RW, recharge near creek | 3 | 0.2 | RW, recharge near creek | 3.5 | 0.2 | RW, recharge near creek | 4 | 0.2 | RW, recharge near creek, recharge where RW is already spread |
| **Total** | | **3.46** | | | **3.40** | | | **3.52** | | | **3.81** | | | **4.20** | |
| **Rank** | | **7** | | | **8** | | | **6** | | | **2** | | | **1** | |

**Table 7-16: Ranking Matrix Summary**

| Alternative | Total Weighted Score | Ranking |
|---|---|---|
| 1 | 2.67 | 10 |
| 2 | 2.77 | 9 |
| 3 | 3.72 | 3 |
| 4 | 3.66 | 5 |
| 5 | 3.68 | 4 |
| 6 | 3.46 | 7 |
| 7 | 3.40 | 8 |
| 8 | 3.52 | 6 |
| 9 | 3.81 | 2 |
| 10 | 4.20 | 1 |

After reviewing and analyzing the results of the scoring and ranking matrix, the next step was to refine the most favorable alternatives. Based on the screening of the 10 alternatives, alternatives 9 and 10 were found to be more favorable than the other alternatives. In turn, these two alternatives were refined to generate four refined alternatives - Alternatives 9R, 10A, 10B, and 10C.

## 7.4 Refined Project Alternatives

This section describes the refined recharge basin alternatives considered for further analysis and design. There are four alternatives considered:

- Alternative 9R
- Alternative 10A
- Alternative 10B
- Alternative 10C

These alternatives were chosen based on the preliminary alternatives evaluation presented in the preceding section. A summary of why these four refined alternatives were selected is provided below:

- All refined alternatives allow for recycled water to be utilized in groundwater recharge.
- Alternative 9R straddles the Buttes and Lancaster sub-basins with approximately half its recharge area in each sub-basin. This design allows flexibility as to which sub-basin receives recharge: Buttes, Lancaster, or both.

- Alternatives 10A, 10B, and 10C are located in the Lancaster Sub-basin, which has the highest specific capacity; roughly double the Pearland and Buttes sub-basins. This reduces the number of recovery wells required.

- Alternative 9R is located east of Littlerock Creek, and LAWA has indicated that if an airport is built in the future, then it will most likely be west of Littlerock Creek.

- Alternatives 10A, 10B, and 10C are located outside (to the north) of LAWA property.

- Alternatives 9R and 10A are located outside of a 10,000-foot buffer zone of the flight path of the Palmdale Air Force Plant 42, but within the five-mile buffer zone. The proposed recharge basins of Alternative 10B are located outside of the five-mile buffer zone, and Alternative 10C is completely outside the five-mile buffer zone.

All four refined alternatives have certain characteristics in common. A summary of these characteristics is provided below:

- All four alternatives have been re-designed and modeled with recovery wells placed in a circumferential pattern, instead of the initial linear pattern. In initial modeling, it was found that a linear pattern around the recharge area would cause excessive drawdown and potentially cause up to 1 foot of subsidence over a 20-year period in the four preferred alternatives. Consequently, a second extraction well placement scheme, based on spacing the extraction wells in a radial pattern, spaced 4,500 feet from the center of the recharge basin, was also evaluated. This scheme appears to largely mitigate the modeled land subsidence, reducing the areal impact and the magnitude of subsidence after 20 years to just 0.1 foot for the area around some of the extraction wells and less than 0.1 foot around the majority of the extraction wells. While 1 foot of subsidence in 20 years could be considered significant, model estimates of 0.1 foot of subsidence after 20 years are considered to be negligible.

- All alternatives have been designed in such a way as to meet the ultimate facility sizing needs of the District, allowing the District to only require a single recharge project for its supply needs.

- The number of recovery wells specified for each alternative provides the recovery capacity necessary for the District's projected ultimate build-out water demand. For the District's potable supply needs, the recovery wells can be phased over time as water demand increases. Early construction of recovery wells beyond the needs of the District would make recovery available for any water banking partners. Maximum extraction rates for dry year supply for partners may require additional wells.

- All alternatives include a distribution system, including a 1-million gallon head tank, distribution system pump station, a chlorination building, and an optional raw water sump and raw water pump station. The head tank and chlorination building are designed for ultimate demands, whereas the pump stations are designed to be implemented through phasing. The design characteristics of each facet listed are described in the subsections that follow.

- The proposed chlorination building is designed to house an on-site hypochlorite (hypo) generator and its appurtenances to feed approximately 125 pounds of chlorine per day at a dosing rate of 0.8 mg/L. Such criteria would utilize a 200 lb/day system. The chlorine generation system consists of a salt truck delivery/fill station, skid-mounted hypo generation unit, feed water softening system, salt/brine storage tank, brine pump, hypo storage tank, hydrogen blower and vent system, chemical metering pumps, piping, and a chemical injector at the point of chlorine application. At 0.8% hypo, double-wall containment is not required and the dilute hypo (bleach) is much less corrosive to pumps and piping. The units have a built-in PLC control system and operate with a constant current and variable brine feed to compensate for any scaling of the electrodes over time. For example, for a system that generates hypo at a rate of 200 ppd of chlorine equivalent with a demand of only 120 ppd would operate for 14.4 hours a day. This system is intended to treat the raw water from the recovery wells either before it enters the head tank or after the tank before the distribution pump station at the District's discretion.

- The distribution pump station is proposed to be implemented in multiple phases, each accommodating an increase in demands. The pump station's transmission line is designed to provide ultimate demands through a 30-inch pipeline to the existing 20-inch pipeline at the corner of Palmdale Boulevard and 60th Street, which serves a hydraulic grade line of 2,800 feet. For the first phase, the pumps are designed to be of a 3+1 spare configuration, providing 3,000 gpm at 400 hp, each. The tables regarding the specific characteristics of each pump station are provided in the alternative subsections that follow. In most cases, the pump horsepower has been slightly oversized in order to accommodate the higher transmission head loss in phase 2. Once the District's demands rise to approximately 14,125 AF/yr, additional pumps may be implemented, which are projected to include 3 additional 2,500 gpm pumps at 400 hp. The lower second phase pump capacity is based on the assumption that, as the demand grows, the system will be required to run more water through the pipeline. The greater flow in the pipeline will increase the dynamic head loss experienced by the system, lowering the existing pump's capacity to approximately 2,500 gpm under ultimate build-out. With possible remediation to the existing pumps, such as the installation of larger impellers, the combined old 3,000 gpm pumps and new 2,500 gpm pumps will accommodate the complete 24,250 AF/yr (approximately 15,000 gpm) ultimate demand with the final 6+1 configuration.

- The raw water pump station is comprised of a 6+1 configuration of 600 hp, 3,000 gpm pumps. The station is designed with suction from a 50,000 gallon sump to supply raw water back to the East Branch canal utilizing the 30-inch raw water pipeline normally used to deliver recharge. Based on the District's discretion, this pump station may also be phased, beginning with a 3+1 configuration in phase 1 and constructing the final two pumps in phase 2. However, in the event that the District creates this system for a water banking partnership, the phasing and number of pumps may be adapted in order to meet the partner's needs. Under the circumstance that the chlorination building is used to chlorinate the water within the head tank, the raw water pump station will be designed with a de-chlorination chemical feed system.

### 7.4.1 Alternative 9R

Alternative 9R is a revision of Preliminary Alternative 9.

**SWP Turnout:** A new 50-cfs turnout would be constructed at the intersection of the aqueduct and 70$^{th}$ Street or 87$^{th}$ Street.

**Groundwater Basin(s):** The alternative is capable of recharging both the Lancaster and Buttes sub-basins.

**Recharge Site:** The proposed 175-acre recharge site is located within the LAWA property and is bounded by Avenue N to the north, Avenue N-8 to the south, and 78$^{th}$ Street to the west. A property line approximately 0.6 mile west of 90$^{th}$ Street defines the eastern border.

**Raw Water Conveyance:** The raw water supply is proposed to be conveyed from the new turnout north along 70th Street or 87$^{th}$ Street/90$^{th}$ Street. The pipeline length varies for the two alignments. The 70$^{th}$ Street alignment would be a 30-inch diameter raw water pipeline running 7.6 miles north to East Avenue N, east approximately 0.9 miles to a point that aligns with a future 79$^{th}$ Street, then south 0.5 miles as a combined 36-inch diameter raw water and recycled water pipeline to the recharge basin diversion structure. The 90$^{th}$ Street alignment would be a 30-inch diameter raw water pipeline running 7.9 miles north to East Avenue N, then west 1.1 miles to the same point described for the 70$^{th}$ Street alignment and south in a combined pipeline.

**Recycled Water Conveyance:** The recycled water is proposed to be supplied from LACSD's existing pipeline along Avenue N through a 24-inch turn-out. For either the 70$^{th}$ or 90$^{th}$ Street raw water supply alignment, a common 36-inch pipeline would run south 0.5 miles to the recharge site diversion structure.

**Recovery Wells:** This alternative requires 21 wells at buildout, 10 wells with a capacity of 600 gpm in the Buttes sub-basin, and 11 wells with a capacity of 1,200 gpm in the Lancaster sub-basin. One well in the Lancaster sub-basin is a spare. The wells in each sub-basin are located 4,500 feet from the center of the recharge site in a radial pattern. The first phase of the project requires 6 wells in the Buttes sub-basin and 6 wells in the Lancaster sub-basin. The remaining 4 wells in the Buttes sub-basin and 5 wells in the Lancaster sub-basin would be constructed in the second phase of the project. The piping for the first phase is sized, and upsized where necessary to deliver water from the wells in both phases to the storage reservoir. The approximate length of each pipeline required by diameter and phase of the project is shown in Table 7-17.

Table 7-17: Alternative 9R Recovery Wells Piping Requirements

| Pipe Diameter (in) | Phase 1 Pipe Length (ft) | Phase 2 Pipe Length (ft) |
|---|---|---|
| 8 | 4,400 | 2,700 |
| 10 | 6,900 | 2,400 |
| 12 | 7,300 | 0 |
| 16 | 6,800 | 0 |
| 20 | 4,500 | 0 |
| 24 | 3,800 | 0 |

**Land Acquisition:** The entire 175-acre recharge site is located within LAWA property and must be leased or secured through a long-term memorandum of understanding (MOU).

**Distribution System Location:** The 1 million-gallon head tank and pump stations are proposed to be located at the northern center of the project site along East Avenue N, which lies at 2,540 feet (MSL) in elevation.

**Potable Water Distribution Pump Station:** The transmission system pipeline is proposed to be a 30-inch alignment running 1.3 miles west on East Avenue N, 3.5 miles south down 70th Street, then 1 mile west via Palmdale Boulevard. The specific characteristics of this station, including ultimate demand, are located on Table 7-17.

**Raw Water Pump Station:** The optional raw water pump station for pumping back to the East Branch would be located adjacent to the distribution system head tank and discharge back into the 30-inch diameter raw water pipeline. A set of valves on the raw water pipeline would allow recharge or pump-back. The specific characteristics of this pump station are also located on Table 7-17.

**Costs:** Table 7-18 presents the cost estimate for Alternative 9R. Net present costs are provided for Phase I, which is from 2018 to 2040, and the total project planning horizon, which is from 2018 to 2067.

Table 7-18: Alternative 9R Pump Station Characteristics

| | Phase I Distribution System | Ultimate Distribution System | Raw Water System |
|---|---|---|---|
| Demand (AF/yr) | 14,125 | 24,250 | 24,250 |
| Flow (gpm) | 8,758 | 15,035 | 15,035 |
| Diameter (in) | 30 | 30 | 30 |
| Full Flow Velocity, (fps) | 4.0 | 6.8 | 6.8 |
| Length (mi) | 5.8 | 5.8 | 8.8 |
| Pump Station Elevation (ft) | 2,540 | 2,540 | 2,540 |
| Static HGL (ft) | 2,800 | 2,800 | 2,940 |
| Static Head (ft) | 260 | 260 | 400 |
| Head Loss[a] (ft) | 47 | 129 | 195 |
| TDH (ft) | 307 | 389 | 595 |
| Pump Capacity (gpm) | 3,000 | 2,500 | 3,000 |
| Required HP | 291 | 307 | 564 |
| Motor Size (HP) | 400[b] | 400 | 600 |
| Number of Pumps | 3+1 | 6+1 | 5+1 |

(a) Notes:
(b) Hazen-Williams roughness constant estimated to be 135.
(c) Motor oversized in phase 1 in order to accommodate future demands on system and modifications to the pumps in order to obtain ultimate demand flows.

Table 7-19: Alternative 9R Cost Estimate

| | Phase I Net Present Costs | Total Net Present Costs |
|---|---|---|
| Turnout | $790,000 | $790,000 |
| Recharge Pipelines | $19,720,000 | $19,720,000 |
| Recharge Basin Construction | $9,000,000 | $9,000,000 |
| Recharge Basin Land Acquisition | $1,550,000 | $1,550,000 |
| Recovery Wells | $22,660,000 | $33,580,000 |
| Well Collection Pipelines | $7,580,000 | $8,040,000 |
| Pump Station | $5,040,000 | $7,460,000 |
| Reservoir | $1,180,000 | $1,180,000 |
| Chlorination Facilities | $390,000 | $390,000 |
| Distribution Pipelines | $14,460,000 | $14,460,000 |
| ***Facilities Subtotal*** | ***$82,370,000*** | ***$96,170,000*** |
| | | |
| ***SWP Table A Water Purchase*** | ***$0*** | ***$25,590,000*** |
| | | |
| SWP Water Purchase | $46,840,000 | $88,630,000 |
| Recycled Water Purchase | $9,560,000 | $21,530,000 |
| ***Water Purchase Subtotal*** | ***$56,400,000*** | ***$110,160,000*** |
| | | |
| Power Costs | $24,970,000 | $52,590,000 |
| O&M Costs | $6,450,000 | $14,000,000 |
| ***O&M Subtotal*** | ***$31,420,000*** | ***$66,590,000*** |
| | | |
| **Grand Total** | **$170,190,000** | **$298,510,000** |
| **Unit Water Cost ($/AF)** | **$1,061** | **$1,110** |

(a) Notes:
(a) Net present costs are shown.
(b) Construction costs are fully burdened with contingency and engineering & administration costs.
(c) Phase I = 2018 – 2040; Total Project = 2018 – 2067.

### 7.4.2 Alternative 10A

Alternative 10A is the first of three adaptations of preliminary Alternative 10.

**SWP Turnout:** A new 50-cfs turnout would be constructed at the intersection of the aqueduct and 70$^{th}$ Street.

**Groundwater Basin(s):** The alternative recharges the Lancaster sub-basin.

**Recharge Site:** The project area's perimeter is comprised of East Avenue L to the north, 75$^{th}$ Street to the east, and 70$^{th}$ Street to the west. The site extends approximately 0.5 miles south of East Avenue L (halfway to East Avenue M). The eight recharge basins are designed to be 750 x 435 feet in a 2 x 4 arrangement. The complete area of the basins, including roads and separations, is approximately 1,730 x 2,060 feet.

**Raw Water Conveyance:** The raw water supply is proposed to be conveyed from the new turnout through 9.2 miles of pipeline along 70th Street, with 7.7 miles of 30-inch diameter raw water pipeline to East Avenue N, and 1.5 miles of 36-inch diameter combined raw water and recycled water pipeline from East Avenue N to the recharge site.

**Recycled Water Conveyance:** The recycled water is proposed to be supplied from LACSD's existing pipeline along Avenue N with a turnout delivering recycled water to the combined raw water and recycled water pipeline on 70$^{th}$ Street described above.

**Recovery Wells:** This alternative requires 16 recovery wells at buildout, all with a capacity of 1,200 gpm in the Lancaster sub-basin. Two of the wells are spares. The wells are located 4,500 feet from the center of the recharge site in a generally radial pattern. Wells are not able to be constructed in the southwest side of the alternative due to the creek. As a result, the location of the wells forms a horseshoe pattern and they are located in closer proximity to each other than the full-radial Alternatives 10B and 10C. The first phase of the project requires 8 wells in the Lancaster sub-basin. The remaining 8 wells would be constructed in the second phase of the project. The piping for the first phase is sized, and upsized where necessary, to deliver water from the wells in both phases to the head tank. The approximate length of pipe required by diameter and phase of the project is shown in Table 7-20.

Table 7-20: Alternative 10A Recovery Wells Piping Requirements

| Pipe Diameter (in) | Phase 1 Pipe Length (ft) | Phase 2 Pipe Length (ft) |
|---|---|---|
| 10 | 5,100 | 5,400 |
| 12 | 4,700 | 0 |
| 16 | 3,100 | 0 |
| 20 | 12,400 | 0 |
| 24 | 4,500 | 0 |

**Land Acquisition:** The entire 160-acre recharge site is located north of LAWA property and must be purchased from private property owners.

**Distribution Site Location:** The 1-million gallon head tank and pump stations are proposed to be located on their own 1-acre parcel at the southwest corner of the project area at the intersection of East Avenue M and 70th Street, which lies at 2,504 feet in elevation. In order to avoid an additional 600 HP pump for the raw water pump station (compared to Alternatives 10B and 10C at slightly higher ground elevations) the head tank for this site is designed with a 40 side wall as opposed to a 24-foot side wall for the other sites, which under normal operating conditions will be assumed to be maintained with a water elevation of 25 to 30 feet.

**Potable Water Distribution Pump Station:** The transmission system pipeline is proposed to be a 30-inch pipeline running 4.6 miles south from 70th Street, then 1 mile west via Palmdale Boulevard. The specific characteristics of this station, including ultimate demand, are located on Table 7-21.

**Raw Water Pump Station:** The optional raw water pump station for pumping back to the East Branch would be located adjacent to the distribution system head tank and discharge back into the 30-inch diameter raw water pipeline. A set of valves on the raw water pipeline would allow recharge or pump-back. The specific characteristics of this pump station are also located on Table 7-21.

**Costs:** Table 7-22 presents the cost estimate for Alternative 10A. Net present costs are provided for Phase I, which is from 2018 to 2040, and the total project planning horizon, which is from 2018 to 2067.

Table 7-21: Alternative 10A Pump Station Characteristics

| | Distribution System | Distribution System (Ultimate) | Raw Water System |
|---|---|---|---|
| Demand (AF/yr) | 14,125 | 24,250 | 24,250 |
| Flow (gpm) | 8,758 | 15,035 | 15,035 |
| Diameter (in) | 30 | 30 | 30 |
| Full Flow Velocity, (fps) | 4.0 | 6.8 | 6.8 |
| Length (mi) | 5.6 | 5.6 | 8.7 |
| Pump Station Elevation (ft) | 2,504 | 2,504 | 2,504 |
| Static HGL (ft) | 2,800 | 2,800 | 2,940 |
| Static Head[a] (ft) | 281 | 281 | 421 |
| Head Loss[b] (ft) | 46 | 124 | 193 |
| TDH (ft) | 327 | 405 | 614 |
| Pump Capacity (gpm) | 3,000 | 2,500 | 3,000 |
| Required HP | 309 | 320 | 581 |
| Motor Size (HP) | 400 | 400 | 600 |
| Number of Pumps | 3+1 | 6+1 | 5+1 |

(a) Notes:
(a) Static head is calculated to take into account the additional 15 feet of head provided by the modified head tank.
(b) Hazen-Williams roughness constant estimated to be 135.

Table 7-22: Alternative 10A Cost Estimate

| | Phase I Net Present Costs | Total Net Present Costs |
|---|---|---|
| Turnout | $790,000 | $790,000 |
| Recharge Pipelines | $23,580,000 | $23,580,000 |
| Recharge Basin Construction | $9,000,000 | $9,000,000 |
| Recharge Basin Land Acquisition | $1,510,000 | $1,510,000 |
| Recovery Wells | $15,110,000 | $24,810,000 |
| Well Collection Pipelines | $8,070,000 | $8,620,000 |
| Pump Station | $5,040,000 | $7,460,000 |
| Reservoir | $1,180,000 | $1,180,000 |
| Chlorination Facilities | $390,000 | $390,000 |
| Distribution Pipelines | $13,960,000 | $13,960,000 |
| ***Facilities Subtotal*** | ***$78,630,000*** | ***$91,300,000*** |
| | | |
| ***SWP Table A Water Purchase*** | ***$0*** | ***$25,590,000*** |
| | | |
| SWP Water Purchase | $46,840,000 | $88,630,000 |
| Recycled Water Purchase | $9,560,000 | $21,530,000 |
| ***Water Purchase Subtotal*** | ***$56,400,000*** | ***$110,160,000*** |
| | | |
| Power Costs | $25,740,000 | $54,110,000 |
| O&M Costs | $5,360,000 | $11,880,000 |
| ***O&M Subtotal*** | ***$31,100,000*** | ***$65,990,000*** |
| | | |
| **Grand Total** | **$166,130,000** | **$293,040,000** |
| **Unit Water Cost ($/AF)** | **$1,036** | **$1,090** |

(a) Notes:
(a) Net present costs are shown.
(b) Construction costs are fully burdened with contingency and engineering & administration costs.
(c) Phase I = 2018 – 2040; Total Project = 2018 – 2067.

### 7.4.3 Alternative 10B

Alternative 10B is a modification of Alternative 10 that is moved farther east from Littlerock Creek. This additional 2-mile distance from the Alternative 10A location is provided in order to place the recharge area outside of the 5-mile zone from the airport, as well as completely out of the influence of the nitrate plume.

**SWP Turnout:** A new 50-cfs turnout would be constructed at the intersection of the aqueduct and 87th Street.

**Groundwater Basin(s):** The alternative recharges the Lancaster sub-basin.

**Recharge Site:** The project area's perimeter is comprised of 90th Street to the west, East Avenue L to the north, and 95th Street to the east. The area extends approximately 0.5 miles south of East Avenue L (halfway to East Avenue M). The sizing and configuration of the recharge site is the same as Alternative 10A.

**Raw Water Conveyance:** The diluent supply is proposed to be conveyed from the new turnout through 9.4 miles of pipeline along 87th/90th Street, with 7.9 miles of 30-inch diameter raw water pipeline to East Avenue N, then 1.5 miles of 36-inch diameter combined raw water and recycled water pipeline from East Avenue N to the diversion structure.

**Recycled Water Conveyance:** The recycled water is proposed to be supplied from LACSD's existing pipeline along Avenue N with a turnout delivering recycled water to the combined raw water and recycled water pipeline along 90th Street described above.

**Recovery Wells:** This alternative requires 16 recovery wells at buildout, all with a capacity of 1,200 gpm in the Lancaster sub-basin. Two of the wells are spares. The wells are located 4,500 feet from the center of the recharge site in a radial pattern. The first phase of the project requires 8 wells in the Lancaster sub-basin. The remaining 8 wells would be constructed in the second phase of the project. The piping for the first phase is sized, and upsized where necessary, to deliver water from the wells in both phases to the storage reservoir. The approximate length of pipe required by diameter and phase of the project is shown in Table 7-23.

Table 7-23: Alternative 10B Recovery Wells Piping Requirements

| Pipe Diameter (in) | Phase 1 Pipe Length (ft) | Phase 2 Pipe Length (ft) |
|---|---|---|
| 10 | 3,400 | 6,300 |
| 12 | 3,400 | 0 |
| 16 | 4,400 | 0 |
| 20 | 11,000 | 0 |
| 24 | 6,300 | 0 |

**Land Acquisition:** The entire 160-acre recharge site is located north of LAWA property and must be purchased from private property owners. However, a small portion of this area has been acquired by the LACSD for their proposed Effluent Management area, and may be acquisitioned from them.

**Distribution Site Location:** The 1-million head tank and pump stations are proposed to be located on their own 1-acre parcel at the southwest corner of the project area at the intersection of East Avenue M and 90th Street, which lies at an elevation of 2,530 feet.

**Potable Water Distribution Pump Station:** The distribution system pipeline is proposed to be a 24-inch alignment running 4.6 miles south from 90th Street, then 3.0 miles west via Palmdale Boulevard. The specific characteristics of this station, including ultimate demand, are located on Table 7-24.

**Raw Water Pump Station:** The optional raw water pump station for pumping back to the East Branch would be located adjacent to the distribution system head tank and discharge back into the 30-inch diameter raw water pipeline. A set of valves on the raw water pipeline would allow recharge or pump-back. The specific characteristics of this pump station are also located on Table 7-24.

**Costs:** Table 7-25 presents the cost estimate for Alternative 10B. Net present costs are provided for Phase I, which is from 2018 to 2040, and the total project planning horizon, which is from 2018 to 2067.

Table 7-24: Alternative 10B Pump Station Characteristics

| | Distribution System | Distribution System (Ultimate) | Raw Water System |
|---|---|---|---|
| Demand (AF/yr) | 14,125 | 24,250 | 24,250 |
| Flow (gpm) | 8,758 | 15,035 | 15,035 |
| Diameter (in) | 30 | 30 | 30 |
| Full Flow Velocity, (fps) | 4.0 | 6.8 | 6.8 |
| Length (mi) | 7.6 | 7.6 | 8.9 |
| Pump Station Elevation (ft) | 2,530 | 2,530 | 2,530 |
| Static HGL (ft) | 2,800 | 2,800 | 2,940 |
| Static Head (ft) | 270 | 270 | 410 |
| Head Loss[a] (ft) | 62 | 169 | 197 |
| TDH (ft) | 332 | 439 | 607 |
| Pump Capacity (gpm) | 3,000 | 2,500 | 3,000 |
| Required HP | 315 | 346 | 575 |
| Motor Size (HP) | 400 | 400 | 600 |
| Number of Pumps | 3+1 | 6+1 | 5+1 |

(a) Note:
(a) Hazen-Williams roughness constant estimated to be 135.

Table 7-25: Alternative 10B Cost Estimate

| | Phase I Net Present Costs | Total Net Present Costs |
|---|---|---|
| Turnout | $790,000 | $790,000 |
| Recharge Pipelines | $24,160,000 | $24,160,000 |
| Recharge Basin Construction | $9,000,000 | $9,000,000 |
| Recharge Basin Land Acquisition | $1,480,000 | $1,480,000 |
| Recovery Wells | $15,110,000 | $24,810,000 |
| Well Collection Pipelines | $8,130,000 | $8,760,000 |
| Pump Station | $5,040,000 | $7,460,000 |
| Reservoir | $1,180,000 | $1,180,000 |
| Chlorination Facilities | $390,000 | $390,000 |
| Distribution Pipelines | $18,940,000 | $18,940,000 |
| ***Facilities Subtotal*** | ***$84,220,000*** | ***$96,970,000*** |
| | | |
| ***SWP Table A Water Purchase*** | ***$0*** | ***$25,590,000*** |
| | | |
| SWP Water Purchase | $46,840,000 | $88,630,000 |
| Recycled Water Purchase | $9,560,000 | $21,530,000 |
| ***Water Purchase Subtotal*** | ***$56,400,000*** | ***$110,160,000*** |
| | | |
| Power Costs | $25,790,000 | $54,660,000 |
| O&M Costs | $5,360,000 | $11,880,000 |
| ***O&M Subtotal*** | ***$31,150,000*** | ***$66,540,000*** |
| | | |
| **Grand Total** | **$171,770,000** | **$299,260,000** |
| **Unit Water Cost ($/AF)** | **$1,071** | **$1,113** |

(a) Notes:
(a) Net present costs are shown.
(b) Construction costs are fully burdened with contingency and engineering & administration costs.
(c) Phase I = 2018 – 2040; Total Project = 2018 – 2067.

### 7.4.4 Alternative 10C

Alternative 10C is located the farthest east from Littlerock Creek. Although no additional distance was required from Air Force Plant 42 and nitrate plume, this alternative was placed farther east in order to utilize a location in which approximately 35% of the land is owned by LACSD for its proposed Effluent Management area.

**SWP Turnout:** A new 42-cfs turnout would be constructed at the intersection of the aqueduct and 87$^{th}$ Street or 106$^{th}$ Street.

**Groundwater Basin(s):** The alternative recharges the Lancaster sub-basin.

**Recharge Site:** The project area's perimeter is comprised of 100$^{th}$ Street to the west, East Avenue L to the north, and 105$^{th}$ Street to the east. The area extends approximately 0.5 miles south of

East Avenue L. The sizing and configuration of the recharge site is the same as Alternatives 10A and 10B.

**Raw Water Conveyance:** The raw water supply is proposed to be conveyed from the new turnout either (1) 7.9 miles north along 87th/90th Street, 1.5 miles east across Avenue N, then 1.5 miles north along 105th Street, or (2) 9.0 miles north along 106th/105th Street. The westerly (90th Street) alignment involves 9.9 miles of 30-inch and 1.5 miles of 36-inch pipeline. The easterly (105th Street) alignment requires 7.5 miles of 30-inch and 1.5 mile of 36-inch pipeline. Although the westerly (90th Street) alignment is 1.9 miles longer, it is also closer the District's distribution system for the delivery of potable extraction water.

**Recycled Water Conveyance:** The recycled water is proposed to be supplied from LACSD's existing pipeline along Avenue N to a turn-out delivering recycled water to the combine raw water and recycled water pipeline along 105th Street described above.

**Recovery Wells:** This alternative requires 16 recovery wells at buildout, all with a capacity of 1,200 gpm in the Lancaster sub-basin. Two of the wells are spares. The wells are located 4,500 feet from the center of the recharge site in a radial pattern. The first phase of the project requires 8 wells in the Lancaster sub-basin. The remaining 8 wells would be constructed in the second phase of the project. The piping for the first phase is sized, and upsized where necessary, to deliver water from the wells in both phases to the storage reservoir. This alternative has two possible locations for the distribution site, and as a result there are two piping system layouts. The well layout and approximate pipe length for each piping system layout is the same for each location of the distribution site. The approximate length of pipe required by diameter and phase of the project is shown in Table 7-26.

Table 7-26: Alternative 10C Recovery Wells Piping Requirements

| Pipe Diameter (in) | Phase 1 Pipe Length (ft) | Phase 2 Pipe Length (ft) |
|---|---|---|
| 10 | 3,400 | 6,300 |
| 12 | 3,400 | 0 |
| 16 | 4,400 | 0 |
| 20 | 11,000 | 0 |
| 24 | 6,300 | 0 |

**Land Acquisition:** The entire 160-acre recharge site is located north of LAWA property and must be purchased from private property owners. However, approximately 35% of this area has been acquired by the LACSD for its Effluent Management area, and may be acquired from them.

**Distribution Site Location:** The 1-million gallon head tank and pump stations may be located on their own 1-acre parcel either at the southwest corner of the project area at the intersection of East Avenue M and 100th Street, lying at an elevation of 2,546 feet, or the southeast corner at the intersection of East Avenue M and 105th Street, lying at an elevation of 2,550 feet.

Potable Water Distribution Pump Station: The distribution system pipeline is proposed to be a 30-inch alignment running from either the west alignment of the east alignment. The west alignment requires 1.0 mile west along East Avenue M, 4.6 miles south from 90th Street, then 3.0 miles west via Palmdale Boulevard. The east alignment requires 4.6 miles south along 105th Street then 4.6 miles west along Palmdale Boulevard. The specific characteristics of both alternatives, including ultimate demands, are located on Table 7-27 and Table 7-28.

**Raw Water Pump Station:** The optional raw water pump station for pumping back to the East Branch would be located adjacent to the distribution system head tank and discharge back into the 30-inch diameter raw water pipeline. A set of valves on the raw water pipeline would allow recharge or pump-back. The specific characteristics of both locations of this pump station are also located on Table 7-27 and Table 7-28.

**Costs:** Table 7-29 presents the cost estimate for Alternative 10C west. Net present costs are provided for Phase I, which is from 2018 to 2040, and the total project planning horizon, which is from 2018 to 2067.

Table 7-27: Alternative 10C West Pump Station Characteristics

| | Distribution System | Distribution System (Ultimate) | Raw Water System |
|---|---|---|---|
| Demand (AF/yr) | 14,125 | 24,250 | 24,250 |
| Flow (gpm) | 8,758 | 15,035 | 15,035 |
| Diameter (in) | 30 | 30 | 30 |
| Full Flow Velocity, (fps) | 4.0 | 6.8 | 6.8 |
| Length (mi) | 8.6 | 8.6 | 9.9 |
| Pump Station Elevation (ft) | 2,546 | 2,546 | 2,546 |
| Static HGL (ft) | 2,800 | 2,800 | 2,940 |
| Static Head (ft) | 254 | 254 | 394 |
| Head Loss[a] (ft) | 70 | 191 | 220 |
| TDH (ft) | 324 | 445 | 614 |
| Pump Capacity (gpm) | 3,000 | 2,500 | 3,000 |
| Required HP | 307 | 351 | 581 |
| Motor Size (HP) | 400 | 400 | 600 |
| Number of Pumps | 3+1 | 6+1 | 5+1 |

(a) Note:
(a) Hazen-Williams roughness constant estimated to be 135.

Table 7-28: Alternative 10C East Pump Station Characteristics

| | Distribution System | Distribution System (Ultimate) | Raw Water System |
|---|---|---|---|
| Demand (AF/yr) | 14,125 | 24,250 | 24,250 |
| Flow (gpm) | 8,758 | 15,035 | 15,035 |
| Diameter (in) | 30 | 30 | 30 |
| Full Flow Velocity, (fps) | 4.0 | 6.8 | 6.8 |
| Length (mi) | 9.2 | 9.2 | 8.5 |
| Pump Station Elevation (ft) | 2,550 | 2,550 | 2,550 |
| Static HGL (ft) | 2,800 | 2,800 | 2,940 |
| Static Head (ft) | 250 | 250 | 390 |
| Head Loss[a] (ft) | 75 | 204 | 188 |
| TDH (ft) | 325 | 454 | 578 |
| Pump Capacity (gpm) | 3,000 | 2,500 | 3,000 |
| Required HP | 308 | 358 | 548 |
| Motor Size (HP) | 400 | 400 | 600 |
| Number of Pumps | 3+1 | 6+1 | 5+1 |

(a) Note:
(a) Hazen-Williams roughness constant estimated to be 135.

