FINAL REPORT

Antelope Valley Water Resource Study

Antelope Valley Water Group

November 1995
K/J 934620.00

Kennedy/Jenks Consultants

PWS-0200-0001

Kennedy/Jenks Consultants

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10 November 1995

Antelope Valley Water Group
c/o City of Palmdale
708 East Palmdale Blvd.
Palmdale, CA 93551

Attention: Mr. Leon Swain

Subject: Antelope Valley Water Resource Study
K/J 934620.00 (6.01)

In accordance with our agreement dated 21 July 1993, Kennedy/Jenks Consultants is pleased to submit forty (40) copies of the final report of Antelope Valley Water Resource Study. The final report incorporates comments from the Antelope Valley Water Group as well as comments received as a result of the four public meetings held to present the results of the study.

The study provides an assessment of the water resources in the valley, develops a water conservation program for the valley, evaluates the feasibility of reclaimed water use, evaluates the feasibility of aquifer storage and recovery, discusses the effects of changes in groundwater levels and provides a water resource protection plan. Recommended actions are also included.

The public should note that the Antelope Valley Water Resource Study is not related to the Antelope Valley Storm Water Conservation and Flood Control District Act (Assembly Bill No. 65). In addition, the Antelope Valley Water Group members concur with Section 4, Part B of the Act which states:

> "Notwithstanding any other provision of law, the district [Flood Control District] may not adopt or implement any groundwater management plan ...unless all of the entities within the boundaries of the district...consent... In preparing, adopting, and implementing any plan, the district shall consult with those entities."

It was a pleasure to work with the members of the Antelope Valley Water Group on this important study. Please contact us if you have any questions or need additional information.

Very truly yours,

KENNEDY/JENKS CONSULTANTS

Lynn M. Takaichi

Lynn M. Takaichi
Vice President

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Enclosures (40)

ANTELOPE VALLEY WATER RESOURCE STUDY
ANTELOPE VALLEY WATER GROUP
K/J 934620.00

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CHAPTER 1

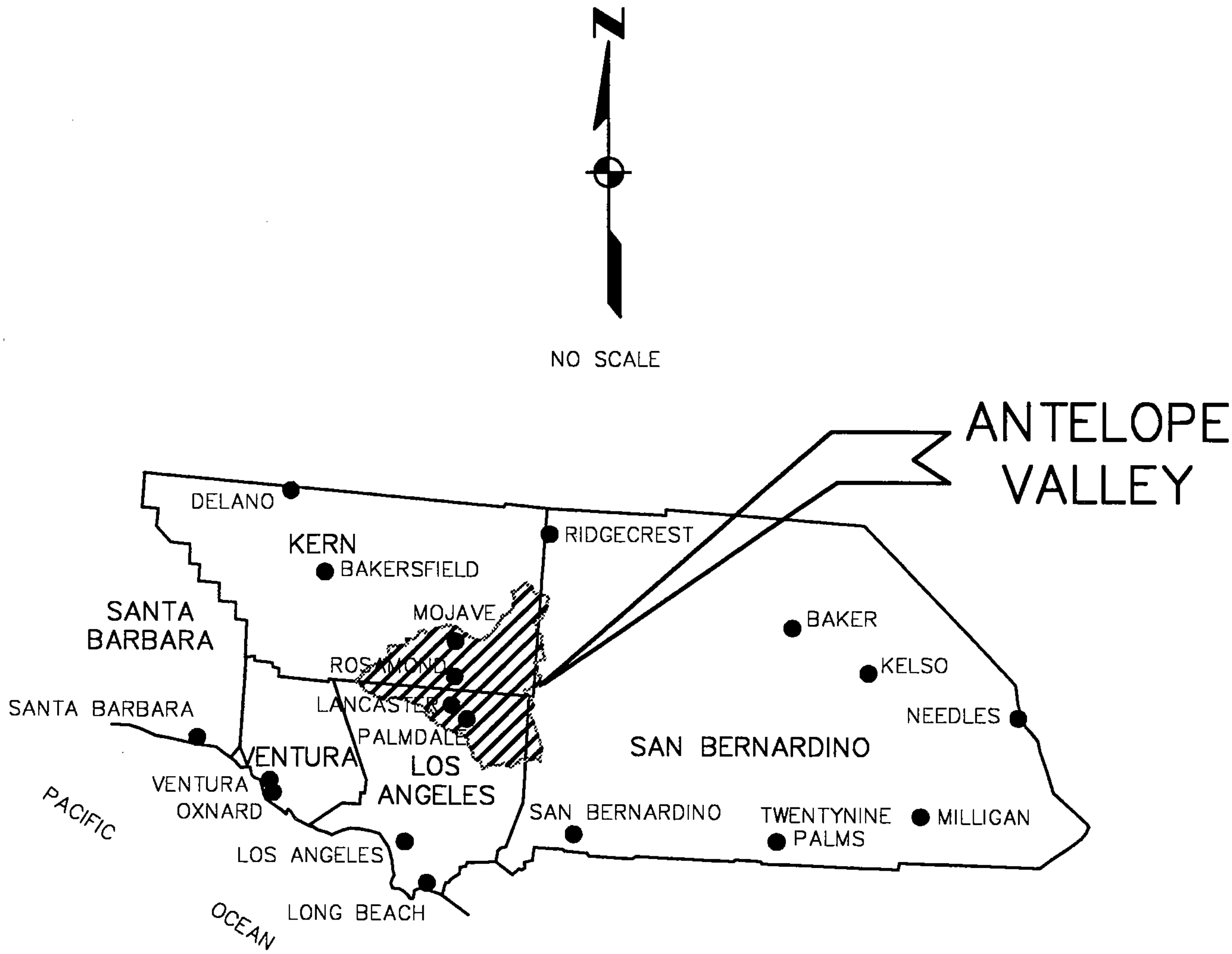
EXECUTIVE SUMMARY

As rapid development has increased the demand for both more water and higher quality water in the Antelope Valley, the competition for available water supplies has increased. Recent water resource studies by individual water purveyors have attempted to provide a technical foundation and/or management strategy for the area's water resources. However, these attempts have generally been met with criticism and mistrust. The Antelope Valley Water Group (AVWG) was formed in 1991 to provide a means of communication for the Valley agencies with an interest in water. Water Group members include the Cities of Palmdale and Lancaster, Edwards Air Force Base (Edwards AFB), Antelope Valley - East Kern Water Agency (AVEK), Antelope Valley United Water Purveyors Association (AVUWPA), Los Angeles County Waterworks Districts, (LACWW), Palmdale Water District (PWD), Rosamond Community Services District (RCSD), and County Sanitation Districts of Los Angeles County (CSDLAC). In an attempt to prepare a water resource study with a regional focus, rather than an individual focus, the AVWG initiated the Antelope Valley Water Resource Study.

STUDY AREA CHARACTERISTICS

The Antelope Valley, as defined for the purposes of this report, encompasses approximately 2,400 square miles in northern Los Angeles County, southern Kern County and western San Bernardino County. (See Figure ES-1.) The Valley is bordered on the southwest by the San Gabriel Mountains, on the northwest by the Tehachapi Mountains, and on the east by a series of hills and buttes that generally follow the San Bernardino County line. Major communities within the Valley include Boron, Edwards AFB, Lancaster, Mojave, Palmdale and Rosamond. Mean daily summer temperatures range from 63° Fahrenheit (F) to 93° F, and mean daily winter temperatures range from 34° F to 57° F. Precipitation ranges from 5 inches per year along the northern boundary of the Valley to 10 inches per year along the southern boundary.

The Antelope Valley is a closed basin. Surface water from the surrounding hills and from the Valley floor flow primarily toward three dry lakes on Edwards AFB: 1) Rosamond Lake, 2) Buckhorn Lake and 3) Rogers Lake. The most hydrologically significant streams include Big Rock Creek, Little Rock Creek, and Amargosa Creek. Except during the biggest rainfall events of a season, surface water flows toward the Valley from the surrounding mountains, quickly percolating into the stream bed and recharging the groundwater basin. Surface water flows that reach the dry lakes are generally lost to evaporation. The Little Rock Creek is the only developed surface water supply in the Valley. The Little Rock Reservoir, jointly owned by PWD and Little Rock Creek Irrigation District (LCID), collects run-off from the San Gabriel Mountains. The dam currently has a useable storage capacity of 600 acre-feet of water; however, PWD and LCID are planning modifications to the dam which will increase the storage capacity to 3,500 acre-feet.



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Antelope Valley Location Map

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Figure ES–1

PWS-0200-0015

The Antelope Valley Groundwater Basin is comprised of two primary aquifers: 1) the principal aquifer and 2) the deep aquifer. The principal aquifer is an unconfined aquifer. Separated from the principal aquifer by clay layers, the deep aquifer is generally considered to be confined. In general, the principal aquifer is thickest in the southern portion of the Valley near the San Gabriel Mountains, while the deep aquifer is thickest in the vicinity of the dry lakes on Edwards AFB. The Antelope Valley Groundwater Basin is divided into twelve subunits. The subunits are Finger Buttes, West Antelope, Neenach, Willow Springs, Gloster, Chaffee, Oak Creek, Pearland, Buttes, Lancaster, North Muroc, and Peerless.

Historically, land uses within the Valley have focused primarily on agriculture; however, the Valley is in transition from predominantly agricultural uses to predominantly residential and industrial uses.

Growth in the Antelope Valley proceeded at a slow pace until 1985. However, between 1985 and 1990, the growth rate increased approximately 1,000 percent from the average growth rate between the years 1956 to 1985. Historical and projected population for the Antelope Valley are shown in Table ES-1 and depicted on Figure ES-2. The medium population curve is selected for use in this report. Projections indicate that approximately 986,000 people will reside in the Valley by the year 2020. This represents an increase of approximately 278 percent from the 1990 population. It is noted that population forecasting is not an exact science due to an element of uncertainty to whether or not the projections will be truly realized. Additionally, the population projections used in the report were obtained from sources that may have been influenced by the rapid growth that occurred in the Valley prior to 1990. Areas of concentrated population within the Valley include Lancaster, Palmdale, Edwards AFB, Rosamond, Mojave, and Boron.

ASSESSMENT OF WATER RESOURCES

Historical water demands were 192,600 acre-feet in 1975, 246,000 acre-feet in 1980, 167,000 acre-feet in 1985 and 144,000 acre-feet in 1989 (USGS, 1994a). Water demands decreased between 1950 to late 1980s due to decreasing irrigated acreage. However, due to the population growth beginning in the mid 1980s, water demands are increasing. Projected water demands for the Antelope Valley are shown on Figure ES-3.

The total available water deliveries for the Antelope Valley were 192,600 acre-feet in 1975, 246,000 acre-feet in 1980, 167,000 acre-feet in 1985 and 144,000 acre-feet in 1989 (USGS, 1994a). Historical water supplies were made up of a combination of local surface water from Little Rock Reservoir, State Water Project (SWP) water, groundwater, and reclaimed water. Table ES-2 shows the potential current and projected water supplies in Antelope Valley. As shown in the table, the potential current water supply ranges between 212,900 and 240,800 acre-feet, and the potential 2020 water supply ranges between 275,700 and 303,600 acre-feet. The water supplies identified in Table ES-2 do not include potential reductions in deliveries due to hydrologic conditions.

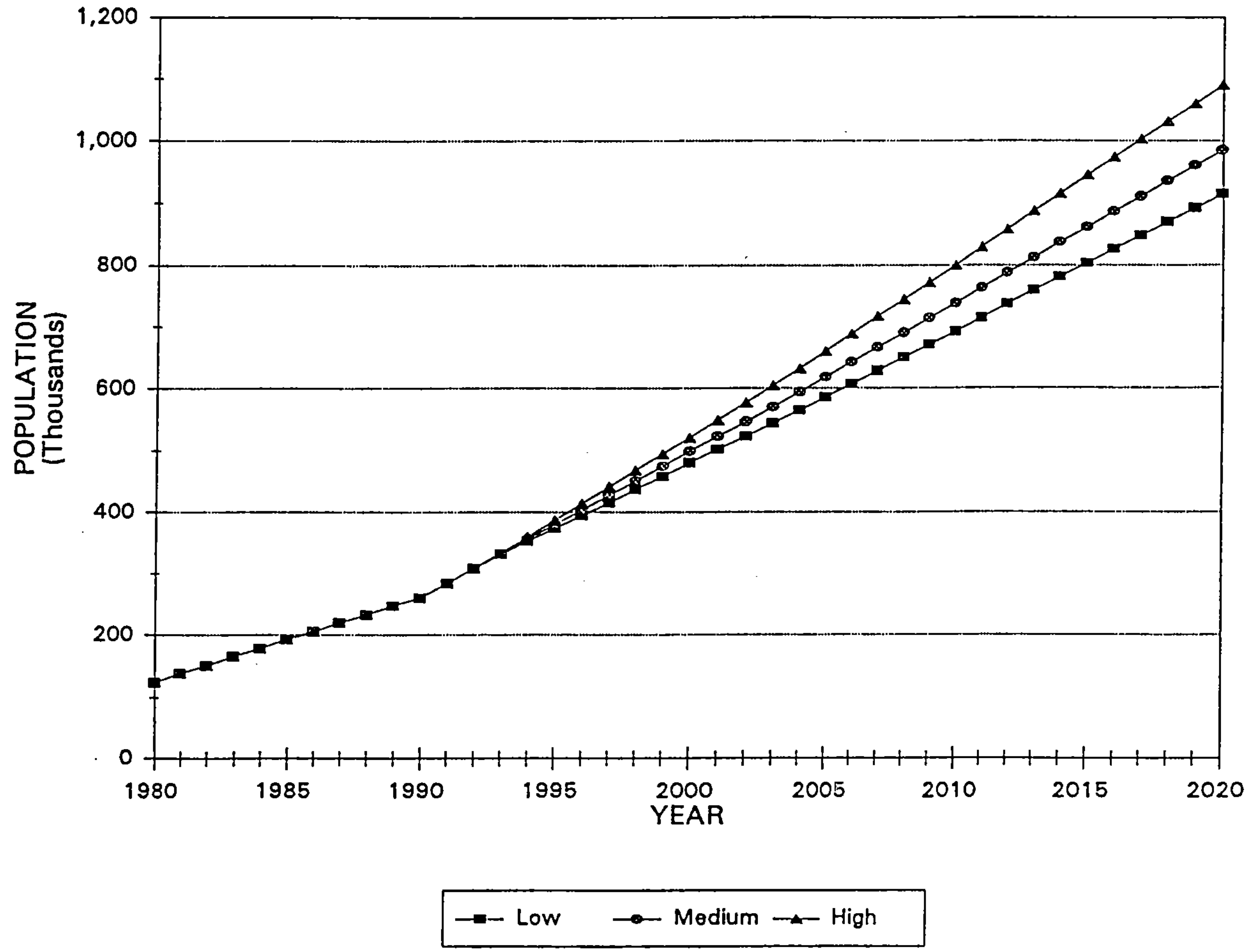
TABLE ES-1

ANTELOPE VALLEY
HISTORICAL AND PROJECTED POPULATION

Area	1980	1990	2010	2020 [1]
Lancaster	48,027	97,291	212,138 [2]	269,558
Palmdale	12,277	68,842	245,341 [3]	326,815
Edwards AFB	8,554	7,423	7,671	7,671
Rosamond	2,869	9,969 [4]	39,256 [5]	52,696
Mojave	2,886	3,793[8]	8,737	11,209
Boron	2,815	2,903	3,071	3,155
Other	46,922	70,179 [6]	221,787 [6]	314,896[6]
Total	124,350	260,400	738,000 [7]	986,000[7]

(1) Extrapolated based on 1990 and 2010 populations except for Palmdale, Edwards AFB, Rosamond and Other. Palmdale is extrapolated based on 1993 and 2010 populations. Rosamond is extrapolated based on 2000 and 2010 populations. Edwards AFB 2020 population is maintained at 2010 level and Other is the difference between the total and the areas of concentrated population.
(2) From SCAG 1993 population projections.
(3) Average of City of Palmdale's General Plan projections and SCAG's 1993 projections.
(4) Interpolated based on 1980 and 1993 populations.
(5) Average of County of Kern's Rosamond Specific Plan projections and projections based on proposed Desert Highlands development.
(6) Difference between total and the areas of concentrated population.
(7) From DWR's November 1993 Draft California Water Plan Update (Bulletin 160).
(8) From Kern Council of Governments.

Groundwater is estimated to have a natural recharge amount of approximately 31,200 to 59,100 acre-feet per year (USGS, 1993). SWP entitlements for the Antelope Valley are currently estimated to be approximately 153,800 acre-feet. Available storage from Little Rock Reservoir was 600 acre-feel; however, modifications to the Little Rock Dam are anticipated to increase the storage capacity to 3,500 acre-feet. According to the PWD, the average annual yield from the new reservoir is estimated to be approximately 7,000 acre-feet. The Palmdale, Lancaster, Rosamond, Edwards AFB, and Mojave Wastewater Reclamation Plants (WRPs) represent the plants with the highest probability of developing a reclaimed water system. The combined 1993 and projected 2020 flow from these five plants represent nearly 98 percent of the total potential reclaimed water supply for the entire Valley and is estimated to be 18.7 million gallons per day (mgd) (20,900 acre-feet per year) and 74.7 mgd (83,700 acre-feet per year) respectively.



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Population Projections–Antelope Valley

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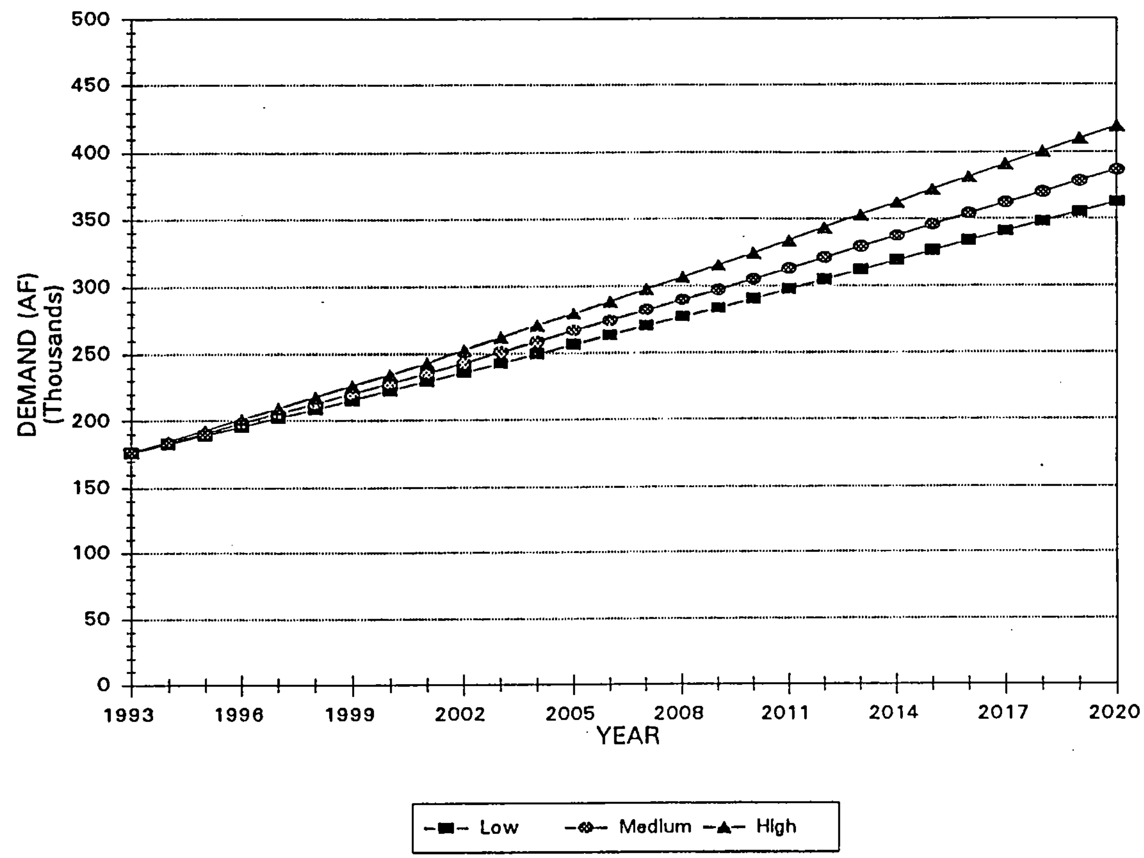
Figure ES–2

It is noted that population forecasting is not an exact science due to an element of uncertainty to whether or not the projections will be truly realized. Additionally, the population projections used in the report were obtained from sources that may have been influenced by the rapid growth that occurred in the Valley prior to 1990.

Figure ES–2



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Water Demand Projections
Antelope Valley

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Figure ES-3

Figure ES-3

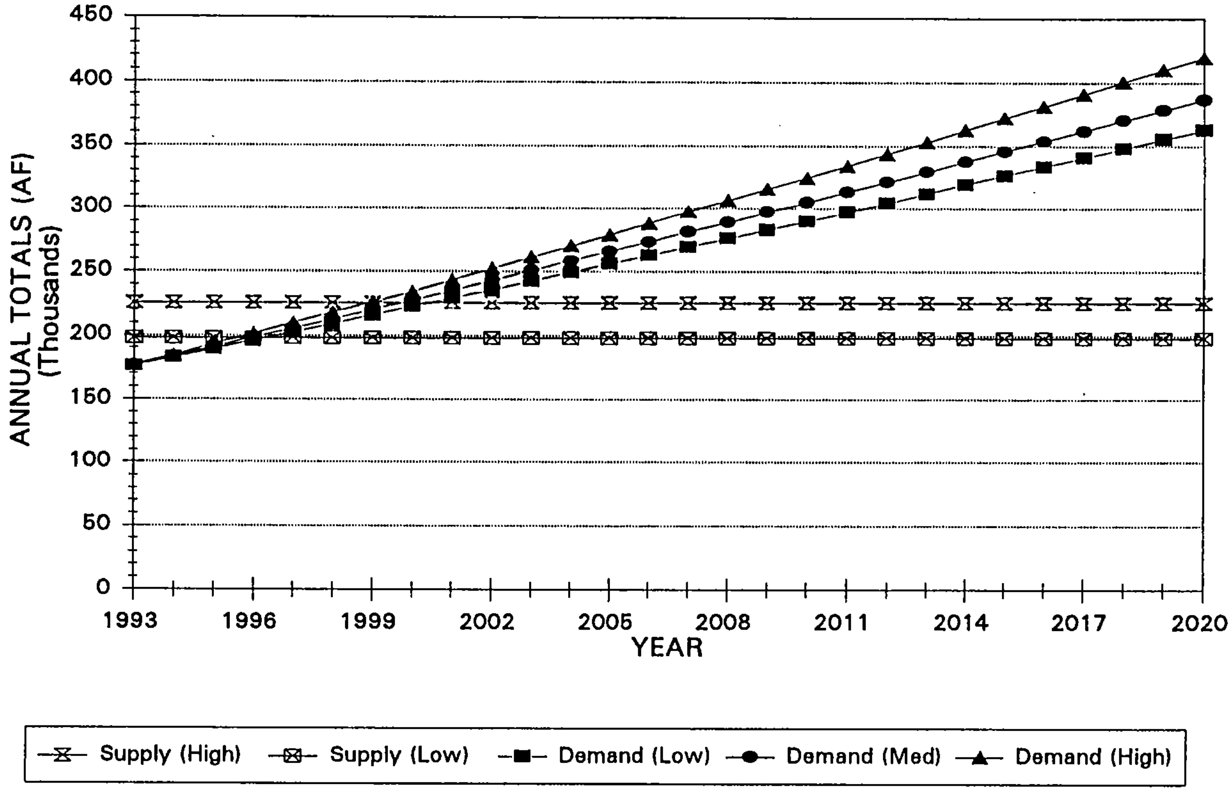
TABLE ES-2

POTENTIAL ANNUAL WATER SUPPLY
FOR THE ANTELOPE VALLEY [1]

Source	1993 Potential Supply (acre-feet)	2020 Potential Supply (acre-feet)
Groundwater [2]	31,200 to 59,100	31,200 to 59,100
State Project Water		
AVEK [3]	134,200	134,200
LCID	2,300	2,300
PWD	17,300	17,300
Subtotal	153,800	153,800
Little Rock Reservoir [4]	7,000	7,000
Reclaimed Water [5]	20,900	83,700
Total [6]	212,900 to 240,800	275,700 to 303,600

(1) Supplies listed have not been adjusted to account for potential reductions in deliveries due to hydrologic conditions.
(2) Estimates of natural recharge from USGS "Study Plan for the Geohydrologic Evaluation of Antelope Valley, and Development and Implementation of Ground-Water Management Models."
(3) Based on historical deliveries of approximately 3 % to areas outside the Antelope Valley, subtracted from AVEK's total entitlement of 138,400 acre-feet per year.
(4) PWD estimates that average yield from the reservoir following modifications to the dam will be 7,000 acre-feet per year.
(5) The numbers shown are current and projected production for Palmdale, Lancaster, Rosamond, Edwards AFB, and Mojave WRPs.
(6) Potential useable stormwater is not included in the total.

Figure ES-4 depicts the high and low water supply projection along with the low, medium and high water demand projection for the Valley to the year 2020. The high and low water supply projection are based on Table ES-2 with one exception, the potential reclaimed water supply listed in Table ES-2 for 1993 and 2020 are not included. Instead, the reclaimed water supply for both 1993 and 2020 is taken as the current reclaimed water use (approximately 6,500 acre-feet). Therefore, the 1993 and 2020 potential supply ranges between 198,500 and 226,400 acre-feet per year. For purposes of the reliability analysis, the high supply curve and medium demand curve are selected. The supply curve does not take into account the issue of reliability and the effects that reliability will have on the yield of each water supply source.



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Potential Supply and Projected Demand
(Without Delivery Reductions)

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Figure ES-4

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Figure ES-4

Figure ES-5 depicts the effects that reliability will have on the yield of the water supplies. The medium demand and projected supply estimates at the 50, 80 and 90 percent probability levels are shown on Figure ES-5. The most optimistic supply assumption (i.e., delivery of 100 percent of available water supplies) is also shown. As shown on the figure, without exceeding groundwater extractions of 59,100 acre-feet per year, the probability of meeting the estimated 1993 water demand is approximately 73 percent. For comparison, the Metropolitan Water District of Southern California (MWD) has established the following service objectives:

Percentage of Demand	Percentage of the Time
80%	100%
90%	92%
100%	90%

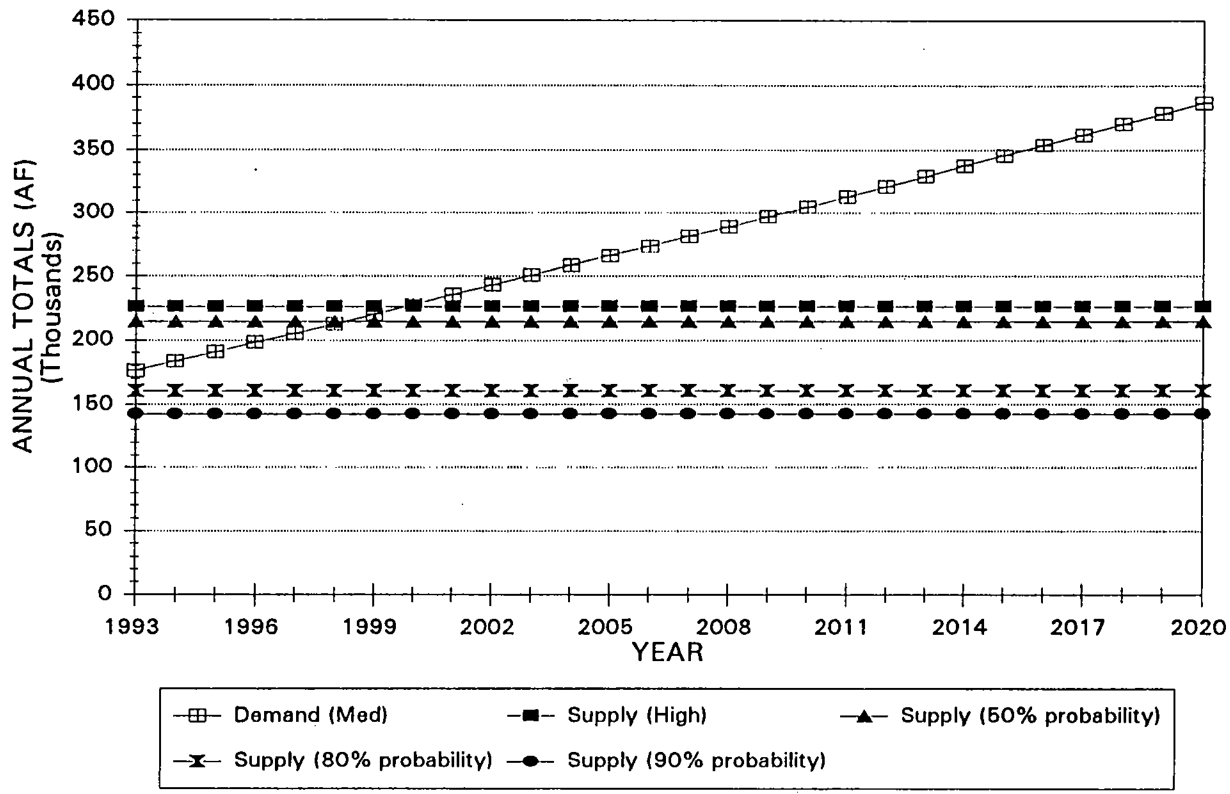
Based on the projections presented on Figure ES-5, the water supply reliability of the Antelope Valley is currently below MWD's objectives. By the year 1998 (projected population of 451,000), 100 percent of the water demand is estimated to be met only 50 percent of the time without overdrafting the groundwater basin. Similarly, by the year 2000 (projected population of 499,000), 100 percent of the potential water supplies would be required to meet the projected water demands without overdrafting the groundwater basin.

To assess the effects of SWP deliveries on groundwater levels, areas that receive SWP deliveries were compared with areas that did not. By comparing the hydrographs from areas that remained in similar land uses, the effect on groundwater levels would be from SWP deliveries and not by other causes (i.e., land use transitions). Hydrographs in areas that do not receive SWP water indicate groundwater levels are generally remaining level, whereas hydrographs in areas that do receive SWP water generally indicate a rising of groundwater levels.

