Table 4.1 USGS Surface Water Gaging Stations

Station No.	Description:	Lat.; Long.*	Data Type	Time Frame
11069200	Lake Hemet WC up Canyon near San Jacinto	33°44'20"; 116°49'30"	Daily flows	1961-1991
11069300	WF San Jacinto Tributary near Valle Vista	33°43'20"; 116°48'00"	Peak flows Daily flows	1962-1973 1961-1967
11069500	San Jacinto River near San Jacinto (Cranston Ranger Station)	33°44'17"; 11649'59"	Real time Peak flows Daily flows Water Qual.	 1921-present 1920-present 1998
11069501	San Jacinto River near San Jacinto plus Canals	33°44'17"; 116°49'59"	Daily flows	1948-1990
11070000	Bautista Creek Near Hemet	33°41'40"; 116°51'00"	Peak flows Daily flows	1947-1969 1947-1969
11070020	Bautista Creek at head of Flood Channel in Hemet	33°42'42"; 116°52'04"	Peak flows Daily flows	1988-2003 1987-present
11070050	Bautista Creek at Valle Vista	33°44'04"; 116°53'33"	Peak flows Daily flows	1970-1987 1969-1987
11070150	San Jacinto River above State Street near San Jacinto	33°49'17"; 116°58'21"	Peak flows Daily flows	1997-present 1996-present
11070158	Line D Storm Drain at Santa Fe St. near San Jacinto	33°46'44"; 116°57'46"	Peak flows	1997-1999
11070160	Line E Storm Drain at Santa Fe St. near San Jacinto	33°46'41': 116°58'18"	Peak flows	1997-1999
11070185	Lamb Canyon at Victory Ranch near San Jacinto	33°51'31"; 117°00'53"	Peak flows	1997-2004
11070190	Laborde Canyon near San Jacinto	33°51'44"; 117°01'29"	Peak flows	1962-1973
11070210	San Jacinto River at Ramona Expressway near Lakeview	33°50'23"; 117°08'06"	Real time Peak flows Daily flows	 2001-present 2000-present

* The longitude and latitude measurements are published figures, but were estimated by the USGS from maps and, therefore, only have an accuracy of +/- 500 feet.

Five gages were installed upstream of Bridge Street in the San Jacinto basin area. Two stream flow gages were installed in the San Jacinto River, one at the State Street (Highway 79) crossing and the other at the Cranston Ranger Station. Three crest stage gages were installed in Potrero Canyon near San Jacinto, Lamb Canyon near San Jacinto, and at an urban runoff site.

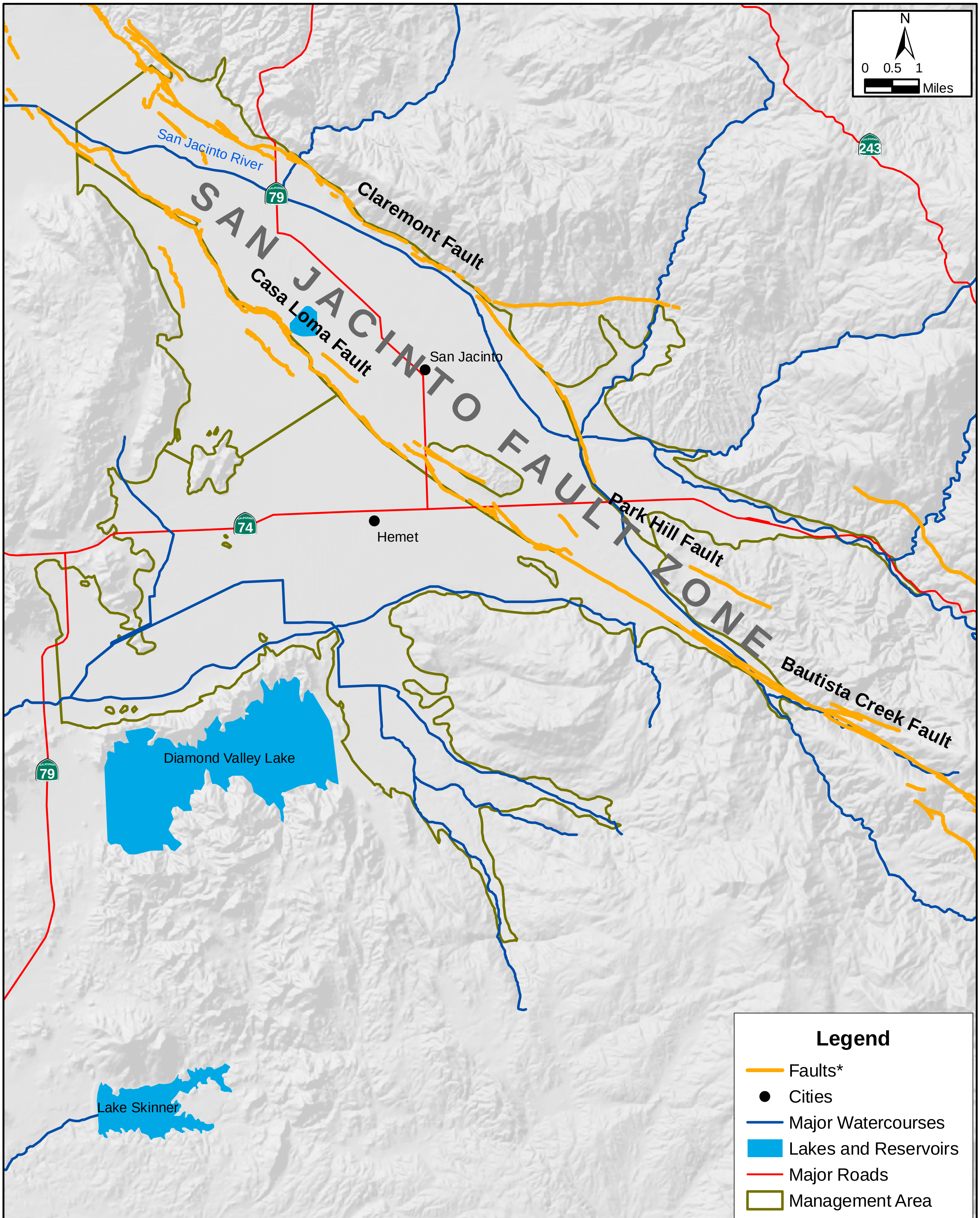
Groundwater recharge in the Canyon and Upper Pressure Management Zones was calculated in addition to the surface runoff leaving the Management Area (including urban runoff) that reaches the Mystic Lake area. The study results are summarized in the USGS Water Resources Investigations Report 02-4090, *Rainfall-Runoff Characteristics and Effects of Increased Urban Density on Streamflow and Infiltration in the Eastern Part of the San Jacinto River Basin, Riverside County,* *California*. The report includes all measured, simulated, and statistical data used to support the conclusions of the study.

After the end of the study, some of the crest stage gages were no longer monitored and fell into disrepair. However, EMWD continues to fund, and USGS continues to operate, the stream gage on the San Jacinto River at State Street. The crest stage gage at Lamb Canyon Creek at Victory Ranch is still jointly funded by EMWD and USGS. For the 2005/2006 monitoring, the effort was funded as part of the Hemet/San Jacinto Monitoring Program by EMWD, LHMWD, and the Cities of Hemet and San Jacinto. The stream gage on the San Jacinto River at Cranston Ranger Station is currently funded and maintained by USGS and Riverside County Flood Control District with real-time data available on the USGS website.

4.3 GEOLOGY

The geology of the Hemet/San Jacinto area, relevant to groundwater supplies, has two primary features: a sediment filled graben, and the San Jacinto fault zone. The sediments in the graben provide for the majority of storage and movement of groundwater in the area and the movement of water is altered by the presence of the faults, which provide most of the internal boundaries for the area’s Management Zones.

The Management Area partially contains a geomorphic feature known as a graben or fault-graben, along with additional permeable materials in alluvium-filled valleys. A graben is a depressed, trough-like structure in the Earth's crust, filled or partially filled with sediments, and usually formed by faulting and the relative downward movement of block-like geologic structures. The San Jacinto graben is a deep, sediment-filled structure approximately 2.5 miles wide and more than 20 miles long and forms the Upper Pressure Management Zone’s boundaries in the Management Area. The Management Area, including the graben, is nearly surrounded by impermeable bedrock mountains and hills. Internally, island-like masses of granite and metamorphic bedrock or older alluvium rise above the valley floor. Surface and near-surface sediments in the graben and alluvium filled valleys are primarily sand and sandy silt with some silt and silty clay. The San Jacinto graben consists of a forebay area in the southeast where surface water recharge primarily occurs and a pressure area in the northwest where deep aquifers exist under confined conditions. The northwest-southeast oriented graben is formed by the right-slipping San Jacinto fault zone, believed to be the most seismically active in southern California. Between 1899 and the present, seven earthquakes of Richter magnitude 6.0 or greater have occurred along the San Jacinto fault between the San Gabriel Mountains and Mexico. This complex zone of faulting and cross faulting has two main branches, the Claremont and the Casa Loma, which form the northeast and southwest borders of the graben, respectively (see Figure 4.4).



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Fault Locations

Hemet / San Jacinto Water Management Plan

*Source: Riverside County

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Figure 4.4

The Claremont fault separates the graben from the Badlands and the San Jacinto Mountains on the northeast. This fault follows Gilman Springs Road from State Highway 60 to the City of San Jacinto, hugging the foothills. It then follows the San Jacinto River before shifting to Bautista Creek south of Valle Vista. To the west, the Casa Loma fault generally parallels the Claremont Fault. The Casa Loma portion of the San Jacinto fault zone forms the southwesterly border of the graben. It runs from Park Hill (also known as Casa Loma) to the northwest toward Reche Canyon. The Bautista Creek fault is an extension of the Casa Loma fault, but is separately named due to differences in fault movement (DWR, 1969). The Bautista Creek fault runs from Bautista Canyon through the intersection of Menlo and San Jacinto Streets, joining the Casa Loma fault on the western side of Park Hill.

The portions of the Management Area outside the graben, to the east of the Claremont Fault and to the west of the Casa Loma and Bautista Creek faults, are sediment filled basins. These sediments are similar in nature to those in the graben, but are much thinner.

The faulting in the Management Area plays an important role in the movement of groundwater and is therefore a key factor in the delineation of Management Zones.

4.4 DELINEATION OF MANAGEMENT ZONES

Groundwater Management Zones (Figure 2.1) were delineated by the RWQCB based on major impermeable boundaries (such as bedrock or faults), flow systems that prevent widespread mixing even without a physical barrier, and water quality. Groundwater flow, whether or not determined by a physical barrier, was the primary characteristic used to define the Management Zones. Water quality data were used to support understanding of the flow regime and to assure that unusually high quality or poor quality waters were distinguished for regulatory purposes. (RWQCB, Resolution No. R8-2004-0001).

The four Management Zones within the Hemet/San Jacinto Management Area are:

1. Canyon;
2. San Jacinto Upper Pressure (Upper Pressure);
3. The Hemet North portion of Lakeview/Hemet North (Hemet North); and
4. Hemet South.

The Canyon Management Zone lies along a northwest to southeast axis in the eastern part of the Management Area. The boundaries of the Canyon Management Zone include the virtually impermeable San Jacinto Mountains to the east and Claremont Fault to the west. The Claremont Fault inhibits flow between Canyon and Upper Pressure Management Zones (DWR, 1969; DWR, 1978; SWRB, 1955).

Like the Canyon Management Zone, the Upper Pressure Management Zone lies along a northwest to southeast axis in the eastern part of the Management Area. The Upper Pressure Management Zone is bounded by the Claremont Fault to the northeast, the Casa Loma and Bautista Creek Faults to the southwest, and the flow system boundary with the San Jacinto Lower Pressure Management Zone to the northwest.

Boundaries of the Hemet North Management Zone include the Casa Loma Fault to the east; the groundwater divide near Esplanade Avenue to the south; the impermeable bedrock of the Lakeview Mountains to the west; and a constricted area of permeable materials between the Lakeview Mountains and the Casa Loma Fault to the northwest. The Casa Loma fault zone is a known barrier to groundwater flow (DWR, 1969; DWR, 1978; SWRB, 1955).

The Hemet South Management Zone boundaries include the Casa Loma and Bautista Creek faults to the east; the groundwater divide near Esplanade Avenue to the north; the groundwater divide in the Winchester area and various crystalline bedrock outcrops to the west. Diamond Valley Lake, a water supply reservoir for the MWD completed in 1999 and filled by 2002, is located southwest of the Hemet South Management Zone. MWD (1991) states that seepage through the permeable materials in the upper 200 feet may take place. The Casa Loma and Bautista Creek faults are known barriers to groundwater (DWR, 1969; DWR, 1978; SWRB, 1955).

For the Management Area as a whole, the mountains (Figure 4.1) form a nearly impermeable boundary such that there are only three pathways for groundwater to migrate to or from other Management Zones outside the Management Area. These locations are:

- Between the Hemet South and Perris South Management Zones, in the southwest;
- Between the Hemet North portion and Lakeview portion of Lakeview/Hemet North Management Zones, in the northwest; and
- Between the Upper Pressure and Lower Pressure Management Zones, in the northwest.

Groundwater flow in and out of the Management Area is important, as water quality is typically better in the Management Area than in the surrounding areas.

4.5 SOILS

The influence of soils on water use and hydrologic processes makes it an important component to consider when estimating changes in water use due to land use change as well as for siting spreading basins for artificial recharge projects.

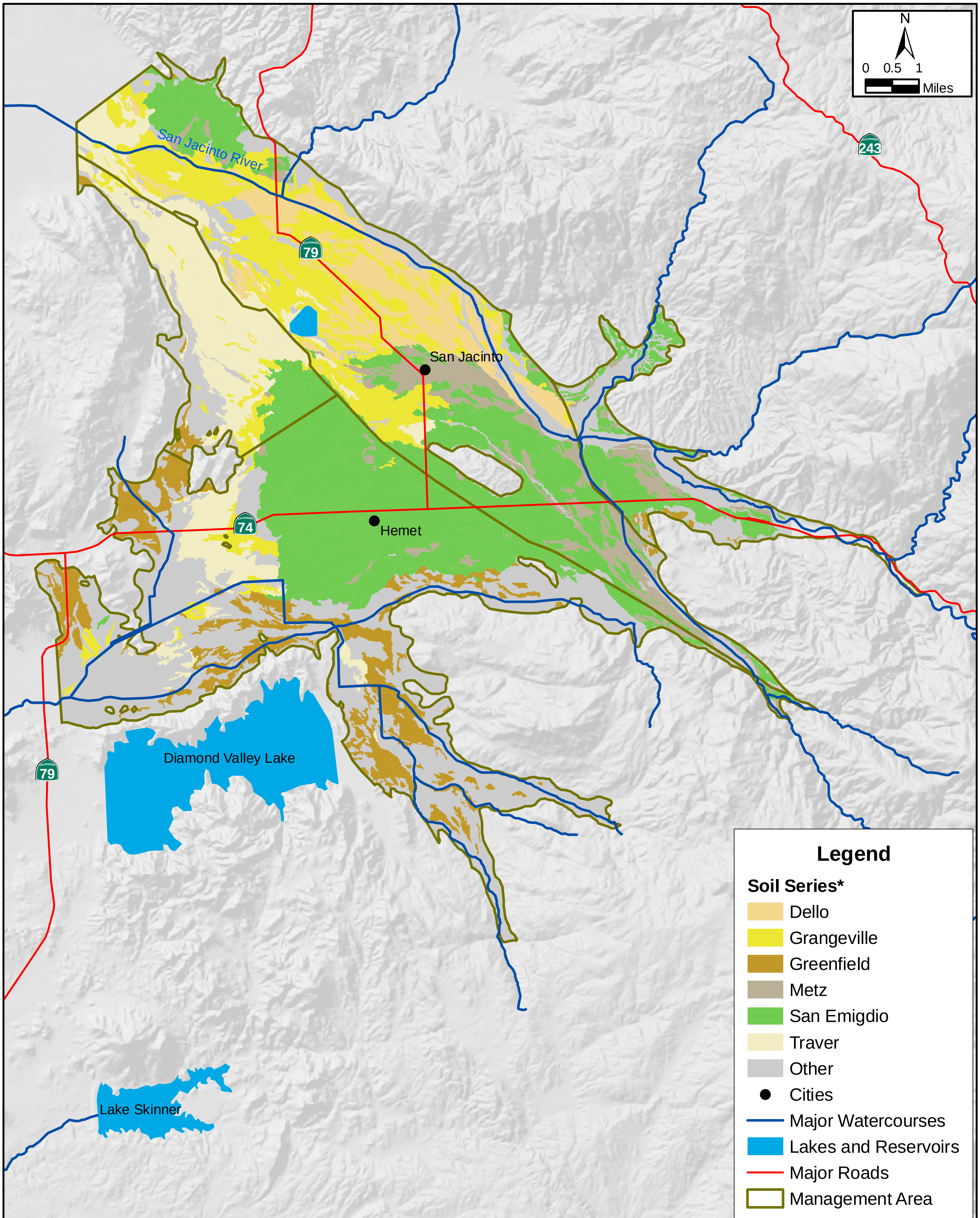
The predominant soils, as defined in the USDA's soil survey (USDA, 1971) at the series level, in the Management Area are shown in Figure 4.5 and are listed below:

- Dello,
- Grangeville,
- Greenfield,
- Metz,
- San Emigdio, and
- Traver.

The remaining soils are classified as "Other" in Figure 4.5 and consist of Chino, Domino, Exeter, Hanford, Pachappa, Ramona, Riverwash, as well as other soil series occurring in less than one square mile of the Management Area.

An important soil classification used by the USDA for hydrology is the hydrologic soils group. The hydrologic soils group can be used to estimate the amount of infiltration that can be expected from a certain soil. This grouping is based on estimates of the intake of water during the latter part of a storm of long duration, after the soil profile is wet and has an opportunity to swell, without the protective effect of any vegetation. Also considered are depths to the seasonal high water table and to a low permeability layer. The classification is useful at a planning level, but detailed studies are required for a thorough understanding of the infiltration capacity of soils. Features such as slope, ground cover, or low permeability materials away from the upper soil profile may impact the soil's capability to infiltrate water.

Under the hydrologic soils group classification system, soils are grouped A to D with "A" having the lowest runoff potential (highest infiltration rates) and "D" having the highest runoff potential (lowest infiltration rates). A map of hydrologic soils groups is provided as Figure 4.6 (USDA-SCS, 1971) and a corresponding table of hydrologic soil groups and soil series is provided in Table 4.2. As can be seen on Figure 4.6, most of the Management Area is classified as "B", soils with a moderate infiltration rate. Of the Management area, nearly 80% are "B" soils, 10% are "A" soils, and the remainder are either "C", "D", or are deemed too variable to be classified. The "A" soils are generally located along the San Jacinto River and Bautista Creek; much of the "variable" soils along these watercourses also have the potential for very high infiltration rates.



