3.0 GENERAL WATERSHED CHARACTERISTICS

The 744 square mile Santa Margarita River Basin lies within the counties of San Diego and Riverside in southern California. Hydrological conditions within the basin are controlled by wintertime tropical and northern pacific storm events; and, to a minor degree, summer monsoon events. While most of the precipitation occurs as rainfall throughout the watershed, snowfall may occur in the higher mountain ranges located in the upper reaches of the watershed. The confluence of the Murrieta and Temecula Creeks, which drain the upper parts of the watershed, forms the 27-mile-long Santa Margarita River, which flows to the Pacific Ocean.

Portions of the Fallbrook PUD service area lies within the Santa Margarita and San Luis Ray River Basins. The Fallbrook PUD provides water to 28,000 acres in and around the unincorporated community of Fallbrook. District boundaries are roughly the Fallbrook Naval Weapons Station and Marine Corps Base Camp Pendleton to the west, the Riverside County Line to the north, Live Oak Park Road to the east and Green Canyon Road to the south. The District was formed to provide water to the community of Fallbrook. Originally, water was supplied from wells in the San Luis Rey valley and the shallow alluvium of the Santa Margarita River. Since that time, the Fallbrook PUD has abandoned those well fields and imports all of the potable water to the community. The Fallbrook PUD has also expanded its services and treats sewage and provides recycled water. Fallbrook imports water from the Colorado River and the State Water Project. Imported water is delivered by the San Diego County Water Authority (CWA), the largest single customer of the Metropolitan Water District (MWD) of Southern California.

3.1 OVERVIEW

The Fallbrook PUD service area is located in both the Santa Margarita and San Luis Ray River watersheds. The Santa Margarita Watershed is divided into an upper basin and a lower basin at the point where the Santa Margarita River passes through the Gorge. The Gorge forms at the confluence of Murrieta and Temecula Creeks, located south of the town of Temecula (Figure 1-3). Three hydrologic sub-basins within the Lower Santa Margarita River Ground-Water Basin, totaling approximately 4,580 acres, form the ground-water area that supplies domestic, military, and agricultural water to Camp Pendleton's southern water system. The three sub-basins in the lower basin are named Upper Ysidora, Chappo, and Lower Ysidora (Figure 1-4). The Upper Ysidora sub-basin covers an area of approximately 860 acres. The Chappo sub-basin covers an area of approximately 2,640 acres and the Lower Ysidora sub-basin covers an area of 1,080 acres (Leedshill-Herkenhoff, 1988). The Fallbrook PUD service area is located approximately five miles northeast of the Upper Ysidora basin.

The Santa Margarita River Basin is typified by a relatively flat alluvial floodplain that drains the watershed from the northeast to the southwest. The Fallbrook PUD encompasses tributaries on both the north and south sides of the Santa Margarita River. Fallbrook retains a central country town setting, where agriculture and rural lands characterize the surrounding area. Terraces and gently to steeply sloping hillsides border the watershed on Camp Pendleton and the Naval Weapons Station southeast of the Fallbrook PUD. At the Lower Ysidora Sub-basin, the topography flattens as the river enters the Pacific Ocean. Surface and ground water is largely restricted to the alluvial regions that are bounded by rock units that form the sloped borders to the north and to the south of the alluvium.

3.2 CLIMATE

The Santa Margarita River Basin is characterized as having a Mediterranean climate with average annual precipitation of 12 inches near the coast (Oceanside) to over 40 inches in the mountainous areas (Santa Rosa Plateau). Warm dry summers and cool rainy winters characterize the climate of the Santa Margarita watershed near the Fallbrook PUD. The climate can be described as typical for southern California and is a semi-arid coastal climate. The climate of the basin is controlled by the Pacific Ocean, which provides light to moderate precipitation during the winter months (November to April). Summers are typically dry since 90 percent of the precipitation occurs during the winter months.

The precipitation trend for Lake O’Neill was assumed to be representative of the precipitation received in the Fallbrook PUD. The long-term average annual precipitation between 1882 and 1999 at Lake O’Neill was 13.9 inches. Annual precipitation amounts at the Lake O’Neill station fluctuate drastically from a minimum of 4.2 inches in 1961 to as much as 40 inches in 1993. Figure 3-1 is an annual departure from mean precipitation graph that represents the wet and dry cycles within the Santa Margarita River Basin at Lake O’Neill. The solid line describes the hydrologic trend in the basin: a negative slope indicates that the trend is to dry conditions and a positive slope indicates that trend is to wetter conditions. For example, a wet period occurred from 1936 until 1941 and 1977 to 1998, while the period from 1942 through 1976 indicates an extended drought. The most recent period from 1991 through 1998 represents a very wet period throughout the Santa Margarita Basin.

Hourly data from the Oceanside rainfall gage in Southern California was used as the primary source of precipitation data for daily calculations for surface water analysis (Chapter 6). Data sets for the period of record were obtained from the Desert Research Institute (DRI). The hourly data from the Oceanside Station provided the required time increment to accurately estimate streamflow below the confluence of the Santa Margarita River and De Luz Creek, as well as the anticipated runoff in the project area.

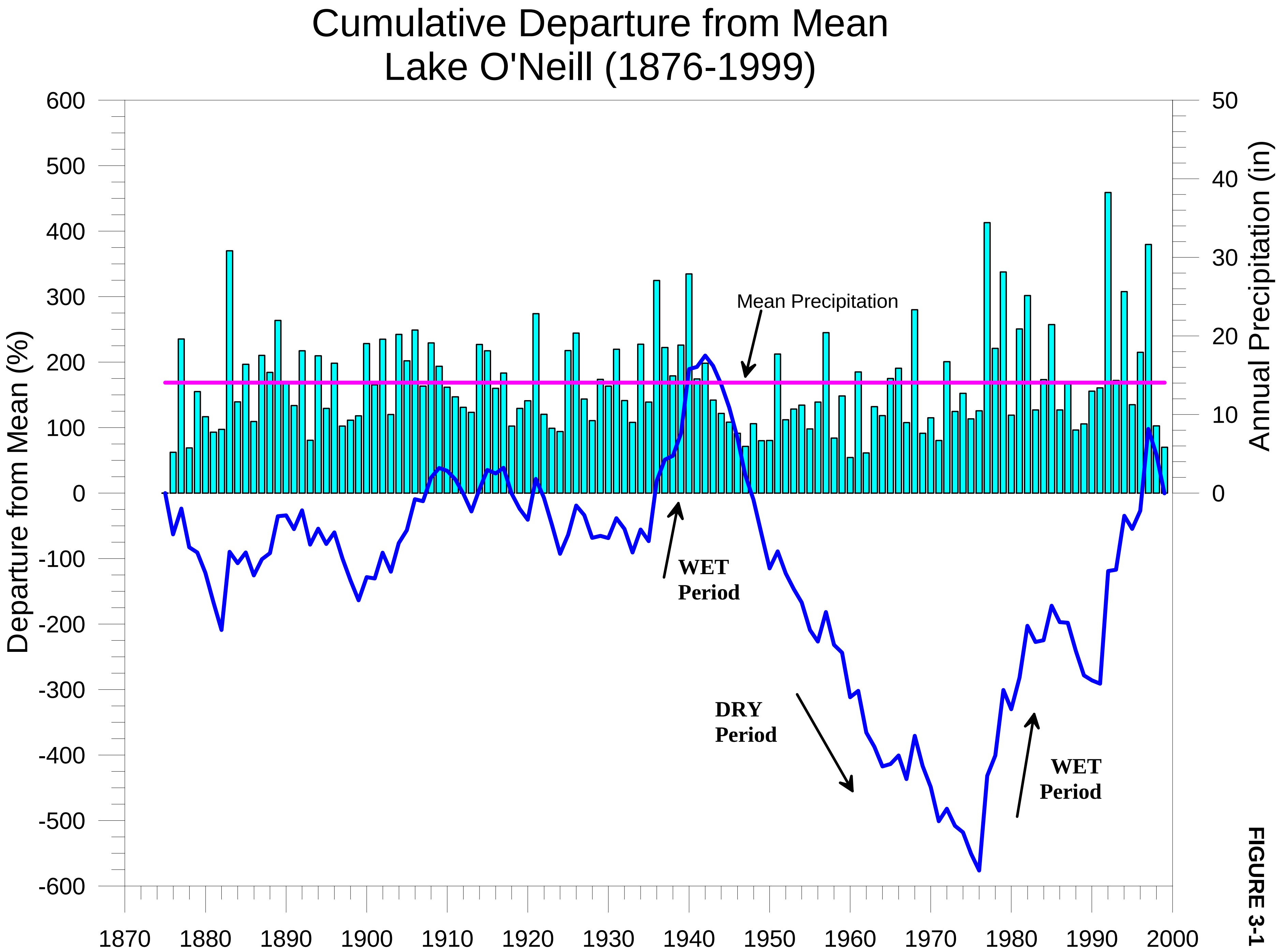
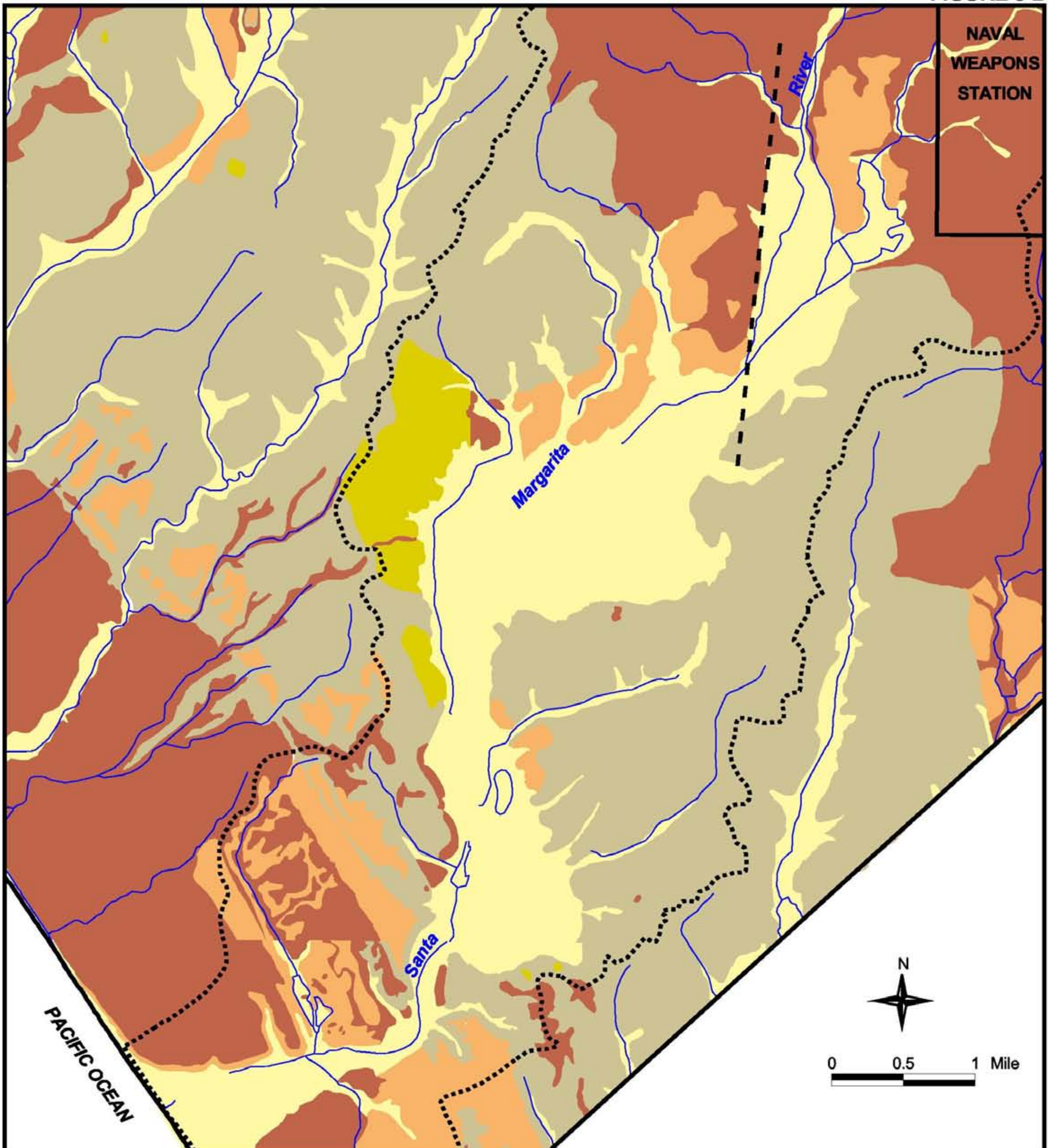