To assess the effects on groundwater levels due to transition from agricultural to urban land uses, hydrographs in areas of agriculture that had transitioned to urban were compared with hydrographs in areas of agriculture that had not transitioned. The rate of decline in water levels prior to 1977-1978 was noticeably more than the rate of decline after 1977-1978 when SWP deliveries started to significantly contribute to the Valley's water supply. Importation of SWP water generally has a beneficial effect on groundwater levels and urbanization generally has an adverse effect on groundwater levels. However, it is likely that the increased use of SWP water could mitigate these adverse effects.

WATER CONSERVATION

Water conservation programs existing in the Antelope Valley are primarily directed at urban areas. These programs are provided through agencies like the City of Lancaster, the LACWW, PWD and RCSD. Urban water conservation programs in the Antelope Valley include ordinances, literature and advertising, and phased water conservation plans. The Agricultural Stabilization and Conservation Service (ASCS)



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Supply and Projected Demand (Includes Delivery Reductions)

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Figure ES-5

office provides agricultural conservation programs for farmers and ranchers. The ASCS provides an Agricultural Conservation Program (ACP) which offers cost sharing to farmers and ranchers to encourage conservation practices on agricultural land that will result in long-term benefits. The Federal Government pays up to 80 percent of the cost of needed conservation practices.

Urban water conservation measures are identified in the September 1991 Memorandum of Understanding Regarding Urban Water Conservation in California and the Urban Water Management Planning Act. The Memorandum of Understanding (MOU) Regarding Urban Water Conservation in California was entered into in 1991 by urban water suppliers, public advocacy organizations and other interested groups who recognized the need for conservation due to increasing water demands for urban, agricultural and environmental uses. Urban water conservation practices or Best Management Practices (BMPs) identified in the MOU are intended to reduce long-term urban water demands. In addition to identifying BMPs, the MOU also included Potential Best Management Practices (PBMPs). The intent of the MOU was to study and then determine whether or not the PBMP's met the criteria designated as BMPs. The Urban Water Management Planning Act requires urban water retailers supplying more than 3,000 acre-feet of water per year or serving more than 3,000 customers to prepare an Urban Water Management Plan (UWMP) to achieve conservation and efficient use of water. The Act requires the UWMP to evaluate specific water management practices.

Agricultural water conservation measures are identified in the Department of Water Resources (DWR) November 1993 draft "California Water Plan Update" (Bulletin 160). Enactment of the Agricultural Water Suppliers Efficient Water Management Act in 1990 requires the DWR to establish an advisory committee to evaluate Efficient Water Management Practices (EWMPs) for agricultural water suppliers. According to Bulletin 160, the advisory committee is working to develop a process for implementation of EWMPs through the agricultural water management plans required under the California Agricultural Water Management Planning Act. A current assessment of the impact of implementation of EWMPs is not available through the DWR.

Although not currently in operation in the Antelope Valley, the Mobile Agricultural Water Conservation Laboratory (Mobile Lab) program can be regarded as a potential conservation program for the Valley. The Mobile Lab operates under the leadership of the local Resource Conservation District, with technical and management assistance from the local Soil Conservation Services (SCS) Field Office. The Mobile Lab provides agricultural growers with individual, site-specific performance evaluations of their irrigation systems by measuring efficiency of the systems. Data are collected for the specific site for calculations on distribution uniformity and application efficiency. Based on an analysis of the results, recommendations or suggestions are made by the Mobile Lab team on management or physical changes to improve water use efficiency of the irrigation system. The program is voluntary and free of charge.

The measures recommended for inclusion in the water conservation plan for the Antelope Valley are listed in Table ES-3. Because agricultural water use is expected to decline significantly during the planning period (1994-2020), the plan consists primarily of urban conservation programs developed for the City of Palmdale, City of Lancaster and Community of Rosamond. Evaluation of urban water conservation measures was performed utilizing the DWR's Water Plan computer software. Benefit to cost (B/C) analyses were performed for each recommended urban water conservation measure to determine cost effectiveness. The overall B/C ratios for the City of Palmdale, City of Lancaster, and Community of Rosamond were calculated to be 4.7, 3.0, and 4.5 respectively.

The Agricultural Water Suppliers Efficient Water Management Practices Act requires the DWR to establish an advisory committee to evaluate EWMPs aimed at agricultural water suppliers concerning conservation of irrigation water. Because the evaluation of the EWWPs will require detailed planning by each water agency and will include analysis of technical feasibility, social and district economic criteria and legal feasibility of each practice, an assessment of the impact of implementation of EWWPs (i.e., costs and water savings) is not currently available through the DWR. Therefore, until DWR's assessment of the EWMPs is complete, analyses of potential agricultural conservation measures for the Valley cannot be provided. However, based on the available case studies, an agricultural water conservation program can be recommended on a preliminary basis. It is recommended that a Mobile Lab program be established to serve agricultural areas in the Antelope Valley.

An implementation schedule as well as the estimated water savings for each conservation measure selected for the Antelope Valley is also shown in Table ES-3. Implementation of the urban conservation measures is assumed to begin in 1994 and continue through the year 2020. (Note that although conservation programs currently exist in the Antelope Valley, for purposes of estimating water savings using DWR's WaterPlan software, the year 1994 was assumed to be the beginning of the planning period.) Estimated water savings from the urban measures range from 0.67 to 87,356 acre-feet for the City of Palmdale, 0.34 to 43,775 acre-feet for the City of Lancaster, and 0.34 to 7,821 acre-feet for the Community of Rosamond. The estimated water savings is shown as the total amount of water saved over the entire implementation period (1994 to 2020). Implementation of the agricultural conservation measure is assumed to begin in 1995 and continue through the year 2020. Estimated water savings for the agricultural measure is 68,800 acre-feet over the entire implementation period (1995 to 2020).

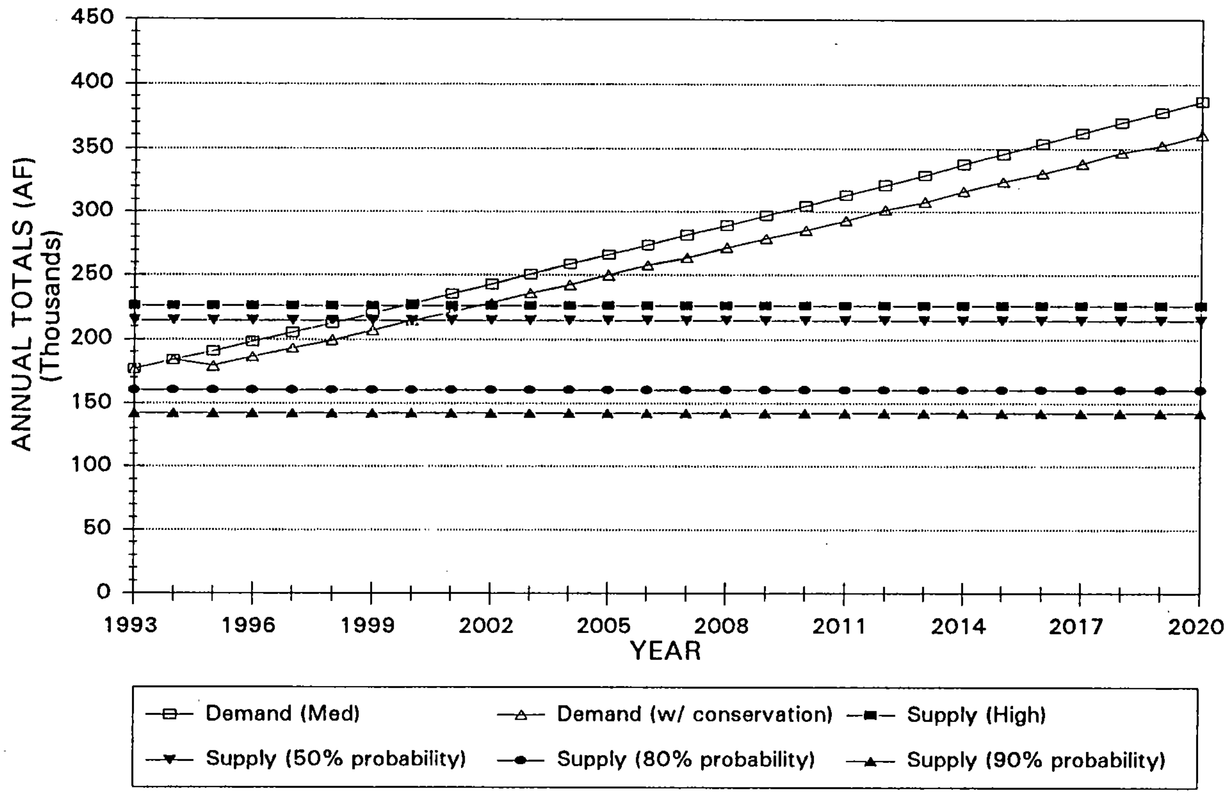
Figure ES-6 depicts the medium water demand with and without implementation of conservation measures and projected supply estimates at the 50, 80, and 90 percent probability levels. The most optimistic supply assumption (i.e., delivery of 100 percent of available water supplies) is also shown. Figure ES-6 is identical to Figure ES-5 with one exception, a second demand curve is provided to show the affect on the projected water demands from implementation of the conservation program discussed above. As shown on Figure ES-6, without exceeding

TABLE ES-3

IMPLEMENTATION SCHEDULE
AND ESTIMATED WATER SAVINGS

Conservation Measure	Implementation Years	Estimated Water Savings (acre-feet)
City of Palmdale		
• Ultra Low-Flush Toilet Ordinance, New Residential [1]	1994-2020	0.67
• Standards for New Large Landscapes [1]	1994-2020	40
• Retrofit Kit Program	1994-2020	7,357
• Information and Education, Residential	1994-2020	78,642
• Seasonal Rates, Residential	1994-2020	52,415
• Uniform or Increasing Block Rates, Residential	1994-2020	87,356
Total		225,811
City of Lancaster		
• Ultra Low-Flush Toilet Ordinance, New Residential [1]	1994-2020	0.34
• Standards for New Large Landscapes [1]	1994-2020	80
• Information and Education, Residential	1994-2020	25,233
• Residential Water Audit and Retrofit Kit	1994-2020	1,245
• Seasonal Rates, Residential	1994-2020	43,775
• Seasonal Rates, Commercial	1994-2020	6,575
• Seasonal Rates, Industrial	1994-2020	10,927
• Uniform or Increasing Block Rates, Residential	1994-2020	43,775
• Uniform or Increasing Block Rates, Commercial	1994-2020	10,961
• Uniform or Increasing Block Rates, Industrial	1994-2020	18,210
• Large Turf Irrigation Audits	1994-2020	9,325
Total		170,106
Community of Rosamond		
• Ultra Low-Flush Toilet Ordinance, New Residential [1]	1994-2020	0.34
• Standards for New Large Landscapes [1]	1994-2020	40
• Seasonal Rates, Residential	1994-2020	5,694
• Uniform or Increasing Block Rates, Residential	1994-2020	5,694
• System Water Audit, Leak Detection, and Repair	1994-2020	7,821
• Residential Retrofit Kit	1994-2020	2,496
Total		21,745
Agricultural		
• Mobile Lab Program	1995-2020	68,800

(1) Existing regulations



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Supply and Projected Demand
(Includes Conservation)

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Figure ES-6

Figure ES-6

groundwater extractions of 59,100 acre-feet per year, the probability of meeting the estimated 1993 water demand is approximately 73 percent. Without a conservation program, by the year 1998 (projected population of 451,000), 100 percent of the water demand is estimated to be met only 50 percent of the time and by the year 2000 (projected population of 499,000), 100 percent of the potential water supplies would be required to meet the water demand. With a conservation program, by the year 2000, 100 percent of the water demand is estimated to be met only 50 percent of the time and by the year 2002 (projected population of 547,000), 100 percent of the potential water supplies would be required to meet the water demand.

USE OF RECLAIMED WATER

The Palmdale WRP, Lancaster WRP, Rosamond WRP, and Edwards AFB WRP have the greatest potential for expansion, as well as the highest projected flows in the year 2020. Therefore, discussion of reclaimed water use focusses on these four plants. Edwards AFB WRP is discussed to a lesser extent than the other three plants, because design of water reclamation facilities are already underway.

The Palmdale WRP is an undisinfected secondary treatment facility with a capacity of 8.0 mgd. The Lancaster WRP is currently the only facility in Antelope Valley supplying tertiary treated water (0.6 mgd design capacity). A majority of the plant's flow is treated to a secondary treatment level. Total capacity of the plant is 10.0 mgd. The Rosamond WRP is a 2.0 mgd primary treatment facility. RCSD is planning to convert the existing system to a 2.0 mgd tertiary treatment facility in 1996. The Edwards AFB WRP is a 1.5 mgd primary treatment facility. Edwards AFB is designing a 2.5 mgd tertiary treatment facility scheduled to be constructed in 1995.

The average daily wastewater flow in the year 2020 is estimated to be 37.2 mgd for the Palmdale WRP and 29.8 mgd for the Lancaster WRP. The average daily wastewater flow in the year 2020 for the Rosamond WRP and the Edwards AFB WRP is estimated to be 3.0 and 2.5 mgd respectively.

Table ES-4 presents a list of high potential reclaimed water users identified in the report. The estimated annual, peak month, peak day and peak hour demands for the high potential reclaimed water users are also shown. The total annual reclaimed water demand is approximately 35,600 acre-feet per year. Total peak month demand is estimated to be approximately 6,300 acre-feet, and total peak day demand is estimated to be 74 million gallons or 216 acre-feet.

The recommended conceptual plan is divided into 4 main reclaimed water systems:

- Palmdale and Lancaster Tertiary System (Tertiary System)
- Palmdale and Lancaster Secondary System (Secondary System)
- Rosamond System
- Edwards AFB System

TABLE ES-4

HIGH POTENTIAL RECLAIMED WATER USERS

User No.	User Name	Current Status	Required Treatment Level	Annual Demand (af/yr)	Peak Month Demand (af/mo)	Peak Day Demand (af/dy)	Peak Day Demand (1000 gpd)	Operating Conditions During Peak Day: Days/week	Operating Conditions During Peak Day: From - To	Operating Conditions During Peak Day: Total Hours	Peak Hour Demand (gpm)
	Palmdale/Lancaster Tertiary System										
	2840 ZONE										
101	Palmdale High School	Existing	Tertiary	138	25.3	0.82	265.9	7	12 am - 6 am	6	739
102	Desert Aire Golf Course	Existing	Secondary-D	120	22.0	0.71	231.2	7	10 pm - 8 am	10	385
104	McAdam Park	Existing	Tertiary	72	13.2	0.43	138.7	7	10 pm - 8 am	10	231
105	Courson Park	Existing	Tertiary	23	4.1	0.13	43.4	7	10 pm - 8 am	10	72
118	Desert Rose Elementary School	Existing	Tertiary	26	4.8	0.15	50.1	7	12 am - 6 am	6	139
120	Tumbleweed Elementary School	Existing	Tertiary	26	4.8	0.15	50.1	7	12 am - 6 am	6	139
122	Cactus K-8 School	Existing	Tertiary	36	6.7	0.22	70.1	7	12 am - 6 am	6	195
124	Mesa Intermediate School	Existing	Tertiary	52	9.5	0.31	100.2	7	12 am - 6 am	6	278
	2840 ZONE TOTAL			493	90.4	2.92	949.7				2,179
	2920 ZONE										
65A	Palmdale Business Park	Future	Tertiary	118	16.6	0.54	174.6	7	12 am - 6 am	6	485
65B	Palmdale Business Park Golf Course	Future	Secondary-D	453	50.9	1.64	535.3	7	12 am - 6 am	6	1,487
100	Antelope Valley Country Club	Existing	Secondary-D	375	68.8	2.22	722.5	7	10 pm - 6 am	8	1,505
107	Desert Sands Park	Existing	Tertiary	68	12.5	0.40	131.0	7	10 pm - 8 am	10	218
121	Yucca Elementary School	Existing	Tertiary	23	4.3	0.14	45.1	7	12 am - 6 am	6	125
128	Highlands High School	Existing	Tertiary	100	18.3	0.59	192.7	7	12 am - 6 am	6	535
134	Summerwind Elementary School	Future	Tertiary	42	7.6	0.25	80.2	7	12 am - 6 am	6	223
	2920 ZONE TOTAL			1,179	179.0	5.77	1,881.4				4,579
	2620 ZONE										
52	Lancaster Business Park	Existing	Tertiary	55	10.0	0.32	105.6	7	12 am - 6 am	6	293
53A	Serrano Ranch	Future	Tertiary	329	60.3	1.95	633.9	7	12 am - 6 am	6	1,761
53B	Serrano Ranch Golf Course	Future	Secondary-D	633	116.1	3.74	1,219.7	7	12 am - 6 am	6	3,388
54	K&B Development (Tract 49864)	Future	Tertiary	47	8.6	0.28	90.2	7	12 am - 6 am	6	250
64	Fox Airfield Commercial Development	Future	Tertiary	1,920	352.0	11.35	3,699.5	7	12 am - 6 am	6	10,276
152A	Lancaster City Park	Existing	Tertiary	150	23.5	0.91	295.0	6	10 pm - 6 am	8	615

TABLE ES-4

HIGH POTENTIAL RECLAIMED WATER USERS

User No.	User Name	Current Status	Required Treatment Level	Annual Demand (af/yr)	Peak Month Demand (af/mo)	Peak Day Demand (af/dy)	Peak Day Demand (1000 gpd)	Operating Conditions During Peak Day: Days/week	Operating Conditions During Peak Day: From - To	Operating Conditions During Peak Day: Total Hours	Peak Hour Demand (gpm)
152B	Lancaster City Park	Future	Tertiary	32	5.9	0.23	73.5	6	10 pm - 6 am	8	153
153	Jane Reynolds Park	Existing	Tertiary	30	5.2	0.20	64.6	6	10 pm - 6 am	8	135
154	Mariposa Park	Existing	Tertiary	28	6.2	0.24	78.3	6	10 pm - 6 am	8	163
155	Eastside Park	Existing	Tertiary	71	10.3	0.40	129.5	6	10 pm - 6 am	8	270
156	El Dorado Park	Existing	Tertiary	40	6.5	0.25	81.0	6	10 pm - 6 am	8	169
158	Skytower Park	Existing	Tertiary	48	8.8	0.34	110.3	6	10 pm - 6 am	8	230
159	Apollo Lakes County Park *	Existing	Tertiary	129	30.4	1.44	470.0	7	12 am - 6 am	6	1,306
160	Antelope Valley High School	Existing	Tertiary	130	23.8	0.77	250.5	7	12 am - 6 am	6	696
161	Desert Winds High School	Existing	Tertiary	8	1.4	0.05	14.8	7	12 am - 6 am	6	41
163	Parkview Intermediate High School	Existing	Tertiary	65	11.9	0.38	124.9	7	12 am - 6 am	6	347
169	Mariposa Elementary School	Existing	Tertiary	38	7.0	0.22	73.1	7	12 am - 6 am	6	203
170	Joshua Elementary School	Existing	Tertiary	56	10.3	0.33	108.7	7	12 am - 6 am	6	302
171	El Dorado Elementary School	Existing	Tertiary	25	4.6	0.15	48.6	7	12 am - 6 am	6	135
172	Linda Verde Elementary School	Existing	Tertiary	28	5.1	0.16	53.6	7	12 am - 6 am	6	149
175A	Joshua Memorial Park	Existing	Secondary-D	90	16.5	0.53	173.4	7	12 am - 6 am	6	482
175B	Joshua Memorial Park	Future	Secondary-D	21	3.9	0.12	40.5	7	12 am - 6 am	6	112
186	New Vista Elementary School	Future	Tertiary	43	7.9	0.26	83.2	7	12 am - 6 am	6	231
	2620 ZONE TOTAL			4,016	736	25	8,022				21,706
	Tertiary System Total			5,688	1,006	33	10,853				28,463
	Palmdale/Lancaster Secondary System										
2	Alfalfa Farm	Existing	Secondary-U	1,151	214.6	7.40	2,627.4	7	12 am - 12 am	24	1,825
2A	Alfalfa Farm	Existing	Secondary-U	1,306	243.6	8.40	2,982.4	7	12 am - 12 am	24	2,071
4	Grain & Alfalfa Farm	Existing	Secondary-U	2,895	540.6	18.90	6,553.8	7	12 am - 12 am	24	4,551
5	Alfalfa Farm	Existing	Secondary-U	2,706	504.6	17.40	6,177.9	7	12 am - 12 am	24	4,290
6A	Alfalfa Farm	Existing	Secondary-U	1,866	348.0	12.00	4,260.6	7	12 am - 12 am	24	2,959
6B	Alfalfa Farm	Existing	Secondary-U	1,120	208.8	7.20	2,556.4	7	12 am - 12 am	24	1,775
8	Nebeker Ranch *	Existing	Secondary-U	4,229	788.8	27.20	9,657.3	7	12 am - 12 am	24	6,706
9	Alfalfa Farm	Existing	Secondary-U	1,617	301.6	10.40	3,692.5	7	12 am - 12 am	24	2,564
9A	Alfalfa Farm	Existing	Secondary-U	746	139.2	4.80	1,704.2	7	12 am - 12 am	24	1,184
11	Alfalfa Farm	Existing	Secondary-U	1,244	232.0	8.00	2,840.4	7	12 am - 12 am	24	1,973
12A	Christmas Tree & Landscape Farm *	Existing	Secondary-U	81	18.8	0.80	233.9	7	12 am - 12 am	24	162

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TABLE ES-4

HIGH POTENTIAL RECLAIMED WATER USERS

User No.	User Name	Current Status	Required Treatment Level	Annual Demand (af/yr)	Peak Month Demand (af/mo)	Peak Day Demand (af/dy)	Peak Day Demand (1000 gpd)	Operating Conditions During Peak Day: Days/ week	Operating Conditions During Peak Day: From - To	Operating Conditions During Peak Day: Total Hours	Peak Hour Demand (gpm)
13	Alfalfa Farm	Existing	Secondary-U	995	185.6	6.40	2,272.3	7	12 am - 12 am	24	1,578
13A	Alfalfa Farm	Existing	Secondary-U	622	116.0	4.00	1,420.2	7	12 am - 12 am	24	986
13B	Alfalfa Farm	Existing	Secondary-U	995	185.6	6.40	2,272.3	7	12 am - 12 am	24	1,578
13C	Alfalfa Farm	Existing	Secondary-U	373	69.6	2.40	852.1	7	12 am - 12 am	24	592
15A	DOA Test Farm	Existing	Secondary-U	32	7.5	0.32	93.6	7	12 am - 12 am	24	65
15B	DOA Pistachio Farm *	Existing	Secondary-U	112	29.4	0.90	338.3	7	12 am - 12 am	24	235
15C	DOA Chestnut Farm *	Existing	Secondary-U	149	39.2	1.20	451.1	7	12 am - 12 am	24	313
15D	DOA Barley Farm *	Existing	Secondary-U	304	57.2	2.20	643.3	7	12 am - 12 am	24	447
18A	Sod Farm	Existing	Secondary-D	684	126.1	5.20	1,683.4	7	12 am - 12 am	24	1,169
173	Paiute Ponds *	Existing	Secondary-D	1,456	228.4	7.37	2,400.0	7	12 am - 12 am	24	1,667
174A	Wagas Land Duck Ponds	Existing	Secondary-D	1,558	186.0	6.00	1,954.8	7	12 am - 12 am	24	1,358
176	Young Ranch	Existing	Secondary-D	253	43.1	1.39	453.0	7	12 am - 12 am	24	315
	Secondary System Total			26,493	4,814	166	58,121				40,362
	Rosamond System										
200	Rosamond Elementary School	Existing	Tertiary	17	3.1	0.10	32.6	7	10 pm - 8 am	10	54
201	Hamilton Elementary School	Existing	Tertiary	65	11.9	0.38	125.2	7	10 pm - 8 am	10	209
202	Rosamond High School	Existing	Tertiary	66	12.1	0.39	127.2	7	10 pm - 8 am	10	212
203	Tropico Middle School	Existing	Tertiary	26	4.8	0.15	50.1	7	10 pm - 8 am	10	83
204	Rare Earth Continuation School	Existing	Tertiary	17	3.1	0.10	32.6	7	10 pm - 8 am	10	54
205	Rosamond Park	Existing	Tertiary	30	5.5	0.18	57.8	7	12 am - 6 am	6	161
206	West Park	Existing	Tertiary	15	2.8	0.09	28.9	7	12 am - 6 am	6	80
207	Desert Highlands Development	Future	Tertiary	209	29.8	1.15	373.3	6	12 am - 6 am	6	1,037
208	Desert Highlands Golf Course	Future	Secondary-D	90	16.5	0.63	206.8	6	12 am - 6 am	6	574
209	Tract 5052	Future	Tertiary	15	2.8	0.09	29.4	7	12 am - 6 am	6	82
210	Tract 5172	Future	Tertiary	58	10.7	0.35	112.6	7	12 am - 6 am	6	313
211	Tract 5188	Future	Tertiary	12	2.2	0.07	23.1	7	12 am - 6 am	6	64
212	Tract 5195	Future	Tertiary	20	3.6	0.12	38.2	7	12 am - 6 am	6	106
213	Tract 5196	Future	Tertiary	19	3.5	0.11	37.0	7	12 am - 6 am	6	103
214	Tract 5198	Future	Tertiary	19	3.5	0.11	37.0	7	12 am - 6 am	6	103
215	Tract 5204	Future	Tertiary	19	3.6	0.11	37.5	7	12 am - 6 am	6	104
216	Tract 5313	Future	Tertiary	4	0.7	0.02	7.8	7	12 am - 6 am	6	22

TABLE ES-4

HIGH POTENTIAL RECLAIMED WATER USERS

User No.	User Name	Current Status	Required Treatment Level	Annual Demand (af/yr)	Peak Month Demand (af/mo)	Peak Day Demand		Operating Conditions During Peak Day			Peak Hour Demand (gpm)
						(af/dy)	(1000 gpd)	Days/ week	From - To	Total Hours	
217	Tract 5394	Future	Tertiary	6	1.0	0.03	10.8	7	12 am - 6 am	6	30
218	Tract 5400	Future	Tertiary	38	7.0	0.23	74.0	7	12 am - 6 am	6	206
220	Tract 4558	Future	Tertiary	12	2.2	0.07	23.4	7	12 am - 6 am	6	65
	Rosamond System Total			758	130.5	4.50	1,465.0				3,661
	Edwards AFB System										
1	Wing Headquarters	Existing	Tertiary	11	1.8	0.06	19.1	7	10 pm - 8 am	10	32
16	Muroc Manner	Existing	Tertiary	19	2.8	0.09	29.7	7	10 pm - 8 am	10	50
1020	IFAST	Existing	Tertiary	19	1.9	0.06	20.3	7	10 pm - 8 am	10	34
1200	Base Operations	Existing	Tertiary	6	1.0	0.03	10.1	7	10 pm - 8 am	10	17
1220	Test Pilot School	Existing	Tertiary	5	0.7	0.02	7.8	7	10 pm - 8 am	10	13
1250	Offices	Existing	Tertiary	0	0.0	0.00	0.2	7	10 pm - 8 am	10	0
1260	Offices	Existing	Tertiary	5	0.8	0.03	8.2	7	10 pm - 8 am	10	14
1400	Engineering	Existing	Tertiary	9	1.3	0.04	13.7	7	10 pm - 8 am	10	23
1440	Ridley Mission Control Center	Existing	Tertiary	25	2.8	0.09	29.5	7	10 pm - 8 am	10	49
1600	T-38	Existing	Tertiary	13	1.1	0.03	11.1	7	10 pm - 8 am	10	19
1609	C-17	Existing	Tertiary	0	0.0	0.00	0.2	7	10 pm - 8 am	10	0
1610	Colonial Inn	Existing	Tertiary	4	0.5	0.02	5.6	7	10 pm - 8 am	10	9
1633	Offices	Existing	Tertiary	3	0.5	0.02	5.1	7	10 pm - 8 am	10	9
1830A	Enviornmental	Existing	Tertiary	5	0.7	0.02	7.1	7	10 pm - 8 am	10	12
2201	Softball Field	Existing	Tertiary	10	1.6	0.05	16.4	7	10 pm - 8 am	10	27
2419	Grass Island	Existing	Tertiary	3	0.4	0.01	4.5	7	10 pm - 8 am	10	8
2421	Civilian Personnel	Existing	Tertiary	3	0.5	0.02	4.9	7	10 pm - 8 am	10	8
2430	OSI	Existing	Tertiary	8	1.2	0.04	12.3	7	10 pm - 8 am	10	20
2453	Education Center	Existing	Tertiary	3	0.4	0.01	4.6	7	10 pm - 8 am	10	8
2500	Oasis Club	Existing	Tertiary	15	2.2	0.07	23.1	7	10 pm - 8 am	10	39
2600	Comm. Building	Existing	Tertiary	7	1.0	0.03	10.3	7	10 pm - 8 am	10	17
2650A	CSC	Existing	Tertiary	13	1.9	0.06	20.3	7	10 pm - 8 am	10	34
2656	Library Park	Existing	Tertiary	16	2.3	0.07	24.4	7	10 pm - 8 am	10	41
2665	Library	Existing	Tertiary	16	2.4	0.08	25.0	7	10 pm - 8 am	10	42
2670	Post Office	Existing	Tertiary	6	0.9	0.03	9.8	7	10 pm - 8 am	10	16
2700	Chapel	Existing	Tertiary	21	3.1	0.10	32.9	7	10 pm - 8 am	10	55

