Palmdale Water District
Recycled Water Facilities Plan

Final

Prepared by:

RMC
Water and Environment

February 2010

Table of Contents

Chapter 1 Introduction 1-1
1.1 Background 1-3
1.2 Report Organization 1-4
Chapter 2 Project Setting 2-1
2.1 Area Characteristics 2-1
2.2 Land Use Trends and Population Projections 2-2
2.3 Water Supply and Use 2-2
2.4 Wastewater Collection and Treatment 2-6
2.5 Recycled Water Facilities 2-7
Chapter 3 Market Assessment 3-1
3.1 Methodology 3-1
3.2 Potential Non-Potable Water Market 3-1
3.3 Recycled Water Supply 3-9
3.4 Recycled Water Quality 3-10
3.5 Market Assessment Summary 3-12
Chapter 4 Project Alternatives Analysis 4-1
4.1 Alternatives Development 4-1
4.2 Cost Estimates 4-21
4.3 Alternative Evaluation 4-23
4.4 Freshwater / No Project Alternative 4-26
Chapter 5 Recommended Project 5-1
5.1 Project Description 5-3
5.2 Project Cost 5-4
5.3 Project Implementation Plan 5-4

Appendices

Appendix A - Detailed Cost Estimates
Appendix B - Project Financing Projections
Appendix C - City of Lancaster Recycled Water Use Ordinance
Appendix D - LACSD Recycled Water Users Handbook – District Nos. 14 and 20
Appendix E - Recycled Water Urban Irrigation User Manual
Appendix F - Storage Analysis
Appendix G - Minutes of Regular Meeting of the Board of Directors of the PWD, August 12, 2009

List of Tables

Table 2-1: Population Projections 2-2
Table 2-2: Palmdale Water District Service Charges ($/month) 2-5
Table 2-3: Palmdale Water District Commodity Charge ($/ccf) 2-5
Table 2-4: Palmdale Water District Elevation Surcharge ($/ccf) 2-5
Table 2-5: Palmdale Water District Water Quality Fee ($/ccf) 2-6
Table 2-6: Palmdale Water District Demand Projections (afy) 2-6
Table 2-7: Palmdale WRP Tertiary Water Supply Projections 2-7
Table 3-1: Title 22 Allowed Uses for Disinfected Tertiary Recycled Water[1] 3-1
Table 3-2: Existing M&I Demands within District Boundaries 3-2
Table 3-3: Future M&I Demands within District Boundaries 3-5
Table 3-4: Average Monthly Demand of Crop Type (AF/Month) 3-6
Table 3-5: Average Day of Peak Month Demand per 100 Acres (MGD) 3-7
Table 3-6: Maximum Initial Recycled Water Recharge Volume Estimates 3-9
Table 3-7: Recycled Water Supply Availability from Palmdale WRP 3-10
Table 3-8: Landscape Irrigation Water Quality Comparison 3-11
Table 4-1: Hydraulic Design Criteria for Model Development 4-2
Table 4-2: Alternative A1 Customers 4-3
Table 4-3: Alternative A2 Customers 4-5
Table 4-4: Alternative B1 Customers 4-7
Table 4-5: Alternative B2 Customers 4-9
Table 4-6: Alternative A+B Customers 4-11
Table 4-7: Alternative C Customers 4-13
Table 4-8: Alternative D Customers 4-14
Table 4-9: Summary of Non-Potable Water Demands for M&I Alternatives 4-15
Table 4-10: Maximum Initial Recycled Water Recharge Volume Estimates 4-18
Table 4-11: M&I Alternatives Cost Estimates 4-22
Table 4-12: Agricultural Alternatives Cost Estimates 4-22
Table 4-13: Groundwater Recharge Alternatives Cost Estimates 4-23
Table 4-14: M&I Alternative Evaluation 4-24
Table 4-15: Agricultural Alternative Evaluation 4-25
Table 4-16: Groundwater Recharge with Advanced Treatment Evaluation 4-26
Table 4-17: Freshwater and No Project Alternative Costs 4-28
Table 5-1: Estimated Project Cost 5-4
Table 5-2: Potential Funding Sources 5-7

List of Figures

Figure 1-1: Project Vicinity and Characteristics 1-2
Figure 2-1: Palmdale Water District Land Use 2-3
Figure 2-2: Palmdale WRP Schematic 2-8
Figure 2-3: Palmdale WRP Planned Effluent Management Schematic 2-9
Figure 2-4: Existing and Planned Regional Recycled Water Facilities 2-10
Figure 2-5: Potable Water Facilities with Potential Non-Potable System Use 2-11
Figure 3-1: Potential M&I Non-Potable Water Customers 3-4
Figure 3-2: Potential Agricultural Recycled Water Customer Areas 3-6
Figure 3-3: Average Day Demand per 100 Acres (MGD) 3-7
Figure 3-4: Groundwater Recharge / Banking Areas 3-9
Figure 4-1: Alternative A1 4-4
Figure 4-2: Alternative A2 4-6
Figure 4-3: Alternative B1 4-8
Figure 4-4: Alternative B2 4-10
Figure 4-5: Alternative A+B 4-12
Figure 4-6: Alternative C 4-13
Figure 4-7: Alternative D 4-14
Figure 4-8: Agricultural Alternative 1 4-16
Figure 4-9: Agricultural Alternatives 2 & 3 4-17
Figure 5-1: Recommended Project 5-2
Figure 5-2: Accelerated Phase 1 Project Facilities 5-3
Figure 5-3: Phase 1 Project Schedule 5-5

List of Abbreviations

afy	acre-feet per year
AV RW Report	Antelope Valley Recycled Water Project Master Planning Report (KJ, 2006)
Ave	Avenue
AVEK	Antelope Valley-East Kern Water Agency
Basin	Antelope Valley Groundwater Basin
Blvd	Boulevard
CCR	California Code of Regulations
CDPH	California Department of Public Health
CEC	California Energy Commission
CEQA	California Environmental Quality Act
ccf	hundred cubic feet
cfs	cubic feet per second
City	City of Palmdale
COC	cycle of concentrations
CY	calendar year
District	Palmdale Water District
DWR	California Department of Water Resources
FY	fiscal year
GWR	groundwater recharge
GWR-RW	groundwater recharge with recycled water
HP	horsepower
IPR	indirect potable reuse
IRWMP	Integrated Regional Water Management Plan
LACSD	Sanitation Districts of Los Angeles County
LCID	Littlerock Creek Irrigation District
LF	linear feet
M&I	municipal and industrial
MCL	Maximum Concentration Level
MG	million gallons
mgd	million gallons per day
NEPA	National Environmental Policy Act
Plan	Recycled Water Master Plan
psi	pounds per square inch
RWC	recycled water contribution
RWQCB	Regional Water Quality Control Board
St	Street
SWP	State Water Project
SWRCB	State Water Resources Control Board
SWRP	Strategic Water Resources Plan
TDS	total dissolved solids
USGS	U.S. Geological Survey
WDR	Waste Discharge Requirements
WRP	Water Reclamation Plant
WTP	Water Treatment Plant
WWD40	Los Angeles County Water Works District 40

Chapter 1 Introduction

The Palmdale Water District (District) is developing the use of non-potable water to offset increased potable water supply demand and diversify the District's water supply options. The District supplies water to a portion of the City of Palmdale (City), as well as areas of unincorporated Los Angeles County (see **Figure 1-1**). Approximately 45 percent of these supplies are from imported surface water from the State Water Project (SWP) and 40 percent are from groundwater. The remaining 15 percent consists of surface water from the District's Littlerock Reservoir; although this supply can vary significantly based on local precipitation.

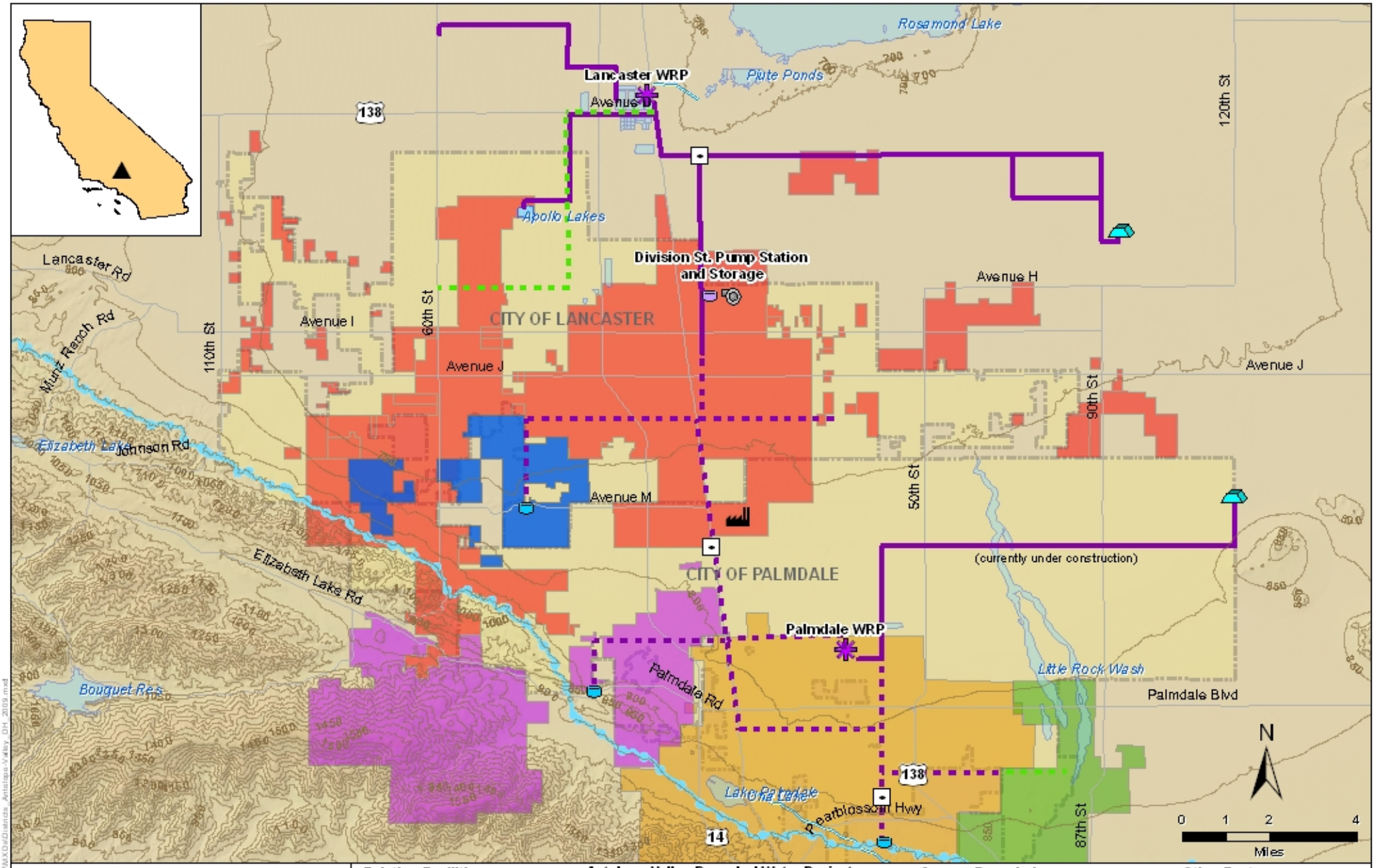
The ability of the District to reliably meet future water demand with existing water supplies is not certain. The Antelope Valley Groundwater Basin (Basin) is severely overdrafted and is currently in the process of adjudication, which will limit and possibly decrease the allowable annual extraction of groundwater. The reliability of SWP water is also in question due to a multitude of issues.[1] Maximizing use of recycled water that will be available from the Palmdale Water Reclamation Plant (Palmdale WRP) will help the District and the Antelope Valley address its water supply uncertainties by capitalizing on a local, reliable source of water, and is a key component of the District's overall Strategic Water Resources Plan (SWRP) that was recently completed.

In 2006, Los Angeles County Water Works District 40 (WWD40) completed the Antelope Valley Recycled Water Project Master Planning Report (AV RW Report) (KJ, 2006). The report recommended a regional recycled water distribution system that included serving some District customers with non-potable demands. Since the completion of the AV RW Report, additional non-potable customer opportunities have been identified, such as private agriculture, and indirect potable reuse via groundwater recharge (GWR) with recycled water (GWR-RW).

This Recycled Water Facilities Plan (Plan) defines a set of alternatives for construction of a new distribution system that would deliver recycled water from the Palmdale WRP to some combination of the District's municipal customers, industrial customers and agricultural customers adjacent to the District, and groundwater recharge that includes recycled water. This Plan includes a water supply assessment that documents projected recycled water supplies and a market assessment to provide demand estimates for a number of non-potable water customers that could potentially be served by the distribution alignments under consideration. Cost estimates were developed for each alternative to determine its feasibility and cost effectiveness. Based on these criteria, a preferred alternative was identified which has been further developed into the Recommended Facilities Plan (Chapter 5). This Plan includes:

- Characterization of the project setting;
- Assessment of the non-potable water market in the District and surrounding areas;
- Development and evaluation of recycled water project alternatives;
- Documentation of non-potable water market assurances; and
- Preparation of a construction financing plan and implementation plan for the recommended facilities.

[1] DWR (2007) identified three general factors that determine water reliability: 1) availability of water from the source; 2) availability of means of conveyance; and 3) level and pattern of water demand in the delivery service area. Through 2027, DWR projects a long-term average delivery of SWP Table A water from the Delta of 63 to 69 percent. In addition, the minimum estimated delivery in a single dry year is 6 to 7 percent and 26 to 36 percent under multi-year drought conditions.



Palmdale Recycled Water Facilities Plan Project Vicinity & Characteristics

Figure 1-1

Existing Facilities
- Water Reclamation Plant
- Recycled Water Pipeline
- Recycled Water Storage
- Division St. Pump Station (Lancaster)

Antelope Valley Recycled Water Project Facilities Planning Report (KJ, 2006) Proposed Facilities
- Conceptual Recycled Water Backbone
- Conceptual Groundwater Recharge Pipeline
- Recycled Water Storage
- Recycled Water Pump Station
- Reservoir

Agency Boundaries
- Palmdale Water District
- Quartz Hill District
- LA County WWD 40-04
- LA County WWD 40-34
- Littlerock Creek Irrigation District

Other Features
- City Boundaries
- Proposed Palmdale Hybrid Power Plant
- California Aqueduct
- Water Bodies
- Elevation Contour (m)

1.1 Background

Due to current and anticipated growth, as well as increasing uncertainty as to the Antelope Valley's ability to meet local water demands with imported water and groundwater, cities and water supply agencies across the Antelope Valley are taking proactive steps towards expanding the use of non-potable water to meet a variety of non-potable and indirect potable uses.

The District's residents and businesses are major users of water in the Antelope Valley and the water demand will likely increase since the District's population is expected to double over the next 20 years. In response to the expected population growth, the Antelope Valley is developing alternative water resources[2] including recycled water facilities to help meet its water supply needs. Developing recycled water use in the District would:

1. **Reduce Dependence on SWP and Groundwater Supplies:** Imported SWP water supplies represent approximately 45 percent and groundwater supplies represent the approximately 40 percent of water used within the District. Recycled water use within and adjacent to the District will help reduce dependency on these sources.
2. **Improve Water Supply Reliability:** Recycled water supply is generally not affected by hydrologic conditions; therefore, it provides additional dry year reliability.
3. **Preserve Potable Water Supplies:** Using recycled water to serve non-potable demands, such as irrigation and industrial demands, will preserve high-quality drinking water supplies for potable needs.

The District has access to a variety of potable and non-potable supply sources. Currently, the District's needs are being fully supplied by potable water; however, two key issues for potable water supplies remain:

1. The ongoing uncertainty of SWP water reliability; and
2. The decreased availability and/or increased cost of groundwater supplies after adjudication.

These issues, coupled with available recycled water, have led the District to explore the addition of a recycled water component to its water supply portfolio. The District is currently developing an SWRP to explore the District's potable and non-potable supply options and create a plan to allow the District to meet its water demands through 2035. This Plan has been developed in conjunction with the SWRP to consider other water supply options.

The Sanitation Districts of Los Angeles County (LACSD) are currently upgrading the Palmdale WRP to tertiary treatment for all inflows to produce recycled water in accordance with Department of Public Health (CDPH) Title 22 requirements (Chapter 3, Division 4, Title 22, California Code of Regulations (CCR), Section 60301). Construction of the Palmdale WRP upgrades is expected to be completed in 2011. As these upgrades come online, there will be additional recycled water available for beneficial reuse by the Antelope Valley.

[2] The Regional Water Management Group (RWMG) of the Antelope Valley completed the Antelope Valley Integrated Regional Water Management Plan (IRWMP) in November 2007 (KJ, 2007). Members of the RWMG include AVEK, AVSWCA, Lancaster, Palmdale, LCID, LACSD, WWD40, PWD, QHWD, and RCSD. The goals of the AV IRWMP were to address: 1) provide reliable water supply to meet Antelope Valley Region's expected demand between now and 2035; 2) Establish a contingency plan to meet water supply need of the region during a plausible disruption of SWP water deliveries; 3) stabilize groundwater levels at current conditions; 4) provide drinking water that meets customer expectations; 5) protect aquifer from contamination; 6) protect natural streams and recharge areas from contamination; **7) maximize beneficial use of recycled water**; 8) reduce negative impacts of stormwater, urban runoff, and nuisance water; 9) preserve open space and natural habitats that protect and enhance water resources and species in the region; 10) maintain agricultural land use within the region; 11) meet growing demand for recreational space; and 12) improve integrated land use planning to support water management.

In addition to reclaimed wastewater, the District also can access raw water from Lake Palmdale to serve as a non-potable water supply. Doing so allows the District to bypass costly treatment needed for potable water and allows the District to use the non-potable system to help regulate water levels in Lake Palmdale, allowing the District to take more State Project Water when it is available. Lastly, the District can proceed immediately with developing a non-potable system using water from Lake Palmdale rather than having to wait another 2 years for tertiary treatment upgrades to be completed at the Palmdale WRP.

Potential recycled water uses in the District include many applications that are suitable for non-potable uses, such as landscape irrigation. In these cases, potable supplies that are currently being used or planned to be used could be offset with direct use of non-potable water. Though the District does not supply private agricultural water users with water, opportunities to trade recycled water for groundwater rights were explored. Also, indirect potable reuse (IPR) via GWR-RW is an opportunity that is considered conceptually in this Plan. Certain key issues would need to be addressed prior to implementation, such as public acceptance and regulatory approval.[3]

1.2 Report Organization

This Plan consists of five chapters and is organized as follows:

Chapter 1 – Introduction: This section describes the need for developing the use of recycled water for the District and an overview of the Plan. It also provides the background and basis for recycled water planning that has been conducted to date.

Chapter 2 - Project Setting: This section characterizes the District including climate, hydrologic features, land use, water supply and use, wastewater treatment and disposal, and existing recycled water facilities.

Chapter 3 - Market Assessment: This section identifies potential non-potable water users within the District, providing estimates of non-potable water demand.

Chapter 4 - Project Alternative Analysis: This section discusses the methodology for developing and evaluating various recycled water project alternatives. It defines design criteria and assumptions and provides a detailed description of each project alternative, including a "No Project Alternative."

Chapter 5 - Recommended Project Plan: This section describes the recommended facilities, including operational strategy, cost, implementation plan and construction financing plan.

[3] The City of Lancaster has proposed a GWR-RW pilot project (RMC, 2008) to be implemented over the next five years to begin to address issues unique to the indirect potable reuse of recycled water via groundwater recharge.

Chapter 2 Project Setting

This section provides a characterization of the District, including information on climate, population, land use, water supply and use, wastewater treatment and disposal.

2.1 Area Characteristics

The following provides general characteristics of the District:

Location: Palmdale Water District is located 60 freeway miles northeast of the Los Angeles metropolitan area and 95 freeway miles southeast of Bakersfield (in Kern County) at an elevation of approximately 2,600 feet above mean sea level. The northern portion (approximately 28 square miles) of the District is covered by the City of Palmdale, while the southern portion is made up of unincorporated Los Angeles County (approximately 19 square miles).

Climate: The District 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 (KJ, 2007). There is little precipitation during the summer from June to September.

Soils and Topography: The District 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 (KJ, 2007). The soil in the District area consists of alluvial deposits that have been derived from erosion of the mountains that border the alluvial plain (LACSD, 2005). 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 large 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.

Hydrologic Features: The District is located in the Antelope Valley Groundwater Basin (Basin), a hydrologically enclosed watershed bounded by the Tehachapi Mountains on the northwest, San Gabriel Mountains and Sierra Pelano Mountains to the south, and low-lying buttes of San Bernardino County to the east. The Basin is comprised of two primary aquifers; the principal (or upper) aquifer and the deep (or lower) aquifer. The principal aquifer is unconfined. The lower aquifer, which is separated from the principal aquifer by clay layers originating from deposition of lacustrine sediment from an ancient lake that used to cover a large part of the Antelope Valley, is generally considered to be confined.

Natural groundwater recharge in the area occurs from percolation of precipitation from the San Gabriel Mountains to the south. These natural flow patterns have been altered somewhat by the presence of a groundwater level depression between the City of Palmdale and the City of Lancaster, caused by high amounts of groundwater pumping (Wildermuth, 2007). In general, groundwater levels appear to be falling in the southern portion of the Basin including the area, which is attributable to the higher levels of pumping taking place there. The amount of recharge to the Basin is not precisely known and substantive amounts of recharge occur only during very wet years. Estimates of natural groundwater recharge rates in the Basin vary from 31,200 to 80,400 acre-feet per year (afy) (KJ, 2007). Human activities are responsible for other sources of recharge such as irrigation of agriculture and landscapes and wastewater effluent management practices. Very little or no recharge results from rainfall on the valley floor as the Antelope

Valley receives less than 10 inches of rainfall per year and most of this is lost through transpiration and evaporation.

2.2 Land Use Trends and Population Projections

2.2.1 Land Use

Existing land use within the District's boundaries is shown in **Figure 2-1**. Within the existing District boundaries, land use is mainly residential. Other uses include commercial and industrial uses and a small amount of agriculture. Land use percentages within District boundaries are: 63.4% vacant, 29.0% residential, 2.3% public and semi-public, 1.8% miscellaneous (utility, mining, canal, right of way, etc.), 1.5% commercial, 0.9% industrial, 0.6% institutional, 0.2% farmland, and 0.3% recreational. The large amount of remaining vacant land in the area leaves significant potential for future growth, with some of the land already allocated for housing development.

2.2.2 Population Projections

Table 2-1 provides a summary of population projections for the District and the Antelope Valley as a whole. As shown in this table the population for the District is expected to more than double between 2005 and 2035.

Table 2-1: Population Projections

	2005	2010	2015	2020	2025	2030	2035
District[1]	110,000	129,000	164,000	195,000	225,000	254,000	280,000
Antelope Valley[2]	450,000	545,000	641,000	774,000	907,500	1,041,000	1,174,000

Notes:

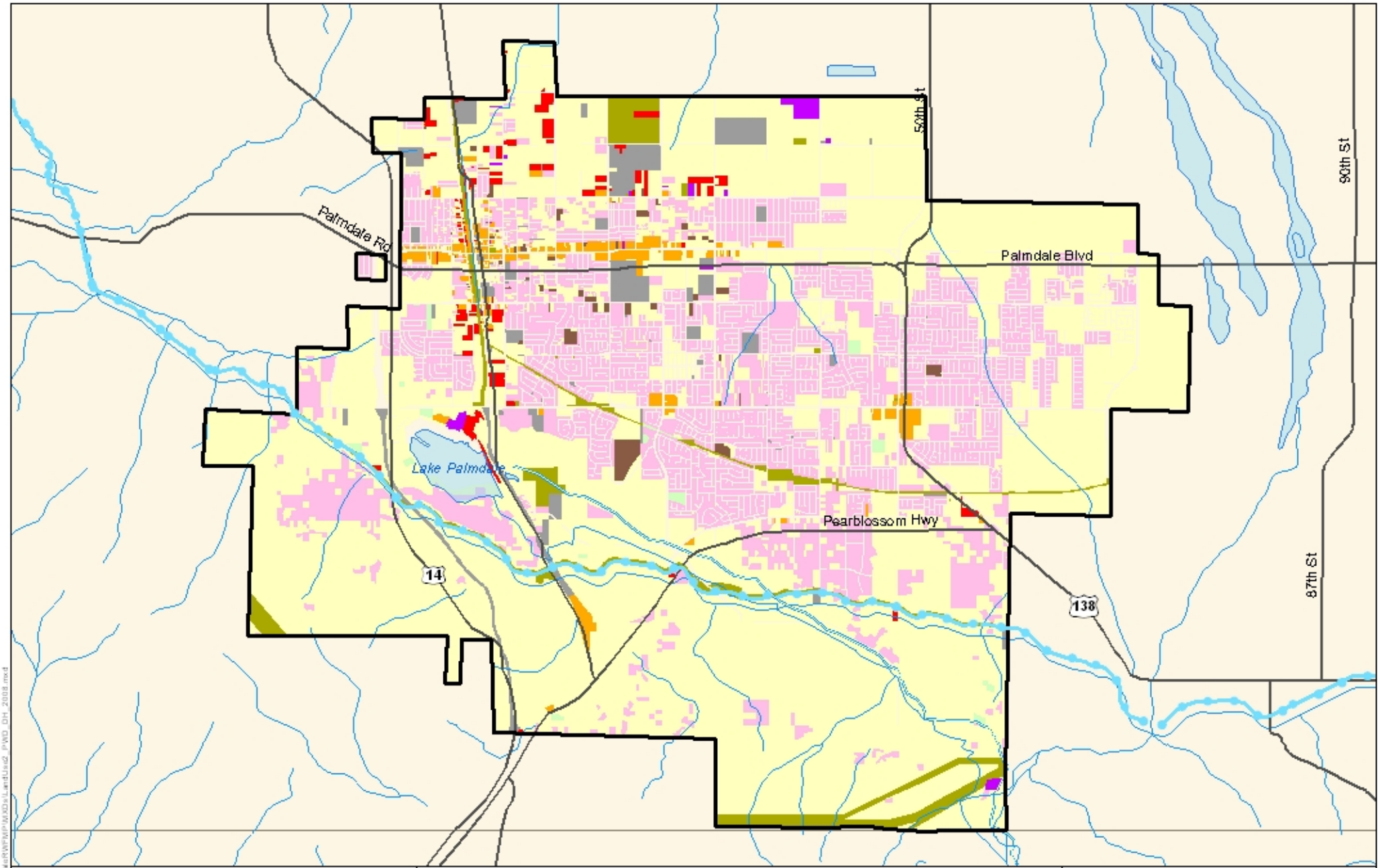
1. District populations from 2005 to 2035 from RMC, 2009c.
2. Antelope Valley populations from 2005, 2015 and 2035 were obtained from KJ, 2007; Table 2-3. Projections for 2010 populations were obtained from interpolation between 2005 and 2015. Projections for 2020, 2025 and 2030 were obtained from interpolations between 2015 and 2035.

2.3 Water Supply and Use

This section describes District water supplies, major water facilities, current rates, and water use trends.

2.3.1 Potable Water Supply Characteristics and Facilities

The District serves the eastern half of the City of Palmdale, which is approximately 75 percent of the City's total population, and unincorporated areas of Los Angeles County. The District's supplies are obtained from Littlerock Creek Dam and Reservoir, SWP water and groundwater. In 2008, the District delivered approximately 25,000 af of potable supplies composed of 45 percent imported water, 15 percent local surface water and 40 percent groundwater (PWD, 2009). The District has a SWP contract for a supply allocation of 21,300 afy.



Palmdale Water District

Land Use

Figure 2-1

PWD Service Area
Water Body
Waterway
California Aqueduct
Highway

Land Use
Residential
Commercial
Industrial
Public/Semi-Public
Irrigated Farm
Dry Farm
Recreational
Institutional
Misc. (Canal, ROW, etc.)
Vacant

N

0 0.5 1 2
Miles

Imported Water

Imported water from the SWP provides approximately 45 percent of the water supply for the District. The SWP is operated by California Department of Water Resources (DWR) and includes 660 miles of aqueduct and conveyance facilities from Lake Oroville in northern California to Lake Perris in southern California. The District is contractually allowed to receive 21,300 afy of SWP water. Availability of SWP water varies from year to year, depending on precipitation, regulatory restrictions, legislative restrictions, and operational conditions. It is especially unreliable during dry years. Over the last decade, the District has received between 41% and 77% of the 21,300 afy (DWR, 2008). The District's connection to the East Branch of the California Aqueduct is limited to 30 cfs (Montgomery Watson, 2001). Also, the District has limited capacity [35 million gallons per day (mgd)] in its existing facilities to treat and deliver imported water to its customers. Imported water supplies stored in Lake Palmdale then treated at the District's Palmdale WTP before being distributed to customers.