Cumulative Departure from Mean
Lake O'Neill (1876-1999)
Departure from Mean (%)
Annual Precipitation (in)
600
500
400
300
200
100
0
-100
-200
-300
-400
-500
-600
50
40
30
20
10
0
1870
1880
1890
1900
1910
1920
1930
1940
1950
1960
1970
1980
1990
2000
Mean Precipitation
WET Period
DRY Period
WET Period

FIGURE 3-1

FIGURE 3-2



Quaternary Younger Alluvium (Qya)
San Onofre Breccia (Tsc)
Quaternary Older Alluvium (QOa)
La Jolla Group (Tij)
Basement Complex (pTb)

Camp Pendleton Marine Base Boundary
Santa Margarita River Basin Boundary
Fault
Stream / Lakeshore

basemap3.apr 07/09/04

GEOLOGY OF THE STUDY AREA

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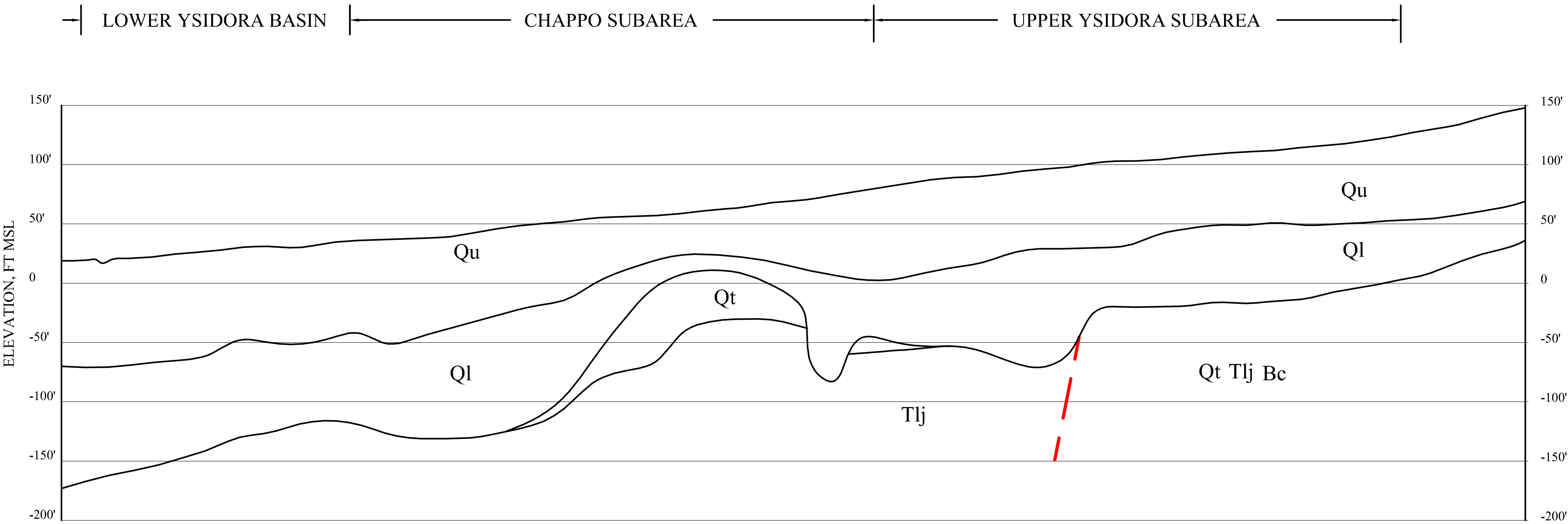
Though the Oceanside precipitation gage was used as the primary component within the analysis, alternative Fallbrook precipitation gages were examined to ensure consistency over the study area. Temperatures generally range between 33° and 90° Fahrenheit. The region is exposed to dry easterly Santa Ana winds in the fall and heavy fog in the summer. The region experiences an occasional winter frost (PRC, 1983).

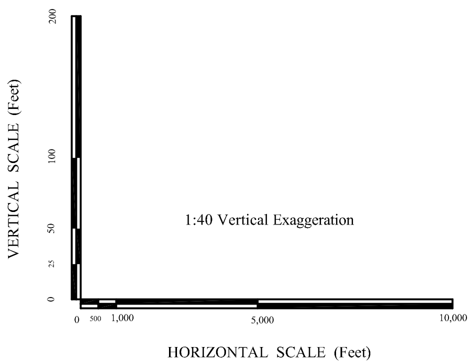
3.3 GEOLOGY AND SOILS

3.3.1 Geology

The Santa Margarita River Basin is located within the Peninsular Ranges Physiographic province of California. It originated during the Triassic period when the region was part of a pre-batholithic group of sandstone and shales. Granites of the Peninsular Range Batholith were formed due to tectonic forces during the Cretaceous period. Beginning during the uplift of the batholith, the overlying rocks were eroded and deposited along the sea causing some sedimentation. In the Tertiary Period sedimentation was amplified, sea levels fluctuated, marine and continental sedimentation increased, and the area was subjected to regional uplift and tilting. During the Quaternary Period, the sea receded and rose during glacial interludes and created marine terraces. In more recent times, movements along faults have caused breaking up of the region into blocks of varying altitudes. Additional rises in sea level filled the current river channels with alluvium. Currently the Santa Margarita basin is a stream-eroded channel filled with unconsolidated alluvium; consolidated sedimentary and igneous rocks underlie it.

The geology of the Santa Margarita River Basin includes the Basement Complex, the San Onofre Formation, the La Jolla Group, and unconsolidated deposits. The Basement Complex is from the Jurassic and Cretaceous age; it is the oldest rock formation in the study area and consists of metamorphic and igneous rocks from the Peninsular Range Batholith (Leedshill-Herkenhoff, 1988). The occurrence of the varying rock types is displayed in plan view on Figure 3-2 and in cross-section on Figure 3-3. As shown in these figures, the Basement Complex is generally limited to the Upper Ysidora Sub-area and composes the slopes around the basin floodplain in the region of the De Luz Creek confluence. The Eocene-age La Jolla Group dominates the perimeter of the floodplain in the Chappo and Lower Ysidora Sub-areas. The La Jolla Group is a thinning-upward sequence of medium sandstone to siltstone and claystone with expansive clays in some sections. This Group is the dominating rock type around the Ysidora Sub-Basin, and it is found primarily to the east and south bordering the valley regions. The middle to upper Miocene age San Onofre Formation consists mostly of breccia but it also has decreasing amounts of conglomerate and sandstone. In the Santa Margarita River Basin it is found only in the Lower Ysidora Sub-Basin in small amounts to the west of the basin. The unconsolidated deposits consist of terrace and old sand dune deposits of Pleistocene age and alluvium and channel deposits of Recent age. The Pleistocene marine terrace deposits range in





Qu	UPPER ALLUVIUM
Ql	LOWER ALLUVIUM
Qt	TERRACE DEPOSITS
Tlj	LA JOLLA FORMATION
Bc	BASEMENT COMPLEX

GEOLOGIC CONTACT, dashed where inferred, queried where uncertain

FAULT, dashed where inferred (USGS, 1954)

Cross Section @ Santa Margarita River; Refer to Figure 4-6 for Location of Cross Section.

Geologic Cross Section of the Lower Santa Margarita River Basin

Marine Corps Base, Camp Penolleton

SOURCES: LAW/CRANDALL, INC. 1995
WORTS & BOSS, 1954

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FIGURE 3-3

03/23/01

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thickness between 20 and 100 feet. The deposits in the fluvial terraces range between 10 and 40 feet. The marine terraces are composed of sand, silt and clay with lenses ranging in size from gravels to boulders. Streams that flowed across the region during the last ice age also deposited terraces. These deposits are most abundant in the northern portion of the Chappo Sub-Basin. Alluvial material of Recent age occurs as floodplain deposits, alluvial fans, and stream channel deposits. The alluvial valley fill occurs throughout the length of the Santa Margarita River Basin. Thickness of these deposits ranges from 50 to 70 feet in the Upper Ysidora Sub-basin to 100 to 150 feet in the Lower Ysidora Sub-basin (Leedshill-Herenhoff, 1988).

3.3.2 Seismic Fault Zones

Geotechnical studies to evaluate the seismic, slope stability, and clay swelling hazards would need to be completed prior to the design phase for the proposed reservoir. Exposures of the onshore extension of the Rose Canyon Fault are located on the Northwest and Southeast sides of the Upper Ysidora on the Base (Figure 3-4). The fault trace is shown on the map as a dotted line where it is hidden beneath the alluvial fill of the Upper Ysidora basin. The Northern extension of the fault trace is approximately 1 mile Southwest of the proposed reservoir dam site. The active regional Elsinore fault zone is located approximately 35 miles to the Northeast of the proposed reservoir site. The Elsinore Fault is considered a sub-block of the San Andreas Fault and trends Northwest-Southeast (CDMG, 1985).

3.3.3 Soils

The types and location of soils were reviewed to determine potential sites for borrow material and to estimate the run-off characteristics of the study area. Maps and studies conducted by the Natural Resources Conservation Service were used to identify the soils in the study area (Figure 3-5). Review of this data indicate that much of the study area is comprised primarily of sandy loams and coarse sandy loams. Detailed discussion of the local soils is further addressed in the Hydrologic Analysis and Engineering Design sections later in this report.

3.4 GROUND WATER

Alluvium is the principal source of ground water in the lower Santa Margarita River Basin. The unconsolidated alluvial deposits are made up of three distinct geologic units: the Upper Alluvium, Lower Alluvium, and Terrace Deposits. The Upper and Lower Alluvium are difficult to differentiate; however, the Lower Alluvium is generally more coarse-grained except in the Upper Ysidora sub-basin where the entire section consists of coarse sand and gravel. These two units are the main ground-water bearing formations. The overlying Terrace deposits consist of older, decomposing partially indurated channel sediments. The total thickness of the

FIGURE 3-4

FAULT PATTERNS

(Defining Blocks and Sublocks)