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Soil Series

Hemet / San Jacinto Water Management Plan

*Source: USDA, 1971

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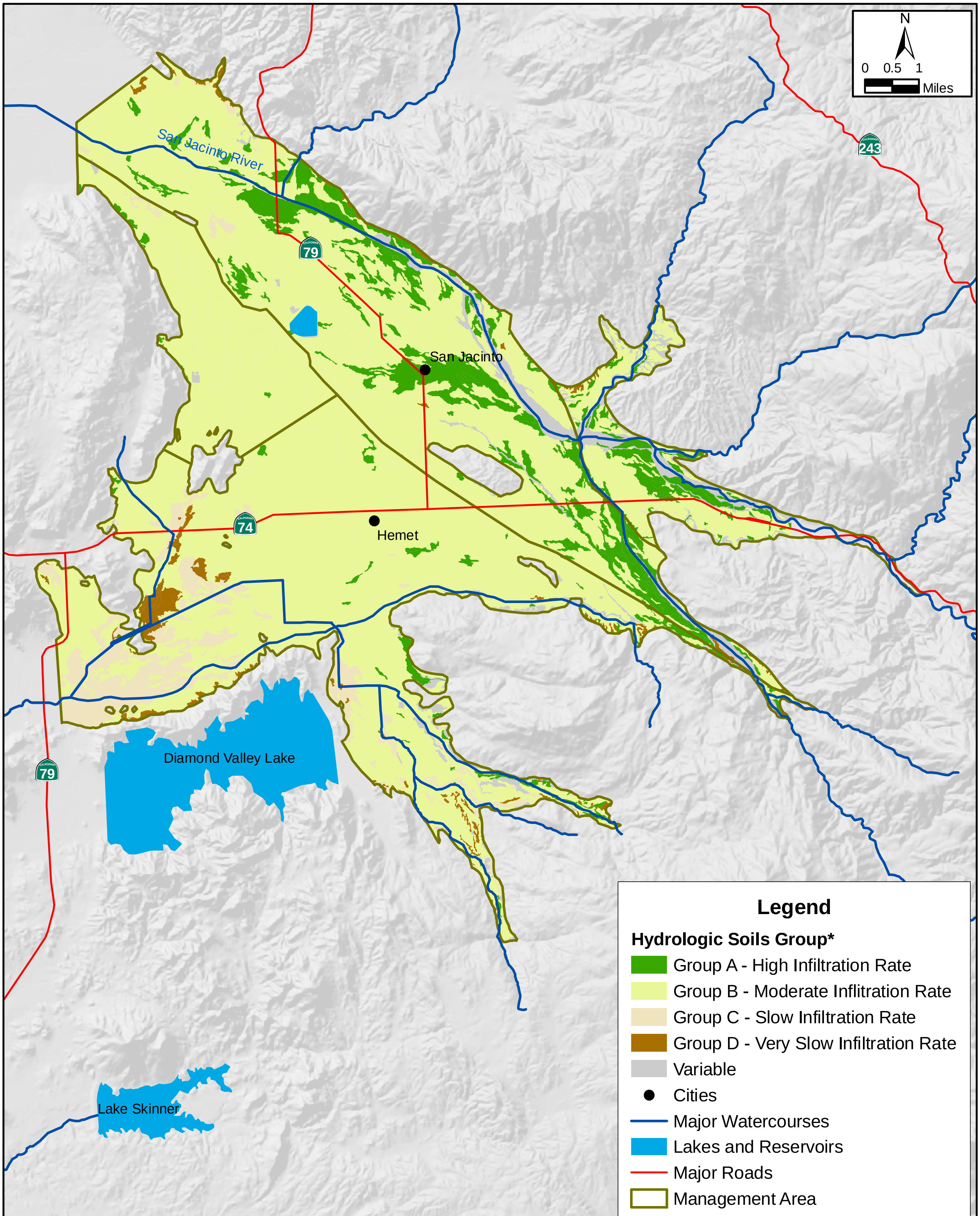
Figure 4.5



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Hydrologic Soils Groups

Hemet / San Jacinto Water Management Plan

*Source: USDA, 1971

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Figure 4.6

Table 4.2 Hydrologic Soils Groups

Common Soil Series	Hydrologic Soils Group	Minor Soil Series	Hydrologic Soils Group
Dello	A-C	Chino	B-C
Grangeville	B-C	Domino	C
Greenfield	B	Exeter	C
Metz	A	Hanford	B
San Emigdio	B	Pachappa	B
Traver	B-C	Ramona	B-C
		Riverwash	variable
		Other	variable

4.6 GROUNDWATER CONDITIONS

As previously stated, groundwater flow between Management Zones is inhibited by geologic faults, (Figure 4.4) notably the Casa Loma Fault, Bautista Creek Fault and Claremont Fault, all strands of the San Jacinto fault zone. The Claremont Fault acts as a barrier to flow between Canyon and Upper Pressure Management Zones, while the Casa Loma Fault is a barrier to flow between the Upper Pressure Management Zone and both the Hemet North and Hemet South Management Zones.

The San Jacinto River enters the basin in the southeast part of the Management Area and flows north and west across the Upper Pressure Management Zone. In most years, all river flow is lost to percolation and limited evapotranspiration in the Canyon and Upper Pressure Management Zones. Recharge from the San Jacinto River and its tributaries forms a large portion of total inflow for the Canyon and Upper Pressure Management Zones.

Groundwater pumping for irrigation and domestic purposes is the principal source of groundwater outflow. Major pumping depressions occur in the Hemet South and Upper Pressure Management Zones.

Historically, extraction in excess of recharge has resulted in lowered groundwater levels and altered directions of groundwater flow.

4.6.1 ARTIFICIAL RECHARGE OPERATIONS

In addition to natural inflows and return flows from agricultural and municipal uses, there has been and continues to be artificial recharge operations in the Management Area. These operations use imported water, when available, typically at lower winter rates, to artificially recharge groundwater through spreading basins. The annual volume of imported water recharged is presented in Figure 4.7. Recharge operations did not begin until 1990. More recently, the Public Agencies have signed memoranda of understanding in 2004 and 2005 to plan for the recharge at two existing recharge facilities in the San Jacinto riverbed.

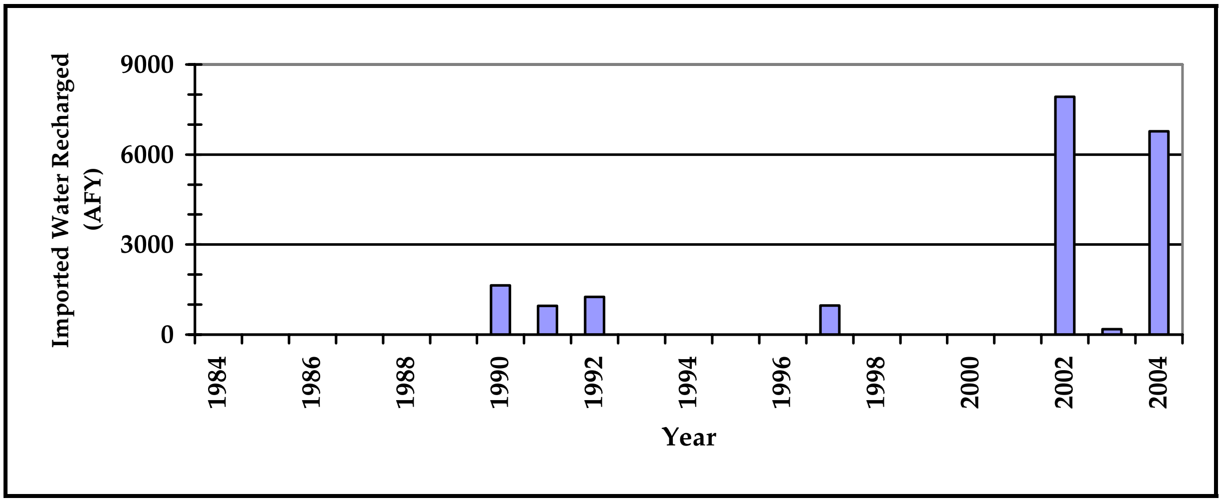
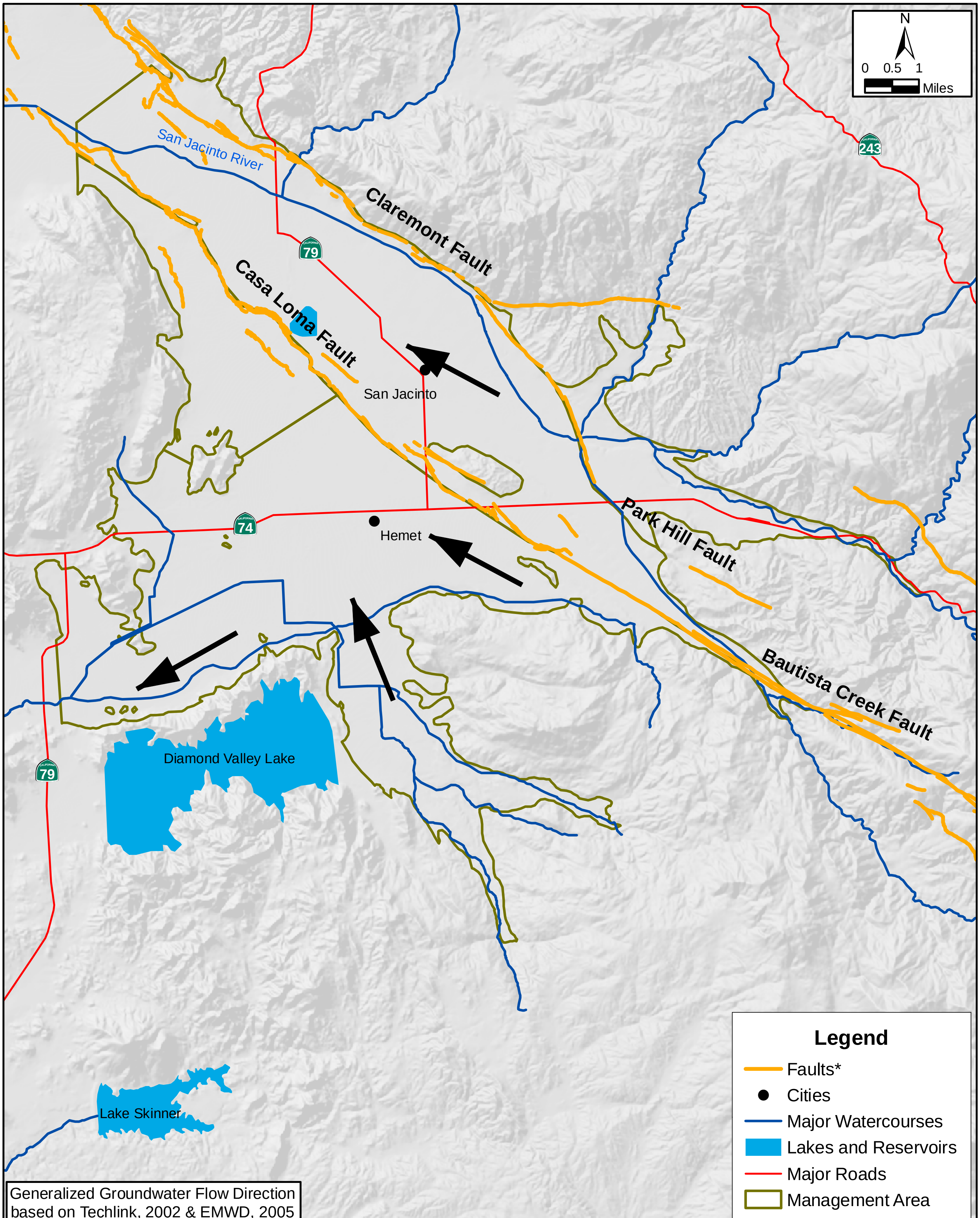


Figure 4.7 Annual Imported Water Recharged

The artificial recharge operations help address the impact of overdraft caused by past groundwater production.

4.6.2 GROUNDWATER LEVELS AND FLOW

Historical groundwater extraction from the Management Area has resulted in a significant drop in groundwater levels. The lowered groundwater levels also changed the direction of flow in parts of the Management Area. Figure 4.8 shows the flow directions in the early 20th Century. Figure 4.9 shows current flow directions. Notable changes over time include the development of a groundwater divide between the Hemet South and Perris South Management Zones (previously flow was out of the Hemet South Management Zone into the Perris South Management Zone and flow from the Hemet North portion to the Lakeview portion of the Lakeview/Hemet North Management Zone due to lower water levels in the Lakeview portion. (TechLink, 2002a)



Early 20th Century Groundwater Flow Direction

Hemet / San Jacinto Water Management Plan

*Source: Riverside County

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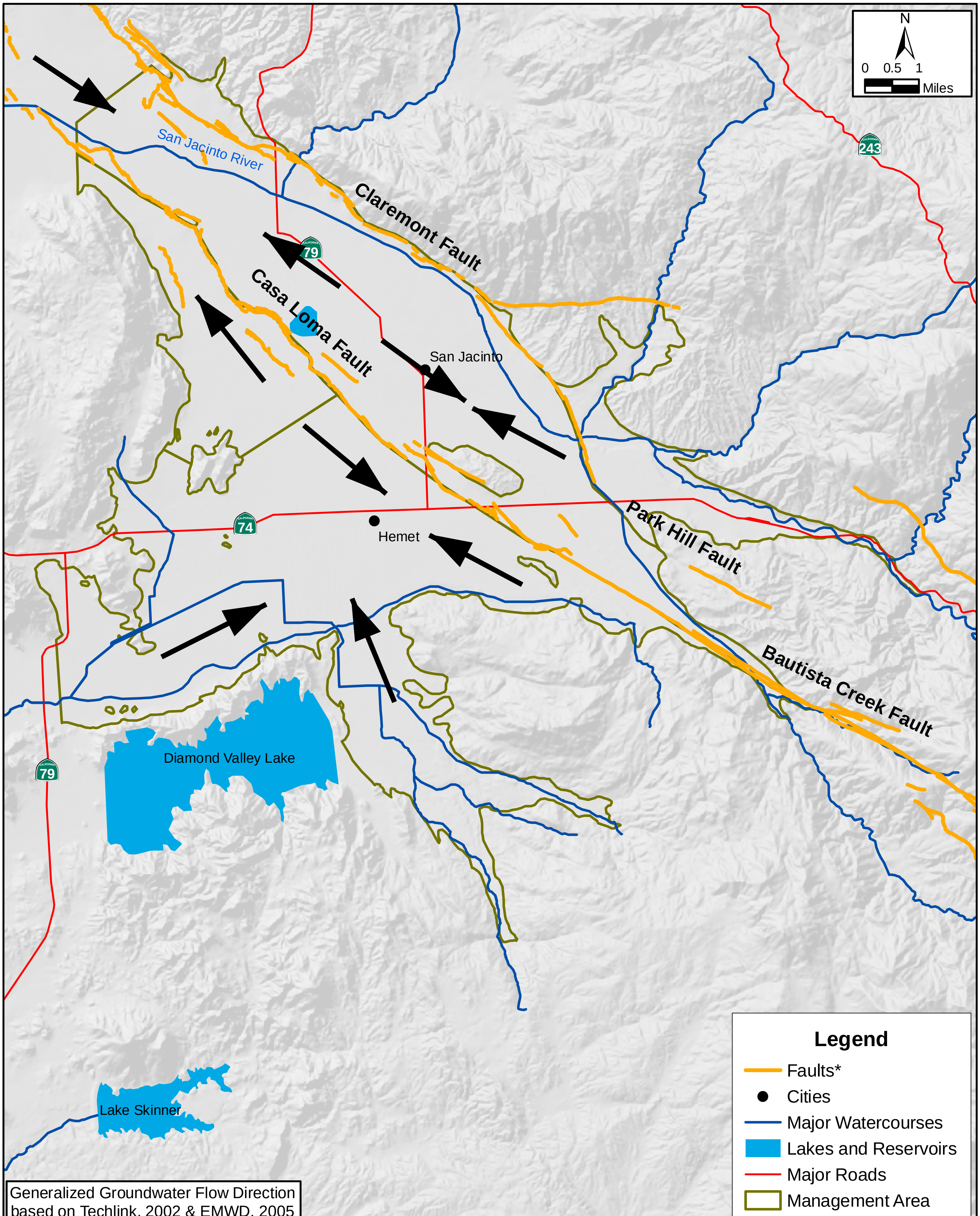
Figure 4.8



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Current Groundwater Flow Direction

Hemet / San Jacinto Water Management Plan

*Source: Riverside County

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Figure 4.9

Figure 4.10 shows Spring 2004 groundwater levels. The groundwater level contours show pumping depressions in the northeastern part of the Hemet South Management Zone and in the northwestern part of the Upper Pressure Management Zone. These pumping depressions are due to concentrated pumping in those areas in excess of the local recharge capacity.

Historical groundwater levels are affected by both climatic conditions, which impact the amount of recharge, and pumping. Historical conditions in the four Management Zones can be studied in relation to their unique setting by analyzing observed water levels at representative wells with long periods of record. Hydrographs for four selected wells are presented in the following sections. The locations of the wells can be found on Figure 4.11.

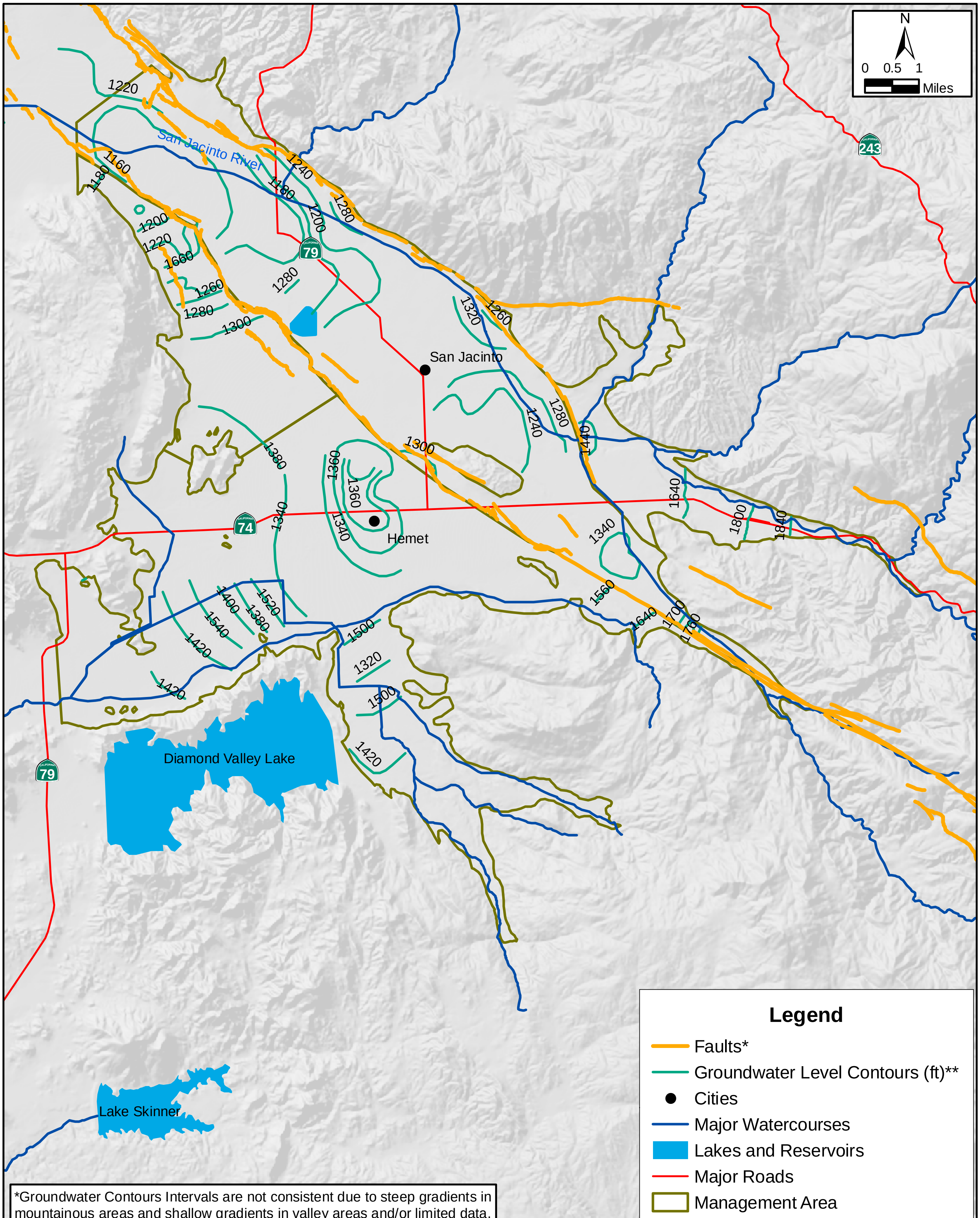
4.6.2.1 Canyon Management Zone

The Canyon Management Zone benefits from significant surface water recharge from the San Jacinto River and its tributaries. This additional recharge reduces the impact of the pumping occurring in the Canyon Management Zone. Figure 4.12 shows groundwater levels from 1948 to 2005 for EMWD's #6 Cienega well. This figure shows the impact of hydrologic variability and pumping in the area. One drought period in the late 1980s resulted in groundwater levels dropping by over 100 feet. Such declines in groundwater levels are likely due to a combination of reduced precipitation, reduced recharge from streamflow, and the effects of pumping. Most of this decline was recovered in the wet period that followed from 1991 to 1993.