Groundwater

As discussed in the previous two sections, groundwater pumping makes up a significant proportion of the District's water supply portfolio, accounting for approximately 40% of supplies during a normal year. The underlying Basin is still in the process of adjudication and groundwater extractions have exceeded natural recharge estimates since the 1920s (USGS, 2003). The Antelope Valley Integrated Regional Water Management Plan (KJ, 2007) noted that historical estimates of natural recharge have ranged from 30,300 to 81,400 afy and the most recent (1991 through 1995) estimates from the U.S. Geological Survey (USGS) contend that groundwater pumpage averaged 81,700 afy. Depending on the results of the ongoing adjudication, the quantity of groundwater supplies available could be decreased and the cost of acquiring additional groundwater supplies would likely increase.

The Basin is composed of a series of subbasins and the District overlies the Lancaster, Buttes and Pearland groundwater subbasins (USGS, 2003). The upper aquifer in the southern area of the Antelope Valley is unconfined and groundwater recharge efforts through spreading will likely impact the upper aquifer (RMC, 2007). As the cities of Lancaster and Palmdale have become more developed and urbanized, there has been a noticeable decline in groundwater levels. Increased groundwater pumping in the Lancaster subbasin to support urban development and agricultural needs has created a significant depression in groundwater levels between the cities of Lancaster and Palmdale with a prominent "ridge" of high groundwater levels present near the LACSD Lancaster WRP agricultural operations (Wildermuth, 2007).

Groundwater quality is suitable for domestic, irrigation and most industrial uses. Total dissolved solids (TDS) and nitrate are the two constituents that present the most concern to groundwater quality in the Basin and arsenic also has emerged as a potential concern (KJ, 2007). Groundwater quality sampling data shows TDS concentrations that range from 110 to 1,480 milligrams per liter (mg/L), with samples at four wells above the recommended secondary drinking Maximum Concentration Level (MCL) of 500 mg/L (RMC, 2007). Nitrate levels ranged from non-detect to 15 mg/L and exceeded the primary drinking water MCL of 10 mg/L in three wells (RMC, 2007).

Surface Water (Littlerock Reservoir)

Littlerock Reservoir is a 3,500 af impoundment located south of the District's boundaries that is co-owned by the District and the Littlerock Creek Irrigation District (LCID). The reservoir captures local surface water runoff from the Littlerock and Santiago Canyons. The District and LCID have long-standing water rights to 5,500 afy from the Littlerock Creek. At the current time, LCID is able to purchase 1,000 afy or 25% of the yield from the reservoir from the District, whichever is less (RMC, 2009c). When the 50-year reservoir rehabilitation agreement between the District and LCID ends in 2042, LCID will regain its water rights according to the 1922 agreement between the District and LCID which stipulates that LCID will receive the first 13 cubic feet per second (cfs) measured at the point of inflow into the reservoir and that the subsequent volumes will be shared between the District (75%) and LCID (25%). The agreement also accords 50% storage capacity to each agency.

The water yield available from the Littlerock Reservoir varies according to the weather and precipitation. Based on an analysis of actual hydrology data from 1949 to 1999, the District average yield was 6,920 afy with a minimum of 1,072 afy and maximum of 14,469 afy (Carollo, 2005). The District's actual take from Littlerock Reservoir from 1995 to 2008 ranged from 3,043 af to 6,900 af. The probability of the District being able to divert their full allotment of 5,500 afy is approximately 50% in any given year. Water from Littlerock Reservoir is suitable for direct agricultural use and for potable use after receiving treatment at the District's Palmdale WTP.

2.3.2 Water System Facilities

The District serves over 121,000 people and approximately 25% of the population in the Antelope Valley. The District water system is comprised of the following components (Carollo, 2008):

- **Groundwater Facilities**: The District operates 29 wells (2 are currently offline and 1 is inactive) for a total maximum capacity of 22.6 mgd and has 3 additional drilled, unequipped wells.
- **Treatment Facilities:** The Palmdale WTP capacity is limited to 35 mgd.

Potable Water Rates

Potable water rates for the District are presented in this section. The District has established a water budget based rate structure which includes an elevation component and a water quality component. The service charges by meter size are shown in **Table 2-2** and commodity charges (based on water budgets) are shown in **Table 2-3**. Water budgets are based on customer classification and average water use. The elevation component and water quality component can be found in **Table 2-4** and **Table 2-5**, respectively.

Table 2-2: Palmdale Water District Service Charges ($/month)

Meter Size (in)	CY 2009	CY 2010	CY 2011	CY 2012	CY 2013	CY 2014
5/8" x 3/4"	25.97	29.60	31.97	34.53	37.29	40.27
1"	50.66	57.75	62.37	67.36	72.75	78.57
1-1/2"	91.81	104.67	113.01	122.08	131.85	142.40
2"	141.20	160.96	173.84	187.75	202.77	218.99
3"	256.43	292.33	315.71	340.97	368.25	397.71
4"	421.05	479.99	518.39	559.86	604.65	653.02
6"	832.59	949.15	1,025.08	1,107.09	1,195.65	1,291.31
8"	1,326.44	1,512.14	1,633.11	1,763.76	1,904.86	2,057.25
10"	1,902.60	2,168.96	2,342.48	2,529.87	2,732.26	2,950.84

Source: PWD, 2009

Table 2-3: Palmdale Water District Commodity Charge ($/ccf)

Tier	CY 2009	CY 2010	CY 2011	CY 2012	CY 2013	CY 2014
Tier 1	0.64	0.73	0.79	0.85	0.92	1.00
Tier 2	2.50	2.59	2.66	2.73	2.80	2.88
Tier 3	3.20	3.31	3.39	3.46	3.55	3.64
Tier 4	4.16	4.30	4.39	4.49	4.60	4.71
Tier 5	5.03	5.14	5.22	5.30	5.39	5.48

Source: PWD, 2009

Table 2-4: Palmdale Water District Elevation Surcharge ($/ccf)

Area	CY 2009	CY 2010	CY 2011	CY 2012	CY 2013	CY 2014
Area 1	0.23	0.25	0.27	0.29	0.31	0.34
Area 2	0.49	0.53	0.57	0.62	0.67	0.72
Area 3	1.71	1.85	2.00	2.16	2.33	2.52

Source: PWD, 2009

Table 2-5: Palmdale Water District Water Quality Fee ($/ccf)

CY 2009	CY 2010	CY 2011	CY 2012	CY 2013	CY 2014
0.20	0.20	0.21	0.22	0.23	0.23

Source: PWD, 2009

2.3.3 Water Use Trends

Water usage by District customers can be characterized as growing relatively slowly over the last ten years. In 2005, the District's water usage was 24,548 afy. **Table 2-6** presents an estimate of water demand through 2035. The Antelope Valley demand projections include an assumed constant agricultural demand (based on assumed crop acreages and water requirements) of 127,000 afy.

Table 2-6: Palmdale Water District Demand Projections (afy)

	2010	2015	2020	2025	2030	2035
District[1]	31,000	40,000	49,000	54,000	60,000	66,000
Antelope Valley[2]	283,000	311,000	341,000	375,000	412,000	456,000

Notes:
1. Source: RMC, 2009c; Figure 3-2
2. Source: KJ, 2007; Table 3-9

2.4 Wastewater Collection and Treatment

Wastewater collection and treatment for the cities of Palmdale and Lancaster is provided by LACSD, which provides service to the Antelope Valley through Districts No. 14 and 20. The two districts serve a combined wastewater service area of approximately 76 square miles and over approximately 310,000 people. Collection is provided through a network of 104 miles of trunk sewers, which are all designed to provide wastewater conveyance through gravity flow.

The Antelope Valley is a closed basin without an outlet to the ocean so the receiving water of effluent from the Palmdale WRP is the Antelope Valley Groundwater Basin, which has designated beneficial uses of Municipal and Domestic Supply and Agricultural Supply. The Lahontan Regional Water Quality Control Board (Lahontan RWQCB) issued revised Waste Discharge Requirements (WDRs) in 2000 (Lahontan RWQCB Order 6-00-57) that set receiving water limits to maintain both of these beneficial uses and ordered LACSD to take action on suspected groundwater nitrate contamination attributed in part to historical land application and agricultural practices. Lahontan RWQCB also issued a cease and desist order (R6V-2004-0039) to reduce and abate land application disposal of effluent. LACSD was disposing of effluent to its Effluent Management Site via crop irrigation above agronomic rates and land application (surface spreading).

Subsequently, LACSD developed the Palmdale WRP 2025 Master Plan (LACSD, 2005) to identify effluent management methods in place of land application and agricultural irrigation above agronomic rates. As discussed in the following section, LACSD is currently upgrading the Palmdale WRP with tertiary treatment facilities, seasonal storage reservoirs, and expanded agricultural irrigation. These improvements will provide the capability to dispose of all effluent at agronomic rates. At completion of the tertiary treatment upgrade, land application will no longer be used. Starting in 2011, all tertiary effluent will need to be delivered to recycled water users (crop irrigation, non-potable municipal, etc.), recharged, or delivered to seasonal storage.

There are no water rights issues associated with use of recycled water from the Palmdale WRP since its planned use for crop irrigation at agronomic rates eliminates potential flow to receiving waters.

2.5 Recycled Water Facilities

2.5.1 Planned Treatment Facilities

Non-potable supplies to serve the study area include recycled water that will be available from the Palmdale WRP in 2011. Other potential non-potable supplies that could be considered in the future, but are outside the scope of this study, are stormwater and lower-quality groundwater that has been rendered non-potable due to the presence of arsenic at levels exceeding 10 µg/L (RMC, 2006b).

The Palmdale WRP is located in the City of Palmdale and has a secondary treatment capacity of 15.0 mgd. In 2007, the Palmdale WRP received an average of 9.5 mgd of inflow and discharged 8.5 mgd of disinfected secondary treated water. As part of a planned set of improvements laid out by the Palmdale WRP 2025 Master Plan and EIR (LACSD, 2005), LACSD planned to upgrade to 15.0 mgd of tertiary treatment capacity; however, due to lower than projected development rates, LACSD now plans to construct 12.0 mgd of tertiary capacity by 2011. Future capacity will be expanded as needed to treat increased wastewater flow.

Palmdale WRP construction activities for this upgrade commenced in early 2008 and production of tertiary treated water from the plant is expected to begin by 2011. **Table 2-7** shows the projected Palmdale WRP tertiary water supply through the year 2035.

Table 2-7: Palmdale WRP Tertiary Water Supply Projections

Units	2011	2015	2020	2025	2030	2035
mgd	10.0	12.6	15.9	18.8	22.1	24.4
afy	11,200	14,100	17,800	21,100	24,800	28,500

Note: All supply projections were estimated based on the flow projections (LACSD, 2005; Table 5-15) but starting with actual flows of 9.5 mgd for 2008 instead of 12.3 mgd.

The current secondary treatment facility consists of comminution, grit removal, primary sedimentation, secondary treatment via oxidation ponds, chlorination, and solids processing through anaerobic sludge digestion and sludge drying beds.

The planned tertiary treatment modifications will upgrade the secondary process to activated sludge, and provide tertiary filtration and chlorination. The upgraded process will consist of comminution, grit removal, primary sedimentation, aeration basin, secondary clarifier, filtration and chlorination. The aeration basin will be operated in nitrification/denitrification mode to increase nitrogen removal. Secondary effluent equalization basins will be constructed following secondary treatment process to allow stabilization of treated flows so that the tertiary effluent flow will be constant and approximately equal to the average daily influent flow. A schematic of the proposed treatment process is shown in **Figure 2-2**.

LACSD plans to manage tertiary effluent that is not purchased by local retailers through agricultural use at agronomic rates at the LACSD Effluent Management Site with flows that exceed demands during low agricultural demand periods kept in seasonal storage reservoirs. Effluent pumps with an initial capacity of 18,700 gpm will be constructed as part of the upgrade to pump the recycled water to the effluent management site and seasonal storage reservoirs via a 36-inch pipeline. LACSD plans to expand the pump station to 28,000 gpm as wastewater flows increase above the initial project capacity. The pump station will be located downstream of existing oxidation ponds that will be converted for use as backup storage.

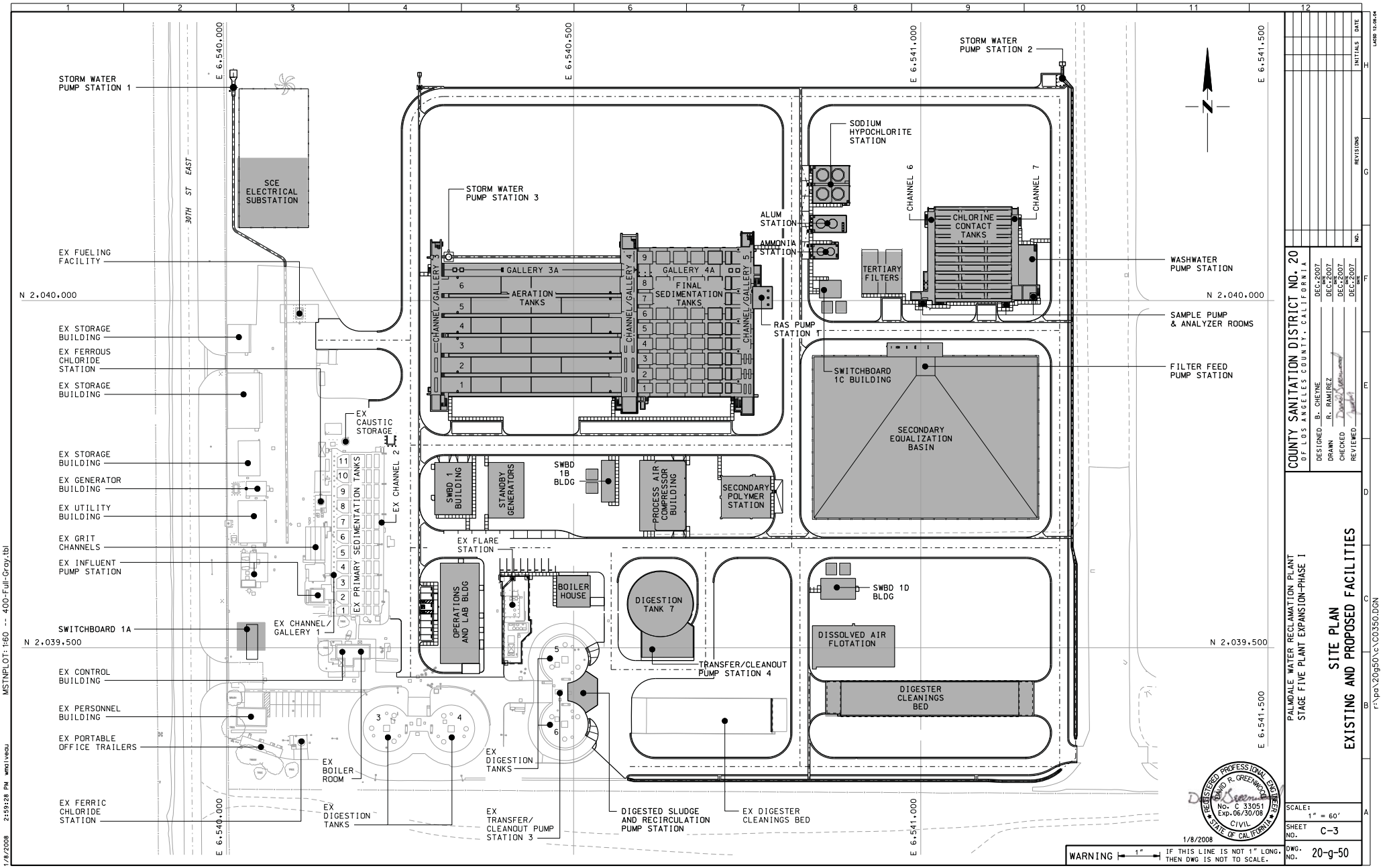
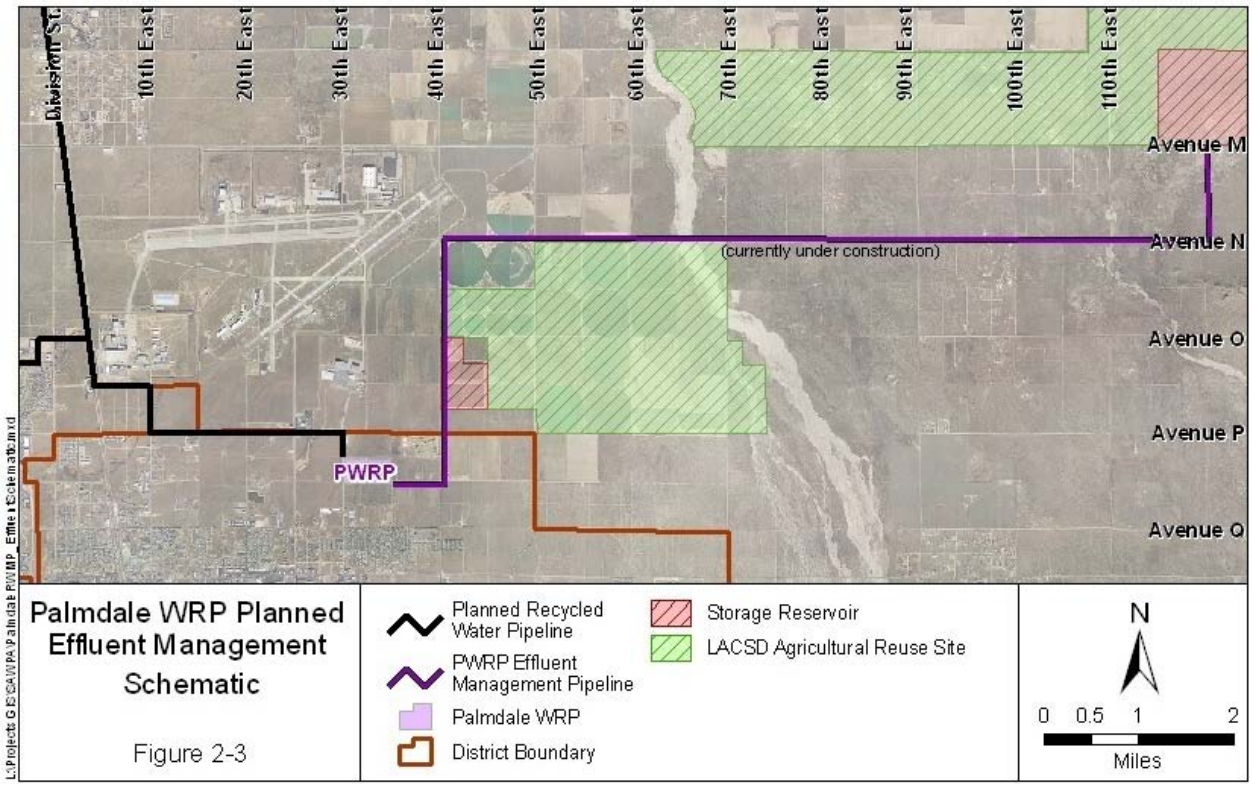


Figure 2-2: Palmdale WRP Schematic

A pump station with a capacity ranging from an initial 38,900 gpm to 58,400 gpm at build-out will be constructed at the seasonal storage reservoirs to convey recycled water to the agricultural reuse sites in coordination with recycled water pumped from Palmdale WRP. The LACSD seasonal storage reservoirs will have 1,540 MG (4,730 af) capacity by 2011 to provide seasonal storage of recycled water from Palmdale WRP. The reservoirs will ultimately be expanded to 2,310 MG (7,100 af) of capacity. The total estimated agricultural land area necessary for full use of recycled water initially is 3,520 acres and 5,140 acres at build-out. **Figure 2-3** shows the planned effluent management strategy for the Palmdale WRP.

Figure 2-3: Palmdale WRP Planned Effluent Management Schematic

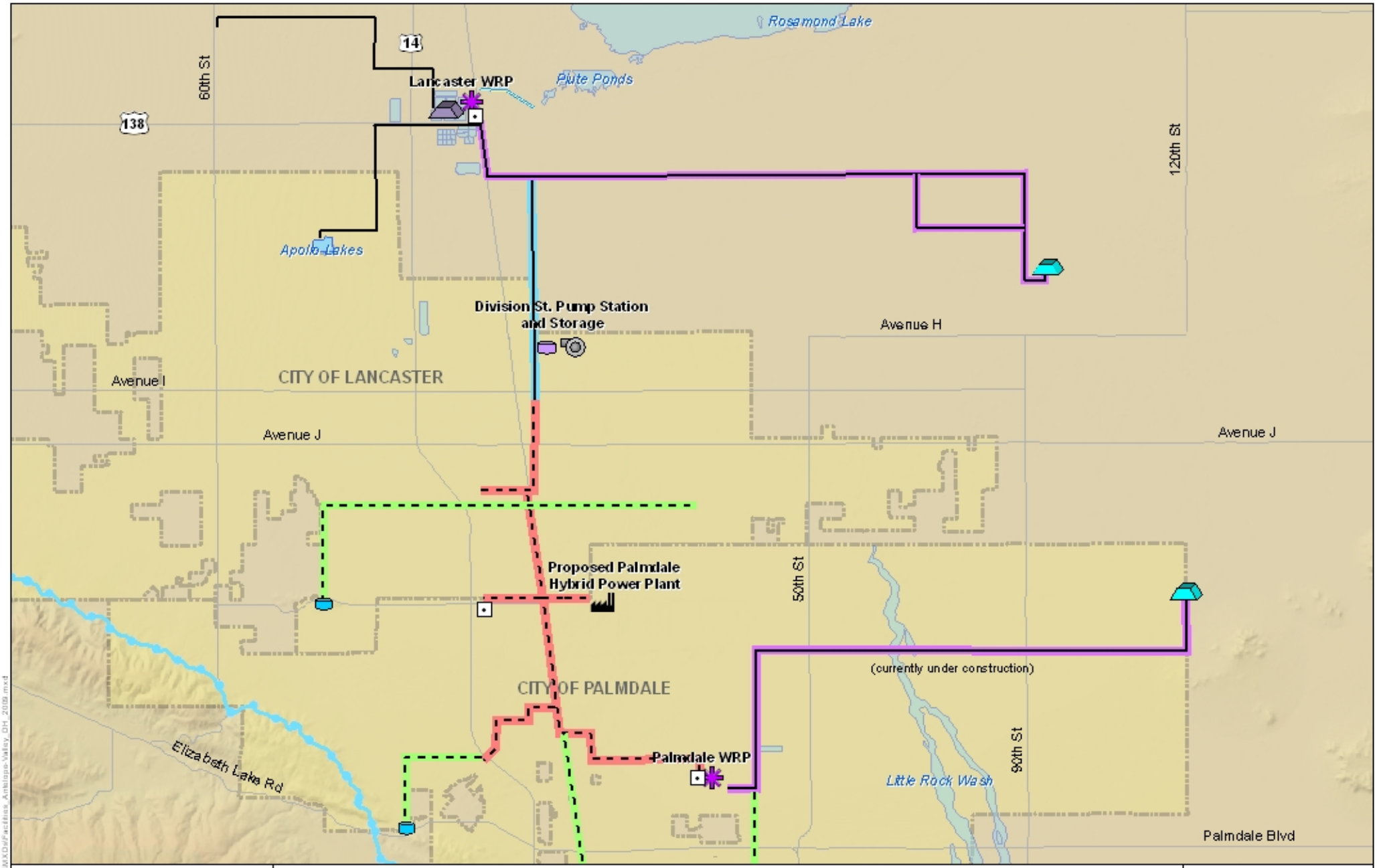


2.5.2 Planned Conveyance Facilities

The AV RW Report (KJ, 2006) laid out a conceptual regional non-potable system that encompasses the District's service area as well as much of the developed portions of the Basin. The concept included a regional backbone pipeline that would connect the Palmdale WRP and the Lancaster WRP.

The City of Lancaster has constructed a portion of the regional system along Division St and connecting to the Lancaster WRP. The City of Palmdale recently completed a Recycled Water Master Plan that proposes to construct the remainder of the regional backbone pipeline from Palmdale WRP to the existing backbone pipeline along Division St in the City of Lancaster. The major corridors of this alignment are Ave P, Sierra Highway, and Division St.

The City of Palmdale project would serve 3,330 afy of existing municipal and industrial recycled water demand and 730 afy of future municipal recycled water demand from the Palmdale WRP. The existing demands include the planned Palmdale Hybrid Power Plant, the Antelope Valley Country Club, and the Desert Aire Golf Course. Future demands consist of two planned business parks near the power plant. All demands are north of the District's service area. These systems are presented in **Figure 2-4**.



Existing and Planned Recycled Water Facilities

Figure 2-4

Existing Facilities
- Water Reclamation Plant
- Recycled Water Pipeline
- Recycled Water Storage
- Division St. Pump Station (Lancaster)
- Reservoir

Proposed Facilities
- Conceptual/Planned Recycled Water Pipeline
- Recycled Water Storage
- Recycled Water Pump Station
- Reservoir

Project
- Regional Recycled Water Concept Facilities
- City of Lancaster Division Street Project Facilities
- City of Palmdale Power Plant Project Facilities
- LACSD Effluent Management Projects

Other Features
- City Boundaries
- Proposed Palmdale Hybrid Power Plant
- California Aqueduct
- Water Bodies

N

0 0.75 1.5 3

Miles

2.5.3 Potable Facilities with Potential for Non-Potable Use

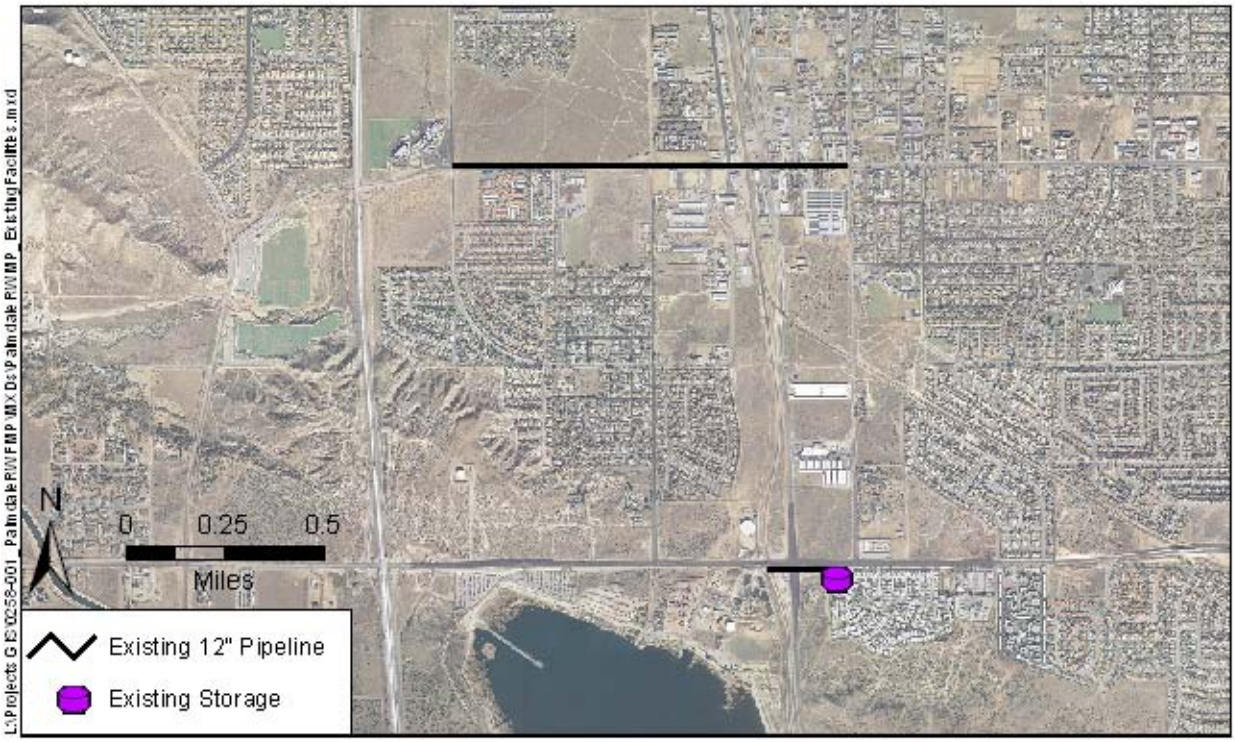
The District has an existing surplus storage tank located near their WTP and several sections of abandoned potable water pipelines that could be utilized by a non-potable system, as shown in **Figure 2-5**.

The existing storage tank is 3.0 MG and located at the southeast corner of Ave S and 10th St E near Lake Palmdale and the Palmdale WTP. The tank is connected to a raw water supply from Lake Palmdale with a 12-inch pipeline, which could potentially be used to supplement recycled water. Also, there are three 75-hp pumps adjacent to the tank that could be used for the non-potable distribution system. Finally, the tank is well-positioned to become part of the regional recycled water system. Use of the storage tank, raw water intertie, and pumps will be considered during alternatives development and definition in Chapter 4.