TABLE ES-4

HIGH POTENTIAL RECLAIMED WATER USERS

User No.	User Name	Current Status	Required Treatment Level	Annual Demand (af/yr)	Peak Month Demand (af/mo)	Peak Day Demand (af/dy)	Peak Day Demand (1000 gpd)	Operating Conditions During Peak Day: Days/week	From - To	Total Hours	Peak Hour Demand (gpm)
2750	FTEMF	Existing	Tertiary	54	7.9	0.26	83.2	7	10 pm - 8 am	10	139
2800	Procurement	Existing	Tertiary	17	2.6	0.08	27.1	7	10 pm - 8 am	10	45
2858	Comm. Bulding	Existing	Tertiary	3	0.4	0.01	4.4	7	10 pm - 8 am	10	7
2860	Security Police	Existing	Tertiary	10	1.5	0.05	15.9	7	10 pm - 8 am	10	26
3497	Self Help	Existing	Tertiary	2	0.3	0.01	3.0	7	10 pm - 8 am	10	5
3500	Civil Engineering	Existing	Tertiary	2	0.2	0.01	2.4	7	10 pm - 8 am	10	4
3507	Dog Pound	Existing	Tertiary	6	0.8	0.03	8.7	7	10 pm - 8 am	10	15
3510	Vehicle Maintenance Shop	Existing	Tertiary	1	0.0	0.00	0.4	7	10 pm - 8 am	10	1
3535	Headquarters	Existing	Tertiary	15	2.3	0.07	23.9	7	10 pm - 8 am	10	40
3535	Off-Site (Rosamond Blvd).	Existing	Tertiary	19	2.9	0.09	30.6	7	10 pm - 8 am	10	51
3804	Jet Test Cell	Existing	Tertiary	4	0.4	0.01	3.7	7	10 pm - 8 am	10	6
3810	Jet Maintenance Facility	Existing	Tertiary	31	4.5	0.15	47.4	7	10 pm - 8 am	10	79
3920	Altitude Chamber	Existing	Tertiary	4	0.6	0.02	6.5	7	10 pm - 8 am	10	11
3940	Programs	Existing	Tertiary	3	0.4	0.01	4.5	7	10 pm - 8 am	10	8
3950	Office	Existing	Tertiary	3	0.5	0.02	4.9	7	10 pm - 8 am	10	8
3950A	Offices	Existing	Tertiary	8	1.2	0.04	12.4	7	10 pm - 8 am	10	21
Q	Dorms	Existing	Tertiary	207	30.8	0.99	323.2	7	10 pm - 8 am	10	539
R	Rosamond Blvd, So. Muroc Dr.	Existing	Tertiary	13	1.9	0.06	20.3	7	10 pm - 8 am	10	34
5201	Softball Field	Existing	Tertiary	12	1.9	0.06	19.5	7	10 pm - 8 am	10	33
5208	Wings Field	Existing	Tertiary	29	4.3	0.14	45.4	7	10 pm - 8 am	10	76
5210	Youth Center	Existing	Tertiary	15	2.3	0.07	23.9	7	10 pm - 8 am	10	40
5211	Hap Arnold Park	Existing	Tertiary	10	1.4	0.05	14.9	7	10 pm - 8 am	10	25
5213	Robers Field	Existing	Tertiary	22	3.3	0.11	34.4	7	10 pm - 8 am	10	57
5214	Bowling	Existing	Tertiary	2	0.3	0.01	3.4	7	10 pm - 8 am	10	6
5215	Little League Field	Existing	Tertiary	7	1.0	0.03	10.6	7	10 pm - 8 am	10	18
5216	Softball Field	Existing	Tertiary	12	1.8	0.06	18.8	7	10 pm - 8 am	10	31
5220	Soccar Field	Existing	Tertiary	10	1.5	0.05	16.0	7	10 pm - 8 am	10	27
5221	Little League Field	Existing	Tertiary	13	2.0	0.06	20.6	7	10 pm - 8 am	10	34
5500	Hospital	Existing	Tertiary	23	2.6	0.08	27.5	7	10 pm - 8 am	10	46
5510	Hospital Barracks	Existing	Tertiary	5	0.8	0.02	7.9	7	10 pm - 8 am	10	13
5513	Dental Clinic	Existing	Tertiary	24	3.6	0.12	37.5	7	10 pm - 8 am	10	63
5550	Veterinary Clinic	Existing	Tertiary	3	0.4	0.01	4.0	7	10 pm - 8 am	10	7
5560	Fire Station	Existing	Tertiary	7	1.1	0.04	11.6	7	10 pm - 8 am	10	19
5600	Officer's Club	Existing	Tertiary	30	4.4	0.14	46.6	7	10 pm - 8 am	10	78
5601	VIP Billeting	Existing	Tertiary	11	1.7	0.05	17.3	7	10 pm - 8 am	10	29

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TABLE ES-4

HIGH POTENTIAL RECLAIMED WATER USERS

User No.	User Name	Current Status	Required Treatment Level	Annual Demand (af/yr)	Peak Month Demand (af/mo)	Peak Day Demand (af/dy)	Peak Day Demand (1000 gpd)	Operating Conditions During Peak Day: Days/week	From - To	Total Hours	Peak Hour Demand (gpm)
5602	Billeting	Existing	Tertiary	10	1.5	0.05	15.2	7	10 pm - 8 am	10	25
5603	Billeting	Existing	Tertiary	10	1.5	0.05	15.2	7	10 pm - 8 am	10	25
5604	Billeting	Existing	Tertiary	10	1.5	0.05	15.2	7	10 pm - 8 am	10	25
5606	Billeting	Existing	Tertiary	10	1.5	0.05	15.2	7	10 pm - 8 am	10	25
6000	Commissary	Existing	Tertiary	12	1.8	0.06	18.5	7	10 pm - 8 am	10	31
6002	Branch Bank	Existing	Tertiary	6	0.8	0.03	8.8	7	10 pm - 8 am	10	15
6005	Baskin Robbins	Existing	Tertiary	6	0.9	0.03	9.4	7	10 pm - 8 am	10	16
6006	Burger King	Existing	Tertiary	10	1.5	0.05	15.6	7	10 pm - 8 am	10	26
6441	Preschool	Existing	Tertiary	2	0.3	0.01	3.4	7	10 pm - 8 am	10	6
6445	Social Actions	Existing	Tertiary	1	0.1	0.00	1.2	7	10 pm - 8 am	10	2
6447	Housing Chapel	Existing	Tertiary	15	2.3	0.07	23.9	7	10 pm - 8 am	10	40
6459	Child Care Center	Existing	Tertiary	4	0.7	0.02	6.8	7	10 pm - 8 am	10	11
7020	Old Youth Center	Existing	Tertiary	26	3.8	0.12	40.4	7	10 pm - 8 am	10	67
B	Park	Existing	Tertiary	25	3.7	0.12	39.3	7	10 pm - 8 am	10	66
C	Park	Existing	Tertiary	23	3.4	0.11	35.4	7	10 pm - 8 am	10	59
F	Park	Existing	Tertiary	62	9.2	0.30	96.9	7	10 pm - 8 am	10	162
G	Park	Existing	Tertiary	4	0.6	0.02	5.8	7	10 pm - 8 am	10	10
H	Park	Existing	Tertiary	12	1.8	0.06	18.4	7	10 pm - 8 am	10	31
I	MH Park Playground	Existing	Tertiary	5	0.8	0.03	8.2	7	10 pm - 8 am	10	14
J	Famcamp	Existing	Tertiary	33	4.9	0.16	51.1	7	10 pm - 8 am	10	85
K	Schools	Existing	Tertiary	156	23.2	0.75	243.7	7	10 pm - 8 am	10	406
L	Golf Course	Existing	Tertiary	934	139.6	4.50	1,467.0	7	10 pm - 8 am	10	2,445
M	Love Avenue	Existing	Tertiary	14	2.2	0.07	22.9	7	10 pm - 8 am	10	38
N	Miscellaneous Use	Existing	Tertiary	82	3.0	0.10	31.9	7	10 pm - 8 am	10	53
O	Industrial Use	Future	Tertiary	28	3.9	0.13	41.0	7	10 pm - 8 am	10	68
P	Irrigation Use	Future	Tertiary	307	43.2	1.39	454.0	7	10 pm - 8 am	10	757
	Edwards AFB System Total			2,685	384.7	12.41	4,043.2				6,739
	GRAND TOTAL			35,624	6,335	216	74,483				79,225

* Current user of reclaimed water
Secondary-D: Disinfected Secondary
Secondary-U: Undisinfected Secondary

The tertiary system would serve tertiary treated reclaimed water to approximately 34 users in three service zones. Service zone maximum water surface elevations are 2,620, 2,840 and 2,920 feet above sea level. The secondary system would serve secondary treated reclaimed water to approximately 23 users in one service zone (maximum water surface elevation of 2,680 feet). The Rosamond system would serve tertiary treated water to approximately 20 users in one service zone (maximum water surface elevation of 2,620 feet).

Main pump stations would be located at the reclaimed water supply. Each of the service zones would contain storage reservoirs, distribution system piping, and booster pump stations.

The estimated construction cost of the reclaimed water system is shown in Table ES-5. As shown in the table, the treatment facilities for the tertiary and the Rosamond systems are $24,417,000 and $7,731,000 respectively. The distribution facilities for the tertiary, secondary, and Rosamond systems are $36,456,000, $67,486,000, and $8,296,000 respectively. The total cost for construction of the entire regional system is approximately $144,386,000 (1994 dollars). Construction costs include 15 percent for contractor overhead and profit, 20 percent for engineering/administration and 25 percent for contingencies.

Edwards AFB is currently designing a 2.5-mgd tertiary wastewater treatment plant. The following is a list of facilities for the planned reclaimed water distribution system:

- A 3,125 gallon per minute (gpm) main pump station at the wastewater treatment plant.
- A 3,125 gpm booster pump station.
- A 2.2 mg storage reservoir.
- Approximately 31,740 feet of polyvinyl chloride (PVC) pipe ranging from 4 to 18 inches in diameter.

The estimated capital cost of the planned distribution facilities is $6,300,000. Operation and Maintenance (O&M) costs were estimated to be $140,000 per year.

Table ES-6 shows the unit cost of the reclaimed water distribution facilities and the unit cost of the treatment facilities for each system. As shown in the table, the unit costs for the distribution facilities for the tertiary, secondary and Rosamond systems are $858, $359 and $1,218 per acre-foot respectively (includes annualized capital). The unit costs for the treatment facilities for the tertiary and Rosamond systems are $999 and $1,649 per acre-foot respectively (includes annualized capital). Total unit costs (distribution and treatment) for the tertiary, secondary and Rosamond systems are $1,857, $359 and $2,867 per acre-foot, respectively. These costs assume construction of the project is financed at market rates instead of low interest loans. The unit costs would be reduced if low interest loans were utilized for construction financing.

TABLE ES-5

PRELIMINARY COST ESTIMATE

COMPONENT	ESTIMATED COST (1994 Dollars)
I. Treatment Facilities	
A. Tertiary System	
Palmdale - 3.0 mgd	$ 6,200,000
Lancaster - 8.0 mgd	9,061,000
SUBTOTAL	$ 15,261,000
Contractor's OH & Profit (15%)	2,289,000
Engineering/Admin (20%)	3,052,000
Contingency (25%)	3,815,000
TOTAL (Tertiary System)	$ 24,417,000
B. Rosamond System	
Rosamond - 2.0 mgd	$ 4,832,000
SUBTOTAL	4,832,000
Contractor's OH & Profit (15%)	725,000
Engineering/Admin (20%)	966,000
Contingency (25%)	1,028,000
TOTAL (Rosamond System)	$ 7,731,000
TOTAL (Treatment Facilities)	$ 32,148,000
II. Distribution Facilities	
A. Tertiary System	
1. Main Pump Stations	
Palmdale - 2,000 gpm	
Lancaster - 5,600 gpm	$ 518,000
	1,004,000
2. Booster Pump Stations	
No. 1 - 1,320 gpm	
No. 2 - 1,520 gpm	$ 249,000
No. 3 - 5,660 gpm	275,000
No. 4 - 8,935 gpm	648,000
No, 5 - 5,600 gpm	875,000
	648,000
3. Reservoirs	
No. 1. - 1.0 mg	
No. 2. - 2.0 mg	$ 500,000
No. 3. - 1.0 mg	1,000,000
No, 4. - 2.4 mg	500,000
No. 5. - 4.6 mg	1,200,000
	2,300,000
4. Distribution Pipelines	
30-inch D.I. (100 LF)	
24-inch PVC (1,600 LF)	$ 15,000
18-inch PVC (93,800 LF)	154,000
16-inch PVC (9,500 LF)	6,754,000
14-inch PVC (43,700 LF)	608,000
12-inch PVC (27,600 LF)	2,447,000
10-inch PVC (7,500 LF)	1,325,000
8-inch PVC (24,900 LF)	996,000
6-inch PVC (12,800 LF)	240,000
	307,000
5. System Flushing and Testing	
	$ 222,000
SUBTOTAL	
Contractor's OH & Profit (15%)	$ 22,785,000
Engineering/Admin (20%)	3,418,000
Contingency (25%)	4,557,000
TOTAL	5,696,000
	$36,456,000

CONTINUED ON RIGHT

COMPONENT	ESTIMATED COST (1994 Dollars)
B. Rosamond System	
1. Main Pump Station	
Rosamond - 1,050 gpm	$ 324,000
2. Booster Pump Stations	
No. 7 - 1,611 gpm	$ 288,000
3. Reservoirs	
No. 9 - 1.5 mg	$ 750,000
4. Distribution Pipelines	
16-inch PVC (2,200 LF)	$ 128,000
12-inch PVC (39,200 LF)	1,882,000
10-inch PVC (19,400 LF)	776,000
8-inch PVC (21,800 LF)	698,000
6-inch PVC (8,600 LF)	206,000
5. System Flushing and Testing	$ 91,000
SUBTOTAL	$ 5,143,000
Contractor's OH & Profit (15%)	771,000
Engineering/Admin (20%)	1,029,000
Contingency (25%)	1,353,000
TOTAL (Rosamond System)	$ 8,296,000
C. Secondary System	
1. Main Pump Stations	
Palmdale - 25,800 gpm	$ 2,591,000
Lancaster - 15,700 gpm	1,846,000
2. Booster Pump Stations	
No. 6 - 3,000 gpm	$ 421,000
3. Open Reservoir	
No. 6 - 400 AF	$ 9,123,000
No. 7 - 565 AF	3,682,000
4. Distribution Pipelines	
42-inch D.I. (43,100 LF)	$9,051,000
36-inch D.I. (48,800 LF)	8,784,000
24-inch D.I. (15,840 LF)	1,901,000
20-inch D.I. (14,700 LF)	1,470,000
16-inch D.I. (5,400 LF)	432,000
14-inch D.I. (18,700 LF)	1,309,000
12-inch D.I. (5,500 LF)	330,000
10-inch D.I. (20,500 LF)	1,025,000
6-inch D.I. (1,300 LF)	39,000
5. System Flushing and Testing	$ 174,000
SUBTOTAL	$ 42,178,000
Contractor's OH & Profit (15%)	6,327,000
Engineering/Admin (20%)	8,436,000
Contingency (25%)	10,545,000
TOTAL (Secondary System)	$ 67,486,000
TOTAL (Distribution Facilities)	$112,238,000
GRAND TOTAL	$ 144,386,000

TABLE ES-6

ECONOMIC ANALYSIS OF THE RECLAIMED WATER SYSTEMS
(1994 DOLLARS)

Distribution Facilities	*Reclaimed Water Demand (AF/YR)*	*Annualized Capital Cost*(1)	*Annual Water Purchase Cost*(2)	*ANNUAL O&M COST*				*Includes Annual Capital Cost*		*Excludes Annual Capital Cost*	
				Pumping Cost(3)	*Parts Cost*(4)	*Labor Cost*(5)	*Total O&M Cost*	*Total Annual Cost*	*Cost per AF*	*Total Annual Cost*	*Cost per AF*
Tertiary System	5,688	$3,714,866	$341,280	$709,145	$84,725	$28,800	$822,670	$4,878,816	$858	$1,163,950	$205
Secondary System	26,493	$6,876,823	$1,589,580	$899,800	$120,024	$14,400	$1,034,224	$9,500,627	$359	$2,623,804	$99
Rosamond System	758	$845,363	$0	$55,200	$14,786	$7,200	$77,186	$922,549	$1,218	$77,186	$102
TOTAL	32,939	$11,437,05 2	$1,930,860	$1,664,145	$219,535	$50,400	$1,934,080	$15,301,99 2	$465	$3,864,940	$117

Treatment Facilities	*Reclaimed Water Demand (AF/YR)*	*Annualized Capital Cost*(1)	*Annual O&M Cost*(6)	*Includes Annual Capital Cost*		*Excludes Annual Capital Cost*	
				Total Annual Cost	*Cost per AF*	*Total Annual Cost*	*Cost per AF*
Tertiary System	5,688	$2,488,092	$2,195,370	$5,683,462	$999	$2,195,370	$386
Rosamond System	758	$787,789	$462,000	$1,249,789	$1,649	$462,000	$609
TOTAL	6,446	$3,275,881	$57,370	$6,933,251	$1,076	$2,657,370	$412

(1) Assumes 20 year period at 8% interest rate.
(2) For tertiary and secondary systems, cost to purchase reclaimed water from County Sanitation Districts of Los Angeles County. Current cost estimated to be $60/acre-feet. For Rosamond system; assumed RCSD operates WRP and purveys water.
(3) Assumes 80% pump efficiency, 90% motor efficiency, and electricity cost of $0.10 per Kwhr. Includes operation costs of booster and reuse pumps.
(4) Assumes annual parts cost to be 1% of construction costs of pumping stations, plus 0.1% of construction costs of storage reservoirs and pipelines.
(5) Assumes $25 per hour.
(6) From Dave Richard's "A Summary of Wastewater Reclamation Costs in California".

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Figure ES-7 depicts the medium demand with and without implementation of conservation measures and projected supply estimated at the 50, 80, and 90 percent probability levels. The most optimistic supply assumption (i.e., delivery of 100 percent of available water supplies) is also shown. Figure ES-7 is based on Figures ES-5 and ES-6 with one exception, the reclaimed water supply for the year 2020 is taken as the supply that will meet the demand for the high potential reclaimed water users identified in Table ES-4 (approximately 35,600 acre-feet). As shown on Figure ES-7, without exceeding groundwater extractions of 59,100 acre-feet per year, the probability of meeting the estimated 1993 water demand is approximately 73 percent. Without a conservation program and including the reclaimed water system identified in this report, by the year 1999 (projected population of 475,000), 100 percent of the water demand is estimated to be met only 50 percent of the time and by the year 2001 (projected population of 523,000), 100 percent of the potential water supplies would be required to meet the water demand. With a conservation program and including the reclaimed water system, by the year 2002 (projected population of 547,000), 100 percent of the water demand is estimated to be met only 50 percent of the time and by the year 2004 (projected population of 595,000), 100 percent of the potential water supplies would be required to meet the water demand.

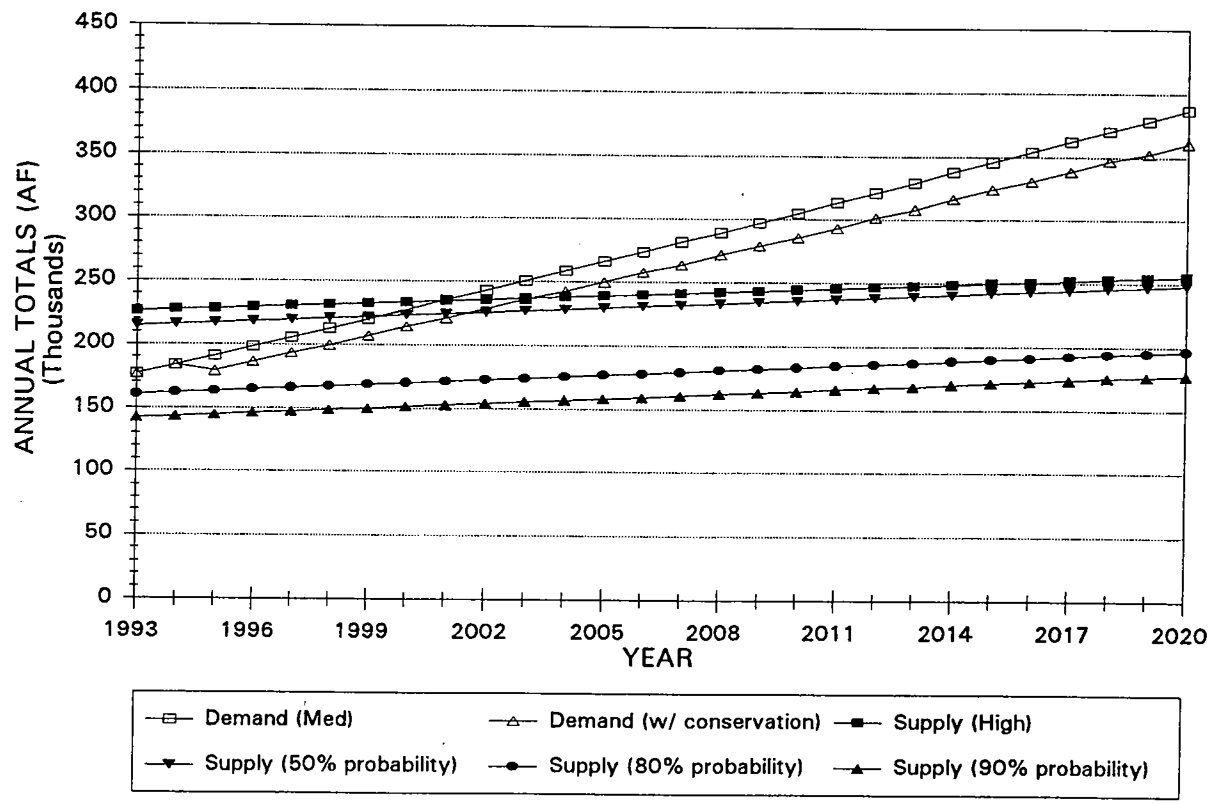
AQUIFER STORAGE AND RECOVERY

Aquifer Storage and Recovery (ASR) include the following methods of storing and recovering water from the groundwater basin:

- Spreading/Infiltration - use of surface spreading basins to allow infiltration of water into the aquifer.
- Injection - use of new or existing wells for direct injection of water into the aquifer.
- In-lieu Use - use of an alternative source of water, other than groundwater, when available, and use of groundwater when the alternative source is unavailable.

The entire groundwater basin of the Antelope Valley is estimated to have 68 million acre-feet of storage of which 13 million acre-feet is currently available (DWR, 1980). Approximately 55 million acre-feet of groundwater was estimated to remain in storage as of 1975. This stored water, however, may not be entirely accessible due to 1) uneconomical pumping depths, 2) distance between the groundwater basin and current users, and 3) the potential for causing land subsidence.

At present, the principal source of recharge of the groundwater in the Antelope Valley is runoff, principally recharged in the foothills of the mountains. Numerous studies have been conducted to estimate natural recharge since 1924, some based on little data. The most recent studies estimate natural recharge at 31,200 to 59,100 acre-feet per year (USGS, 1993).



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Supply and Projected Demand
(Includes Reclaimed Water Use)

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Figure ES-7

Figure ES-7

There are a variety of source waters that could be available for recharge into the groundwater of the Antelope Valley. They include:

- SWP
  - Treated potable water
  - Untreated water directly from the California Aqueduct

- Reclaimed Water (for spreading only)
  - Secondary treatment
  - Tertiary treatment

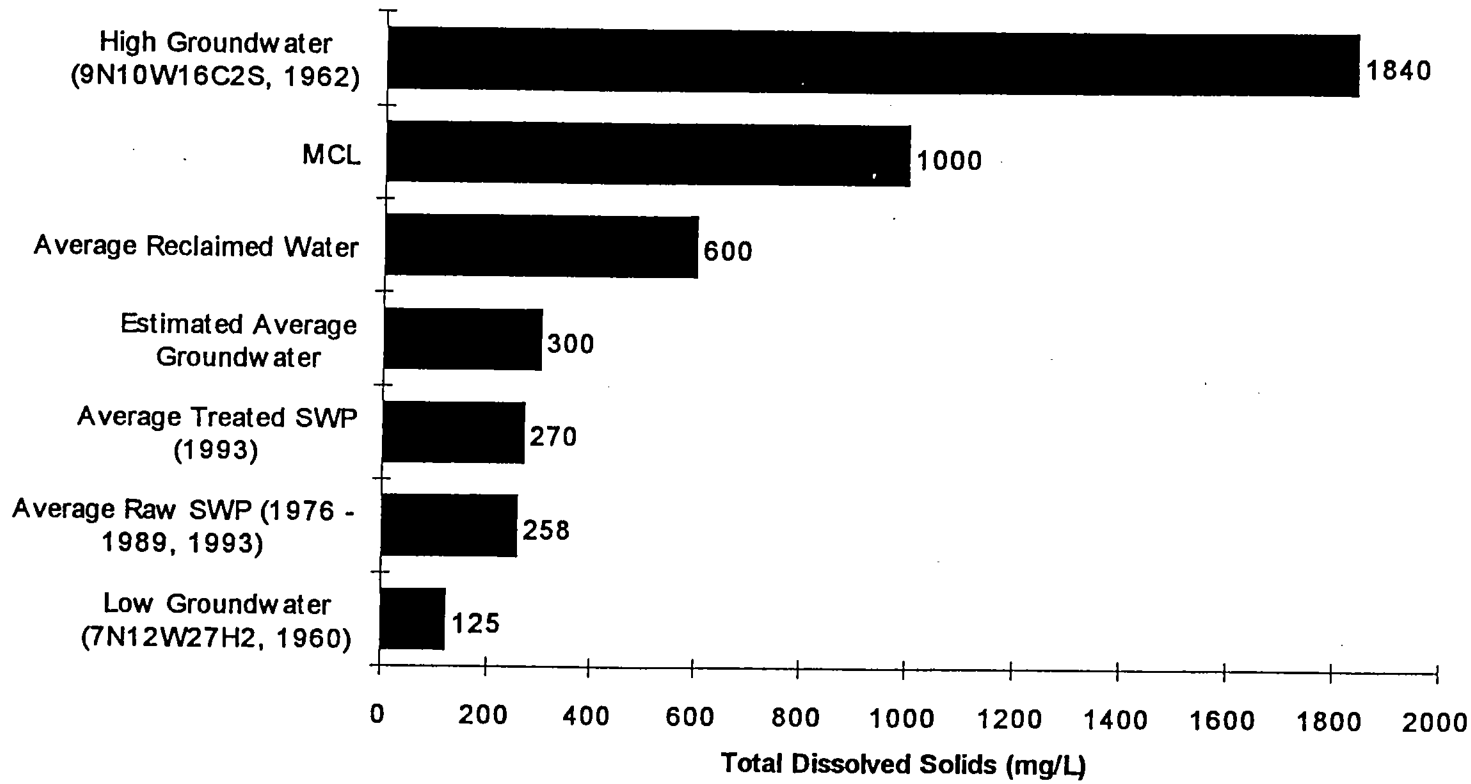
- Surface Water
  - Little Rock Creek and Little Rock Reservoir
  - Big Rock Creek
  - Amargosa Creek

The range in total dissolved solids (TDS) values of the potential sources of groundwater in the Antelope Valley is shown on Figure ES-8. The average raw SWP TDS value is an average of the annual average from 1976 to 1989 and 1993 (1993 TDS average is obtained from the average of January through June of 1993). The highest groundwater TDS level within the wells for which data were evaluated was 1840 milligrams per liter (mg/L) in a well located on Edwards AFB where perched water tables and the accompanying high salts occur. The low groundwater TDS of 125 mg/L occurred in a well in the LACWW wellfield near Lancaster. The average TDS value was estimated at about 300 mg/L based on the wells for which water quality was evaluated.

Certain characteristics affect economic viability and technical feasibility and are a key to a successful ASR program. If the aquifer is unsuitable for groundwater extraction, it is likely to be unsuitable for groundwater infiltration or injection. The following characteristics are desirable for both infiltration and injection programs:

- Suitable surface and sub-surface hydrogeologic conditions
- Adequate storage capacity
- Proximity to potential recharge water sources
- Proximity to existing groundwater production sites
- Impermeable faults to impound groundwater
- Compatible water quality

Both infiltration and injection require aquifer materials that have a high ability to accept and transmit water. These materials include sands and gravels at the surface for rapid infiltration and in the subsurface for rapid acceptance of injected water. As previously mentioned, there is an estimated available storage of 13 million acre-feet in the Antelope Valley aquifers. In order to have a cost-effective recharge program, the potential recharge sites should be located within a reasonable distance and hydraulic gradient of the potential source waters. Potential infiltration and injection sites should be assessed relative to the location of the existing facilities in order to minimize capital costs. In certain instances where



Note: Groundwater samples collected between 1960 - 1992 at wells in Antelope Valley

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Water Quality Comparison in Antelope Valley

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Figure ES-8

it is necessary to control the ultimate storage location of the infiltrated or injected groundwaters, fault and bedrock control of the groundwater impound may be a necessary characteristic that will need to be investigated further. In addition, it is important that the potential recharge site has good quality groundwater that will not compromise the quality of the water to be infiltrated or injected.

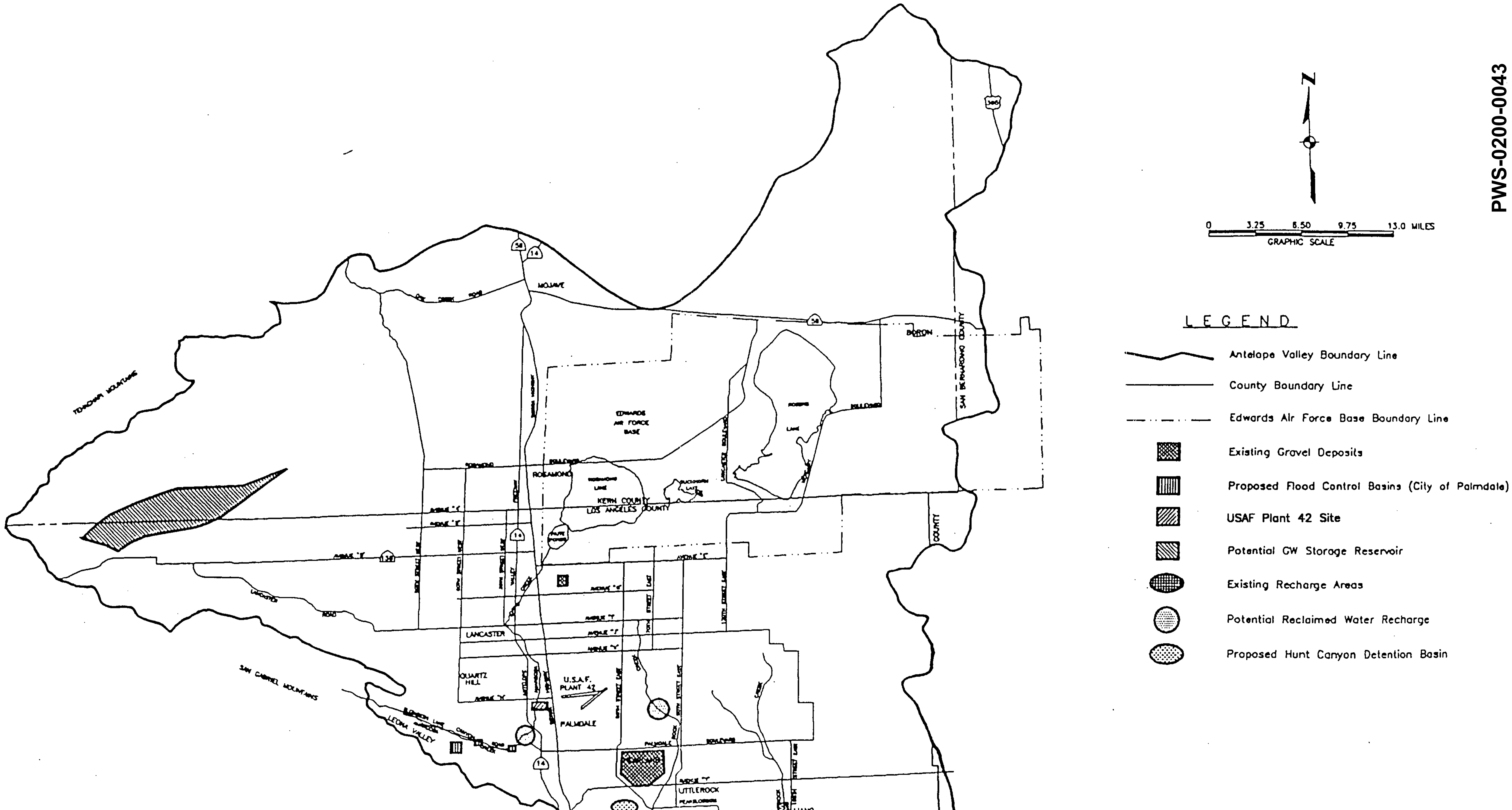
Based on the characteristics favorable to a good surface infiltration site and previous work that has been conducted in assessing infiltration sites, the following areas have been focussed on for more detailed analysis:

- Little Rock Creek
- Big Rock Creek
- Amargosa Creek
- West Antelope Subunit
- Groundwater recharge zones described in the Los Angeles County Department of Public Works (LACDPW) "Final Report on the Antelope Valley Comprehensive Plan of Flood Control and Water Conservation," dated June 1987.

