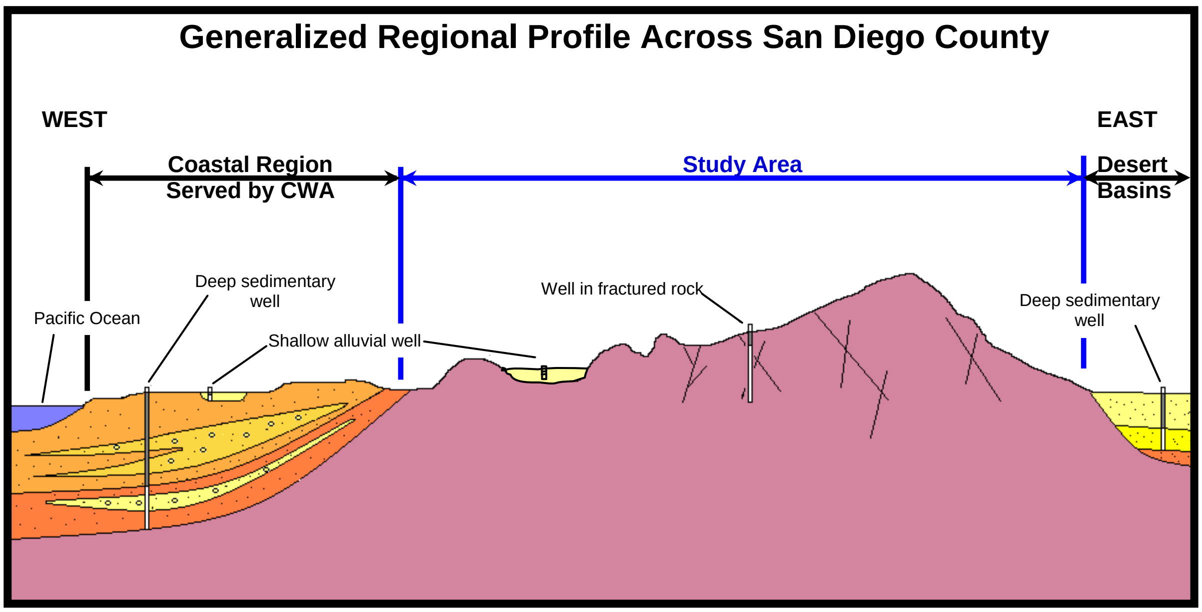
APPENDIX D
GROUNDWATER STUDY

FINAL

County of San Diego
Department of Planning and Land Use
General Plan Update
Groundwater Study



Prepared by:

County of San Diego
Department of Planning and Land Use
5201 Ruffin Road, Suite B
San Diego, CA 92123

April 2010

County of San Diego
Department of Planning and Land Use
General Plan Update
Groundwater Study

Prepared by:

County of San Diego
Department of Planning and Land Use
5201 Ruffin Road, Suite B
San Diego, CA 92123

James J. Bennett
California Certified Hydrogeologist, #854, Expires 4/30/2012
California Professional Geologist #7707, Expires 4/30/2012

April 2010

LIST OF PREPARERS AND TECHNICAL REVIEWERS

County of San Diego

Jim Bennett, P.G., C.HG., DPLU, Primary Author
Gary Ross, DPLU, GIS Analysis
Robert Flamenbaum, DPLU, GIS Graphics
Kevin Heaton, P.G., C.HG., DEH, Technical Review

Other Contributors

Murray Wunderly, P.G., C.HG., Terra Pacific Group, Contributing Author
Doug Roff, C.E.G., C.HG., Earth Tech, Inc., Technical Advisor

Groundwater Technical Review Panel

Dr. Jay Jones, P.G., Environmental Navigation Services, Inc.
John Peterson, P.G., C.HG., Peterson Environmental Services
Doug Roff, C.E.G., C.HG., Earth Tech, Inc.
Matt Wiedlin, P.G., C.HG., Wiedlin & Associates
Murray Wunderly, P.G., C.HG., Terra Pacific Group

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

LIST OF ACRONYMS

afy	acre-feet per year
btoc	Below Top of Casing
CEQA	California Environmental Quality Act
CIMIS	California Irrigation Management Information System
CWA	San Diego County Water Authority

DDWEM	California Department of Public Health Division of Drinking Water and Environmental Management
DEH	San Diego County, Department of Environmental Health
DPLU	San Diego County, Department of Planning and Land Use
DWR	California Department of Water Resources
EPA	Environmental Protection Agency
ETo	Potential Evapotranspiration
GIS	Geographical Information Systems
GP	General Plan
GPEIR	General Plan Environmental Impact Report
gpm	Gallons per Minute
GWET	Groundwater Evapotranspiration
LUFT	Leaking Underground Fuel Tank
MCL	Maximum Contaminant Level
MTBE	methyl tert-butyl ether
msl	Mean Sea Level
NOAA	National Oceanic and Atmospheric Administration
ONI	Oceanic Niño Index
PVMWC	Pine Valley Mutual Water Company
RWQCB	San Diego Regional Water Quality Control Board
SANDAG	San Diego Association of Governments
SCS	Soil Conservation Service
SWRCB	State Water Resources Control Board
TDS	Total Dissolved Solids
USDA	United States Department of Agriculture
USGS	United States Geological Survey

1 INTRODUCTION

As part of the County of San Diego (County) General Plan Update Environmental Impact Report (GPEIR), this groundwater report was prepared to evaluate the impacts of the proposed General Plan Update (GP Update) land uses on groundwater resources within the groundwater dependent portion of the County.

1.1 Objectives

The objectives of this report are to:

1) Evaluate current impacts to groundwater resources from existing land uses in groundwater dependent areas of the County;

2) Evaluate the impacts to groundwater resources from the maximum build-out of the proposed GP Update in groundwater dependent areas of the County;

3) Evaluate the cumulative impacts to groundwater resources from the maximum build-out of the proposed GP Update to Indian Reservations, lands under Federal and State jurisdiction including military bases and parks, and land immediately adjacent to San Diego County including Riverside County, Imperial County, and Mexico; and

4) Provide alternatives to proposed GP Update land use densities in the event of predicted significant unavoidable impacts to groundwater resources.

Due to the large size of the study area, the results from this study provide a regional-scale screening-level assessment to evaluate impacts to groundwater resources from the maximum build-out of the proposed GP Update. It should be noted that site-specific hydrogeologic investigations will be necessary to evaluate local impacts to groundwater resources for future individual groundwater discretionary projects. Examples of site-specific details which are not possible to obtain at a study of this scale include evaluation of an individual well's ability to meet its land use objectives, evaluation of potential well interference from a specific well or wells to onsite or offsite well users, local hydrogeologic conditions, and assessment of site water quality.

1.2 Scope of Work

To meet the objectives of this report, the study included the following tasks:

1) Compiling and summarizing existing groundwater conditions in the County. This includes a discussion of topography, climate, land use, groundwater demand, geology, soils, aquifer types, hydrologic inventory, well inventory, historical groundwater levels, water quality, and potential groundwater problem areas.

2) Development of a Geographical Information Systems (GIS) analytical tool to apply the Thornthwaite Method soil moisture balance methodology and obtain an estimate of groundwater recharge through 34 years of precipitation including severe droughts and wet periods. This includes compilation of historical precipitation and evapotranspiration rates, estimates of surface water runoff rates, and soil types and soil moisture capacity of soils;

3) Estimation of groundwater demand from existing land uses, land uses proposed under the current GP, and land uses proposed under the GP Update;

4) Mapping of aquifer types and estimation of groundwater storage capacity of aquifers throughout the study area;

5) An evaluation of long-term groundwater availability by comparison of estimated monthly groundwater recharge estimated over a 34 year period of record to groundwater demand from existing land uses, land uses proposed under the current General Plan, and land uses proposed under the GP Update on a basin-by-basin basis. Each evaluated basin will indicate predicted changes of groundwater in storage for the various land-use scenarios through 34 years;

6) Compile estimates of the minimum volume of groundwater in storage in each basin under the various land-use scenarios: existing groundwater demand, proposed groundwater demand under the current General Plan, and proposed groundwater demand under the GP update (Table 3-12, Figure 3-8, and Appendix C). With these tables and figures, it is possible to identify areas where existing or proposed land uses may have a potentially significant impact on groundwater resources. If at any time, groundwater in storage is reduced to a level of 50% or less of maximum theoretical storage capacity as a result of groundwater extraction, groundwater impacts would be considered potentially significant;

7) Evaluation of <u>existing</u> water demand that may have a potentially significant localized impact on groundwater resources that would manifest as substantial water table decline;

8) Evaluation of <u>existing</u> areas of low well yield which may have a potentially significant impact to land uses proposed under the GP Update in these areas;

9) Evaluation of <u>existing</u> water quality conditions that may have a potentially significant impact to land uses proposed under the GP Update in these areas; and

10) Development of possible mitigation measures and alternatives to reduce any potentially significant and unavoidable impacts to groundwater resources.

1.3 Study Boundaries

The GP Update Groundwater Study area to evaluate long-term groundwater availability comprises approximately 1,885 square miles (roughly the size of the state of Delaware) which is entirely groundwater dependent. The study area is bounded by Riverside County to the north, the international boundary with the Republic of Mexico to the south, County unincorporated and incorporated land served by the County Water Authority (CWA) member agencies to the west, and desert basin aquifers and Imperial County to the east (Figure 1-1). It is assumed that no imported water is, or will likely be available for the foreseeable future within the study area. This is due to the lack of infrastructure, the limited availability of water in the desert southwest, the cost of providing these services, and the political approval needed to extend the CWA boundaries further to the east.

Unincorporated areas excluded from this study include the western region of the County within the CWA, which is largely supplied with imported water from member agencies of the CWA. The analysis methodology used in this groundwater study is not applicable to desert basins, hence the exclusion of desert basin aquifers in the eastern portion of the County. Borrego Valley, a desert basin aquifer, has been in an overdraft condition for decades. There have been groundwater investigations by the United States Geological Survey (USGS), the California Department of Water Resources (DWR), and others, which provide documentation of the groundwater conditions within Borrego Valley. Desert basin aquifers, outside of Borrego Valley, have a relatively low amount of existing and proposed development with no documented cases of overdraft known by the County. A summary of groundwater conditions within Borrego Valley are discussed separately in Appendix A. The water supply situation of unincorporated lands within the CWA is discussed separately within the GPEIR.

2 EXISTING CONDITIONS

The following subsections include details describing the physical, geologic, and hydrogeologic characteristics of the GP Update groundwater study area. This includes a discussion of topography, climate, land use, groundwater demand, geology, soils, aquifer types, hydrologic inventory, well inventory, historical groundwater levels, water quality, and potential groundwater problem areas.

2.1 Topographic Setting

The approximately 1,885 square-mile study area (Figure 1-1) lies within the Peninsular Ranges Physiographic Province, which is characterized by mountainous ridges and hills interspersed by intermountain valleys and basins (Figure 2-1). There is a meandering north-south mountainous ridgeline [elevations range from about 3,000 to 5,000 feet above mean sea level (ft msl)] which divides the study area into two hydrologic regions. Precipitation that falls west of the divide flows toward the Pacific Ocean, and precipitation east of the divide flows toward the Salton Sea Basin. The most prominent physical features in the region lie along and largely west of this divide in a series of northwest-trending mountains. From north to south, the major mountain ranges include Palomar Mountain, Volcan Mountains, Cuyamaca Mountains, and the Laguna Mountains. Elevations range from 5,000 to over 6,500 ft msl. Valley floors are interspersed between hills and mountains, and range from small and narrow (such as Pine Valley) to broad and large (such as Warner Valley). Valleys vary in elevation from 500 ft msl in the San Luis Rey River Valley to over 4,000 ft msl in the intermountain valleys within Cuyamaca Rancho State Park. Valley areas are typically underlain by a well developed soil profile with varying thicknesses of stream deposited alluvium and weathered bedrock (residuum). The mountainous terrain has a relatively thin to non-existent mantle of soil with bedrock and/or boulders exposed on the ground surface in many areas.

2.2 Climate

For the purposes of this study, climate is defined as the areal and temporal rainfall distribution and evapotranspiration within each of the basins. In 2004, DPLU produced an updated County-wide average precipitation map (County of San Diego, 2004). The map utilized 95 rainfall stations to depict average annual precipitation based on over 50,000 monthly records collected from July 1971 through June 2001 (Figure 2-2). The methodology used rainfall data combined with environmental variables such as elevation and location in a spatial autoregressive model that employed maximum likelihood estimation to produce a precipitation surface. The resulting precipitation map is the most accurate representation of average precipitation ever produced for the County of San Diego. Potential evapotranspiration rates were obtained from the California Irrigation Management Information System [CIMIS) (DWR, 1999)].

2.2.1 Precipitation

Average precipitation across San Diego County is highly variable (Figure 2-2). The western coastal and foothills region of the County averages between 6 to 18 inches per year, with increasing amounts in the foothills. The central mountainous region averages between 15 to 35 inches per year. This higher rainfall is attributable to the orographic effect created by the higher elevations of the mountains, which raises and cools the moist marine air as it moves inland from the ocean over the mountains. The highest precipitation in the County occurs on Palomar Mountain (elevation 6,140 ft msl) and Cuyamaca Peak (elevation 6,512 ft msl), with precipitation in the wettest years exceeding 70 inches. In contrast, rainfall diminishes rapidly with decreasing elevation on the eastern slopes of the mountains and into the deserts. While outside of the study area, some desert areas have reported rainfall less than one inch in extremely dry years.

Looking at the annual precipitation values from July 1948 through June 2007 (averaged from Lindbergh Field, Campo, Cuyamaca, Palomar Observatory, and Lake Henshaw), it is readily apparent that year-to-year rainfall in the County has been highly variable (Figure 2-3). In only a few years precipitation approximated average rainfall, with most years either above or below-average. A linear trend shown in black on the figure indicates a flat to very slight increase in average precipitation over the past 60 years. However, to reflect precipitation fluctuations, a 5-year moving average shown in red on the figure indicates the cyclical nature of precipitation with 3 periods of above-average rainfall and 4 periods of below-average rainfall. The current period of below-average rainfall began in the 1998-1999 rainfall season punctuated by one significantly above-average year of precipitation in 2004-2005 and one fairly-average rainfall season in 2002-2003. This current dry period has included two of the five driest years on record since 1948. This below-average period is similar to conditions in the late 1950s to early 1960s, which included three of the five driest years on record since 1948.

<u>El Niño/La Niña Effects on Precipitation:</u> Weather patterns throughout the world have been linked to cycles of warmer- or cooler-than-average surface water temperatures in the equatorial Pacific Ocean from between South America and the dateline. Warmer than average equatorial surface water temperatures are known as “El Niño”, and cooler than average surface water temperatures are known as “La Niña.” Historically, El Niño and La Niña conditions recur approximately once every 3 to 7 years and vary in both intensity and duration. During El Niño conditions, the period of October through March generally tends to be wetter than average in southern California. In contrast to El Niño, La Niña conditions bring generally dryer-than-average winters to southern California (NOAA, 1998). It should be noted that not all El Niño periods have brought above-average rainfall, and not all La Niña periods have brought below-average rainfall.

To compare El Niño/La Niña impacts to historical annual precipitation in the County, a comparison of annual historical precipitation from July 1950 through June 2007 (averaged from Lindbergh Field, Campo, Cuyamaca, Palomar Observatory, and Lake Henshaw) was made to the Oceanic Niño Index (ONI) value for a given rainfall year (Figure 2-4). The ONI is a tool used by the National Oceanic and Atmospheric Administration (NOAA) to monitor, assess, and predict El Niño/La Niña conditions (NOAA, 2008). El Niño conditions are characterized by a positive ONI equal to or greater than 0.5 degrees C. La Niña conditions are characterized by a negative ONI equal to or less than -0.5 degrees C. The correlation coefficient (r^2=0.2787) indicates a low correlation between annual precipitation values and ONI. However, the figure shows that during El Niño years, approximately 85% of the time there were wetter-than-average conditions. During La Niña, the opposite was true with approximately 85% of the time being dryer-than-average conditions. When conditions were neutral with an ONI of -0.5 to 0 degrees C, rainfall was below-average approximately 75% of the time. When conditions were neutral and between an ONI of 0 degrees and +0.5 degrees C, rainfall was above-average about as often as it was below-average. In summary, the data show a strong correlation between El Niño bringing above-average rainfall and La Niña bringing below-average rainfall. When the conditions were "neutral" (ONI between -0.5 and +0.5 degrees C) the data are scattered.

Overall, the El Niño/La Niña phenomenon provides a tool in evaluating potential rainfall patterns for an upcoming rainfall season. However, since El Niño/La Niña cannot be accurately predicted beyond several months into the future, it is difficult to predict an upcoming year's precipitation with a high level of confidence. In addition, precipitation does not always follow the typical El Niño/La Niña patterns. As scientific research continues to expand regarding this phenomenon, it may be possible to predict future precipitation for an upcoming season with greater confidence.

2.2.2 Evapotranspiration

The term "evapotranspiration" refers to the total transfer of moisture to the atmosphere from the soil, water bodies, vegetative canopy, and plants. Evapotranspiration represents a significant portion of water lost from a given watershed. Types of vegetation and land use significantly affect evapotranspiration and therefore, the amount of water leaving a watershed. Factors that affect evapotranspiration include the plant type (root structure and depth), the plant's growth or level of maturity, percentage of soil cover, solar radiation, humidity, temperature, and wind.

Monthly reference evapotranspiration (ETo), which is a measure of potential evapotranspiration from a known surface, such as irrigated grass or alfalfa has been estimated for San Diego County by CIMIS (Figure 2-5). As would be expected, the lowest ETo rates are typically during the cooler and wet winter months and highest during the summer. The lowest annual ETo rates in the County occur along the coastal region due to the marine influence with high humidity and moderate temperatures year round. In contrast, the highest annual ETo rates occur in the desert region due to the extremely dry air and very hot summers.

2.2.3 Climate Change

Climate change due to increasing greenhouse gas emissions (and other atmospheric contaminants) over the next century is inevitably uncertain. This is because of the chaotic nature of the global climate system, because of model imperfections, and because of uncertainties regarding what path human-induced emissions of greenhouse gases will follow (Dettinger, 2005). However, modeling results from global climate change models are consistent in predicting increases in temperatures globally with increasing greenhouse gases resulting from human activity (Kiparsky and Gleick, 2003). Current climate model projections indicate that even the most benign of the projected climate-change scenarios are sufficient to significantly alter California's water supply within the next 25 years (Barnett et al. 2004; Dettinger et al. 2004; Van Rheenen et al. 2004). However, the linkages between climate and groundwater are inherently complex, and potential effects from climate change on groundwater resources are not fully known at this time. It was recently stated by Dr. Michael Dettinger of the USGS/Scripps Institution of Oceanography and Sam Earman of the Desert Research Institute that "at this time it is unclear whether overall groundwater recharge will increase, decrease, or stay the same at any scale in the western United States. It is possible that groundwater supplies will fare well, overall in a warming world, but they may also fare poorly." (Dettinger and Earman, 2007). Due to the speculative nature of the potential effects of climate change on groundwater resources, this document does not create a guideline for determining significance for climate change's potential impact on groundwater resources.