District staff identified several sections of abandoned potable water pipelines that could be converted for non-potable water use. In particular, a 12-inch line in Ave R between Sierra Highway and Division St is located along the proposed backbone pipeline alignment through the City. These locations may be along potential non-potable water pipeline alignments so there could be potential cost savings by using the existing pipeline instead of installing a new pipeline.

There are four trenchless construction methods that may be applicable in this situation: 1) traditional sliplining; 2) close-fitting sliplining; 3) cured-in-place pipe; and 4) pipe bursting. All four trenchless methods are less expensive than using open cut to install a new pipeline; although the specific method will be determined following the detailed hydraulic analysis. The chosen method depends on the minimum diameter needed for the non-potable system and the maximum diameter that would be available from applying each trenchless method within the given diameter of the selected abandoned pipe. The first three methods reduce the available inner diameter while pipe bursting allows for the diameter to be increased.

Figure 2-5: Potable Water Facilities with Potential Non-Potable System Use



Chapter 3 Market Assessment

This section presents an assessment of the market for non-potable water use within the District.

3.1 Methodology

The goals of the non-potable water market assessment are to identify near- and long-term uses of non-potable water within the District's service area. The market assessment included a detailed examination within the service area of potential users and demands, supply availability, implementation challenges, and development of the basis of calculating and implementing fees for non-potable water infrastructure, installation and utilization. The methodology used for the market assessment is described below.

- Identify Potential Users
- Determine Potential Non-Potable Water Demands
- Confirm Availability of Recycled Water Supply
- Evaluate Recycled Water Quality

3.2 Potential Non-Potable Water Market

Table 3-1 includes a list of potential non-potable water users allowed by the DPH for disinfected tertiary recycled water meeting Title 22 standards. This Plan focuses on municipal and industrial (M&I) and agricultural customers. Groundwater recharge (GWR) with recycled water (GWR-RW) is also considered but, if chosen, would be part of a long-term recycled water strategy because GWR-RW projects typically take 5 to 15 years to implement.

Table 3-1: Title 22 Allowed Uses for Disinfected Tertiary Recycled Water[1]

Municipal Uses
Parks and playgrounds
School yards
Residential landscaping
Unrestricted access golf courses
Food crops where edible portion is produced above ground and not contacted by recycled water
Cemeteries
Freeway landscape
Restricted access golf courses
Any non-edible vegetation where access is controlled so that irrigated area cannot be used as if it were part of a park, playground or school yard
Industrial & Commercial Uses
Industrial or commercial cooling
Flushing toilets and urinals
Agricultural Uses
Ornamental nursery stock and sod farms where access by the general public is not restricted
Pasture for animals producing milk for human consumption
Orchards where the recycled water does not come into contact with the edible portion of the crop
Vineyards where the recycled water does not come into contact with the edible portion of the crop

Non food-bearing trees (no irrigation with recycled water for 14 days prior to harvesting or allowing general public access)
Fodder crops (e.g. alfalfa) and fiver crops (e.g. cotton)
Seed crops no eaten by humans
Food crops – contact with edible portion of the crop, including all crop roots
Food crops that undergo commercial pathogen-destroying processing before consumption by humans
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
Indirect Potable Uses
Groundwater recharge[2]

Notes:

1. This table does not represent an all-inclusive list of recycled water uses. See California Health Laws Related to Recycled Water, "The Purple Book" (June 2001)[4] for requirements for impoundment, cooling, and other uses.
2. Allowed under special case by case permits with the RWQCB.

3.2.1 Municipal and Industrial Demands

M&I non-potable water demands within the District represent a range of potential uses and users. Most of the customers include landscape irrigation at parks, golf courses, and schools. Demands for existing sites are based on 2008 meter records, while demands for future sites are based on estimated irrigated acreage in the AV RW Report. It is estimated that there will be 1,556 afy of existing non-potable water demand for the District, and 1,856 afy at build-out.

Potential non-potable water customers for the District consist of existing and planned schools, parks and golf courses, and a concrete pipe manufacturing company. Potential District M&I customers are shown in **Figure 3-1** and identified as either an existing or future demand. **Table 3-2** provides a summary of annual average water demand, average day of peak month (June) demand and maximum hourly flow rate during the irrigation period for existing District customers. It is assumed that these customers do not have on-site operational storage; therefore, recycled water demand is distributed evenly over a 10-hour irrigation period (from 8:00 pm to 6:00 am).

Table 3-2: Existing M&I Demands within District Boundaries

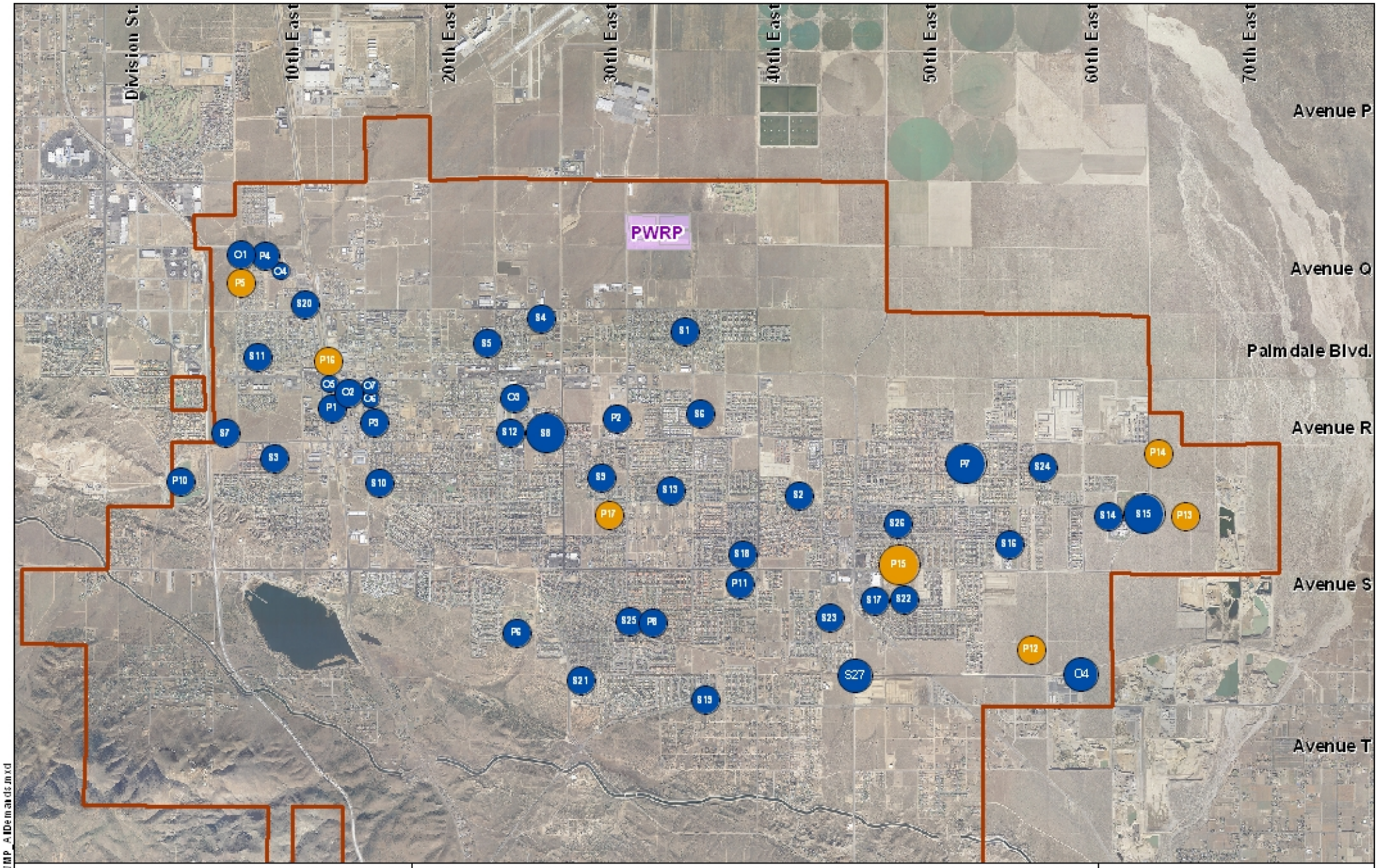
Site ID	Customer	Estimated Irrigated Area[1]	Average Annual Demand[2]	Avg Day Peak Month Demand[3]	Peak Day Demand[4]	Peak Hour Demand[5]
		(ac)	(afy)	(mgd)	(mgd)	(gpm)
Schools						
S1	Manzanita Elementary School	3.8	24.4	0.03	0.04	73
S2	Mesquite Elementary School	3.4	24.7	0.03	0.04	74
S3	Palm Tree Elementary School	3.3	29.0	0.04	0.05	86
S4	Phoenix High School	0.5	11.7	0.02	0.02	35
S5	Tamarisk Elementary School	3.3	22.0	0.03	0.04	65
S6	Wildflower Elementary School	3.8	26.5	0.04	0.05	79
S7	Palmdale Learning Plaza	6.6	46.8	0.06	0.08	139
S8	Palmdale High School	5.6	112.6	0.15	0.20	335
S9	Desert Rose Elementary School	4.4	20.6	0.03	0.04	61
S10	Tumbleweed Elementary School	5.6	25.0	0.03	0.04	74
S11	Yucca Elementary School	3.2	15.0	0.02	0.03	45

[4] www.cdph.ca.gov/certlic/drinkingwater/Documents/Recharge/Purplebookupdate6-01.PDF

Site ID	Customer	Estimated Irrigated Area[1]	Average Annual Demand[2]	Avg Day Peak Month Demand[3]	Peak Day Demand[4]	Peak Hour Demand[5]
		(ac)	(afy)	(mgd)	(mgd)	(gpm)
S12	Cactus K-8	4.5	33.6	0.04	0.06	100
S13	Mesa Intermediate School	9.1	37.7	0.05	0.07	112
S14	Los Amigos School	1.7	27.7	0.04	0.05	82
S15	Pete Knight High School	20	209.3	0.28	0.37	623
S16	Shadow Hills Intermediate School	7.0	88.8	0.12	0.16	264
S17	Yellen Learning Center School	2.1	14.4	0.02	0.03	43
S18	Oak Tree Learning Center	7.1	36.8	0.05	0.07	110
S19	Barrel Springs Elementary School	2.5	58.0	0.08	0.10	173
S20	R. Rex Parris High School	1.7	14.1	0.02	0.03	42
S21	Desert Willow Intermediate School	3.0	36.8	0.05	0.07	110
S22	Buena Vista Elementary School	7.1	48.0	0.06	0.09	143
S23	Cimmaron Elementary School	2.8	16.2	0.02	0.03	48
S24	Golden Poppy Elementary School	2.3	25.9	0.03	0.05	77
S25	Joshua Hills Elementary School	3.4	22.9	0.03	0.04	68
S26	Chaparral Elementary School	2.5	14.1	0.02	0.03	42
S27	High School (47th & Pearblossom)		26.2	0.04	0.05	78
Parks						
P1	Dr. Robert C. St. Clair Parkway	2.8	17.9	0.02	0.03	53
P2	McAdam Park	15.3	61.0	0.08	0.11	182
P3	Courson Park	4.0	31.7	0.04	0.06	94
P4	Desert Sands Park	11.3	24.9	0.03	0.04	74
P6	Desert Lawn Memorial Park	14	32.3	0.04	0.06	96
P7	Domenic Massari Park	30	145.4	0.19	0.26	433
P8	Joshua Hills Park	3.5	16.3	0.02	0.03	48
P10	Pelona Vista Park	26.2	93.3	0.12	0.17	278
P11	Dry Town Water Park	7.1	32.0	0.04	0.06	95
Other						
O1	American Indian Little League	4.5	10.1	0.01	0.02	30
O2	Ponciltan Square	1.5	11.8	0.02	0.02	35
O3	Palmdale Pony League	21.4	19.6	0.03	0.04	58
O4	Trailer Shay	0.0	10.0	0.01	0.02	30
O5	Palmdale City Library	0.2	4.9	0.01	0.01	15
O6	Palmdale Parks & Rec Office	0.3	2.9	0.004	0.01	9
O7	Palmdale Playhouse	0.1	2.2	0.003	0.04	7
		Total	**1,585**	**2.10**	**2.91**	**4,718**

Notes:

1. Estimated Irrigated Area was calculated based on aerial photos of each location.
2. From 2008 District meter records minus 10% for customers with both potable and non-potable uses.
3. Calculated using a peaking factor of 1.5 (vs. annual average demand), based on 2008 District meter records.
4. Calculated using a peaking factor of 2.0 (vs. annual average demand), based on evapotranspiration data.
5. Calculated using a peaking factor of 2.4 (vs. peak day demand), assuming irrigation operations occurs for 10 hours every night from 8 pm to 6 am.



PWD Municipal Demands

Figure 3-1

Customers
- Existing
- Future

Demand
- ≥ 1 AFY
- ≥ 10 AFY
- ≥ 100 AFY

Other Features
- PWRP
- District Boundary

N

0 0.25 0.5 1
Miles

L:\Projects GIS\SAWPA\Palmdale RWMP_AIDemands.mxd

Future non-potable water customers are listed in **Table 3-3** and are also included in **Figure 3-1.**

Table 3-3: Future M&I Demands within District Boundaries

Site ID	Customer	Estimated Irrigated Area[1]	Average Annual Demand[2]	Avg Day Peak Month Demand[3]	Peak Day Demand[4]	Peak Hour Demand[5]
		(ac)	(afy)	(mgd)	(mgd)	(gpm)
Parks						
P5	Desert Sands Expansion	4.0	29	0.04	0.05	86
P12	60th St E/Ave S-8 Park	19.2	84	0.11	0.15	250
P13	72nd St E/Ave R-8 Park	10.4	42	0.06	0.08	125
P14	70th St E/Ave R Park	10.4	42	0.06	0.08	125
P15	Sam Yellen Park	0.8	105	0.14	0.19	313
P16	Sierra Hwy Green Belt	0.2	16	0.02	0.03	48
P17	Palmdale Park	0.3	11	0.01	0.02	33
	Total	**329**	**0.44**	**0.59**	**980**	

Notes:

1. Estimated Irrigated Area was calculated based on aerial photos of each location.
2. From 2008 District meter records minus 10% for customers with both potable and non-potable uses.
3. Calculated using a peaking factor of 1.5 (vs. annual average demand), based on 2008 District meter records.
4. Calculated using a peaking factor of 2.0 (vs. annual average demand), based on evapotranspiration data.
5. Calculated using a peaking factor of 2.4 (vs. peak day demand), assuming irrigation operations occurs for 10 hours every night from 8 pm to 6 am.

3.2.2 Agricultural Demands

Agricultural operations have elected to convert to recycled water use in many settings in California, thereby reducing their pumping needs and making groundwater available for other uses and reducing overdraft. Agricultural water demand in the Los Angeles County portion of the Antelope Valley was estimated to be 127,000 afy based on approximately 25,000 acres of crop irrigation in 2005 (KJ, 2007). Actual agricultural water usage in the vicinity of this study area could not be determined within the scope of this study because most agricultural users receive their supply from private groundwater wells. The District does not serve agricultural customers.

An estimate of potential study area demand can be made from information provided about agricultural land currently in production. The total agricultural acreage owned or leased by potential private agricultural users in the vicinity of the Palmdale Airport was estimated to be 1,640 acres (**Figure 3-2**) (Nebeker, 2007). This would translate to a potential demand of 8,450 afy based on average crop water use requirements in the Antelope Valley of 5.1 af per acre in normal years (estimated from an weighted average of crops from KJ, 2007). This estimate would vary depending on the specific mix of actual crop types and associated water requirements as shown in **Table 3-4**.

Figure 3-2: Potential Agricultural Recycled Water Customer Areas

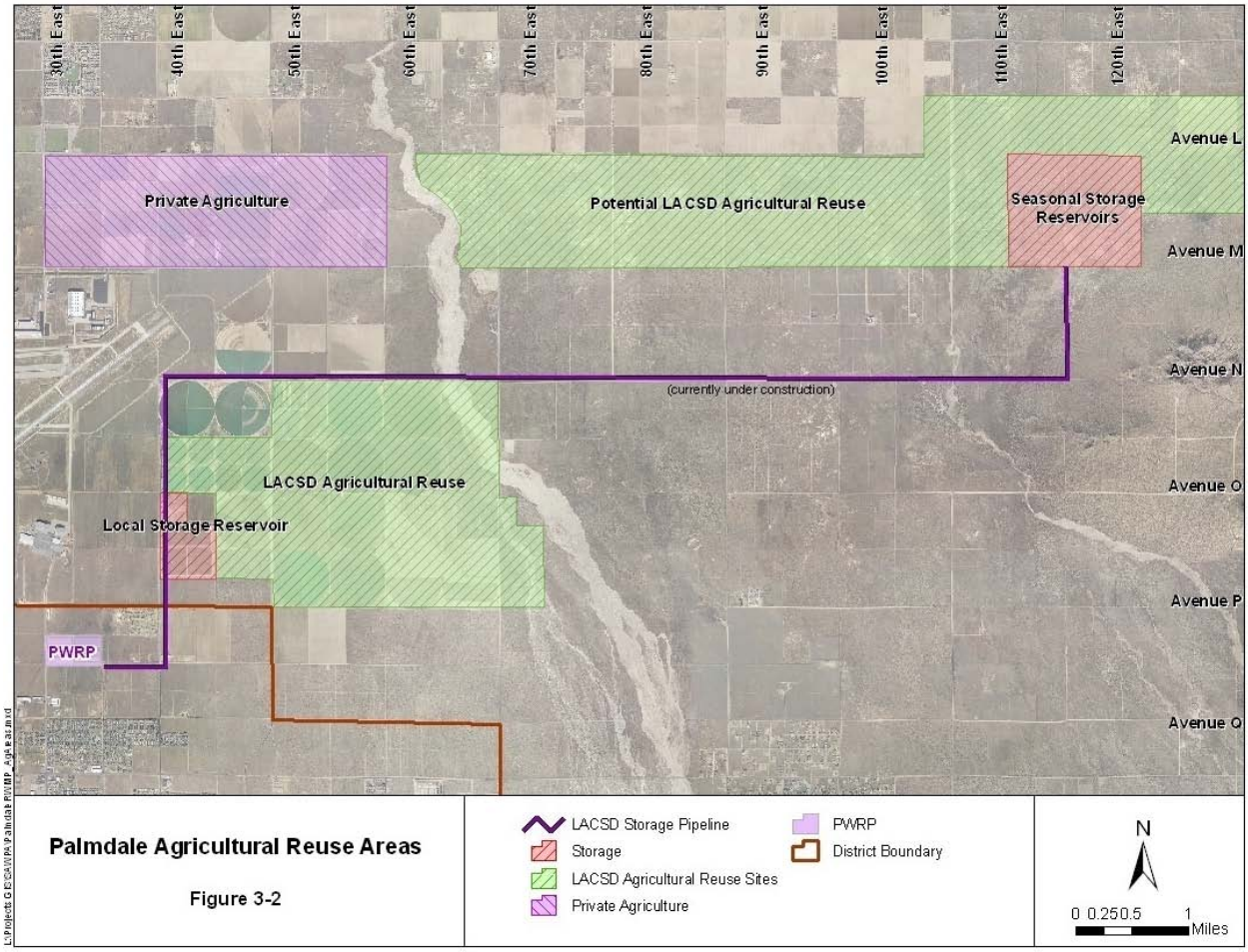


Table 3-4: Average Monthly Demand of Crop Type (AF/Month)

Date	Pasture/ Sod	Alfalfa	Sudan	Onions	Melons	Peas/ Beans	Deciduous Fruit Trees	Carrots	Potatoes
Jan	0.22	0.09							
Feb	0.29	0.32						0.09	
Mar	0.51	0.53		0.15	0.09	0.04	0.21	0.23	0.30
Apr	0.67	0.70		0.28	0.36	0.21	0.42	0.62	0.69
May	0.85	0.89		0.84	0.94	0.96	0.64	0.95	1.01
Jun	0.97	1.02	0.15	1.11	0.92	1.01	0.83	1.00	0.69
Jul	1.08	1.13	1.05	1.05	0.16	0.26	1.00		
Aug	0.98	1.02	0.95	0.72			0.92		
Sep	0.78	0.82	0.72				0.72		
Oct	0.60	0.63	0.66				0.49		
Nov	0.31	0.25					0.13		
Dec	0.21	0.08							
Total	**7.5**	**7.5**	**3.5**	**4.2**	**2.5**	**2.5**	**5.4**	**2.9**	**2.7**

Source: Adapted from KJ, 2007; Tables 3-12 & 3-13

The types of crops typically grown in the Palmdale area include (KJ, 2007):

- Field crops (alfalfa hay, grain hay, sudan hay, irrigated pasture)
- Vegetable crops (onions, melons)
- Fruits / nuts / grapes
- Root crops (carrots, potatoes)
- Miscellaneous nursery (mostly sod)

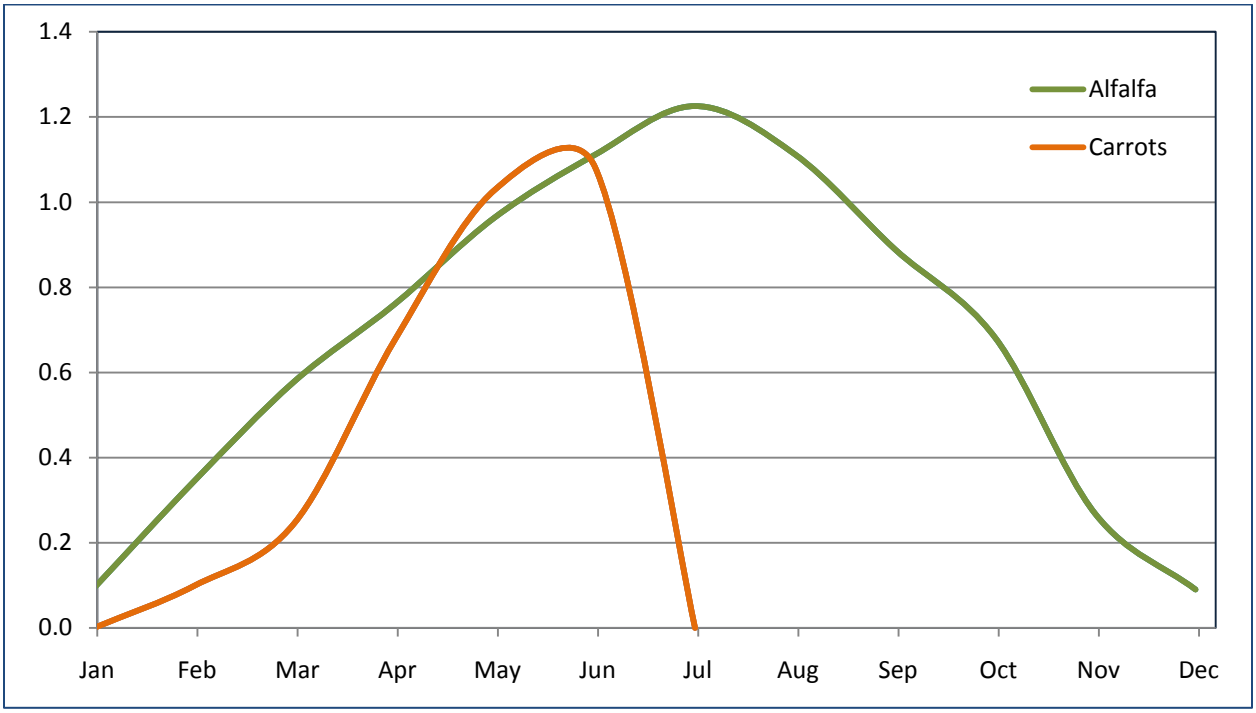
Average annual agricultural demands range from 2.5 afy per acre (afy/ac) to 7.5 afy/ac, and the average day of the peak month (ADPM) demands range from 0.011 mgd per acre (mgd/ac) to 0.013 mgd/ac (**Table 3-5**). These ranges indicate that annual demands between crop types vary widely but the peak demands do not vary significantly. This would generally result in a higher unit cost of recycled water service for the crops with lower annual demands because delivery facilities should be sized to meet peak demands; so each crop type would have similar capital costs but the costs are spread across a lower volume of annual water deliveries. Also, irrigation periods throughout the year for each crop type vary but the peak demands generally occur in June and July (**Figure 3-3**), which are also the peak demand periods for landscape irrigation customers, meaning water supply availability may be an important factor when considering agricultural customers for recycled water service.

Table 3-5: Average Day of Peak Month Demand per 100 Acres (MGD)

Pasture/ Sod	Alfalfa	Deciduous Fruit Trees	Onions	Sudan	Melons	Peas/ Beans	Carrots	Potatoes
1.2	1.2	1.3	1.2	1.1	1.2	1.1	1.1	1.2

Source: Adapted from KJ, 2007; Table 3-14

Figure 3-3: Average Day Demand per 100 Acres (MGD)



Source: Adapted from KJ, 2007; Tables 3-12 & 3-13

Agricultural customers must be willing buyers of recycled water and financial arrangements usually provide the users incentive to join. For example, AVEK has an "indirect recharge" via in-lieu use of raw (untreated) imported water instead of groundwater and charges a rate for this water that is competitive

with the cost of groundwater pumping. The cost of groundwater pumping is likely to change once the adjudication proceedings are complete so the competitive cost of recycled water is difficult to predict at this time. It is likely to increase due to a combination of a groundwater extraction fee and/or reduced allotment of groundwater rights.

Therefore, for the purposes of this study, we have assumed that 800 acres converted to recycled water use would be a modest estimate and 1,600 acres would be an aggressive estimate. The associated annual demand from this acreage could range from 2,000 afy (e.g. 800 acres of melons) to 12,000 afy (e.g. 1,600 acres of alfalfa.

3.2.3 Groundwater Recharge

Recharge of the Antelope Valley Groundwater basin using blends of non-potable sources, including recycled water, is another potential use for recycled water. Use of recycled water for GWR would help alleviate overdraft and offers an opportunity for indirect potable reuse. The technical, regulatory, institutional, and financial challenges surrounding GWR-RW in the Antelope Valley were examined in the Lancaster GWR Feasibility Study (RMC, 2007). The report concluded that GWR-RW with a blend of raw (untreated) imported water and/or stormwater was feasible with respect to these challenges.

The District's Strategic Water Resources Plan (SWRP) is considering five areas in the vicinity of the District and located within 6 miles of the PWRP (see **Figure 3-4**) that are conducive to groundwater recharge as part of a groundwater banking program. The SWRP is recommending implementation of GWR with imported water at the five areas in the following order:

1. **Upper Amargosa Creek:** Site is close to the California Aqueduct, has some stormwater capture potential, and recharge water flows to existing District wells; however, there is limited recharge capacity.
2. **Upper Littlerock Creek:** Site is close to the California Aqueduct, has moderate stormwater capture potential, recharge water flows to existing District wells, and has moderate recharge capacity.
3. **Palmdale 14-East (Anaverde):** Site is next closest to the California Aqueduct (along Anaverde Creek), recharge water flows to existing District wells, and has moderate recharge capacity.
4. **Lower Amargosa Creek:** Site has high stormwater capture potential and high recharge capacity but the recharge volume is limited by the getaway capacity[5] and bird strike concern from adjacent Palmdale Airport. Also, new extraction facilities will need to be constructed to capture the recharge water.
5. **Lower Littlerock Creek:** Site has high stormwater capture potential and high recharge capacity but will require twice as many wells as the other sites due to limited aquifer extraction capacity and will require additional conveyance pipes due to its location farthest from existing District water system.

Initial modeling of potential groundwater recharge and extraction operations at each of these locations (conducted for the SWRP) identified probable upper limits for recharge capacity at each of these locations. **Table 3-6** summarizes the estimated maximum recharge volume for each area based on a combination of basin recharge capacity (how quickly the recharge water travels from land surface to the groundwater surface) and aquifer getaway capacity (how quickly recharge water moves away from the recharge area to avoid mounding / backup of recharge water under the basin). Table 3-6 also includes the associated initial maximum recycled water component.

[5] Getaway capacity is the ability of the recharged water to move away from the recharge area and can determine the rate of sustainable recharge. Limited getaway capacity causes recharge water to build up to the surface of the recharge basin (referred to as mounding) over a period of years.