Table 7-29: Alternative 10C West Cost Estimate

| | Phase I Net Present Costs | Total Net Present Costs |
|---|---|---|
| Turnout | $790,000 | $790,000 |
| Recharge Pipelines | $23,130,000 | $23,130,000 |
| Recharge Basin Construction | $9,000,000 | $9,000,000 |
| Recharge Basin Land Acquisition | $1,100,000 | $1,100,000 |
| Recovery Wells | $15,110,000 | $24,810,000 |
| Well Collection Pipelines | $8,130,000 | $8,760,000 |
| Pump Station | $5,040,000 | $7,460,000 |
| Reservoir | $1,180,000 | $1,180,000 |
| Chlorination Facilities | $390,000 | $390,000 |
| Distribution Pipelines | $21,440,000 | $21,440,000 |
| ***Facilities Subtotal*** | ***$85,310,000*** | ***$98,060,000*** |
| | | |
| ***SWP Table A Water Purchase*** | ***$0*** | ***$25,590,000*** |
| | | |
| SWP Water Purchase | $46,840,000 | $88,630,000 |
| Recycled Water Purchase | $9,560,000 | $21,530,000 |
| ***Water Purchase Subtotal*** | ***$56,400,000*** | ***$110,160,000*** |
| | | |
| Power Costs | $25,400,000 | $54,090,000 |
| O&M Costs | $5,360,000 | $11,880,000 |
| ***O&M Subtotal*** | ***$30,760,000*** | ***$65,970,000*** |
| | | |
| **Grand Total** | **$172,470,000** | **$299,780,000** |
| **Unit Water Cost ($/AF)** | **$1,075** | **$1,115** |

(a) Notes:
(b) Net present costs are shown.
(c) Construction costs are fully burdened with contingency and engineering & administration costs.
(d) Phase I = 2018 – 2040; Total Project = 2018 – 2067.

Table 7-30 presents a summary of the net present costs for each alternative.

Table 7-30: Alternatives Net Present Cost Summary

| Alternative | Facility Costs ($) | SWP Table A Water Costs ($) | Water Purchase Costs ($) | O&M Costs ($) | Total Costs ($) | Unit Cost ($/AF) |
|---|---|---|---|---|---|---|
| 9R | $96,170,000 | $25,590,000 | $110,160,000 | $66,590,000 | $298,510,000 | $1,110 |
| 10A | $91,300,000 | $25,590,000 | $110,160,000 | $65,990,000 | $293,040,000 | $1,090 |
| 10B | $96,970,000 | $25,590,000 | $110,160,000 | $66,540,000 | $299,260,000 | $1,113 |
| 10C | $98,060,000 | $25,590,000 | $110,160,000 | $65,970,000 | $299,780,000 | $1,115 |

(a) Notes:
(b) Net present costs are shown.
(c) Construction costs are fully burdened with contingency and engineering & administration costs.

## 7.5 Refined Alternatives Evaluation

Included herein are the four most favorable alternatives as recommended by Kennedy/Jenks. Each is described as it relates to the evaluation criteria.

### 7.5.1 Alternative 9R

The original Alternative 9 is within approximately 0.2 miles of Littlerock Creek, limiting the location of the recovery wells that meet the setback distance, required to comply with regulatory travel time requirements. As such, Alternative 9R was shifted slightly to the northeast to increase the distance from the creek while maintaining 50% of its recharge area over each of the Buttes and Lancaster sub-basins. Although moving Alternative 9R further northeast is an option, this would place the recharge area within the flight path of Air Force Plant 42, which is not advisable.

The Buttes sub-basin is shallower than the Lancaster sub-basin and has a lower hydraulic conductivity. As such, recovery wells placed within this sub-basin are estimated to produce half the capacity as wells within the Lancaster sub-basin. According to groundwater modeling results, if the site were to be located completely in the Buttes sub-basin, then the recharge basin would be susceptible to mounding. This aspect of the Buttes sub-basin combined with the lessening of possible recovery well capacities requires the alternative to straddle both basins. In addition, because there are very few existing wells in the Buttes sub-basin, there is little available information to characterize the groundwater in the area. Such unknowns produce a level of uncertainty paired with the sub-basin.

The recharge area is characterized by native scrub vegetation and is a more likely habitat for sensitive species. Furthermore, the northern region of the site contains a cultural resource noted as an isolated well cement cover, which provides evidence of possible past agricultural use and cultural significance. The elevations range from a peak elevation of approximately 2,574 feet to 2,529 feet sloping toward the northwest. This range in elevations is amenable to construction of recharge basins using a balanced cut and fill approach.

This alternative lies approximately 2.45 miles from the nitrate plume. Although this site is farther than Alternative 10A, there may be related concerns regarding the possible effect of the nitrate plume on future water quality. Similarly, the site is within the 5-mile buffer consigned by the FAA for the airport. Within this zone, the project would be required to take precautions against attracting any wildlife that could cause a bird strike. Such additional precautions may increase the capital and operating costs of the project.

The project area is contained within LAWA property. Utilizing land that is already owned by another institution may be advantageous because of public acceptance is streamlined as no new parties can acquire land in the area. Conversely, coordination with LAWA for the land would be required. Discussions would most likely conclude in a long-term lease agreement via a memorandum of understanding (MOU) for the property at a rate and time frame to be negotiated, could burden the alternative with additional risk as well as property acquisition issues.

The distribution system for this alternative is expected to be the second smallest of the alternatives. Its southwesterly location proves an advantage with regard to distribution piping, allowing for the total pipe length for both raw water and distribution pumping systems to be a combined 14.6 miles. The advantages and disadvantages of the system are reflected in the alternative's total cost.

Details pertaining to the evaluation criteria are defined below.

1) **Total Cost:** The total net present cost is $170,190,000 for Phase I and $298,510,000 for the total project, which makes Alternative 9R more expensive than Alternative 10A, but less expensive than Alternatives 10B and 10C.

2) **Unit Water Cost:** The unit water cost for this location has been estimated to be $1,110/AF, which is comparable to the other alternatives.

3) **Recharge and Recovery Capacity:** This alternative requires an additional four wells compared to Alternatives 10A through 10C. As such, it has received a lower but moderate score.

4) **Recovery Water Quality:** The proximity to the nitrate plume is greater than Alternatives 10B and 10C, but less than Alternative 10A. As such, Alternative 9R receives a greater score than Alternative 10A but less than the other two.

5) **Environmental Impact:** The environmental concerns and cultural evidences give Alternative 9R a higher risk for environmental and cultural obstacles, granting a lower score for Environmental Sensitivity.

6) **Implementation Risk and Uncertainty:** The placement of the alternative in the Buttes sub-basin casts some uncertainty in its design due to the lack of information available for the sub-basin. Also, the proximity to the nitrate plume creates a level of uncertainty in future water quality, granting it a lower score comparatively.

7) **Property Acquisition:** The location within LAWA property is less preferable than a property the District may own, giving it a lower score.

8) **Institutional Issues:** Projected issues stem from the recharge area's proximity to Air Force Plant 42, creating concerns with the FAA and wildlife entities. As such, this alternative has been given a low score due to higher probability of institutional issues.

9) **Public Acceptance:** This alternative is expected to be more accepted publicly due to the inability of the public to use the land from LAWA, granting it a high score.

### 7.5.2 Alternative 10A

Alternative 10A is the most similar to the original Alternative 10 in location, but has been moved east away from Littlerock Creek. The close proximity of Alternative 10 to the creek creates a concern with environmental sensitivity. Furthermore, the proximity to the creek also included institutional and permitting issues, specifically with the USACE and CDFW. As such, Alternative 10's location was adjusted to Alternative 10A in order to accommodate the specified concerns as well as provide space to the west for the required groundwater travel time between the recovery wells and the recharge area without placing any wells to the west of the creek. The change in location also increases the distance of the recharge area from the Air Force Plant 42 Airport and nitrate plume.

Alternative 10A is located completely within the Lancaster sub-basin. This sub-basin is the most widely used for groundwater production and is deeper than Buttes or Pearland sub-basins. As such, the recovery wells in this sub-basin are expected to achieve 1,200 gpm, which requires fewer wells to be installed than Alternative 9R, saving the project in capital cost and land acquisition. For the radial well layout, the projected subsidence for Alternative 10A after 20 years is estimated to be 0.10 foot for 10 of the 15 wells, which is essentially negligible.

The recharge area is characterized by scrub vegetation that is not expected to contain sensitive species and is considered one of the least constrained alternatives both environmentally and culturally. The northwestern region of the site contains two locations that are considered developed, which appear to be homes. According to the 2014 percolation tests, the average infiltration rates are 2.2 feet per day (fpd) in the northern region and 6.0 fpd in the southern region. Values of approximately 2 fpd are considered to be good; equal or greater than 4 fpd are considered to be excellent. The elevations range from a peak elevation of approximately 2,501 feet to 2,473 feet sloping toward the northwest. This range in elevations is amenable to construction of recharge basins using a balanced cut and fill approach.

At approximately 1.9 miles, this alternative is farther from the nitrate plume than the Preliminary Alternative 10 but still remains within an area of influence. According to the most recent groundwater modeling performed by Kennedy, the nitrate plume is estimated to potentially reach the recharge area in 20 years, causing future water quality issues. Its location also lies within the five-mile buffer zone prescribed by the FAA. Like Alternative 9R, being within the buffer zone will force the project to include wildlife precautions which may increase capital and operating costs.

This alternative lies outside of the LAWA property but contains two homes. The area is nearly completely owned by private property owners, which could complicate land acquisition and public acceptance.

The distribution system for this alternative is expected to be the smallest of the three alternatives (10A, 10B, and 10C). Its westerly location and close proximity to 70$^{th}$ Street proves to be an advantage with regard to piping, allowing for the total pipe length for both raw water and distribution systems to be a combined 14.3 miles. However, the requirement of a taller head tank in order to accommodate the low elevation of the site may result in increased expense for the head tank and reduced operational flexibility. The advantages and disadvantages of the system are reflected in the alternative's total cost.

Details as pertaining to the evaluation criteria are defined below.

1) **Total Cost:** The total net present cost is $166,130,000 for Phase I and $293,040,000 for the total project, which is the lowest estimate of the four alternatives.

2) **Unit Water Cost:** The unit water cost for this alternative is $1,090/AF, which is comparable to the other alternatives.

3) **Recharge and Recovery Capacity:** This alternative provides PWD's ultimate water demand with 16 wells compared to the 21 required by Alternative 9R, granting a higher score.

4) **Recovery Water Quality:** Alternative 10A is situated closest to the nitrate plume, giving it the lowest score of the four.

5) **Environmental Impact:** This alternative is considered one of the least constrained with no considerable cultural or biological risks.

6) **Implementation Risk and Uncertainty:** There is a certain level of uncertainty for future water quality due to project's proximity to the nitrate plume. Furthermore, there is a slight risk associated with the amount of subsidence the wells are expected to encounter, albeit only 0.10 feet after 20 years.

7) **Property Acquisition:** Although the project is placed outside of LAWA property, the property in question is owned almost completely by private owners, including two homes. As such, property acquisition is expected to be moderately difficult for this alternative.

8) **Institutional Issues:** The project area lies within the five-mile flight zone prescribed in the Federal Aviation Administration FAA's 2007 WAAC, granting a lower score.

9) **Public Acceptance:** Since this alternative lies within private property, there may be issues with the current property owners.

### 7.5.3 Alternative 10B

Alternative 10B is a modification of Alternative 10A that has been moved farther east from Littlerock Creek. Although Alternative 10A was placed the required distance away from the creek for the recovery wells to remain east of the creek, it remained within the affected area of the nitrate plume as well as the five mile buffer from the Air Force Plant 42. Alternative 10B resolves these issues over Alternative 10A. This alternative is nearly a duplicate of Alternative 10A with regard to capacity and environmental, but is no longer influenced by the airport or nitrate plume.

Alternative 10B is also located completely within the Lancaster sub-basin. As such, the recovery wells in this sub-basin are expected to achieve 1,200 gpm, which allows for fewer to be installed than Alternative 9R, saving the project in the area of capital cost and land acquisition, while remaining comparable to 10A. For the radial well layout, the projected subsidence for Alternative 10B is estimated to be 0.10 foot for 4 of the 16 wells, which creates less risk than that of 10A.

The recharge area is characterized by scrub vegetation and is considered unconstrained both environmentally and culturally. However, the southern region of the site contains suitable habitat for the Mohave ground squirrel and a historical record of its presence. According to the percolation tests, the average infiltration rate is 9.4 feet per day in the northern region but the southern region has not been measured. The elevations range from a peak elevation of approximately 2,535 feet to 2,501 feet sloping toward the northwest. This range in elevations is amenable to construction of recharge basins using a balanced cut and fill approach.

This alternative lies outside of the LAWA property, lies outside the 5-mile flight zone, and contains only agricultural property. The area is nearly completely owned by private property owners, which could make land acquisition more difficult, although not to the extent as Alternative 10A. Furthermore, the LACSD's proposed future Effluent Management area encompasses the site in question, although few parcels have been purchased to date. Being within areas that the LACSD has already acquired will make land acquisition less difficult as well as bolster public acceptance since the land is already taken and expected to be used for similar purposes as the LCGRRP.

The distribution system for this alternative is larger than Alternatives 9R and 10A, but less than Alternative 10C. Its northeasterly location proves a disadvantage in regard to distribution piping, causing the total pipe length for both raw water and distribution systems to be a combined 16.5 miles. The advantages and disadvantages of the system are reflected in the alternative's total cost.

This alternative's relation to the evaluation criteria is outlined below.

1) **Total Cost:** The total net present cost is $171,770,000 for Phase I and $299,260,000 for the total project, which is higher than Alternatives 9R and 10A, but lower than Alternative 10C.

2) **Unit Water Cost:** The unit water cost for this alternative is $1,113/AF, which is comparable to the other alternatives.

3) **Recharge and Recovery Capacity:** The capacity is the same as Alternative 10B. However, this location is expected to have a higher infiltration rate than Alternative 10A, granting a higher score than both Alternatives 9R and 10A.

4) **Recovery Water Quality:** Alternative 10B lies a considerable distance away from the nitrate plume, which should provide enough of a buffer to no longer be considered a concern.

5) **Environmental Impact:** This alternative is expected to have less of an impact than Alternative 9R, but due to the possible presence of the Mohave ground squirrel, may have a higher environmental impact than Alternative 10A. As such, the scoring for this criterion is between the two.

6) **Implementation Risk and Uncertainty:** A level of uncertainty lies with the environmental impacts due to the MGS. In the case that the squirrel is encountered, there may be some regulatory obstacles to overcome. Also, the lack of percolation information for the southern

portion of the project area also provides a level of uncertainty, though not to the extent as the lack of information for the Buttes basin in Alternative 9R.

7) **Property Acquisition:** The location does not contain any homes and lies outside of the LAWA property with some minor land owned by LACSD. As such, property acquisition is expected to be less difficult than Alternatives 9R or 10A.

8) **Institutional Issues:** The recharge basins for the site are located outside of the five-mile flight zone. As such, no institutional issues are expected.

9) **Public Acceptance:** In terms of land acquisition, the project area is located across private property with no homes. Although the alternative lies within the LACSD Effluent Management area, the LACSD has not acquired much land this far west. As such, the scoring for this criterion is similar to Alternative 10A but slightly higher without having to purchase two existing homes.

### 7.5.4 Alternative 10C

Alternative 10C is located the farthest east from Littlerock Creek. Although Alternative 10B was placed the required distance away from the creek, nitrate plume, and airport, another alternative has been provided in order to utilize the land for the LACSD's Effluent Management area. This alternative is nearly identical to Alternative 10B with regard to capacity and general environment.

Alternative 10C is also located completely within the Lancaster sub-basin. As such, the recovery wells in this sub-basin are expected to achieve 1,200 gpm, which allows for fewer to be installed than Alternative 9R, saving the project in the area of capital cost and land acquisition, while remaining comparable to Alternatives 10A and 10B. For the radial well layout, the projected subsidence for Alternative 10A after 20 years is estimated to be 0.10 foot for 2 of the 16 wells.

With no remarks regarding cultural or environmental impacts, the recharge area is considered one of the least constrained in both aspects. According to the 2014 percolation tests, the average infiltration rate is 9.4 feet per day in the northern region and 12 feet per day in the southern region. The elevations range from a peak elevation of approximately 2,550 feet to 2,515 feet sloping toward the northwest. This range in elevations is amenable to construction of recharge basins using a balanced cut and fill approach.

This alternative lies completely outside of the LAWA property as well as the FAA five-mile buffer zone and contains only agricultural property. Approximately 65% of the land is owned by private property owners, but approximately 35% of the land has been acquired for the LACSD's Effluent Management area. Being within areas that the LACSD has already acquired will make land acquisition less difficult as well as bolster public acceptance since the land is already taken and expected to be used for similar purposes as the LCGRRP.

Although the distribution system for this alternative has the optimal elevation of all the alternatives, its pipeline is longer than the all the other alternatives. Its northeasterly location proves a disadvantage in regard to distribution piping, causing the total pipe length for both raw water and distribution systems to be a combined 18.5 miles if the western distribution site location is chosen and 17.7 miles if the eastern site is chosen. The advantages and disadvantages of the system are reflected in the alternative's total cost.

This alternative's relation to the evaluation criteria is outlined below.

1) **Total Cost:** The total net present cost is $172,470,000 for Phase I and $299,780,000 for the total project, which is the highest total cost for the four alternatives.

2) **Unit Water Cost:** The unit water cost for this alternative is $1,115/AF, which is comparable to the other alternatives.

3) **Recharge and Recovery Capacity:** The capacity is the same as Alternatives 10A and 10B. This alternative has the most information regarding the percolation rate as well as the highest rate among the four alternatives, granting it the highest score of the four.

4) **Recovery Water Quality:** Alternative 10C lies the farthest from the nitrate plume, eliminating the plume as a concern.

5) **Environmental Impact:** This alternative is considered the least constrained.

6) **Implementation Risk and Uncertainty:** Although there is always some level of uncertainty, the location of this alternative within the LACSD Effluent Management area and distance from the nitrate plume with no environmental or cultural concerns allows a considerable amount of confidence compared to the other alternatives. In addition, the sub-regional groundwater model showed essentially no subsidence after 20 years, and the lowest values compared to the other alternatives.

7) **Property Acquisition:** This alternative has been placed outside of LAWA property. However, the alternative location lies closer to the LACSD Effluent Management area and 35% of the area is already owned by LACSD, which should lessen the difficulty of land acquisition.

8) **Institutional Issues:** This project area is out of the five-mile flight zone prescribed by the FAA.

9) **Public Acceptance:** Since this alternative lies within the LACSD Effluent Management area, the public is likely to already expect the land to be used by a public entity for similar purposes. As such, this location is likely to have one of the highest public acceptance scores.

### 7.5.5 Alternatives Scoring

The weighted scoring matrix for the final four alternatives is provided in Table 7-31. The ranking matrix summary is provided as Table 7-32.

**Table 7-31: Ranking Matrix Summary**

| Alternative | Total Weighted Score | Ranking |
|---|---|---|
| 9R | 3.09 | 4 |
| 10A | 3.20 | 3 |
| 10B | 4.27 | 2 |
| 10C | 4.82 | 1 |

## Table 7-32: Final Four Alternatives Scoring and Ranking

| | | | Alternative 9R | | | Alternative 10A | | | Alternative 10B | | | Alternative 10C | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Criteria** | **Weight** | **Scoring Description** | **Score** | **Weighted Score** | **Comment** | **Score** | **Weighted Score** | **Comment** | **Score** | **Weighted Score** | **Comment** | **Score** | **Weighted Score** | **Comment** |
| Total Cost | 15% | 1 - 5 (Best) | 4.91 | 0.7 | $298,510,000 | 5.00 | 0.8 | $293,040,000 | 4.90 | 0.7 | $299,260,000 | 4.89 | 0.7 | $299,780,000 |
| Unit Water Cost | 15% | 1 - 5 (Best) | 4.91 | 0.7 | $1,110 | 5.00 | 0.8 | $1,090 | 4.90 | 0.7 | $1,113 | 4.89 | 0.7 | $1,115 |
| Recharge and Recovery Capacity | 15% | 1 - 5 (Best) | 3.75 | 0.6 | Buttes and Lancaster Basin | 5.00 | 0.8 | Lancaster Basin | 5.00 | 0.8 | Lancaster Basin | 5.00 | 0.8 | Lancaster Basin |
| Recovery Water Quality | 10% | 1 - 5 (Best) | 2 | 0.2 | Moderate Proximity to Nitrate Plume | 0 | 0.0 | Expected Contact to Nitrate Plume | 5 | 0.5 | No Contact with Nitrate Plume | 5 | 0.5 | No Contact with Nitrate Plume |
| Environmental Impact | 10% | 1 - 5 (Best) | 3 | 0.3 | Largely unconstrained - contains suitable habitat and cultural resource | 4 | 0.4 | Least Consrained | 3 | 0.3 | Largely Unconstrained - Contains Suitable Habitat for MGS | 5 | 0.5 | Least Constrained |
| Implementation Risk and Uncertainty | 10% | 1 - 5 (Best) | 1 | 0.1 | Least Known about Buttes Basin, proximity to Plume | 2 | 0.2 | Proximity to Plume | 2 | 0.2 | MGS Possibility | 4 | 0.4 | |
| Property Acquisition | 10% | 1 - 5 (Best) | 1 | 0.1 | Lease or MOU | 2 | 0.2 | Property ownership, two homes on site | 4 | 0.4 | Property ownership, very little LACSD Effluent Management | 5 | 0.5 | Property ownership, 35% LACSD Effluent Management |
| Institutional Issues | 10% | 1 - 5 (Best) | 1 | 0.1 | Airport Proximity | 1 | 0.1 | Airport Proximity | 5 | 0.5 | Outside FAA Zone | 5 | 0.5 | Outside FAA Zone |
| Public Acceptance | 5% | 1 - 5 (Best) | 5 | 0.3 | LAWA property | 1 | 0.1 | All Private Property, Presence of Homes | 3 | 0.2 | Mostly Private Property, Little LACSD | 4 | 0.2 | 65% Private Property, 35% LACSD, within Effluent Management |
| **Total** | **100%** | **5** | | **3.09** | | | **3.20** | | | **4.27** | | | **4.82** | |
| **Rank** | | | | **4** | | | **3** | | | **2** | | | **1** | |

**Table 7-33: Transmission Piping Hydraulic Calculations (Using Hazen-Williams)**

| Pipeline | Description | Length (ft) | Maximum Flow (cfs) | Begin Elevation (ft) | End Elevation (ft) | Pump Head (ft) | Recommended Pipe Size (in) | Velocity (fps) | Friction Head Loss (ft) | Minor Head Loss (ft) | End HGL (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Raw Water/Return Water | Aqueduct to Pump Station | 45,200 | 50 | 2939 | 2554 | 0 | 36 | 7.1 | 165 | 18 | 2756 |
| | Pump Station to Aqueduct | 45,200 | 41.4 | 2550 | 2943 | 526 | 36 | 5.8 | 119 | 14 | 2943 |
| Potable Water | Pump Station to PWD POC (Phase 1) | 48,600 | 26.2 | 2567 | 2624 | 369 | 30 | 5.3 | 130 | 6 | 2800 |
| | Pump Station to PWD POC (Phase 2) | 48,600 | 33.4 | 2567 | 2624 | 445 | 30 | 6.8 | 204 | 8 | 2800 |
| Recycled Water | POC to Distribution Box (RIPs to Ponds) | 530 | 22.2 | 2586 | 2541 | 0 | 30 | 4.5 | 1 | 1 | 2584 |
| | POC to Distribution Box (Ponds to RIPs) | 530 | 22.2 | 2560 | 2541 | 0 | 30 | 4.5 | 1 | 1 | 2558 |
| Combined Recharge Supply | Distribution Box to Splitter Box | 3,000 | 72 | 2541 | 2535 | 0 | 48 | 5.8 | 5 | 1 | 2535 |

# CHAPTER 8

# EVALUATION OF BEST ALTERNATIVE (10C)

Based on the screening of the original preliminary 10 alternatives, the best two preliminary alternatives (Alternatives 9 and 10) were identified. In turn, Alternative 9 was refined and Alternative 10 was expanded to include three different options (A, B, and C), resulting in the final four refined alternatives: 9R, 10A, 10B, and 10C. Evaluation of the four refined alternatives resulted in the identification of the best the alternative for further consideration, which is Alternative 10C.

## 8.1 Proposed Facilities

### 8.1.1 Preliminary Design Criteria

Upon completion of the Preliminary Alternative/Feasibility Study (included in FAAST PIN # 30947 as Attachment C), which evaluated ten site locations and further evaluated four refined alternatives, the Preliminary Design Report (included in FAAST PIN # 30947 as Attachment T1) for the selected Alternative 10C was undertaken. Further refinement of the design criteria resulted in the following:

**Pipelines: Raw Water/Return Water Pipeline (8.6 miles of 36-inch diameter pipeline):** The Raw Water/Return Water Pipeline is approximately 8.6 miles in length and will connect the Distribution Site with the East Branch of the California Aqueduct at the proposed SWP Turnout. The 36-inch diameter pipeline will travel north along 105th Street East from the SWP Turnout for approximately 2.3 miles. It will then traverse west along East Avenue S for approximately 0.1 mile, and then north along 105th Street East for approximately 1.5 miles to the terminus of 105th Street East at East Palmdale Boulevard. The Raw Water/Return Water Pipeline will continue north from the intersection of 105th Street East and East Palmdale Boulevard, along the future 105th Street East alignment through undeveloped land for approximately 4.7 miles to connect with the Distribution Site. At the Distribution Site, raw water will flow through the proposed hydro-turbine, and return water can be pumped back to the California Aqueduct through the RWPS. Raw water flowing through the hydro-turbine or by-passing the turbine, will flow by gravity from the Distribution Site through the Combined Recharge Supply Pipeline the last 0.6 mile to the Recharge Site.

- **Potable Water Pipeline (9.2 miles of 30-inch diameter pipeline):** The Potable Water Pipeline includes construction of a 30-inch diameter pipeline that originates at the PWPS and proceeds south along the same alignment as the Raw Water/Return Water Pipeline, and then traverses west along East Palmdale Boulevard, until 60th Street East.

- **Recycled Water Pipeline (0.1 mile of 30-inch diameter pipeline):** The Recycled Water Pipeline includes the construction of a 30-inch diameter pipeline that will connect to an existing LACSD 48-inch diameter recycled water pipeline at the intersection of 105th Street East and East Avenue M. The proposed 30-inch diameter Recycled Water Pipeline will traverse north and west for approximately 0.1 mile to a Distribution Box on the Distribution Site where the recycled water will flow by gravity through the Combined Recharge Supply Pipeline the last 0.6 mile to the Recharge Site.

**SWP Turnout:** The new 50-cubic foot/second (cfs) SWP Turnout will be located at the intersection of the East Branch of the California Aqueduct and 106th Street East. The proposed turnout will connect to the side of the Aqueduct with a 36-inch diameter pipeline, and water will flow through the pipeline into an underground metering vault adjacent to the Aqueduct, before traveling north to the Recharge Site.

**Hydro-turbine and Pressure Reducing Valves:** The proposed dual-nozzle Turgo turbine accommodates flows as low as 10 cfs and as high as 40 cfs, with corresponding net heads as high as 371 feet and as low as 268 feet, respectively. The maximum expected system output at 40 cfs for the turbine is 770 kilowatts (kW). In order to evaluate the potential of the hydropower project, turbine cost benefits were calculated. The current average energy cost of $0.14/kWh was used in the analysis.

**Recharge Site:** The Recharge Site is 160 acres with four 20-acre cut-and-fill earth embankment recharge basins with shotcrete-lined interior slopes. The basins will occupy approximately 100 acres in the center of the 160-acre Recharge Site and provide 80 acres of basin floor for infiltration. With a perimeter access road around the toe of the recharge basin berms, approximately 110 acres will be fenced. The design infiltration rate based on limited field testing is 3 feet/day.

The Splitter Box, which has four chambers, will receive water from the Distribution Box and allow it to flow by gravity out the chamber(s) with opened sluice gates to each of four respective recharge basins.

**Recovery Wells:** The project will include 16 Recovery Wells occurring in two phases with all wells having a target capacity of 1,200 gallons per minute (gpm). Recovery Wells will be configured in a radial pattern surrounding the Recharge Site, located on a 1.5-mile by 1.5- mile square, centered around the Recharge Site. The Recovery Wells are set back 0.5 miles on each side of the Recharge Site to provide greater than six months of travel time, as required by the State Water Resources Control Board (SWRCB) Division of Drinking Water (DDW), for recycled water traveling from the recharge basins to the Recovery Wells. A Well Collection Pipeline will connect the Recovery Wells to the Distribution Site. The piping for Phase 1 is sized for ultimate capacity and is located either in existing or future street alignments. The Phase 1 Well Collection Pipeline will include approximately 5.7 miles of 12-, 16-, 20-, 24- and 36-inch diameter pipelines, with the remaining 0.3 miles of 12-inch diameter pipeline to be constructed at the same time as the Phase 2 Recovery Wells.

**Distribution Site and Chlorination System:** The 1-million-gallon Storage Tank and Pump Station Building (with chlorination facilities) will be located on a 2-acre parcel approximately 0.5 mile south of the recharge basins, at the northwest corner of the intersection of Avenue M and 105$^{th}$ Street East. This system's primary purpose is to generate, store, and deliver the chlorine used for disinfection of the potable water produced by the Recovery Wells.

**Storage Tank:** Groundwater that is to meet potable water requirements is pumped into the Storage Tank. The purpose of the Storage Tank is threefold:

1) **Disinfection:** Chlorine, which is generated on-site in the form of sodium hypochlorite, is injected into the 30-inch diameter tank inlet. The Storage Tank is sized, and the inlet and outlet pipes are designed to meet the required chlorine contact time for disinfection.

2) **Pump Can Pressurization:** The water level of the Storage Tank provides static head, and therefore pressurization, of the pump cans for the PWPS vertical turbine pumps in the Pump Station Building.

3) **Return Water Air Gap:** The water level of the Storage Tank provides sufficient head for the operation of the return water air gap piping, control valves, and structure that serve the RWPS wet well in the Pump Station Building.

**Potable Water Pump Station:** The Potable Water Pump Station will pump potable water from the Storage Tank to the District's distribution pipeline's point of connection to the 2800 Zone. The PWPS consists of 7 vertical turbine pumps, 2 of which are for future expansion.

**Return Water Pump Station:** The optional Return Water Pump Station is designed to accommodate water banking partners and will consist of a 6-pump system to pump un-disinfected potable water from the Well Collection Pipeline to the East Branch of the California Aqueduct. This RWPS will be located adjacent to the 1-million-gallon Storage Tank and discharge back into the 36-inch diameter Raw Water/Return Water Pipeline. It is not required for this pump station to be implemented until a water banking partnership is achieved.

### 8.1.2 Process Description

Water for groundwater recharge is obtained from two sources: raw water from the East Branch of the California Aqueduct and recycled water from the LACSD PWRP.

Raw water enters the 36-inch diameter transmission pipeline through a 50 cfs turnout in the East Branch of the California Aqueduct (SWP Turnout). Raw water passes through the sluice gate at the turnout entrance, into the transmission pipeline, and then passes through a magnetic flow meter and manual shut-off valve. The 36-inch diameter Raw Water/Return Water Pipeline continues 8.6 miles until reaching the Pump Station site, where the water enters the Hydroturbine Room. Water flows between 10 and 40 cfs enter the hydro-turbine to convert excess pressure head to electricity, and water flows below 10 cfs and above 40 cfs are bypassed completely through two parallel pressure reducing valves. Discharge from the hydro-turbine and pressure reducing valves combines into a single 36-inch diameter pipeline and flows into the Distribution Box.

Flow control for the raw water delivery is accomplished downstream in the Hydro-turbine Room using the two nozzles at the hydro-turbine when the hydro-turbine is in service, and using the two 16-inch diameter pressure-reducing valves (PRVs) with electronic actuated rate of flow control when the turbine is being by-passed.

Recycled water is obtained through a new 30-inch diameter outlet in the existing 48-inch diameter LACSD recycled water pipeline. Water flow is measured with a magnetic flow meter, modulated by a control valve, and limited from back-flowing with a check valve. The water flows by gravity to the Distribution Box, where is it combined with SWP Water, and potentially with blow-off water from the Recovery Wells and overflow water from the Storage Tank.

The combined recycled water and SWP Water exits the Distribution Box and flows by gravity 0.6 miles to the Splitter Box though a 48-inch diameter pipeline. The Splitter Box provides flow distribution to any or all of the four recharge basins. Four separate chambers are each equipped with 36-inch diameter sluice gates that deliver water through four independent 36-inch diameter pipelines to each basin inlet structure. Overflow weirs in the Splitter Box to each chamber provide equal flow distribution to all chambers with an open sluice gate. The sluice gates to Basins 1, 2, and 3 will be manually operated, while the sluice gate for Basin 4 will have a motor operator. Since Basin 4 cannot overflow to a successively lower basin, rather it overflows to the ground, the basin is equipped with a float switch that will signal the motor-operated sluice gate to close. If the water level in the Splitter Box exceeds normal operating levels, then it will flow into an overflow chamber and then into the first pipeline and to Basin 1.