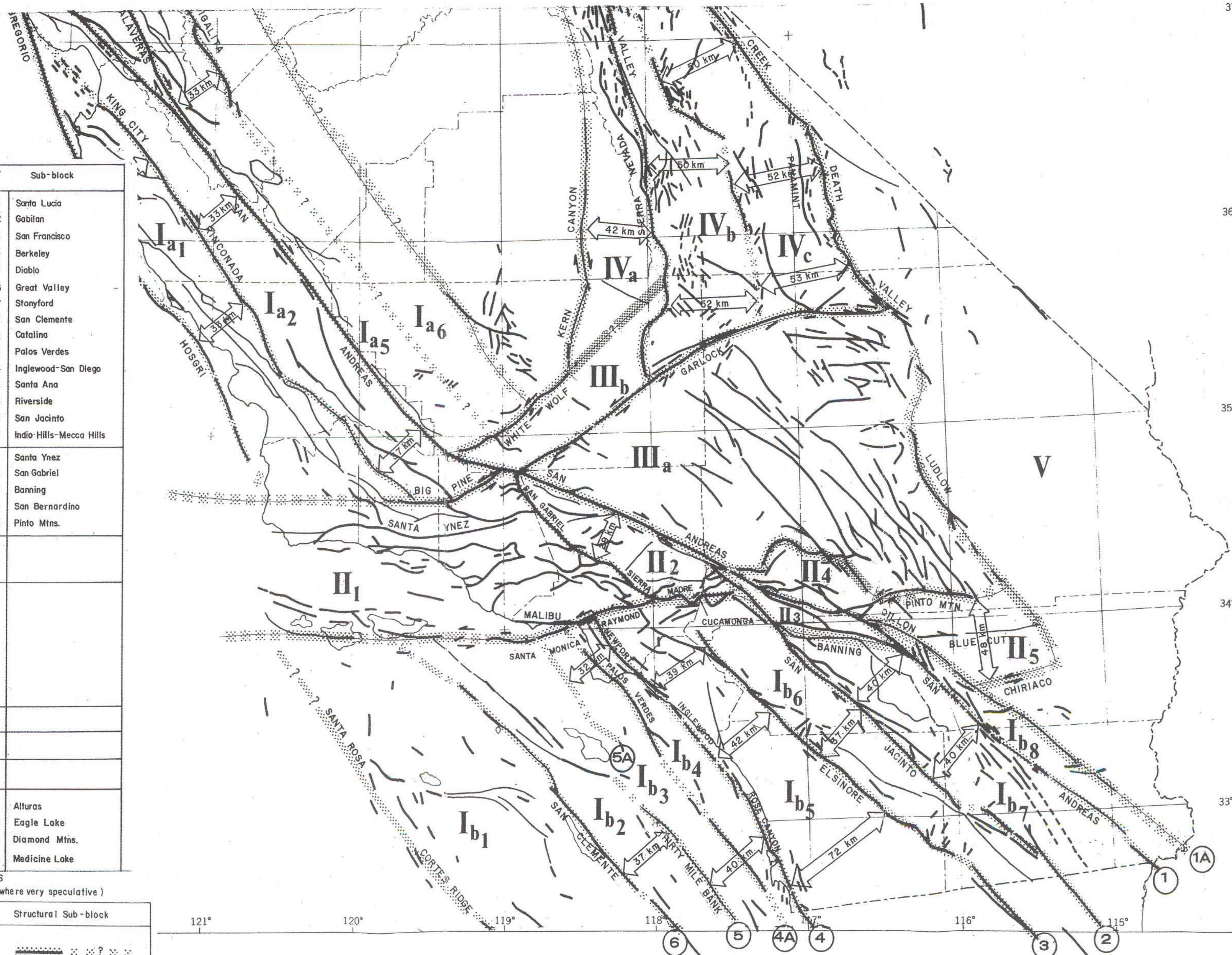
Structural Province	Predominant Fault Trend		Blocks		Sub-block
I	NW (San Andreas trend)	a	Coast Ranges	1	Santa Lucia
				2	Gabilan
				3	San Francisco
				4	Berkeley
				5	Diablo
				6	Great Valley
				7	Stonyford
		b	Peninsular Ranges	1	San Clemente
				2	Catalina
				3	Palos Verdes
				4	Inglewood-San Diego
				5	Santa Ana
				6	Riverside
				7	San Jacinto
				8	Indio-Hills-Mecca Hills
II	E-W (transverse trend)		Transverse Ranges	1	Santa Ynez
				2	San Gabriel
				3	Banning
				4	San Bernardino
				5	Pinto Mtns.
III	NE (Garlock trend)	a	Mojave		
		b	Tehachapi		
IV	N-S (Owens Valley trend)	a	Kern Canyon		
		b	Panamint		
		c	Death Valley		
		d	Warner		
		e	East Sierra		
		f	Cascade		
		g	Gorda		
V	Multiple		Sonoran Desert		
VI	Complex		Sierra Nevada		
VII	Thrusts		Klamath		
VIII	Complex		Modoc	1	Alturas
				2	Eagle Lake
				3	Diamond Mtns.
				4	Medicine Lake

BOUNDARIES

(Segmented where projected; queried where very speculative)

Boundary defined by	Major Structural Stock	Structural Sub-block
Quaternary fault		
Pre-Quaternary fault *		
Minor Pre-Quaternary fault * (fault not shown)		

* Pre-Quaternary faults may include a fault whose age is unknown or has not been evaluated; it may in fact, be Quaternary



0 50 100 MILES

0 50 100 KILOMETERS

Regional Fault Map near Santa Margarita River Basin

Source: California Department of Conservation; Division of Mines and Geology, Plate 2, Map C; Fault and Geologic Maps of California accompanied by Bulletin 201. 1985

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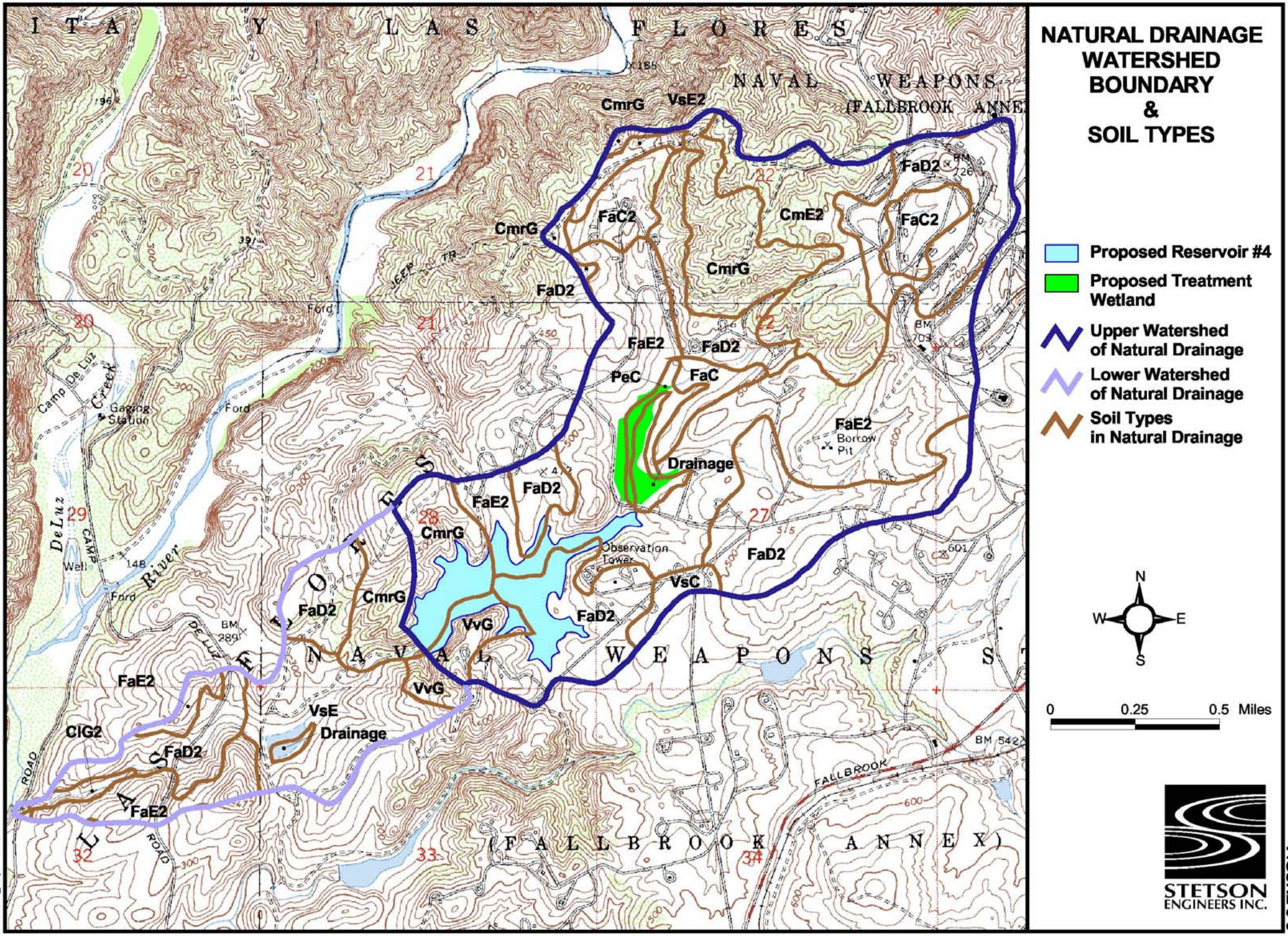

FIGURE 3-5

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alluvium increases downstream from about 120 feet at the De Luz Creek confluence to about 200 feet at the coast.

The lower Santa Margarita River basin on Camp Pendleton is composed of three hydrogeologic sub-basins, the Upper Ysidora, the Chappo, and the Lower Ysidora. Ground water in the Upper Ysidora and Chappo sub-basins is essentially unconfined, while in the Lower Ysidora sub-basin it is semi-confined due to lenses of fine sediments. The Basement Complex in the Upper Ysidora sub-basin forms the sides and bottom of the basin. Sandstone and shale of the La Jolla formation forms the sides and bottom of the basin in the Chappo sub-basin and part of the Lower Ysidora Sub-basin. The Basement Complex transmits little or no water to the alluvium. The La Jolla formation transmits small quantities of water to the basin.

As the sea level rose approximately 200 feet during the Quaternary period, the Santa Margarita River deposited alluvial fill in the three basins forming two distinct geologic layers, the upper alluvium (Qu) and the lower alluvium (Ql). In each sub-basin, the subsurface hydraulic properties vary within these two alluvial units based on the sorting of gravels, sands, and finer grained sediments as the river deposited them in response to the rising seawater levels.

In the Upper Ysidora Sub-Basin, the Ql and Qu units consist of very permeable, well sorted sands and gravels with cobbles resulting in high infiltration rates from river water, percolation basins, and rainfall. Five Base water supply wells pump in the Upper Ysidora. In the Chappo, the Qu is mostly composed of less transmissive silt, sandy silt, and clay, except beneath the river where there are sands and gravels, and in an apparent subsurface stream channel beneath the supply depot area. The Ql unit of the Chappo Sub-Basin consists of well-sorted gravels and sands and comprises another main water bearing unit for eight production wells. The Lower Ysidora Sub-Basin's Qu consists of less permeable silt and clay, intermixed with some sand. The Ql of the Lower Ysidora Sub-Basin contains mixed gravel, sand, silt, and clay. Some areas are very permeable, especially near the Lower Ysidora-Chappo narrows that define the boundary between the two sub-basins. Currently, two irrigation wells are producing in the Lower Ysidora.

The Upper Ysidora sub-basin extends from the confluence of De Luz Creek and the Santa Margarita River to the Basilone Road narrows comprising a length of approximately 2 miles and a surface area of approximately 860 acres. Within this sub-basin, the primary recharge to the ground-water aquifer is seepage from the river and underflow from subsurface gravels in the Santa Margarita River stream channel alluvium. Other ground-water inflows include percolation from precipitation, range front recharge, percolation pond recharge, and infiltration from conveyance channels (from the diversion weir, spill and release from Lake O'Neill). The release channel receives flows from Lake O'Neill, and prior to September 12, 1999, from Sewage Treatment Plant (STP) Oxidation Pond 1. Primary outflows within this sub-basin include production well pumping, evapotranspiration (ET) from phreatophytes along the riparian corridor, and underflow through the narrows at Basilone Road. Water is diverted from the Santa Margarita River as it flows through the Upper Ysidora sub-basin, near the Naval Hospital, to five percolation recharge ponds and Lake O'Neill. The estimated ground-water storage capacity of the Qu is 7,500 AF and of the Ql is 5,000 AF (Troxall and Hofman, 1954).

The Chappo sub-basin extends for approximately 3.3 miles from the narrows at Basilone Road to the narrows at the northern end of the Lower Ysidora sub-basin. The surface area of the alluvium in the Chappo sub-basin is approximately 2,180 acres. Within this sub-basin, the primary recharge to the ground-water aquifer is seepage from the river and underflow from the upper sub-basin. Other ground-water inflows include percolation from precipitation, range front recharge and infiltration from Oxidation Ponds 8 and 3. There is minor return flow from irrigation of parade grounds and plants, but this is not considered a source of ground-water recharge as the grasses and trees use most of the applied water before it reaches the ground-water table. Primary outflows within this sub-basin include production well pumping, phreatophyte ET along the riparian corridor, and underflow through the narrows to the Lower Ysidora. The estimated ground-water storage capacity of the Chappo is 27,000 AF (Troxall and Hofman, 1954).

The Lower Ysidora Sub-Basin extends for approximately 2.7 miles from the narrows beneath the Chappo to another narrows in the bedrock near the estuary and mouth of the Santa Margarita River. The surface area of the Lower Ysidora sub-basin is approximately 1,020 acres. Within this sub-basin, the primary recharge to the ground-water aquifer is seepage from the river, underflow from the Chappo Sub-Basin, and infiltration from the wetlands where discharge from Oxidation Pond 2 enters the basin. Until 1993, another primary inflow was the percolation of secondary treated effluent from Oxidation Pond 13. Other ground-water inflows include percolation from precipitation and range front recharge. Primary outflows within this sub-basin include irrigation well pumping, ET by phreatophytes along the riparian corridor and wetland areas, and underflow through the narrows at the base of the Lower Ysidora.