Based on a review of recent scientific literature regarding climate change, the following provides a brief summary of potential effects to groundwater resources from increasing temperatures and changes in precipitation:

Temperature: Increasing average temperatures would generally lead to an increase in the potential for evaporation (Kiparsky and Gleick, 2003). During the wet winter months, this would translate to the potential for greater drying of the soil between storm events. This could result in a reduction in groundwater recharge. Evapotranspiration rates would also increase with temperature if other factors that affect evapotranspiration, such as cloudiness, humidity, and atmospheric carbon dioxide content stay the same. This could result in an increase in water demand for irrigated crops, landscaping, and native vegetation including phreatophytes. However, future atmospheric carbon dioxide is expected to increase, which may act to reduce water consumption by plants (DWR, 2006).

Precipitation: The amount of precipitation that occurs, as well as seasonal precipitation patterns, timing, and intensity of individual storm events all play a direct role in the amount of groundwater recharge that occurs. While modeling of projected temperature changes is broadly consistent across most modeling efforts, there are disagreements in future precipitation projections. Some recent regional modeling efforts conducted for the western United States indicate that overall precipitation will increase (Kiparsky and Gleick, 2003).

Models predicting the greatest amount of warming generally predicted moderate decreases in precipitation, while models with smaller increases in temperature tended to predict moderate increases in precipitation. When some of the most extreme projections are underweighted, the central tendency in the projections is toward moderately decreased precipitation (Dettinger 2005, DWR 2006,). While more research is needed, climate change could affect the intensity, duration, and timing of precipitation events in California. It could also affect the spatial distribution and temporal variability of precipitation. Significant changes in one or more of these factors could have serious consequences for water resources management (DWR, 2006).

In summary, while the effects of climate change on local groundwater resources are not fully known, it is essential that the County continue to follow closely the work of climate scientists and others. Continued research will hopefully shed light on the many uncertainties of the linkages between climate change and its potential effects on local groundwater supplies.

2.3 Land Use

Land uses within the study area are generalized into three categories: (1) private lands, (2) public and military lands, and (3) Indian reservations (Figure 2-6). Details of each are discussed below:

Private Lands: Approximately 25% of the study area comprises privately held land. Land uses include existing residential, commercial, industrial, agricultural, open space, and undeveloped lands. Most residential lots are large in comparison to urbanized areas, with most lots larger than four acres and ranging up to hundreds of acres in size. There are several communities and areas that were developed with lot sizes smaller than 4 acres (Figure 2-7). Specific areas include Julian, Wynola, Cuyamaca, Morena Village, Descanso, Pine Valley, Warner Springs, Shelter Valley, Guatay, and several other areas. These clustered development areas utilize a concentrated amount of groundwater in a relatively small area. In general, the potential for water shortages is greater in areas with clustered development especially if underlain by fractured rock with little alluvium/residuum. Additionally, water quality impacts are possible if individual clustered lots are served by septic systems.

Public and Military Lands: Approximately 60% of the lands within the study area are public and military land with limited development potential in the foreseeable future. This land potentially provides a significant amount of groundwater recharge to adjacent privately owned groundwater dependent areas. The largest public land area is the Cleveland National Forest. Other notable public holdings include the Cuyamaca Rancho State Park, the Otay National Cooperative Land and Wildlife Management Area, and the Anza Borrego Desert State Park. The County also has a number of local parks and campgrounds in the study area. Military lands include the U.S. Navy La Posta Microwave Station in the Campo area, a very small military parcel on Laguna Mountain, and a remote training site in Warner Springs.

Indian Reservations: Approximately 15% of the study area comprises Indian Reservation lands. There are 15 Indian Reservations within the study area. Land use varies from little to no development in the cases of Capitan Grande Reservation, Cuyapaipe Reservation, and Inaja-Cosmit Indian Reservation, to a large casino, hotel, golf course, and residences at the Barona Reservation. Those with casinos and a number of other amenities include Barona, Campo, La Jolla, La Posta, Pala, Pauma, Rincon, Santa Ysabel, and Viejas Indian Reservations.

2.4 Water Demand

The unincorporated portion of the County east of the CWA line (approximately 65% of the total area of the County) is totally dependent on groundwater resources, which provides the only source of water for over 41,000 residents (U.S. Census Bureau, 2000).

While some community water systems east of the CWA keep records of overall well production, there are very few wells metered to quantify production. As a result, it is difficult to estimate the overall quantity of groundwater being used. However, it is possible to provide an estimation of the amount of existing groundwater use based on reported average quantities of water use for various land-use types. Water demand in the groundwater dependent portion of the County for this study has been broken down into the following general categories: (1) Residential, (2) Commercial/Industrial and other land uses, (3) Agriculture, (4) Small Water Systems, and (5) Indian Reservations. Each is generally discussed below as follows:

Residential: Groundwater-dependent residences are either served by onsite private wells or by groundwater provided by a water system such as a small water company or water district. Residential water uses include household consumption, irrigation of landscape and/or agricultural crops, watering horses or other livestock, and pumping water to fill swimming pools or ponds. The majority of residential lots are on septic systems in which a substantial portion of the water used indoors is recharged back into the groundwater system via the septic system. A local groundwater modeling analysis conducted for the San Diego Regional Water Quality Control Board (RWQCB) indicated that under soil conditions conducive for successful leach fields, 90 to 99 percent of leachate from leach fields reaches the water table (Huntley, 1987).

For purposes of this study, it is estimated that an average residence has a consumptive use of 0.5 acre-feet of water per year per single-family residence (consumptive use is the amount of water lost from the groundwater resource due to human use, including evaporation and evapotranspiration losses associated with human use). The County Groundwater Ordinance (Ordinance No. 9826, N.S., Section 67.703) requires that all groundwater investigations subject to the Ordinance use this value for residential uses. This number was originally established in the Groundwater Ordinance in 1991 based on findings from a USGS groundwater study in Lee Valley (Kaehler and Hsieh, 1991). From 1983 to 1988, groundwater pumping for indoor use and irrigation from four households in Lee Valley were recorded and averaged 0.52 acre-feet per year. When considering septic system returns to the aquifer from water used indoors, the consumptive use value was considerably less than 0.52 acre-feet per year. Hence, the value of 0.5 acre-feet per year for consumptive loss was conservative.

As part of this study, additional information was obtained which substantiates the residential consumptive use value of 0.5 acre-feet per year per residence. The CWA member agencies, which serve water to approximately 97% of County residents estimate that the average household has a water demand of approximately 0.5 acre-feet per year (CWA, 2006). Additionally, residential water uses recorded from over 1,000 residences served by three groundwater-dependent water service agencies was evaluated. The average groundwater demand per service connection during higher than average production years (drought years) was 0.48 acre-feet. Below, is a summary of the information obtained from each water service agency.

1) Descanso Community Water District: As of 2008, the water district served approximately 310 residential service connections in the community of Descanso. Water production records were reviewed from 1999 to 2004 during an extended drought period. Using the peak annual production value that occurred in 2002, the water district's gross water demand per water connection averaged 0.36 acre-feet during that high demand year.

2) Los Tules Mutual Water Company: As of 2004, the water company served approximately 91 single-family residences in the community of Warner Springs. Water production records were reviewed for the year 2004, which the last year of an extended drought. The gross water demand per residence averaged 0.63 acre-feet. As summarized by the water company, the full-time residences averaged 0.87 acre-feet, and the part-time residences averaged 0.32 acre-feet.

3) Pine Valley Mutual Water Company: As of 2008, the water company served approximately 695 service connections (675 were residential connections) in the community of Pine Valley. Water production records were reviewed from 1999 through 2004 during an extended drought period. Using the peak annual production value that occurred in 2002, the water company's gross water demand per water connection averaged 0.45 acre-feet during that high demand year.

<u>Commercial/Industrial:</u> Commercial/industrial uses are mostly located within small community town centers, but are also located sporadically throughout the backcountry. Commercial uses include store front and retail trade strip malls, low-rise office buildings, libraries, post offices, and fire and police stations. Industrial uses include extractive industry

(mining), light industrial, and warehousing/public storage. Estimated water demand generally ranges from none to approximately 1 acre-foot per year per business.

Agriculture: In 1998, DWR conducted a detailed survey of irrigated agricultural land in the County, which included review of aerial photography and extensive field visits to collect site-specific data. These data represent the most detailed information at a countywide scale to estimate water demand from agricultural uses. Data collected include acreages of land being actively irrigated, the specific types of crops, and the estimated applied water to specific crop types. Figure 2-8 depicts the mapped agricultural areas from the survey, which are being used to estimate water demand from agricultural lands within this study. There is a wide range of irrigated agricultural uses within the study area. General categories include grazing and dry land farming, irrigated pasture lands and alfalfa, irrigated orchards and vineyards (citrus, avocados, apples, grapes, etc.), and irrigated truck crops (seasonally planted crops such as lettuce or tomatoes). Some of the main water-intensive agricultural production areas are within Pala/Pauma (variety of crop types including citrus, avocados, nursery crops, and cut flowers), Julian (apples), Jamul (citrus and avocados), east of Ramona (ranches/egg ranch), and outside the study area in Borrego Valley (citrus and palms). Water use for plants varies depending on weather factors including air temperature, relative humidity, wind speed, and solar radiation; soil factors such as soil texture, structure, density, and chemistry; and plant factors such as plant type, root depth, foliar density, height, and stage of growth (CIMIS, 2005). Water demand can range from little to none for dry land farmed areas to over 4 acre-feet per acre per year for irrigated alfalfa and other water-intensive plant types.

Small and State Water Systems: Small and community water systems with up to 200 service connections are regulated by the County of San Diego Department of Environmental Health (DEH), Land Use Program. As of 2008, there are 169 small water systems that DEH regulates and monitors the reporting of water quality samples to ensure that they comply with the California Safe Drinking Water Act for supplying potable water (Figure 2-9). There are a number of water uses (with widely ranging water demand) associated with these water systems including campgrounds, resorts, retreat centers, schools, residences, restaurants, and parks.

Water systems with over 200 service connections are regulated by the California Department of Public Health Division of Drinking Water & Environmental Management (DDWEM) (Figure 2-10). The majority of these state regulated systems purvey groundwater to residential users.

Indian Reservations: County estimates of tribal groundwater use are based mainly on environmental documents which have been prepared by the tribes for casino projects, and reported average quantities of water that are used for given land uses known to exist on each Reservation. There are a variety of land uses on Indian Reservations that require water including casinos, hotels, residences, restaurants, agricultural irrigation, and in one case a golf course on the Barona Indian Reservation. Estimated water demand ranges from none on undeveloped lands (Capitan Grande, Cuyapaipe, and Inaja Cosmit Indian Reservations) to over 500 acre-feet per year (afy) on the Barona, Pala, and Rincon Indian Reservations. Barona Indian Reservation, with an estimated groundwater demand of greater than 500 afy has historically exceeded the sustainable yield of its basin. In the 2002 *Report on the Need for Emergency Water Supply* prepared for the Barona Tribal Authority, the report documented the depleted groundwater supply at the Reservation and concluded that "the groundwater basin will not be able to supply the current demand without significantly exceeding the safe yield." (Civiltec Engineering, Inc., 2002) Groundwater levels were reported to be at historic lows and some of their existing wells were reported to only operate for short times during a 24-hour period without losing suction due to low pumping levels. In recent years, the tribe has reportedly trucked in water to supplement its declining groundwater supply (Sweeney, 2007).

2.5 Geology and Soils

2.5.1 Geology

The study area is located within the Peninsular Ranges Province of Southern California, a geomorphic province with a long and active geologic history. A generalized geologic map of San Diego County is shown on Figure 2-11. The Peninsular Ranges are underlain by an extensive Mesozoic-aged plutonic complex known as the Southern California batholith. The batholith contains hundreds of individual plutons that were intruded into pre-existing older rocks such as the Triassic Julian Schist and late Triassic-Jurassic gneissic and granitic rocks in the Cuyamaca-Laguna Mountain belt (Walawender, 2000). The intrusive rocks of the Southern California batholith consist largely of granitic and gabbroic rocks. Gabbroic rocks, which are relatively resistant to weathering, can be seen in stark contrast to the surrounding terrain at Cuyamaca Peak, Tecate Peak, Viejas Mountain, and Los Piños Mountain. Monzogranites, also resistant to weathering, can be seen on Lawson Peak in Jamul and Stonewall Peak in the Rancho Cuyamaca State Park. Tonalites, due to their faster weathering rates, can be seen as relatively lower, rolling terranes throughout the Peninsular Ranges.

The Peninsular Ranges were subject to regional uplift and erosion throughout the Tertiary Period. Continued erosion and downcutting of drainage courses through the Quaternary Period have resulted in the present topography. In general, trends of several of the major drainage courses that have developed appear to be controlled by ancient fractures or major joint systems within the crystalline bedrock. Drainages are underlain by thin to moderate thicknesses of sandy stream-deposited alluvium.

A weathering profile of variable thickness has developed upon bedrock that underlies the valley floors throughout the study area. The ongoing weathering process has created a layer of residuum (decomposed granite), which typically consists of moderately to highly decomposed rock material that grades erratically downward to unweathered bedrock material.

Residuum is generally deeper in flat and valley bottom areas, and thinner to non-existent in the steeper upland areas.

2.5.2 Soils

The United States Department of Agriculture (USDA, 1973) mapped the soils over the groundwater-dependent portion of the County with the exception of Rancho Cuyamaca State Park and Anza-Borrego Desert State Park.

The USDA has classified soil runoff potential into four hydrologic soil groups labeled A through D (Figure 2-12). Group A and B soils exhibit the greatest percolation rates and Group C and D soils, exhibit lowest percolation rates. The hydrologic soil groups are defined as follows:

Group A soils have low runoff potential and high infiltration rates when thoroughly wetted. They consist chiefly of deep, well-to excessively-drained sand or gravel and have a high rate of water transmission (greater than 0.30 inches per hour [in/hr]).

Group B soils have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately-well to well-drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15-0.30 in/hr).

Group C soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hr).

Group D soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0-0.05 in/hr).

2.6 Aquifer Characteristics

Within San Diego County, several hydrogeologic environments exist. These different environments can be grouped into three generalized categories: fractured rock aquifers, alluvial and sedimentary aquifers, and desert basins (Figure 2-13). The study area is underlain primarily by fractured rock aquifers and alluvial and sedimentary aquifers which are generally discussed below. Desert basins, which underlie approximately 14% of the unincorporated portion of the County, are located east of the study area. The Borrego Valley aquifer, a desert basin aquifer with a long-term overdraft condition, is discussed separately in

Appendix A. The following describes the hydrogeologic characteristics of fractured rock and alluvial and sedimentary aquifers within the study area.

2.6.1 Fractured Rock Aquifers

Fractured rock underlies approximately 73% of the unincorporated area of the County. These rocks are typically crystalline or metavolcanics associated with the Peninsular Ranges batholith of southern California and Baja California. The majority of the mountainous region of the County consists of these fractured rocks.

Groundwater Recharge and Storage

Fractured rock aquifers are present in the foothills and mountainous regions of the County where precipitation is higher than in the lower elevation regions. As a result, recharge rates to fractured rock aquifers can be greater than in the lower elevation areas. Additionally, due to the low storage capacity, recharge to fractured rock aquifers can cause relatively fast rises to the water table, and similarly fast declines to the water table from groundwater pumping in years without significant recharge. In some areas of the County with particularly low storage, the static groundwater levels (as measured in unpumped wells) have risen or declined in excess of 100 feet in particularly rainy seasons or dry seasons, respectively.

Fractured rock aquifers typically have much less storage capacity than aquifers comprised of unconsolidated sediments. Storage in fractured rock within the County spans several orders of magnitude from essentially zero and up to 1 percent of the total volume of the aquifer. Specific yield values in San Diego County fractured rock are estimated to range from about 0.001% to 1%.

In many cases, fractured rock aquifers are overlain by a layer of weathered bedrock (residuum) and/or a layer of alluvium. The presence of residuum or alluvium may provide additional storage capacity if the water levels extend up into these layers. Water stored in these layers may drain into the fractured rock beneath them as water is pumped from the fractured rock. The additional storage in these surficial units may significantly enhance the availability of groundwater resources in some areas relying on groundwater from fractured rock.

Well Yield

Wells in a fractured rock aquifer typically yield relatively low production capacities. In some instances wells may derive water from only one or a few water-bearing fractures. Additionally, it is very difficult to estimate potential production rates for any new well drilled, and wells drilled only a few tens of feet from one another may have significantly different water production rates. This is because water-producing fracture locations and orientations are difficult to identify and predict, and fractures intersected by one well may not be intersected by nearby wells. There are a number of factors which determine the long-term yield for a well in fractured rock aquifers including the number of fractures intersected, aperture (fracture opening sizes), spacing, orientation, and interconnectivity of fractures, the amount of recharge, the amount of groundwater in storage in the surrounding aquifer, other nearby groundwater extraction, and the installation techniques for a well. To provide a simple illustration of the variability of well yields in fractured rock, Figure 2-14 shows three theoretical wells superimposed on a photograph of a fractured granitic outcrop. Theoretical Well 1 intersects a highly-permeable fracture and a few lower-permeable fractures and would likely have the highest production rate. Well 2 only intersects lower-permeable fractures and would likely have a lower production rate. Well 3 doesn't intersect any fractures and would result in a dry well.

As required by State law, DEH maintains confidential records of wells (i.e., well logs) drilled in the County. Records were reviewed for 750 wells within fractured rock aquifers in the study area. These logs often provide an estimate of well production rates in gallons per minute (gpm). This estimate is usually based on a one or two-hour air-lift test. A longer test would be required to obtain a more accurate value for long-term pumping capacity. In many cases, the rate indicated on a well log is higher than the actual sustainable pumping capacity of a given well. The well yields reported varied widely. The median well yield reported was approximately 15 gpm. In 86 wells (approximately 11% of wells reviewed), well yield was reported as less than 3 gpm. These wells may struggle to meet the demands of a single-family residence. Several wells also reported a well yield greater than 100 gpm. The average depth of wells drilled was approximately 430 feet deep, with the deepest wells drilled over 1,500 feet deep.

Groundwater Levels

It is important to understand the impacts to groundwater within the County from precipitation trends. Figure 2-15 shows historic groundwater levels from a well in Lawson Valley, a fractured rock aquifer that DPLU has monitored since 1982. Historic groundwater levels from an alluvial aquifer in Pine Valley are also shown to illustrate the differences in water level declines between these two aquifer types. Annual precipitation shown is based on an approximate average between the two areas. It should be noted that the water levels are influenced by groundwater pumping which has slowly increased with continued development through the time period shown. The water levels rises in the fractured rock well show that in general, significant recharge occurs during years of above-average precipitation. The average years provide a limited amount of recharge, and the below-average years provide very little to no recharge. Following the well-above-average rainfall in 1982-1983, groundwater levels within the fractured rock well reached its first low in 1989 and 1990 after seven years of average-to below-average rainfall. The well-above-average rainfall in 1992-1993 caused the water table to rise to historic highs. Two other very wet years in 1994-1995 and 1997-1998 caused the water table to again rise to near historic high water levels. Groundwater levels dropped from 1998 to 2004 during an extended drought period and reached its historic low in 2004. In 2005, well-above-average rainfall from one wet season caused the water table to rebound 80 feet to recover all losses observed during six years of drought. Well-below-average rainfall in 2006 and 2007 caused groundwater levels to drop similar to past droughts. Winter rainfall in 2008 again caused groundwater levels to rebound to near historic highs.