The recharge basins are each designed with a recharge area of 20 acres and an operating water level of 2 feet. Basin 1 is nearest to the Splitter Box, while Basin 4 is the farthest, with Basin 2 and Basin 3 in between. Each basin has approximately a 2.5-foot elevation drop, so Basin 4 is the lowest elevation while Basin 1 is the highest. If the water level in Basins 1, 2, or 3 reaches 2.5 feet, then the water will begin flowing over an outlet weir to an outlet pipeline that joins the inlet pipeline for the adjacent down gradient basin.

To extract the groundwater, 8 Recovery Wells (for Phase 1) and 8 additional Recovery Wells, total 16 wells (for Phase 2), radially arranged, will discharge into the Well Collection Pipeline. The pipeline starts to the north of the recharge basins, with one side proceeding clockwise around the wells and the other counterclockwise, until combining at the Distribution Site; see drawing C34 in Volume 2. The Well Collection Pipeline begins as a 12-inch diameter pipeline and expands to 16-, 20-, and 24-inch diameter pipeline to account for the increased water flow from each Recovery Well. The two pipeline segments combine as a 36-inch diameter pipeline on the Distribution Site, where well RC-1 discharges directly into the 36-inch diameter pipeline.

Each Recovery Well has a small on-site blow-off pond for well startup. However, for operations that require longer blow-off periods, water can be routed through the Well Collection Pipeline until reaching the Distribution Site where it branches off the Well Collection Pipeline and enters the blow-off pipeline. The branches are located upstream of the convergence point between the east and west portions of the Well Collection Pipeline. This allows for either the east or west branch to be blown-off while the other branch remains in service. Wells located along the branch that is being blown-off will be temporarily shut off. Water in the blow-off pipeline is routed to the Distribution Box so that it can be recharged again.

When the extracted groundwater reaches the Distribution Site, potable water is chlorinated and pumped to the point of connection to the District's 2800 Zone. Return water can also be pumped back to the East Branch of the California Aqueduct. A tee at the end of the Well Collection Pipeline routes the groundwater to the Storage Tank through the 30-inch diameter tank inlet, with the option to direct a portion of the supply to the RWPS. Chlorine is normally added to the tank inlet for disinfection. If the Storage Tank is out of service, then a 36-inch diameter pipeline by-passes the tank and has a back-up chlorine injection point for disinfection. The Storage Tank outlet pipe connects to the PWPS, where 4-duty plus 1-spare pumps in Phase 1, expandable to 6-duty plus 1-spare pumps in Phase 2, pump the water 9.2 miles in the 30-inch diameter Potable Water Pipeline to the District's point of connection.

The RWPS conveys non-disinfected potable water to the East Branch of the California Aqueduct for use by potential partner agencies. Since the RWPS delivers water back through the same 8.6-mile 36-inch diameter Raw Water/Return Water Pipeline used to deliver SWP Water for recharge, the pipeline can only be used in one direction at a time. It is envisioned that recharge will occur roughly 6 normal and wet years out of 10 years, and that return pumping will occur roughly 4 dry years out of 10 years. When the non-disinfected potable water is pumped back through the RWPS, an air gap is necessary to provide cross-connection control to separate the Raw Water/Return Water Pipeline from the potable system. The air gap requires wet well storage for the RWPS pumps, which is provided by a rectangular cast-in-place concrete wet well sized to store a minimum of 75,000 gallons. This sizing provides approximately 10 minutes of operational storage for a single return water pump or 2 minutes for the maximum 5-pump flow.

The RWPS discharge header connection to the 36-inch diameter Raw Water/Return Water Pipeline connects the RWPS to the Hydro-turbine Room. Housed within the Hydro-turbine Room are two pressure relief valves and associated pipelines, which serve the dual purpose of providing by-pass capability to the hydro-turbine during recharge operations as well as pressure relief to the RWPS during pump back, negating the need for a pressure relief pipeline within the pump room for the RWPS.

### 8.1.3 Facility Sizing

The Raw Water/Return Water Pipeline is designed to convey up to 50 cfs (36,100 AF/yr) and the Recycled Water Pipeline is designed for an ultimate capacity of up to 22.2 cfs (16,100 AF/yr). Both water sources are combined in a Distribution Box at the Distribution Site, and water flows by gravity to the Recharge Site. The Distribution Box, Combined Recharge Supply Pipeline, and Splitter Box, are all sized to convey up to 52,200 AF/yr.

Groundwater is extracted by the Recovery Wells and delivered to a 1 MG Storage Tank at the Distribution Site. Potable water is pumped to the District's distribution system with a point of connection to the 2800 Zone at the intersection of 60th Street East and East Palmdale Boulevard. The Potable Water Pipeline is sized for an ultimate capacity of 33.5 cfs (24,250 AF/yr). Alternatively, the groundwater can be pumped back to the East Branch of the California Aqueduct through the Raw Water/Return Water Pipeline at up to 41.5 cfs (30,000 AF/yr).
Table 8-1 shows the design criteria.

Table 8-1: Facility Sizing Summary

| Facility | Unit | Preliminary Design |
|---|---|---|
| SWP East Branch Turnout | cfs | 50 |
| Raw Water/Return Water Pipeline Diameter | inches | 36 |
| Recycled Water Pipeline Diameter | inches | 30 |
| Combined Recharge Supply | inches | 48 |
| Potable Water Pipeline | inches | 30 |
| Maximum Recycled Water Delivery | AFY | 16,100 |
| Maximum SWP Delivery (PWD) | AFY | 31,300 |
| Maximum SWP Delivery w/Partners | AFY | 36,100 |
| Maximum Total Recharge | AFY | 52,200 |
| Recharge Site | acres | 160 |
| Recharge Basins | acres | 80 |
| Recovery Wells - Phase 1 | each | 8 |
| Recovery Wells - Total | each | 16 |
| Capacity of 16 Wells at 100% w/ No Spare | AFY | 30,970 |
| Storage Tank | MG | 1.0 |
| Potable Water Pump Station | AFY | 24,250 |
| Return Water Pump Station | AFY | 30,000 |

(a) cfs = cubic feet per second
(b) AFY = acre feet per year
(c) MG = million gallons
(d) gpm = gallons per minute

### 8.1.4 Cost Estimate

The preliminary (10 percent design level Opinion of Probable Construction Cost for the Project is $78.4 million without a contingency and in current dollars. With a 15 percent contingency, the Opinion of Probable Construction Cost increases to $90.2 million. For capital planning, 15 percent should be added for Engineering Design and Construction Management; thus, the total funding requirement is $103.7 million. This total is broken down into two phases: $85.3 million and $18.4 million as described below.

The detailed costs were broken out for each of 17 specification divisions. The Division 1 cost for mobilization/demobilization is assumed to be 7 percent of the total costs before the markups are applied. The following markups are assumed for the Opinion of Probable Construction Cost:

- Contractor's Markup on Subs: 10 percent
- Taxes (Los Angeles County): 9.00 percent
- Contractor's Overhead and Profit: 12 percent
- Contingency: 15 percent
- Escalation: 2 percent per year

The Opinion of Probable Construction Cost, which is based on the preliminary design, is a Class 4 in accordance with American Association of Cost Engineers. A Class 4 contains an assumed accuracy of +30 percent to -15 percent of the actual cost of the Project.

The Project phasing for each of the major infrastructure categories is summarized in Table 8-2. The cost estimate for the two phases of well drilling and installation, with 8 Recovery Wells in each phase, includes the construction of five temporary percolation ponds and use of temporary piping for step testing and constant rate testing of each well. If all 16 Recovery Wells are constructed in a single phase, then the temporary facilities would only be required once, and a savings of approximately $200,000 would be realized.

Table 8-2: Construction Phasing by Category of Infrastructure

| Infrastructure | Phase 1 | Phase 2* |
|---|---|---|
| Well Drilling | 8 Recovery Wells | 8 Recovery Wells |
| Well Equipping, Site Work, and Buildings | 8 Recovery Wells | 8 Recovery Wells |
| Recharge Site | All | |
| Pipelines | All, except 1,680 linear feet (LF) of 12-inch diameter Well Collection Pipeline | 1,680 LF of 12-inch diameter Well Collection Pipeline from RW-9 to RW-10 |
| Distribution Site | All, except RWPS mechanical and electrical. Air Gap Structure and Return Water Wet Well included in Phase 1 | RWPS air gap piping, modulating plug valves, pumps, motors, discharge piping and appurtenances, discharge header, VFD panels, electrical cables, and control wiring |

* Phase 2 or work to be initiated for water banking partners.

A summary of the Opinion of Probable Construction Cost is presented below in Table 8-3.

Table 8-3: Opinion of Probable Construction Costs by Phase

| Infrastructure | Phase 1 | Phase 2* | Total |
|---|---|---|---|
| Well Drilling | $5,470,000 | $5,470,000 | $10,940,000 |
| Well Equipping, Site Work, and Buildings | $6,060,000 | $6,050,000 | $12,110,000 |
| Recharge Site | $9,170,000 | $0 | $9,170,000 |
| Pipelines | $39,430,00 | $170,000 | $39,600,000 |
| Distribution Site | $14,080,000 | $4,300,000 | $18,380,000 |
| *Subtotal* | *$74,250,000* | *$15,950,000* | *$90,200,000* |
| Design and Construction Management | $11,140,000 | $2,390,000 | $13,530,000 |
| **Total**** | **$85,390,000** | **$18,340,000** | **$103,730,000** |

* Phase 2 or work to be initiated for water banking partners.
** Includes $2,750,000 in Phase 1 for the hydro-turbine, which could be considered optional.

### 8.1.5 Energy Analysis

In order to determine and maximize electricity output at a hydropower facility, as well as classify the facility as large (>30 megawatt [MW]), small (<30 MW), mini (<1 MW), or micro (<100 kilowatt [kW]), the expected flow and net head available for the system must be considered. Table 8-4 outlines the average flow and net head conditions for the 36-inch diameter Raw Water/Return Water Pipeline, running approximately 8.6 miles, which will be used for approximately 6 years out of 10 when SWP Water is delivered from the East Branch of the California Aqueduct to the Recharge Site. The Hazen-Williams equation is used to calculate head losses due to friction (hf) using a C-value of 135, design flows (Q) ranging from 10 to 50 cfs, and a hydraulic pipe diameter of 36 inches. The brake horsepower equation is used to calculate the potential power output (kW), with design flows from 10 to 50 cfs and an estimated efficiency of 85%.

As can be seen in Table 8-4, the range in electricity production is 268 to 780 kW with the maximum production occurring at 44 cfs. Electricity production drops off at flows higher than 44 cfs due to greater head loss, with the potential production of 758 kW at 50 cfs. Given the wide range in flow, a 2-nozzle turgo impulse turbine was selected preliminarily with an operating range of 10 to 40 cfs. Any flows under 10 cfs or over 40 cfs will be bypassed through either one or two 16-inch diameter pressure reducing valves with the turbine in standby. Hence, the estimated maximum production is 770 kW of electricity. Given that the maximum electricity production is less than 1 MW, the application is referred to as a “mini hydropower” facility.

Table 8-4: Average Flow and Net Head Ranges Available for the PRGRRP and the Percentage of Time that Each will Occur

| Q (gpm) | Q (cfs) | Hf (ft) | Net Head (ft) | HP | kW | % Time |
|---|---|---|---|---|---|---|
| 4,500 | 10.0 | 8.6 | 371.4 | 358.7 | 268 | 2 |
| 4,900 | 10.9 | 10.1 | 369.9 | 389.1 | 290 | |
| >4,900 | >10.9 | | | | | 8 |
| 5,400 | 12.1 | 12.1 | 367.9 | 426.4 | 318 | |
| >5,400 | >12.2 | | | | | 10 |
| 6,600 | 14.7 | 17.5 | 362.5 | 513.5 | 383 | |
| >6,600 | >14.7 | | | | | 20 |
| 8,900 | 19.9 | 30.5 | 349.5 | 667.7 | 498 | |
| >8,900 | >19.9 | | | | | 15 |
| 11,000 | 24.6 | 45.2 | 334.8 | 790.6 | 590 | |
| >11,000 | >24.6 | | | | | 10 |
| 13,400 | 29.9 | 65.1 | 314.9 | 905.8 | 676 | |
| >13,400 | >29.9 | | | | | 10 |
| 15,600 | 34.8 | 86.2 | 293.8 | 983.7 | 734 | |
| >15,600 | >34.8 | | | | | 10 |
| 16,800 | 37.5 | 98.9 | 281.1 | 1013.6 | 756 | |
| >16,800 | >37.5 | | | | | 10 |
| 17,900 | 40.0 | 111.3 | 268.7 | 1032.6 | 770 | |
| >17,900 | >40.0 | | | | | 5 |
| 19,700 | 44.0 | 132.9 | 247.1 | 1045.1 | 780 | |
| 22,400 | 50.0 | 168.5 | 211.5 | 1016.8 | 758 | |

In addition to bypassing low and high flows, the pressure reducing valves are used when the turbine is offline for repairs or maintenance. Based on the Cla-Val product data, two 16-inch diameter pressure reducing valves can combine to meet the maximum flow condition of 50 cfs.

Canyon Industries, based in Deming, Washington, manufactures a variety of turbines and recommends a dual-nozzle Turgo turbine for this Project. The proposed turbine accommodates the design conditions shown in Table 8-5, in addition to flows as low as 10 cfs and as high as 40 cfs, with corresponding net heads as high as 371.4 feet and as low as 268.7 feet, respectively. Given the aforementioned design conditions, the expected system output at 40 cfs for the turbine is 770 kW.

Table 8-5: DesignConditions for Turgo Turbine

| Criteria | Value | Units |
|---|---|---|
| Equipment Life | 35 | Years |
| Number of Units | 1 | Turbine |
| Maximum Flow | 40 | cfs |
| Minimum Flow | 10 | cfs |
| Maximum Available Head | 371 | Feet |
| Minimum Available Head | 268 | Feet |
| Maximum Energy Production | 770 | kW |
| Minimum Energy Production | 268 | kW |
| Capacity Factor | 60 | Percent |
| Turbine Size | 770 | kW |

The supplier's cost for the recommended dual-nozzle Turgo is approximately $800,000, and includes the following primary equipment:

- Canyon dual-nozzle Turgo with hydraulic actuation
- Induction generator 480/3/60
- Switchgear and control panels for automated grid parallel operation
- Hydraulic power unit skid
- Turbine inlet valve
- Bifurcation piping with dismantling joints and structural steel equipment mounting frames

A 35-year analysis is provided based on estimated annual SWP Table A Amount allocations and recharge water deliveries from the East Branch of the California Aqueduct. Four average operating conditions are shown in Table 8-6, with their corresponding flow, net head, and average deliveries. It is assumed that in a period of 10 years, 6 years are normal to wet, and 4 years are dry, which is reflected in the average SWP delivery column of the table.

Table 8-6: Range of Average Flow, Delivery, and Net Head Conditions Available for Turbine

| Average Annual Delivery when Available (AF/yr) | Average Flow when Operating (cfs) | Average SWP Deliveries (Assuming 6 years out of 10) (AF/yr) | Net Head Available at Turbine (feet) |
|---|---|---|---|
| 10,000 | 13.8 | 6,000 | 364 |
| 15,000 | 20.8 | 9,000 | 347 |
| 20,000 | 27.7 | 12,000 | 324 |
| 25,000 | 34.6 | 15,000 | 295 |

In order to evaluate the potential of the hydropower project, turbine cost benefits are provided in Table 8-7 based on the average conditions in Table 8-6. The current average energy cost of $0.14/kWh was used in the analysis. For the average range of flows, the Net Present Value (NPV) of Average Annual Net Savings is expected to be approximately $7.7 million to $16.0 million over the next 35 years. Therefore, the hydropower project is financially beneficial even at the low-end average operating conditions, and becomes more beneficial as more water is delivered.

Table 8-7: Range of Turbine Cost Benefits Based on Average Conditions

| Average Annual Delivery when Available (AF/yr) | Energy Production at 85% Efficiency (kW) | Average Annual Energy Production (kWh/Year) | NPV of Average Net Savings over 35 Years | Average Annual Net Savings | Average Unit Cost Savings per AF |
|---|---|---|---|---|---|
| 10,000 | 362 | 1,902,672 | $7,714,402 | $392,340 | $65 |
| 15,000 | 517 | 2,717,352 | $11,206,648 | $569,107 | $63 |
| 20,000 | 643 | 3,379,608 | $14,045,507 | $712,801 | $59 |
| 25,000 | 732 | 3,847,392 | $16,042,105 | $814,057 | $54 |

Another benefit of the hydropower project is that is qualifies for the California Public Utilities Commission's Self-Generation Incentive Program (SGIP). The hydropower turbine falls under the "Pressure Reduction Turbines" category; therefore, the incentive received is either: a) 30% of the Capital Cost (shown in Table 8-8) or b) $1.07 x 1000 x the size of the Project in kW, whichever is less. The total SGIP incentive for this hydropower project could be as high as $824,000 ($1.07 x 1000 x 770 kW), which is less than 30% of the Capital Cost of $828,000. However, only 50% of the total incentive is received up front, and the remaining 50% is received in increments of 10% per year based on annual production over the first 5 years. For each of the average annual delivery conditions described above (10,000, 15,000, 20,000, or 25,000 AF/yr) PWD would receive only 47, 67, 83, or 95 percent of the maximum annualized payments of $412,000 based on less than full production, as shown in Table 8-9. Currently, the SGIP allows incentives to be available through January 1, 2016. However, because Governor Brown recently increased the Renewables Portfolio Standard percentage goal for the state, renewal of this program is very likely in the short-term.

Table 8-8: Capital Cost Breakdown for Hydropower Turbine

| Cost Element | Cost |
|---|---|
| Turbine Vendor Package | $800,000 |
| Building (1700 sf at $250/sf) | $425,000 |
| Piping and By-pass | $250,000 |
| Mechanical Install (30% of turbine price) | $240,000 |
| Electrical/Instrumentation (20% of turbine price) | $160,000 |
| **Construction Subtotal** | **$1,875,000** |
| Contractor Mark-up, Taxes, Bonds (12% of Installed Cost ) | $225,000 |
| Contingency - included in estimates | $0 |
| Escalation to Midpoint of Construction (6%) | $125,000 |
| **Construction Total** | **$2,225,000** |
| Design Engineering (8% of Construction Cost) | $178,000 |
| Regulatory/Permitting (6% of Construction Cost) | $134,000 |
| Construction Management (8% of Construction Cost) | $178,000 |
| Agency Administration (2% of Construction Cost) | $45,000 |
| **TOTAL** | **$2,760,000** |

Table 8-9: Total SGIP Incentive for Range of Average SWP Deliveries

| Average Annual Delivery when Available (AF/yr) | Estimated Incentive Based on kW Produced in Years 1 through 5 | SGIP Total Incentive | Percent of Maximum SGIP Incentive |
|---|---|---|---|
| 10,000 | $412,000 + $194,000 | $606,000 | 73% |
| 15,000 | $412,000 + $277,000 | $689,000 | 84% |
| 20,000 | $412,000 + $344,000 | $756,000 | 92% |
| 25,000 | $412,000 + $392,000 | $804,000 | 98% |

### 8.1.6 Reliability of Facilities

As mentioned above, the Palmdale Wastewater Treatment Plant currently provides approximately 10,000 AF/yr of tertiary recycled water for agriculture. The capacity of the wastewater plant is currently 12 mgd, which would be sufficient to meet the projected demand for recycled water and provide water for potable reuse for the project. Thus, there will be sufficient capacity in the system to meet existing project demands and the additional demands at project completion. Overall, recycled water is a highly reliable source of water because wastewater is being continually produced.

Should operations at the new facility be interrupted to the point where water cannot be accepted from the wastewater plant, the water can be routed to two above ground storage ponds that the LACSD's currently operates to store water when the supply is larger than the agriculture demand. The two storage ponds have a combined capacity of 900 million gallons.

# CHAPTER 9

# SUMMARY OF REGULATORY COMPLIANCE

## 9.0 Introduction

This section details the various state regulatory requirements for Groundwater Recharge and Recovery Projects (GRRP) utilizing recycled water in California and provides evidence of project compliance and/or planned compliance actions for the PRGRRP. The Title 22 Engineering Report was completed in February 2016 and submitted to SWRCB for review. The document has been uploaded to FAAST PIN ID # 30947 as Attachment T4. The regulations for GRRPs are administered by the DDW and the RWQCBs under Title 22. Prior to the finalization of the GRRP regulations, the SWRCB adopted an amendment to the Policy for Water Quality Control for Recycled Water (Recycled Water Policy) effective April 25, 2013 to address future actions related to monitoring constituents of emerging concern (CEC) in recycled water. The purpose of the 2013 amended Recycled Water Policy is to provide direction to RWQCBs regarding the criteria to be used when issuing permits for recycled water projects.

The following section summarizes the water quality, treatment, monitoring and reporting requirements of these regulations; however, readers should refer to the regulations for precise requirements and conditions (SWRCB, 2013; CDPH 2014).

## 9.1 Compliance with Pathogenic Microorganism Control (Title 22 §60320.108)

The GRRP regulations have the following requirements regarding pathogenic microorganism reduction by a groundwater replenishment project utilizing recycled water:

- At a minimum the recycled municipal wastewater applied at a GRRP shall receive treatment that meets the definition of 1) filtered wastewater (§60301.320) and 2) disinfected tertiary recycled water (§60301.230).
- GRRP treatment must achieve at least 12-log enteric virus reduction, 10-log *Giardia* cyst reduction and 10-log *Cryptosporidium* oocyst reduction.
- With the exception of soil-aquifer treatment, for each pathogen, at least three separate unit processes must be credited with achieving at least 1-log reduction and no single treatment process will be credited with greater than 6-log reduction.

As described in Chapters 5 and 6 of this project report, the tertiary effluent produced at the Palmdale Wastewater Treatment Plant meets the definition of “filtered wastewater” and “disinfected tertiary recycled water” as defined in Title 22.

Pathogenic microorganism removal credits are obtained at the PRGRRP by a combination of 1) secondary wastewater treatment processes (biological treatment), 2) tertiary recycled water treatment processes (chemical disinfection) and 3) soil-aquifer treatment (SAT). Table 9-1 lists the proposed removal credits for the treatment processes of the PRGRRP. At least three treatment processes are anticipated to achieve at least 1-log removal each for enteric virus.

Pathogen removal credits for the PRGRRP are expected to meet 12-log enteric virus removal, 10-log Giardia cyst removal and 10-log Cryptosporidium oocyst removal (Table 9-1), making the Project compliant with DDW GRRP regulations.

**Table 9-1: Proposed PRGRRP Pathogen Removal Credits**

| Pathogen | Units | Proposed Credits | Pathogen | Reduction | Total Log Reduction | DDW Req'd Log Reduction |
|---|---|---|---|---|---|---|
| | | Palmdale WRP | | SAT [a][b] | | |
| | | Secondary Treatment | Tertiary Treatment[c] | | | |
| Enteric Virus | Log | 1.9 | 4.1 | 6 [a] | 12 | 12 |
| Giardia cysts | Log | | | 10 [b] | 10 | 10 |
| Cryptosporidium oocysts | Log | | | 10 [b] | 10 | 10 |

*(a) Notes: DDW = Division of Drinking Water; SAT = Soil-Aquifer Treatment*

*(a) Assumes an underground travel time to nearest drinking water well of 48 months, as estimated using the USGS's MODFLOW groundwater model. Per GRRP regulations this estimation method is credited with 0.5-log virus removal per month underground retention time, resulting in a 6-log virus removal credit.*

*(b) A qualifying filtered, disinfected tertiary recycled water with at least 6 months of underground retention time is credited with 10-log Giardia cyst reduction and 10-log Cryptosporidium oocyst reduction.*

*(c) Reduction credits for tertiary treatment were estimated based on a compliance assessment report prepared by LACSD for the Montebello Forebay Groundwater Recharge Project. For tertiary treatment at Palmdale WRP, it was assumed that all pathogen reduction is achieved solely by chemical disinfection*

### 9.1.1 Pathogen Reduction Credit Estimation Methodology

The proposed pathogen removal credits for the Palmdale WRP treatment processes were estimated using a compliance assessment report prepared by LACSD for the Montebello Forebay Groundwater Recharge Project which receives disinfected tertiary recycled water from several water reclamation plants. Pathogen reduction during SAT was determined using the USGS finite difference MODFLOW groundwater model.

### 9.1.2 Pathogen Removal at the Palmdale WRP

The Palmdale Wastewater Treatment Plant train consists of primary sedimentation followed by activated sludge operated with nitrification/denitrification zones for secondary treatment. Tertiary treatment is achieved by cloth media disk filters and chemical disinfection. The filters have a nominal filtration rating of 10 microns and are operated at or below a maximum load rating of 6 gallons per minute per square foot. Chemical disinfection is achieved using chloramination with a minimum CT (product of total chlorine residual concentration and contact time) value of 450 $mgCl_2$-min/L and a minimum modal contact time of 90 minutes.

For the purpose of determining pathogen removal credits, the full Palmdale Wastewater Teatment train was divided into 1) secondary treatment processes and 2) tertiary treatment processes.

### 9.1.3 Removal by Secondary Treatment Processes

To estimate pathogen reduction through secondary treatment (i.e., activated sludge), LACSD used representative pathogen reduction information developed by from Rose et al. (2004) and a risk assessment conducted by Olivieri et al. (2007). This study evaluated reduction in pathogens and indicator organisms for a collection of reclamation facilities. Pathogen removal from those facilities were used to estimate average log reduction credits for secondary biological treatment. The 10th percentile of pathogen log reduction values were used to determine the proposed pathogen removal credits during secondary treatment at LACSD WRPs as 1.9-log reduction through secondary treatment.

A comparison of unit processes at Facilities A through F from Rose *et al.* (2004) and Olivieri *et al.* (2007) with those of the Palmdale WRP is shown in Table 9-2. Pathogen removal data from Rose *et al.* (2004) and Olivieri *et al.* (2007) are shown in Table 9-3.

**Table 9-2: Comparison of Facilities from Rose *et al.*, 2004 with the Palmdale WRP**

| Treatment | Facility A | Facility B | Facility C | Facility D | Facility E | Facility F | Palmdale WRP |
|---|---|---|---|---|---|---|---|
| Primary Treatment | Grit removal | Grit removal | Grit Removal Primary Clarifier | Grit removal | Grit Removal Equilization Basin | Grit Removal | Sedimentation |
| Secondary Treatment | Activated sludge | Activated sludge | Activated Sludge | Activated sludge | Nitrification | Biological Nutrient Removal | Activated Sludge, NdN |
| Mean Cell Residence Time (d) | 6-8 | 3.5-6 | 1.6-2.7 | 3-5 | 8.7-13.3 | 8-16 | 21.5-29.5 |

*Notes: NdN = Nitrification/denitrification, d = days*

**Table 9-3: Pathogen Log Reductions during Secondary Treatment from Olivieri *et al*., 2007**

| Sample | Enteric Viruses | Sample | Enteric Viruses |
|---|---|---|---|
| A-1 | 2.12 | D-1 | 2.06 |
| A-2 | 2.35 | D-2 | 2.41 |
| A-3 | 2.14 | D-3 | 2.49 |
| A-4 | 1.97 | D-4 | 2.54 |
| A-5 | 1.64 | D-5 | 2.65 |
| B-1 | 2.09 | D-6 | 2.75 |
| B-2 | 2.39 | E-1 | 2.57 |
| B-3 | 1.94 | E-2 | 2.66 |
| B-4 | 2.25 | E-3 | 1.76 |
| B-5 | 2.82 | E-4 | 1.88 |
| C-1 | 2.06 | F-1 | 2.70 |
| C-2 | 1.82 | F-2 | 2.76 |
| C-3 | 2.04 | F-3 | 2.61 |
| C-4 | 2.00 | F-4 | 3.20 |

| Sample | Enteric Viruses | Sample | Enteric Viruses |
|---|---|---|---|
| C-5 | 2.37 | F-5 | 3.13 |
| **10th Percentile Value (of all samples)** | | | **1.9** |

### 9.1.4 Removal by Tertiary Treatment Processes

For tertiary treatment at Palmdale Wastewater Treatment Plant, it was conservatively assumed that all pathogen reduction is achieved solely by chemical disinfection; any microorganism removal by the cloth filters was disregarded. The Palmdale wastewater plant is similar to LACSD's San Jose Creek West (SJCW) and Pomona Wastewater Treatment Plant's. Disinfection of effluent leaving the SJCW and Pomona WRPs is accomplished by chloramination. Following filtration, chlorine and ammonia are added to form chloramines. The Palmdale WRP, SJCW and Pomona WRPs are operated to meet a CT of 450 mg-min/L. To determine the virus reduction that occurs during chloramination at the LACSD WRPs, bench-scale studies were conducted on the disinfection of poliovirus with chloramines in secondary effluent from the SJCW WRP. This study found a lower 90 percent confidence limit of a 4.1-log reduction, and an upper 90 percent confidence limit of a 5.7-log reduction. Until further data and evaluations are performed, the SJCW WRP credit of 4.1-log virus inactivation is being used. LACSD received Conditional Approval from DDW for the SJCE WRP credit on August 21, 2013 and final approval of an Operations Plan on April 22, 2015.

### 9.1.5 Pathogen Removal by Soil Aquifer Treatment at the PRGRRP

Per Title 22 Section 60320.108, a groundwater replenishment project utilizing surface application that demonstrates at least 6 months of underground retention time will be credited with 10-log Giardia cyst reduction and 10-log Cryptosporidium oocyst reduction. The virus reduction credits for soil-aquifer treatment reduction are dependent on the underground retention time with 1-log/month, 0.67-log/month and 0.5-log/month granted for tracer studies using an added tracer, an intrinsic tracer, or numerical modeling respectively.

Preliminary modeling (i.e. numerical modeling using the MODLFOW Groundwater finite difference model developed by the USGS) estimates that the shortest travel time to the nearest drinking water well during Phase 1a is 48 months. The underground retention time (RT) credit allowed for numerical modeling methods of estimation is 0.5 months RT credited per month of estimated underground RT. Therefore the proposed RT credit for the PRGRRP exceeds the maximum credit of 6 months; the travel time conditions necessary to obtain 10-log Giardia cyst and 10-log Cryptosporidium oocyst reduction credits.

The virus removal credit allowed for numerical modeling methods of estimating underground retention time is 0.5-log reduction per month of estimated underground RT. The minimum underground travel time of 48 months predicted by the MODFLOW groundwater model therefore supports an initial estimate of virus reduction credits for SAT of 6 log. A tracer study will be completed at the site prior to commencing groundwater replenishment. However, the proposed PRGRRP Project pathogen reduction credits are currently in compliance with GRRP regulations in the absence of an improved estimate of underground retention time.

## 9.2 Compliance with Nitrogen Compound Control (Title 22 §60320.110)

This regulation specifies required monitoring activities related to total nitrogen present in the recharge water applied at the recharge basins. Samples may be collected before or after surface application.

At the PRGRRP, total nitrogen will be monitored in the Recharge Water (monitored after surface application in the Recharge Test Basin). Recharge Water will be sampled for total nitrogen twice weekly, at least three days apart. Per Title 22 §60320.126, total nitrogen will be monitored in groundwater on a quarterly basis.

The limit for total nitrogen in the Recharge Water is 10 mg/L. The average concentration of total nitrogen in the Palmdale WRP tertiary recycled water from January 2012 through November 2015 was 7.3 mg/L, with a maximum detected concentration of 14.4 mg/L. In recent years, total nitrogen concentrations in the tertiary recycled water have dropped with an average concentration of 6.5 mg/L and a maximum detected concentration of 9.8 mg/L between January 2014 and November 2015. Based on trends in the water quality of the tertiary effluent of the Palmdale Wastewater Treatment Plant 9-5it is anticipated that the water quality requirements for total nitrogen compound prior to surface application will be met in the Recycled Water. The diluent water source for the PRGRRP, SWP Water, is a DDW-approved drinking water source and is not anticipated to contribute significantly to total nitrogen loading of the Recharge Water. This will result in a reduction in the total nitrogen concentration at times when SWP Water is available and actively diluting the Recycled Water. This will not be the case during dry years when only Recycled Water is being recharged.

## 9.3 Compliance with Regulated Contaminants and Physical Characteristics Control (Title 22 §60320.112), Additional Chemical and Contaminant Monitoring (Title 22 §60320.120) and Monitoring Well Requirements (Title 22 §60320.126)

This section describes compliance actions with regulations on monitoring of recycled water and groundwater for those chemical constituents with regulated maximum contaminant levels, action levels, or notification levels, as well as priority toxic pollutants and any additional constituents specified by DDW based on Project-specific considerations. Compliance monitoring for surrogates, contaminants of emerging concern (CECs), and wastewater indicator compounds are discussed in the Title 22 Engineering Report.

As specified in DDW regulations for groundwater replenishment reuse projects utilizing surface application of recycled water, The PRGRRP will collect samples of the tertiary recycled water produced at the Palmdale WRP and groundwater to the PRGRRP recharge site to be analyzed for regulated chemical constituents. The constituent categories, monitoring locations and monitoring frequencies are summarized in Table 9-4. The following monitoring locations will be used to determine compliance with Title 22 §60320.112, §60320.120 and §60320.126:

- **Recycled Water:** Samples of the disinfected tertiary effluent recycled water prior to blending will be sampled from the Palmdale WRP.

- **Recharge Water**: Recharge water after application will be monitored by sampling of the water present in the Recharge Test Basin before percolation. Recharge water after percolation will be monitored in a series of monitoring wells located below the Recharge Test Basin. Monitoring wells will be placed beneath this basin at between 10 and 30 feet below the soil surface to sample the groundwater mound that develops below the basin during recharge.

