

Other Concerned Agencies

Other agencies that may require notification and permits are the Los Angeles County Environmental Health Department, the Kern County Environmental Health Department, the affected water agencies, and Edwards AFB.

CHARACTERISTICS FOR GOOD INFILTRATION AND INJECTION SITES

Certain characteristics affect economic viability and technical feasibility and are a keys 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 and are described in greater detail below:

- 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.

Suitable Surface and Sub-surface Hydrogeologic Conditions

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. Infiltration conducted by the Department of Agriculture indicated an average infiltration rate of 3 acre-feet per wetted acre per day during a 115 day spreading test at the Kings Canyon percolation basin west of Fairmont in Antelope Valley (USGS, 1967). Using this infiltration rate, with percolation occurring for 365 days per year, approximately 41 acres would be required to infiltrate 45,000 acre-feet per year. The areal requirements may vary as a function of the depth of water in the impoundment, clogging of the pond bottom, etc. As mentioned earlier, there is a significant deposit of alluvial materials at the base of the San Gabriel Mountains.

For subsurface injection, aquifer hydraulic characteristics appropriate for groundwater withdrawal would also be appropriate for injection. However, more detailed, site-specific studies would have to be conducted to determine hydraulic characteristics for both infiltration and injection.

Adequate Storage Capacity

Both infiltration and injection require aquifer materials that can store the excess water that will be recharged. Specific yield of 0.01 to 0.30 in an unconfined aquifer would provide good storage characteristics (Freeze, 1979). As discussed earlier, there is an estimated available storage of 13 million acre-feet in the Antelope Valley aquifer. A more detailed, site-specific study would be required to evaluate storage at a specific location.

Proximity to Potential Recharge Water Sources

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. In general, potential recharge sites were selected to be downgradient from potential source waters to minimize capital construction costs (pipelines and channels) and pumping costs.

Proximity to Existing Groundwater Production Sites

Both LACWW and the Palmdale Water District (PWD) have existing wellfields with facilities such as wells, pump stations, and distribution piping already in place. Potential infiltration and injection sites are being assessed relative to the location of the existing facilities in order to minimize capital costs.

Impermeable Faults and Bedrock to Impound Groundwater

In certain instances where 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. Some of the reasons for wanting control of the groundwater storage are to 1) prevent blending with lower quality waters, 2) reduce the infrastructure requirements for extracting the water, and 3) prevent other users from taking advantage of the recharged waters.

Compatible Water Quality

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. Therefore, each potential infiltration or injection site requires an in-depth water quality analysis and comparison with the potential source waters.

SUMMARY OF RELEVANT STUDIES

There have been a number of studies conducted that discuss potential sites for ASR projects. These studies and reports were used to identify the higher potential sites. The studies are summarized in Table 7-1.

It should be noted that the majority of the detailed, site-specific studies have been conducted only for the Amargosa Creek area. The other potential ASR areas are only described in general terms and will require more detailed studies.

FACTORS SPECIFIC TO SURFACE INFILTRATION

As described above, the basic characteristics of a good surface infiltration site requires good soils, adequate storage, compatible water quality, location relative to potential source waters, and locations near wellfields. In addition, surface infiltration sites require consideration of both the potential losses to evaporation and

TABLE 7-1
SUMMARY OF PREVIOUS STUDIES IDENTIFYING POTENTIAL RECHARGE AREAS

Source	Area	Purpose	Status
USGS (Bloyd), 1967	W. Antelope Valley, 10 other areas in AV	Underground Reservoir	No further studies conducted
LACFCD, 1970	Little and Big Rock Creeks	Water Conservation and Flood Control	--
DWR, 1979		Storage and recapture of SWP water in AV	Spreading not feasible because all faults are not good barriers
DWR (District), 1980	Upper reaches of Little and Big Rock Creeks	Alternatives for comprehensive water management plan	--
LACFCD, 1983	Big Rock Creek Drainage, near apex of fan and SE portion of Valyermo Basin	Feasibility for recharge	--
LACFCD, 1985/85	Hunt Canyon in Little Rock Creek Basin	Feasibility for spreading grounds	Area should be good spreading ground
Geosols, 1987	Amargosa Creek	Retention Basin	Follow-up work by Robert Bein, William Frost & Associates, 1993
LACDPW, 1987	Valley-wide	Comprehensive Flood Control and Water Conservation Plan, includes mention of 6 groundwater recharge preserves	More detailed plans for Palmdale and Lancaster have been prepared
USGS/SWRCB/RWQCB (Duell), 1987	Valley-wide	Groundwater Monitoring Network	Sampling of 200 wells has been coordinated by USGS
DWR (Southern District), 1988	Little Rock Creek and Reservoir	Water Supply and Management Investigation, Dam Safety analysis	LCID and PWD have recently completed dam improvements and increased the storage in the reservoir
LACDPW-Land Development Division, 1989	Antelope Valley (LA County portion) (prepared for Hydraulics and Water Conservation Division for LACWWW)	Spreading Grounds Study - Phase I Preliminary Report	Selected alluvial fans of Little and Big Rock Creeks and Amargosa Creek as prospective areas for runoff recharge
LACDPW-Materials Engineering Division, 1991	Amargosa Creek/Air Force Site (prepared for Hydraulics and Water Conservation Division for LACWWW)	Phase 2 - Detailed surface and sub-surface hydrogeologic investigation	Assessed high potential of site for recharge basin and/or injection
LACDPW-Hydraulics and Water Conservation Division, 1992	Amargosa Creek/Air Force Creek (prepared for Waterworks and Sewer Maintenance Division)	Groundwater Recharge Concept Plan	Recommended site for pilot injection program (underway by USGS) and pilot percolation recharge program using Amargosa Creek runoff
Robert Bein, William Frost & Associates, 1993	Amargosa Creek (prepared for City of Palmdale)	Creek Improvement Project with flood control/detention basins	Draft EIR prepared, flood control basins could function as recharge basins
Earth Systems, 1994	Amargosa Creek (prepared for City of Palmdale)	Assess most likely areas of potential recharge in Amargosa Creek channel	Report concludes that significant groundwater recharge occurs in Amargosa Creek channel

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the long travel time of the recharged water through the unsaturated zone. The Lancaster Water Reclamation Plant has an estimated evaporation rate of 107 inches or 9 feet of evaporation each year. This rate could significantly impact the total volume of water recharged. More detailed analysis of evaporation at the specific

site may be required to better assess the impact of evaporation and to develop criteria for when the spreading grounds should be used.

Although the surface soils in many parts of Antelope Valley are favorable for surface infiltration, the distance to the water table will influence when the infiltrated water is available to be pumped out. Depending on the hydraulic conductivity of the soils and the hydraulic gradient, it is estimated that travel times through the unsaturated zone may take 5 to 50 years. This factor needs to be considered in selecting potential surface recharge areas.

POTENTIAL SURFACE RECHARGE AREAS

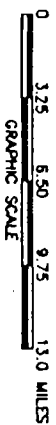
Based on the characteristics favorable to a good surface infiltration site described above, and previous work that has been conducted in assessing infiltration sites, the following areas have been focussed on for more detailed analysis:

- Little Rock Creek
- Big Rock Creek
- Amargosa Creek
- West Antelope Sub-unit
- Groundwater recharge zones described in the Los Angeles County Department of Public Work (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 recharge sites can be found on Figure 7-13. Each of the potential recharge sites for which there is sufficient information are described in further detail below with respect to the specific area selected, the potential source waters that could serve the recharge area, and a comparison of water quality for the potential sources and the groundwater of the potential recharge areas.

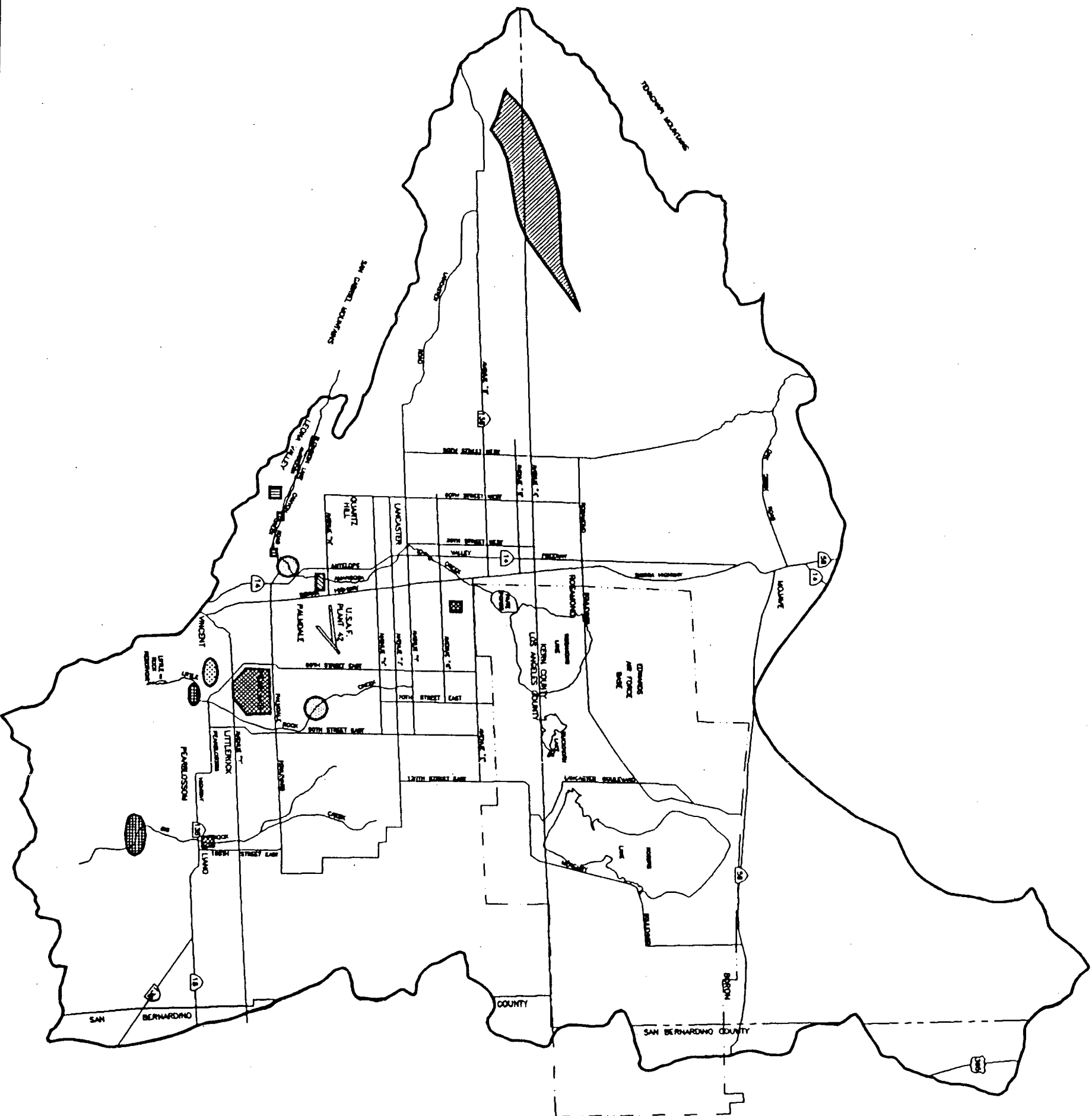
Little Rock Creek

There are several potential surface recharge sites within the Little Rock Creek watershed which have many of the favorable characteristics for surface recharge. The creek has a watershed area of about 50 square miles and water within the watershed is impounded in the Little Rock Reservoir. The average annual runoff from the watershed for a period from 1931 to 1989 is 14,870 acre-feet (DWR, 1988).



LEGEND

- Antelope Valley Boundary Line
- County Boundary Line
- Edwards Air Force Base Boundary Line
- Existing Gravel Deposits
- Proposed Flood Control Basins (City of Palmdale)
- USAF Plant 42 Site
- Potential GW Storage Reservoir
- Existing Recharge Areas
- Potential Reclaimed Water Recharge
- Proposed Hunt Canyon Detention Basin



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Existing and Potential
Surface Recharge Areas

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Figure 7-13

The Little Rock Reservoir is operated jointly by the PWD and the Little Rock Creek Irrigation District (LCID). The Little Rock Dam has recently undergone a seismic retrofit and construction to increase its height for greater storage volume (3,500 acre-feet). Historical annual diversions (1956 to 1990) for PWD and LCID have averaged approximately 1,300 and 1,400 acre-feet respectively (LAW Environmental, 1991). These numbers will most likely change based on the increased storage now available. According to a 1922 agreement between the two Districts, all water from within the watershed are allocated and accounted for.

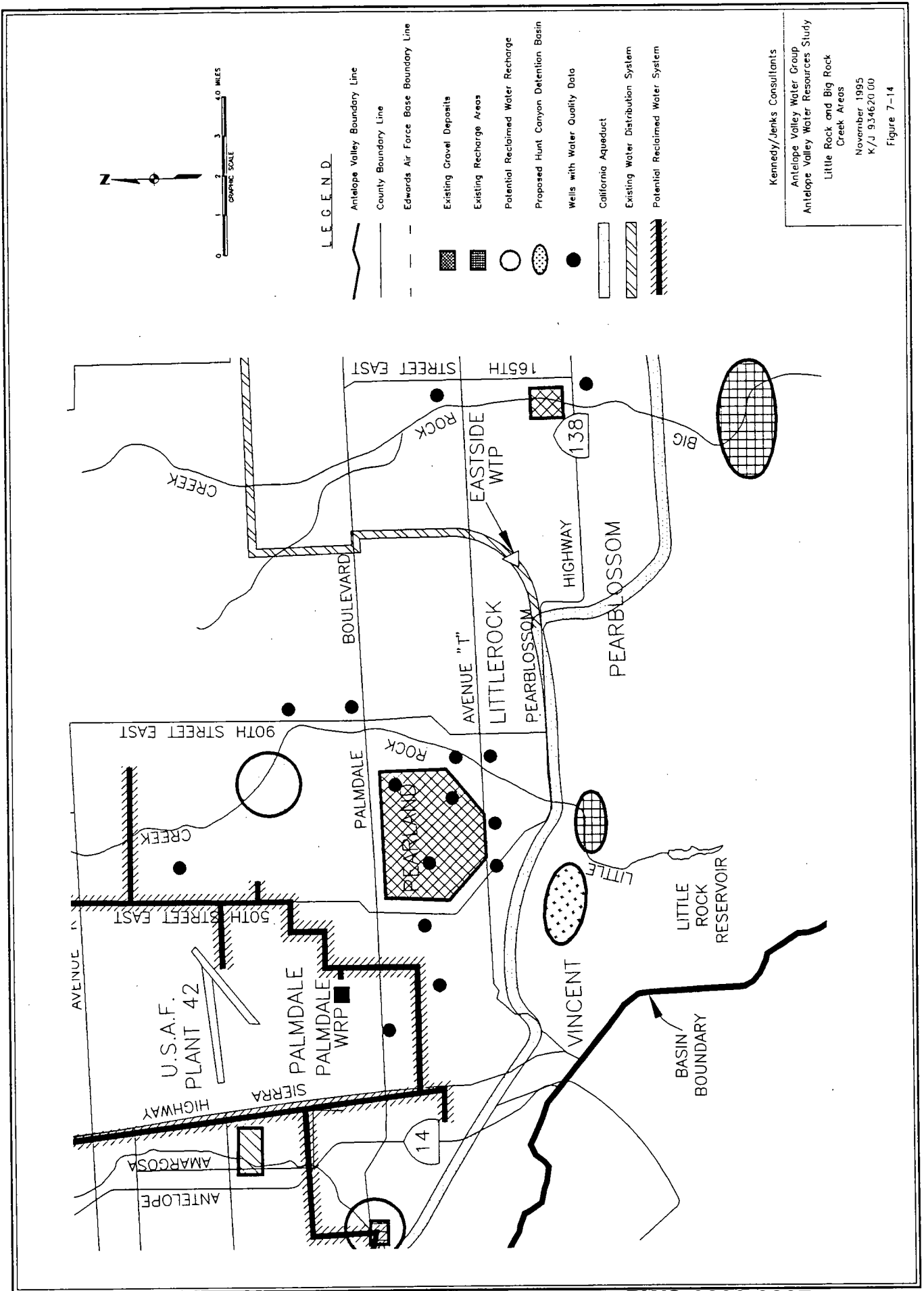
In addition to the water in the Little Rock Reservoir, both Districts also use groundwater and imported water from the SWP to meet their water demands. The PWD stores Little Rock Reservoir water and SWP water in the Palmdale Lake prior to treatment and distribution to their service area.

There is one existing (Cienega area) and several potential recharge areas near Little Rock Creek as shown on Figure 7-14 and listed as follows:

- Cienega Area (T4NR9W, Sections 10,11, 16 and 17).
- Gravel Deposits Site (T5NR11W, Sections 2 and 3; T6NR11W, Sections 35 and 36).
- Hunt Canyon Detention Basin.
- Department of Airport Property (T6NR11W, Sections 2 and 11).

Descriptions of the above sites are presented below. Additional data such as percolation tests and exploratory borings with pump test, geophysical logging, and water quality data may be required at the sites.

Cienega Area. The LCID uses about 300 acre-feet annually to recharge the Cienega area (DWR, 1988), a small aquifer located about 2 miles downstream of the Little Rock Dam. (See Figure 7-14.) This water is later pumped and used to serve domestic users within the LCID service area. The Cienega area should be investigated further to assess available storage in the aquifer and the volume of available water for recharge. Because of the existing facilities for recharge, extraction and distribution, this area may be a good candidate for additional storage of excess Little Rock Creek waters. The Cienega area is upgradient from the California Aqueduct and the reclaimed water system as shown on Figure 7-14. Due to the potential water quality impacts from mixing those waters with Little Rock Creek waters, these water supplies should not be considered potential recharge sources for the Cienega area. By restricting the recharge source waters to Little Rock Creek, the regulatory requirements would be significantly reduced and/or eliminated. No water quality data were located for the Cienega area.



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Little Rock and Big Rock
Creek Areas

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Figure 7-14

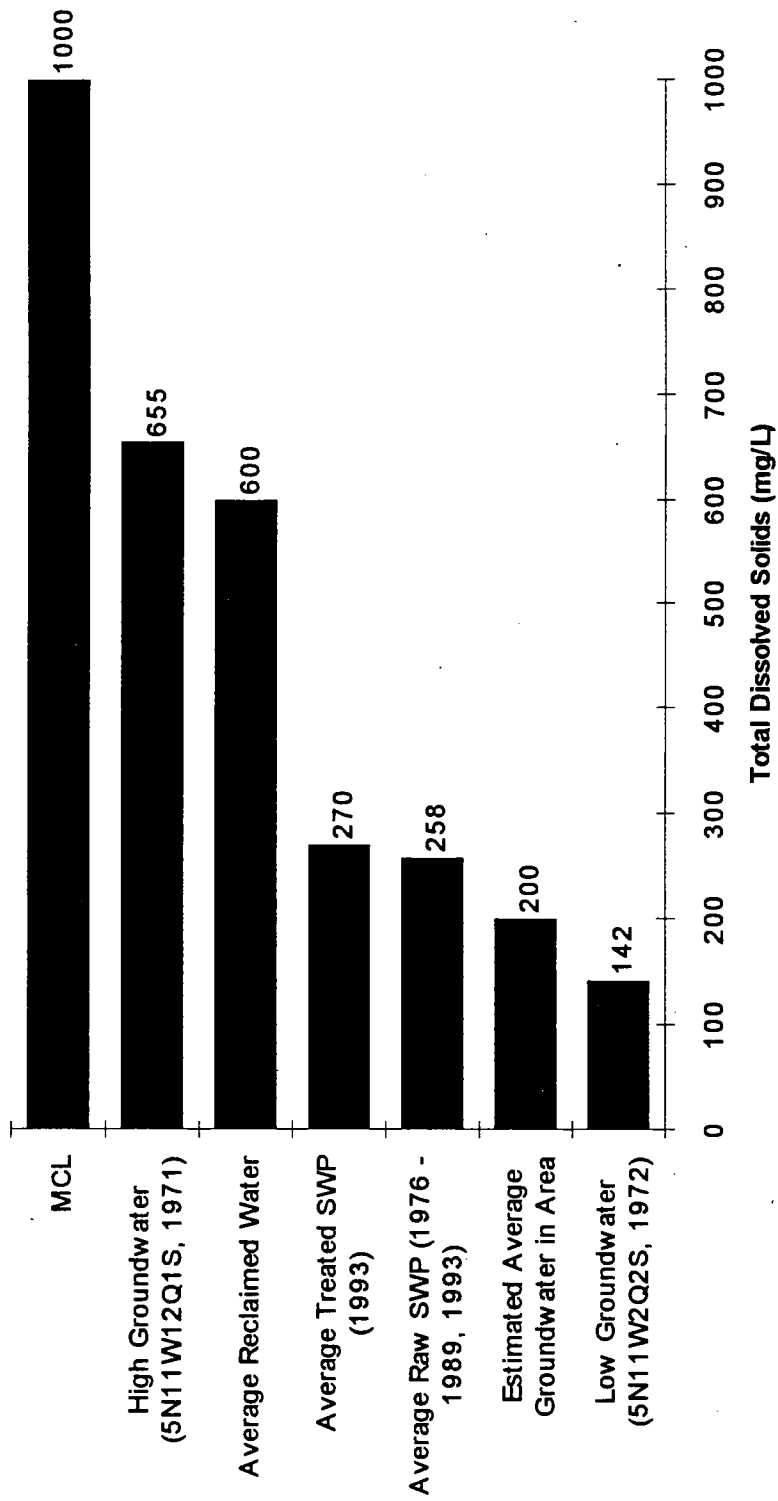
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Gravel Deposits Site. Another area that has good potential for recharge is located in Township 5 North, Range 11 West, Sections 2 and 3, and Township 6 North, Range 11 West, Sections 35 and 36. (See Figure 7-14.) These areas have known gravel deposits which generally indicates good infiltration rates. The gravel deposits are west of the Little Rock Creek wash and therefore should not require an NPDES permit for surface discharge of reclaimed water. These areas could easily be served by a turnout from the California Aqueduct. The proposed reclaimed water line that would serve the area near Palmdale Boulevard and 40th Street West is about 3.5 miles from and 140 feet below the elevation of the gravel pits and would therefore require piping and pumping facilities to serve the area. If there is sufficient flow in Little Rock Creek, waters from the creek could be diverted to the gravel areas. The gravel deposits are located within a mile of a known PWD well (T6NR11W34N1S) and are also within a mile of other wells that are of unknown use. (See Figure 7-14.)

Based on readily available data, the wells found in Table 7-2 were referenced for water quality data. The wells are located on Figure 7-14. As shown in Table 7-2, there is little recent water quality data. The water quality of the wells has been compared to average water quality for potential source waters of the SWP and reclaimed water as shown on Figure 7-15. There is a single well (5N11W12Q1S) with high TDS and high nitrates in the area. The poor water quality is probably attributable to the intense poultry farming that occurred there in the 1950s to 1960s. However, the TDS levels in other wells in the area are generally lower than the potential recharge sources of reclaimed or SWP waters.

The available data are insufficient to assess the overall impacts to groundwater quality of the recharge of SWP or reclaimed waters to this area. Well construction data and water quality samples from the wells should be collected and analyzed to assess the present day condition of the water quality in the aquifers.

