Section 3 | Issues and Needs

The purpose of this section is to identify the issues, needs, challenges and priorities for the Antelope Valley Region through the year 2035 related to water supplies and other resources. The section will assess the current and projected water demands of the Antelope Valley Region, which include agricultural and M&I demands on groundwater, imported water, and recycled water as well as an analysis of the current and projected supplies[1] needed to meet those demands. In addition, an assessment of the water quality issues and challenges affecting these sources will be presented. A discussion of the flood management, environmental resource management, and land use planning issues will be presented, as these issues affect the water supply and demand requirements within the Antelope Valley Region. Finally, the issues and needs resulting from climate change are discussed.

3.1 Water Supply Management Assessment

As development has increased the demand for both quantity and quality water in the Antelope Valley Region, the competition for available water supplies has also increased. Development of new water supplies and protection of existing water supplies, provision of proper infrastructure, and the need to maintain the groundwater levels are crucial to successfully meeting the future water demands within the Antelope Valley Region.

In order to assess the water supply for the Antelope Valley Region, a water budget was developed. Figure 3-1 presents a schematic of the water budget elements and their relationships. The main components of the water budget include demands, water entering, surface storage, groundwater storage, direct deliveries, recycle/reuse, and water leaving. Each of these components is discussed in more detail below.

[1] The analyses provided in the IRWM Plan are strictly for long-term planning purposes and have not been conducted to answer the questions being addressed within the adjudication.

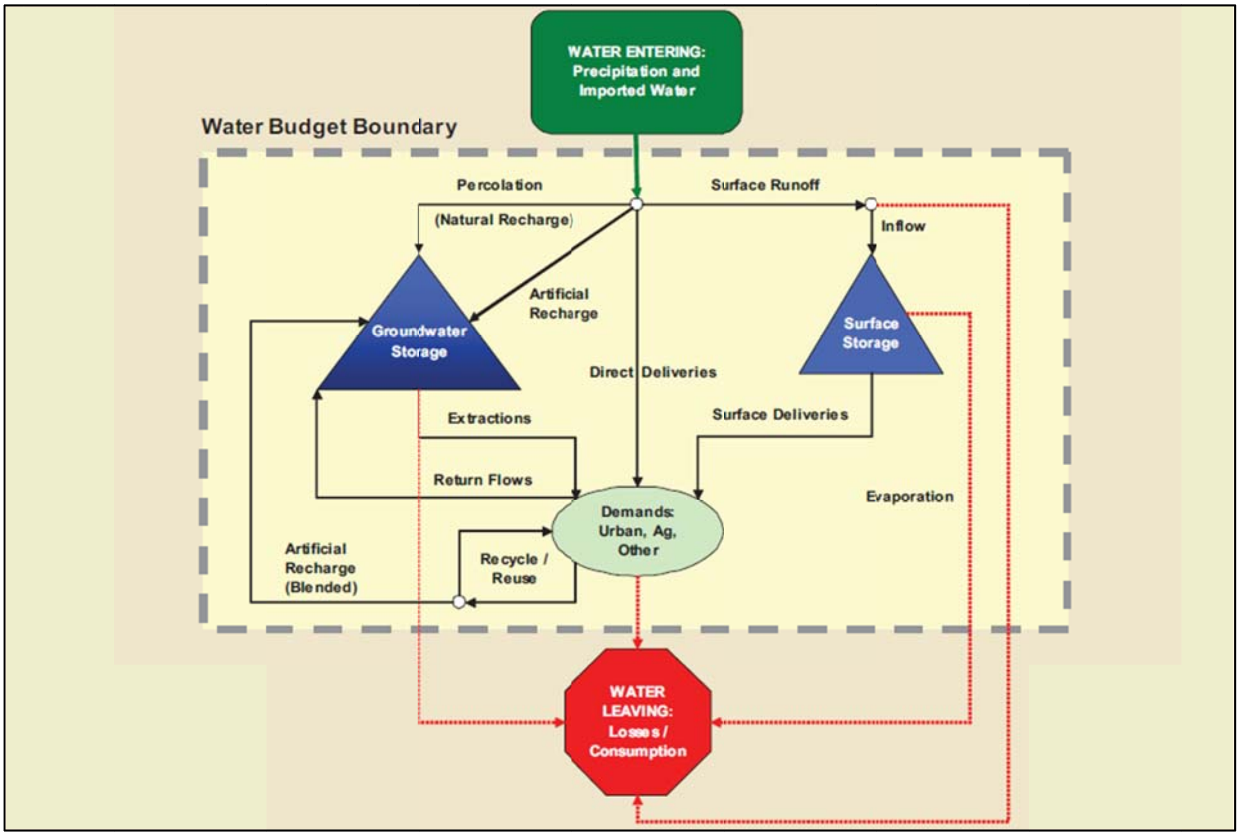
3.1.1 Water Entering

This component of the water budget includes sources of water from outside of the Antelope Valley Region entering the water budget boundary, such as precipitation and imported water.

3.1.1.1 Precipitation

As discussed in Section 2, the average annual precipitation for the Antelope Valley Region is approximately 7.5 inches per year. Precipitation entering the Antelope Valley Region is lost to evaporation (see Section 3.1.7), percolated to groundwater storage as natural recharge (see Section 3.1.6), or carried as runoff to surface storage (see Section 3.1.5).

Figure 3-1: Water Budget Schematic



Note: Some surface runoff provides water for environmental demands, including wetlands, clay pan/vernal pools, sand dune water sequestering, and dry lake bed resurfacing.

3.1.1.2 Imported Water

Imported water entering the Antelope Valley Region could come from a number of sources including the SWP, desalination, or transfers/exchanges with outside agencies. Currently, the only source of imported water to the Antelope Valley Region is SWP water. SWP water is used in the Antelope Valley Region for direct deliveries (see Section 3.1.2) or for artificial recharge to groundwater storage (see Section 3.1.6).

Imported Water Infrastructure

Imported water to the Antelope Valley Region is generally SWP water that is released from Lake Oroville into the Feather River where it then travels down the river to its convergence with the Sacramento River, the state's largest waterway. Water flows down the Sacramento River into the

Sacramento-San Joaquin Delta. From the Delta, water is pumped into the California Aqueduct. The Antelope Valley Region is served by the East Branch of the California Aqueduct. Water taken from the California Aqueduct by local SWP Contractors is then treated before distribution to customers.

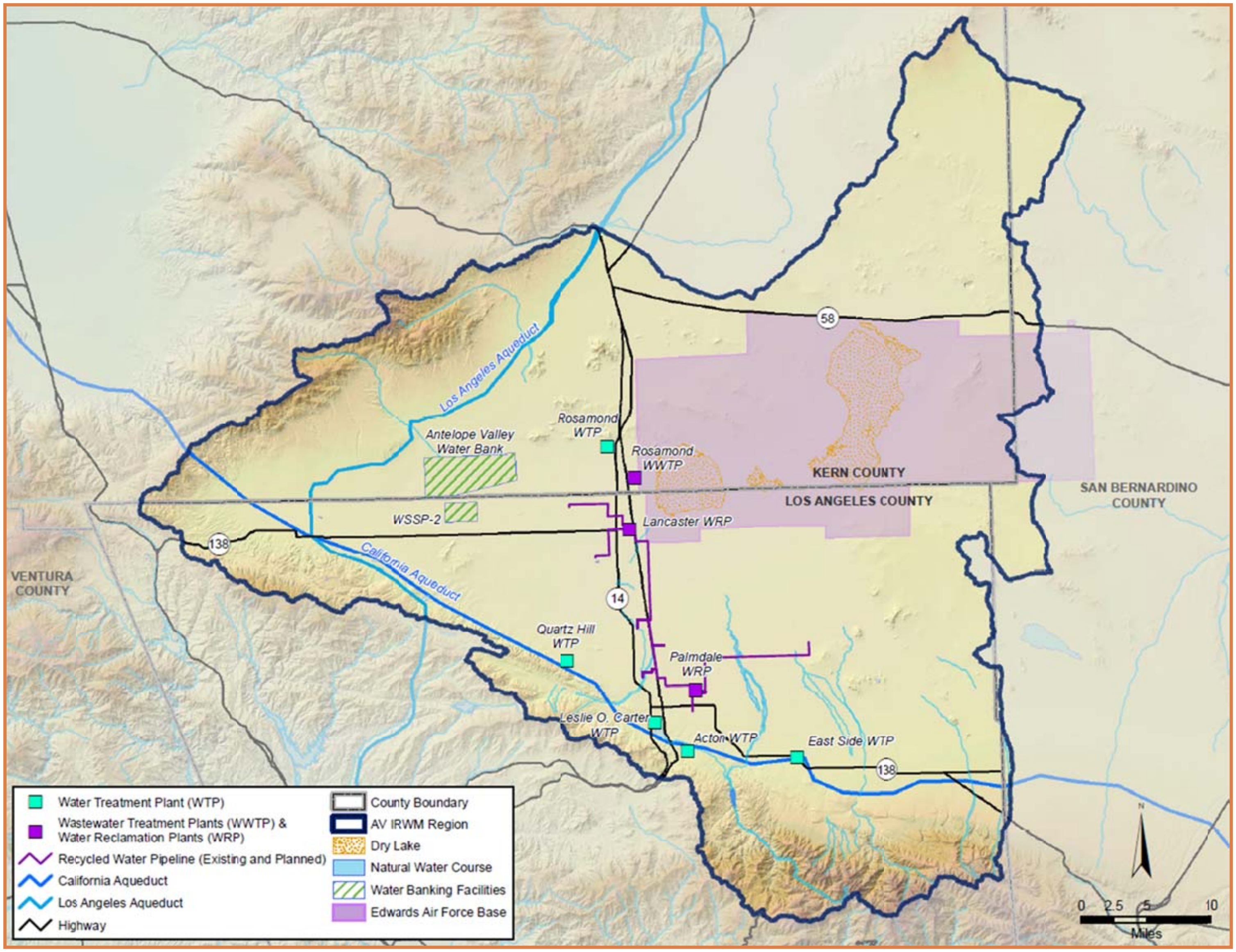
AVEK currently treats SWP water with four Water Treatment Plants (WTPs) that are capable of treating approximately 132,280 AFY of imported water. The main WTP, Quartz Hill WTP, is rated for 90 million gallons per day (mgd) (100,890 AFY). The Eastside WTP, expanded in 1988, provides a treatment capacity of 10 mgd (11,210 AFY). Rosamond WTP is a 14 mgd (15,695 AFY) capacity treatment plant. The fourth AVEK plant, Acton WTP, has a capacity of 4 mgd (4,484 AFY) and is located outside of the Antelope Valley Region boundaries. LACWD 40, QHWD, and RCSD all receive treated water from AVEK.

PWD’s water treatment plant capacity is 35 mgd (39,235 AFY), but it is limited to treating 28 mgd (31,390 AFY) in accordance with the CDPH requirements to keep one filter offline in reserve (PWD 2001). Planned improvements at the plant will increase its treated output to 35 mgd. PWD is also in the preliminary design stage for a new water treatment plant with an initial capacity of 10 mgd.

LCID has an agreement with PWD to provide treatment for LCID’s raw SWP water.

Major water-related infrastructure in the Antelope Valley Region is shown on Figure 3-2.

Figure 3-2: Major Infrastructure



Reliability

The amount of SWP supply that would be available for a given water demand is highly variable and depends on hydrologic conditions in northern California, the amount of water in SWP storage reservoirs at the beginning of the year, regulatory and operational constraints, and the total amount of water requested by contractors. The variability of SWP deliveries is described in the California DWR "Final 2011 SWP Reliability Report" (Reliability Report), the intent of which is to assist SWP contractors in assessing the reliability of the SWP component of their overall supplies.

In the Reliability Report, DWR presents the results of its analysis of the reliability of SWP supplies, based on model studies of SWP operations. In general, DWR model studies show the anticipated amount of SWP supply that would be available for a given SWP water demand, given an assumed set of physical facilities and operating constraints, based on 82 years of hydrology. The results are interpreted as the capability of the SWP to meet the assumed demand over a range of historic conditions for that assumed set of physical facilities and operating constraints. Although new facilities are planned to increase the water delivery capability of the SWP (such as delta improvements), the analyses contained in the Reliability Report assume no additional facilities. The effects of climate change were factored into the modeled future conditions.

The Reliability Report shows that existing SWP facilities will on average receive 61 percent of their full Table A Amount for current demand conditions and 60 percent of their full Table A Amount for 2031 demand conditions. This means that the SWP, using existing facilities operated under current regulatory and operational constraints, and with all contractors requesting delivery of their full Table A Amounts in most years, could deliver 60 percent of total Table A Amounts on a long-term basis. The Reliability Report also projects that SWP deliveries during multiple-year dry periods could average about 35 percent of total Table A Amounts and could possibly be as low as 9 percent during an unusually dry single year (the driest in 82 years of historical hydrology) according to DWR's 2011 modeling results. (DWR 2012b).

On August 31, 2007, a U.S. District Judge ruled that the SWP was in violation of the federal Endangered Species Act because it threatened the existence of the Delta smelt, a fish species living in the Sacramento Delta. To help protect the species, the Judge ordered water imports from the north to be cut by up to 35 percent from the SWP and the Central Valley Project, until the Biological Opinion for the species could be prepared. The U.S. Fish and Wildlife Service (USFWS) issued a Biological Opinion (BO) on the Long-Term Operational Criteria and Plan for the SWP and Central Valley Project on December 15, 2008, determining that the two water projects would likely jeopardize the continued existence of the species. The findings of this BO called for adaptively managed flow restrictions and have continued to influence pumping in the Delta despite ongoing debate and litigation. In 2009, the National Marine Fisheries Service (NMFS) issued a BO for winter-run and spring-run Chinook salmon and steelhead that put similar limits on pumping through part of the year and restrictions on total Delta exports during the months of April and May.

The SWP supply estimates in this IRWM Plan rely on the projections made in DWR's 2011 Reliability Report for future supply. DWR's projected supply estimates incorporate the restrictions set by both the USFWS and NMFS BOs, while acknowledging the challenge of accurately determining future water reliability as a result of adaptive management techniques and the potential for future changes in court rulings.

3.1.2 Direct Deliveries

Direct deliveries to the Antelope Valley Region consist of the SWP water contracted through AVEK, LCID, and PWD. The SWP is operated by DWR for the benefit of the SWP contractors. The SWP is the nation's largest state-built water and power development and conveyance system. The SWP includes 660 miles of aqueduct and conveyance facilities from Lake Oroville in the north to Lake Perris in the south. It also includes pumping and power plants, reservoirs, lakes, storage tanks, canals, tunnels, and pipelines that capture, store, and convey water to 29 water agencies.

The SWP is contracted to deliver a maximum 4.17 million AFY of Table A water to the 29 contracting agencies. Table A water is a reference to the amount of water listed in “Table A” of the contract between the SWP and the contractors and represents the maximum amount of water a contractor may request each year. AVEK, which is the third largest state water contractor, has a Table A Amount of 141,400 AFY. Approximately three (3) percent of AVEK’s Table A deliveries have historically been supplied to AVEK customers outside of the Antelope Valley IRWMP Region boundary, leaving a maximum of about 137,150 AFY available for AVEK customers inside the IRWMP Region boundary.

By October 1st of every year, each contractor provides DWR a request for water delivery up to their full Table A Amount for the next year. Actual delivery from DWR may vary from the request due to variances in supply availability resulting from hydrology, storage availability, regulatory or operating constraints. When supply is limited, water is allocated based on a percentage of full contractual Table A Amounts.

A summary of the historical deliveries of SWP to the Antelope Valley Region are provided in Table 3-1. The table illustrates the Antelope Valley Region’s increasing dependence on SWP water.

Table 3-1: Summary of Historical Wholesale (Imported) Supply (AFY) in the Antelope Valley Region

Year	AVEK Deliveries	AVEK Table A	PWD Deliveries	PWD Table A	LCID Deliveries	LCID Table A	Region Deliveries	Region Table A
1975	8,068	35,000	0	5,580	520	520	8,588	41,100
1980	72,407	69,200	0	11,180	191	1,150	72,598	81,530
1985	37,064	40,000	1,558	14,180	0	1,730	38,622	55,910
1990	47,206	132,100	8,608	17,300	1,747	2,300	57,561	151,700
1995	47,286	138,400	6,961	17,300	480	2,300	54,727	158,000
2000	83,577	138,400	9,060	21,300	0	2,300	92,637	162,000
2005	59,831	141,400	11,712	21,300	0	2,300	71,543	165,000
2010	57,713	141,400	10,969	21,300	0	2,300	68,682	165,000

Source: DWR 2012b

Future availability of the SWP water was estimated by DWR in its 2011 Reliability Report (2012b). For an average water year, it is anticipated that 61 percent of the Table A Amount in 2011 and 60 percent in year 2031 would be available for delivery to contractors. For a single dry water year, delivery of Table A water decreases to 9 percent for 2011 and 11 percent in year 2031. For a multi-dry water year, delivery of Table A water is estimated at 35 percent for 2011 and 34 percent in year 2031. For the purposes of this IRWM Plan, 2015 through 2035 deliveries were estimated at the 2031 delivery percentages. Maximum Table A water that could be available for the Region includes 137,150 AFY from AVEK (inside the IRWMP Region), 21,300 AFY from PWD, and 2,300 AFY from LCID.

In addition to SWP reliability constraints, AVEK is currently unable to beneficially apply its entire Table A amount of SWP water, even during years when the full Table A amount is available. This inability to fully use available supply is caused by the variability of demand during winter and summer and the limitations on existing infrastructure to receive, store, and deliver water to users. AVEK currently provides most of their water through direct deliveries to meet current demand (i.e., without storage). When demand is high during summer months, the aqueduct bringing water to AVEK has a conveyance capacity below the demand for water. Conversely, during the winter months, demand is much lower than aqueduct capacity. To accommodate the need to store water during the winter months for use in the dry summer months, AVEK has planned to use water banking projects to increase their ability to fully use the SWP allotment. AVEK and various partners recently completed the WSSP-2 that allows them to store up to 150,000 AF of water in the ground (as of late 2013, 35,000 AF is the total amount stored for all of the parties). Currently, the maximum withdrawal capacity in any one year is 20 mgd (approximately 23,000 AFY) and plans are underway to increase that annual withdrawal capacity to 50 mgd (approximately 56,000 AFY). Excess SWP water may be placed in the water bank during winter months when M&I demands are low (AVEK 2013).

To determine the most reasonable amount of available SWP water for AVEK, this analysis assumes that SWP reliability is limiting (i.e., not conveyance capacity). Without the WSSP-2 water bank, the conveyance capacity limitation would only allow AVEK to deliver 81,750 AFY. This estimate is based on 400 AF/day SWP deliveries from June 15 to September 30 that are limited by conveyance capacity and 150 AF/day SWP deliveries for the rest of the year that are limited by customer demands. This value is lower than 83,700 AFY, which is the value obtained by multiplying the SWP reliability factor of 61% to the available Table A amount of 137,150 AFY for AVEK customers inside the IRWMP Region. However, since these values are close (83,700 – 81,750 = 1,950), and since the WSSP-2 water bank is operational, this analysis assumes that the water bank can be used each year to supplement AVEK imported supplies in summer months to 61% of their Table A amount in 2010 and to 60% of their Table A amount in years 2015 through 2035.

Table 3-2 provides a summary of projected SWP availability to the Antelope Valley Region based on these assumptions.

Table 3-2: Summary of Projected Wholesale (Imported) Supply (AFY) in the Antelope Valley Region

	2010	2015	2020	2025	2030	2035
Maximum Table A	160,750	160,750	160,750	160,750	160,750	160,750
Average Year(a)	98,100	96,500	96,500	96,500	96,500	96,500
Reliability(b)	61%	60%	60%	60%	60%	60%
Single Dry Year(c)	14,500	17,700	17,700	17,700	17,700	17,700
Reliability(b)	9%	11%	11%	11%	11%	11%
Multi-Dry Year(c)	56,300	54,700	54,700	54,700	54,700	54,700
Reliability(b)	35%	34%	34%	34%	34%	34%

Notes: Numbers rounded to nearest 100 AFY.

(a) Assumes supply equivalent to the Antelope Valley Region's maximum Table A Amount (160,750 AFY) multiplied by the SWP reliability. This assumption relies on another assumption that conveyance constraints can be overcome by using the WSSP-2 water bank to supplement small amounts of water during an average year up to Table A amounts.

(b) Determined from DWR's Final 2011 "State Water Project Reliability Report" (DWR 2012b).

(c) Assumes supply equivalent to the Antelope Valley Region's maximum Table A Amount (160,750 AFY) multiplied by the SWP reliability. This assumption relies on another assumption that conveyance constraints can be overcome by using the WSSP-2 water bank to supplement small amounts of water during single dry year and multi-dry year periods.

3.1.3 Water Demands

The following subsection discusses the historical, current and projected water demands for the Antelope Valley Region. The demands are presented with urban demand (based on per capita estimates) and two agricultural scenarios (average and dry year estimates). Rainfall in the Region during average years typically reduces agricultural demands on imported supplies, therefore dry year agricultural demands are higher than average years. Projected water demands for the Antelope Valley Region are presented in Table 3-3 and graphically presented in Figure 3-3 and Figure 3-4. Later in this Section, water budgets are developed for the Region that compare average water years, dry water years, and multi-dry water years.

Table 3-3: Water Demand Projections (AF) for the Antelope Valley Region

	2010	2015	2020	2025	2030	2035
Urban Demand						
Boron	400	400	400	1,000	1,000	1,000
California City[(a)]	0	0	0	0	0	0
Edwards AFB	1,000	1,000	1,000	1,000	1,000	1,000
Mojave	1,000	1,000	1,000	1,000	1,000	1,000
North Edwards	200	200	200	200	200	200
Rosamond	4,000	4,000	4,000	5,000	5,000	5,000
Unincorporated Kern County	1,000	1,000	1,000	1,000	1,000	1,000
Lake Los Angeles	3,000	3,000	3,000	3,000	3,000	4,000
Lancaster	33,000	36,000	39,000	41,000	43,000	45,000
Littlerock	200	200	200	200	200	200
Palmdale	33,000	36,000	40,000	42,000	44,000	46,000
Quartz Hill	2,000	3,000	3,000	3,000	3,000	3,000
Sun Village	3,000	3,000	3,000	3,000	3,000	4,000
Unincorporated LA County	6,000	6,000	6,000	7,000	7,000	8,000
Total Urban Demand	87,000	95,000	103,000	108,000	113,000	118,000
Agricultural Demand						
Agricultural Demand Average Year	92,000	92,000	92,000	92,000	92,000	92,000
Agricultural Demand Dry Year	98,000	98,000	98,000	98,000	98,000	98,000
Total Region Average Year Demand	**179,000**	**187,000**	**195,000**	**200,000**	**205,000**	**210,000**
Total Region Dry Year Demand	**185,000**	**193,000**	**201,000**	**206,000**	**211,000**	**216,000**

Notes: All numbers rounded to nearest 1,000 AF (values below 500 AF were rounded to the nearest 100).
(a) California City has a population center outside the Region and only minimal population inside the Region.