The general location of existing and potential surface recharge sites can be found on Figure ES-9. Infiltration as a mechanism to recharge groundwater appears to be technically feasible. The sites with the highest potential for recharge by spreading appear to be:

- Amargosa Creek south of Avenue "N" between 10th Street West and Division Street (LACDPW Site).
- Little Rock Creek near Avenue "N" between 60th Street and 70th Street East, Department of Airport (DOA) Property.
- Amargosa Creek near Elizabeth Lake Road and 25th Street West.

There are several potential recharge sources including SWP water, reclaimed water, and natural recharge waters which should be generally acceptable for infiltration from a water quality perspective. More detailed water quality analyses should be conducted at the potential recharge sites to gather current information on the condition of the aquifer in these specific locations. Until those data are available, comparisons of water quality with the potential recharge sources cannot be reliably made. If specific areas for recharge are selected that have water quality that is worse than the potential source waters, the recharge program may benefit the aquifer.



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Existing and Potential
Surface Recharge Areas

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Figure ES-9

In addition, the potential formation of wetlands at the LACDPW site and the DOA site could result in increased wildfowl activity that could interfere with airfield operations. Depending on the timing of the operation of spreading ponds at the sites, this concern could be mitigated or reduced by developing an operation plan that accounts for migration patterns of the wildfowl.

Overall, further investigation will be required at each of the specific sites and should include, at a minimum, the following:

- Water quality of source waters and groundwater.

- Quantity and timing of availability of source waters.

- Hydrogeologic characteristics including travel times through unsaturated zones and percolation rates.

- Concerns of wildfowl interference at airfield operations.

- Location of extraction sites and travel times to those sites.

Potential injection areas include the municipal wellfields within the existing LACWW and PWD municipal wellfields (See Figure ES-10). Specific areas within the wellfields that have been assessed include:

- Potential LACDPW wells at Avenue K-8 and Division Street.

- Wells in USGS/LACWW/AVEK Injection Study.

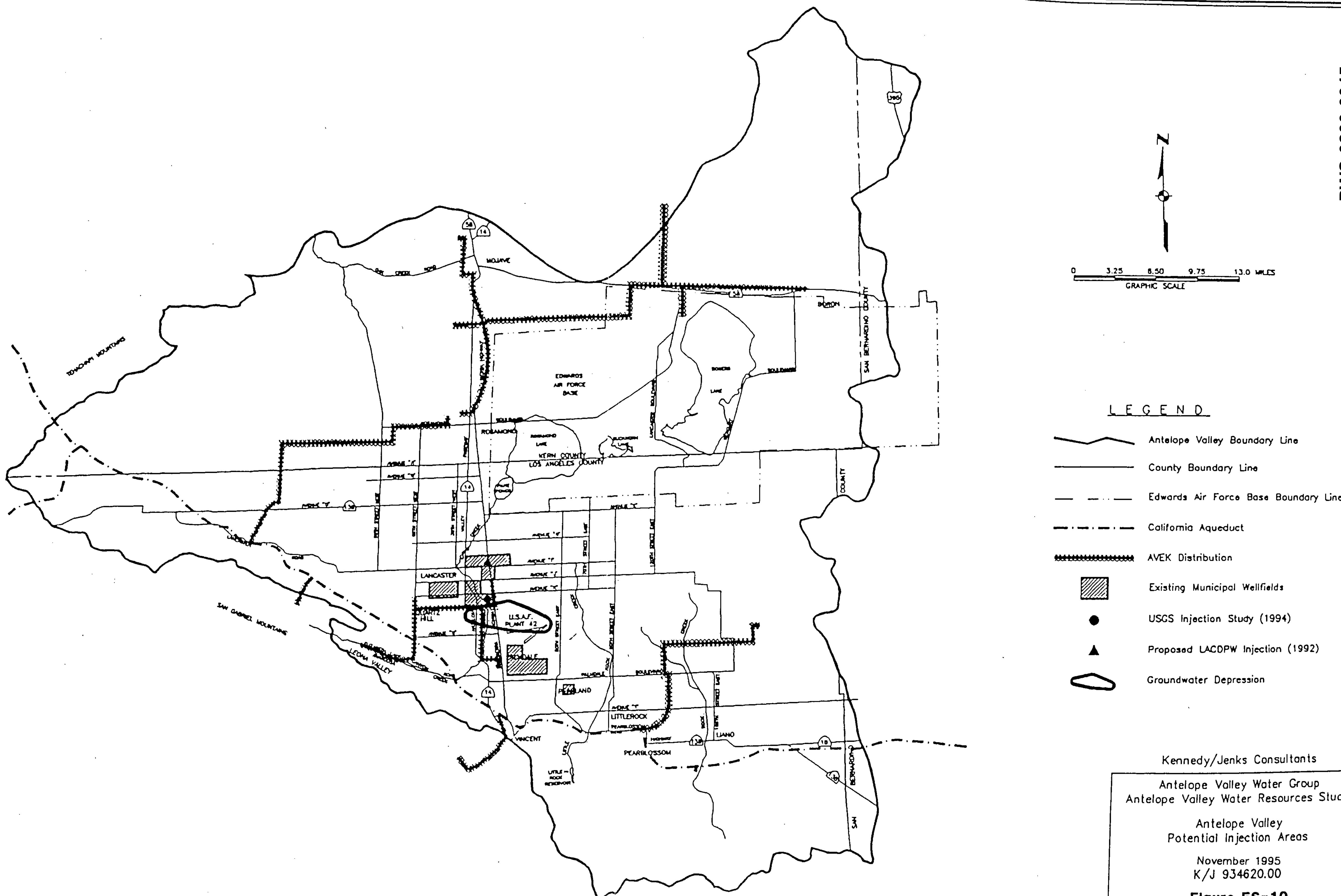
Injection has not been extensively studied in the Valley, however, groundwater recharge by injection appears to be technically feasible. The existing wellfields could provide both the injection and extraction facilities necessary to conduct such a program. The specific areas that should be explored further because of their proximity to the distribution system and potential treated SWP water are:

- LACWW wells located:

    - South of Avenue "K" between 10th Street West and Division Street (where USGS is conducting its injection study).

    - South of Avenue "L" between 10th Street West and Division Street (adjacent to the area above).

- PWD wells south of Avenue "P" between 20th Street East and 40th Street East.



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Antelope Valley
Potential Injection Areas

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Figure ES-10

It appears that treated SWP water should be generally acceptable for injection from a water quality perspective. The presence of trihalomethanes (THMs) in the treated SWP water may require treatment and/or alternative disinfection methods. Although higher concentrations of THM in the injected water than in the groundwater could be considered a violation of the Regional Water Quality Control Board's non-degradation policy for water quality, injection of treated State water has been allowed in other groundwater basins. However, more detailed water quality analyses will have to be conducted at the potential injection sites to gather current information on the condition of the aquifer water quality in these specific locations. Until those data are available, comparisons of water quality with the potential recharge source cannot be reliably made. If specific areas for recharge are selected that have water quality that is worse than the potential source waters (i.e., higher nitrates), the recharge program may benefit the aquifer.

Depending on the results of the USGS's injection study, significant additional work will be required and should include, at a minimum, the following:

- Estimation of the actual volumes that could be injected at each site.
- Evaluation of aquifer behavior during injection and extraction and a determination of aquifer characteristics at specific sites.
- Evaluation of potential ground surface effects during injection and extraction.
- Determination of upgrades that may be required at each well and pump station.
- Evaluation of the operation of the injection/extraction system based on the availability of treated SWP water.
- Evaluation of the potential changes to water treatment plant operations that may be required to continue injection and extraction over the long-term.

EFFECTS OF CHANGES IN GROUNDWATER LEVELS

According to the USGS, groundwater levels in the Lancaster area have declined by as much as 200 feet from 1915 to 1988 (USGS, 1994). Conversely, well hydrographs maintained by AVEK and in cooperation with the USGS, indicate groundwater levels in portions of the Valley have risen in recent years. Declining groundwater levels over a long period of time generally indicate over-extraction from a groundwater basin; conversely, increasing groundwater levels over a long period of time may indicate under-extraction from a basin (or recovery from over-extraction). In addition to these obvious indications, changes in groundwater levels are of concern, because a variety of damages can result.

Potential damages attributable to changes in groundwater levels include land subsidence, increased pumping costs, waterlogging, and water quality degradation.

Damages can range from minor structural damage to major physical damage to the ground surface rendering land virtually useless. Table ES-7 lists potential damages attributable to changes in groundwater levels. As indicated in Table ES-7, declining groundwater levels potentially result in two primary damages: 1) land subsidence and 2) increased pumping costs. Land subsidence is defined by USGS as the vertical lowering of the land surface over an area of many square miles (USGS, 1991) and may be the result of a variety of causes. Regardless of the cause of land subsidence, the resulting damages are similar. In general, damages will be most pronounced when subsidence gradients (change in subsidence levels over a given distance) are high. Increased pumping costs result directly from declining groundwater levels. As the pumping lift increases, so does the power cost to lift the water. As groundwater declines, additional pump bowls and larger motors may be necessary.

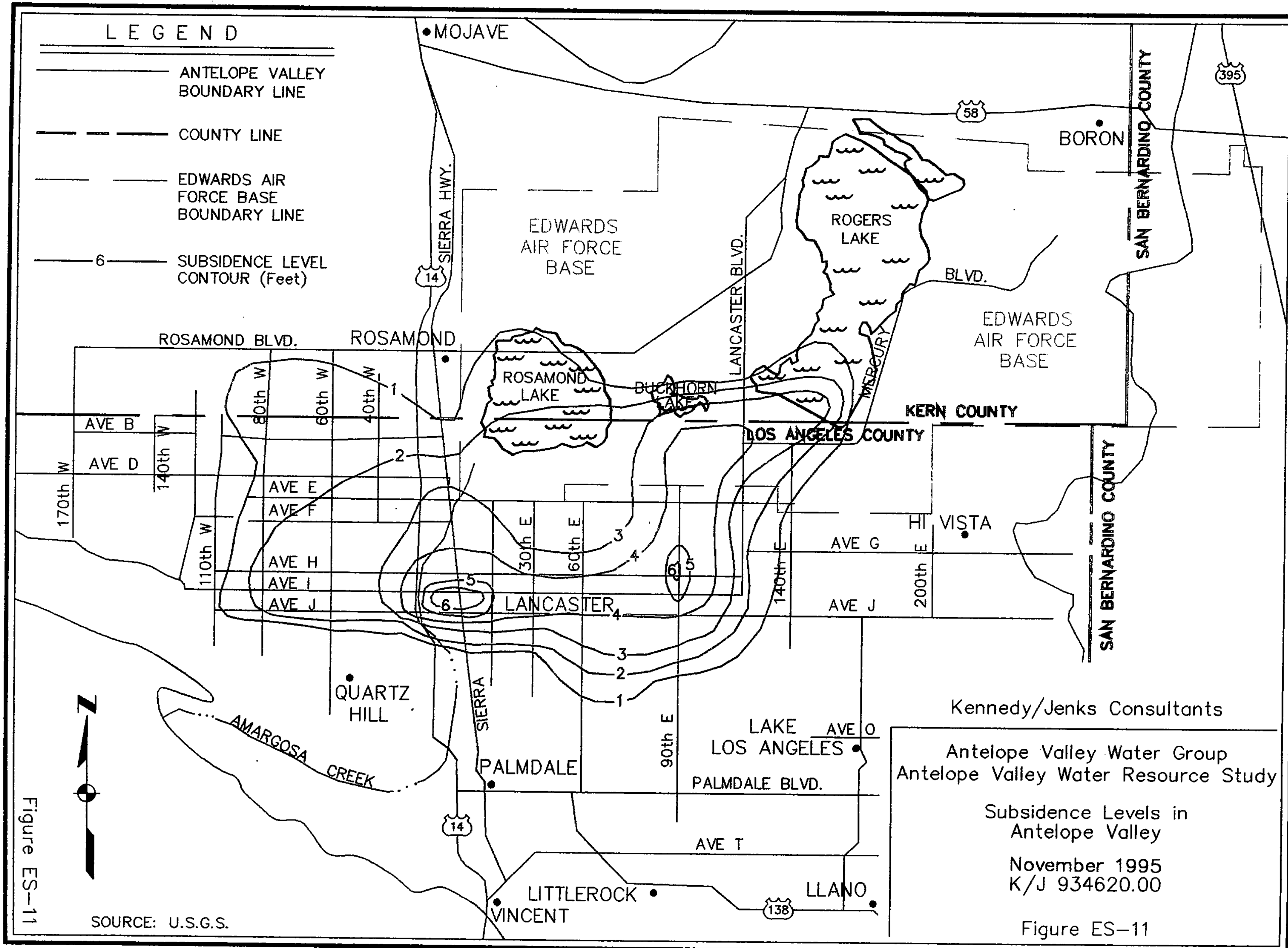
Potential damages attributable to increasing groundwater levels include waterlogging and water quality degradation. Waterlogging is defined as saturation of soil with water. The effects of waterlogging are dependent not only upon the elevation of the groundwater table but also on the soil type. Generally, the effects of waterlogging will be most noticeable in granular soils. Water quality degradation can result from nitrates being drawn down into the aquifers by rising groundwater levels and then being spread by depressions caused from overpumping. Nitrates are the end product of aerobic stabilization of organic nitrogen and, as such, occur in polluted waters that have undergone self-purification. Nitrate in groundwater can come from fertilizer, poultry manure, or domestic wastewater. Nitrates can cause blue baby syndrome which can be fatal for infants.

Subsidence levels of up to 7 feet have occurred in some areas of Antelope Valley. (See Figure ES-11.) Conversations held with various agencies and companies indicate that within the Antelope Valley, the Lancaster and Edwards AFB areas are currently experiencing problems or damages that appear to be related to land subsidence. USGS (1992) reported that as much as 2 feet of land subsidence had affected Antelope Valley by 1967 and was causing surface deformations at Edwards AFB. Fissures, cracks and depressions on Rogers Lakebed were affecting the use of the lakebed as a runway for airplanes and space shuttles. A paper by Thomas L. Holzer and Malcolm Clark titled "Earth Fissure in T7N, R11W, Section 3 near Lancaster, California" in January 1981, identified a fissure measuring approximately 0.35 miles long, up to 7.5 feet deep and 3 feet wide located between Avenues G and H and between 50th and 60th Streets East. A study done by Geolabs - Westlake Village (1991) studied a 10 square mile area in Lancaster identified to have fissures and sinklike depressions. The report identified fissures ranging in width from one inch to slightly over one foot. The lengths of the fissures ranged mainly between 50-200 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. Other potentially significant damages identified and may or may not be attributable to land subsidence include structural damage to the wastewater treatment plant building on Edwards AFB, cracked sidewalks and pavement.

TABLE ES-7

POTENTIAL DAMAGES ATTRIBUTABLE TO CHANGES IN GROUNDWATER LEVELS

Declining Groundwater Levels	*Increasing Groundwater Levels*
Land subsidence resulting in the following: • Development of cracks, fissures, sinklike depressions and softspots. • 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. • Lawsuits. Increased pumping costs.	Waterlogging resulting in the following: • Increased liquefaction potential. • Structural damage. • Rendering septic systems useless. • Costs associated with repairs and rebuilding. • Reduction in land value. Water quality degradation.



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Subsidence Levels in Antelope Valley

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Figure ES-11

Increasing groundwater levels have occurred in portions of the Valley. For most of these areas, no damage related to these increases has been identified, due to the fact the groundwater level is still significantly below the ground surface. However, for the Leona Valley area in the southern portion of the Valley, damages potentially attributable to increasing groundwater levels were identified in April 1993. The apparent damages appear to be typical and include waterlogging and water quality degradation.

WATER RESOURCE PROTECTION PLAN

The basic water resource protection strategy focuses on minimizing demand growth, protecting and optimizing the use of existing water resources, and developing additional water resources to meet projected future demands. Specific elements of the recommended strategy are presented below:

- Improve Utilization of Available Water Supplies
- Manage the Groundwater Basin
- Protect Groundwater Quality
- Reduce Long Term Water Demands
- Improve State Water Project Reliability
- Obtain Additional Imported Water Supplies

To implement the basic strategy identified above, the water purveyors in the Antelope Valley must initiate several institutional, engineering, financial, and public education activities. The recommended actions that appear to be the most important are:

- Create institutional framework to manage the development and use of water supplies including groundwater basin. Two approaches are:
    - Coordinated Agreement by the Water Purveyors
    - Special Act Legislation

- Determine the safe yield of the Antelope Valley groundwater basin.
    - Review alternative approaches to developing safe yield estimates, determine the most appropriate approach, and perform the necessary studies.

- Continue the current groundwater monitoring program and publish an annual report on basin conditions.
    - Make the best use of available wells and existing monitoring efforts and install new monitoring wells in key areas to improve groundwater level and quality network.
    - Protect existing benchmarks.
    - Expand existing land subsidence monitoring network to include tighter control in subsidence-prone areas.
    - Conduct Global Positioning System surveys on a more frequent basis to provide more adequate monitoring of land subsidence.

- Install additional continuous monitoring gages for streamflow.
- Collect and compile groundwater extraction data.
- Publish an annual report of Basin conditions and groundwater management activities.

- Develop a program to optimize the use of available water supplies.
  - Implement or facilitate the implementation by others of the water conservation, reclaimed water, stormwater management and aquifer storage and recovery programs.
  - Consider the application of groundwater replenishment assessments to fund a portion of the program cost.
  - Consider the application of basin equity assessments.

- Develop the recommended water conservation, reclaimed water, stormwater management and aquifer storage and recovery programs.
  - Conduct detailed program-specific planning studies.
  - Evaluate cost allocation between the water management elements of the programs and other institutional beneficiaries.

- Actively encourage the DWR to complete the State water project and/or improve reliability.
  - Continue to monitor the development of Federal-State Bay Delta protection plans.
  - Encourage the development of consistent operating procedures for Delta water exports.
  - Actively participate in discussion with DWR over water and cost allocation issues.

- Obtain additional imported water supplies.
  - Implement a phased water acquisition program.

- Develop a revenue plan to implement the recommended programs. Potential revenue sources include:
  - Replenishment Assessments
  - Basin Equity Assessments
  - Production Assessments
  - Facility Capacity Fees
  - Standby Charges

- Initiate public education program.
  - Provide information regarding integrated water management, the framework of the recommended programs, and the financial resources required.
  - Provide information regarding implementation issues of the individual programs.
  - Publish an annual report of basin conditions and groundwater management activities.

CHAPTER 2

INTRODUCTION

This chapter presents a brief background of the Antelope Valley Water Group and the need for a water resource study. The objectives, scope of services and conduct of the study are summarized.

BACKGROUND AND AUTHORIZATION

The Antelope Valley encompasses approximately 2,400 square miles in northern Los Angeles County, southern Kern County, and western San Bernardino County. The water demands within the Antelope Valley are serviced by a variety of water purveyors, including large wholesale agencies, irrigation districts, special districts providing primarily municipal and industrial water, investor-owned water companies, mutual water companies, and private well-owners.

Water supply for the Valley comes from three primary sources: the State Water Project (SWP), the Little Rock Dam, and the Antelope Valley Groundwater Basin. The Valley's SWP entitlements total 153,800 acre-feet per year. With proper treatment, SWP water is a high quality water well-suited for municipal and industrial (M&I) uses; however, in light of the recent drought, the reliability of the SWP water supply is being questioned. The Littlerock Dam is currently undergoing modifications that will increase storage capacity to 3,500 acre-feet. Water stored at the Littlerock Dam is used directly for agricultural uses and is used for M&I uses following treatment. The Antelope Valley Groundwater Basin is a large basin comprised of a principal aquifer, which is utilized the most, and deep aquifers. Groundwater levels appear to be dropping in portions of the basin and rising in other portions. Water quality is generally good (i.e., Total Dissolved Solids is less than 1,000 parts per million) Valley-wide except for the northeast portion of the Valley, the borders of the Lancaster Subunit, and some shallow wells in North Edwards and Boron. Some high concentrations of boron associated with naturally-occurring boron deposits, and high nitrates associated with fertilizer use and poultry farming near the towns of Littlerock and Quartz Hill are some areas of exception. The groundwater in the basin is used for both agricultural and M&I uses.

Reclaimed water and stormwater are secondary sources of water supply. A portion of the effluent from the Valley's two large wastewater treatment plants, County Sanitation Districts of Los Angeles County (CSDLAC) plants in Palmdale and Lancaster, is used for maintenance of wetlands, agricultural irrigation, landscape irrigation, and a park impoundment. The unused effluent is spread and percolates into the ground or evaporates. Stormwater from the mountains and hills surrounding the Valley and from the Valley itself is either collected in basins or drains naturally towards the low center of the Valley. Virtually none of this surface flow exits the Valley. Previous efforts at stormwater recharge by surface spreading appear to have been marginally successful. The United States Geological Survey

(USGS) estimates that approximately 1.4 million acre-feet of average annual precipitation is lost to evaporation each year.

Historically, land uses within the Antelope Valley have been focused on agriculture; however, the valley is in transition from predominately agricultural uses to predominately residential and industrial uses. An estimated 332,000 people currently reside within the Valley. It is projected that the population of the Valley will reach nearly 1,000,000 in the year 2020. This represents an increase of 201 percent from the current population.

As rapid development has increased the demand for both more water and higher quality water and the prolonged drought has caused curtailments of SWP deliveries, the competition for available water supplies has increased. Recent water resource studies by individual water purveyors have attempted to provide a technical foundation and/or management strategy for the area's water resources. However, these attempts have generally been met with criticism and mistrust.

The Antelope Valley Water Group (AVWG) was formed in 1991 to provide a means of communication for the Valley agencies with an interest in water. Water Group members include the Cities of Palmdale and Lancaster, Edwards Air Force Base (Edwards AFB), Antelope Valley - East Kern Water Agency (AVEK), Antelope Valley United Water Purveyors Association (AVUWPA), Los Angeles County Waterworks Districts, (LACWW), Palmdale Water District (PWD), Rosamond Community Services District (RCSD), and CSDLAC. In an attempt to prepare a water resource study with a regional focus, rather than an individual focus, the AVWG initiated the Antelope Valley Water Resource Study. The agencies that contributed funds for the water resource study (AVWG Technical Advisory Committee members) include the cities of Palmdale and Lancaster, AVEK, LACWW, USGS, AVUWPA, PWD, RCSD, and CSDLAC.

The AVWG divided the study into two elements. The first element is being performed by USGS and focuses on 1) evaluation of the past and present water use and source of supply, 2) projection of water demands into the future, 3) development of a detailed study plan for the basic hydrogeology, 4) development of a detailed study plan for a groundwater management model, and 5) assessment of land subsidence. The draft report was completed in October 1993, and the final report is scheduled for completion in late 1994.

On 21 July 1993, AVWG, with the City of Palmdale as the contracting agency, authorized Kennedy/Jenks Consultants to proceed with the second element of the water resource study. The second element focuses on 1) assessment of water resources in light of the demands projected by USGS, 2) evaluation of the feasibility of aquifer storage and recovery, 3) development of a regional water conservation plan, 4) assessment of effects of changes in groundwater levels, 5) development of alternative plans for water resource protection, and 6) preparation of a report compiling USGS and consultant data and results.

OBJECTIVES

The primary objective of AVWG's water resource study is to develop consensus on a water resource management plan that addresses the need of the M&I purveyors to reliably provide the quantity and quality of water necessary to serve the growth projected by the planning agencies while concurrently addressing the need of agricultural users to have adequate supplies of reasonable cost irrigation water.

In order to achieve this objective, the following specific goals were developed:

- To provide the technical foundation for the consensus plan.
- To develop an innovative water resource development plan that optimizes existing resources.
- To achieve an acceptable compromise between urban and agricultural objectives.
- To develop a water resource management strategy to implement the consensus plan.

SCOPE OF SERVICES

To accomplish the objectives, the following scope of services was developed:

Task 1 - Project Management

1.1 Attend a kick-off meeting to discuss the scope of work and applicable procedures for the project and to collect available background data from the meeting participants.

1.2 Prepare a monthly technical memorandum discussing project status, preliminary findings, and project direction to be distributed to the Technical Advisory Committee members and USGS for review.

1.3 Prepare an agenda and organize and chair meetings of the Technical Advisory Committee and USGS to discuss the technical memorandum and other issues.

1.4 Conduct public meetings on status and results of the study.

Task 2 - Collect and Review Available Studies

2.1 Collect and review available studies.

2.2 Interview each of the participating agencies for information on their concerns, ideas, and planned projects.

Task 3 - Assess Water Resources

3.1 Collect and review USGS data on past, present, and future water demands (USGS Elements I and II); past and present sources of supply; and future availability of local groundwater supplies.

3.2 Identify the available sources of reclaimed water, the quantity of reclaimed water available projected to the year 2020, and the current uses of reclaimed water.

3.3 Using probability analysis, assess the reliability of surface water provided by the Littlerock Dam and reclaimed water.

3.4 Collect the reliability analyses from the State Department of Water Resources (DWR) and the Metropolitan Water District of Southern California and use these evaluations to assess the reliability of SWP water, based on both current SWP facilities and projects proposed to enhance the SWP yield.

3.5 Perform a risk analysis of the ability of local and imported water supplies, including reclaimed water and proposed SWP enhancement projects, to meet water demands to the year 2020.

3.6 Based on data gathered in subtask 3.1, assess the effects of variations in SWP water supply on groundwater levels by comparing historical groundwater levels to historical SWP water supplies.

3.7 Based on data gathered in subtask 3.1, assess the effects on groundwater levels of a transition from a predominantly agricultural demand (highly dependent upon groundwater) to a M&I demand.

Task 4 - Evaluate Feasibility of Implementing Aquifer Storage and Recovery Methods

4.1 Collect and review information from USGS (USGS Element III and IV) and existing studies on the hydrogeologic characteristics of the basin.

4.2 From data gathered from USGS and supplemental information gathered from Los Angeles County and DWR, inventory wells within the basin.

4.3 Based on data collected in subtask 4.1, identify areas suitable for groundwater recharge by surface infiltration or subsurface injection.

4.4 Review the basin plan prepared by the Regional Water Quality Control Board.

4.5 Based on information collected in subtask 4.1 and 4.4, assess the effect on groundwater quality of recharge of treated and untreated potable water.

4.6 Based on information collected in subtask 4.1 and 4.4, assess the effect on groundwater quality of recharge of reclaimed water.

<u>Task 5 - Evaluate the Feasibility of Use of Reclaimed Water</u>

5.1 Identify potential users of reclaimed water and their corresponding water demands.

5.2 Evaluate the cost and feasibility of converting the existing wastewater treatment plants to tertiary treatment.

5.3 Evaluate the cost and feasibility of constructing a backbone reclaimed water system.

5.4 Based on subtasks 4.6 and 5.1 through 5.3, develop a conceptual plan for use of reclaimed water.

<u>Task 6 - Develop and Evaluate Water Conservation Alternatives</u>

6.1 Collect and review information on conservation programs existing in the Valley.

6.2 Review state mandated water conservation measures (best management practices) for applicability to the Antelope Valley.

6.3 Based on other water conservation programs throughout the State and information from the DWR including Water Plan program, assess the effectiveness of existing and applicable state mandated water conservation measures in terms of cost versus water savings.

9.5 Address public comments in report.

9.6 Prepare a final report and submit one hundred (100) copies to AVWG.

CONDUCT OF THE STUDY

The information developed in this second element of AVWG's water resource study is a result of review of existing studies; contact with the AVWG members, other water purveyors and cities within the Antelope Valley, USGS, Edwards AFB personnel, and residents of the Valley; contact with a number of local, state, and federal agencies; field work; office analysis; and computer modeling. The initial phase of the project was concerned with the collection and evaluation of existing data and reports. Discussions with the planning, operations, and engineering staffs of the water purveyors, wastewater treatment plant owners, cities, and Edwards AFB were conducted to assess current and future operations relating to water and reclaimed water. Data gathered and analyses generated by USGS during the first element of the water resource study were collected and reviewed during the first phase of the study.

Subsequent phases were concerned with evaluation of the data collected in light of Tasks 3 through 7 described previously in "Scope of Services" and development of a plan which increases the reliability of the available water supplies. Technical issues addressed include the following:

- The use of reclaimed water without adverse crop effects or groundwater degradation.
- The use of stormwater without adversely affecting flood control operations.
- Maximum groundwater use prior to water quality degradation.
- Beneficial use of state water when full entitlements are available.
- Basic management options to maximize conjunctive use opportunities, maintain water quality and avoid adverse impacts due to fluctuating ground water levels.
- Implementation of water conservation opportunities without coercive measures.

Through analysis of data and development of water supply enhancement opportunities, a plan for optimizing existing water resources was developed. Capital costs were estimated and issues associated with implementation of these opportunities were discussed.