Hunt Canyon Detention Basin. The Los Angeles County Flood Control District's (LACFCD) Hunt Canyon Detention Basin Site is another potential recharge site in the Little Rock Creek area (LACFCD, 1985-86). Several borings and wells were installed to a depth of 180 feet for a proposed basin which appears to be feasible for a spreading ground. However, the site is several hundred feet above and several miles from both the California Aqueduct and any reclaimed water facilities. Therefore, the only economic supply source will be Little Rock Creek. There do not appear to be any water supply wells that could be used to extract water from the basin. No water quality data were located for this area.



Note: Groundwater samples at 8 wells collected from 1950, 1960 - 1978, 1992.

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Water Quality Near Little Rock Creek
Gravel Deposits

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Figure 7-15

TABLE 7-2

WELL SUMMARY NEAR LITTLE ROCK CREEK GRAVEL DEPOSITS

<i>Well Number</i>	<i>Length of Water Quality Data Collected</i>	<i>Well Owner</i>	<i>Approximate distance from proposed recharge site (miles)</i>
5N11W1M1S	1992, Specific Conductivity only	Little Rock Sand and Gravel	< 1
5N11W2Q2S	1971 - 1977	Lane	< 1
5N11W8H1S	1992	unknown	1
5N11W9A3S	1964 - 1975	PWD	1
5N11W12Q1S (1)	1963 - 1978	LCID	1
6N11W20G2S	1972 - 1974	PWD (out of service?)	4
6N11W32P1S	1950, 1973 - 1974	PWD (out of service?)	< 1
6N11W34N1S	1967, 1971, 1973	PWD	< 1
6N11W36G1S	1964, 1992	unknown	< 1

(1) Indicated high nitrates due to poultry farming.

Department of Airport Property. A site that has potential for recharge of reclaimed water is located near Little Rock Creek on the Department of Airport (DOA) property along Avenue "N" between 60th Street east and 70th Street east (Township 6 North, Range 11 West, Sections 2 and 11). This site should have permeable surface soils because it straddles the Little Rock Creek. It is also located near the terminus of the reclaimed water pipeline conveying secondary treated water. Any excess water from Little Rock Creek would also be fed to this area as could SWP water if appropriate conveyance structures are constructed. At present, there appear to be no extraction and distribution systems in this area. The discharge of reclaimed water to this site may require an NPDES permit since the creek may be considered an ephemeral surface water. This site may be problematic if a wetlands is created as a result of the recharge activity due to the wildfowl that may nest there. The wildfowl could pose a threat to aircraft flying operations at the United States Air Force (USAF) Plant 42 airfield.

There are very few water quality samples in the area. The water quality data that were located are summarized below in Table 7-3.

TABLE 7-3

WELL SUMMARY NEAR DEPARTMENT OF AIRPORT SITE

<i>Well Number</i>	<i>Length of Water Quality Data Collected</i>	<i>Well Owner</i>	<i>Approximate distance from proposed recharge site (miles)</i>
6N11W3P1S	1965	unknown	1
7N11W33Q1S	1973 - 1982	unknown	2.5
7N11W34H1S	1972, 1973	unknown	1

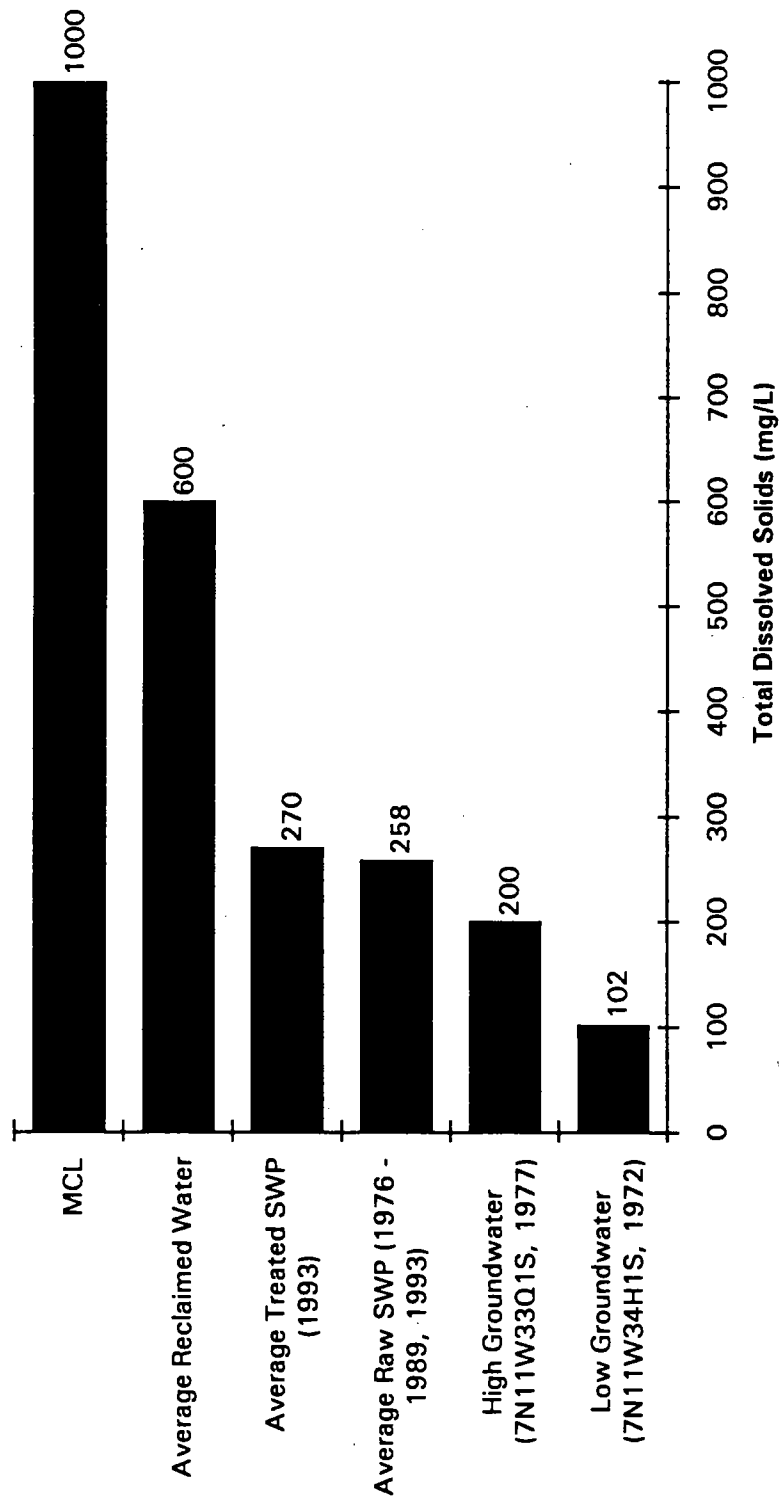
The quality of the groundwater in this area as compared to potential source waters is shown on Figure 7-16. The TDS levels in the groundwater vary from 102 to 200 mg/L while the TDS in the source waters ranges from 258 to 600 mg/L. However, the available data are insufficient to assess the overall impacts to groundwater quality of the recharge of SWP or reclaimed waters to these areas. Well construction data and water quality samples from the wells should be collected and analyzed to assess the present day condition of the water quality in the aquifers.

Big Rock Creek

There are a few potential surface recharge sites within the Big Rock Creek watershed which may be appropriate for surface recharge. The creek has a watershed area of about 23 square miles (USGS, 1967) and has an average flow of 13,200 acre-feet per year with a maximum discharge of 64,830 acre-feet per year measured in 1978 - 1979. There are wells in the Valyermo area with water level data; however, there are little other data presently available. It is unknown if there are any large municipal users of the water, or whether the users of groundwater are strictly single family homes.

There is one existing (Valyermo Basin) and one potential recharge area near Big Rock Creek as shown on Figure 7-14 and listed as follows:

- Valyermo Basin (T4NR9W, Sections 7, 8, 9, 10, 16, 17)
- Gravel Deposits Site (T5NR9W, Section 18)



Note: Groundwater samples at 3 wells collected from 1965, 1972, 1973, 1977, 1979

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Water Quality Near Little Rock Creek
Potential Reclaimed Site

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Figure 7-16

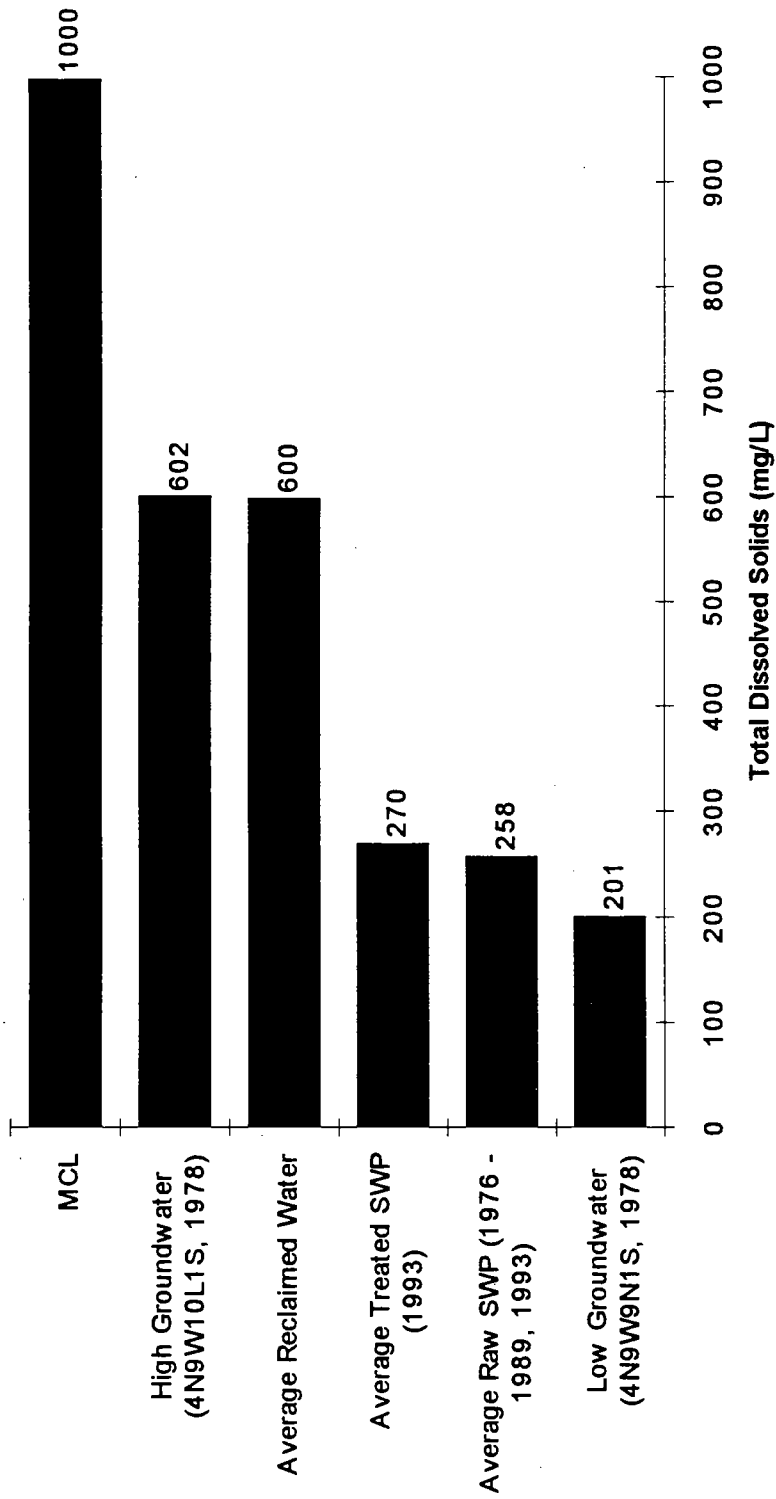
Descriptions of the two sites are presented below. Well construction data and water quality samples from the wells should be collected and analyzed to assess the present day condition of the water quality in the aquifers. In addition, other data such as percolation tests and exploratory borings with pump test and geophysical logging would be required at each site.

Valyermo Basin. Although there appears to be no continuous measurement of waters being recharged at the spreading grounds, the Hydraulic and Water Conservation Division of the LACDPW periodically measures inflow to the Valyermo Basin (LACDPW-LDD, 1989). At present, excess Big Rock Creek water appears to be the only potential recharge source. This is due to the Valyermo Basin being upgradient and over two miles away from the California Aqueduct. The recommended reclaimed water systems are even further away and would require even more pumping of source water than from the California Aqueduct. The use of Big Rock Creek water for additional recharge to Valyermo should require little or no regulatory approvals.

Water quality data for the wells in Table 7-4 were reviewed for applicability for recharge. A comparison of the quality of the groundwater with other potential recharge sources is shown on Figure 7-17. The limited water quality data indicate a range of TDS from 201 mg/L to 602 mg/L which is similar to the range of TDS values for the potential recharge sources. However, the available data are insufficient to assess the overall impacts to groundwater quality of the recharge of SWP or reclaimed waters to these areas.

Gravel Deposits Site. In addition to the existing spreading grounds in the Valyermo Basin, there is an area of gravel deposit (Township 5 North, Range 9 West, Section 18) in the Big Rock Creek which suggests good infiltration capacities. (See Figure 7-14.) This area could be served with untreated SWP water with the construction of a turnout. It is a considerable distance from the reclaimed water system and therefore does not appear economical to recharge with reclaimed water at this site. There are only a few wells in the area that could provide water quality data as shown in Table 7-5.

A comparison of the TDS values between the groundwater, SWP and reclaimed waters is shown on Figure 7-18. The TDS for the wells range from 209 to 424 mg/L. Based on the water quality data that are available, there are insufficient data to assess the overall impacts to groundwater quality of the recharge of SWP or reclaimed waters to these areas.



Note: Groundwater samples at 3 wells collected from 1956 - 1959, 1964, 1971-1972, 1977- 1978

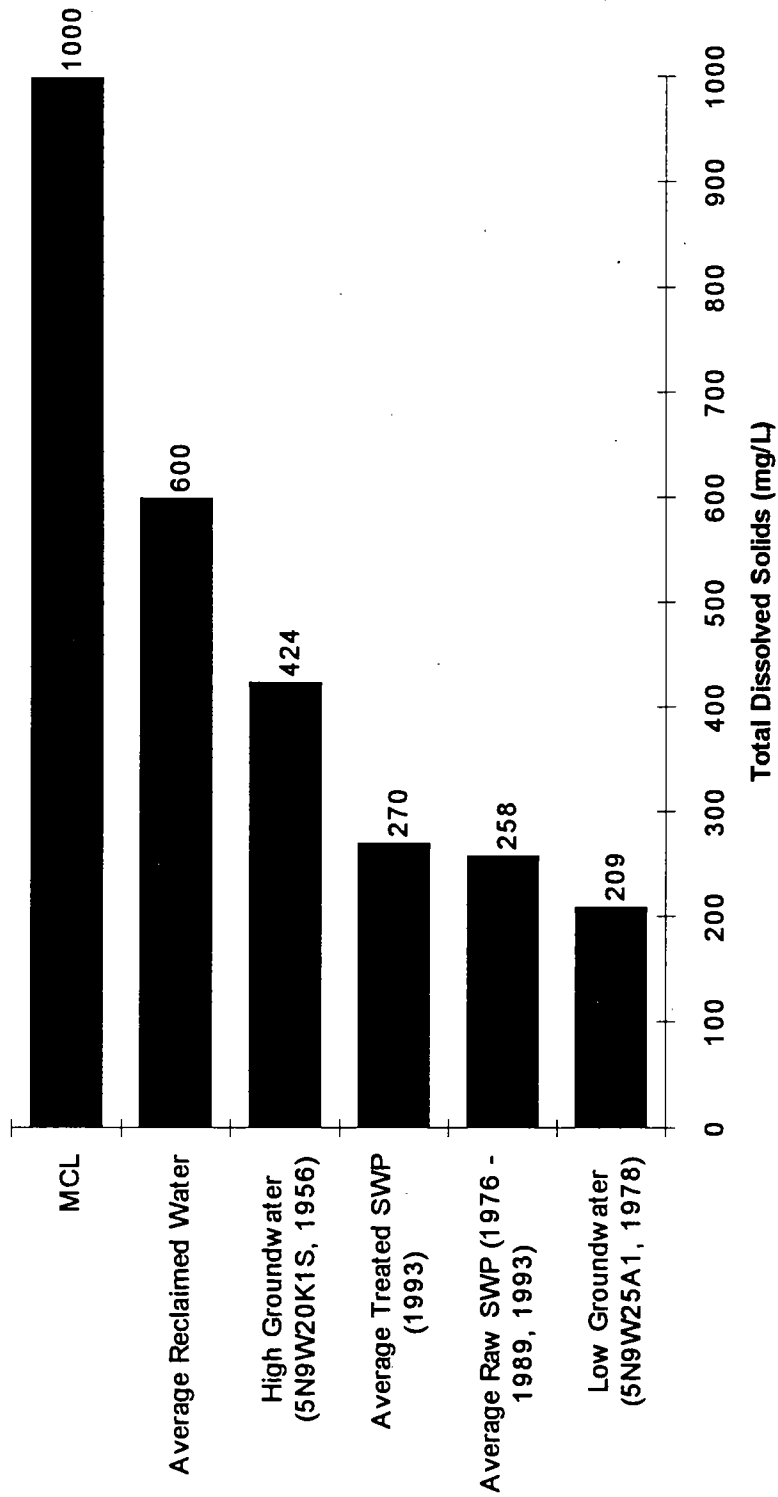
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Water Quality Near Big Rock Creek -
Valyermo Area

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Figure 7-17



Note: Groundwater samples at 4 wells collected from 1969, 1971-1978

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Water Quality Near Big Rock Creek
Gravel Deposits

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Figure 7-18

TABLE 7-4

WELL SUMMARY FOR BIG ROCK CREEK NEAR VALYERMO

<i>Well Number</i>	<i>Length of Water Quality Data Collected</i>	<i>Well Owner</i>	<i>Approximate distance from proposed recharge site (miles)</i>
4N9W9N1S	1971, 1972, 1974, 1977, 1978	unknown	< 1
4N9W9N4S	1969	unknown	< 1
4N9W10L1S	1976 - 1978	unknown	< 1
4N9W10M2S	1973 - 1975	unknown	< 1

TABLE 7-5

WELL SUMMARY NEAR BIG ROCK CREEK GRAVEL DEPOSITS

<i>Well Number</i>	<i>Length of Water Quality Data Collected</i>	<i>Well Owner</i>	<i>Approximate distance from proposed recharge site (miles)</i>
5N9W5C1	1972 - 1977	unknown	2.5
5N9W20K1S	1956, 1958, 1959	unknown	1
5N9W25A1	1964 - 1978	unknown	7

Amargosa Creek

The Amargosa Creek watershed is approximately 20 square miles and although there are no stream gages, estimated runoff varies from 800 acre-feet per year to 9,000 acre-feet per year with an estimated storm discharge from the creek of 23,000 cubic feet per second (cfs) (LACDPW-LDD, 1989). The discharge from the creek is relatively low when compared to Big Rock and Little Rock Creeks because the watershed does not extend to the snow line. However, the potentially high volumes of storm flows have led to flooding problems in the flatter portions of the creek bed near Lancaster. In addition, extensive flood detention and flood control measures are currently being proposed. Of the watersheds, Amargosa Creek has had the most detailed study of potential recharge areas.

Although there are some users of groundwater from Amargosa Creek in the Leona Valley, there do not appear to be significant diversions of the surface flows out of the creek and very few other users of the water. If allowed to flow unrestricted, the waters, which do not naturally recharge the groundwater from the channel bottom, would eventually flow to the Piute Ponds.

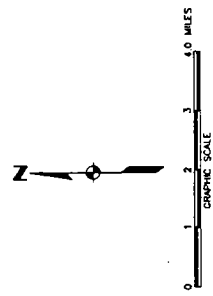
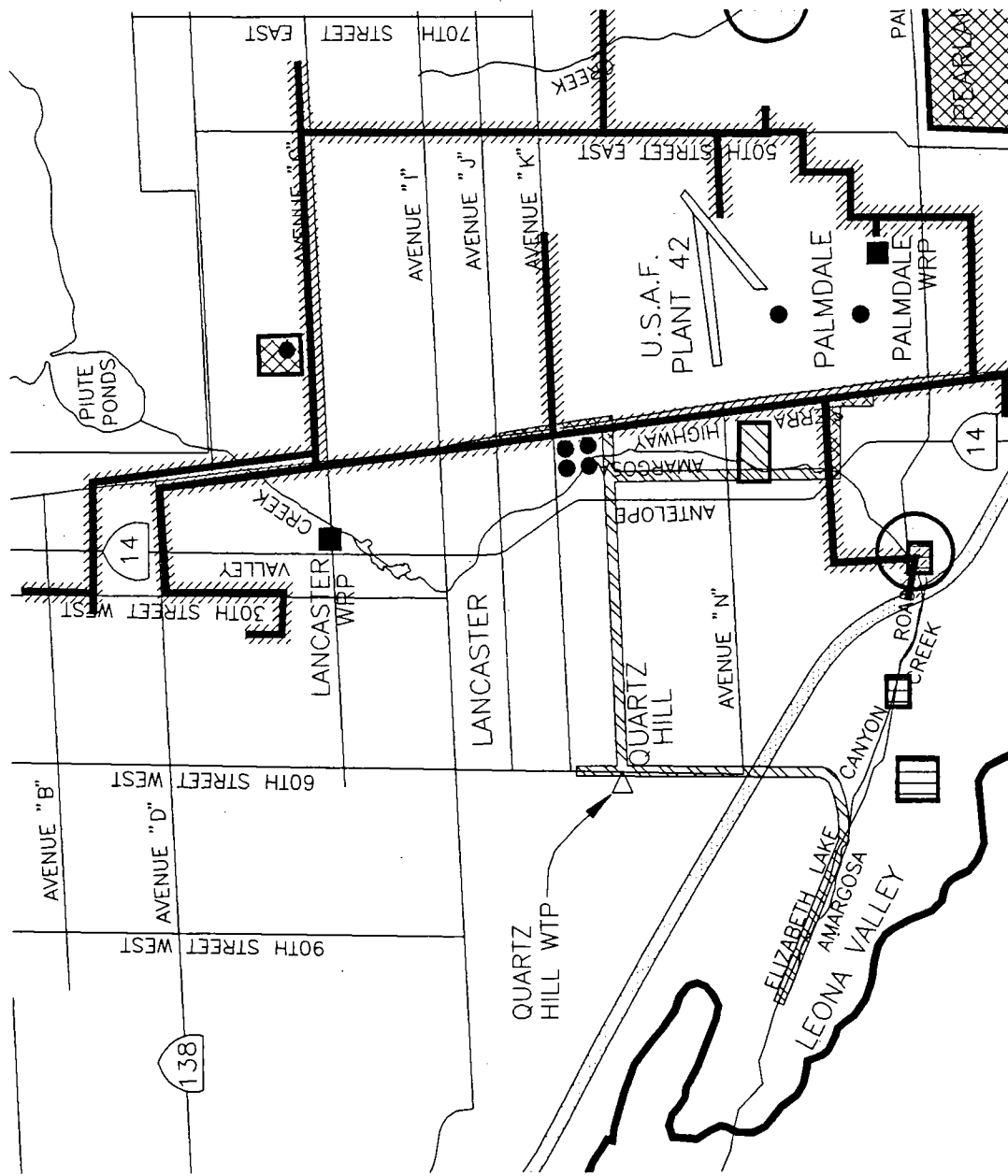
There are no existing groundwater recharge basins in use in the Amargosa Creek area. However, several possible locations are shown on Figure 7-19 and listed as follows:

- City of Palmdale's Proposed Flood Detention Basins.
- Amargosa Creek between 15th and 25th Streets West.
- USAF Plant 42 Site.
- Gravel Deposits Site near 8N12W Section 35.