- **Groundwater**: As described in the Title 22 engineering report, two (2) groundwater monitoring wells will be used for compliance monitoring: 1) one well located no less than two weeks but no more than six months of travel time through the saturated zone affected by the PRGRRP and 2) one well located between the PRGRRP recharge basins and the nearest drinking water well.

As described in further detail in Title 22 Engineering Report, the proposed monitoring and reporting plan for the PRGRRP fulfills the monitoring and reporting requirements for regulated contaminants stipulated in Title 22 §60320.112, §60320.120 and §60320.126.

**Table 9-4: Proposed Frequency and Location of Constituent Monitoring for Compliance with Title 22 §60320.112, Title 22 §60320.120 and Title 22 §60320.126**

| | Monitoring Frequency | | |
|---|---|---|---|
| **Constituent Category** | **Recycled Water** | **Recharge Water (d)** | **Groundwater** |
| Constituents with Primary Drinking Water MCLs, except Disinfection byproducts, Nitrate and Nitrite | Q | -- | -- |
| Disinfection byproducts | Q (d) | --Q(d) | -- |
| Nitrate and Nitrite | -- (b) | -- | Q |
| Copper and Lead | Q | -- | -- |
| Constituents with Secondary Drinking Water MCLs | A | -- | Q |
| Constituents with Notification Levels (e.g. NDMA) | Q (d) | Q (d) | -- (c) |
| Priority Toxic Pollutants | Q | -- | Q |
| Total Nitrogen | -- | BW (a) | Q |

*(a) Notes: MCLs = maximum contaminant levels, NDMA = N-nitrosodimethylamine, BW = biweekly (at least three days apart), M = monthly, Q = quarterly, A = annually*

*(a) Monitoring of this constituent in this water supply is a requirement of Title 22 §60320.110. This constituent may be monitored in the recharge after surface application regardless of the fraction of recycled water present in the recharge water.*

*(b) Monitoring of nitrate or nitrite in the recycled water used for recharge not a requirement of Title 22 Article 5.1. Indirect Potable Reuse: Groundwater Replenishment—Surface Application. Nitrate and nitrite are monitored monthly in the tertiary effluent of the Palmdale WRP.*

*(c) Monitoring of all constituents with notification levels in recharge water or groundwater is not specifically required by these particular regulatory sections; however, monitoring of NDMA in the downgradient groundwater will be performed on a quarterly basis as required by the SWRCB's Recycled Water Policy. Monitoring Well No.1 is the proposed compliance point for NDMA.*

*(d) For these constituents, recharge water (including recharge water after surface application) may be monitored for compliance in lieu of recycled water if the fraction of recycled water in the recharge water to be monitored is equal to or greater than the average fraction of recycled water in the recharge water applied over the quarter. Recharge water after application will be monitored in the Recharge Test Basin and below the Recharge Test Basin by series of lysimeters located. between 10 and 30 feet below the soil surface.*

## 9.4 Compliance with Diluent Water Requirements (Title 22 §60320.114)

Title 22 §60320.114 describes the DDW requirements regarding use of diluent water for groundwater replenishment reuse projects, including acceptable diluent source waters, diluent water quality monitoring and reporting requirements, and requirements regarding the method for determining the volume of diluent water to be credited.

### 9.4.1 Diluent Water Source Evaluation and Monitoring

The sources of diluent water to the PRGRRP are the California State Water Project (SWP) and groundwater underflow. The SWP is a DDW-approved drinking water source, therefore no source water evaluation is needed. In addition, as a DDW-approved drinking water source, the requirement for quarterly monitoring of nitrate and nitrite are also waived; however nitrate and nitrite are already monitored in this source water by the Department of Water Resources (DWR) Division of Operations and Maintenance Water Quality Section.

A water quality monitoring program is required to ensure that diluent water does not exceed a primary drinking water MCL, a secondary drinking water MCL upper limit, or a notification level. With the exception of nitrate and nitrite, Title 22 §60320.114 does not specify the required monitoring frequency for diluent water monitoring. As described in Title 22 Engineering Report, Monitoring and Reporting Program, the diluent water for the PRGRRP will be monitored annually for constituents with primary MCLs, notification levels or secondary MCLs. Monitoring for a number of these constituents in SWP is already performed by the DWR. This data will be included in reports of diluent water quality for the PRGRRP. Only those constituents not already part of DWR's monitoring program from the SWP will be sampled at the PRGRRP recharge site. Water quality monitoring of the underflow groundwater will be performed at Monitoring Well No.3 located approximately 1 mile upstream of the southeast corner of the Recharge Site to provide representative sampling of the groundwater quality directly up-gradient of and under-flowing the Project.

### 9.4.2 Proposed Diluent Water Credit

The Title 22 engineering report describes the conveyance to and blending of all water sources at the Project recharge site. In summary,

1) **SWP Water:** A sluice gate at the East Branch of the California Aqueduct canal can be manually opened and closed. In order to monitor this delivery, the California Department of Water Resources (DWR) meter status at the turnout is communicated via SCADA (supervisory control and data acquisition system). Flow control for delivery of SWP Water is provided by electronic actuated rate of flow control valves.

2) **Recycled Water:** Delivery of recycled water to the Distribution Box by gravity flow to the Recharge Site is controlled through the recycled water turnout meter vault structure with a motor-operated control valve.

3) **Underflow Diluent:** Naturally occurring groundwater underflow has been identified as a source of diluent water for the Project. The findings indicated that when extraction from Phase 1a recovery wells is considered, the groundwater underflow fraction is

approximately 22.5% of the total extracted water, representing available underflow diluent water that would contribute to meeting RWC requirements for the Project.

The SWP Water and recycled water combined flow enters the Splitter Box by which water is delivered to the recharge basins. Both recycled municipal water and diluent water transmission pipelines are metered, providing continuous monitoring for delivery flow rates via SCADA. This flow data will be used to determine the diluent water credit and recycled water contribution. As both recycled water and diluent water will be entering the recharge basins at the same location, no difference in travel-time needs to be addressed when calculating the fraction of recycled water contribution. Recharge water arrives at the water table beneath the recharge basins after approximately 150 days of travel time through the unsaturated zone, therefore dilution of the recharge water by the under-flowing groundwater will be delayed by 150 days following application at the recharge basins.

There are no plans to utilize stormwater as a diluent water source for the PRGRRP therefore no method for crediting this sources is needed at this time.

## 9.5 Compliance with Recycled Municipal Wastewater Contribution (RWC) Requirements (Title 22 §60320.116)

Each month the PRGRRP will calculate the running monthly average recycled wastewater contribution (RWC) by dividing the total volume of recycled water by the total volume of water (recycled water and diluent water) recharged over the preceding 120 months. The calculation of the running monthly average RWC will begin after 30 months of recycled water application.

Per the requirements of Title 22 §60320.116 for projects performing groundwater replenishment by surface application of recycled water, the proposed initial maximum RWC of the PRGRRP will not exceed 0.2 (20 % recycled municipal wastewater and 80 % diluent water).

A groundwater replenishment project may petition to increase its maximum RWC provided that the concentration of wastewater TOC concentration in the recharge water will not exceeded 0.5 mg/L divided by the proposed maximum RWC. Following an operating period to be determined but no shorter than 52 weeks, the maximum RWC for the PRGRRP will be re-evaluated based on demonstrated performance of soil-aquifer treatment in the vadose zone below the recharge basins.

Table 9-5 summarizes the proposed schedule for increases to the maximum RWC of the Palmdale GRRP. This proposed schedule is subject to evaluation of the soil-aquifer treatment factor in the vadose zone below the recharge basin and full compliance with DDW requirements for petitioning to increase the maximum RWC of a replenishment project. Any future changes to the RWC will be contingent on obtaining approval and an updated permit from the DDW and Regional Board.

**Table 9-5: Anticipated Annual Flows and RWC by Phase**

| Phase | Year | Recycled Water (AFY) | SWP Diluent Water (AFY) | Underflow Diluent Water (AFY) | Total Recharge (AFY) | RWC (%) | Extraction (AFY) |
|---|---|---|---|---|---|---|---|
| 1a | 2019-2038 | 3,600 | 4,710 | 1,690 | 8,310 | 36% | 7,500 |
| 1b | 2039-2058 | 6,598 | 8,207 | 1,690 | 14,806 | 40% | 8,050 |
| 2 | 2059-2068 | 5,690 | 6,845 | 1,690 | 12,535 | 40% | 10,800 |

## 9.6 Compliance with Total Organic Carbon (TOC) and Soil-Aquifer Treatment (SAT) Process Requirements (Title 22 §60320.118)

DDW requires that groundwater replenishment projects utilizing surface application assess the effectiveness of the SAT process by monitoring of total organic carbon (TOC), indicator compounds and surrogate parameters in the recycled water prior to SAT and the water after SAT. Monitoring activities related to compliance with Title 22 §60320.118 are summarized in Table 9-6.

**Table 9-6: Proposed Monitoring of Soil-Aquifer Treatment for Compliance with Title 22 §60320.118**

| | Total Organic Carbon | | CEC Indicator Compounds | |
|---|---|---|---|---|
| Sampling Location | Frequency | Limit (mg/L) | Frequency | Minimum Percent Removal (%) |
| Recycled Water | W | -- | Q | -- |
| Recharge Test Basin Lysimeters | W | 0.5/RWC | Q | -- |
| Groundwater (MW#1) | Q | 0.5/RWC | Q | 90 |

In addition, the SWRCB's Recycled Water Policy requires monitoring activities related to SAT performance and contaminants of emerging concern (CECs). The requirements of this regulation share some similarities with those of Title 22 §60320.118 and are discussed in Title 22 Engineering Report.

### 9.6.1 TOC Monitoring

Total Organic Carbon (TOC) in the recharge water will be sampled weekly in the monitoring wells located below the Recharge Test Basin and quarterly in the groundwater monitoring well downgradient of the PRGRRP recharge site. During initial operation, compliance with Title 22 §60320.118 will be determined based on monitoring of Recharge Test Basin wells. When diluent water is present the TOC concentration value will be amended to negate the effects of the diluent water (i.e. the TOC value will be adjusted by the RWC). The maximum concentration (in mg/L) of TOC allowable in the recharge water in the zone of percolation below the recharge basins is 0.5/RWC. Compliance with the maximum allowable limits for TOC will be determined based on the 20-week running average of all TOC results and the average of the last four TOC results.

The site-specific effectiveness of soil-aquifer treatment at the PRGRRP will be evaluated using monitoring wells located below the Recharge Test Basin. TOC removal with depth will be evaluated. The Recharge Test Basin is a proposed 10,000 square feet recharge area that will be operated continuously to evaluate soil-aquifer treatment and monitor recharge water quality. Monitoring wells will be placed beneath this basin at between 10 and 30 feet below the soil surface to sample the groundwater mound that develops below the basin during recharge. Results from Recharge Test Basin monitoring wells will be compared to the nearest downgradient monitoring well.

Following a time period of monitoring to be determined based on consultation with the DDW and Regional Board, the SAT treatment factor for TOC removal at the PRGRRP site will be determined. In order to isolate the removal of wastewater-derived TOC from that of organic carbon present in the diluent water, only TOC monitoring data obtained during periods when the recharge water consists of 100% recycled water (i.e., a RWC of 1) will be used to calculate the soil-aquifer treatment factor.

Following determination and regulatory approval of the soil-aquifer treatment factor for the PRGRRP, the TOC concentration will be monitored weekly in the undiluted recycled water and will be corrected via the soil-aquifer treatment factor to obtain the TOC concentration in the percolated recharge water. Quarterly monitoring of TOC in the downgradient monitoring well will continue.

### 9.6.2 Indicator Compound Monitoring

To monitor the treatment efficiency of SAT at the PRGRRP site, at least three (3) indicator compounds will be selected that will achieve greater than 90% reduction during SAT (excluding effects of dilution water). Indicator compounds shall be measured in the recycled water and in downgradient groundwater at a well located within 30-days underground travel time. Quarterly, a monitoring report will be delivered to DDW demonstrating 90% or greater removal of selected indicator CECs during SAT.

#### *9.6.2.1 Selection of SAT Indicator Compounds*

A literature and treatment plant survey performed by Drewes *et al.* (2011) screened occurrence data for indicator compounds with occurrences in secondary- or tertiary-treated wastewater of above 80% at levels at least five times higher than their respective quantification limits. Based on treatment performance achieved at pilot- and full-scale facilities practicing indirect potable reuse, a list of indicator compounds obtaining good removal during SAT (i.e., greater than 90%) was developed (Table 9-7).

Further, a subset of indicator compounds consisting of Atenolol, Iopromide. Gemfibrozil, and caffeine typically show greater than 90% removal during SAT with short subsurface travel times (i.e., 2 to 3 days) (Drewes, 2011). These compounds were typically observed in tertiary-treated wastewater at concentrations greater than or equal to 50 ng/L (Drewes *et al.*, 2011), sufficiently high to allow for proper quantification. Following verification of occurrence in Palmdale WRP tertiary-treated wastewater, some combination of these four compounds would be ideal candidate indicator compounds to monitor SAT performance per the requirements of Title 22 §60320.118.

Prior to beginning of operation, and at five-year intervals thereafter, an occurrence study shall identify candidate indicator compounds present in Palmdale WRP tertiary effluent suitable to monitor the treatment efficiency of SAT at the PRGRRP site. The study protocol, results and indicator compound selected shall be reviewed and approved by DDW. The list of potential indicator compounds with suitable occurrence levels in Palmdale WRP tertiary effluent will be cross-referenced with the list of indicator compounds that typically achieve good removal during SAT in Table 9-7 in order to select, subject to regulatory approval, the three (3) indicator compounds that will be monitored for compliance with Title 22 §60320.118 at the PRGRRP.

**Table 9-7: Candidate List of Commonly Occurring Indicator Compounds with Good Removal ( > 90%) during SAT at Surface Spreading Operations (Drewes *et al.,* 2011)**

| Good Removal (> 90%) | | | |
|---|---|---|---|
| Acetyl cedrene | Diclofenac | Indolebutyric acid | Nonylphenol |
| Atenolol | EDTA | Iopromide | OTNE |
| Atorvastatin | Erythromicin | Isobornyl acetate | Propranolol |
| Benzophenone | Estrone | Meprobamate | Propylparaben |
| Benzyl acetate | Fluoxetine | Methyl ionine | Sulfamethoxazole [(a)] |
| Benzyl salicylate | Galaxolide | Methyl salicylate | Terpineol |
| Bisphenol A | Gemfibrozil | Metoprolol | Tonalide |
| BHA | Hexyl salicylate | Musk ketone | Triclocarban |
| Bucinal | Hexylcinnamaldehyde | Musk xylene | Triclosan |
| Caffeine | Hydrocodone | Naproxen | Trimethoprim |
| DEET | Ibuprofen | NDMA | |

*(a) Notes:*
*(b) Surface spreading system conditions (0% dilution with native groundwater) include: 1) partially nitrified wastewater, > 100 ft vadose zone, > 2 week subsurface travel time and 2) nitrified/denitrified wastewater, <10 ft vadose zone, > 2 months subsurface travel time*
*(a) Sulfamethoxazole removal is dependent on primary redox conditions and is more favorable under anoxic conditions*

### 9.6.3 Proposed Soil Column Pilot Study

Prior to initiating groundwater recharge, the capacity of the PRGRRP site soils to treat Palmdale WRP tertiary effluent via SAT will be assessed using a soil column pilot study. The study will be designed to approximate the flow conditions anticipated in the subsurface of the PRGRRP recharge site (i.e., unsaturated flow followed by saturated flow, simulating the vadose then saturated zone transport of the recharge water between the recharge basin and Monitoring Well No.1). Constituents to be evaluated in the column pilot study will include (but are not limited to): TOC, NDMA and proposed SAT indicator compounds identified by the CEC occurrence study.The protocol for the pilot study and the study's results will be submitted for review and approval by DDW.

## 9.7 Compliance with Response Retention Time Requirements (Title 22 §60320.124)

Title 22 §60320.124 specifies that recycled water must be retained underground for a period of time sufficient to allow project sponsors sufficient response time to identify treatment failures and implement corrective actions for the protection of public health. The minimum underground retention time deems sufficient for suitable response allowed by the regulation is 2 months; however, the proposed response time is subject to approval by the DDW.

To demonstrate the achieved underground retention time is no less than the approved response retention time, an added tracer study must be performed. With DDW approval, an intrinsic tracer may be used, but will only be credited with 0.67 months of credit per month of retention time estimated using the intrinsic tracer.

The hydraulic conditions under which the tracer study is performed must be representative of normal GRRP operations and must be initiated within the first three months of operation.

### 9.7.1 Proposed Minimum Response Time for the PRGRRP

Site-specific factors were used to determine the most appropriate minimum response time for the PRGRRP. The proposed necessary response time will be a factor of the time required to detect a problem and the time needed to respond to the problem.

The time required to detect a problem (for example exceedance of a primary drinking water MCL in the downgradient groundwater) is a factor of the travel time to the nearest monitoring well, the sampling frequency of that monitoring well, the time required to obtain sample results and the time required to perform corrective action and/or provide alternative drinking water supplies to affected downstream well owners.

The nearest groundwater monitoring well is located 60 days downgradient of the recharge basins (under Phase 1a conditions). This well is sampled quarterly (or every three months). Because the time between sample collection activities is longer than the travel time of groundwater between the recharge basin and the well, the time to detect an abnormal result from this well is equivalent to the sampling frequency, three (3) months or twelve (12) weeks.

The time required for sample analysis and receipt of results will vary somewhat depending on the particular analytical lab performing the analysis, constituent monitored and method used. Most EPA- and DDW-approved analytical methods have maximum sample holding times between 14 and 28 d. Using sample holding times as an estimate of sample turnaround time, the maximum time required for return of an abnormal sample result is not expected to exceed one (1) month or four (4) weeks. Prior to initiating corrective action, collection and analysis of confirmation samples will be performed. The estimated time required for rush turnaround of analytical results is approximately one (1) week. The total time required for sample analyses is therefore estimated to be five (5) months.

The time required for corrective action will vary highly depending on the action needed. Prior to initiating any corrective action, notification of and coordination with regulatory agencies is estimated to require two (2) weeks. Potential corrective actions could include: changes to the treatment process at the Palmdale WRP, identification of a problem in the wastewater source control program, cessation of groundwater injection and/or providing owners of nearby drinking water wells with an alternative drinking water supply. The action most protective of human health is the supply alternative water supplies to impacted users therefore this action was used as a benchmark for the time required for corrective action. In the case of the PRGRRP, the nearest drinking water wells will be the recovery wells for the PRGRRP that are owned by PWD. As the project sponsor of the PRGRRP, PWD can cease pumping of these wells as needed. No additional time is therefore needed to provide for an alternative drinking water supply. The estimated time required to initiate corrective action is therefore two (2) weeks.

As summarized in Table 9-8, the proposed minimum response time for the PRGRRP 19 weeks or approximately five (5) months.

**Table 9-8: Proposed PRGRRP Response Retention Time**

| Response Retention Time | Duration |
|---|---|
| Underground travel time to nearest downgradient compliance monitoring well | 12 weeks |
| Sample collection, analysis, reporting and regulatory consultation time | 5 weeks |
| Regulatory consultation time and corrective action | 2 weeks |
| **Proposed Response Retention Time Total** | **19 weeks** |

### 9.7.2 Proposed Preliminary PRGRRP Response Retention Time

An intrinsic tracer study will be initiated at the PRGRRP within the first three months of operation. Until the completion of this tracer study, a preliminary proposed response time was estimated using the USGS's MODFLOW finite difference model.

The analysis found that the minimum groundwater travel times between the recharge basin and associated extraction well network was about 4 years (48 months) during Phase 1a. Per Title 22, numerical estimation methods using validated finite difference models are credited with 0.5 months of response retention time per month of estimated underground retention time (RT). The proposed credited response retention time (RRT) for the PRGGP is therefore,

$$48\, months\ estimated\ RT\ \times \frac{0.5\, months\ RRT}{months\ estimated\ RT} = \mathbf{24\ months\ RRT}$$

The proposed preliminary RRT for the PRGGP is 24 months, a factor of 12 times longer than the minimum RRT of 2 months required by DDW and a factor of 4.8 times longer than the proposed PRGRRP-specific minimum RRT of 5 months.

## 9.8 Compliance with State Water Board Recycled Water Policy (SWRCB Resolution No. 2013-0003)

The 2013 Amended Recycled Water Policy delineates State Water Resources Control Board requirements for groundwater recharge projects. The purpose of the 2013 amended Recycled Water Policy is to provide direction to Regional Water Quality Control Boards (RWQCBs) regarding the criteria to be used when issuing permits for recycled water projects.

This recycled water policy has two components which pertain to groundwater replenishment project utilizing recycled water (SWRCB, 2013).

1. Recycled Water Groundwater Recharge Projects
2. Anti-degradation

### 9.8.1 Recycled Water Groundwater Recharge Projects

Groundwater recharge projects utilizing recycled water are required by the State Water Resources Control Board to monitor for constituents of emerging concern (CECs). Recycled water monitoring programs for groundwater recharge and reuse projects must include monitoring of: (1) human health-based CECs; (2) performance indicator CECs; and (3) surrogates.

Monitoring requirements for CECs and surrogates shall proceed in phases to allow monitoring requirements to be refined based on findings from the previous monitoring phase.

- Initial Assessment Monitoring Phase: To be conducted for a period of one (1) year to identify the occurrence of CECs and surrogates in the recycled water and groundwater and to specify the expected removal percentages for performance indicator CECs and surrogates. Monitoring frequency for this phase is summarized in Table 9-9.

- Baseline Monitoring Phase: To be conducted for a period of three (3) years following the initial assessment monitoring phase to assess and refine which health-based and performance indicator CECs and surrogates are appropriate to monitor standard facility operation. If a performance indicator CEC is found to be a poor indicator, an alternative indicator shall be proposed. Monitoring frequency for this phase is summarized in Table 9-9.

- Standard Operation Monitoring: Performance indicator CECs and surrogate that provide an indication of operational performance shall be selected for monitoring of standard operation performance. The list of health-based CECs may be revised to remove CECs from the list of monitoring constituents if previous monitoring results meet minimum threshold levels as defined in SWRCB Resolution No. 2013-0003. Monitoring frequency for this phase is summarized in Table 9-9.

Table 9-9 summarizes the CECs and surrogates to be monitored at the PRGRRP per SWRCB Resolution No. 2013-0003. All CECs listed in Table 9-9 will be monitored during an initial assessment monitoring phase of one year. Based on the findings of this initial assessment, the list of performance indicator CECs required for monitoring may be refined for subsequent monitoring phases. All health-based CECs listed shall be monitored during the initial assessment phase and baseline monitoring phase, but may be revised for subsequent monitoring.

CECs to be monitored for compliance with SWRCB Resolution No. 2013-0003 shall be monitored in two locations,

1. The tertiary recycled water produced at the Palmdale WRP prior to surface spreading, and
2. Monitoring Well No. 1 located within 60 days downgradient of the recharge site (under Phase 1a conditions).

Information on all proposed monitoring and reporting activities is also available in the Title 22 engineering report which is located in FAAST PIN # 30947 as Attachment T4.

**Table 9-9: Proposed Monitoring of Contaminants of Emerging Concern (CECs) and Surrogate Compounds for Compliance with SWRCB Resolution No. 2013-0003**

| | | | Monitoring Frequency (RW/GW) [b] | |
|---|---|---|---|---|
| Constituent [a] | Constituent Group | Indicator Type/Surrogate | Initial Assessment | Baseline & Standard Operation |
| 17β-Estradiol | Steroid hormone | Health | Q/Q | SA/SA |
| Caffeine | Stimulant | Health & Performance | Q/Q | SA/SA |
| N-Nitrosodimethylamine (NDMA) | Disinfection byproduct | Health | Q/Q | SA/SA |
| Triclosan | Antimicrobial | Health | Q/Q | SA/SA |
| Gemfibrozil | Pharmaceutical | Performance | Q/Q | SA/SA |
| Iopromide | Pharmaceutical | Performance | Q/Q | SA/SA |
| N,N-Diethyl-meta-toluamide (DEET) | Personal care product | Performance | Q/Q | SA/SA |
| Sucralose | Food additive | Performance | Q/Q | SA/SA |
| Total organic carbon | Surrogate | | W/Q | W/Q |
| Ammonia | Surrogate | | Q/Q | Q/Q |
| Nitrate | Surrogate | | Q/Q | Q/Q |
| Ultraviolet (UV) light absorption | Surrogate | | Q/Q | Q/Q |

Notes:

(a) Frequencies: D = daily, W = weekly, BW = Biweekly (twice per week), M = monthly, Q = quarterly, A = annually, SA = semiannually (twice per year)

(a) The list of constituents will be refined between each monitoring phase. The initial list of constituents to be monitored during the initial assessment monitoring phase is shown.

(b) RW = recycled water, GW = groundwater

### 9.8.2 Antidegradation (SWRCB Resolution No. 68-16)

The State Water Board Resolution No. 68-16 Anti-degradation Policy specifies that any activity involving disposal of waste to high quality water must ensure that the highest water quality consistent with the maximum benefit to the people of the state will be maintained. Groundwater recharge projects using recycled water have potential to lower water quality within a basin and must demonstrate compliance with Resolution No. 68-16.

Under this anti-degradation policy, every groundwater basin in California must adopt a salt and nutrient management plan (SNMP). Each SNMP should be tailored to site-specific factors and water quality concerns in each basin. Each plan must address all sources of salt and/or nutrients to the groundwater basin, including recycled water irrigation projects and groundwater recharge reuse projects.

Until a SNMP is in effect, the SWRCB's Recycled Policy states that compliance may be demonstrated by showing a project utilizes less than 10% of available basin or sub-basin assimilative capacity (or multiple projects utilizing less than 20%) over a ten year time frame.

Once a SNMP is in effect for a basin demonstration of compliance should be consistent with the requirements of that SNMP.

#### *9.8.2.1 Salt and Nutrient Management Plan (SNMP) for the Antelope Valley (May 2014)*

The basin groundwater quality and potential water quality impacts of planned water and recycled water projects on the Antelope Valley groundwater aquifer were examined to address long-term groundwater basin sustainability. The Salt and Nutrient Management Plan (SNMP) for the Antelope Valley was released in May 2014 and reports the findings of this study. The Lahontan Regional Water Control Board provided a letter of acceptance, dated December 8, 2014 of the Salt and Nutrient Management Plan. The letter is loaded into FAAST PIN #30947 as Attachment D.

The findings of the SNMP indicated that overall quality of the groundwater in the Antelope Valley is stable and below water quality management goals based on designated beneficial uses (AVSNMPSG, 2014). Future water use is projected to increase arsenic concentrations in the groundwater; however, the basin average will remain within an acceptable range to protect anticipated beneficial uses therefore no new implementation measures were recommended.

A monitoring plan was designed to determine whether salt and nutrient concentrations over time are consistent with SNMP predictions and whether existing measures to manage SNMP constituents are effective or if additional measures are necessary (AVSNMPSG, 2014).

#### *9.8.2.2 Assimilative Capacities of the Antelope Valley Basin*

The SNMP for the Antelope Valley established water quality management goals based on the beneficial use of groundwater as a source of drinking water and agricultural irrigation water. Based on these water quality goals and existing aquifer water quality, basin and sub-basin assimilative capacities were established for seven constituents: arsenic, total chromium, fluoride, nitrate, total dissolved solids, chloride and boron. The values for the greater Antelope Valley basin and the Lancaster sub-basin, the proposed location of the PRGRRP, are summarized in Table 9-10.

Several sub-basins in the Antelope Valley Basin exceed the water quality management goal for arsenic and therefore possessed no assimilative capacity. These levels are attributed to natural occurring arsenic in the basin rocks and soils (SNMP, 2014). High natural levels of arsenic result in an overall average Antelope Valley basin assimilative capacity that is relatively low (Table 9-10)). According to the SNMP, it is unlikely that the management goal for arsenic will be achievable in the groundwater given the high natural occurrence in the Antelope Valley and that management such as well head treatment will likely be necessary. The Lancaster sub-basin, the proposed location of the PRGRRP, has assimilative capacities for all seven constituents, including arsenic, that are equal to or greater than those of the basin-wide average values (Table 9-10).

**Table 9-10: Groundwater Quality and Assimilative Capacities for the Antelope Valley Basin and Lancaster Sub-basin**

| | Arsenic | Boron | Chloride | Fluoride | Nitrate | Chromium | TDS |
|---|---|---|---|---|---|---|---|
| | μg/L | mg/L | mg/L | mg/L | mg/L | μg/L | mg/L |
| Water Quality Management Goal | 10 | 0.7 | 238 | 1 | 10 | 50 | 450 |
| **Average Antelope Valley Groundwater Basin** | | | | | | | |
| Baseline Water Quality | 9.66 | 0.17 | 38.4 | 0.44 | 1.97 | 5.53 | 350 |
| Assimilative Capacity | 0.3 | 0.53 | 200 | 0.6 | 8.0 | 44 | 99.8 |
| **Lancaster Sub-basin** | | | | | | | |
| Baseline Water Quality | 8.88 | 0.14 | 35.2 | 0.43 | 1.53 | 6.10 | 325 |
| Assimilative Capacity | 1.1 | 0.56 | 203 | 0.6 | 8.5 | 44 | 124.7 |

#### *9.8.2.3 SNMP Salt Balance Model*

Salt impacts of ongoing and future water use projects in the Antelope Valley were assessed using a conceptual mass balance model, accounting for direct loading and unloading of water and salts to the groundwater aquifer. Flows to the groundwater included natural recharge, return flows from agricultural irrigation and outdoor municipal water use, on-site waste disposal systems and aquifer recharge projects. Details on the data sources and application of this model are available in the Salt and Nutrient Management Plan for the Antelope Valley (AVSNMPSG, 2014).

This Salt Balance relied on several conservative assumptions, including:

- For each water usage, a certain fixed percentage of the applied water (e.g. 25% for agricultural use, 100% for recharge projects) was designated as return flows to groundwater; however, the model assumed 100% of the mass of each constituent in the applied water enters the groundwater with the return flow, disregarding any uptake, attenuation or transformation of chemicals.

- Water and constituents were assumed to mix instantaneously on an annual basis, neglecting the time for applied water to travel through the soil and reach groundwater.

- Constituent values for different water sources were obtained from recent water quality sampling. For constituents below detection limits, the constituent detection limit was conservatively assumed to be present in the water when calculating cumulative impacts to the groundwater.

This model was used to predict the impacts of water projects over 10 and 25 year planning periods (2010-2035). Fourteen reuse or recharge projects were included in the Salt Balance Model and assessed during the anti-degradation analysis performed in the SNMP, including seven irrigation projects with recycled water and four recharge projects using imported (i.e., State Water Project) water. The PRGRRP was not included in the SNMP analysis because sufficient information to assess impacts was not available at the time the SNMP was performed.

#### *9.8.2.4 Impact of the PRGRRP on Assimilative Capacity Usage*

Using the same methodology as the 2014 SNMP, the impact of the PRGRRP, in addition to the eleven reuse/recharge projects previously included in the 2014 SNMP, was evaluated. Per the methodology used in the 2014 Antelope Valley SNMP, Project impacts on the assimilative capacity were determined relative to the average Antelope Valley Basin assimilative capacity rather than the individual sub-basin where the projects are/will be located.

The constituent concentrations used in the Salt Balance model are summarized in Table 9-11. Constituent values were obtained from the SNMP with the exception of concentration increases from domestic indoor use for boron, chloride, chromium, fluoride and nitrate. Representative values for domestic increases in these constituents were taken from Asano *et al.*, 2007.

It was assumed that the recycled water quality for all projects was the same. The tertiary recycled water produced at the Palmdale WRP has equal or lesser concentrations than those listed in Table 9-11 for all 7 constituents included in this anti-degradation analysis. The assumption of a uniform recycled water quality is therefore conservative with regard to the impacts on groundwater quality by the PRGRRP.

The anticipated start date of the PRGRRP is 2018, therefore impacts up through 2028 were assessed to evaluate the combined projects' impacts on assimilative capacity over a 10 year time period as recommended by the SWRCB's Recycled Water Policy. The concentration increase and assimilative capacity used for all seven water quality constituents are summarized in Table 9-12 for:

- "No RW Project" : Current Antelope Valley water uses only (disregarding any recycled water or recharge projects),
- "SNMP RW Projects" : All recycled water and recharge projects previously evaluated in the 2014 SNMP, and
- "SNMP RW Projects + PRGRRP": All recycled water and recharge projects previously evaluated as well as the PRGRRP.

As reported in Table 9-12, the expected combined impact of the PRGRRP and other SNMP RW projects on boron, chloride, chromium, fluoride, and nitrate are negligible (less than or equal to 2% usage of the average basin assimilative capacity). The impact of recycled water and recharge projects is anticipated to increase the assimilative capacities of TDS and arsenic relative to current non-recycled water uses.

Total dissolved solids (TDS) is anticipated to increase by 2028, but to no greater than 16 % of assimilative capacity for this constituent. Arsenic levels in the greater Antelope Valley basin are expected to exceed 20% of the average basin assimilative capacity by 2028. Relative to impacts by the projects previously included in the 2014 SNMP, the PRGRRP is expected to have no impact on the percent usage of assimilative capacity of arsenic and to increase the percent usage of assimilative capacity of TDS by less than 0.5%. The inclusion of the PRGRRP does not result in appreciable increased utilization of the basin's assimilative capacity compared to levels previously deemed acceptable.

Although arsenic is anticipated to exceed 20% of assimilative capacity of the greater Antelope Valley basin within 10 years of initiation of the PRGRRP, and recharge projects previously evaluated in the 2014 SNMP, the SNMP states that it is unlikely that the water quality management goal will be achievable for arsenic in the groundwater given the high natural occurrence of this chemical (SNMP, 2014). Implementation of the identified projects is preferable to not having the increased supply available, especially during drought conditions (AVSNMPSG, 2014).