Figure 3-4: Groundwater Recharge / Banking Areas

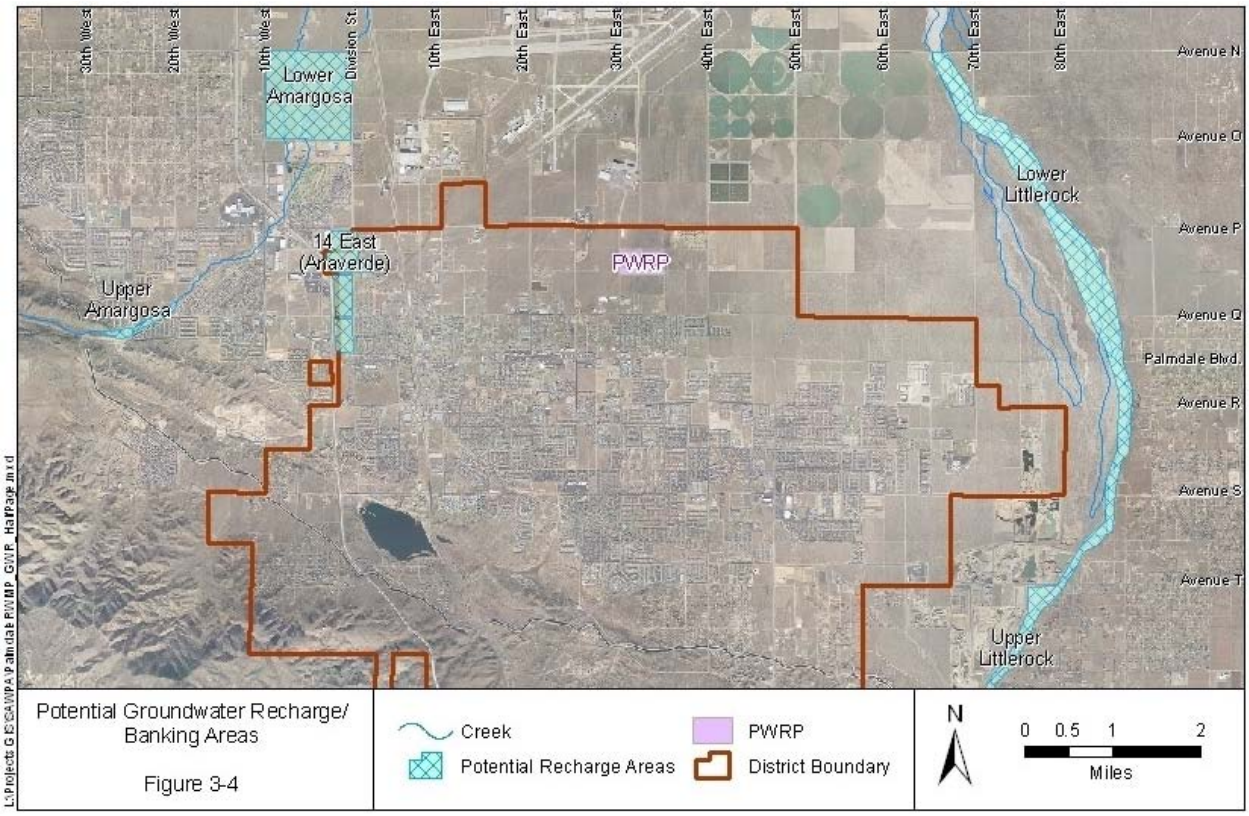


Table 3-6: Maximum Initial Recycled Water Recharge Volume Estimates

Recharge Area	Total Annual Recharge of All Supplies[1]	Maximum Initial Annual Recycled Water Recharge Volume[2]	
		Tertiary Treated	Advanced Treated
Upper Amargosa Creek	3,000 afy	600 afy	1,500 afy
Upper Littlerock Creek	13,000 afy	2,600 afy	6,500 afy
Palmdale 14-East	18,000 afy	3,600 afy	9,000 afy
Lower Amargosa Creek	60,000 afy	12,000 afy	30,000 afy
Lower Littlerock Creek	over 600,000 afy	over 120,000 afy	over 300,000 afy

Note:

1. Source: RMC, 2009c. Average annual recharge over a 3-year period
2. Based on the current CDPH Draft Groundwater Recharge Regulations, the minimum initial blend ratio for tertiary treated recycled water is frequently determined by TOC and typically results in a 4:1 blend ratio (diluent water: recycled water). The minimum initial blend ratio for advanced treated recycled water (reverse osmosis and advanced oxidation) is set initially at 1:1 (diluent water: recycled water).

3.3 Recycled Water Supply

The Palmdale WRP will provide recycled water to customers described in the previous section. This Plan did not evaluate the use of recycled water from Lancaster WRP for District demands but does consider it a feasible backup supply once the regional backbone system between Lancaster and Palmdale is constructed.

The Palmdale WRP will provide up to 10.0 mgd of recycled water upon completion of upgrades in 2011. Expansion of capacity in the future is planned but dates have not yet been determined. **Table 3-7** compares the amount of available supply with customer demands on an annual, daily, and hourly basis.

Table 3-7: Recycled Water Supply Availability from Palmdale WRP

	Existing (as of 2011)				Future (as of 2020)			
Annual Demand	**Avg Annual (afy)**	**Avg Day, Peak Month (mgd)**	**Peak Day (mgd)**	**Peak Hour (gpm)**	**Avg Annual (afy)**	**Avg Day, Peak Month (mgd)**	**Peak Day (mgd)**	**Peak Hour (gpm)**
Available Supply from PWRP	**11,200**	**10.0**	**10.0**	**6,940**	**17,800**	**15.9**	**15.9**	**11,040**
City of Palmdale Demands[1]								
Golf Courses[2]	730	1.0	1.3	900	730	1.0	1.3	900
Palmdale Hybrid Power Plant	2,600	3.5	4.6	3,190	2,600	3.5	4.6	3,190
Existing Subtotal	*3,330*	*4.5*	*5.9*	*4,090*	*3,330*	*4.5*	*5.9*	*4,090*
Business / Industrial Parks[3]	--	--	--	--	730	1.0	1.3	900
Total	**3,330**	**4.5**	**5.9**	**4,090**	**4,060**	**5.5**	**7.2**	**4,990**
Surplus Supply from PWRP	**7,870**	**5.5**	**4.1**	**2,850**	**13,740**	**10.4**	**8.7**	**6,050**

Notes
1. Each customer has on-site storage for daily operations.
2. Includes Antelope Valley Country Club and Desert Aire Golf Course.
3. Includes two business/industrial parks near Palmdale Hybrid Power Plant and owned by the City of Palmdale.

Based on a comparison of the M&I demands identified in Table 3-2 and Table 3-3 and surplus recycled water supplies identified in Table 3-7, M&I peak day demand is less than available day supply but existing peak hour demands exceed peak hour supply so daily storage may be necessary for some M&I alternatives. Also, agriculture and groundwater recharge alternatives have the potential to exceed the total annual volume of available recycled water so these uses would be mutually exclusive if one project is large enough.

Supply shortages during the peak season for agricultural use could be addressed by providing recycled water from the LACSD seasonal storage reservoirs. Also, most agricultural customers have sufficient existing groundwater pumping capacity and will likely continue to use groundwater such that peak demands can be met with a combination of recycled water and groundwater when necessary.

Supply shortages during the peak season for groundwater recharge could be addressed by reducing use of recycled water for GWR during these periods and maximizing use for GWR during the offseason. Also, groundwater recharge projects can take over 10 years to implement so 2020 supply conditions may alleviate some supply shortages. However, average annual supply will ultimately limit the maximum recycled water for groundwater recharge from Palmdale WRP.

Based on the discussion in this section, supply availability will be a limiting factor during development of recycled water alternatives in Chapter 4.

3.4 Recycled Water Quality

The potential customers described in the previous section have different water quality needs according to the intended use. This section examines water quality issues associated with using recycled water for landscape irrigation, agricultural irrigation, and GWR-RW.

3.4.1 Municipal Landscape Irrigation

Water quality guidelines for landscape use are available. **Table 3-8** characterizes three degrees of restriction for use of reclaimed water based on various water quality constituents (although specific requirements vary depending on the type of plant) and provides a comparison to actual secondary and expected tertiary Palmdale WRP effluent water quality.

Table 3-8: Landscape Irrigation Water Quality Comparison

		Degree of Restriction on Use [1]			
Constituent	**Units**	**None**	**Slight to Moderate**	**Severe**	**PWRP Tertiary Effluent [3]**
		Salinity			
Elect. Conductivity	dS/m	< 0.7	0.7 - 3.0	> 3.0	*
TDS	mg/L	< 450	450 - 2,000	> 2,000	550
		Specific Ion Toxicity			
Sodium (Na) [4,5]					
Surface Irrigation	SAR	< 3	3 - 9	> 9	*
Sprinkler Irrigation	mg/L	< 70	> 70		**132**
Chloride (Cl) [4,5]					
Surface Irrigation	SAR	< 140	140 - 350	> 350	*
Sprinkler Irrigation	mg/L	< 100	> 100		**176**
Boron (B)	mg/L	< 0.7	0.7 - 3.0	> 3.0	0.4
		Miscellaneous Effects			
pH	-	6.5 - 8.4			7.5 - 9.0
Total Nitrogen [6]	mg/L	< 5	5 - 30	> 30	< 10
Bicarbonate [7]	mg/L	< 90	90 - 500	> 500	*
Residual Chlorine [7]	mg/L	< 1.0	1.0 - 5.0	> 5.0	< 5.0

*No data available
Bold indicates effluent quality exceeds "moderate" value
Notes:

1. Adapted from Metcalf and Eddy, 2007.
2. From 2006-07 monitoring results of secondary effluent (LACSD, 2007).
3. Expected tertiary effluent levels for Palmdale WRP (LACSD, 2007).
4. Values apply to most tree crops and woody ornamentals which are sensitive to sodium and chloride.
5. With overhead sprinkler irrigation and low humidity (< 30%), sodium or chloride levels greater than 70 or 100 mg/L, respectively, have resulted in excessive leaf adsorption and crop damage to sensitive crops.
6. Total nitrogen should include nitrate-nitrogen, ammonia-nitrogen, and organic-nitrogen. Although forms of nitrogen in wastewater vary, the irrigated plant responds to the total nitrogen.
7. Overhead sprinkling only.

Based on the comparison of landscape irrigation water quality requirements to Palmdale WRP tertiary effluent, there would be slight to moderate restrictions for sprinkler irrigation on recycled water from Palmdale WRP based on TDS, sodium and chloride levels (surface irrigation restrictions could not be determined because of a lack of SAR data).

If the plant health becomes an issue for landscape irrigation, multiple mitigation measures are available to reduce salt buildup. Granulated gypsum can be added to turf grasses to keep salinity levels soils at acceptable levels. Recycled water could also be blended with potable or raw water to reduce salt buildup.

3.4.2 Agricultural Irrigation

As with municipal landscape irrigation, salt buildup can be a problem for many kinds of foliage. The majority of crops typically grown in the Palmdale area (see Section 3.2.2) are considered "sensitive" to "moderately sensitive" to salt (Jarwal, et al., 2006). Of these, beans, carrots and fruits can be the most sensitive to salt. Also, onions and fruit crops can be sensitive to boron.

Actual salt tolerance will vary depending on climate, soil conditions, cultivar/rootstock, stage of crop growth and agricultural practices but TDS in irrigation water exceeding 450 mg/L could result in yield reductions. Thus, some crops may be sensitive to recycled water from the Palmdale WRP. One way this can be managed is by blending with groundwater to reduce the TDS concentration.

3.4.3 Groundwater Recharge

Water quality requirements for groundwater recharge projects are primarily defined by the Draft California Department of Public Health (CDPH) Groundwater Recharge Regulations[6] to protect human health and by requirements defined by the RWQCB in either a Water Recycling Requirements (WRR) or Waste Discharge Requirements (WDR) permit. The Draft GWR Regulations require the recycled water to meet CDPH drinking water standards, specifically:

- Primary Maximum Contaminant Levels (MCLs):
- MCLs for disinfection byproducts in Title 22 CCR Section 644439
- Action levels for lead and copper in Title 22 CCR Section 64678
- Secondary MCLs for the constituents and characteristics in Title 22 CCR Tables 64449-A and B ("Upper" levels), except for color

The regulations also include dilution requirements expressed as the recycled water contribution (RWC), which is the fraction of total volume of recharge water that is recycled water. The draft regulations limit the RWC to a maximum average of 25 percent for recharge with tertiary treated recycled water and 50 percent with advanced treated water, with exceptions and increases granted under certain conditions. The allowable RWC, which is generally tied to total organic carbon (TOC) contributions, is a critical factor in determining how much recycled water can be used for a recharge project, and/or what additional control measures have to be undertaken.

The Lancaster GWR Feasibility Study (RMC, 2007) determined that a RWC of 20% is appropriate based on water quality data from Lancaster WRP. The same assumption was applied for recycled water from the Palmdale WRP in the Palmdale Recycled Water GWR FS (Wildermuth, 2007).

3.5 Market Assessment Summary

Three distinct markets were evaluated for non-potable water use by the District:

1. Municipal and Industrial
2. Agricultural
3. Indirect Potable (via groundwater recharge)

Each market was found to be viable but each has a large range of potential demand with M&I customers limited to approximately 1,920 afy, agricultural customers up to 12,000 afy, and indirect potable reuse over 10,000 afy.

The following was determined for the municipal and industrial sector:

- Up to 1,590 afy existing and 330 afy future non-potable demands were identified.
- Service to all existing non-potable customers could not be met during the peak season until additional wastewater flows are realized.

[6] www.cdph.ca.gov/certlic/drinkingwater/Documents/Recharge/DraftRechargeReg2008.pdf

- Recycled water quality should not cause any significant issues.
- Customers could be served with recycled water by 2011.

The following was determined for the agricultural sector:

- Over 12,000 afy existing demands were identified but the ultimate volume delivered to customers will be dependent on crop type and the customer's willingness to use recycled water (based on economics, perception, etc.).
- Service to over 12,000 afy of agricultural demands could not be met from the Palmdale WRP with the existing annual supply let alone be met during the peak season until additional wastewater flows are realized; however, over 6,000 afy and up to 18 mgd could be supplied from LACSD's seasonal storage facilities.
- Recycled water quality should not cause any significant issues but some crop types grown in the Valley are sensitive to salt and will require additional investigation to determine potential mitigation measures (such as blending with groundwater to lower overall salt levels).
- Customers could be served with recycled water by 2011 but implementation may be delayed until the Antelope Valley groundwater basin adjudication proceedings are completed.

The following was determined for groundwater recharge with recycled water:

- Maximum initial recharge volumes range from 600 afy to over 300,000 afy depending on the site and level of treatment.
- Over 10,000 afy of recycled water supplies could not be met with the existing annual supply until additional wastewater flows are realized and peak season supply limitations may require higher deliveries during the off-season compared with the peak season to maximize available supplies.
- Recycled water quality should not cause any significant issues as long as CDPH blending requirements are met.
- GWR-RW operations would not likely start until 2020 due to notable issues (e.g. public acceptance) that would need to be addressed prior to implementation.

Overall, peak season recycled water supplies are limited and part of the alternatives evaluation in the following chapter will consider this when developing and evaluating potential projects.

Chapter 4 Project Alternatives Analysis

This chapter presents the development and analysis of recycled water alternatives for District plus a no project alternative. Each alternative is defined as the combination of the treatment, storage, pumping, and distribution options necessary to serve targeted users located within the District.

The development of alternatives involved defining the following components for each alternative:

- **Service Area**: Where would recycled water be used?
  Recycled water would be used within the District service area, as well as private agricultural and groundwater recharge sites just outside of the District service area.
- **Treatment**: Where would recycled water be produced?
  Recycled water would be produced at the Palmdale WRP.
- **Pumping**: Where would pump stations be required to deliver recycled water to customers at minimum pressure?
  Hydraulic analysis will determine optimal locations for transmission and booster pump stations under each alternative. At a minimum, a new pump station at PWRP would need to be constructed.
- **Storage**: How much recycled water would need to be stored and where?
  The District currently has one potable storage tank that could be converted for recycled water storage. The need for operational storage will be evaluated as part of the hydraulic analysis in tandem with the pumping evaluation.
- **Distribution**: How would recycled water be distributed to the users?
  Pipelines would generally be installed in major corridors (roadways or along property boundaries) in public right-of-way, when available. Alignments will be developed based on location of users, cost and impact to the public during construction.

The following approach was adopted to meet the objectives described above:

1. Develop conceptual alternatives (including preliminary pipeline sizing, pipeline alignment, pumping requirements and storage requirements).
2. Develop conceptual level cost estimates for each alternative.
3. Obtain input from District staff to refine alternatives.
4. Evaluate the advantages and disadvantages of each conceptual alternative.
5. Recommend an alternative based on evaluation criteria (such as cost effectiveness, capital requirements, recycled water use and implementation flexibility).

4.1 Alternatives Development

This section details the development of various recycled water use alternatives to serve municipal, agricultural and groundwater recharge uses. First, customers were identified for each alternative based on serving large demands (greater than 25 afy) and then customers along an alignment to serve the large demands. Then, facilities for each alternative were defined. For M&I alternatives, a hydraulic analysis using H_2OMap modeling software was performed to determine the pipelines, pump stations and storage facilities needed to serve the identified customers. For agricultural and groundwater recharge alternatives, pipelines, pump stations and storage facilities were defined using a spreadsheet hydraulic model. The hydraulic criteria shown in **Table 4-1** were used as a basis for both models.

Table 4-1: Hydraulic Design Criteria for Model Development

System Component	Criteria
Min Delivery Pressure	60 psi - without on-site storage 20 psi - with on-site storage
Max System Pressure	140 psi for PVC pipe, 200 psi for Ductile Iron pipe
Pipe Material	Up to 12" diameter: PVC, C900 Class 150 14" to 36" diameter: Ductile Iron, Class 250 or PVC, C905 Class 235
Allowable Velocity Range	2 to 8 feet per second
Hazen-Williams Coefficient for Head Loss Calculation	135 for PVC pipe 110 for Ductile Iron pipe (assumes aging and degradation of mortar lining)

Storage

Due to hourly demand patterns, an hour-by-hour analysis was conducted to determine the storage requirements to optimize recycled water distribution. The Palmdale WRP will incorporate secondary effluent equalization so that tertiary effluent flow will be constant throughout the day and approximately equal the average daily wastewater influent flow. The average daily influent flow was therefore compared to recycled water demand during typical daily peak demand periods, which would be the irrigation period from 8:00 pm to 6:00 am for landscape irrigation sites without storage. As shown in **Table 3-7**, approximately 4.1 mgd would be available during peak demand periods.

The hydraulic modeling demonstrated that some alternatives would require operational storage at defined locations within the distribution system. The storage facilities associated with each alternative are discussed in the next section. Where appropriate, the alternatives utilize the surplus potable tank near Lake Palmdale (see Section 2.5.3). A spreadsheet analysis of storage requirements is included in **Appendix F**. Also, storage tanks were added with pump stations between pressure zones.

4.1.2 Municipal and Industrial Alternatives

The District has the opportunity to replace up to 1,900 afy of potable water use by M&I customers with non-potable water. This section defines seven M&I alternatives for further evaluation. The alternatives are:

- **Alternative A1 (Alt A1):** Downtown Palmdale non-potable demands east of Sierra Highway
- **Alternative A2 (Alt A2):** Downtown Palmdale non-potable demands
- **Alternative B1 (Alt B1):** Easter Palmdale non-potable demands
- **Alternative B2 (Alt B2):** Alternative B1 plus Palmdale High School and surrounding non-potable demands
- **Alternative A+B (Alt A+B):** Both Downtown and Easter Palmdale non-potable demands
- **Alternative C (Alt C):** Palmdale High School non-potable demands service from planned regional backbone pipeline along Ave P
- **Alternative D (Alt D):** Desert Sands Park non-potable demands service from planned regional backbone pipeline along Ave P

Alternative A1

Alt A would supply up to 431 afy to Downtown Palmdale customers (see **Table 4-2**). The major corridors of this alignment are 35th St East and Ave R. As shown in **Figure 4-1**, this alignment utilizes the existing District owned storage tank at Ave S near Lake Palmdale which can be tied into the lake.

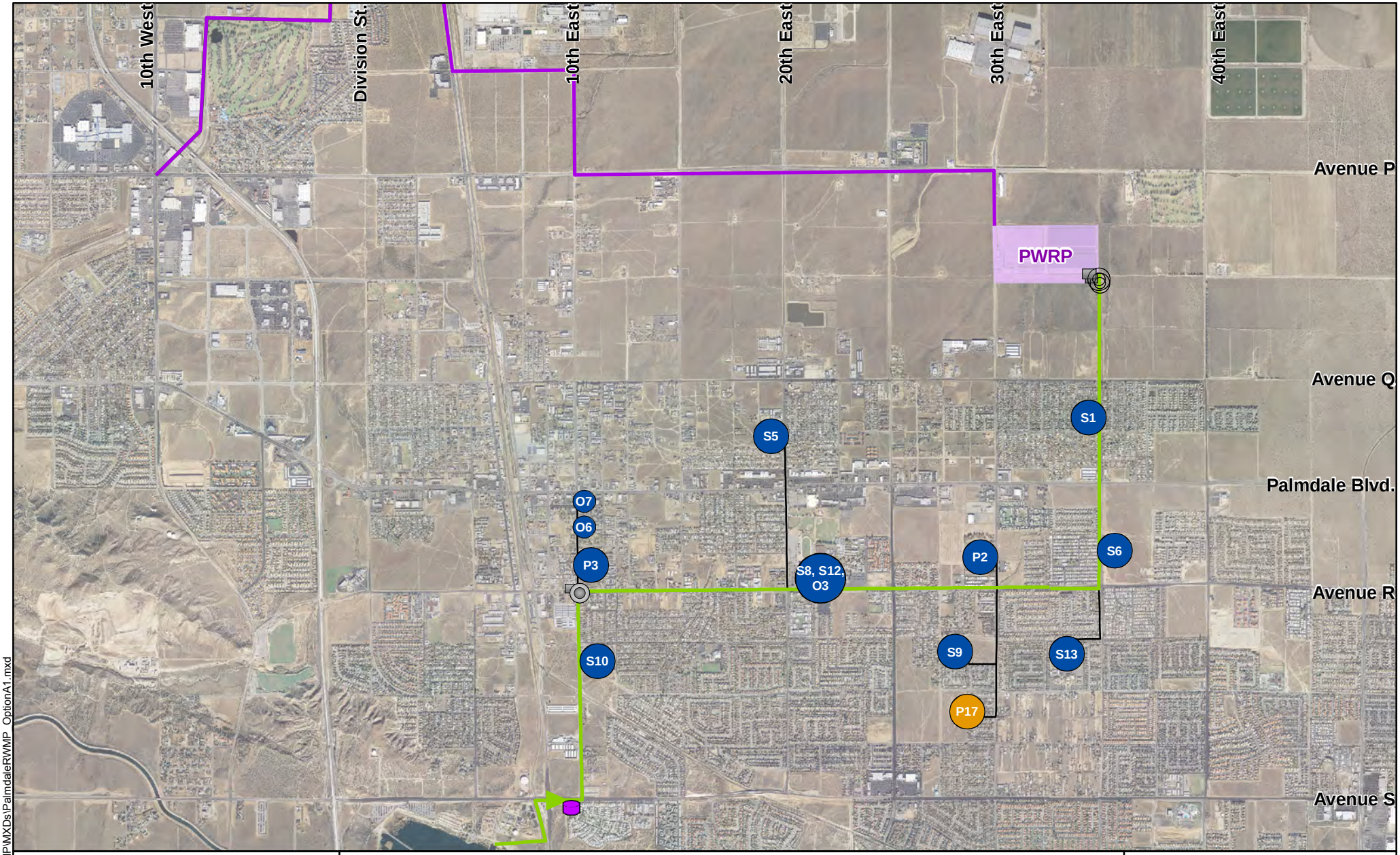
Table 4-2: Alternative A1 Customers

Site ID	Customer	Estimated Irrigated Area[1]	Average Annual Demand[2]	Avg Day Peak Month Demand[3]	Peak Day Demand[4]	Peak Hour Demand[5]
		(ac)	(afy)	(mgd)	(mgd)	(gpm)
Existing						
S1	Manzanita Elementary School	3.8	24.4	0.03	0.04	73
S5	Tamarisk Elementary School	3.3	22.0	0.03	0.04	65
S6	Wildflower Elementary School	3.8	26.5	0.04	0.05	79
S8	Palmdale High School	5.6	112.6	0.15	0.20	335
S9	Desert Rose Elementary School	4.4	20.6	0.03	0.04	61
S10	Tumbleweed Elementary School	5.6	25.0	0.03	0.04	74
S12	Cactus K-8	4.5	33.6	0.0.4	0.06	100
S13	Mesa Intermediate School	9.1	37.7	0.05	0.07	112
P2	McAdam Park	15.3	61.0	0.08	0.11	182
P3	Courson Park	4.0	31.7	0.04	0.06	94
O3	Palmdale Pony League	21.4	19.6	0.03	0.04	58
O6	Palmdale Parks & Rec Office	0.3	2.9	0.004	0.01	9
O7	Palmdale Playhouse	0.1	2.2	0.003	0.004	7
	Subtotal Existing		***420***	***0.56***	***0.75***	***1,249***
Future						
P17	Palmdale Park	0.3	11.0	0.01	0.02	33
	Subtotal Future		***11***	***0.01***	***0.02***	***33***
		Total:	**431**	**0.58**	**0.77**	**1,282**

Note: See Table 3-2 for footnotes.

The following facilities are required to meet Alt A1 demands:

- **Pipelines:** Approximately 27,980 LF of 12" distribution pipe and 14,990 LF of 4" to 10" laterals.
- **Storage:** Use existing 3.0 MG storage tank located on Ave S and 10th St East for daily operational storage.
- **Pump Stations:** A 90-hp pump station is needed to fill the storage tank for 14 hours during the day and should be located in the vicinity of the Palmdale WRP. Use existing 75-hp pump station located at the storage tank and will be used to supply demand during the night.



Palmdale Water District Municipal and Industrial Alternative A1

Figure 4-1

Customers
- Existing
- Future

Demand
- ≥ 1 AFY
- ≥ 10 AFY
- ≥ 100 AFY

Facilities
- Planned Regional System
- Laterals
- PWRP
- Pump Station
- Storage

Pipe Diameter
- <12 in.
- 12 in.
- 14 in.
- 16 in.

N

0 0.25 0.5 1
Miles

L:\Projects GIS\0258-001 PalmdaleRWFMP\MXDs\PalmdaleRWMP_OptionA1.mxd

Alternative A2

Alt A would supply up to 744 afy to Downtown Palmdale customers (see **Table 4-3**). The major corridors of this alignment are 35th St East, Ave R, Division St and Sierra Highway. As shown in **Figure 4-2,** this alignment crosses Highway 14 to serve Pelona Vista Park, and utilizes the existing District owned storage tank at Ave S near Lake Palmdale which can be tied into the lake.