Figure 3-3: Regional Average Year Water Demand

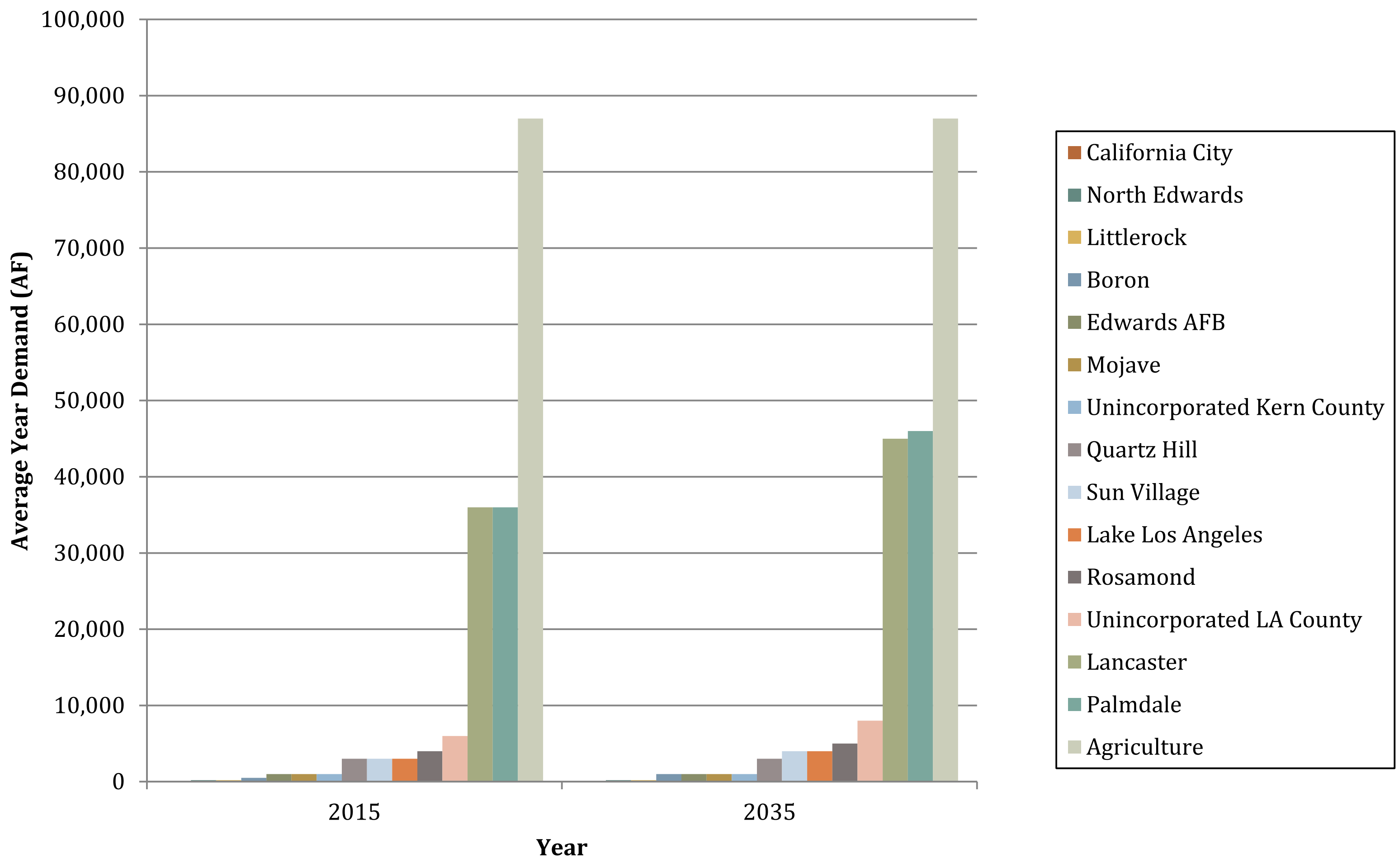
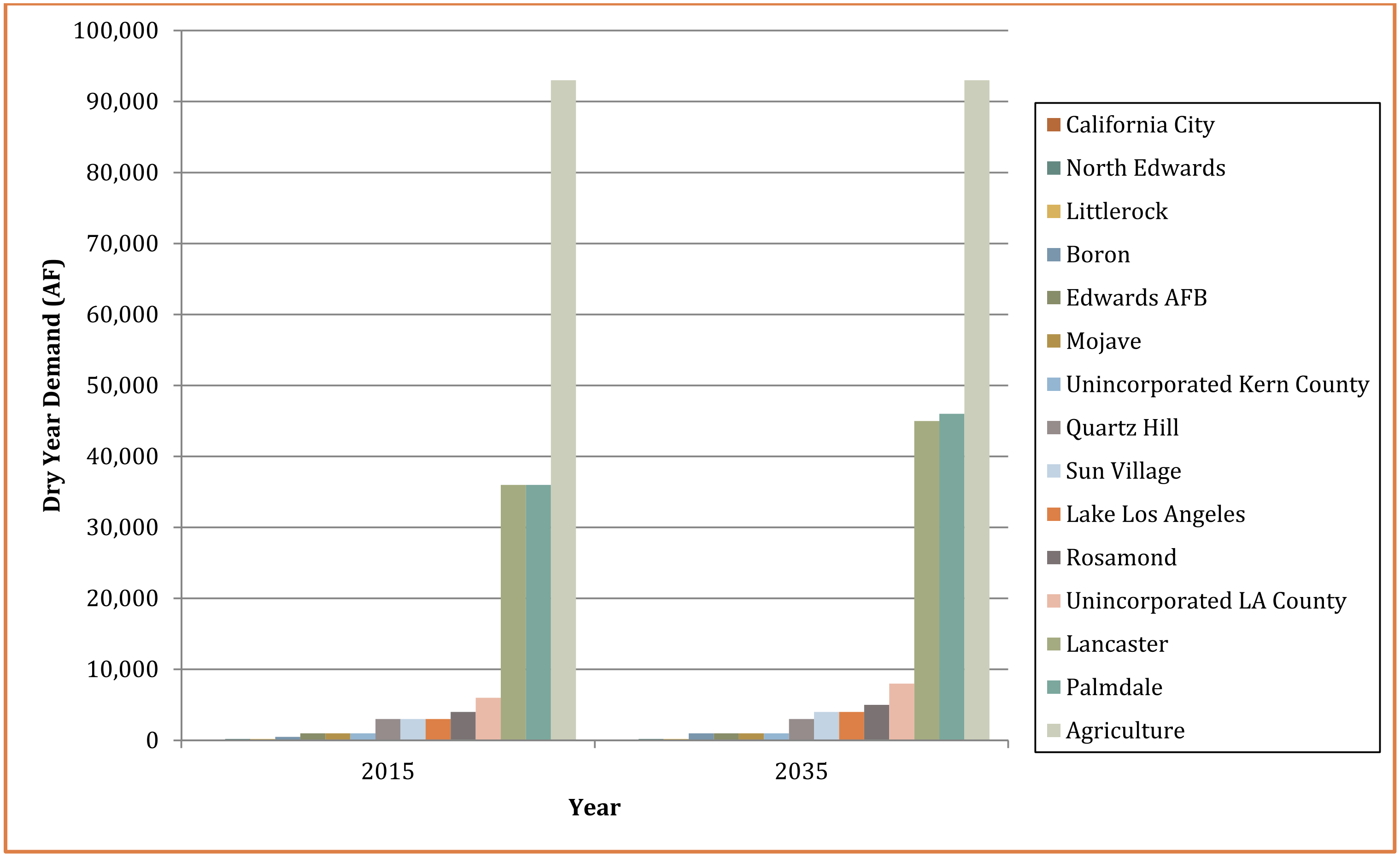


Figure 3-4: Regional Dry Year Water Demand



3.1.3.1 Urban (Municipal and Industrial) Demand

Urban water demands for 2010 were developed from the population projections presented in Table 2-3 (in Section 2) and utilize a regional water use per capita estimate of 199 gallons per day (gpd) per person (or 0.223 AFY per person). This per capita water use estimate was determined using a weighted average of total per capita water use estimates for the major water supply agencies in the Antelope Valley Region as shown in Table 3-4. As discussed in Section 2, growth rates within an agency are consistent and thus an average per capita water use is an appropriate estimate of demand. The rates of water use in areas that receive water from sources other than those included in Table 3-4 were assumed to have minimal impact on the average per capita rate and therefore were not included in the calculations to determine the average for the Region.

The per capita water use values could be reduced in the future with the implementation of more robust demand management measures. With the implementation of Senate Bill x7-7 in 2009, water suppliers have been required to reduce their average per capita daily water use rate by 20 percent from a baseline value by December 31, 2020. Each water purveyor may calculate their baseline per capita water use rate a number of ways. Whether an agency meets targets or not, they are required to design and implement water conservation programs to further reduce per capita consumption. With the implementation of these programs, it is expected that the average per capita water use in the Region will decrease. Once the next round of Urban Water Management Plans (UWMPs) are developed in 2015, the Region will have a better understanding of at the progress made on reducing per capita water demand.

Table 3-4: Per Capita Urban Water Use in the Antelope Valley Region

	2010 Population	2010 Urban Water Demand (AF)	Average per Capita Water Use (AFY/person)
AVEK (excluding purveyors)[(a)]	84,000	15,000	0.181
LCID[(b)]	3,000	1000	0.310
LACWD 40[(c)]	172,000	46,000	0.265
PWD[(d)]	109,000	20,000	0.181
QHWD[(d)]	18,000	6,000	0.314
RCSD[(d)]	18,000	3,000	0.170
Total	**403,000**	**90,000**	
Regional Average Per Capita Water Use (AFY/person)			**0.223**

Notes: All numbers rounded to the nearest 1,000. Numbers do not include private well owners. It is assumed that the demand and population numbers reported in the UWMPs provide an approximate per capita estimate for the Region.
(a) As determined from data in the AVEK's 2010 UWMP. Values exclude population and demand numbers for LCID, LACWD 40, PWD, QHWD, and RCSD that fall inside the AVEK service area.
(b) Values exclude LCID agricultural demand. Demand verified by personal communication with Brad Bones at LCID on August 21, 2013. Population sizes from the Annual CDPH Drinking Water Program Report.
(c) Population size from the Annual CDPH Drinking Water Program Report. Water demand based values from the Antelope Valley 2010 Integrated UWMP, based on land use.
(d) Based on values provided in the 2010 UWMPs and 2009 actual water use.
(e) Antelope Valley Region per capita water use was determined by dividing total water demand by total population. These numbers do not include private well owners.

3.1.3.2 Private Pumping/Small Mutual Water Demand

Water demands from private pumping and from small mutual water companies in the Antelope Valley Region are difficult to quantify as accurate data is not readily available. These demands were accounted for in Table 3-3 since people served by private wells and by small mutual water companies were included in the population projections. The Antelope Valley Region average per capita water use that was estimated in Table 3-4 was assumed to represent these populations.

3.1.3.3 Agricultural Water Demand

Historical total applied agricultural water demand (1999 to 2012) for the Antelope Valley Region is summarized in Table 3-5. Historical agricultural demand was determined by multiplying estimated crop water requirements from the County Farm Advisors by the crop acreages provided by the Los Angeles and Kern County Agricultural Commissioners' Inspection Reports. The crop water requirements are discussed in more detail below.

Prior to 2000, an accounting of the agricultural acreage within the Kern County portion of the Antelope Valley Region was not available. For the 2007 IRWMP, it had been assumed that Kern County agricultural groundwater demand was 18 percent of Los Angeles County agricultural groundwater demand. The 18 percent was determined by the USGS in 2003 from land use maps and agricultural pumpage data for Los Angeles County in 1961 and 1987. For the 2013 IRWMP Update, recent data from the Kern County Farm Bureau were used in the calculations in lieu of the 18 percent estimate.

Table 3-5: Historical Agricultural Water Use in the Antelope Valley Region

Year	Los Angeles County Ag Demand (AF)	Kern County Ag Demand (AF)	Total Ag Demand (AF)
1999	97,000	35,000	132,000
2000	109,000	36,000	145,000
2001	101,000	37,000	138,000
2002	105,000	39,000	144,000
2003	110,000	34,000	144,000
2004	104,000	27,000	131,000
2005	98,000	29,000	127,000

Note: Numbers rounded to the nearest 1,000 AF and assume average water year crop requirements.

Crop Water Requirements

Crop water use in the Antelope Valley Region can vary significantly from State-wide averages due to the unique requirements presented by the Antelope Valley Region's climate and physical characteristics, including low rainfall, sandy soils, and heavy winds. Thus, it is appropriate to develop crop water requirements specific to the Antelope Valley Region.

The first step in determining the crop water requirements involves determining the evapotranspiration for each crop (ETc) using the following equation:

$$ETc = Kc * ETo$$

Where Kc is the crop coefficient and ETo is the reference evapotranspiration.

An estimate of the ETo for Lancaster was developed based on data from the California Irrigation Management Information System (CIMIS) weather station in Palmdale, CA and historical water use ETo values for Palmdale. The Kc varies with the crop, its stage of development, and the frequency of irrigation; but it is independent of the location. Crop coefficients were adapted from a variety of published reports. The crop coefficients are presented in Table 3-6.

Table 3-6: Crop Coefficient (Kc) Estimates

Date	Pasture	Alfalfa[(a)]	Sudan[(b)]	Sod	Onions	Deciduous Fruit Trees[(c)]	Carrots	Potatoes
1-Jan	1.0	0.40		1.0				
15-Jan	1.0	0.40		1.0				
1-Feb	1.0	1.00		1.0			0.31	
15-Feb	1.0	1.15		1.0			0.31	
1-Mar	1.0	1.15		1.0	0.30	0.25	0.31	0.55
15-Mar	1.0	1.05		1.0	0.30	0.54	0.55	0.61
1-Apr	1.0	1.05		1.0	0.30	0.60	0.82	0.88
15-Apr	1.0	1.05		1.0	0.53	0.66	1.03	1.16
1-May	1.0	1.05		1.0	0.83	0.72	1.11	1.21
15-May	1.0	1.05		1.0	1.14	0.79	1.13	1.19
1-Jun	1.0	1.05		1.0	1.14	0.84	1.05	0.87
15-Jun	1.0	1.05	0.3	1.0	1.14	0.86	1.00	0.55
1-Jul	1.0	1.05	0.85	1.0	1.04	0.92		
15-Jul	1.0	1.05	1.10	1.0	0.92	0.94		
1-Aug	1.0	1.05	0.85	1.0	0.80	0.94		
15-Aug	1.0	1.05	1.10	1.0	0.68	0.94		
1-Sep	1.0	1.05	0.85	1.0		0.94		
15-Sep	1.0	1.05	1.00	1.0		0.91		
1-Oct	1.0	1.05	1.10	1.0		0.85		
15-Oct	1.0	1.05	1.10	1.0		0.79		
1-Nov	1.0	1.05		1.0		0.70		
15-Nov	1.0	0.40		1.0				
1-Dec	1.0	0.40		1.0				
15-Dec	1.0	0.40		1.0				

Sources: Hansen, B.R.; Shwannkl, L.; and Fulton, A. "Scheduling Irrigation: When and How much Water to Apply," Water Management Series Publication Number 3396, Department of Land, Air & Water Resources, University of California, Davis. Pruitt, W.O.; Fereres, E.; Kelta, K.; and Snyder, R.L., "Reference Evapotranspiration (ETo) for California," UC Bull. 1922.
Notes:
(a) Kc of 1.05 takes into account reduced ETo during the cuttings throughout the season.
(b) Sudan was cut on 7/1, 8/16, and 10/16. ETo reduced for 1 to 2 weeks after cutting.
(c) Deciduous Fruit Tree Crop Coefficient were adapted from Orloff, S.B., "Deciduous Orchard Water Use: Clean Cultivated Trees for a Normal Year in Littlerock," Local Extension Publication.

Table 3-7 provides the ETc estimates for the Antelope Valley Region. The ETc is an estimate of the net water requirements for a crop (i.e., the amount of water) that is required for proper plant growth. Additionally, there are net water requirements for the crop which occur outside of the growing season. These include water applied to prepare the soil for planting, fumigation, and to prevent wind erosion. The sum of the ETc and these non-growing water requirements consist of the overall net crop requirement. The net water requirement does not account for water losses from inefficient irrigation systems, deep percolation, or runoff. In order to determine the gross water requirement, or the total amount of water which must be applied to the crop, the following calculation is used:

Gross Water Requirement = Net Water Requirement/Irrigation System Efficiency

Table 3-7: Crop Evapotranspiration (ETc) Estimates for the Antelope Valley Region

Date	Pasture/Sod ETo[(a)]	Alfalfa	Sudan	Sod	Onions	Deciduous Fruit Trees	Carrots	Potatoes
1-Jan	0.84	0.34	0.00	0.84	0.00	0.00	0.00	0.00
15-Jan	0.98	0.39	0.00	0.98	0.00	0.00	0.00	0.00
1-Feb	1.24	1.24	0.00	1.24	0.00	0.00	0.38	0.00
15-Feb	1.65	1.90	0.00	1.65	0.00	0.00	0.51	0.00
1-Mar	2.21	2.54	0.00	2.21	0.66	0.55	0.69	1.22
15-Mar	2.86	3.00	0.00	2.86	0.86	1.54	1.57	1.74
1-Apr	3.10	3.26	0.00	3.10	0.93	1.86	2.54	2.73
15-Apr	3.35	3.52	0.00	3.35	1.78	2.21	3.45	3.89
1-May	3.56	3.74	0.00	3.56	2.95	2.56	3.95	4.31
15-May	4.23	4.44	0.00	4.23	4.82	3.34	4.78	5.03
1-Jun	4.42	4.64	0.00	4.42	5.04	3.71	4.64	3.85
15-Jun	4.63	4.86	1.39	4.63	5.28	3.98	4.63	2.55
1-Jul	4.69	4.92	3.99	4.69	4.88	4.31	0.00	0.00
15-Jul	4.89	5.13	5.38	4.89	4.50	4.60	0.00	0.00
1-Aug	4.30	4.52	3.66	4.30	3.44	4.04	0.00	0.00
15-Aug	4.00	4.20	4.40	4.00	2.72	3.76	0.00	0.00
1-Sep	3.21	3.37	2.73	3.21	0.00	3.02	0.00	0.00
15-Sep	2.68	2.81	2.68	2.68	0.00	2.44	0.00	0.00
1-Oct	2.21	2.32	2.43	2.21	0.00	1.88	0.00	0.00
15-Oct	1.83	1.92	2.01	1.83	0.00	1.45	0.00	0.00
1-Nov	1.43	1.50	0.00	1.43	0.00	1.00	0.00	0.00
15-Nov	1.10	0.44	0.00	1.10	0.00	0.00	0.00	0.00
1-Dec	0.98	0.39	0.00	0.98	0.00	0.00	0.00	0.00
15-Dec	0.90	0.36	0.00	0.90	0.00	0.00	0.00	0.00
TOTAL (inches)	65.29	65.76	28.66	65.29	37.86	46.26	27.15	25.31

Note:
(a) Pasture ETo from the California Irrigation Management Information System (CIMIS), Palmdale Station 197 from January to December 2012.

The irrigation system efficiency used in this study, 75 percent, was developed from field observations by the University of California researchers and the Natural Resources Conservation Service (NRCS). Irrigation efficiency is the ratio of irrigation water used in evapotranspiration to the water applied or delivered to a field or farm. Greater controls are utilized by agricultural operations that use recycled water that justify higher irrigation efficiencies (discussed later in this document).

A summary of the crop water requirements is presented in Table 3-8. The crop water requirements for a single dry year and multi-dry years are the same. It is assumed that approximately 3 inches of net water demand would be met by rainfall for average water years and thus average year water requirements include a reduction in the total net water requirements.

Table 3-8: Crop Water Requirements for the Antelope Valley Region

Water Requirements	Pasture	Alfalfa	Sudan	Sod	Onions	Deciduous Fruit Trees	Carrots	Potatoes
Net ETo	65.29	65.76	28.66	65.29	37.86	46.26	27.15	25.31
Net Soil					3.54		4.46	
Net Non-Growing	0	2.00[a]	4	4	6.00[b]	0	6.50[b]	4
Total Net Dry Years (in.)	65.29	67.76	32.66	69.29	47.40	46.26	38.11	29.31
Total Net Average Years[c] (in.)	62.29	64.76	29.66	66.29	44.40	43.26	35.11	26.31
Irrigation Efficiency (%)	75	75	75	75	75	75	75	75
Total Gross for Dry Years (in.)	87.05	90.34	43.55	92.39	63.20	61.68	50.81	39.08
Total Gross for Dry Years (AF/acre)	7.25	7.53	3.63	7.70	5.27	5.14	4.23	3.26
Total Gross for Avg. Years (in.)	83.05	86.34	39.55	88.39	59.20	57.68	46.81	35.08
Total Gross for Average Years (AF/acre)	6.92	7.20	3.30	7.37	4.93	4.81	3.90	2.92

Notes:
(a) Assumes a 5-year life of an alfalfa stand. Includes the water requirement for pre-irrigation before field preparation and planning, and irrigation before and after application of herbicides.
(b) Includes water requirements for pre-irrigation before field preparation, fumigation, and "water capping" after fumigation.
(c) It is assumed that approximately 3 inches of net water demand would be met by rainfall for average water years and thus average year water requirements include a reduction in the total net water requirements.

Crop Acreages

Data regarding crop acreages in the Antelope Valley Region was available from the Los Angeles County and Kern County Commissioner Crop Reports. Table 3-9 provides a comparison of historical crop acreages in the Antelope Valley Region.

Table 3-9: Comparison of the Historical Crop Acreages

	1999	2000	2001	2002	2003	2004	2005	2010
Ag Commissioner[a]								
Field Crops	NA	NA	11,592	11,234	11,305	10,624	11,975	13,080
Vegetable/Root Crops	NA	NA	12,282	15,804	14,763	13,312	10,760	4,906
Fruits/Nut/Grapes Crops	NA	NA	2,866	1,947	1,955	1,920	2,117	603
Misc Nursery	NA	NA	621	617	599	608	675	450
Antelope Valley Region Total	**---**	**---**	**27,361**	**29,602**	**28,622**	**26,464**	**25,526**	**19,040**

Notes:
(a) Acreages for Kern County were estimated using the ratios of LA County Ag to Kern County Ag from the Inspection Reports (from 2007 IRWMP).

Projected Agricultural Demand

Projected water year agricultural demand is summarized in Table 3-10. Projections assume that crop acreages will remain approximately the same as in 2012 with the understanding that some shifting of acreages between crops may occur. Table 3-10 provides the estimates of agricultural water use for average and dry water years.

Table 3-10: Agricultural Water Use in the Antelope Valley Region

		Average Water Year		Dry Water Years	
Crop	**Acreage[(a)]**	**Gross Crop Water Requirements (AF/acre)[(b)]**	**Gross Water Demand (AFY)[(c)]**	**Gross Crop Water Requirements (AF/acre)[(b)]**	**Gross Water Demand (AFY)[(c)]**
Field Crops					
Alfalfa Hay	5,370	7.20	38,700	7.53	40,400
Grain Hay	7,160	3.30	23,600	3.63	26,000
Sudan Hay	300	3.30	1,000	3.63	1,100
Irrigated Pasture	250	6.92	1,700	7.25	1,800
Other Crops					
Onions	1,142	4.93	5,600	5.27	6,000
Fruits/Nuts/Grapes	603	4.81	2,900	5.14	3,100
Root Crops	3,764	3.90	14,700	4.23	15,900
Misc. Nursery (mostly sod)	450	7.37	3,300	7.70	3,500
Total Projected Ag Demand (AFY)	**19,000**		**92,000**		**98,000**

Notes: Totals rounded to the nearest 1,000 AF.
(a) Data from Los Angeles and Kern County Commissioner Reports. Acreage does not include land cultivated for recycled water purposes.
(b) From Farm Advisor gross crop water requirements specific to Antelope Valley Region.
(c) Acreage multiplied by crop water requirements.