Local conditions may result in impacts that differ from the larger, basin-averaged effects. For example, the Lancaster sub-basin where the PRGRRP will be located has an assimilative capacity for arsenic greater than 250 % higher than the average assimilative capacity of the greater Antelope Valley used in this anti-degradation analysis (Table 9-11)). The water quality of nearby wells as reported in the GAMA database, suggests that local groundwater adjacent to the PRGRRP recharge site has lower levels of arsenic than the Antelope Valley basin including some areas of the Lancaster Subbasin. The local groundwater therefore has significantly higher assimilative capacity than is reported in Table 9-11

**Table 9-11:Constituent Concentrations Used in the Salt Balance Model**

| Constituent | Units | Aquifer Baseline | Imported Water | Recycled Water | Natural Recharge | Increase from Domestic Indoor Use |
|---|---|---|---|---|---|---|
| Arsenic | µg/L | 9.66 | 3.8 | 1 (a) | 1 (a) | 0.5 (b) |
| Boron | mg/L | 0.17 | 0.16 | 0.6 | 0.05 | 0.15 (c) |
| Chloride | mg/L | 38.4 | 85 | 167 | 3.7 | 35 (c) |
| Chromium | µg/L | 5.5 | 1 (a) | 1 (a) | 1 (a) | 0.5 (b) |
| Fluoride | mg/L | 0.44 | 0.1 | 0.36 | 0.3 | 0.3 (c) |
| Nitrate | mg/L-N | 1.97 | 0.9 | 7 | 0.08 | 0.005 (b) |
| Total Dissolved Solids | mg/L | 350 | 300 | 500 | 150 | 175 |

(a) Notes:
(b) Values for all water quality constituents were taken from the 2014 Salt and Nutrient Management Plan for the Antelope Valley, except where noted.
(a) Constituent was not detected in this water source; to be conservative the standard method detection limit was assumed.
(b) Increase in domestic wastewater is typically negligible; to be conservative one half the standard method detection limit was assumed.
(c) Median values taken from Asano, T., Burton, F.L., Leverenz, H.L., Tsuchihashi, R., Tchobanoglous, G., 2007. Water Reuse: Issues, Technologies and Applications, McGraw-Hill: New York.

**Table 9-12: Assimilative Capacity Used by 2028**

| Constituent | Concentration Increase by 2028 (mg/L) | | | Percent Assimilative Capacity Used by 2028 (%) | | |
|---|---|---|---|---|---|---|
| | No RW Projects | SNMP RW Projects | SNMP RW Projects + PRGRRP | No RW Projects | SNMP RW Projects | SNMP RW Projects + PRGRRP |
| Arsenic | 0.00009 | 0.000095 | 0.000094 | 25 | 28 | 28 |
| Boron | 0.005 | 0.010 | 0.010 | 1 | 2 | 2 |
| Chloride | 2.1 | 4.2 | 4.3 | 1 | 2 | 2 |
| Chromium | 0.00003 | 0.00002 | 0.00002 | <1 | <1 | <1 |
| Fluoride | 0.009 | 0.009 | 0.01 | 2 | 2 | 2 |
| Nitrate | 0.02 | 0.05 | 0.06 | <1 | <1 | <1 |
| Total Dissolved Solids | 10.0 | 15.4 | 15.7 | 10 | 15.4 | 15.7 |

(a) Notes:

(b) RW = recycled or recharge water projects; SNMP RW = recycled or recharge water projects previously included in the 2014 SNMP for the Antelope Valley; PR GRRP = Palmdale Regional Groundwater Recharge and Recovery Project

### *9.8.2.5 SNMP Monitoring Program*

A representative number of water supply wells were selected for inclusion in the SMNP monitoring program based on their proximity to water projects, including 23 in the Lancaster sub-basin (AVSNMPSG, 2014). Recycled waters are to be monitored annually. Public supply wells are generally monitored every other year; however, additionally monitoring may be needed in special circumstances, for example, if a maximum contaminant is exceeded.

The SNMP monitoring program includes monitoring of: total dissolved solids (TDS), nitrate, arsenic, total chromium, fluoride and boron. As a new project, it is the responsibility of the PWD to designate a groundwater well for inclusion in the SNMP monitoring program. The PWD will provide annual data reports of groundwater downgradient of the PRGRRP recharge basins (as monitored in Monitoring Well No. 1.) The Title 22 engineering report shall be consistent with the requirements of the SNMP for the Antelope Valley, these constituents will be monitored on an annual basis.

Other constituents, such as constituents of emerging concern (CECs), may be added the Antelope Valley SNMP in the future, particularly for those projects using recycled water for groundwater recharge, but are not required at this time. A number of regulated and unregulated constituents will be monitored in the groundwater downgradient of the PRGRRP recharge site and can be provided as needed for inclusion in the SNMP.

The SNMP monitoring report is prepared and submitted to the Lahontan Regional Board every three years. At the time of the 2014 SNMP, the group responsible for reporting to the Regional Board was undecided. Following consultation with the Antelope Valley Salt and Nutrient Management Plan Stakeholders Group, the PWD will provide PRGRRP groundwater monitoring data to the reporting group at the to be determined requested frequency.

# CHAPTER 10

# PROJECT PHASING

This section provides a general description of Project facilities as they relate to meeting Title 22 requirements. New facilities will be constructed to convey source waters to the recharge ponds and to recover groundwater for distribution through the potable water system. The following sections describe major facilities, phasing, and anticipated flows for recharge and extraction production. Specific facility design criteria and detailed drawings are provided in the Preliminary Design Report (T1) and Plans and Specs (T9) (search FAAST PIN # 30947).

Note: Grant funding and a SRF loan is being sought for only Phase 1a.

## 10.0 Project Description

The Project includes construction of new facilities to deliver SWP Water from the California Aqueduct combined with recycled water from the Palmdale WRP to a surface spreading basin on an undeveloped site in northeast Palmdale to recharge the groundwater aquifer. Project facilities include pipelines to convey source waters to the recharge site, recovery (pumping) wells to extract water, and pumping stations to either deliver water to customers or pump water back to the California Aqueduct.

As introduced in Chapter 9, Title 22 regulations for surface application of tertiary disinfected recycled water require blending recycled water with the untreated diluent water source at a specified blending ratio. The source waters for the PRGRRP include recycled water from the Palmdale Wastewater Treatment Plant and diluent water from the SWP and naturally occurring groundwater.

The project is proposed to be developed in the following three phases to meet Title 22 requirements, align with PWD's future water demands and spread capital infrastructure investments over time:

- Phase 1a will include construction of facilities to meet water demands over the first 20 years, to initially meet a recycled water contribution of 20 percent, and demonstrate the ability of the project to meet Title 22 requirements.

- Phase 1b will expand facilities to meet PWD water demands for the next 20 years at an increased recycled water contribution percentage.

- Phase 2 will build-out Project facilities to meet PWD's water demand through 50 years (2068).

Table 10-1 summarizes the average annual source water contributions, anticipated recharge volumes and potential extraction volumes for each of the three phases. The overview of project facilities in subsequent sections in this Chapter describes facilities associated with the ultimate Project build-out. The Title 22 Engineering Report provides additional details about the sources and distribution of diluent flows associated with each Phase to meet regulatory requirements for recycled water contribution.

**Table 10-1: Average Annual Flows by Project Phase**

| Phase | Period | Average RW (AFY) | Average Diluent[1] (AFY) | Total Recharge (AFY) | Average Extraction (AFY) |
|---|---|---|---|---|---|
| Phase 1a | 2019-2038 | 3,600 | 6,400 | 8,310 | 7,500 |
| Phase 1b | 2039-2058 | 6,598 | 9,897 | 14,806 | 8,050 |
| Phase 2 | 2059-2068 | 5,690 | 8,535 | 12,535 | 10,800 |

[1] Diluent water includes SWP Water and native groundwater flows.

## 10.1 Overview of Project Facilities

The overall Project at build-out is schematically illustrated in Figure 10-1.

**Figure 10-1: PRGRRP Process Flow Diagram (Build-out)**

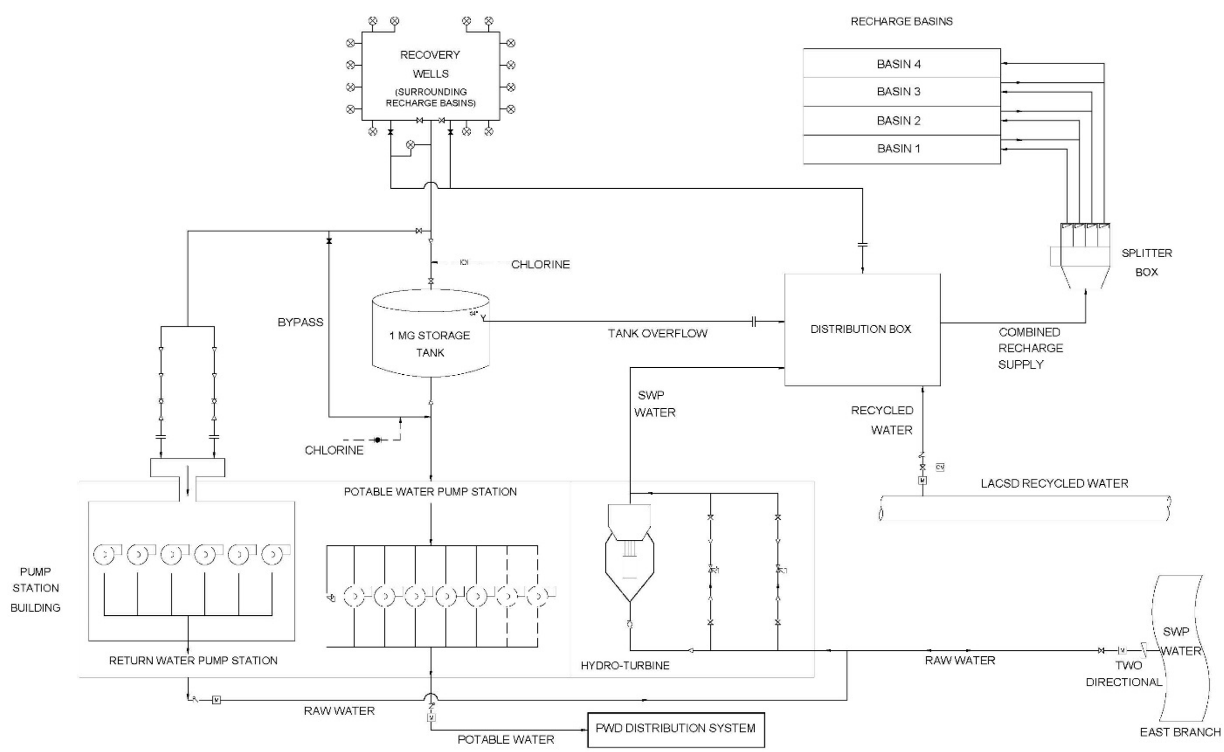



Table 10-2 lists the major facilities associated with conveyance of source water to the recharge facilities and the extraction of groundwater for distribution to the potable water system. Each of these facilities is described in the subsequent sections.

**Table 10-2: Overview of Project Facilities**

| Source Conveyance and Recharge Facilities | |
|---|---|
| Raw Water Pipeline | Conveys SWP via gravity from the East Branch of the California Aqueduct to the Distribution Site. |
| Recycled Water Pipeline | Conveys recycled water from the Palmdale WRP by gravity to the Distribution Site. |
| Distribution Site | Includes the Hydro-Turbine and Distribution Box (along with other extraction and distribution facilities) |
| Hydro-Turbine | Converts excess pressure head from SWP flows to electricity. |
| Distribution Box | Combines SWP Water with Recycled Water. |
| Combined Recharge Supply Pipeline | Conveys recharge supply water from the Distribution Site to the Splitter Box via gravity. |
| Splitter Box | Provides flow distribution to any or all of the four Recharge Basins. |
| Recharge Basins | Four, 20-acre cut-and-fill earth embankment recharge basins with shotcrete-lined interior slopes. |
| Recharge Test Basin | One, 0.23 acre equipped with multiple sampling wells |
| Monitoring Wells | Two downgradient and one up-gradient monitoring wells installed to support a groundwater sampling program. |

| Extraction and Distribution Facilities | |
|---|---|
| Recovery Wells | Up to 16 wells configured in a radial pattern surrounding the Recharge Site, to be installed in phases |
| Well Collection Pipeline | Connect the Recovery Wells to the Distribution Site |
| Distribution Site | Includes Pump Stations, Storage Tank, and Chlorine Room (along with other source conveyance facilities) |
| Storage Tank | Groundwater destined for the potable water distribution system is conveyed to the Storage Tank for disinfection |
| Chlorine System | Chlorine generated on-site in the form of sodium hypochlorite is injected into Storage Tank inlet |
| Potable Water Pump Station (PWPS) | Pump potable water from the Storage Tank to the PWD potable water distribution pipeline |
| Potable Water Pipeline | Connects the Potable Water Pump Station to the PWD potable water distribution pipeline |
| Return Water Pump Station (RWPS) | An optional pump station that would bypass the Storage Tank to pump non-chlorinated return water to the East Branch of the California Aqueduct, only if a water banking partnership is achieved. |
| Return Water Pipeline | A two-directional segment of the Raw Water pipeline to convey non-chlorinated return water to the East Branch of the California Aqueduct. |

### 10.1.1 Source Conveyance and Recharge Facilities

This section provides an expanded description of the facilities listed in Table 10-2. Additional detail about alignments and design criteria is provided Preliminary Design Report (T1) and Plans and Specs (T9) (search FAAST PIN # 30947).

Raw Water Pipeline - The Raw Water Pipeline (also referred to as the Return Water Pipeline) includes 8.6 miles of 36-inch diameter pipeline designed to convey up to 50 cfs (36,100 AFY). Raw water will enter the transmission pipeline through a turnout in the East Branch of the California Aqueduct (SWP Turnout). Raw water will then pass through a sluice gate at the turnout entrance, through an algae screen (traveling screen), into the transmission pipeline, and then through a magnetic flow meter and manual shut-off valve. The transmission pipeline will deliver raw water to the Hydro-Turbine at the Distribution Site.

Recycled Water Pipeline - The Recycled Water Pipeline includes 0.1 mile of 30-inch diameter pipeline designed for an ultimate capacity of up to 22.2 cfs (16,100 AFY). The Recycled Water Pipeline will connect to an existing LACSD 48-inch diameter recycled water pipeline at the intersection of 105th Street East and East Avenue M and discharge to the Distribution Box at the Distribution Site. Recycled water deliveries will be measured with a magnetic flow meter, modulated by a control valve, and limited from back-flowing with a check valve.

Distribution Site - The Distribution Site includes the following facilities associated with source water conveyance: (1) Hydro-Turbine and (2) Distribution Box. An electrical room and control room are also located at the site along with ancillary pipeline between facilities.

Hydro-Turbine - SWP Water from the Raw Water Pipeline will be directed to the Hydro-turbine Room at the Distribution Site. Flows between10 and 40 cfs will enter the hydro-turbine to convert excess pressure head to electricity, and water flows below 10 cfs and above 40 cfs will be bypassed completely through two parallel pressure reducing valves. Flow control for the raw water delivery will be accomplished downstream in the Hydro-turbine Room using the two nozzles at the hydro-turbine when the hydro-turbine is in service, and using the two 16-inch diameter pressure-reducing valves (PRVs) with electronic actuated rate of flow control when the turbine is being by-passed. Discharge from the hydro-turbine or the pressure reducing valves will flow by gravity through a 36-inch diameter pipeline into a Distribution Box.

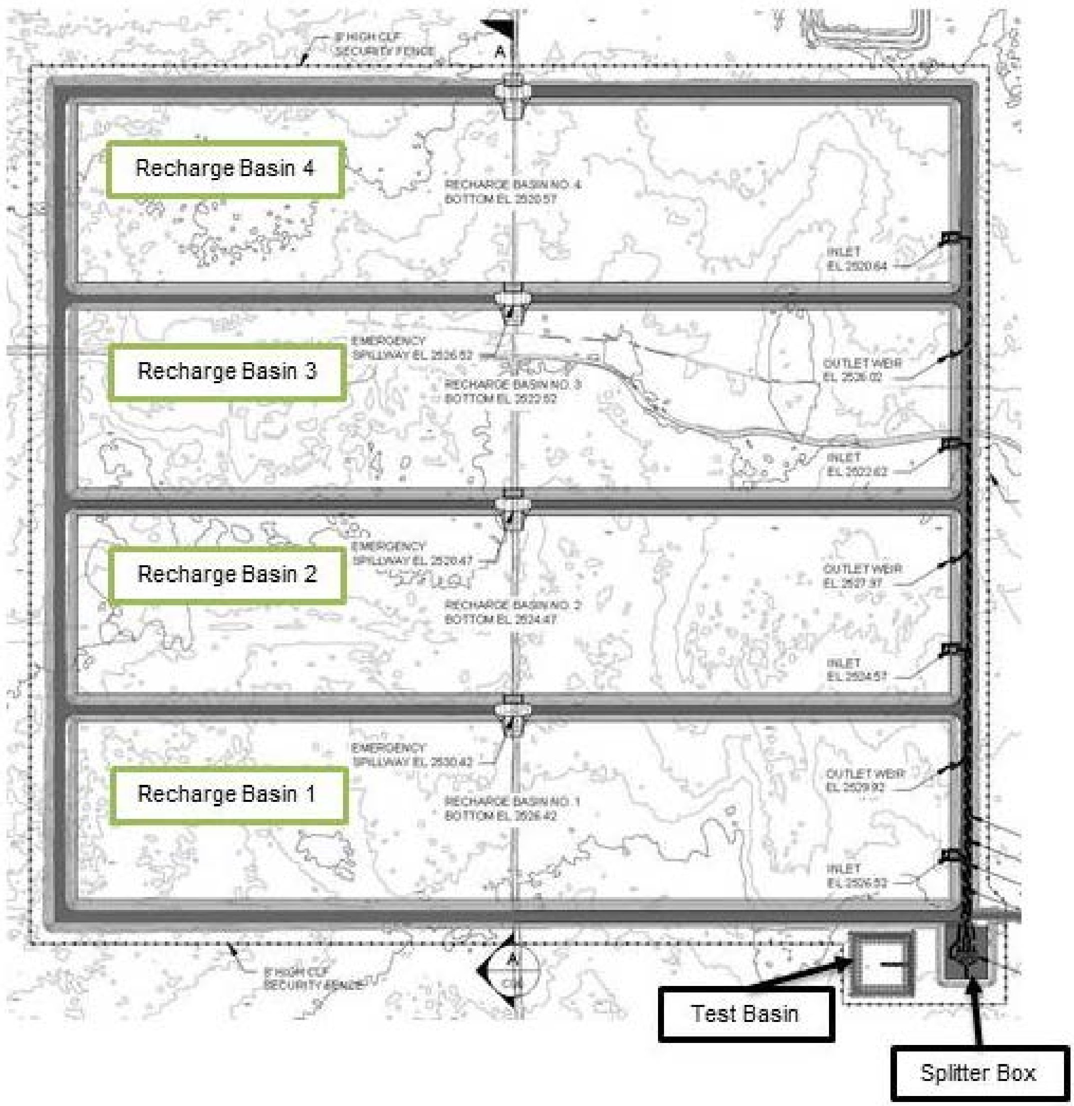
Distribution Box - Recycled water flows will be combined with SWP Water in the Distribution Box, when diluent water is being delivered. The Distribution Box can receive intermittent flow from the Recovery Well pipeline blow-off or from the Storage Tank overflow. The combined recycled water and SWP Water will exit the Distribution Box and flow by gravity to the Splitter Box Combined Recharge Supply Pipeline. The Distribution Box is sized to convey up to 52,200 AFY.

Combined Recharge Supply Pipeline - The Combined Recharge Supply Pipeline will be a 0.6 mile, 48-inch diameter pipeline sized to convey up to 52,200 AFY from the Distribution Box to the Splitter Box.

Splitter Box - The Splitter Box will provide flow distribution to any or all of the four recharge basins, as well as the Recharge Test Basin. Four separate chambers will each be equipped with 36-inch diameter sluice gates that deliver water through four independent 36-inch diameter pipelines to each basin inlet structure. Overflow weirs in the Splitter Box to each chamber will provide equal flow distribution to all chambers with an open sluice gate. The sluice gates to Basins 1, 2, and 3 will be manually operated, while the sluice gate for Basin 4 will have a motor operator. The Splitter Box is sized to convey up to 52,200 AFY.

Recharge Basins - The Recharge Site will be 160 acres with four 20-acre cut-and-fill earth embankment recharge basins with shotcrete-lined interior slopes. The basins will occupy approximately 100 acres in the center of the Recharge Site and provide 80 acres of basin floor for infiltration. With a perimeter access road around the toe of the recharge basin berms, approximately 110 acres will be fenced. Figure 10-2 shows the layout of the recharge basins as well as the associated structures.

**Figure 10-2 Schematic of Recharge Basins**




The recharge basins are each designed with an operating water level of 2 to 3 feet. Basin 1 is nearest to the Splitter Box, while Basin 4 is the farthest, with Basin 2 and Basin 3 in between. Each basin has approximately a 2.0-foot elevation drop, so Basin 4 is the lowest elevation while Basin 1 is the highest. If the water level in Basins 1, 2, or 3 reaches a predetermined water level, typically 3.0 feet, then the water will begin flowing over an adjustable outlet weir to an outlet pipeline that joins the inlet pipeline for the adjacent down gradient basin. Each recharge basin will also be constructed with an emergency spillway at a water depth of 4.0 feet.

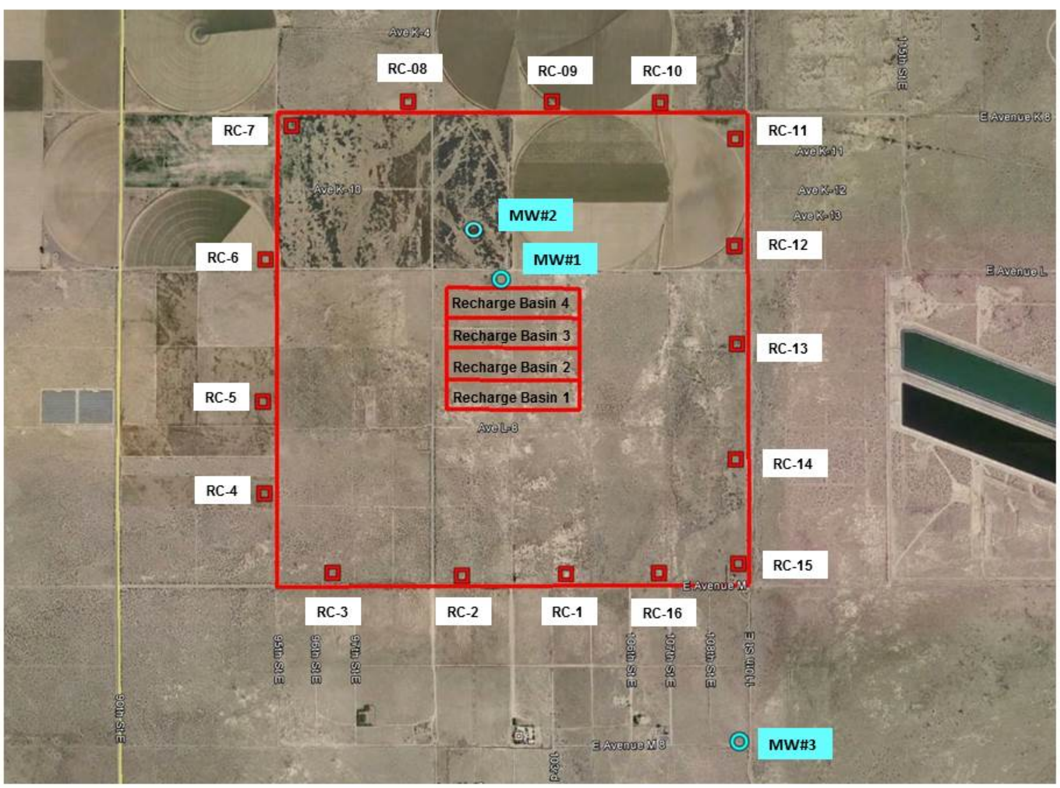
The design infiltration rate (3 feet/day) for the recharge basins is based on limited field testing. Obtaining a more accurate measurement of infiltration rate will provide a more accurate assessment of the required sizing for the recharge basins. PWD will construct and operate a temporary Pilot Infiltration Test Basin prior to construction of the full-scale recharge basins. The

Pilot Infiltration Test Basin will be on the order of 0.5 to 1.0 acres and will only be operated for up to 30 days to confirm actual site infiltration rates to guide the sizing of the recharge basins to achieve the ultimate recharge capacity for the Project.

Recharge Test Basin - A permanent Recharge Test Basin will be constructed and equipped with multiple sampling wells designed to sample at various depths below the floor of the basin (tentatively 10, 20, and 30-foot depths). The recharge test area will be approximately 10,000 sq ft (100 feet x 100 feet) or 0.23 acres. Unlike the four primary recharge basins, which are rotated from wet to dry for routine maintenance, the Recharge Test Basin can be operated continuously in order to evaluate SAT for TOC reduction as well as other parameters. The Splitter Box will be constructed with an 8-inch diameter pipeline to the Recharge Test Basin and equipped with a motor-operated control valve in order to maintain a constant predetermined level in the test basin.

Monitoring Wells - The project will include three groundwater monitoring wells (MW) to meet Title 22 requirements, as described in Section 9. The proposed monitoring well locations are shown in Figure 10-3 Two monitoring wells will be located approximately 120 feet (MW#1) and 800 feet (MW#2) downgradient from the recharge basins to represent roughly 60 days and 12 months travel time through the saturated zone. A third monitoring well (MW#3) will be located approximately 1 mile upstream of the southeast corner of the Recharge Site to provide representative sampling of the groundwater quality directly up-gradient of the Project.

**Figure 10-3: Monitoring and Recovery Well Locations**



### 10.1.2 Extraction and Distribution Facilities

Recovery Wells - Sixteen (16) Recovery Wells, radially arranged around the Recharge Basins, are proposed at full Project build-out (see Figure 10-3). The phasing plan for installation of the recovery wells is discussed later in Section 10.2 of this Chapter.

Each Recovery Well will pump extracted groundwater through a 10-inch diameter discharge header that is upsized to a 12-inch diameter pipeline underground leaving the well building. All wells are proposed to have a standard design based on previous geophysical tests and modeling of the aquifer, although final screen placement will vary based on results from well bore hole drilling, geophysical logging and sample analyses. The individual 12-inch diameter pipeline for each Recovery Well will connect to the common Well Collection Pipeline system that conveys all of the extracted water to the Distribution Site.

Well Collection Pipeline - The Well Collection Pipeline starts north of the recharge basins, with one side proceeding clockwise around the wells and the other counterclockwise, until combining at the Distribution Site. The Well Collection Pipeline begins as a 12-inch diameter pipeline and expands to 16-, 20-, and 24-inch diameter pipeline to account for the increased water flow from each Recovery Well. The two pipeline segments combine as a 36-inch diameter pipeline on the Distribution Site.

Distribution Site - The Distribution Site includes the following facilities associated with extraction and distribution facilities: (1) Storage Tank, (2) Chlorine System, (3) Potable Water Pump Station (PWPS) and (4) Return Water Pump Station (RWPS). Electrical, control and chemical rooms are also located at the site, along with ancillary pipeline between facilities.

When the extracted groundwater reaches the Distribution Site, the potable water will either be (1) chlorinated in a disinfection tank and pumped to PWD's distribution system, or (2) pumped back to the East Branch of the California Aqueduct without chlorination.

Storage Tank - Groundwater will be extracted by the Recovery Wells and delivered to a 1 MG Storage Tank at the Distribution Site. Potable water will be pumped to PWD's distribution system with a point of connection to the 2800 Zone at the intersection of 60th Street East and East Palmdale Boulevard. The Potable Water Pipeline will be sized for an ultimate capacity of 33.5 cfs (24,250 AFY). Alternatively, the groundwater can be pumped back to the East Branch of the California Aqueduct through the Raw Water/Return Water Pipeline at up to 41.5 cfs (30,000 AFY).

Chlorine System - The chlorination system will be located in the Chlorine Room at the southeast corner of the pump station. This system's primary purpose is to generate, store, and deliver the chlorine used for disinfection of the potable water produced by the Recovery Wells. Chlorine will be generated on-site in the form of sodium hypochlorite and injected into the 30-inch diameter tank inlet. The Storage Tank is sized, and the inlet and outlet pipes are designed to meet the required chlorine contact time for disinfection.

Potable Water Pump Station - The water level of the Storage Tank will provide static head, and therefore pressurization, of the pump cans for the PWPS vertical turbine pumps in the Pump Station Building. Potable, chlorinated water will be pumped by the PWPS through the Potable Water Pipeline to the point of connection to the PWD 2800 Zone. Water entering the 2800 Zone has a hydraulic grade line of 2800 feet.

Potable Water Pipeline - The 9.2 miles of 30-inch diameter Potable Water Pipeline will originate at the PWPS and proceed south along the same alignment as the Raw Water/Return Water Pipeline, and then traverses west along East Palmdale Boulevard, until 60th Street East.

Return Water Pump Station (RWPS) - The water level of the Storage Tank will provide sufficient head for the operation of the return water air gap piping, control valves, and structure that serve the RWPS wet well in the Pump Station Building. The RWPS will convey non-disinfected potable water to the East Branch of the California Aqueduct for use by potential partner agencies.

Return Water Pipeline - Return water pumped back to the East Branch of the California Aqueduct, by-passing the Storage Tank and disinfection, will be pumped by the RWPS back through the same 8.6-mile 36-inch diameter Raw Water/Return Water Pipeline used to deliver SWP Water for recharge. Thus, the pipeline can only be used in one direction at a time. It is envisioned that recharge will occur roughly 6 normal and wet years out of 10 years, and that return pumping will occur roughly 4 dry years out of 10 years.

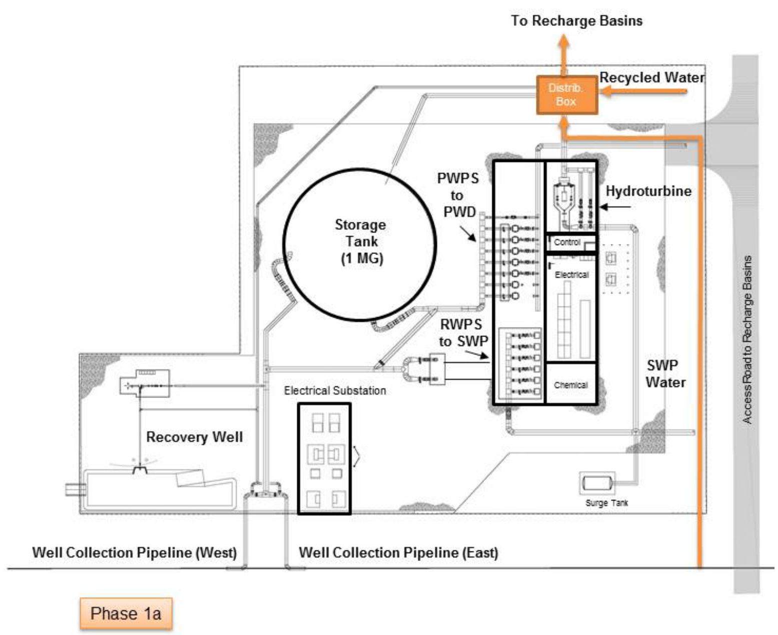
## 10.2 Project Facility Phasing

This section provides additional details about the facilities associated with each of the three project phases.

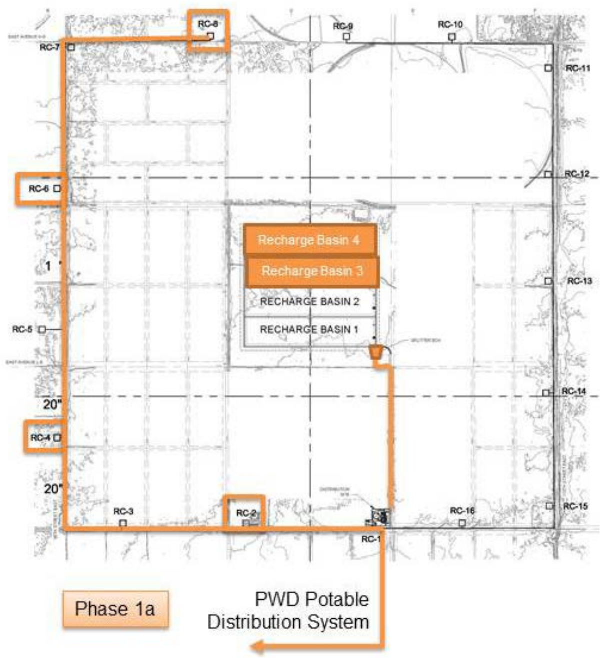
### 10.2.1 Phase 1a

Phase 1a of the Project includes 4 of 16 Recovery Wells, the western portion of the collection pipeline, the raw water/return water pipeline and turnout, recycled water pipeline and turnout, distribution box, combined recharge supply pipeline, splitter box, two of the four recharge basins, and on-site chlorine generation and injection at a selected recovery well. Figure 10-4 illustrates the Phase 1a facilities on the Recharge Site.