3.5 SURFACE HYDROLOGY

In the Upper Basin of the Santa Margarita River, Murrieta Creek and Temecula Creek combine to form the 27-mile long Santa Margarita River that flows to the Pacific Ocean. Immediately downstream from the confluence of these two creeks, USGS streamflow gage #11044000 marks the location of the station referred to as the "Gorge". The 78-year period of record associated with this gage records the run-off from the 586 square mile drainage area that dominates the Santa Margarita Basin. A hydrograph of daily historical streamflow at the Gorge is shown in Figure 3-6. The remaining 154 square miles drainage area below the Gorge is defined as the Lower Santa Margarita River Basin.

Below the confluence of Murrieta Creek and Temecula Creek, the Santa Margarita River flows through a narrow, precipitous canyon, from the Gorge downstream to a point below its confluence with De Luz Creek. Beyond this point, it flows onto the coastal floodplain until eventually draining into the Pacific Ocean. The entire lower basin has a drainage area of approximately 154 square miles, where De Luz Creek is the primary tributary to the Santa Margarita River. De Luz Creek drains a relatively undeveloped 47.5 square mile watershed, and precipitation runoff comprises virtually all flow in the creek (FPUD, 1994).

The locations of the major tributaries that feed into the Santa Margarita River and the gaging station locations maintained by the USGS and the DWR are presented in Figure 3-7. Table 3-1 lists the location and available periods of record for selected streamflow gages in the Santa Margarita River Basin. An entire list of all stations in the Santa Margarita River Basin is provided in the Appendix.

TABLE 3-1

SELECTED STREAMFLOW GAUGING STATIONS IN THE SANTA MARGARITA RIVER BASIN

Station Name	Station ID #	Operating Agency	Period of Record	Drainage Area [mi^2]
Deluz Creek near Deluz	11044800	USGS	10/92-Present	33.0
Deluz Creek near Fallbrook	11044900	USGS	10/51-9/67, 10/89-Present	47.5
Fallbrook Creek near Fallbrook	11045300	USGS	10/93-Present	7.0
Murrieta Creek at Temecula	11043000	USGS	10/25-Present	222.0
O'Neill Ditch near Ysidora	----	USGS	10/30-9/60	-
Rainbow Creek near Fallbrook	11044250	USGS	11/89-Present	10.3
Sandia Creek near Fallbrook	11044350	USGS	10/89-Present	21.1
Santa Margarita River at FPUD Sump	11044300	USGS	10/89-Present	620.0
Santa Margarita River at Ysidora	11046000	USGS	3/23-Present	723.0
Santa Margarita River near Deluz Station	11045000	USGS	10/24-9/26	705.0
Santa Margarita River near Fallbrook	11044500	USGS	10/24-9/80	644.0
Santa Margarita River near Temecula (Gorge)	11044000	USGS	2/23-Present	588.0
Santa Margarita River Tributary near Fallbrook	11044600	USGS	10/61/ - 09/65	0.5

Precipitation runoff comprises a significant majority of surface flow in the Santa Margarita River basin. Local runoff generated by precipitation events is dependent on soil

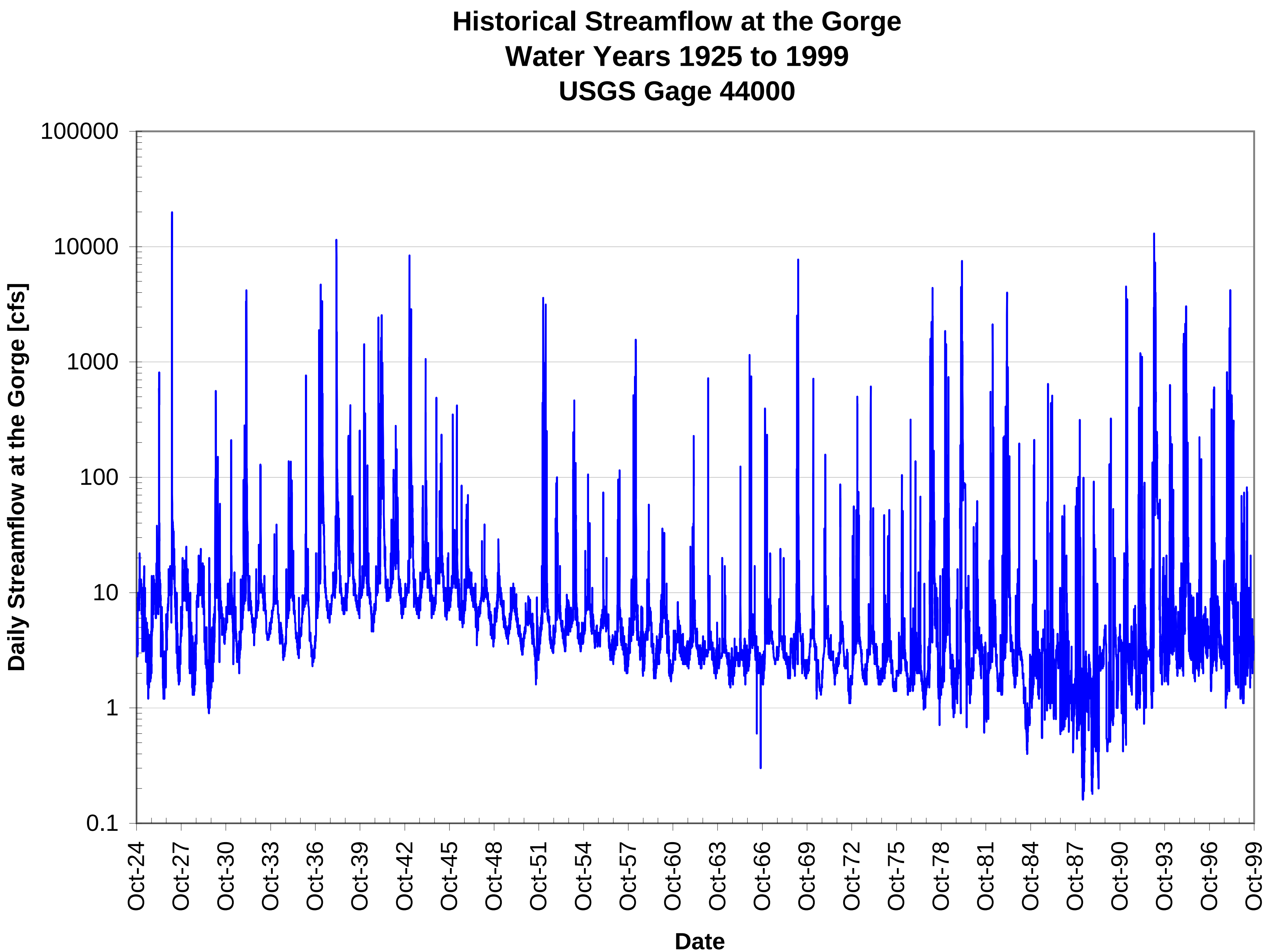
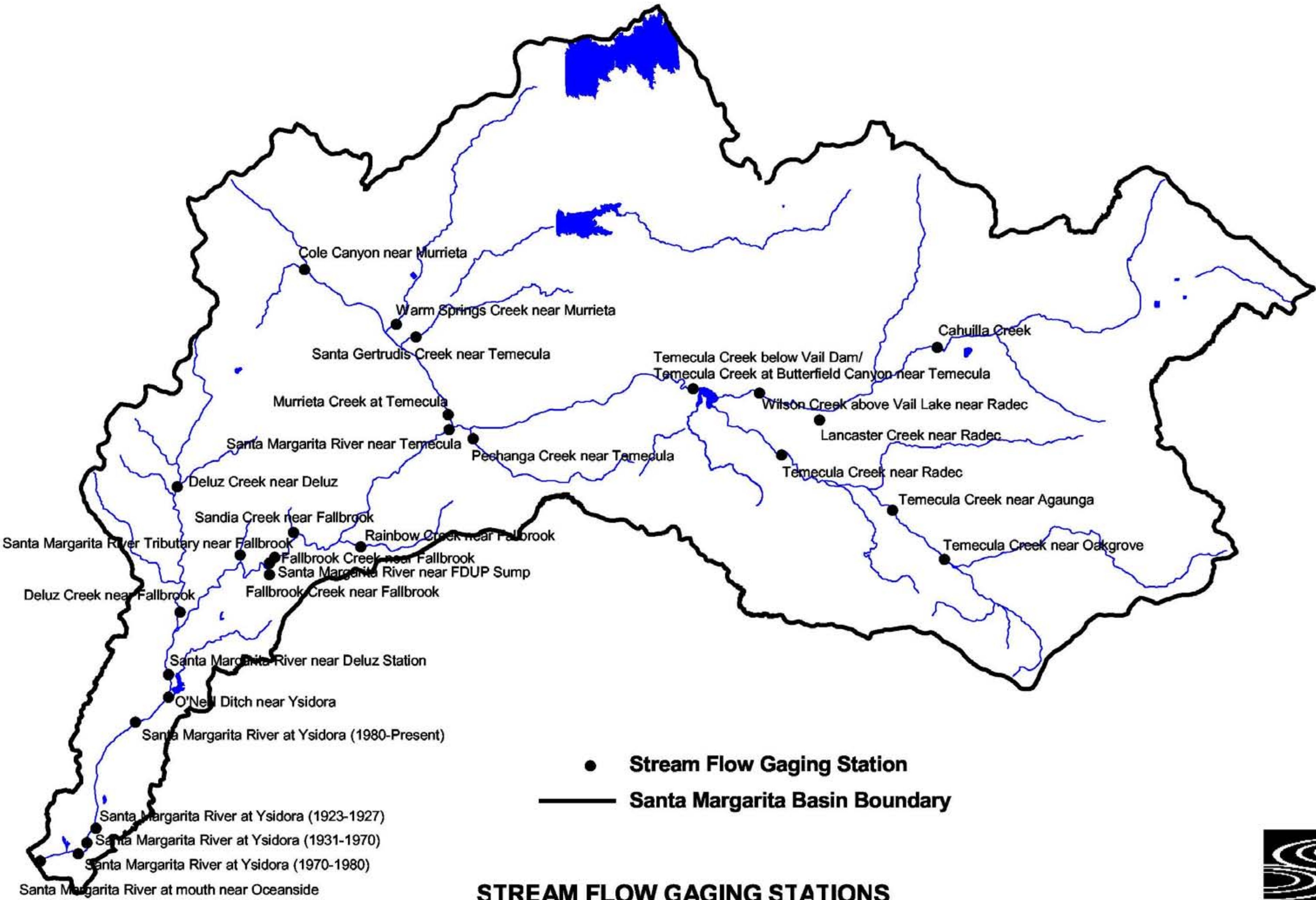

Historical Streamflow at the Gorge
Water Years 1925 to 1999
USGS Gage 44000
Daily Streamflow at the Gorge [cfs]
100000
10000
1000
100
10
1
0.1
Oct-24
Oct-27
Oct-30
Oct-33
Oct-36
Oct-39
Oct-42
Oct-45
Oct-48
Oct-51
Oct-54
Oct-57
Oct-60
Oct-63
Oct-66
Oct-69
Oct-72
Oct-75
Oct-78
Oct-81
Oct-84
Oct-87
Oct-90
Oct-93
Oct-96
Oct-99
Date

FIGURE 3-6



STREAM FLOW GAGING STATIONS
SANTA MARGARITA RIVER WATERSHED

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FIGURE 3-7

characteristics, land slopes, existing soil moisture, storm intensity, and storm duration. Due to these factors, the runoff varies greatly from year to year, month to month, and location to location. Within the alluvial floodplain, runoff is generally minimal due to the flatness of topography, undeveloped characteristic of the area, and sandy soil. In the foothills and mountainous areas dominated by bedrock formations, runoff may be significant during large precipitation events.

The Santa Margarita River is often dry for several months of the year in parts of the Chappo and Lower Ysidora sub-basins. In extremely dry years, historical records at the Ysidora stream gage indicate that there has been no surface flow at all reaching the ocean. In extremely wet years, the mean daily flow has reached as high as 19,500 cfs and the peak daily flow has exceeded 44,000 cfs (January 1993). The hydrologic variability of the Santa Margarita River makes it both a destructive and vulnerable source of water for its many users.

3.6 WATER QUALITY AND THE SAN DIEGO BASIN PLAN

The regulation, protection, and management of California waters is carried out by the State Water Resources Control Board (SWRCB) and the Regional Water Quality Control Board (RWQCB). The nine Regional Boards are responsible for adopting and enforcing a Water Quality Control Plan or Basin Plan. The study area for the conjunctive use project is located within the San Diego Region, Region 9, and is thus regulated by the San Diego Basin Plan.