2.6.2 Alluvial and Sedimentary Aquifers

Alluvial and sedimentary aquifers account for approximately 13% of the unincorporated area of the County. These aquifers are typically found in river and stream valleys, around lagoons, near the coastline, and in the intermountain valleys. Sediments in these aquifers are composed of mostly consolidated (defined as sedimentary rock) or unconsolidated (defined as alluvium or colluvium) gravel, sand, silt, and clay. Most of these aquifers have relatively high hydraulic conductivity, porosity, and storage and in general would be considered good aquifers on the basis of their hydrogeologic characteristics. However, many alluvial and sedimentary aquifers in the County have relatively thin saturated thickness and therefore limited storage. Alluvial and sedimentary aquifers can be underlain by fractured rock aquifers, which potentially provide additional storage.

Groundwater Recharge and Storage

Surface water bodies within an alluvial or sedimentary aquifer may increase the recharge due to leakage from the water body into the subsurface. Because alluvial basins generally occur in low-lying areas of a watershed, surface water runoff may accumulate in streams, lakes, or other surface depressions within alluvial basins and can provide an additional recharge source to these basins.

Alluvial and sedimentary aquifers typically have significant storage capacity, with specific yield values between 1 and 30% (Freeze and Cherry, 1979).

Well Yield

Wells in an alluvial or sedimentary aquifer typically yield relatively high volumes of water. Coarse-grained sediments such as sand or gravel typically produce higher volumes of water than finer-grained sediments such as silts or clays. In coarse-grained sediments, well yields may be hundreds to over a thousand gpm and are more limited by inefficiencies in the well itself or pump capacity, rather than by limitations in the aquifer's ability to produce water.

Well logs were reviewed of 63 wells within alluvial aquifers in the study area. These logs provide an estimate of well production rates in gpm. This estimate is usually based on a one or two-hour pumping test. A longer test would be required to obtain a more accurate value for long-term pumping capacity. In many cases, the gpm rate indicated on a well log is higher than the actual sustainable pumping capacity of a given well. The median well yield reported was approximately 36 gpm. The highest well yields were reported in Warner Valley, Pala, and Pauma with several wells greater than 500 gpm and one well in Warner Valley reported at 1,500 gpm. While not noted in the well logs reviewed, there are several wells with yields reported at greater than 1,000 gpm in Jacumba Valley. Though a well may be capable of very high yield, in the long-term, its sustainable yield will be a function of the aquifer's rate of recharge and groundwater storage capacity.

2.7 Hydrologic Inventory and Groundwater Conditions

2.7.1 Hydrologic Features

The majority of the study area is located within the San Diego hydrologic region in which runoff from precipitation flows down the slopes towards the Pacific Ocean (Figure 2-1). A small portion of the study area also lies within the Colorado hydrologic region in which runoff flows towards the Salton Sea.

The San Diego and Colorado hydrologic regions have been subdivided into hydrologic units, hydrologic areas, and hydrologic sub areas by the State Water Resources Control Board (SWRCB). The study area has 9 hydrologic units within the San Diego Hydrologic Region and 3 hydrologic units within the Colorado Hydrologic Region (Figure 2-1). These hydrologic units are further divided into hydrologic areas and subareas.

Figure 2-1 shows the major water courses in the study area which include (from north to south) the San Luis Rey River, San Dieguito River, San Diego River, Sweetwater River, Otay River, and the Tijuana River. While a few streams flow year-round, most flow only during the winter and spring months in response to rainfall or snowmelt. There are no natural lakes located within the study area. However, there are a number of surface water reservoirs which collect local runoff including Henshaw, Wohlford, Sutherland, Cuyamaca, San Vicente, El Capitan, Loveland, Otay, Barrett, and Morena reservoirs. Water is periodically released from some of the reservoirs for uses by CWA member agencies west of the study area. None of the surface water from the reservoirs is available for local use within the groundwater-dependent portion of the County. There are also a number of smaller impoundments and small unnamed ponds located sporadically throughout the study area.

Lake Henshaw is also supplemented by groundwater pumped from a well field in Warner Valley, which is maintained and operated by the Vista Irrigation District. From 1992 through 2007, the Vista Irrigation District pumped an average of 6,300 acre-feet of groundwater per year into Lake Henshaw. The reservoirs and surface water rights are owned mostly by the City of San Diego, as well as the City of Escondido, Helix Water District, and Vista Irrigation District.

2.7.2 Inventory of Wells

To support a population of over 41,000 residents and various commercial, industrial and agricultural users, there are thousands of individual private and public wells located throughout the 1,885 square mile study area. DEH has over 15,000 confidential supply well logs on file throughout the County from well permits dating back to the 1970s. Additionally, there are likely thousands of additional un-permitted wells that were drilled prior to that 1970s. As discussed in the aquifer types section above, well log records from 813 wells were reviewed to obtain specific geologic and hydrologic information for this study. Since there are large tracts of public, Indian, and undeveloped lands, information from well logs are not available over large portions of the study area.

DPLU maintains a database of groundwater level records from nearly 400 wells throughout the County (locations shown on Figures 2-16 through 2-30). Monitoring records for some wells go back as far as the early 1980s. Currently, water levels from over 100 wells are monitored quarterly by DPLU, and groundwater levels are also received from water districts, water companies, and other entities.

2.7.3 Historical Groundwater Levels

Monitored wells with records of historical groundwater levels within each planning group, sponsor group, and planning area are depicted on Figures 2-16 through 2-30. Within the study area, there are no historical groundwater level records on file with DPLU within the Potrero Community Planning Group, the Cuyamaca Community Sponsor Group, the Pala - Pauma Valley Community Sponsor Group, or the Tecate Community Sponsor Group areas. To provide an understanding of groundwater level trends, well hydrographs have been generated for specific areas within each planning group, sponsor group, and planning area (Figures 2-31 through 2-64). The well hydrographs selected provide a representative understanding of groundwater level trends within each area. Select wells with incomplete/relatively short well records, water levels not representative of static conditions, or in areas with dense distributions of wells were not included as hydrographs. The legend on each well hydrograph figure indicates whether wells have been actively used ("active") versus unused ("inactive") at any point during its period of record. Water levels were obtained from "active" wells when the well was not pumping, but it is possible in some cases that water levels were collected before the well had fully recovered to static water level conditions. Therefore, it is likely that some "active" wells water levels were recorded as deeper than actual static water level conditions.

Below is a discussion of groundwater level trends from wells monitored from specific locations within each planning group, sponsor group, and planning area.

Alpine Community Planning Group (monitored wells are shown on Figure 2-16)

Hidden Glen: Figure 2-31 depicts groundwater levels of three wells with records ranging from 1984 to 2008. The wells are located within a small, rural residential valley underlain by fractured bedrock near a small seasonal stream. The water levels have varied between 1 and 55 feet below top of casing (btoc) with recorded historic lows reached in July 1990, July 1997, and July 2002. The most recent water levels from April 2008 have rebounded from winter rainfall to some of the shallowest groundwater levels recorded for these wells.

Overall, the water table declines noted during dryer years recover during the well above-average rainfall years.

Viejas Valley: Figure 2-32 depicts groundwater levels of three wells with records ranging from 2000 to 2008. The wells are located in a residential valley area underlain by fractured rock along Willows Road and south of Interstate-8 directly south of the Viejas Indian Reservation. It should be noted that several of the residences in this area have parcel sizes less than 1-acre in size. The water levels have varied between 19.1 to 87.1 feet btoc. Water levels have fluctuated in response to seasonal groundwater pumping and rainfall patterns.

Boulevard Community Planning Group (monitored wells are shown on Figure 2-17)

Manzanita: Figure 2-33 depicts groundwater levels of two wells with records ranging from 1993 to 2008. The wells are located in a residential and commercial area of Boulevard underlain by fractured bedrock. The Manzanita area has a few clusters of residential and commercial parcels on lots smaller than 2 acres and commercial lots including a school and a plant nursery. Since April 1996, water levels have slowly declined by 30 feet in well BOU-03 to a historical low groundwater level of 125.8 feet btoc in January 2008. Contrary to other wells monitored in this region, the well showed no evidence of the water table recovering in 2005 from above-average rainfall that year. Well BOU-05 has only limited period of record. Water levels have varied between 33.4 to 74.8 feet btoc.

Tierra Del Sol: Figure 2-34 depicts groundwater levels of four wells with records ranging from 1993 to 2008. The wells are located in a rural residential area underlain by fractured bedrock. The water levels have varied between 2.4 to 40 feet btoc with historic lows reached in three of the wells in 2003 and 2004 after several years of well-below-average rainfall. Water levels rebounded in 2005 in response to well-above-average rainfall in all four wells. Overall, the water table declines noted during dryer years recover during the well above-average rainfall years.

Campo Community Planning Group (monitored wells are shown on Figure 2-18)

Cameron Corners: Figure 2-35 depicts groundwater levels of 14 wells with records ranging from 2000 to 2008. The wells are located within a mixed use rural town center with small commercial uses fronting along Hwy 94, residences including the 222-lot Campo Hills subdivision with lot sizes less than ¼-acre, agricultural use on Star Ranch, the Rancho Del Campo facility with a variety of water uses, and the Border Patrol and Campo Road Station. 12 of the wells are underlain by an alluvial basin up to 100 feet in thickness, and two wells (CAM-21 and CAM-33) are underlain by fractured bedrock. Water in the wells underlain by alluvium has varied between 1 to 25 feet btoc. Water levels in the two fractured rock wells have ranged from 36 to 42 feet btoc. Based on the few historic well records, it appears that the lowest groundwater levels occurred in 2004 at the height of the historic drought period, and shallowest in 2005 in response to the well-above-average rainfall that season.

Morena Village: Figure 2-36 depicts groundwater levels of five wells with records ranging from 1992 to 2008. The wells are located within a densely developed residential community with over 300 residences (average parcel size just over 1-acre) underlain by fractured bedrock. The majority of the residences are provided groundwater from two water companies located in Morena Village. The water company wells pump relatively large amounts of groundwater from only a few wells. Between 1995 and 1997, well CAM-03 declined by approximately 200 feet to approximately 230 feet btoc. Between 1998 and 2004, well CAM-04 declined approximately 100 feet to 205 feet btoc. Water level records for CAM-04 end in 2004, so it is unknown how much the water table recovered with the well-above-average rainfall of 2004-2005. In contrast to wells CAM-03 and CAM-04, the other three wells water levels have much less variation with water levels historically ranging between approximately 9 to 81 feet bgs with historic lows reached in 2004.

Other Areas of Campo: Figure 2-37 depicts groundwater levels of 20 wells with records ranging from 2003 to 2008. The wells are located in four different areas of Campo, with six wells (CAM-10 through CAM-15) located on the site of the future Children's Village facility along Lake Morena Drive, one well (CAM-06) along Buckman Springs Road east of Morena Village, three wells (CAM-07 through CAM-09) within a preserve area, and the remaining 11 wells (CAM-16 through 19, CAM-37 through CAM-32) located along and near Miller Creek on Circle F Ranch. With the exception of some of the wells screened within alluvium at Circle F Ranch, the areas are underlain by fractured bedrock overlain with varying thicknesses of residuum. The preserve area is located in an upland area with the other fractured rock wells located in valley locations. The shallowest groundwater levels are found in wells within alluvium at Circle F Ranch, with water levels near or at the ground surface with wet-dry seasonal fluctuations. The deepest water levels are found in fractured rock wells with no saturated residuum, with water levels as deep as 71 feet btoc in well CAM-10 at the Children's Village site.

Descanso Community Planning Group (monitored wells are shown on Figure 2-19)

Descanso: Figure 2-38 depicts groundwater levels of five wells with records ranging from 1989 to 2008. The wells are located within the valley area of the community of Descanso, which is underlain by a thin mantle of alluvium and thicker amounts of residuum over fractured bedrock. The Descanso Community Water District draws its groundwater for approximately 900 residents from this area as well as a number of private residential well users. The water levels have varied between 2 and 77 feet btoc with historic lows reached in 1990/1991 and 2003/2004 after several years of well below-average rainfall. In April 2008, water levels in wells DES-01, DES-07, and DES-08 from recent rainfall in the winter of 2007-2008 were between 5 to 21 feet btoc. Well DES-01, which is an actively pumped well, has shown recent fluctuations of up to 50 feet in groundwater levels between winter and summer months. Overall, the water table declines noted during dryer years recover during the well-above-average rainfall years.

Descanso Detention Facility: Figure 2-39 depicts groundwater levels from one well with a record from 1990 to 2005. The Descanso Detention facility is located southwest of the community of Descanso and is underlain by fractured bedrock. The water levels have varied between 6 to 72 feet btoc with historic lows reached in 1990, 1996, and 2003. Historic shallow groundwater levels were recorded in 1995. Overall, the water table declines noted during dryer years recover during the well above-average rainfall years.

Jamul-Dulzura Community Planning Group (monitored wells are shown on Figure 2-20)

Bee Valley/Deerhorn Valley: Figure 2-40 depicts groundwater levels of three wells with records ranging from 1981 to 2008. The wells are located within two rural residential valley areas underlain by fractured bedrock. The water levels have varied widely between 4 to 174 feet btoc with historic lows reached in July 1990 and October 2004. These wide ranging fluctuations indicate low storage within the fractured rock aquifer surrounding these wells. Water levels have rebounded as much as 150 feet in a single wet season as evidenced in Wells JAM-08 and JAM-09 between August 1990 and April 1991. In the same wells, it has also fallen as much as 100 feet between February and August of 1983. Overall, based upon the water level records from these wells, the fractured rock aquifer that underlies this area likely has a low storage capacity that is subject to localized rapid declines in the water table. However, the water table declines noted during dryer years recover during the well above-average rainfall years.

Honey Springs Road: Figure 2-41 depicts groundwater levels of four wells with records ranging from 1981 to 2008. The wells are located within a rural residential area underlain by fractured bedrock. With the exception of well JAM-02, water levels have varied between 3 and 67 feet btoc with historic lows reached in August 1990 and 2003/2004. In response to well above-average rainfall in 2004-2005, the water level of 2.6 feet btoc in well JAM-11 represented the shallowest groundwater level recorded. Underscoring the wide variability of water levels within different wells drilled in fractured rock aquifers, water levels in well JAM-02 have varied between 3 and 179 feet btoc. Water levels were shallowest in April 1983 (3 feet btoc) and with historic lows reached in November 1990 and September 2004. Based upon the water level records from this well, the fractured rock aquifer that underlies this area likely has a low storage capacity that is subject to localized rapid declines in the water table. However, the water table declines noted during dryer years recover during the well-above-average rainfall years.

Lawson Valley: Figure 2-42 depicts groundwater levels of three wells with records ranging from 1981 to 2008. The wells are located within a rural residential valley underlain by fractured bedrock. Wells JAM-26 and JAM-43 mimic one another through time. Water levels have varied between 8 and 26 feet btoc with historic lows reached in August 1990 and 2003/2004. Again underscoring the wide variability of water levels within different wells drilled in fractured rock aquifers, water levels in well JAM-31 have varied between 17 and 102 feet btoc. Water levels were shallowest in July 1993 (17 feet btoc) with historic lows reached in 2002 and 2004. Water levels rebounded 80 feet in a single wet season between August 2004 and April 2005. Water levels have also fallen as much as 30 to 40 feet in a single season. These fluctuations are within normal variations seen in supply wells within fractured rock. Overall, the water table declines noted during dryer years recover during the well-above-average rainfall years.

Lee Valley/Lyons Valley: Figure 2-43 depicts groundwater levels of nine wells with records ranging from 1982 to 2008. The wells are located within rural residential valleys and foothills above the valley underlain by fractured bedrock. The water levels have varied between 5 and 117 feet btoc with historic lows reached in 1990/1991 and 2003/2004 after several years of below-average rainfall. Due to the large fluctuations in well JAM-14 which would make other well hydrographs hard to read, it was not included on Figure 2-43. Water levels within this well have fluctuated more than any other well monitored in Lee Valley with water levels of 46 feet btoc in April 1995 to 225 feet btoc in October 2004. Water levels rebounded over 100 feet by April 2005 to 113 feet btoc. Overall, the water table declines within wells monitored during dryer years recover during the well-above-average rainfall years.

Julian Community Planning Group (monitored wells are shown on Figure 2-21)

Julian Town Center: Figure 2-44 depicts groundwater levels of five wells with records ranging from 1994 to 2006. The wells are located within and near the community town center of Julian, underlain by fractured bedrock. The Julian Community Services District and Majestic Pines Community Services District pump their groundwater from this area for nearly 800 combined service connections to residential and commercial customers. The water levels have varied between 75 to 298 feet btoc. In June of 1998, groundwater levels in the wells were at their shallowest at depths between 75 to 120 feet btoc. From 1998 to 2004, water levels declined substantially with water levels recorded at their lowest in 2004 and 2005 between 161 to 288 feet btoc. As compared to wells monitored in other communities within the study area, the water table showed a relatively poor response to the well above-average rainfall of 2004-2005. Water levels recovered by as much as 70 feet from the 2004-2005 rainfall, but as of 2006 the water table remained near historic lows.

KQ Ranch: Figure 2-45 depicts groundwater levels of five wells with records ranging from 1989 to 2007. The wells are located east and west of Route 79 on and near the KQ Ranch RV Resort, underlain by fractured bedrock. The water levels have varied between 55 to 322 feet btoc, with historic lows reached in 2004 and 2007. With the exception of well JLN-15, the wells indicate general groundwater declines throughout the period monitored with few notable exceptions. Exceptions include minor rebounds in water levels from well above-average rainfall in 2004-2005. Since 1989, water levels in these wells have declined between 22 and 70 feet. Well JLN-15 is located within the community of Harrison Park, with water table declines noted from 1998-2004 which completely recovered from the well-above-average rainfall of 2004-2005.

Volcan Road: Figure 2-46 depicts groundwater levels of three wells with records ranging from 1995 to 2006. The wells are approximately three miles north of the Julian town center in a rural area underlain by fractured bedrock. These wells are used by the Julian Community Services District and the water is piped back to the town to augment the town's water supply from local town wells. The water levels have varied between 18 to 96 feet btoc with historic lows reached in 2002 to 2004 after several years of well below-average rainfall. Water levels rebounded in 2005 between 30 and 50 feet in response to well above-average rainfall. No substantial declines in the groundwater table are documented in these wells. Overall, the water table declines noted during dryer years recover during the well above-average rainfall years.