Changes are also seen seasonally, with groundwater levels changing by as much as 100 feet from late fall to late spring. These seasonal changes in water levels are also due to a combination of reduced precipitation, reduced recharge from streamflow, and the effects of pumping.

4.6.2.2 Upper Pressure Management Zone

The Upper Pressure Management Zone benefits from surface water recharge from the San Jacinto River and its tributaries and supplies most of the groundwater for the Management Area. However, even with significant recharge from surface water as well as other inflows, wells in the Upper Pressure Management Zone have shown a decline in water levels over time. Figure 4.13 presents water level elevations for EMWD's #9 Hewitt and Evans well, showing a consistent decline through the dry period of the 1950s, 1960s, and 1970s with a drop of more than 200 feet over the 30-year period. The hydrologically wet and normal periods during 1978 to 1986 resulted in a recovery of about half the decline from the previous three decades. Since 1986, groundwater levels have dropped approximately 200 feet. The changes seen in the well



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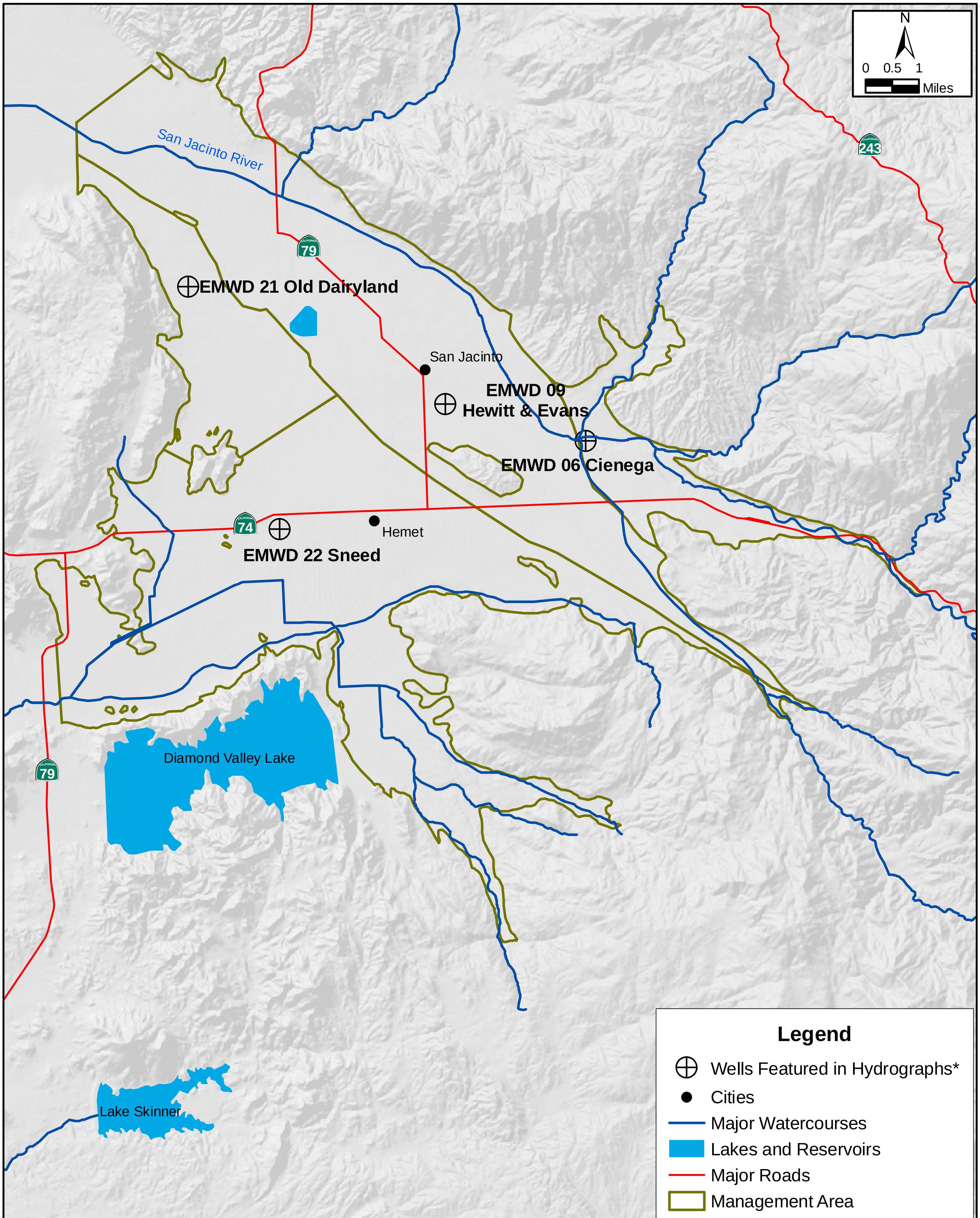
Spring 2004 Groundwater Elevation

Hemet / San Jacinto Water Management Plan

*Source: Riverside County
**Source: EMWD, 2005

October 2007

Figure 4.10



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Location of Representative Well Hydrographs

Hemet / San Jacinto Water Management Plan

*Source: EMWD

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Figure 4.11

Figure 4.12 Groundwater Elevation
Canyon Management Zone, EMWD #6 Cienega

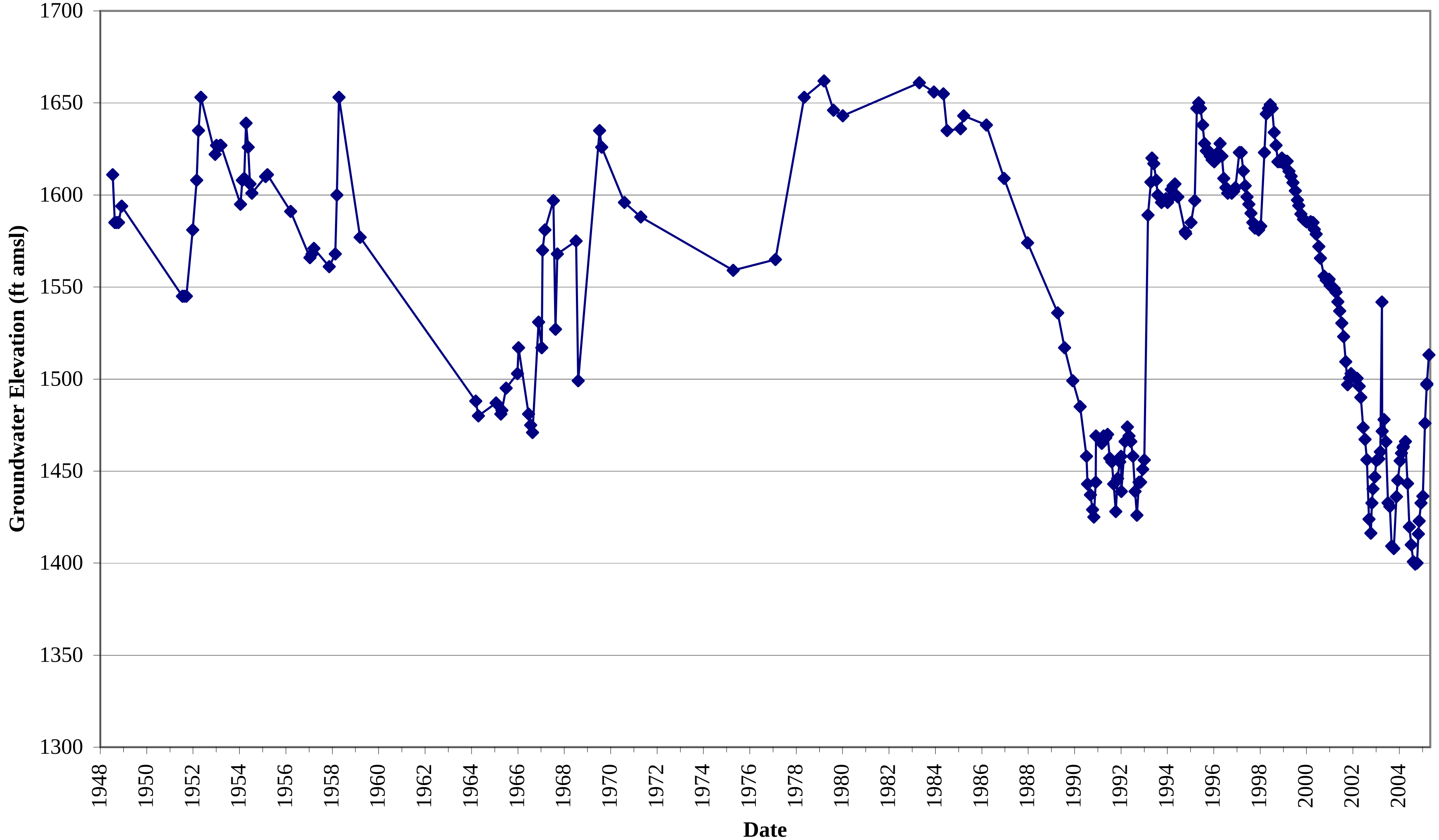
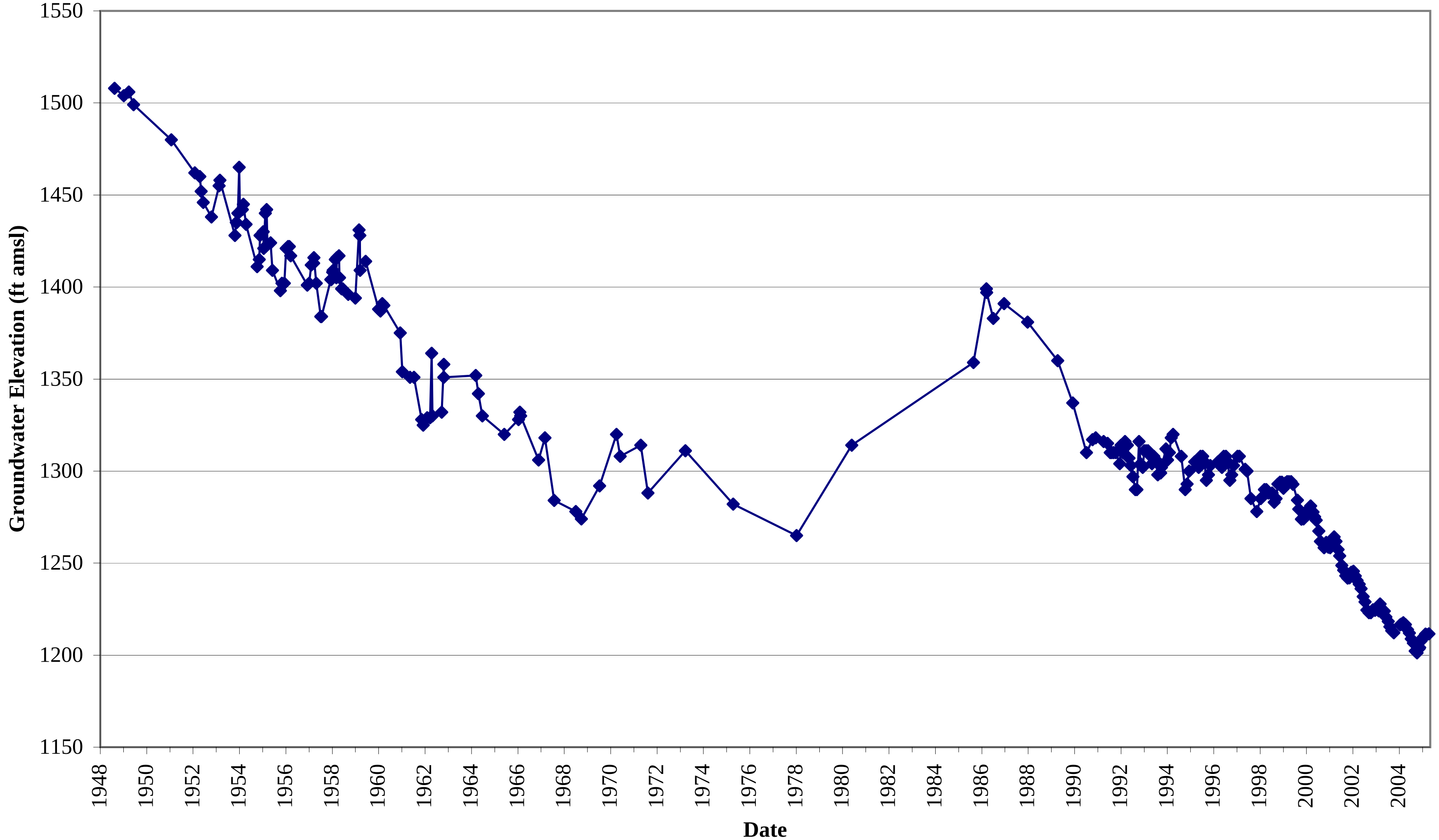


Figure 4.13 Groundwater Elevation
Upper Pressure Management Zone, EMWD #9 Hewitt and Evans



are likely due to a combination of reduced precipitation, reduced recharge from streamflow, and effects of pumping.

4.6.2.3 Hemet North Portion of the Lakeview/Hemet North Management Zone

Groundwater levels in Hemet North portion of the Lakeview/Hemet North Management Zone have shown a steady decline followed by recent stabilization. These declines occur even though significantly less water was pumped from the Hemet North portion than from other Management Zones. The Hemet North portion does not receive as much surface water recharge as Upper Pressure and Canyon Management Zones, thus impacts of pumping are more pronounced than they might be in those Management Zones. Figure 4.14 shows groundwater levels at EMWD's #21 Old Dairyland well. Since the beginning of the record in 1966, groundwater levels have steadily declined, with little variability. After dropping more than 100 feet from the mid-1960s to the mid-1990s, groundwater levels have stabilized at an average of 1,250 feet above mean sea level.

4.6.2.4 Hemet South Management Zone

Groundwater levels in the Hemet South Management Zone have shown a steady decline, although the recent rate of decline has slowed. Figure 4.15 shows groundwater levels at EMWD's #22 Sneed well since the beginning of the record in 1952. While data is limited for the 1952 to 1990 period, groundwater levels declined through the 1952-1990 period, and the increased data available from 1990 to 2005 shows little variability. Groundwater level declines have slowed but have still dropped approximately 20 feet in the past 10 years.

4.6.3 GROUNDWATER BUDGET

The changes in groundwater levels and flow directions are the result of changes in the balance of inflows and outflows from the Management Area. A groundwater budget can identify potential causes of an imbalance. The groundwater budget presented in Table 4.3 shows average annual values for the components of total inflow and total outflow. The values are based on a water balance spreadsheet tool developed for use by the TC. This Excel-based tool allowed the TC members to investigate the impact of inclusion and exclusion of specific water budget components, such as artificial recharge, imported water, and others, as well as the implications of different data sources, such as the calibrated groundwater model and the database or reported values with underflow estimates. This allowed for a more thorough understanding of the potential impacts of definitions of water budget components on the calculated yield and overdraft. The values presented in Table 4.3, as agreed upon by the TC, are the results of the calibrated groundwater model except for groundwater extraction, which is

Figure 4.14 Groundwater Elevation
Hemet North Management Zone, EMWD #21 Old Dairyland

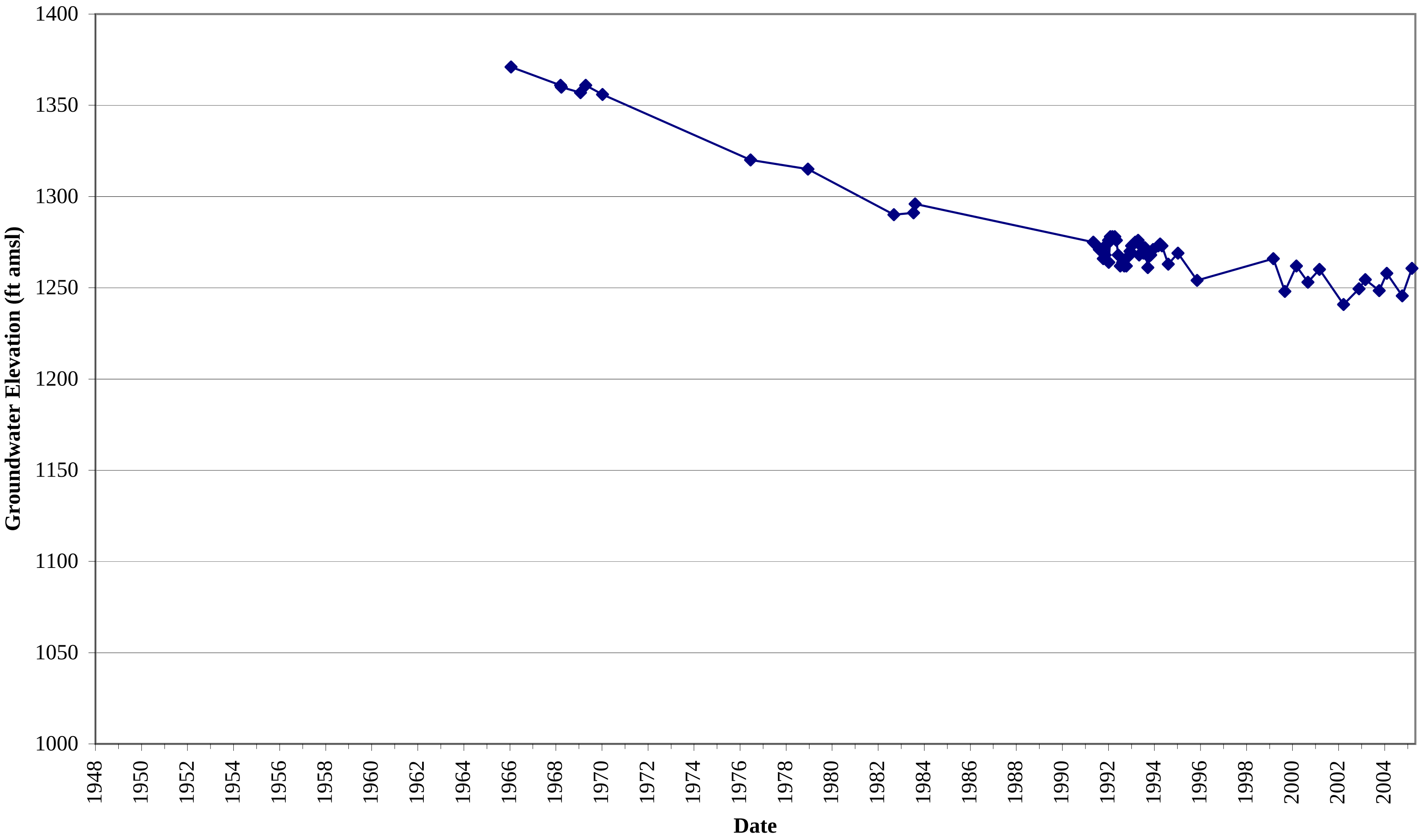
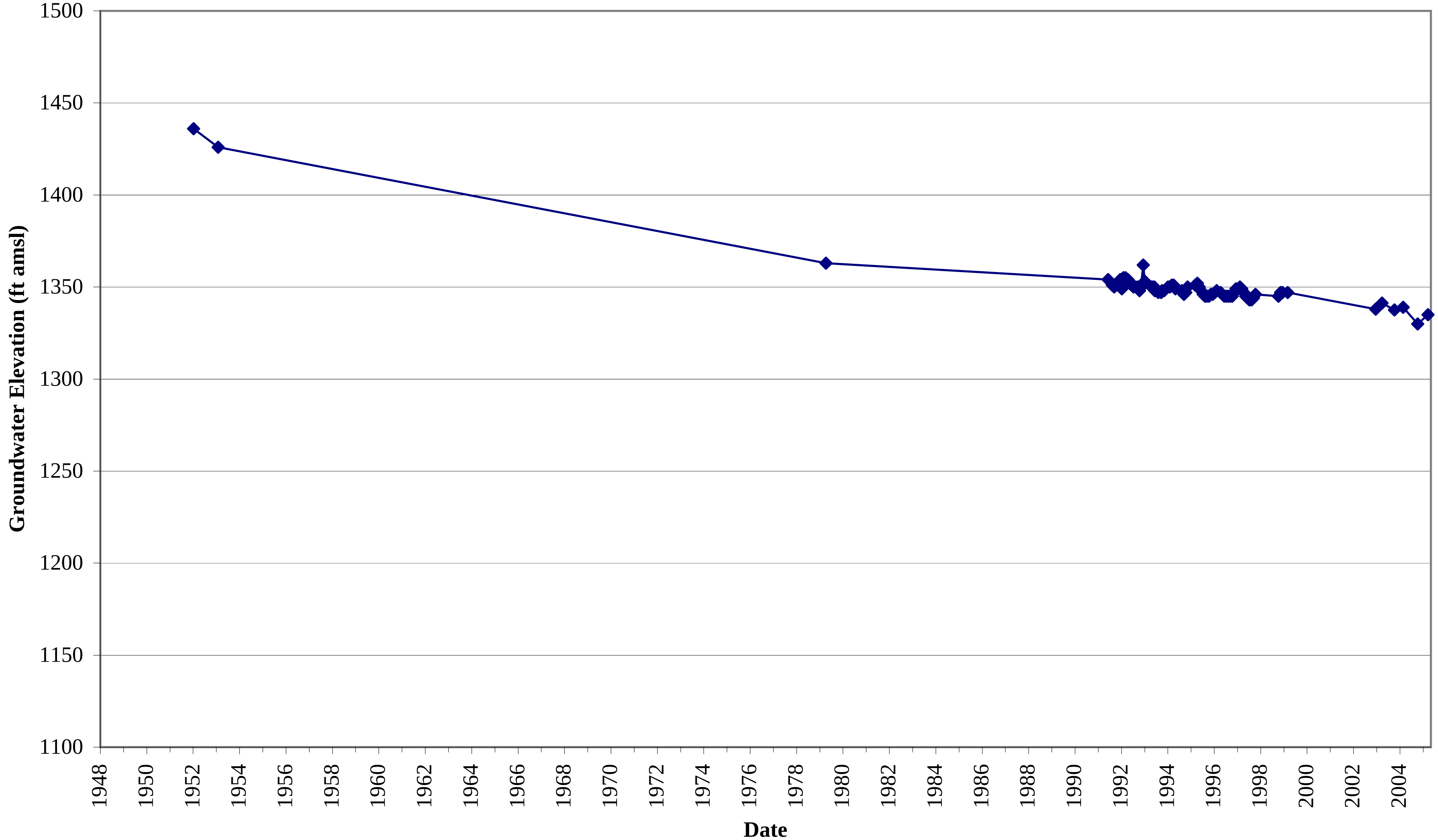


Figure 4.15 Groundwater Elevation
Hemet South Management Zone, EMWD #22 Sneed



obtained from the data tabulated in *Assessment of Historical and Projected Land and Water Use Data* (WRIME, 2003a).