3.1.4 Recycle/Reuse

3.1.4.1 Recycled Water Sources

Recycled water in the Antelope Valley is available from three primary sources: (1) the Lancaster WRP, (2) the Palmdale WRP, and (3) the Rosamond Wastewater Treatment Plant (WWTP). All three plants treat wastewater to a tertiary level. Since the RWMG prioritized the need to maximize beneficial use of water supplies within the Antelope Valley Region, proposed recycled water users served by these WRPs have been included below for discussion purposes, but only existing recycled water users are included in the Water Budget estimates for this Plan. Significant investments have been made to expand and upgrade the treatment plants to develop these recycled water supplies. Figure 3-5 shows the locations of the facilities and proposed infrastructure necessary to provide the recycled water quantities shown in Table 3-11.

EAFB has two treatment plants that distribute recycled water to the base. These include the EAFB Air Force Research Laboratory Treatment Plant which is a secondary wastewater treatment plant that discharges all its effluent to the evaporation ponds at the base.

The second plant is the EAFB Main Base WWTP which produces tertiary treated effluent for landscape irrigation at the base golf course with excess effluent discharged to the evaporation ponds when irrigation demand is low. Recycled water from these plants is not included in supply and demand calculations since all water is used on the base.

Table 3-11 provides a summary of the projected availability of the recycled water to the Antelope Valley Region through 2035.

Table 3-11: Potential Availability of Recycled Water (AFY) to the Antelope Valley Region

	2012	2015	2020	2025	2030	2035
Lancaster WRP[(a)(b)]	10,000	11,000	13,000	14,000	16,000	17,000
Palmdale WRP[(a)]	10,000	11,000	12,000	12,000	13,000	13,000
Rosamond WWTP[(c)]	---	1,000	1,000	1,000	1,000	1,000
Total Study Area	20,000	23,000	26,000	27,000	30,000	31,000

Notes: Totals rounded to the nearest 1,000 AF.
(a) Source: LACSD communication in December 2013.
(b) LWRP water availability excludes water used for environmental maintenance.
(c) Source: Rosamond 2010 UWMP, Table 6-3.

Recycled Water Infrastructure

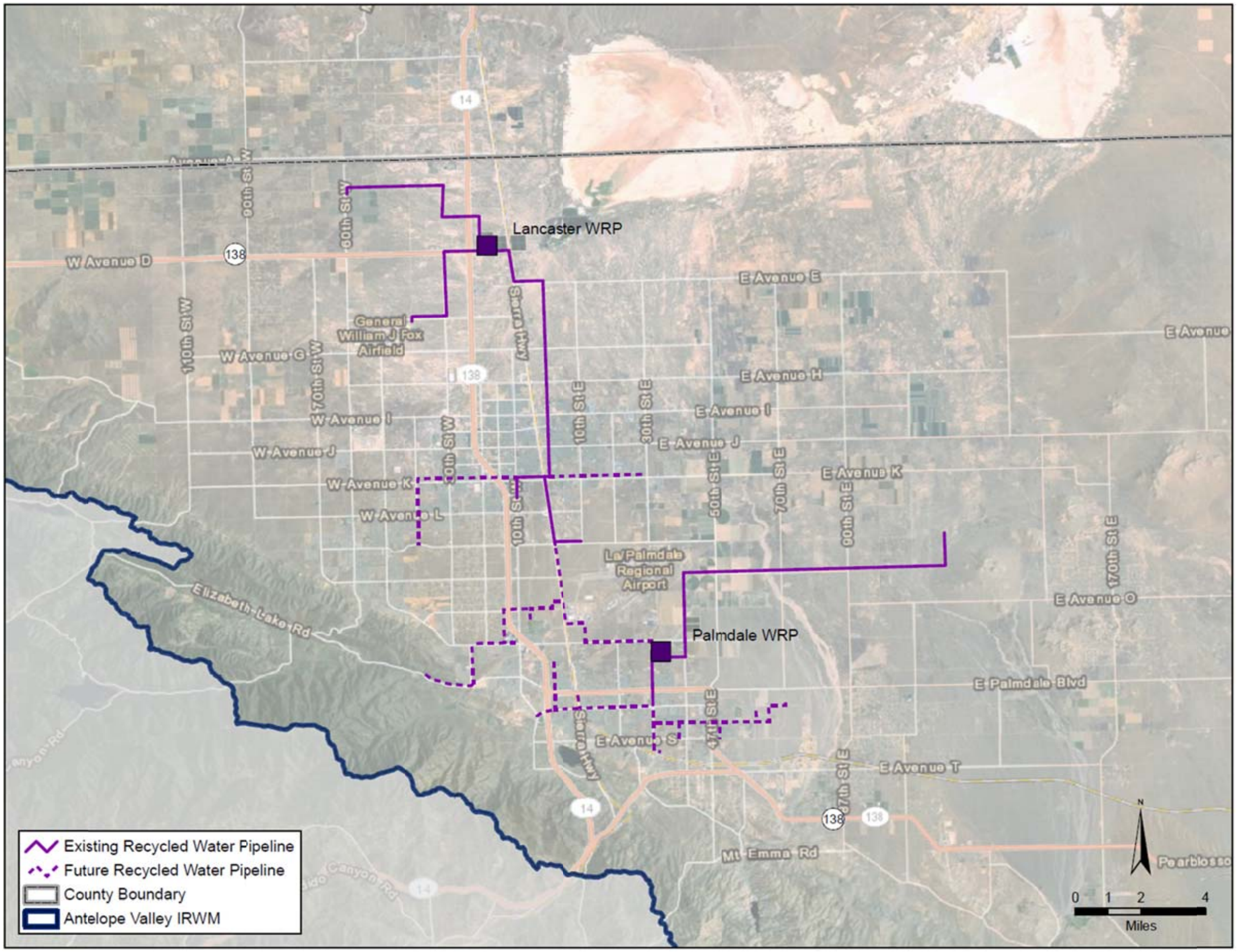
Distribution Pipeline: As shown in Figure 3-5, the recycled water distribution system in Lancaster, which serves sites such as Apollo Lakes, has been expanded for urban reuse as part of the Division Street Corridor Project. Figure 3-5 also shows the LACWD 40 Recycled Water Backbone distribution pipeline which is intended to further expand urban reuse in the Antelope Valley Region. This expansion throughout the Antelope Valley Region is a direct result of the substantial coordination and cooperation between Kern and Los Angeles Counties.

Lancaster WRP: The Lancaster WRP, built in 1959 and located north of the City of Lancaster, is owned, operated, and maintained by Los Angeles County Sanitation District No. 14. The Lancaster WRP, which has a permitted capacity of 18.0 mgd, treated an average flow of 14.1 mgd in 2012 to tertiary standards for agricultural and landscape irrigation, municipal and industrial (M&I) reuse, wildlife habitat, maintenance, and recreation. Recycled water produced at the Lancaster WRP and accounted for in the environmental maintenance and recreation reuse at Apollo Community Regional Park and Piute Ponds is not included in the potential availability (Table 3-11), since these flows will not likely be available for other M&I use in the Region.

Palmdale WRP: The Palmdale WRP, built in 1953 and located on two sites adjacent to the City of Palmdale, is owned, operated, and maintained by LACSD 20. Palmdale WRP, which has a permitted capacity of 12.0 mgd. The plant treated an average flow of 9.04 mgd in 2012 to tertiary standards. All tertiary treated water is used for agricultural and M&I reuse.

Rosamond WWTP: The Rosamond WWTP, located in the City of Rosamond, is owned, operated, and maintained by the RCSD. Rosamond WWTP, currently has a permitted capacity of 2.0 mgd. RCSD has recently increased the capacity to 2.5 mgd. The expansion will help supplement the existing tertiary treatment and disposal facility. The expanded plant is expected to be permitted in the fall of 2013 at which time it will be fully operational. The tertiary treated recycled water will be provided for landscape irrigation at median strips, parks, schools, senior complexes and new home developments.

Figure 3-5: Proposed Recycled Water Infrastructure



Reliability

Recycled water is assumed to be 100 percent reliable since it is based on a consistent water supply and is not expected to change for average, single-dry, or multi-dry year water conditions. Use of recycled water as a supply is limited more by recycled water infrastructure and demand for recycled water than reliability of such water as a supply.

3.1.4.2 Recycled Water Demand

Table 3-12 summarizes the existing and projected recycled water demand as listed in the 2014 SNMP for the Antelope Valley (Appendix G). While expanded recycled water use in the Antelope Valley Region is highly likely, only current recycled water uses are included in this IRWM Plan's supply and demand calculations to show the need for increased end use of recycled water supply. Recycled water used for environmental and recreational area maintenance at Piute Ponds and Apollo Community Regional Park is not included in demands since it was excluded from the recycled water availability in Table 3-11. Current M&I recycled water use for both the Lancaster and Palmdale WRPs is approximately 82 AFY. Approximately 3 AFY was used in 2010.

Current demands for recycled water include those for the North LA/Kern County Regional Recycled Water Project. To date, only a portion of the recycled water backbone project has been built. The Division Street Corridor uses an average of 2 AFY (personal communication with Aracely Jaramillo, LACWD 40) with approximately 3 AFY used in 2010. The Palmdale Regional Recycled Water Authority's water line to McAdam Park in Palmdale uses about 80 AFY (personal communication with Gordon Phair, City of Palmdale), but the Palmdale water line was not built until after 2010.

Although there is the potential to provide 31,000 AFY of recycled water, this is not an accurate estimate of future recycled water supply since distributions systems and end users are required to make use of that supply. Thus, while Table 3-12 provides the anticipated future recycled water demand to be served by the backbone system, those supplies not currently in use are not included in the Plan's supply and demand calculations.

Other future users of recycled water in the Region include the eSolar Power Plant and the Palmdale Hybrid Power Plant. Recycled water demand estimates for these projects are included in Table 3-12. The eSolar Sierra Sun Tower Power Plant is a solar thermal pilot project in the City of Lancaster that would potentially convert to using recycled water instead of potable water in the future. The Palmdale Hybrid Power Plant Project involves the construction of a 570 mega-watt (MW) natural gas and solar thermal electricity generating facility that would use recycled water for its cooling water demands. It should be noted that both the Palmdale Hybrid Power Plant and the eSolar Power Plant constitute new uses of water, meaning that supplying these facilities with recycled water would not offset potable water that is currently being used.

Table 3-12: Summary of Current and Projected Recycled Water Use Demands (AFY) in the Antelope Valley Region

	2010	2015	2020	2025	2030	2035
North LA/Kern County Regional Recycled Water Project	3	7,121	8,673	10,225	11,777	13,330
RCSD WTP Recycled Water Use	---	---	100	100	100	100
eSolar Power Plant	---	80	80	80	80	80
Palmdale Hybrid Power Plant	---	3,400	3,400	3,400	3,400	3,400
PWD Groundwater Recharge Project	---	---	---	---	5,000	5,000
Total Recycled Water Demand	**3**	**10,601**	**12,253**	**13,805**	**20,357**	**21,910**

Note: Demands do not include recycled water use for environmental maintenance.
Source: Draft Salt and Nutrient Management Plan for the Antelope Valley, Table 3-5 (portion). AFY values for the PWD Groundwater Recharge Project are adjusted for recent information obtained during IRWM project solicitation.

3.1.5 Surface Storage

3.1.5.1 Runoff

Surface water supplies in the Antelope Valley Region generally consist of runoff from Littlerock and Santiago Canyons in the Angeles National Forest that is intercepted by the Littlerock Dam and Reservoir. Littlerock Reservoir is co-owned by PWD and LCID. PWD and LCID jointly have long-standing water rights to 5,500 AFY from Littlerock Creek flows. Raw water is conveyed to Lake Palmdale for treatment and use via the Palmdale Ditch.

PWD is currently undergoing actions to increase the yield at Littlerock Reservoir. PWD's Littlerock Creek Sediment Removal Project proposes to restore the reservoir capacity to 3,325 AF through the removal of 900,000 cubic yards of sediment from behind the dam.

3.1.5.2 Surface Deliveries

LCID is currently able to purchase 1,000 AFY, or 25 percent yield from the reservoir from PWD, whichever is less (PWD 2001). This amount is effective until the 1992 reservoir rehabilitation agreement between PWD and LCID ends in 2042. When the 50-year term of the agreement expires, LCID regains its water rights according to the 1922 agreement between PWD and LCID. The 1922 agreement states that LCID has the exclusive right to the first 13 cubic feet per second (cfs) measured at the point of inflow to the reservoir. Flows greater than 13 cfs will be shared by PWD and LCID, with 75 percent to PWD and 25 percent to LCID. In addition, each district is allotted 50 percent of the Littlerock Reservoir storage capacity (PWD 2001). Currently, water from Littlerock Reservoir is only used for M&I uses.

Table 3-13 provides a summary of the historical surface deliveries from Littlerock Reservoir.

Table 3-13: Historical Surface Deliveries from Littlerock Reservoir (AFY)

Year	PWD Diversions	LCID Diversions	Total Diversions
1975[(a)]	1,586	1,513	3,099
1980[(a)]	913	1,950	2,863
1985[(a)]	1,460	1,375	2,835
1990[(a)]	110	200	310
1995[(a)]	3,771	0	3,771
2000[(a)]	6,500	0	6,500
2005[(a)]	6,900	0	6,900
2010[(b)]	1,861	0	1,861

Notes:
(a) PWD 2001.
(b) PWD 2010 UWMP.

Surface Water Infrastructure

The surface water storage facilities in the Antelope Valley Region include Littlerock Reservoir and Lake Palmdale. Littlerock Reservoir has an average seasonal inflow of approximately 3,500 AFY but an estimated storage capacity of only 2,765 AF due to sediment accumulation behind the dam.

Littlerock Reservoir discharges into Lake Palmdale, which has a capacity of approximately 4,250 AF. Lake Palmdale stores both surface water runoff and SWP imported water until the water is conveyed from the lake through a 42-inch pipeline to PWD's water treatment plant.

Reliability

In the PWD 2010 UWMP, historical data were used to determine how the reliability of the Littlerock Dam and Reservoir surface water supplies would be affected for average, single-dry, and multi-dry water years. PWD expects to use 4,000 AFY of its diversion rights in average, dry, and multi-dry water years. This was calculated as 50% of the average available yield from the Reservoir of 8,000 AF.

According to the PWD 2001 Water Master Plan, a reliability analysis was performed for the reservoir yield using actual hydrology from 1949 to 1999, obtained from the Los Angeles County Department of Public Works (LACDPW). This analysis estimated surface water ranging from a minimum of 1,178 to a maximum of 15,900 AFY (PWD 2001).

3.1.5.3 Evaporative/Conveyance Losses

There is an estimated conveyance loss of 9 percent for surface water deliveries (PWD 2001). This reduces the expected average annual yield to approximately 6,920 AFY. Additionally, there are evaporative losses at the reservoir site. In the PWD 2001 Water Master Plan, evaporative loss was estimated using monthly data for the Antelope Valley Region and reservoir area-capacity curve. Evaporative losses were incorporated into the expected annual surface deliveries and therefore do not need to be accounted for separately.

3.1.6 Groundwater Storage

3.1.6.1 Overview of Groundwater Storage

Groundwater Infrastructure

LCID has four (4) groundwater wells that supplied approximately 1,800 AFY of water in 2012 with half the supply going to agriculture. The wells have a maximum pumping capacity of 4,800 gpm (personal communication with Brad Bones, LCID, August 21, 2013)

LACWD 40 has 54 active wells. The combined groundwater extraction capacity is estimated at 38,000 AFY (33.6 mgd), yet this estimate does not necessarily reflect the maximum pumping capacity of LACWD 40.

PWD has twenty-five (25) active groundwater wells throughout the Lancaster and Pearland groundwater subunits, and the San Andreas Rift Zone. The total instantaneous capacity for all PWD wells operating is 16,093 gpm (25,958 AFY). PWD's total groundwater pumping in 2010 was 8,000 AFY and they project to consistently be able to pump 12,000 AFY for average, dry and multi-dry years (PWD 2011).

QHWD currently operates eleven (11) wells for a total maximum pumping capacity of 9,165 AFY (5,681 gpm) (LACWD 40 & QHWD 2011).

RCSD has three (3) wells with a combined maximum pumping capacity of 2,825 gpm (4,557 AFY). One new well is anticipated to come online in the near future with another 800 to 1,000 gpm capacity.

Reliability

Since long-term recharge is expected to be stable, it is anticipated that groundwater pumping, and hence supply, will be reliable even in short-term and multiple year droughts. Thus groundwater is considered a very reliable supply for the Antelope Valley Region. However, the pending adjudication may affect how much groundwater can physically be supplied to the Antelope Valley Region in the future. It is important to note that the return flows are dependent upon anticipated demand and may fluctuate with changes in the anticipated demand. The return flow estimates are meant to indicate a sense of the impact of return flows to the groundwater basin.

3.1.6.2 Percolation

For purposes of this IRWM Plan, direct percolation from precipitation on the Antelope Valley Region floor is assumed to be negligible. However, indirect percolation from irrigation return flows on the Antelope Valley Region floor does occur. There is the potential for direct percolation on the Antelope Valley Region floor to have an impact to the overall water budget. This component of the water budget is currently being studied in the Antelope Valley Region, and if new information is discovered that greatly differs from this assumption, this IRWM Plan may be amended to reflect this.

3.1.6.3 Total Sustainable Yield

TSY is composed of natural recharge, supplemental recharge from imported water, and associated return flows. Natural recharge can be variable and difficult to quantify. Historical estimates of natural recharge have ranged from 30,300 AFY to 81,400 AFY based on a variety of approaches (USGS 2003, USGS 1993). The earliest estimates of natural recharge ranged from 50,000 AFY to 81,400 AFY and were based on limited streamflow and rainfall data (USGS 1993). Later estimates were based on developing a relationship between rainfall and runoff and ranged from 40,280 AFY to 53,000 AFY (USGS 1993). An alternative method used a groundwater model, and found a natural recharge estimate of 30,300 AFY achieved a balance within the model (USGS 2003). Estimates for return flows are typically calculated using a percentage of applied water used for M&I irrigation, agricultural irrigation, and agricultural irrigation with recycled water. These estimates are added to recharge to get TSY. As part of the current adjudication proceedings, the TSY has been determined to be 110,000 AFY (i.e., recharge and return flows). A list of documents that reference estimates for TSY, natural recharge, and return flows is included in Appendix I.

For the purposes of this IRWM Plan, the adjudication finding for TSY (110,000 AFY) is utilized to determine the amount of water that may be sustainably pumped from the basin and represents the combination of natural recharge and return flows from M&I, agricultural, and agricultural reuse. Therefore, these components of TSY are not calculated separately. This Plan acknowledges that other estimates have been developed for TSY in the Valley as mentioned above.

For the purposes of this Plan, as determined by the Stakeholder Group at the October 16, 2013 stakeholder meeting, the discussions that follow in Sections 3 and 6 will utilize the 110,000 AFY for TSY for water balance and projection purposes[2]. Although unlikely, it is important to note that the value for TSY may be revisited by the Court after a period of monitoring and documentation. If a motion is filed with the Court to revise the TSY, the IRWMP will be updated to reflect the subsequent discussion.

3.1.6.4 Artificial Recharge

One typical source of artificial recharge is water banking through spreading basins that allow the water to infiltrate into the ground. Several water banking projects have been proposed in the Region and are discussed in later Sections of this Plan. AVEK's WSSP-2 project was completed in 2010 and can store up to 150,000 AFY. This project is a collaboration between several agencies. The partners can currently withdraw up to 20 mgd (approximately 23,000 AFY).

Another type of artificial recharge is through ASR projects. ASR projects involve the storage of water in an aquifer via artificial groundwater recharge when water is available (usually during spring runoff), and recovery of the stored water from the aquifer when water is needed (usually late summer). The source of water used for ASR can vary. Currently, the only source of ASR water available to the Antelope Valley Region is SWP water, but blended and non-blended recycled water are potential future sources. Although the Region plans to develop groundwater recharge projects with blended recycled water in the future, currently only SWP water is utilized for ASR in the Antelope Valley to a very limited extent.

LACWD 40 is the only agency within the Antelope Valley Region that has attempted to utilize ASR as a water supply management practice. Their program includes the use of new or existing wells for direct injection of water into the aquifer. LACWD 40's ASR program operated under a Conditional Waiver of Waste Discharge Requirements, for a period of 5 years with groundwater monitoring requirements stipulated in the waiver. The 2004 waiver stipulated that LACWD 40 could only inject water to fill the basin to the 2,150 feet groundwater contour interval. This groundwater depression has a radius of approximately 2 miles centered around the middle of Lancaster. As a condition of the waiver, LACWD 40 could only inject up to 6,843 AFY. For the first few years of the project, LACWD was only able to inject approximately 1,500 AFY. In 2010, another five-year Conditional Waiver was approved.

As of December 2010, all injection activities were halted as a result of operational and financial restraints. No future injection is being projected.

For the purposes of this Plan, ASR extraction of banked water will be considered to be negligible since injection has been discontinued.

[2] The number for TSY used in this 2013 IRWMP Update is selected strictly for long-term planning purposes and is not intended to answer the questions being addressed within the adjudication process

3.1.6.5 Extractions

Groundwater for the Antelope Valley Region is extracted from the Antelope Valley Groundwater Basin, as described in Section 2. Historically, groundwater has been the primary water supply source for the Antelope Valley Region.

When significant pumping in the Antelope Valley Region began (early 1900's), a decline in groundwater levels ensued in response to the change in the extraction versus recharge ratio. These changes varied spatially and temporally across the Antelope Valley Region. For instance, the eastern portion of the Buttes and Pearland subunits (described in Section 2.4.2.1) had relatively unchanged groundwater levels (declines of approximately 20 feet), whereas the western portion of these subunits had declines up to 100 feet. The groundwater level changes in the Lancaster subunit were more dramatic and varied with land use, with depressions of up to 200 feet in 1961 in areas with increased agricultural pumping (City of Lancaster 2007). With the introduction of SWP water and increasing urbanization, the water table depressions have either stabilized or increased in the Antelope Valley Region. However, a significant pumping depression from concentrated municipal groundwater pumping is still evident within the southern portion of the Lancaster subunit, between the Cities of Palmdale and Lancaster. Figure 3-6 to Figure 3-10 provide a set of contour maps of the groundwater levels for the Antelope Valley Region from 1915 to 2006.

3.1.6.6 Losses/Subsurface flow

Losses from evaporation and riparian evapotranspiration are discussed in Section 3.1.7 and have been included in the overall estimate of water loss for the water budget. Since the basin is a closed basin, losses from subsurface flow are assumed to be negligible for the purposes of this IRWM Plan.

3.1.7 Water Leaving

The final component to the Water Budget is water leaving the Antelope Valley Region. This includes water lost (either to evaporation or from subsurface flow) and water consumed. Total losses in the Antelope Valley Region have been estimated at approximately 10,000 AFY (USGS 1993). This estimate includes losses attributed to streambed wetting, riparian evapotranspiration, surface and soil evaporation, and diversions. However, further investigation and study are needed to more accurately determine the water losses in the Antelope Valley Region.