Lakeside Community Planning Group (monitored wells are shown on Figure 2-22)

Old Barona Road: Figure 2-47 depicts groundwater levels of four wells with records ranging from 1999 to 2008. The wells are located in a residential area underlain by fractured bedrock at the end of Old Barona Road. Residential lots in this area are located near and on the top of a watershed divide and many lots average less than 1 acre per parcel. The Barona Indian Reservation is located directly to the north. The Barona Indian Reservation began watering their golf course in the summer of 1999, and several residents along Old Barona Road reported well problems beginning in the same year. In 2002, 20 residences reported having seriously depleted or dry wells. Wells LAK-12 and LAK-19 are located in the center of the area with reported dry wells, and water levels were approximately 270 feet btoc in each of these wells when DPLU first monitored the wells in the summer of 2000. Water levels from June 2002 through May 2004 in well LAK-12 were greater than 420 feet btoc (the measuring tape was only 420 feet long). Water levels in LAK-19 reached a low of 381 feet btoc in June 2002. Water levels in wells LAK-12 and LAK-19 rebounded by approximately 275 feet in the well above-average wet season of 2004-2005. Since 2005, water levels in wells LAK-19 and LAK-12 again dropped to water levels of 323 and 426 feet btoc respectively in January 2008. Based upon water level records from these wells, the fractured rock aquifer that underlies this area likely has a very low storage capacity that is subject to rapid declines in water table elevation and groundwater availability. It should be noted that there is no data available to definitively correlate whether the depleted and dry wells were impacted by water demand at the Barona Indian Reservation. The lack of recharge from drought conditions, clustered wells on small residential parcels, and low storage capacity of the aquifer are other potential causal factors to be considered for the depleted wells along Old Barona Road.

Wells LAK-17 and LAK-11 do not indicate severe water declines as recorded in wells LAK-12 and LAK-19. Well LAK-17 is located approximately 720 feet east and topographically downgradient of well LAK-12. Between August 2000 and November 2006, water levels remained near or at approximately 90 feet btoc. In January 2007, the water table rose and has remained at levels approximately 20 to 24 feet btoc. Well LAK-11 is located approximately 1,300 feet south of well LAK-19. In the period of record of July 1999 to February 2004, the water table dropped approximately 18 feet to 41 feet btoc. Based on water level records in the other wells in this area, it is likely that water levels in this well rebounded during the above-average wet season of 2004-2005.

State Route 67: Figure 2-48 depicts groundwater levels of two wells with records ranging from 1992 to 2005. The wells are located in a rural residential area underlain by fractured bedrock along Highway 67. Water levels in well LAK-07 have the worst recorded declines of groundwater levels of any well that DPLU has monitored. Water levels in 1995 were approximately 225 feet btoc and dropped over 500 feet to over 740 feet btoc (the measuring tape was only 740 feet long) in 2003. The water table rebounded over 450 feet to 271 feet btoc in August 2005. Well LAK-10 also recorded severe water declines between 1995 and 2003, with the well going dry in 2003. Based upon water level records from these wells, the fractured rock aquifer that underlies this area likely has a very low storage capacity that is subject to rapid declines in water table elevation and groundwater availability. However, the rapid water table declines noted during dryer years do recover during the well above-average rainfall years.

Wildcat Canyon Road: Figure 2-49 depicts groundwater levels of eight wells with records ranging from 1993 to 2008. The wells are located widely ranging topographic settings in a rural residential area underlain by fractured bedrock. Wells LAK-02 through LAK-04 are located on a wildlife preserve. Well LAK-15 is located nearly one mile west of Wildcat Canyon Road in the Muth Valley area. The rest of the wells are located on properties along Wildcat Canyon Road. Well LAK-04 is located adjacent to a seasonal stream within a wildlife preserve and has the least variation of water levels of the wells in this area. From 2000 to 2008, water levels ranged from 17 to 30 feet btoc. Well LAK-06 is located on a hill about 100 feet above Wildcat Canyon Road, and represents the greatest variation of water levels. From 2000 to 2008, water levels ranged from 150 to greater than 530 feet btoc (the measuring tape was only 530 feet long). Based upon the water level records from these wells, the fractured rock aquifer in localized areas likely has a very low storage capacity that is subject to localized rapid declines in the water table and groundwater availability. However, the rapid water table declines noted during dryer years do recover during the well above-average rainfall years.

Pine Valley Community Planning Group (monitored wells are shown on Figure 2-23)

Guatay: Figure 2-50 depicts groundwater levels of three wells with records ranging from 1992 to 2008. The wells are located in a residential area underlain by fractured bedrock. Residential lots in this area average less than 2.5 acres per parcel. The water levels have varied from 2.5 to greater than 380 feet btoc. Well PIN-06 was dry in November 2002, with water levels greater than 180 feet btoc. Well PIN-05 had water levels greater than 360 to 380 feet btoc (deeper than the pump intake) in February 2002 and July 2004. From July 2004 to January 2006, water levels rebounded over 250 feet to a depth of 126 feet btoc. Based upon water level records from these wells, the fractured rock aquifer that underlies this area likely has a low storage capacity that is subject to rapid declines in water table elevation and groundwater availability. However, the rapid water table declines noted from 1998-2004 recovered from the well-above-average rainfall of 2004-2005.

Pine Valley: Figures 2-51 through 2-54 depict groundwater levels of eight wells with records ranging from 1981 to 2008. The wells are located within the valley area of the community of Pine Valley, which is underlain by an alluvial basin and residuum over fractured bedrock. As of 2008, the Pine Valley Mutual Water Company (PVMWC) pumped groundwater to 695 connections serving 675 residential and 20 commercial customers. There are also a small number of private residential well users. Four figures of water level trends provide a more detailed understanding of groundwater conditions within different hydrogeologic settings in Pine Valley.

Figure 2-51 depicts groundwater levels of wells PIN-08 and PIN-14 in the southern end of the valley. These wells are underlain by 30 and 87 feet of residuum, respectively, overlying fractured bedrock. These two wells were taken out of production in the 1990s due to contamination of the aquifer from a nearby leaking underground fuel tank. The water levels have varied between 13 and 58 feet btoc, with historic lows reached in 1996, 2002, and 2007. Groundwater levels were shallowest during each of the three well above-average rainfall years in the 1990s.

Figure 2-52 depicts groundwater levels of wells PIN-07 and PIN-16, which recently have accounted for approximately 65% of PVMWC well production. These wells are underlain by at least 80 feet of alluvium and residuum overlying fractured bedrock. The water levels have varied between 10 and 131 feet btoc, with historic lows reached in 2003 and 2004. Water levels rebounded in 2005 and 2006 in response to well above-average rainfall. Water levels in early 2006 were at approximately 20 feet btoc, which is approximately 10 feet deeper than historic shallow groundwater levels recorded in the 1990s. Overall, the water levels show the stress of pumping large amounts of groundwater from these wells but have shown almost a full recovery of the water table from one above-average rainfall season in 2004-2005.

Figure 2-53 depicts groundwater levels of wells PIN-04, PIN-10, and PIN-11, which are located near Pine Creek near and at the discharge point of the watershed. Wells PIN-10 and PIN-11 recently have accounted for approximately 15% of PVMWC well production. These wells are underlain by as much as 98 feet of alluvium and residuum overlying fractured bedrock. The water levels have varied between 6 and 51 feet btoc, with historic lows reached between 2002 and 2004. Recharge was evident with the water table recovering during each wet season through the dryer years of 1998-2004. This is likely due to the wells proximity to Pine Creek.

Figure 2-54 depicts groundwater levels of well PIN-03. This well is underlain by fractured bedrock with likely very little (if any) saturated alluvium/residuum. Wells PIN-13 and PIN-15 (not shown as well hydrographs) are located near PIN-03 and are also underlain by fractured bedrock with little to no saturated alluvium/residuum. These two wells have similar historic water level patterns. Wells PIN-03, PIN-13, and PIN-15 recently have accounted for approximately 20% of PVMWC well production. The water levels in PIN-03 have varied between 18 and 293 feet btoc, with historic lows reached in 2004. Water levels rebounded approximately 270 feet in March 2005 to 23 feet btoc. Summer groundwater pumping routinely draws down groundwater levels more than 150 feet (and over 200 feet in the driest years). In most years, water levels recover during the wet season to approximately 20 to 30 feet btoc. The three PVMWC wells in this area are heavily pumped and draw from a fractured rock aquifer with little alluvium. This area is subject to rapid declines in water table elevation during the summer months. However, based on the water level records, recharge to these wells appears rapid and reliable in the wet season, with the water table recovering each winter.

Ramona Community Planning Group (monitored wells are shown on Figure 2-24)

Ballena Valley: Figure 2-55 depicts groundwater levels of five wells with records ranging from 1982 to 2008. The wells are located north and south of Highway 78 in Ballena Valley between Ramona and Santa Ysabel. The area is underlain by a thin layer of alluvium and/or residuum overlying fractured bedrock. There are a number of agricultural uses in the valley, which historically have pumped large amounts of groundwater for irrigation of pastures. It was estimated that in the 1980s as much as 800 acre-feet of groundwater was pumped annually (County of San Diego, 1992). Wells RAM-01, -03, -09, -10, -12, -20, and -21 have all been recorded as going dry at least once during their period of monitoring with deepest water levels recorded at depths greater than 500 feet deep. The water levels shown for well RAM-09 is representative of typical impacts from groundwater pumping in the valley with water levels varying from 16 to greater than 400 feet btoc. Water levels do recover during the winter months but typically plummet each summer in response to heavy groundwater pumping rending some wells inoperable. The northwest (well RAM-08), west (well RAM-10), and southwest (well RAM-16) portions of the valley are the only areas in which no appreciable declines in the water table have been recorded. Also, well RAM-12, located in the far southwest corner of the valley had no appreciable impacts from groundwater pumping until 2001. Based on a review of aerial photographs, between 2000 and 2002 irrigation of pastures near well RAM-12 likely caused the water table to plummet and the well was recorded as dry in January 2005 (water levels greater than 300 feet btoc). Overall, this valley has had groundwater problems in and near areas of agricultural irrigation in most summers through the period of record.

Clevenger Canyon: Figure 2-56 depicts groundwater levels of three wells with records ranging from 1992 to 2008. The wells are located in a rural residential area south of Route 78 within a canyon underlain by fractured bedrock. The water levels have varied between 7 and 66 feet below top of casing (btoc) with historic lows reached in 2002, 2004, and 2007. Historic shallow groundwater levels were recorded in 1993 and 2005. Overall, the water table declines noted during dryer years recover during the well-above-average rainfall years.

Ramona Trails Drive: Figure 2-57 depicts groundwater levels of two wells with records ranging from 1996 to 2008. The wells are located in a rural residential area surrounded by relatively steep slopes near the top of a watershed divide and underlain by fractured bedrock. Well RMA-17 has been dry (water levels greater than 500 feet btoc) through extended periods. The water table rose over 470 feet in six months to a depth of 31 feet btoc in April 2005. The well was again recorded as dry from readings taken between August 2007 and March 2008. The water levels in well RMA-06 varied between 46 and 112 feet btoc with historic lows reached in 2004 after several years of below-average rainfall. Water levels rebounded in 2005 and 2006 in response to well-above-average rainfall. Water levels in June 2006 were at historic shallow groundwater levels. Based upon the limited information from water level records from well RMA-17, the fractured rock aquifer that underlies this area likely has a very low storage capacity that is subject to localized rapid declines in water table elevation and groundwater availability. However, the water table declines noted during dryer years recover during the well-above-average rainfall years.

Jacumba Community Sponsor Group (monitored wells are shown on Figure 2-25)

Jacumba Town Center: Figure 2-58 depicts groundwater levels of two wells with records ranging from 1990 to 2007. The wells are located within the community town center of Jacumba, which is underlain by alluvium and/or residuum over fractured bedrock. The water levels have varied from artesian (1.5 feet above the ground surface) to 22.5 feet below top of casing (btoc) with historic lows reached in 1991 and 2005. Overall, the water table declines noted between 1998 and 2004 recovered from the well above-average rainfall of 2004-2005.

Mountain Empire Community Planning Area (monitored wells are shown on Figure 2-26; due to recent vandalism to tribal wells, actual locations of wells are not clearly depicted)

La Posta Indian Reservation: Figure 2-59 depicts groundwater levels of 10 wells with records ranging from 2006 to 2007. The wells pump groundwater for the tribe's casino and are located on relatively undeveloped land on the La Posta Indian Reservation which is underlain by fractured bedrock. The water levels in the two years of monitoring ranged from 11 to 81 feet below top of casing (btoc). No trends can be extrapolated from only two years of water level data.

North Mountain Planning Area (monitored wells are shown on Figure 2-27 through 2-30)

Palomar Mountain: Figure 2-60 depicts groundwater levels of five wells with records ranging from 1994 to 2007. The wells are located at the Palomar Christian Conference Center (wells PAL-05 and PAL-06) and the Palomar Yoga Center (wells PAL-01, PAL-03, and PAL-04) which are both underlain by fractured bedrock. Water levels in Wells PAL-05 and PAL-06 have varied from artesian (above the ground surface) to 82 feet below top of casing (btoc). Wells PAL-01, PAL-03, and PAL-04 closely mimic one another. Water levels in these wells have varied from 84 to 281 feet btoc. From 1998 to 2004, water levels steadily dropped with water levels recorded in 2004/2005 between 191 to 281 feet btoc. The water table rose only during periods of well above-average rainfall which occurred in 1994-1995, 1997-1998, and 2004-2005. Water levels in 2005 recovered by as much as 115 feet, but did not fully recover to the historic high groundwater levels recorded in 1998.

Ranchita Town Center: Figure 2-61 depicts groundwater levels of seven wells with records ranging from 2001 to 2007. The wells are located within the community of Ranchita, which is underlain by alluvium and/or residuum over fractured bedrock. The water levels have varied between 19 and 140 feet below top of casing (btoc). The water levels show minor fluctuations through the period of record, with few appreciable rises or declines in the water table. Well NOR-05, located in the far eastern portion of Ranchita has shown a slow decline of the water table of 15 feet from 2001 to 2007.

Santa Ysabel Indian Reservation: Figure 2-62 depicts groundwater levels of three wells with records ranging from 2005 to 2007. The wells are located on the Santa Ysabel Indian Reservation, which is underlain by fractured bedrock. Wells NOR-26 and NOR-27 remain relatively unchanged through the period monitored with water levels of approximately 10 and 95 feet btoc, respectively. Water levels in NOR-27 have varied between 428 to 617 feet btoc. No trends can be extrapolated from only two years of water level data.

State Route 79: Figure 2-63 depicts groundwater levels of eight wells with records ranging from 2001 to 2008. The wells are located in rural residential and commercial areas, which are underlain by alluvium and/or residuum overlying fractured bedrock. The water levels have varied between 22 to 263 feet btoc with historic lows reached in 2004 after several years of well-below-average rainfall. In 2005, water levels rose to the shallowest recorded in several of the wells. Overall, the water table declines noted during dryer years recover during the well-above-average rainfall years.

Warner Springs Golf Course: Figure 2-64 depicts groundwater levels of four wells with records ranging from 2002 to 2007. The wells are located on the Warner Springs Golf Course, which is underlain by alluvium. The water levels have varied between 15 and 173 feet btoc, with water levels declining each summer from groundwater pumping for the golf course and recovering each winter.

2.8 Water Quality

The thousands of water supply wells that draw water from the groundwater resources of the County have traditionally produced high-quality drinking water. However, naturally-occurring and more recently anthropogenic sources of contamination have caused the quality of groundwater to be adversely effected in localized areas. The most common anthropogenic sources include leaking underground fuel tanks, sewer and septic systems, agricultural applications, and facilities with excess animal waste. The most common contaminants in groundwater within San Diego County include elevated nitrate, naturally-occurring radionuclides, total dissolved solids (TDS), and bacteria. DEH compiled a map which depicts areas of potential nitrate and naturally-occurring radionuclide problem areas in the County (Figure 2-65). Problem areas mapped are based on a subset of wells in which nitrate and radionuclides (gross alpha and uranium) have exceeded their respective maximum contaminant levels (MCLs) in groundwater samples analyzed. The map is based on a limited set of analytical data from water systems regulated by DEH and the State.

Nitrate: Nitrate impacts in the County are most common from small lots and/or areas of shallow groundwater on septic systems, excess nitrate used in agricultural applications, and feed lots. As depicted on Figure 2-65, nitrate impacts are most common in the more urbanized areas west of the study area within the CWA. This includes portions of the communities of Rainbow, Valley Center, Ramona, Escondido, San Marcos, Crest, and Jamul. This can largely be attributed to imported water being brought into these basins. The imported water, which allowed more dense development, results in artificial recharge through septic systems along with irrigation return flows, which have caused shallow groundwater conditions and septic system failures. Potential mapped nitrate problem areas within the study area include Morena Village, the Cameron Corners area of Campo, and a small portion of Alpine along Interstate 8. Other areas of potential concern within the study area are clustered residences located on parcels less than 4 acres as depicted on Figure 2-65. There are no data available over a vast portion of the County, and there are likely areas with potential problems that are unmapped.

Radionuclides: Naturally-occurring radionuclides are present to some extent in nearly all rocks and soil throughout the world and leach into groundwater from natural mineral deposits. As depicted on Figure 2-65, potential radionuclide problem areas include portions of the

Campo/Lake Morena area, Potrero, Jamul/Dulzura, Guatay, Julian/Cuyamaca, the Lake Wohlford area, north and south of Route 78 area east of Ramona, Warner Springs, and east and west of Route 79 near the Riverside County border. There are no data available over a vast portion of the County, and there are likely areas with potential problems that are unmapped.

Total Dissolved Solids: TDS originate naturally from the dissolution of rocks and minerals, and also can be from septic systems, agricultural runoff and recharge, and storm water runoff. Some common areas with elevated concentrations of TDS in the County are found in coastal sedimentary formations and deeper connate water found in desert basins.

Coliform Bacteria: Elevated bacteria in groundwater occur primarily from human and animal wastes. Old wells with large openings and wells with inadequate well seals are most susceptible to bacteriological contamination from insects, rodents, or animals entering the well.

Other Constituents of Concern: Other contaminants of potential concern, which may occur in localized areas include: herbicides, pesticides and other complex organics, petroleum products including methyl tert-butyl ether (MTBE) and volatile organic compounds, and metals. As depicted on Figure 2-65, potential localized contamination of groundwater from leaking underground fuel tanks (LUFTs) include sites in the Cameron Corners area of Campo, Julian, Guatay, Pine Valley, and several other areas (DEH, 2008). In a few cases, water supply wells were inactivated due to the possibility of inducing flow of the contaminated groundwater from LUFTs.

2.9 Potential Groundwater Problem Areas

2.9.1 Large Quantity/Clustered Groundwater Users

Aquifers with limited groundwater in storage (e.g., fractured rock aquifers) and/or limited groundwater recharge (any aquifer located in an area of low rainfall) may experience shortages from large groundwater users, such as water companies or districts, agricultural, or other large operations. There are several communities and areas that were developed with lot sizes smaller than 4 acres in size (Figure 2-7). These areas, especially if underlain by fractured rock aquifers with little to no residuum or alluvium are also potentially susceptible to localized groundwater problems.