Table 4.3 Groundwater Budget for the Management Area
(Average Annual Volume for Water Years 1984-2004*)

Inflow Component	Volume (AFY)	Outflow Component	Volume (AFY)
Recharge from Rainfall	8,900	Groundwater Production	57,800
San Jacinto River and Bautista Creek Recharge	9,900	Subsurface Outflow from Hemet South to Perris South	300
Recharge from Public Agency Sales	2,900	Subsurface Outflow from Hemet North to Lakeview	1,500
Recharge from Irrigation	9,600		
Conjunctive Use Recharge	800		
Reclaimed Water Recharge	1,500		
Subsurface Inflow from Mountain Fronts	8,000		
Subsurface Inflow from Lower Pressure to Upper Pressure	1,700		
Total	43,300	**Total**	59,600

* Values for Groundwater Production represent 1984-2004 averages, an update from the 1984-2003 values presented in WRIME, 2003a. All other data is taken from the 1984-1999 modeling results (TechLink, 2002a).

The total average annual inflow is 43,300 AFY and the total average annual outflow is 59,600 AFY, resulting in an average annual deficit of 16,300 AFY for the 20-year hydrologic period of 1984 to 2004. Nearly all (97%) outflow is from groundwater extraction while inflow is primarily natural recharge, representing 66% of inflow and the remainder a direct result of recharge from applied water or other human activities. The 1984-2004 hydrologic period presented in Table 4.3 represents the period during which the most consistent and continuous data for the Management Area is available. It should be noted, however, that this period does not necessarily represent the long-term groundwater basin conditions, and as described in Section 4.9 of this document, long-term overdraft is estimated based on longer periods, as well as other methods and criteria.

4.6.4 LAND SUBSIDENCE

In additional to water quantity and quality concerns, there is the potential for further land subsidence in the Management Area, although not at rates to cause significant damage.

Widespread land subsidence has been observed in the San Jacinto basin as the area and its groundwater resources have been developed. Three forms of subsidence have been reported by the U.S. Environmental Protection Agency (Boen, et al., 1971): local or regional tectonic adjustments along the faults in the area; groundwater withdrawals and subsequent artesian head decline; and soil collapse or compaction due to causes other than tectonic or artesian head decline. In the graben, tectonic subsidence has averaged 0.2 in/yr (4.5 mm/year) over the past 40,000 years and subsidence due to groundwater withdrawal and aquifer compaction is 1 - 1.2 in/yr (2.5 - 3 cm/yr) (Morton, 1995). Lofgren (1975, 1976) reported in studies that, through the years, the periods of subsidence tend to correspond to the periods of groundwater production; land surface elevation at the well tends to be lower each year; and subsidence has been greater within the graben than on either side.

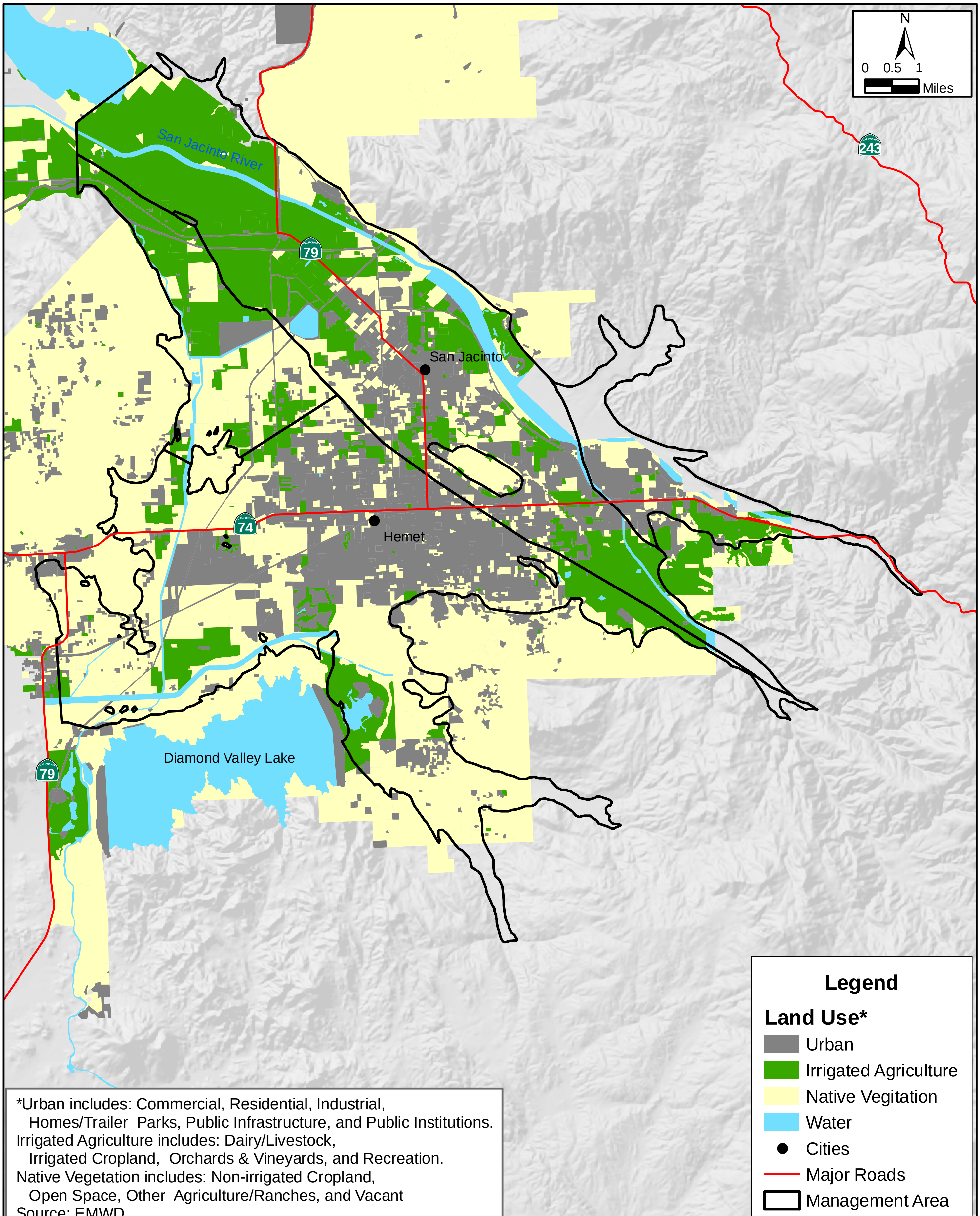
4.7 LAND USE

Land use in the Management Area has experienced changes over the past half-century. The conversion from agricultural or undeveloped lands to urban uses has an impact on basin hydrogeology as well as on water demand. Figure 4.16 and Table 4.4 show land uses in 1998 for most of the project area.

Table 4.4 Land Use Distribution Based on the 1998 Survey

Land Use	Canyon	Upper Pressure	Hemet South	Hemet North	Total
Total Area (acres)	4,400	21,200	25,300	5,600	56,500
% Urban and Suburban	24%	24%	36%	11%	28%
% Irrigated Crops and Recreational	12%	49%	15%	47%	31%
% Non-Irrigated Crops and Native Vegetation	16%	24%	45%	42%	35%
% Unmapped	48%	3%	4%	0%	7%

Much of the urban uses in the area are recent. This is shown by the significant population growth in the area, as highlighted Figure 4.17, which displays population data from the decennial US Census reports and a 2004 US Census estimate for the incorporated areas of Hemet and San Jacinto.



*Urban includes: Commercial, Residential, Industrial, Homes/Trailer Parks, Public Infrastructure, and Public Institutions.
Irrigated Agriculture includes: Dairy/Livestock, Irrigated Cropland, Orchards & Vineyards, and Recreation.
Native Vegetation includes: Non-irrigated Cropland, Open Space, Other Agriculture/Ranches, and Vacant
Source: EMWD

WRIME	**1998 Land Use** Hemet / San Jacinto Water Management Plan	October 2007 Figure 4.16

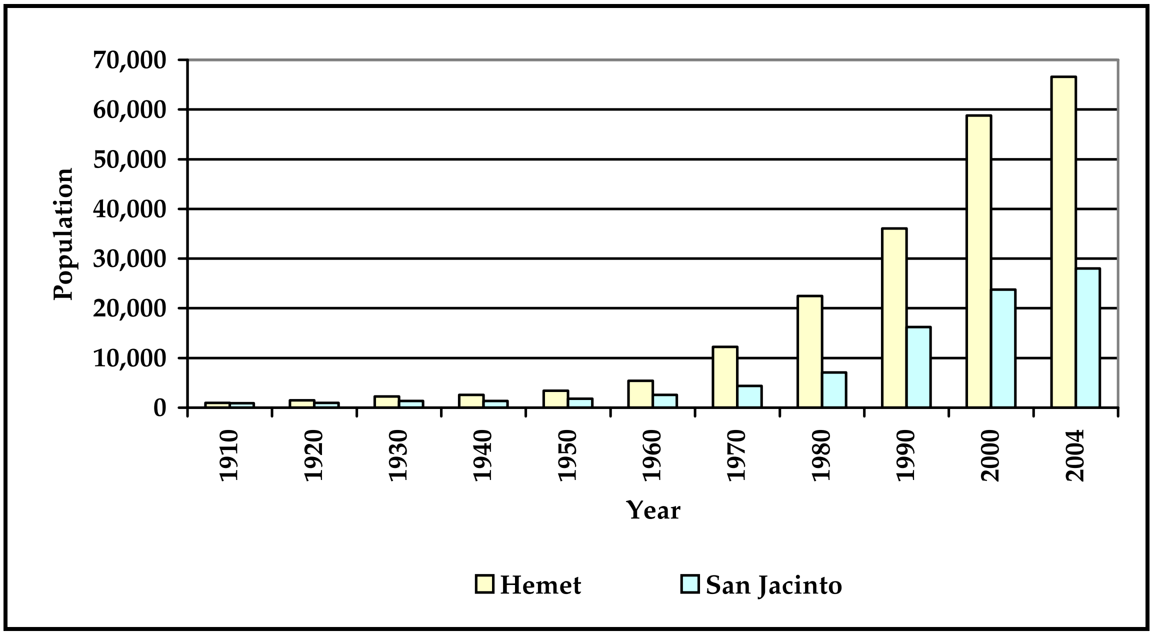


Figure 4.17 Population Growth in Incorporated Hemet and San Jacinto

From 1950 to 2004, the population in Hemet increased twenty-fold and the population in San Jacinto increased sixteen-fold. Such urbanization results in changes in both water demand and hydrologic processes. For newly urbanized areas that were previously non-irrigated, water demands obviously increase significantly. Areas that change from irrigated agricultural uses to urban uses do not typically see major changes in the total annual water demand. However, water demand from urban users is typically less elastic than water demand from agricultural users, making drought contingencies more important. The requirements for water quality are also typically more stringent for urban users. From a hydrologic perspective, urbanization results in an increase in the impervious land area, e.g., more pavement and buildings, with the resulting increased runoff and decreased infiltration. Additionally, the water used indoors by urban users is sent to treatment plants, shifting the potential for recharge of this water from the area of use to the treatment plant area.

The urbanization trend is not unique to the Management Area, but has been pervasive throughout the fringes of urbanized Southern California. While the rate of urbanization may change in the future, the trend of urbanization is likely to continue and to play a significant role in land use and water demand. Further discussion of future land use changes may be found in Section 5.

4.8 CURRENT WATER SUPPLIES

There are four Public Agencies primarily responsible for water supply in the Management Area: EMWD, LHMWD, and Cities of Hemet and San Jacinto. In addition, Private Water Producers produce groundwater and purchase water from the Public Agencies, and the Soboba Tribe pumps groundwater for its respective uses. Each entity pumps groundwater, and some entities also utilize a mix of some of the following sources: surface water diversions, surface water and/or groundwater purchases, surface water imports, and recycled water. The water supply conditions in the Management Area and the interrelationships among the various agencies is a primary factor for future water management in the area. Figure 4.18 shows these interrelationships in a diagram form.

Figure 4.19 shows the makeup of the water supply and how this mix has changed from 1985 to 2004 for the Management Area. Groundwater is the predominant source of water supplies for the Management Area. The remaining sources are smaller, but still important, sources of water. Supplies listed by entity are provided in Appendix F. Note that items such as sales to other agencies are not subtracted in these supply values, resulting in a supply that represents both wholesale and retail supplies. As a result of this definition, supplies will not equal the historical demand. Historical demand for the individual entities is shown in Figures 4.20 – 4.25.

4.8.1 GROUNDWATER

All entities pump groundwater for all or a portion of their water supply. The quantity of groundwater extraction for each Management Zone is shown in Figures 4.26a, 26b, and 4.27.