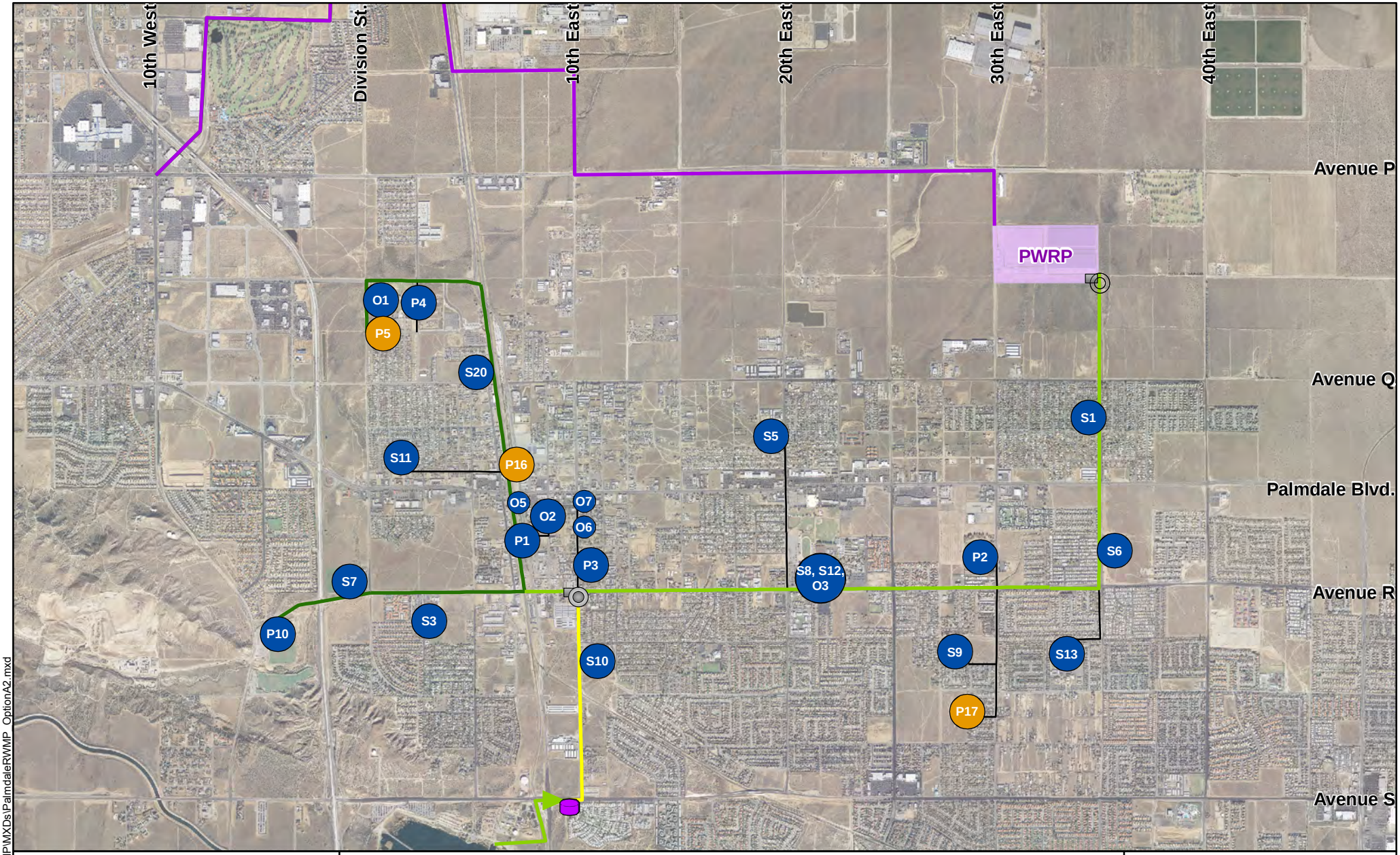
Table 4-3: Alternative A2 Customers

Site ID	Customer	Estimated Irrigated Area[1]	Average Annual Demand[2]	Avg Day Peak Month Demand[3]	Peak Day Demand[4]	Peak Hour Demand[5]
		(ac)	(afy)	(mgd)	(mgd)	(gpm)
Existing						
	Alternative A1		*420*	*0.56*	*0.75*	*1,249*
S3	Palmtree Elementary School	3.3	29.0	0.04	0.05	86
S7	Palmdale Learning Plaza	6.6	46.8	0.06	0.08	139
S11	Yucca Elementary	3.2	15.0	0.02	0.03	45
S20	R. Rex Parris High School	1.7	14.1	0.02	0.03	42
P1	Dr. Robert C. St. Clair Parkway	2.8	17.9	0.02	0.03	53
P4	Desert Sands Park	11.3	24.9	0.03	0.04	74
P10	Pelona Vista Park	26.2	93.3	0.12	0.17	278
O1	American Indian Little League	4.5	10.1	0.01	0.02	30
O2	Ponciltan Square	1.5	11.8	0.02	0.02	35
O5	Palmdale City Library	0.2	4.9	0.01	0.01	15
	Subtotal Existing		***688***	***0.92***	***1.23***	***2,046***
Future						
	Alternative A1		*11*	*0.01*	*0.02*	*33*
P5	Desert Sands Expansion	4.0	29.0	0.04	0.05	86
P16	Sierra Hwy Green Belt	0.2	16.0	0.02	0.03	48
	Subtotal Future		***56***	***0.08***	***0.10***	***167***
		Total:	**744**	**0.98**	**1.30**	**2,213**

Note: See Table 3-2 for footnotes.

The following facilities are required to meet Alt A2 demands:

- **Pipelines:** Approximately 27,980 LF of 12" to 14" distribution pipe and 36,460 LF of 4" to 10" laterals.
- **Storage:** Use existing 3.0 MG storage tank located on Ave S and 10th St East for daily operational storage.
- **Pump Stations:** A 200-hp pump station is needed to fill the storage tank for 14 hours during the day and should be located in the vicinity of the Palmdale WRP. Use existing 75-hp pump station is located at the storage tank which will be used to supply demand during the night.



Palmdale Water District
Municipal and Industrial
Alternative A2

Figure 4-2

Customers
- Existing
- Future

Demand
- ≥ 1 AFY
- ≥ 10 AFY
- ≥ 100 AFY

Facilities
- Planned Regional System
- Laterals
- PWRP
- Pump Station
- Storage

Pipe Diameter
- <12 in.
- 12 in.
- 14 in.
- 16 in.

N

0 0.25 0.5 1
Miles

L:\Projects GIS\0258-001 PalmdaleRWFMP\MXDs\PalmdaleRWMP_OptionA2.mxd

Alternative B1

Alt B1 would supply up to 1,081 afy to Eastern Palmdale customers (see **Table 4-4**). The major corridors of this project are 35th St East and Ave S. As shown in **Figure 4-3,** this alignment utilizes LACSD storage ponds at 40th St East and Ave O-8 for pump station operational reliability.

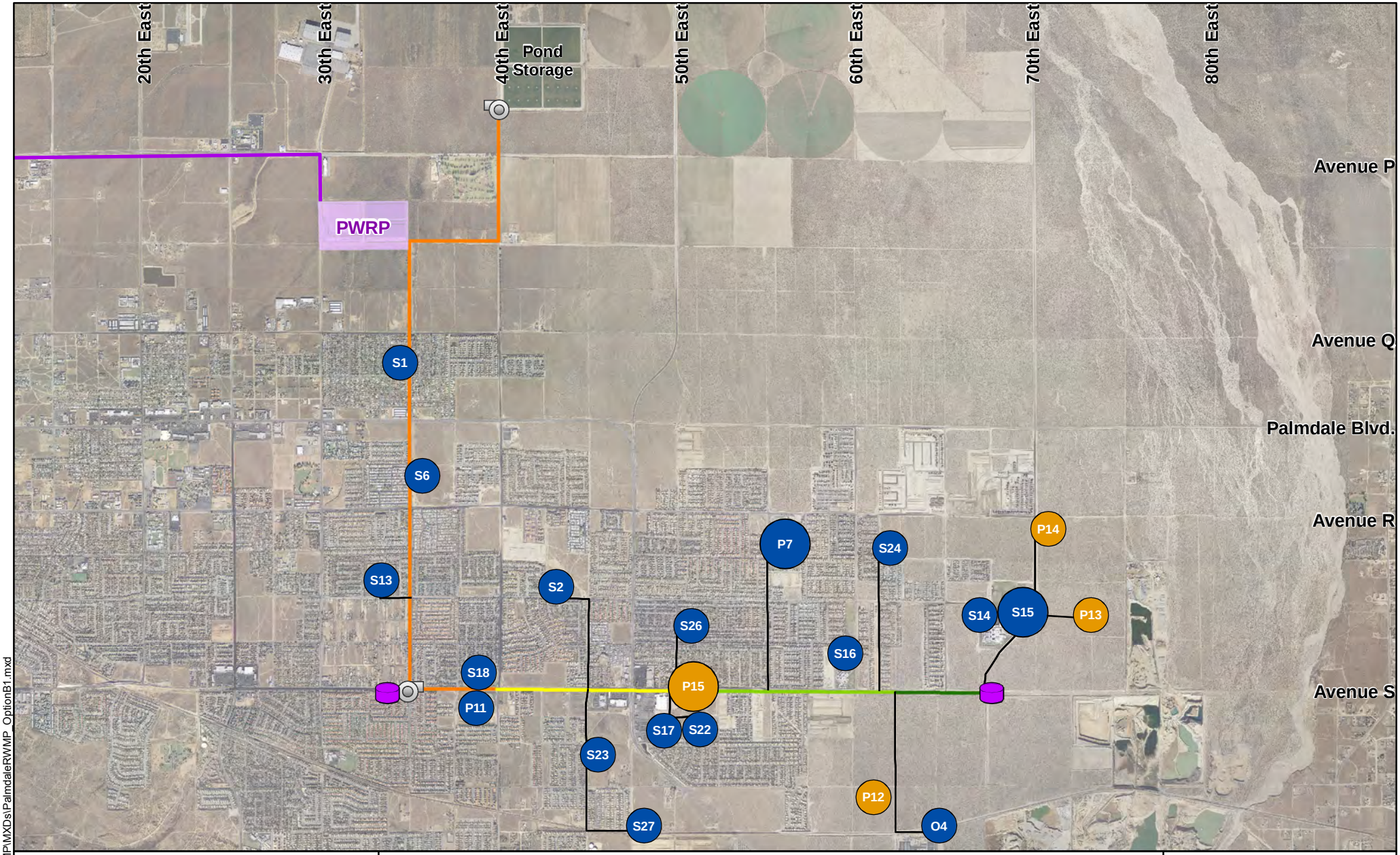
Table 4-4: Alternative B1 Customers

Site ID	Customer	Estimated Irrigated Area[1]	Average Annual Demand[2]	Avg Day Peak Month Demand[3]	Peak Day Demand[4]	Peak Hour Demand[5]
		(ac)	(afy)	(mgd)	(mgd)	(gpm)
Existing						
S1	Manzanita Elementary School	3.8	24.4	0.03	0.04	73
S2	Mesquite Elementary School	3.4	24.7	0.03	0.04	74
S6	Wildflower	3.8	26.5	0.04	0.05	79
S13	Mesa Intermediate School	9.1	37.7	0.05	0.07	112
S14	Los Amigos School	1.7	27.7	0.04	0.05	82
S15	Pete Knight High School	20	209.3	0.28	0.37	623
S16	Shadow Hills Intermediate School	7.0	88.8	0.12	0.16	264
S17	Yellen Learning Center School	2.1	14.4	0.02	0.03	43
S18	Oak Tree Learning Center	7.1	36.8	0.05	0.07	110
S22	Buena Vista Elementary School	7.1	48.0	0.06	0.09	143
S23	Cimmaron Elementary School	2.8	16.2	0.02	0.03	48
S24	Golden Poppy Elementary School	2.3	25.9	0.03	0.05	77
S26	Chaparral Elementary School	2.5	14.1	0.02	0.03	42
S27	High School (47th & Pearblossom)	6.8	26.2	0.04	0.05	78
P7	Domenic Massari Park	30	145.4	0.19	0.26	433
P11	Dry Town Water Park	7.1	32.0	0.04	0.06	95
O4	Trailer Shay	--	10.0	0.01	0.02	30
	Subtotal Existing		***808***	***1.08***	***1.44***	***2,405***
P12	60th St E/Ave S-8 Park	19.2	84.0	0.11	0.15	250
P13	72nd St E/Ave R-8 Park	10.4	42.0	0.06	0.08	125
P14	70th St E/Ave R Park	10.4	42.0	0.06	0.08	125
P15	Sam Yellen Park	0.8	105.0	0.14	0.19	313
	Subtotal Future		***273***	***0.37***	***0.49***	***813***
		Total:	**1,081**	**1.45**	**1.93**	**3,218**

Note: See Table 3-2 for footnotes.

The following facilities are required to meet Alt B1 demands:

- **Pipelines:** Approximately 36,910 LF of 10" to 16" distribution pipe and 32,420 LF of 4" to 12" laterals.
- **Storage:** LACSD storage ponds at 40th St East and Ave O-8 are proposed to be utilized for pump station operational reliability. A 1.0 MG storage tank would be located at Ave S and 35th St East, and a second 1.0 MG storage tank would be located at Ave S and 65th St East.
- **Pump Stations:** A 200-hp pump station is needed in the vicinity of the LACSD storage ponds to deliver water during 10-hour irrigation period. A 100-hp pump is needed near Ave S and 35th St



Palmdale Water District Municipal and Industrial Alternative B1

Figure 4-3

Customers
- Existing
- Future

Demand
- ≥ 1 AFY
- ≥ 10 AFY
- ≥ 100 AFY

Facilities
- Planned Regional System
- Laterals
- PWRP
- Pump Station

Pipe Diameter
- <12 in.
- 12 in.
- 14 in.
- 16 in.

N

0 0.25 0.5 1
Miles

L:\Projects GIS\0258-001_PalmdaleRWFMP\MXDs\PalmdaleRWMP_OptionB1.mxd

East to provide a minimum delivery pressure of 60 psi to customers on the perimeter of the system. An additional 100-hp will be needed at the Palmdale WRP pump station and an additional 100-hp pump would be needed near Ave S and 35th St East as future customers are connected.

- **Booster Pump:** A 10-hp booster pump would be needed to serve the future park at 60th St East and Ave S-8 due to its high elevation.

Alternative B2

Alt B2 expands on Alt B1 by adding Palmdale High School plus customers along the pipeline route (as proposed in Alt A1) and would supply 1,340 afy (see **Table 4-5**). The major corridors of this project are 35th St East, Ave S, and Ave R. As shown in **Figure 4-4**, this alignment utilizes LACSD storage ponds at 40th St East and Ave O-8 for pump station operational reliability.

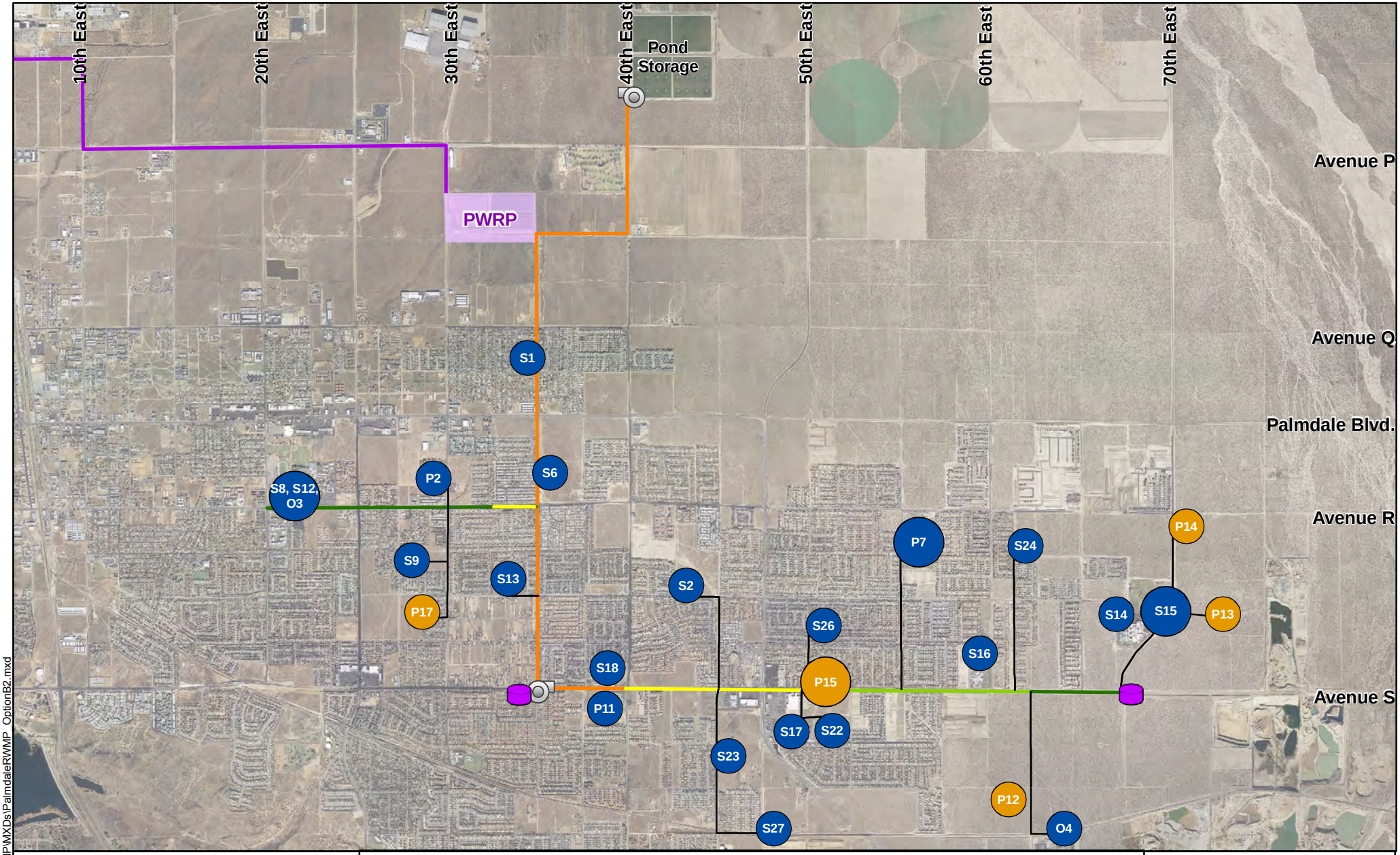
Table 4-5: Alternative B2 Customers

Site ID	Customer	Estimated Irrigated Area[1]	Average Annual Demand[2]	Avg Day Peak Month Demand[3]	Peak Day Demand[4]	Peak Hour Demand[5]
		(ac)	(afy)	(mgd)	(mgd)	(gpm)
Existing						
--	*Alternative B1*		*808*	*1.08*	*1.44*	*2,405*
S8	Palmdale High School	5.6	112.6	0.15	0.20	335
S9	Desert Rose Elementary	4.4	20.6	0.03	0.04	61
S12	Cactus K-8	4.5	33.6	0.05	0.06	100
O3	Palmdale Pony League	21.4	19.6	0.03	0.04	58
P2	McAdam	15.3	61.0	0.08	0.11	182
	Subtotal Existing		***1,056***	***1.41***	***1.89***	***3,142***
Future						
--	*Alternative B1*		*273*	*0.37*	*0.49*	*813*
P17	Palmdale Park	0.3	11.0	0.01	0.02	33
	Subtotal Future		***284***	***0.38***	***0.51***	***845***
		Total:	**1,340**	**1.79**	**2.39**	**3,988**

Note: See Table 3-2 for footnotes.

The following facilities are required to meet Alt B2 demands:

- **Pipelines:** Approximately 44,940 LF of 8" to 16" distribution pipe and 39,420 LF of 4" to 12" laterals.
- **Storage:** LACSD storage ponds at 40th St East and Ave O-8 are proposed to be utilized for pump station operational reliability. A 1.0 MG storage tank would be located at Ave S and 35th St East, and a second 1.0 MG storage tank would be located at Ave S and 65th St East.
- **Pump Stations:** A 300-hp pump station is needed in the vicinity of the LACSD storage ponds to deliver water during 10-hour irrigation period. A 100-hp pump is needed near Ave S and 35th St East to provide a minimum delivery pressure of 60 psi to customers on the perimeter of the system. An additional 100-hp will be needed at the Palmdale WRP pump station and an additional 100-hp pump would be needed near Ave S and 35th St East as future customers are connected.
- **Booster Pump:** A 10-hp booster pump would be needed to serve the future park at 60th St East and Ave S-8 due to its high elevation.



Palmdale Water District Municipal and Industrial Alternative B2

Figure 4-4

Customers
- Existing
- Future

Demand
- ≥ 1 AFY
- ≥ 10 AFY
- ≥ 100 AFY

Facilities
- Planned Regional System
- Laterals
- PWRP
- Pump Station

Pipe Diameter
- <12 in.
- 12 in.
- 14 in.
- 16 in.

N

0 0.25 0.5 1
Miles

L:\Projects GIS\0258-001 PalmdaleRWFMP\MXDs\PalmdaleRWMP_OptionB2.mxd

Alternative A+B

Alt A+B would combine Alt A2 and Alt B1 to supply up to 1,736 afy of identified demand. This alternative serves the majority of M&I non-potable customers identified in the market assessment in Section 3.2.1 (see **Table 4-6**). Customers not proposed to be served with recycled water were estimated to not be cost effective. The major corridors of this alignment are 35th St East, Ave R, Ave S, Division St and Sierra Highway. This alignment would have to cross Highway 14 to capture Pelona Vista Park. As shown in **Figure 4-5**, this alignment crosses Highway 14 to serve Pelona Vista Park, utilizes a pre-existing District owned storage tank at Ave S near Lake Palmdale**,** and utilizes LACSD storage ponds at 40th St East and Ave O-8.

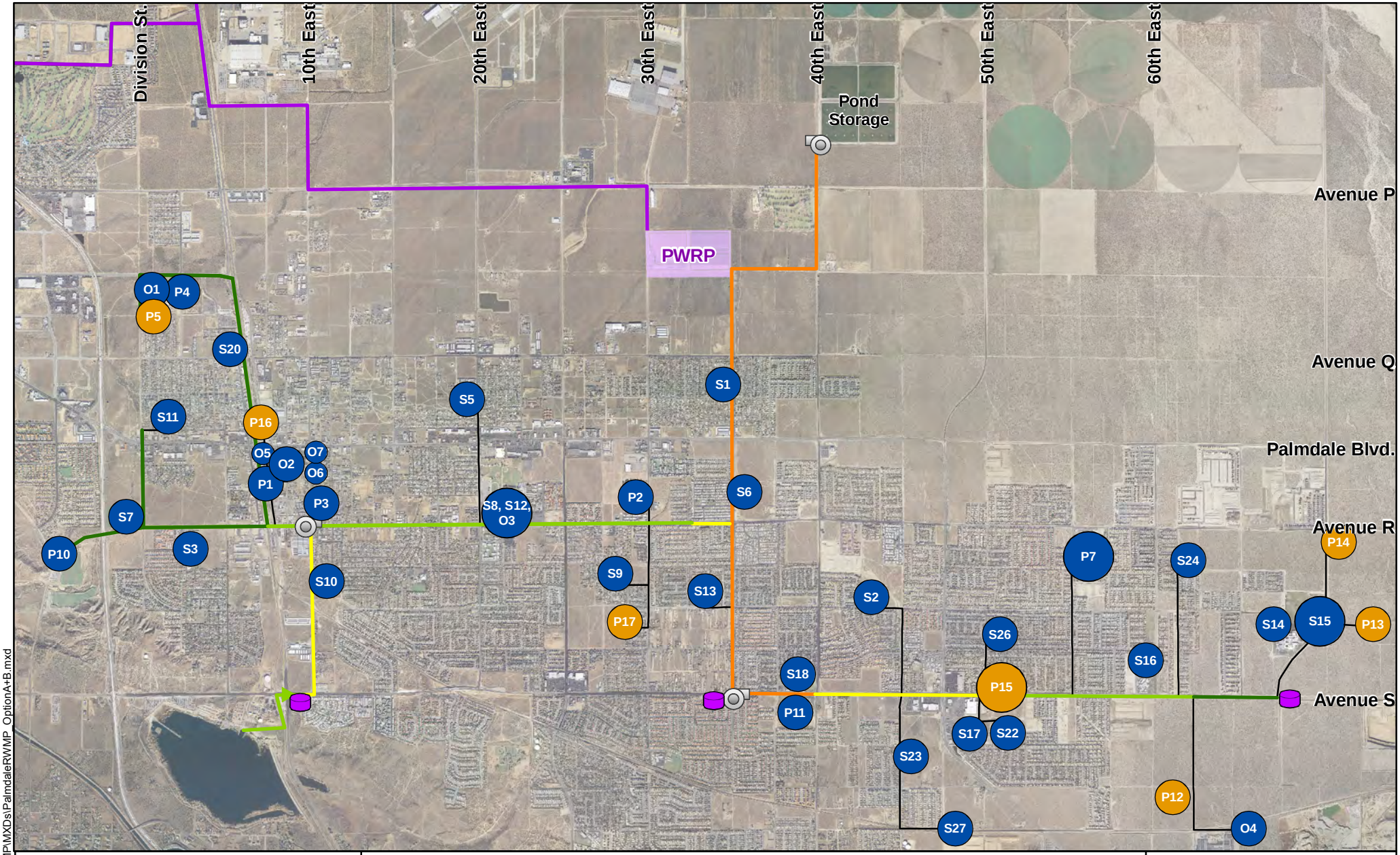
Table 4-6: Alternative A+B Customers

Site ID	Customer	Estimated Irrigated Area[1]	Average Annual Demand[2]	Avg Day Peak Month Demand[3]	Peak Day Demand[4]	Peak Hour Demand[5]
		(ac)	(afy)	(mgd)	(mgd)	(gpm)
	Existing Customers	278	1,407	1.88	2.51	4,188
	Future Customers	45	329	0.44	0.59	979
		Total:	**1,736**	**2.33**	**3.10**	**5,167**

Note: Alternative includes all identified M&I demands from Table 3-2. See Table 3-2 for footnotes.

The following facilities are required to meet Alt A+B demands:

- **Pipelines:** Approximately 66,980 LF of 8” to 16” distribution pipe and 55,060 LF of 4” to 12” laterals.
- **Storage:** An existing 3.0 MG storage tank is located on Ave S and 10th St East. This tank would be required for daily operational storage. A 1.0 MG storage tank would be located at Ave S and 35th St East, and a second 1.0 MG storage tank would be located at Ave S and 65th St East.
- **Pump Stations:** A 200-hp pump station is needed to fill the storage tank for 14 hours during the day and should be located in the vicinity of the Palmdale WRP. An existing 75-hp pump station is located at the storage tank which will be used to supply demand during the night. A 180-hp pump would be needed near Ave S and 35th St East to provide a minimum delivery pressure of 60 psi to customers on the edges of the Eastern Palmdale system. An additional 100-hp will be needed at this pump station once future customers are connected and an additional 100-hp will be needed at the Palmdale WRP pump station.



Palmdale Water District Municipal and Industrial Alternative A+B

Figure 4-5

Customers
- Existing
- Future

Demand
- ≥ 1 AFY
- ≥ 10 AFY
- ≥ 100 AFY

Facilities
- Planned Regional System
- Laterals
- PWRP
- Pump Station
- Storage

Pipe Diameter
- <12 in.
- 12 in.
- 14 in.
- 16 in.

N

0 0.25 0.5 1
Miles

L:\Projects GIS\0258-001_PalmdaleRWFMP\MXDs\PalmdaleRWMP_OptionA+B.mxd

Alternative C

Alt C would supply up to 200 afy of identified demand (see **Table 4-7**). Alt C would branch off of the planned Palmdale WRP recycled water backbone along Ave P to serve Palmdale High School and adjacent customers. The major corridor of this alignment is 20th St East. As shown in **Figure 4-6**, this alignment would cause little disruption as it does not go through the commercial downtown area.

Table 4-7: Alternative C Customers

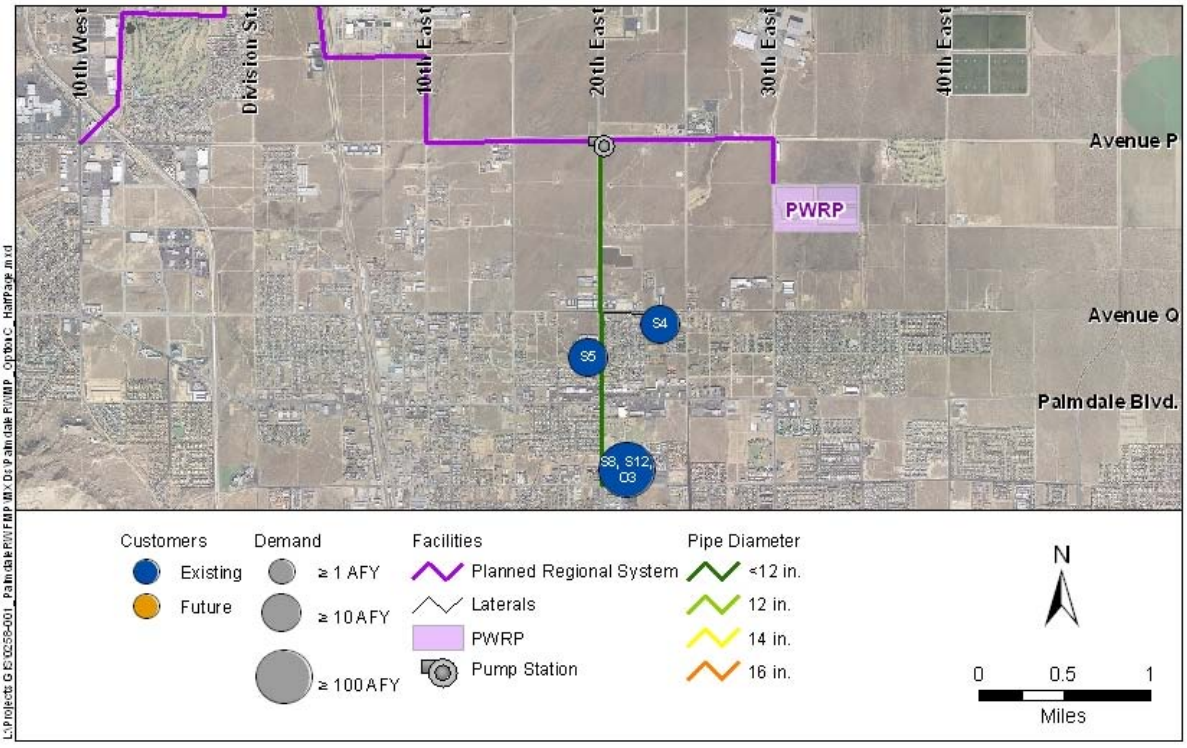
Site ID	Customer	Estimated Irrigated Area[1]	Average Annual Demand[2]	Avg Day Peak Month Demand[3]	Peak Day Demand[4]	Peak Hour Demand[5]
		(ac)	(afy)	(mgd)	(mgd)	(gpm)
Existing						
S4	Phoenix High School	0.5	11.7	0.02	0.02	35
S5	Tamarisk Elementary School	3.3	22.0	0.03	0.04	65
S8	Palmdale High School	5.6	112.6	0.15	0.20	335
S12	Cactus K-8	4.5	33.6	0.04	0.06	100
O3	Palmdale Pony League	21.4	19.6	0.03	0.04	58
		Total:	**200**	**0.27**	**0.36**	**594**

Note: See Table 3-2 for footnotes.