Throughout the study, regular meetings with the AVWG Technical Advisory Committee were held and progress reports were presented. Interim work products were submitted to the Committee for review and comments were received.

CHAPTER 3

STUDY AREA CHARACTERISTICS

This chapter describes the general environmental setting of the Antelope Valley in terms of location, climate and hydrologic features. Brief descriptions of land use and population trends are also included. The United States Geological Survey (USGS) 1994 draft report titled "Land Use and Water Use in the Antelope Valley, California" and the USGS 1987 report titled "Geohydrology of the Antelope Valley Area California and Design for a Groundwater-Quality Monitoring Network" were the primary sources of information presented in this chapter.

LOCATION

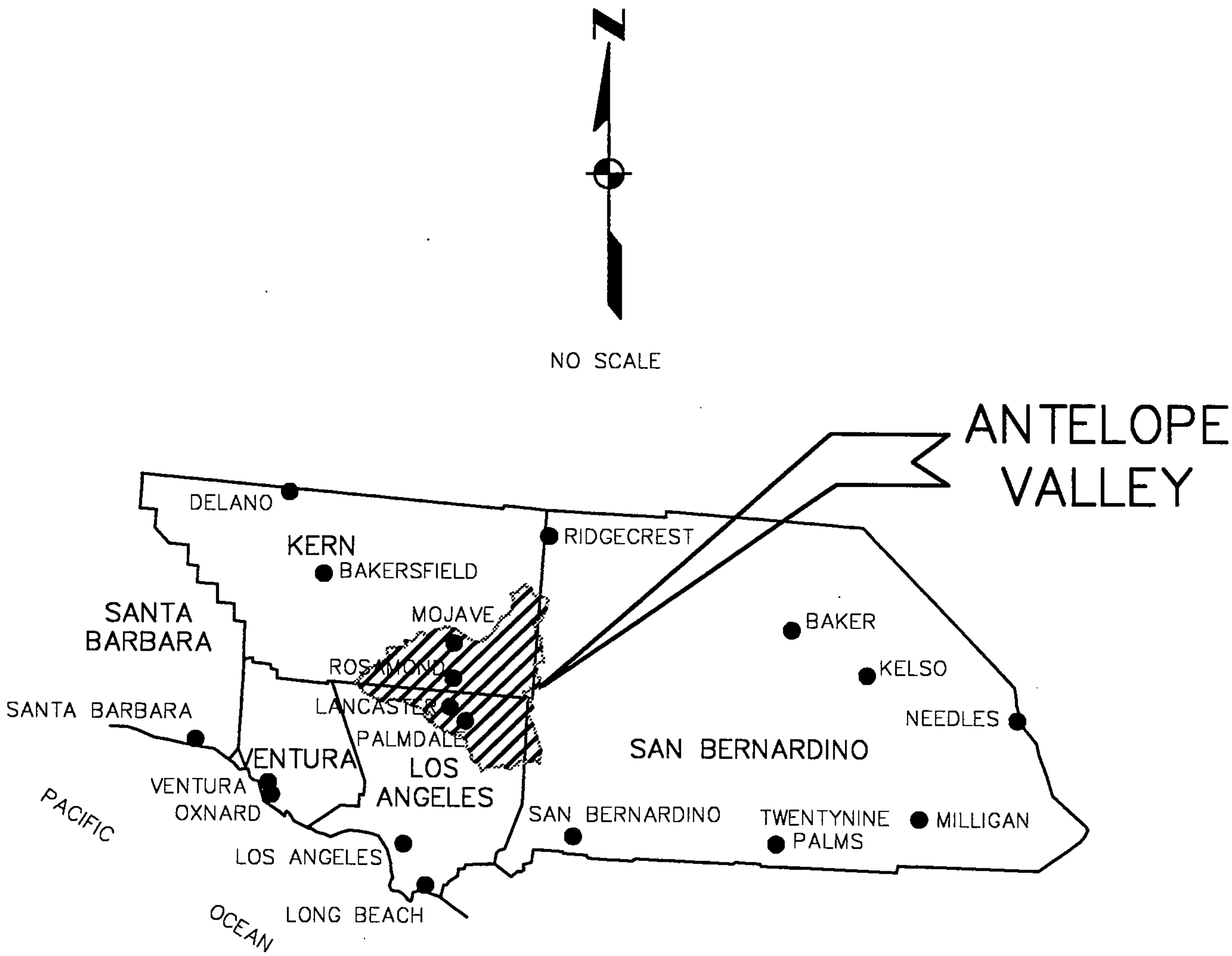
The Antelope Valley, as defined for the purposes of this report, encompasses approximately 2,400 square miles in northern Los Angeles County, southern Kern County and western San Bernardino County. (See Figure 3-1.) The Valley is bordered on the southwest by the San Gabriel Mountains, on the northwest by the Tehachapi Mountains, and on the east by a series of hills and buttes that generally follow the San Bernardino County line. (See Plate 1.)

As shown on Plate 1, major communities within the Valley include Boron, Edwards Air Force Base (AFB), Lancaster, Mojave, Palmdale and Rosamond. Smaller communities include Little Rock, Quartz Hill, Leona Valley, Pearblossom, Llano and Pearland. The communities are concentrated in the eastern portion of the Valley.

Four major roadways traverse the Valley. The Antelope Valley Freeway (I-14) and the Sierra Highway both bisect the Valley from north to south. The Pearblossom Highway (Highway 138) traverses the southeastern and central-western portions of the Valley in an east-west direction. Highway 58 traverses the northern portion of the Valley in an east-west direction.

CLIMATE

Comprising the southwestern portion of the Mojave Desert, the Valley ranges in elevation from approximately 2,300 feet to 3,500 feet above sea level. Vegetation native to the Valley are typical of high desert and include Joshua trees, saltbush, mesquite, sagebrush, and creosote bush. The Valley climate is characterized by hot summer days, cool summer nights, cool winter days and cool winter nights. Typical of a semiarid region, mean daily summer temperatures range from 63° Fahrenheit (F) to 93° F, and mean daily winter temperatures range from 34° F to 57° F. The growing season is primarily from April through October. Precipitation ranges from 5 inches per year along the northern boundary of the Valley to 10 inches per year along the southern boundary. Historical precipitation for the Lancaster area is shown on Figure 3-2.



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Antelope Valley Water Resource Study

Antelope Valley Location Map

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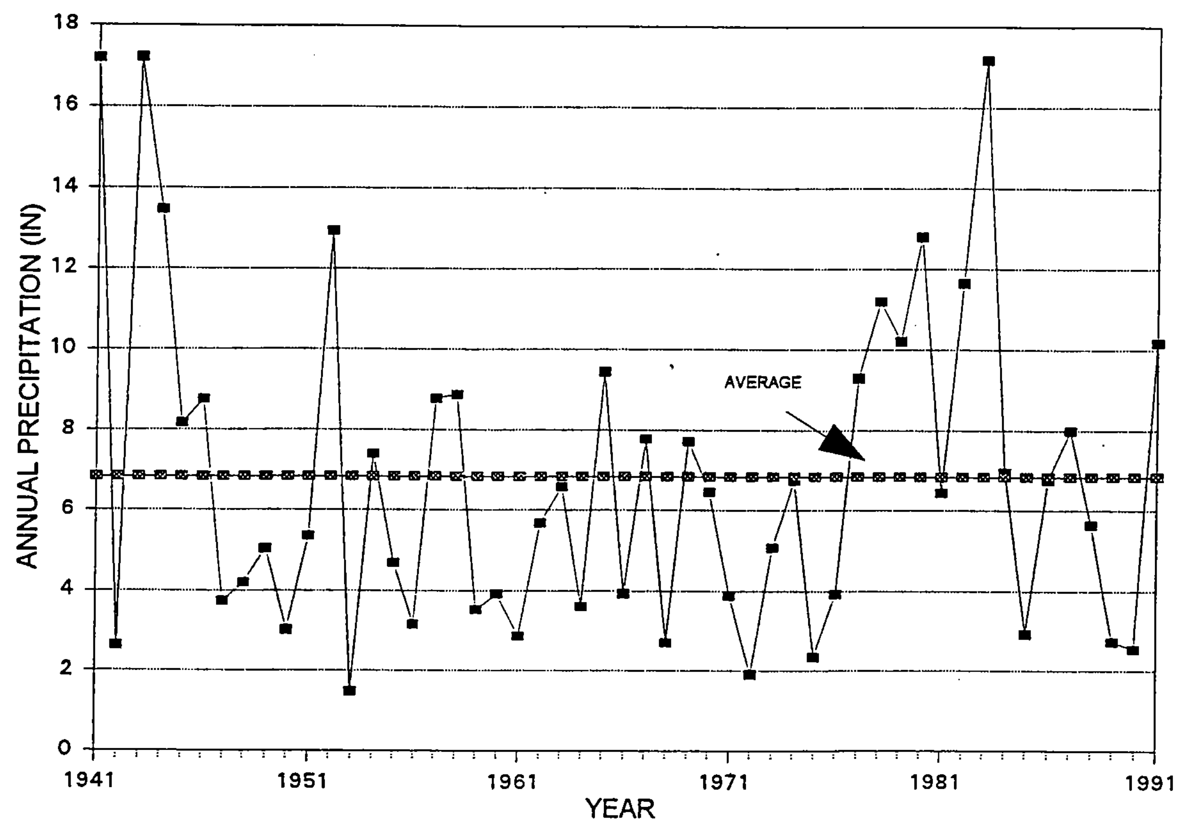
Figure 3–1



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Historical Precipitation for Lancaster

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Figure 3–2

HYDROLOGIC FEATURES

Surface water and groundwater features of the Antelope Valley are discussed below.

Surface Water

The Antelope Valley is a closed basin. Surface water from the surrounding hills and from the Valley floor flow primarily toward three dry lakes on Edwards AFB: 1) Rosamond Lake, 2) Buckhorn Lake and 3) Rogers Lake.

Surface water flows are carried by ephemeral streams. The most hydrologically significant streams begin in the San Gabriel Mountains in the southwestern edge of the Valley and include, from east to west, Big Rock Creek, Little Rock Creek, and Amargosa Creek. (See Plate 1.) Except during the biggest rainfall events of a season, surface water flows toward the Valley from the surrounding mountains, quickly percolating into the stream bed and recharging the groundwater basin. Surface water flows that reach the dry lakes are generally lost to evaporation. It appears that little percolation occurs in the Valley other than near the base of the surrounding mountains due to impermeable layers of clay overlying the groundwater basin. USGS estimates that nearly 1.4 million acre-feet of surface water in the Valley is lost to evapotranspiration each year (USGS, 1987).

The Little Rock Creek is the only developed surface water supply in the Valley. The Little Rock Reservoir, jointly owned by Palmdale Water District (PWD) and Little Rock Creek Irrigation District (LCID), collects run-off from the San Gabriel Mountains. (See Plate 1.) The Dam currently has a useable storage capacity of 600 acre-feet of water; however, PWD and LCID are planning modifications to the dam which will increase the storage capacity to 3,500 acre-feet. These modifications are scheduled for completion in 1994. Historically, water stored at the Little Rock Dam has been used directly for agricultural uses within LCID's service area and for municipal and industrial (M&I) uses within PWD's service area following treatment at PWD's water purification plant.

Groundwater

The Antelope Valley Groundwater Basin is comprised of two primary aquifers: 1) the principal aquifer and 2) the deep aquifer. The principal aquifer, an unconfined aquifer, actually provided artesian flows in 1909. Separated from the principal aquifer by clay layers, the deep aquifer is generally considered to be confined. In general, the principal aquifer is thickest in the southern portion of the Valley near the San Gabriel Mountains, while the deep aquifer is thickest in the vicinity of the dry lakes on Edwards AFB.

The Antelope Valley Groundwater Basin is divided into twelve subunits as shown on Plate 1. The subunits are Finger Buttes, West Antelope, Neenach, Willow Springs, Gloster, Chaffee, Oak Creek, Pearland, Buttes, Lancaster, North Muroc, and Peerless. Studies performed by the USGS and the State Department of Water Resources (DWR) indicate that groundwater levels appear to be generally dropping in the eastern areas of the basin and rising in the western areas. Groundwater quality is excellent within the principal aquifer but degrades toward the northern portion of the dry lake areas. Considered to be generally suitable for domestic, agricultural, and industrial uses, the water in the principal aquifer has a total dissolved solids (TDS) concentration ranging from 200 to 800 milligrams per liter (mg/L). The deeper aquifers typically have higher TDS levels. Hardness ranges from 50 to 200 mg/L and high fluoride, boron, and nitrates are a problem in some areas of the basin. The groundwater in the basin is used for both agricultural and M&I uses.

LAND USE

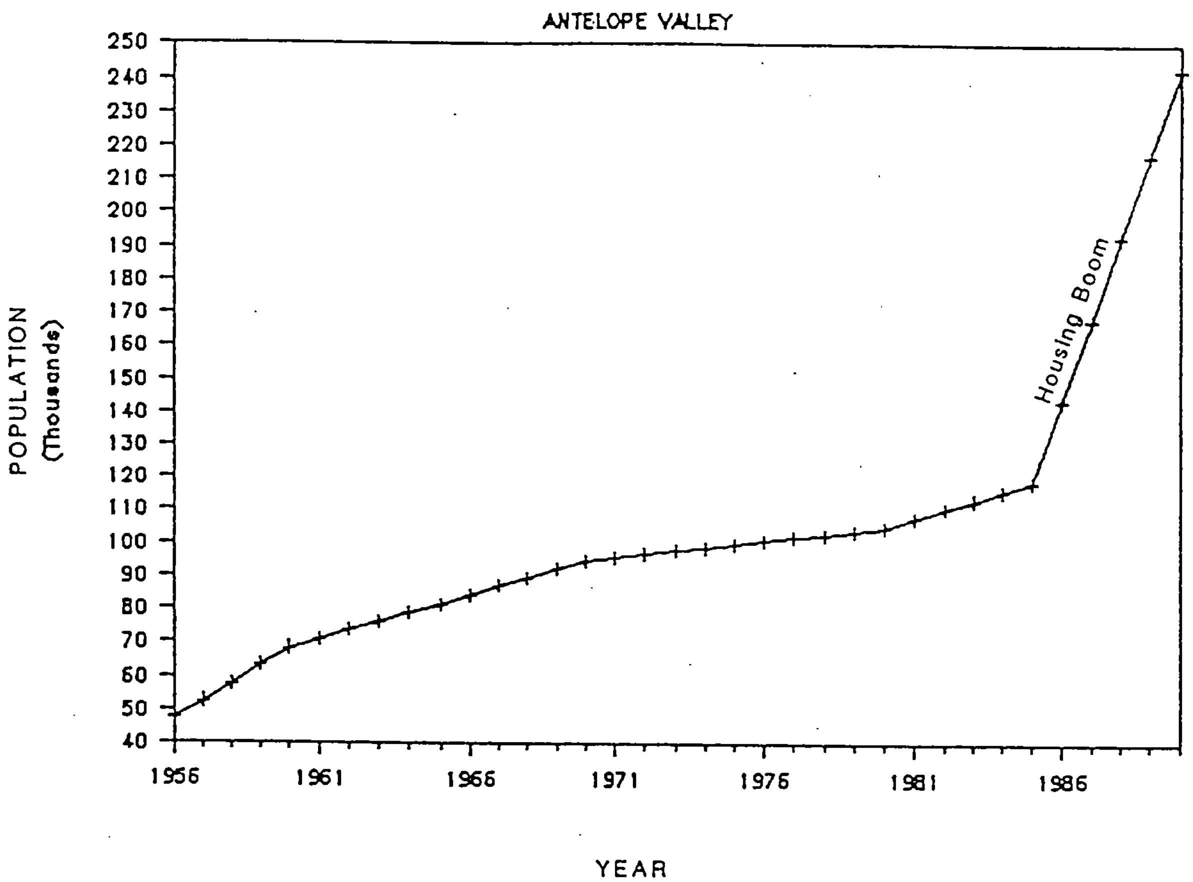
Historically, land uses within the Valley have focused primarily on agriculture; however, the Valley is in transition from predominantly agricultural uses to predominantly residential and industrial uses. USGS's 1994 draft report indicates that agricultural land use has decreased from 73,000 acres in the early 1950s to 12,854 acres in 1993. The USGS (1994a) cites the DWR prediction that agricultural land use will decrease to approximately 900 acres in 2020. Historically, crops grown in the Valley have included alfalfa, wheat, barley and other livestock feed crops. In recent years, onions, turf and orchards have become more prominent. Broken down by the various types of crops, acreages in 1993 were 6,124 acres for alfalfa, 955 acres for pasture and turf, 835 acres for grain, 32 acres for field crops, 2,645 acres for truck crops and 2,263 acres for deciduous trees.

The increase in residential land use is evident from the population growth in the Valley which is discussed in the next section. With significantly lower prices than in Southern Los Angeles County, the Valley housing market has seen an increase in commuters to the Los Angeles area.

Industrial land use in the Valley consists primarily of manufacturing for the aerospace industry and mining. Edwards AFB, and the U.S. Air Force Flight Production Center (Plant 42) provide a strong aviation and military presence. Reductions or realignments in the defense industry could adversely affect this presence. Mining of Borate in the northern areas of the Valley and salt extract, rock, gravel and sand in the southern areas of the Valley contribute to the Valley's industrial land uses.

POPULATION

Historically, growth in the Antelope Valley proceeded at a slow pace until 1985. However, between 1985 and 1990, the growth rate increased approximately 1,000 percent from the average growth rate between the years 1956 to 1985. (See Figure 3-3.)



Source: Law Environmental November 25, 1991
"Water Supply Evaluation,
Antelope Valley, California"

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Antelope Valley Water Group
Antelope Valley Water Resource Study

Historical Population – Antelope Valley

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K/J 934620.00

Figure 3-3

Historical and projected population for the Antelope Valley are shown in Table 3-1 and depicted on Figure 3-4. Population data and projections were based primarily on information presented in the USGS 1994 draft report. USGS 2010 and 2020 projections for the Antelope Valley were provided by the DWR in a preliminary draft of Bulletin 160. However, in the Bulletin 160 draft dated November 1993, DWR revised the projections. Table 3-1 reflects these revisions. Projections indicate that approximately 986,000 people will reside in the Valley by the year 2020. This represents an increase of approximately 278 percent from the 1990 population. Areas of concentrated population within the Valley include Lancaster, Palmdale, Edwards AFB, Rosamond, Mojave, and Boron.

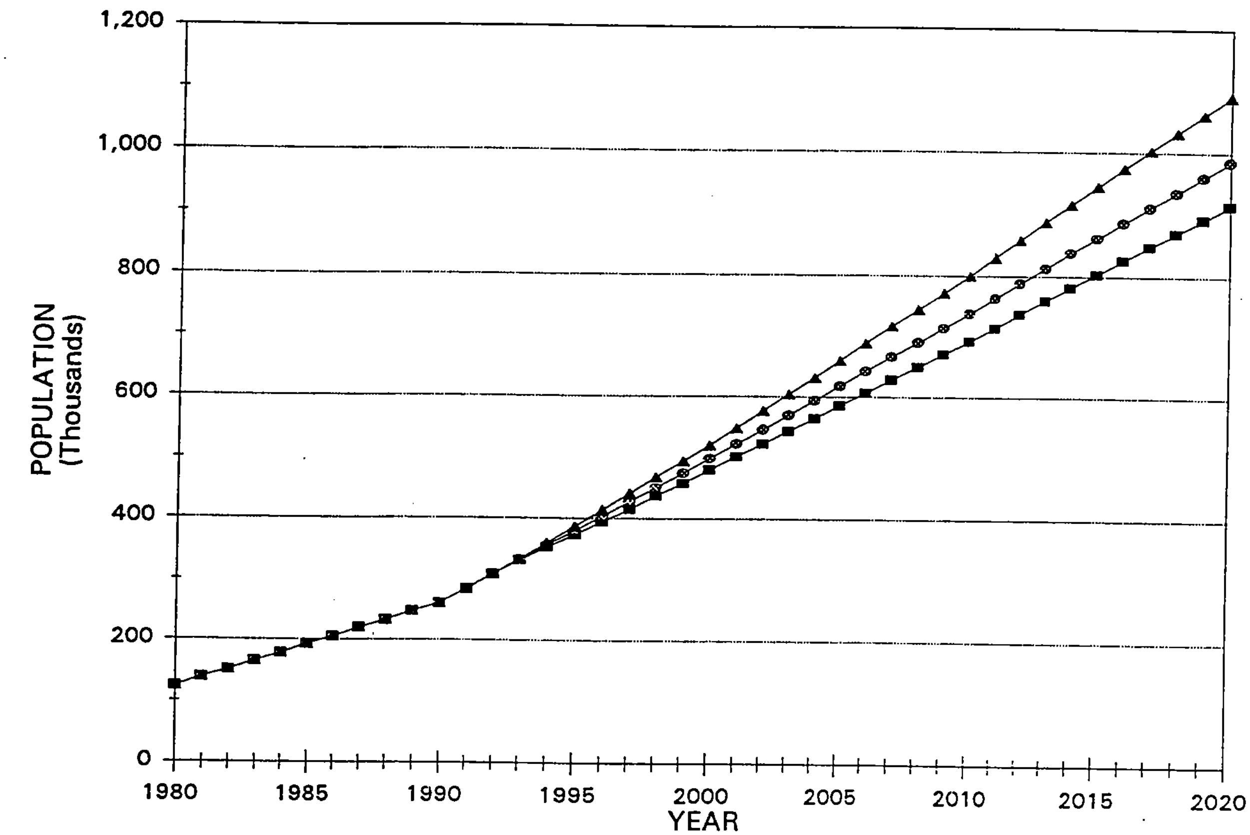
It is noted that population forecasting is not an exact science due to an element of uncertainty to whether or not the projections will be truly realized. Additionally, the population projections used in this report were obtained from sources that may have been influenced by the rapid growth that occurred in the Valley just prior to 1990. (See Figure 3-3.)

TABLE 3-1

ANTELOPE VALLEY
HISTORICAL AND PROJECTED POPULATION

Area	*1980*	*1990*	*2010*	*2020* [1]
Lancaster	48,027	97,291	212,138 [2]	269,558
Palmdale	12,277	68,842	245,341 [3]	326,815
Edwards AFB	8,554	7,423	7,671	7,671
Rosamond	2,869	9,969 [4]	39,256 [5]	52,696
Mojave	2,886	3,793[8]	8,737	11,209
Boron	2,815	2,903	3,071	3,155
Other	46,922	70,179 [6]	221,787 [6]	314,896[6]
Total	124,350	260,400	738,000 [7]	986,000[7]

(1) Extrapolated based on 1990 and 2010 populations except for Palmdale, Edwards AFB, Rosamond and Other. Palmdale is extrapolated based on 1993 and 2010 populations. Rosamond is extrapolated based on 2000 and 2010 populations. Edwards AFB 2020 population is maintained at 2010 level and Other is the difference between the total and the areas of concentrated population.
(2) From SCAG 1993 population projections.
(3) Average of City of Palmdale's General Plan projections and SCAG's 1993 projections.
(4) Interpolated based on 1980 and 1993 populations.
(5) Average of County of Kern's Rosamond Specific Plan projections and projections based on proposed Desert Highlands development.
(6) Difference between total and the areas of concentrated population.
(7) From DWR's November 1993 Draft California Water Plan Update (Bulletin 160).
(8) From Kern Council of Governments.



It is noted that population forecasting is not an exact science due to an element of uncertainty to whether or not the projections will be truly realized. Additionally, the population projections used in the report were obtained from sources that may have been influenced by the rapid growth that occurred in the Valley prior to 1990.

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Population Projections–Antelope Valley

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Figure 3–4

Figure 3–4

Projections to 2010 for Edwards AFB, Mojave, and Boron presented in the USGS report were utilized in Table 3-1, and revisions are described in the following sections. Population for Edwards AFB in the year 2020 was assumed to remain at the projected 2010 population. Projections to 2020 for Mojave and Boron were extrapolated from the actual 1990 and projected 2010 populations. USGS projections for Palmdale, Lancaster, and Rosamond were revised and are described in Table 3-1.

Descriptions of the method, assumptions and sources used to estimate the projections are discussed below.

Palmdale

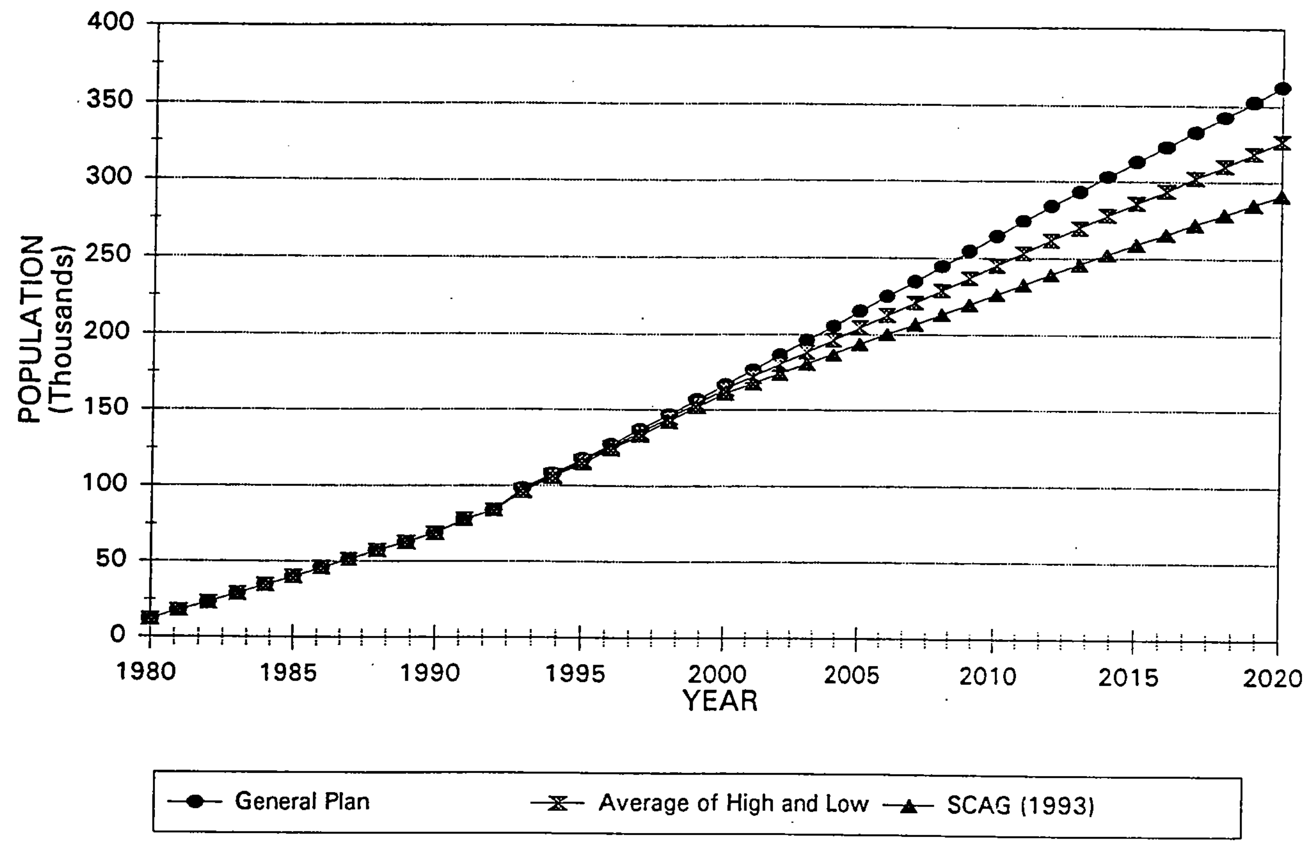
Three population projections were done for the City of Palmdale. (See Figure 3-5.) The high curve was based on the City of Palmdale, January 25, 1993."General Plan." The City projected a population of 264,215 people by the year 2010. Based on this projection and the estimated 1992 population of 84,238, population for 2020 was extrapolated. The low curve was based on the Southern California Association of Government (SCAG) 1993 estimates of 161,203 person in 2000 and 226,465 persons in 2010, extrapolated to 2020. An average of the high and low curve provided a medium curve. The medium curve was selected for use in this report.

Lancaster

Three population projections were done for the City of Lancaster. (See Figure 3-6). The method used for estimating projections was obtained primarily from the City of Lancaster 1992 "State of the City Report" (SOC Report). The SOC Report provided a low, medium and high curve based on the average growth rate experienced by the City between 1980 and 1990 (low curve), the average growth experienced by the City between 1985 and 1990 (medium curve), and SCAG 1989 estimates (high curve). The average growth for the three curves were 4,071, 6,407, and 7,274 persons per year respectively.

The City's average growth rates for the three curves in the SOC Report have been revised for the purposes of this report for the following reasons: 1) the SOC Report used an estimate of 88,732 for the 1990 population but the U. S. Census Bureau reports a 1990 population of 97,291 (Department of Community Development, 1993), and 2) in 1993 SCAG decreased its population estimates for Lancaster.

Using the most recent data available, the low curve was revised and is based on an average growth of 4,941 persons per year between 1980 and 1990. The medium curve is based on SCAG 2000 and 2010 estimates of 152,280 and 212,138, respectively, and extrapolated to 2020 based on an average growth rate of 5,742 people per year (average growth rate between 1990 actual and 2010 projected population).



