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

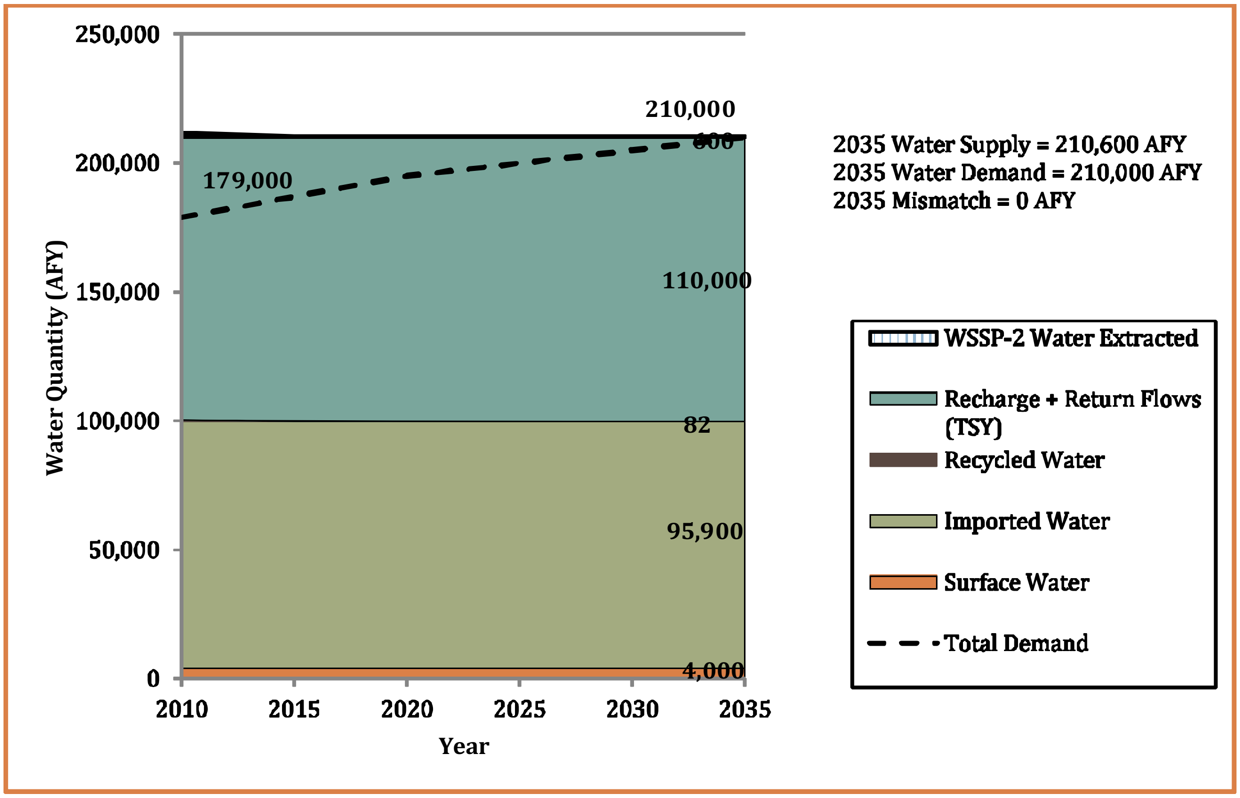


Table 3-14: Water Budget Comparison for an Average Water Year

	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