The following facilities are required to meet existing Alt C demands:

- **Pipelines:** Approximately 8,920 LF of 8” pipe. Laterals include 3,570 LF of 4” pipe.
- **Pump Stations:** A 50-hp pump station is needed at the turnout from regional backbone pipeline at approximately 20th St East and Ave P to provide a minimum delivery pressure of 60 psi. This assumes that the planned backbone system pump station at the Palmdale WRP operates as planned to serve Power Plant project customers.

Figure 4-6: Alternative C



Alternative D

Alt D would supply up to 80 afy of identified demand (see **Table 4-8**). Alt D would branch off of the planned regional recycled water backbone to serve Desert Sands Park and adjacent customers. As shown in **Figure 4-7**, this alignment would cause little disruption as it does not go through the commercial downtown area.

Table 4-8: Alternative D Customers

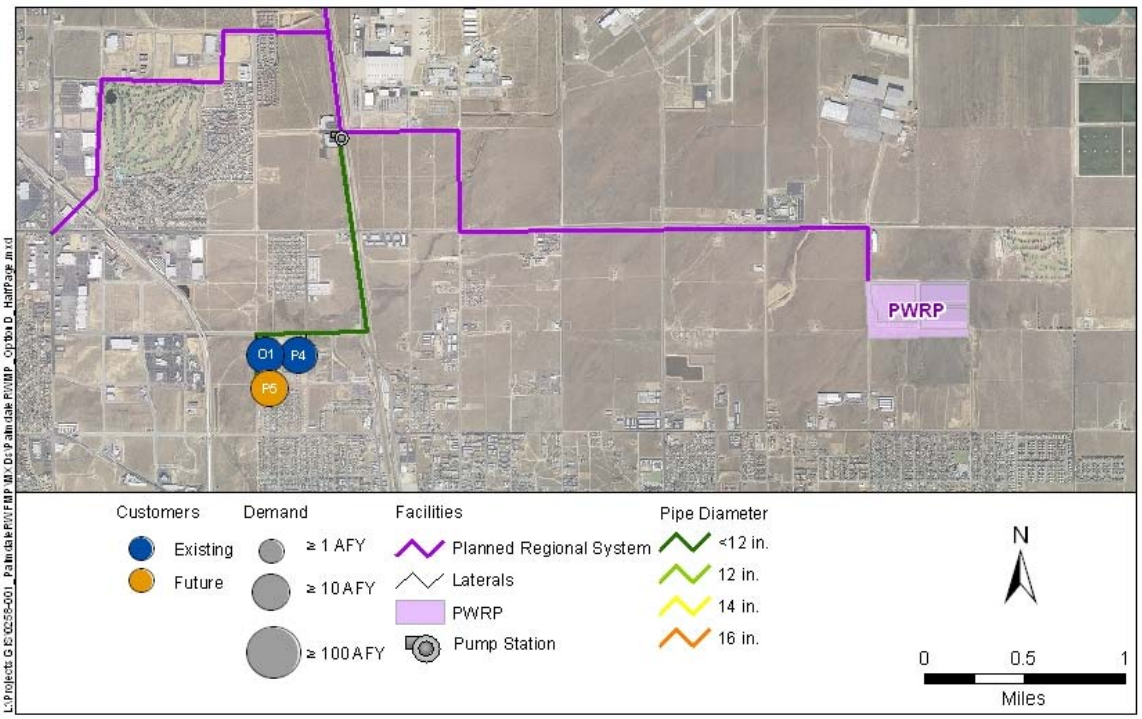
Site ID	Customer	Estimated Irrigated Area[1]	Average Annual Demand[2]	Avg Day Peak Month Demand[3]	Peak Day Demand[4]	Peak Hour Demand[5]
		(ac)	(afy)	(mgd)	(mgd)	(gpm)
Existing						
P4	Desert Sands Park	11.3	24.9	0.03	0.04	74
O1	American Indian Little League	4.5	10.1	0.01	0.02	30
	Subtotal Existing		***35***	***0.04***	***0.06***	***104***
Future						
P5	Desert Sands Expansion	4.0	29.0	0.04	0.05	86
	Total:		**64**	**0.08**	**0.11**	**190**

Note: See Table 3-2 for footnotes.

The following facilities are required to meet existing Alt D demands:

- **Pipelines:** Approximately 8,210 LF of 6" pipe. Laterals include 1,280 LF of 4" pipe.
- **Pump Stations:** A 20-hp pump station is needed at the turnout from regional backbone pipeline at approximately Sierra Hwy and Ave O-8 to provide a minimum delivery pressure of 60 psi. This assumes that the planned backbone system pump station at the Palmdale WRP operates as planned to serve Power Plant project customers.

Figure 4-7: Alternative D



Summary of Municipal and Industrial Alternatives

Non-potable water demands for each alternative are summarized in **Table 4-9**.

Table 4-9: Summary of Non-Potable Water Demands for M&I Alternatives

Alternative	Average Annual (afy)		
	Existing	Future	Total
Alternative A1	420	11	**431**
Alternative A2	688	56	**744**
Alternative B1	808	273	**1,081**
Alternative B2	1,056	284	**1,340**
Alternative A+B	1,407	329	**1,736**
Alternative C	200	--	**200**
Alternative D	35	29	**64**

4.1.3 Agricultural Alternatives

As discussed in Section 3.2.2, for the purposes of this study, we have assumed that 800 acres converted to recycled water use would be a modest estimate and 1,600 acres would be an aggressive estimate. The associated annual demand from this acreage could range from 2,000 afy (e.g. 800 acres of melons) to 12,000 afy (e.g. 1,600 acres of alfalfa). Also, the associated average day, peak month demands could range from 9.6 mgd to 19.2 mgd with peak hour demands of 16,000 gpm to 32,000 gpm (applying a peaking factor of 2.4 based on daily operations from 8:00 pm to 6:00 am); however, the available recycled water supply available in 2020 is estimated to be 9.7 mgd so this level of demand cannot be met directly from the Palmdale WRP.

As discussed in Section 3.2.2, an alternative supply that would only be applicable to agricultural uses is the recycled water seasonally stored by LACSD as part of their Agriculture Reuse Project storage reservoirs. The LACSD storage facilities include pump stations with an initial total capacity of 38,900 gpm with plans for expansion to 58,400 gpm in future phases. The initial pump station capacity would be enough to supply 1,600 acres of agricultural operations.

Agricultural alternatives have been developed for:

1. Maximizing available supplies serving 800 acres from Palmdale WRP
2. Serving 800 acres from LACSD seasonal storage
3. Serving 1,600 acres from LACSD seasonal storage

Facilities for each of the three agricultural alternatives are defined here. Note that the infrastructure required to serve carrots and alfalfa is the same even though the annual demands are different because the peak day demands are the same.

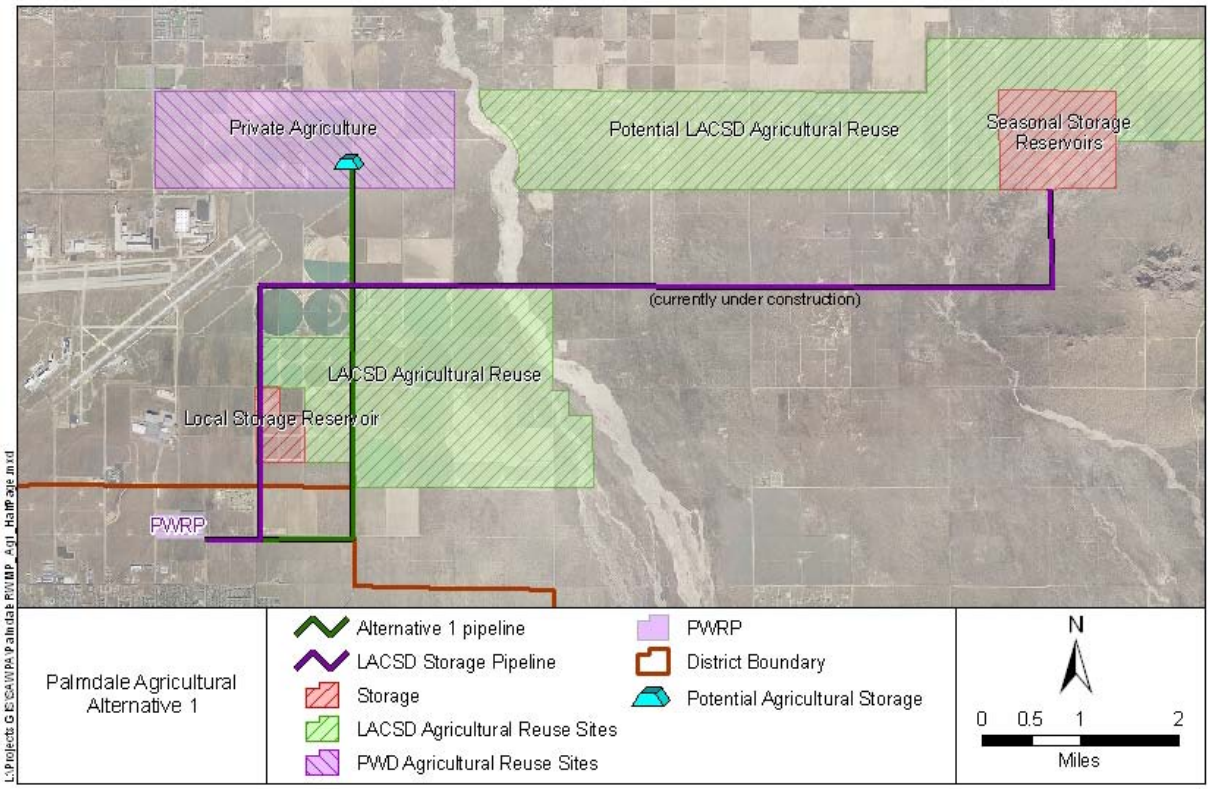
Also, each alternative assumes a storage reservoir will be constructed to store water during the day for irrigation between 8 pm and 6 am. Similar to the LACSD reservoirs, the storage reservoir is assumed to be constructed by excavating and compacting native soils and a synthetic liner with low permeability will be installed along the floor and walls to minimize infiltration.

Agriculture Alternative 1 (Alt Ag1)

Alt Ag1 is based upon the available supply from Palmdale WRP during the average day, peak month (5.0 mgd in 2011 and 9.7 in 2020), which could supply approximately 800 acres by 2020. Annual use would initially range from 1,000 afy to 3,000 afy (depending on the crop type) and increase to a range of 2,000

afy to 6,000 afy by 2020. The alternative assumes a new pipeline would be constructed from the Palmdale WRP to the agricultural areas with a primary route along 50th St East (see **Figure 4-8**).

Figure 4-8: Agricultural Alternative 1



The following facilities are required for Alt Ag1:

- **Pipelines:** Approximately 69,000 LF of 24" pipe from the Palmdale WRP to the storage facility and approximately 5,000 LF of 12" laterals.
- **Pump Stations:** A 340-hp pump station is needed and should be located in the vicinity of the Palmdale WRP.
- **Storage:** Approximately 5.7 MG of storage capacity is required on the private agricultural site.

Agriculture Alternative 2 (Alt Ag2)

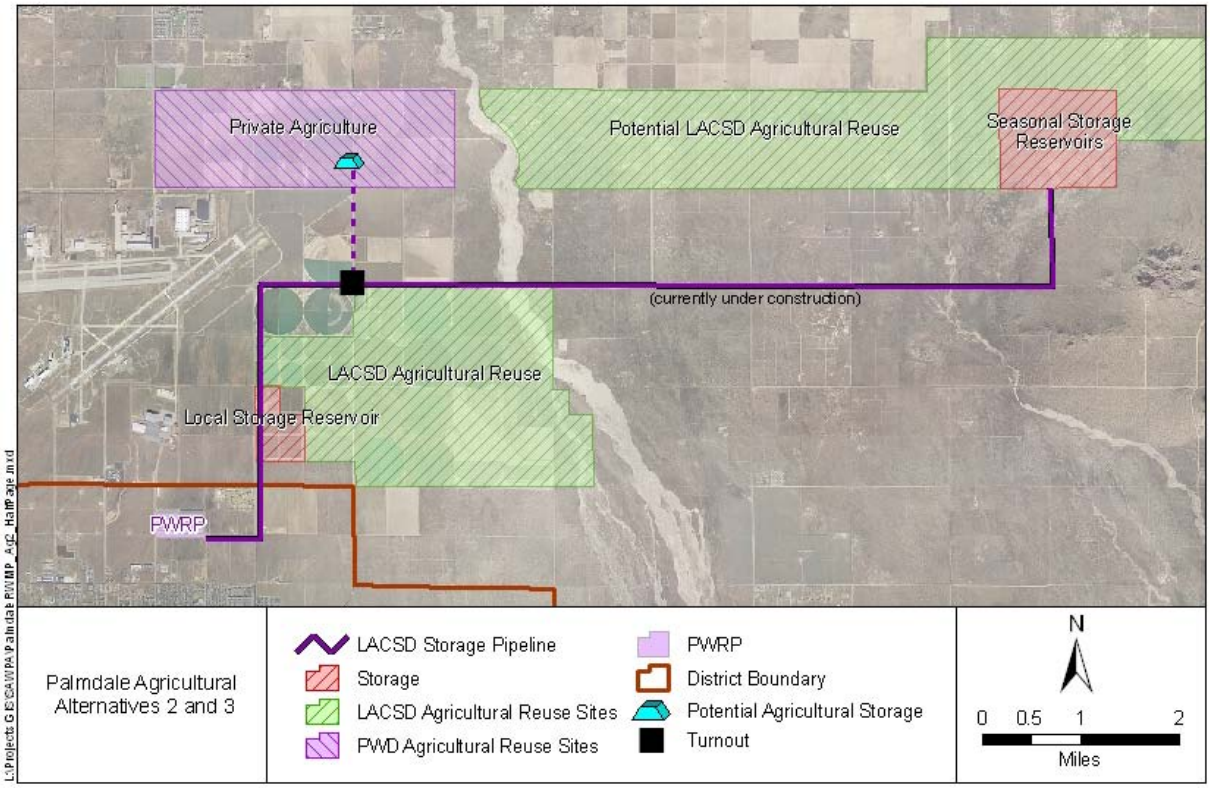
Alt Ag2 will serve 800 acres of agricultural operations with up to 16,000 gpm of recycled water from the LACSD seasonal storage reservoirs. Annual use would range from approximately 2,000 afy to 6,000 afy, depending on the crop type. The alternative would use the planned LACSD pipeline and pump station but would require additional facilities to convey the recycled water to the agricultural customers (see **Figure 4-9**).

The following facilities are required for Alt Ag2:

- **Pipelines:** Approximately 5,300 LF of 24" pipe from the LACSD Agricultural Reuse pipeline to the storage facility and approximately 5,000 LF of 12" laterals. Also, a new 24" turnout will be needed to connect to the planned LACSD Agricultural Reuse pipeline.

- **Pump Stations:** No pump station is needed because the pipeline pressure at the turnout should be sufficient.
- **Storage:** Approximately 5.7 MG of storage capacity is required on the private agricultural site.

Figure 4-9: Agricultural Alternatives 2 & 3



Agriculture Alternative 3 (Alt Ag3)

Alt Ag3 is a larger version of Alt Ag2. This alternative will serve 1,600 acres of agricultural operations with up to 32,000 gpm of recycled water from the LACSD seasonal storage reservoirs. Annual use would range from approximately 4,000 afy to 12,000 afy, depending on the crop type. Although, annual use on the higher end of the range could not be fully met due to limited surplus supplies until about 2019, when growth catches up with demand. As with Alt Ag2, the alternative would use planned LACSD pipeline and pump station but would require additional facilities to convey the recycled water to the agricultural customers (see **Figure 4-9**).

The following facilities are required for Alt Ag3:

- **Pipelines:** Approximately 5,300 LF of 24" pipe from the LACSD Agricultural Reuse pipeline to the storage facility and approximately 5,000 LF of 12" laterals. Also, a new 24" turnout will be needed to connect to the planned LACSD Agricultural Reuse pipeline.
- **Pump Stations:** No pump station is needed because the pipeline pressure at the turnout should be sufficient.
- **Storage:** Approximately 11.2 MG of storage capacity is required on the private agricultural site.

4.1.4 Groundwater Recharge Alternatives

Selection of an area to conduct GWR-RW requires consideration of multiple components, including recharge / injection sites, imported water, storm water, recycled water and extraction facilities. It is beyond the scope of this study to evaluate all of these factors so the objective of this study was to only define the recycled water component of a GWR-RW project so that these findings will be incorporated into the District's Strategic Water Resources Plan.

This section conducts a brief prioritization / ranking on the five recharge sites based on their appeal for GWR with tertiary treated water and GWR with advanced treated water. The assessment assumes that a GWR with imported water project will be implemented at the site and that recycled water will be added to this project so only recycled water components of the project would need to be considered. This evaluation is then combined with the site's ranking for GWR with imported water (discussed in Section 3.2.3) to select up to two sites for each quality of recycled water further defined later in this chapter.

As previously presented in **Table 3-6**, **Table 4-10** summarizes the maximum initial recharge volumes of recycled water with either tertiary treatment or advanced treatment.

Table 4-10: Maximum Initial Recycled Water Recharge Volume Estimates

Recharge Area	Total Annual Recharge of All Supplies[1]	Maximum Initial Annual Recycled Water Recharge Volume[2]	
		Tertiary Treated	Advanced Treated
Upper Amargosa Creek	3,000 afy	600 afy	1,500 afy
Upper Littlerock Creek	13,000 afy	2,600 afy	6,500 afy
Palmdale 14-East (Anaverde)	18,000 afy	3,600 afy	9,000 afy
Lower Amargosa Creek	60,000 afy	12,000 afy	30,000 afy
Lower Littlerock Creek	over 600,000 afy	over 120,000 afy	over 300,000 afy

Notes:
1. Source: RMC, 2009c. Average annual recharge over a 3-year period.
2. Based on the current CDPH Draft Groundwater Recharge Regulations, the minimum initial blend ratio for tertiary treated recycled water is frequently determined by TOC and typically results in a 4:1 blend ratio (diluent water: recycled water). The minimum initial blend ratio for advanced treated recycled water (reverse osmosis and advanced oxidation) is set initially at 1:1 (diluent water: recycled water).

GWR with Tertiary Treated Water

For GWR with tertiary treated water, proximity to existing and planned recycled water conveyance facilities was considered the primary criteria. The sites are ranked in order of appeal for GWR with tertiary treated water:

1. **Lower Littlerock Creek:** Site location allows for the use of planned LACSD Agricultural Reuse pipeline for recycled water delivery and recycled water recharge capacity (over 120,000 afy) exceeds recycled water supply.
2. **Lower Amargosa Creek:** Site is adjacent to the planned regional backbone pipeline along Sierra Highway and recycled water recharge capacity (12,000 afy) is on the upper limit of available recycled water.
3. **Palmdale 14-East (Anaverde):** Site is within 2 miles of the planned regional backbone pipeline along Ave P (Rancho Vista Blvd) but has moderate recycled water recharge capacity (3,600 afy).
4. **Upper Amargosa Creek:** Site's limited recharge capacity (600 afy) combined with distance from recycled water source will probably result in high unit costs.

5. **Upper Littlerock Creek:** Extension of the Eastern Palmdale non-potable system (if constructed) would allow for a short pipeline extension to this site but limited soil aquifer treatment may be a fatal flaw (both technically and politically) for conducting GWR with tertiary water.

The ranking of sites for GWR with tertiary treated water is almost the reverse order of the ranking from the SWRP for GWR with imported water so the combined ranking is not clear. To select the top sites for GWR with tertiary treated for further consideration, first Upper Amargosa Creek and Upper Littlerock Creek need to be eliminated from consideration due to probable high costs and a potential fatal flaw, respectively. The remaining sites are all potential GWR with tertiary treated water sites but Palmdale 14-E can be eliminated from further definition because its only difference with Lower Amargosa Creek is 1 to 2 miles of pipe so the costs should not differ much (for the purposes of this study). Therefore, GWR with tertiary treated water at Lower Amargosa Creek and Lower Littlerock Creek will be further defined.

The following facilities are required to conduct 10,000 afy of GWR with tertiary treated water at Lower Amargosa Creek:

- **Pipelines:** Approximately 2,000 LF of 24" pipe from the regional backbone pipeline along Sierra Highway, which is planned to be 24", to the site, including a crossing of Sierra Highway. A 30" pipe would be preferred to reduce head loss and water velocity but the regional backbone is planned for 24" and design criteria are still met so a 24" pipe has been assumed. The higher head loss and associated pumping costs are reflected in increased O&M costs. A new 24" turnout would be required on the regional backbone pipeline as well as approximately 5,000 LF of 12" laterals.
- **Pump Stations:** No pump station is needed because the pipeline pressure at the turnout should be sufficient.

The following facilities are required to conduct 10,000 afy of GWR with tertiary treated water at Lower Littlerock Creek:

- **Pipelines:** Approximately 5,000 LF of 30" pipe from the LACSD pipeline and approximately 5,000 LF of 12" laterals. A new 30" turnout would be required on the regional backbone pipeline.
- **Pump Stations:** No pump station is needed because the pipeline pressure at the turnout should be sufficient.

GWR with Advanced Treated Water

For GWR with advanced treated water, proximity to potential advanced treatment facility sites was considered the primary criteria. Selection of potential advanced treatment sites mainly focuses on proximity to tertiary treatment process, brine management options, and proximity to large power supply. Potential sites, in order of preference, include:

1. **Palmdale Hybrid Power Plant (Power Plant):** This site will have ample power supply and operating zero liquid discharge facilities to address brine. The primary concern with the site is impacts of water quality changes to tertiary treated water during distribution on the advanced treatment process.
2. **PWRP:** This site should have adequate power supply and would be located adjacent to the tertiary treatment process but brine management facilities would need to be constructed. Also, a parallel pipeline that contains only advanced treated water would probably be needed in addition to the planned tertiary treated pipelines for non-potable demands.
3. **GWR On-Site:** This site would require new power supplies and brine management facilities but would avoid parallel pipe issues of a PWRP advanced treatment facility.

Of these options, advanced treatment at Power Plant and Palmdale WRP is preferred. Considering this review of advanced treatment sites, the GWR sites are ranked in order of appeal for GWR with advanced treated water:

1. **Lower Amargosa Creek:** Site is within 2 miles of the Power Plant (and 5 miles of the Palmdale WRP) and recycled water recharge capacity (30,000 afy) exceeds available volume of advanced treated water.
2. **Palmdale 14-East (Anaverde):** Site is within 4 miles of both the Power Plant and Palmdale WRP and recycled water recharge capacity (9,000 afy) is on the upper limit of available recycled water.
3. **Lower Littlerock Creek:** Site is within 5 miles of the Palmdale WRP and recycled water recharge capacity (over 300,000 afy) exceeds recycled water supply. Advanced treatment at the GWR site is an option so that the LACSD Agricultural Reuse pipeline with tertiary treated water can be utilized but this is not preferred.
4. **Upper Littlerock Creek:** Site is within 6 miles of the Palmdale WRP and has adequate recharge capacity (6,500 afy). Advanced treatment at the GWR site is an option if the Eastern Palmdale non-potable system is constructed because the site is approximately 1 mile from the terminus but remote treatment is not preferred.
5. **Upper Amargosa Creek:** Site's limited recharge capacity (1,500 afy) combined with distance from both the Palmdale WRP and Power Plant will probably result in high unit costs. Advanced treatment at the GWR is an option but not preferred.

The ranking of sites for GWR with advanced treated water is almost the reverse order of the ranking from the SWRP for GWR with imported water so the combined ranking is not clear. To select the top sites for GWR with tertiary treated for further consideration, first Upper Amargosa Creek should be eliminated from consideration due to probable high costs. Upper Littlerock Creek and Lower Littlerock Creek have similar new facility requirements so, to limit the number of alternatives defined, Lower Littlerock Creek can be eliminated since Upper Littlerock Creek has a better GWR with imported water ranking.

Finally, similar to the GWR with tertiary treated water site selection process, Palmdale 14-East can be eliminated from further definition because its only difference with Lower Amargosa Creek is approximately 2 miles of pipe so the costs should not differ much (for the purposes of this study). Therefore, GWR with advanced treated water at Lower Amargosa Creek and Upper Littlerock Creek will be further defined.

The following facilities are required to conduct 10,000 afy of GWR with advanced treated water at Lower Amargosa Creek:

- **Treatment:** An 18.3-mgd advanced treatment facility (MF/RO/AOP) is assumed to be located at the Power Plant to produce 14.0-mgd for recharge.
- **Evaporation Ponds:** A 4.3-mgd brine management facility that utilizes of 350 acres of small evaporation ponds.
- **Pipelines:** Approximately 10,000 LF of 30" pipe from Power Plant to the site.
- **Pump Stations:** A 780-hp pump station is needed and should be located in the vicinity of the Power Plant.

The following facilities are required to conduct 10,000 afy of GWR with tertiary treated water at Lower Littlerock Creek:

- **Treatment:** An 18.3-mgd advanced treatment facilities (MF/RO/AOP) are assumed to be located at the Palmdale WRP to produce 14-mgd for recharge.
- **Evaporation Ponds:** A 4.3-mgd brine management facility that utilizes that utilizes 350 acres of small evaporation ponds.
- **Pipelines:** Approximately 25,000 LF of 30" pipe from Power Plant to the site.
- **Pump Stations:** A 290-hp pump station is needed and should be located in the vicinity of the Palmdale WRP.

The following facilities are required to conduct 6,500 afy of GWR with tertiary treated water at Upper Littlerock Creek:

- **Treatment:** An 11.8-mgd advanced treatment facilities (MF/RO/AOP) are assumed to be located at the terminus of the Eastern Palmdale non-potable system to produce 9.0-mgd for recharge.
- **Brine Management:** A 2.8-mgd brine management facility that utilizes that utilizes 230 acres of small evaporation ponds.
- **Pipelines:** Approximately 5,000 LF of 30" pipe from the advanced treatment site to the GWR site.
- **Pump Stations:** A 320-hp pump station is needed and should be located in the vicinity of the advanced treatment site.

4.2 Cost Estimates

This section summarizes the major costs for each alternative. Facilities for the M&I alternatives were defined for the two demand scenarios: existing conditions and future conditions.

Key Cost Estimate Assumptions

Cost estimates in Appendix A are based on the following key assumptions for raw construction costs:

- Proposed pipe is Class 150, AWWA C900 PVC pipe for pipes up to 12" in diameter and cement mortar lined and coated steel pipe for pipes 14" or greater in diameter.
- Unit costs were developed for open trench construction of recycled water pipe.
- Costs include laterals to each individual user.
- Costs include pipe appurtenances such as isolation and air release valves.
- Costs do not include the cost to upgrade the Palmdale WRP to tertiary treatment since LACSD is implementing the project separate from this study and LACSD already has project funding mechanisms in place.
- Costs do not include provisions for on-site retrofits since these costs are not eligible for WRFP funding. Typical costs per site range from $500 to $5,000 and can be financed by the customer or the purveyor. Financing options are discussed further in Section 0.

The following contingencies and allowances were added to the raw construction costs to determine the total project cost:

- Conceptual Design Level Contingency[7] was estimated to be 20% of the sum of the raw construction cost and the General Overhead Contingency.
- Pre-construction tasks, such as engineering and environmental documentation, were estimated to be 15% of the sum of the raw construction cost and the planning contingency cost.
- Construction tasks, such as construction management, engineering services during construction, and legal, were estimated to be 15% of the sum of the raw construction cost and the planning contingency cost.

Total capital costs were annualized assuming an opportunity cost of capital at 5% over 25 years. Operation and maintenance annual costs were estimated as the sum of 1% of construction cost, 5% of pump station costs, 5% of storage tank costs, electricity costs and recycled water purchase costs. Estimated operating and maintenance (O&M) costs were combined with the annualized costs and then divided by the annual non-potable water demand to derive a unit cost.

[7] The American Association of Cost Engineers defines this as a Class 3 or Budget level estimate, which is expected to be accurate within plus 30% or minus 15%. A 20% contingency of the construction cost total was included to account for unknown conditions that may arise during design and construction.

Municipal and Industrial Alternatives

Planning level cost estimates for each alternative is summarized in **Table 4-11**. Detailed cost estimates for each alternative are presented in Appendix A.