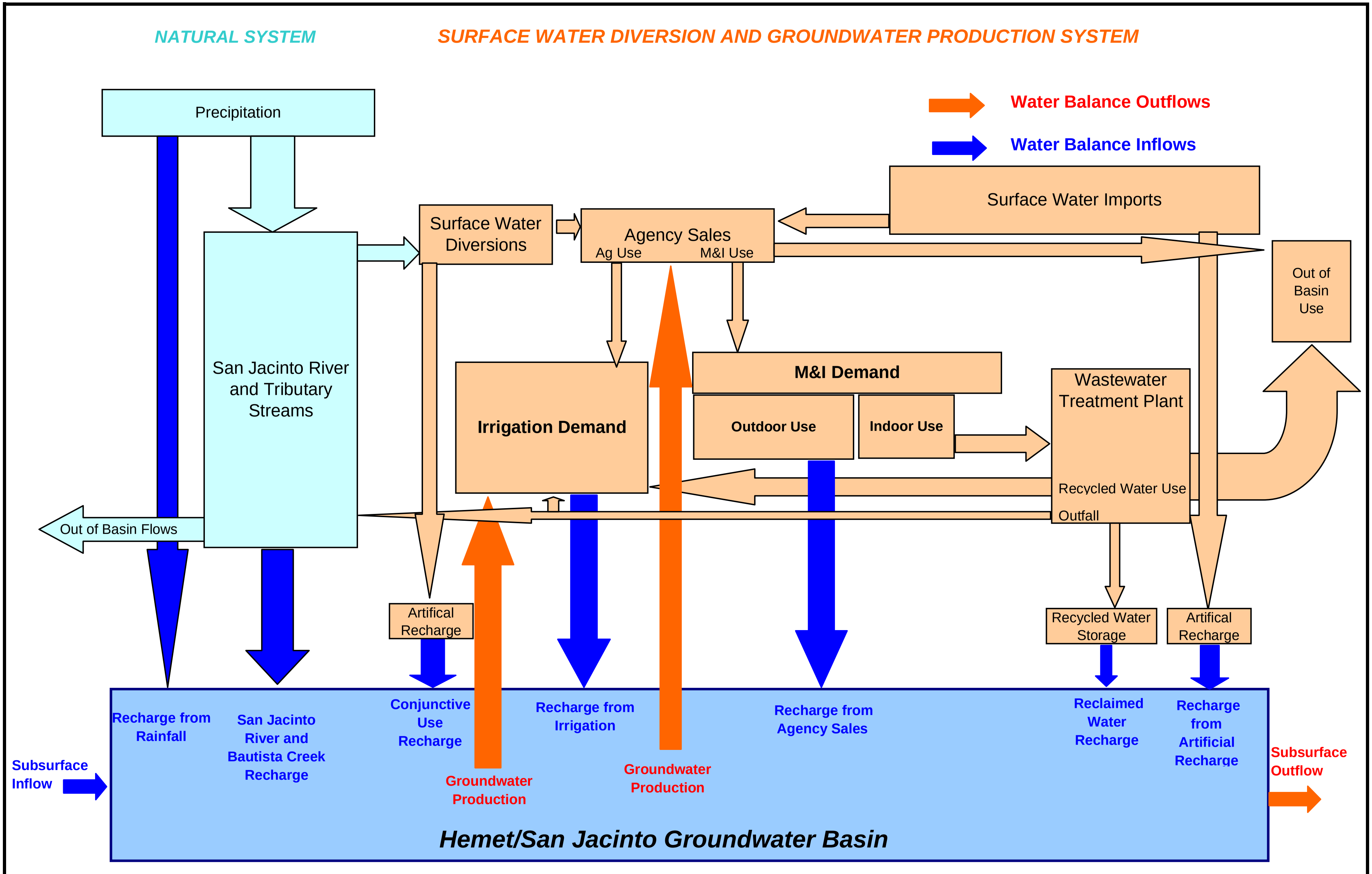


Figure 4.18 Components of Hemet/San Jacinto Groundwater Balance

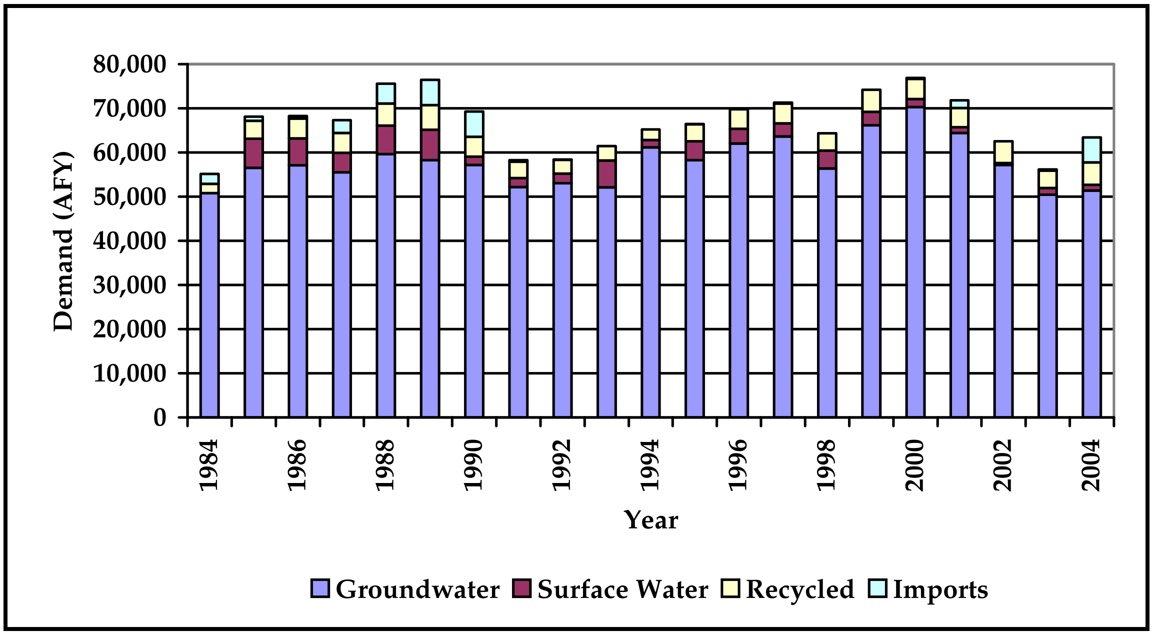


Figure 4.19 Annual Management Area Water Supplies

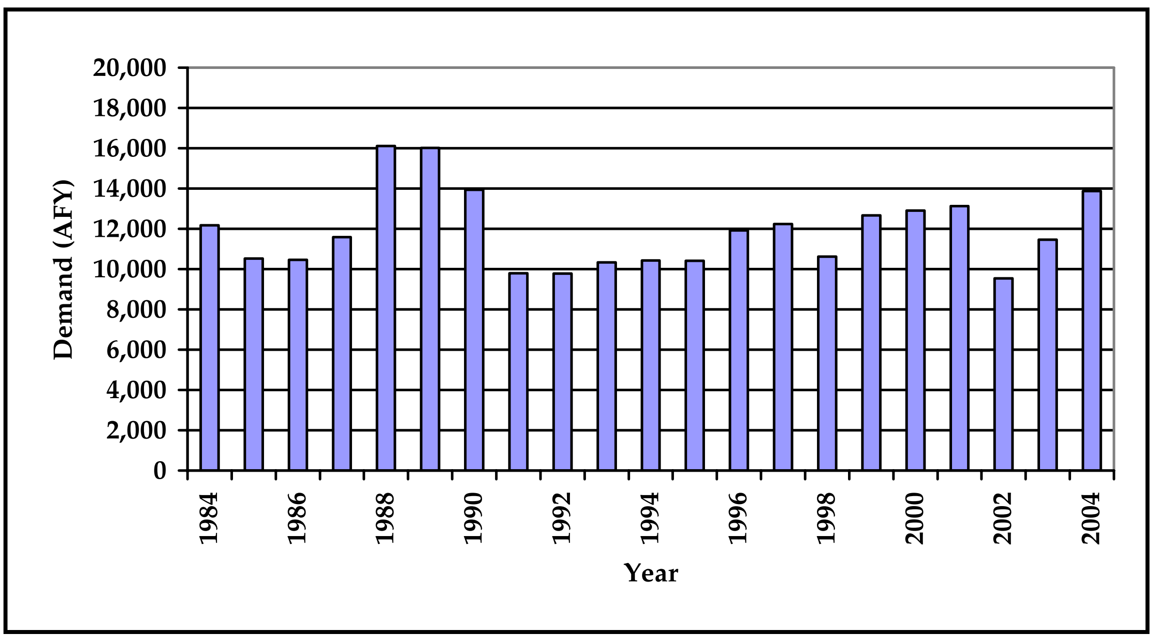


Figure 4.20 EMWD Historical Annual Demand

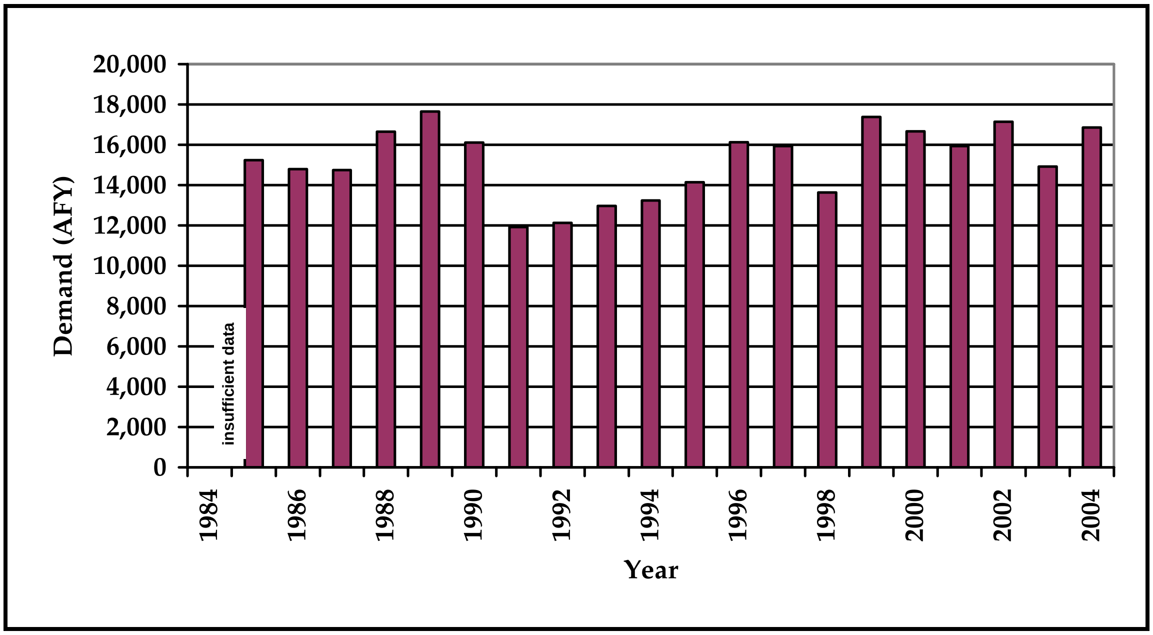


Figure 4.21 LHMWD Historical Annual Demand

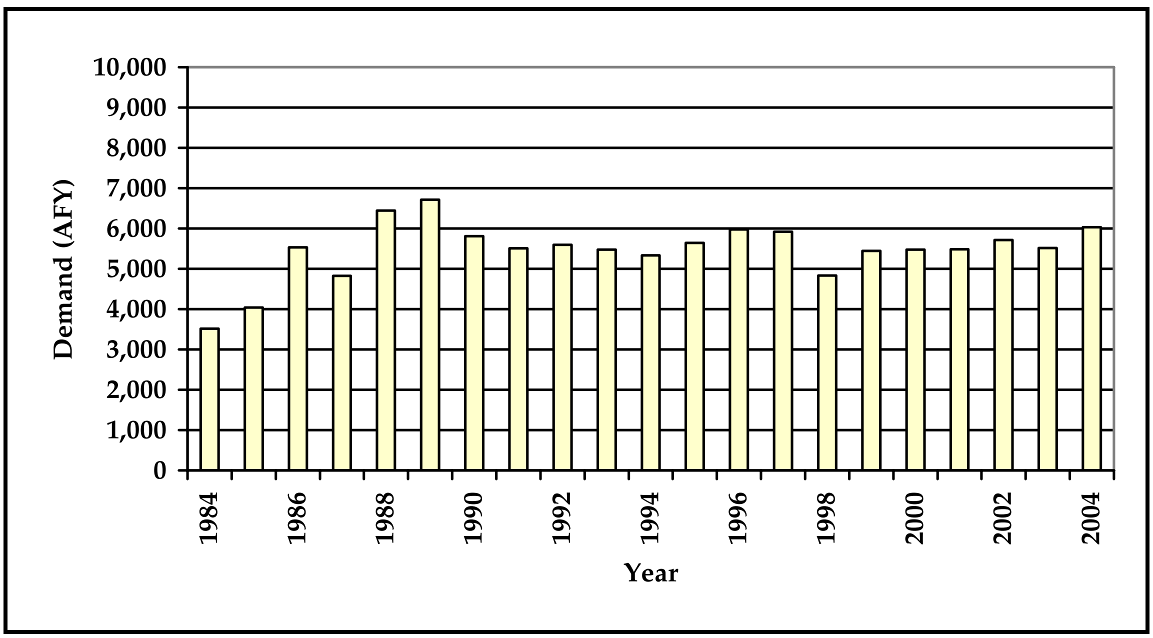


Figure 4.22 City of Hemet Water Service Area Historical Annual Demand

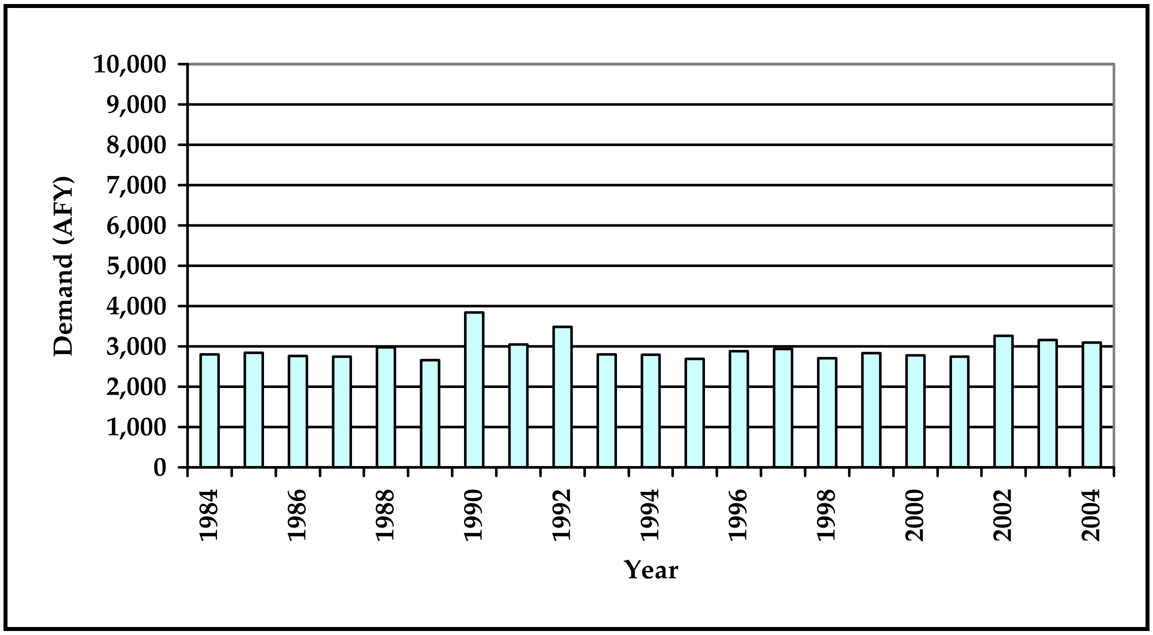


Figure 4.23 City of San Jacinto Water Service Area Historical Annual Demand

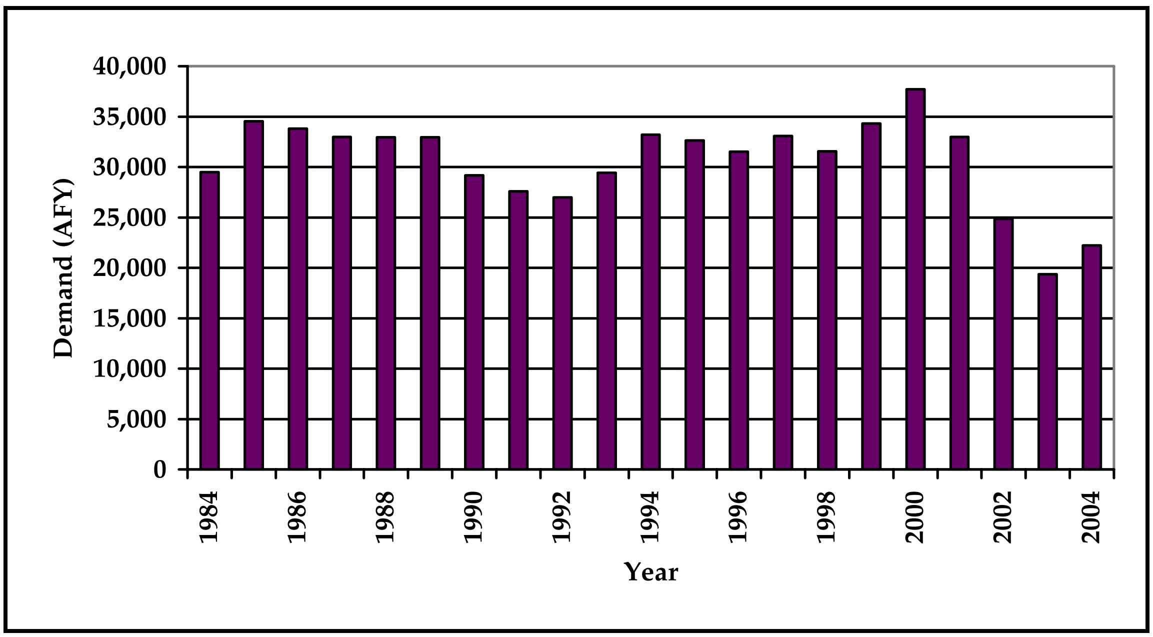


Figure 4.24 Private Water Producers Historical Annual Demand

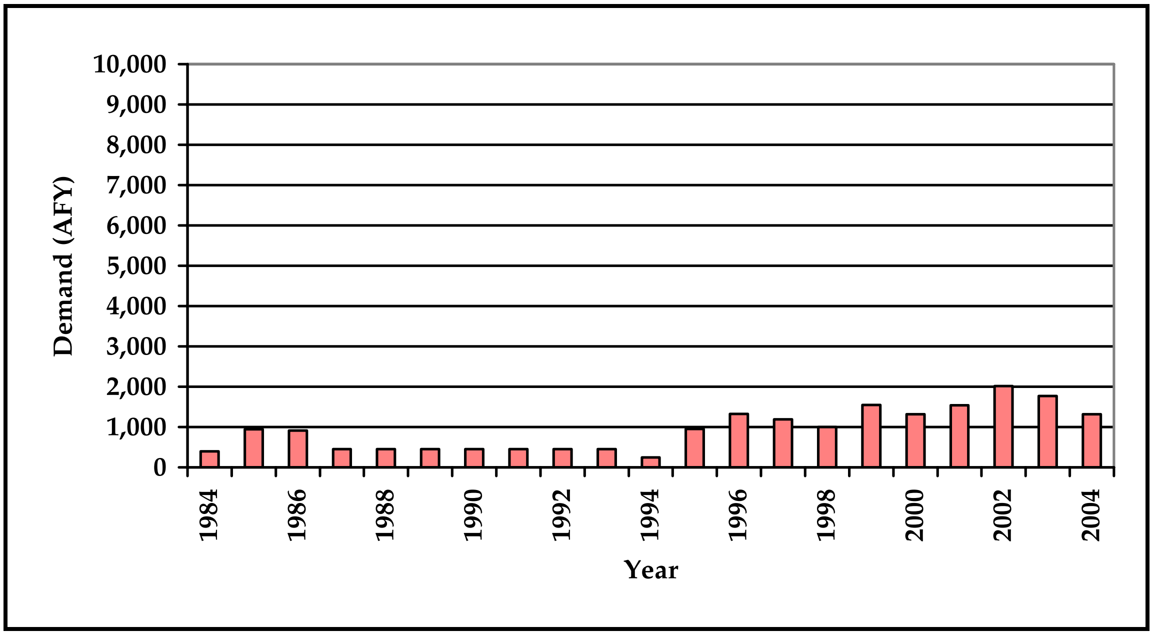


Figure 4.25 Soboba Historical Annual Demand

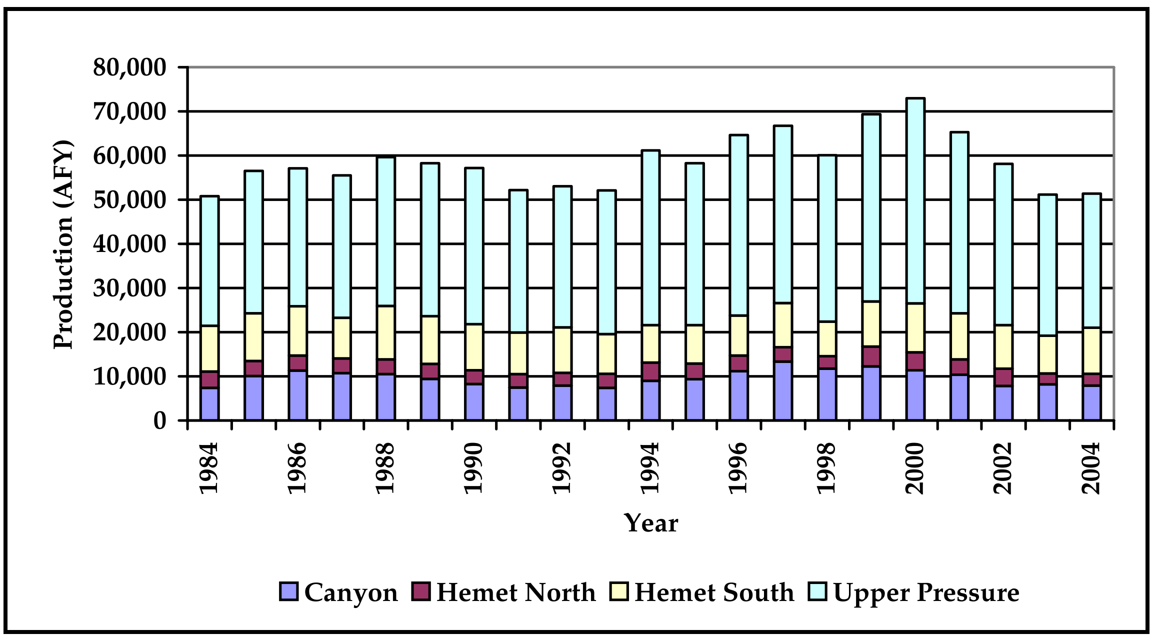


Figure 4.26a Annual Groundwater Production, by Management Zone

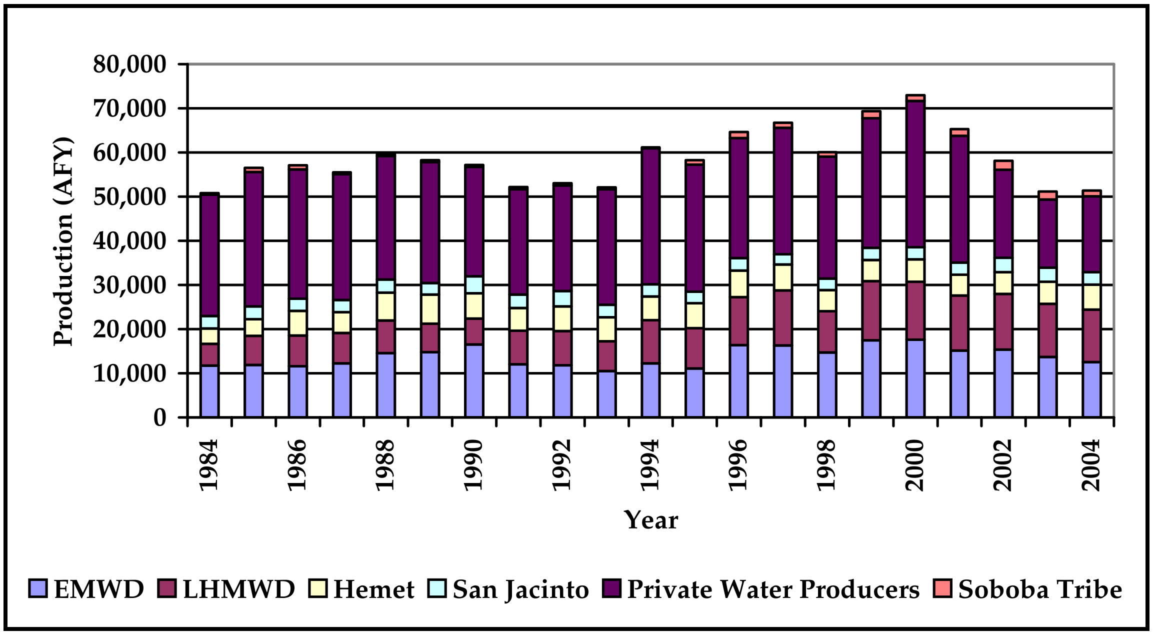


Figure 4.26b Annual Groundwater Production, by Entity

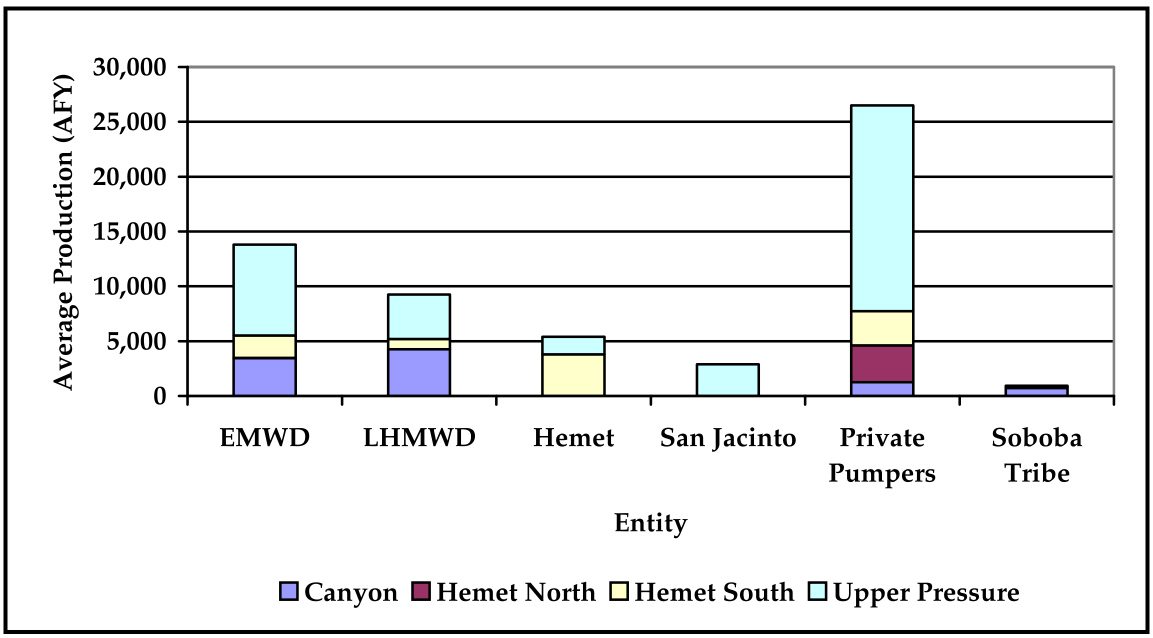


Figure 4.27 Average Annual Entity Groundwater Production, by Management Zone, 1984-2004

Since 1984, each entity except for the City of San Jacinto has pumped groundwater from multiple Management Zones. San Jacinto's pumping during that time period has always been from the Upper Pressure Management Zones. The percentage of the water supply from groundwater for each remaining entity, compared to other components of the water supply, is shown in Figures 4.28a-e as a pie chart breaking down the entity's 2004 groundwater supply by

Management Zone. Additionally, Figure 4.29a-e presents stacked area charts showing the historical annual percentage of groundwater supply from each Management Zone.

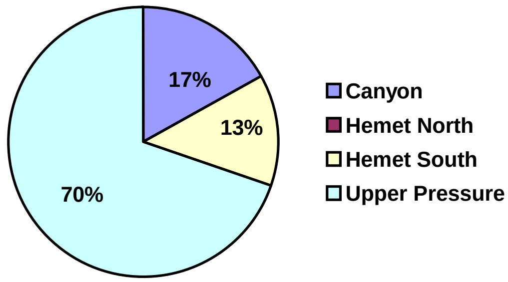


Figure 4.28a EMWD 2004 Groundwater Production, Percentage by Supply Source

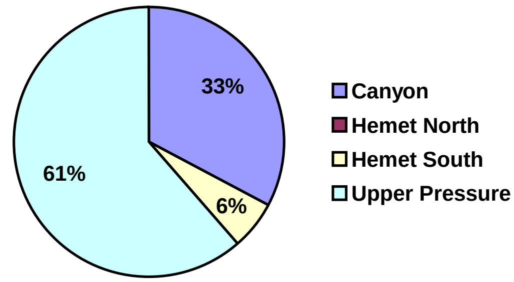


Figure 4.28b LHMWD 2004 Groundwater Production, Percentage by Supply Source

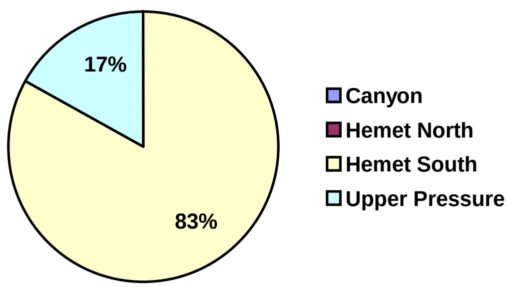


Figure 4.28c City of Hemet Water Service Area 2004 Groundwater Production, Percentage by Supply Source

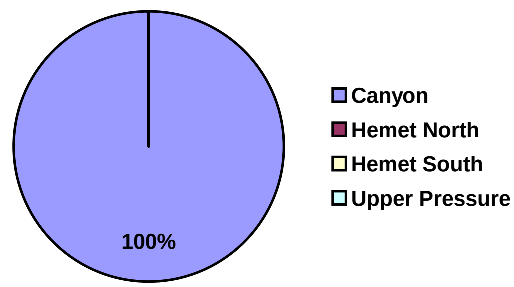


Figure 4.28d Soboba 2004 Groundwater Production, Percentage by Supply Source

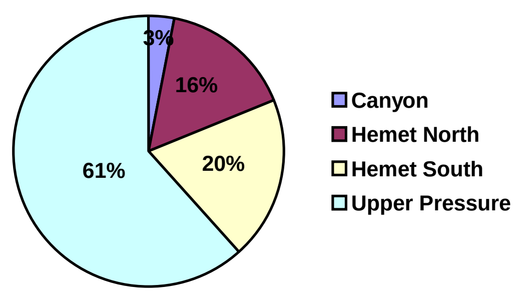


Figure 4.28e Private Water Producers 2004 Groundwater Production, Percentage by Supply Source

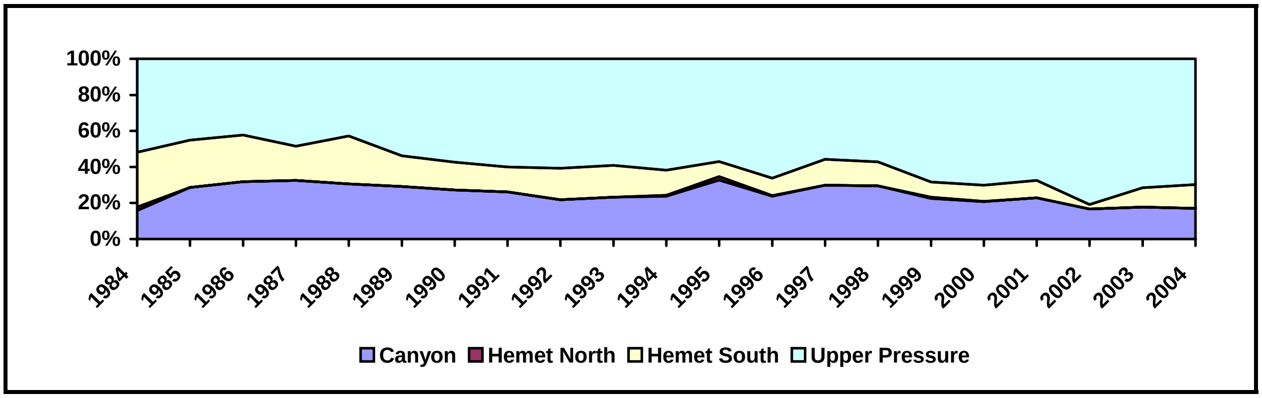


Figure 4.29a EMWD Historical Groundwater Production, Percentage by Supply Source

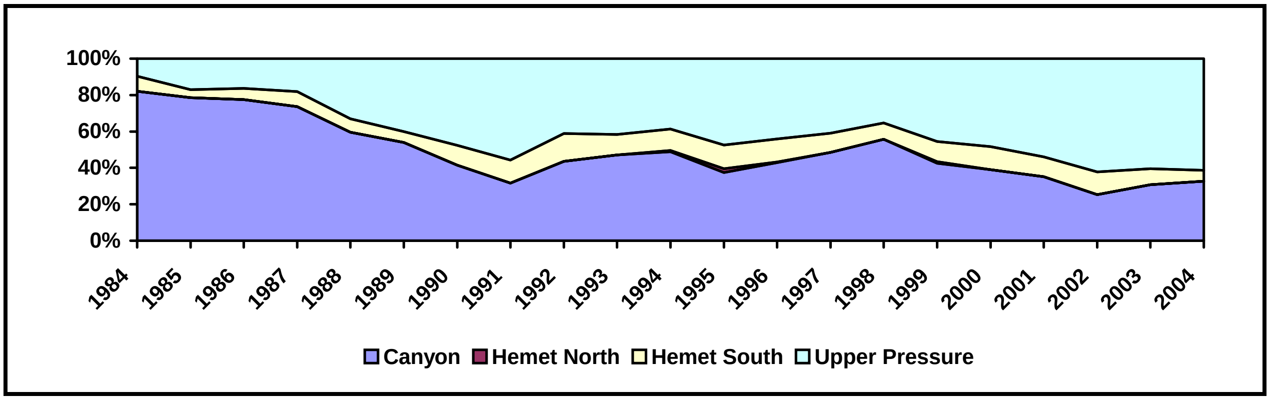


Figure 4.29b LHMWD Historical Groundwater Production, Percentage by Supply Source

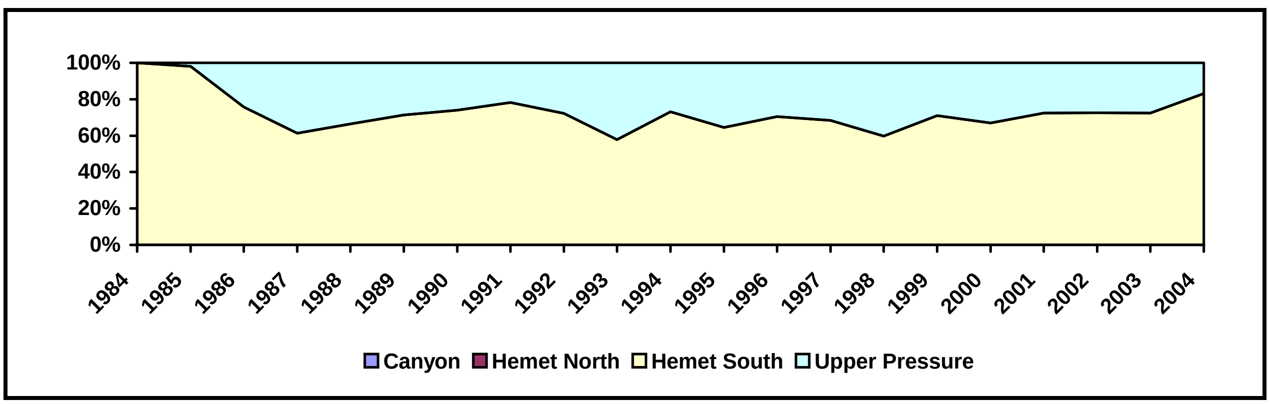


Figure 4.29c City of Hemet Water Service Area Historical Groundwater Production, Percentage by Supply Source

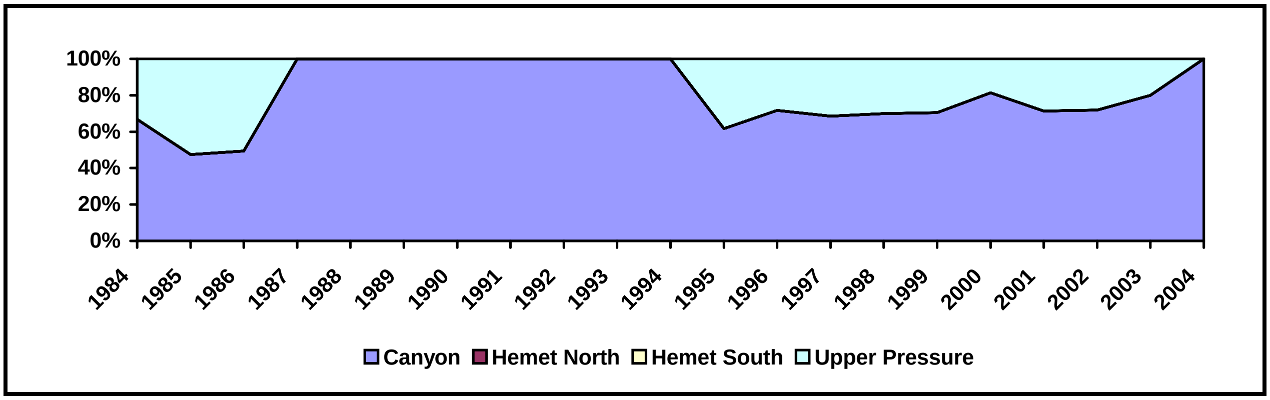


Figure 4.29d Soboba Historical Groundwater Production, Percentage by Supply Source

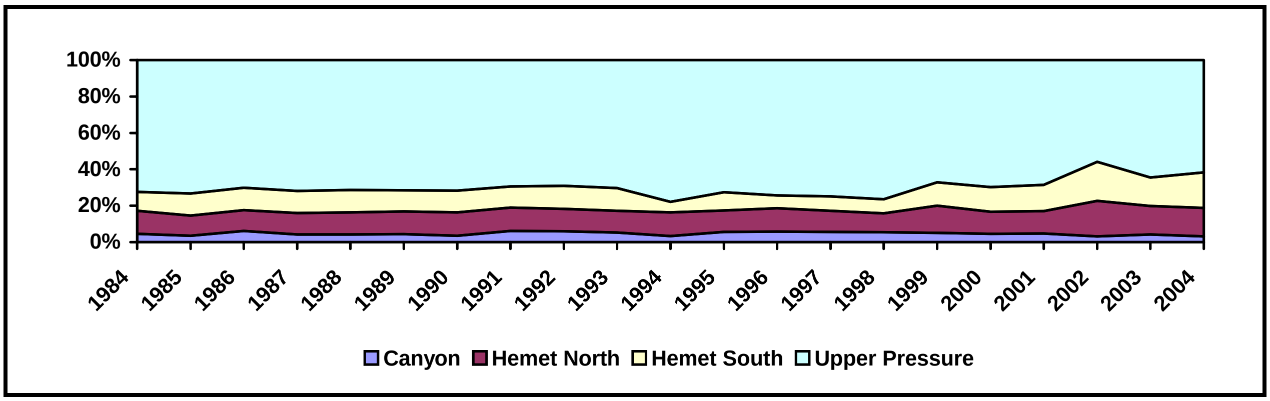


Figure 4.29e Private Water Producers Historical Groundwater Production, Percentage by Supply Source