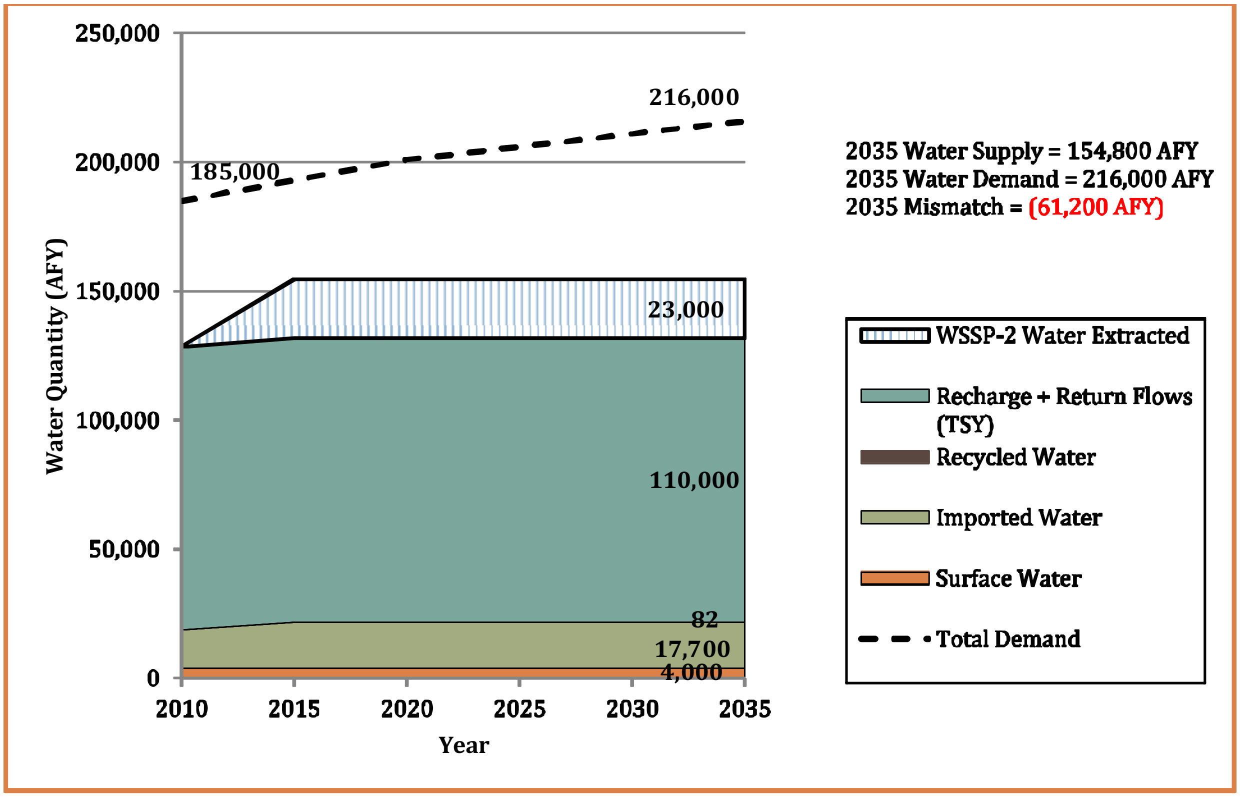


Table 3-15: Water Budget Comparison for a Single-Dry Water Year

	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

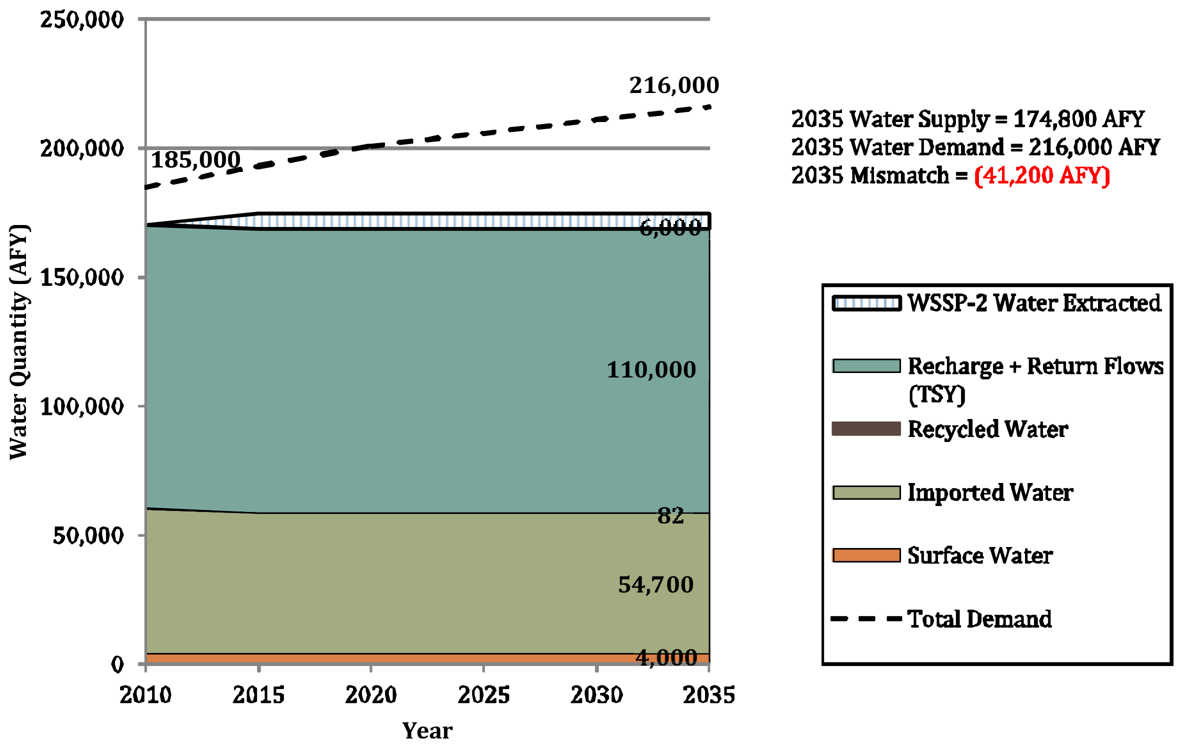