Descriptions of the above sites are presented below. Well construction data and water quality samples from the wells should be collected and analyzed to assess the present day condition of the water quality in the aquifers. In addition, other data such as percolation tests and exploratory borings with pump test and geophysical logging would be required at each site.

City of Palmdale's Proposed Flood Detention Basins. Three detention basins with a total storage of about 2,150 acre-feet are planned by the City of Palmdale. These flood detention facilities could function as recharge basins if operated properly and if recharge did not interfere with the normal operations of the facility. The three proposed basins are located close to Amargosa Creek in Leona Valley, near Elizabeth Lake Road as shown on Figure 7-19. The main drawback to the basins are that they are in areas where there are no existing groundwater extraction facilities. They could be easily served by Amargosa Creek water, when available. Only one small basin (40 acre-feet), could be easily served by the California Aqueduct, the other two basins are upgradient of the Aqueduct. Reclaimed water service would also require piping and pumping facilities to the two upgradient detention basins.

There have been significant soils investigation (Earth Systems, 1994) of the stream channel because of groundwater users concerns that channelization of Amargosa Creek for flood control would result in reduced recharge of groundwater. No water quality data for wells near the flood detention facilities have been located. The available data are insufficient to assess the overall impacts to groundwater quality of the recharge of SWP or reclaimed waters to these areas.



LEGEND

- Antelope Valley Boundary Line
- County Boundary Line
- Edwards Air Force Base Boundary Line
- Existing Gravel Deposits
- Proposed Flood Control Basins (City of Palmdale)
- USAF Plant 42 Site
- Potential Reclaimed Water Recharge
- Wells with Water Quality Data
- California Aqueduct
- Existing Water Distribution System
- Potential Reclaimed Water System

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 Figure 7-19

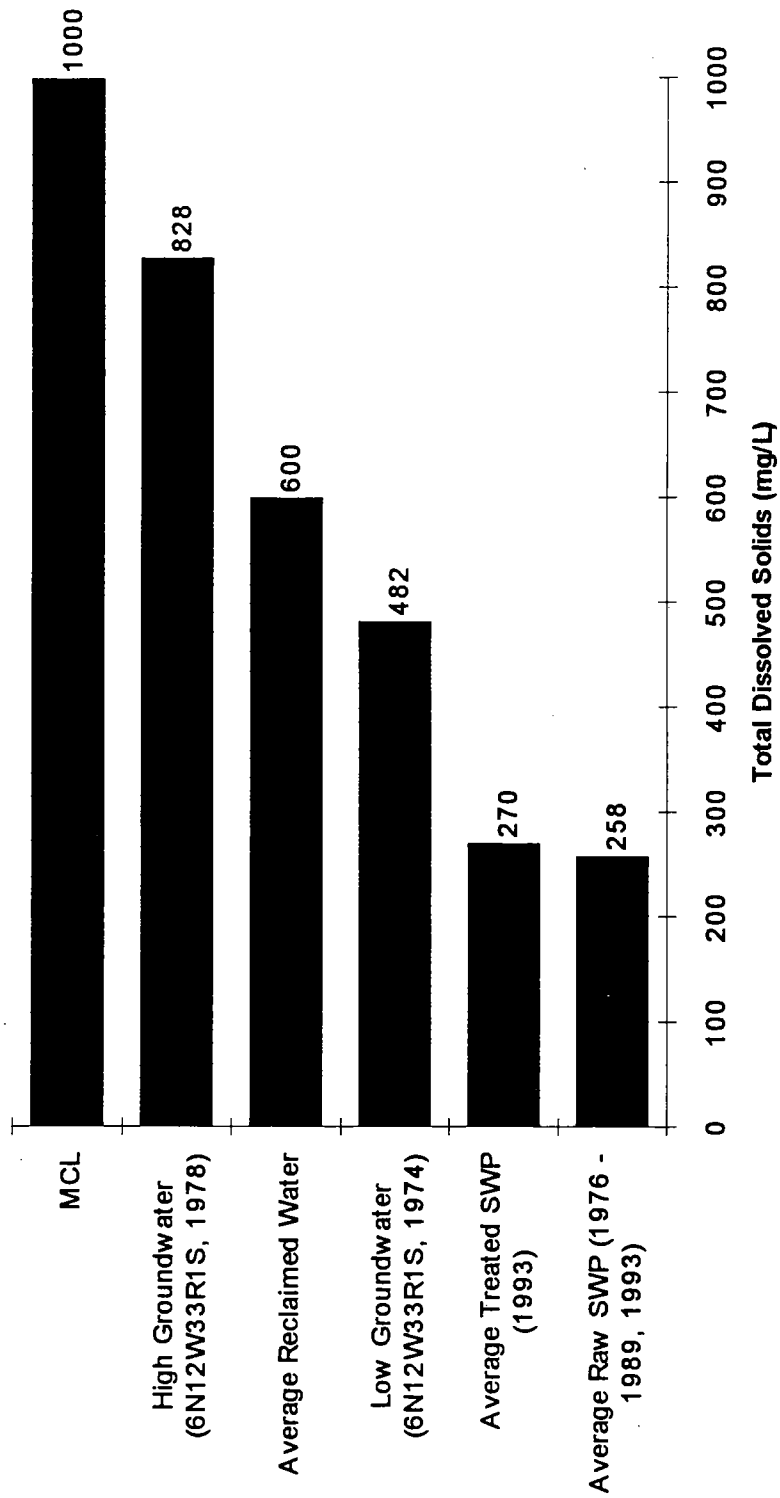
Amargosa Creek between 15th and 25th Streets West. This area is close to the City of Palmdale's proposed flood detention facilities and has been identified because of the favorable conditions identified in the soils investigation mentioned above (Earth Systems, 1994). In addition, this area is quite close to both the potential reclaimed water facilities and the California Aqueduct, as well as the Amargosa Creek channel, and could therefore be served by these potential sources. (See Figure 7-19.) It should be noted that this site may require an NPDES permit for reclaimed water recharge because Amargosa Creek appears to be an ephemeral creek.

There are few wells in the area of the potential recharge area (Township 6 North, Range 12 West, Sections 27, 28, 29). The only well in the area (6N12W30R1S) was located about one mile from the proposed recharge area and had TDS levels ranging from 482 to 828 mg/L for samples collected from 1974 to 1978. In addition, the well also had high nitrates varying from 32.4 to 340 mg/L. A comparison of the TDS in the well to SWP and reclaimed waters is found on Figure 7-20. The available data are insufficient to assess the overall impacts to groundwater quality of the recharge of SWP or reclaimed waters to these areas.

USAF Plant 42 Site. The LACDPW investigated the USAF Plant 42 site located south of Avenue "N" between 10th Street East and Division Street (the north half of Township 6 North, Range 12 West of Section 10) in 1991 for hydraulic parameters and feasibility for recharge (LACDPW-MED, 1991). Through 3 deep borings ranging from 640 to 800 feet in depth, 11 shallow borings ranging from 30 to 70 feet in depth, 5 shallow percolation tests, soil sampling, electric logs, and other field and laboratory data, the infiltration/surface percolation was estimated at 10^{-2} cm/sec, and the hydraulic conductivity ranged from 10^{-2} cm/sec to 10^{-5} cm/sec in the first 100 feet of material below the sub-surface. In addition, the transmissivity was estimated at 55,000 gpd/ft.

These sample parameters were sufficient to recommend a proposed pilot percolation program on the east side of the site to better assess the site's capabilities with respect to actual field conditions. The proposed percolation test could use Amargosa Creek waters after the flood control projects are completed. The LACDPW report mentions that there may be shallow low-permeability zones in the subsurface that could reduce the percolation rate. This possibility needs to be investigated further. In addition, the report notes that the presence of migratory fowl in this area could pose a hazard to the aircraft flying operations at the USAF Plant 42 airfield.

The study did not collect any water quality samples. There were two wells that were within a few miles of the proposed site for which water quality data could be obtained. The wells are summarized in Table 7-6.



Note: Groundwater samples at 1 well collected from 1974 - 1978

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Water Quality Near Amargosa Creek
Potential Reclaimed Site

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Figure 7-20

A comparison of the groundwater quality with data for the potential sources is shown on Figure 7-21. The data indicate that the groundwater quality is quite good relative to the potential recharge sources with a range of TDS values from 129 to 268 mg/L. However, the available data are insufficient to assess the overall impacts to groundwater quality of the recharge of SWP or reclaimed waters to these areas.

TABLE 7-6

WELL SUMMARY NEAR USAF GROUNDWATER RECHARGE SITE

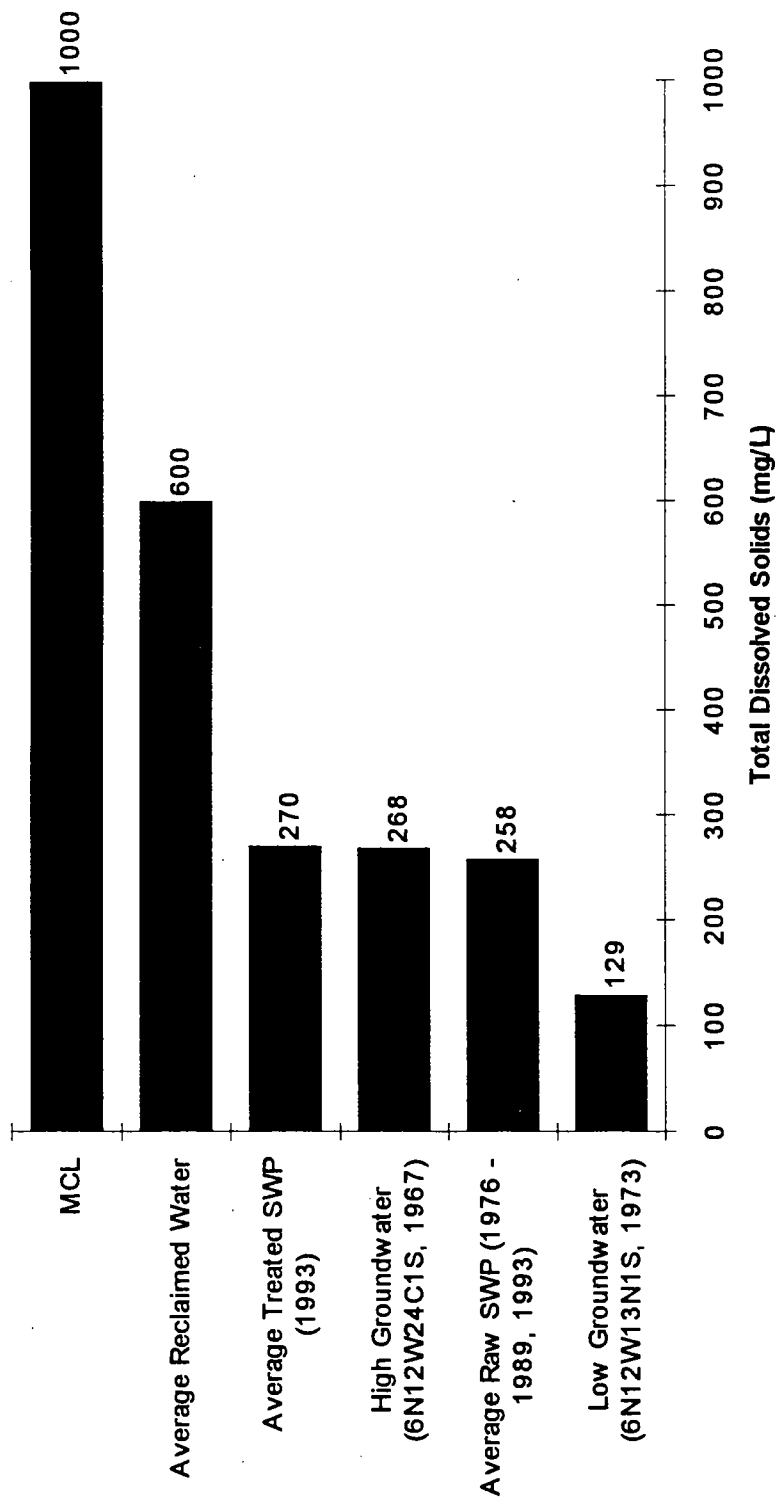
<i>Well Number</i>	<i>Length of Water Quality Data Collected</i>	<i>Well Owner</i>	<i>Approximate distance from proposed recharge site (miles)</i>
6N12W13N1S	1967, 1968, 1972 - 1978	PWD	3
6N12W24C1S	1963, 1967, 1969, 1972 - 1973	PWD (out of service?)	4

Gravel Deposits Site. In addition to the potential facilities described above, there are gravel deposits further north within two miles of Amargosa Creek near Avenue "F" and 10th Street East (Township 8 North, Range 12 West, Section 35). This site is close to the proposed reclaimed water distribution system as shown on Figure 7-19 but would require conveyance of Amargosa Creek and/or SWP waters to the site. Very little is known about this site. There is one well (8N12W35N1S) that has been located in the vicinity for which information is summarized in Table 7-7.

TABLE 7-7

WELL SUMMARY NEAR AMARGOSA CREEK GRAVEL DEPOSITS

<i>Well Number</i>	<i>Length of Water Quality Data Collected</i>	<i>Well Owner</i>	<i>Approximate distance from proposed recharge site (miles)</i>
8N12W35N1S	1970 - 1972	unknown	< 1



Note: Groundwater samples at 2 wells collected from 1963, 1967 - 1978

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Water Quality Near Amargosa Creek
Surface Recharge Sites

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Figure 7-21

The water quality data that were collected have been compared to the reclaimed water and SWP water on Figure 7-22. TDS levels in the groundwater are generally lower than in the potential source waters. The available data are insufficient to assess the overall impacts to groundwater quality of the recharge of SWP or reclaimed waters to these areas.

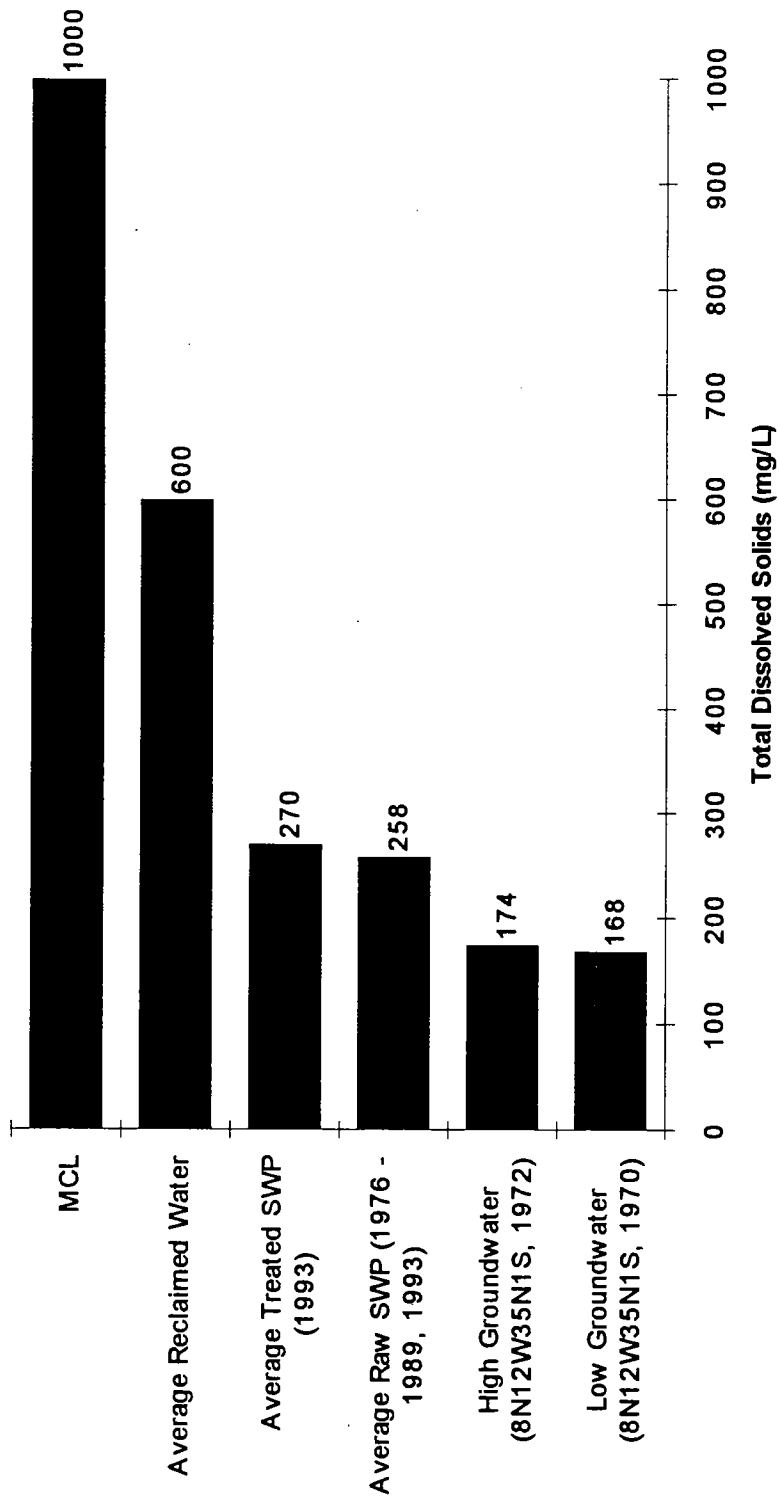
West Antelope Sub-unit

As described in the hydrogeology section of this chapter, the Antelope Valley is criss-crossed with faults which divide the Valley into sub-units as shown on Plate 1. The West Antelope Sub-unit is bounded on the southwest by consolidated rock, on the south and southeast by the Randsburg/Mojave fault, and on the north by an unnamed fault (USGS, 1967). The presence of these faults and the consolidated rock appear to provide groundwater barriers which would give hydraulic control over the sub-unit. That is, any waters that may be recharged in the sub-unit would remain in the sub-unit and would not flow into adjacent sub-units.

The West Antelope Sub-unit is located in a sparsely populated portion of the Valley and straddles the Kern and Los Angeles County lines near the California Aqueduct. (See Figure 7-23.) Although there are few natural sources of water in the sub-unit, Bloyd suggested that the sub-unit would be a suitable repository for temporary, long-term storage of water (USGS, 1967). In 1965, the USGS, in cooperation with AVEK, conducted a test-well drilling program to determine the feasibility of using the sub-unit to store water. It was estimated at the time that a 10 square mile portion of the entire sub-unit that extended 200 feet above the water table could store 1,280,000 acre-feet. The USGS/AVEK feasibility study indicated that recharge could be efficiently accomplished by using a spreading-basin or by constructing injection wells.

The feasibility study indicated that there were insufficient data to assess the ability to recover the water in an efficient and economic manner. Bloyd mentions that large pumping yields are obtained in part of the West Antelope Sub-unit. There were two wells for which groundwater data were available. The wells are summarized below in Table 7-8 and shown on Figure 7-23.

A comparison of the groundwater quality with the potential source waters of the SWP are shown on Figure 7-24. The TDS levels in the groundwater are generally higher than the SWP water which indicates that the SWP water will be a good potential recharge source for this site. The available data are insufficient to assess the overall impacts to groundwater quality of the recharge of SWP waters to this area. Well construction data and water quality samples from the wells should be collected and analyzed to assess the present day condition of the water quality in the aquifers. In addition, other data such as percolation tests and exploratory borings with pump test and geophysical logging would be required.