The pie charts show that in 2004 the Upper Pressure Management Zone provided the majority of groundwater for four of the six entities. The Hemet South Management Zone provided the majority of water to the City of Hemet Water Services Area and The Canyon Management Zone provided all groundwater for the Soboba Tribe.

The only significant trend seen in the 1984 - 2004 historical annual charts is LHMWD's shift in groundwater sources from majority Canyon Management Zone water in the mid-1980s to mostly Upper Pressure Management Zone water recently. These charts also emphasis the importance of the Upper Pressure Management Zone, as it was a component of the groundwater supply for all entities over the 1984 – 2004 time period.

4.8.2 Imported Water

EMWD is a member agency of the MWD, and, as such, is able to import water from Northern California via the State Water Project and from the Colorado River Aqueduct. Imported water is used for supply as well as for groundwater recharge; this section only discusses imported water for supply, imported water for recharge is discussed in Section 4.6.1. District-wide, imported water comprises 80% of EMWD's total potable water supply. However, imported water is a small portion of EMWD's water supply in the Management Area due to the availability of high quality groundwater, which is less common in the rest of the EMWD service area. Over the 1984-2004 period, imported water represented 13% of EMWD's supply and 2% of the total Management Area supply (WRIME, 2003a). In 2004, imported water represented 41% of EMWD's supply and 9% of the total supply for the Management Area (EMWD, 2005a,b).

The usage of imported water for direct use has been variable over the past decades, as shown in Figure 4.30. The volume of water imported was reduced in 1991 as the importation of unfiltered Colorado River water to the Management Area was curtailed to meet the requirements of the Surface Water Treatment Rule, part of the Safe Drinking Water Act.

Imported water usage in recent years has increased, which in turn reduced the stress on groundwater resources in the Management Area.

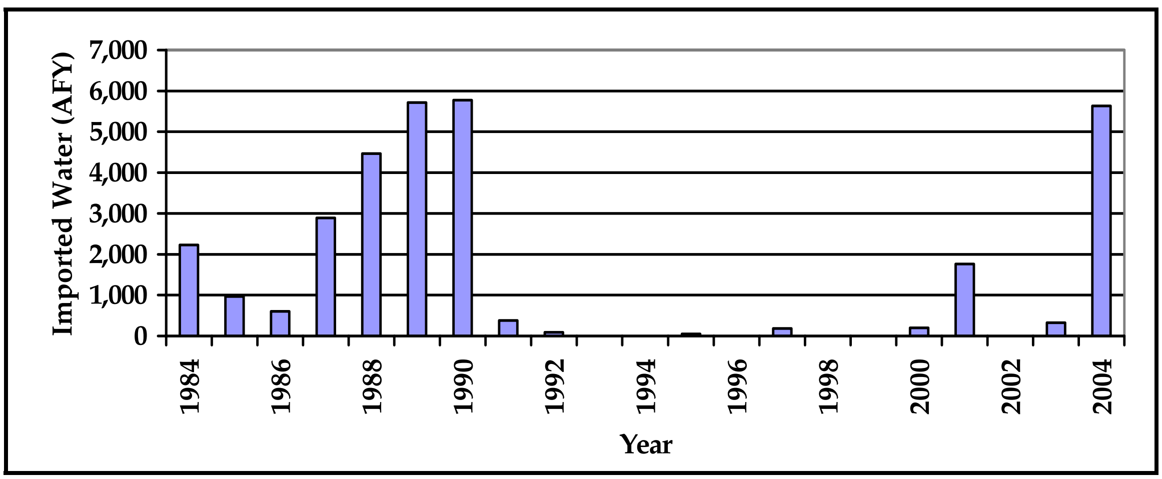


Figure 4.30 Annual Imported Water Supply

4.8.3 RECYCLED WATER

Recycled water is treated at EMWD's San Jacinto Valley Regional Water Reclamation Facility and is currently used primarily for irrigation in the public municipal areas, industrial uses, and agricultural irrigation purposes in the Management Area and for habitat creation at the California Fish and Game San Jacinto Wildlife Area outside the Management Area. Recycled water is a highly reliable source of supply and will increase in availability as the population of the Management Area increases. Most of the recycled water is sold by EMWD to private land owners for agricultural irrigation. Recycled water usage in the Management Area has been fairly stable over the past decades, with approximately 5,000 AF supplied in 2004. Annual amounts of recycled water use are presented in Figure 4.31.