**Figure 10-4: Phase 1a Facilities**




**Phase 1a Source to Conveyance and Recharge Facilities**

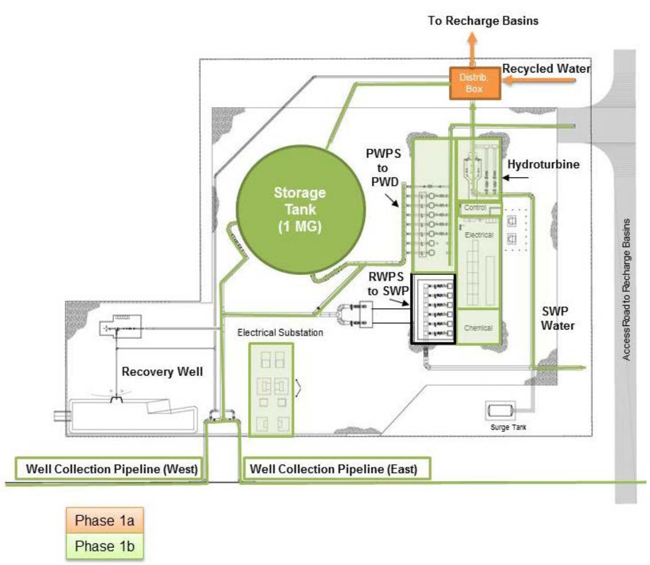



**Phase 1a Extraction and Distribution Facilities**

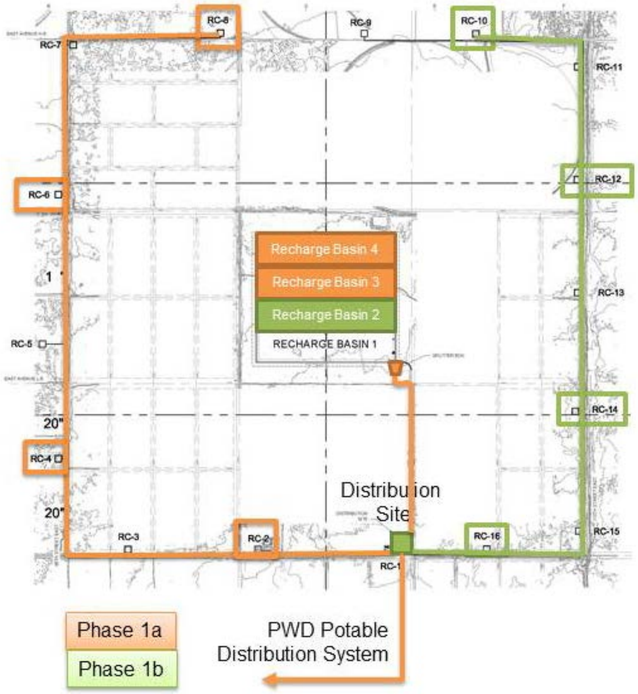
## 10.2.2 Phase 1b

Phase 1b of the Project includes an additional four Recovery Wells, Recharge Basin 3, storage tank, electrical substation, and construction of the Distribution Site facility including the PWPS, electrical room, hydro-turbine, chemical room, and control room. Figure 10-5 illustrates the Phase 1b facilities on the Recharge Site.

**Figure 10-5: Phases 1a and 1b Facilities**




**Phase 1b Source to Conveyance and Recharge Facilities**

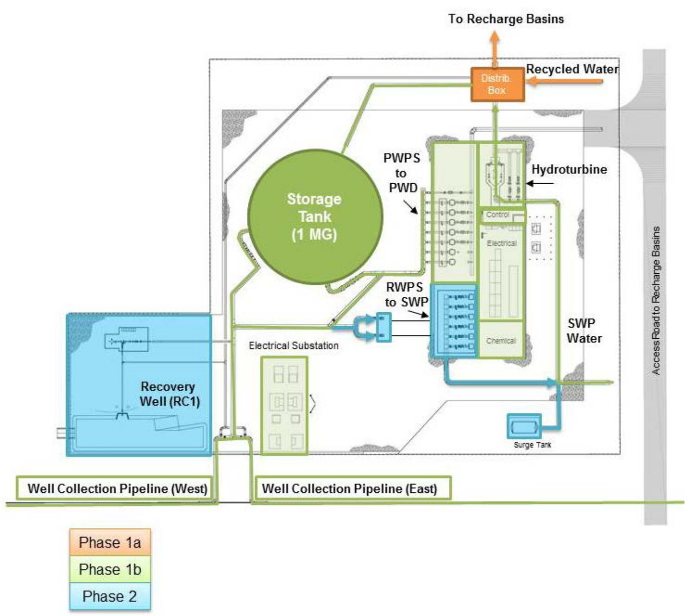



**Phase 1b Extraction and Distribution Facilities**

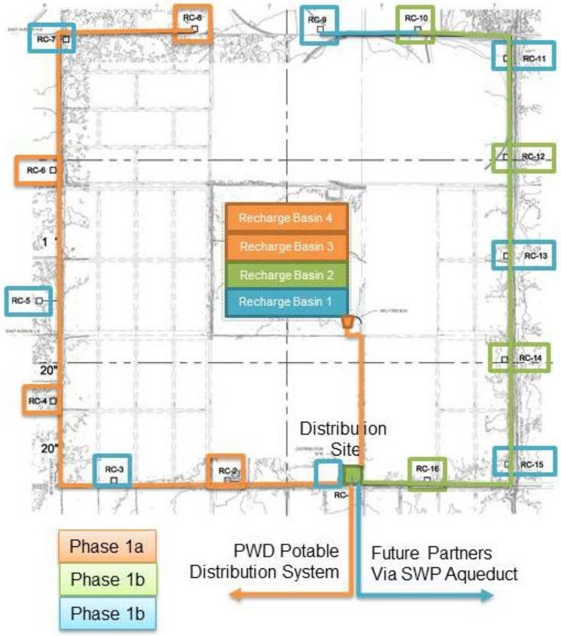
### 10.2.3 Phase 2

Phase 2 includes the additional 8 Recovery Wells, the remaining section of Well Collection Pipeline, the remaining 2 PWPS pumps, and the RWPS. Should sufficient interest exist among potential water bank partners, then the Phase 2 Recovery Wells, Well Collection Pipeline, and RWPS could be constructed earlier than the PWD water demand trigger for Phase 2. Figure 10-6 illustrates the Phase 2 facilities on the Recharge Site.

**Figure 10-6: Phase 2 Facilities**




**Phase 2 Source to Conveyance and Recharge Facilities**




**Phase 2 Extraction and Distribution Facilities**

# CHAPTER 11

# PHASE 1a AND STATE WATER RESOURCE MANAGEMENT OBJECTIVES

## 11.0 PROJECT GOALS

The Palmdale Water District (PWD) is actively addressing water reliability challenges with a proposed Project that will replenish the area's diminished groundwater basin by using and reusing its water supply to achieve the highest possible efficiency during both wet and dry year

The goal is to meet PWD's long-term water needs through the development of local, sustainable cost-effective and drought-resistant supplies.

The overarching objective is to develop a groundwater banking, storage, and extraction program, using a combination of raw imported State Water Project (SWP) water and locally produced recycled water delivered to a new recharge basin in the Lancaster Subbasin to supplement future groundwater well pumping needs.

Additional objectives of the proposed Project include:

- Help to provide a diversified portfolio of ground and surface water;
- Increase reliability of water supply;
- Replenish groundwater supplies;
- Save for future dry periods; and
- Provide a cost-effective solution for long-term water supply.

## 11.1 STATE MANGEMENT OBJECTIVES

The Department of Water Resources through the California Water Plan has developed the following six broad objectives for evaluating water management plans.

- Reduce Water Demand
- Improve operation efficiency and transfer of water
- Increase water supply
- Improve water quality
- Practice resource stewardship
- Improve flood management

The following sections address how the Palmdale Regional Groundwater Recharge and Recovery Project (PRGRRP) meets these objectives.

### 11.1.1 Reduce Water Demand

The project would reduce water demand on State Water Project diversions from the Bay-Delta Area by utilized the effluent from the Palmdale Wastewater Plant. Phase 1 of the PRGRRP project would through indirect use deliver 3600 acre-feet annually to recharge basins northeastern unincorporated areas near the northeaster edge of the City of Palmdale. Prior to being recharged it will be blended with State Water Project Water. Phase 1a and 2 will utilize another 2,900 acre-feet of recycled water for a total of 6,500 acre-feet of recycled water. Therefore, this water recycling project would use 6,500 acre-feet of effluent from the wastewater plant and reduce demands on water diversions from the Bay-Delta area by a corresponding amount.

### 11.1.2 Improve Operation Efficiency and Transfer Water

The PRGRRP indirect use project would contribute to water efficiency in the Antelope Valley by recycling water from the LA County Sanitation District No. 20 Palmdale Wastewater Plant. This project along with other planned recycled water project will efficiently use 100% of the water supply in the service area of the Palmdale Water District.

### 11.1.3 Increase Water Supply

A recycled water project is a local, drought-resistant and reliable supply that is generally not impacted by climate change. The main goal of implementing a recycled water project is to maximize the use of recycled water. The more a new supply that an alternative produces, the more favorable it becomes.

The Phase 1 PRGRRP indirect use project would use 3,600 acre-feet annually from the Palmdale Wastewater Treatment Plant. A follow up phase of the direct use will use another 2,900 acre-feet with the City of Palmdale.

Total increase in water supply would be about 6,500 acre-feet.

### 11.1.4 Practice Resource Stewardship

By implementing the PRGRRP project the PWD would move toward the goal of 100% water efficiency by recycling all of the water from the Palmdale Wastewater Project. The Palmdale Recycled Water Authority along with City of Palmdale and Palmdale Water District are in the process with LA County Sanitation District No. 20 to have all of the water rights from the Palmdale Wastewater Plant transferred to the Palmdale Recycled Water Authority. At the present time the average effluent flow from the plant is approximately 10,000 acre-feet per year.

### 11.1.5 Improve Water Quality

The project would not improve or impair water quality.

### 11.1.6 Improve Flood Management

The project would not improve or impair flood management

## 11.2 Palmdale Recycled Water Authority Objectives

Objectives of the Authority include but is not limited to the following:

- Long term water supply reliability
- Environmental Sustainability
- Amount of financing required
- Cost effectiveness

### 11.2.1 Long Term Water Supply Reliability

This Phase 1 of the PRGRRP will provide 3,600 acre-feet of additional water supply per year. Over the long term, the implementation of the Phases 1a and 2 will provide an additional reliable water supply of approximately 6,500 acre-feet from the Palmdale Wastewater Plant.

### 11.2.2 Environmental Sustainability

The project would not directly affect the environment of the Palmdale Water District Service area. However, it could have beneficial effects on the environmental issues in the Bay-Delta by reducing demands on transfer of water from that area.

### 11.2.3 Amount of Financing Required

The total project cost of $55,000,000 would be supported by a $15,000,000 and State Revolving Fund (SRF) loan interest loan of $40,000,000 at a 1.7% interest rate and 30-year loan period. This will require a annual repayment of $1,700,000 per year.

### 11.2.4 Cost Effectiveness

When all of the revenues generated by the sale of recycled water, meter fees and other items, the Palmdale Water District estimates that revenues would be $1,980 per acre-foot. This would generate annual revenues of $7,100,000 per year. This yields a benefit cost ratio in of 4.2 to 1.0 (computed by dividing $7,100,000 in benefits by $1,700,000 in annual costs) meaning the project is cost effective.

# CHAPTER 12

# ECONOMIC ANALYSIS USING SWRCB PROCEDURES

This chapter presents the economic analysis of the alternatives. The procedure for completing the economic analysis is as outlined by the State Water Resources Control Board in the publication – "Guidelines for Preparing Economic Analysis for Water Recycling Projects", April 2011. These procedures evaluate a project on a net present value (NPV) basis.

## 12.0 Project Phases

The project is proposed to be developed in the following three phases to meet Title 22 requirements, align with PWD's future water demands and spread capital infrastructure investments over time. Phases 1a would be constructed to meet PWD water demands to the year 2038, Phase 1b would be constructed to meet PWD demands in the time period of 2039 to 2058, and Phase 2 would be constructed to meet water demands to serve the build out population for the service area of the PWD that take place from 2059 to 2068.

- **Phase 1a** will include construction of facilities over the first 20 years to initially meet a recycled water content (RWC) of 20 percent and demonstrate the ability of the project to meet Title 22 requirements. Phase 1a facilities include construction of conveyance pipelines from the source waters to two recharge basins, four recovery wells and a well collection pipeline that connects to PWDs potable water distribution system.

- **Phase 1b** will expand facilities to meet PWD's water demands for the 20 years following Phase 1a. Phase 1b facilities include construction of a third recharge basin, up to four additional recovery wells, a water storage tank to meet chlorine contact time requirements, and the distribution site facility including an electrical room, control room, chlorine generation, and a Potable Water Pump Station (PWPS) to send flows back to the PWD potable water distribution system.

- **Phase 2** will build-out Project facilities to meet PWD's water demand through ultimate demand or can be constructed to accompany partner agencies. Phase 2 includes construction of all remaining facilities including the fourth recharge basin, up to eight additional recovery wells, If partner agencies participate in the recharge project, a Return Water Pump Station (RWPS) that would bypass the storage tank to pump non-chlorinated return water to the East Branch of the California Aqueduct would be constructed.

## 12.1 Diluent Water Contributions by Phase

The anticipated average annual recycled water recharge, SWP diluent recharge, and underflow diluent flows are provided in Table 12-1. It is anticipated that after the first three years of the project, the recycled water content will increase to 30 percent for two years, then increase to 40 percent thereafter. Similarly, recycled water recharge will initially begin with 2,000 AFY when the recycled water content is 20 percent. When the recycled water content is 30 percent, the recycled water recharge will increase to 3,000 AFY and when the recycled water content is 40 percent, the recycled water recharge will increase to 3,600 AFY in Phase 1a. Starting in Phase 1b, the maximum amount of recycled water recharge will be applied based on the recycled water content and available diluent supply. The recycled water recharge amount will decrease over time as the amount of SWP supply utilized at the Leslie O. Carter Water Treatment Plant increases over time.

**Table 12-1: Anticipated Annual Flows and Recycled Water Contribution by Phase**

| Phase | Year | Recycled Water (AFY) | SWP Diluent Water (AFY) | Underflow Diluent Water (AFY) | Total Recharge (AFY) | RWC (%) | Extraction (AFY) |
|---|---|---|---|---|---|---|---|
| 1a | 2019-2038 | 3,600 | 4,710 | 1,690 | 8,310 | 36% | 7,500 |
| 1b | 2039-2058 | 6,598 | 8,207 | 1,690 | 14,806 | 40% | 8,050 |
| 2 | 2059-2068 | 5,690 | 6,845 | 1,690 | 12,535 | 40% | 10,800 |

## 12.2 Cost Estimates For Phases

Funding under the Proposition 1 Water Recycling Program is being sought for only Phase 1a of the long range water recycling program of the Palmdale Water District. The costs for each Phase are present in Table 12-2.

**Table 12-2 Costs by Phase for Palmdale Water District's Long-Range Water Recycling Program**

| Infrastructure | Phase 1a | Phase 1b | Phase 2 | Total |
|---|---|---|---|---|
| Well Drilling (4/4/8) | $2,735,000 | $2,735,000 | $5,470,000 | $10,940,000 |
| Well Equipping, Site Work, & Buildings (4/4/8) | $3,027,500 | $3,027,500 | $6,055,000 | $12,110,000 |
| Recharge Site (2/1/1) | $5,000,000 | $2,084,500 | $2,084,500 | $9,169,000 |
| Pipelines | $36,400,000 | $3,300,000 | $170,000 | $39,870,000 |
| Distribution Site (Incl Phase 1a Chlorine Equip) | $1,000,000 | $13,080,000 | $4,300,000 | $18,380,000 |
| **Subtotal** | **$48,160,000** | **$24,230,000** | **$18,080,000** | **$90,470,000** |
| Design & Construction Management (15%) | $7,220,000 | $3,630,000 | $2,710,000 | $13,570,000 |
| **Total** | **$55,380,000** | **$27,860,000** | **$20,790,000** | **$104,040,000** |

## 12.3 Parameters Used In Economic Analysis

| | | |
|---|---|---|
| Useful life of Project | = | 30 years |
| Recycled Water Market Price | = | $1,980 per acre-foot |
| Potable Water Replacement Factor | = | 1.0 |
| Reference Cost Year | = | 2017 |
| First Year of Operation | = | 2018 |
| Last Year of Operation | = | 2048 |
| Financing Period | = | 30 years |
| Annual Interest Rate | = | 1.7% |

Discount Rate = 6.00%

## 12.4 Economic Analysis Summary

Since funding is only being sought for Phase 1a, an economic analysis for Phase 1b and 2 are not presented. However, an analysis of the completed project at buildout has been included. A summary table of the results of the economic analysis is presented below.

| Alternative | Phase 1a (2019-2038) | Complete Project |
|---|---|---|
| Annual Cost/AF | $835 | $974 |
| NPV | $697 M | $951 M |
| NPV/AF | $3,018 | $2,934 |
| Water Delivery (AF) | 7,500 | 10,800 |

## 12.5 Detailed Tables Of Economic Analysis

The detailed analysis of for Phase 1a and the complete water recycling at build-out is included in the Tables 12-3 (Phase 1a) and Table 12-4 (project at buildout) on the pages that follow.

Phase 1a - Table 12-3

**This alternative would deliver 7,500 acre-feet to water users in the Palmdale Water District service area.**

| **Project Information** | *User Input* |
| --- | --- |
| Name of Agency | Palmdale Water District |
| Name of person conducting analsysis | James Riley |
| Phone number | 661-456-1020 |
| email: | jriley@palmdalewater.org |
| **Reuse project information** | |
| Project name | Palmdale Regional Groundwater Recharge and Recovery Project |
| Project location | Palmdale, California |
| Indirect potable, or non-potable water production | Direct |
| Does the project operate year-round or seasonally | Year Round |
| Phases of operation (with years) | 20 |
| **Name Of Alternative** | **Phase 1a** |
| **Project Users** | Palmdale Water District |

**Table 12.4A Standard Assumptions**

*User Input*

**Table 12.4A: Time and Interest**

| Description | Amount | Unit | Other Assumptions |
|---|---|---|---|
| *Useful Life of Project* | 30 | years | |
| *Installed Capacity (final project)* | 7,500 | AF per year | Changing AF per year here will change AF volume in all Worksheets |
| *Recycled Water Market Price* | $1,980 | per AF | Based on Palmdale Water District Financial Department |
| *(Note: market price based on revenues generated to Palmdale Water District)* | | | |
| *Potable Water Replacement Factor (for RW)* | 1.0 | | Recycled water would replace a corresponding volume of potalbe water. Therefore a replacement factor of 1.0 is used. |
| *Project Design Year* | 2016 | | |
| *Reference Cost Year (Ref Yr)* | 2016 | | |
| *First Year of Project Construction* | 2017 | APPROVED | |
| *Project First Year of Operation (Last Year of Construction)* | 2018 | APPROVED | |
| *Project Last Year of Operation* | 2048 | | |
| *Financing Period* | 30 | years | |
| *Annual Interest Rate* | 1.70% | | PWD is assuming that 1.7% SRF money is still available |
| *Discount Rate* | 6.00% | | |

**Notes:**

'Project Last Year of Operation' is equal to 'Project First Year of Operation' and 'Period of Analysis'
'Project Reference Year' is set by 'Project First Year of Operation'
Maximum analysis is 100 years + 2 years for design & construction

**Table 12.4B Fresh Water Supply Alternative**

User Input

*Assume Fresh Water Alternative is State Water Project*

| Table 12.4B: Annual Fresh Water Alternative Cost | Costs (2016 $) | Comments | | |
|---|---|---|---|---|
| | | Water Volume (AF) | $ per acre-foot | |
| Annual O&M costs of water supply treatment | $1,500,000 | 7500 | $200 | Based on Palmdale Water District costs |
| Annual O&M costs of water transmission | $1,500,000 | 7500 | $200 | Based on Palmdale Water District costs |
| Annual O&M costs of water distribution | $937,500 | 7500 | $125 | Based on Palmdale Water District costs |
| Annual O&M costs of wastewater treatment and disposal | $1,200,000 | 7500 | $160 | Based on estimates from LA County Sanitation D |
| Annual fresh water supply cost | $30,000,000 | 7500 | $4,000 | |
| Note: For annual fresh water supply cost, it is assumed that the water supply would need to be purchased on a yearly basis at competitive market prices. And therefore is not amortized over the SRF loan period of 20 years. Also the fresh water supply cost is assumed to escalate at a rate of 2% per year as used in calculations in Table 4.1 | | | | |
| **Total** | **$35,137,500** | | | |

Notes:
Costs represented as present worth values
Without Project assumes future unmet water demand will incur a shortage cost

**Table 12.4C Baseline - Total Volume For Entire Project**

**Table 12.4C: Total Volume For Entire Project**

| | Total Volume (af) |
|---|---|
| **Total Lifetime Recycled Water Produced** | 225,000 |
| **Total Lifetime Fresh Water Alternative Produced** | 225,000 |

*Note: Total lifetime fresh water alternative must be equal to or greater than the total lifetime recycled water produced in order to demonstrate that there is fresh water supply throughout the project

**Table 12.4D Identify and Quantify Benefits**

| | |
|---|---|
| Alternative | **Phase 1a** |
| Project Participant | **Palmdale Water District** |

Note: City of Palmdale perspective is same as Palmdale Water District

**Table 12.4D Identification and Quantification of Benefits**

| A | B | | C | D | | E |
|---|---|---|---|---|---|---|
| **Item** | **Benefit** | | **Comments** | | **Quantifiable** | **Confidence in Estimates (Total Sum = 1.0)** |
| 1 | **Avoided costs of water supply development/purchase (potable water)** | | $ per acre-foot | | YES | |
| | Purchase of State Water Project Water | | | $5,500 | High Estimate | 0.2 |
| | *(Note: Information based on Palmdale Water District Operation)* | | | $4,000 | Best Estimate | 0.7 |
| | | **Water Volume (AF)** | | $3,500 | Low Estimate | 0.1 |
| | | **7500** | | | **Expected Value** | **1.0** |
| 2 | **Avoided O&M costs of water transmission** | | | | YES | |
| | Cost to Convey State Water Project Water | | | $300 | High Estimate | 0.2 |
| | *(Note: Information based on Palmdale Water District Operation)* | | | $200 | Best Estimate | 0.7 |
| | | **Water Volume (AF)** | | $175 | Low Estimate | 0.1 |
| | | **7500** | | | **Expected Value** | **1.0** |
| 3 | **Avoided O&M costs of water supply treatment** | | | | YES | |
| | | **Water Volume (AF)** | | $225 | High Estimate | 0.1 |
| | | **7500** | | $200 | Best Estimate | 0.8 |
| | *(Note: Information based on Palmdale Water District Operation)* | | | $175 | Low Estimate | 0.1 |
| | | | | | **Expected Value** | **1.0** |
| 4 | **Reclaimed water sales revenues** | | | | YES | |
| | | **Water Volume (AF)** | | $2,000 | High Estimate | 0.1 |
| | | **7500** | | $1,980 | Best Estimate | 0.8 |
| | *(Note: Information based on Palmdale Water District Operation)* | | | $1,900 | Low Estimate | 0.1 |
| | | | | | **Expected Value** | **1.0** |
| 5 | | | | | | |

**Table 12.4E Identify and Quantify Costs**

| | |
|---|---|
| Alternative | **Phase 1a** |
| Project Participant | **Palmdale Water District** |

**Table 12.4E : Identification and Quantification of Costs**

| A | B | | C | D | E |
|---|---|---|---|---|---|
| **Item** | **Cost** | | **Comments** | **Quantifiable** | **Estimates (Total Sum = 1.0)** |
| 1 | **Capital costs for recycled water distribution** | | Capital Costs in Dollars | YES | |
| | Planning Level Costs are a Class 4 Cost Estimate | | $60,000,000 | High Estimate | 0.3 |
| | Annual Capital Cost Interest = 6% and Years = 20 | | $55,000,000 | Best Estimate | 0.5 |
| | | **6%** | $50,000,000 | Low Estimate | 0.2 |
| | | **30** | | **Expected Value** | **1.0** |
| 2 | **O&M costs for recycled water distribution** | | Costs per acre-foot | YES | |
| | *(Note: Information based on Palmdale Water District operations)* | | $150 | High Estimate | 0.3 |
| | | | $125 | Best Estimate | 0.6 |
| | | Water Volume (AF) | $110 | Low Estimate | 0.1 |
| | | **7500** | | **Expected Value** | **1.0** |
| 3 | **Increased admin costs** | | Percent of Construction | YES | |
| | Assume increased admininstration can be represented by | | 1.5% | High Estimate | 0.6 |
| | a percent of construction | | 1.25% | Best Estimate | 0.3 |
| | | | 1% | Low Estimate | 0.1 |
| | | | | **Expected Value** | **1.0** |
| 4 | **Other (specify):** | | Costs per acre-foot | YES | |
| | Annual Payments to Los Angeles County Sanitation District | | $600 | High Estimate | 0.2 |
| | for water from Palmdale Wastewater Treatment Plant 1/ | | $180 | Best Estimate | 0.5 |
| | | Water Volume (AF) | $160 | Low Estimate | 0.3 |
| | | **7500** | | **Expected Value** | **1.0** |
| 5 | | | | | |
| | 1/ Source of costs of treated water from wastewater plant is from discussions with Los Angeles County Sanitation District | | | | |

**Table 12.4F Evaluate Project**

| | |
|---|---|
| Alternative | **Phase 1a** |
| Project Participant | **Palmdale Water District** |

Discount Rate 6.00%

**Table 12.4F Project Evaluation**

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| **Year** | **Annual Benefits** | **Discounted Benefits** | **Annual Costs** | **Discounted Costs** | **Net Benefits (discounted)** |
| 2016 | $49,811,250 | $52,799,925 | $7,280,287 | $7,717,105 | $45,082,820 |
| 2017 | $50,807,475 | $50,807,475 | $7,349,817 | $7,349,817 | $43,457,658 |
| 2018 | $51,541,493 | $48,624,050 | $7,420,738 | $7,000,696 | $41,623,353 |
| 2019 | $52,290,190 | $46,538,083 | $7,493,077 | $6,668,812 | $39,869,271 |
| 2020 | $53,053,862 | $44,545,046 | $7,566,863 | $6,353,284 | $38,191,762 |
| 2021 | $53,841,987 | $42,647,897 | $7,642,124 | $6,053,278 | $36,594,619 |
| 2022 | $54,645,875 | $40,834,577 | $7,718,891 | $5,768,004 | $35,066,572 |
| 2023 | $55,465,841 | $39,101,229 | $7,797,193 | $5,496,713 | $33,604,516 |
| 2024 | $56,302,205 | $37,444,182 | $7,877,061 | $5,238,696 | $32,205,487 |
| 2025 | $57,155,298 | $35,859,941 | $7,958,527 | $4,993,278 | $30,866,663 |
| 2026 | $58,025,452 | $34,345,176 | $8,041,621 | $4,759,823 | $29,585,352 |
| 2027 | $58,913,009 | $32,896,716 | $8,126,378 | $4,537,727 | $28,358,989 |
| 2028 | $59,818,317 | $31,511,543 | $8,212,830 | $4,326,416 | $27,185,127 |
| 2029 | $60,741,731 | $30,186,779 | $8,301,011 | $4,125,348 | $26,061,431 |
| 2030 | $61,683,614 | $28,919,685 | $8,390,955 | $3,934,007 | $24,985,678 |
| 2031 | $62,644,334 | $27,707,649 | $8,482,699 | $3,751,906 | $23,955,744 |
| 2032 | $63,624,269 | $26,548,184 | $8,576,277 | $3,578,581 | $22,969,604 |
| 2033 | $64,623,802 | $25,438,919 | $8,671,727 | $3,413,593 | $22,025,327 |
| 2034 | $65,643,326 | $24,377,596 | $8,769,085 | $3,256,526 | $21,121,069 |
| 2035 | $66,683,241 | $23,362,059 | $8,868,391 | $3,106,986 | $20,255,073 |
| 2036 | $67,743,953 | $22,390,258 | $8,969,683 | $2,964,597 | $19,425,661 |
| 2037 | $68,825,880 | $21,460,235 | $9,073,001 | $2,829,005 | $18,631,230 |
| 2038 | $69,929,446 | $20,570,124 | $9,178,386 | $2,699,872 | $17,870,253 |
| TOTAL | **$1,363,815,849** | **$788,917,329** | **$187,766,624** | **$109,924,071** | **$678,993,258** |

**Table 13.3 G**
**Supplementary Table for Project Evaluation**

| | Volume (AF) | Net Benefit/AF |
|---|---|---|
| **Total RW Delivered** | **225,000** | **$3,018** |
| **Total Fresh Water Alternative** | **225,000** | **$3,018** |

**Table 12.4H : Summary of Sensitivity Analysis**

| A | B | C | D |
|---|---|---|---|
| Variable 1 - Discount Rate | | | |
| Discount Rate Values | Total Monetized Benefit Discounted | Total Monetized Cost Discounted | Total Monetized Net Benefit Discounted |
| 3.00% | $1,014,188,740 | $140,489,680 | $873,699,060 |
| 4.00% | $928,287,819 | $128,846,516 | $799,441,303 |
| 5.00% | $853,782,099 | $118,736,262 | $735,045,836 |
| 6.00% | $788,917,329 | $109,924,071 | $678,993,258 |
| 7.00% | $732,237,185 | $102,214,848 | $630,022,337 |
| 8.00% | $682,528,876 | $95,446,014 | $587,082,861 |
| 9.00% | $638,779,278 | $89,481,664 | $549,297,613 |

*Note: Please see guidance for assessment of values

**Table 12.4I : Economic Assessment**

**ECONOMIC ASSESSMENT**

| RECYCLED WATER | | |
|---|---|---|
| annual cost/acre-ft | $835 | /acre-ft |
| Expected Net Present Value (NPV) | $678,993,258 | |
| Expected Net Present Value (NPV)/acre-ft | $3,018 | /acre-ft |

**Water Recycling is economically cost-effective**

**Cost Effective:**
**Water recycling is economically cost-effective because the expected net present value per acre-ft for the recycled water project is positive. Therefore the proposed recycled water project is recommended.**

## Project at Buildout - Table 12-4

**This alternative would deliver 10,800 acre-feet to water users in the Palmdale Water District service area.**

| **Project Information** | *User Input* |
|---|---|
| Name of Agency | Palmdale Water District |
| Name of person conducting analsysis | James Riley |
| Phone number | 661-456-1020 |
| email: | jriley@palmdalewater.org |
| **Reuse project information** | |
| Project name | Palmdale Regional Groundwater Recharge and Recovery Project |
| Project location | Palmdale, California |
| Indirect potable, or non-potable water production | Direct |
| Does the project operate year-round or seasonally | Year Round |
| Phases of operation (with years) | 20 |
| **Name Of Alternative** | **Project at Buildout** |
| **Project Users** | Palmdale Water District |

**Table 12.4A Standard Assumptions**

*User Input*

**Table 12.4A: Time and Interest**

| Description | Amount | Unit | Other Assumptions |
|---|---|---|---|
| *Useful Life of Project* | 30 | years | |
| *Installed Capacity (final project)* | 10,800 | AF per year | Changing AF per year here will change AF volume in all Worksheets |
| *Recycled Water Market Price* | $1,980 | per AF | Based on Palmdale Water District Financial Department |
| *(Note: market price based on revenues generated to Palmdale Water District)* | | | |
| *Potable Water Replacement Factor (for RW)* | 1.0 | | Recycled water would replace a corresponding volume of potalbe water. Therefore a replacement factor of 1.0 is used. |
| *Project Design Year* | 2016 | | |
| *Reference Cost Year (Ref Yr)* | 2016 | | |
| *First Year of Project Construction* | 2017 | APPROVED | |
| *Project First Year of Operation (Last Year of Construction)* | 2018 | APPROVED | |
| *Project Last Year of Operation* | 2048 | | |
| *Financing Period* | 30 | years | |
| *Annual Interest Rate* | 1.70% | | PWD is assuming that 1.7% SRF money is still available |
| *Discount Rate* | 6.00% | | |

**Table 12.4B Fresh Water Supply Alternative**

*User Input*

*Assume Fresh Water Alternative is State Water Project*

| Table 12.4B: Annual Fresh Water Alternative Cost | Costs (2016 $) | Comments | | |
|---|---|---|---|---|
| | | Water Volume (AF) | $ per acre-foot | |
| Annual O&M costs of water supply treatment | $2,160,000 | 10800 | $200 | Based on Palmdale Water District costs |
| Annual O&M costs of water transmission | $2,160,000 | 10800 | $200 | Based on Palmdale Water District costs |
| Annual O&M costs of water distribution | $1,350,000 | 10800 | $125 | Based on Palmdale Water District costs |
| Annual O&M costs of wastewater treatment and disposal | $1,728,000 | 10800 | $160 | Based on estimates from LA County Sanitation Districts |
| Annual fresh water supply cost | $43,200,000 | 10800 | $4,000 | |
| Note: For annual fresh water supply cost, it is assumed that the water supply would need to be purchased on a yearly basis at competitive market prices. And therefore is not amortized over the SRF loan period of 20 years. Also the fresh water supply cost is assumed to escalate at a rate of 2% per year as used in calculations in Table 4.1 | | | | |
| **Total** | **$50,598,000** | | | |

Notes:
Costs represented as present worth values
Without Project assumes future unmet water demand will incur a shortage cost

**Table 12.4C Baseline - Total Volume For Entire Project**

**Table 12.4C: Total Volume For Entire Project**

| | Total Volume (af) |
|---|---|
| **Total Lifetime Recycled Water Produced** | **324,000** |
| **Total Lifetime Fresh Water Alternative Produced** | **324,000** |