Note: Groundwater samples at 1 well collected from 1970 to 1972

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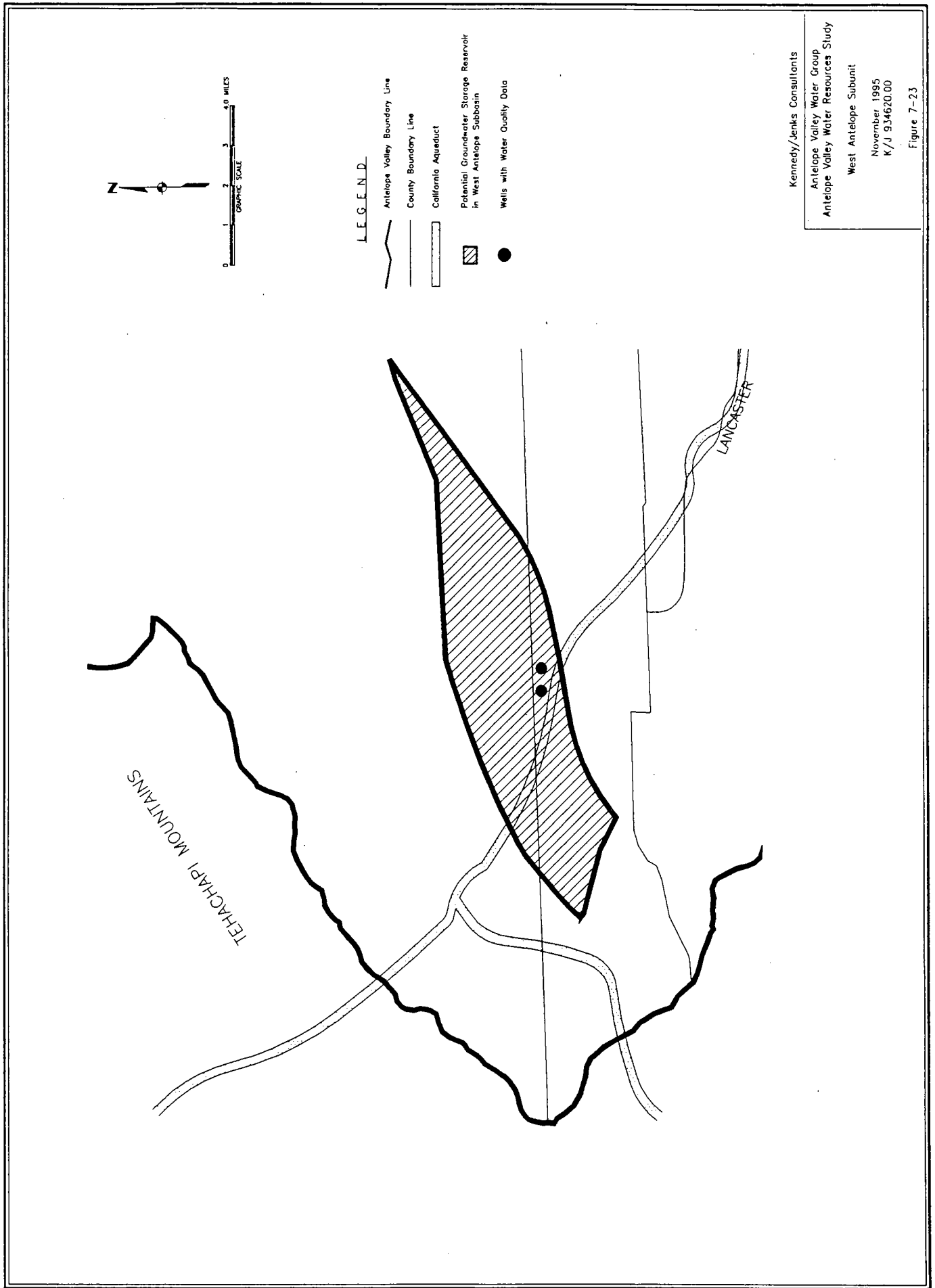
Antelope Valley Water Group
Antelope Valley Water Resource Study

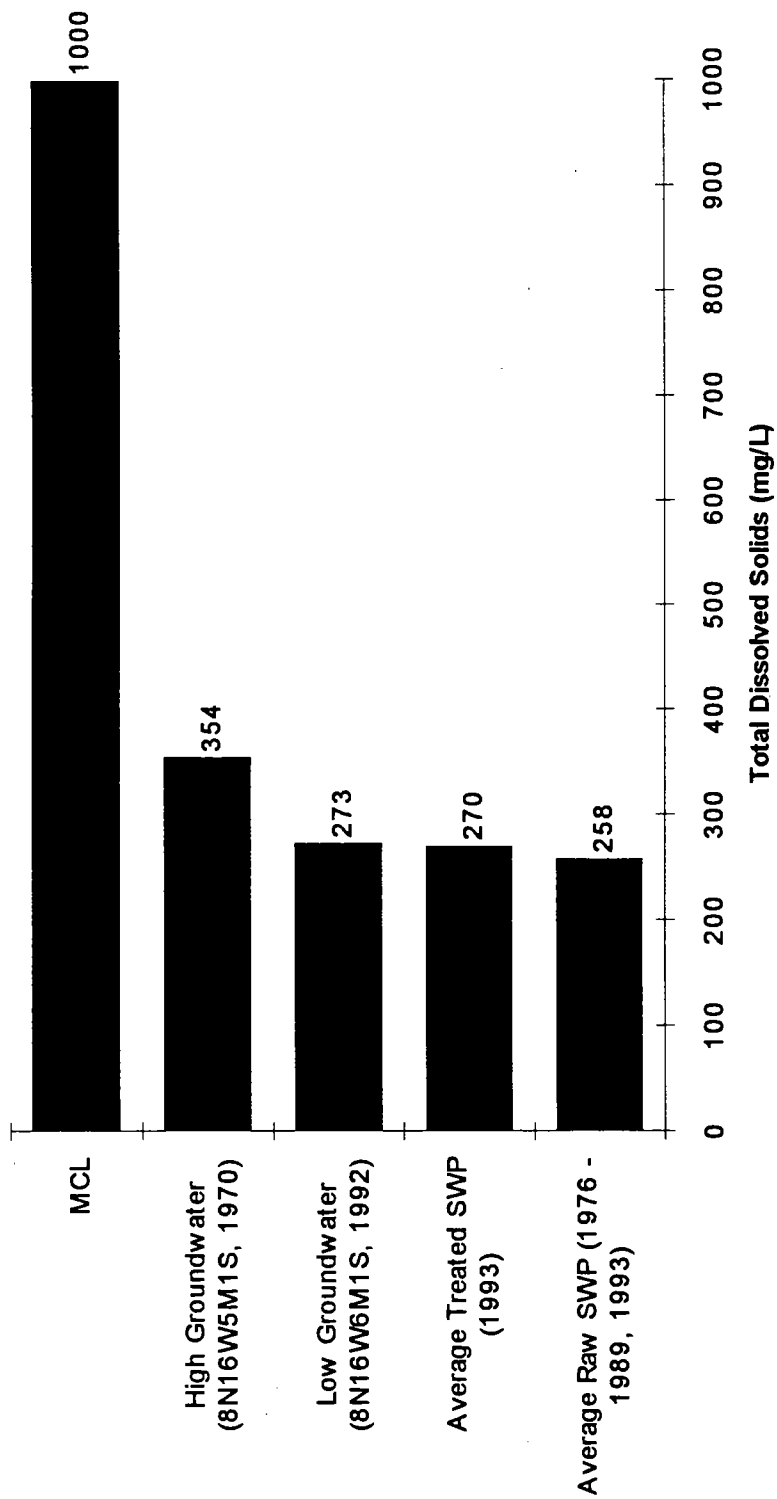
Water Quality Near Amargosa Creek
Gravel Deposits

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Figure 7-22





Note: Groundwater samples at 2 wells collected in 1965, 1970 - 1972, and 1992

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Water Quality in West Antelope Subunit

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Figure 7-24

TABLE 7-8

WELL SUMMARY NEAR WEST ANTELOPE Sub-unit

<i>Well Number</i>	<i>Length of Water Quality Data Collected</i>	<i>Well Owner</i>	<i>Approximate distance from proposed recharge site (miles)</i>
8N16W5M1S	1967, 1970 - 1972	unknown	< 1
8N16W6M1S	1992	unknown	< 1

This site, however, is far from the majority of the existing water users and has no distribution system that would connect to the users. This site may be best operated as a storage facility which would be served by a new turnout from the California Aqueduct that leads to either spreading grounds or injection/extraction wells. When the water is needed, the extraction wells could pump into the California Aqueduct to convey the water to the potential use areas. The economic viability of this type of operating scenario would have to be explored in detail and is closely tied to the availability and reliability of the SWP waters.

FEASIBILITY OF INFILTRATION

Based on the information presented above, infiltration as a mechanism to recharge groundwater appears to be technically feasible. There are good potential recharge areas available in several locations. 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 (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.

In addition, the potential formation of wetlands at the USAF Plant 42 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 SITES

Characteristics important to a potential injection site were discussed previously. In addition, selection of potential injection sites for this study were also based on their location relative to existing groundwater depressions. The following section discusses issues associated with injection and describes potential injection areas.

Issues Associated With Injection

Some of the technical issues associated with injection into groundwater basins restrict the types of water that can be used for injection. For example, the water needs to be free of suspended matter/bacteria which could clog screens. In addition, injecting untreated SWP water may fall under the area of groundwater under the direct influence of surface water, and therefore may become subject to the Surface Water Treatment Rule (SWTR). The SWTR would require additional treatment of the water for potable uses. Additional treatment would reduce the cost-effectiveness of an injection program. For these reasons, it is recommended that only treated water be injected. Another issue that has been raised is that treated SWP that has been disinfected with chlorine, can be subject to trihalomethane (THM) formation in excess of the MCL. At present, it appears that the concentration of THMs in the groundwater is usually low. Therefore, the injection of treated SWP water could result in groundwater degradation. Treated SWP water may require alternative disinfection methods that would reduce or eliminate the problem of THM formation.

The issue of injection versus extraction rate will also need to be addressed. Due to the fact that injection rates are 50 to 100% of extraction rates, operational plans to account for the rate of injection, rate of extraction, volume of water available, and period of when the waters are available for injection and extraction will be required. In addition, new ASR facilities can be quite expensive because of the construction of new wells and pumping facilities. However, the relatively high cost for new ASR facilities can be offset by the reduced pumping costs as a result of increased water levels.

Potential Injection Areas

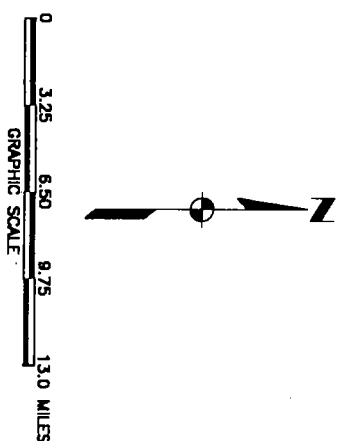
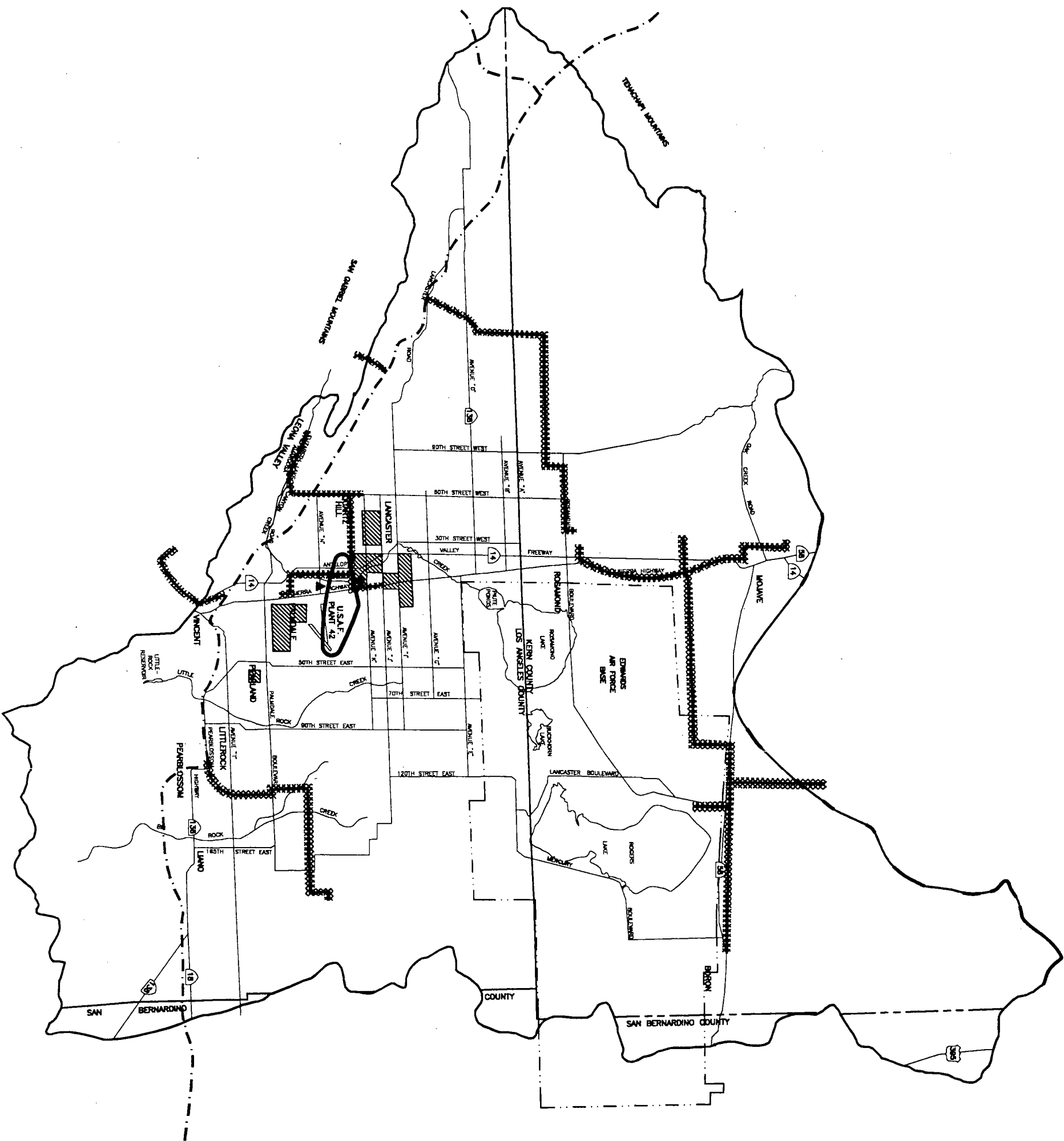
Based on the constraints and criteria described above, the municipal wellfields within the existing LACWW and PWD municipal wellfields were considered potential injection areas. (See Figure 7-25.) Specific areas that have been assessed include:

- USAF Plant 42 Site.
- Wells in USGS/LACWW/AVEK Injection Study.

Injection has not been extensively studied in the Valley. The areas listed above are discussed below.

USAF Plant 42 Site. A study performed in 1991 by the Los Angeles County Department of Public Works (LACDPW) evaluated the water recharge potential of the USAF Plant 42 site (LACDPW-MED, 1991). The site is bounded by 10th Street West, Avenue N and Division Street. The study, which included percolation, permeability and pumping tests, concluded that injection into the saturated zone at a depth of 460 to 600 feet appeared feasible from a geological point of view. According to the study, the acceptance rate of injected water into the saturated zone was approximately 70 percent of the pumping extraction rate. A later study performed by LACDPW (LACDPW-HWCD, 1992) proposed using LACWW District No. 4's production well No. 8 as a test injection well (See USGS/LACWW/AVEK Injection Study below). If the test results are favorable, LACWW District's wells No. 13, 33 and 42 would be converted to ASR wells. In addition, the report noted that new ASR wells could be constructed at the USAF Plant 42 site if additional water were available for recharge.

USGS/LACWW/AVEK Injection Study. The USGS, LACWW, and AVEK participated jointly in an injection study. The purpose of the study was to determine field-scale estimates of multi-aquifer and well hydraulic parameters governing the storage and movement of groundwater near the wells. These parameters included injection rates, storage coefficients, transmissivities, and a general assessment of aquifer responses to the injection. The field portion of the study was completed around June 1, 1994 and preliminary results are expected in August 1994. Discussion with USGS staff indicates that unexpected changes to land surface occurred during the injection program and that complete results would be available within two months (USGS, 1994b). The USGS/LACWW/AVEK study did not include a water quality component. However, water quality analyses of the injected, native and recovered water of the injection test were conducted by LACWW.



LEGEND

- Antelope Valley Boundary Line
- County Boundary Line
- Edwards Air Force Base Boundary Line
- California Aqueduct
- AVEK Distribution
- Existing Wellfields
- USGS Injection Study (1994)
- LACDPW Injection Site (1991)
- Groundwater Depression

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Antelope Valley
Potential Injection Areas
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Figure 7-25

Although there are many wells in the area, the readily available water quality information was relatively limited. The wells that were evaluated in the vicinity of the potential injection sites are summarized in Table 7-9. The water quality data that were available indicate that the TDS levels in the groundwater are generally lower than the SWP or reclaimed water as shown on Figure 7-26. The available data are insufficient to assess the overall impacts to groundwater quality of the recharge of SWP or reclaimed waters to these areas. Well construction data and water quality samples from the wells should be collected and analyzed to assess the present day condition of the water quality in the aquifers. In addition, other data such as percolation tests and exploratory borings with pump test and geophysical logging may be required.

FEASIBILITY OF INJECTION

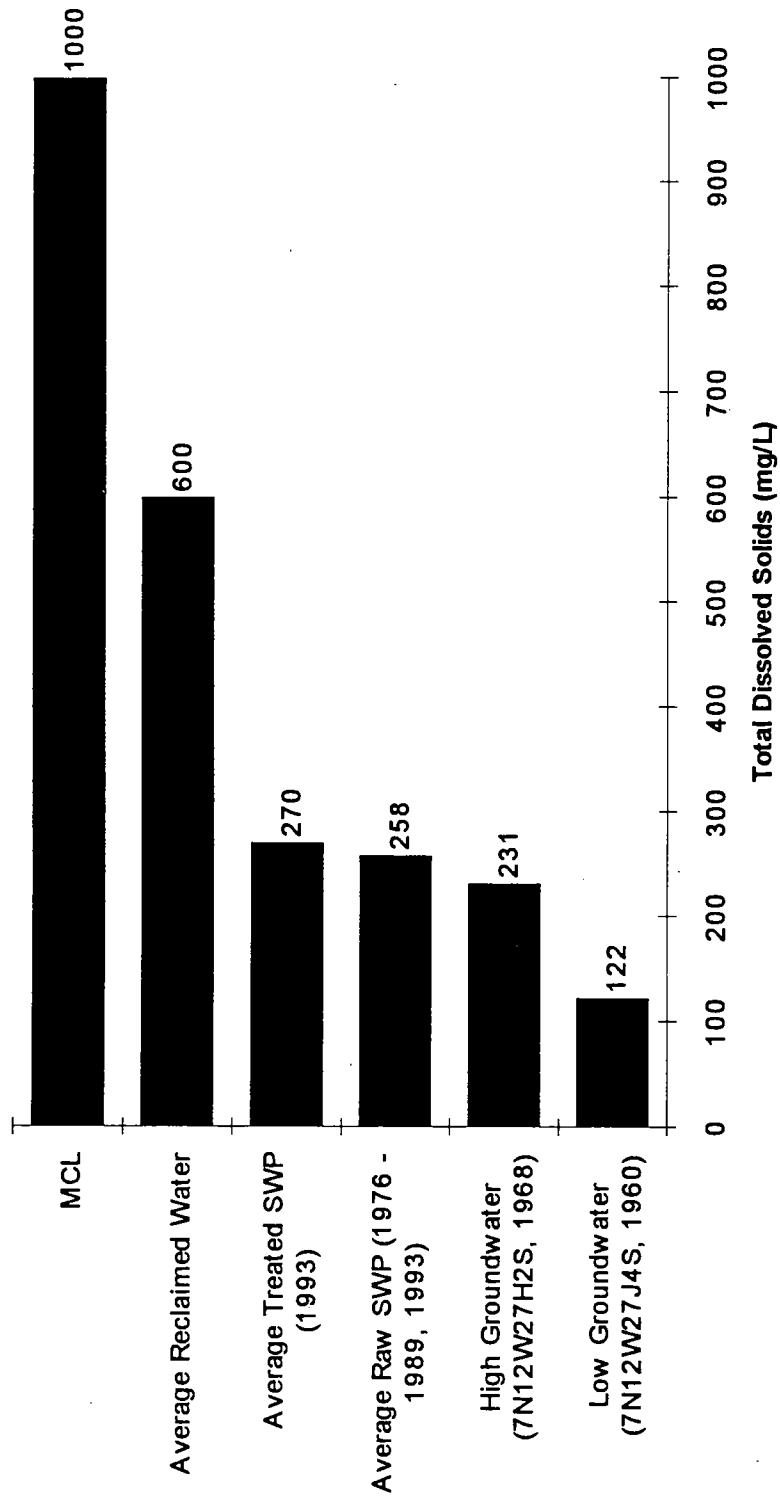
Based on the information presented above, groundwater recharge by injection appears to be technically feasible. The existing wellfields could provide both the injection and extraction facilities necessary to conduct such a program. The specific areas that should be explored further because of their proximity 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.

TABLE 7-9

WELL SUMMARY NEAR POTENTIAL INJECTION SITES

<i>Well Number</i>	<i>Length of Water Quality Data Collected</i>	<i>Well Owner</i>	<i>Approximate distance from proposed recharge site (miles)</i>
7N12W27H2S	1960, 1961, 1964 - 1970, 1992	LACWW	< 1
7N12W27J4S	1957 - 1970	LACWW	< 1
7N12W27J5S	1953, 1960 - 1970	LACWW	< 1



Note: Groundwater samples at 3 wells collected from 1957, 1960, 1964, 1964 - 1970, 1992

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Water Quality Near Amargosa Creek
Potential Injection Sites

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Figure 7-26

It appears that treated SWP water should be generally acceptable for injection from a water quality perspective. The presence of 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 RWQCB-LH's non-degradation policy for water quality, injection of treated SWP 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.

It is noted that an ASR test was completed in 1992 for the North Las Posas Basin as part of a cooperative study agreement between Calleguas Municipal Water District and Metropolitan Water District of Southern California. Potable treated surface water from the SWP was injected into the groundwater basin through an ASR well, stored for a short time, and then extracted. Findings of the ASR demonstration project included 1) an injection rate of up to 620 gpm was achieved, 2) the groundwater basin was capable of a significant amount of recharge by injection wells, 3) the groundwater in storage and the injected water were compatible, and 4) the quality of the recovered water met all federal and state drinking water standards.

CHAPTER 8

EFFECTS OF CHANGES IN GROUNDWATER LEVELS

This chapter discusses the effects of changes in groundwater levels in the Antelope Valley. A brief introduction as well as discussions on potential damages attributable to changes in groundwater levels, land subsidence in California, and changes in groundwater levels in the Antelope Valley are presented.

INTRODUCTION

According to the United States Geological Survey (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 Antelope Valley-East Kern Water Agency (AVEK) and in cooperation with the USGS, indicate groundwater levels in portions of the Valley have risen in recent years. Appendix E presents figures from a recent USGS report showing the potentiometric head (representative of groundwater levels) in the Antelope Valley from 1957 through 1992. As shown in the USGS figures, groundwater levels generally declined from 1957 to 1975. However, between 1975 and 1981, groundwater levels in the eastern portion of the valley changed only slightly, in the central portion declined, and in the western portion increased. From 1981 to 1992, groundwater levels in the Valley generally increased although they continued to decline in the Lancaster area. An August 1994 report entitled "Hydrogeologic Assessment of Palmdale Business Park Center, Antelope Valley, Los Angeles County, California" by Richard C. Slade & Associates indicates that although groundwater levels are declining in the Lancaster area, the rate of decline has decreased since 1977. Hydrographs collected for 18 wells near the report project showed groundwater levels rising in about half of the wells. The remaining wells still indicated declining levels but at a slower rate of decline.

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. These potential damages are discussed in the following section.

POTENTIAL DAMAGES ATTRIBUTABLE TO CHANGES IN GROUNDWATER LEVELS

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 8-1 lists potential damages attributable to changes in groundwater levels.

TABLE 8-1

POTENTIAL DAMAGES ATTRIBUTABLE TO CHANGES IN GROUNDWATER LEVELS

<i>Declining Groundwater Levels</i>	<i>Increasing Groundwater Levels</i>
<p>Land subsidence resulting in the following:</p> <ul style="list-style-type: none"> • 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. <p>Increased pumping costs.</p>	<p>Waterlogging resulting in the following:</p> <ul style="list-style-type: none"> • Increased liquefaction potential. • Structural damage. • Rendering septic systems useless. • Costs associated with repairs and rebuilding. • Reduction in land value. <p>Water quality degradation.</p>

Potential Damages Attributable to Declining Groundwater Levels

As indicated in Table 8-1, declining groundwater levels potentially result in two primary damages: 1) land subsidence and 2) increased pumping costs. These two types of damages are discussed in greater detail below.

Land Subsidence. 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. Poland (1984) lists the following common causes of land subsidence:

- Solution of underlain common soluble components such as salt, gypsum, and limestones where the components are slowly dissolved and the surface sinks.
- Subsurface erosion where subsurface flow tunnels (piping) are developed, transporting grains of silt and sand along a horizontal path to an outlet. Enlargement of the tunnel reduces the support capacity of the surface materials and the ground surface collapses.
- Tectonic activity where slow earth movements and earthquakes cause downward displacement of the land surface.
- Compaction of low-density sedimentary deposits due to loading where settling of construction fill or natural sediment deposits cause surface to subside.
- Compaction of low-density sedimentary deposits due to hydrocompaction where application of water to low density, moisture deficient deposits produce volume loss, creating a rapid "shallow subsidence."
- Compaction of low-density sedimentary deposits due to extraction of fluids such as oil, gas, and water.
- Compaction of low-density sedimentary deposits due to drainage of the water table for mining and/or farming operations where peat deposits are extensive. Peat is a type of soil that contains more than 50 percent organic matter (USGS, 1991). Dewatering shallow peat deposits allows the peat to dry, leading to oxidation and decomposition. In addition, changes in physical and chemical characteristics of peat result in extreme volume reductions.

Regardless of the cause of land subsidence, the resulting damages are similar. (See Table 8-1.) In general, damages will be most pronounced when subsidence gradients (change in subsidence levels over a given distance) are high.