Due to the fact that production wells for residential and agricultural water uses are not metered or regulated for water extraction rates by the County, future localized groundwater problems are possible anywhere in the County from large quantity groundwater users. Private residential users of groundwater are estimated to have a consumptive use of approximately 0.5 acre-feet of groundwater per year per residence. However, there have been isolated reports through the years of single-family homes that have used far greater quantities.

Additionally, due to the low storage capacity of fractured rock aquifers, excessive use of groundwater by a single user in fractured rock can cause localized impacts to neighboring properties.

As was discussed in Section 2.4 and Section 2.7.3, the following areas have been identified as having the potential for localized groundwater problems (especially at the height of extended drought periods) from pumping large amounts of groundwater:

1. Ballena Valley: This valley has historicall used up to 800 acre-feet of groundwater per principally for agricultural uses. DPLU has records indicating water level declines up to 500 feet in a single summer.

2. Guatay: Localized rapid declines in the water table are possible in Guatay due to its 81 residences and other uses pumping its groundwater from a relatively small area at the top of a watershed divide underlain by fractured rock with low storage capacity. Water levels in a well monitored by the County in 2002 and 2004 were recorded as dry, with water levels deeper than 380 feet below the ground surface. However, the water table declines noted from 2002 to 2004 recovered during the well above-average rainfall of 2004-2005.

3. Julian Town Center: Two water districts pump groundwater from this area for nearly 800 combined service connections to residential and commercial customers. As compared to wells in other areas of the study area, the water table showed a relatively poor recovery response to the well above-average rainfall of 2004-2005. The water table recovered by as much as 70 feet from the 2004-2005 rainfall, but as of 2006 the water table was depleted again to near historic lows.

4. Morena Village: Two water companies pump groundwater from this area to over 300 residences (average parcel size just over 1 acre). Rapid declines of the water table have been recorded in two wells. Within one well, water level declines of up to 200 feet occurred in a two-year period. It should be noted that rapid groundwater declines were not noted in three other wells monitored within Morena Village, which may indicate that rapid declines that have occurred are localized. Also, the water companies have reportedly periodically struggled with providing adequate water supplies during extended drought periods.

2.9.2 Low Well Yield

As was discussed in Section 2.6, fractured rock aquifers characteristics vary significantly. While the majority of wells drilled in fractured rock in the County have adequate well yield to meet the needs of a typical single-family home, there are wells with very low well yields located sporadically throughout the County in fractured rock. Of 750 well logs reviewed in fractured rock aquifers for this study, approximately 11% of the wells had reported well yields of less than 3 gpm which may be inadequate to meet the demand of a single-family residence.

While low well yields are possible anywhere within fractured rock areas, steep slope areas above the valley floor are particularly prone to having lower well yield. This is largely due to groundwater storage values in steep slope areas often being substantially lower than valley areas, and having a smaller tributary watershed than wells located in valley areas.

Based on the areas in which DPLU has historical groundwater level information, the following areas have been identified as having the potential for low well yield which could result in rapid declines of the water table and groundwater availability:

Old Barona Road, Route 67, Wildcat Canyon Road, and Ramona Trails Drive: Well networks from these areas all have examples of wells with extreme variations of water levels, with declines of 500 feet recorded and recovery of the water table by as much as 450 feet in a single wet season. Periodic trucking of imported water may be needed in these areas to meet the needs of a typical single-family residence.

2.9.3 Groundwater Quality Impacts

As was discussed in Section 2.8, the most common contaminants in groundwater within San Diego County include elevated nitrate, naturally-occurring radionuclides, TDS, and bacteria. The following areas have been identified as having the potential for water quality impacts which are defined as having constituents at elevated concentrations of their respective MCL which can limit the availability of potable groundwater:

Nitrate: As depicted on Figure 2-65, potential nitrate problem areas include portions of the communities of Rainbow, Valley Center, Ramona, Escondido, San Marcos, Crest, Jamul, Morena Village, the Cameron Corners area of Campo, and a small portion of Alpine along Interstate 8. Other regional areas of potential concern within the study area are clustered residences located on parcels less than 4 acres also depicted on Figure 2-65.

Naturally-Occurring Radionuclides: As depicted on Figure 2-65, potential radionuclide problem areas include portions of the Campo/Lake Morena area, Potrero, Jamul/Dulzura, Guatay, Julian/Cuyamaca, the Lake Wohlford area, north and south of Route 78 area east of Ramona, Warner Springs, and east and west of Route 79 near the Riverside County border.

TDS: Common areas with elevated concentrations of TDS in the County are found in coastal sedimentary formations and deeper connate water found in desert basins.

Coliform Bacteria: Old wells with large openings and wells with inadequate well seals are most susceptible to bacteriological contamination from insects, rodents, or animals entering the well.

Leaking Underground Fuel Tanks: As depicted on Figure 2-65, areas of potential localized contamination of groundwater from LUFTs include sites in the Cameron Corners area of

Campo, Julian, Guatay, Pine Valley, and Santa Ysabel. In a few cases, water supply wells were inactivated due to the possibility of inducing flow of the contaminated groundwater from the LUFTs.

3 GROUNDWATER IMPACT ANALYSIS

To evaluate the impacts of proposed GP Update land uses on groundwater quantity, Sections 3.1 through 3.3 below contain conditions that, if it occurs, would be considered potentially significant impacts. These guidelines are based on the following question listed in the CEQA Guidelines, Appendix G, VIII. Hydrology and Water Quality:

b) Would the proposed project substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume of a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits are granted)?

To evaluate the impacts to proposed GP Update land uses related to water quality, Section 3.4 below contains a condition, if it occurs, would be considered a potentially significant impact. This guideline is based on the following question listed in the CEQA Guidelines, Appendix G, VIII. Hydrology and Water Quality:

a) Would the proposed project violate any water quality standards or waste discharge requirements?

3.1 50% Reduction in Storage

To evaluate potential cumulative impacts to a given basin, the County often requires proposed discretionary projects to conduct a water balance analysis of the basin which involves estimating groundwater recharge through at least a 30-year period, comparing yearly recharge with proposed extraction for each of those years, tracking cumulative depletion of storage during successive years of storage depletion (drought), and determining if extraction is in excess of sustained yield if the cumulative depletion of storage exceeds 50% of the total storage capacity of a given basin. Because drought conditions cannot be accurately predicted, the utilization of 30 years of historical precipitation data ensures that a reasonably foreseeable drought condition will be evaluated. Such an analysis incorporates climate variability and provides assurance that groundwater use, even during periods of limited recharge in extended drought periods, does not produce a significant impact to groundwater users dependent on groundwater. During drought years, recharge may be negligible, and water extracted from the aquifer may be derived solely from storage. The available storage in the aquifer must be large enough to supply water throughout the duration of the drought. To assure sustainable groundwater use through drought conditions, the resulting sustainable yield for a basin as calculated from the water balance analysis is a fraction of average annual groundwater recharge. Further details regarding the conservative nature of the 50% criterion are contained within the *County of San Diego Guidelines for Determining Significance – Groundwater Resources* (DPLU, 2007, p.22-24).

3.1.1 Guideline for Determining Significance

The following guideline will be used as a screening tool to identify potential cumulative impacts to proposed land uses within each of 86 basins evaluated in this study (this guideline will also separately evaluate impacts from existing conditions and at the maximum build-out allowed under the current General Plan):

For land uses proposed at the maximum build-out allowed under the GP Update, groundwater impacts will be considered potentially significant if a soil moisture balance, conducted using at least 30 years of precipitation data, concludes that at any time groundwater in storage within a basin is reduced to a level of 50% or less of maximum theoretical storage as a result of groundwater extraction.

3.1.2 Methodology

The evaluation of long-term groundwater availability for each basin within this study involved estimating the rate of groundwater recharge, the available storage capacity, and the rate of groundwater consumption. To estimate cumulative impacts to each basin, the soil moisture balance methodology was used to calculate groundwater recharge on a monthly basis for a 34-year time period (July 1971 through June 2005). The County had previously compiled over 50,000 precipitation records from the years 1971 through 2001 that were readily available for this study. The study included an additional four years beyond the 30 year period to ensure inclusion of the below average period of rainfall that occurred from 1998 to 2004 and the above average rainfall year in 2004-2005. The groundwater demand and groundwater storage capacity were then estimated for each basin. A comparison of monthly recharge with groundwater extraction was made to calculate depletion of groundwater in storage during months when groundwater extraction exceeded recharge. If the cumulative depletion of storage of a basin during any month (over the 34-year period calculated) reached a level of 50% or less as a result of groundwater extraction, this was considered a potentially significant impact. The 50% criterion was established to address the unique characteristics of the County fractured rock aquifers which are characterized by limited storage capacity and very limited groundwater recharge during droughts and excess recharge during wet periods. These unique characteristics typically cause large fluctuations of the groundwater table over the short-term which are generally not observed in aquifers with large storage capacity.

3.1.2.1 Basin Approach

Groundwater typically occurs within a basin, which is defined as a hydrologic unit of groundwater storage more or less separate from neighboring groundwater storage areas. For fractured rock aquifers which underlie the majority of the study area, the edges of the basin are typically presumed to be the topographic divides or watershed boundaries. The approximately 1,885 square-mile study area consists of 9 hydrologic units within the San

Diego Hydrologic Region and 3 hydrologic units within the Colorado Hydrologic Region (Figure 2-1). These hydrologic units are further divided into hydrologic areas and subareas. To provide a screening level evaluation of long-term groundwater availability, each of 86 hydrologic subareas within the study area were analyzed. The term "basin" will be used in this document for defining the lateral extent of each hydrologic subarea.

During the calibration phase, basins were identified where historical groundwater levels could be compared to groundwater in storage calculations through the same time period. To accurately depict groundwater in storage results to well hydrographs, the Pine basin required subdivision into two sub-basins, which were named "Pine North" and "Pine South." Additionally, to provide a realistic comparison of water levels to calculated groundwater in storage results during the calibration phase for Morena Village, the Morena basin was also subdivided into "Morena South" for the Morena Village area and "Morena" for the remainder of the watershed.

Section 2.9.1 identified four areas (Ballena Valley, Guatay, Julian Town Center, and Morena Village) as having the potential for localized groundwater problems from pumping large amounts of groundwater. Each of the basins in which these areas are located was evaluated to determine whether further subdivision was necessary to more accurately depict groundwater in storage results. This resulted in further subdivision of the Descanso basin into two sub-basins, which were named "Descanso" and "Guatay." Additionally, the San Felipe basin in which the Julian Town Center is partially located was subdivided into two sub-basins, which were named "San Felipe North" and "San Felipe South."

3.1.2.2 Groundwater Recharge

Selection of Recharge Method

Prior to initiating work on this groundwater study, an initial research phase was conducted to select the appropriate groundwater recharge method. This was necessary because there is no standard for preparing this type of study. Additionally, there have only been localized study areas throughout portions of the County, which cannot be readily applied to a study of this scope. The methodology chosen for the study must take into account the availability of data, resources, and time limitations.

A final methodology was selected based on the availability of data and the time and resources available to conduct the study. The methodology adopts a soil moisture budget approach, known as the Thornthwaite Method, which has been the main method of estimating groundwater recharge for discretionary projects within San Diego County for the past 25 years. This method calculates recharge based on monthly variations in precipitation, evapotranspiration, runoff, and soil moisture. This method assumes spatially-distributed recharge – not just recharge focused along drainages as some other methods do.

The objectives of this study require that information from a variety of disciplines and research areas be combined into a unified methodology. The accurate calculation of groundwater recharge is exceedingly difficult and dependent on numerous site-specific factors, many of which are not fully known. Because it would be infeasible to conduct studies and collect site-specific data countywide, the selected soil moisture balance methodology enables a reasonable estimate of groundwater recharge based on existing published data and conditions.

An evaluation has been conducted on other available methodologies to estimate groundwater recharge. While some methods require extensive field data collection, others require sophisticated modeling and calibration procedures. Other methods evaluated either required data that were not readily available or methodologies that required time and/or resources beyond those allotted to this study. It should be noted that all methodologies are normally subject to large uncertainties and errors, especially when applied to a large study area.

Recharge Equation

The equation commonly used to calculate groundwater recharge using the Thornthwaite Method is:

R(i) = P(i) - RO(i) - PET(i) - (SMC - SM(i))

where

R(i) = Recharge during the i^{th} month.
P(i) = Precipitation during the i^{th} month.
RO(i) = Run-off during the i^{th} month
PET(i) = Potential evapotranspiration during the i^{th} month.
SMC = Soil moisture capacity
SM(i) = Soil moisture at beginning of i^{th} month.

Conceptually, this equation states that any precipitation in excess of runoff (infiltration) is available for evapotranspiration up to a limiting rate, called the potential evapotranspiration. If infiltration exceeds potential evapotranspiration in any month, excess moisture can be stored by the soil, up to the soil moisture capacity. Any infiltration in excess of potential evapotranspiration which increases the soil moisture above the soil moisture capacity results in groundwater recharge. Water stored in the soil during periods of excess precipitation is available for evapotranspiration during periods when potential evapotranspiration exceeds infiltration.

There are three scenarios which can occur and require the following conditional statements.

a) Soil Saturated. If recharge occurred in the previous month, then the soil must be saturated at the beginning of the month:

If R(i-1) > 0 then

SM(i) = SMC

b) Soil Wetting. If recharge was zero for the previous month, then it must be determined whether precipitation is greater than evapotranspiration plus runoff for the current month:

If (P(i) – (PET(i)+RO(i)) ≥ 0, then

SM(i) = P(i) – (PET(i) +RO(i)) + SM(i-1)

This equation is to be used in cases where there was no recharge in the previous month but precipitation was equal to or greater than evapotranspiration and runoff. This takes into account soil moisture from the previous month plus any precipitation that exceeded PET + RO. At the end of this calculation, there was also a check to ensure that the SM(i) that was calculated does not exceed the maximum amount possible SMC. If P(i)-(PET(i)+RO(i)) <0, then the statement below applies.

c) Soil Drying. If recharge for the previous month was zero and precipitation was less than the sum of PET + RO, an exponential function was used for soil drying. In reality, in most months PET is greater than the actual evapotranspiration rate and should be reduced as the soil dries and plants wilt.

If (P(i) – (PET(i)+RO(i)) < 0, then

$$SM(i) = SM(i-1)\ \exp\frac{(P(i) - PET(i))}{SMC}$$

In order to estimate groundwater recharge over the study area, the calculation was programmed into computer code that was integrated with Geographical Information Systems (GIS) software. Each basin was divided into 300-foot-by-300-foot grids for data input in GIS. The computer code and an explanation of the code are provided in Appendix B.

Data Compilation

Estimation of groundwater recharge required data compilation to estimate monthly precipitation, runoff, potential evapotranspiration, and soil moisture capacity.

Precipitation: Rainfall is the principal means for replenishment of soil moisture and groundwater recharge. The County's Groundwater Limitations Map as described in Section 2.2 provides an estimate of the 30-year average rainfall throughout the County from July 1971 through June 2001. The map was produced at a resolution of 300 feet, with average precipitation through the time period contained within individual 300-foot-by-300-foot grid cells in GIS. Since the soil moisture balance methodology requires monthly precipitation data in order to estimate groundwater recharge, further work was needed to provide an estimation of monthly values of precipitation for each 300-foot-by-300-foot grid. P(i) was derived by multiplying the average precipitation value within each grid by a fractional statistical yearly and monthly distribution obtained precipitation records utilized in creation of the County Groundwater Limitations Map. Additional precipitation data were also obtained from July 2001 through June 2005 to include the end of a severe drought through October 2004 and the very wet winter of 2004-2005. Table 3-1 shows the 34 yearly fractions and 408 monthly fractions of precipitation from July 1971 through June 2005. This table was then applied to the 30-year average precipitation value contained within each 300-foot-by-300-foot to provide 408 unique monthly values of precipitation.

Runoff: Measurements of runoff from stream gaging stations provide the most accurate depiction of runoff occurring within a given watershed. Since runoff records are unavailable for nearly all watersheds within the study area, runoff must be estimated. The United States Department of Agriculture (USDA) Soil Conservation Service (SCS) developed the Curve Number Method which considers the hydrologic soil group and land use type in determining an antecedent runoff condition (USDA, 1986). The technique is based on a simplified infiltration model of runoff and empirical approximations. The method is based on selection of a curve number that has been developed by empirically rating the hydrologic performance of a large number of soils and vegetative covers throughout the United States. The type of land use dictates the amount of impervious cover and greatly influences the ability of water to infiltrate the soil surface. While the method was designed for a single storm event, it can be scaled to find average monthly runoff values.

With the exception of Rancho Cuyamaca State Park and Anza-Borrego Desert State Park, infiltration rates of soils have been classified by the USDA into four hydrologic soil groups according to their minimum infiltration rate throughout the study area. Hydrologic soil groups were approximated for unmapped areas within Rancho Cuyamaca State Park and Anza-Borrego State Park (Figure 2-12). For unmapped areas adjacent to mapped areas, the hydrologic soil groups were assigned based on the classifications of adjacent mapped soil types. For unmapped areas too far from adjacent mapped areas, lands less than 25% in slope were assigned as hydrologic soil group B, and areas greater than 25% slope were assigned as hydrologic soil group D.

Runoff curves were developed for various combinations of hydrologic soil groups and land uses (see Table 3-2) which was then incorporated into GIS to code each 300-foot-by-300-foot grid cell with a unique curve number. RO(i) was calculated by using the SCS runoff equation for each cell based on the amount of rainfall that occurred in a given month.

Evapotranspiration: ETo, which is a measure of potential evapotranspiration from a known surface, such as grass or alfalfa has been estimated for San Diego County by CIMIS (Figure

2-5 and Table 3-3). For this study, the ETo rates published by CIMIS were used as a surrogate for PET rates required by the Thornthwaite method. PET(i) was calculated from the ETo rates to code each 300-foot-by-300-foot grid. Using these values is conservative because they are based on irrigation needs of grass/alfalfa crops which assume a continuous source of moisture and does not consider summer dormancy (caused by decreased soil moisture beyond the wilting point) exhibited by many native species.

Soil Moisture Capacity: The USDA mapped nearly 250 soil types in their study of the County. The USDA included a range of SMC for nearly all of these soil types. SMC was estimated for as the mean value from the USDA data to code each 300-foot-by-300-foot grid (Table 3-4). For cases where no SMC was listed by the USDA, an estimation of SMC was made for that particular soil type based on similar soil types.

3.1.2.3 Groundwater Demand

Estimation of groundwater demand for input into the water balance analysis required data compilation of existing demand, demand under maximum build-out of the GP Update, and demand under the maximum build-out of the current GP. Additionally, the annual demand was broken into monthly fractions to account for seasonal patterns of groundwater usage.