Figure 3-6: 1915 Groundwater Level Contour Map of the Antelope Valley Region

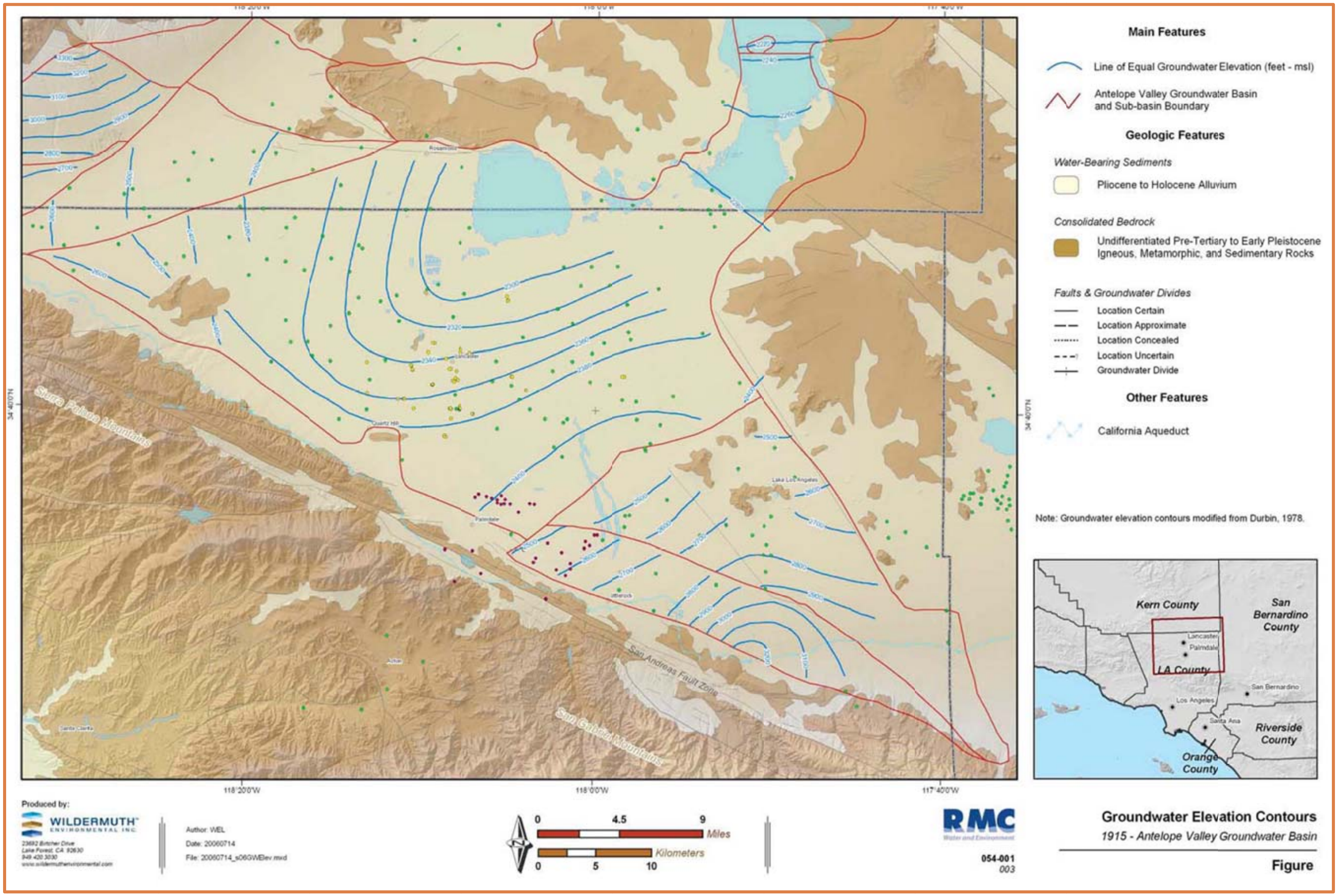


Figure 3-7: 1961 Groundwater Level Contour Map of the Antelope Valley Region

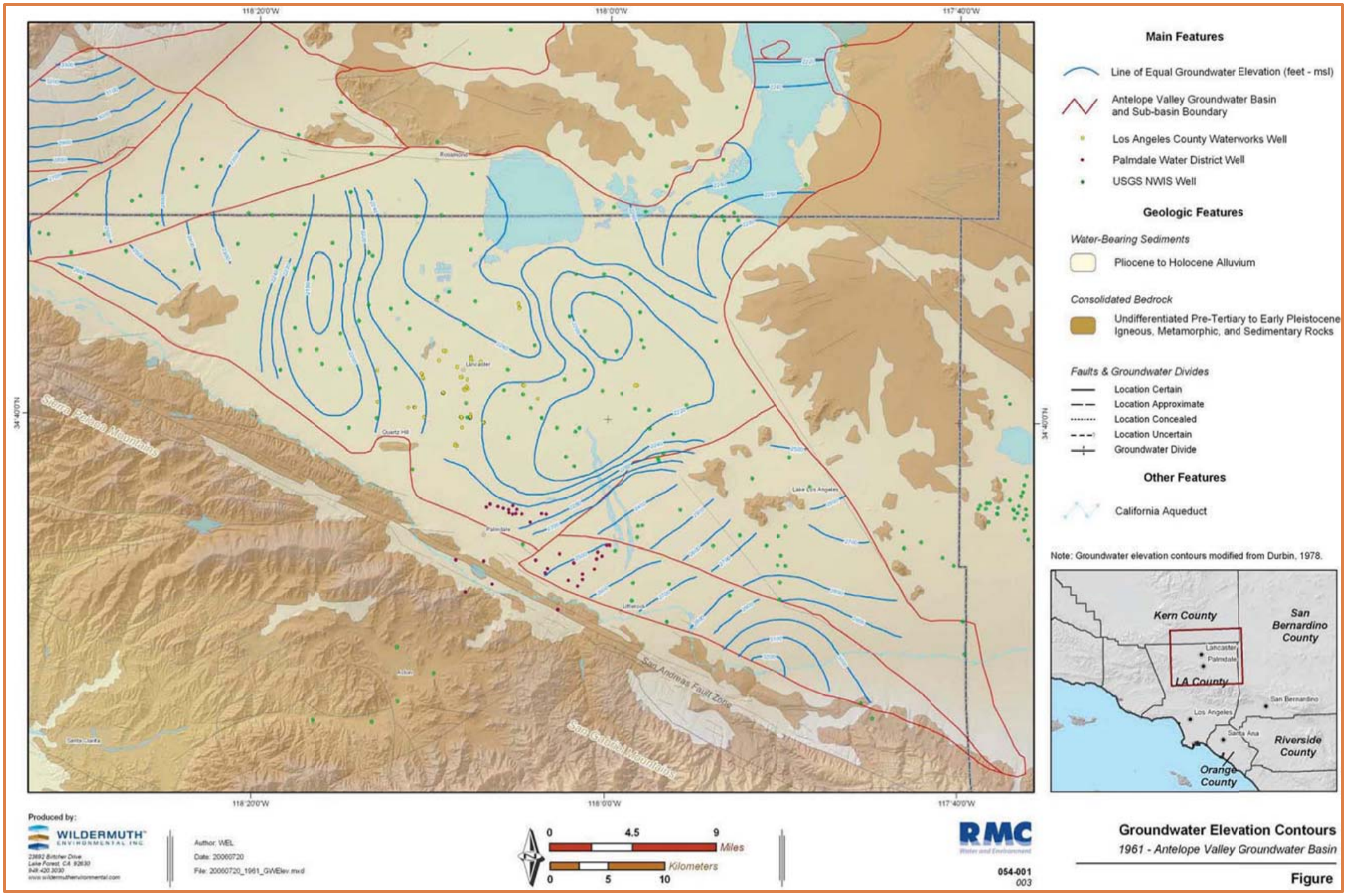


Figure 3-8: 1979 Groundwater Level Contour Map of the Antelope Valley Region

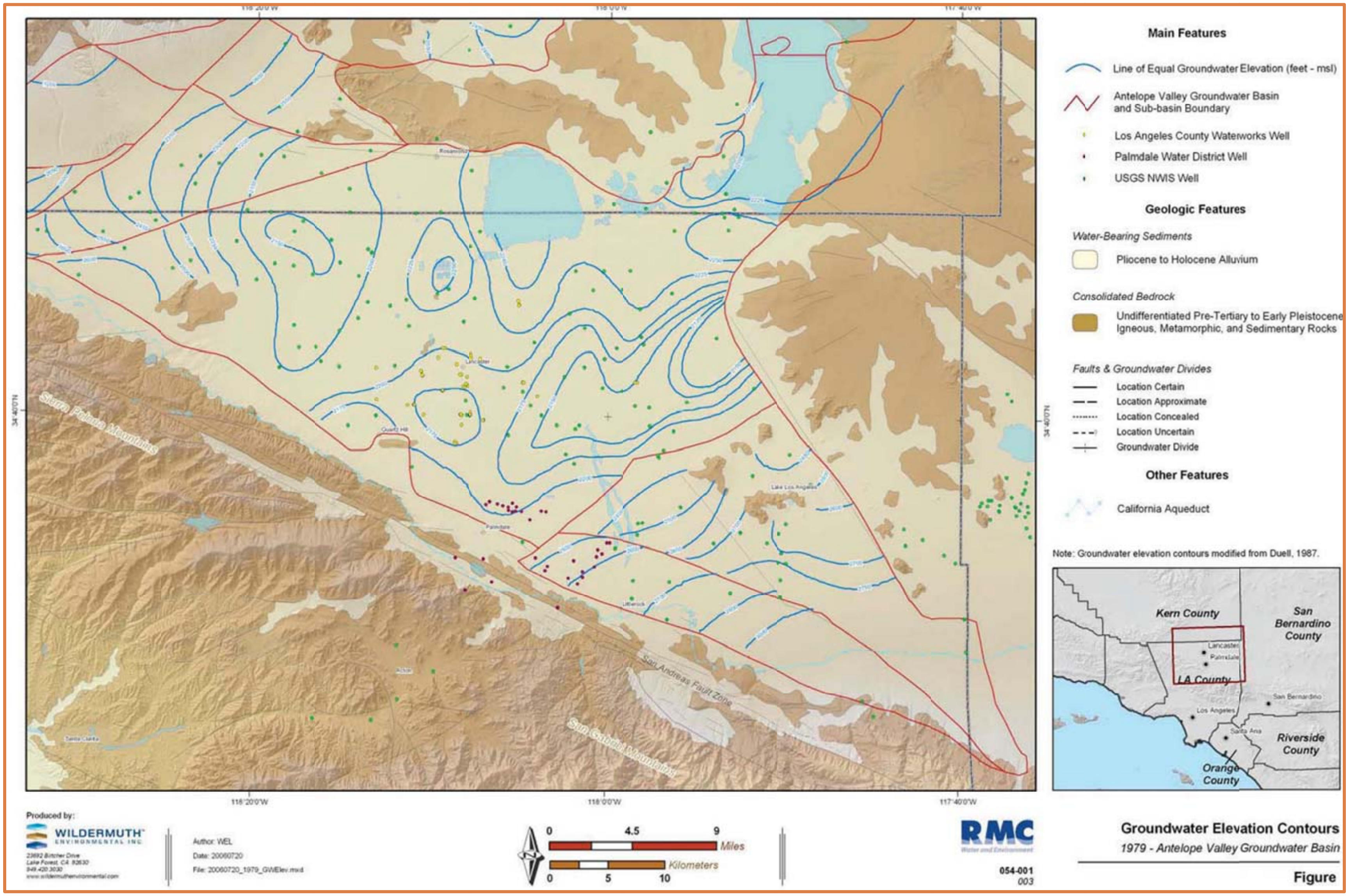


Figure 3-9: 1988 Groundwater Level Contour Map of the Antelope Valley Region

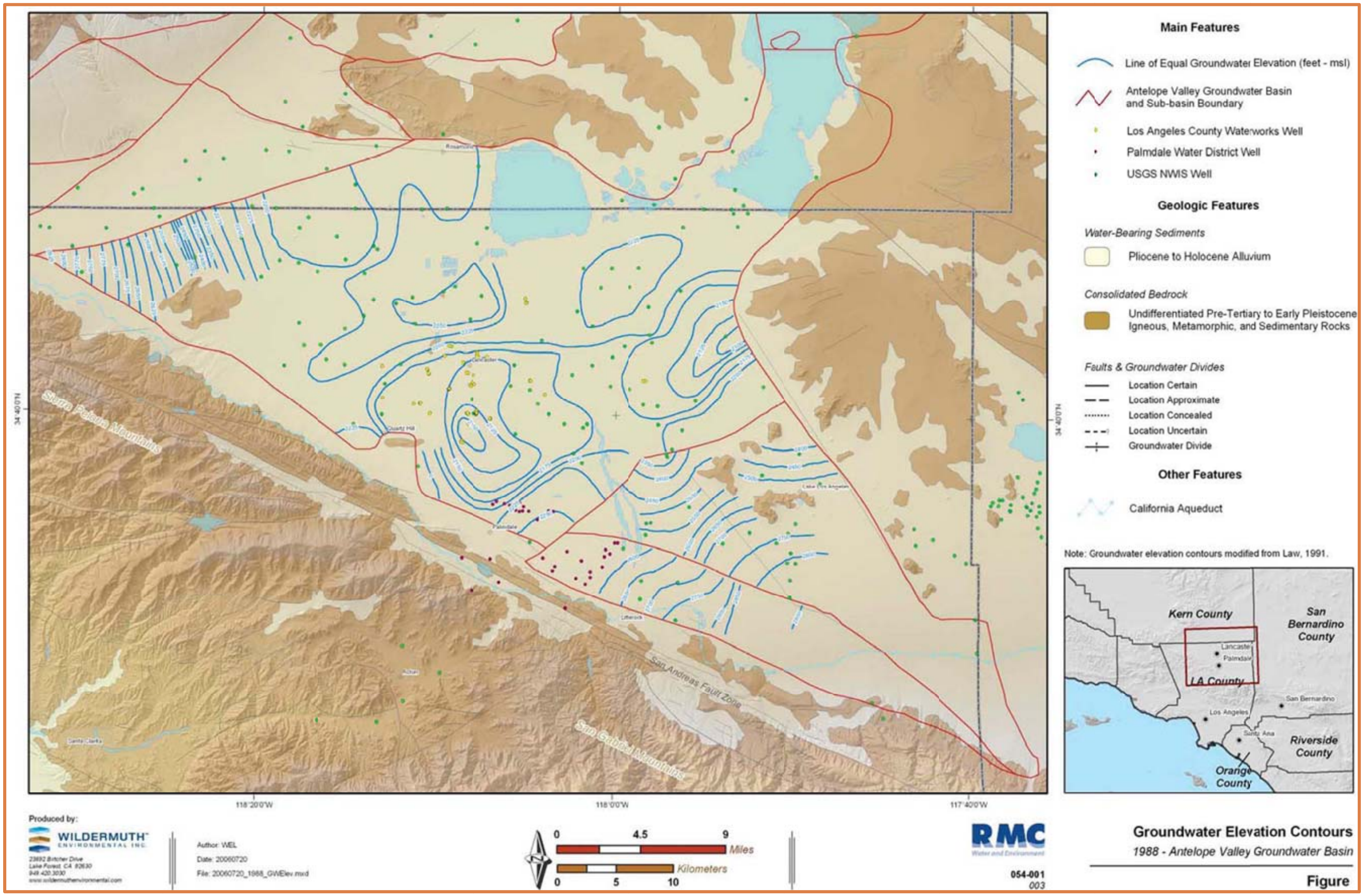
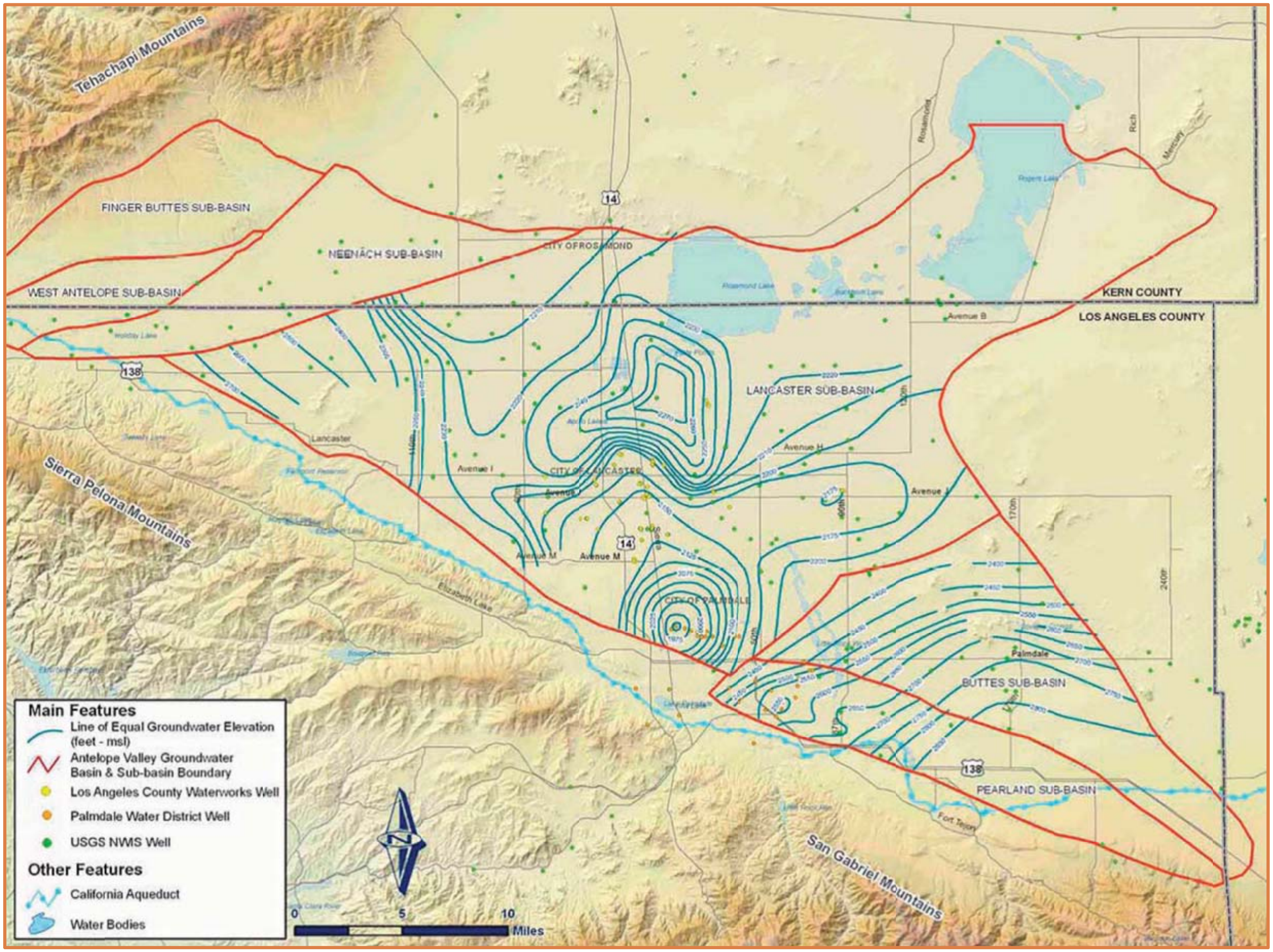


Figure 3-10: 2006 Groundwater Level Contour Map of the Antelope Valley Region



3.1.8 Water Budget Comparisons

3.1.8.1 Average Water Year

Figure 3-11 and Table 3-14 provide a comparison of the supply and demand for the Antelope Valley Region for an average water year. It is assumed that an average year requires reserves equal to the average year mismatch (if demand exceeds supply). A range for the required reserves was determined from the maximum and minimum of the individual year reserves between 2010 and 2035. For an average water year supplies are projected to exceed demands. Because of the uncertainty in several supply and demand estimates including SWP deliveries and projected demand, there is still potential for a deficit to occur. Additional projects and management actions to remedy any potential supply deficits are discussed in Section 5, Resource Management Strategies, and Section 6, Project Integration and Objectives Assessment.

3.1.8.2 Single-Dry Water Year

Figure 3-12 and Table 3-15 provide a comparison of the supply and demand for the Antelope Valley Region for a single-dry water year. As shown by the comparison, future demand exceeds the existing and planned water supplies through 2035. For a single dry water year the range of mismatch between supply and demand is 56,400 AFY to 61,200 AFY. This Plan assumes that AVEK's WSSP-2 water bank will be in operation during the planning horizon and that a sufficient amount of wet years or water transfers will have occurred between dry year periods to keep the bank at full capacity prior to a single-dry year. The maximum withdrawal in any one year is currently 23,000 AFY (20 mgd); therefore it is assumed that this amount would be available in a single-dry year. It is possible that banked water will not be available during dry years, in which case the mismatch would be more severe (up to 84,200 AFY). Figure 3-12 assumes 23,000 AFY of water bank supply. Additional projects and management actions to remedy these supply deficits are discussed in Section 5, Resource Management Strategies, and Section 6, Project Integration and Objectives Assessment. The WSSP-2 project partners plan to increase the withdrawal capacity from 20 mgd (23,000 AFY) to 50 mgd (56,000 AFY) within the 2035 planning horizon, but this is not reflected in Figure 3-12 since the expansion is a planned project (i.e., not operational now). These findings for a single dry year indicate the need to secure additional water supplies for the Region.

3.1.8.3 Multi-Dry Water Year

Figure 3-13 provides a comparison of the supply and demand for the Antelope Valley Region for a multiple-dry water year. Table 3-16 provides a comparison of the supply and demand for the Antelope Valley Region for a multi-dry water year. Each year shown is assumed to be the first of a 4-year dry period. As shown by the comparison, future demand exceeds the existing and planned water supplies through 2035. For multi-dry water years the range of mismatch between supply and demand is 14,600 AFY to 41,200 AFY. This Plan assumes that AVEK's WSSP-2 water bank will be in operation during the planning horizon and that a sufficient amount of wet years or water transfers will have occurred between dry year periods to keep the bank at full capacity prior to a four-year dry period. The maximum withdrawal in any one year is currently 23,000 AFY (20 mgd); therefore it is assumed that approximately ¼ of this amount would be used each year of the 4-year dry period (about 6,000 AFY). It is possible that banked water will not be available during a multi-dry year, in which case the mismatch would be more severe (up to 47,200 AFY). Additional projects and management actions to remedy these supply deficits are discussed in Section 5, Water Management Strategies, and Section 6, Project Integration and Objectives Assessment. The WSSP-2 project partners plan to increase the withdrawal capacity from 20 mgd (23,000 AFY) to 50 mgd (56,000 AFY) within the 2035 planning horizon, but this is not reflected in Figure 3-13 since the expansion is a planned project (i.e., not operational now). These findings for a multi-dry year period indicate the need to secure additional water supplies for the Region.