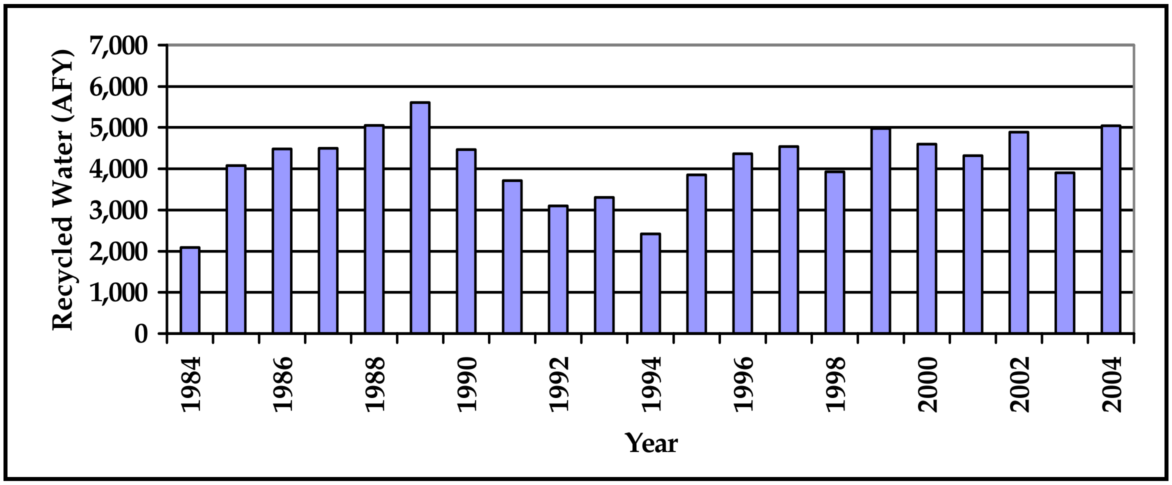


Figure 4.31 Annual Recycled Water Supply

4.8.4 SURFACE WATER

LHMWD has pre-1914 rights for the diversion and storage of surface water from the San Jacinto River and its tributaries. These rights date back to the late 1800s, and the diversion amounts are filed each year with the Division of Water Rights, State Water Resources Control Board on Annual Notices of Groundwater Extraction or Diversion, numbers G330016, G330017, and G330018.

When available, LHMWD diverts surface water for direct use. It should be noted that the San Jacinto River is an ephemeral river. The river may not flow every year and, therefore, there may be occasional years where diversion is not possible. Annual surface water diversions for 1985-2004 are shown in Figure 4.32. Details of the surface water rights are discussed in Section 7.1.

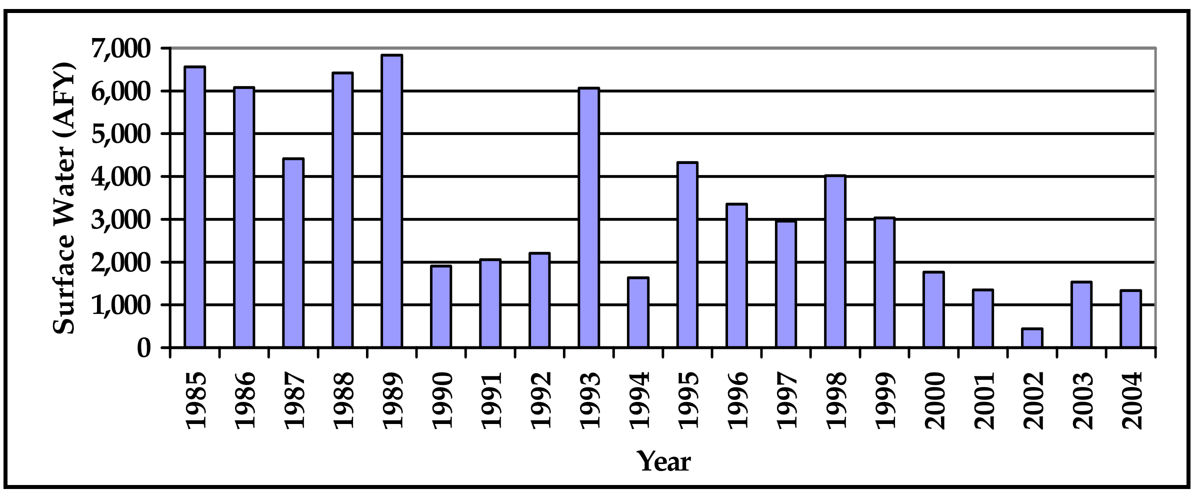


Figure 4.32 Annual Surface Water Supply

EMWD's surface water diversions are not utilized for direct use and are therefore not considered part of the water supply. More information on EMWD's surface water diversions is included in Section 7, Surface Water Rights.

4.8.5 PURCHASES FROM EMWD

LHMWD, City of Hemet, and City of San Jacinto purchase water from EMWD to supplement their water supplies. The annual volume of water sold to the other agencies by EMWD is shown in Figure 4.33. In addition to these sales, EMWD sells recycled water to private land owners for agricultural irrigation.

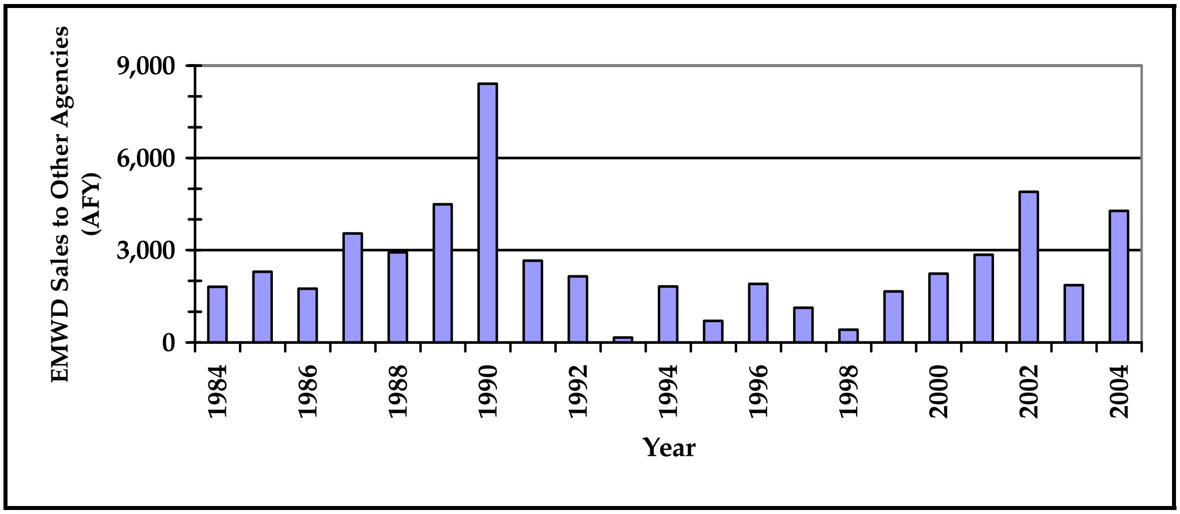


Figure 4.33 Annual Sales by EMWD to Other Agencies within Management Area

4.9 ESTIMATES OF SAFE YIELD AND OVERDRAFT

4.9.1 SAFE YIELD

The Safe Yield of the Management Area is defined in the Stipulated Judgment as the long term, average quantity of water supply in the Management Area that can be pumped without causing undesirable results, including the gradual reduction of natural groundwater in storage over long-term hydrologic cycles.

The following clarifying notes are presented to better define the Safe Yield definition:

- **Period of Record:** Safe Yield is a function of annual variability of the hydrology, but should reflect long-term average conditions, including wet and dry replenishment conditions. Identification of "long term, average" is important, but difficult to determine, as precipitation is highly variable from year to year and subject to long-term climatic changes. As hydrologic data will continue to be collected and a greater understanding of the hydrology will be gained, the period of record for determining the Safe Yield will be subject to change over time.

- **Water Supply Components:** The following components of water supply are considered in the definition of Safe Yield:
  - a. Natural recharge from infiltration of precipitation,
  - b. Recharge from infiltration of streamflow and other surface water runoff,
  - c. Recharge from infiltration of irrigation applied water on agricultural lands,
  - d. Recharge from infiltration of outdoor irrigation in the urbanized areas,
  - e. Artificial recharge, such as replenishment programs, historically operated, using imported, recycled, and surface water diversions,
  - f. Subsurface groundwater inflows, such as from the Lower Pressure Management Zone and the boundaries of the basin, and
  - g. Subsurface groundwater outflows, such as to the Lakeview portion of the Lakeview/Hemet North Management Zone.
- **Study Area:** Safe Yield is calculated for the Management Area as one unit, and not by the smaller units of Management Zones.
- **Undesirable Effects:** The definition of Safe Yield emphasizes protection of groundwater in storage. It is assumed that potential undesirable effects on water quality are indirectly addressed, and therefore are not included in the analysis.

The Safe Yield of the Management Area has been estimated in a number of studies in the past. A summary of methods, hydrologic periods, and results from each study is presented in Table 4.5.

Two major methodologies have traditionally been used to estimate the Safe Yield: (1) Water Balance methodology, and (2) Change in storage methodology. These methods are briefly described below.

Table 4.5 Published Estimates of Safe Yield for the Management Area

Yield Study	Method	Time Period	Safe Yield (AFY)	Pumping (AFY)	Overdraft (AFY)
Fritz and Rosell*, 1947	Water Balance (Conventional)	1920-1945	27,400 (35,100 w/o trees/brush)	32,400	4,800
Schwartz*, 1967	Water Balance (Conventional)	1923-1960	26,100	n/a	12,100
EMWD White Paper, 2000	Water Level Recovery Analysis	Variable	50,000	60,600	10,600
GIS Recharge Estimates	Change in Storage (GIS)	1998-2003	39,700	n/a	n/a
WRIME, 2003d	Water Balance (Conventional)	1984-2001	44,700	59,000	14,300
Based on TechLink, 2002a	Water Balance (Model-based)	1984-1999	41,300	58,000	16,700

* Fritz and Rosell (1947) and Schwartz (1967) both used a larger geographic area that roughly included what is today called the San Jacinto-Lower Pressure Management Zone. This additional area is the area northwest of Bridge Street to Redlands Boulevard in Moreno Valley.

4.9.1.1 Method 1 - Water Balance Method

The water balance method utilizes inflows and outflows from the basin to estimate change in storage and the Safe Yield of the basin. The amount of pumping that can be sustained with little or no long-term change in storage is the Safe Yield of the basin. The Safe Yield estimate may be calculated by

Safe Yield = Change in Groundwater Storage + Groundwater Production,

where Change in Groundwater Storage is Inflows less Outflows. The estimate must be over a long-term base period which reflects a number of wet, normal, and dry periods. Groundwater production values are based on historical data as reported by the Public Agencies and estimated for the Private Water Producers. The TC has reviewed and agreed to the data for use in the Water Balance Method. The following inflow and outflow components are used to calculate Change in Groundwater Storage for the Management Area:

<u>Inflows</u>

- Recharge from Retail Water Sales,
- Recharge from Irrigation Return Flow,
- Recharge from Precipitation,

- Grant Avenue Ponds Diversion Recharge,
- Reclaimed Ponds Recharge,
- Recharge from Recycled Water Sales,
- Subsurface Inflow from Other Management Zones,
- Bautista Creek Recharge,
- San Jacinto River Recharge, and
- Boundary Inflow.

Outflows

- Subsurface Outflow to Other Management Zones,
- Boundary Outflow, and
- Groundwater Production.

4.9.1.2 Method 2 - Change in Storage Methodology

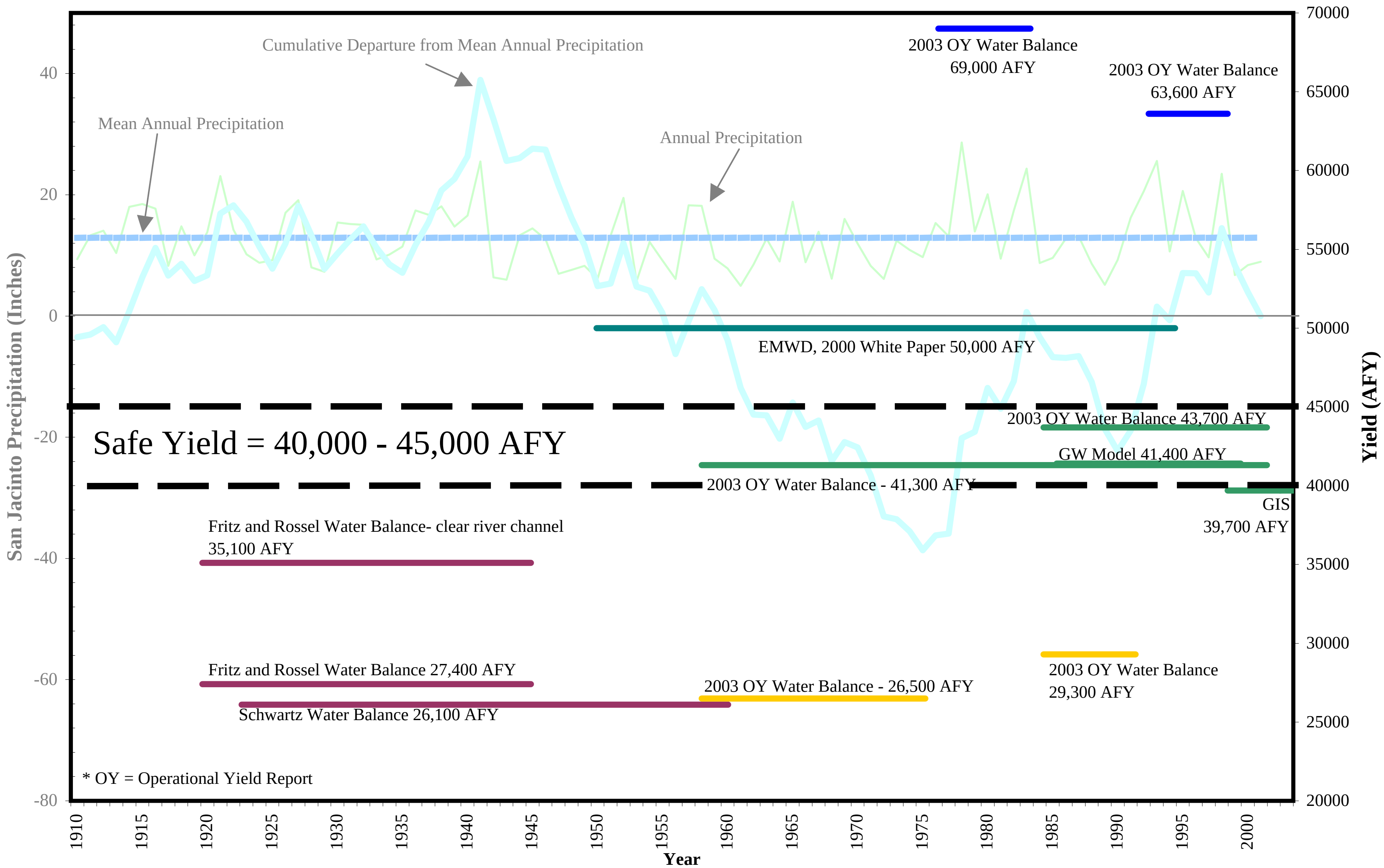
This method uses a GIS database to develop surfaces of groundwater elevations based on observed groundwater levels at multiple control points (i.e., wells) throughout the Management Area for two different time periods. The product of change in volume between the two surfaces at two different times and the specific yield of the aquifer determines the change in storage between those two time points. The Safe Yield is then calculated as the sum of the calculated change in storage and the groundwater production during the same time period. Variations of this method are used based on the spatial distribution, including vertical distribution, of the specific yield in the aquifer system.

4.9.1.3 Summary of Previous Yield Estimates

Calculation of Safe Yield is a function of the hydrologic period used in the analysis. Figure 4.34 presents the long-term hydrologic conditions as precipitation at San Jacinto gaging station (RCFC&WCD Site #186), along with estimates of the Safe Yield. As indicated in the figure, the Safe Yield estimates range from 26,400 to 44,700 AFY. Since the two estimates made by Fritz & Rosell (1947) and Schwartz (1967) are based on much older data sets and short-term hydrologic records, and the geographic area may not be consistent with some of the more recent estimates, the TC decided in its August 25, 2005 meeting not to use these estimates. Instead, the TC concluded that the Safe Yield of the Management Area ranges from approximately 40,000 to 45,000 AFY based on the most recent analyses.

The TC also concluded that the following guidelines for estimation of Safe Yield of the Management Area be considered by the Watermaster when calculating Safe Yield in the future:

Figure 4.34 Safe Yield Estimates



- Review and modify Safe Yield, if necessary, upon the recommendation of the TC or as the Watermaster may determine.
- Use latest available data with consideration for proper spatial, temporal, and vertical characteristics of the aquifer system.
- Consider a long period of record that includes above average, below average, and normal conditions.
- Consider latest methodologies that can provide more flexibility based on the available data and information, as necessary.
- Consider using the San Jacinto Watershed Groundwater Model, with appropriate updates and calibration, for re-estimation of groundwater conditions, as needed.

4.9.2 OVERDRAFT

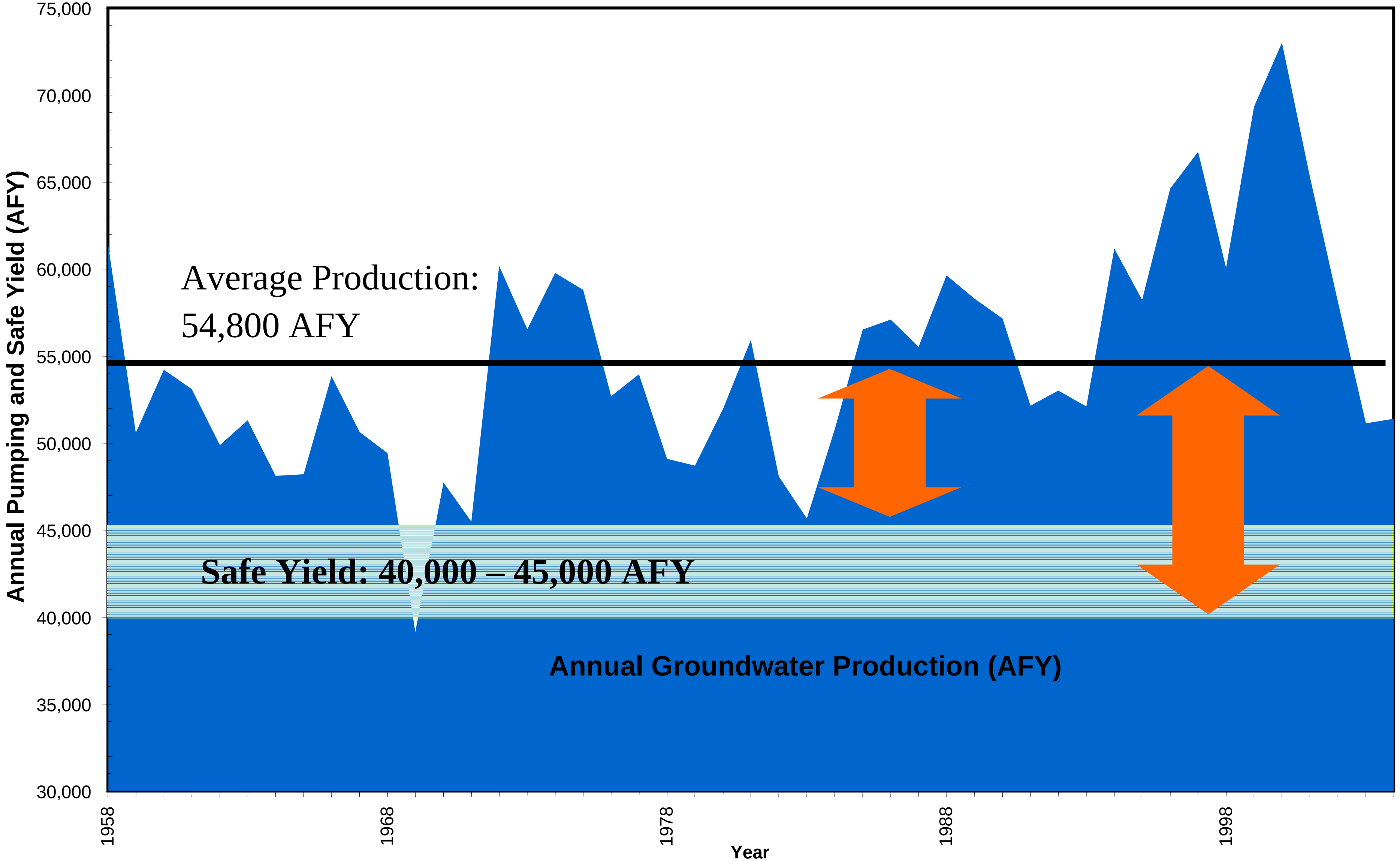
Overdraft is defined in the Stipulated Judgment as the condition whereby groundwater production in the Management Area exceeds the Safe Yield, creating undesirable conditions in the basin. The amount of overdraft is calculated as the difference between long-term average annual groundwater production in the Management Area and Safe Yield. Figure 4.35 shows the estimated annual groundwater production in the Management Area, along with the range of Safe Yield. Based on this figure, the overdraft in the Management Area is estimated to be 10,000 to 15,000 AFY. For planning purposes and to evaluate options to reduce the overdraft, this Plan assumes that the overdraft is at least 10,000 AFY.