Existing Demand

Since very few groundwater users in the groundwater dependent portion of the County keep records of overall well production, it is difficult to estimate the overall quantity of groundwater supplies being used in the study area. Therefore, estimations of water demand have been made based on reported average quantities of water use for the variety of land uses in the study area. The San Diego Association of Governments (SANDAG) maintains a GIS database of existing land uses in the unincorporated portion of the County. SANDAG land use codes were placed into water demand categories, and water demand estimates were made for each water demand category (Table 3-5 through 3-9).

Residential, Commercial, Industrial, and Military: As shown in Table 3-5, existing water demand was estimated by placing SANDAG land use codes into water demand categories which included single-family residential, second dwelling units, multi-family residential, lower water use service related commercial and light industrial, higher water use offices/religious facilities/heavy industrial/public facilities, and military facilities. Water demand assumptions are based on typical commercial and industrial wastewater flow rates estimated by the EPA (EPA, 2002). Additional water from outdoor use and landscaping was also assumed to produce a generalized estimate of water demand. The water demand was then applied to each parcel or unit based upon 2006 land uses reported by SANDAG.

Irrigated Agriculture: Existing agricultural demand was estimated based upon the 1998 DWR survey of irrigated agricultural land in the County. These data represent the most detailed information at a countywide scale to estimate water demand from agricultural uses. As shown in Table 3-6, the various crop types surveyed by DWR were placed into five agricultural water demand categories for field crops, orchards and vineyards, and truck crops. Based on DWR actual applied water demands for each crop type from 1998 to 2001, an average applied water demand was estimated for each agricultural water demand category. DWR reported that the actual planted and irrigated acreage will always be less than the gross area mapped, because of ditches, farm roads, other roads, farmsteads, etc. To account for this, approximately 5% of the mapped irrigated areas (15 of 303 areas) was randomly selected to evaluate how much of the actual mapped areas appeared to have crops or graded area for the purpose of irrigated agricultural use. The percentage of irrigated crops was estimated within each mapped area by using 1997 aerial imagery. Approximately 70% of the land mapped appeared to have crops or graded area for the purpose irrigated agricultural use. Therefore, the irrigated land mapped by DWR was reduced by 30% to take this into account. It is important to note the standard deviation was 31%, indicating a wide variation in the percentage of lands actually being irrigated. Therefore, there is substantial potential for over- or underestimating agricultural water demand using the DWR dataset. Since there is no better Countywide agricultural dataset with which to utilize for this study, basins with mapped irrigated agricultural demand should be evaluated with caution, with the knowledge that estimated agricultural demand is subject to substantial error. While not available for this study, it is anticipated that DWR will be conducting an updated survey of irrigated agricultural land in 2009 for the County, with results potentially available in 2010.

In a recent study in southern California, the USGS estimated that approximately 5 to 30% of applied water to crops passes through the root zone and becomes groundwater recharge (Hanson et al., 2003). Therefore, the applied water demand was further reduced by 10% to account for irrigation return flow back into the aquifer.

In evaluation of initial long-term groundwater availability results, the Jamul basin was identified as having a potentially significant impact to groundwater resources due to the large amount of irrigated agricultural land in the basin. Since 1998, the actively irrigated agricultural land in the Jamul basin has been placed into a permanent open space preserve. The results in this basin were modified to not include the agricultural demand.

Golf Courses: The Warner Springs Golf Course and Barona Indian Reservation Golf Course are the only two golf courses in the study area. As shown in Table 3-7, the Warner Springs Golf Course was estimated to have a total demand of 607 afy. The Barona Indian Reservation Golf Course water demand was evaluated separately under Indian Reservation water demand.

Small Water Systems: There are 143 small water systems regulated by DEH in the study area including campgrounds, resorts, retreat centers, schools, residences, restaurants, and parks. As shown in Table 3-8, the small water systems were placed into five small water system water demand categories for mobile home parks, overnight use, fulltime day use, parks day use, restaurants, commercial/stores, systems in which the County has metered water use data, and residential. Water demand assumptions were applied to each category based upon the number of connections or population of a given system. The demands per person were based on typical commercial and industrial wastewater flow rates estimated by the EPA (EPA, 2002).

Indian Reservations: Groundwater use on the 15 Indian Reservations (with the exception of proposed groundwater use under recent State of California Indian gaming compacts) within the study area is not subject to County regulations. In recognition of tribal rights to the groundwater beneath their lands, this study has not included any groundwater recharge or storage from Indian Reservations in the basin-by-basin analysis (with the exception of the Barona Reservation as explained below). The basin boundaries were redrawn to exclude such land with the assumption that each Reservation could potentially utilize groundwater beneath its land for future uses. As such, this water should not be considered as a potential benefit for future groundwater users in the unincorporated portion of the County. The only exception is for cases where a given Indian Reservation has been documented to exceed its sustainable yield to the potential detriment of off-Reservation groundwater users. The Barona Indian Reservation historically has exceeded the sustainable yield of its basin and has reportedly trucked in water to supplement its declining water supply. Since the Reservation is known to have exceeded its sustainable yield, this must be accounted for in future groundwater resources planning for the unincorporated land adjacent to the Barona Reservation. Additionally, approximately 20 off-Reservation residences along Old Barona Road have reported seriously depleted to dry wells. It should be noted that there is no data available to definitively correlate whether the depleted and dry wells were impacted by water demand at the Barona Indian Reservation. The lack of recharge from drought conditions, clustered wells on small residential parcels, and low storage capacity of the aquifer are other potential causal factors to be considered for the depleted wells along Old Barona Road. The Barona Indian Reservation is estimated to use greater than 500 acre-feet of groundwater per year for its golf course, casino, and hotel (Table 3-9). No other documented cases of groundwater pumping exceeding the sustainable yield to the potential detriment of County groundwater users have been documented from the other 14 Indian Reservations within the study area.

Current GP and GP Update Demand

Anticipated future groundwater use was estimated for the study area based on lands still available for subdivision at the maximum allowable densities permitted by the current GP (Figure 3-1) and the five alternatives considered as part of the of the GP Update. There are five GP Update alternatives as follows:

1. GP Update Referral Map (Proposed Project) (Figure 3-2): The Referral Map is the map the Board of Supervisors created during the land use mapping phase of the project which incorporated a number of the property referrals that are not included in the Draft Land Use Map.

2. GP Update Draft Land Use Map (Figure 3-3): The map was also endorsed by the Board of Supervisors during the land use mapping phase. It is also the map where the Board directed continued refinements relating to meeting the Housing Element allocation and where additional modifications were made to achieve a more balanced road network.

3. GP Update Hybrid Map (Figure 3-4): This map strikes a balance between the Referral Map and the Draft Land Use Alternative Map.

4. GP Update Environmentally Superior Map (Figure 3-5): To complete a reasonable range of alternatives for the GPEIR, an Environmentally Superior Alternative has been developed. The mapping portion of this reflects a more stringent application in restricting growth in portions of the Semi-Rural and the Rural Lands Regional Categories. The Environmentally Superior Alternative is intended to evolve as the EIR analysis identifies areas of significant impacts where changes in land use can reduce or alleviate the impact. Therefore, the map for this alternative is in a draft stage and is subject to modification as the EIR analysis progresses.

5. GP Update Cumulative Impacts Map: This map evaluates each of the alternatives proposed and selects the most aggressive growth allowed for each area.

Current GP Demand Assumptions: Groundwater demand for residential land use categories was assumed at 0.5 afy per parcel based on the maximum densities allowed. Service-commercial and visitor-serving commercial do not have maximum allowable densities associated with their designation. Therefore, groundwater demand was estimated at 0.3 afy per acre for lands with these designations. There are no other GP designations in the study area with associated potential future water use.

GP Update Demand Assumptions: Groundwater demand for residential land use categories was assumed at 0.5 afy per parcel based on the maximum densities allowed. General commercial, rural commercial, and medium impact industrial each have potential future water use but do not have maximum allowable densities associated with their designation. Therefore, groundwater demand was estimated at 0.3 afy per acre for general commercial, 0.3 afy per two acres for rural commercial, and 0.3 afy per five acres for medium impact industrial. There are no other GP Update designations in the study area with associated potential future water use.

Future Demand Constraints: As documented in detail in Appendix B, a number of constraints were taken into consideration to provide a more realistic expectation of future development potential under the various General Plan scenarios. Constraints included already built lands, 100-year flood plains, wetlands, public lands, future roads, habitat preserves, Alquist-Priolo fault zones, airport noise, airport hazard zones, forest conservation initiative lands, slopes greater than 25%, Tier I and II vegetation, and pre-approved mitigation areas.

Monthly Demand

Groundwater pumping throughout a given year is typically the least during the winter months and greatest during the summer months. This is largely due to the fact that outdoor water use is curtailed during the winter due to rains and dormancy of many plant species. Conversely, outdoor water use is high during the dry summer growing season. To take this into account in the input of groundwater demand into the water balance analysis, monthly fractions of annual water use were obtained by averaging monthly groundwater demand records from the Julian Community Services District, the Pine Valley Mutual Water Company, and the Descanso Community Services District (Table 3-10). The monthly fractions were input to fractionalize annual groundwater demand from all uses estimated for this study.

3.1.2.4 Groundwater in Storage

Because groundwater recharge does not occur at a constant rate from year to year, there must be sufficient drainable groundwater in storage to provide water during years of below average recharge. Groundwater is stored in the study area in fractured rock aquifers and alluvial and sedimentary aquifers as discussed previously in Section 2.6. From these aquifer types, five hydrogeologic units have been identified in the study area:

1. Moderately Fractured Crystalline Rock
2. Slightly Fractured Crystalline Rock
3. Residuum (decomposed crystalline rock)
4. Alluvial River Valleys and Basins
5. Coastal Marine and non-Marine Sedimentary Formations

Groundwater storage capacity was required to be calculated for input into the water balance analysis for each hydrogeologic unit. The storage capacity of a given basin is the sum of the storage capacity of the hydrogeologic units. To estimate groundwater in storage for each hydrogeologic unit, estimates of specific yield, the potential saturated thickness, and the areal extent of the unit were required (Table 3-11, Figures 3-6 and 3-7). Specific yield is the ratio of volume of water that rock or soil will yield by gravity drainage to the volume of rock or soil. Hence, if one cubic foot of saturated rock or soil will yield 0.1 cubic feet of water under gravity drainage, the specific yield is 0.1 or 10 percent. Since site-specific values of specific yield are not known, these values have been estimated for this study as discussed below.

<u>Moderately Fractured Crystalline Rock (Figure 3-6):</u> While the actual range for specific yield in rock likely ranges from about 0.0001% to 1%, a value of 0.1% in valley areas is a generally accepted estimate of average conditions in fractured rock aquifers in the County. Based on well depths typically encountered in fractured rock aquifers in the County, a saturated thickness of 500 feet was assumed. The areal extent of this unit was limited only to areas underlain by fractured rock with slopes less than 25%. A filter was created in GIS (1/16 of a

square mile) to remove small "islands" of areas greater than 25% that were located in areas dominated by slopes less than 25% and vice-versa.

Slightly Fractured Crystalline Rock (Figure 3-6): While the actual range for specific yield in rock likely ranges from about 0.0001% to 1%, a value of 0.01% in steep slope areas is a generally accepted estimate of average conditions in fractured rock aquifers in the County. Based on well depths typically encountered in fractured rock aquifers in the County, a saturated thickness of 500 feet was assumed. The areal extent of this unit was limited only to areas underlain by fractured rock with slopes greater than 25%.

Residuum (Figure 3-7): Based on the range of weathering, residuum can have a specific yield ranging from about 1 to 10%. A study of how weathering processes change the effective porosity of granodiorite was conducted in Turkey. The effective porosity ranged from 3.48% in relatively unweathered rock samples to 9.08% in completely weathered rock (Tuğrul, 2004). For this study, a value of 5% specific yield was applied to this unit. This unit is made up of weathered bedrock and is typically located in lowland areas. Differential weathering of bedrock, due to non-uniform fracturing and differences in mineralogy, produces an undulating contact between the unweathered bedrock and decomposed granite. Due to these factors, it is not easy to accurately predict the thickness of residuum underlying a specific region without site-specific information such as boring or well logs. However, weathering is generally found to be deeper in the flat and valley bottom areas, and thinner in the steeper upland areas. Since the areal extent has never been mapped Countywide, well log records from 813 wells were reviewed to obtain specific geologic information to estimate the saturated thickness and extent of this unit. In the absence of well log data, this unit has very conservatively been unmapped in vast portions of the study area. While well beyond the required time and resources allotted to this study, there are several thousand additional well logs that could be reviewed to fill in data gaps. Statistical analysis considering surface roughness and slope could also be utilized to estimate the areal extent and thickness over the vast region without any site-specific data.

Alluvial River Valleys and Basins (Figure 3-7): Based on the range of specific yield in alluvium of about 1 to 30%, a value of 10% was applied to this unit. The saturated thickness of this unit was estimated based on a review of well logs and previous groundwater studies. In cases where no site-specific information was available for a mapped area, a conservative default value of 10 feet of saturated thickness was assumed. The areal extent of this unit was limited to areas mapped by the CGS at a scale of 1:750,000 and a few additional areas based on well logs reviewed. It is likely that saturated alluvium exists in drainages throughout the study area at a detail beyond the generalized geologic mapping used for this study.

Coastal Marine and Non-marine Granular Formations (Figure 3-6): Based on the range of specific yield in sedimentary formations of about 1 to 30%, a value of 5% was applied to this unit. In the absence of site-specific data to verify saturated thickness of this unit, a saturated thickness of 50 feet was assumed. The areal extent of this unit was limited to areas mapped by the CGS at a scale of 1:750,000 (Figure 3-6).

3.1.2.5 Long-Term Groundwater Availability

In order to estimate long-term groundwater availability over the study area, the recharge equations were first programmed into computer code that was integrated with GIS software. Groundwater demand for each of the seven land use scenarios was input into GIS, and groundwater in storage was also input. The computer code and GIS tools were used to calculate inflow to groundwater storage and outflow from groundwater storage on a month-by-month basis for each of the 86 basins in the study area over a 34-year period. An explanation of the computer code and GIS tools utilized for calculation of long-term groundwater availability is provided in Appendix B. The output was a series of Excel® spreadsheets, which indicate whether groundwater in storage will be reduced to 50% or less at any time as a result of groundwater extraction during the 34-year period. Data output from each basin is included in Appendix C. Basin-by-basin results are shown on Figure 3-8.

Calibration and Sensitivity Analysis: A general calibration of groundwater recharge was made by comparing groundwater in storage through time as calculated for existing conditions with years of historical groundwater levels in the Lee Valley basin. Runoff, which is the least known and most uncertain value of the recharge parameters used in this analysis, was adjusted to provide a relative match of groundwater in storage through time with actual historical groundwater levels. After calibration was completed for the Lee Valley basin, a comparative analysis was performed in two other basins in Pine Valley and a basin in Morena Village. Detailed documentation of calibration is included in Appendix D.

A sensitivity analysis was also performed for the recharge, demand, and storage parameters used in the long-term groundwater availability analysis. By varying each parameter, it was possible to determine how sensitive the results were to changes of each parameter. This provides an understanding as to the overall uncertainty in the long-term groundwater availability analysis. Detailed documentation of the sensitivity analysis is included in Appendix D.

3.2 Large Quantity/Clustered Groundwater Users

Impacts on future well production in a given area may be impacted by the combined drawdown of existing well(s) in a given area. Well interference reduces the well yield in affected wells by reducing the available drawdown in the well. The magnitude of well interference is dependent on the number and spacing of wells, the pumping rate, groundwater recharge, properties of the aquifer, and duration over which the pumping has occurred.

3.2.1 Guideline for Determining Significance

As a screening tool, the following guideline will be used to identify potential impacts to proposed land uses from known areas where existing drawdown may prevent future wells from meeting their proposed land-use objectives:

For land uses proposed at the maximum build-out allowed under the proposed GP Update, groundwater impacts will be considered potentially significant in identified areas of the County which may be currently impacted by the combined drawdown of existing well(s).

3.2.2 Methodology

As was discussed in Section 2.9.1, generally susceptible areas that could be impacted by the combined drawdown of existing well(s) include clustered residences on lots smaller than 4 acres, irrigated agricultural lands, and other known large groundwater users. Such areas have been mapped on Figure 3-9. These areas were then compared to any historical groundwater level data available to identify areas with the potential for localized groundwater problems. Based on historical water levels, Section 2.9.1 identified Ballena Valley, Guatay, Julian Town Center, and Morena Village as having the potential for localized groundwater problems from pumping large amounts of groundwater. For many of the generally susceptible areas shown on Figure 3-9, no data or information was available, so groundwater conditions were reported as unknown.

3.3 Low Well Yield

Well yield and storage infrastructure must be capable of providing the water demand for a given project in groundwater-dependent areas of the County. For proposed residential groundwater discretionary projects on private wells, DPLU requires proposed projects to conduct well testing on selected lots in which well production during the well test must be at least 3 gpm for each well tested. Wells tested that cannot meet this requirement are considered to have a significant impact.

3.3.1 Guideline for Determining Significance

As a screening tool, the following guideline will be used to identify areas where there is a potential for low well yield:

For land uses proposed at the maximum build-out allowed under the proposed GP Update, groundwater impacts will be considered potentially significant in identified areas of the County which have a high frequency of wells with low well yield.

3.3.2 Methodology

Identification of areas with low well yield involved evaluating historical groundwater level information and review of confidential well logs. Section 2.9.2 identified areas as having the potential for low well yield based on historical groundwater level information which included three areas in Lakeside (Old Barona Road, Route 67, and Wildcat Canyon Road) and Ramona Trails Drive in the Ramona area. To further illustrate areas that have a high frequency of wells with low well yield, Figure 3-10 depicts well production rates reported from the confidential well logs reviewed for this study. Any areas that have a series of wells with an indicated production rate of less than 3 gpm were screened as potential susceptible areas for low well yield.

Areas identified are based on historical water level records reviewed from over 300 monitored wells and 813 confidential well logs. This is a limited dataset considering the large size of the overall study area. Also, there are large public tracts of land, Indian Reservations, and open space, in which no data is available.

3.4 Water Quality

For future development dependent on groundwater, it is imperative that the water is potable. If groundwater in an area is not potable, then any discussion of available groundwater resources is moot. Any groundwater that has contaminants that exceed the Federal and State primary MCLs is not potable. Therefore, any project dependent on this contaminated groundwater does not have a viable source of water.

3.4.1 Guidelines for Determining Significance

As a screening tool, the following guideline will be used to identify areas where there is a potential for water quality impacts:

For land uses proposed at the maximum build-out allowed under the proposed GP Update, groundwater impacts may be potentially significant in identified areas of the County indicating constituents exceeding their respective Primary State or Federal MCLs.

3.4.2 Methodology

Sections 2.6 and Section 2.9.3 identified areas with the potential for water quality impacts and the data was compiled on Figure 2-65. To illustrate areas with potential for water quality impacts, Figure 2-65 depicts potential nitrate and naturally-occurring radionuclide problem areas, locations of known LUFTs, and clustered residential parcels smaller than 4-acres to indicate areas of potentially elevated nitrates from clustered septic systems.