The current Basin Plan was adopted in September 1994 with amendments in May 1998. The primary goals of this plan are to designate beneficial uses for surface and ground waters, designate narrative and numerical water quality objectives for protection of these uses, and establish implementation measures to meet these objectives. The RWQCB regulates waste discharge and reclaimed water use in order to minimize and control adverse effects on the quality and beneficial uses of the surface and ground waters. The RWQCB is responsible for issuing and enforcing "Waste Discharge Permits", and "Master Reclamation Permits".

The guidelines established in the basin plan refer to both basin-wide objectives and objectives determined for specific Hydrologic Units and Areas. The study area is located in the Ysidora Hydrologic area (numbered 2.10 in the Basin Plan). The Ysidora Hydrologic Area is a subset of the Santa Margarita Hydrologic Unit (numbered 2.00). The Lower Ysidora (2.11), Chappo (2.12), and Upper Ysidora (2.13) are Hydrologic Subareas contained within the Ysidora Hydrologic Area.

The Base's water supply is provided by wells completed in the aquifer underlying the Santa Margarita River Basin. Ground water from the wells is known to contain high levels of total dissolved solids (TDS), total organic carbon (TOC), iron, and manganese. The drinking water TDS and piping system corrosion byproducts (copper) have a negative impact on wastewater sludge generated at the treatment plants. At well locations closer to the ocean, higher dissolved solids concentrations are observed, indicating a saltwater-freshwater interface typical in a coastal area.

Water quality monitoring stations indicate that the river suffers from excessive TDS and nitrate. Since Camp Pendleton is the last water user on the extensive Santa Margarita River system, nutrient levels, particularly nitrogen, have increased in recent years due to the intensive use of agricultural fertilizers in the Upper Watershed. Likewise, a dramatic expansion of residential, commercial and industrial development during the past decade in the Upper Basin has produced more urban runoff and wastewater discharge.

3.6.1 Beneficial Uses

The Basin Plan designates beneficial uses based on four types of water bodies: inland surface waters, coastal waters, reservoirs and lakes, and ground water. The Regional Board has established 23 specific beneficial uses which are also defined on a statewide basis. The following tables summarize the beneficial uses of surface water and ground water in the Upper Ysidora hydrologic subarea (2.13). (Table 3-2)

An existing beneficial use ordinarily must be designated for protection unless another beneficial use requiring more stringent objectives is designated. (California Water Code § 13000). Also, designation of a beneficial use shall not require a waste of water pursuant to the California Constitution, Article X, Section 2.

TABLE 3-2

BENEFICIAL USES FOR THE YSIDORA HYDROLOGIC AREA

Beneficial Use		Inland Surface Waters	Ground Water	Lakes and Reservoirs
		Santa Margarita River	Ysidora Basin	O'Neill Lake
	Code	***2.13***[1]	***2.10***[2]	***2.13***[1]
Municipal and Domestic Supply	MUN	●	●	●
Agricultural Supply	AGR	●	●	●
Industrial Process Supply	PROC	●	●	●
Industrial Service Supply	IND	●	●	●
Ground Water Recharge	GWR			
Freshwater Replenishment	FRSH			
Navigation	NAV			
Hydropower Generation	POW			
Contact Water Recreation	REC-1	●		●
Non-Contact Water Recreation	REC-2	●		●
Commercial and Sport Fishing	COMM			
Aquaculture	AQUA			
Warm Freshwater Habitat	WARM	●		●
Cold Freshwater Habitat	COLD	●		●
Inland Saline Water Habitat	SAL			
Estuarine Habitat	EST			
Marine Habitat	MAR			
Wildlife Habitat	WILD	●		●
Preservation of Biological Habitats of Special Significance	BIOL			
Rare, Threatened, or Endangered Species	RARE	●		
Spawning, Reproduction, and/or Early Development	SPWN	●	Existing Beneficial Use	●

Source: San Diego Basin Plan
1.Upper Ysidora Hydrologic Subarea
2.Ysidora Hydrologic Area

3.6.2 Water Quality Objectives

Water quality objectives are established to protect the established beneficial uses of specific hydrologic areas and subareas. The basin plan establishes water quality objectives, both narrative and numerical for many potential pollutants. The objectives are achieved primarily through the establishment of waste discharge requirements. A summary of selected water quality objectives applicable to inland surface waters and ground waters is provided below. The information shown below consists of narrative objectives as well as a tabulation of numerical objectives. Table 3-3 presents the numerical objectives for inland surface waters and ground waters in the Basin Plan.

3.6.2.1 Bacteria - Total and Fecal Coliform

Waters designated for contact recreation: the fecal Coliform concentration based on a minimum of not less than five samples for any 30 day period, shall not exceed a log mean of 200/100 ml, nor shall more than 10% of total samples during a 30-day period exceed 400/100 ml. Waters designated for non-contact recreation: the average fecal coliform concentrations for any 30-day period, shall not exceed 2,000/100 ml, nor shall more than 10% of total samples during a 30-day period exceed 4,000/100 ml.

3.6.2.2 Bio-Stimulatory Substances (Nitrogen and Phosphorus)

Inland surface waters shall not contain concentrations that promote aquatic growth to the extent that growths cause nuisance or adversely affect beneficial uses. Concentrations of nitrogen (N) and phosphorus (P) shall be maintained below levels that stimulate algae and emergent plant growth. Threshold P concentrations shall not exceed 0.05 mg/l in any stream where it enters a standing body of water or 0.025 mg/l in any standing body of water. The desired goal to prevent plant nuisance in flowing waters appears to be 0.1 mg/l total P. These values are not to be exceeded more than 10% of the time unless specific studies indicated otherwise. There have been no analogous threshold values set for nitrogen, but natural ratios of nitrogen to phosphorus are to be determined by surveillance and monitoring and upheld. In the absence of specific data the following ratio should be used N:P = 10:1, on a weight to weight basis.

3.6.2.3 Chlorides

The secondary MCL for chlorides is 500 mg/l. Concentrations between 100 and 140 mg/l are considered to be safe for irrigation waters. Irrigation waters containing 140-350 mg/l may be harmful to plants.

3.6.2.4 Dissolved Oxygen

Dissolved Oxygen (DO) levels shall not be less than 5.0 mg/l in inland surface waters designated with MAR or WARM beneficial uses or less than 6.0 mg/l for those designated COLD. The annual mean DO concentration shall not be less than 7 mg/l more than 10% of the time

3.6.2.5 pH

In inland surface waters, the pH shall fall between 6.5 and 8.0.

3.6.2.6 Total Dissolved Solids

TDS may consist of carbonates, bicarbonates, chlorides, sulfates, phosphates, nitrated, magnesium, sodium, iron, manganese and other substances. The recommended drinking water standard for TDS is 500mg/l with an upper limit of 1000 mg/l. Excessively high concentrations can be harmful to plants.

The table shown below (Table 3-3) summarizes the numerical water quality objectives in the Basin Plan for inland surface waters and ground waters. (RWQCB, 1994).

TABLE 3-3

NUMERICAL WATER QUALITY OBJECTIVES FOR THE YSIDORA HYDROLOGIC AREA

Constituent	Inland Surface Waters	Ground Waters
Total Dissolved Solids	750	750
Chloride	300	300
Sulfate	300	300
Percent Sodium	60	60
Nitrate	N/A	10
Iron	0.30	0.30
Manganese	0.05	0.05
MBAS	0.50	0.50
Boron	0.75	0.75
Turbidity (NTU)	20	20
Color units	20	20
Fluoride	1.0	1.0

Source: San Diego Basin Plan

All constituents shown above are concentrations in mg/l unless otherwise indicated.

The objectives for inland surface waters correspond to their designated beneficial uses. In 1978 the Regional Board deleted some ground-water quality objectives and beneficial uses for the Ysidora Hydrologic area. The basis of this move was to promote wastewater reclamation. It was determined that the loss of ground-water supplies in these areas was outweighed by the long-term increase in wastewater reclamation made possible by allowing reclaimed water discharges which are high in TDS. This change was made pursuant to Resolution No 78-6.

4.0 RECLAIMED WATER USE

4.1 OVERVIEW

The purpose of this study is to determine the feasibility of incorporating tertiary treated wastewater from the Fallbrook PUD in a conjunctive use program with Camp Pendleton. The wastewater produced at the Fallbrook sewage treatment plant provides a source of supply that may be used to reduce Fallbrook's reliance on imported water, increase its reliable water supply, and provide a cost-effective source of much needed water. As described in the following chapters in greater detail, wastewater will be recycled and reused for beneficial use by the Fallbrook PUD and Camp Pendleton.

The purpose of this chapter is to outline applicable laws, regulations, and governing bodies that oversee the use of tertiary treated water in California. Other projects describing the use of tertiary treated wastewater in California have also been included to provide the reader with an understanding of the reclamation of wastewater effluent. Finally, the existing facilities and anticipated discharge rates from the Fallbrook treatment plant are explained in detail for later use in this study.

4.2 APPLICABLE LAWS AND REGULATIONS

4.2.1 Federal Laws and Regulations

The Federal Water Pollution Control Act of 1972, also known as the Clean Water Act (CWA), is the principle federal law related to water quality. The goal of the CWA is to "restore and maintain the chemical, physical and biological integrity of the Nation's waters" in order to make all surface waters "fishable" and "swim-able". The CWA requires states to adopt water quality standards to protect the health and welfare of the public, enhance the quality of water and serve the purposes of the CWA. The federal regulations used to implement the CWA are contained in Title 40 of the Code of Federal Regulations.

The National Environmental Policy Act of 1969 (NEPA) declares the national environmental policy and its goals. The primary objectives of NEPA are to ensure that environmental factors are considered in federal decision making processes and to provide full public disclosure of any federal action. NEPA requires that an Environmental Impact Statement (EIS) be filed for any project that may significantly affect the quality of the human environment prior to receiving federal approval. Should the conjunctive use project proceed to the implementation stage, NEPA compliance would be required for the project.

The Federal Endangered Species Act (ESA) requires all federal agencies, in consultation with the U.S. Fish & Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS), to ensure that their actions do not jeopardize the continued existence of endangered or threatened species or result in the destruction of critical habitat for these species. The ESA is specifically directed at projects that are subject to NEPA, which may adversely impact threatened and endangered species. Should the conjunctive use project proceed, information should be requested from the USFWS regarding the presence of endangered or threatened species or their critical habitat located within the project area. This information would then be used to develop a Biological Assessment (BA) which will determine effects on listed species due to the project actions. If the project is found to result in negative impacts to listed species, a formal consultation with USFWS and NMFS must be initiated by the Department of Defense. The product of this consultation would be a Biological Opinion (BO), or determination, by the USFWS or NMFS whether the project would jeopardize the continued existence of the listed species. If the BO finds that the project would jeopardize the continued existence of a listed species, then reasonable and prudent measures would be incorporated into the project alternatives to reduce potential affects to a level that is not likely to jeopardize the continued existence of the species

4.2.2 State of California Laws and Regulations

The principle laws and regulations of the state of California that relate to water quality and the scope of this project are the Water Code, the Health and Safety Code, and Title 22 of the California Code of Regulations (CCR).

The California Environmental Quality Act (CEQA) of 1977 is the state level equivalent of NEPA. Similar to NEPA, the overall goal of CEQA is to provide full public disclosure of projects and ensure that environmental factors are properly considered during the decision making process. CEQA requires that any projects having a significant impact on the environment must file and Environmental Impact Report (EIR). The EIR is made available for public review and comment prior to the project receiving State approval.

4.2.2.1 California Water Code

The California Water Code contains the provisions and guidelines for almost every aspect of water and its use in the state of California. Division 7 of the Water Code is known as the Porter-Cologne Water Quality Control Act. This act establishes the regulatory structure to protect water quality and beneficial uses of the waters of California. Under the Porter-Cologne, the Regional Water Quality Control Board (RWQCB) has the power to create and adopt a Water

Quality Control Plan or Basin Plan. The Basin Plan establishes the water quality objectives and criteria as well as beneficial uses of the waters in a given region of the state.

Provisions for the use of reclaimed water in California are set forth in Division 7, Chapter 7 of the Water Code. Sections 13500-13556 of this chapter are commonly known as the *Water Recycling Law.* The Water Recycling Law requires the Department of Health Services (DHS) to establish statewide criteria for each type of use of recycled water (§ 13522.5). The Regional Board in cooperation with DHS is to establish specific objectives and requirements for any proposed recycled water project pursuant to the Basin Plan and statewide criteria. Any requirements not addressed by the statewide criteria will be addressed on a case by case basis. (§ 13523) (DHS, "Purple Book", 2001).