Development of cracks, fissures, sinklike depressions and softspots are indications on the ground surface of subsidence and can result in damages to existing structures, decreases in land values, changes in drainage patterns, and degradation of groundwater quality. Cracks are narrow openings less than 0.1 feet wide, fissures are large cracks as long as 9 miles, sinklike depressions are localized holes and depressions with underground voids enlarged as a result of vertical and lateral movement of water (often called piping), and softspots are areas or spots that have lost load-bearing capacity (USGS, 1992).

Changes in drainage patterns are caused by formation of cracks, fissures, and sinklike depressions, as well as changes in the ground surface slope. These changes can result in new areas vulnerable to flooding or an increase in existing areas vulnerable to flooding, as well as an increase or change in erosion.

Degradation of groundwater quality may result from formation of fissures. Fissures may extend to the water table, providing a direct conduit between the ground surface and the groundwater table (USGS, 1992). Contamination of groundwater could occur through transport of stormwater directly to the groundwater basin. Stormwater runoff contains various contaminants such as petroleum products, metals, salts, silts, fertilizers, and bacterial contaminants from human and animal sources. Common constituents found in storm water runoff are listed below:

- Total Suspended Solids
- Biochemical Oxygen Demand
- Chemical Oxygen Demand
- Total Phosphorus
- Soluble Phosphorus
- Total Kjeldahl Nitrogen
- Nitrate - Nitrogen
- Total Copper
- Total Lead
- Total Zinc

Reduction in groundwater storage may result from compaction of de-watered, low-density, sedimentary deposits.

In addition to changes in the physical properties of the land or groundwater, land subsidence can cause damages to man-made structures and can result in a cost to agencies or individuals.

Differential amounts of subsidence can result in changes in the gradient of gravity pipelines (sewer and storm sewer) and canals. Changing the gradient of these facilities can reduce their capacities and may require modifications to existing pumping stations or construction of new ones.

Damage to well casings, pipelines, buildings, roads, railroads, bridges, levees, and other structures may result from compaction of low-density, sedimentary deposits; formation of cracks, fissures, sinklike depressions, and softspots; and changes in the ground surface and subsurface slopes and elevations. Well casing collapses in subsidence areas are generally considered to be a result of changes in pressure exerted on the casing due to compaction of low-density sedimentary deposits. In addition, well pads protruding above the ground surface may result from formation of sinklike depressions or lowering of ground surface elevations. Separation or cracking of structures, such as pipelines, building walls and foundations, roads, railroads, bridges, and levees, may result due to formation of cracks, fissures and sinklike depressions, as well as changes in ground surface and subsurface slopes. The structural integrity of foundations may be damaged as a result of softspots.

Depending on the extent of damages to facilities, there will be costs associated with repair, replacement, or construction of required new facilities. In addition, reductions in land value may occur primarily as a result of development of cracks, fissures, sinklike depressions, and softspots. Depending upon the degree of ground surface damage, the land may be rendered virtually useless for development. Lawsuits may be filed against agencies thought to be responsible for the subsidence by property owners experiencing damaged structures or reduced land values.

Although subsidence is generally associated with decreasing groundwater levels, there may also be subsidence due to increasing groundwater levels. This is evident in the case of the groundwater mound north of the City of Lancaster. The mound is located near the terminus of Amargosa Creek and the wastewater treatment ponds near Rosamond Lake. According to USGS, rates of subsidence from 1975 to 1981 were higher near the mound than in surrounding areas. USGS's hypothesis for this observation is as follows:

"If wastewater effluent discharged to ponds and water from other recharge sources are perched on fine-grained sediment layers, that water is not hydraulically connected to the water table. In this case, the perched water would cause an increase in geostatic stress without a corresponding increase in pore pressure and thus would result in increased effective stress and compaction in both the principal and deep aquifers...If the ground-water-level contours represent a water-table mound in the principal aquifer and not perched water, the pore spaces would be saturated, and the higher pore pressure probably would counteract the increased geostatic stress resulting from loading by the ground-water-mound. However, because the hydraulic connection between the deep aquifer and the water table (principal aquifer) is impeded by a confining bed of low permeability, compaction would occur at depth as a result of increased effective stress caused by the disparity between the increased geostatic stress and the negligible increase in pore pressure in the deep aquifer. Thus compaction would result..."

Increased Pumping Costs. 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

Potential damages attributable to increasing groundwater levels include waterlogging and water quality degradation. (See Table 8-1.) These potential damages are discussed below.

Waterlogging. 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.

Increased liquefaction potential results when the water table is high in a loosely compacted, granular soil. Liquefaction is the sudden drop in bearing capacity in soils of saturated non-cohesive particles, such as sand, during ground movement (i.e., seismic events). The soil essentially turns into a liquid allowing structures previously supported by the soil to sink. Proximity to faults is an important consideration when evaluating the potential for liquefaction to occur.

Structural damage due to waterlogging may result in "floating" of foundations or other structures or differential settlement upon dewatering of waterlogged soils. Floating occurs when structures have greater buoyancy than weight and upward forces are greater than downward forces. Floating is most likely to occur with granular soils. Differential settlement will most likely occur with dewatering of low-density soils which will result in compaction.

Septic systems may become useless with waterlogging because saturated soils will not allow infiltration of liquid from septic system leach fields.

Depending on the extent of damages to facilities, there will be costs associated with repair or replacement of facilities. In addition, reductions in land values may occur. Depending upon the degree of waterlogging, the land may be rendered virtually useless for development.

Water Quality Degradation. 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. Nitrate nitrogen is the most highly oxidized form of nitrogen found in wastewater. 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. In blue baby syndrome, nitrates interfere with the blood's ability to distribute oxygen to the tissues. Also, nitrates can cause cancer by reaction to certain foods and water.

LAND SUBSIDENCE IN CALIFORNIA

Because noticeable land subsidence has occurred in the Antelope Valley in the last 40 years, a survey of land subsidence in California was conducted to indicate the potential degree of subsidence and the damages associated with subsidence.

According to Poland (1984), California has the largest area of subsidence in the United States (nearly 6,000 square miles). In addition, the three areas in the United States with the most severe problems are 1) the Houston-Galveston area in Texas, 2) the San Joaquin Valley in California, and 3) the Santa Clara Valley in California. Figure 8-1 depicts areas in California identified to have had or currently have land subsidence problems. Land subsidence in these areas has been attributed to extraction of groundwater or petroleum or, in some cases, has not yet been tied to either. Table 8-2 lists the subsidence areas in California along with the maximum subsidence, area of subsidence, time of principal occurrence and problems/damages within those areas. Brief discussions on the two principal areas which have had the greatest levels of subsidence due to groundwater withdrawal are included below. Information was primarily obtained from Poland's 1984 Guidebook.

Santa Clara Valley

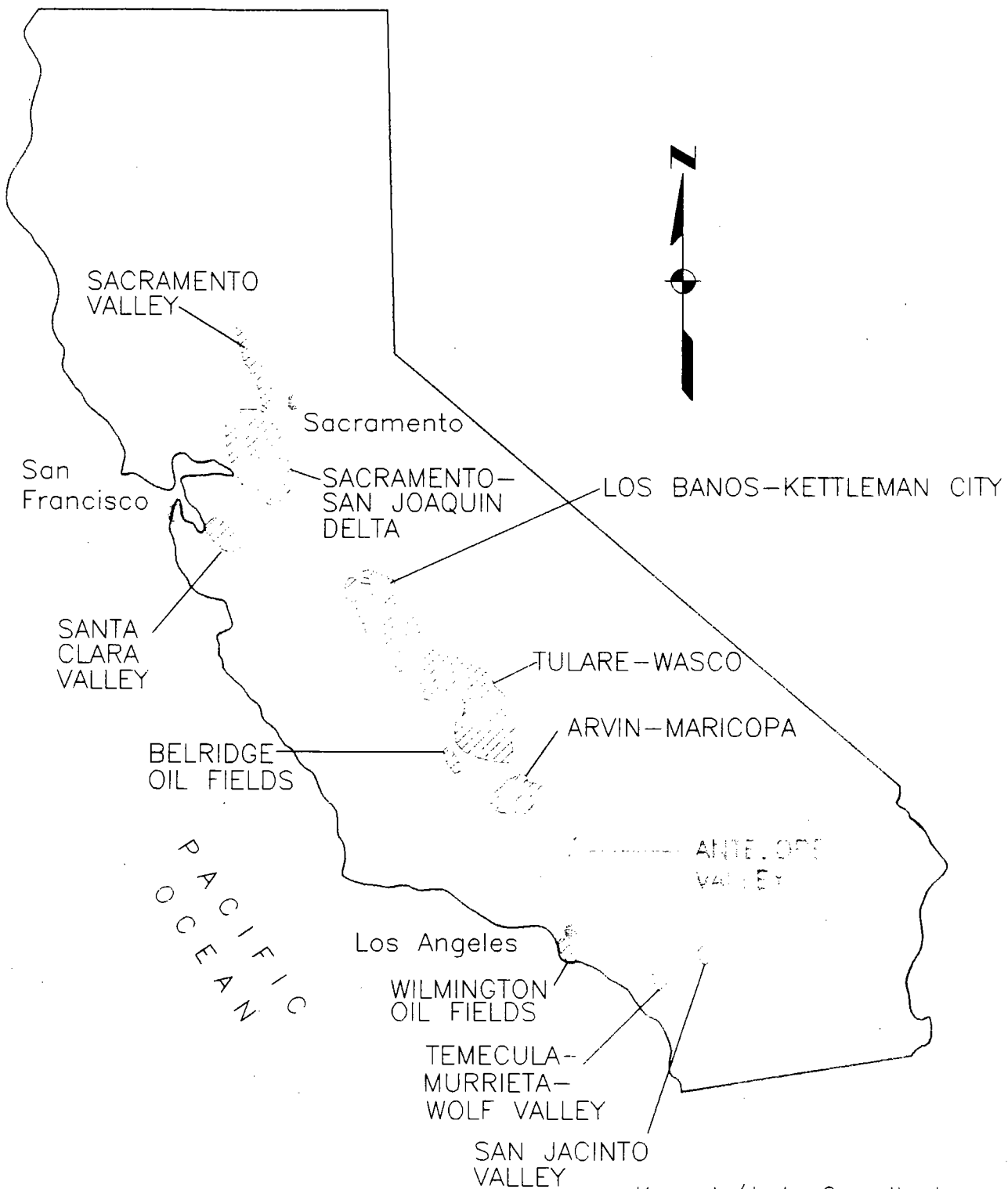
Land subsidence in the Santa Clara Valley was first noted in 1933. By 1969 the central part of the City of San Jose had subsided approximately 13 feet. The land subsidence was in response to a major decline in artesian head of the underlying groundwater basin. Groundwater pumping peaked in the early to mid-1960s, reaching nearly 200,000 acre-feet per year. By 1966, the artesian head in one well was approximately 180 feet below land surface compared to 12 feet above land surface in 1916. Recovery of artesian head in 1970-75 was due to increase in surface water imports, favorable rainfall supply, and decreased pumping of groundwater.

Partial estimates of the costs attributed to subsidence in the Santa Clara Valley indicate total costs were in excess of \$35 million.

San Joaquin Valley

By 1966, yearly extraction of groundwater for irrigation in the San Joaquin Valley reached nearly 10 million acre-feet per year. This excessive withdrawal created an overdraft of approximately 4 million acre-feet per year in the 1950s and early 1960s. The potentiometric surface in some areas was drawn down nearly 600 feet. Importation of surface water resulted in groundwater withdrawal decrease, and, by the early 1970s, hundred of wells were unused, artesian heads were recovering, and subsidence was sharply reduced.

Partial estimates of the costs attributed to subsidence in the San Joaquin Valley indicate total costs were in excess of \$50 million.



LEGEND

Approximate Areas of Subsidence

Note: Subsidence areas shown are those potentially related to extraction of underground fluids.

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Areas of Land Subsidence
in California

November 1995
K/J 934620.00

Figure 8-1

PWS-0200-0241

TABLE 8-2

AREAS OF LAND SUBSIDENCE
IN CALIFORNIA (1)

<i>Location</i>	<i>Maximum Subsidence (ft)</i>	<i>Area of Subsidence (mi²)</i>	<i>Time of Principal Occurrence</i>	<i>Problems/Damages</i>
Antelope Valley	6.6	463	1955-78 +	Collapsed well casings. Structural damages to buildings. Increase in areas subject to flooding. Development of fissures, cracks, and sinkholes, some of which affect the lakebed runway at Edwards Air Force Base.
Sacramento Valley	2.3	193	1955-78 +	NA
Sacramento-San Joaquin Delta	21	NA	NA	Increased maintenance required on joints and foundations of the Mokelumne Aqueduct. Potential additional pumping requirements for transport of water enroute to central and southern California (due to changed aqueduct slopes). Increased agricultural drainage requirements to maintain sufficient unsaturated zone below land surface for crop production. Increased potential for levee failures and flooding.
Santa Clara Valley	13.5	251	1918-70	Failure of hundreds of irrigation wells. Damage to railroads, roads, bridges, storm and sanitary sewers. Required construction of a new pumping station at a regional sewage treatment plant. Reduction in value of 17 square miles of land which previously stood above sea level. Required construction of new levees and repeated raising of levees to restrain landward movement of bay waters. Required raising of roads and railroads to stay above flood waters.

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TABLE 8-2
AREAS OF LAND SUBSIDENCE
IN CALIFORNIA (1)
(Continued)

<i>Location</i>	<i>Maximum Subsidence (ft)</i>	<i>Area of Subsidence (mi²)</i>	<i>Time of Principal Occurrence</i>	<i>Problems/Damages</i>
San Joaquin Valley Los Banos- Kettleman City Tulare-Wasco Arvin-Maricopa	29.5 14.1 9.2	2,394 1,421 695	1930-75 1930-70 1940-70	Repairs and remedial work of water transport structures (i.e. Delta-Mendota Canal and Friant-Kern Canal). Gradient changes in the San Joaquin river which affected the transport characteristics of the river and altered levee requirements. Failure of hundreds of irrigation wells.
San Jacinto Valley	3.2	4 +	1950-75 +	Collapsed well casings. Collapsed piping at wells protruding above the ground. Flooding. Aggravation and leaking of MWD's Casa Loma Siphon, leading to replacement with flexible joint piping in the 1970's. Damage to MWD's San Diego pipeline at the San Jacinto Reservoir. Increased repairs and rebuilding of roads. Cracking of sewer pip

TABLE 8-2
AREAS OF LAND SUBSIDENCE
IN CALIFORNIA (1)
(Continued)

<i>Location</i>	<i>Maximum Subsidence (ft)</i>	<i>Area of Subsidence (mi²)</i>	<i>Time of Principal Occurrence</i>	<i>Problems/Damages</i>
Temecula-Murrieta- Wolf Valley	NA	15	1987 +	Severe structural damage to residential and business park areas, requiring abandonment and/or major repairs. Lawsuits alleging over \$25 million in damages filed against the developers, County of Riverside, local water district, and several geological and soils engineering consulting firms. Slower rate of appreciation for residential land value.
Belridge Oil Fields	3-5	3	1986-89	Damage to oil production well equipment.

NA = Data not available at this time.

MWD = Metropolitan Water District of Southern California.

ft = feet.

mi² = square miles.

(1) = Subsidence areas described are those potentially related to extraction of underground fluids.

CHANGES IN GROUNDWATER LEVELS IN ANTELOPE VALLEY

The Antelope Valley has experienced declining and increasing groundwater levels. Damages attributable to declining groundwater levels have been identified within the study area; and damages attributable to increasing groundwater levels have been identified. Studies conducted related to both declining and increasing groundwater levels are described below.

Declining Groundwater Levels

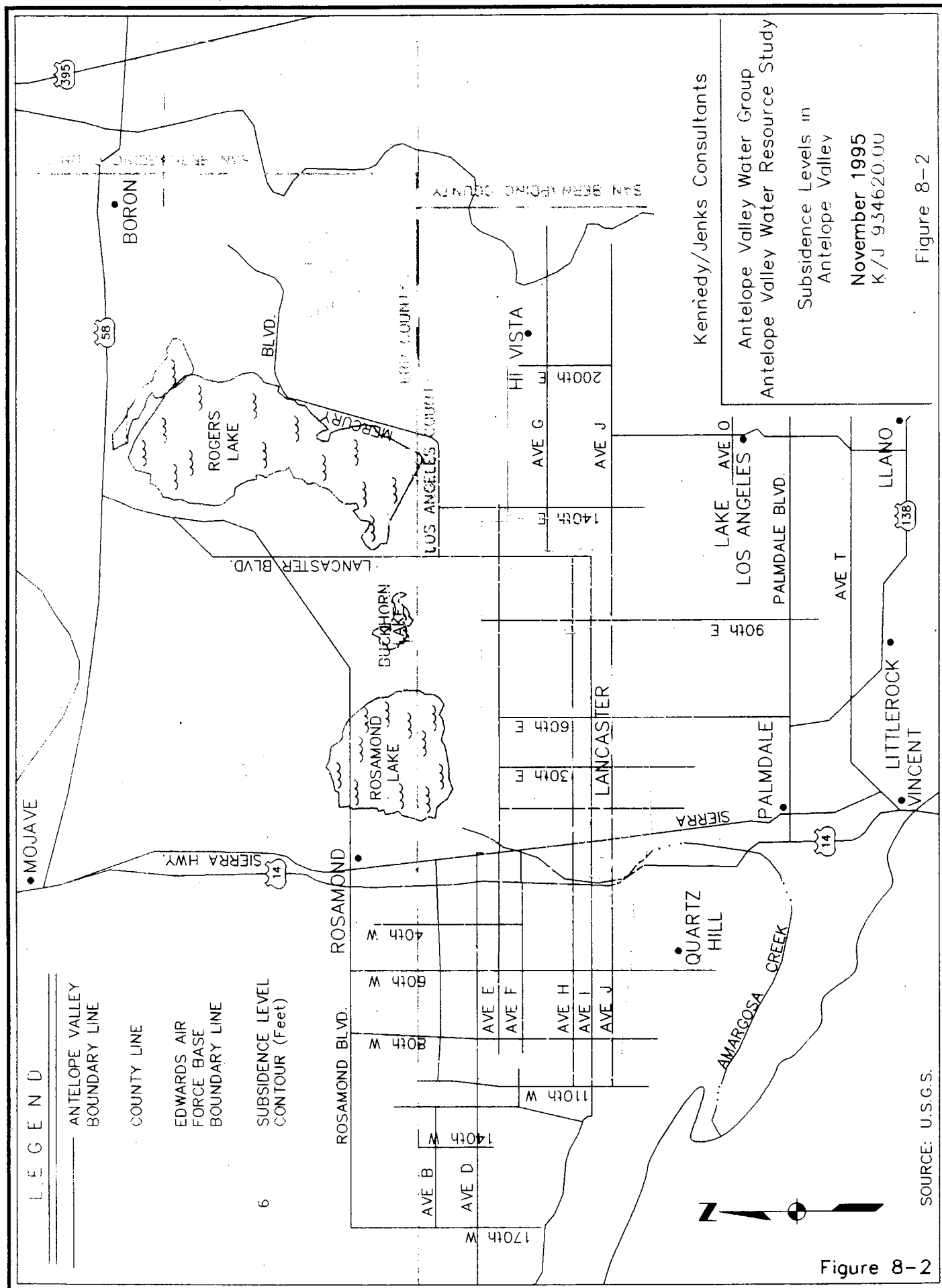
Groundwater use in the Antelope Valley was at its highest in the 1950s and 1960s as a result of agricultural demands (USGS, 1994a). According to USGS, land subsidence in Antelope Valley was first reported by Lewis and Miller in the 1950s (USGS, 1992). Since then, studies have shown subsidence levels of up to 7 feet occurring in some areas of Antelope Valley. (See Figure 8-2.) Conversations held with various agencies and companies indicate that within the Antelope Valley, the Lancaster and Edwards Air Force Base (AFB) areas are currently experiencing problems or damages that appear to be related to land subsidence. (See Figure 8-3 for locations of areas.) Table 8-3 lists land subsidence problems identified in Antelope Valley.

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

USGS Report 92-4035. 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. Appendix F provides pictures of various problems Edwards AFB is currently experiencing. In addition, depressions, fissures and cracks on the lakebed may not be detected until aircraft or space shuttles exceed the load capacity of the soil. Another concern was potential contamination of the water table through fissures which can provide direct access for toxic materials.

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

USGS Report 93-4114. USGS (1993b), reported that land subsidence effects had been noted on Rogers Lake in the form of depressions, fissures and cracks. The report identified pumping of groundwater as the cause of the land subsidence. As much as 90 feet of groundwater level decline has occurred in the South Base well field, and an average annual compaction rate of 5.57×10^{-2} feet was measured at the Holly site near the South Track well field. (See Location 3 on Figure 8-3.)