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Population Projections—City of Palmdale

November 1995
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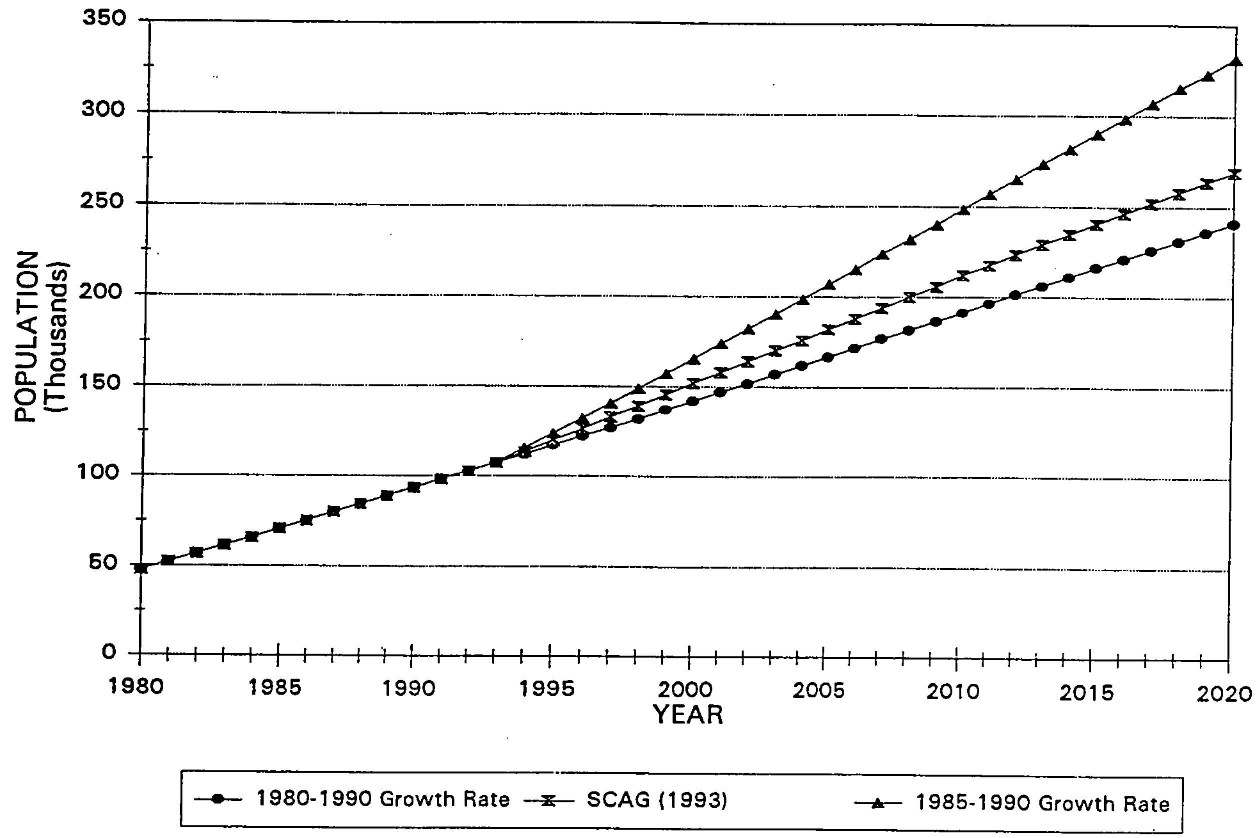
Figure 3–5

Figure 3–5



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Population Projections—City of Lancaster

November 1995
K/J 934620.00

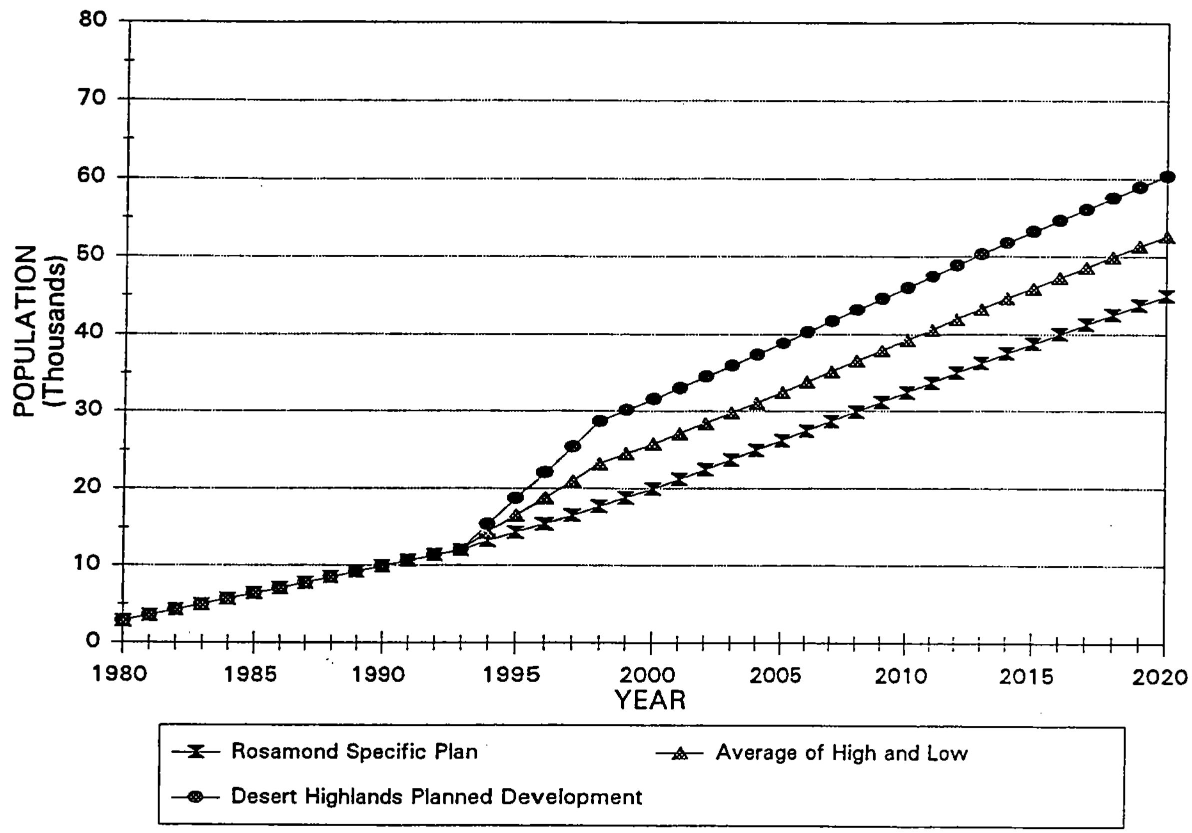
Figure 3–6

Figure 3–6

The high curve is based on the City's average growth of 8,307 people per year between 1985 and 1990. The medium curve was selected for use in this report.

Rosamond

Three population projections were done for the area of Rosamond. (See Figure 3-7.) The low curve was based on the 1993 population of 12,095 provided by Rosamond Community Services District (RCSD), and 2000 and 2010 population estimates of 20,000 and 32,500, respectively, provided in the County of Kern 1992 "Rosamond Specific Plan." Population for 2020 was extrapolated based on 2000 and 2010 population estimates. The high curve was based on an assumption that approximately 7,000 homes from the proposed Desert Highlands development will be inhabited by the year 1998. This translates to approximately 28,800 people residing in Rosamond in 1998. Population to 2020 was extrapolated based on the 1980 and projected 1998 population. An average of the low and high curves provided a medium curve. The medium curve was selected for use in this report.



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Antelope Valley Water Resources Study

Population Projections –
Community of Rosamond

November 1995
K/J 934620.00

Figure 3–7

PWS-0200-0070

Figure 3–7

CHAPTER 4

ASSESSMENT OF WATER RESOURCES

This chapter assesses the ability of available water resources within the Antelope Valley to meet the water demands of the Valley through the year 2020. Elements of the chapter include a description of water demands and supplies, an evaluation of the reliability of water supplies, an assessment of the effects of State Water Project deliveries on groundwater levels, and an assessment of the effects on groundwater levels due to transition from a predominantly agricultural area to a predominantly urban area.

WATER DEMANDS

The following section discusses historical, current and projected water demands for the Antelope Valley. The United States Geological Survey (USGS) draft "Land Use and Water Use in the Antelope Valley, California" dated March 14, 1994 (1994 Draft Report) is the primary source of information for the Water Demands and Water Supplies sections.

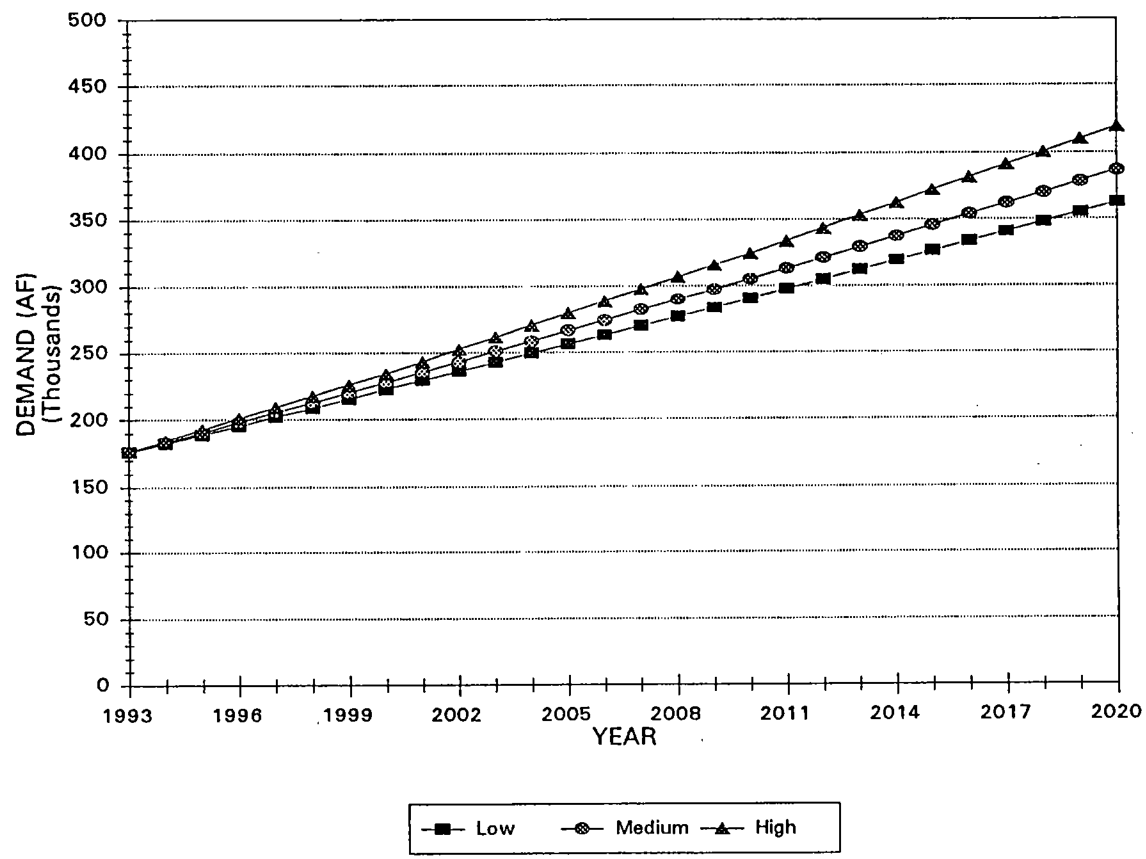
Historical Demands

Historical water demands were 192,600 acre-feet in 1975, 246,000 acre-feet in 1980, 167,000 acre-feet in 1985 and 144,000 acre-feet in 1989 (USGS, 1994a). Water demands decreased between 1950 to late 1980s due to decreasing irrigated acreage. However, due to the population growth beginning in the mid 1980s, water demands are increasing. Approximately 63 percent of total recorded water demands in 1990 were met by public water suppliers (USGS, 1994a).

Current and Projected Demands

Projected water demands for the Antelope Valley are shown on Figure 4-1. Projections were based on the summation of the individual water demand projections for the City of Palmdale, City of Lancaster, Rosamond Community Services District (RCSD), Other and Agricultural. These individual water demand projections are presented on Figures 4-2 to 4-6. Water demand projections to the year 2020 for the various cities\communities\categories are described below. Low, medium and high water demand projections are based on low, medium and high population projections presented in Chapter 3.

City of Palmdale. Water demand projections for the City of Palmdale are based on a per capita demand of 0.32 acre-feet per person per year derived from 1993 population and water use data from Palmdale Water District (PWD) and applied to the low, medium, and high population projections.



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Antelope Valley Water Resources Study

Water Demand Projections
Antelope Valley

November 1995
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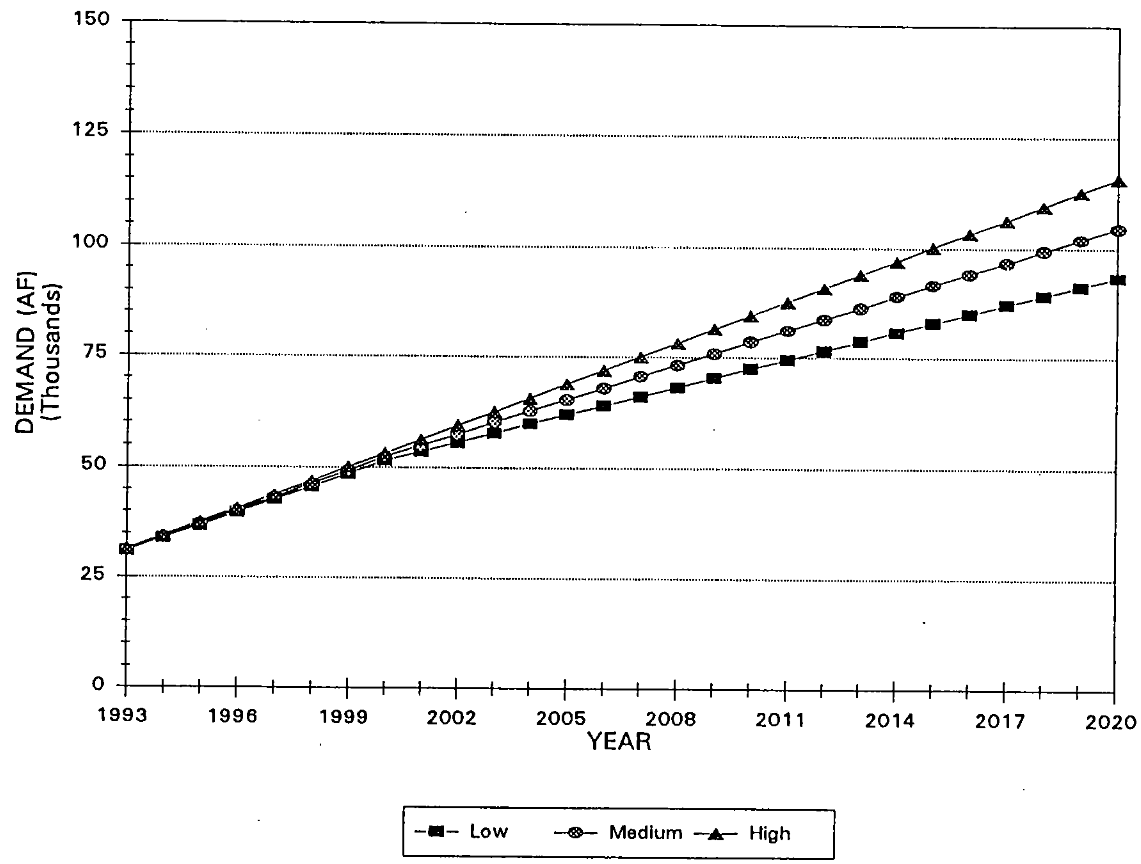
Figure 4–1



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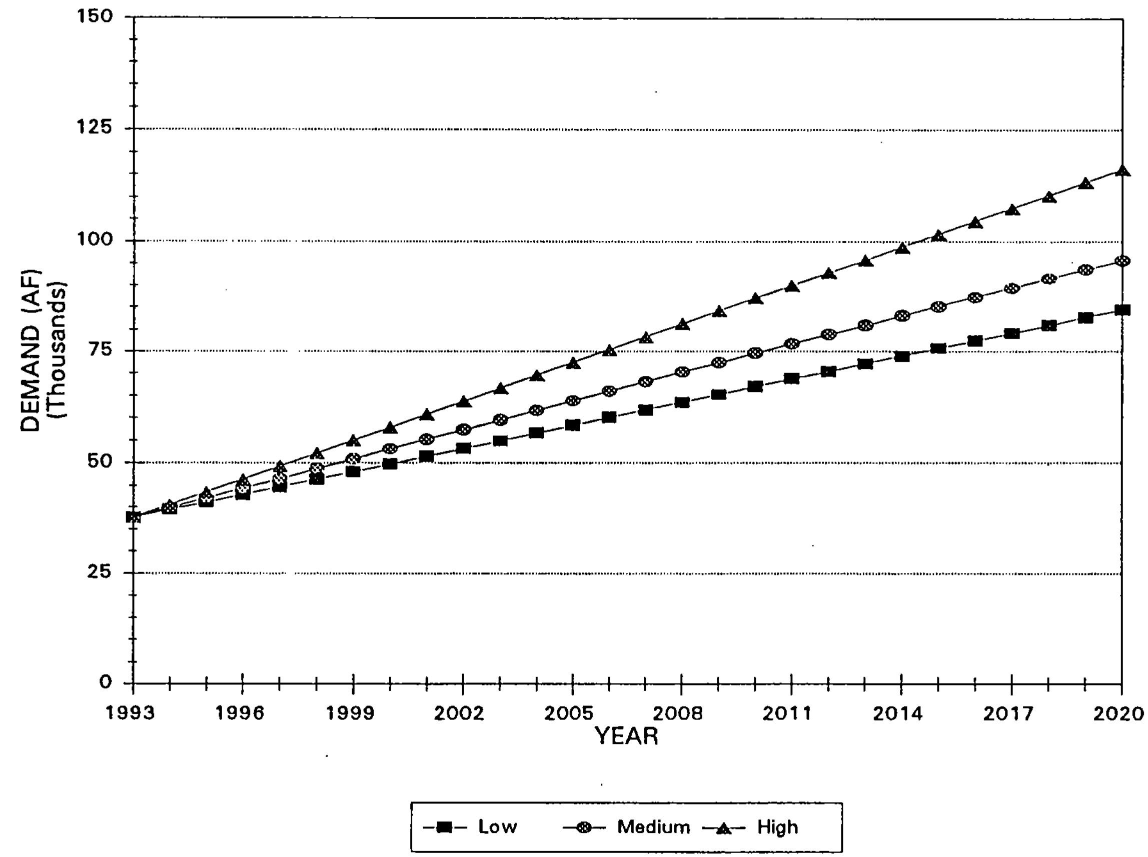
Antelope Valley Water Group
Antelope Valley Water Resources Study

Water Demand Projections
Palmdale

November 1995
K/J 934620.00

Figure 4–2

PWS-0200-0073 Figure 4–2



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Antelope Valley Water Group
Antelope Valley Water Resources Study

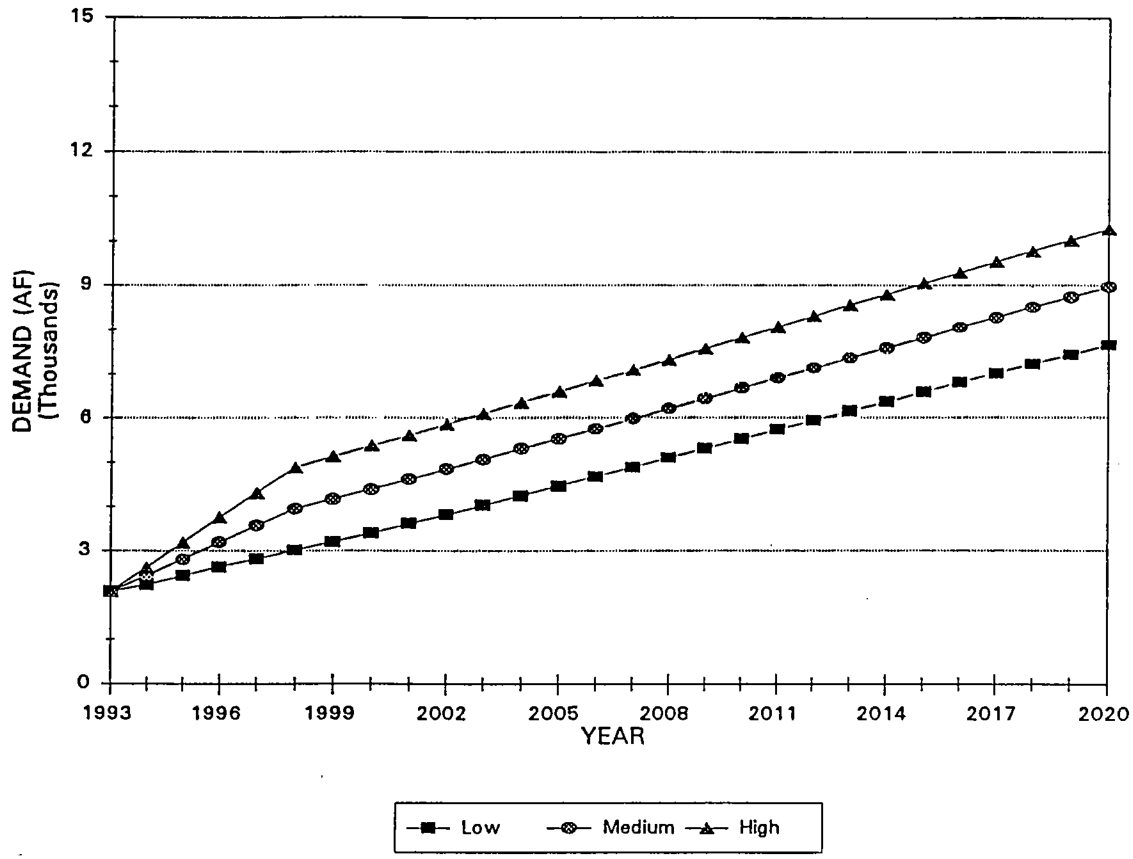
Water Demand Projections
Lancaster

November 1995
K/J 934620.00

Figure 4–3

PWS-0200-0074

Figure 4–3



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Antelope Valley Water Group
Antelope Valley Water Resources Study

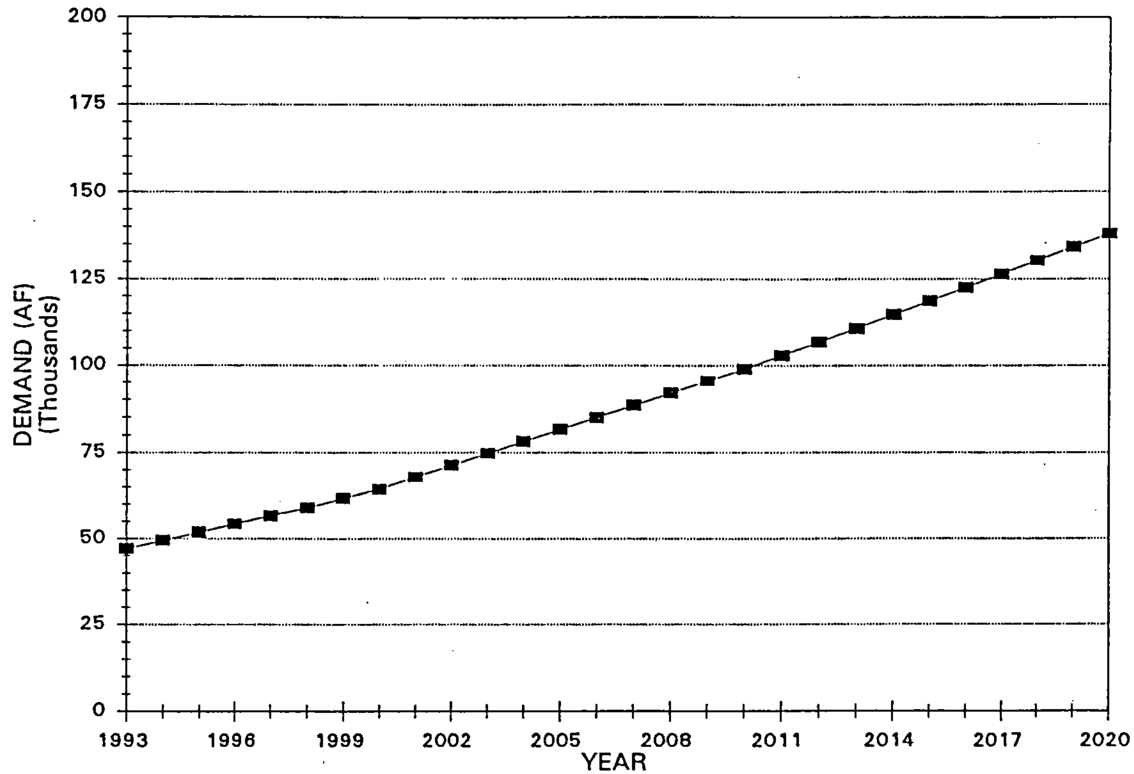
Water Demand Projections
Rosamond

November 1995
K/J 934620.00

Figure 4–4

PWS-0200-0075

Figure 4–4



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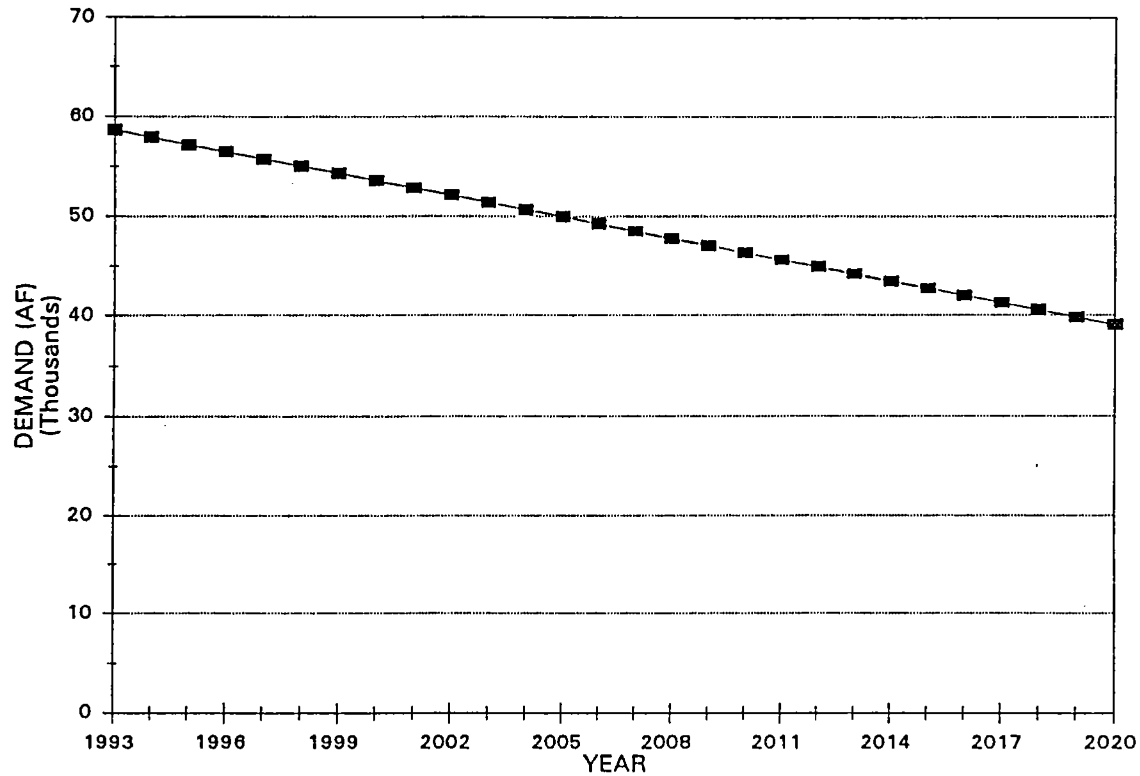
Antelope Valley Water Group
Antelope Valley Water Resources Study

Water Demand Projections
Other

November 1995
K/J 934620.00

Figure 4–5

Figure 4–5



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Antelope Valley Water Group
Antelope Valley Water Resources Study

Water Demand Projections
Agricultural

November 1995
K/J 934620.00

Figure 4–6

City of Lancaster. Water demand projections for the City of Lancaster are based on a per capita demand of 0.35 acre-feet per person per year derived from information provided in the City of Lancaster 1992 State of the City (SOC) report and applied to the low, medium, and high population projections. (The City of Lancaster water demand is consistent with the Los Angeles County Waterworks water demand of 0.32 to 0.34 acre-feet per person per year.)

RCSD. Water demand projections for the RCSD are based on a per capita demand of 0.17 acre-feet per person per year derived from 1993 population and water use data from RCSD and applied to the low, medium, and high populations.

Other. Water demand projections for the Other category are based on a per capita demand of 0.41 acre-feet per person per year derived from 1990 population and water use data provided by the Antelope Valley United Water Purveyors Association and applied to the population projection presented in Chapter 3. The Other category includes Edwards Air Force Base (AFB), Mojave, Boron and Other from Table 3-1.

Agricultural. As shown in Table 4-1, current and projected 2020 agricultural water uses in the Antelope Valley are approximately 59,000 acre-feet and 39,100 acre-feet respectively. Current agricultural acreage were obtained from the USGS's 1994 Draft Report. Estimates of agricultural acreage for the year 2020 are based on the acreage that would be necessary for reclaimed water use (i.e., identified as high potential reclaimed water users in Chapter 6 plus half of the existing agricultural acreage (not including the high potential reclaimed water users). Water demands are based on typical water use data obtained from the Soil Conservation Service.

AVAILABLE WATER SUPPLIES

Available water resources in the Antelope Valley consists of local groundwater, surface water from Little Rock Reservoir, imported water from the State Water Project (SWP), and reclaimed water. Stormwater runoff, although not presently managed well or used, is a resource that has potential for greater use in the Antelope Valley (USGS, 1994a). This chapter focuses on water supplies from groundwater, Little Rock Reservoir, SWP and reclaimed water. A brief description of historical, current and projected water supplies for the Valley is presented below.

Historical Supplies

The total available water deliveries for the Antelope Valley were 192,600 acre-feet in 1975, 246,000 acre-feet in 1980, 167,000 acre-feet in 1985 and 144,000 acre-feet in 1989 (USGS, 1994a). Historical water supplies were made of a combination of local surface water from Little Rock Reservoir, SWP water, groundwater, and reclaimed water. Groundwater has supplied between 50 to 90 percent of the total annual water supply in the Antelope Valley in recent years. This may be due in part to the recent drought condition which affected deliveries from the SWP and

TABLE 4-1

CURRENT AND PROJECTED AGRICULTURAL LAND AND WATER USE IN THE ANTELOPE VALLEY

Crop	Acres (1)	Net Annual Water Use (2) (inches)	Gross Annual Water Use (3) (acre-feet/acre)	Annual Water Demand (4) (acre-feet)
1993 Irrigated Crops				
Alfalfa	6,124	48.55	6.2	37,969
Pasture/Turf	955	41.18 (5)	5.3	5,062
Grain	835	10.73	1.4	1,169
Field Crops	32	10.73	1.4	45
Truck Crops	2,645	17.02	2.2	5,819
Deciduous Trees/Vines	2,263	29.67 (6)	3.8	8,599
Total	12,854			58,663
2020 Irrigated Crops				
Alfalfa	4,639 (7)	48.55	6.2	28,762
Pasture/Turf	595 (7)	41.18 (5)	5.3	3,154
Grain	613 (7)	10.73	1.4	858
Field Crops	16 (7)	10.73	1.4	22
Truck Crops	1,323 (7)	17.02	2.2	2,911
Deciduous Trees/Vines	900 (8)	29.67 (6)	3.8	3,420
Total	8,086			39,127

(1) From USGS 1994 draft report "Land Use and Water Use in the Antelope Valley, California", Table 1.
(2) From USDA Soil Conservation Service (SCS). Rainfall occuring during the growing season is assumed to be insignificant.
(3) Net annual water use divided by an irrigation efficiency factor of 0.65 and converted to acre-feet /acre.
(4) Acreage multiplied by the gross annual water use.
(5) Average of pasture and turf net annual water use as provided by SCS.
(6) Average of almonds, orchards, pecans, pistachios, and walnuts net annual water use as provided by SCS.
(7) Assumed to be the sum of the estimated acres to be served reclaimed water, and half of the 1993 crop acreages (excludes estimated acreage to be served reclaimed water).
(8) From USGS 1994 draft report, Table 1. Estimate provided to USGS by DWR.

diversions from the Little Rock Reservoir. The following sections describes historical water supplies for the Valley.