The Water Code defines an exception to issuance of permit requirements based on salinity concentrations. Section 13523.5 of the Water Code states "*A regional board may not deny issuance of water reclamation requirement to a project which violates only a salinity standard in the basin plan*". (DHS, "Purple Book", 2001).

The Water Recycling Act of 1991 is contained in Chapter 7.5 of the Water Code. This Act contains legislative findings related to the importance of the use of recycled water in California. Under this Act, the State of California set a water recycling goal of 700,000 acre-ft by the year 2000 and 1 million acre-ft by the year 2010. (DHS, "Purple Book", 2001).

4.2.2.2 California Code of Regulations - Title 22, Division 4, Environmental Health

The statewide drinking water standards are contained under this title. The drinking water standards are important to this project because most waste discharge requirements include compliance with these standards. The CCR contains both narrative and numerical objectives for various contaminants.

Chapter 3 of Division 4 of Title 22 is entitled Water Recycling Criteria. The criteria were established by the DHS pursuant to the Water Recycling Law. The Water Recycling Criteria define the allowable uses of recycled water and specific requirements related to each use including the required level of treatment and setback distances from domestic supply wells. (DHS, "Purple Book", 2001).

Article 3 of Chapter 3, entitled Uses of Recycled Water, defines the allowable uses and treatment level required for each use of recycled water (§ 60303-60307). A brief summary of selected uses and associated treatment requirements are provided below.

Recycled water used for surface irrigation, where direct human contact is possible, must be disinfected tertiary recycled water with specific limits on turbidity. For surface irrigation of food crops where direct contact with the edible portion of foods does not exist, the recycled water must be at least disinfected secondary 2.2 recycled water. Other surface irrigation where contact with humans and or edible foods is not likely, the water must be at least disinfected secondary 23 recycled water. Recycled water that is to be impounded in areas designated as unrestricted for recreational use must be at least disinfected tertiary recycled water. For restricted impoundments the water must be at least disinfected secondary 2.2 recycled water. (DHS, "Purple Book", 2001).

Article 4 of Chapter 3, entitled *Use Area Requirements*, specifies the setback distances required for various uses of recycled water and treatment levels. Disinfected tertiary recycled water may not be used for irrigation within 50 ft of a domestic supply well nor impounded within 100 ft of a domestic supply well. (§ 60310).

Article 5.1 of Chapter 3, entitled *Groundwater Recharge* states that recycled water used for ground-water recharge of domestic water supply aquifers by surface spreading shall be at all times of a quality that fully protects public health. DHS recommendations to the Regional Boards for proposed ground-water recharge projects will be made on an individual case by case basis where the use of reclaimed water involves a potential risk to public health. DHS recommendations will be based on all relevant aspects of each project, including the following factors: treatment provided; effluent quality and quantity; spreading area operations; soil characteristics; hydrogeology; residence time; and distance to withdrawal. (DHS, "Purple Book", 2001).

Though there are currently no statutory statewide regulations for the use of recycled water for ground-water recharge, there is a proposed set of draft regulations that define, in some detail, regulations and objectives for this use of recycled water. Currently, the San Diego Region 9 RWQCB is using the proposed regulations and criteria for the issuance of new discharge permits. An overview of these draft regulations is provided in Section 4.2.4.

4.2.2.3 State Water Resources Control Board Reclamation Policy

Resolution 77-1, also known as the Reclamation Policy, was passed in January 1977 in order to ensure that the waters of the State are used to the fullest extent possible and are not unreasonably wasted. The policy requires the State and Regional Boards to support and promote water reclamation projects. The State Board adopted four principles in order to implement the Reclamation Policy.

1. The State Board encourages and recommends funding for water reclamation projects that do not adversely affect vested water rights, unreasonably impair instream beneficial uses or place an unreasonable burden on present water supply systems. The Board states that beneficial uses will be made of wastewater that would otherwise be discharged to brackish waters, reclaimed water will be used to replace or supplement the use of fresh water or higher quality water, and that reclaimed water will be used to preserve, restore, or enhance instream beneficial uses.

2. The State and Regional Boards shall encourage reclamation and reuse of water in water-short areas of the state and encourage conservation of the State's water resources.

3. The State Board will encourage the use of recycled water with consideration to its primary responsibility to protect and enhance beneficial uses of water and protect the general public health.

4. The State and Regional Boards shall take appropriate actions, recommend legislation, and actions by other agencies in the area of planning, funding, water rights, regulation and enforcement, research and demonstration, and public education of reuse projects.

4.2.3 Regional Water Quality Control Board - San Diego Basin Plan

The Regional Board defines water reclamation as a process consisting of the treatment of wastewater to a level of quality suitable for reuse, transportation of the water to the area of reuse, and application of the reclaimed water to an actual use. The Basin Plan indicates the following typical uses of reclaimed water in the San Diego region: agricultural irrigation; landscape irrigation; landscape, recreational and wildlife impoundments; ground-water recharge; commercial toilet flushing; and stream enhancement.

4.2.3.1 Reclaimed Water Policy

The RWQCB states five water quality management policies in the San Diego Basin Plan. Policy Two, of the Basin Plan, states "Water shall be reclaimed and reused to the full extent possible." The policy of the Regional Board is very similar to the Reclamation Policy in that it includes principles 1 and 2 shown above. The Regional Board policy further states that it will require wastewater treatment facilities to provide for appropriate storage or disposal of surplus reclaimed water. The Regional Board has developed a plan to implement water quality objectives of the Basin Plan in respect to reclaimed water. A summary of this plan is provided below.

4.2.3.2 Water Reclamation Requirements

The Regional Board prescribes water reclamation requirements to reclaimed water producers and those governing the use of reclaimed water. The Regional Board may not deny issuance of water reclamation requirements to a project which violates only a salinity standard in the Basin Plan. Master reclamation requirements are issued to suppliers, distributors, or both, of reclaimed water as part of the waste discharge requirements. These reclamation requirements must include compliance with statewide reclamation criteria (uses not governed are made on a case by case basis). The permitee must establish the regulations governing users and construction and design of the reclamation system. Quarterly recycled water reports must be filed to the Board and systems and facilities must be inspected and monitored for compliance. (RWQCB, 1994).

4.2.3.3 Waste Discharge Prohibitions

Discharges of recycled water to lakes or reservoirs or tributaries thereof which serve as municipal water supplies are prohibited unless the Regional Board issues a NPDES permit. NPDES permits regulate discharges to water, while Waste Discharge Requirements regulate discharges to land.

4.2.3.4 Action Plan on Water Reclamation

The RWQCB will consider amendments to the Basin Plan in order to encourage water reclamation. The RWQCB will consider projects involving stream replenishment with reclaimed water if a water quality management plan can be established to ensure that the recycled water will comply with DHS requirements for non-restricted recreational use. The RWQCB will encourage the use of ephemeral streams, not used for domestic supply, for conveyance of reclaimed water. The RWQCB will encourage economic incentives for use of reclaimed water.

The RWQCB addresses the fact that conventional wastewater treatment is not designed to significantly reduce mineral concentrations. The Basin Plan states that due to the variability of influent streams which are beyond the control of the discharger, the RWQCB will not enforce penalties for noncompliance due to excessive TDS loading.

4.2.3.5 Implementation of Ground-Water Quality Objectives for Reclaimed Water Discharge

The RWQCB is to establish effluent limitations designed to protect beneficial uses and ensure compliance with SWRCB Resolution 68-16, entitled “Statement of Policy with Respect to Maintaining High Quality of Waters in California” and also known as the State Anti-degradation

Policy. The use of reclaimed water will be encouraged in ground-water basins where reuse is clearly beneficial. For discharges up-gradient of municipal supplies, the RWQCB will adopt numerical effluent limitations for constituents at levels not lower than the quality of the basin's water supply but no higher that the Basin Plan ground-water quality objective. The RWQCB will also require the implementation of salinity control measures to ensure the long-term use of reclaimed water for agriculture and landscaping applications.

4.2.3.6 Reclaimed Water Storage Requirements

Excess reclaimed water must be discharged to storage facilities until it is needed, discharged to an ocean outfall, or discharged to inland surface waters for ground-water replenishment or stream enhancement under the terms of an NPDES permit. When reclaimed storage ponds are necessary, at least 84 days of storage capacity must be provided or a storage capacity provided based on predetermined water balance calculations.

4.2.4 Pending Laws and Regulations

4.2.4.1 Title 22, Division 4, Chapter 3, Recycling Criteria

The most current draft regulations prepared by the DHS are dated April 23, 2001. Though these regulations have not been adopted, they do represent the "most current thinking of the DHS" regarding water recycling. Of specific interest in the draft regulations is the inclusion of specific statewide objectives and criteria for the use of recycled water in ground-water recharge projects.

Article 5.1 has been renamed Planned Groundwater Recharge Reuse Projects (PGRRP) and defines control mechanisms for the control of pathogenic microorganisms, total nitrogen, regulated contaminants and physical constituents, non-regulated contaminants, and monitoring procedures. The following is a summary of applicable controls contained in this article.

For surface spreading, the wastewater must remain underground for a minimum of six months before it is extracted for use as a drinking water supply and the minimum distance from point of recharge to extraction must be greater than 500 ft. (DHS, "Draft", 2001).

An exact concentration of total Nitrogen is not provided but it is believed that the value will fall in the range of 1 to 10 mg/l. The current nitrate standard is 10 mg/l while the nitrite standard is 1 mg/l. Preliminary evaluations have shown that the lower standard may be necessary (that is 1 mg/l). (DHS, "Draft", 2001.)

The recycled water quality must comply with the Primary MCL's established in § 64444 of the CCR including inorganic chemicals (except N compounds), radionuclides, organic chemicals, and other new and pending regulations such as arsenic and uranium. The recycled water must comply with the water quality objectives of the Basin Plan. The recycled water quality must comply with the secondary MCL's established in § 64449 of the CCR. Recycled water shall not exceed any Public Health Goal or level of contaminant in the receiving ground water, whichever is higher unless otherwise approved by DHS. (DHS, "Draft", 2001)

The Recycled Water Contribution (RWC) is the fraction of total PGRRP water that is of recycled water origin. The RWC shall not exceed fifty percent unless otherwise specified by the DHS. No water shall be extracted from a basin in which the RWC exceeds the limit established by DHS. (DHS, "Draft", 2001)

Monitoring wells must be installed and monitored on a quarterly basis. The project may get approval to reduce the minimum well setback distance to 200 ft if the required retention time can be maintained. The project may also gain approval to raise the RCW above 50 percent if it can be shown that the recycled water has reached monitoring wells for a period of five years and been in compliance with the RCW. (DHS, "Draft", 2001)

Again it is important to explain the status and implications of these proposed draft regulations. These regulations are not currently law and thus are not enforceable to date. It is believed that these regulations in whole or part will become law in the near future. The Regional Board, for all intensive purposes, considers these regulations as law today. The Regional Board uses the criteria shown above for any new ground-water recharge projects in the basin. The Orange County Water Districts produced an EIR/EIS for their Groundwater Replenishment System (GWRS) project in 1998. This document indicates that the GWRS was designed to meet the proposed regulations, in their 1998 form. Based on the general acceptance of these regulations, the current Feasibility Study is designed in accordance with the Draft Proposed Regulations.

4.3 SIMILAR PROJECTS

4.3.1 Groundwater Replenishment System - Orange County, California

4.3.1.1 Project Background

The Groundwater Replenishment System (GWRS) was developed as a joint project between the Orange County Water District (OCWD) and the Orange County Sanitation District (OCSD). At final build-out, this project will reuse up to 120,000 acre feet per year (AFY) in order to supplement ground-water supplies, provide additional water for salt intrusion barriers, industrial and irrigation uses.

The GWRS will further extend the OCWD's use of recycled water. OCWD has been using recycled water produced at its Water Factory 21 plant for injection into the Talbert Gap Seawater Intrusion Barrier since the early 1970's. During the 1980's, OCWD initiated the Green Acres Project (GAP) in which reclaimed water was provided for landscape and industrial uses. These earlier projects led to the development of the GWRS. Feasibility studies for the GWRS were conducted in 1996, a project report was produced in 1997, and a Program EIR/Tier 1 EIS was produced in 199. The OCWD and OCSD voted to move forward with the first Phase of the project in March 2001.