Figure 3-11: Water Supply Summary for an Average Water Year

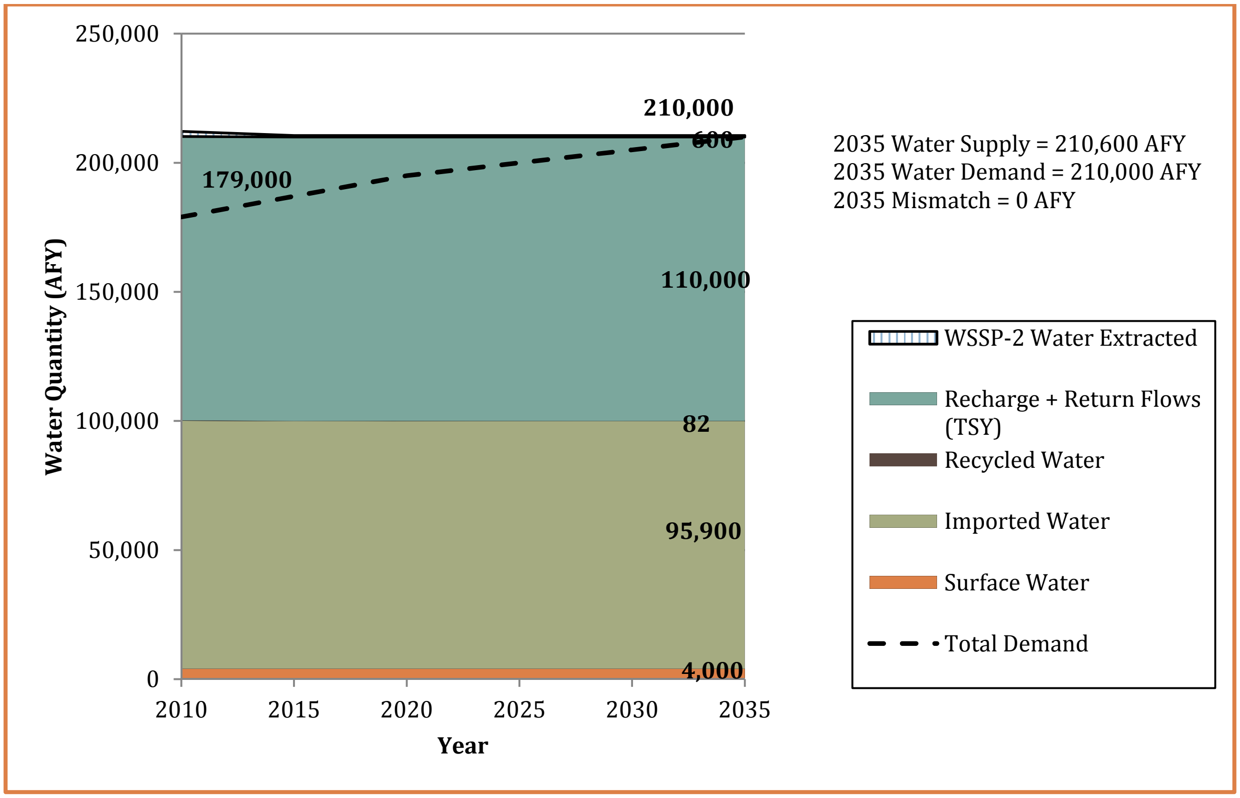


Table 3-14: Water Budget Comparison for an Average Water Year

	2010	2015	2020	2025	2030	2035
Groundwater Storage						
Recharge + Return Flows (TSY)	110,000	110,000	110,000	110,000	110,000	110,000
WSSP-2 Water Extracted[(a)]	2,000	600	600	600	600	600
Subsurface Flow Loss	0	0	0	0	0	0
Direct Deliveries	96,100	95,900	95,900	95,900	95,900	95,900
Recycle/Reuse[(b)]	82	82	82	82	82	82
Surface Storage						
Surface Deliveries	4,000	4,000	4,000	4,000	4,000	4,000
Total Supply	**212,200**	**210,600**	**210,600**	**210,600**	**210,600**	**210,600**
Demands[(c)]						
Urban Demand	87,000	95,000	103,000	108,000	113,000	118,000
Ag Demand	92,000	92,000	92,000	92,000	92,000	92,000
Total Demand	**179,000**	**187,000**	**195,000**	**200,000**	**205,000**	**210,000**
Supply and Demand Mismatch	**33,200**	**23,600**	**15,600**	**10,600**	**5,600**	**600**

Notes: Values are rounded to the nearest 100.
(a) Assumes small withdrawals from WSSP-2 will occur to overcome conveyance constraints and enable utilization of 60-61% of AVEK Table A (SWP reliability estimate). See explanation in Section 3.1.2.
(b) Recycled water demands for 2010-2035 reflect existing 2013 M&I demands (i.e., Division Street Corridor and McAdam Park).
(c) Demand includes groundwater extractions.

Figure 3-12: Water Supply Summary for a Single-Dry Water Year

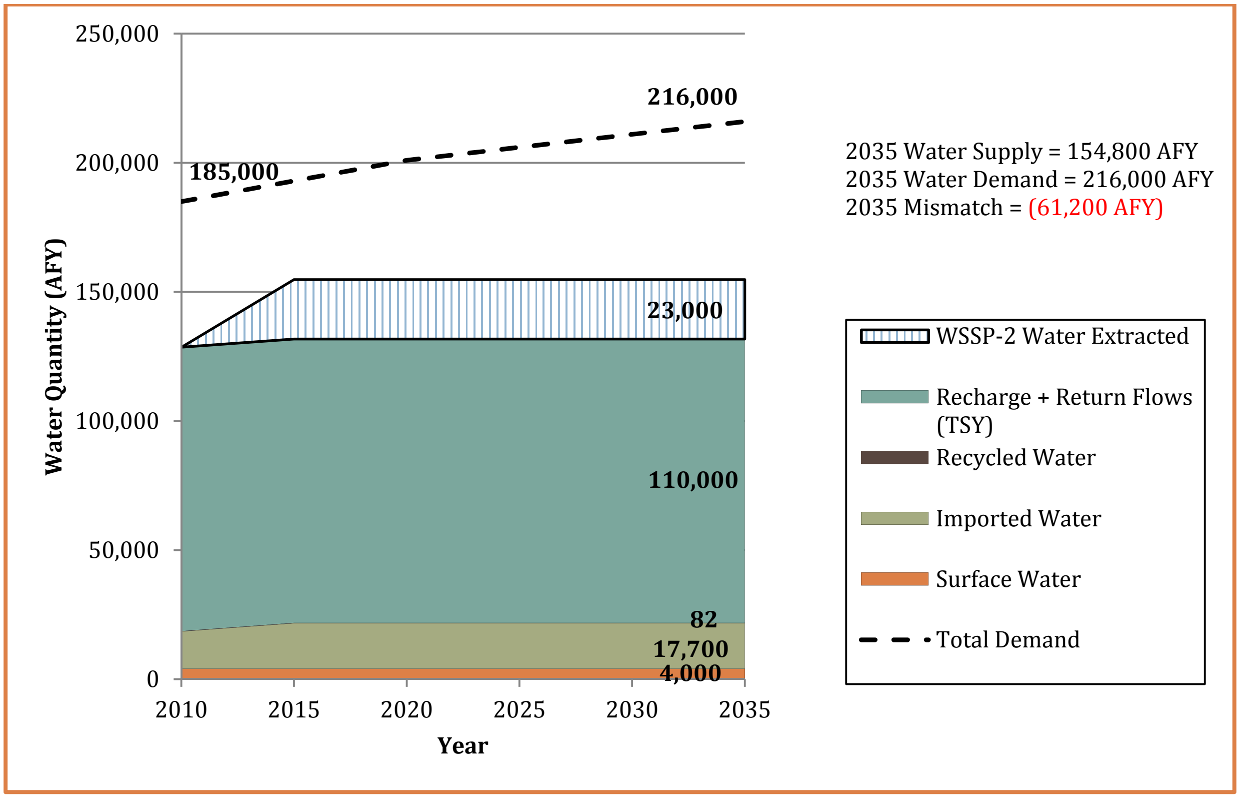


Table 3-15: Water Budget Comparison for a Single-Dry Water Year

	2010	2015	2020	2025	2030	2035
Groundwater Storage						
Recharge + Return Flows (TSY)	110,000	110,000	110,000	110,000	110,000	110,000
WSSP-2 water Extracted[(a)]	0	23,000	23,000	23,000	23,000	23,000
Subsurface Flow Loss	0	0	0	0	0	0
Direct Deliveries	14,500	17,700	17,700	17,700	17,700	17,700
Recycle/Reuse[(b)]	82	82	82	82	82	82
Surface Storage						
Surface Deliveries	4,000	4,000	4,000	4,000	4,000	4,000
Total Supply	**128,600**	**154,800**	**154,800**	**154,800**	**154,800**	**154,800**
Demands[(c)]						
Urban Demand	87,000	95,000	103,000	108,000	113,000	118,000
Ag Demand	98,000	98,000	98,000	98,000	98,000	98,000
Total Demand	**185,000**	**193,000**	**201,000**	**206,000**	**211,000**	**216,000**
Supply and Demand Mismatch	**(56,400)**	**(38,200)**	**(46,200)**	**(51,200)**	**(56,200)**	**(61,200)**

Notes: Values are rounded to the nearest 100.
(a) Assumes periodic wet years have occurred to allow quantities of SWP deliveries above AVEK demands to fill the water bank.
(b) Recycled water demands for 2010-2035 reflect existing 2013 M&I demands (i.e., Division Street Corridor and McAdam Park).
(c) Demand includes groundwater extractions.

Figure 3-13: Water Supply Summary for a Multi-Dry Water Year

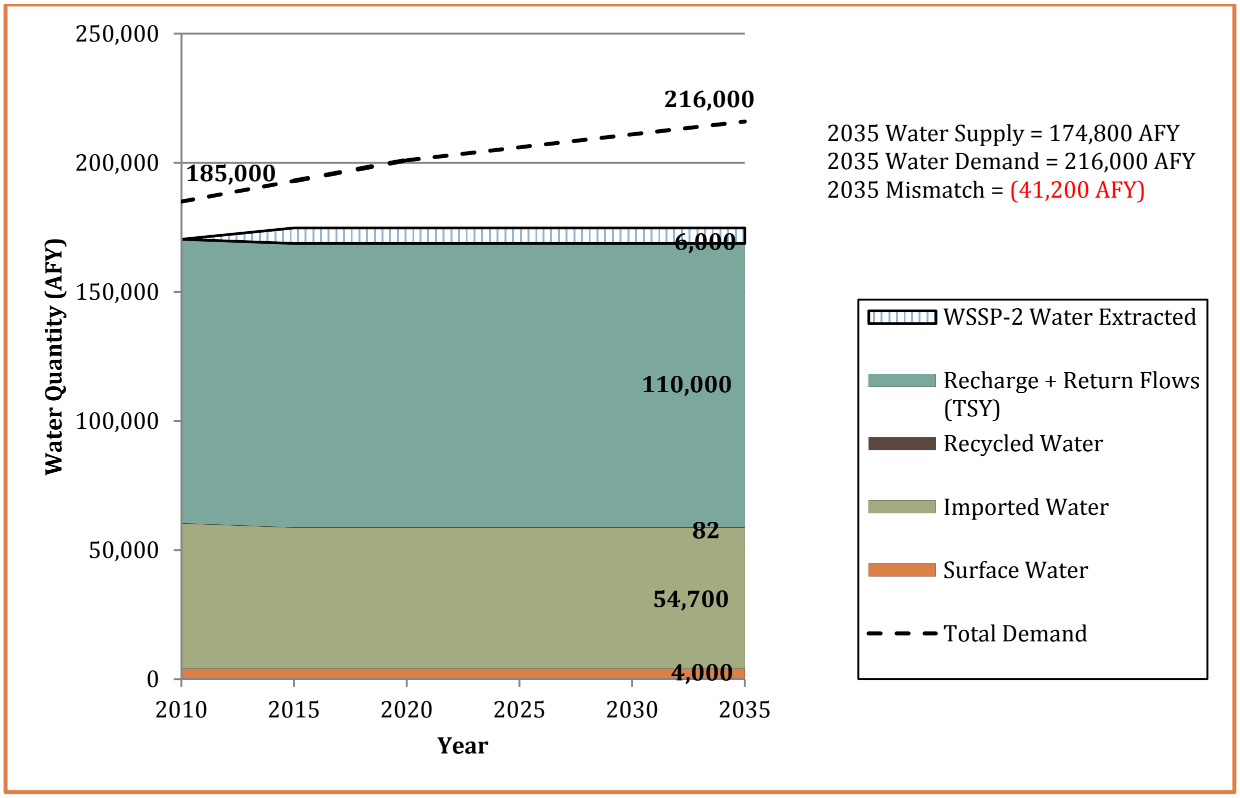


Table 3-16: Water Budget Comparison for a Multi-Dry Water Year

	2010	2015	2020	2025	2030	2035
Groundwater Storage						
Recharge + Return Flows (TSY)	110,000	110,000	110,000	110,000	110,000	110,000
WSSP-2 Water Extracted[(a)]	0	6,000	6,000	6,000	6,000	6,000
Subsurface Flow Loss	0	0	0	0	0	0
Direct Deliveries	56,300	54,700	54,700	54,700	54,700	54,700
Recycle/Reuse[(b)]	82	82	82	82	82	82
Surface Storage						
Surface Deliveries	4,000	4,000	4,000	4,000	4,000	4,000
Total Supply	**170,400**	**174,800**	**174,800**	**174,800**	**174,800**	**174,800**
Demands[(c)]						
Urban Demand	87,000	95,000	103,000	108,000	113,000	118,000
Ag Demand	98,000	98,000	98,000	98,000	98,000	98,000
Total Demand	**185,000**	**193,000**	**201,000**	**206,000**	**211,000**	**216,000**
Supply and Demand Mismatch	**(14,600)**	**(18,200)**	**(26,200)**	**(31,200)**	**(36,200)**	**(41,200)**

Notes: Values assume 4-year dry period begins in the year shown and are rounded to the nearest 100.
(a) Assumes periodic wet years have occurred to allow quantities of SWP deliveries above AVEK demands to fill the water bank. Full bank storage is evenly distributed over the 4-year dry period, rounding to about 6,000 AFY each year.
(b) Recycled water demands for 2010-2035 reflect existing 2013 M&I demands (i.e., Division Street Corridor and McAdam Park).
(c) Demand includes groundwater extractions.

3.1.9 Regional Water Supply Issues and Needs

The key issues, needs, challenges, and priorities for the Antelope Valley Region with respect to water supplies include the following, which are discussed in greater detail below:

- Regional reliance on imported water;
- Groundwater use is not managed;
- Mismatch between supplies and demands
- Existing facility limitations; and
- Land subsidence effects

3.1.9.1 Reliance on Imported Water

As shown from the supply and demand comparisons, the Antelope Valley Region relies on SWP for approximately 46 percent of its total supply in an average year, approximately 31 percent of its total supply in a multi-dry year, and approximately 11 percent of its total supply in a single-dry year.

The availability of SWP supply is known to be variable. It fluctuates from year to year depending on precipitation, regulatory restrictions, legislative restrictions, and operational conditions, and is particularly unreliable during dry years. The DWR Reliability Report (2012) anticipates a minimum delivery of 9 percent of full Table A Amounts for 2011 demand conditions and 11 percent of full Table A Amounts for 2031 demand conditions. The Antelope Valley Region likely cannot meet expected demands without imported water, and the variable nature of the supply presents management challenges to ensure flexibility.

3.1.9.2 Groundwater is not Managed

One of the more prevalent concerns in the Antelope Valley Region relates to management of the Antelope Valley Groundwater Basin. Groundwater has and continues to be an important resource within the Antelope Valley Region. As discussed in Section 2, groundwater has provided between 50 and 90 percent of the total water supply in the Antelope Valley Region since 1972 (USGS 2003). Projected urban growth, coupled with limits on the available local and imported water supply, are likely to continue to increase the reliance on groundwater. If the groundwater basin is not managed wisely, the basin can become overdrafted and reduce the long-term viability of the groundwater supply.

3.1.9.3 Mismatch between Supplies and Demands

The population in the Antelope Valley is expected to increase through the planning horizon resulting in an increase in water demand. Decreases in estimated population growth have reduced the mismatch between supply and demand since the 2007 IRWM Plan. Yet, even with less population growth, water supply is still a limiting factor during dry periods. In order to maintain supplies and meet the growing needs of the region, agencies will need to diversify the Region's water supply portfolio with additional imported sources, additional water conservation, additional recycled water, and groundwater recharge and recovery projects.

The Antelope Valley Region water agencies have typically relied on imported water and/or groundwater for their water supply needs. Currently, these water supplies are limited by SWP supply fluctuations, groundwater basin overdraft and the need for facility improvements. The water agencies and municipalities are pursuing various alternatives, such as recycled water and recharge programs, to decrease their vulnerability to short-term variances in imported water and groundwater sources.

SWP water reliability is a function of hydrologic conditions, state and federal water quality standards, protection of endangered species and water delivery requirements. Though the SWP contracts contain maximum Table A Amounts for each contractor, this is not a guarantee of how much imported water will be available for delivery each year.

Water agencies in the Antelope Valley Region cannot entirely rely on un-managed groundwater pumping because excessive pumping for many years has stressed the basin. According to the USGS, groundwater pumping in the Antelope Valley Region has exceeded the recharge rate in many years since the early 1920s (USGS 2003). This approach to groundwater pumping will change in the future as the adjudication process for establishing groundwater rights is completed.

Additionally, as detailed below in Section 3.5, "Land Use Management Assessment" water is a limiting factor of the Antelope Valley Region's growth rate. In order to accommodate this projected growth, the supply of water in the Antelope Valley Region for dry and multi-dry year periods must be increased.

3.1.9.4 Limitations of Existing Facilities

In order to address the deficiency in supply, the water supply agencies in the Antelope Valley Region will need to modify existing infrastructure to accommodate an increase in delivery and storage capacity for new supply.

AVEK has capacity constraints in the summer and limited demand for water during the winter months. Thus, additional storage or recharge in the winter months is required in order for them to beneficially use their full Table A amount in some years. It may also be possible for some AVEK customers to regulate their water supply deliveries such that more could be taken during winter months when demands are typically low.

LACWD 40's facilities improvements will include well efficiency and rehabilitation projects, reservoirs and pipelines throughout its system to meet current and projected water supply requirements. LACWD 40 is pursuing the use of recycled water as an alternative source for irrigation and recharge purposes.

PWD's plan for improvements and expansion of its existing infrastructure was recently developed in its 2010 Strategic Water Resources Plan. According to the Plan, PWD is identifying additional water sources by investigating the potential to increase the storage capacity of Littlerock Reservoir, establishing groundwater recharge and water banking facilities, maximizing the use of recycled water (tertiary treated recycled water for irrigation and industrial/commercial uses), creating and maintaining future imported water opportunities, and implementing water conservation programs. PWD's 2010 Recycled Water Facilities Plan details construction alternatives for expanding recycled water as a water supply option.

QHWD plans to enlarge existing wells or drill new wells to meet additional demands. There are no plans for QHWD to invest in recycled water in the near future because tertiary treatment and recycled water pipelines are too costly.

RCSD will need new wells, a reservoir, and additional transmission mains to meet projected demands (RCSD 2004).

Furthermore, the current planned regional recycled water distribution system would only deliver water to M&I users and groundwater recharge projects. Additional infrastructure would be required to deliver recycled water to any potential agricultural users other than the LACSD effluent management sites or adjacent users.

3.1.9.5 Effects of Land Subsidence

Groundwater use in the Antelope Valley Region was at its highest in the 1950s and 1960s as a result of agricultural demands (USGS 2003). According to USGS, land subsidence in Antelope Valley Region was first reported by Lewis and Miller in the 1950s (USGS 1992). Since then, studies have shown subsidence levels of up to 7 feet occurring in some areas of Antelope Valley Region (see Figure 3-14). Conversations held with various agencies and companies indicate that within the Antelope Valley Region, the Lancaster and EAFB areas are currently experiencing problems or damages that appear to be related to land subsidence (see Figure 3-15). EAFB has been actively involved in projects aimed at preventing future land subsidence. The adjudication process has as one of its primary goals the permanent stabilization of groundwater levels and prevention of overdraft.

Land subsidence results in the following impacts:

- Development of cracks, fissures, sink-like depressions and soft spots.
- Change in natural drainage patterns often resulting in increased areas of flooding or increased erosion.
- Degradation of groundwater quality.
- Permanent reduction in groundwater storage capacity.
- Change in gradient in gravity pipelines (sanitary and storm sewers) or canals often resulting in lost capacity.
- Damage to well casings, pipelines, buildings, roads, railroads, bridges, levees, etc.
- Costs associated with repairs and rebuilding.
- Costs associated with construction of new facilities such as pumping stations for gradient changes.
- Reduction in land value.
- Legal actions.
- Increased pumping costs.

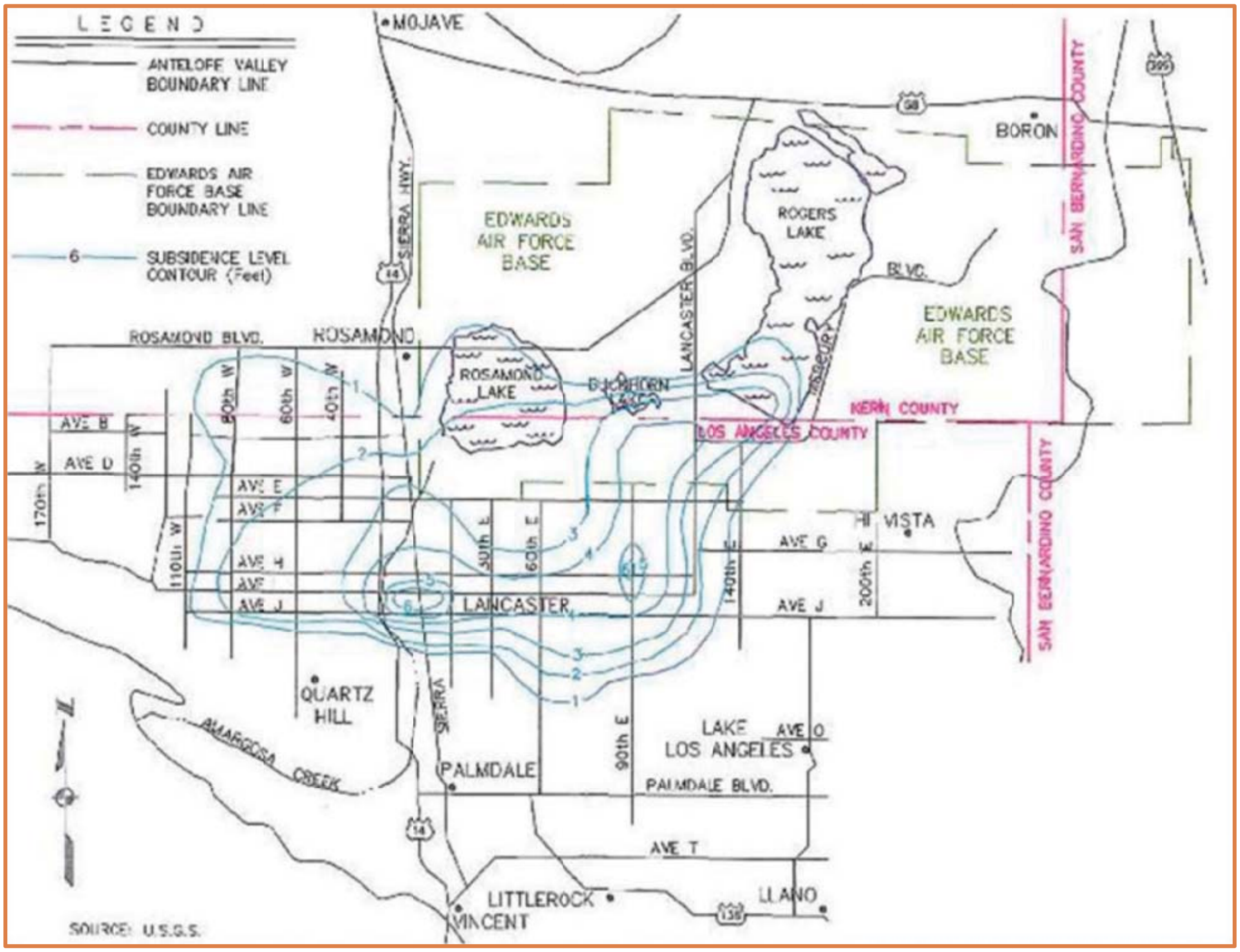
Table 3-17 lists land subsidence problems identified in Antelope Valley Region.