*Note: Total lifetime fresh water alternative must be equal to or greater than the total lifetime recycled water produced in order to demonstrate that there is fresh water supply throughout the project

**Table 12.4D Identify and Quantify Benefits**

| | |
|---|---|
| Alternative | **Project at Buildout** |
| Project Participant | **Palmdale Water District** |

Note: City of Palmdale perspective is same as Palmdale Water District

**Table 13.3D Identification and Quantification of Benefits**

| A | B | | C | | D | E |
|---|---|---|---|---|---|---|
| **Item** | **Benefit** | | **Comments** | | **Quantifiable** | **Confidence in Estimates (Total Sum = 1.0)** |
| 1 | **Avoided costs of water supply development/purchase (potable water)** | | $ per acre-foot | | YES | |
| | Purchase of State Water Project Water | | | $5,500 | High Estimate | 0.2 |
| | *(Note: Information based on Palmdale Water District Operation)* | | | $4,000 | Best Estimate | 0.7 |
| | | **Water Volume (AF)** | | $3,500 | Low Estimate | 0.1 |
| | | **10800** | | | **Expected Value** | **1.0** |
| 2 | **Avoided O&M costs of water transmission** | | | | YES | |
| | Cost to Convey State Water Project Water | | | $300 | High Estimate | 0.2 |
| | *(Note: Information based on Palmdale Water District Operation)* | | | $200 | Best Estimate | 0.7 |
| | | **Water Volume (AF)** | | $175 | Low Estimate | 0.1 |
| | | **10800** | | | **Expected Value** | **1.0** |
| 3 | **Avoided O&M costs of water supply treatment** | | | | YES | |
| | | **Water Volume (AF)** | | $225 | High Estimate | 0.1 |
| | | **10800** | | $200 | Best Estimate | 0.8 |
| | *(Note: Information based on Palmdale Water District Operation)* | | | $175 | Low Estimate | 0.1 |
| | | | | | **Expected Value** | **1.0** |
| 4 | **Reclaimed water sales revenues** | | | | YES | |
| | | **Water Volume (AF)** | | $2,000 | High Estimate | 0.1 |
| | | **10800** | | $1,980 | Best Estimate | 0.8 |
| | *(Note: Information based on Palmdale Water District Operation)* | | | $1,900 | Low Estimate | 0.1 |
| | | | | | **Expected Value** | **1.0** |

**Table 12.4E Identify and Quantify Costs**

| | |
|---|---|
| Alternative | **Project at Buildout** |
| Project Participant | **Palmdale Water District** |

**Table 12.4E : Identification and Quantification of Costs**

| A | B | C | D | E |
|---|---|---|---|---|
| **Item** | **Cost** | **Comments** | **Quantifiable** | **Estimates (Total Sum = 1.0)** |
| 1 | **Capital costs for recycled water distribution** | Capital Costs in Dollars | YES | |
| | Planning Level Costs are a Class 4 Cost Estimate | $110,000,000 | High Estimate | 0.3 |
| | Annual Capital Cost Interest = 6% and Years = 20 | $104,000,000 | Best Estimate | 0.6 |
| | **6%** | $95,000,000 | Low Estimate | 0.1 |
| | **30** | | **Expected Value** | **1.0** |
| 2 | **O&M costs for recycled water distribution** | Costs per acre-foot | YES | |
| | *(Note: Information based on Palmdale Water District operations)* | $150 | High Estimate | 0.3 |
| | | $125 | Best Estimate | 0.6 |
| | Water Volume (AF) | $110 | Low Estimate | 0.1 |
| | **10800** | | **Expected Value** | **1.0** |
| 3 | **Increased admin costs** | Percent of Construction | YES | |
| | Assume increased admininstration can be represented by | 1.5% | High Estimate | 0.6 |
| | a percent of construction | 1.25% | Best Estimate | 0.3 |
| | | 1% | Low Estimate | 0.1 |
| | | | **Expected Value** | **1.0** |
| 4 | **Other (specify):** | Costs per acre-foot | YES | |
| | Annual Payments to Los Angeles County Sanitation District | $600 | High Estimate | 0.2 |
| | for water from Palmdale Wastewater Treatment Plant 1/ | $180 | Best Estimate | 0.5 |
| | Water Volume (AF) | $160 | Low Estimate | 0.3 |
| | **10800** | | **Expected Value** | **1.0** |
| 5 | | | | |
| | 1/ Source of costs of treated water from wastewater plant is from discussions with Los Angeles County Sanitation District | | | |

**Table 12.4F Evaluate Project** Alternative: **Project at Buildout**

Project Participant: **Palmdale Water District**

Discount Rate 6.00%

**Table 12.4F Project Evaluation**

| A<br>Year | B<br>Annual Benefits | C<br>Discounted Benefits | D<br>Annual Costs | E<br>Discounted Costs | F<br>Net Benefits (discounted) |
|---|---|---|---|---|---|
| 2016 | $71,728,200 | $76,031,892 | $12,399,701 | $13,143,683 | $62,888,209 |
| 2017 | $73,162,764 | $73,162,764 | $12,503,905 | $12,503,905 | $60,658,859 |
| 2018 | $74,219,749 | $70,018,631 | $12,610,193 | $11,896,408 | $58,122,223 |
| 2019 | $75,297,874 | $67,014,840 | $12,718,607 | $11,319,515 | $55,695,325 |
| 2020 | $76,397,562 | $64,144,866 | $12,829,189 | $10,771,634 | $53,373,232 |
| 2021 | $77,532,462 | $61,412,972 | $12,941,983 | $10,251,262 | $51,161,709 |
| 2022 | $78,690,060 | $58,801,791 | $13,057,032 | $9,756,974 | $49,044,817 |
| 2023 | $79,870,811 | $56,305,770 | $13,174,383 | $9,287,420 | $47,018,350 |
| 2024 | $81,075,176 | $53,919,622 | $13,294,080 | $8,841,323 | $45,078,300 |
| 2025 | $82,303,629 | $51,638,315 | $13,416,172 | $8,417,472 | $43,220,842 |
| 2026 | $83,556,650 | $49,457,053 | $13,540,705 | $8,014,723 | $41,442,330 |
| 2027 | $84,834,732 | $47,371,271 | $13,667,730 | $7,631,989 | $39,739,283 |
| 2028 | $86,138,376 | $45,376,622 | $13,797,294 | $7,268,242 | $38,108,380 |
| 2029 | $87,468,093 | $43,468,962 | $13,929,450 | $6,922,510 | $36,546,452 |
| 2030 | $88,824,404 | $41,644,347 | $14,064,249 | $6,593,869 | $35,050,478 |
| 2031 | $90,207,841 | $39,899,015 | $14,201,744 | $6,281,445 | $33,617,570 |
| 2032 | $91,618,947 | $38,229,385 | $14,341,989 | $5,984,411 | $32,244,975 |
| 2033 | $93,058,275 | $36,632,044 | $14,485,039 | $5,701,982 | $30,930,062 |
| 2034 | $94,526,390 | $35,103,738 | $14,630,949 | $5,433,414 | $29,670,324 |
| 2035 | $96,023,866 | $33,641,365 | $14,779,778 | $5,178,004 | $28,463,362 |
| 2036 | $97,551,293 | $32,241,971 | $14,931,584 | $4,935,083 | $27,306,889 |
| 2037 | $99,109,268 | $30,902,738 | $15,086,426 | $4,704,019 | $26,198,719 |
| 2038 | $100,698,402 | $29,620,979 | $15,244,364 | $4,484,212 | $25,136,767 |
| TOTAL | **$1,963,894,822** | **$1,136,040,954** | **$315,646,545** | **$185,323,498** | **$950,717,456** |

**Table 12.4 G**
**Supplementary Table for Project Evaluation**

| | Volume (AF) | Net Benefit/AF |
|---|---|---|
| Total RW Delivered | 324,000 | $2,934 |
| Total Fresh Water Alternative | 324,000 | $2,934 |

**Table 12.4H Sensitivity Analysis**

Alternative

Project Participant

**Table 12.4H : Summary of Sensitivity Analysis**

| A | B | C | D |
|---|---|---|---|
| Variable 1 - Discount Rate | | | |
| Discount Rate Values | Total Monetized Benefit Discounted | Total Monetized Cost Discounted | Total Monetized Net Benefit Discounted |
| 3.00% | $1,460,431,786 | $236,522,768 | $1,223,909,018 |
| 4.00% | $1,336,734,459 | $217,024,876 | $1,119,709,583 |
| 5.00% | $1,229,446,222 | $200,089,137 | $1,029,357,085 |
| 6.00% | $1,136,040,954 | $185,323,498 | $950,717,456 |
| 7.00% | $1,054,421,546 | $172,402,218 | $882,019,328 |
| 8.00% | $982,841,581 | $161,053,801 | $821,787,781 |
| 9.00% | $919,842,160 | $151,051,247 | $768,790,913 |

*Note: Please see guidance for assessment of values

**Table 12.4I : Economic Assessment**

| ECONOMIC ASSESSMENT | | |
|---|---|---|
| **RECYCLED WATER** | | |
| annual cost/acre-ft | $974 | /acre-ft |
| Expected Net Present Value (NPV) | $950,717,456 | |
| Expected Net Present Value (NPV)/acre-ft | $2,934 | /acre-ft |
| Water Recycling is economically cost-effective | Cost Effective: Water recycling is economically cost-effective because the expected net present value per acre-ft for the recycled water project is positive. Therefore the proposed recycled water project is recommended. | |

# CHAPTER 13

# PHASE 1a - CONSTRUCTION FINANCING PLAN AND PROGRAM REVENUES

The focus of this chapter is to present the financing plan for Phase 1a of the Palmdale Regional Groundwater Recharge and Recovery Project (PRGRRP). The project is seeking grant funding of 35% with a limitation of $15,000,000 and a low interest construction loan of the balance of $40,380,000 at 1.7%. Attachment C in FAAST PIN # 30947 contains the 2014 water rate study.

## 13.0 Sources and Timing of Funds for Design and Construction

**Table 13-1 – Source and Timing of Required Funding for Phase 1a**

| **Funding Needs and Source of Funding** | **Funding Requirement By Years** | | |
|---|---|---|---|
| | **2016** | **2017** | **2018** |
| **Funding Needs** | | | |
| — Design/Construction Management | $2,220,000 | $4,000,000 | $2,000,000 |
| — Construction | - | $30,000,000 | $17,160,000 |
| *Subtotal* | $2,220,000 | $34,000,000 | $19,160,000 |
| **Prop 1 – Water Recycling** | | | |
| — Grant Portion (limited to $15,000,000) | $777,000 | $11,900,000 | $2,323,000 |
| — SRF Loan | $1,443,000 | $22,100,000 | $16,837,000 |
| *Subtotal* | $2,220,000 | $34,000,000 | $19,160,000 |

## 13.1 Pricing Policy for Recycled Water

The recycled water will be sold at potable water rates.

## 13.2 Costs That Can Be Allocated to Water Pollution Control

No costs for the project will be allocated to water pollution control.

## 13.3 Annual Projection of Costs and Revenues

### 13.3.1 Water Prices for Each User or Category of Users

The unit price of water for 2016 are shown below. Increases of 4% per annum will be needed during the early years of repayment.

| **Commodity Rates ($/ccf)** | |
|---|---|
| Tier 1 | $0.76 |
| Tier 2 | $0.89 |
| Tier 3 | $2.53 |
| Tier 4 | $3.81 |
| Tier 5 | $4.92 |
| Tier 6 | $6.32 |

| **Monthly Meter Charges** | |
|---|---|
| 1" and Below | $33.33 |
| 1.5" | $100.00 |
| 2.0" | $153.35 |
| 3.0" | $277.83 |
| 4.0" | $455.66 |
| 6.0" | $900.23 |
| 8.0" | $1,433.72 |
| 10.0" | $2,056.14 |

| Connection Type | Number of Connections | Currenty Monthly Service Charge | Average Monthly Billing Per Connection (Last 12 Months) | Average Monthly Revenues(Last 12 Months) |
|---|---|---|---|---|
| Residential (SFR) | 25075 | $32.05 - $96.15 | $50.68 | $1,270,801 |
| Residential (MFR) | 583 | $32.05 - $438.13 | $170.67 | $99,500 |
| Commercial/Industrial | 708 | $32.05 - $1,977.06 | $293.04 | $207,474 |
| Irrigation | 226 | $32.05 - $1,132.75 | $291.67 | $65,916 |
| Other | 21 | $32.05 - $294.90 | $223.65 | $4,697 |
| **Total** | **26,613** | | | **$1,648,388** |

### 13.3.2 Recycled Water Used By Each User or Category

The PRRRP Phase 1 component would serve all category of users consisting of indoor residential and business use as well as city parks and outdoor landscaping. Amount of water provided by the Phase 1 component is 7,500 acre-feet. The 7,500 acre-feet equates to 3,267,000 hundred cubic feet.

### 13.3.3 Annual Costs (Required Revenue) of the Phase 1a Project

Based on SRF loan of $40,380,000 with a 30-year repayment period at 1.7% interest the annual cost to repay would be $1,700,000.

### 13.3.4 Allocation of Costs to Users

All of the annual repayment of $1,700,000 would be allocated to Tier 1 thru Tier 6 users.

### 13.3.5 Unit Price of Recycled Water for Each User to Category Users

The unit price for the indirect use recycled water is shown below. These costs do not include other revenue generating fees such as meters.

| Tier | Unit Price/ccf | % of Historical Use | Allocation of 7,500 AF | Allocation of water use based on ccf | Projected Revenue in $ |
|---|---|---|---|---|---|
| Tier 1 | $0.76 | 52% | 3,900 AF | 1,698,840 | $ 1,291,118 |
| Tier 2 | $0.89 | 35% | 2,625 AF | 1,143,450 | $ 1,017,671 |
| Tier 3 | $2,53 | 7% | 525 AF | 228,690 | $ 578,586 |
| Tier 4 | $3.81 | 3% | 225 AF | 98,010 | $ 373,418 |
| Tier 5 | $4.92 | 1% | 75 AF | 32,670 | $ 160,736 |
| Tier 6 | $6.32 | 2% | 150 AF | 65,340 | $ 412,949 |

### 13.3.6 Unit Costs to Serve Each User or Category of Users

Unit costs are computed by dividing the annual cost of $1,700,000 by the annual water use of 7,500 acre-feet. This computes to be $230 per acre-foot. This does not include the full range of operating costs of the District that needs to be considered. That analysis is included in Section 13.4.

### 13.3.7 Benefits and Sensitivity Analysis Assuming Portions of Potential Users Fail to Use Recycled Water

Using the State Water Resources Control Board set of procedures for economic analysis, the following values were computed. It is noted that for these calculations, the project cost of $55,000,000 was used in which the grant funding of has been included in project cost for analysis purposes.

**Table 13-2 - Effect of Potential Users to Fail to Use Recycled Water for Phase 1a**
**(Note: annual cost/AF and NPV are based on using the SRWCB economic spreadsheet model)**

| | **Assume Different Amounts of Recycled Water Sold** | | | |
|---|---|---|---|---|
| Percent Water Sold | 100% | 90% | 80% | 75% |
| Amount of Water Sold | 7,500 AF | 6,750 AF | 6,000 AF | 5,625 AF |
| Total Project Cost | $55M | $55 M | $55 M | $55 M |
| Annual Cost/AF | $835/AF | $886/AF | $950/AF | $988/AF |
| NPV | $679 M | $605 M | $531 M | $495M |
| NPV/AF | $3,018/AF | $2,987/AF | $2,949/AF | $2,926/AF |

## 13.4 Spreadsheet Calculations for Phase 1a

The spreadsheet calculation for the preferred alternative of 7,500 acre-feet and a cost of $55,000,000 is contained in Tables 13-3 and 13-4 on the following pages.

<u>Other Parameters Used in the analysis</u>

| | | |
|---|---|---|
| Useful life of Project | = | 30 years |
| Recycled Water Market Price | = | $1,980 per acre-foot |
| Potable Water Replacement Factor | = | 1.0 |
| Reference Cost Year | = | 2017 |
| First Year of Operation | = | 2018 |
| Last Year of Operation | = | 2048 |
| Financing Period | = | 30 years |
| Annual Interest Rate | = | 1.7% |
| Discount Rate | = | 6.00% |

## Table 13-3 Project Information for Phase 1a

| **Project Information** | *User Input* |
| --- | --- |
| Name of Agency | Palmdale Water District |
| Name of person conducting analsysis | James Riley |
| Phone number | 661-456-1020 |
| email: | jriley@palmdalewater.org |
| **Reuse project information** | |
| Project name | Palmdale Regional Groundwater Recharge and Recovery Project |
| Project location | Palmdale, California |
| Indirect potable, or non-potable water production | Direct |
| Does the project operate year-round or seasonally | Year Round |
| Phases of operation (with years) | 20 |
| **Name Of Alternative** | **Phase 1a** |
| **Project Users** | Palmdale Water District |

**Table 13.3A Standard Assumptions**

*User Input*

**Table 13.3A: Time and Interest**

| Description | Amount | Unit | Other Assumptions |
|---|---|---|---|
| *Useful Life of Project* | 30 | years | |
| *Installed Capacity (final project)* | 7,500 | AF per year | Changing AF per year here will change AF volume in all Worksheets |
| *Recycled Water Market Price* | $1,980 | per AF | Based on Palmdale Water District Financial Department |
| *(Note: market price based on revenues generated to Palmdale Water District)* | | | |
| *Potable Water Replacement Factor (for RW)* | 1.0 | | Recycled water would replace a corresponding volume of potalbe water. Therefore a replacement factor of 1.0 is used. |
| *Project Design Year* | 2016 | | |
| *Reference Cost Year (Ref Yr)* | 2016 | | |
| *First Year of Project Construction* | 2017 | APPROVED | |
| *Project First Year of Operation (Last Year of Construction)* | 2018 | APPROVED | |
| *Project Last Year of Operation* | 2048 | | |
| *Financing Period* | 30 | years | |
| *Annual Interest Rate* | 1.70% | | PWD is assuming that 1.7% SRF money is still available |
| *Discount Rate* | 6.00% | | |

**Notes:**

'Project Last Year of Operation' is equal to 'Project First Year of Operation' and 'Period of Analysis'
'Project Reference Year' is set by 'Project First Year of Operation'
Maximum analysis is 100 years + 2 years for design & construction

**Table 13.3B Fresh Water Supply Alternative**

*User Input*

*Assume Fresh Water Alternative is State Water Project*

| Table 13.3B: Annual Fresh Water Alternative Cost | Costs (2016 $) | Comments | | |
|---|---|---|---|---|
| | | Water Volume (AF) | $ per acre-foot | |
| Annual O&M costs of water supply treatment | $1,500,000 | 7500 | $200 | Based on Palmdale Water District costs |
| Annual O&M costs of water transmission | $1,500,000 | 7500 | $200 | Based on Palmdale Water District costs |
| Annual O&M costs of water distribution | $937,500 | 7500 | $125 | Based on Palmdale Water District costs |
| Annual O&M costs of wastewater treatment and disposal | $1,200,000 | 7500 | $160 | Based on estimates from LA County Sanitation Districts |
| Annual fresh water supply cost | $30,000,000 | 7500 | $4,000 | |
| Note: For annual fresh water supply cost, it is assumed that the water supply would need to be purchased on a yearly basis at competitive market prices. And therefore is not amortized over the SRF loan period of 20 years. Also the fresh water supply cost is assumed to escalate at a rate of 2% per year as used in calculations in Table 4.1 | | | | |
| **Total** | **$35,137,500** | | | |

Notes:
Costs represented as present worth values
Without Project assumes future unmet water demand will incur a shortage cost

**Table 13.3C Baseline - Total Volume For Entire Project**

**Table 13.3C: Total Volume For Entire Project**

| | Total Volume (af) |
|---|---|
| **Total Lifetime Recycled Water Produced** | 225,000 |
| **Total Lifetime Fresh Water Alternative Produced** | 225,000 |

*Note: Total lifetime fresh water alternative must be equal to or greater than the total lifetime recycled water produced in order to demonstrate that there is fresh water supply throughout the project

**Table 13.3D Identify and Quantify Benefits**

| | |
|---|---|
| Alternative | **Phase 1a** |
| Project Participant | **Palmdale Water District** |

Note: City of Palmdale perspective is same as Palmdale Water District

**Table 13.3D Identification and Quantification of Benefits**

| A | B | | C | D | | E |
|---|---|---|---|---|---|---|
| **Item** | **Benefit** | | **Comments** | **Quantifiable** | | **Confidence in Estimates (Total Sum = 1.0)** |
| 1 | **Avoided costs of water supply development/purchase (potable water)** | | $ per acre-foot | YES | | |
| | Purchase of State Water Project Water | | $5,500 | High Estimate | | 0.2 |
| | *(Note: Information based on Palmdale Water District Operation)* | | $4,000 | Best Estimate | | 0.7 |
| | | **Water Volume (AF)** | $3,500 | Low Estimate | | 0.1 |
| | | **7500** | | | **Expected Value** | **1.0** |
| 2 | **Avoided O&M costs of water transmission** | | | YES | | |
| | Cost to Convey State Water Project Water | | $300 | High Estimate | | 0.2 |
| | *(Note: Information based on Palmdale Water District Operation)* | | $200 | Best Estimate | | 0.7 |
| | | **Water Volume (AF)** | $175 | Low Estimate | | 0.1 |
| | | **7500** | | | **Expected Value** | **1.0** |
| 3 | **Avoided O&M costs of water supply treatment** | | | YES | | |
| | | **Water Volume (AF)** | $225 | High Estimate | | 0.1 |
| | | **7500** | $200 | Best Estimate | | 0.8 |
| | *(Note: Information based on Palmdale Water District Operation)* | | $175 | Low Estimate | | 0.1 |
| | | | | | **Expected Value** | **1.0** |
| 4 | **Reclaimed water sales revenues** | | | YES | | |
| | | **Water Volume (AF)** | $2,000 | High Estimate | | 0.1 |
| | | **7500** | $1,980 | Best Estimate | | 0.8 |
| | *(Note: Information based on Palmdale Water District Operation)* | | $1,900 | Low Estimate | | 0.1 |
| | | | | | **Expected Value** | **1.0** |

**Table 13.3E Identify and Quantify Costs**

| | |
|---|---|
| Alternative | **Phase 1a** |
| Project Participant | **Palmdale Water District** |

**Table 13.3E : Identification and Quantification of Costs**

| A | B | | C | D | E |
|---|---|---|---|---|---|
| **Item** | **Cost** | | **Comments** | **Quantifiable** | **Estimates (Total Sum = 1.0)** |
| 1 | **Capital costs for recycled water distribution** | | Capital Costs in Dollars | YES | |
| | Planning Level Costs are a Class 4 Cost Estimate | | $60,000,000 | High Estimate | 0.3 |
| | Annual Capital Cost Interest = 6% and Years = 20 | | $55,000,000 | Best Estimate | 0.5 |
| | | **6%** | $50,000,000 | Low Estimate | 0.2 |
| | | **30** | | **Expected Value** | **1.0** |
| 2 | **O&M costs for recycled water distribution** | | Costs per acre-foot | YES | |
| | *(Note: Information based on Palmdale Water District operations)* | | $150 | High Estimate | 0.3 |
| | | | $125 | Best Estimate | 0.6 |
| | | Water Volume (AF) | $110 | Low Estimate | 0.1 |
| | | **7500** | | **Expected Value** | **1.0** |
| 3 | **Increased admin costs** | | Percent of Construction | YES | |
| | Assume increased admininstration can be represented by | | 1.5% | High Estimate | 0.6 |
| | a percent of construction | | 1.25% | Best Estimate | 0.3 |
| | | | 1% | Low Estimate | 0.1 |
| | | | | **Expected Value** | **1.0** |
| 4 | **Other (specify):** | | Costs per acre-foot | YES | |
| | Annual Payments to Los Angeles County Sanitation District | | $600 | High Estimate | 0.2 |
| | for water from Palmdale Wastewater Treatment Plant 1/ | | $180 | Best Estimate | 0.5 |
| | | Water Volume (AF) | $160 | Low Estimate | 0.3 |
| | | **7500** | | **Expected Value** | **1.0** |
| 5 | | | | | |
| | 1/ Source of costs of treated water from wastewater plant is from discussions with Los Angeles County Sanitation District | | | | |

**Table 13.3F Evaluate Project**

| | |
|---|---|
| Alternative | **Phase 1a** |
| Project Participant | **Palmdale Water District** |

Discount Rate 6.00%

**Table 13.3F Project Evaluation**

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| **Year** | **Annual Benefits** | **Discounted Benefits** | **Annual Costs** | **Discounted Costs** | **Net Benefits (discounted)** |
| 2016 | $49,811,250 | $52,799,925 | $7,280,287 | $7,717,105 | $45,082,820 |
| 2017 | $50,807,475 | $50,807,475 | $7,349,817 | $7,349,817 | $43,457,658 |
| 2018 | $51,541,493 | $48,624,050 | $7,420,738 | $7,000,696 | $41,623,353 |
| 2019 | $52,290,190 | $46,538,083 | $7,493,077 | $6,668,812 | $39,869,271 |
| 2020 | $53,053,862 | $44,545,046 | $7,566,863 | $6,353,284 | $38,191,762 |
| 2021 | $53,841,987 | $42,647,897 | $7,642,124 | $6,053,278 | $36,594,619 |
| 2022 | $54,645,875 | $40,834,577 | $7,718,891 | $5,768,004 | $35,066,572 |
| 2023 | $55,465,841 | $39,101,229 | $7,797,193 | $5,496,713 | $33,604,516 |
| 2024 | $56,302,205 | $37,444,182 | $7,877,061 | $5,238,696 | $32,205,487 |
| 2025 | $57,155,298 | $35,859,941 | $7,958,527 | $4,993,278 | $30,866,663 |
| 2026 | $58,025,452 | $34,345,176 | $8,041,621 | $4,759,823 | $29,585,352 |
| 2027 | $58,913,009 | $32,896,716 | $8,126,378 | $4,537,727 | $28,358,989 |
| 2028 | $59,818,317 | $31,511,543 | $8,212,830 | $4,326,416 | $27,185,127 |
| 2029 | $60,741,731 | $30,186,779 | $8,301,011 | $4,125,348 | $26,061,431 |
| 2030 | $61,683,614 | $28,919,685 | $8,390,955 | $3,934,007 | $24,985,678 |
| 2031 | $62,644,334 | $27,707,649 | $8,482,699 | $3,751,906 | $23,955,744 |
| 2032 | $63,624,269 | $26,548,184 | $8,576,277 | $3,578,581 | $22,969,604 |
| 2033 | $64,623,802 | $25,438,919 | $8,671,727 | $3,413,593 | $22,025,327 |
| 2034 | $65,643,326 | $24,377,596 | $8,769,085 | $3,256,526 | $21,121,069 |
| 2035 | $66,683,241 | $23,362,059 | $8,868,391 | $3,106,986 | $20,255,073 |
| 2036 | $67,743,953 | $22,390,258 | $8,969,683 | $2,964,597 | $19,425,661 |
| 2037 | $68,825,880 | $21,460,235 | $9,073,001 | $2,829,005 | $18,631,230 |
| 2038 | $69,929,446 | $20,570,124 | $9,178,386 | $2,699,872 | $17,870,253 |
| TOTAL | **$1,363,815,849** | **$788,917,329** | **$187,766,624** | **$109,924,071** | **$678,993,258** |

**Table 13.3 G**
**Supplementary Table for Project Evaluation**

| | Volume (AF) | Net Benefit/AF |
|---|---|---|
| **Total RW Delivered** | **225,000** | **$3,018** |
| **Total Fresh Water Alternative** | **225,000** | **$3,018** |

**Table 13.3H Sensitivity Analysis**

Alternative

Project Participant

**Table 13.3H : Summary of Sensitivity Analysis**

| A | B | C | D |
|---|---|---|---|
| Variable 1 - Discount Rate | | | |
| Discount Rate Values | Total Monetized Benefit Discounted | Total Monetized Cost Discounted | Total Monetized Net Benefit Discounted |
| 3.00% | $1,014,188,740 | $140,489,680 | $873,699,060 |
| 4.00% | $928,287,819 | $128,846,516 | $799,441,303 |
| 5.00% | $853,782,099 | $118,736,262 | $735,045,836 |
| 6.00% | $788,917,329 | $109,924,071 | $678,993,258 |
| 7.00% | $732,237,185 | $102,214,848 | $630,022,337 |
| 8.00% | $682,528,876 | $95,446,014 | $587,082,861 |
| 9.00% | $638,779,278 | $89,481,664 | $549,297,613 |

*Note: Please see guidance for assessment of values

Table 13.3I : Economic Assessment

| ECONOMIC ASSESSMENT | | |
|---|---|---|
| RECYCLED WATER | | |
| annual cost/acre-ft | $835 | /acre-ft |
| Expected Net Present Value (NPV) | $678,993,258 | |
| Expected Net Present Value (NPV)/acre-ft | $3,018 | /acre-ft |
| Water Recycling is economically cost-effective | Cost Effective: Water recycling is economically cost-effective because the expected net present value per acre-ft for the recycled water project is positive. Therefore the proposed recycled water project is recommended. | |

# Table 13-4 Phase 1a Pro-Forma Analysis

| Year | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|
| Rate Action | 0.00% | 4.00% | 4.00% | 4.00% | 4.00% | 4.00% | 4.00% | 4.00% | 4.00% | 4.00% |
| Operating Revenues | | | | | | | | | | |
| Wholesale Water (AVEK & LCID) | $ 160,000 | $ 166,400 | $ 173,056 | $ 179,978 | $ 187,177 | $ 194,664 | $ 202,451 | $ 210,549 | $ 218,971 | $ 227,730 |
| Water Sales | $ 8,435,851 | $ 9,036,484 | $ 9,679,965 | $ 14,665,105 | $ 15,431,141 | $ 16,234,996 | $ 12,745,454 | $ 13,652,890 | $ 18,821,922 | $ 19,793,105 |
| Meter Fees | $ 11,922,377 | $ 12,456,924 | $ 13,015,160 | $ 13,598,573 | $ 14,208,303 | $ 14,845,053 | $ 15,510,516 | $ 16,205,991 | $ 16,932,287 | $ 17,691,326 |
| Water Quality Fees | $ 934,500 | $ 962,535 | $ 991,411 | $ 1,021,153 | $ 1,051,788 | $ 1,083,342 | $ 1,115,842 | $ 1,149,317 | $ 1,183,797 | $ 1,219,311 |
| Elevation Fees | $ 400,000 | $ 416,000 | $ 432,640 | $ 449,946 | $ 467,943 | $ 486,661 | $ 506,128 | $ 526,373 | $ 547,428 | $ 569,325 |
| Initiative Revenue (Palmdale Recharge and Recovery) | $ - | $ - | $ - | $ - | $ 5,000,000 | $ 5,150,000 | $ 5,304,500 | $ 5,463,635 | $ 5,627,544 | $ 5,796,370 |
| Drought Surcharge | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Other | $ 860,000 | $ 894,400 | $ 930,176 | $ 967,383 | $ 1,006,078 | $ 1,046,321 | $ 1,088,174 | $ 1,131,701 | $ 1,176,969 | $ 1,224,048 |
| Total Operating Revenues | $ 22,712,728 | $ 23,932,743 | $ 25,222,407 | $ 30,882,138 | $ 37,352,431 | $ 39,041,038 | $ 36,473,066 | $ 38,340,457 | $ 44,508,917 | $ 46,521,215 |
| | | | | | | | | | | |
| Operating Expenses | | | | | | | | | | |
| Initiative Expenses (Palmdale Recharge and Recovery) | $ - | $ - | $ - | $ - | $ 5,000,000 | $ 5,150,000 | $ 5,304,500 | $ 5,463,635 | $ 5,627,544 | $ 5,796,370 |
| Customer Care | $ 1,386,750 | $ 1,428,353 | $ 1,871,203 | $ 1,927,339 | $ 1,985,159 | $ 2,044,714 | $ 2,106,056 | $ 2,169,237 | $ 2,234,314 | $ 2,301,344 |
| Directors | $ 121,473 | $ 125,117 | $ 128,871 | $ 132,737 | $ 136,719 | $ 140,820 | $ 145,045 | $ 149,396 | $ 153,878 | $ 158,495 |
| Administration | $ 3,201,500 | $ 3,297,545 | $ 3,396,471 | $ 3,498,365 | $ 3,603,316 | $ 3,711,416 | $ 3,822,758 | $ 3,937,441 | $ 4,055,564 | $ 4,177,231 |
| Engineering | $ 1,279,250 | $ 1,317,628 | $ 1,357,156 | $ 1,397,871 | $ 1,439,807 | $ 1,483,001 | $ 1,527,491 | $ 1,573,316 | $ 1,620,516 | $ 1,669,131 |
| Facilities | $ 6,513,750 | $ 6,709,163 | $ 6,910,437 | $ 7,117,750 | $ 7,331,283 | $ 7,551,222 | $ 7,777,758 | $ 8,011,091 | $ 8,251,424 | $ 8,498,966 |
| Operations | $ 2,449,250 | $ 2,522,728 | $ 2,598,409 | $ 2,676,362 | $ 2,756,652 | $ 2,839,352 | $ 2,924,533 | $ 3,012,269 | $ 3,102,637 | $ 3,195,716 |
| Finance | $ 1,168,250 | $ 1,203,298 | $ 1,239,396 | $ 1,276,578 | $ 1,314,876 | $ 1,354,322 | $ 1,394,952 | $ 1,436,800 | $ 1,479,904 | $ 1,524,301 |
| Water Conservation | $ 365,750 | $ 376,723 | $ 388,024 | $ 399,665 | $ 411,655 | $ 424,004 | $ 436,725 | $ 449,826 | $ 463,321 | $ 477,221 |
| Human Resources | $ 420,350 | $ 432,961 | $ 445,949 | $ 459,328 | $ 473,108 | $ 487,301 | $ 501,920 | $ 516,977 | $ 532,487 | $ 548,461 |
| Information Technology | $ 867,750 | $ 893,783 | $ 920,596 | $ 948,214 | $ 976,660 | $ 1,005,960 | $ 1,036,139 | $ 1,067,223 | $ 1,099,240 | $ 1,132,217 |
| Water Purchases | $ 2,050,000 | $ 2,152,500 | $ 2,260,125 | $ 2,373,131 | $ 2,491,788 | $ 2,616,377 | $ 2,747,196 | $ 2,884,556 | $ 3,028,784 | $ 3,180,223 |
| OAP Charge (Prior Year) | $ 150,000 | $ 154,500 | $ 159,135 | $ 163,909 | $ 168,826 | $ 173,891 | $ 179,108 | $ 184,481 | $ 190,016 | $ 195,716 |
| Water Recovery | $ (475,000) | $ (489,250) | $ (503,928) | $ (519,045) | $ (534,617) | $ (550,655) | $ (567,175) | $ (584,190) | $ (601,716) | $ (619,767) |
| Water Quality (GAC Media) | $ 934,500 | $ 962,535 | $ 991,411 | $ 1,021,153 | $ 1,051,788 | $ 1,083,342 | $ 1,115,842 | $ 1,149,317 | $ 1,183,797 | $ 1,219,311 |
| Plant Expenditures | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| General Projects | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Replacement Capital Projects | $ 3,000,000 | $ 3,090,000 | $ 3,182,700 | $ 3,278,181 | $ 3,376,526 | $ 3,477,822 | $ 3,582,157 | $ 3,689,622 | $ 3,800,310 | $ 3,914,320 |
| Total Operating Expenses | $ 23,433,573 | $ 24,177,580 | $ 25,345,958 | $ 26,151,539 | $ 31,983,548 | $ 32,992,890 | $ 34,035,004 | $ 35,110,998 | $ 36,222,019 | $ 37,369,255 |
| | | | | | | | | | | |
| Net Operating Income | $ (720,845) | $ (244,837) | $ (123,550) | $ 4,730,599 | $ 5,368,883 | $ 6,048,148 | $ 2,438,062 | $ 3,229,459 | $ 8,286,898 | $ 9,151,959 |