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Subsidence Levels in
Antelope Valley

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Figure 8-2

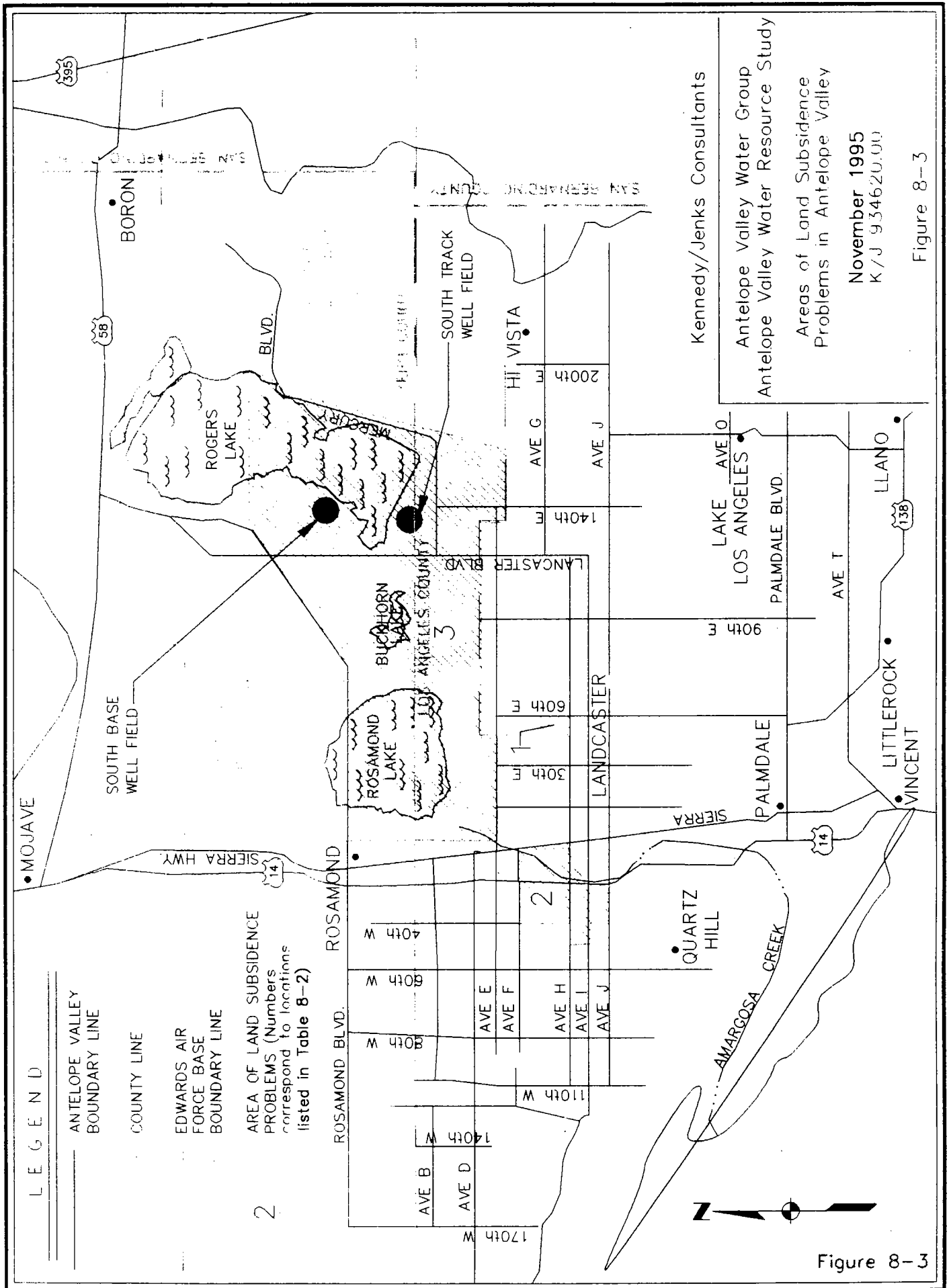


Figure 8-3

Figure 8-3

TABLE 8-3
LAND SUBSIDENCE PROBLEMS IDENTIFIED
IN ANTELOPE VALLEY

<i>Location</i>	<i>Description</i>	<i>Maximum Subsidence (ft)</i>	<i>Problems/Damages/Concerns</i>
1	Area bounded by 50th and 60th Streets east and Avenues G and H (T7N-R11W-S3)	3-4	Development of cracks and fissures.
2	Northwest portion of City of Lancaster	4-5	<p>Development of cracks, fissures and sinkholes in the following areas (Geolabs, 1991):</p> <p>In the vicinity of KAVL and KBVM radio towers</p> <p>Near the proposed site for High Desert Hospital complex</p> <p>East of a residential project at the southeast corner of 30th St. West and Ave. "I"</p> <p>In the vicinity of LA County Detention Facility south of Ave. "I"</p> <p>The "H" Street Bridge over Amargosa Creek where up to 4" of lateral separation is present across the central expansion joint ⁽¹⁾.</p>

TABLE 8-3
LAND SUBSIDENCE PROBLEMS IDENTIFIED
IN ANTELOPE VALLEY
(Continued)

<i>Location</i>	<i>Description</i>	<i>Maximum Subsidence (ft)</i>	<i>Problems/Damages/Concerns</i>
3	Edwards Air Force Base	3.3	<p>Failure of several well casings.</p> <p>Increase in area subject to flooding.</p> <p>Structural damage to wastewater treatment plant building.</p> <p>Wells protruding above the ground.</p> <p>Development of cracks, fissures, sinkholes and softspots on Rogers Lakebed, affecting use of the lakebed as a runway for planes and space shuttles.</p>

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

USGS Report 93-148. USGS (1993a) was completed as part of USGS's study to determine the relation between groundwater withdrawals and land subsidence at Edwards AFB (Report 4114). The report is a compilation of drilling, construction, and subsurface data collected during the installation of 40 piezometers at 13 sites on the base in 1991 and 1992.

USGS 1994 Draft Report. USGS (1994) revealed that land subsidence throughout Antelope Valley has reached nearly 7 feet. As shown on Figure 8-2, USGS indicated that subsidence levels of 6.6 feet have occurred near Avenue I and Division Street, and Avenue H and 90th Street East. The draft report stated that there was a general correlation between groundwater level declines and the distribution and rate of subsidence. In addition, the report estimated a conservative loss of approximately 50,000 acre-feet of storage in the groundwater sub-unit in the area that has been affected by 1 foot or more of land subsidence.

Holzer and Clark, January 1981. 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. (See Location 1 on Figure 8-3.) The paper identified the owner of the property who stated that fissures became evident in early 1978 near Little Rock Creek. Upon flooding from the Little Rock Creek in 1980, the fissures further appeared. The owner had occupied the property since 1928 and stated that neither irrigation nor floods in 1938 or 1969 had caused any fissures to appear. The paper hypothesized that the crack was caused by differential subsidence related to groundwater withdrawal.

Geolabs, February 1991. A study done by Geolabs - Westlake Village (1991) studied a 10 square mile area in Lancaster identified to have fissures and sinklike depressions. (See Location 2 on Figure 8-3). 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. Appendix F provides pictures of the fissures. The report concluded that the fissures were due to tensional forces created by subsidence, which may be related to groundwater withdrawal due to the correlation between areas of significant subsidence and areas of pronounced groundwater level decline. Areas of concern identified in the report are included in Table 8-3.

Current Study. In addition to reviewing the reports summarized above, as a part of this study, companies and agencies within the Antelope Valley were surveyed regarding potential damages attributable to groundwater level declines and field visits of affected areas were conducted. Companies and agencies surveyed include the following:

- Antelope Valley-East Kern Water Agency
- CALNEV Pipelines
- City of Lancaster, Redevelopment Center
- City of Lancaster, Road Maintenance Department
- City of Palmdale, Engineering Department
- City of Palmdale, Road Maintenance Department
- County Sanitation Districts of Los Angeles County
- Edwards AFB
- Kern County Flood Plain Management Section
- Los Angeles County Waterworks District, Sewer Department
- Rosamond Community Services District
- Southern California Gas Company
- Southern Pacific Railroad
- State Fire Marshall, Pipeline Safety Division

Other than those damages identified in the reports summarized above, structural damage to the wastewater treatment plant building on Edwards AFB was the only other potentially significant damage identified and may or may not be attributable to land subsidence. Other minor existing damages that may or may not be attributable to groundwater level declines include cracked sidewalks and pavement.

To assess existing and potential degradation to the groundwater supply, an attempt was made to correlate typical stormwater runoff constituents and similar constituents in the groundwater supply. The hypothesis was that areas of fissuring should show higher degrees of contamination if runoff was reaching the aquifers through the fissures.

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

In addition to subsidence-related problems, groundwater level declines of up to 200 feet in the Valley have resulted in increased pumping costs. USGS (1994) cites the increased pumping costs as the primary reason for a decline in agricultural production during the 1970s. The Los Angeles County Waterworks believes that attractive land prices along with increased pumping costs have also contributed to the decline in agricultural production.

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

Increasing Groundwater Levels

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. (Note that although the Leona Valley does not overlie the Antelope Valley groundwater basin, precipitation contributes to the groundwater basin through the Amargosa Creek. Therefore, the Leona Valley is hydrologically connected to the groundwater basin and is considered a part of the Antelope Valley).

Following the winter rains of 1992/93, springs began to appear in Leona Valley. Some springs appeared in locations where springs existed prior to the recent drought. In other cases, springs appeared in locations for which there was no record of prior springs. The cause of the springs has not been determined, although residents speculated the cause was movement of the north branch of the San Andreas Fault, which extends through Leona Valley; the USGS speculated the cause was increased groundwater recharge from the heavy winter rains. Chemical analyses of the spring water was performed by USGS in order to determine if the water was recharge water or deep water forced to the surface by fault movements. Water exposed to the atmosphere since 1941 (recharge water) would contain tritium, a by-product of nuclear weapons testing. According to discussions with USGS (USGS, 1994b), results of the chemical analysis indicate the spring water is not deep water forced up by the faults. USGS attempted to obtain funding to further study the springs but was unsuccessful. However, County of Los Angeles took aerial photos and infrared to locate the springs.

Regardless of the cause of the increasing groundwater levels in Leona Valley, the apparent damages appear to be typical and include waterlogging and water quality degradation. (See Table 8-1.) Springs surfaced under at least two homes and water from springs threatened the structural integrity of a barn. Coincident to the appearance of the springs, high nitrate levels were discovered in the primary well used by the Antelope Valley Water Company to serve Leona Valley. A representative of the Department of Health Services indicated nitrates in groundwater supplies usually increase as the water table rises.

To assess impacts on groundwater quality due to rising groundwater levels in other areas of the Valley, an attempt to correlate rising nitrate problems and rising groundwater levels was made. Hydrographs maintained by the Antelope Valley - East Kern Water Agency (AVEK) for wells in the Antelope Valley were reviewed to

locate wells with rising groundwater levels. Water quality information maintained by AVEK were also reviewed. Historical trends in nitrate levels of the wells were reviewed to find correlations. Based on the investigation, it was discovered that most wells were not tested for nitrates and, for the wells that were, not enough data were available to determine whether or not there was a correlation. Therefore, it is currently unknown whether nitrate problems due to rising groundwater levels are occurring in the Valley.

If groundwater levels should continue to rise (especially in areas of farmland), groundwater quality should be closely monitored. Individual water purveyors servicing the areas where groundwater levels are rising may test for nitrates, from which data may be obtained.

CHAPTER 9

WATER RESOURCE PROTECTION PLAN

The previous chapters of this report evaluate the existing water resources of the Antelope Valley as well as the need to develop additional water resources or implement additional water management techniques. This chapter integrates these evaluations into a water resource protection plan so that a consensus approach to providing an acceptable level of water resource reliability for the Antelope Valley can be developed. A description of recommended monitoring programs is also presented.

CONCLUSIONS OF PREVIOUS CHAPTERS

Based on the evaluations presented in previous chapters, the following general conclusions and observations are summarized:

1. The Antelope Valley encompasses approximately 2,400 square miles. The area has an arid environment and precipitation varies widely.
2. Since the mid-1980s, the population in the Antelope Valley has grown rapidly. Significant growth is expected to continue in all areas, except Edwards Air Force Base (AFB) and Boron, during the study period (1993 to 2020).
3. As the population increases, corresponding water demands are expected to increase. Increased water demands can be attributed almost exclusively to the expected development of the Valley. Agricultural water demands are expected to decline during the study period. These demands would be expected to decline even further if the areas were not necessary for wastewater disposal purposes.
4. The Valley currently has several available water resources, including groundwater, imported State water, diversions from Little Rock Creek, and reclaimed water. Of these, all are currently being utilized; however, imported State water and reclaimed water are not being utilized at their full capability. Unfortunately, unlike groundwater, the lack of use results in a loss of the water resource. Little Rock Dam is currently being modified and this modification is expected to increase the ability to utilize stormwater diversions from Little Rock Creek.
5. The Antelope Valley Groundwater Basin is divided into twelve subunits and is comprised of two primary aquifers: the principal aquifer and the deep aquifer. The groundwater quality is generally considered excellent. The recharge of the groundwater has been estimated to be 31,200 to 59,100 acre-feet per year.

6. With the exception of the groundwater supply, the available water resources are subject to delivery fluctuations. The reliability of the groundwater supply is generally considered to have a 100 percent delivery reliability when operating within the range of natural recharge. Because of limitations on Delta exports of water as well as fluctuations in hydrologic conditions, there is considerable delivery uncertainty associated with State water deliveries. Similarly, fluctuations in hydrologic conditions and limitations of diversion capabilities affect the delivery reliability of water from Little Rock Creek. Reclaimed water reliability is affected by the uncertainty associated with wastewater generation projections but generally has a 100 percent reliability when reclaimed water use is much lower than wastewater generation.
7. Based on the water supplies currently utilized in the Antelope Valley, without exceeding groundwater extractions of 59,100 acre-feet per year, the probability of meeting the estimated 1993 water demand is approximately 73 percent. This delivery reliability is generally below the objectives of comparable water utilities. Based on the water demand projections derived from population projections, the probability of meeting the projected water demand is expected to decline to zero by the year 2000 (i.e., demand exceeds the total available supplies), unless additional water management programs are implemented.
8. The water purveyors currently compensate for the lack of water supply reliability by groundwater extractions in excess of prior recharge estimates.
9. A review of historical groundwater levels indicates that the transition from agricultural to urban land use causes a decline in groundwater levels but the delivery of State water can offset adverse effects on groundwater levels. The delivery of State water to agricultural areas can result in rising groundwater levels.
10. Full development of the identified water conservation program is estimated to save nearly 500,000 acre-feet of water over the 1994 to 2020 planning period; however, the program would not affect the water demand until the year 1995. Without the water conservation program, the probability of meeting the 1995 water demand is estimated to be approximately 66 percent. With the water conservation program, the probability increases to approximately 71 percent. The date at which demand exceeds the total available supply would be extended to the year 2002.

11. Potential expansion of existing reclaimed water uses appears feasible. The identified reclaimed water system would distribute both

secondary and tertiary treated wastewater. The projected reclaimed water use of high potential users is 35,600 acre-feet per year.
12. Full development of the identified reclaimed water potential would increase the delivery reliability of water supplies. Without the identified reclaimed water system or the water conservation program, the probability of meeting the 1995 water demand is estimated to be approximately 66 percent. With both the reclaimed water program and the conservation program, the probability increases to approximately 72 percent. The date at which demand exceeds the total available supply would be extended to the year 2004.
13. Aquifer storage and recovery (ASR) involves groundwater recharge by spreading or injection. Recovery would be accomplished by wells, primarily existing wells. ASR can also be accomplished by in lieu delivery of alternative water sources. Based on the hydrogeologic characteristics of the Antelope Valley, groundwater recharge by both spreading and injection appears feasible. Potential water sources for recharge include State water, reclaimed water, and local stormwater. The areas having the most potential for spreading are Amargosa Creek south of Avenue "N" between 10th Street West and Division Street, Little Rock Creek near Avenue "N" between 60th Street and 70th Street East, and Amargosa Creek near Elizabeth Lake Road and 25th Street West. The areas having the most potential for injection are Los Angeles County Waterworks (LACWW) wells located south of Avenue "K" between 10th Street West and Division Street; LACWW wells located south of Avenue "L" between 10th Street West and Division Street; and Palmdale Water District (PWD) wells south of Avenue "P" between 20th Street East and 40th Street East. Site specific evaluations will be required to evaluate the recharge potential and technical, economic and environmental feasibility of each site.
14. Groundwater levels have declined significantly in certain areas of the Antelope Valley. In these areas, land subsidence has generally accompanied the declining groundwater levels. Although damages attributed to land subsidence have been relatively modest when compared to subsidence problems identified in other parts of California, significant problems can occur as demonstrated in the San Joaquin Valley. Similarly, rising groundwater levels can also cause problems such as waterlogging and water quality degradation.

BASIC WATER RESOURCE PROTECTION STRATEGY

Based on the identified water resource problems as well as the evaluations presented in the previous chapters, a basic water resource protection strategy has been developed. The 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. Because groundwater moves slowly, under-utilization generally does not result in a significant loss of this resource. Conversely, under-utilization of reclaimed water, stormwater or imported State water could result in irretrievable resource losses unless capabilities to store and recover these water supplies are available. The recent modifications to Little Rock Dam and Reservoir and potential aquifer storage and recovery programs are activities which should improve utilization of the available water supplies. Direct utilization of the reclaimed water, stormwater, and imported State water in lieu of groundwater would minimize the requirements of potential ASR programs.
- Manage the Groundwater Basin. The Antelope Valley Groundwater Basin has a large capacity to store water. Over the last several decades, the volume of water in storage has declined significantly but is still large. As agriculture decreases, it is expected that urbanization will be the primary cause of increased water demands. Accordingly, to bring groundwater extractions more in line with the estimated safe yield of the Basin, the first phase of this element should be to limit any further reductions in groundwater levels. When this objective has been accomplished, the second phase of this element should be to replenish the Basin to the extent feasible so that it can be utilized to compensate for delivery fluctuations in other water supplies, particularly the delivery of State water.
- Protect Groundwater Quality. The Antelope Valley Groundwater Basin is an important component of the water resources for the Valley. Not only does the Basin provide a reliable yield but it also can serve as a reservoir to optimize the use of the Valley's other water resources. One of the primary threats to the use of this valuable resource is potential water quality degradation. Generally, the groundwater quality is excellent. To maintain this water quality, it is important to protect the Basin from contamination by industrial activities and other land uses, introduction of foreign water with a lower quality, or rising groundwater levels that free contaminants adsorbed onto soil particles.

- Reduce Long Term Water Demands. The need for additional water supplies can be mitigated by long-term reductions in water demands. By implementation of selected water conservation programs, the existing water resources can be extended cost-effectively. Furthermore, the ability to obtain and transfer supplemental water supplies may be facilitated by the efficient use of available supplies.
- Improve State Water Project (SWP) Reliability. Of the water resources available to the Antelope Valley, imported State water is by far the most significant and has the greatest potential for providing additional future water supplies. Unfortunately, this water supply also currently has the greatest delivery uncertainty. Issues related to environmental concerns in the Bay-Delta, SWP financing and water supply allocations are being addressed by Federal and State agencies. Because the resolution of these issues will have a significant affect on the water supply/demand balance in the Antelope Valley, active participation in these negotiations is essential.
- Obtain Additional Imported Water Supplies. Regardless of whether the utilization of existing water resources is optimized, additional imported water supplies will be necessary to meet projected water demands. To minimize groundwater overdraft, these additional supplies should be obtained in timely increments. In order to acquire additional water supplies, the necessary financial resources must be available and water agencies in the Antelope Valley must be ready to act. The greatest opportunity to acquire additional imported water appears to be through water transfers among SWP or Central Valley Project contractors.

RECOMMENDED ACTIONS

To implement the basic strategy outlined 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:

1. Create an institutional framework to manage the development and use of water supplies.

To maintain equity among the competing water users and manage the utilization of the available water supplies, an institutional framework is desirable. The selected framework must be capable of accommodating the large number of water interests in the Antelope Valley. There are basically four approaches to the creation of multi-jurisdictional groundwater management:

- coordinated agreement by the water purveyors
- joint exercise of powers
- codified special districts
- special act legislation

Each of these approaches are discussed in the following paragraphs.

Coordinated Agreement by the Water Purveyors. Through a contract arrangement among the purveyors, the functions of groundwater management can be accomplished. This arrangement would require agreement between the signatory parties to exercise any power, including enforcement, or collect any levies. This approach has been utilized by other water utilities, particularly investor-owned utilities, to resolve specific groundwater utilization disputes. It should be noted, however, that agreements with investor-owned utilities should receive the approval of the California Public Utilities Commission to support their validity. The primary difficulties with this approach are as follows:

- Although the approach may be appropriate to resolve individual issues, it would be difficult to utilize this approach for issues as complex as groundwater management.
- Unanimous agreement among the parties would be necessary to perform any groundwater management function, and specific agreements among the parties would be necessary for each new function. This process could be time-consuming and cumbersome.
- Because groundwater rights are similar to property rights, parties other than the current water purveyors could initiate groundwater use within the basin. To continue effective groundwater management, it would be necessary for these parties to also become signatories to the agreements.

For these reasons, coordinated agreement among the water purveyors does not appear to be a viable approach to groundwater management unless the issues are relatively well-defined. Recent legislation (AB 255) may make this approach viable if the basin is in critical overdraft as identified in Department of Water Resources (DWR) Bulletin 118. AB 255, enacted in 1991, authorizes any local agency whose jurisdiction includes groundwater basins subject to critical overdraft to establish, by ordinance or resolution, programs for the management of groundwater resources within the area in which water service is being provided. The bill authorizes the local agency to fix and collect fees, subject to voter approval, for the extraction of groundwater and to levy a water replenishment assessment. The measure also requires local agencies with overlapping boundaries which conduct groundwater management programs to meet, at least annually, to coordinate their programs. AB 3030, enacted in 1992, repeals AB 255 and expands the authority contained in AB 255 for local agencies to manage groundwater. (See Appendix G for Synopsis of AB 3030.) AB 3030 provides the authority and procedures to develop and

implement groundwater management plans. Groundwater management authority created under AB 3030 generally has the powers granted to a water replenishment district. The characteristics and powers contained in AB 3030 are summarized in Table 9.1.

Joint Exercise of Powers. Under the provisions of Article 1 of Chapter 5, Division 7, Title 1, of the Government Code, public agencies in California can exercise any powers common to the parties. If the water purveyors were public agencies, this approach could be utilized to perform certain groundwater management functions. Recent legislation (AB 2014) also allows mutual water companies to participate with public agencies in joint powers agreements. Water interests in the Antelope Valley include the County of Los Angeles, cities, special districts, investor-owned water companies, mutual water companies, Federal government, and individual water users. The County of Los Angeles, Kern County or certain special districts could be utilized to represent unincorporated areas overlying the sub-basins.

The primary difficulty with this approach is that the powers of the joint powers authority would be limited to the powers common to the Cities, special districts, mutual water companies, and the County. In addition, joint powers authorities are generally formed so that unanimity is required to take actions. The adequacy of the authority's powers will depend on the specific approach to groundwater management desired by the authority. A joint powers authority could also exercise the powers provided in AB 3030.

Codified Special Districts. The California Water code contains provisions for the formation of several types of special water districts. Based on a review of these enabling acts, water replenishment districts appear to be the most appropriate codified special district to perform groundwater management activities. The characteristics and powers of a water replenishment district are summarized in Table 9.1.

The primary function of a water replenishment district is to obtain supplemental water supplies to directly or indirectly replenish an overdrafted groundwater basin. This approach to groundwater management is somewhat reactive in that it focuses on mitigating overdraft conditions rather than other water management techniques such as conjunctive operation of the basin.

Special Act Legislation. Because each special legislative act is customized for a particular situation, a groundwater management agency formed by special act legislation tends to be unique. Upon passage these acts are usually codified in the Water Code Appendix. An example of a special act groundwater management agency is the Orange County Water District which was created in 1933.

Based on a review of these acts, enabling legislation generally contains the following provisions:

TABLE 8.1

SUMMARY OF GROUNDWATER MANAGEMENT AUTHORITIES

Formation				Internal Organization		Powers											Financial Authority		Enforcement Authority					
Agency	Reference	Year	By	Directors	Board	GW Studies	GW Management	Design & Operating Standards	GW Replenishment	Regulation of Extraction	Regulation of Export	Regulation of Beneficial Uses	Protection of GW Quality	Other Significant Powers	Water Rates	Taxes	Replenishment Extraction Assessment	Benefit Assessment	Standby Charges	Special Charges	Injunctive Relief	Penalties/Interest	Suit	Lien
Water Replenishment District	Div 18 of WC	1855	Petition by 10% of voter election	5	elected by division	X			X	X		X	X	(1)	X	X	X	X			X	X	X	X
Orange County Water District	Chapter 40 WC Appendix	1833	Special Act	10	7 elected by division: 3 appointed by cities comprising division	X	X		X	X	X		X	(2)		X	X			X	X	X	X	X
Monterey Peninsula WMD	Chapter 116 WC Appendix	1877	Special Act	7	5 elected at large or by division 1 Supervisor 1 appointed by cities	X	X		X	X		X	X	(3)	X	X	X	X	X		X	X	X	X
Fox Canyon GMA	Chapter 121 WC Appendix	1982	Special Act	5	5 appointed (1 each by Ventura County, UWCDC, cities & mutual & special Districts; 4 members choose 1)	X	X	X		X		X	X				X			X	X	X	X	X
Pajaro Valley WMA	Chapter 124 WC Appendix	1984	Special Act	7	4 elected by division 3 appointed (1 each by Monterey County, Santa Cruz County & City of Watsonville)	X	X	X	X	X		X	X				X	X	X	X	X	X	X	X
Mono County Tri-Valley GMD	Chapter 128 WC Appendix	1989	Special Act	7	1 appointed by Supervisors 3 elected at large 3 property owners w/ extraction facilities elected at large (can designate substitute)	X	X	X	X	X	X	X						X			X	X	X	X
Honey Lake Valley GMD	Chapter 129 WC Appendix	1989	Special Act	5	4 elected at large 1 appointed by Supervisors	X	X	X	X	X	X	X					X	X			X	X	X	X
Ojai Basin GMA	SB534	1991	Special Act	5	5 appointed (1 each by City of Ojai, CMWD, Ojai WCD, SCWC & mutuals)	X	X	X	X	X	X	X	X				X		X	X	X	X	X	X
Local Agencies (4)	AB 3030 Part 2.75 of WC	1992	Local Agency providing water service and overlying a GW Basin	(5)	(5)	X	X	X	X	X		X	X		X	X	X	X			X	X	X	X

Notes:

(1) Actions Outside District

(2) Hydro, Recreation, Wastewater, and Storm Drainage

(3) Conjunctive use of Groundwater and surface water; water storage outside district; water reclamation; water rights protection; and contract for groundwater remediation.