The following paragraphs present brief discussions on several studies done on land subsidence in the Antelope Valley Region.

Geolabs, February 1991. A study done by Geolabs - Westlake Village (1991) studied a 10 square mile area in Lancaster identified to have fissures and sink-like depressions (see Location 2 on Figure 3-15). The report identified fissures ranging in width from one inch to slightly over one foot. The lengths of the fissures ranged mainly between 50 to 200 feet, with the longest continuous fissures in the 600-700 foot range. Sinkholes ranged mainly between one to five feet deep and less than four feet in diameter. One sinkhole measured 20 feet long and 15 feet wide. The report concluded that the fissures were due to tensional forces created by subsidence, which may be related to groundwater withdrawal due to the correlation between areas of significant subsidence and areas of pronounced groundwater level decline. Areas of concern identified in the report are included in Table 3-17.

USGS Report 92-4035. USGS (1992) reported that as much as 2 feet of land subsidence had affected Antelope Valley Region by 1967 and was causing surface deformations at EAFB. Fissures, cracks and depressions on Rogers Lake were affecting the use of the lakebed as a runway for airplanes and space shuttles. In addition, depressions, fissures and cracks on the lakebed may not be detected until aircraft or space shuttles exceed the load capacity of the soil. Another concern

Figure 3-14: Subsidence Levels in the Antelope Valley Region



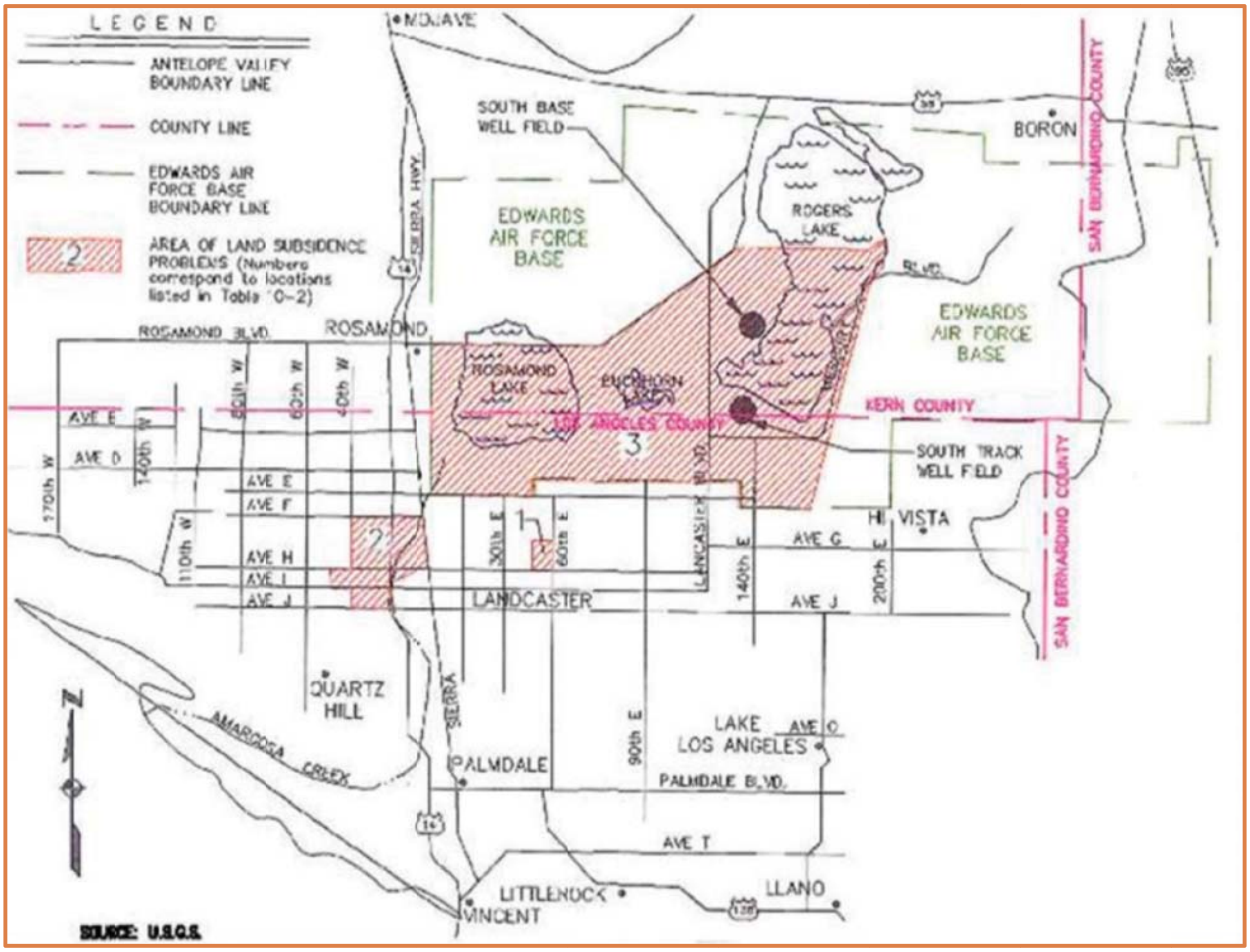
was potential contamination of the water table through fissures which can provide direct access for toxic materials.

To determine the significance of land subsidence conditions, bench marks were surveyed using a Global Positioning System (GPS) in 1989. Differential levels were surveyed for 65 bench marks from 1989 to 1991. It was discovered that total land subsidence ranged from 0.3 to 3.0 feet.

USGS Report 93-4114. USGS (1993b), reported that land subsidence effects had been noted on Rogers Lake in the form of depressions, fissures and cracks. The report identified pumping of groundwater as the cause of the land subsidence. As much as 90 feet of groundwater level decline has occurred in the South Base well field, and an average annual compaction rate of 5.57 x 10^{-2} feet was measured at the Holly site near the South Track well field (see Location 3 on Figure 3-15).

USGS 1994 Draft Report. USGS (1994) revealed that land subsidence throughout Antelope Valley Region has reached nearly 7 feet. As shown on Figure 3-15, USGS indicated that subsidence levels of 6.6 feet have occurred near Avenue I and Division Street, and Avenue H and 90th Street East. The draft report stated that there was a general correlation between groundwater level declines and the distribution and rate of subsidence. In addition, the report estimated a conservative loss of approximately 50,000 AF of storage in the groundwater subbasin in the area that has been affected by 1 foot or more of land subsidence.

Figure 3-15: Areas of Potential Land Subsidence in the Antelope Valley Region



1995 Water Resource Study. In addition to reviewing the reports summarized above, companies and agencies within the Antelope Valley Region were surveyed regarding potential damages attributable to groundwater level declines and field visits of affected areas were conducted. Companies and agencies surveyed include the following:

- AVEK
- Calnev Pipelines
- Lancaster, Redevelopment Center
- Lancaster, Road Maintenance Department
- Palmdale, Engineering Department

- Palmdale, Road Maintenance Department
- LACSD
- EAFB
- Kern County Flood Plain Management Section
- Los Angeles County Waterworks District, Sewer Department
- RCSD
- Southern California Gas Company
- Southern Pacific Railroad
- State Fire Marshall, Pipeline Safety Division

Table 3-17: Land Subsidence Concerns for the Antelope Valley Region

Location	Description	Maximum Subsidence (ft)	Problems/Damages/Concerns
1	Area bounded by 50th and 60th Streets east and Avenues G and H (T7N-R11W-S3)	3-4	• Development of cracks and fissures
2	Northwest portion of Lancaster	4-5	• Development of cracks and fissures in the following areas of concern: • In the vicinity of KAVL and KBVM radio towers near the proposed site for High Desert Hospital complex • East of a residential project at the southeast corner of 30th St. West and Ave. "I" • In the vicinity of LA County Detention Facility south of Ave. "I" • The "H" Street Bridge over Amargosa Creek where up to 4" of lateral separation is present across the central expansion joint[a].
3	EAFB	3.3	• Failure of several well casings. • Increase in area subject to flooding. • Structural damage to wastewater treatment plant building. • Wells protruding above the ground. • Development of cracks, fissures, sinkholes and softspots on Rogers Lakebed, affecting use of the lakebed as a runway for planes and space shuttles.

Note:
(a) Geolabs reports that the separation may be due to differential settlement or, may be related to the same mechanism which is causing the fissuring in the area.

Other than the damages identified in the reports summarized above, structural damage to the wastewater treatment plant building on EAFB was the only other potentially significant damage identified and may or may not be attributable to land subsidence. Other minor existing damage that may or may not be attributable to groundwater level declines includes cracked sidewalks and pavement. To assess existing and potential degradation to the groundwater supply, an attempt was made to correlate typical stormwater runoff constituents and similar constituents in the groundwater supply. The hypothesis was that areas of fissuring should show higher degrees of contamination if runoff was reaching the aquifers through the fissures.

The Los Angeles County Watershed Management Division monitors surface water; however it does not monitor typical stormwater constituents, only general minerals. Therefore, it is currently unknown whether groundwater degradation due to subsidence is occurring in the Antelope Valley Region. However, should fissuring continue, degradation to the groundwater supply could be a potential problem and should be investigated. Individual water purveyors servicing the area where fissuring is occurring may test for some of the constituents found in stormwater, from which data may be obtained.

In addition to subsidence-related problems, groundwater level declines of up to 200 feet in the Antelope Valley Region have resulted in increased pumping costs. USGS (1994) cites the increased pumping costs as the primary reason for a decline in agricultural production during the 1970s.

It is recommended that monitoring of subsidence levels and groundwater levels continue in the Antelope Valley Region as indicators of future problems due to subsidence and current progress toward balancing groundwater use. Monitoring of groundwater quality for typical stormwater constituents in areas of fissures is recommended as an indicator of the degradation potential due to fissures.

3.1.10 AB 3030 Water Supply Considerations

The following Assembly Bill (AB) 3030 elements are also associated with groundwater supply management within the Antelope Valley Region. A discussion of how these elements are addressed in this IRWM Plan is provided below.

Mitigation of Conditions of Overdraft. Although the groundwater basin is not currently adjudicated, an adjudication process has begun and is in the final stages. Although there are no existing restrictions on pumping, water rights are likely to be assigned as part of the adjudication process. The groundwater adjudication process is a management action discussed in this IRWM Plan.

Replenishment of Groundwater Extracted by Water Producers. Several groundwater recharge and banking projects are being considered and evaluated as part of this IRWM Plan. Some have been implemented or are in the process of being implemented. Additionally, EAFB has been actively involved in projects aimed at refilling the depleted aquifers. The goals of these projects are to recharge/bank sufficient groundwater supply in wet years for use during dry years, thereby minimizing long-term impacts to groundwater levels.

Monitoring of Groundwater Levels and Storage. Groundwater level and storage monitoring is a direct indicator of the groundwater supply. The RMS (provided in Section 5) discussion will include management and compilation of existing water levels and water quality monitoring data to facilitate analysis of current conditions, and to help plan for the future.

Facilitating Conjunctive Use Operations. Conjunctive use operations relate to the combined use of surface water and groundwater to optimize resources and minimize adverse effects of using a single source. Conjunctive use will be facilitated as part of this IRWM Plan through many of the water supply management projects described in more detail in Section 5. Conjunctive use opportunities with native water are limited, however, due to the relatively small amount of native surface and groundwater available. Thus, the success of conjunctive use operations will depend heavily on the ability to import water from outside of the Antelope Valley Region and on the ability to supplement with recycled water.

3.2 Water Quality

Water quality is a major concern in the Antelope Valley Region. The Region's dependence on its groundwater source makes it vital that the quality of the groundwater be protected. With the increase of groundwater recharge projects, which are essential to ensuring the availability of groundwater and preventing land subsidence, it is crucial to monitor the quality of the recharged imported, local surface and recycled water. Water quality management in the Antelope Valley Region is therefore focused on maintaining and improving existing water quality and preventing future contamination.

3.2.1 Local Groundwater Quality

Groundwater quality in the Antelope Valley Region is excellent within the principal aquifer but degrades toward the northern portion of the dry lakes areas. The groundwater is typically characterized by calcium bicarbonate near the surrounding mountains and is characterized by sodium bicarbonate or sodium sulfate in the central part of the basin (Duell 1987 as cited in DWR 2004). In the eastern part of the basin, the upper aquifer has sodium-calcium bicarbonate type water and the lower aquifer has sodium bicarbonate type water (Bader 1969 as cited in DWR 2004). Considered to be generally suitable for domestic, agricultural, and industrial uses, the water in the principal aquifer has a TDS concentration ranging from 200 to 800 mg/L. The deep aquifer typically has a higher TDS level. Hardness ranges from 50 to 200 mg/L, and high fluoride, boron, nitrates, chromium and antimony are a problem in some areas of the basin. The groundwater in the basin is used for both agricultural and M&I purposes.

Arsenic is closely monitored in the Region. It is a naturally occurring inorganic contaminant often found in groundwater and occasionally found in surface water. Anthropogenic sources of arsenic include agricultural, industrial and mining activities. Arsenic can be toxic in high concentrations, and is linked to increased risk of cancer when consumed for a lifetime at or above the regulated MCL. Arsenic levels above the MCL of 10 ppb have been observed in the Antelope Valley Region. Ten LACWD 40 wells have tested above the MCL. Of the ten wells, one is not in use and the remaining are blended, with lower arsenic concentrated groundwater or surface water, to concentrations below 8 ppb or 80% of the MCL. QHWD has also observed levels above the MCL in a number of wells and utilizes the same blending method to manage arsenic levels. Similarly, RCSD has observed levels of arsenic in the range of 11 to 14 ppb in three (3) of its wells. RCSD is utilizing similar methods to LACWD 40 to manage arsenic levels so that delivered water meets the arsenic MCL. PWD has arsenic levels below 2 ppb or at Non-Detect (ND) concentrations. It is not anticipated that the existing arsenic problem will lead to future loss of groundwater as a supply for the Antelope Valley Region. Arsenic is also an issue in some DAC areas such as Boron.

An emerging contaminant of concern is hexavalent chromium or chromium-6. Chromium-6 can occur naturally in the environment from the erosion of natural chromium deposits, but can also be produced by industrial processes where it is used for chrome plating, dyes and pigments, and leather and wood preservation. This element has been known to cause cancer when inhaled and has also been linked to cancer when ingested. Though there is a total chromium MCL of 50 ppb in California, there is not currently a chromium-6 MCL at either the federal or state level. California has set a public health goal (PHG) of 0.02 ppb for chromium-6, and as of August 23, 2013 has proposed an MCL of 10 ppb. Twelve wells belonging to various agencies within the southern portion of the Region have tested in excess of this proposed MCL within the last ten years, and will therefore need to be monitored as the state moves forward with the adoption of this MCL (SWRCB 2013).

In addition to arsenic and chromium-6 issues, there have also been concerns with nitrate levels above the current MCL of 45 ppm and high TDS levels in portions of the Basin. Groundwater monitoring data from the mid-to-late 1990s indicate nitrate (as NO_3) concentrations periodically exceeding the primary MCL for drinking water of 45 ppm in two wells located in the southern portion of the groundwater basin near the Palmdale WRP. Agricultural fertilization practices and discharge of treated wastewater has likely contributed to the elevated levels. Actions have already been implemented by LACSD to address these concerns and to minimize any impact from treated wastewater, including, treatment upgrades, a change in effluent management practices, the implementation of a recycled water distribution system, and performing groundwater remediation activities near the Palmdale WRP site.

3.2.2 Imported Water Quality

DWR must monitor the effects of diversions and SWP operations to ensure compliance with existing water quality standards, in particular the maintenance of salinity levels in key parts of the Delta to help maintain its natural ecosystem. DWR also regulates the quality of non-Delta water entering the SWP, known as "non-project turn-ins". These non-project turn-ins typically originate as groundwater, and in particular "pump back" projects that store imported water in groundwater banks, though other waters include excess surface flows or flood waters. DWR requires the proponents of any turn-in proposal to demonstrate that the water is of consistent, predictable and acceptable quality and that the comingled water does not result in a diminution of water quality (DWR 2012a).

The current water quality conditions in the California Aqueduct (data taken from Station KA024454, Check 29 near Lake Webb) are compared to the current federal primary and secondary drinking water standards and are provided in Table 3-18. It is important to note that while some constituents do not have a primary MCL (bromide, total organic carbon, TDS, and chloride) high levels of these constituents can be of concern, especially with regard to potential treatment costs to downstream users.

3.2.2.1 Imported Water Quality Infrastructure

SWP water is treated by PWD's treatment plant for use by PWD and LCID, and by the four AVEK facilities (Quartz Hill WTP, Eastside WTP, Rosamond WTP, and Acton WTP) prior to delivery to the other water purveyors.

PWD's water treatment plant (the Leslie O. Carter Water Treatment Plant) is a conventional design plant using chlorine as the disinfectant and has a permitted capacity of 28 mgd. Screening and metering are provided at the outlet of Palmdale Lake and head of the plant, followed by treatment chemical addition, flash mixing, three-stage tapered energy flocculation, clarification utilizing plate settlers and sediment removal systems, multi-media filters, and disinfection. Treated water is stored in a 6 million-gallon reservoir, which supplies water into the distribution system. Decanted water from the solids removal process is returned to Lake Palmdale. The plant is currently undergoing a second phase of improvements designed to meet Stage II Disinfection-by-Products regulations. Improvements include additional filters and adding granulated activated carbon contactors to the processes. This will allow the continued use of chlorine as the disinfectant and increase the capacity to 35 mgd.

Table 3-18: Comparison of SWP Water Quality Criteria (2013) to SWP Actual Data

Constituent	SWP Water Quality Data (Sta. KA024454)[(a)(b)]			Current Drinking Water Standards (2013)
	Max.	Min.	Avg.	
Aluminum (Dissolved) (mg/L)	<0.01	<0.01	<0.01	1
Antimony (Dissolved) (ug/L)	< 1	< 1	< 1	6
Arsenic (Dissolved) (ug/L)	5	< 1	2	10
Barium (Dissolved) (mg/L)	0.04	0.02	0.03	1
Beryllium (Dissolved) (ug/L)	< 1	< 1	< 1	4
Bromide (Dissolved) (ug/L)	430	30	180	No standard
Cadmium (Dissolved) (ug/L)	< 1	< 1	< 1	5
Chromium (Total) (ug/L)	< 1	1	2.5	50
Copper (Dissolved) (ug/L)	2	<1	1.4	1,300
Fluoride (Dissolved) (ug/L)	(c)	(c)	100	2,000
Iron (ug/L)	28	< 5	12	300[(d)]
Manganese (ug/L)	7	< 5	< 5	50[(d)]
Mercury (inorganic) (ug/L)	< 0.2	< 0.2	< 0.2	2
Nickel (Dissolved) (ug/L)	2	< 1	1	No standard
Nitrate as N (mg/L)	6.9	< 0.1	2.7	10
Selenium (dissolved) (ug/L)	1	< 1	< 1	50
Silver				100[(d)]
Sulfate (dissolved) (mg/L)	60	14	33	250[(d)]
Total Organic Carbon (mg/L)	8.2	0.9	3.2	No standard
Zinc (dissolved) (ug/L)	21	< 5	8.4	5,000[(d)]
TDS (mg/L)	334	97	220	500[(d)]
Specific Conductance (uS/cm)	601	154	377	No standard
Chloride (dissolved) (mg/L)	117	19	57	250[(d)]

Notes: All values in ug/L unless otherwise noted.
(a) SWP Water Quality data collected by DWR between 1/1/2010 and 12/31/2012.
(b) SWP Water Quality data not shown was not sampled by DWR.
(c) One sample available.
(d) Denotes secondary standard.

The Quartz Hill WTP was the first plant built by AVEK. The treatment plant receives water by gravity flow from the California Aqueduct. Screening and metering are provided at the head of the plant, followed by treatment chemical addition, flash mixing, tapered energy flocculation, clarification utilizing traveling bridges for sediment removal, dual media filters, and disinfection. Treated water is stored in a 9.2 million-gallon reservoir which supplies water by gravity into the distribution system. Decanted water from the solids removal process is returned to the plant influent. After the completion of a recent expansion, the Quartz Hill WTP became capable of producing 90 mgd of potable water for consumers.

Expansion of the Eastside WTP located between Littlerock and Pearblossom to 10 mgd was completed in late 1988. It can now serve the needs of about 44,000 consumers.

The 14 mgd Rosamond WTP was established to support the needs of consumers in southeastern Kern County, an area that includes Rosamond, Mojave, California City, EAFB and Boron. Rosamond WTP is capable of providing water for 60,000 consumers.

The 4 mgd Acton WTP was completed in 1989. Water is pumped from the plant site near Barrel Springs Road, on Sierra Highway, to Vincent Hill Summit. From there it is pumped into a Los

Angeles County Waterworks pipeline for transport to the Acton area. The plant's capacity is sufficient to supply the needs of 17,000 consumers.

3.2.3 Wastewater and Recycled Water Quality

Tertiary treated effluent from the Region's three water reclamation plants will be of sufficient quality to meet unrestricted use requirements. It may then be used for irrigating landscapes of freeways, parks, schools, senior complexes and new home developments. The effluent will also meet all Waste Discharge Requirements (WDRs). Revised WDRs for the Lancaster WRP were issued in 2009 and in 2011 for the Palmdale WRP. For recharge of recycled water, blending or additional water quality requirements may be needed. The management of TDS and nutrients from recycled water will be addressed by the SNMP for the Antelope Valley, an effort that is being conducted in parallel with this 2013 IRWMP Update. Recycled water from the EAFB Air Force Research Laboratory Treatment Plant and the Main Base WWTP is not included in this discussion of recycled water quality since all water is used on the base.

3.2.4 Local Surface Water and Stormwater Runoff Quality

Littlerock Reservoir, jointly owned by PWD and LCID, is the only developed surface water source in the Antelope Valley Region. The reservoir discharges to Lake Palmdale and the water is ultimately treated by PWD's WTP. The quality of the water in Lake Palmdale is considered good.

The Basin Plan for the Lahontan Region contains a specific ammonia objective for Amargosa Creek downstream of the LACSD 14 discharge point, and to the Piute Ponds and associated wetlands based on the USEPA 1999 freshwater criteria for total ammonia. This objective is pH and temperature dependent and shall not exceed the acute and chronic limits more than once every three years, on average. In addition, the highest four-day average concentration for total ammonia in a 30-day period cannot exceed 2.5 times the chronic toxicity limit.

The management of TDS and nutrients from imported water will be addressed by the SNMP for the Antelope Valley, an effort that is being conducted in parallel with this 2013 IRWMP Update.

3.2.5 Regional Water Quality Issues and Needs

The key issues, needs, challenges, and priorities for the Antelope Valley Region with respect to water quality include the following, which are discussed in greater detail below:

- Concern for meeting water quality regulations;
- Closed basin with no outfall for discharge;
- Must provide wastewater treatment for growing population;

3.2.5.1 Concern for Meeting Water Quality Regulations

The Region has a number of concerns regarding water quality regulations, including: (1) meeting water quality regulations for groundwater recharge, (2) meeting ever-evolving regulations, and (3) contaminants of concern.

Meeting Water Quality Regulations for Groundwater Recharge

There are a variety of source waters that could be available for recharge into the groundwater of the Antelope Valley Region. They include, but are not limited to:

- State Water Project:
    - Treated potable water
    - Untreated raw water direct from the California Aqueduct
- Reclaimed Water (for spreading only or blending):
    - Tertiary treated
- Captured Stormwater

The water quality of the recharged water depends on which supply is used. There are restrictions to the quality of the water recharged as outlined in the Lahontan RWQCB Basin Plan. Recharge source water would need to meet these requirements before recharge could occur. Additionally, requirements are stricter for water that is injected versus water that is percolated. Water that LACWD 40 recharged through its ASR program met the RWQCB's water quality requirement.