Groundwater. Historically, groundwater has been the primary water supply source for the Antelope Valley. Groundwater pumpage for the Los Angeles County portion of the Antelope Valley peaked in 1956 with 268,000 acre-feet, followed by a decline to 45,000 acre-feet in 1983 (USGS, 1994a). Since 1983, groundwater use increased to a high of 91,000 acre-feet in 1991. However, estimates of total pumpage may be low due to incomplete data obtained from the California State Water Resources Control Board. Apparently, all registered well owners in the Los Angeles County portion of the Antelope Valley have not consistently reported annual pumpage. In addition, pumpage data for much of the Kern County portion of the Valley were not available.

State Water Project. SWP deliveries to the Valley began in 1972. The Antelope Valley - East Kern Water Agency (AVEK), PWD, and Little Rock Creek Irrigation District (LCID) provide SWP water to the Antelope Valley. As shown in Table 4-2, deliveries peaked in 1981 with approximately 80,000 acre-feet. Since 1981 however, deliveries have ranged between 14,000 and 58,000 acre-feet per year. SWP entitlements are also shown in Table 4-2. Between 1976 and 1982, total deliveries ranged between 19 and 92 percent of the total entitlements. Between 1983 and 1992, total deliveries ranged between 9 and 69 percent of the total entitlements.

Little Rock Reservoir. Historically, the available storage from Little Rock Reservoir was 600 acre-feet. As shown in Table 4-3, diversions from the reservoir ranged from 310 to nearly 7,700 acre-feet from 1956 to 1990. Current modifications to the dam are anticipated to increase the storage capacity to 3,500 acre-feet.

Reclaimed Water. Wastewater influent reached nearly 21,000 acre-feet in 1990 (USGS, 1994a). The combined wastewater flows from Edwards AFB, the City of Palmdale and the City of Lancaster contributed to approximately 92 percent of the 21,000 acre-feet. According to the USGS, approximately 6,000 acre-feet was reused for irrigation and wetlands in 1990, and nearly 5,500 acre-feet was used for land disposal. Historical average daily flows from the Palmdale, Lancaster, Rosamond, and Edwards AFB Water Reclamation Plants (WRPs) are shown in Table 6-2.

Current and Projected Supplies

Table 4-4 shows the potential current and projected water supplies in Antelope Valley. As shown in the table, the potential current water supply ranges between 212,900 and 240,800 acre-feet, and the potential 2020 water supply ranges between 275,700 and 303,600 acre-feet. The only difference between the current and 2020 potential supply is the reclaimed water supply, which is expected to increase as the population in the Valley increases. The water supplies identified in Table 4-4 do not include potential reductions in deliveries due to hydrologic conditions. A brief description of each supply source is presented below.

TABLE 4-2

HISTORICAL DELIVERIES AND ENTITLEMENTS
(AVEK, PWD AND LCID)

Year	*AVEK Deliveries (acre-feet)*	*AVEK Entitlements (acre-feet)*	*PWD Deliveries (acre-feet)*	*PWD Entitlements (acre-feet)*	*LCID Deliveries (acre-feet)*	*LCID Entitlements (acre-feet)*
1972	53	20,000	0	1,620	338	170
1973	20	25,000	0	2,940	290	290
1974	1,259	30,000	0	4,260	400	400
1975	8,068	35,000	0	5,580	520	520
1976	27,782	44,000	0	6,900	589	640
1977	11,202	50,000	0	8,220	111	730
1978	44,137	57,000	0	9,340	208	920
1979	60,493	63,000	0	10,260	133	1,040
1980	72,407	69,200	0	11,180	191	1,150
1981	79,375	75,000	0	11,700	1,270	1,270
1982	50,291	81,300	0	12,320	0	1,380
1983	32,961	87,700	0	12,940	38	1,500
1984	32,662	35,000	0	13,560	1	1,610
1985	37,064	40,000	1,558	14,180	0	1,730
1986	32,449	42,000	3,096	14,800	163	1,840
1987	34,094	44,000	5,379	15,420	1,080	1,960
1988	34,079	46,000	1,770	16,040	419	2,070
1989	45,280	125,700	9,009	16,660	971	2,190
1990	47,206	132,100	8,608	17,300	1,747	2,300
1991	9,568	138,400	3,914	17,300	522	2,300
1992	37,490	138,400	6,600	17,300	1,143	2,300

Source: Department of Water Resources "Management of the California State Water Project", Bulletin 132-92, December 1992.

Groundwater. Groundwater is estimated to have a natural recharge amount of approximately 31,200 to 59,100 acre-feet per year (USGS, 1993). Average natural recharge estimates from previous investigations were obtained by the USGS and adjusted according to factors such as diversion, evapotranspiration, and similar drainage area (natural recharge estimates from various investigations were calculated based on different interpretations of surface water drainage areas).

State Water Project. SWP entitlements for the Antelope Valley are currently estimated to be approximately 153,800 acre-feet. The entitlements of AVEK, PWD and LCID are 138,400, 17,300, and 2,300 acre-feet per year respectively. A small

TABLE 4-3

HISTORICAL DIVERSIONS FROM LITTLE ROCK RESERVOIR

Year	PWD Diversions (acre-feet)	LCID Diversions (acre-feet)	Total Diversions (acre-feet)
1956	2,422	1,869	4,291
1957	1,752	117	1,869
1958	2,434	2,436	4,870
1959	1,311	2,041	3,352
1960	385	609	994
1961	0	386	386
1962	5,534	2,142	7,676
1963	136	979	1,115
1964	262	1,842	2,104
1965	1,318	1,739	3,057
1966	0	1,922	1,922
1967	0	2,534	2,534
1968	3,150	1,741	4,891
1969	2,105	2,261	4,366
1970	1,396	1,849	3,245
1971	1,389	1,663	3,052
1972	1,360	1,587	2,947
1973	1,523	1,672	3,195
1974	938	1,651	2,589
1975	1,586	1,513	3,099
1976	1,151	NA	1,151
1977	468	NA	468
1978	2,024	1,688	3,712
1979	913	1,950	2,863
1980	913	1,950	2,863
1981	1,638	1,040	2,678
1982	1,680	1,604	3,284
1983	714	1,199	1,913
1984	927	1,464	2,391
1985	1,460	1,375	2,835
1986	332	1,250	1,582
1987	0	1,000	1,000
1988	1,330	1,000	2,330
1989	1,400	700	2,100
1990	110	200	310

Source: Law Environmental "Water Supply Evaluation, Antelope Valley, California", for Palmdale Water District, November 25, 1991.

portion of AVEK entitlements have historically been delivered to areas outside the Antelope Valley borders. Based on information provided by AVEK, it is estimated that approximately 3 percent of historical deliveries made to AVEK did not serve the Antelope Valley. For this report, it is assumed that 3 percent of future deliveries made to AVEK will continue to serve areas outside the Valley borders.

TABLE 4-4

POTENTIAL ANNUAL WATER SUPPLY
FOR THE ANTELOPE VALLEY (1)

Source	*1993 Potential Supply (acre-feet)*	*2020 Potential Supply (acre-feet)*
Groundwater (2)	31,200 to 59,100	31,200 to 59,100
State Project Water		
AVEK (3)	134,200	134,200
LCID	2,300	2,300
PWD	17,300	17,300
Subtotal	153,800	153,800
Little Rock Reservoir (4)	7,000	7,000
Reclaimed Water (5)	20,900	83,700
Total (6)	212,900 to 240,800	275,700 to 303,600

(1) Supplies listed have not been adjusted to account for potential reductions in deliveries due to hydrologic conditions.
(2) Estimates of natural recharge from USGS "Study Plan for the Geohydrologic Evaluation of Antelope Valley, and Development and Implementation of Ground-Water Management Models."
(3) Based on historical deliveries of approximately 3 % to areas outside the Antelope Valley, subtracted from AVEK's total entitlement of 138,400 acre-feet per year.
(4) PWD estimates that average yield from the reservoir following modifications to the dam will be 7,000 acre-feet per year.
(5) The numbers shown are current and projected production for Palmdale, Lancaster, Rosamond, Edwards AFB, and Mojave WRPs.
(6) Potential useable stormwater is not included in the total.

Little Rock Reservoir. Available storage from Little Rock Reservoir was 600 acre-feet. Modifications to the Little Rock Dam are anticipated to increase the storage capacity to 3,500 acre-feet. According to the PWD, the average annual yield from the new reservoir is estimated to be approximately 7,000 acre-feet.

Reclaimed Water. Table 4-5 lists the wastewater treatment facilities in the Antelope Valley with the 1993 and projected 2020 reclaimed water flow. Current

TABLE 4-5

RECLAIMED WATER SOURCES

Facility Name	*1993 Flow (mgd)*	*Projected 2020 Flow (mgd)*	*Current Users of Reclaimed Water*
Palmdale WRP	7.4	37.2	Los Angeles City Department of Airports Pistachio Farm Chestnut Farm Christmas Tree Farm Landscape Plant Farm Barley Farm
Lancaster WRP	8.4	29.8	Apollo Lakes County Park - Aquatic Park Piute Ponds - Wetlands Nebeker Ranch - Alfalfa Farm
Rosamond WRP	0.8	3.0	None
Edwards AFB WRP	1.7	2.5	None
Mojave WRP (1)	0.4	2.2	None
Plant 42 WRP (2)	0.25	0.25	None
Desert Lake WRP (3)	0.08	0.4	None
Boron WRP (1)	0.12	0.6	None
Edwards AFB Missile Test Site WRP (2)	0.05	0.05	None
Edwards AFB N. Base WRP (2)	0.075	0.075	None
Boron Federal Prison WRP (2)	0.01	0.01	None
Total	***19.29***	***76.09***	***N/A***

(1) Projected reclaimed water supply is based on Mojave WRP's 1990 flow per capita (180 gallons/capita/day) applied to 2020 projected population.

(2) Projected reclaimed water supply is assumed to remain the same as existing supply.

(3) Projected reclaimed water supply is based on Mojave WRP's historical growth rate of 0.0124 million gallons per day per year (1980-1993).

N/A Not Applicable.

users, if any, are also listed. As shown in the table, 1993 and projected 2020 reclaimed water flows are estimated to be approximately 19.29 (21,600 acre-feet per year) and 76.09 million gallons per day (mgd) (85,200 acre-feet per year) respectively. Reclaimed water from the Palmdale WRP is currently used on the Department of Airport (DOA) property. A portion of the flow is used at various farms on the property. The remaining flow is currently spread over the 2600 acres of DOA land. Reclaimed water from the Lancaster WRP is used at Nebeker Ranch to irrigate alfalfa crops. A small portion is used at the Apollo Lake County Park, and the remaining flow is currently diverted to Piute Ponds.

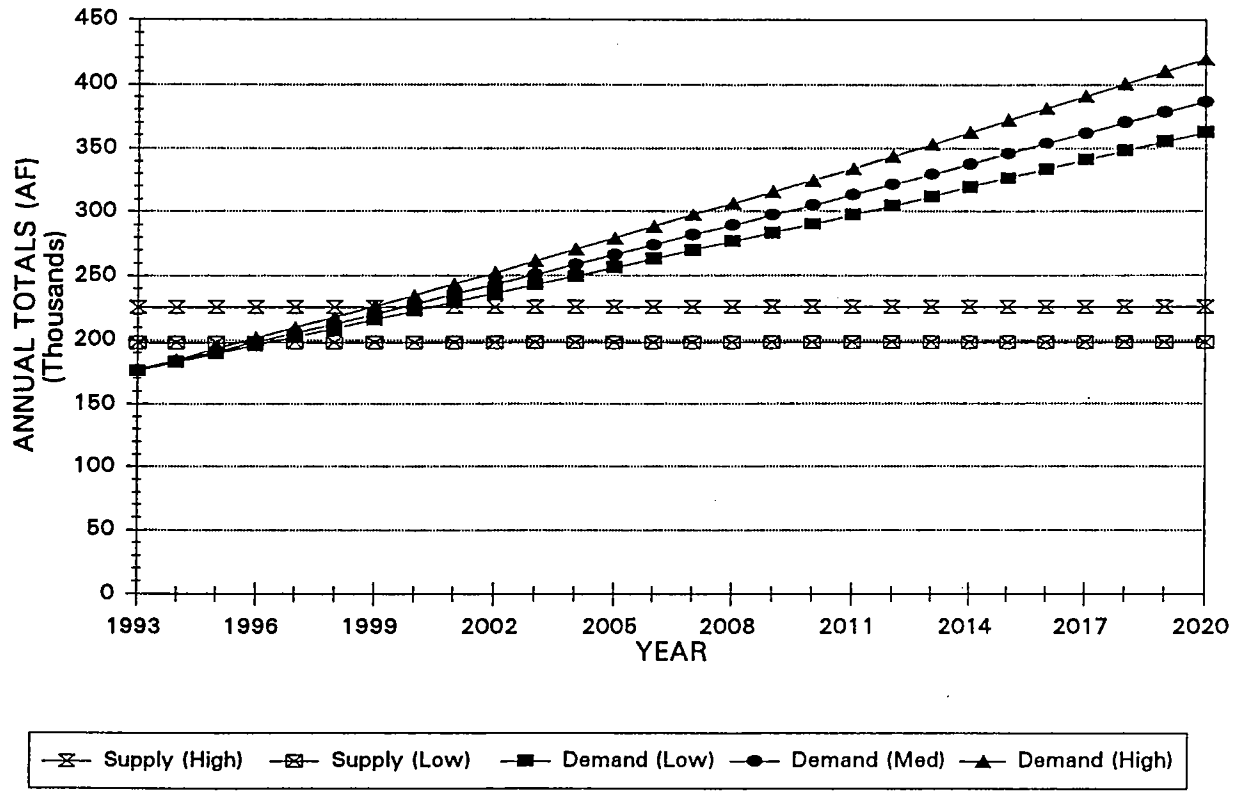
The Palmdale, Lancaster, Rosamond, Edwards AFB, and Mojave WRPs represent the plants with the highest probability of developing a reclaimed water system. The combined 1993 and projected 2020 flow from these five plants represent nearly 98 percent of the total potential reclaimed water supply for the entire Valley and is estimated to be 18.7 mgd (20,900 acre-feet per year) and 74.7 mgd (83,700 acre-feet per year) respectively.

RELIABILITY OF WATER SUPPLIES

Figure 4-7 depicts the high and low water supply projection along with the low, medium and high water demand projection for the Valley to the year 2020. The high and low water supply projection are based on Table 4-4 with one exception; the potential reclaimed water supply listed in Table 4-4 for 1993 and 2020 is not included. Instead, the reclaimed water supply for both 1993 and 2020 is taken as the current reclaimed water use (approximately 6,500 acre-feet). Therefore, the 1993 and 2020 potential supply ranges between 198,500 and 226,400 acre-feet per year. For purposes of the reliability analysis, the high supply curve and medium demand curve are selected. (See Figure 4-8.) The supply curve does not take into account the issue of reliability and the effects that reliability will have on the yield of each water supply source. The following section assesses the reliability of SWP water, Little Rock Reservoir water and reclaimed water. Groundwater is considered 100 percent reliable when the amount considered available for withdrawal is less or equal to the estimated natural recharge amount.

Reliability of SWP Supply

The Department of Water Resources (DWR) utilizes a computer model called DWRSIM to simulate operation of the SWP. The model operates the SWP on a monthly basis, using the actual hydrology from 1922 through 1992. The output of the model provides an estimate of annual quantities of water that could be available to meet SWP entitlement requests. The model takes into account many variables and assumptions such as minimum Delta outflow requirements, facility improvements, and pumping operation at the Delta export pumps. The most significant factors that affect the SWP supply estimates are the future demand, Delta environmental requirements and future SWP facilities. Total entitlement of all SWP contractors is 4.2 million acre-feet per year.



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Potential Supply and Projected Demand
(Without Delivery Reductions)

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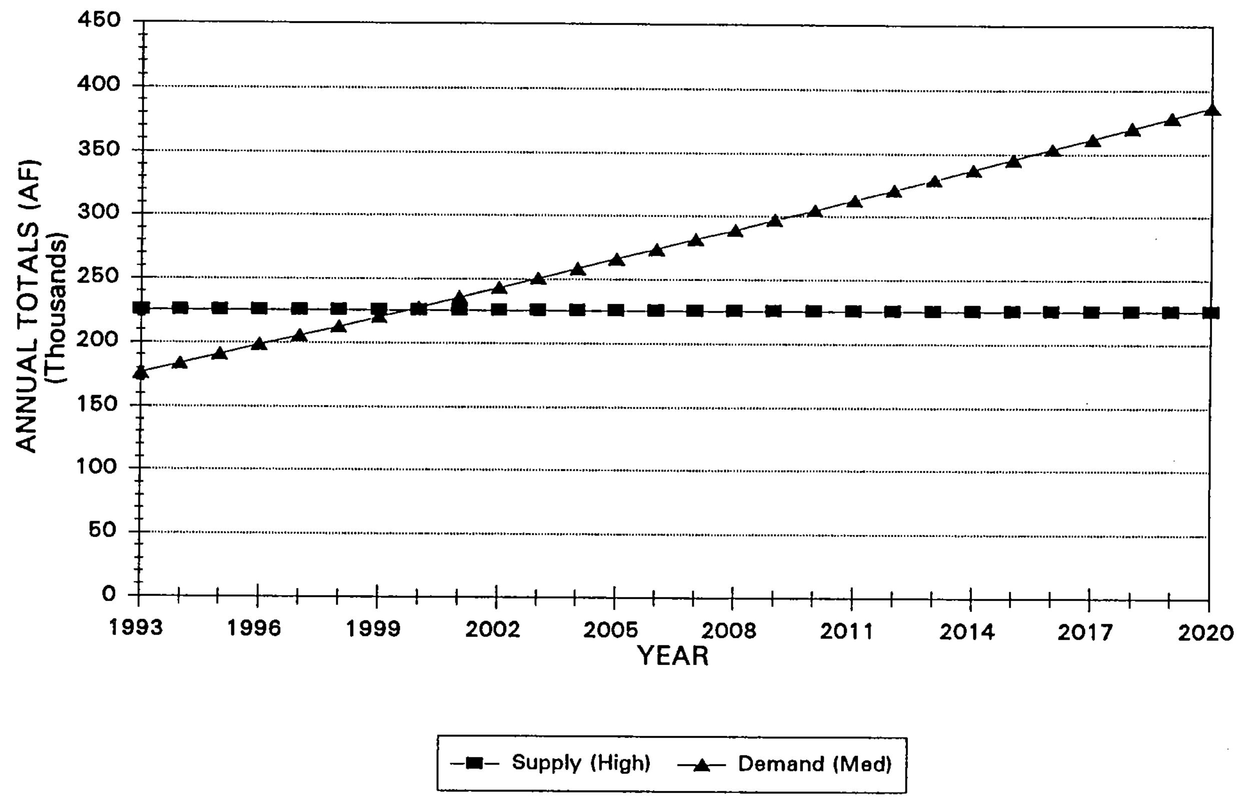
Figure 4–7



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Projected Demand
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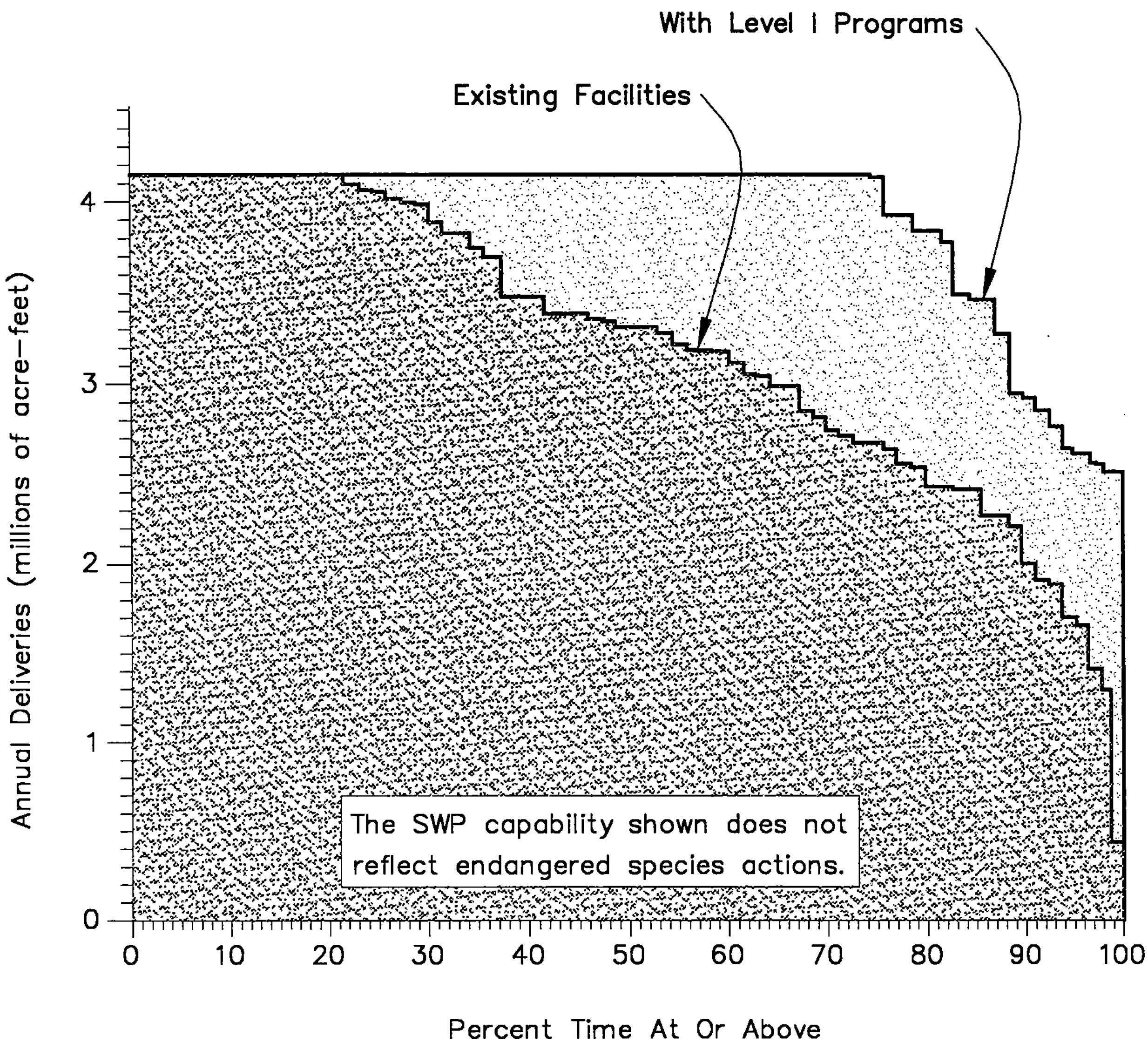
Figure 4–8

The reliability of SWP water is currently undergoing significant changes. Pending actions from federal requirements are currently being discussed that will significantly impact future SWP water supply. Biological opinions have been issued under the Endangered Species Act which will affect operation of the Delta. In February 1993, the National Marine Fisheries Service (NMFS) issued a biological opinion concerning the operation of the Central Valley Project (CVP) and SWP for winter-run chinook salmon. In February 1994, the United States Fish and Wildlife Services (FWS) issued their biological opinion concerning operation of the CVP and SWP for the Delta smelt. Both species have been listed under the State and Federal Endangered Species Acts. These opinions are intended to restrict pumping at the SWP and CVP export pumps in the Delta. In addition to the Delta pumping restrictions, the Environmental Protection Agency (EPA) issued a draft proposal for additional flow requirements in December 1993 under the Clean Water Act. The EPA is considering establishing stricter Bay/Delta water quality standards.

Figure 4-9 shows the SWP delivery capability for year 2020 with existing and Level 1 water supply management programs. Level 1 Water Management Programs include the South Delta Water Management Program (interim), Kern Water Bank (underground storage), Los Banos Grandes Facilities (open storage south of the Delta) and Long Term Delta program. The curves do not include pending federal requirements discussed above. As shown on Figure 4-9, with existing facilities, the SWP will be able to meet its requirements of 4.2 million acre-feet about 20 percent of the time. Level 1 Water Management Programs will enable the SWP to meet its requirements about 75 percent of the time.

Figure 4-10 shows the SWP delivery capability for year 2000 with existing facilities and Federal requirements. With these requirements, it is anticipated that the SWP will not be capable of ever delivering the full entitlement of all of the contractors. Based on Figure 4-10, the percentage of time that SWP delivery request anticipated to be met is summarized in Table 4-6. The DWR notes that "due to significant uncertainties regarding how Delta impacts will be allocated among all water users," several key factors related to implementation of the Federal Delta standards have not been considered in Figure 4-10. Not all of the criteria required by the NMFS and FWS in their biological opinions are included in Figure 4-10. The most significant criterion not modeled is the "take" limit at the SWP and CVP export pumps in the Delta. "Take" is defined as the maximum number of fish that can be killed by Delta pumping during certain periods. If "take" limits are exceeded for winter-run chinook salmon and Delta smelt, pumping can be restricted. The DWRSIM model does not account for pumping restrictions that might occur if "take" limits are exceeded.

Additionally, the Coordinated Operation Agreement (COA) between the CVP and the SWP is also not accounted for on Figure 4-10. The COA is an agreement between the United States Bureau of Reclamation and the DWR that establishes the basis for how the CVP and the SWP will be operated. The COA ensures that each project receives an equitable share or negotiated amounts of water supplies from the Central Valley's supply. If Federal requirements are enacted, the sharing



Based on D 1485 and 4.2 Million Acre Feet Maximum Delivery

SWP Level I Water Management Programs
- South Delta Water Management Program
- Kern Water Bank – First Stage
- Kern Water Bank – Second Stage
- Kern Water Bank – Local Elements
- Los Banos Grandes Facilities
- Long Term Delta Program

Source: Department of Water Resources, Draft, November 1993, "California Water Plan Update"

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Delivery Capability of SWP (w/o Federal Requirements)

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Figure 4–9

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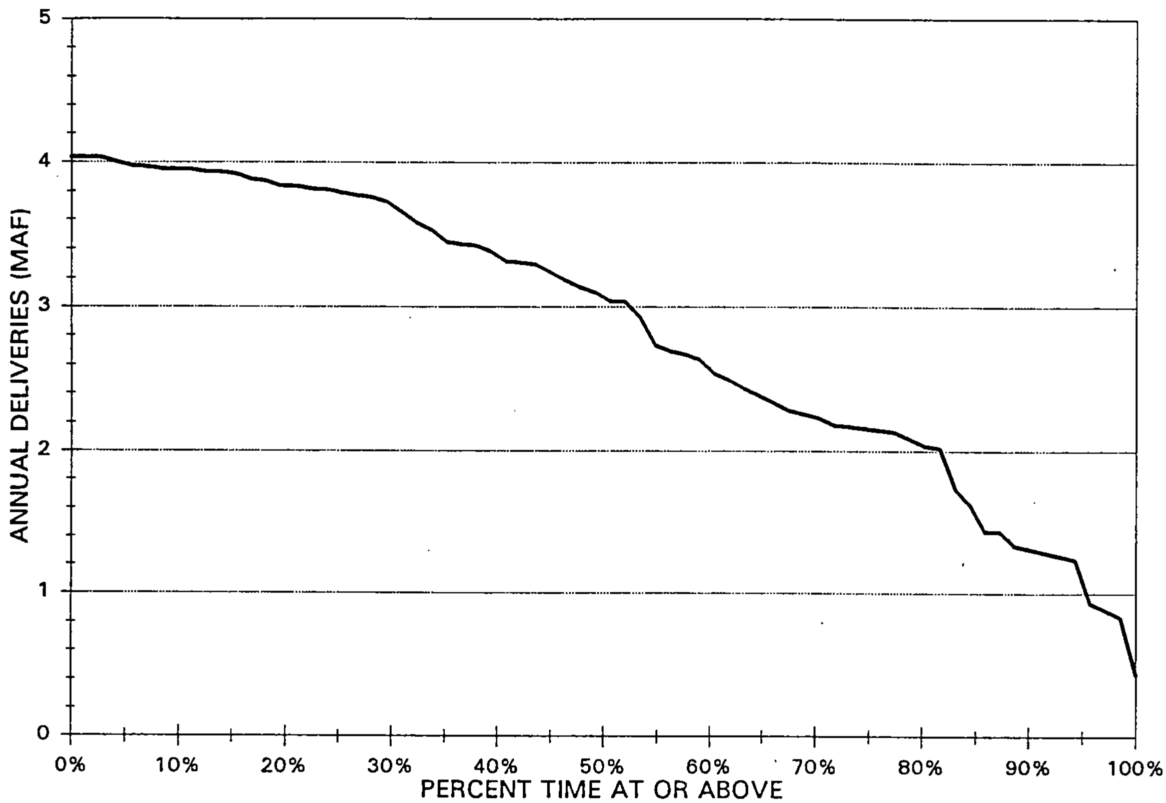

Assumptions:

- D 1485
- 4.1 MAF Maximum Delivery
- Existing Facilities
- Federal Requirements for Salmon, Smelt and Delta Water Quality

Source: Department of Water Resources

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Delivery Capability of SWP (with Federal Requirements)

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Figure 4–10

responsibility assumptions used in the program will change due to changes in the operating criteria of the system. As the new regulations are developed, the DWR will attempt to analyze the potential impacts in its model. It is anticipated that new Delta environmental requirements will decrease the estimated SWP supply from that shown in Figure 4-10.