(4) Could be joint powers authority

(5) Depends on local agency

- a. formation
- b. internal organization
- c. powers
- d. financing authority
- e. enforcement

Special act groundwater management agencies are formed by action of the legislature. Until the enactment of AB 255 and AB 3030, special act legislation was the most common non-judicial approach to formation of a groundwater management agency. Generally, these agencies are governed by a board of directors consisting of five to seven members. The selection method for board members varies widely. In most cases the board of directors is appointed or is composed of a combination of appointed and elected members. Depending on their unique role in local water regulation, the agencies have differing powers. Generally, the agencies are empowered to conduct groundwater studies and perform groundwater management by regulation of both extractions and beneficial uses of extracted water. Usually, these agencies can also perform groundwater replenishment activities. Like watermasters established by adjudication, assessments for extraction or replenishment are the most common form of financing authority, although other authorities such as benefit assessments and standby charges are usually provided. The authority to enforce its powers is also provided through a variety of enforcement powers.

The enabling legislation of several special act groundwater management agencies was reviewed. The characteristics and powers of these agencies are summarized in Table 9.1. As indicated, the powers and organization of each agency has been customized for the individual political and technical situation of that area. Consequently, each agency differs from the others. Because these agencies are designed for the unique conditions of an area, special act legislation has become the most common non-judicial approach to groundwater management.

Recommended Institutional Approach. Based on the forgoing discussion of the alternative institutional approaches to groundwater management, it is apparent that the most desirable approach is to utilize AB 3030 or special act legislation to create a groundwater management agency. By utilizing special act legislation, the board and its powers can be customized to the unique political and hydrogeologic conditions of the area.

The procedures to implement the powers authorized under AB 3030 are outlined in the legislation (codified in Part 2.75 of the Water Code). Cooperation among the water purveyors overlying a groundwater basin are strongly encouraged and groundwater management powers are limited to the local agencies service area.

To initiate special act legislation, the water purveyors in the Antelope Valley should initiate discussions regarding the general form of the agency, with particular focus on the composition of the board of directors and groundwater management powers.

If general consensus is achieved, draft legislation can be prepared and circulated for review by the individual water purveyors. When the provisions of the legislation have been mutually agreed upon, a legislative sponsor to carry the legislation can be selected.

2. Determine the safe yield of the Antelope Valley Groundwater Basin.

In its study plan to develop a groundwater management model for the Antelope Valley, USGS estimates that the estimated natural recharge of the groundwater basin ranges from 31,200 to 59,100 acre-feet per year based on equalizing adjustments to recharge estimates of previous investigations. Although this range is relatively narrow compared to the projected water demands of the Antelope Valley, it is important to develop the foundation upon which a consensus safe yield estimate can be based.

The USGS study plan presents a sophisticated approach that utilizes hydrologic monitoring, chemical tracers, and remote sensing to develop estimates of natural recharge. These estimates would be incorporated into a proposed groundwater flow model which could be utilized to provide safe yield estimates based on the selected groundwater management strategy.

Whether this management modeling approach or a less sophisticated hydrologic approach is utilized, a single safe yield estimate for the groundwater basin, or preferably a single safe yield estimate for each sub-unit, would be desirable. This estimate would provide the basis upon which consensus can be achieved and upon which a water management plan can be based. In the absence of a consensus estimate, conflict among the groundwater users is likely to occur as the cost of alternative water supplies increase. Accordingly, it is recommended that the water interests in the Antelope Valley review alternative approaches to developing safe yield estimates, determine the most appropriate approach, and perform the necessary studies.

3. Continue the current groundwater monitoring program and publish an annual report on basin conditions.

As part of a cooperative effort of the Antelope Valley-East Kern Water Agency (AVEK) and Edwards AFB, USGS currently conducts a comprehensive monitoring program in the Antelope Valley. Monitoring activities include groundwater levels, groundwater quality, land surface deformation (subsidence), aquifer compaction, and streamflow. The Survey Division of the County of Los Angeles Department of Public Works maintains records of destroyed benchmarks, and sets new benchmarks within the unincorporated portion of the County as needed. In addition, benchmarks have been set on all existing and will be set on all future LACWW water wells.

Groundwater levels are currently monitored as part of the cooperative AVEK network in conjunction with groundwater studies at Edwards AFB. The AVEK network is comprised of about 150 wells within the Antelope Valley. Water levels are measured annually or semiannually. Forty Piezometers were installed at Edwards AFB by the USGS, 12 of which are currently monitored continuously (every 15 minutes), the other 28 are measured by hand every six weeks. Combined, these networks are fairly sparse, given the size of the Valley (about 2,400 square miles). Making best use of available wells and existing monitoring efforts by various entities, and installing monitoring wells in key areas could improve the groundwater level network substantially.

USGS measures groundwater quality in 5 to 10 wells per year from the AVEK network described above. Other agencies, notably the DWR and the Los Angeles County Sanitation Districts, also measure groundwater quality. In addition, public water suppliers perform analyses of their water supplies as required by the California Department of Health Services and Title 22 of the California Code of Regulations.

USGS has collected geodetic data using the Global Positioning System (GPS) for the purpose of determining land subsidence at Edwards AFB in 1989, and Valley-wide in 1992. The Valley-wide network consists of 85 benchmarks. Unfortunately, several of these benchmarks have been destroyed since 1992 because of various construction-related causes (e.g., installation of Metro Line tracks, and road widening). Accordingly, it is recommended that remaining benchmarks be protected, or that new "offset" benchmarks be provided by marking them in such a way that construction crews would not destroy them without approval. In addition, the network could be expanded to include tighter control in subsidence-prone areas by including all existing and future production wells in these areas.

Three extensometers have been installed at two sites at Edwards AFB for the direct and continuous measurement of aquifer-system compaction, which results in land subsidence. GPS surveys are typically done on an annual or less frequent basis, which could be inadequate for monitoring to avoid land subsidence. Extensometers provide a real-time measurement of aquifer-system compaction, which can aid in making decisions regarding the daily distribution of groundwater withdrawals.

USGS currently operates 8 rain gages in Antelope Valley, which supplement the Los Angeles County and National Oceanic and Atmospheric Administration networks. Precipitation data are important for estimating groundwater recharge as well as rainfall/runoff relationships for flood control purposes.

Streamflow data are sparse in the Antelope Valley. USGS currently operates 8 continuous gages, but only one of them is on the three primary sources of groundwater recharge from the San Gabriels (Big Rock, Little Rock, and Amargosa Creeks), and that gage is in the upper reaches of Big Rock Creek before the creek passes through Valyermo. Accordingly, installation of additional continuous-monitoring gages is recommended. In addition, it is recommended that water use data (including groundwater usage) be collected over a long term period.

The municipal and industrial (M&I) and major agricultural groundwater pumpers generally measure their groundwater extractions and submit this information to the Department of Water Resources. It is recommended that these data be regularly collected and compiled. The pumpers that do not measure groundwater extractions are anticipated to be agricultural and small domestic water users. Because USGS projects that agricultural land use in the Antelope Valley (other than agriculture irrigated with reclaimed water) is expected to decline significantly, the effect of these unmonitored extractions should be limited. Accordingly, for pumpers that do not monitor groundwater extractions, indirect methods, such as estimates based on power or consumption use can be utilized for groundwater management purposes.

A significant volume of data is collected annually. These data provide limited value without technical interpretation. Accordingly, it is recommended that the data be published on an annual basis, together with a summary report of the Basin conditions and groundwater management activities. This document should be informative to both water managers as well as the public.

4. Develop a program to optimize the use of available water supplies.

To optimize the use of groundwater, annual extractions should be reduced to safe yields or economic disincentives sufficient to allow groundwater recharge should be implemented. In lieu of groundwater, other water supplies should be utilized to the extent feasible. In the use of alternative water supplies, priority should be given to utilization of supplies which may be lost by non-use. Currently, the supplemental water supply whose use could be better utilized is imported State water. When State water is available, it should be fully utilized, thereby reserving the groundwater for periods of reduced delivery of State water. Similarly, when made available, reclaimed water should be utilized to the maximum extent allowed by the distribution system, and groundwater recharge should remain an important consideration in all stormwater management plans. To the extent that direct use of these resources cannot be accomplished, facilities to recover the resources and store them in underground aquifers should be provided.

The primary barriers to reducing groundwater use are the lower cost of groundwater compared to surface water and access to alternative water supplies. To overcome these barriers it is recommended that the groundwater management authority implement or facilitate the implementation by others of the water conservation, reclaimed water, stormwater management, and aquifer storage and recovery programs recommended in this study. These activities are discussed in the following recommended action. In addition, it is recommended that the authority consider the application of groundwater replenishment assessments to fund a portion of the program costs. A replenishment assessment is typically levied on extractions beyond an allocated annual volume. These allocations are usually limited to the safe yield of the Basin, although transition periods to achieve this level are often utilized. To implement this assessment, the available safe yield of the Basin must be allocated equitably among the competing users. At a minimum, replenishment assessments should be levied on new or increased groundwater use.

The primary barrier to shifting groundwater use to alternative supplies such as imported State water is again economic (i.e., the lower cost of groundwater). Accordingly, it is recommended that the groundwater management authority also consider the application of basin equity assessments. A basin equity assessment is typically an assessment levied on one water source (e.g., groundwater) to reduce the cost of another source (e.g., State water or reclaimed water); thus, basin equity assessments are revenue neutral. The amount of these assessments are dependent upon the magnitude of the desired water use shift as well as the urgency of the shift.

5. Develop the recommended water conservation, reclaimed water, stormwater management, and aquifer storage and recovery programs.

Previous chapters of this report describe water conservation, reclaimed water, stormwater management, and aquifer storage and recovery programs. These programs are intended to reduce water demands or improve the utilization of the available water supplies, thereby reducing the need and extending the timing for additional imported water supplies. Accordingly, it is recommended that the groundwater management authority implement or facilitate the implementation by others of these programs.

To implement these programs, more detailed program-specific planning studies will be necessary. In these studies, one of the key issues that should be addressed is the cost allocation between the water management elements of the program and the other institutional beneficiaries. With the exception of the water conservation program for which only cost-effective water management activities are included, the programs provide benefits to related activities. For example, the reclaimed water, together with the aquifer storage and recovery program, is expected to reduce the cost of wastewater disposal. Similarly, stormwater recharge activities may be necessary to implement flood control facilities. Accordingly, the relative benefits of the recommended programs should be evaluated so that an equitable distribution of costs can be determined.

6. Actively encourage the California Department of Water Resources to complete the State Water Project and/or improve reliability.

The reliability of imported water from the State Water Project has been undergoing significant changes. These changes are primarily the result of environmental concerns in the Bay-Delta and possible revisions to the water and cost allocation procedures of the DWR.

As a result of a series of biological opinions issued by the United States Fish and Wildlife Service, water exports from the Bay-Delta have been restricted and are currently interrupted by ongoing estimates of "takings" of endangered species. This operating procedure has created considerable uncertainty over the amount of water that may be exported by the SWP as well as over operational reservoir

releases or potential water transfers from north of the Delta. Accordingly, it is recommended that the State water contractors in the Antelope Valley continue to monitor the development of Federal-State Bay Delta protection plans and encourage the development of consistent operating procedures for Delta water exports.

The issues related to DWR's water allocation procedures involve Article 18(a) of the SWP contract which specifies the procedures for water shortage allocations, and the issues related to DWR's cost allocation procedures involve the need of the SWP agricultural contractors to receive repayment relief, particularly for the water supply diverted for Bay-Delta water quality improvements. Article 18(a) of the SWP contract specifies that water supply reductions are proportioned according to the contractor's entitlement and applied to the contractor's request. Historically, DWR has proportioned the reductions based on the contractor's request and also applied the reduction to the contractor's request. Because demands for State water are increasing and the available supply is restricted, the water shortage provisions of Article 18(a) will become increasingly more important. Similarly, as the agricultural contractors continue to advocate repayment relief, the cost of State water to the municipal and industrial contractors may increase. The California Research Bureau has recently evaluated alternative approaches to SWP financing. Several of these alternatives would significantly increase the future cost of imported water. For these reasons, it is recommended that the State water contractors in the Antelope Valley actively participate in discussion with DWR over water and cost allocation issues.

7. Obtain additional imported water supplies.

Water demand projections for the Antelope Valley indicate that the underlying water demands are expected to range from 363,000 to 420,000 acre-feet by the year 2020. Even with an active water conservation program, the medium water demand projection is 361,000 acre-feet in the year 2020. If the recommended reclaimed water program is implemented, the maximum available water supply is estimated to be 256,000 acre-feet in the year 2020; however, reliability issues related to imported State water are likely to result in deliveries below this level. Therefore, it is apparent that additional imported water supplies will be necessary. The probable source of additional imported water supplies will be other State water contractors with excess or unaffordable entitlements. Furthermore, it would be desirable for the State water contractors in the Antelope Valley to immediately initiate the acquisition of these water supplies and complete the acquisition of some additional water prior to the year 2000. In acquiring additional water supplies, it is recommended that the State water contractors implement a phased water acquisition program as cost-effective water supplies become available. By utilizing a phased program, additional water supplies can be obtained prior to the development needs of the area while minimizing the financial impact of the new water supplies.

To implement a water acquisition program, sufficient financial resources will be necessary. Because the need for additional imported water is caused primarily by new development, it is recommended that the cost of these water supplies be incorporated into the facility capacity fees levied on new development.

8. Develop a revenue plan to implement the recommended programs.

To implement the recommendations of this study, the costs associated with the recommendations must be allocated equitably among the beneficiaries (i.e., local vs. regional, water supply vs. wastewater disposal, and groundwater recharge vs. stormwater management). In addition, the costs allocated to water management activities must be distributed equitably among the competing water interests (i.e., new vs. existing, groundwater vs. surface water, agricultural vs. municipal, and retail vs. wholesale). The allocated costs are anticipated to include the costs of the recommended programs, acquisition costs of additional water supplies, equalization of water supply costs, and administration costs of water management. To provide sufficient revenues to fund these costs, the following revenue sources are recommended:

Replenishment Assessments. Replenishment assessments are assessments imposed on groundwater extractions in excess of the safe yield allocation. It is recommended that these assessments be used to fund the portion of the recommended programs allocated to water management.

Basin Equity Assessments. Basin equity assessments are revenue-neutral assessments imposed on groundwater users that have access to alternative water supplies. It is recommended that these assessments be used to encourage the utilization of alternative water supplies.

Production Assessments. Production assessments are assessments imposed on all groundwater use or all water use regardless of the source. It is recommended that these assessments be used to support the administration costs of water management.

Facility Capacity Fees. Facility capacity fees are fees imposed on new development to offset the economic impact on public facilities. It is recommended that these fees be utilized to acquire the additional imported water supplies to serve the new development.

Standby Charges. Standby charges are charges imposed on landowners on a per parcel or per acre basis. It is recommended that these charges be considered as an alternative to replenishment, basin equity, or production assessments when groundwater extractions are not or cannot be metered.

9. *Initiate a public education program.*

The water resources protection plan includes recommendations that the proposed groundwater management authority and the water purveyors in the Antelope Valley implement several programs to improve water management. Improvements include reductions in projected water demands, better use of the available water resources, and acquisition of additional imported water supplies. These programs will require new revenue sources to equitably fund the recommended programs. To effectively communicate the objectives and activities of the new water management institution, an active public education program is recommended.

There are two levels to the recommended public education program. One level would focus on the need for integrated water management in the Antelope Valley, the framework of the recommended programs, and the financial resources required. The other level would focus on the implementation issues of the individual programs. To obtain public support for a new water management institution as well as its associated fees and charges, the public must understand the legitimacy and nature of complex water issues and the effectiveness of the recommended institutions and programs. Furthermore, each of the recommended programs is also complex, and the public must understand the justification and activities of the individual programs.

The success of the public education program will depend on the unanimity and credibility of the existing water institutions in the Antelope Valley in presenting the information necessary to understand these complex issues. This credibility is developed not only through public education but also through public participation in the development of the programs to address the wide range of water issues facing the Antelope Valley.

ANTELOPE VALLEY WATER RESOURCE STUDY

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APPENDIX A

Description of BMPs

EXHIBIT 1

BEST MANAGEMENT PRACTICES, IMPLEMENTATION
SCHEDULES, ASSUMPTIONS AND POTENTIAL BEST
MANAGEMENT PRACTICES FOR URBAN WATER CONSERVATION
IN CALIFORNIA

SECTION A. BEST MANAGEMENT PRACTICES

This section contains those Best Management Practices ("BMPs") that signatory water suppliers commit to implementing. Suppliers' water needs estimates will be adjusted to reflect estimates of reliable savings from this category of BMPs. For some BMPs, no estimate of savings is made.

It is recognized by all parties that a single implementation method for a BMP would not be appropriate for all water suppliers. In fact, it is likely that as the process moves forward, water suppliers will find new implementation methods even more effective than those described. Any implementation method used should be at least as effective as the methods described below.

1. INTERIOR AND EXTERIOR WATER AUDITS AND INCENTIVE PROGRAMS FOR SINGLE FAMILY RESIDENTIAL, MULTI-FAMILY RESIDENTIAL, AND GOVERNMENTAL/INSTITUTIONAL CUSTOMERS.

Implementation methods shall be at least as effective as identifying the top 20% of water users in each sector, directly contacting them (e.g., by mail and/or telephone) and offering the service on a repeating cycle; providing incentives sufficient to achieve customer implementation (e.g., free showerheads, hose end sprinkler timers, adjustment to high water use bills if customers implement water conservation measures, etc.). This could be a cooperative program among organizations that would benefit from its implementation.

2. PLUMBING, NEW AND RETROFIT.
 - a. ENFORCEMENT OF WATER CONSERVING PLUMBING FIXTURE STANDARDS INCLUDING REQUIREMENT FOR ULTRA LOW FLUSH ("ULF") TOILETS IN ALL NEW CONSTRUCTION BEGINNING JANUARY 1, 1992.

Implementation methods shall be at least as effective as contacting the local building departments and providing information to the inspectors; and contacting major developers and plumbing supply outlets to inform them of the requirement.

- b. SUPPORT OF STATE AND FEDERAL LEGISLATION PROHIBITING SALE OF TOILETS USING MORE THAN 1.6 GALLONS PER FLUSH.

- c. PLUMBING RETROFIT.

Implementation methods shall be at least as effective as delivering retrofit kits including high quality low-flow showerheads to pre-1980 homes that do not have them and toilet displacement devices or other devices to reduce flush volume for each home that does not already have ULF toilets; offering to install the devices; and following up at least three times.

- 3. DISTRIBUTION SYSTEM WATER AUDITS, LEAK DETECTION AND REPAIR.

Implementation methods shall be at least as effective as at least once every three years completing a water audit of the water supplier's distribution system using methodology such as that described in the American Water Works Association's "Manual of Water Supply Practices, Water Audits and Leak Detection;" advising customers whenever it appears possible that leaks exist on the customers' side of the meter; and performing distribution system leak detection and repair whenever the audit reveals that it would be cost effective.

- 4. METERING WITH COMMODITY RATES FOR ALL NEW CONNECTIONS AND RETROFIT OF EXISTING CONNECTIONS.

Implementation methods shall be requiring meters for all new connections and billing by volume of use; and establishing a program for retrofitting any existing unmetered connections and billing by volume of use; for example, through a requirement that all connections be retrofitted at or within six months of resale of the property or retrofitted by neighborhood.

- 5. LARGE LANDSCAPE WATER AUDITS AND INCENTIVES.

Implementation methods shall be at least as effective as identifying all irrigators of large (at least 3 acres) landscapes (e.g., golf courses, green belts, common areas, multi-family housing landscapes, schools, business parks,

cemeteries, parks and publicly owned landscapes on or adjacent to road rights-of-way); contacting them directly (by mail and/or telephone); offering landscape audits using methodology such as that described in the Landscape Water Management Handbook prepared for the California Department of Water Resources; and cost-effective incentives sufficient to achieve customer implementation; providing follow-up audits at least once every five years; and providing multi-lingual training and information necessary for implementation.

6. **LANDSCAPE WATER CONSERVATION REQUIREMENTS FOR NEW AND EXISTING COMMERCIAL, INDUSTRIAL, INSTITUTIONAL, GOVERNMENTAL, AND MULTI-FAMILY DEVELOPMENTS.**

Implementation methods shall be enacting and implementing landscape water conservation ordinances, or if the supplier does not have the authority to enact ordinances, cooperating with cities, counties and the green industry in the service area to develop and implement landscape water conservation ordinances pursuant to the "Water Conservation in Landscaping Act" ("Act") (California Government Code §§ 65590 et seq.). The ordinance shall be at least as effective as the Model Water Efficient Landscape Ordinance being developed by the Department of Water Resources. A study of the effectiveness of this BMP will be initiated within two years of the date local agencies must adopt ordinances under the Act.

7. **PUBLIC INFORMATION.**

Implementation methods shall be at least as effective as ongoing programs promoting water conservation and conservation related benefits including providing speakers to community groups and the media; using paid and public service advertising; using bill inserts; providing information on customers' bills showing use in gallons per day for the last billing period compared to the same period the year before; providing public information to promote other water conservation practices; and coordinating with other governmental agencies, industry groups and public interest groups.

8. **SCHOOL EDUCATION.**

Implementation methods shall be at least as effective as ongoing programs promoting water conservation and conservation related benefits including working with the school districts in the water supplier's service area to provide educational materials and instructional assistance.

9. COMMERCIAL AND INDUSTRIAL WATER CONSERVATION.

Implementation methods shall be at least as effective as identifying and contacting the top 10% of the industrial and commercial customers directly (by mail and/or telephone); offering audits and incentives sufficient to achieve customer implementation; and providing follow-up audits at least once every five years if necessary.

10. NEW COMMERCIAL AND INDUSTRIAL WATER USE REVIEW.

Implementation methods shall be at least as effective as assuring the review of proposed water uses for new commercial and industrial water service and making recommendations for improved water use efficiency before completion of the building permit process.

11. CONSERVATION PRICING.

Implementation methods shall be at least as effective as eliminating nonconserving pricing and adopting conserving pricing. For signatories supplying both water and sewer service, this BMP applies to pricing of both water and sewer service. Signatories that supply water but not sewer service shall make good faith efforts to work with sewer agencies so that those sewer agencies adopt conservation pricing for sewer service.