## Table 13-4 Phase 1 Pro-Forma Analysis (Continued)

| Year | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|
| Rate Action | 0.00% | 4.00% | 4.00% | 4.00% | 4.00% | 4.00% | 4.00% | 4.00% | 4.00% | 4.00% |
| Non-Operating Revenue | | | | | | | | | | |
| Assessments (Debt Service) | $ 4,670,000 | $ 4,716,700 | $ 4,763,867 | $ 4,811,506 | $ 4,859,621 | $ 4,908,217 | $ 4,957,299 | $ 5,006,872 | $ 5,056,941 | $ 5,107,510 |
| Assessments (1%) | $ 1,825,000 | $ 1,843,250 | $ 1,861,683 | $ 1,880,299 | $ 1,899,102 | $ 1,918,093 | $ 1,937,274 | $ 1,956,647 | $ 1,976,213 | $ 1,995,976 |
| Successor Agency Component (Prop Tax) | $ 200,000 | $ 200,000 | $ 200,000 | $ 200,000 | $ 200,000 | $ 200,000 | $ 200,000 | $ 200,000 | $ 200,000 | $ 200,000 |
| Interest | $ 35,000 | $ 36,050 | $ 37,132 | $ 38,245 | $ 39,393 | $ 40,575 | $ 41,792 | $ 43,046 | $ 44,337 | $ 45,667 |
| Market Adjustments on Investments | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Capital Improvement Fees | $ 50,000 | $ 51,500 | $ 53,045 | $ 54,636 | $ 56,275 | $ 57,964 | $ 59,703 | $ 61,494 | $ 63,339 | $ 65,239 |
| Other Operating Revenues | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Non-Operating Revenue | $ 6,780,000 | $ 6,847,500 | $ 6,915,726 | $ 6,984,687 | $ 7,054,391 | $ 7,124,849 | $ 7,196,068 | $ 7,268,058 | $ 7,340,830 | $ 7,414,392 |
| | | | | | | | | | | |
| Non-Operating Expenses | | | | | | | | | | |
| Non-Operating Expense Line Items | | | | | | | | | | |
| *State Water Project* | $ 3,438,000 | $ 2,271,570 | $ 2,305,644 | $ 2,340,228 | $ 2,375,332 | $ 2,410,962 | $ 2,447,126 | $ 2,483,833 | $ 2,521,090 | $ 2,558,907 |
| *Capital Leasing* | $ - | $ (163,125) | $ (217,500) | $ (217,500) | $ (217,500) | $ (217,500) | $ (217,500) | $ (217,500) | $ (217,500) | $ (217,500) |
| *Water Conservation* | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| *Butte County Table A Lease* | $ 1,200,000 | $ 1,218,000 | $ 1,236,270 | $ 1,254,814 | $ 1,273,636 | $ 1,292,741 | $ 1,312,132 | $ 1,331,814 | $ 1,351,791 | $ 1,372,068 |
| Total Non-Operating Expense Line Items | $ 4,638,000 | $ 3,326,445 | $ 3,324,414 | $ 3,377,542 | $ 3,431,468 | $ 3,486,202 | $ 3,541,758 | $ 3,598,147 | $ 3,655,382 | $ 3,713,475 |
| | | | | | | | | | | |
| Capital Expenditures | $ 1,500,000 | $ 16,500,000 | $ 21,500,000 | $ 21,500,000 | $ 1,500,000 | $ 1,500,000 | $ 1,500,000 | $ 1,500,000 | $ 1,500,000 | $ 1,500,000 |
| *Currently Funded from Restricted Reserves* | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Grant Funded | $ - | $ 5,000,000 | $ 5,000,000 | $ 5,000,000 | $ - | $ - | $ - | $ - | $ - | $ - |
| SRF Funded | $ - | $ 10,000,000 | $ 15,000,000 | $ 15,000,000 | $ - | $ - | $ - | $ - | $ - | $ - |
| *Private Equity Funded* | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| *Pay-Go Funded* | $ - | $ - | $ 671,053 | $ 1,500,000 | $ 1,500,000 | $ 1,500,000 | $ 1,500,000 | $ - | $ 1,500,000 | $ 1,500,000 |
| *Debt Funded* | $ 1,500,000 | $ 1,500,000 | $ 828,947 | $ - | $ - | $ - | $ - | $ 1,500,000 | $ - | $ - |
| Debt Service Payments | | | | | | | | | | |
| *Principal Paid on Long-Term Debt* | $ 1,557,553 | $ 1,665,453 | $ 1,712,084 | $ 1,766,595 | $ 1,824,583 | $ 1,891,002 | $ 1,965,396 | $ 2,032,628 | $ 2,240,000 | $ 2,310,000 |
| *Interest Paid on Long-Term Debt* | $ 2,161,369 | $ 2,278,709 | $ 2,249,509 | $ 2,195,471 | $ 2,139,669 | $ 2,071,427 | $ 2,000,408 | $ 1,926,521 | $ 1,937,394 | $ 1,876,275 |
| Principal Paid on SRF Debt | $ - | $ - | $ - | $ - | $ 1,063,371 | $ 1,081,448 | $ 1,099,833 | $ 1,118,530 | $ 1,137,545 | $ 1,156,883 |
| Interest Paid SRF Debt | $ - | $ - | $ - | $ - | $ 699,877 | $ 681,799 | $ 663,415 | $ 644,718 | $ 625,703 | $ 606,364 |
| *Principal Paid on Private Equity Debt* | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| *Interest Paid on Private Equity Debt* | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - |
| Total Non-Operating Expenses | $ 8,356,922 | $ 7,270,607 | $ 7,957,060 | $ 8,839,608 | $ 10,658,968 | $ 10,711,879 | $ 10,770,810 | $ 9,320,543 | $ 11,096,023 | $ 11,162,997 |
| | | | | | | | | | | |
| Net Non-Operating Income | $ (1,576,922) | $ (423,107) | $ (1,041,334) | $ (1,854,921) | $ (3,604,576) | $ (3,587,030) | $ (3,574,742) | $ (2,052,485) | $ (3,755,194) | $ (3,748,606) |

## Table 13-4 Phase 1 Pro-Forma Analysis (continued)

| Year | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|
| Rate Action | 0.00% | 4.00% | 4.00% | 4.00% | 4.00% | 4.00% | 4.00% | 4.00% | 4.00% | 4.00% |
| | | | | | | | | | | |
| Net Income | $ (2,297,767) | $ (667,944) | $ (1,164,884) | $ 2,875,678 | $ 1,764,307 | $ 2,461,117 | $ (1,136,680) | $ 1,176,974 | $ 4,531,705 | $ 5,403,354 |
| Cash Balances | | | | | | | | | | |
| Beginning Unrestricted Cash Balance | $ 12,253,595 | $ 9,955,828 | $ 9,287,884 | $ 8,123,000 | $ 10,998,678 | $ 12,762,985 | $ 15,224,102 | $ 14,087,422 | $ 15,264,396 | $ 19,796,100 |
| Net Change to Cash Balances | $ (2,297,767) | $ (667,944) | $ (1,164,884) | $ 2,875,678 | $ 1,764,307 | $ 2,461,117 | $ (1,136,680) | $ 1,176,974 | $ 4,531,705 | $ 5,403,354 |
| Ending Cash Balance | $ 9,955,828 | $ 9,287,884 | $ 8,123,000 | $ 10,998,678 | $ 12,762,985 | $ 15,224,102 | $ 14,087,422 | $ 15,264,396 | $ 19,796,100 | $ 25,199,454 |
| | | | | | | | | | | |
| Coverage and Targets | | | | | | | | | | |
| Debt Service Coverage (W/Out Reserves) | 1.55x | 1.60x | 1.64x | 2.88x | 2.12x | 2.25x | 1.63x | 1.78x | 2.58x | 2.73x |
| Debt Service Coverage Target | 1.10x | 1.50x | 1.50x | 1.50x | 1.50x | 1.50x | 1.50x | 1.50x | 1.50x | 1.50x |
| Debt Service Coverage (W/Reserves) | 4.23x | 3.96x | 3.69x | 5.66x | 4.35x | 4.91x | 4.09x | 4.45x | 5.91x | 6.97x |
| Days' Cash | 155 | 140 | 117 | 154 | 146 | 168 | 151 | 159 | 199 | 246 |
| Days' Cash Target | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 | 180 |

# CHAPTER 14

# CONSTRUCTION IMPLEMENTATION PLAN

## 14.0 Implementation Plan

This section describes the next steps required for implementation of the proposed Project facilities, including a summary of recommended additional studies, design and construction packaging, and implementation schedule.

## 14.1 Additional Studies

The next step in implementation of the Project is to utilize the Preliminary Design Report and 30% level design specs to develop contract documents for the proposed facilities. Several studies are recommended to inform the design development in the next phase, including:

- Geotechnical Investigation – to incorporate site-specific sub-surface considerations for all Project facilities.
- Surge Analysis – to develop design of the surge tank that will be located at the Distribution Site for protection of the Raw Water/Return Water Pipeline.
- Corrosion Evaluation – to develop cathodic protection design for all pipelines.
- Potholing – to further develop design of all pipelines by identifying potential utility conflicts.

In addition, it is recommended to install several monitoring wells in or around the Recharge Site and institute a quarterly groundwater sampling program to collect at least two years of background water quality data in the Lancaster Sub-basin. This data will be required to obtain permitting approval from the Lahontan RWQCB.

## 14.2 Design & Construction Packaging

It is anticipated that the Project facilities will be divided into six design/construction packages that can be bid individually. This division will allow multiple facilities to be constructed in parallel, which will reduce the overall construction schedule. It will also foster a more competitive bidding environment by allowing more firms to compete on smaller individual packages, which will potentially reduce overall construction cost. Elements of the design/construction packages are as follows:

- Well Drilling
- Well Equipping
- Large Pipelines, including:
- Raw Water/Return Water Pipeline
- Potable Water Pipeline
- Recycled Water Turnout and Recycled Water Pipeline
- SWP Turnout

- Small Pipelines, consisting of the well collection pipelines
- Recharge Basins
- Distribution Site, consisting of all of the facilities located at the Distribution Site, including:
- Potable Water Pump Station
- Return Water Pump Station
- Pump Station Building
- Storage Tank
- Hydro-turbine

## 14.3 Permits, Right of Way, Design, Construction

Permitting for the Project will be significant due to the indirect potable reuse of the recycled water and the multiple jurisdictions the transmission pipelines pass through.

### 14.3.1 Construction Permits - Local and State

The following permits are anticipated to be required by local agencies:

- Los Angeles County Well Drilling Permit for well drilling
- Los Angeles County Well Operating Permit for well operation
- Los Angeles County Encroachment Permit for pipeline construction in right-of-ways
- Palmdale City Traffic Control Permit for traffic control during pipeline construction
- Union Pacific Encroachment Permit for pipeline crossing
- The following permits are anticipated to be required for construction by State agencies:
- Site specific Storm Water Pollution Prevention Plan (SWPPP) prepared by the various construction contractors
- DWR Encroachment Permit for turnout construction
- Occupational Safety and Health Administration (OSHA) Underground Classification
- Permit for jack and bore

### 14.3.2 State Permitting for Groundwater Replenishment Using Recycled Water

In 2009, the State of California adopted Resolution No. 2009-0011 with the goal of increasing the use of recycled water in the state. Within the revised Water Code, Section 13521 requires the California Department of Public Health (CDPH) to develop uniform recycled water criteria as it relates to public health protection. This task was reassigned to the SWRCB DDW. The permit for the indirect potable reuse of recycled water will be managed by the Lahontan RWQCB, which requires the submission of a Report of Waste Discharge for discharging recycled water for ground water recharge via surface spreading. The Title 22 Engineering Report will support the Report of

Waste Discharge by demonstrating how the project complies with the Title 22 Groundwater Replenishment Using Recycled Water Regulations adopted on June 18, 2014. Approval of the Title 22 Engineering Report must be obtained from both DDW and RWQCB, with the RWQCB the permitting agency.

The Title 22 Engineering Report was submitted during February 2014 to the SWRCB DDW for preliminary approval, and then to the RWQCB. The report will describe the existing. LACSD PWRP treatment process, the SWP Water supply as the blending source, groundwater spreading facilities, groundwater residence time, distance to the Recovery Wells, distance to existing potable wells, and related information. The current Title 22 report for the LACSD PWRP will be referenced or included as an appendix, at the discretion of the DDW and RWQCB. The Title 22 report summarized information from the Antelope Valley Integrated Water Management Plan, Salt and Nutrient Management Plan, and Lahonton RWQCB Basin Plan. An anti-degradation analysis was completed to demonstrate that the proposed Project complies with the basin plan objectives.

The Title 22 report demonstrates to DDW and the RWQCB that the proposed groundwater recharge Project, system redundancy, groundwater monitoring and contingency plans meet Title 22 and all DDW permitting requirements, with the anticipation that the Project can be successfully permitted during the design phase.

The Title 22 Engineering Report includes the following elements:

- Project Overview
  - Background
  - Project location
  - Project history
  - Project description
  - Responsible parties
  - Purpose of this report
- Sources of water
  - State Water Project supply
    - Water quality
    - Water quantity and supply reliability
  - LACSD Palmdale Water Reclamation Plant
    - Recycled water quantity and quality
- Water quality standards and treatment requirements
- Water reclamation facility description
  - Wastewater characteristics
- Groundwater basin description
  - Hydrogeology
  - Existing groundwater quality
  - Basin plan objectives
- Groundwater recharge facilities
  - Water supply source blending
  - Groundwater modeling
  - Recharge water retention time
- Groundwater wells
  - Existing wells and proximity to recharge basin(s)
  - New wells
- Groundwater recharge and reuse system monitoring and reporting program

  - Monitoring provisions
  - Groundwater monitoring
  - Extraction well water quality monitoring
  - Reporting
- Contingency plan

Once the project is approved by the DDW and RWQCB, and a permit is issued by RWQCB, The District will submit an application for a Domestic Water Supply Permit Amendment to add the new Recovery Wells, Distribution Site (including chlorination), and Potable Water Pipeline to its water system facilities and Operations Plan.

### 14.3.3 California Environmental Quality Act

CEQA requires every project proposed in the State of California to be examined for potential effects on the environment. An Environmental Impact Report (EIR) for the PRGRRP was completed and filed on November 25, 2015. The document was uploaded to FAAST in November 2015. For each topic evaluated in detail in the EIR, the discussion included a description of baseline conditions, significance criteria, impact analysis, and measures (as applicable) to avoid, minimize, or mitigate impacts on the environment to less than significant levels. These topics included:

- Air quality
- Biological resources
- Cultural resources
- Geology and soils
- Greenhouse gas emissions and climate change
- Groundwater and Surface water hydrology, and water quality
- Noise

The Draft EIR report was sent to various state and federal agencies including the State Water Resources Control Board. The findings and mitigation measures will be incorporated in the final design phase of the Project.

Since the District is seeking SWRCB Clean Water State Revolving Fund (SRF) program funds for the Project, and because the SRF Program is partially funded by the USEPA, the Project requires compliance not only with CEQA, but also with federal regulations such as the Clean Air Act, Endangered Species Act, and National Historic Preservation Act Section 106 as part of the SWRCB's CEQA-Plus requirements. Based on the District's environmental consultants scope of work for the PRGRRP that included the Federal process described below, the technical studies prepared for the Project addressed the applicable Federal components required for analysis as part of the CEQA Plus scope. The District has submitted the required documents to the SWRCB, who in turn, will distribute the submittal package to the appropriate federal agencies for a 30-day review as required by the CEQA-Plus process. This distribution is in addition to the standard State Clearinghouse public review requirements under CEQA.

### 14.3.4 Federal National Environmental Protection Act

Because the District may be seeking federal funding through the U.S. Department of Interior Bureau of Reclamation (Reclamation) for the Project, the Project must comply with the National Environmental Policy Act (NEPA). Therefore, the District's environmental consultants prepared two separate documents: one EIR under CEQA and one Environmental Assessment (EA)/Finding of No Significant Impact (FONSI) under NEPA. The preparation of two stand-alone documents will allow the District to review, finalize, and approve the EIR (in which the District will be the lead agency) at a more accelerated rate than if a joint NEPA/CEQA document (in which both District and Reclamation will be lead agencies) is prepared. Under this scenario, the CEQA document's approval will not be held up by Reclamation if it is reviewing and processing a joint NEPA/CEQA document.

In addition, to comply with federal requirements, the project will require a National Historic Preservation Act (NHPA) Section 106 Consultation with the State Historic Preservation Officer.

## 14.4 Operational Plan

The project's control system will be able to monitor and control the multiple components for the following: 1) SWP Water delivery, 2) recycled water delivery, 3) recharge basins, 4) Recovery Well production, 5) chlorine treatment, 6) potable water delivery to the District's distribution system, and 7) return water delivery to the East Branch of the California Aqueduct.

1) **SWP Water:** For seasonal changes in SWP Water delivery, a sluice gate at the East Branch of the California Aqueduct canal can be manually opened and closed. In order to monitor this delivery, the California Department of Water Resources (DWR) meter status at the turnout is communicated via SCADA (supervisory control and data acquisition system). Flow control for delivery of SWP Water is provided at the hydro-turbine through adjustment of the two hydro-turbine nozzles. The predesigned hydro-turbine has an operating range of 10 to 40 cfs. The full flow above or below the operating range of the hydro-turbine is by-passed through one or both 16-inch diameter PRVs in the Hydroturbine Room. As such, the PRVs will be specified as electronic actuated rate of flow control valves.

2) **Recycled Water:** Delivery of recycled water to the Distribution Box by gravity flow to the Recharge Site is controlled through the recycled water turnout meter vault structure with a motor-operated control valve.

3) **Recharge Basins:** Delivery of water to the recharge basins is through a Splitter Box with manually operated sluice gates to Basins 1, 2, and 3, and a motor-operated sluice gate to Basin 4. Each manually operated sluice gate will be equipped with an open/close limit switch, and the delivery of water is monitored with alarms by level sensors equipped in each basin.

4) **Recovery Wells:** The Recovery Well layout is designed to recover the majority of the recharge water. The number of wells can be adjusted to match the target flow rate to meet potable and raw water/ return water demands; however, a near radial pattern of operating wells is ideal. With Variable Frequency Drives (VFDs), the wells can operate from approximately 50 to 100% of their design capacity, with the most efficient energy use (kilowatt-hours/AF [kWh/AF]) anticipated in the range of 70 to 90% capacity. Thus, the number of wells can be selected accordingly. Recovery Well start-up can be initiated in

remote auto or manual. The operator should confirm the oil lube status prior to pump operation, under routine maintenance, in order to protect the well shaft bearings.

A pump control valve (Cla-Val) will be utilized to first discharge water through the 8-inch diameter blow-off line, then after a pre-determined period of time (typically 10 minutes) a second pump control valve will discharge to the Well Collection Pipeline through the 10-inch diameter discharge header. The discharge line will incorporate two air vacuum release valves, pressure gauge, sample tap, mag meter, and gate valve. A flow switch to indicate no flow status, and a pressure switch to indicate high pressure, will be also be installed in the well discharge line with alarm and shut-down settings.

5) **Chlorination System**: Potable water entering the 1 MG Storage Tank is normally chlorinated through the inlet of the tank using a two-pump (with alternating duty) chemical metering pump skid located in the Chlorine Room. The chlorine residual analyzer on the tank outlet will monitor the chlorine dose, in order to maintain the disinfection target of 4-log Virus inactivation.

6) **PWD Distribution System:** The Storage Tank provides suction to the PWPS that is equipped with 4 duty plus 1 standby 400 HP pumps with VFDs. The number of pumps used is established by the operator to match potable water demand. The pump speed is controlled by the target water level in the tank.

7) **Pump Back to East Branch:** Flow from the Storage Tank through the Air Gap Structure leading to the Return Water Wet Well is controlled through two motor-operated 18-inch diameter modulating plug valves; a single plug valve is operated for low flow conditions. The plug valve operation is tied to the wet well water level. The number of return water pumps is based on the target flow, and the pump speed is controlled by the on-site magnetic flow meter. To prevent overflow of the wet well in the event of a power failure, a 480v uninterruptable power supply (UPS) is proposed to drive the plug valves closed.

A personal computer with a hot redundant spare will reside in the control room of the pump station and will operate using Wonderware software. The system will link remotely with the existing SCADA system via radio. As such, the District's operators can monitor and control the Project remotely.

## 14.5 Construction Schedule

A proposed facility design & construction schedule is provided In Figure 14-1. The permitting work can begin after the completion of the Title 22 Engineering Report and just prior to the completion of the environmental compliance work.

It is assumed that development of the contract documents will begin after the environmental compliance task is completed. The District has the option to start the design development earlier in order to expedite implementation of the Project. Most of the facility packages will be designed, bid, and constructed in parallel. The only exception is the well equipping, which will need to follow the completion of the well drilling. All of the facilities are anticipated to be constructed by late summer or early fall of 2018.

| Task Name | Duration | Start | Finish | Predecessors |
|---|---|---|---|---|
| PDR Completion | 0 days | Fri 11/6/15 | Fri 11/6/15 | |
| Blue Ribbon Panel | 100 days | Fri 11/6/15 | Thu 3/24/16 | 1 |
| Title 22 Engineering Report | 80 days | Fri 11/6/15 | Thu 2/25/16 | 1 |
| Permitting | 60 days | Fri 6/24/16 | Thu 9/15/16 | 3,5FS-15 days |
| Environmental Compliance Comple | 0 days | Fri 7/15/16 | Fri 7/15/16 | |
| **Well Drilling** | **325 days** | **Mon 8/1/16** | **Fri 10/27/17** | |
| Design | 60 days | Mon 8/1/16 | Fri 10/21/16 | 5 |
| Bid | 45 days | Mon 10/24/1 | Fri 12/23/16 | 7 |
| Construction | 220 days | Mon 12/26/1 | Fri 10/27/17 | 8 |
| **Well Equipping** | **440 days** | **Mon 1/2/17** | **Fri 9/7/18** | |
| Design | 60 days | Mon 1/2/17 | Fri 3/24/17 | 5 |
| Bid | 45 days | Mon 7/10/17 | Fri 9/8/17 | 9FS-80 days |
| Construction | 260 days | Mon 9/11/17 | Fri 9/7/18 | 12 |
| **Large Pipelines** | **385 days** | **Mon 10/3/16** | **Fri 3/23/18** | |
| Design | 120 days | Mon 10/3/16 | Fri 3/17/17 | 5 |
| Bid | 45 days | Mon 3/20/17 | Fri 5/19/17 | 15 |
| Construction | 220 days | Mon 5/22/17 | Fri 3/23/18 | 16 |
| **Small Pipelines** | **235 days** | **Mon 10/3/16** | **Fri 8/25/17** | |
| Design | 100 days | Mon 10/3/16 | Fri 2/17/17 | 5 |
| Bid | 45 days | Mon 2/20/17 | Fri 4/21/17 | 19 |
| Construction | 90 days | Mon 4/24/17 | Fri 8/25/17 | 20 |
| **Recharge Basins** | **405 days** | **Mon 10/3/16** | **Fri 4/20/18** | |
| Design | 100 days | Mon 10/3/16 | Fri 2/17/17 | 5 |
| Bid | 45 days | Mon 2/20/17 | Fri 4/21/17 | 23 |
| Construction | 260 days | Mon 4/24/17 | Fri 4/20/18 | 24 |
| **Distribution Site** | **503 days** | **Mon 10/3/16** | **Wed 9/5/18** | |
| Design | 130 days | Mon 10/3/16 | Fri 3/31/17 | 5 |
| Bid | 45 days | Mon 4/3/17 | Fri 6/2/17 | 27 |
| Construction | 328 days | Mon 6/5/17 | Wed 9/5/18 | 28 |

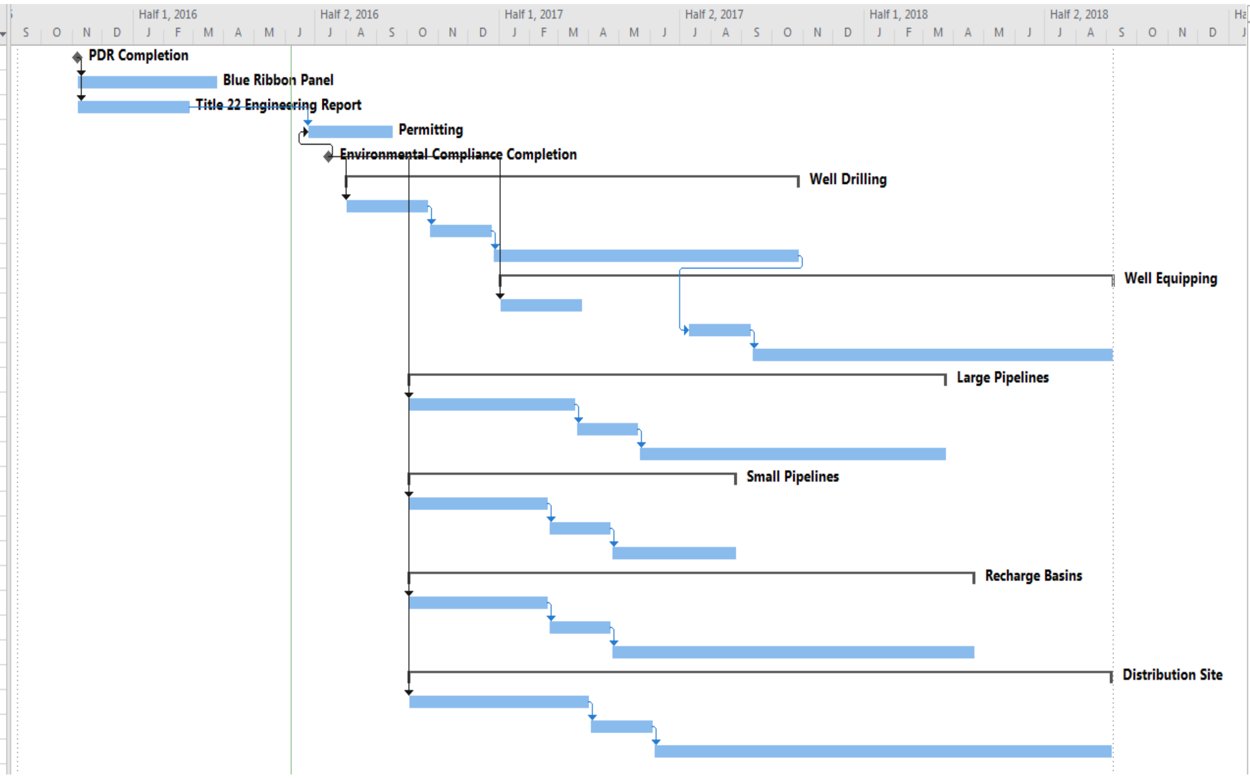



**Figure 14-1 Design and Construction Schedule – dependent on grant and construction loan funding**

# Appendix A - List of Acronyms

| | |
|---|---|
| AF | acre-feet |
| AF/yr | acre-feet/year |
| AG | Air gap Separation |
| AOP | Advanced Oxidation Process |
| Aqueduct | California Aqueduct |
| AVEK | Antelope Valley-East Kern Water Agency |
| CAO | Cleanup and Abatement Order |
| CAS | Conventional Activated Sludge |
| CCF | Hundred Cubic Foot |
| CDPH | California Department of Health |
| CDO | Cease and Desist Order |
| CEQA | California Environmental Quality Act |
| cfs | cubic feet per second |
| CIP | Capital Improvement Program |
| Cla-Val | pump control valve |
| DAF | Dissolved Air Flotation |
| DC | Double Check Valve Assembly |
| DDW | California Division of Drinking Water |
| DPR | Direct Potable Reuse |
| DWR | California Department of Water Resources |
| EA | Environmental Assessment |
| ECU | equivalent capacity unit |
| EIR | Environmental Impact Report |
| EM | Effluent Management |
| EPA | Environmental Protection Agency |
| FAA | Federal Aviation Administration |
| FAT | Full Advanced Treatment |
| FEMA | Federal Emergency Management Agency |
| FONSI | Finding of No Significant Impact |
| FPR | Facilities Planning Report |
| fps | feet per second |
| ft | feet or feet above mean sea level |
| GAC | Granular Activated Carbon |
| gal | gallons |
| GHG | Greenhouse Gas Emissions |
| gpd | gallons per day |
| gpm | gallons per minute |
| Helix | Helix Environmental Planning, Inc. |

| | |
|---|---|
| hf | head losses due to friction |
| HGL | hydraulic grade line |
| HP | horsepower |
| HVAC | heating, ventilating, and air conditioning |
| hypo | sodium hypochlorite |
| in | inches |
| IPR | Indirect Potable Reuse |
| JPA | Joint Powers Authority |
| kW | kilowatt |
| kWh/AF | kilowatt-hour/acre-foot |
| LCID | Littlerock Creek Irrigation District |
| LOCWTP | Leslie O. Carter Water Treatment Plant |
| LACSD | Los Angeles County Sanitation District |
| LAWA | Los Angeles World Airports |
| LWRP | Lancaster Water Reclamation Plant |
| lbs | pounds |
| LCGRRP | Littlerock Creek Groundwater Recharge and Recovery Project |
| LF | linear foot |
| LMDS | Landscape Maintenance Districts |
| MCL | Maximum Contaminant Level |
| MDD | maximum day demand |
| MG | million gallons |
| mg/L | milligrams per liter |
| mgd | million gallons per day |
| mi | miles |
| MOU | memorandum of understanding |
| msl | mean sea level |
| MW | megawatt |
| NDN | Nitrification/Denitrification |
| NEPA | National Environmental Protection Act |
| NHPA | National Historic Preservation Act |
| NPV | Net Present Value |
| O&M | Operation and Maintenance |
| OSHA | Occupational Safety and Health Administration |
| PDR | preliminary design report |
| PHPP | Palmdale Hybrid Power Plant |
| PLC | programmable logic controller |
| ppb | parts per billion |
| ppd | pounds per day |
| ppm | parts per million |
| RGRRP | Palmdale Regional Groundwater Recharge & Recovery Project |

| | |
|---|---|
| Project | Palmdale Regional Groundwater Recharge & Recovery Project |
| PRV | pressure reducing valve |
| PRWA | Palmdale Recycled Water Authority |
| psi | pounds per square inch |
| PWD | Palmdale Water District |
| PWPS | Potable Water Pump Station |
| PWRP | Palmdale Wastewater Treatment Facility |
| Q | design flows |
| Reclamation | U.S. Bureau of Reclamation |
| RWPS | Return Water Pump Station |
| RGRRP | Regional Groundwater Recharge and Recovery Project |
| RWC | Recycled Water Contribution |
| RWQCB | Regional Water Quality Control Board |
| RP | Reduced Pressure Principle Backflow Prevention Device |
| SAT | Soil Aquifer Treatment |
| SCADA | supervisory control and data acquisition system |
| SGIP | Self-Generation Incentive Program |
| sq ft | square feet |
| SRF | State Revolving Fund |
| SWP | State Water Project |
| SWPPP | Storm Water Pollution Prevention Plan |
| SWRCB | State Water Resources Control Board |
| TDH | total dynamic head |
| TDS | total dissolved solids |
| UPS | uninterruptable power supply |
| USEPA | U.S. Environmental Protection Agency |
| USGS | U.S. Geological Survey |
| VFD | variable frequency drive |
| WDR | Waste Discharge Requirement |
| WRR | Water Recycling Requirement |