Table 3-16: Water Budget Comparison for a Multi-Dry Water Year

	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.

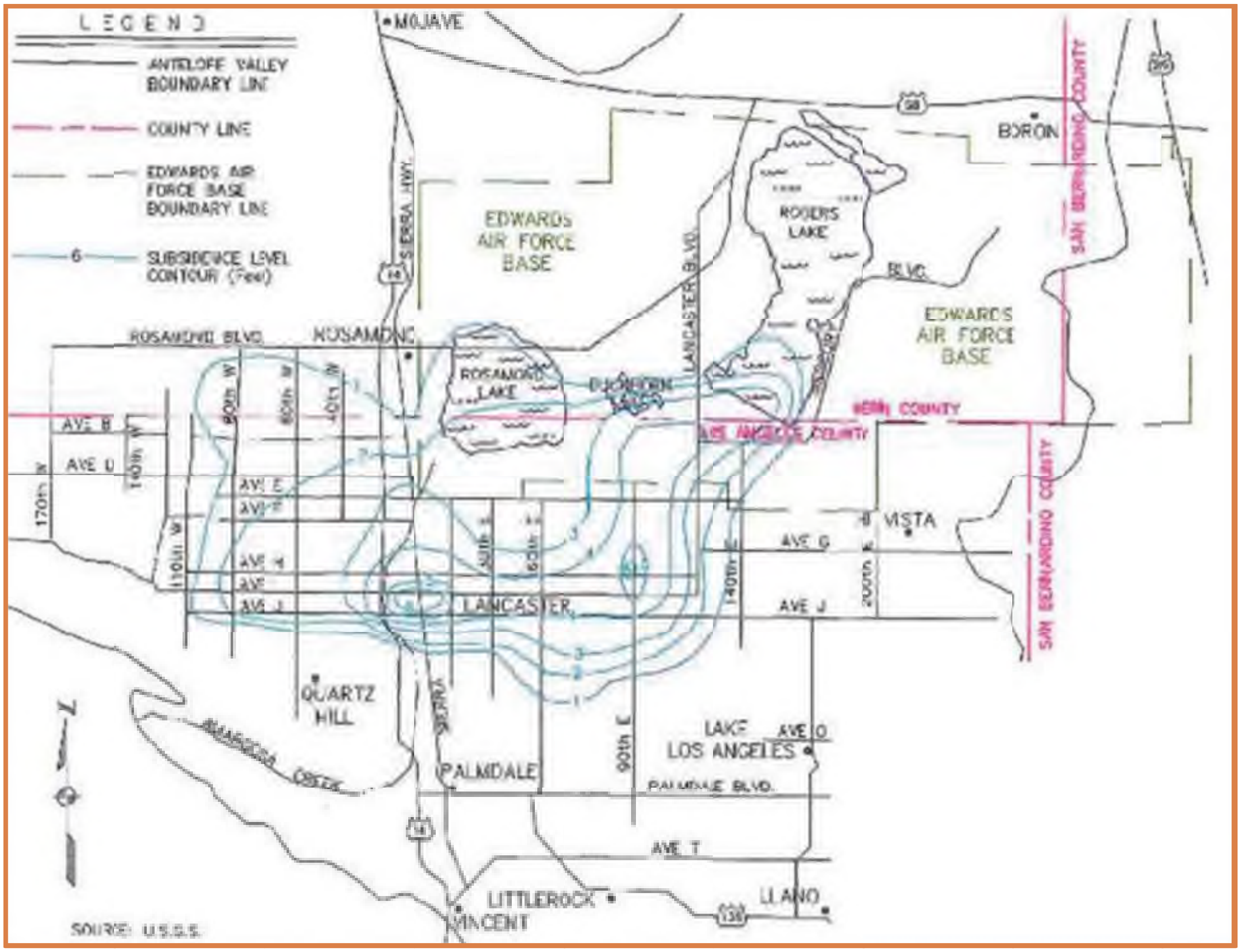
Table 3-17 lists land subsidence problems identified in Antelope Valley Region.