Meeting Evolving Regulations

In response to groundwater quality concerns, the RWQCB Lahontan Region is revising the WDRs for WRPs in the Antelope Valley Region. For example, the WDR for Palmdale WRP has been amended (Board Order R6V-2011-0012) to limit the reuse of secondary-treated effluent to only certain agricultural sites, and to list effluent concentration limits for both secondary and tertiary treated effluent. The ability to comply with these evolving regulations is expected to be both economically and technologically challenging.

Contaminants of Concern

Contaminants such as arsenic, nitrate, and potentially chromium-6 will require water suppliers, WRPs, and WTPs to conduct routine monitoring and sampling of their systems and could impact their treatment methods. The ability to remove these contaminants also has a positive economic impact on the agricultural community since it reduces the impact to crops. It also benefits the WRPs and WTPs striving for compliance with more stringent WDRs.

3.2.5.2 Closed Basin with No Outfall for Discharge

As described in Section 2, the Antelope Valley Groundwater Basin is a closed topographic basin with no outlet to the ocean. Therefore, any treated effluent (recycled water) generated in the Antelope Valley Region must be percolated, reused, evaporated, or transpired by plants. This places great responsibility on the wastewater treatment providers in the Antelope Valley Region to provide alternative effluent management methods while still being compliant with their WDRs.

3.2.5.3 Must Provide Wastewater Treatment for Growing Population

Population increases in the Antelope Valley Region will result in higher wastewater flow rates and the need to provide additional wastewater treatment and effluent management capacity. As mentioned above, the groundwater basin is a closed basin, so all treated effluent must be managed (e.g., reuse, evaporation, and percolation) and cannot simply be discharged to an ocean outlet. Wastewater projections through the planning period are indicated above in Section 3.1.4.

3.2.6 AB 3030 Water Quality Considerations

Additionally, the following AB 3030 elements relate to water quality management within the Antelope Valley Region. A discussion of how these elements are addressed in this IRWM Plan is provided below.

The Control of Saline Water Intrusion. Seawater intrusion is a natural process that occurs in nearly all coastal aquifers and is a condition of salt water flowing in to freshwater aquifers.

Seawater intrusion becomes a problem when excessive pumping of freshwater from an aquifer reduces the water pressure and draws seawater into new areas, degrading the water quality of those new areas. Since the Antelope Valley Region is not a coastal community, this AB 3030 plan element is not applicable. Furthermore, existing evidence suggests that the possibility of saline intrusion from other nearby aquifers is not likely because the basin is a closed basin.

Identification and Management of Wellhead Protection Areas and Recharge Areas. Identification and management of wellhead protection areas and recharge areas are important to both the quality of groundwater within the Antelope Valley Region, and for providing storage of available supplies in underground aquifers. Several groundwater recharge projects are being considered and evaluated as part of this IRWM Plan. The AVSWCA "Study of Potential Recharge Areas in the Antelope Valley" evaluated, identified, and ranked potential recharge sites within the Antelope Valley Region. Additionally, AVEK is considering expansion of water banking facilities; and Lancaster, Palmdale, and PWD are proposing recharge projects or feasibility studies as part of this IRWM Plan.

Regulation of the Migration of Contaminated Groundwater. Groundwater quality within the Antelope Valley Groundwater Basin is excellent within the principal aquifer but degrades toward the north. The main contaminant of concern in the Antelope Valley Region is arsenic. Boron CSD's Arsenic Management Feasibility Study and Well Design, part of this IRWM Plan, is one project under design to mitigate recent arsenic contamination. Other projects proposed to address this management component include recycled water projects that call for the regulation of the discharge of treated effluent into the local groundwater basins.

Administration of a Well Abandonment and Well Destruction Program. The purpose of a well abandonment and well destruction program is to regulate such activities for water, agricultural, or other wells (i.e., industrial, monitoring, observation, etc.) so that groundwater in the Antelope Valley Region will not be contaminated or polluted, and water obtained from wells will be suitable for beneficial use and will not jeopardize the health, safety or welfare of the people of the Antelope Valley Region. Administration of such a program could, for example, come through issuance of a countywide well destruction ordinance. This groundwater management component is considered as a potential management action within Section 6.

Identification of Well Construction Policies. Similar to the program purpose discussed above, a well construction policy is intended to regulate the construction, reconstruction, or modification of water, agricultural, or other wells (i.e., industrial, monitoring, observation, etc.) so that groundwater in the Antelope Valley Region will not be contaminated or polluted, and water obtained from wells will be suitable for beneficial use and will not jeopardize the health, safety or welfare of the people of the Antelope Valley Region. Administration of such a policy could, for example, come through issuance of a countywide well construction ordinance. This groundwater management component is considered as a potential management action in Section 6.

Construction and Operation by Local Agency of Groundwater Contamination Cleanup, Recharge, Storage, Conservation, Water Recycling, and Extraction Projects. This IRWM Plan includes an assessment of potential groundwater contamination clean-up (i.e., Arsenic Mitigation Project), recharge, storage, conservation, and expansion of existing water recycling projects.

3.3 Flood Management

The Antelope Valley Region is a closed watershed without a natural outlet for storm water runoff (LACDPW 1987). Precipitation in excess of 12 inches in the surrounding mountains creates numerous streams that carry highly erodible soils onto the valley floor, forming large alluvial river washes (Rantz, 1969 as cited in USGS 1995). Larger streams, including Big Rock Creek, Littlerock

Creek, Amargosa Creek, Cottonwood Creek, and Anaverde Creek then meander across the alluvial fans in poorly-defined flow paths that change from storm event to storm event.

Stormwater runoff that does not percolate into the ground eventually ponds and evaporates in the impermeable dry lake beds at EAFB near the Los Angeles/Kern County line (LACDPW 1987). The 60 square mile playa is generally dry but is likely to be flooded following prolonged precipitation. Fine sediments carried by the stormwater inhibit percolation as does the impermeable nature of the playa soils (LACDPW 1987). Historical flooding has shown surface water to remain on the playa for up to five months until the water evaporates (LACDPW 2006).

Portions of the Antelope Valley floor are subject to flooding due to runoff from the nearby foothills (City of Lancaster 1997). The flooding sometimes exceeds the capacities of the limited drainage facilities and engineered flood channels. Examples of existing flood control facilities include the engineered channels and retention basins on Amargosa Creek. Storms of a 20-year frequency or greater can overflow these facilities (LACSD 2005). There is also a flood retention basin along Anaverde Creek; and when this basin is overtopped, flooding occurs in the vicinity of 20th Street East, 30th Street East, and Amargosa Creek. Summer thunderstorms also increase the potential for flash floods, creating a yearlong potential problem.

Following severe flooding in the Antelope Valley Region in 1980, 1983, and 1987, the LACDPW prepared the “Antelope Valley Comprehensive Plan of Flood Control and Water Conservation.” This plan proposed floodplain management in the hillside areas, structural improvements in the urbanizing areas and non-structural management approaches in the rural areas. In the hillside areas, the plan recommended restricting development to areas outside of entrenched watercourses. In the areas prone to flooding, the plan recommended improvements such as open channel conveyance facilities and storm drains through communities as well as detention and retention basins located at the mouths of the large washes (LACDPW 1987).

Both the City of Palmdale and the City of Lancaster have incorporated major elements of the LACDPW comprehensive plan into their own planning efforts; however, there are no identified funding mechanisms or schedule for major improvements except in the established areas of Palmdale, Lancaster, and along Amargosa Creek (City of Lancaster 1997, LACDPW 2004). The cities have annexed portions of Los Angeles County, which coupled with a gradual decrease in housing construction since the early 1990s has limited County revenue from developer fees necessary to fund the construction of facilities in unincorporated areas of the Region.

In 1991, LACDPW teamed with the cities and unincorporated communities on a ballot measure whereby the portion of the Antelope Valley Region that lies within Los Angeles County would be included within the Los Angeles County Flood Control District, or a new Antelope Valley Flood Control District would be formed (LACDPW 2004). That measure failed as did a similar measure in Kern County; new measures proposed regionally in 2006 also failed. The lack of coordinated flood control is problematic and flooding will continue to increase in severity as urban development and associated impervious surfaces increase the potential amount of runoff and local flooding.

3.3.1 Regional Flood Management Issues and Needs

The key issues, needs, challenges, and priorities for the Antelope Valley Region with respect to flood management include the following, which are discussed in greater detail below:

- Lack of coordination throughout Antelope Valley Region;
- Poor water quality of runoff;
- Nuisance water and dry weather runoff;

- Difficulty providing flood control without interfering with groundwater recharge;
- Habitat and dry lakebed requirements to protect natural processes;
- Baseline flooding and sediment/erosion not well defined;
- No development guidelines for alluvial fans;
- Protection of habitat processes and sensitive habitats which rely on surface flow such as Antelope Valley Significant Ecological Areas (SEA), Piute Ponds, clay pans, mesquite woodlands, and dry lakes.

An Integrated Flood Management Summary Document was developed during the 2013 IRWMP Updates and is included in Appendix F.

3.3.1.1 Flood Management Efforts are not Well Coordinated throughout Antelope Valley Region

Flood management efforts are currently performed by local jurisdictions within their particular area (e.g., City of Palmdale undertakes flood control within its boundaries), but there is no regional entity that coordinates flood control for the entire Antelope Valley Region. In the past, Los Angeles County prepared a regional plan for flood control, but its implementation has been hindered by a lack of funds. Ballot measures that would result in the creation of regional flood control districts have failed in the region.

Flood management activities also need to be coordinated with other agencies, such as water purveyors, to support a multi-use perspective. For example, the development of stormwater capture and infiltration basins in the upper watershed areas will not only reduce flooding in the lower watershed (urban) areas but also contribute to groundwater recharge during the winter months. This groundwater recharge provides additional water supply in the summer months. In a similar fashion, activities of the development community will also need to be coordinated with flood management. New impervious surfaces not only increase peak surface flows but also decrease groundwater recharge capability.

3.3.1.2 Poor Water Quality of Runoff

Toxic pollutants are found within the Antelope Valley Region associated with the transport of sediment from the mountainous areas and mobilization of urban contaminants during storm events (Lahontan RWQCB 1994). Stormwater flows from the mountain areas to the Antelope Valley floor traverse highly erodible soils, which results in significant transport of sediments.

The sediment not only has the tendency to bulk peak flow and increase flood levels through sedimentation, but it also transports naturally-occurring contaminants such as arsenic and other heavy metals. Other contaminants, such as salts associated with de-icing of roads and parking lots are carried to the valley floor during rainfall events. In urban areas on the valley floor, contaminants such as pesticides, trash, oil, gasoline, radiator fluid, and animal wastes accumulate during dry months and are then mobilized at concentrated levels during storm events.

Runoff from urban areas is increasing as the Antelope Valley Region develops. The heavy sediment content and urban runoff contaminants make this storm water flow undesirable for many uses, and poorly planned urban development further upsets the natural system within a watershed as follows:

- Direct impacts such as filling of wetlands, riparian areas, drainages, and other natural waters;
- Generation of pollutants and sediment during and after construction;
- Alteration of flow regimes;
- Reduction of groundwater recharge by impervious surfaces and stormwater collector systems;
- Disruption of watershed-level aquatic functions including pollutant removal, flood water retention, and habitat connectivity.

These impacts typically degrade water quality, increase peak flows and flooding, and destabilize stream channels. The resulting condition then requires engineered solutions to the disrupted flow patterns which lead to near-total loss of natural functions and values in the affected basins. Impacts can be minimized through municipal stormwater programs that require use of Best Management Practices (BMPs) and conditions to be placed on new development proposals. Ideally stormwater programs would be developed through stakeholder involvement as part of an integrated program that would identify concepts and projects developed to maximize flood control benefits, water quality benefits, water supply benefits, and protection of natural surface flow routes and levels thereby protecting natural environments downstream.

3.3.1.3 Nuisance Water and Dry Weather Runoff

Stagnant or “nuisance” water is standing water that ponds and fails to infiltrate even after prolonged periods. In the Antelope Valley Region there are several areas with impervious soils (including the dry lakes at EAFB) and perched clay layers prone to supporting nuisance water.

Dry-weather runoff is defined as urban runoff water that enters the drainage system due to human activities (e.g., car washing, lawn irrigation). Dry-weather runoff can also result from illicit connections to the storm water or sewer systems. This type of runoff concentrates contaminants in urban runoff and can negatively affect the water quality of receiving waters (e.g., groundwater).

Nuisance water and other dry weather flows need to be managed to prevent accumulation of contaminants by providing short and long term solutions through an integrated approach.

3.3.1.4 Difficulty in Providing Flood Management without Interfering with Groundwater Recharge

The Antelope Valley Region is underlain by groundwater, which is a major source of water supply in the area. A poorly-designed flood management program could slow, limit, or direct groundwater recharge to unfavorable areas. In addition, groundwater recharge focused on recharge of stormwater flows could introduce urban runoff contaminants into the groundwater aquifer. Ideally, excess stormwater could be properly treated and directed to areas that allow recharge of groundwater through an integrated management program that combines flood management, water quality improvements, and water supply augmentation.

3.3.1.5 Habitat and Dry Lakebed Requirements to Protect Natural Processes

Stormwater runoff within the Antelope Valley is carried by ephemeral streams. Between 0.36 inches and 0.56 inches of rainfall in the first 24 hours is required to saturate the soils and initiate surface flow runoff. As runoff moves from the headwaters to the lakebeds, some of the flow percolates into the stream beds and recharges the groundwater. Other portions flow through well-defined washes that change to braided alluvial fan washes and then top the channels and move as sheet flow across the lower valley floor, filling clay pan depressions (similar to vernal pools and potholes) and wetlands (most notable being Piute Ponds). Some of this water percolates into sand dunes where the water is sequestered for later use; the remainder flows down to the valley floor into the dry lakebeds at EAFB. The amount of flow depends on the size of the storm and how much rainfall has already occurred recently. It has been documented in the "Surface Flow Study Technical Report" (EAFB 2012) that a 5 year storm (approximately 2.5 inches) is sufficient to provide 946 +/- 189 acre feet of surface water flow to Rosamond Dry Lake with the peak discharge measured at 92 cfs. The total sediment discharge measured was 1,542 metric tons. However the error rate is high at +/- 30%. Rogers and Buckhorn Dry Lakes were not measured. Stormwater runoff is important to downstream habitats throughout the Valley. These habitats are seen at EAFB as particularly valuable to sustain the surface structure of the dry lakebeds for their operational missions, the overall air quality of the Antelope Valley, and the Piute Pond Complex's wetland functions and values (Deal 2013).

3.3.1.6 Baseline Flooding and Sediment/Erosion Not Well Defined

Although the mechanisms of flooding and sediment transport and deposition are well known in the Antelope Valley Region, very little definitive information is available regarding flood extents, depths, velocities or areas of deposition and sedimentation. The Federal Emergency Management Agency (FEMA) conducted hydrologic and hydraulic analysis of the region starting in the early 1980s and ending in the late 1990s to prepare approved Flood Insurance Rate Maps (FIRM). The FEMA analysis was done at different times and to different levels of detail for different panels and does not include EAFB. The mapping FEMA provided for the different flooding zones should be viewed as approximate and is in need of an update.

3.3.1.7 No Development Guidelines for Alluvial Fans

Alluvial fans are classified as high flood hazard areas according to FEMA and development on alluvial fans is discouraged. Although development is discouraged, there are engineering techniques that can reduce the risk of property loss or loss of life. A guidelines document could be developed that presents the risks of alluvial fan flooding along with mitigation techniques and approximate costs for the Antelope Valley Region.

3.3.1.8 Protection of Habitat Processes and Sensitive Habitats which rely on Surface Flow such as Antelope Valley Significant Ecological Areas (SEA), Piute Ponds, Clay Pans, Mesquite Woodlands, and Dry Lakes

Habitat processes and sensitive habitats that rely on surface flow are discussed in more detail in Section 3.4.

3.4 Environmental Resources

The Antelope Valley Region is part of a subbasin within the Mojave Desert. The climate and physical environment is typical of the high desert with the exception of the southern edge of the Antelope Valley Region which includes a cooler upland area. The area has many unique environmental features and several plant and animal species are endemic to this desert area.

Unique Habitats

The Antelope Valley Region is generally flat and sparsely vegetated, but is interspersed with buttes, mountain ranges, and dry lakes (Bureau of Land Management [BLM] 2005). Rogers Lake is the largest and flattest playa in the world (BLM 2005). Freezing temperatures are limited to a few winter days but in the summer temperatures often exceed 100 degrees Fahrenheit. The Antelope Valley Region is characterized by creosote bush and saltbush plant communities which make up approximately 75 percent of the natural lands in the Western Mojave Desert. A small percentage of natural lands in the area can be characterized as Mojave mixed woody scrub community. A very small percentage of the Antelope Valley Region could be characterized as freshwater or alkali wetlands (BLM 2005). A comprehensive delineation of wetlands in the Antelope Valley Region has not been conducted. However, the Antelope Valley Region is home to numerous desert washes (Little Rock Creek, Big Rock Creek, Amargosa Creek, Cottonwood Creek System), as well as man-made lakes (Little Rock Creek Reservoir, Lake Palmdale), sag ponds (an enclosed depression formed where active or recent fault movement results in impounded drainage), and areas of rising groundwater. Freshwater marsh, wetland, and alkaline meadow habitat is present within the Piute Pond Complex. Wetland and wash areas are found within the Mesquite woodland. While wetland and riparian areas are limited in the Antelope Valley Region, these areas are important resources to birds migrating along the Pacific Flyway (LACSD 2004).

The unique habitat of the Antelope Valley Region means the Region is also home to several special status species, including plants, reptiles, birds, and mammals. Several regulatory protections and practices for these special status species are in place in the Antelope Valley Region, such as SEA designations by Los Angeles County, Desert Wildlife Management Area (DWMA) designations by USFWS, and development of a Habitat Conservation Plan (HCP) by the BLM.

Habitat Conservation

Habitat conservation activities in the Region include the establishment of SEAs and the development of habitat conservation plans such as the Antelope Valley Region Areawide Plan and the West Mojave HCP.

SEAs are defined by Los Angeles County and generally encompass ecologically important or fragile areas that are valuable as plant or animal communities and often important to the preservation of threatened or endangered species. Preservation of biological diversity is the main objective of the SEA designation. SEAs are neither preserves nor conservation areas, but areas where Los Angeles County requires development to be designed around the existing biological resources (Los Angeles County 2006). Design criteria in SEAs include maintaining watercourses and wildlife corridors in a natural state, set-asides of undisturbed areas, and retaining natural vegetation and open space (Los Angeles County 1986).

The three Significant Ecological Areas in the Antelope Valley Region according to the Draft Los Angeles County General Plan Update include the Antelope Valley SEA, the Joshua Tree Woodland SEA, and the San Andreas SEA. (Los Angeles County 2012)

Antelope Valley SEA

The Antelope Valley SEA is located within the central portion of the Antelope Valley, primarily east of the cities of Palmdale and Lancaster, within a predominantly unincorporated area of Los Angeles County. This area includes tributary creeks to Littlerock and Big Rock Creeks downstream to the valley floor and floodplain zones of Rosamond, Buckhorn and Rogers dry lakes. Given the large area encompassed by this SEA, it has a highly diverse biota along with diverse desert habitats.

The watershed areas upstream of the dry lake beds provide wash, scrub, and desert riparian habitat for various plant, bird and burrowing mammal species. In particular, the South Fork of Big Rock Creek is part of the federally-designated critical habitat of the mountain yellow-legged frog, and serves as nesting area for bird species such as the gray vireo. The dry lake beds serve as habitat for many desert plants and wildlife species once found broadly across the Valley. The Piute Ponds and dry lakes have distributed habitat of marshy alkali grassland, alkali flats, and cattail and bulrush marsh augmented by wastewater treatment facilities that have additional ponds. The dry lake beds contain botanical features unique and limited in distribution, including the Mojave spineflower and the only healthy stands of mesquite in Los Angeles County.

The Desert-Montane area of this SEA, which centers on Mescal Creek, provides a combination of desert and montane habitats, making this one of the most diverse areas in the County. Beside creosote bush scrub, sagebrush scrub, and Joshua tree woodland found in the desert floor, this area also includes pinyon-juniper woodland, desert chaparral, and mixed conifer forest habitat. While some of these are considered common habitats, the area is valuable because this SEA is the only site where these communities are found in an uninterrupted band.

The Antelope Valley SEA also includes desert butte habitat which has increased biological diversity relative to surrounding areas. The steep slopes of buttes act as refuges for many biological resources. Desert buttes provide roosting and nesting areas for birds, den sites for mammals, and habitat for the desert wildflower and Joshua tree woodland areas. Suitable habitat for the Mojave ground squirrel (listed as "Threatened" under the California Endangered Species Act and "Special Concern" by the federal Endangered Species Act) is found in these butte areas.

Joshua Tree Woodland SEA

The Joshua Tree Woodland SEA is located in the western portion of the Antelope Valley in unincorporated Los Angeles County west and northwest of the Antelope Valley California Poppy Reserve. This SEA provides habitat to various plant and animal communities, particularly Joshua tree woodland. The scrubland, woodland and grassland habitats in this SEA provide foraging and cover habitat for year-round resident and seasonal resident song birds and raptors. In addition to Joshua trees, sensitive species in this SEA include the alkali mariposa lily, California horned lizard, golden eagle, Swainson's hawk, burrowing owl, loggerhead shrike, western mastiff bat, and Tehachapi pocket mouse.

San Andreas SEA

The San Andreas SEA is located in the western portion of the Antelope Valley in unincorporated Los Angeles County, and includes a small portion of the western Tehachapi foothills and then stretches in a southeasterly direction to include Quail Lake, the northern foothills of Liebre Mountain and Sawmill Mountain, large portions of Portal Ridge, Leona Valley, Ritter Ridge, Fairmont and Antelope Buttes, Anaverde Valley, Lake Palmdale, and terminating at Barrel Springs (a sag pond near the City of Palmdale). Vegetation in this SEA is extremely diverse, and includes desert scrub, chaparral, grassland, wildflower fields, southern willow scrub, foothill woodland, Joshua tree woodland, oak woodlands, southern cottonwood-willow riparian forest, freshwater marsh, alkali marsh, alluvial wash vegetation and ruderal vegetation. Given this variety of vegetation, wildlife within this SEA is diverse and abundant, and includes a number of sensitive species such as the California red-legged frog, California horned lizard, prairie falcon, southwestern willow flycatcher, Mojave ground squirrel, and the California condor.

West Mojave Plan

The *West Mojave Plan* is an HCP developed by the BLM with collaboration from multiple other jurisdictions and agencies, including the City of Palmdale, City of Lancaster, Los Angeles County, the California Department of Fish and Game, and the USFWS. The *West Mojave Plan* also acts to amend the California Desert Conservation Area Plan. The Planning Area for the *West Mojave Plan* includes the entire Antelope Valley Region. The objective of this HCP is to develop a comprehensive strategy to preserve and protect the desert tortoise, the Mojave ground squirrel, and over 100 other sensitive plants, animals and habitats. The HCP would establish additional conservation areas for the desert tortoise and Mojave ground squirrel and alter allowable motorized vehicle routes on BLM managed lands. Jurisdictions that have adopted the HCP must follow the selected conservation strategies, but benefit from a streamlined process when permitting activities that may affect endangered species covered by the plan (BLM 2005).