Table 4-11: M&I Alternatives Cost Estimates

Alternative	# of Customers	Existing & Future Demand	Capital Cost[1]	O&M Cost[1]	NPV Unit Cost[2]
Alt A1	14	431 afy	$13.68 M	$0.31 M / yr	$1,800
Alt A2	25	744 afy	$20.91 M	$0.37 M / yr	$1,500
Alt B1	21	1,081 afy	$28.21 M	$0.36 M / yr	$1,400
Alt B2	27	1,340 afy	$32.51 M	$0.41 M / yr	$1,200
Alt A+B	44	1,736 afy	$48.52 M	$0.68 M / yr	$1,500
Alt C	5	200 afy	$3.35 M	$0.03 M / yr	$800
Alt D	3	64 afy	$2.10 M	$0.02 M / yr	$1,800

Notes:
1. Values are in March 2009 dollars. The Los Angeles Construction Cost Index applied was 9,802.
2. Construction costs were escalated to the mid-point of construction (March 2011) using a 3% inflation factor, O&M was escalated at an annual inflation rate of 2.5%, and a 5.0% discount rate was applied. Debt service was calculated assuming a 5% financing rate over 30 years. See Appendix A for more details.

The M&I alternative with the lowest unit cost is Alt C, which likely resulted from serving several high demand users (in the vicinity of Palmdale High School) while utilizing available capacity in the planned regional recycled water backbone from a portion of the conveyance. However, this alternative precludes implementation of Alts A2, B1, B2 and A+B under correct cost assumptions. Alts A2, B1, B2 and A+B have similar unit costs and are evaluated beyond unit cost in Section 4.3.1.

Agricultural Cost Estimates

Planning level cost estimates for each agricultural alternative is summarized in **Table 4-12**. Detailed cost estimates for each alternative are presented in Appendix A.

Table 4-12: Agricultural Alternatives Cost Estimates

Alternative	Demand	Capital Cost[1]	O&M Cost[1]	NPV Unit Cost[2]
Alt Ag1 – Carrots	2,100 afy	$31.60 M	$0.43 M / yr	$710 / af
Alt Ag1 – Alfalfa	6,300 afy	same as above	$0.49 M / yr	$240 / af
Alt Ag2 – Carrots	2,000 afy	$14.20 M	$0.28 M / yr	$340 / af
Alt Ag2 – Alfalfa	6,000 afy	same as above	$0.31 M / yr	$130 / af
Alt Ag3 – Carrots	4,000 afy	$21.50 M	$0.52 M / yr	$270 / af
Alt Ag3 – Alfalfa	12,000 afy	same as above	$0.58 M / yr	$110 / af

Notes:
1. Values are in March 2009 dollars. The Los Angeles Construction Cost Index applied was 9,802.
2. Construction costs were escalated to the mid-point of construction (March 2011) using a 3% inflation factor, O&M was escalated at an annual inflation rate of 2.5%, and a 5.0% discount rate was applied. Debt service was calculated assuming a 5% financing rate over 30 years. See Appendix A for more details.

As anticipated, the agricultural alternatives that utilized the LACSD effluent management pipeline for much of the conveyance (Ag2 and Ag3) were less expensive than Ag1, which assumed new facilities from the Palmdale WRP. Also, the impact of crop type on unit cost is evident for each alternative. Both

carrots and alfalfa have the same peak demand so capital facilities must be sized the same (and, thus, costs the same) while O&M for service to alfalfa is slightly higher primarily due to increased energy costs from increased volume of water pumped.

Groundwater Recharge Cost Estimates

Planning level cost estimates for Phase 1 of each alternative is summarized in **Table 4-13**. Detailed cost estimates for each alternative are presented in Appendix A.

Table 4-13: Groundwater Recharge Alternatives Cost Estimates

Alternative	Demand	Capital Cost[1,2]	O&M Cost[1,2]	NPV Unit Cost[1,3]
Tertiary GWR @ Lower Amargosa Creek	10,000 afy	$3.8 M	$0.4 M / yr	$40 / af
Tertiary GWR @ Lower Littlerock Creek	10,000 afy	$5.9 M	$0.4 M / yr	$50 / af
Advanced GWR @ Lower Amargosa Creek	10,000 afy	$190 M	$5.1 M / yr	$1,000 / af
Advanced GWR @ Lower Littlerock Creek	10,000 afy	$310 M	$5.1 M / yr	$1,030 / af
Advanced GWR @ Upper Littlerock Creek	6,500 afy	$120 M	$3.5 M / yr	$1,020 / af

Notes:
1. Costs included here are only for the recycled water portion of a groundwater recharge project and, therefore, exclude costs for supplying blend water, recharge basins, and extraction facilities.
2. Values are in March 2009 dollars. The Los Angeles Construction Cost Index applied was 9,802.
3. Construction costs were escalated to the mid-point of construction (March 2011) using a 3% inflation factor, O&M was escalated at an annual inflation rate of 2.5%, and a 5.0% discount rate was applied. Debt service was calculated assuming a 5% financing rate over 30 years. See Appendix A for more details.

The unit cost GWR with tertiary treated water is obviously significantly lower than implementing GWR with advanced treated water primarily because of the addition of MF/RO/AOP treatment facilities and brine disposal facilities. Also, the tertiary GWR alternatives benefitted from utilizing planned recycled water pipelines to reduce conveyance costs but the advanced treatment options would need separate pipelines to convey the higher quality water so each have new conveyance pipelines.

4.3 Alternative Evaluation

Evaluation criteria were developed to assess each recycled water alternative. The evaluation criteria are:

- **Net Present Value Unit Cost:** The unit cost is useful for rough comparisons between alternatives for cost effectiveness and for rough comparison with other water supplies. A lower unit cost is preferred.
- **Capital Requirements:** Because of capital investment needed, the bulk of project funding would likely come from grants and loans (such as municipal or SRF). Smaller capital requests are preferred due to the array of capital needs for other water projects by the District.
- **Non-Potable Water Use:** The use of non-potable water avoids the use of potable water (and is the primary benefit of implementing this project) so higher non-potable water use is preferred.
- **Raw Water Connection:** A raw water connection from Lake Palmdale (via the existing tank and intertie) could supplement recycled water during peak demand periods and provides the potential for accelerated non-potable service since the recycled water will not be available until 2011.

- **Implementation Flexibility:** The ability to adapt decisions for the timing and scope of each alternative allows project partners to respond to changing conditions in the region. More flexibility is beneficial so that the District can apply limited funds to the greatest benefit and can react to changes that alter priorities for recycled water use conditions (such as new development or conclusion of adjudication proceedings).

4.3.1 Municipal & Industrial Alternatives

In **Table 4-14**, each M&I alternative was assigned a high (good), medium (average), and low (poor) rating for each evaluation criteria. Weighting of each criteria and assignment of numerical ratings were not conducted because this is a qualitative evaluation. Rather, the number of high, medium and low ratings was summed at the bottom of the table for discussion purposes.

Table 4-14: M&I Alternative Evaluation

Criteria		Alt A1	Alt A2	Alt B1	Alt B2	Alt A+B	Alt C	Alt D
NPV Unit Cost ($/af)		$1,800	$1,500	$1,400	$1,300	$1,500	$800	$1,800
Capital Requirements		M	M	L	L	L	H	H
Non-Potable Water Use		L	M	M	H	H	L	L
Raw Water Intertie		H	H	L	L	H	L	L
Implementation Flexibility		M	M	M	M	M	L	L
Rating	**(Interpretation)**	**Totals**						
High (H)	(Good)	1	1	--	1	2	1	1
Medium (M)	(Average)	2	3	2	1	1	--	--
Low (L)	(Poor)	1	--	2	2	1	3	3

The rationale for the ratings is summarized for each evaluation criteria:

- **Capital Requirements:** Alt C and Alt D had the lowest capital requirements so they received the highest rating. Alt A1 and Alt A2 had capital requirements an order of magnitude higher, giving them a moderate rating. Alt B1, Alt B2 and Alt A+B had the highest capital requirements and so were given the lowest rating.
- **Non-Potable Water Use:** Alt C and Alt D had the lowest non-potable water use so they received the lowest rating. Alt B2 and Alt A+B both serve more than two-thirds of the identified M&I demands so they received the highest rating. Alt A1, Alt A2 and Alt B1 serve one-third to two-thirds of the identified M&I demands so they received a moderate rating.
- **Raw Water Connection:** Alt A1, Alt A2, and Alt A+B provide connections to raw water from Lake Palmdale through utilization of the existing storage tank. The other alternatives do not have this connection.
- **Implementation Flexibility:** Alt C and Alt D had low ratings because implementation of these alternatives would increase the unit costs for all alternatives that serve their customers (which is all alternatives except for Alt B1). The other alternatives have medium ratings because they can be constructed in phases and sufficient recycled water supplies remain for agricultural or groundwater recharge alternatives that the District may decide to implement in the future.

Alt C has the lowest unit cost but serves a small amount of non-potable water and reduces the cost-effectiveness of future non-potable system expansion for all of the alternatives that serve the Palmdale High School area (which is all alternatives except for Alt B1 and Alt D) so Alt C was not further considered. Of the other alternatives, the unit costs are relatively similar among Alt A2, Alt B1, Alt B2 and Alts A+B. Of these alternatives, Alt A+B converts the most amount of existing potable use to non-

potable use and has the most future non-potable water demands. The District SWRP identified both near-term and long-term potable supply shortfalls and maximizing recycled water use for non-potable demands was a key recommendation of the first round of actions to be taken by the District. Therefore, Alt A+B is the preferred non-potable alternative.

The preferred alternatives, Alt A+B, will likely need to be implemented in phases over multiple years primarily due to capital financing constraints. The first portion of the preferred alternative to be constructed would either serve Downtown Palmdale (Alt 1 or Alt 2) or Eastern Palmdale (Alt B1 or B2). Comparing these service areas, Alt A1 and Alt A2 are preferred over Alt B1 and Alt B2 because both have access to a backup raw water supply from Lake Palmdale and future demands also make up almost 20% of Alt B1 and Alt B2, meaning cost effectiveness is dependent on timely connection of future customers. Alt A2 is preferred over Alt A1 due to use of more non-potable water, the lower unit cost and being within the District's existing capital constraints.

Therefore, based on this evaluation, Alt A+B is the preferred alternative with implementation of the Alt A2 portion first followed by the remainder of Alt A+B (which is roughly Alt B) in the future.

4.3.2 Agricultural Alternatives

In **Table 4-15**, each agricultural alternative was assigned a high (good), medium (average), and low (poor) rating for each evaluation criteria. Weighting of each criteria and assignment of numerical ratings were not conducted because this is a qualitative evaluation. Rather, the number of high, medium and low ratings was summed at the bottom of the table for discussion purposes.

Table 4-15: Agricultural Alternative Evaluation

Criteria	Alt Ag1 Carrots	Alt Ag1 Alfalfa	Alt Ag2 Carrots	Alt Ag 2 Alfalfa	Alt Ag 3 Carrots	Alt Ag 3 Alfalfa
Unit Cost ($/af)	$710	$240	$340	$130	$280	$110
Capital Requirements	L	L	H	H	M	M
Recycled Water Use	L	M	L	M	M	H
Implementation Flexibility	M	M	M	M	M	M
Rating (Interpretation)	**Totals**					
High (H) (Good)	--	--	1	1	--	1
Medium (M) (Average)	1	2	1	2	3	2
Low (L) (Poor)	2	1	1	--	--	--

The rationale for the ratings is summarized for each evaluation criteria:

- **Capital Requirements:** Alt Ag1 alternatives require the lowest capital requirement, and so received high ratings. Alt Ag3 alternatives have capital requirements nearly twice as high as Alt Ag 1, and so received moderate ratings. Alt Ag2 alternatives had the highest capital requirements, and so received low ratings.
- **Recycled Water Use:** Alt Ag1 and Alt Ag 2 for carrots had the lowest recycled water use, so they received low ratings. Alt Ag 3 for Alfalfa would use the highest amount of recycled water, and so received a high rating. Other alternatives require amounts of water between the previously discussed alternatives, and so received moderate ratings.
- **Implementation Flexibility:** All alternatives have an equal amount of implementation flexibility. All agricultural options occur in the same area, meaning that one alternative would not be chosen to the detriment of another.

Though the recommended Agricultural Alternative would be Alt Ag3 – Alfalfa, the SWRP states that agricultural use of recycled water would not provide sufficient supply benefits relative to complex contractual requirements, therefore agricultural exchange alternatives be considered further for the initial RW project phase; however, agricultural recharge is still an available option and should be pursued (RMC, 2009).

4.3.3 Groundwater Recharge Alternatives

Table 4-16 presents an evaluation of the groundwater recharge alternatives. Only alternatives using advanced treated water were evaluated as the SWRP makes the assumption that advanced treatment will be implemented for any GWR-RW project.

Table 4-16: Groundwater Recharge with Advanced Treatment Evaluation

Criteria	Lower Amargosa Creek	Lower Littlerock Creek	Upper Littlerock Creek
Unit Cost ($/af)	$1,000	$1,030	$1,020
Capital Requirements	L	L	M
Recycled Water Use	H	H	H
Implementation Flexibility	H	H	H
Rating (Interpretation)			
High (H) (Good)	2	2	2
Medium (M) (Average)	--	--	1
Low (L) (Poor)	1	1	--

The rationale for the ratings is summarized for each evaluation criteria:

- **Capital Requirements:** GWR-RW at Lower Amargosa Creek and Lower Littlerock Creek both require a large capital investment, giving them a low rating. GWR-RW at Upper Littlerock Creek is lower than the other two alternatives, but still has a large capital requirement, giving it a moderate rating.
- **Recycled Water Use:** All GWR-RW options allow for very high recycled water use, and so all received a high rating.
- **Implementation Flexibility:** These alternatives may be implemented at any time and in any combination, giving them all an equally high rating.

Due to the long period of time before which GWR-RW could begin, this plan does not currently have a recommended GWR-RW alternative, but should be considered in conjunction with a future imported water GWR program.

4.4 Freshwater / No Project Alternative

This study considered a Freshwater alternative and a "No Project" Alternative for comparison with the M&I recycled water alternatives, this. These alternatives are defined in the subsequent section followed by a comparison with recycled water alternatives.

4.4.1 Freshwater Alternative

For the Freshwater Alternative, the volume of recycled water proposed to be used would need to be offset by a similar volume of new water supplies. As discussed in Section 2.3.1, potable water from District consists approximately of 45 percent imported water, 40 percent groundwater, and 15 percent local surface water (though the contribution varies significantly from year to year). Continued groundwater pumping would exacerbate basin overdraft conditions and would likely be reduced or become more

expensive once the adjudication process is complete. Assuming no new groundwater supplies are probable, the new demands would require District to acquire new SWP supplies and potentially require expansion of existing imported water conveyance and treatment facilities. Overall, if Alt A+B M&I demands were served with imported water instead of recycled water:

- 1,736 AFY of new imported water supply would need to be acquired for new water customers instead of using recycled water
- 1,736 AFY of recycled water would continue to be used by LACSD at their agricultural reuse sites.

4.4.2 No Project Alternative

For the No Project Alternative, potable water would continue to be used by existing M&I customers and planned M&I demands would require the acquisition of new potable water supplies. Overall, if Alt A+B M&I demands were not served with recycled water:

- 1,407 afy of existing potable water supplies from District would continue to be used; of this, approximately 633 afy would be imported water, 211 afy would be groundwater, and 563 afy would be local surface water
- 329 afy of new imported water supply would need to be acquired for new water customers instead of using recycled water
- 1,736 afy of recycled water would continue to be used by LACSD at their agricultural reuse sites.

4.4.3 Cost Estimate

The Freshwater Alternative and No Project Alternative costs were assessed by estimating the unit costs of their respective water supplies, including:

- New imported water from SWP
- Existing imported water from SWP
- Existing groundwater extraction
- Existing local surface water

The cost for new imported water from the SWP varies but an average value of $7,600/af was used in the District SWRP (RMC, 2009). This value includes the cost to purchase permanent SWP water rights, the SWP average year delivery of approximately 60% water rights, the SWP transport fee, the cost of additional aqueduct capacity, and the cost of water treatment. For comparison with recycled water, the cost of banking imported water in above average water years for extractions in below average water years must be included due to the annual variability in SWP deliveries. The Semitropic-Rosamond Water Bank Authority is currently being developed in the Antelope Valley with a cost of approximately $2,030/af by a project participant (Semitropic, 2008). Approximately 50% of imported water would need to be banked in wet years for use in dry years so groundwater banking costs would apply to 50% of the imported water volume. Combining the cost to acquire imported water plus the cost to bank half the water equates to $1,615/af.

Existing imported water and groundwater unit costs were values of $400/af and $180/af, respectively, were used in the District SWRP (RMC, 2009). Adding groundwater banking to existing imported water would raise the unit cost to $1,415/af. Local surface water was assumed to cost $200/af, which includes treatment costs only. Based on these values, approximate unit costs for the Freshwater and No Project alternatives were developed, as shown in **Table 4-17**.

Table 4-17: Freshwater and No Project Alternative Costs

Monetized Benefit	Unit Cost	Freshwater Alternative		No Project Alternative	
		Supplies	Annual Cost	Supplies	Annual Cost
Existing Imported Water	$1,415 / af	--	--	633	$895,700
Existing Groundwater	$180 / af	--	--	211	$38,000
Existing Local Surface Water	$200 / af	--	--	563	$112,600
New Imported Water	$1,615 / af	1,736	$2,803,640	329	$531,300
Total		**1,736**	**$2,803,640**	**1,736**	**$1,577,600**
Total Unit Cost		**$1,615/af**		**$910/af**	

4.4.4 Comparison with Recycled Water Alternatives

Although the Freshwater and No Project alternatives would avoid potential short-term environmental impacts, such as traffic impacts from construction activities and noise impacts from operation of equipment and vehicles, there would be several major long-term benefits associated with implementing Alt A+B (KJ, 2008):

- **Reduced Demand for Imported Water from SWP:** By offsetting current potable water use with recycled water, existing and new SWP imports would be reduced. Reduced imported water demand for existing uses avoids the costs of existing SWP imports.
- **Reduced Demand for Groundwater:** By offsetting current potable water use with recycled water, existing groundwater pumping would be reduced. Reduced groundwater pumping avoids pumping and treatment costs and contributes to reduced overdraft conditions in the basin.
- **Improved Water Supply Reliability:** Alt A+B would provide a local water source that is drought resistant and is not subject to SWP cutbacks.
- **Recycled Water Put to Highest Beneficial Use:** Recycled water would be applied toward District M&I demands instead of agriculture by LACSD at their agricultural reuse sites.
- **Reduced Stress on the SWP and Bay-Delta:** By reducing demands for existing and new SWP imports, capacity (i.e. pumping) constraints on SWP facilities are relieved and exports of water from the ecologically-stressed Sacramento Bay-Delta are reduced.
- **Reduced Introduction of Salts to the Basin:** By reducing SWP imports with recycled water, salts that would be imported into the Antelope Valley from continued and additional imported water deliveries are avoided.
- **Reduced Fertilizer Costs:** Recycled water contains higher nutrient contents than existing supplies and, as a result, less fertilizer is required for landscape irrigation applications.
- **Reduced Carbon Dioxide Emissions:** By offsetting imported water demands with locally produced recycled water, Alt A+B would avoid carbon dioxide emissions generated y transporting imported water to the Antelope Valley.

There are also potential avoided costs for LACSD from reducing effluent management efforts at the agricultural reuse sites, such as avoided investment in agricultural reuse facilities and agricultural operations. Conversely, LACSD would not realize revenue from sales of agricultural produce. Estimation of incremental and avoided costs associated with effluent management were beyond the scope of this study; however, the Lancaster Groundwater Recharge Feasibility Study (RMC, 2007) found a net benefit to using recycled water for non-potable and indirect potable reuses.

Chapter 5 Recommended Project

The recommend recycled water project (Project) for the District is Alt A+B (see **Figure 5-1**), as described in Section 4.3. This Project was recommended for the following reasons:

- **Cost Effectiveness:** Alt A+B had the highest qualitative ratings and a relatively similar unit cost ($1,500/AF) compared to the other M&I alternatives, and was found to be cost effective overall.
- **Customers Served:** Alt A+B provides service to the maximum number of customers.
- **Raw Water Connection:** Alt A+B provides a connection with raw water from Lake Palmdale (via the existing tank and intertie) that could supplement recycled water supply, and can begin delivering non-potable water before tertiary treated recycled water is available.
- **Implementation Flexibility:** Implementation of Alt A+B allows for the flexibility of implementing in segments (i.e. implement the Alt A2 portion of A+B in phase 1, and the remaining in phase 2), and gives District the option of eventually implementing GWR-RW and/or agriculture reuse through in-lieu exchange.

The Project will be implemented in phases over multiple years due to limited capital financing and so that appropriate analysis of the non-potable system expansion can be conducted with consideration of agricultural reuse and groundwater recharge with recycle water (GWR-RW).

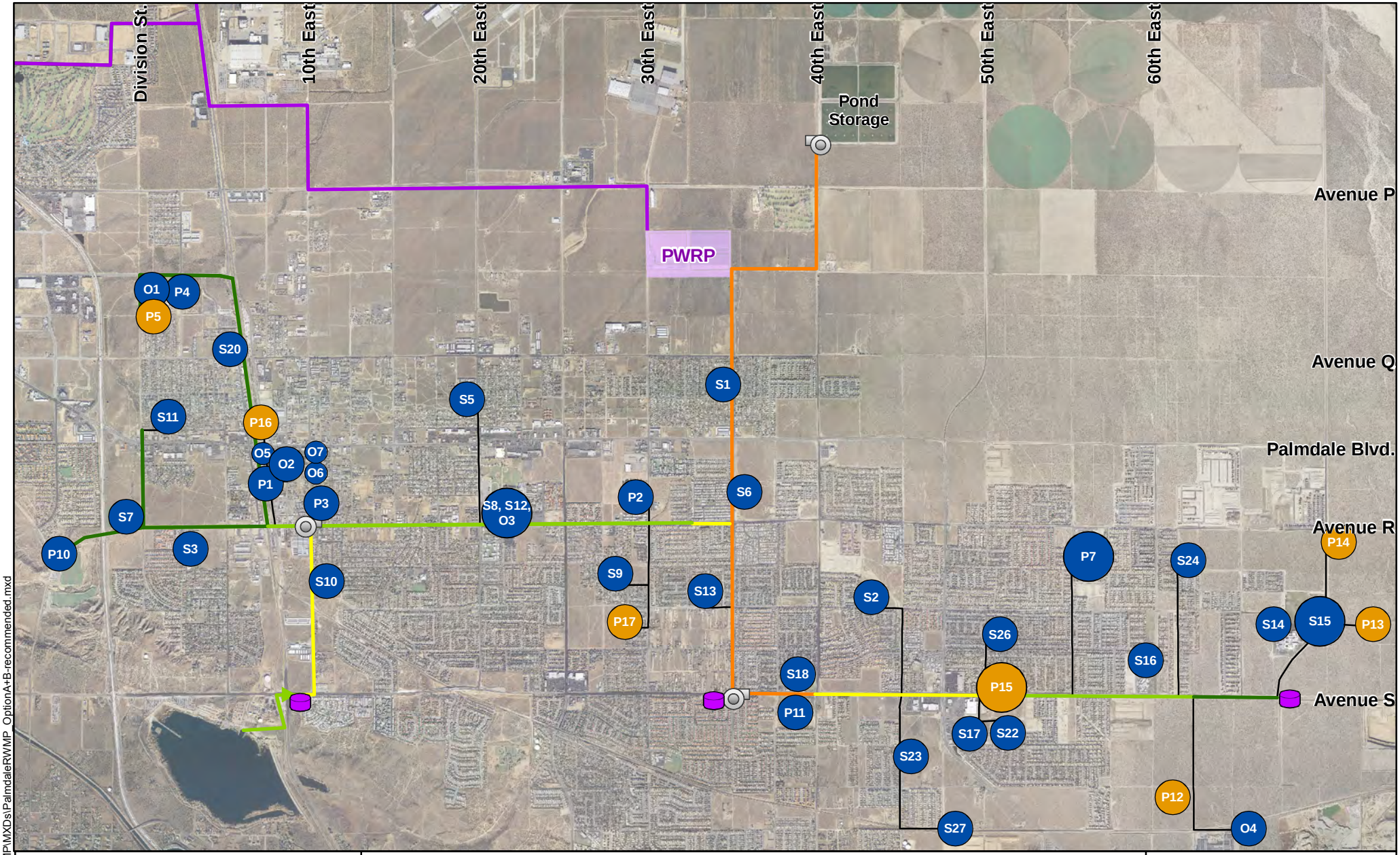
The general phasing approach is to construct the Downtown Palmdale portion of the Project (similar to Alt A2) first (Phase 1) and then construct the Eastern Palmdale portion of the project (similar to Alt B1) second (Phase 2). The Downtown Palmdale portion is preferred over the Easter Palmdale portion because some existing facilities can but utilized (abandoned storage tank and pipes), associated raw (non-potable) water connection for supplemental supply, and most customers are existing.

In addition, a portion of the Phase 1 project can be constructed prior to recycled water supply becoming available from the Palmdale WRF, which will not occur until mid-2011. Therefore, the District is planning to serve raw water from Lake Palmdale via a portion of the proposed Phase 1 non-potable system to serve customers in the area immediately north of Lake Palmdale. This is referred to as the Phase 1 Accelerated Project and is shown in **Figure 5-2**.

Successful implementation of the Phase 1 Accelerated Project allows District to reduce potable water demands sooner than the Phase 1 Project and reduces District's dependence on the timely completion of the Palmdale WRP tertiary treatment upgrades to begin serving non-potable water. Once recycled water is available from the Palmdale WRF, the remainder of the Phase 1 Project would be constructed as described previously. Future expansion of the non-potable system beyond the first phase is discussed in the next section.

Once the non-potable system has been developed, agricultural reuse and further research into GWR-RW should be pursued. The District should pursue implementing a recycled water exchange program with local agriculture interests to provide in-lieu groundwater exchange, thus improving groundwater storage in the basin area near the District's wells.

Further research into GWR-RW should be pursued as the most significant and most reliable use for recycled water for the District is recharge. Facilities and blend supplies will already be in place due to the construction of facilities for recharging imported water via surface spreading. It should be noted that the process for obtaining regulatory and public approval for GWR-RW is lengthy and frequently complicated. Due to minimal research and public outreach on the topic in the Antelope Valley, it will be necessary for the District, in combination with partners, to embark on thoughtful and comprehensive investigation of groundwater recharge with recycled water.



Palmdale Water District Municipal and Industrial Recommended Alternative

Figure 5-1

Customers
- Existing
- Future

Demand
- ≥ 1 AFY
- ≥ 10 AFY
- ≥ 100 AFY

Facilities
- Planned Regional System
- Laterals
- PWRP
- Pump Station
- Storage

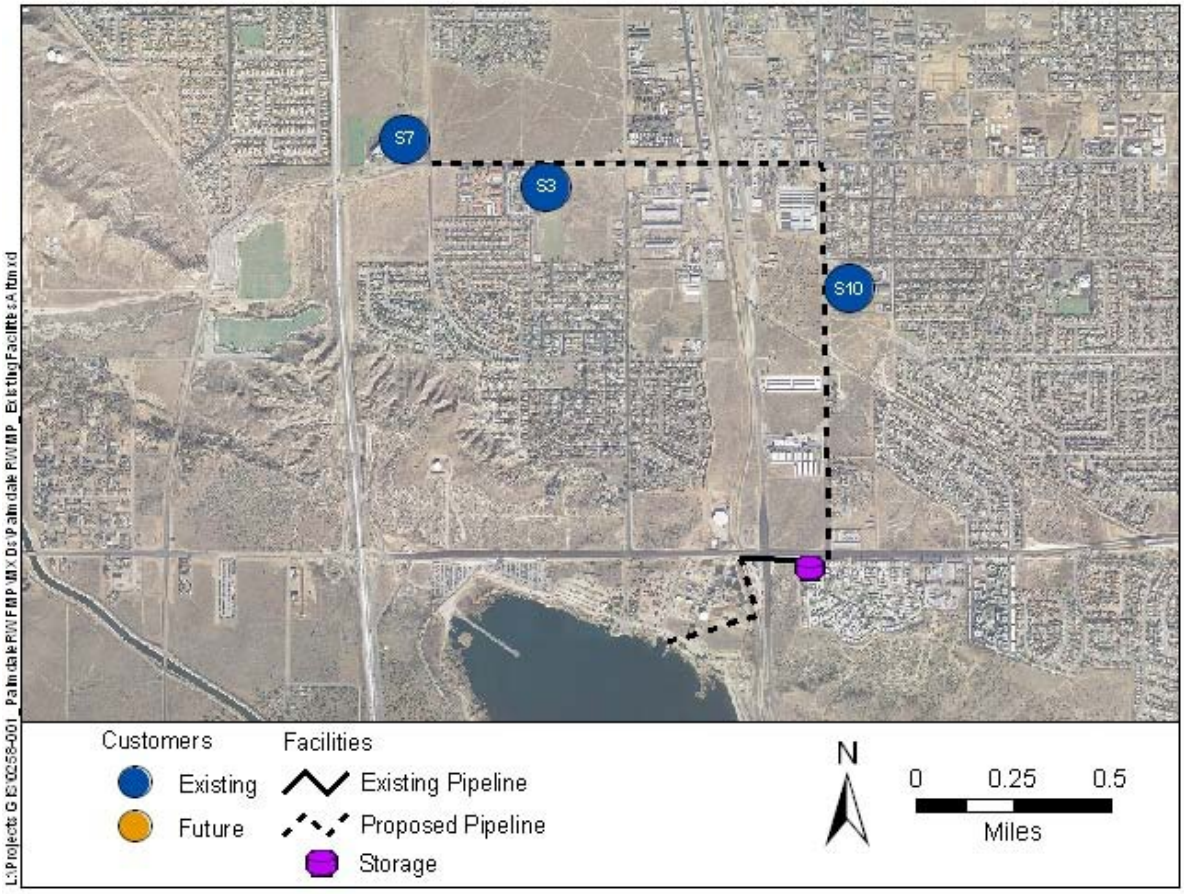
Pipe Diameter
- <12 in.
- 12 in.
- 14 in.
- 16 in.