4.10 WATER QUALITY CONDITIONS

This section presents a summary of the groundwater quality conditions in the Management Area. This description will assist in establishing a baseline condition for future water management efforts to maintain or improve groundwater quality in the Management Area. The TC has decided that the water quality conditions in the Management Area would be evaluated based on TDS and nitrate levels. This is consistent with the TIN/TDS studies (Wildermuth, 2000) and the emphasis on TDS and nitrate in the Basin Plan as amended (RWQCB, 2004).

The Management Area lies within the jurisdiction of the RWQCB, Santa Ana Region 8. The RWQCB implements state and federal laws through adoption of Water Quality Control Plans or Basin Plans (RWQCB, 1995). The Basin Plan establishes both the legal beneficial use designations and sets the standards to protect these uses. The Basin Plan was recently amended (RWQCB, 2004) to incorporate an updated TDS and Nitrogen Management Plan for the Santa Ana Region, including revised groundwater Management Zones (combining Hemet North and Lakeview into one Management Zone; Hemet North remains treated separately from Lakeview

Figure 4.35 Groundwater Production and Range of Safe Yield Estimates



in this Plan), TDS and nitrate quality objectives for groundwater, TDS and Nitrogen waste load allocations, and stream reach designations.

Within the Santa Ana Watershed, which includes the Management Area, a statistical method has been developed to use nitrate (as N) and TDS to evaluate the status of water quality; to compare sub-basin concentrations; and to trigger management actions (RWQCB, 2004; Wildermuth, 2000, 2005). Point statistics were used to show (i) historical ambient water quality conditions as represented by the 1954-1973 time period, (ii) 1997 Current ambient water quality conditions as represented by the 1978-1997 time period, and (iii) 2003 Current ambient water quality conditions as represented by the 1984-2003 time period. A summary of the data is shown in Table 4.6, revealing nitrate (as N) levels below the MCL of 10 mg/L for all cases. TDS exceeds the recommended secondary MCL of 500 mg/L in Hemet South (current and historical) and Hemet North (current and historical), and TDS exceeds the maximum secondary MCL of 1000 mg/L in the 1997 current levels in Hemet South.

Table 4.6 Historical (1954-1973), 1997 Current (1978-1997), and 2003 Current (1984-2003) Ambient Nitrate as N and TDS Concentrations (mg/L)

Sub-basin	Nitrate as N [1]				TDS[2]			
	Basin Plan Objective[3]	Historical	1997 Current	2003 Current	Basin Plan Objective[4]	Historical	1997 Current	2003 Current
Canyon	2.5	2.5	1.6	2.1	230	**234**	220	**420**
Upper Pressure	1.4	1.4	**1.9**	**1.7**	320	**321**	**370**	**370**
Hemet South	4.1	4.1	**5.2**	**5.4**	**730**	**732**	**1030**	**850**
Hemet North	1.8	1.8	**2.7**	**3.4**	520	519	**830**	**840**

Source: Wildermuth, 2005. 2003 update 1984-2003)
[1] Table 3-2
[2] Table 3-1
[3] Basin Plan Amendment, 2004 (Table 5-4)
[4] Basin Plan Amendment, 2004 (Table 5-3)

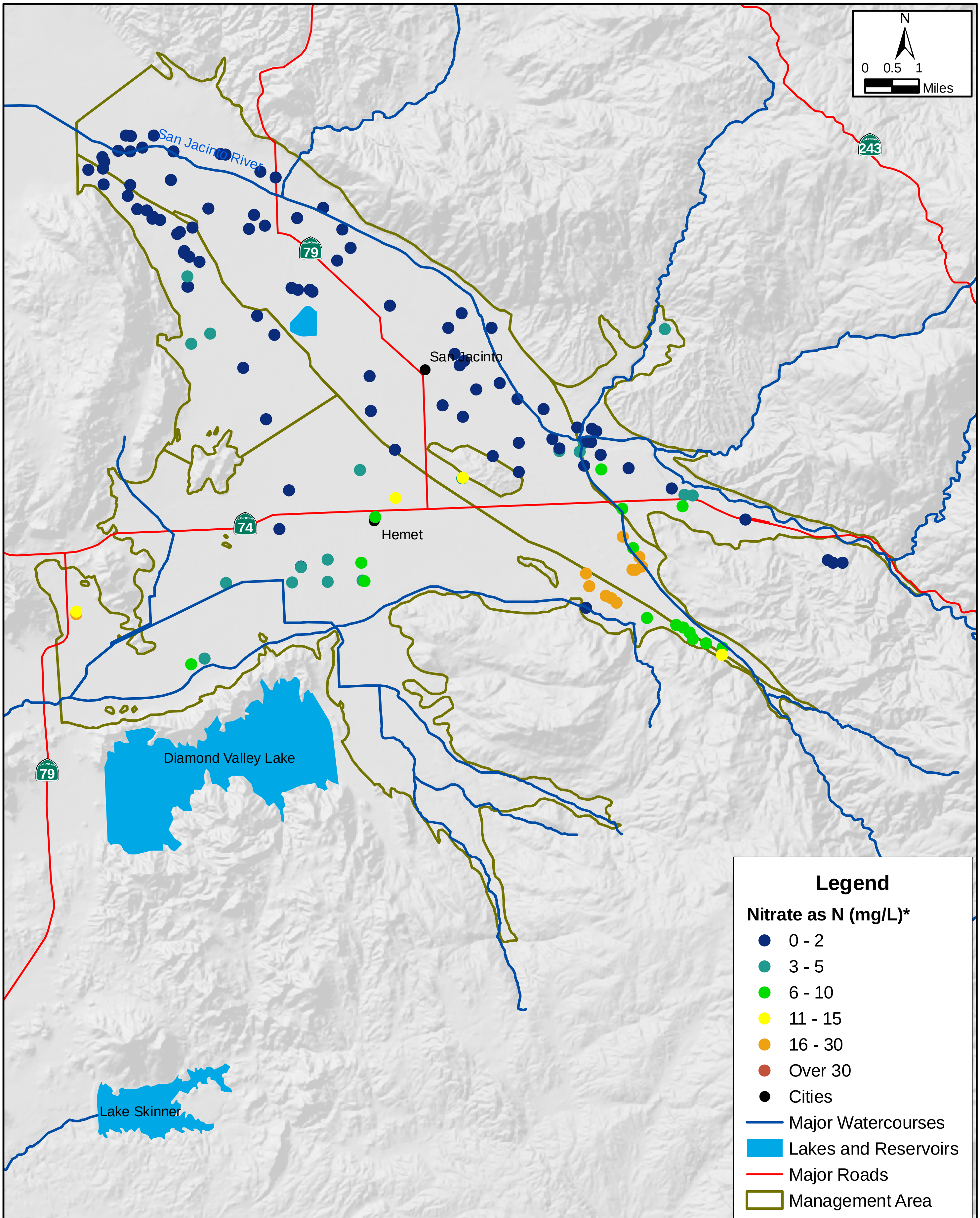
The point statistics and water quality objectives were used by the RWQCB to develop estimates of assimilative capacity. Areas with assimilative capacity are able to accept waters with higher concentrations of a constituent than the concentration in the receiving waters because natural processes such as recharge and dilution will allow for the water quality objectives to continue to be met. The most recent computations indicate that Hemet South, Hemet North, Canyon, and Upper Pressure Management Zones do not currently have assimilative capacity for TDS. For nitrate, the Hemet South, Hemet North, and Upper Pressure Management Zones do not have assimilative capacity remaining, and the Canyon area has only a very small amount of nitrate that it can assimilate (0.4 mg/l nitrate as N; Wildermuth, 2005).

Table 4.7 shows the changes seen over the 30-year time period between the historical and 2003 Current time periods. The Canyon Management Zone shows a decrease in nitrate as N concentrations while all other nitrate (as N) and TDS concentrations for all other Management Zones show increases in concentrations of between 0.3 and 1.6 mg/L nitrate (as N) and 49 to 321 mg/L TDS. It should be noted that changes seen between these time periods are a combination of true changes in ambient water quality and artificial changes due to limitations in monitoring data and the estimation technique (Wildermuth, 2005). In the future, as current monitoring programs assemble more data, a long-term record of analytical data at specific wells will be available to better show changes over time at specific locations.

Table 4.7 Change in Ambient Concentration (mg/L) of Nitrate as N and TDS, Between Historical (1954-1973) and 2003 Current (1984-2003) Time Periods

Sub-basin	Change in Nitrate as N (mg/L)	Change in TDS (mg/L)
Canyon	-0.4	186
Upper Pressure	0.3	49
Hemet South	1.3	118
Hemet North	1.6	321

The most recent data from public and private wells, as complied by EMWD, were used to plot the 2004 nitrate (as N) and TDS conditions as shown in Figures 4.36 and 4.37. While these values are taken from wells screened at different depths, the plots show the general variability in concentrations across the Management Area.



RIME

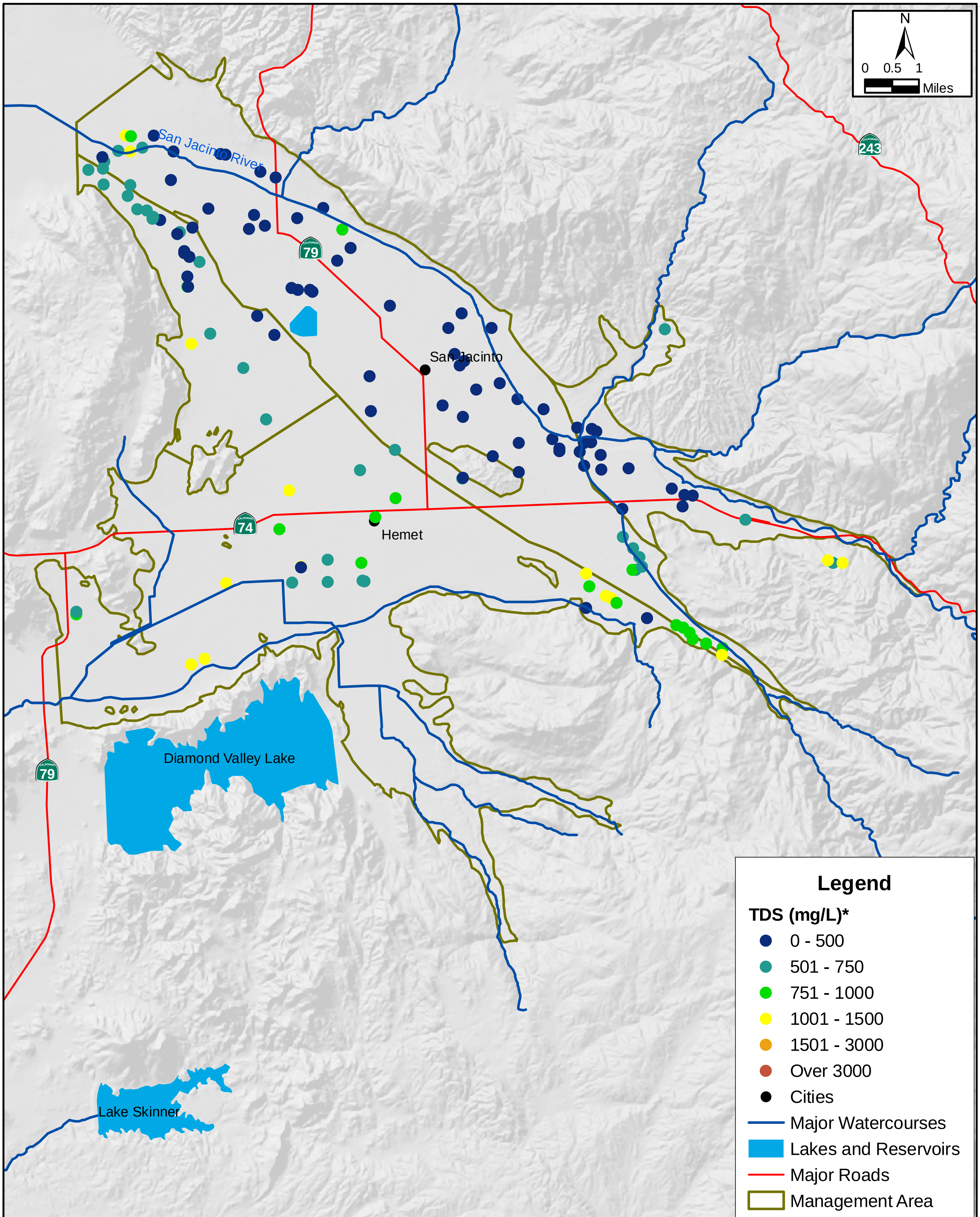
2004 Nitrate as N Concentrations in Groundwater (mg/L)

Hemet / San Jacinto Water Management Plan

*Source: EMWD

October 2007

Figure 4.36



RIME

2004 TDS Concentrations in Groundwater (mg/L)

Hemet / San Jacinto Water Management Plan

*Source: EMWD

October 2007

Figure 4.37

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SECTION 5 PROJECTED WATER DEMANDS AND FUTURE PLAN PHASES

5.1 PROJECTED LAND USE CONDITIONS

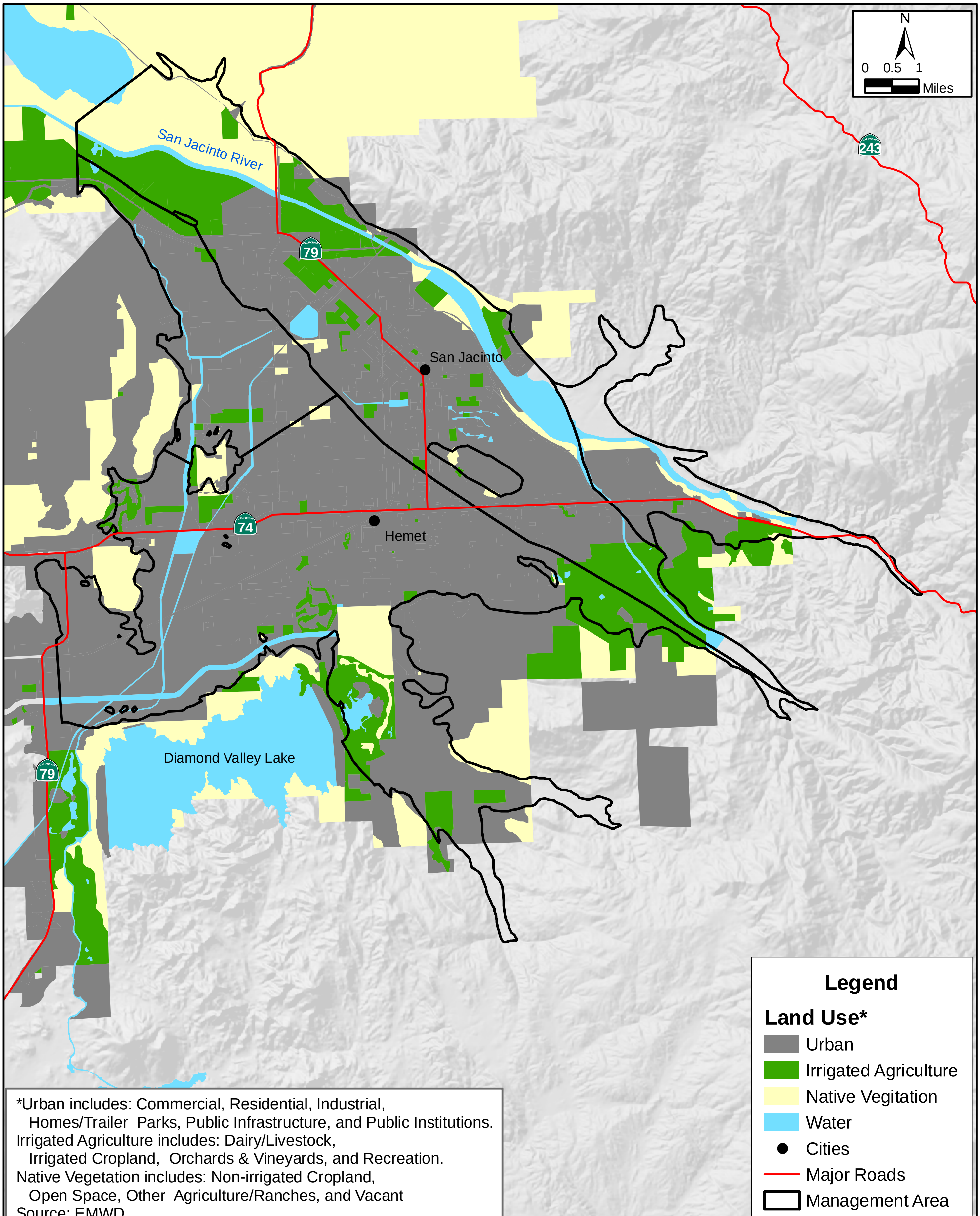
This Section presents a brief description of the projected land use conditions in the Management Area. Figure 5.1 shows the general land use categories at build-out.

Area UWMPs echo the projected urban growth indicated in the build-out land use:

- EMWD UWMP – EMWD service area population, including areas outside the Management Area, projected to increase from 494,000 in 2005 to 830,000 in 2025. (EMWD, 2005a)
- LHMWD UWMP – LHMWD service area population projected to increase from 39,100 in 2005 to 49,500 in 2025. (LHMWD, 2005)
- Hemet UWMP:
  - City of Hemet population projected to increase from 78,600 in 2005 to 154,000 in 2025; and
  - City of Hemet water system service area population projected to increase from 20,200 in 2005 to 22,300 in 2025. (Hemet, 2006)
- San Jacinto UWMP:
  - City of San Jacinto population projected to increase from 34,100 in 2005 to 63,600 in 2025; and
  - City of San Jacinto water system service area population projected to increase from 13,200 in 2005 to 24,000 in 2025. (San Jacinto, 2005)

The total land use acreage for each category is estimated and presented in Table 5.1.

Based on Tables 5.1 and 4.3, the urban area is projected to increase from 28% in the 1998 survey to 65% at build out. This increase is due to a combination of conversion of agricultural land and undeveloped land to urban uses. These future conversions have significant implications on the total projected water demand in the Management Area, as well as impacts on the precipitation, runoff, and recharge conditions. This concept is further discussed in the following sections.



*Urban includes: Commercial, Residential, Industrial,
Homes/Trailer Parks, Public Infrastructure, and Public Institutions.
Irrigated Agriculture includes: Dairy/Livestock,
Irrigated Cropland, Orchards & Vineyards, and Recreation.
Native Vegetation includes: Non-irrigated Cropland,
Open Space, Other Agriculture/Ranches, and Vacant
Source: EMWD

WRIME

2025 Projected Ultimate Land Use

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Figure 5.1