4.3.1.2 Project Need

Currently the water supplied to OCWD customers is a mix of local water and imported water. Approximately 40% is from local ground water and surface waters, while 60% is water purchased from the State Water Project and the Colorado River. Current regional demand is about 500,000 AFY and is expected to increase to 680,000 AFY by 2020. The increased water demand simply cannot be met by current local supply sources.

4.3.1.3 Project Objectives

The primary objectives of the GWRS project are to provide a safe, reliable water supply to meet increased demands; increase the local water supply by approximately 120,000 AFY by the year 2020; reduce OCWD reliance on imported water; improve the overall quality of the ground-water basin; provide increased ground-water source protection from seawater intrusion; supplement the GAP during summer months; reduce the need for additional ocean outfall facilities; increase drought protection in Orange County. (Black & Veatch, 1998)

4.3.1.4 System Operations

The GWRS will be comprised of three major systems: advanced wastewater treatment and pumping facilities; major conveyance pipelines between the treatment works and an existing recharge basin; extension of the existing seawater intrusion barrier. Secondary effluent from OCSD's Reclamation Plant No. 1 will be used as the source supply for the GWRS. This plant will be expanded in order to provide about 80 MGD to the GWRS. The treated effluent from Plant No. 1 will then go through advanced treatment processes including membrane filtration, reverse osmosis, granular activated carbon, and disinfection using ultraviolet radiation and sodium hypochlorite addition. (Black & Veatch, 1998) The reclaimed water would then be supplied to the three main points of use described below.

The project is designed to be implemented in three phases. Phase 1 will produce approximately 70,000 AFY by the year 2004, Phase 2 will add an additional 25,000 AFY by the year 2010 and Phase 3 will produce a total of 120,000 AFY by the year 2020. The phasing is designed to match the increase in water demands for three principal uses: seawater intrusion barrier, GAP, and ground-water recharge at the Anaheim Recharge Facility.

The recycled water will either be recharged via an injection well system along the western portion of Orange County or via surface spreading basins at the Anaheim Recharge Facility. The surface spreading will meet the DHS 50 percent blending requirement by using an equal portion of reclaimed water and imported water. The specific operations of the ground-water recharge system are still being investigated. It is estimated that recycled water flows to the spreading basins will range from 30 MGD in summer to 50 MGD during the winter. (Black & Veatch, 1998)

The Talbert Gap Barrier currently injects blended water. Under the GWRS, the possibility exists for injection of 100 percent recycled water. The proposed 50 blending requirement may be waived by DHS if the project is permitted under the DHS “research and demonstration” clause. The Talbert Gap Barrier will receive reclaimed water throughout the year. During the summer months, it is estimated that between 30-40 MGD will be needed to maintain specified water levels. For a direct injection project such as this it will be required that all organics are removed prior to injection, the water has a minimum residence time in the aquifer of at least 12 months, and there is a minimum 2,000 foot separation between the injection point and any domestic supply well. (Black & Veatch, 1998)

The GWRS will also supply supplemental water to the GAP during summer months for landscape irrigation and industrial uses. It is estimated that the GWRS will supply up to 5 mgd of recycled water to the GAP for up to 60 days a year.

4.3.1.5 Expected Results

The treatment facilities described above will produce reclaimed water that has no greater than 2.0 mg/l TOC, a TN concentration of less than 10 mg/l, and TDS levels less than 250 mg/l. It is anticipated that the water quality of the final product water will be very similar for all of the planned uses of the recycled water. It is also believed that the overall water quality of the ground-water basin will improve over time due to the use of recycled water with a lower TDS than the imported water and local surface water sources currently being used for recharge. The improved seawater barrier will also lower the intrusion of salt water into the ground-water basin. (Black & Veatch, 1998)

4.3.1.6 Project Costs

The total estimated capital cost of this project is $383 million. Phase 1 is estimated at $250 million, $63 million for Phase 2 and $70 million for Phase 3. The unit costs of water associated with each phase of the project are $516/AF, $462/AF, and $437/AF for Phases 1 through 3, respectively. (Black & Veatch, 1998) It is estimated that the total annual benefit of this project is approximately $40 million due to reduced reliance on the purchase of imported water, improvement of the quality of the ground-water basin, enhanced water supply reliability and drought protection, and significant cost avoidances in construction of otherwise needed facilities. OCWD is also anticipating a significant amount of federal, state, and local funding for the project. Expected grants are currently in the neighborhood of $57 million.

4.3.2 East Valley Water Recycling Project - Los Angeles, California

4.3.2.1 Project Background

The East Valley Water Recycling Project (EVWRP) was initiated in response to a goal adopted by the L.A. City Council to reuse at least 40% of the city's wastewater by the year 2010. The EVWRP will ultimately reuse up to 35,000 AFY of reclaimed water for ground-water recharge. The plan is to deliver tertiary effluent via a pipeline to the Hansen Spreading Grounds. (WateReuse, 1999)

4.3.2.2 Project Need and Objectives

The city is no longer allowed to export the same quantity of water from the Mono Basin that it has historically. This project will replace a portion of the lost water and will decrease the City's demand for imported water from the State Project and the Colorado River. The project will also help control the need for extreme conservation measures during dry years by providing a more reliable water supply. (WateReuse, 1999)

4.3.2.3 Project Operations

The project consists of two major phases: Phase IA includes construction of a large pipeline from the reclamation treatment plant to the Hansen Spreading Grounds and an extensive monitoring well system. This phase will deliver up to 10,000 AFY to the spreading grounds. Phase IB consists of the construction of an additional pipeline to deliver recycled water to the

Pacoima Spreading Grounds. Phase II of the project relates to construction of facilities such as pumping stations and transmission limes to deliver recycled water to irrigation and industrial users. (WateReuse, 1999)

Tertiary treated effluent from the Donald C. Tillman Water Reclamation Plant serves reclaimed water source for this project. In 1995, Water Reclamation Requirements were issued for a permit allowing the recharge of up to 10,000 AFY at the Hansen Spreading Grounds. This permit allowed for a three year demonstration project. The facilities required for the first phase of the project are now complete but operation has been delayed by the L.A. City Council (USBR So Cal Office website).

4.3.2.4 Project Costs

The construction cost for Phase IA was approximately $52 million. This yields a unit water cost of $194/AF, delivered. (WateReuse, 1999) It is important to note that LADWP has received a large amount of funding for this project. To date the USBR has funded $13 million, 50% is being funded by the State of California and only 25% of the economic burden is being transferred to the tax payers through rate adjustments. Without the state and federal funding the unit cost of the delivered water is $478/AF. (WateReuse, 1999) The LADWP states that comparative costs for desalination can range from $800 to $2000/AF. (LADWP website)

4.3.3 Water Repurification Project - San Diego, California

4.3.3.1 Project Background and Objectives

The San Diego County Water Authority (SDCWA) and the Metropolitan Water District of Southern California (MWD) and the USBR have proposed a surface water augmentation project for indirect potable reuse of reclaimed water. The source of this water is San Diego's North City Water Reclamation Plant. This project would provide up to 20,000 AFY of reclaimed water. This project will reduce the City's reliance on imported water, increase its reliable water supply, and provide a cost-effective source of much needed water.

4.3.3.2 Project Operations

The project water from the North City plant is tertiary effluent water that has been treated using microfiltration, reverse osmosis, ion exchange, and ozonation. The plan is to deliver the reclaimed effluent from the plant to the San Vicente Reservoir where the reclaimed water will be blended with imported water. The water will travel to the Alvarado Filtration Plant before it is introduced to the potable water supply. The project was approved for design in 1997 but was put on hold in 1998 due to policy and public perceptions. (WateReuse, 1999)

4.3.3.3 Project Costs and Benefits

The total capital cost of this project is $168 million. This yields a unit cost for product water of $1060 prior to consideration of outside funding. The City is expected to receive funding from federal sources, a zero interest loan in the amount of $50 million from the State Revolving Fund and other economic incentives for the use of reclaimed water. After consideration of the available funding, the unit cost of product water is expected to be $578/AF. (White Paper) The benefits associated with this project include the additional source water and reliability mentioned above as well as significant cost avoidance that would otherwise be needed. The cost avoidance includes not needing to construct and expand the current non-potable distribution system and the increase in collection and treatment system necessary to treat flows that cant be handled by the North City Plant. (WateReuse, 1999)

4.3.4 Montebello Forebay - Los Angeles County, California

The County Sanitation Districts of L.A. County, L.A. Department of Public Works, and the Water Replenishment District of Southern California (WRD) have cooperated in the Montebello Forebay indirect potable reuse groundwater replenishment project since 1962. This project uses tertiary treated reclaimed water to recharge the ground-water basin. The WRD is the largest regulated recycled water user in the state of California. This project replenishes up to 60,000 AFY of reclaimed tertiary water supplied by four reclamation plants. The WRD has developed an intensive monitoring program which has shown that there have been no detrimental effects on water quality in the area due to this use of recycled water. (WRD website)

4.3.5 Scottsdale Water Campus, Arizona

The Scottsdale Water Campus is a true “indirect” potable reuse treatment system. This system is currently the largest facility in the nation to treat wastewater effluent to drinking water quality for ground-water recharge. The project was developed to meet increased wastewater flows, avoid expansion of a jointly owned facility in Phoenix, provide reclaimed water for use on golf courses, and recharge reclaimed water to secure recharge credits as required by the 1980 Arizona Ground-Water Management Act. This Act requires either natural or artificial recharge equal to the volume of ground-water withdrawals. (Clune & Vernon, 2001)

The Water Campus is a conventional activated sludge facility with a treatment capacity of 12 MGD. During periods of low demand for reclaimed water, advanced treatment including microfiltration and reverse osmosis are used to treat water used to recharge the potable aquifer underlying the Water Campus. A new generation of thin composite RO membranes are used which provide high removal of dissolved materials at about half the normal operating pressure of most RO systems. This allows the facility to conserve a lot of energy and thus reduces the overall cost of the system operations. The water quality goals of the facility include reduction in concentrations of TOC, TDS, VOC, synthetic organic compounds, metals, disinfection byproducts, and microbiological compounds. The system includes an extensive monitoring program with testing during various stages of treatment and at several monitoring wells throughout the site. (Clune & Vernon, 2001)

The Water Campus is able to produce potable quality water from wastewater effluent for less than $1.30/1,000 gallons, which equates to about $425/AF.

4.4 FALLBROOK PUD WWTP FACILITIES

The Fallbrook PUD treatment plant produces an average of 2,000 AF of treated effluent annually. The plant is capable of producing up to 2.7 MGD and releases at an average rate of 2.0 MGD. The Fallbrook PUD sells some of the effluent water to reclaimed water users while the remaining portion of the effluent is discharged to the Pacific Ocean at Oceanside, CA via the outfall pipeline. Reclaimed water use varies seasonally and can range from 10-30% of the total effluent during the winter months and reach volumes greater than 60% in warmer months. The Fallbrook PUD's NPDES Permit states that the wastewater treatment unit operations and processes consist of preliminary treatment be screening , grit removal, primary sedimentation, biological treatment using activated sludge followed by secondary clarification, and tertiary treatment by flocculation, sand filtration, and chlorination.

4.4.1 Treatment Plant Operations

The FPUD WWTP, known as Treatment Plant No. 1, utilizes the following treatment processes. Prechlorination for odor control, bar screening, aerated grit removal, primary sedimentation, fine bubble aeration activated sludge, secondary sedimentation, secondary effluent equalization and chlorine disinfection. In order to provide reclaimed water, the water is further treated by alum and polymer injection, flocculation tanks, rapid sand filters, and chlorine disinfection (RWQCB, 1991). Preliminary treatment by screening, grit removal and primary sedimentation and secondary treatment using activated sludge followed by secondary clarification. The treated effluent is then discharged to the 16-inch ocean outfall pipeline where it flows to the Pacific Ocean. FPUD has an agreement with the city of Oceanside to allow the discharge of up to 2.4 MGD of effluent through the outfall. The reclaimed water used for irrigation purposes is either withdrawn from the land outfall or is piped directly from the FPUD onsite reservoir.