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



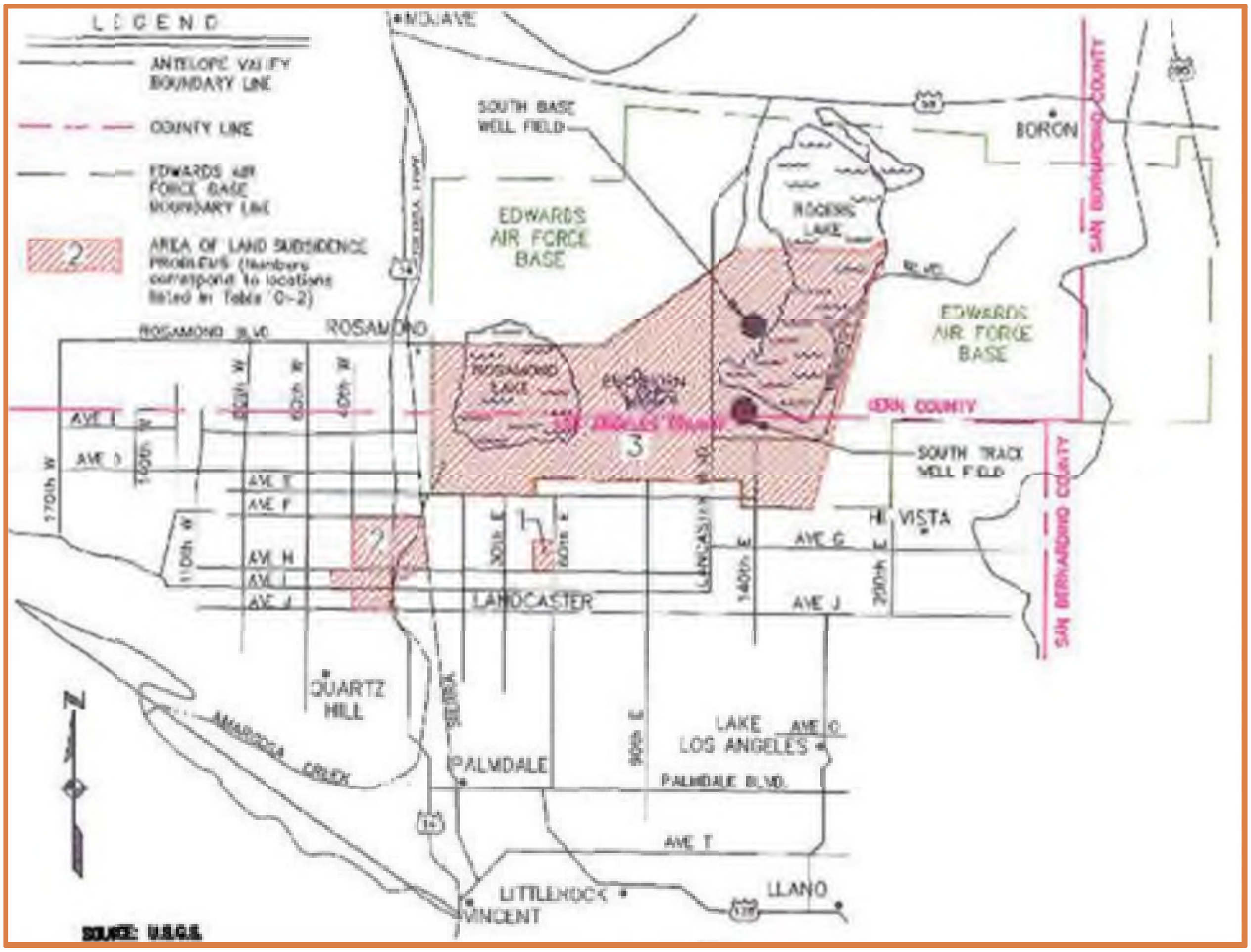
was potential contamination of the water table through fissures which can provide direct access for toxic materials.

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 5.57×10^{-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;