3.5 Significance of Impacts Prior to Mitigation

Below is a discussion of potential groundwater impacts prior to mitigation for each of the four guidelines for determining significance. The long-term groundwater availability results provide a first level screening tool to identify potential cumulative impacts to proposed land uses at maximum build-out allowed under the GP Update within each basin evaluated in this study. The other three guidelines are used as additional screening tools to identify localized areas within each basin which may be impacted from existing large quantity/clustered groundwater users, identified areas which contain a high frequency of wells with low well yield, and identified areas indicating water quality constituents exceeding their respective Primary State or Federal MCLs.

3.5.1 50% Reduction in Storage

A summary of long-term groundwater availability results for each of the 86 basins evaluated are provided in Table 3-12 and illustrated on Figure 3-8. Data output from each basin are included in Appendix C. The results presented indicate the minimum groundwater in storage estimated to occur in any given month over the 34-year period for each land use alternative analyzed. If the minimum groundwater in storage is reduced to a level of 50% or less of maximum theoretical storage in any month as a result of groundwater extraction, it is considered a potentially significant impact. Unlike alluvial basins, it should be understood that groundwater impacts within fractured rock basins are typically limited to localized areas near a given pumping well (or wells) and impacts from any given area likely do not extend basin-wide. For this reason, the second guideline identifies large quantity/clustered groundwater users within the study area where localized groundwater impacts are most likely to occur. Future groundwater uses in these areas are particularly susceptible to water supply problems. In the discussion of each potentially impacted basin identified under the GP Update Referral Map alternative, localized problem areas within each basin are identified (Figure 3-9).

3.5.1.1 Existing Conditions

Under existing conditions, the following basins were identified as having groundwater in storage reduced to a level of 50% or less of maximum storage in at least one month during the 34-year period analyzed (minimum calculated groundwater in storage are shown in parenthesis):

1. Ballena Valley (0%): The results indicate that groundwater in storage on average is estimated to be approximately 33% of maximum theoretical storage during the 34-years evaluated and impacts may occur within the basin during all but the above average rainfall years. Localized impacts are possible in the areas under active irrigation. This valley reportedly used up to 800 acre-feet of groundwater per year in the 1980s. DPLU has records indicating water level declines up to 500 feet in a single summer. The existing conditions groundwater demand was estimated at 362 afy, which reflects a significant reduction of agricultural groundwater demand as of the year 1998. Since the groundwater in storage estimated was limited to a saturated thickness of 500 feet, the results indicating a minimum groundwater in storage of 0% are reasonable.

2. Barona (42%): The results indicate that groundwater in storage on average is estimated to be approximately 80% of maximum theoretical storage during the 34-

years evaluated and impacts may occur within the basin during the driest years. Of the estimated existing demand of 645 afy, approximately 557 afy is estimated to be pumped from the Barona Indian Reservation. The amount of groundwater pumped by the Barona Reservation has historically exceeded the sustainable yield of its basin and the tribe has reportedly trucked in water to supplement its depleted groundwater supply. It should be noted that there is no data available to definitively correlate whether the depleted and dry wells in nearby residences along Old Barona Road have been impacted by water demand at the Barona Indian Reservation.

3. Engineer Springs (26%): The results indicate that groundwater in storage on average is estimated to be approximately 71% of maximum theoretical storage during the 34-years evaluated and impacts may occur within the basin during below average rainfall years. The small community of Engineer Springs has several dozen lots smaller than 4-acres located in a relatively small basin. This area would be most susceptible to groundwater problems. The results indicate that groundwater in storage under existing conditions may drop below 50% during extended dry periods. Initial static water levels recorded on five confidential well logs in this basin ranged from 45 to 260 feet bgs at the time the wells were drilled. There are no records of long-term groundwater levels in Engineer Springs to provide a better understanding of long-term groundwater conditions.

4. Guatay (0%): The results indicate that groundwater in storage on average is estimated to be approximately 42% of maximum theoretical storage during the 34 years evaluated and impacts may occur within the basin during below average rainfall years. Localized rapid declines in the water table are possible in Guatay due to its 81 residences and other uses pumping its groundwater from a relatively small area at the top of a watershed divide underlain by fractured rock.

5. Las Lomas Muertas (0%): The results indicate that groundwater in storage on average is estimated to be approximately 31% of maximum theoretical storage during the 34-years evaluated and impacts may occur within the basin during average and below average rainfall years. However, approximately 448 afy of the 467 afy of existing demand is from agricultural irrigation within a specific area in the basin. Only 19 afy of groundwater is being used in other portions of the basin outside of the agricultural area. Impacts are considered to be less than significant for the majority of the basin outside of the agricultural area.

6. Lee (36%): The results indicate that groundwater in storage on average is estimated to be approximately 80% of maximum theoretical storage during the 34-years evaluated and impacts may occur within the basin during the driest years. The community of Lee Valley has over 100 single-family residences along with an RV park, a Bible Camp, and approximately 12-acres of actively irrigated agricultural land in an isolated

area in the southwest portion of the basin. This equates to an estimated existing groundwater demand of approximately 102 afy. The agricultural land accounts for approximately 25% of the overall existing demand. Since it is located in an isolated portion of the basin, impacts from agricultural demand are not likely impacting the more developed portions of Lee Valley. Without the agricultural demand included in the existing water demand, the basin was calculated to have a minimum of 54% in storage in the worst month. This provides a more reasonable depiction of actual groundwater conditions for the majority of Lee Valley as noted in Section 2.7.3. From 1983 to 1988, groundwater demand was estimated to average approximately 42 afy from about 50 single-family residences and other uses (Kaehler and Hsieh, 1991). Therefore, there has been a significant increase in groundwater pumping since the 1980s. The existing conditions demand was applied to each year from July 1971 to June 2005, and since the demand is more than double of the 1980s demand, impacts are magnified from what is depicted in the DPLU water level monitoring database for Lee Valley.

7. Morena South (37%): The results indicate that groundwater in storage on average is estimated to be approximately 78% of maximum theoretical storage during the 34-years evaluated and impacts may occur within the basin during the driest years. Two water companies pump groundwater from this area to over 300 clustered residences with an average parcel size of just over 1 acre. Rapid declines of the water table have been recorded in two wells. Within one well, water level declines of up to 200 feet occurred in a two-year period. It should be noted that rapid groundwater declines were not noted in three other wells monitored within Morena Village, which may indicate that rapid declines that have occurred are localized.

8. San Felipe South and Spencer (0%): The results indicate that groundwater in storage on average is estimated to be approximately 28% (San Felipe South) and 43% (Spencer) of maximum theoretical storage during the 34-years evaluated and impacts may occur within the basin during all but the above-average rainfall years. The Julian Community Services District and Majestic Pines Community Services District pump their groundwater from these basins for nearly 800 combined service connections to residential and commercial customers. In addition, there is an estimated 493 afy of irrigated agricultural demand within the Spencer basin based on the 1998 conditions. Section 2.9.1 identified the Julian town center as a potential groundwater problem area based on historical groundwater levels. The town center currently receives its water from the basins in town as well as from wells located approximately 3 miles north within the Witch Creek basin. The groundwater results do not take this into account and places all the water demand within the San Felipe and Spencer basins. Impacts may be less than significant for rural portions of the basins outside of the clustered development area of the Julian Town Center, agricultural areas, and clustered residential areas.

3.5.1.2 GP Update Referral Map

Under the GP Update Referral Map alternative, Lyon and Pine South basins were the only basins identified as potentially impacted that was not identified as a potential cumulatively significant impact under existing conditions. The Viejas basin was also identified as potentially significant under the GP Update Cumulative Impacts alternative. This is due to a 445-acre area which is identified as general commercial compared to Rural Lands-40 (one residential dwelling unit per 40-acres) on the Referral Map alternative.

Under maximum build-out of the GP Update Referral Map alternative, the following basins were identified as having groundwater in storage reduced to a level of 50% or less of maximum storage in at least one month during the 34-year period analyzed (minimum calculated groundwater in storage are shown in parenthesis):

1. Ballena Valley (0%): A maximum of approximately 34 additional residential units are possible at build-out, which would use an estimated additional 17 afy of groundwater.

2. Barona (38%): A maximum of approximately 78 additional residential units are possible at build-out, which would use an estimated additional 39 afy of groundwater.

3. Engineer Springs (0%): A maximum of approximately 24 additional residential units are possible at build-out, which would use an estimated additional 12 afy of groundwater.

4. Guatay (0%): A maximum of approximately 18 additional residential units are possible at build-out along with commercial uses, which would use an estimated additional 13 afy of groundwater.

5. Las Lomas Muertas (0%): A maximum of approximately 344 additional residential units are possible at build-out, which would use an estimated additional 172 afy of groundwater. The majority of additional demand is from an approximate 2-square mile area of the basin with a designation of Semi-Rural Residential (SR-4), which allows for one dwelling unit per 4, 8, or 16 acres. Localized impacts are possible adjacent and near the actively irrigated agricultural land. Impacts are also possible if the SR-4 area is developed at a density of 1 dwelling unit per 4-acres.

6. Lee (16%): A maximum of approximately 54 additional residential units are possible at build-out, which would use an estimated additional 27 afy of groundwater.

7. Lyon (50%): A maximum of approximately 66 additional residential units are possible at build-out, which would use an estimated additional 33 afy of groundwater.

Groundwater in storage is reduced to 50% in the worst month calculated when all 66 additional residential units are included as demand. With 65 additional residential units, groundwater in storage is reduced to 51% in the worst month calculated, which is considered less than significant. Therefore, this basin is on the borderline of a potentially significant impact at maximum build-out.

8. Morena South (0%): A maximum of approximately 136 additional residential units are possible at build-out along with commercial uses, which would use an estimated additional 72 afy of groundwater.

9. Pine South (37%): A maximum of approximately 224 additional residential units are possible at build-out, which would use an estimated additional 112 afy of groundwater. For detailed analysis of groundwater in Pine Valley see Appendix E.

10. San Felipe South and Spencer (0%): A maximum of approximately 214 additional residential units are possible at build-out in the San Felipe South basin, which would use an estimated additional 110 afy of groundwater, along with commercial uses. A maximum of approximately 120 additional residential units are possible at build-out in the Spencer basin along with commercial uses, which would use an estimated additional 67 afy of groundwater.

3.5.1.3 Current General Plan

A total of 24 basins were identified as having a potentially significant impact to groundwater resources at maximum build-out of the current GP. When compared to the GP Update Referral Map alternative, this results in 13 additional basins with potentially significant impacts to groundwater resources. Below is a list of the 13 additional basins where groundwater in storage is reduced to a level of 50% or less of maximum storage in at least one month during the 34-year period analyzed under maximum build-out of the current GP. In parenthesis, the first number indicates minimum groundwater in storage calculated under the GP Update Referral Map alternative. The second number represents the minimum groundwater in storage calculated under the current GP:

1. Bee Canyon (66%, 2%)
2. Collins (91%, 47%)
3. Escondido (74%, 5%)
4. Hill (83%, 7%)
5. Hipass (89%, 29%)
6. Inaja (62%, 48%)
7. Jacumba Valley (74%, 1%)
8. Jamacha (60%, 0%)
9. Lower Culp (71%, 4%)

10. Poway (55%, 17%)
11. Reed (75%, 0%)
12. San Felipe North (84%, 3%)
13. Tecate (80%, 0%)

3.5.2 Large Quantity/Clustered Groundwater Users

Generally susceptible areas that could be impacted by the resultant drawdown of existing well(s) include clustered residences on lots smaller than 4 acres, irrigated agricultural lands, and other known large groundwater users. Such areas have been mapped on Figure 3-9. As shown in red on Figure 3-9 and discussed in Section 2.9.1, the following areas have been identified as having the potential for localized groundwater problems (especially at the height of extended drought periods) from pumping large amounts of groundwater. With the exception of Guatay, all of these areas lie within basins that were considered to have a potential cumulatively significant impact to groundwater resources under existing conditions (as discussed in Section 3.5.2).

1. Ballena Valley
2. Guatay
3. Julian Town Center
4. Morena Village

Based on historical water levels from wells monitored by DPLU as discussed in Section 2.6, several clustered residential areas (shown in blue on Figure 3-9) do not indicate localized groundwater problems. It should be noted that areas shown in blue within the Jamul/Dulzura Planning Group are each susceptible to localized rapid declines in the water table. However, there have not been reported cases of clusters of wells not being able to meet their land use objectives in these areas. Furthermore, water table declines noted during dryer years recover during the well-above-average rainfall years. The rest of the large quantity/clustered groundwater users areas were mapped as “undetermined” (shown in gray on Figure 3-9) since there were no historical data readily available to indicate the local groundwater conditions.

3.5.3 Low Well Yield

As was discussed in Section 2.6.1, wells in a fractured rock aquifer typically yield relatively low volumes of water. While most wells drilled in the County have been able to meet the needs of a typical single-family residence, approximately 11% of the 750 well logs reviewed within fractured rock aquifer areas had a reported well production rate of less than 3 gpm. As illustrated on Figure 3-10, areal distribution of well yields often show no discernable pattern in fractured rock aquifers, and wells located near one another often have a large difference in yield. However, certain areas do have a series of wells with low production rates. Any area that has a series of wells with an indicated production rate of less than 3 gpm was screened in red on Figure 3-10 as a potentially susceptible area for low well yield. Portions of Lakeside, Ramona, and Morena Village have been identified as areas which have a high frequency of wells with low well yield. Also, all steep slope areas depicted as "slightly fractured crystalline rock" on Figure 3-6 are also considered generally susceptible to having low yielding wells. Each area is discussed below:

1. Lakeside Area (Old Barona Road, Route 67, and Wildcat Canyon Road): As discussed in Section 2.7.3 and 2.9.2, some wells monitored along Old Barona Road, Route 67, and Wildcat Canyon Road have extreme variations of water levels indicative of low well yield. Of 31 well logs reviewed along Old Barona Road and the Wildcat Canyon Road area, 14 indicated well yields of 3 gpm or less. Of 12 well logs reviewed in the Route 67 area, 8 logs indicate a well yield of 3 gpm or less. Three were "dry" wells. One well was drilled to a depth of 840 feet with no water. The well logs indicate that these localized areas are generally characterized by low well production. Some single-family residences in these areas will likely require periodic trucking of imported water (especially during extended droughts) to support their residential water uses.

2. Morena Village: Of 30 wells reviewed in Morena Village, six wells reported well yields of 3 gpm or less. One was a "dry" well. The overall median well yield of the 30 wells was approximately 9 gpm, with production rates widely ranging from 0 gpm in one well up to 60 gpm. Overall, 20% of the wells reviewed in Morena Village may have difficulty meeting the needs of a typical single-family residence.

3. Steep Slope Areas: While low well yields are possible anywhere within fractured rock areas, steep slope areas above the valley floor are particularly prone to having lower well yield. As discussed in Section 2.7.3, Ramona Trails Drive in Ramona is a good example of a steep slope area with low yielding wells. All steep slope areas depicted as "slightly fractured crystalline rock" on Figure 3-6 can be considered as particularly susceptible to having low yielding wells.

3.5.4 Water Quality

The following areas have been identified as having the potential for water quality impacts which are defined as having constituents at elevated concentrations above their respective Primary Federal or State MCL, which can limit the availability of potable groundwater (see Figure 2-65):

Nitrate: Potential nitrate problem areas include portions of the following communities:

1. Alpine along Route 8
2. Cameron Corners in Campo
3. Crest
4. Escondido
5. Jamul
6. Morena Village
7. Rainbow

8. Ramona
9. San Marcos
10. Valley Center

Other regional areas of potential concern within the study area are clustered residences located on parcels less than 4 acres also depicted on Figure 2-65. If the clustered residences are on individual septic systems, the smaller parcel sizes could result in localized nitrate impacts. Also, areas of historic intensive agricultural activities could also have localized nitrate impacts.

Naturally-Occurring Radionuclides: Potential radionuclide problem areas include portions of the following communities:

1. Campo/Lake Morena
2. Cuyamaca/Julian
3. Guatay
4. Jamul/Dulzura
5. Lake Wohlford
6. Potrero
7. Ramona (east)
8. Route 79 (Dodge Valley) Near Riverside County Border
9. Warner Springs

Leaking Underground Fuel Tanks: Areas of potential localized contamination of groundwater from leaking underground fuel tanks include sites in the Cameron Corners area of Campo, Julian, Pine Valley, and several other areas. In a few cases, water supply wells were inactivated due to the possibility of inducing flow of the contaminated groundwater from the leaking underground storage tanks.

Other Constituents of Concern: The other two large-scale constituents of concern in the study area include TDS and coliform bacteria. Neither of these constituents is thought to occur over large areas of the study area at levels exceeding their respective MCLs. However, localized impacts from these constituents are possible.

3.6 Potential Impacts to Other Jurisdictions

An inventory of GP Update Referral Map land uses proposed in the groundwater dependent portion of the County adjacent to neighboring jurisdictions was compiled (Table 3-13 and Table 3-14). The land uses proposed provide a screening tool to evaluate potential groundwater impacts to neighboring jurisdictions.

3.6.1 Riverside County

Proposed land uses in the groundwater dependent portion of the County adjacent to Riverside County include mostly national forest, state parks, and open space with some areas designated rural lands with a density of one dwelling unit per 40 acres. Due to the rural nature of land uses proposed adjacent to Riverside County, potential groundwater impacts to Riverside County as a result of the project are considered to be less than significant.

3.6.2 Imperial County

Proposed land uses adjacent to Imperial County are mostly state park designated with undeveloped land near the Imperial County line. There is an area east of Ocotillo Wells with designated rural lands which allow for one dwelling unit per 40 acres and 80 acres. Also, there is an area along Highway 8 in the southeast corner of the County with designated rural lands which allow for one dwelling unit per 80 acres. Due to the rural nature of land uses proposed adjacent to Imperial County, potential groundwater impacts to Imperial County as a result of the project are considered to be less than significant.

3.6.3 Mexico

With the exception of the communities of Tecate and Jacumba, proposed land uses in the groundwater dependent portion of the County adjacent to Mexico consist of open space, and rural lands which allow for one dwelling unit per 40 acres and 80 acres. Due to the rural nature of land uses proposed adjacent to Mexico in these areas, potential groundwater impacts to Mexico as a result of the project are considered to be less than significant.

The port-of-entry community of Tecate includes proposed designations of medium impact industrial, general and neighborhood commercial and rural lands which allow for one dwelling unit per 40-acres. The 2002 population of Tecate was 143, and total population at build-out of the proposed GP is anticipated to be approximately 400 people. This is dwarfed by the population of the adjacent city of Tecate, Mexico, which is estimated by 2020 to have a population of approximately 231,900 people (Parsons Transportation Group, 2000). Due to the low growth potential relative to its neighboring community of Tecate, Mexico, potential groundwater impacts to Tecate, Mexico as a result of the GP Update are considered to be less than significant.