The design capacity of the secondary treatment facilities is 2.7 MGD. The tertiary effluent produced has a turbidity of less than 2 NTU and a BOD concentration of less than 10 mg/l (NPDES Permit). The Fallbrook PUD has a NPDES permit for discharge of secondary effluent to the Oceanside Ocean Outfall (OOO). However the Fallbrook PUD treats most water to a tertiary level and has supplied tertiary filtered effluent to reuse customers since 1990.

4.4.2 Water Quality

This section discusses the water quality discharge requirements for the FPUD WWTP. A summary of selected numerical objectives of the NPDES Permit, the Recycled Water permit, are tabulated with the Fallbrook PUD water quality sampling results from the year 2000 in Table 4-1. The Fallbrook PUD's sampling results reflect the average concentration for the year 2000. Permit limitations shown are 30-day average and daily maximum concentration limits, where applicable. All values shown have units of mg/l unless otherwise indicated.

4.4.2.1 NPDES Permit

The Fallbrook PUD is authorized to discharge effluent from its wastewater treatment plant under Regional Board Order No. 20001-12. Treated effluent is discharged to the Pacific Ocean at the Oceanside Ocean Outfall via the Fallbrook Land Outfall. The allowable discharge capacity of the plant is 2.7 MGD, the design capacity of the secondary treatment facility. (RWQCB, 2000)

Section B of this order contains the discharge specifications for effluent discharged from Treatment Plant No. 1 to the OOO.

Under this order the Fallbrook PUD is required to submit an extensive monthly monitoring report. This report includes plant effluent flow rates, daily, weekly, monthly and semi-annual sampling analytical results.

4.4.2.2 Recycled Water Permit

The Regional Board issued Order No. 91-39 in May of 1991. This order is the Waste Discharge Requirements for Fallbrook Sanitary District Plant Nos 1 and 2 Reclamation Projects. This Order was amended in 1995 to reflect the fact that the treatment plant ownership was transferred from Fallbrook Sanitary District to the Fallbrook PUD. The title of the order was then changed to "Waste Discharge Requirements for Fallbrook Public Utility District. (RWQCB, 1995) This order establishes the use of reclaimed water for irrigation.

TABLE 4-1

FPUD EFFLUENT WATER QUALITY AND PERMITTED LIMITATIONS

Constituent	FPUD 2000 Average	Permitted Limits: NPDES Permit	Permitted Limits: Recycled Water Permit
Potable Water Supply			
Total Dissolved Solids	467	-	-
Chloride	78	-	-
Sulfate	169	-	-
WWTP Influent			
Flow (MGD)	1.98	-	-
Carbonaceous BOD	208	-	-
Total Suspended Solids	313	-	-
WWTP Effluent			
Flow (MGD)	1.87	-	3.1
Nitrification Inhibited BOD	5.70	25	-
Total Dissolved Solids	749	-	450 O.S.[1]
Turbidity (NTU)	1.55	75	-
Residual Chlorine	4.40	-	-
Coliform (MPN/100ml)	2.40	-	23
Ammonia as N	7.90	200	-
Carbonaceous BOD	5.70	-	25
Total Suspended Solids	4.40	30	30
Percent Sodium	49.0	-	60
Chloride	137	-	150 O.S.[1]
Sulfate	208	-	150 O.S.[1]
Iron	0.10	-	0.3/0.85
Manganese	0.04	-	0.5/0.15
MBAS	0.17	-	0.5
Boron	0.42	-	0.5
Fluoride	0.26	-	1
Nitrate as N	6.94	-	10
Total Kjeldahl Nitrogen	10.60	10	-
Total Phosphate	2.28	-	-

1. O.S. indicates Over Supply concentration

Section B of this order contains the discharge specifications for discharge to the Upper Ysidora Hydrographic Subarea. The specifications dictate that all effluent used for irrigation must conform to the CCR Title 22, Division 4, Chapter 3 (Reclamation Criteria) for irrigation of parks, playgrounds, schoolyards, etc. These criteria are specified in Section 60304, which states that the water must be tertiary treated effluent.

Under this order, the Fallbrook PUD is required to submit monthly and quarterly monitoring reports. These reports include water quality sampling analytical results, reclaimed water flow rates, reclaimed water users, and any instances of noncompliance with the discharge specifications.

4.4.2.3 Effluent Water Quality

The Fallbrook PUD is required to sample and report water quality results pursuant to their NPDES and Recycled Water permits as described above. The main parameters of concern are Nitrate-N, Ammonia, and thus total Nitrogen, Total Phosphate-P, TDS, Sodium, and Chloride. These components will be of special interest in the design and operation of the treatment wetland and when trying to meet the projected water Regional Board water quality objectives.

According to the Regional Board, it will be critical for the design to show that a TN concentration of 1 mg/l and a TP concentration of 0.1 mg/l can be met prior to discharge into the Santa Margarita River.

A summary of the various water quality objectives and 2000 monthly sampling data for the Fallbrook PUD are included as the Appendix. The objectives shown in this Appendix are derived from the Basin Plan, the NPDES and Recycled Water Permits, and the Fallbrook PUD's Annual Report data. This summary shows the constituents that are reported in the Fallbrook PUD's monitoring reports and analytical laboratory reports.

4.4.3 Current and Future Production

The Fallbrook PUD provided Stetson Engineers with a graph showing the Wastewater Plant 1 Capacity Projection through the year 2027. According to the Fallbrook PUD projection, the plant will reach 75% capacity in the year 2009, and 91% capacity by June 2027 (2.161 average MGD). This represents a 10-yr average EDU growth rate of 1.06%/yr. As of January 2000, the plant is running at 68% its capacity, with an average flow of 1.825 average MGD. The capacity of the plant when running at 100% would average 2.7 MGD.

A twenty-year period was chosen to simulate the future wastewater production at the plant. It was assumed that in model year 20, the plant would operate at 91% capacity (equivalent to the 2027 projection). The plant production for model years 1 through 19 was back calculated using a 10-yr average EDU growth rate of 1.06%/yr. Thus, the annual projected flow used ranged from 2.002 MGD to 2.161 MGD (Table 4-2).

TABLE 4-2

FPUD WWTP PROJECTED ANNUAL FLOW

Model Year	Capacity (MGD)	Daily Capacity (CFS)	Flow (AFY)
1	2.002	3.10	2,242
2	2.024	3.13	2,267
3	2.046	3.17	2,291
4	2.068	3.20	2,317
5	2.091	3.23	2,342
6	2.114	3.27	2,367
7	2.137	3.31	2,393
8	2.160	3.34	2,420
9	2.184	3.38	2,446
10	2.207	3.42	2,473
11	2.232	3.45	2,500
12	2.256	3.49	2,527
13	2.281	3.53	2,555
14	2.306	3.57	2,583
15	2.331	3.61	2,611
16	2.356	3.65	2,639
17	2.382	3.69	2,668
18	2.408	3.73	2,697
19	2.434	3.77	2,727
20	2.461	3.81	2,757
TOTAL	**44.48**	----	**49,821**
Average	2.22	3.44	2,491
Median	2.22	3.43	2,486
Maximum	2.46	3.81	2,757
Minimum	2.00	3.10	2,242

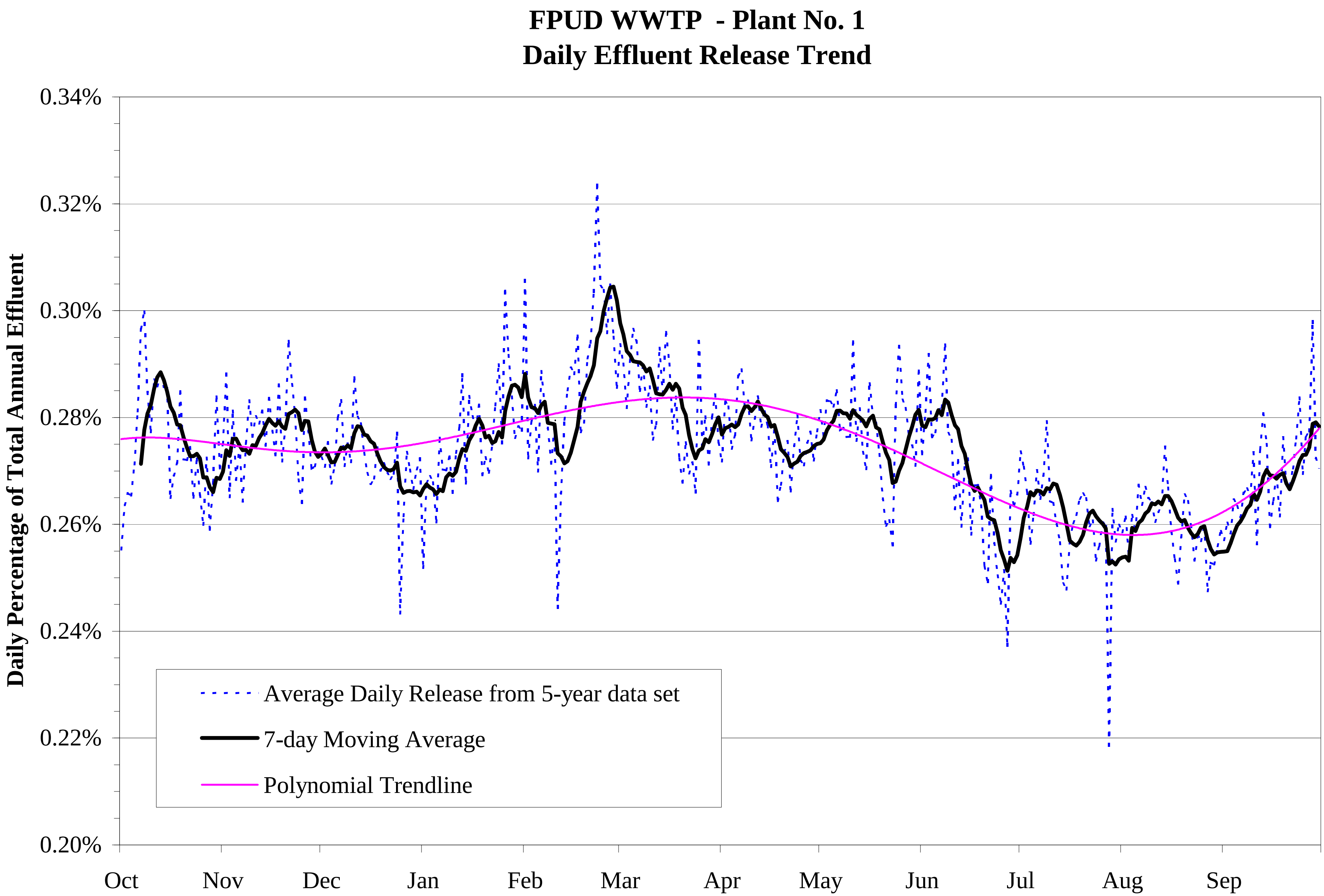
4.4.4 Development of Trend-Lines

In order to account for the daily fluctuation in WWTP effluent over a given year, a trend line representing these fluctuations was developed. The purpose of this calculation was to determine a daily percentage of total annual effluent that could be applied to each model year in the Reclaimed Water Reservoir Operation Model (RWROM).

The daily WWTP effluent flow from the Fallbrook PUD Plant No. 1 was used as the base data for this calculation. Daily data was available from 1990 to 2001, but the data from 1990 to 1995 was not complete. Therefore, only data from the October of 1995 through September of 2000 was used for this calculation. The data was arranged in water years, beginning with October 1, 1995 and ending with September 30, 2000. This yielded five water years worth of daily effluent data (in million gallons). The total WWTP effluent was calculated for each of the five water years. Then a daily percentage for each day was calculated as in the following example:

For October 1, 1995 the effluent was 1.710 MG; the total effluent for WY 1996 was 584 MG. Thus, 0.292% of the total WY 1996 WWTP effluent was discharged on October 1st. This value is a daily percentage of total effluent for a single water year. This process was repeated for each day of each of the five water years, using the appropriate water year total effluent value. Then the daily percentage for each calendar day was calculated by averaging the five calculated daily percentages of the five water years for each calendar day. This produced a single daily percentage value for each calendar day based on a 5-year average.

Because this average data still showed a lot of "noise" when plotted, a six-degree polynomial trend-line was fit to the 5-year average values. The equation of this trend-line was then used to calculate the final set of daily percentages to be used as the WWTP effluent daily trend. The five-year average daily percentages and the polynomial trend-line, including its equation, are shown in Figure 4-1. Also shown is the seven-day moving average of the five-year average percentages.



*Note: 5-year data set = Water Years 1996-2000

FIGURE 4-1