Nonconserving pricing provides no incentives to customers to reduce use. Such pricing is characterized by one or more of the following components:

- a. Rates in which the unit price decreases as the quantity used increases (declining block rates);
- b. Rates that involve charging customers a fixed amount per billing cycle regardless of the quantity used;
- c. Pricing in which the typical bill is determined by high fixed charges and low commodity charges.

Conservation pricing provides incentives to customers to reduce average or peak use, or both. Such pricing includes:

- a. Rates designed to recover the cost of providing service; and
- b. Billing for water and sewer service based on metered water use.

Conservation pricing is also characterized by one or more of the following components:

- c. Rates in which the unit rate is constant regardless of the quantity used (uniform rates) or increases as the quantity used increases (increasing block rates);
- d. Seasonal rates or excess-use surcharges to reduce peak demands during summer months;
- e. Rates based upon the long-run marginal cost or the cost of adding the next unit of capacity to the system;
- f. Lifeline rates.

12. LANDSCAPE WATER CONSERVATION FOR NEW AND EXISTING SINGLE FAMILY HOMES.

Implementation methods shall be at least as effective as providing guidelines, information and incentives for installation of more efficient landscapes and water saving practices (e.g., encouraging local nurseries to promote sales and use of low water using plants, providing landscape water conservation materials in new home owner packets and water bills, sponsoring demonstration gardens); and enacting and implementing landscape water conservation ordinances or, if the supplier does not have the authority to enact ordinances, cooperating with cities, counties, and the green industry in the service area to develop and implement landscape water conservation ordinances pursuant to the "Water Conservation in Landscaping Act ("Act") (California Government Code §§ 65590 et seq.). The ordinance shall be at least as effective as the Model Water Efficient Landscape Ordinance being developed by the Department of Water Resources.

13. WATER WASTE PROHIBITION.

Implementation methods shall be enacting and enforcing measures prohibiting gutter flooding, sales of automatic (self-regenerating) water softeners, single pass cooling systems in new connections, nonrecirculating systems in all new conveyer car wash and commercial laundry systems, and nonrecycling decorative water fountains.

14. WATER CONSERVATION COORDINATOR.

Implementation methods shall be at least as effective as designating a water conservation coordinator responsible for preparing the conservation plan, managing its implementation, and evaluating the results. For very small water suppliers, this might be a part-time responsibility. For larger suppliers this would be a full-time responsibility with additional staff as appropriate. This work should be coordinated with the supplier's operations and planning staff.

15. FINANCIAL INCENTIVES.

Implementation methods shall be at least as effective as:

- a. Offering financial incentives to facilitate implementation of conservation programs. Initial recommendations for such incentives will be developed by the Council within two years of the initial signing of the MOU, including incentives to improve the efficiency of landscape water use; and
- b. Financial incentives offered by wholesale water suppliers to their customers to achieve conservation.

16. ULTRA LOW FLUSH TOILET REPLACEMENT.

Water suppliers agree to implement programs for replacement of existing high-water-using toilets with ultra-low-flush toilets (1.6 gallons or less) in residential, commercial, and industrial buildings. Such programs will be at least as effective as offering rebates of up to \$100 for each replacement that would not have occurred without the rebate, or requiring replacement at the time of resale, or requiring replacement at the time of change of service. This level of implementation will be reviewed by the Council after development of the assumptions included in the following two paragraphs using the economic principles included in paragraphs 3 and 4 of Exhibit 3.

- a. Assumptions for determining estimates of reliable savings from installation of ultra-low-flush toilets in both existing and new residential, commercial, and industrial structures will be recommended by the Council to the State Water Resources Control Board ("State Board") by December 31, 1991 for use in the present Bay/Delta proceedings.

- b. Should the Council not agree on the above assumptions, a panel will be formed by December 31, 1991 to develop such assumptions. The panel shall consist of one member appointed from the signatory public advocacy group; one member appointed from the signatory water supplier group; and one member mutually agreed to by the two appointed members. The assumptions to be used for this BMP will be determined by a majority vote of the panel by February 15, 1992 using the criteria for determining estimates of reliable savings included in this MOU. The decision of the panel will be adopted by the Council and forwarded to the State Board by March 1, 1992.

APPENDIX B

Urban Water Management Planning Act and Subsequent Amendments

Assembly Bill No. 797

CHAPTER 1009

An act to add and repeal Part 2.6 (commencing with Section 10610) to Division 6 of the Water Code, relating to water conservation.

[Approved by Governor September 21, 1983. Filed with Secretary of State September 22, 1983.]

LEGISLATIVE COUNSEL'S DIGEST

AB 797, Klehs. Water: management planning.

(1) Under existing law, local water suppliers may, but are not required to, adopt and enforce water conservation plans.

This bill would require every urban water supplier providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually to prepare and adopt, in accordance with prescribed requirements, an urban water management plan containing prescribed elements. The bill would require the plan to be filed with the Department of Water Resources, and would require the department to annually prepare and submit to the Legislature a report summarizing the status of the plans. The bill would require each supplier to periodically review its plan in accordance with prescribed requirements, would specify requirements for actions or proceedings arising under the bill, and would specify related matters.

The bill would make legislative findings and declarations in this connection.

The provisions of the bill would remain in effect only until January 1, 1991.

(2) Article XIII B of the California Constitution and Sections 2231 and 2234 of the Revenue and Taxation Code require the state to reimburse local agencies and school districts for certain costs mandated by the state. Other provisions require the Department of Finance to review statutes disclaiming these costs and provide, in certain cases, for making claims to the State Board of Control for reimbursement.

This bill would impose a state-mandated local program as its requirements would be applicable to local public agencies.

However, the bill would provide that no appropriation is made and no reimbursement is required by this act for a specified reason.

The people of the State of California do enact as follows:

SECTION 1. Part 2.6 (commencing with Section 10610) is added to Division 6 of the Water Code, to read:

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PART 2.6. URBAN WATER MANAGEMENT PLANNING

CHAPTER 1. GENERAL DECLARATION AND POLICY

10610. This part shall be known and may be cited as the "Urban Water Management Planning Act."

10610.2. The Legislature finds and declares as follows:

(a) The waters of the state are a limited and renewable resource subject to ever increasing demands.

(b) The conservation and efficient use of urban water supplies are of statewide concern; however, the planning for that use and the implementation of those plans can best be accomplished at the local level.

10610.4. The Legislature finds and declares that it is the policy of the state as follows:

(a) The conservation and efficient use of water shall be actively pursued to protect both the people of the state and their water resources.

(b) The conservation and efficient use of urban water supplies shall be a guiding criterion in public decisions.

(c) Urban water suppliers shall be required to develop water management plans to achieve conservation and efficient use.

CHAPTER 2. DEFINITIONS

10611. Unless the context otherwise requires, the definitions of this chapter govern the construction of this part.

10611.5. "Conservation" means those measures that limit the amount of water used only to that which is reasonably necessary for the beneficial use to be served.

10612. "Customer" means a purchaser of water from a water supplier who uses the water for municipal purposes, including residential, commercial, governmental, and industrial uses.

10613. "Efficient use" means those management measures that result in the most effective use of water so as to prevent its waste or unreasonable use or unreasonable method of use.

10614. "Person" means any individual, firm, association, organization, partnership, business, trust, corporation, company, public agency, or any agency of such an entity.

10615. "Plan" means an urban water management plan prepared pursuant to this part. A plan shall describe and evaluate reasonable and practical efficient uses and conservation activities. The components of the plan may vary according to an individual community or area's characteristics and its capabilities to efficiently use and conserve water. The plan shall address measures for residential, commercial, governmental, and industrial water management as set forth in Article 2 (commencing with Section 10630) of Chapter 3. In addition, a strategy and time schedule for

implementation shall be included in the plan.

10616. "Public agency" means any board, commission, county, city and county, city, regional agency, district, or other public entity.

10617. "Urban water supplier" means a supplier, either publicly or privately owned, providing water for municipal purposes either directly or indirectly to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually. An urban water supplier includes a supplier or contractor for water, regardless of the basis of right, which distributes or sells for ultimate resale to customers. This part applies only to water supplied from public water systems subject to Chapter 7 (commencing with Section 4010) of Part 1 of Division 5 of the Health and Safety Code.

CHAPTER 3. URBAN WATER MANAGEMENT PLANS

Article 1. General Provisions

10620. (a) Every urban water supplier serving water directly to customers shall, not later than December 31, 1985, prepare and adopt an urban water management plan in the manner set forth in Article 3 (commencing with Section 10640).

(b) Every person that becomes an urban water supplier after December 31, 1984, shall adopt an urban water management plan within one year after it has become an urban water supplier.

(c) An urban water supplier indirectly providing water to customers may adopt an urban water management plan or participate in areawide, regional, watershed, or basinwide urban water management planning; provided, however, an urban water supplier indirectly providing water shall not include planning elements in its water management plan as provided in Article 2 (commencing with Section 10630) that would be applicable to urban water suppliers or public agencies directly providing water, or to their customers, without the consent of those suppliers or public agencies.

(d) An urban water supplier may satisfy the requirements of this part by participation in areawide, regional, watershed, or basinwide urban water management planning where those plans will reduce preparation costs and contribute to the achievement of conservation and efficient water use.

(e) The urban water supplier may prepare the plan with its own staff, by contract, or in cooperation with other governmental agencies.

10621. Each urban water supplier shall periodically review its plan at least once every five years. After the review, it shall make any amendments or changes to its plan which are indicated by the review. Amendments or changes in its plan shall be adopted and filed in the manner set forth in Article 3 (commencing with Section 10640).

Article 2. Contents of Plans

10630. It is the intention of the Legislature, in enacting this part, to permit levels of water management planning commensurate with the numbers of customers served and the volume of water supplied.

10631. A plan shall include all of the following elements:

(a) Contain an estimate of past, current, and projected water use and, to the extent records are available, segregate those uses between residential, industrial, commercial, and governmental uses.

(b) Identify conservation measures currently adopted and being practiced.

(c) Describe alternative conservation measures, if any, which would improve the efficiency of water use with an evaluation of their costs and their environmental and other significant impacts.

(d) Provide a schedule of implementation for proposed actions as indicated by the plan.

(e) Describe the frequency and magnitude of supply deficiencies, including conditions of drought and emergency, and the ability to meet short-term deficiencies.

10632. In addition to the elements required pursuant to Section 10631, a plan projecting a future use which indicates a need for expanded or additional water supplies shall contain an evaluation of the following:

(a) Waste water reclamation.

(b) Exchanges or transfer of water on a short-term or long-term basis.

(c) Management of water system pressures and peak demands.

(d) Incentives to alter water use practices, including fixture and appliance retrofit programs.

(e) Public information and educational programs to promote wise use and eliminate waste.

(f) Changes in pricing, rate structures, and regulations.

10633. The plan shall contain an evaluation of the alternative water management practices identified in Sections 10631 and 10632, taking into account economic and noneconomic factors, including environmental, social, health, customer impact, and technological factors.

Evaluation of the elements in Section 10632 shall include a comparison of the estimated cost of alternative water management practices with the incremental costs of expanded or additional water supplies, and in the course of the evaluation first consideration shall be given to water management practices, or combination of practices, which offer lower incremental costs than expanded or additional water supplies, considering all the preceding evaluation factors.

Article 3. Adoption and Implementation of Plans

10640. Every urban water supplier required to prepare a plan pursuant to this part shall prepare its plan pursuant to Article 2 (commencing with Section 10630).

The supplier shall likewise periodically review the plan as required by Section 10621, and any amendments or changes required as a result of that review shall be adopted pursuant to this article.

10641. (a) An urban water supplier required to prepare a plan may consult with, and obtain comments from, any public agency or state agency or any person who has special expertise with respect to water conservation and management methods and techniques.

(b) In order to assist urban water suppliers in obtaining needed expertise as provided for in subdivision (a), the department, upon request of an urban water supplier, shall provide the supplier with a list of persons or agencies having expertise or experience in the development of water management plans.

10642. Prior to adopting a plan, the urban water supplier shall make the plan available for public inspection and shall hold a public hearing thereon. Prior to the hearing, notice of the time and place of hearing shall be published within the jurisdiction of the publicly owned water supplier pursuant to Section 6066 of the Government Code. A privately owned water supplier shall provide an equivalent notice within its service area. After the hearing, the plan shall be adopted as prepared or as modified after the hearing.

10643. An urban water supplier shall implement its plan adopted pursuant to this chapter in accordance with the schedule set forth in its plan.

10644. An urban water supplier shall file with the department a copy of its plan no later than 30 days after adoption. Copies of amendments or changes to the plans shall be filed with the department within 30 days after adoption.

The department shall annually prepare and submit to the Legislature a report summarizing the status of the plans adopted pursuant to this part.

CHAPTER 4. MISCELLANEOUS PROVISIONS

10650. Any actions or proceedings to attack, review, set aside, void, or annul the acts or decisions of an urban water supplier on the grounds of noncompliance with this part shall be commenced as follows:

(a) An action or proceeding alleging failure to adopt a plan shall be commenced within 18 months after that adoption is required by this part, or within 18 months after commencement of urban water service by a supplier commencing that service after January 1, 1984.

(b) Any action or proceeding alleging that a plan, or action taken pursuant to the plan, does not comply with this part shall be

commenced within 90 days after filing of the plan or amendment thereto pursuant to Section 10644 or the taking of that action.

10651. In any action or proceeding to attack, review, set aside, void, or annul a plan, or an action taken pursuant to the plan by an urban water supplier on the grounds of noncompliance with this part, the inquiry shall extend only to whether there was a prejudicial abuse of discretion. Abuse of discretion is established if the supplier has not proceeded in a manner required by law or if the action by the water supplier is not supported by substantial evidence.

10652. The California Environmental Quality Act (Division 13 (commencing with Section 21000) of the Public Resources Code) does not apply to the preparation and adoption of plans prepared and adopted under this part. Nothing in this part shall be interpreted as exempting projects for implementation of the plan or for expanded or additional water supplies from the provisions of the California Environmental Quality Act.

10653. The adoption of a plan shall satisfy any requirements of state law, regulation, or order, including those of the State Water Resources Control Board, for the preparation of water management plans or conservation plans; provided, that if the State Water Resources Control Board requires additional information concerning water conservation to implement its existing authority, nothing in this part shall be deemed to limit the board in obtaining that information. The requirements of this part shall be satisfied by any water conservation plan prepared to meet federal laws or regulations after the effective date of this part, and which substantially meets the requirements of this part, or by any existing water management or conservation plan which includes the contents of a plan required under this part.

10654. All costs incurred by an urban water supplier in developing or implementing its plan shall be borne by it unless otherwise provided for by statute.

10655. If any provision of this part or the application thereof to any person or circumstances is held invalid, that invalidity shall not affect other provisions or applications of this part which can be given effect without the invalid provision or application thereof, and to this end the provisions of this part are severable.

10656. This part shall remain in effect only until January 1, 1991, and as of that date is repealed, unless a later enacted statute, which is chaptered before January 1, 1991, deletes or extends that date.

SEC. 2. No appropriation is made and no reimbursement is required by this act pursuant to Section 6 of Article XIII B of the California Constitution or Section 2231 or 2234 of the Revenue and Taxation Code because the local agency or school district has the authority to levy service charges, fees, or assessments sufficient to pay for the program or level of service mandated by this act.

Assembly Bill No. 2661

CHAPTER 355

An act to amend Sections 10631, 10632, and 10644 of, to add Section 10645 to, and to repeal Section 10656 of, the Water Code, relating to water.

[Approved by Governor July 18, 1990. Filed with
Secretary of State July 19, 1990.]

LEGISLATIVE COUNSEL'S DIGEST

AB 2661, Klehs. Water management planning.

(1) Under the Urban Water Management Planning Act, which is to remain in effect only until January 1, 1991, every urban water supplier providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre-feet of water annually is required to prepare and adopt, in accordance with prescribed requirements, an urban water management plan containing prescribed elements. The plan is required to be filed with the Department of Water Resources, and the department is required to annually prepare and submit to the Legislature a report summarizing the status of the plans. Each supplier is required to periodically review its plan in accordance with prescribed requirements.

This bill would delete the January 1, 1991, termination date, thereby imposing a state-mandated local program since the requirements of the act are specifically applicable to local public agency water suppliers. The bill would revise the required elements of the plan and would make related changes. The bill would require the water supplier and the department to make the plan available for public review within 30 days after filing of the plan with the department. The bill would require the department in its annual report to highlight the outstanding elements of individual plans and would also require the department to prepare reports and provide data for specified legislative hearings. The bill would require the department to provide a copy of the report to each supplier which has filed its plan with the department.

(2) The California Constitution requires the state to reimburse local agencies and school districts for certain costs mandated by the state. Statutory provisions establish procedures for making that reimbursement.

This bill would provide that no reimbursement is required by this act for a specified reason.

The people of the State of California do enact as follows:

SECTION 1. Section 10631 of the Water Code is amended to
REPEAL

read:

10631. A plan shall include all of the following elements:

(a) Contain an estimate of past, current, and projected water use and, to the extent records are available, segregate those uses between residential, industrial, commercial, and governmental uses.

(b) Identify conservation measures currently adopted and being practiced.

(c) Describe alternative conservation measures, including, but not limited to, consumer education, metering, water saving fixtures and appliances, lawn and garden irrigation techniques, and low water use landscaping, which would improve the efficiency of water use with an evaluation of their costs and their environmental and other significant impacts.

(d) Provide a schedule of implementation for proposed actions as indicated by the plan.

(e) Describe the frequency and magnitude of supply deficiencies, based on available historic data and future projected conditions comparing water supply and demand, including a description of deficiencies in time of drought and emergency, and the ability to meet deficiencies.

(f) To the extent feasible, describe the method which will be used to evaluate the effectiveness of each conservation measure implemented under the plan.

(g) Describe the steps which would be necessary to implement any proposed actions in the plan.

SEC. 2. Section 10632 of the Water Code is amended to read:

10632. In addition to the elements required pursuant to Section 10631, a plan projecting a future use which indicates a need for expanded or additional water supplies shall contain an evaluation of the following alternatives:

(a) Waste water reclamation.

(b) Exchanges or transfer of water on a short-term or long-term basis.

(c) Management of water system pressures and peak demands.

(d) Issues relevant to meter retrofitting for all uses.

(e) Incentives to alter water use practices, including fixture and appliance retrofit programs.

(f) Public information and educational programs to promote wise use and eliminate waste.

(g) Changes in pricing, rate structures, and regulations.

SEC. 3. Section 10644 of the Water Code is amended to read:

10644. An urban water supplier shall file with the department a copy of its plan no later than 30 days after adoption. Copies of amendments or changes to the plans shall be filed with the department within 30 days after adoption.

Plans filed under this section shall describe the basis for the decision of the urban water supplier to add, change, or retain conservation measures.

The department shall annually prepare and submit to the Legislature a report summarizing the status of the plans adopted pursuant to this part. The report prepared by the department shall highlight the outstanding elements of individual plans. The department shall provide a copy of the report to each urban water supplier which has filed its plan with the department. The department shall also prepare reports and provide data for any legislative hearings designed to consider the effectiveness of plans submitted pursuant to this part.

SEC. 4. Section 10645 is added to the Water Code, to read:

10645. Not later than 30 days after filing a copy of its plan with the department, the urban water supplier and the department shall make the plan available for public review during normal business hours.

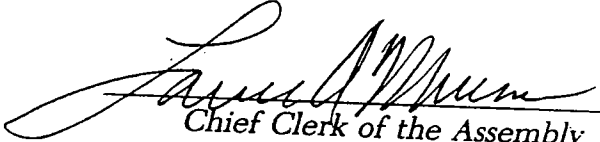
SEC. 5. Section 10656 of the Water Code is repealed.

SEC. 6. No reimbursement is required by this act pursuant to Section 6 of Article XIII B of the California Constitution because the local agency or school district has the authority to levy service charges, fees, or assessments sufficient to pay for the program or level of service mandated by this act. Notwithstanding Section 17580 of the Government Code, unless otherwise specified in this act, the provisions of this act shall become operative on the same date that the act takes effect pursuant to the California Constitution.

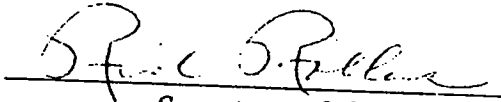
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Assembly Bill No. 11

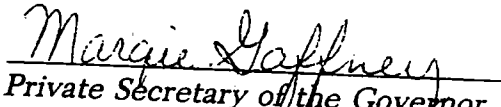
Passed the Assembly September 13, 1991


Chief Clerk of the Assembly

Passed the Senate September 11, 1991


Secretary of the Senate

This bill was received by the Governor this 27th
day of September, 1991, at 1:40 o'clock P.M.


Private Secretary of the Governor

CHAPTER _____

An act to amend Sections 10620, 10621, 10631, and 10632 of, and to add Section 10656 to, the Water Code, relating to water.

LEGISLATIVE COUNSEL'S DIGEST

AB 11, Filante. Urban water management plans.

(1) Existing law requires every urban water supplier serving water directly to customers to, not later than December 31, 1985, prepare and adopt an urban water management plan. Existing law authorizes an urban water supplier indirectly providing water to customers to adopt an urban water management plan or to participate in urban water management planning.

This bill would, instead, require every urban water supplier, whether serving water directly or indirectly to customers, to prepare and adopt an urban water management plan, as prescribed.

(2) Existing law requires the urban water management plan to include a prescribed description of water supply deficiencies.

This bill would delete that provision and would require the urban water management plan to include an urban water shortage contingency plan, as specified. The bill would require each urban water supplier to coordinate the preparation of its urban water shortage contingency plan with other urban water suppliers and public agencies in the area to the extent practicable. ~~The bill would require each urban water supplier, not later than January 31, 1989, to prepare, adopt, and submit to the Department of Water Resources an amendment to its urban water management plan which meets the requirements relating to the preparation of the urban water shortage contingency plan. The bill would make an urban water supplier that does not submit the amendment by that date ineligible to receive drought assistance from the state until the urban water management plan is submitted, as prescribed.~~

(3) Existing law exempts the preparation and

adoption of urban water management plans from the California Environmental Quality Act.

This bill would exempt the implementation of urban water shortage contingency plans from that act. The bill would provide that the exemption provisions do not exempt specified projects from the requirements of that act.

The people of the State of California do enact as follows:

SECTION 1. Section 10620 of the Water Code is amended to read:

10620. (a) Every urban water supplier shall prepare and adopt an urban water management plan in the manner set forth in Article 3 (commencing with Section 10640).

(b) Every person that becomes an urban water supplier after December 31, 1984, shall adopt an urban water management plan within one year after it has become an urban water supplier.

(c) An urban water supplier indirectly providing water shall not include planning elements in its water management plan as provided in Article 2 (commencing with Section 10630) that would be applicable to urban water suppliers or public agencies directly providing water, or to their customers, without the consent of those suppliers or public agencies.

(d) (1) An urban water supplier may satisfy the requirements of this part by participation in areawide, regional, watershed, or basinwide urban water management planning where those plans will reduce preparation costs and contribute to the achievement of conservation and efficient water use.

(2) Each urban water supplier shall coordinate the preparation of its urban water shortage contingency plan with other urban water suppliers and public agencies in the area, to the extent practicable.

(e) The urban water supplier may prepare the plan with its own staff, by contract, or in cooperation with other governmental agencies.

SEC. 2. Section 10621 of the Water Code is amended