Open Space Areas

The open space and rural character of the Antelope Valley Region is treasured by many of its residents. During a poll conducted as part of its General Plan Update, the City of Lancaster found that “open space,” “views,” and “desert environment” were commonly cited as key to the area’s quality (City of Lancaster 2006). Typical population densities in southern California suburban areas generally range from roughly 2,500 persons per square mile and increase to more than 7,500 persons per square mile in urbanized areas. By comparison, the high desert area (Mojave Desert in general) only averages about 680 persons per square mile (BLM 2005). The Census Bureau utilizes a minimum threshold of 1,000 persons per square mile to denote an urbanized setting. The Antelope Valley Region is characteristic of a large rural environment.

Ecological Processes

The ecological integrity of the Antelope Valley Region includes a critical range of variability in its overall biodiversity, important ecological processes and structures, regional and historical context, and sustainable cultural practices. The ability to maintain biodiversity and ecosystem health while accommodating new growth is a challenge in the Antelope Valley Region, which is home to a variety of unique and sensitive species endemic to the area. An overriding consideration becoming more prevalent with the implementation of the West Mojave Plan is the promotion of ecosystem processes that sustain a healthy desert ecosystem. Knowledge to support management decisions will require improved understanding of desert ecology.

We need to understand processes that change ecosystem dynamics because they are the most effective tools available to land managers who are asked to maintain or restore the health of the natural environment. Important ecological processes in the Antelope Valley Region include competition (for nutrients, water, and light), fire, animal damage, nutrient cycling, carbon accumulation and release, and ecological genetics.

Understanding genetic structure is basic knowledge for implementing biologically sound programs dealing with breeding, restoration, or conservation biology, all of which is at the basis of the West Mojave Plan for endangered species in the Region (e.g., desert tortoise and Mojave ground squirrel). Genetic structure also determines responses to changing conditions regardless of whether change is induced by management, lack of management, fluctuating climatic gradients, or global warming.

3.4.1 Regional Environmental Resource Issues and Needs

The following is a list of the key issues, needs, challenges, and priorities for environmental management within the Antelope Valley Region, as determined by the stakeholders:

- Conflict among industry, growth, and preservation of natural areas and open space/Desire to preserve open space;
- Protection of threatened and endangered species; and
- Removal of invasive non-native species from sensitive ecosystems.

3.4.1.1 Conflict among Industry, Growth and Preservation of Natural Areas and Open Space/Desire to Preserve Open Space

As described earlier, because of its proximity to the Los Angeles Area, the Antelope Valley Region is subject to increasing demand for community development, recreation, and resource utilization. As described in Section 2.10, population in the Antelope Valley Region is expected to increase by

153 percent between 2010 and year 2035. Some of this growth will result in conversion of agricultural land, but more of this growth will occur in locations that are currently natural areas. Loss of both agricultural acreage and natural areas decreases the amount of open space in the Antelope Valley Region.

3.4.1.2 Protection of Threatened and Endangered Species

Pressures for growth and recreational activities in the Antelope Valley Region have been linked to significant declines in desert species such as the desert tortoise, Mojave ground squirrel and burrowing owl. Growth of urban areas results in loss of available or suitable habitat for sensitive species. For example, studies of the desert tortoise have shown a significant downward decline in the population from 1975 to 2000 related to urban growth (USFWS 2006).

Besides loss of habitat, proximity to human development can be harmful to sensitive species. Human development introduces roadway traffic, pesticides, urban runoff, and non-native species, which degrade habitat and food sources for sensitive species. Land use practices, such as cattle and sheep grazing and mining are also considered harmful to many species. Recreational uses, such as off-highway vehicle use, are known to conflict with sensitive species habitat. For example, a vehicle traveling over a tortoise burrow could cause a desert tortoise to be trapped inside the burrow or make the burrow unusable when they are needed to escape predation or extreme weather conditions (USFWS 2006). In recreational areas, sensitive wildlife may seek shelter in the shade of vehicles and be crushed when those vehicles are subsequently moved. Improper disposal of food wastes and trash by recreational users often attracts predators of the sensitive species, such as common ravens. Dogs brought onto public lands by recreational visitors can also disturb, injure, or kill sensitive species.

3.4.1.3 Removal of Invasive Non-native Species from Sensitive Ecosystems

Non-native species (such as arundo and tamarisk) are listed as 'A-1' invaders (the most invasive and widespread wildland pest plants) by the California Invasive Plant Council and as noxious weeds by the California Department of Food and Agriculture (CDFA). While the degree and specifics of problems associated with these species vary, general negative effects associated with the establishment of tamarisk within the Antelope Valley Region include the following:

- Water Quality: Reduction in the shading of surface water, resulting in reduction of bank-edge river habitats, higher water temperature, lower dissolved-oxygen content, elevated pH, and conversion of ammonia to toxic unionized ammonia.
- Water Supply: Loss of surface and groundwater through heavy consumption and rapid transpiration.
- Flooding: Obstruction of flood flows with associated damage to public facilities, including bridges and culverts, and to private property, such as farm land.
- Erosion: Increased erosion of stream banks, associated damage to habitats and farmlands due to channel obstructions, and decreased bank stability associated with shallow-rooted arundo.
- Fire Hazards: Substantially increased danger of wildfire occurrences, intensity, and frequency, and a decrease in the value that riparian areas provide as firebreaks or buffers when infested with arundo.
- Native Habitats: Displacement of critical riparian habitat through monopolization of soil moisture by dense monocultures of arundo and tamarisk (particularly near Piute Ponds).

- Native Wildlife: Reduction in diversity and abundance of riparian-dependent wildlife due to decreased habitat quality, loss of food and cover, and increased water temperatures.
- Threatened and Endangered Species: Substantial reductions in suitable habitat available for state and federally listed species such as the least Bell's vireo.

3.5 Land Use

Cities and counties (for unincorporated areas) are the regulatory agencies responsible for land use planning within the State of California. Land use regulations and policies such as general plans, zoning ordinances, California Environmental Quality Act (CEQA) compliance, and permit conditions can be valuable policy and implementation tools for effective water management. The California Government Code establishes requirements for the development of General Plans to guide land use decisions, of which water resources play an important role. "Water resources" is typically not an 'element' of a General Plan, but is discussed within the context of the General Plans required 'elements'; land use, circulation, housing, conservation, open space, noise, and safety.

Land uses within the Antelope Valley Region are provided for in local and regional policies and regulations, including the Los Angeles County General Plan (adopted in 1980), the Antelope Valley Areawide General Plan (adopted December 1986), Kern County General Plan (approved June 2004), the City of Palmdale General Plan (last updated 1993) and the City of Lancaster General Plan (last updated 1997). The Los Angeles County General Plan, last adopted in 1980; is currently being updated as part of a multi-year planning effort.

State legislation has also addressed the gap between land use planning and water resource management. In 2001, two water supply planning bills, Senate Bill 610 (SB 610) and Senate Bill 221 (SB 221), were enacted that require greater coordination and more extensive data to be shared between water suppliers and local land use agencies for large development projects and plans. SB 610, codified as Water Code sections 10910 and 10911, requires the public water system that may supply water to a proposed residential development project of more than 500 dwelling units (or a development project with similar water use), to prepare a water supply assessment for use by the lead planning agency in its compliance with CEQA. Such a water supply assessment (WSA) is performed in conjunction with the land use approval process associated with the project and must include an evaluation of the sufficiency of the water supplies available to the water supplier to meet existing and anticipated future demands. SB 221 requires projects which include tentative tract maps for over 500 dwelling units to obtain verification from the water system operator that will supply the project with water that it has a sufficient water supply to serve the proposed project and all other existing and planned future uses, including agricultural and industrial uses, in its area over a 20-year period, even in multiple dry years. SB 221 is intended as a "fail safe" mechanism to ensure that collaboration on finding the needed water supplies to serve a new large subdivision occurs before construction begins.

As growth in the Antelope Valley Region is rapidly increasing, and larger development projects are being proposed, the preparation of WSAs or written verifications pursuant to these bills is becoming increasingly more common, forcing water purveyors in the area to question their ability to provide service to these developments. If water supplies are deemed not available, developers in the Antelope Valley Region will be required to find water outside the Antelope Valley Region in sufficient quantities to serve their projects.

3.5.1 Regional Land Use Issues and Needs

The key issues, needs, challenges, and priorities for the Antelope Valley Region with respect to land use management include the following, which are discussed in greater detail below:

- Growing public demand for recreational opportunities;
- Pressure for growth in the Antelope Valley Region;
- Loss of local culture and values; and
- Dust control.

3.5.1.1 Growing Public Demand for Recreational Opportunities

The Antelope Valley Region offers many recreational opportunities. The Antelope Valley Region has over 410 acres of developed park land including 27 parks, 22 softball fields, five baseball fields, 21 soccer fields and 17 tennis courts. In addition there are over 3,000 acres of natural park land and approximately 5,600 acres of upland and wetland natural areas at Piute Ponds. The Antelope Valley Region is also home to the 1,700 acre California Poppy Reserve and the Arthur B. Ripley Desert Woodland State Park. A portion of the Sierra Highway between Avenue H and the Kern County line is designated as a bikeway in the Antelope Valley Areawide Plan. Many recreational activities take place in the eastern, less populated areas of the Antelope Valley Region. BLM has identified the following types of recreational activities in the high desert: motorcycle activities, four wheel drive exploring, sightseeing, target shooting, hunting, experimental vehicles/aircraft, model rocketry, dry land wind sailing, endurance equestrian rides, hiking, mountain biking, bird watching, botany, rockhounding, camping, and picnicking.

The Antelope Valley Region is located only 90 miles from downtown Los Angeles; the proximity allows residents to utilize the Antelope Valley Region as their "recreational backyard." The high desert Antelope Valley Region has attracted nearly 2 million visitor-trips a year for off-highway vehicle recreation and nearly 1.5 million visitors to State and National Parks in the area (BLM 2005). BLM estimates that 85 percent of recreational visitors to the high desert are from the urban areas of Southern California. Demand for recreational resources in the Antelope Valley Region is particularly acute due to the lack of other similar resources near these urban areas and due to a decrease in recreational opportunities elsewhere. For example, since 1980 the number of acres of off-highway vehicle recreation areas has decreased by 48 percent in California. In the same time period off-highway vehicle registrations in California increased by 108 percent (BLM 2005). As population increases in Southern California and the Antelope Valley Region, there will be increasing pressure to maintain and expand the Antelope Valley Region's recreational opportunities.

3.5.1.2 Pressure for Growth in the Antelope Valley Region

Historically, land uses within the Antelope Valley Region have focused primarily on agriculture. This is partly dependent on the types of soils found in the area, the majority of which have been classified by the U.S. Soil Conservation Service as prime soils, which are best for agricultural production. Coupled with lower water costs and favorable climatic conditions, productivity has been maintained throughout the years, although pressures for developable land have also increased (Los Angeles County 1993). Approximately 73,000 acres of land in the Antelope Valley Region were in agricultural production in the early 1950s (USGS 1995). There was a surge in irrigated acreage when AVEK introduced SWP water to the western Antelope Valley Region in 1972 at prices competitive with the costs of pumping

ground water (LACDPW 1989). However, the overall trend for agricultural land use continued to decrease through the 1980s and 1990s. During the late 1980s, carrot farmers in the San Joaquin Valley undertook marketing efforts to assess the acceptability of a potential new product, "baby carrots," to the public. Response was so positive that within only a few years, an entirely new market was created. Demand for these new, smaller carrots was so high, and they were so profitable, that farmers expanded into the Antelope Valley Region and other desert regions in search of additional planting acreage. The profit margin of this crop is such that cost of water is not a limiting factor for carrot farmers.

Currently, land uses within the Antelope Valley Region are in transition as the predominant land use is shifting from agriculture to residential and industrial. The increase in residential land use is evident from the population growth in the Antelope Valley Region. As presented in Section 2.10, growth in the Antelope Valley Region was slow until 1985, but increased rapidly (approximately 1,000 percent of the average growth rate between the years 1956 to 1985) as these land uses shifted. Population projections for the Antelope Valley Region indicate that nearly 550,000 people will reside in the Antelope Valley Region by the year 2035, an increase of approximately 153 percent from the 2010 population (refer to Section 2.10.2 for population projections analysis). The two most populous cities in the Valley Region are Lancaster and Palmdale. As residential development continues to grow within the middle of the Antelope Valley Region, the agricultural operations are now found farther to the west and east than in previous decades.

The large migration of people to the Antelope Valley Region is primarily based on economics. With significantly lower home prices than in other portions of Los Angeles County, the Antelope Valley Region has become an attractive and affordable alternative to living in the congested and expensive Los Angeles area. Additionally, it was recognized that the Antelope Valley Region is the last large available open space “opportunity” for development in Los Angeles County, including residential, commercial/industrial, retail, and agricultural.

Development in the Antelope Valley is also projected to be influenced by the construction of California’s high-speed rail. The rail is planned to head northbound from Los Angeles to Bakersfield through a station in Palmdale. With the addition of high-speed rail station connecting the Antelope Valley to the rest of the state, development pressures in the Region are likely to increase.

3.5.1.3 Local Culture and Values Could be Lost

The Stakeholders of this IRWM Plan have expressed concerns about the changing land use trends in the Antelope Valley Region, and feel that with the tremendous pressure for growth in the Antelope Valley Region, local culture and values could ultimately be lost.

Currently, industrial land use in the Antelope Valley Region consists primarily of manufacturing for the aerospace industry and mining. EAFB and the U.S. Air Force Flight Production Center (Plant 42) provide a strong aviation and military presence in the Antelope Valley Region. Reductions or realignments in the defense industry could adversely affect this presence.

Mining operations also contribute to the Antelope Valley Region’s industrial land uses. Mining, a large part of the history of the Antelope Valley, has been less prominent in recent years, yet there are several mines that still produce quantities of gold and silver. One such mine, the Golden Queen Mine (formerly known as the Silver Queen mine) is beginning a full scale recovery of gold, silver and aggregate within the next two years. A formal grand opening of the Golden Queen headquarters was completed in mid- October 2013 in the community of Mojave and many jobs are expected to come from the mining operation. Rio Tinto’s Borax mine in the community of Boron is considered one of the largest employers in the Antelope Valley aside from the U.S. Government, employing over

300 workers. Aside from these operations, rock and gravel quarrying is also conducted in the southeastern part of the Antelope Valley Region along the mountain foothills.

Land use shifts increase the demand for water supply and higher quality water, thereby increasing the competition for available water supplies. This change in land use and increase in supply competition affects the dependence on imported SWP and groundwater supply, impacts fluctuations in groundwater levels, and heightens concerns over the potential for contamination and reliability of these supply sources.

As the Los Angeles population rapidly expanded into the Antelope Valley Region, bringing with it the desire for more cultural amenities and new skills and resources, the Antelope Valley Region became more metropolitan in character. The increase in population and development of tract housing, retail centers and business parks has altered the formerly low density, rural and agrarian character of many local communities.

Today, competing demands are placed on limited available resources. Many of these competing demands stem from the range of local cultural values that characterize the Antelope Valley Region. Decisions regarding future land use and the dedication of water resources will need to weigh varying agricultural, metropolitan, and industrial needs as they continue to develop, and as the balance between these interests continues to change.

Stakeholders commonly expressed the need to develop a balance of resources, while preserving the area's natural environment and rural history. Despite the need to ensure economic vitality and longevity by bringing new industry and employment opportunities to the Antelope Valley Region, residents of the Antelope Valley Region believe preserving a "hometown" feel and developing a strong sense of neighborhood stability are critical to strengthening the identity of the community and Region. The preservation of existing natural open space, achieved in part through a development strategy focused on infill and parcel redevelopment combined with environmental conservation, are key components of preserving the Antelope Valley Region's rural character and strengthening the health, vitality and security of growing urban areas.

3.5.1.4 Dust Control

Dust control is a particular issue in the Antelope Valley as more land is disturbed and voided of vegetation by activities such as solar farming and mining. Disturbance to the soil causes a loss of soil protection that initiates dust issues and causes excessive runoff of soil particles and contaminants. Water supply can be impacted by a reduction of plant material in the soil that reduces soil permeability and water storage.

Water quality impacts from soil disturbance activities stem from an increase in runoff and a decrease in soil protection. Excessive runoff increases sediment and contaminant loading to streams and natural areas. Disturbed vegetation cover can also degrade ecosystems and delay the reestablishment of natural stream areas, which further impacts water quality.

Other environmental impacts from soil disturbance and vegetation cover loss include increased dust storms and lifestyle disturbance. Dust storms can cause road closures, a decline of populations in rural areas, and loss of utility services among other things. As land use in the Antelope Valley changes impacts to these resources need to be considered and balanced. As flood control and surface flow runoff diversion projects are considered, impacts to the dry lakebeds also need to be considered. A lack of surface water flow to maintain the cryptobiotic surface layer will cause breakdown of the lakebed surface structure and add to regional dust storm issues.

3.5.2 AB 3030 Land Use Considerations

The following AB 3030 elements also concern land use planning within the Antelope Valley Region. A discussion of how these elements are addressed in this IRWM Plan is provided below.

Development of Relationships with State and Federal Regulatory Agencies. As discussed in Section 1.2 several State regulatory agencies have participated in the development of this IRWM Plan and thus a relationship with these agencies has been established.

Review of Land Use Plans and Coordination with Land Use Planning Agencies to Assess Activities which Create a Reasonable Risk of Groundwater Contamination. As discussed in Section 1.2 several land use planning departments and agencies have participated in the development of this IRWM Plan and thus a level of coordination has been established. Additionally, as part of this IRWM Plan, projects selected for implementation are assessed for water quality and land-use impacts and integration, as well as for consistency with local and regional General Plan documents.

3.6 Climate Change

3.6.1 Identification of Vulnerabilities

Understanding the potential impacts and effects that climate change is projected to have on the Region allows an informed vulnerability assessment to be conducted for the Region's water resources. A climate change vulnerability assessment helps a Region to assess its water resource sensitivity to climate change, prioritize climate change vulnerabilities, and to ultimately guide decisions as to what strategies and projects would most effectively adapt to and mitigate against climate change. DWR has recommended IRWM Regions use the Climate Change Handbook for Regional Planning (developed by USEPA, DWR, Army Corps, and the Resource Legacy fund) as a resource for methodologies to determine and prioritize regional vulnerabilities. The Climate Change Handbook provided specific questions that help to identify key indicators of potential vulnerability, including:

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

The Region's Climate Change Subcommittee conducted an exercise to answer vulnerability questions taken from Box 4-1 of the Climate Change Handbook and associated the answers with potential water management issues/vulnerabilities. See Appendix H for the completed vulnerability question worksheet. Included in this analysis are qualitative vulnerability questions framed to help assess resource sensitivity to climate change and prioritization of climate change vulnerabilities within a region. Answers to vulnerability questions are given for the Region with local examples provided as justification for the answer. Vulnerability issues are prioritized in the next section.


The Climate Change Subcommittee discusses the vulnerabilities of the Region's water resources to climate change

3.6.2 Prioritization of Vulnerabilities

The vulnerability issues identified in the climate change analysis discussed above were reviewed by the Climate Change Subcommittee, and some of the language was refined to better articulate the vulnerability issues of the Region. The revised vulnerability issues were then prioritized into three tiers based upon the perceived risk and importance of the issue. Those vulnerabilities posing the greatest risk of occurrence and resulting in the greatest impacts upon occurrence were ranked as the highest priority.

The list of prioritized vulnerabilities developed by the Workgroup is shown in Table 3-19, and they are discussed further below. Note that the vulnerability issues shown in Appendix H do not exactly match those in Table 3-19 since refinements and edits were made to the vulnerabilities during the prioritization process.

Table 3-19: Prioritized Regional Vulnerability Issues

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

The justifications as to why the following vulnerability issues were classified as high priority are provided below:

- *Limited ability to meet summer demand and decrease in seasonal reliability*: The Region has high irrigation demands during summers. Increases in temperature due to climate change would likely increase this already high demand, as well as decrease supplies available.
- *Increases in flash flooding, with particular attention paid to the balance of flood control with habitat and lakebed needs which EAFB depends on*: As discussed previously, flooding is common in the Region, particularly in the foothill areas. The projected increase in storm intensity will likely increase the occurrence and intensity of flash flooding. This increase

will need to be managed carefully in light of habitats that depend on these seasonal flash floods and the needs of EAFB.

- *Lack of groundwater storage to buffer drought*: Groundwater levels are a longstanding issue in the Region. The Region is limited in terms of the groundwater stored from year to year, and has issues with groundwater quality in some areas. Should a prolonged drought occur, this resource may not be available to buffer supply needs during additional drought years.
- *Decrease in imported supply*: The Region is heavily dependent upon imported water supplies which are very susceptible to the impacts of climate change given their reliance on seasonal snowpack. The Region could not be solely dependent upon local resources to sustain the current economy, so some imported water must be secured. The supply is highly vulnerable at its source given the dependence upon the stability of the California Bay Delta levee system. Climate change impacts to this area from higher sea level rise and higher storm surges could be catastrophic to the supply.
- *Invasives can reduce supply available*: Invasive species are becoming more common in the Region, and may increase with the projected changes to temperature and precipitation. Certain invasive species, such as Tamarisk and Arundo, may reduce the water supply available for native species.
- *Increased impacts to water dependent species and decrease in environmental flows*: A number of water dependent species are present in the Region that require certain stream flows to maintain habitats, such as those species dependent on the Piute Ponds. The projected changes to local temperature and precipitation may impact these environmental flows, and impact water dependent species, particularly since these species have limited opportunity for migration.
- *Increased constituent concentrations*: Decreases in stream flows may reduce the ability for these streams to dilute water quality constituents. Should stream flows decrease due to increases in temperature and decreases in annual precipitation, the water quality of local streams may be impacted. In addition, the projected increase in wildfires in the surrounding mountains may lead to increased erosion and sedimentation in local streams.

It is the intention of the stakeholder group to maintain an ongoing process to gather data and revisit the prioritized vulnerabilities every five years along with other updates to the Antelope Valley IRWM Plan. This data collection and analysis will be directed by the A-Team.

3.7 DAC Issues and Needs

To help characterize DAC areas in the Region, identify DAC water resource issues, and develop implementation strategies (including a monitoring plan), two separate technical memoranda were prepared during the 2013 IRWMP Updates:

- *DAC Water Supply, Quality and Flooding Data Final Draft TM* (August 2, 2013) – This document explains the methodology used to identify DAC areas in the Region with census and Geographical Information System (GIS) tools; develops maps for DACs; documents the DAC outreach efforts undertaken as a part of the 2013 IRWMP Updates; and outlines specific issues for DACs related to water supply, water quality, and flooding. Maps are included that further illustrate the scope of these issues. The document also provides a preview of monitoring studies that are needed to address data gaps in these three water-related areas.
- *DAC Monitoring Plan Final Draft TM* (September 25, 2013) – This document summarizes the water supply, water quality, and flood protection issues for DACs in the Region; develops monitoring objectives; and provides guidance for data dissemination and reporting.

The monitoring objectives developed in this TM may be summarized as:

- Water supply
  - Track volume of supplies delivered to DACs by water source and supplier
  - Assess conditions of aging facilities (wells, treatment systems and pipelines) to determine need for new or improved infrastructure
- Water quality
  - Track the quality of drinking water delivered to DACs
  - Map groundwater quality issues in DACs to determine areas of poor groundwater quality and need for treatment
- Flood protection
  - Track flood incidents in DACs to determine need for flood infrastructure improvements (flood incident date and location, storm intensity, and flood depth.

For additional details on these topics, these documents are included in Appendix D.