N

0 0.25 0.5 1
Miles

L:\Projects GIS\0258-001_PalmdaleRWFMP\MXDs\PalmdaleRWMP_OptionA+B-recommended.mxd

Figure 5-2: Accelerated Phase 1 Project Facilities



5.1 Project Description

The Project would provide approximately 1,736 afy of non-potable water to downtown and eastern Palmdale customers. The project would include the following facilities:

- **Pipelines:** Approximately 66,980 LF of 8" to 16" distribution pipe and 55,060 LF of 4" to 12" laterals.
- **Storage:** An existing 3.0 MG storage tank is located on Ave S and 10th St East. This tank would be required for daily operational storage. A 1.0 MG storage tank would be located at Ave S and 35th St East, and a second 1.0 MG storage tank would be located at Ave S and 65th St East.
- **Pump Stations:** A 200-hp pump station is needed to fill the storage tank for 14 hours during the day and should be located in the vicinity of the Palmdale WRP. An existing 75-hp pump station is located at the storage tank which will be used to supply demand during the night. A 180-hp pump would be needed near Ave S and 35th St East to provide a minimum delivery pressure of 60 psi to customers on the edges of the Eastern Palmdale system. An additional 100-hp will be needed at this pump station once future customers are connected and an additional 100-hp will be needed at the Palmdale WRP pump station.

5.2 Project Cost

As shown in **Table 5-1**, the capital cost for the Project is $48.5 million. A more detailed cost estimate is provided in Appendix A.

Table 5-1: Estimated Project Cost

Project Elements	Estimated Cost[1]
Capital Costs	
Recycled Water Pipeline - Mains & Laterals	$22,016,000
Pipe Appurtenances	$2,201,600
Crossings	$730,000
Pumping	$2,514,000
Storage	$2,400,000
Raw Construction Cost Subtotal	*$29,861,600*
Conceptual Design Level Contingency (20%)	$5,972,000
Change Order Allowance (5%)	$1,493,000
Construction Cost Subtotal	*$37,327,000*
Pre-Construction: Eng/Design, Env. Docs, etc. (15%)	$7,465,000
During Construction: CM, ESDC, Legal (15%)	$3,733,000
Project Capital Cost Total	**$48,524,600**
Present Value[2]	
Debt Service (financing at 6% over 30 years)	$46,445,403
O&M Costs (initially $0.37 M / year)	$11,356,696
Total Present Value Cost	**$57,802,100**
Unit Costs	
Total Recycled Water Production	39,000 af
Present Value per AF	**$1,500/ af**

Notes:
1. All costs in March 2009 dollars (Los Angeles ENR CCI = 9,802)
2. Present value analysis assumes capital cost inflation rate of 3.0%, O&M inflation rate of 2.5%, and a discount rate of 5.0%.

5.3 Project Implementation Plan

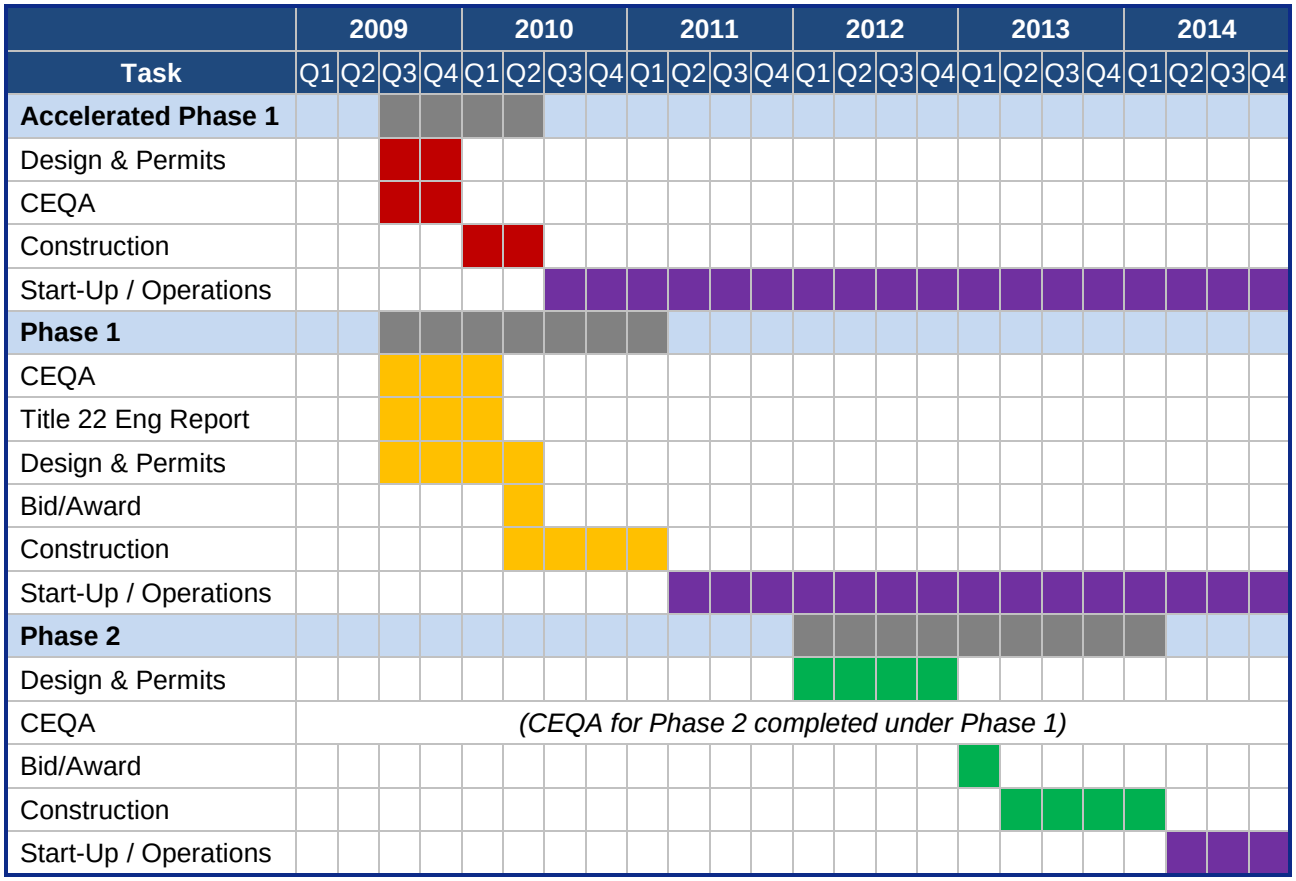
Numerous tasks (including environmental documentation, permitting, public outreach, funding, design, and construction) need to be undertaken between completion of this Plan and start of Project operations in the District. The purpose of the implementation plan is to describe these tasks and provide an approximate schedule for their completion. This section identifies major tasks and then discusses each major task, recommended approach, and status. This section addresses the following Project items:

- Schedule
- Financing Plan
- Implementation Considerations

5.3.1 Schedule

Tertiary treatment upgrades to the Palmdale WRP are currently underway and are scheduled for completion in mid-2011. The Accelerated Phase 1 Project is estimated to start prior to this, in 2010 following construction. The Phase 1 Project is estimated to start operation in Spring 2012 following the completion of the upgrades. All existing Project customers would connect to the Project in 2012 and the future Phase 1 Project customer would connect once it comes on-line, which was estimated to be in 2015. The Phase 2 project is estimated to start once Phase 1 in up and running, in mid-2014. The Project implementation schedule is presented in **Figure 5-3.**

Figure 5-3: Phase 1 Project Schedule



5.3.2 Financing Plan

This section discusses potential funding sources, revenue sources and reuse incentives. Project capital funds will likely come from a combination of funds from the District and willing project partners. A summary of potential outside funding sources for the Phase 1 Project is provided below and summarized in **Table 5-2**.

- **SWRCB State Revolving Fund (SRF) Loan:** The SRF Loan Program is administered by the SWRCB. The program provides low-interest loan funding for a wide array of design and construction projects, including construction of publicly-owned wastewater treatment facilities, local sewers, sewer interceptors, and water reclamation facilities. The SRF Loan Program provides 20-year loan with an interest rate set at half of the State Bond General Obligation Rate (typically 2.5% to 3.5%). The loan maximum is $25 million; however it may be increased to $50 million pending approval by the SWRCB. The SWRCB is accepting new applications and is processing those applications that were previously under review. In order to qualify for a SRF

loan, the sponsor must apply for placement on the Priority List and subsequently, the sponsor must submit a Master Plan. District plans to submit this project for the 2010 priority list.

- **SWRCB WRFP Construction Grant:** A Construction Grant is available through the WRFP administered through the SWRCB. The Construction Grant can provide up to 25% of the construction cost with a cap of $5 million. The sponsor must submit a Facilities Plan and Water Conservation Plan as specified in WRFP Guidelines (SWRCB, 2008). It is currently unknown how much is available for grant funding as the legislature has suspended those funds.
- **United States Bureau of Reclamation (USBR) Title XVI:** In 1992, Congress authorized the USBR to participate in local recycled water projects under "The Reclamation Wastewater and Groundwater Studies and Facilities Act," known as Title XVI. Title XVI funds are available for feasibility studies and/or design and construction costs. The Federal contribution is capped at 50% of the total study cost, and 25% of the total project cost (including construction), or $20 million per project.

  The federal appropriation process typically requires that the project sponsor notifies the USBR two years prior to the year the funds are sought. In order to be eligible, the project must meet legal and institutional requirements, including National Environmental Policy Act (NEPA) compliance and consultation with US Fish and Wildlife Service and National Marine Fisheries Service. A cost sharing agreement can only be approved after all feasibility and environmental requirements are met.
- **DWR Proposition 84:** This is an implementation grant program for California with two rounds of funding. The first round of funding will award $200 to $300 million and the second would be $500 million across California; however, only approximately $27 million is expected to be available for both rounds for entire Lahontan region. A number of project types are eligible for funding. They include: flood control projects, planning and feasibility studies focusing on climate change and impacts on flood and water systems; integration of flood and water systems, prevention of stormwater contamination, urban greening energy reduction, water conservation, and improvements to water quality. Competitive grants are also available for local and regional parks, land use plans designed to promote water conservation, and community revitalization.
- **USBR Challenge Grant Program (Formerly Water 2025 Program and Water for America Program):** Through the Challenge Grant Program, the USBR provides 50% cost share funding to irrigation and water districts and states for projects focused on water conservation, efficiency, and water marketing. Projects are selected through a competitive process, based on their ability to meet the goals identified in *Water 2025: Preventing Crises and Conflict in the West* (USBR, 2005). The focus is on projects that can be completed within 24 months that will help to prevent crises and conflict over water. The USBR will fund up to $300,000 per project and is distributed annually. The District would have to submit an application for funding and obtain the required environmental documentation which may include the NEPA.

Table 5-2: Potential Funding Sources

Program	Amount Available	Comments
Grant Funding		
SWRCB Recycled Water Funding Program[1]	Up to 25% of construction cost up to $5M	Legislature has suspended these funds
USBR Title XVI Program[2]	Up to 25% of construction cost up to $20M	Funding dependant on earmarks by Congress
DWR Prop 84[3]	Up to $15M per project	Two rounds of funding opportunities. Project must be included in regional package. First round in FY 09/10
USBR Challenge Grants[4]	Up to $300,000 per project	
Loan Sources		
SWRCB SRF[5]	Up to $25 million; possible increase to $50M with approval by SWRCB	Priority list made yearly; $200M-$300M available yearly; Loan available once per recipient per year
Municipal Bonds	Bonds could supplement other funding sources for Project capital costs. Different types of bonds (e.g., revenue bonds, general obligation bonds, certificate of participation) should be considered.	

Notes:
1. Water Recycling Funding Program Guidelines (SWRCB, 2004)
2. Guidelines for Preparing, Reviewing, and Processing Water Reclamation and Reuse Project Proposals under Title XVI (USBR, 1992)
3. Proposition 84; www.grantsloans.water.ca.gov
4. Water 2025 Challenge Grant Program website; http://www.usbr.gov/wci/grants.html
5. SWRCB SRF; www.waterboards.ca.gov/water_issues/programs/grants_loans/srf

Grant funding is limited and unlikely so the best outside capital funding source would likely be to pursue a low interest loan under the SWRCB SRF Loan Program since SRF loans have lower rates than municipal bonds; however, the District should still track opportunities, particularly Proposition 84.

Revenue Sources and Incentive Program

This section discusses potential revenue sources and presents potential incentives to users to connect to the non-potable system. Recycled water rates and charges (e.g. monthly fee for maintenance and administration costs of providing recycled water service), connection fees and other funds are possible sources of revenue.

- **Rates:** The District could collect a recycled water rate based on volume sold to M&I customers. The rates could be a source of income for the District to pay back borrowed capital funds.
- **Capital Facilities Charges (Connection Fees):** Capital Facilities Charges also known as Connections Fees are charged to new developments for the right to connect to the water and wastewater system. Connection fees associated with new developments would help cover the cost of developing available capacity necessary to serve growth and constructing recycled water facilities (transmission main, storage, and pumping). Fees could also be used to transfer existing potable users to the non-potable system, such as metering and retrofits.
- **Developer Contributions:** The District envisions recycled water to be used in future development areas for uses such as landscape irrigation and possibly residential irrigation. Developers are generally required to construct water, wastewater and stormwater infrastructure as a condition of development. Developers may also be required to install recycled water infrastructure such as transmission pipelines or dual plumb buildings. Upsizing transmission

pipelines could be financed by the utility or by a latecomer agreement, whereby the incremental cost of upsizing is retroactively reimbursed by later developments.

As discussed in the SWRP, the District is considering implementation of a water supply connection fee to assist in the construction of new water supply projects. The balance of funds required to construct and operate recycled water projects beyond recycled water sales revenues is envisioned to be covered by this new fee (as well as other water projects). Although, the fee is only one option being considered right now and the ultimate funding mechanism(s) will be recommended in the SWRP.

Financial Incentives

Incentive programs are typically implemented by agencies to assist and encourage possible users to connect to the non-potable system. These incentives typically include some level of financial incentives, such as recycled water rates lower than potable rates and non-monetary incentives, such as level of service provisions during drought conditions. A mandatory use ordinance, is required by the SWRCB, and is usually used in addition to rather than in lieu of other incentives.

Most recycled water projects include a Recycled Water Mandatory Use Ordinance for specific "reuse area" within which recycled water must be used for particular applications. District may develop an ordinance in the near future. However, successful project implementation usually requires both a carrot (financial incentives) and a stick (use ordinance). Financial incentives are discussed in this section.

The most common financial incentive for use of recycled water is setting the rate lower than the potable water rate – typically 70 to 90 percent. A lower rate provides an immediate incentive for existing customers to switch and new development to choose recycled water instead of potable water. Currently, the District is considering implementing a recycled water rate at 90% of the potable rate.

Use of recycled water includes initial and periodic costs for the customer beyond those that potable water customers normally require. Examples of these costs include:

- Development permit review
- On-site retrofits and signage
- Annual cross connection testing
- On-site supervisor training

One way to increase the attractiveness for customers to convert to recycled water is for the District to cover these costs either through purchase of equipment or providing the service itself. For example, the District could review development permits for free for recycled water customers. Also, the District could provide staff to support the annual testing requirements and offer free on-site supervisor training for customers.

For retrofit costs, the District could either pay for all the costs without reimbursement by the customer or pay for all the costs and recover the funds through a slightly higher recycled water rate. If the recycled water rate is set as a percentage of the potable rate, the District can recover the funds by applying the (higher) potable water rate for recycled water. In this way the customer does not have any increased monthly costs until the retrofit funds are recouped and the District successfully adds a new recycled water customer.

Non-Monetary Incentives

Recycled water use provides several non-monetary incentives for customers, particularly water supply reliability and positive community image. Recycled water supply is generally not affected by hydrologic conditions so potential water shortages in dry years should not impact the customer. In addition, converting to recycled water carries a positive economic value by projecting the recycled water customer as "green" to the community. Public education and information program recognizing the benefits of using recycled water for the community would typically be necessary to enhance the role of this incentive.

Project Costs and Revenues

This section presents the Project capital costs, financing costs, annual expenditures, and annual revenues. The purpose of this financial analysis is to provide the District with a preliminary understanding of the costs of developing and maintaining the Project.

The Project capital costs for all phases to be financed were estimated by escalating the total capital cost to the mid-point of construction, assuming annual inflation of 3 percent, which is equal to a $56.1 million. Note that the limit on SRF loans is $25 million. All pre-construction costs were assumed to be covered by existing District funds. No grant contributions were assumed since no grant is anticipated to be secured in the short-term. The annual costs and revenue projections for the first 30 years of the Project operations are defined in **Appendix B** and are based on the following assumptions:

- Construction costs would be supported by obtaining a SRF construction loan with a 20-year repayment period at a 2.5 percent interest rate. A debt service reserve of 10 percent was assumed.
- Recycled water is sold to existing customers at 90% of the Tier 2 potable rate, which is $980/af (July 2009)
- Annual expenses are assumed to result from annual O&M costs and debt service. O&M costs are adjusted to increase by an inflation rate of 4 percent annually.

Conclusions

Funding options that were identified include state and federal funding, bonds, recycled water rates, connection fees, and impact fees (see **Table 5-2**). The capital funds would be repaid recycled water revenues. The District plans to apply a RW rate of 90% of potable Tier 2 and make up the revenue shortfall with connection fees.

5.3.3 Regulatory Items

This section addresses the following regulatory items necessary for Project implementation:

- Environmental Documentation
- Title 22 Engineering Report
- RWQCB Master Water Recycling Requirements

Environmental Documentation

A Programmatic Environmental Impact Report has been prepared (ESA, 2008) for the regional recycled water system defined in AV RW Report. The document provides project-level coverage for construction and operation of recycled water pipelines and non-potable reuse applications as identified in the AV RW Report, and provides program-level coverage for the use of recycled water for groundwater recharge, agricultural irrigation, and construction and operation of pump stations and storage reservoirs.

An Initial Study/Mitigated Negative Declaration (IS/MND) will be prepared for this Facilities Plan as part of the CEQA-Plus[8] environmental review process required for the SRF Construction Loan program. The IS/MND will be necessary to seek coverage of the project under the Master Reclamation Permit currently sought by LACSD. The environmental review process will include public outreach as well as stakeholder workshops.

[8] From SWRCB Guidelines: The SRF Loan Program is partially funded by the U.S. Environmental Protection Agency (USEPA) and subject to federal environmental regulations, including the Endangered Species Act (ESA), the National Historic Preservation Act (NHPA), and the General Conformity Rule for the Clean Air Act (CAA). USEPA has chosen to use CEQA as the compliance base for California's SRF Loan Program, in addition to compliance with ESA, NHPA and CAA. Collectively, the SWRCB calls these requirements CEQA-Plus. Additional federal regulations also may apply.

Title 22 Engineering Report

The District will need to prepare a Title 22 Engineering Report for the Project in accordance with CCR Title 22 and CDPH *Guidelines for the Preparation of an Engineering Report for the Production, Distribution, and Use of Recycled Water* (2001). The report is prepared for submittal to the Lahontan RWQCB CDPH, and Los Angeles County Department of Health Services as part of the project permitting process. The report content typically includes recycled water production facilities, transmission and distribution facilities and use areas.

RWQCB Master Water Recycling Requirements

LACSD received a Master Water Recycling Permit from the Lahontan RWQCB for use of tertiary recycled water from the Palmdale WRP for landscape irrigation and industrial applications. The RWQCB can issue a Master Water Recycling Permit to the recycled water supplier in lieu of waste discharge requirements or water reclamation requirements for recycled water users. The permit includes waste discharge requirements and rules and regulations for recycled water users.

The CEQA document and Title 22 Engineering Report for the project will incorporate and reflect information from the Master Permit. The Lahontan RWQCB will ultimately decide whether the Project is covered by the Master Permit after the Title 22 Engineering Report and CEQA review is complete. If the RWQCB decides that the project cannot be covered under the Master Permit, a separate application for Water Reclamation Requirements would need to be secured from the Lahontan RWQCB by the District or LACSD prior to starting operations.

5.3.4 Institutional Items

This section addresses the following institutional items necessary for Project implementation:

- Use Ordinance
- Standard User Agreement
- User Manual
- Recycled Water User Commitment / Coordination

Use Ordinance

The District plans to adopt a recycled water use ordinance to promote the use of recycled water. The ordinance will be based on the City of Lancaster's Recycled Water Use Ordinance (see Appendix C), which is consistent with requirements of the *Water Recycling Funding Program Guidelines* (SWRCB, 2004).

User Manual

The District plans to use the *Recycled Water User Handbook* developed by the LACSD (2008) (see Appendix D). The handbook includes:

- General information about LACSD's recycled water program
- State and local standards, regulations and guidelines for the use of recycled water
- Information on the duties and responsibilities of water purveyors and recycled water users
- Information on operational requirements at reuse sites
- Information on notification and reporting

LACSD suggests using their handbook in conjunction with the *Recycled Water Urban Irrigation User's Manual* developed by the Los Angeles County Recycled Water Advisory Committee (2005) (see Appendix E). The manual describes the general rules, regulations and best management practices for use

of recycled water at individual sites in Los Angeles County. The manual is approved by both CDPH and Los Angeles County Department of Health Services.

Standard User Agreement

The District will develop a standard Recycled Water User Agreement between the District and each individual recycled water user. The agreement will include the application process for recycled water service and recycled water user requirements for safe use of recycled water, as described in the LACSD *Recycled Water User Handbook*. The user agreement will facilitate the addition of qualified users to the recycled water distribution system.

Recycled Water User Commitment / Coordination

It is a requirement of the SWRCB (and good practice) that user commitment be obtained for a project to be eligible for state funding through the SWRCB Water Recycling Funding Program. The District has started engaging directly with potential users to obtain commitment to use recycled water. This commitment will be memorialized in the user agreement. The District will continue working closely with the potential users to obtain user commitment.

5.3.5 Operation and Maintenance Activities

Ongoing project activities include maintenance of distribution system facilities, billing and customer service, and inspection/backflow prevention testing. District will operate the non-potable system and, therefore, provide staff and equipment for system operations. Based on experience with other water agencies and recycled water programs, the Project will likely need at least one recycled water coordinator and one certified operator. The District could use existing trained staff in the interim. Staff could be added as-needed, most likely in association with each major system expansion.

- **Recycled Water Coordinator:** Responsible for coordinating most of the activities identified in Section 5.3.4. The coordinator's responsibilities would also include billing and customer service. The coordinator would not need any particular certification but prior experience with water and non-potable system would be a plus.
- **Certified Operator:** The operator would be responsible for field work, including system O&M, meter reading, onsite supervisor training, and site inspection. The operator should have a California/Nevada AWWA distribution operator certificate and a California/Nevada AWWA treatment operator certificate would be a plus. Also, prior experience with non-potable system and backflow prevention would be a plus. PWD currently has operators that meet these criteria.

Both operator and coordinator should be familiar with the Recycled Water User Manual (see Appendix D) and should attend a training program on recycled water. Such programs are currently offered either through recycled water consultants or local professional societies, such as local chapters of WateReuse association.

Large equipment should be made available to recycled water program staff include a dump truck, a backhoe, a pick-up/utility vehicle, and spare mechanical parts for critical facilities such as the pump station.

5.3.6 Other Implementation Considerations

Some other issues that will need to be taken into consideration prior to implementing this alternative include:

- **Construction Impacts:** The project alignment for this alternative involves construction along Ave R. The traffic impacts will need to be evaluated prior to confirming the alignment.
- **User Retrofit Needs:** All irrigation systems may require retrofits to convert to recycled water but further investigation is needed. Funding of the retrofits was discussed in the previous section.

- **Water Quality:** Additional coordination with the customers regarding specific water quality concerns and on-going maintenance needs will need to be conducted.
- **Public Outreach:** Public support and acceptance is generally critical to a successful recycled water program. The District should develop a public outreach program to build support for recycled water projects in the community in coordination with public outreach efforts organized by the Antelope Valley IRWMP group. The program would supplement public involvement activities that would be required as part of the environmental review process. The program should include developing a website dedicated to recycled water in the District, and conducting a series of workshops to inform the public about this Facilities Plan, and other proposed projects.
  The RWFP was discussed at a regular, public meeting of the District's Board of Directors held on August 12, 2009. Meeting minutes which include a discussion of the RWFP can be found in **Appendix G**. An additional comment period will take place during the CEQA review process.

References

Carollo Engineers (Carollo), 2008. Palmdale Water District Final Water System Master Plan Update. October.

Carollo, 2005. Palmdale Water District 2005 Urban Water Management Plan. Prepared for Palmdale Water District. December.

County Sanitation Districts of Los Angeles County (LACSD), 2008. Recycled Water User Handbook. July 1.

Department of Water Resources (DWR), 2008. State Water Project Delivery Reliability Report 2007. August.

KJ, 2007. Final Report, Antelope Valley Integrated Regional Water Management Plan (IRWMP). Prepared for the Regional Water Management Group of the Antelope Valley IRWMP. November.

KJ, 2006. Final Master Planning Report, Antelope Valley Recycled Water Project. Prepared for Los Angeles County Department of Public Works Waterworks District No. 40. August.

KJ, December 2005. 2005 Integrated Urban Water Management Plan for the Antelope Valley. Prepared for Los Angeles County Department of Public Works Waterworks District No. 40.

Jarwal, Som, Anne-Maree Bolanda, Daryl Stevens and Robert Faggian, May 2006. *Using Recycled Water in Horticulture: A Growers Guide*. Prepared for the Victoria (Australia) Department of Primary Industries.

LACSD, 2009. Email correspondence in March 2009.

LACSD, 2005. Final Palmdale Water Reclamation Plant 2025 Master Plan and Environmental Impact Report. September.

Los Angeles County Recycled Water Advisory Committee, 2005. Recycled Water Urban Irrigation User's Manual.

Metcalf and Eddy, Inc. 2007. Water Reuse: Issues Technologies and Applications. McGraw Hill. New York.

Nebeker, Gene, 2007. E-mail correspondence in October 2007.

Palmdale Water Disrict (PWD), 2009. Water Rates. http://www.palmdalewater.org/IS/CS/rates.html.

RMC Water and Environment (RMC), 2009. Strategic Water Resources Plan. Prepared for Palmdale Water District. August.

RMC, 2008. Fatal Flaw Analysis Technical Memorandum for Groundwater Recharge Using Recycled Water Project. Prepared for the City of Lancaster. April.

RMC, 2007. Groundwater Recharge Feasibility Study. Prepared for the City of Lancaster. May.

Semitropic-Rosamond Water Bank Authority (Semitropic), 2008. Participation in the Semitropic-Rosamond Water Bank Authority (SRWBA). Draft Term Sheet. December 9.

State Water Resources Control Board (SWRCB), 2008. Water Recycling Funding Program Guidelines. July.

Wildermuth Environmental Inc. (Wildermuth), 2007. Recycled Water Groundwater Recharge Feasibility Study. Prepared for Palmdale Water District. July.

Appendix A - Detailed Cost Estimates

Appendix B - Project Financing Projections

Appendix C - City of Lancaster Recycled Water Use Ordinance

(Please see CD Insert)

Appendix D - LACSD Recycled Water Users Handbook – District Nos. 14 and 20

(Please see CD Insert)

Appendix E - Recycled Water Urban Irrigation User Manual

(Please see CD Insert)

Appendix F - Storage Analysis

Appendix G - Minutes of Regular Meeting of the Board of Directors of the PWD, August 12, 2009