Figure 4-10 assumes existing SWP facilities. According to the DWR, additional future SWP facilities are anticipated to increase the estimated SWP supply, however, until the various Delta issues are resolved, the feasibility of constructing additional SWP facilities and accurately estimating the increased water supply from such facilities is difficult to determine. It is anticipated that new facilities will increase the reliability and delivery capability of the SWP supply.

TABLE 4-6

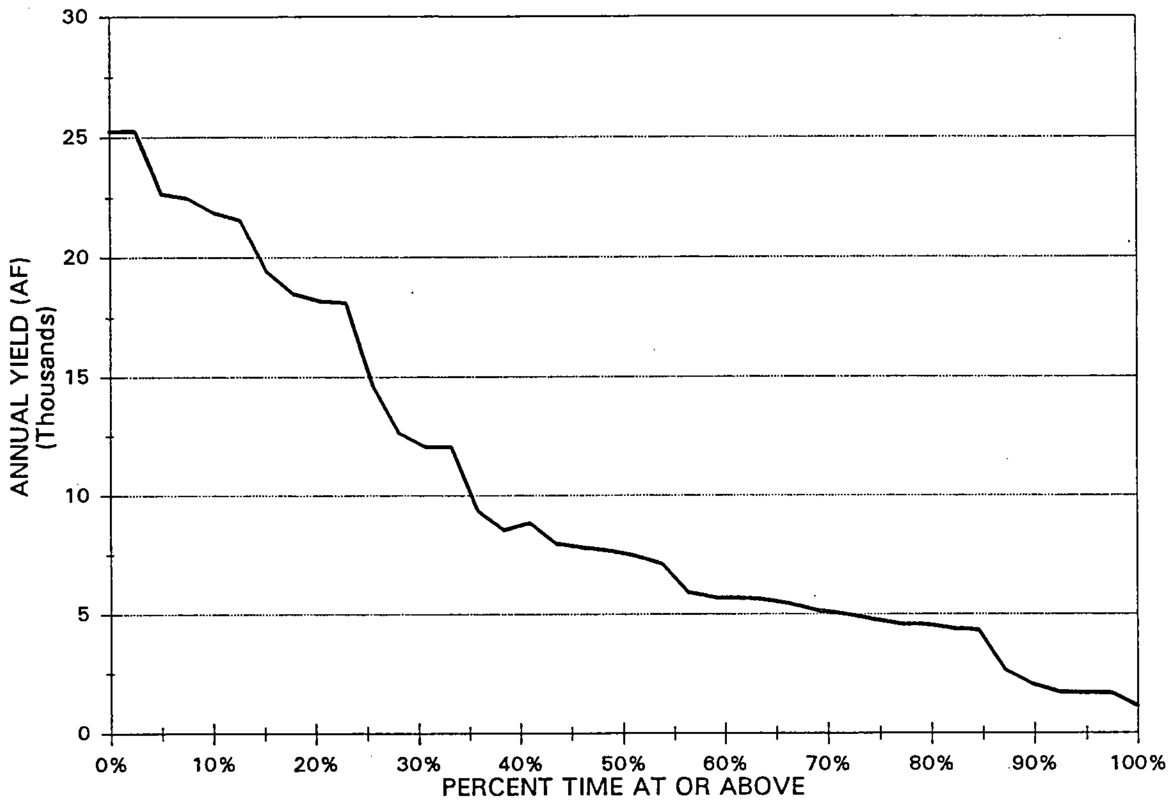
PROBABILITY OF WATER SUPPLIES

Probability	*Current Estimated Supply (acre-feet)*	*2020 Estimated Supply (acre-feet)*
Groundwater		
100% probability of getting 100% of potential supply	59,100	59,100
State Water Project		
50% probability of getting at least 76% of potential supply	116,800	116,800
80% probability of getting at least 50% of potential supply	77,000	77,000
90% probability of getting at least 36% of potential supply	46,200	46,200
Little Rock Reservoir		
50% probability of getting at least 100% of potential supply	7,000	7,000
80% probability of getting at least 64% of potential supply	4,500	4,500
90% probability of getting at least 30% of potential supply	2,100	2,100
Reclaimed Water		
100% probability of getting 100% of potential supply (current)	6,500	6,500

Reliability of Little Rock Reservoir Supply

Figure 4-11 shows the yield capability of Little Rock Reservoir. The reliability analysis for the Little Rock Reservoir water supply was based on the maximum yield from the reservoir using actual hydrology from 1954 to 1993. To obtain the annual yield from the Reservoir, estimates for beginning storage, inflows, evaporation, diversions, overflows and ending storage volume were calculated on a monthly basis. The total annual diversions were the sum of the monthly diversions.

PWD provided information on operational constraints for the model. One constraint is a limitation on diversions to the maximum channel capacity between Little Rock



Assumptions:

- Minimum 500 AF Recreational Storage from January through Labor Day.
- Maximum Diversions Limited by Maximum Channel Capacity to Lake Palmdale.
- Inflows from 1954 to 1993 will repeat.

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Yield Capability of Littlerock Dam

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Figure 4–11

PWS-0200-0092

Reservoir and Lake Palmdale. The second constraint is a minimum pool of 500 acre-feet of storage for recreational purposes from January through Labor Day. Starting with the beginning storage volume, inflow from Little Rock Creek and Santiago Creek was added. Streamgage data from Little Rock Creek (No. L1-R) and Santiago Creek (No. F125-R) was obtained from the Los Angeles County Department of Public Works. Evaporation was deducted using DWR's evapotranspiration curves and PWD's data for storage volume and surface area. If the amount left in the reservoir was greater than the overflow volume of the Reservoir, the difference was assumed to overflow. The amount left in storage (minus the minimum 500 acre-feet recreational storage) was assumed to be diverted.

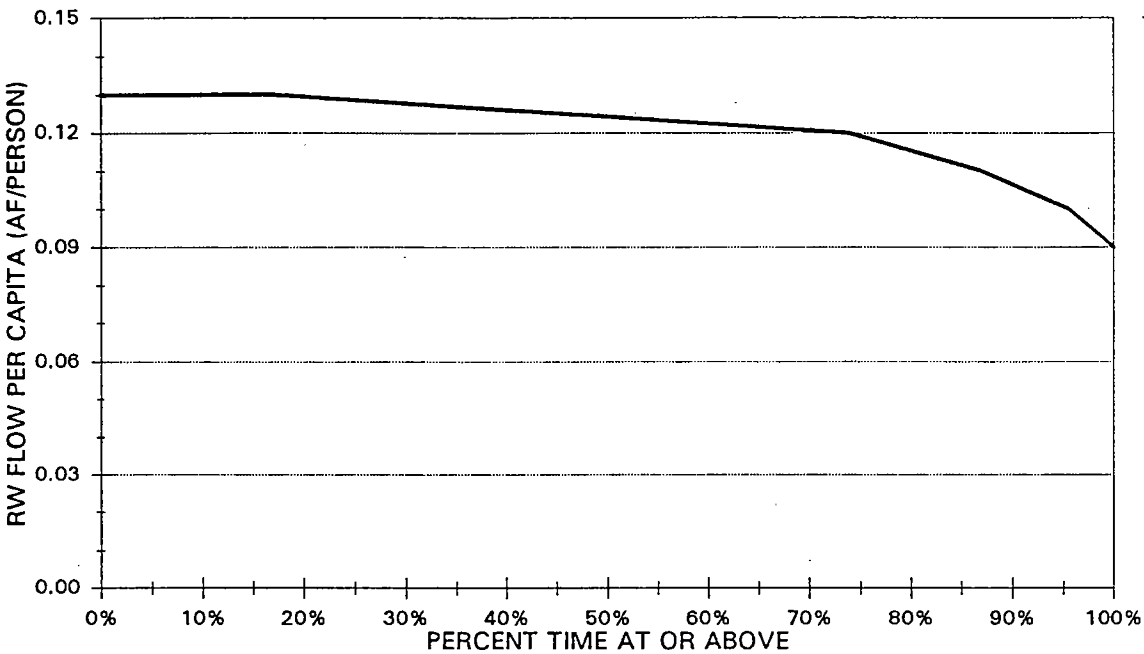
Assuming 1954 to 1993 hydrology, the analysis projects annual diversions ranging between 1,170 to 25,300 acre-feet per year. PWD estimates an annual average yield of 7,000 acre-feet from the Reservoir. Therefore, although the analysis indicated potential diversions greater than 7,000 acre-feet, this report assumes 7,000 acre-feet as the maximum annual yield. The result of the analyses is shown on Figure 4-11 and summarized in Table 4-6. Based on the analysis, Little Rock Reservoir can yield 7000 acre-feet or 100 percent of the supply at least 50 percent of the time.

Reliability of Reclaimed Water Supply

The reliability analysis for reclaimed water is based on wastewater influent from 1970 to 1992. Historical wastewater production from the Palmdale and Lancaster WRPs divided by historical population for the two cities provided wastewater production per capita. This unit production of wastewater from 1970 to 1992 ranged from 0.09 to 0.13 acre-feet per person per year. Figure 4-12 represents the frequency that the unit production of reclaimed water exceeded a given value. Figures 4-13 and 4-14 are based on Figure 4-12 and the 1993 and 2020 population estimates for the Valley. Based on this analysis, the wastewater treatment plants in the Valley could reliably produce 20,900 acre-feet per year in 1993 and 60,000 acre-feet per year in the year 2020. However, because the potential reclaimed water supply for both 1993 and 2020 is taken as the current reclaimed water use (approximately 6,500 acre-feet), the reclaimed water supply is considered 100 percent reliable. This is summarized in Table 4-6.

Reliability of Available Water Supplies

Figure 4-15 depicts the yield capabilities of the combined water supplies for the Antelope Valley. The graphs are based on the combined probability of available water supplies. However, because groundwater and reclaimed water have a 100 percent reliability, weighted averages were used to compute the reliability of the aggregate water supply. As mentioned previously, the potential water supply is 225,900 acre-feet per year (assuming a high estimate for the groundwater supply). From Figure 4-15, the probability of receiving 100 percent of the supply is approximately 29 percent. As the probability increases, the yield capability



Assumptions:

- Reclaimed Water Flow based on combined flow from Palmdale and Lancaster WRP's (1970 to 1992).
- Population based on combined City of Palmdale and City of Lancaster populations from 1970 to 1992.

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Unit Production of Reclaimed Water

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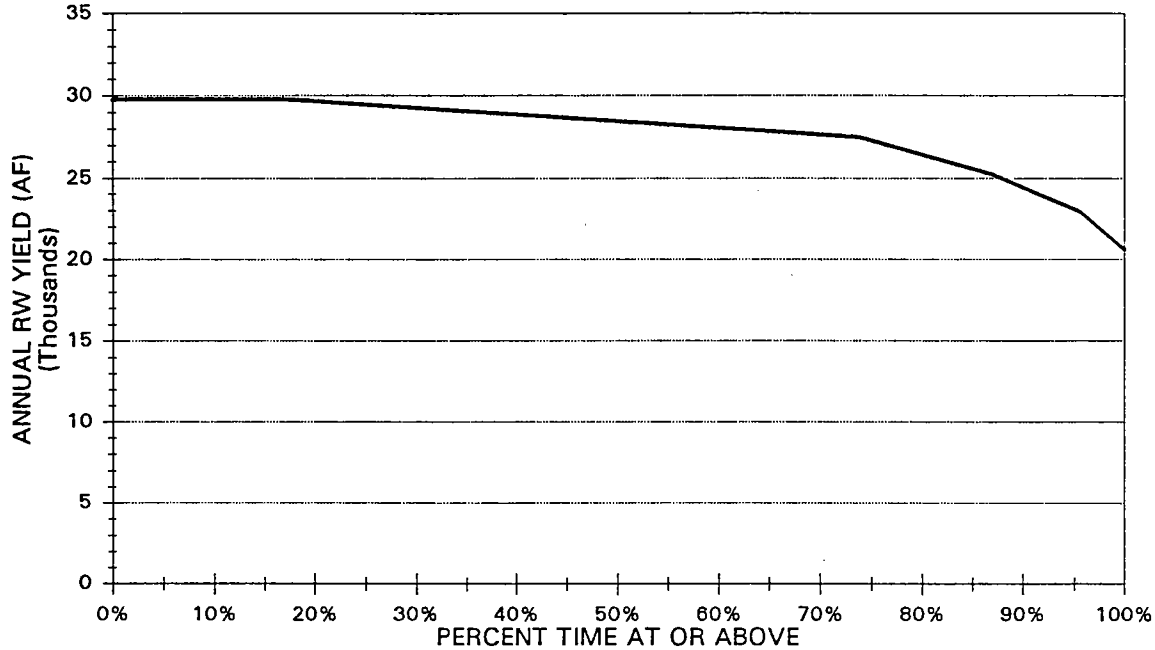
Figure 4–12



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1993 Production Capability of Reclaimed Water

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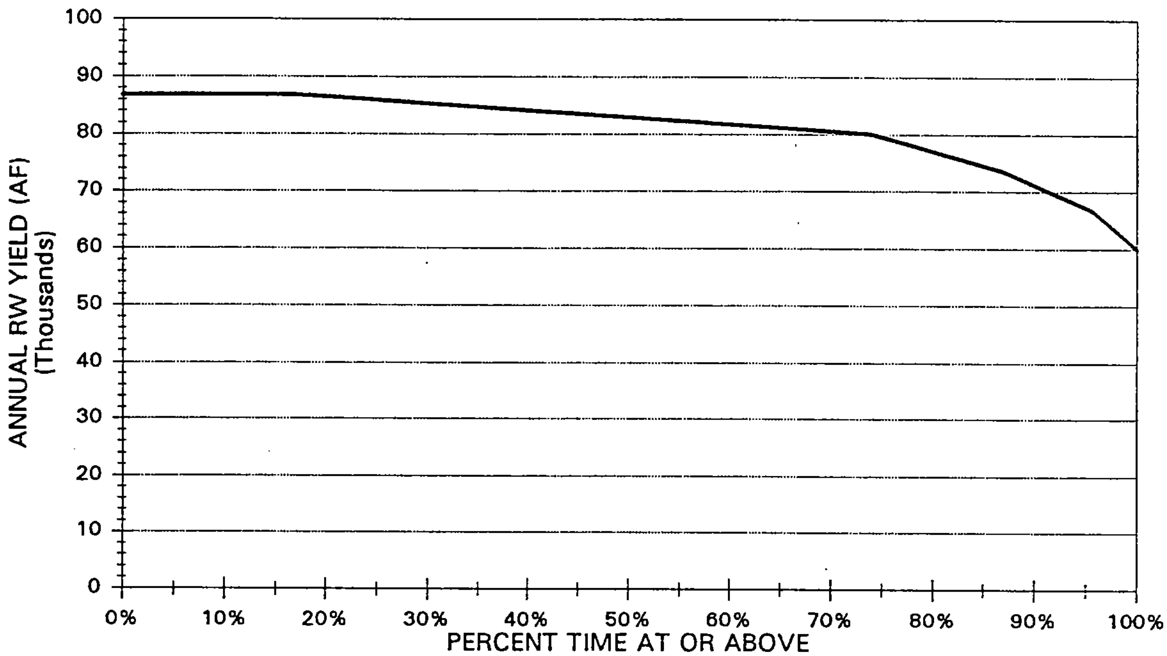
Figure 4–13

PWS-0200-0095



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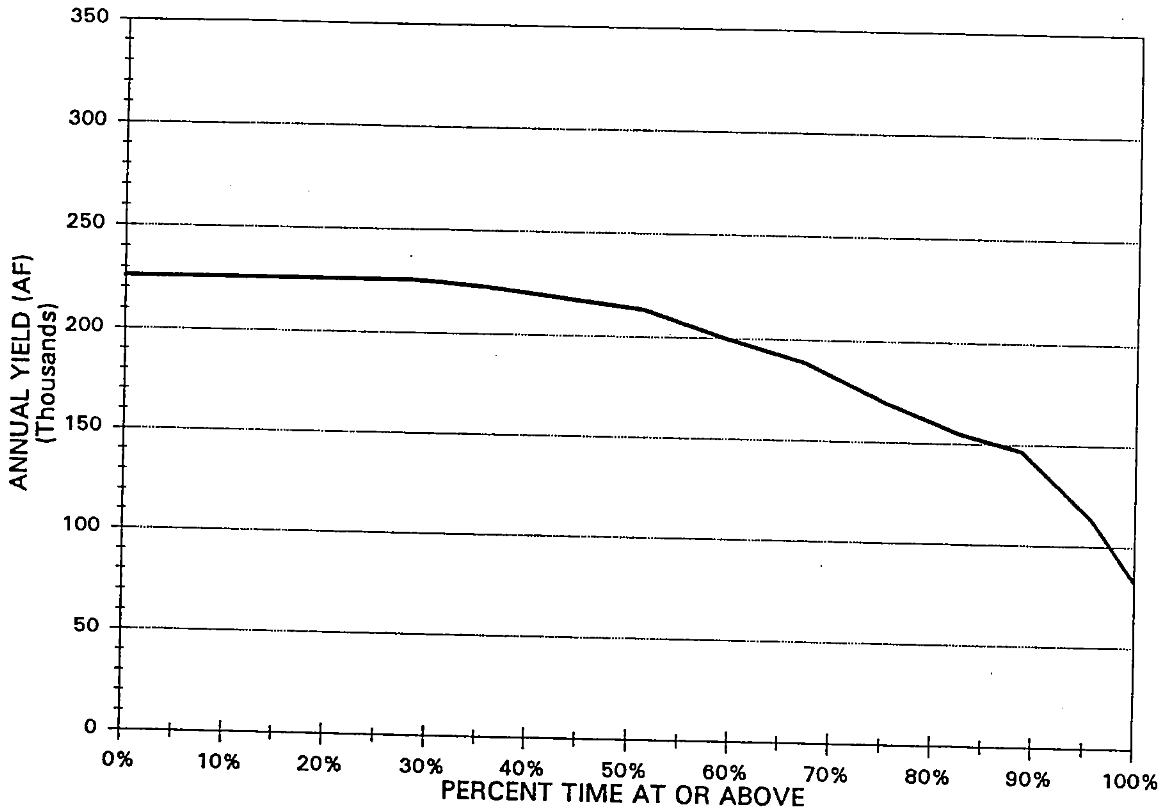
2020 Production Capability of Reclaimed Water

November 1995
K/J 934620.00

Figure 4–14



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Yield Capability of Available Water Supplies

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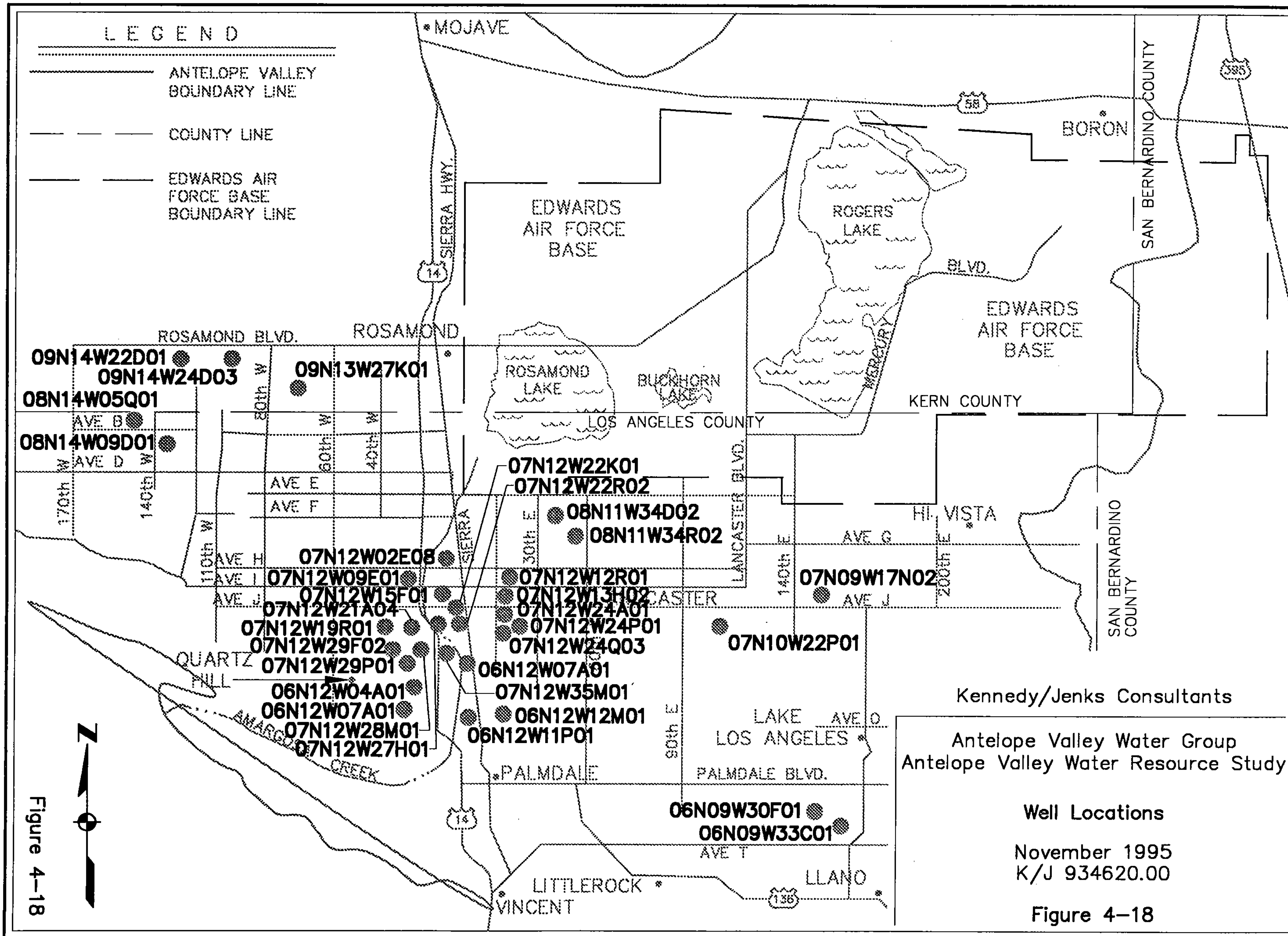
Figure 4–15

PWS-0200-0097


LEGEND
ANTELOPE VALLEY BOUNDARY LINE
COUNTY LINE
EDWARDS AIR FORCE BASE BOUNDARY LINE
MOJAVE
ROSAMOND
BORON
EDWARDS AIR FORCE BASE
ROGERS LAKE
ROSAMOND LAKE
BUCKHORN LAKE
KERN COUNTY
LOS ANGELES COUNTY
SAN BERNARDINO COUNTY
SIERRA HWY.
ROSAMOND BLVD.
MERCURY BLVD.
LANCASTER BLVD.
HI VISTA
QUARTZ HILL
AMARGOSA CREEK
PALMDALE
PALMDALE BLVD.
LAKE LOS ANGELES
LITTLEROCK
LLANO
VINCENT
AVE B
AVE D
AVE E
AVE F
AVE G
AVE H
AVE I
AVE J
AVE O
AVE T
170th W
140th W
110th W
80th W
60th W
40th W
30th E
90th E
140th E
200th E
09N14W22D01
09N14W24D03
09N13W27K01
08N14W05Q01
08N14W09D01
07N12W22K01
07N12W22R02
08N11W34D02
08N11W34R02
07N12W02E08
07N12W09E01
07N12W15F01
07N12W21A04
07N12W19R01
07N12W29F02
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06N12W04A01
06N12W07A01
07N12W28M01
07N12W27H01
07N12W12R01
07N12W13H02
07N12W24A01
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07N12W24Q03
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07N09W17N02
07N10W22P01
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06N09W33C01
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Antelope Valley Water Resource Study
Well Locations
November 1995
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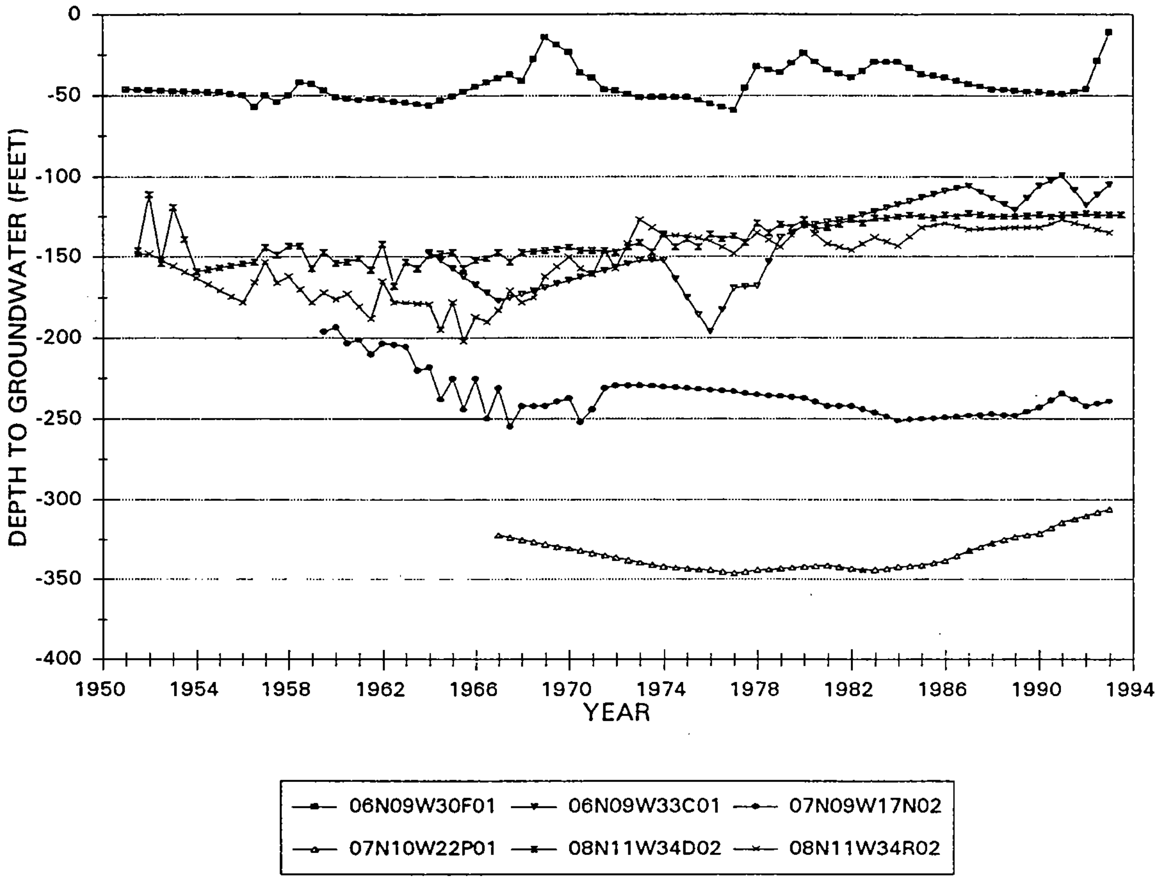
Figure 4–18

Figure 4–18



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Hydrographs in Agricultural Areas Without SWP Water

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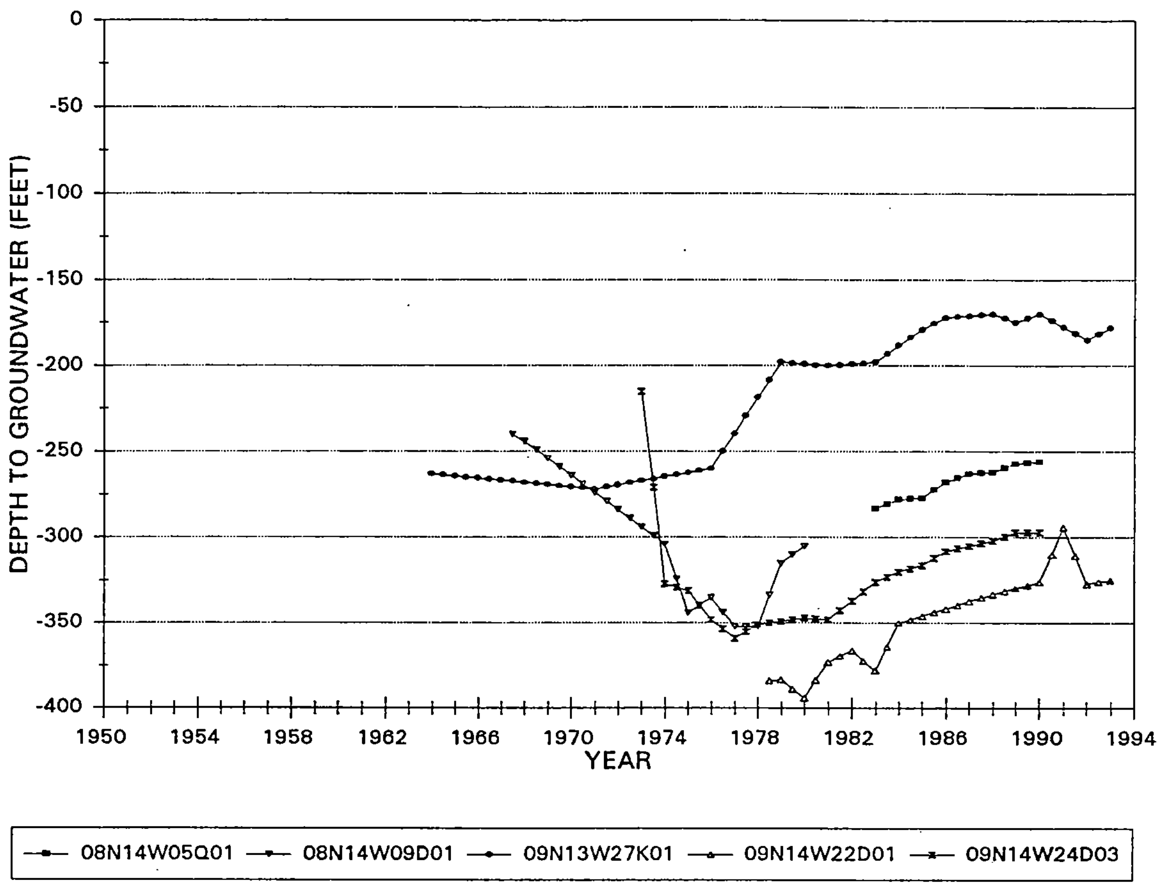
Figure 4–19



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Hydrographs in Agricultural Areas With SWP Water

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Figure 4–20