The community of Jacumba includes proposed designations of semi-rural residential which would allow for 1 dwelling unit per 1, 2, or 4 acres, neighborhood commercial, and public/semi-public facilities. There is also a specific plan area which could allow for up to 2,125 residential dwelling units as well as commercial uses. The 2002 population of Jacumba was 671, and total population at build-out of the proposed GP is anticipated to be approximately 4,550 people. There is very little development within Mexico adjacent to Jacumba with the exception of the small community of Jacume (population of approximately 335 people), located approximately 1.2 miles south of the United States.

The community of Jacume is located in the Flat Creek watershed, which flows from south to north into the Jacumba area in California. Since the Flat Creek watershed flows from south to north into the United States, the tributary watershed of Jacume is entirely within Mexico. Additionally, the Boundary Creek and Carrizo Gorge watersheds, located mostly or completely within the United States also flow into the Jacumba area. Due to the distance between Jacume and Jacumba, and Jacume's tributary watershed lying entirely within Mexico, potential groundwater impacts to Jacume, Mexico as a result of the project are considered to be less than significant.

3.6.4 State and Federal Lands

As shown on Figure 2-6, approximately 60% of the study area is State and Federal lands public or military land) which potentially provide a significant amount of groundwater recharge to adjacent privately owned groundwater dependent areas. The vast majority of the lands in this category are undeveloped. In cases where development has occurred, such as local parks or campgrounds, there is potential for impacts to groundwater resources from offsite development. However, the majority of land adjacent to State and Federal Lands are designated open space, or rural lands which allow for one dwelling unit per 40 acres and 80 acres. Therefore, groundwater impacts to State and Federal lands as a result of the project are considered to be less than significant.

3.6.5 Indian Reservations

An inventory of GP Update Referral Map land uses proposed in the groundwater dependent portion of the County adjacent to each Indian Reservation is provided in Table 3-14. As discussed in Section 3.1.2.3, this study has not included any groundwater recharge or storage from Indian Reservations in the basin-by-basin analysis as a potential benefit for future groundwater users in the unincorporated portion of the County.

Campo Indian Reservation: The community of Live Oak Springs, which is south of Campo Indian Reservation, is designated as semi-rural, which allows one dwelling unit per 4, 8, and 16 acres. The land within this designation appears to be already built out with no future subdivision possible. The rest of the land surrounding Campo Reservation is designated semi-rural to rural, which allows one dwelling unit per 10, 20, 40, or 80 acres. Due to the semi-rural to rural land use designations, groundwater impacts to the Campo Indian Reservation as a result of the project are considered to be less than significant.

Los Coyotes Indian Reservation: The community of Warner Springs, which is west of Los Coyotes Indian Reservation, is part of a specific plan area currently including an 18-hole golf course, a 250-room resort, an airport, equestrian facilities, and restaurants. There is additional development planned including approximately 685 residences. There is land adjacent to the Reservation that is designated as village residential, which allows for 2.9 dwelling units per acre. While there is relatively dense development within Warner Springs, the County has not received any allegations of impacts to well users within the Los Coyotes Indian Reservation. Based on a review of aerial photography, the nearest developed areas on the Reservation are located over one mile from Warner Springs in a different watershed. Due to the distance between developed Reservation areas and Warner Springs and lying within different watersheds, the potential groundwater impacts to the Los Coyotes Reservation as a result of the project are considered to be less than significant.

Other Indian Reservations: Six of the 15 Indian Reservations in the study area (Capitan Grande, Cuyapaipe, Inaja-Cosmit, Manzanita, Santa Ysabel, and Viejas) are surrounded by lands with the densest designation as rural lands which allow for one dwelling unit per 40 acres. Seven Indian Reservations (Barona, La Jolla, La Posta, Mesa Grande, Pala, Pauma, and Rincon) are surrounded by lands with the densest designations as semi-rural to rural lands which allow for one dwelling unit per 10 or 20 acres. In some cases, there are denser designations proposed within adjacent off-Reservation lands within the CWA. Lands within the CWA will likely receive its water from a CWA member agency. Due to the rural land use designations adjacent to these 13 Indian Reservations, groundwater impacts as a result of the project are considered to be less than significant.

3.7 Mitigation Measures and Alternatives

Below is a discussion of potential mitigation measures and alternatives which could reduce or minimize potentially significant groundwater impacts which were identified in this groundwater study. Since most mitigation measures available for groundwater quantity problems are infeasible for most projects, the Environmentally Superior Alternative is recommended for a number of areas in the study area.

3.7.1 50% Reduction in Storage and Large Quantity/Clustered Groundwater Users

For areas identified as potentially significant under these guidelines, mitigation would be limited to finding a water source elsewhere to import into the impacted area. These mitigation measures are also options for cases of low well yield or poor water quality. Three options are presented below with the feasibility indicated in paranthesis:

1. Importing Groundwater from Another Basin (Infeasible for Most Projects): It may be possible to obtain a viable water supply for a given project from another groundwater basin which is not impacted and importing the water to the project site. An example project would be the Julian Community Services District, in which the Julian town center receives its water both from local wells in the town as well as from wells located approximately 3 miles to the north in a different basin. The water is pumped and then piped into town. Piping in groundwater from an offsite source can be a complex and costly process which could involve water rights issues, obtaining the proper permits to encroach on public roadways or other private properties to convey the water, and possibly setting up a water district/water company. This mitigation measure may prove infeasible for most projects.

2. Importing Water from CWA (Feasible only for projects within or adjacent to CWA line): Several areas have been identified east of the CWA line in which wells may not have adequate production to supply the needs of a typical single-family residence. In such areas (with the exception of lands directly adjacent to the CWA line where annexation may be possible), importation of water from the CWA is not a feasible mitigation

measure. This is due to lack of infrastructure, the limited availability of water within the desert southwest, the cost of providing these services, and the political approval to extend the CWA boundaries. In areas of the County where imported water from a CWA member agency is available, the primary mitigation measure would be to use imported water.

3. Trucking in Water (Infeasible): Existing residents with inadequate or dry wells in the groundwater dependent portions of the County have resorted to trucking water to their properties from local water districts and other sources such as an offsite well. The County does not consider trucked water as a guaranteed long-term source of water since a water district can rescind or preclude the selling of trucked water in times of drought and limited water supplies. Therefore, for future discretionary permits which rely on a potable water source, this would not be a feasible mitigation measure.

4. Building Moratorium (Likely infeasible): A moratorium on building permits and development applications by the County could be proposed. This would effectively result in no increase in the amount of groundwater extracted from a groundwater impacted basin or localized area. There are obvious socioeconomic impacts that would occur as the result of a building moratorium. A moratorium should only be considered if there is conclusive scientific evidence that indicates an imminent groundwater supply shortage already exists in the given impacted basin or localized area.

Since the options presented are likely not feasible for most projects, the GP Update Environmentally Superior Alternative could be selected to minimize future development potential in areas identified as potentially significant. It is recommended that the land use densities within the Environmentally Superior Alternative be revised (as necessary) within these areas to allow only large rural lots.

3.7.2 Low Well Yield

For projects with inadequate well yield, three additional potential mitigation measures have been identified in addition to importing water to the project site:

1. County or State Regulated Water System (Feasible for some projects): If a particular project is located near an existing water district or water company, it may be possible for the project to annex to the existing district/company. If a particular tentative parcel map or tentative map has lots in which an inadequate water supply is identified and it is infeasible to receive groundwater resources from a local water district/company, it may be possible for the project to propose formation of either a DEH or DDWEM-regulated water system. This would allow for (a) well(s) to be placed in areas of the project which could produce an adequate supply of water for all lots (including lots with potentially inadequate well production). DEH-regulated water systems for public water supply include state small water systems (5 to 14 service connections) and community water systems (15 to 199 service connections. Water systems that have 200 or more service connections are regulated by the DDWEM.

2. Drill and Test Additional Well(s) (Feasible for Some Projects): Additional wells and testing can be conducted in an attempt to find a well with adequate well yield. Drilling and testing additional wells is expensive and time-consuming, and there are no guarantees that the new well(s) will be able to produce an adequate quantity of water to meet the project's land use objectives.

3. Well Sharing Agreement (Infeasible): For purposes of obtaining an adequate potable supply of water, existing property owners may share well water through a well sharing agreement. Such an agreement would be subject to DEH well sharing guidelines (DEH, 2008). If the parcels exceed 4 service connections, then the use of the well would be considered a public water system and Title 22 requirements would apply. This would include the well's construction to meet public water supply well standards, and approval to operate as a public drinking water system through DEH. However, it is DEH policy that a shared well agreement would not apply nor be considered for proposed tentative parcel maps or tentative maps.

Since future projects placed in areas identified with the potential for low well yield would likely result in wells unable to meet their land use objectives, the GP Update Environmentally Superior Alternative could be selected to minimize future development potential. It is recommended that the land use densities within the Environmentally Superior Alternative be revised (as necessary) within these areas to allow only large rural lots.

3.7.3 Water Quality

For projects with poor water quality, two mitigation measures have been identified in addition to importing water to the project site:

1. County or State Regulated Water System (Feasible for Some Projects): For projects where any constituent exceeds its primary MCL and a discretionary permit requires a potable groundwater supply, mitigation could be implemented by providing a water treatment system that reduces impacts to below the MCL. To ensure proper water treatment in accordance with the California Safe Drinking Water Act, the County requires discretionary permits which require treatment to form or merge with a water system regulated by DEH (up to 200 service connections) or the State (greater than 200 service connections). This ensures proper treatment of constituents and does not place the responsibility of treatment on private individuals. While the County will allow point-of-use or point-of-entry treatment for contaminants in wells on existing legal lots, it will not approve discretionary permits for private wells dependent on water treatment. The County would also not consider well sharing agreements as an option for treatment for discretionary permits as this would still place the responsibility of treatment on private individuals. For smaller projects, the ongoing costs of a DEH regulated State small water system (5 to 14 service connections) may prove to be economically infeasible. For

discretionary permits with less than 5 service connections proposed, there is no feasible state water system category available. In some cases, such as aquifers contaminated with gasoline from a leaking underground fuel tank, the County may not approve projects reliant on groundwater in such areas. Therefore, there may be specific cases where water quality impacts prove to be significant and unmitigable.

2. Drill and Test Additional Well(s) (Feasible for Some Projects): Additional wells and testing can be conducted in an attempt to find onsite potable water. Drilling and testing additional wells is expensive and time-consuming, and there are no guarantees that the new well(s) will have a potable water supply.

4 SUMMARY OF GROUNDWATER IMPACTS AND MITIGATION

The table below provides a summary of basins or specific areas which could have a potentially significant groundwater quantity or quality impacts under build-out of the GP Update. Feasible mitigation or alternatives are identified below to reduce impacts to groundwater resources. Implementation of the GP Update will result in significant and unmitigable impacts to groundwater resources, especially in areas that already have existing groundwater supply or water quality problems.

50% Reduction in Storage	Feasible Mitigation Measures/Alternatives
Ballena Basin Barona Basin Engineer Springs Basin Guatay Basin Lee Basin Las Lomas Muertas Basin Lyon Basin Morena South Basin (Morena Village) *Pine South San Felipe South Basin Spencer Basin	Environmentally Superior Alternative
Large Quantity/ Clustered Groundwater Users	
Community of Guatay Julian Town Center	Environmentally Superior Alternative
Low Well Yield	
Lakeside Area (Old Barona Road, Route 67, and Wildcat Canyon Road) Morena Village	1. County or State-Regulated Water System 2. Drill and Test Additional Well(s) 3. Environmentally Superior Alternative
Water Quality	
Nitrate: 1. Alpine along Route 8 2. Cameron Corners in Campo 3. Crest 4. Escondido 5. Jamul 6. Morena Village 7. Rainbow 8. Ramona 9. San Marcos 10. Valley Center	1. County or State-Regulated Water System 2. Drill and Test Additional Well(s)

Water Quality (Continued)	Feasible Mitigation Measures/Alternatives
Radionuclides: 1. Campo/Lake Morena 2. Cuyamaca/Julian 3. Guatay 4. Jamul/Dulzura 5. Lake Wohlford 6. Potrero 7. Ramona (east) 8. Route 79 (Dodge Valley) Near Riverside County Border 9. Warner Springs	1. County or State-Regulated Water System 2. Drill and Test Additional Well(s)

*The *County of San Diego DPLU Pine Valley Cumulative Groundwater Study* provided in Appendix E of this document provides additional specific mitigation measures, alternatives, and recommendations in response to the predicted significant and unavoidable impacts to groundwater resources that serve the Pine South basin.

5 RECOMMENDATIONS AND LIMITATIONS

5.1 Recommendations

This study provides the first County-wide evaluation of groundwater resources within the groundwater-dependent portion of the County and provides valuable information that has never before been available in one document. Below are a number of suggested recommendations to implement changes to current regulations, develop screening tools for evaluating future discretionary projects, and to maintain and expand knowledge of groundwater resources within San Diego County:

1. Potential Groundwater Ordinance Amendment: Section 67.721 of the County Groundwater Ordinance contains specific regulations for how to evaluate discretionary projects that are located within groundwater impacted basins as identified on the County Groundwater Limitations Map on file with the Clerk of the County Board of Supervisors. The map has never contained any groundwater impacted basins. This study identifies several potentially impacted basins as well as areas susceptible to low well yield. It is recommended that these areas be potentially considered for additional detailed study and possible inclusion on the County Groundwater Limitations Map as groundwater impacted basins. Also, the regulations within Section 67.721 should be revised to take into consideration current methodologies for identifying a long-term adequate groundwater supply for projects.

2. Develop GIS Screening Tools: The information obtained from this study should be integrated into the DPLU GIS Mapping Application to screen future discretionary permits. Specifically, Figure 2-65 and Figures 3-8 through 3-10 should be included as layers to aid in scoping future groundwater investigations. As additional water quality data, well log information, and historical water levels are collected, the maps should periodically be updated and revised with the new information.

3. DPLU Groundwater Monitoring Network: The DPLU groundwater monitoring network has proven to be invaluable to understanding long-term groundwater conditions in the County. It is recommended that the results from this study be used to identify potential new areas in which to seek wells to add to the network.

4. DPLU Groundwater Database: Over the past several years, DPLU has worked on developing a groundwater database as a repository of historical water level data, precipitation data, evaporation data, information from confidential well logs, and information from past groundwater investigations (aquifer tests, water quality data, water level data). It is recommended that this database be integrated with GIS to provide spatial representation of the information amassed. This information would then be readily available to provide important historical groundwater information for future groundwater discretionary projects.

5. Other Groundwater Recharge Methods: The County has relied upon the soil moisture balance methodology to estimate groundwater recharge for groundwater investigations over the past 25 years. An evaluation was conducted for this study on other available methodologies to calculate groundwater recharge. Most require field data collection, time and/or resources that make the methodologies infeasible even on a single basin. The chloride mass balance was a promising alternative recharge method to the soil moisture balance, and it is particularly applicable to undeveloped semi-arid to arid areas such as San Diego County. The methodology does require analysis of chloride from groundwater samples collected from a series of wells. However, it is relatively inexpensive compared to other alternate recharge methodologies. It is recommended that as a comparative tool (as time and resources permit), the chloride mass balance methodology be applied to undeveloped basins as a comparative tool to the soil moisture balance methodology.

5.2 Limitations

This groundwater study provides a screening level analysis of existing groundwater conditions and potential groundwater impacts under maximum build-out of the GP Update for the groundwater dependent portion of the County outside of desert basins. Due to the sheer size and complexity of the 1,885 square mile study area, the long-term groundwater availability results presented (being based on a limited amount of readily available information) are subject to substantial error and uncertainty. Therefore, a conservative approach was mandatory to bias any potential errors towards overestimation of potential impacts. For the large quantity/clustered groundwater users, low well yield, and water quality guidelines, there was only a limited number of data in which to identify potential impacts. Therefore, it is inevitable that areas of the County were unidentified as having potential groundwater impacts. It should be clear that site-specific groundwater investigations are necessary for future groundwater-dependent discretionary permits to provide specific details that cannot be provided at the scale in which this study was conducted. It is also possible that site-specific information may provide information that could be contrary to the results of this study.

Below is a discussion of some of the main limitations of estimating long-term groundwater availability at a Countywide scale.

50% Reduction in Storage

Artificial Constraints: As shown on Figure 3-8, basins on the western edge of the study area were artificially constrained at the CWA line, and on the eastern edge at the boundary of the desert basins. In some cases, the basins were cut into two or more pieces. The long-term groundwater availability results in these basins may have less groundwater recharge and storage calculated than is naturally occurring since the results are based on odd shaped areas. In addition, some of these basins may be receiving substantial septic or irrigation return flows from imported water within the adjacent CWA area.

In recognition of tribal water rights to groundwater beneath their lands, some of the basins were artificially constrained to not include any groundwater recharge, storage, or demand from Indian Reservations (with the exception of Barona Reservation). As such, long-term groundwater availability results in these basins are conservatively constrained so that future development cannot take advantage of groundwater resources on tribal lands.

The Pala and Pauma basins are particularly troublesome as each is artificially constrained by both the CWA and Indian Reservations. Within the adjacent CWA area there are many large agricultural users which are not accounted for. Only 35% of the Pauma basin and 30% of the Pala basin was actually within the study boundaries. Each basin was cut into multiple non-contiguous pieces. Based on these limitations, the results in these areas can not be relied upon for a screening level assessment of either basin.

Basin Boundaries: The study was conducted in 86 hydrologic basins to provide a generalized assessment of groundwater resources within the study area. To more accurately reflect long-term groundwater availability would require many of the larger basins to be sub-divided into smaller basins. This would likely result in hundreds of individual sub-basins, which is well beyond the time and resources allocated to this study. Therefore, site-specific groundwater investigations are necessary for future groundwater-dependent discretionary permits in which the specific project's tributary basin would be analyzed. However, this study did include subdivision of basins to aid in the calibration process (Morena Village, Pine Valley) or in which there was data that indicated the potential for localized groundwater problems (Guatay and Julian).

Groundwater Demand: Since very few groundwater users in the groundwater-dependent portion of the County keep records of overall well production, the vast majority of groundwater demand estimated in this study was based on placing various land use types into groundwater demand categories. This provides a generalized estimate of demand, but is subject to substantial error. One demand category which was not quantified due to lack of readily available data was groundwater exportation activities such as those taking place on Palomar Mountain. Additionally, it is impossible at this scale to catch all of the small details of local groundwater pumping which is occurring, which is only possible through site-specific groundwater investigations.

Groundwater in Storage: Groundwater in storage within fractured rock aquifers can vary widely over several orders of magnitude. Due to this wide variability, the estimates made in this report are subject to substantial error. Saturated residuum, which provides a substantial amount of additional groundwater in storage to fractured rock aquifer areas, was very conservatively unmapped in vast portions of the study area where well log data was not available. In addition, the areal extent of saturated alluvium was limited to areas mapped by the CGS at a scale of 1:750,000 and a few additional areas based on well logs reviewed. It is likely that saturated alluvium exists in drainages throughout the study area at a detail beyond generalized geologic mapping used for this study.

Runoff: The water balance conducted does not explicitly quantity (1) groundwater discharge between various basins (it assumes each basin is a closed system where inflows = outflows), (2) groundwater evapotranspiration (GWET) from phreatophytes, (3) potential surface water base flow supported by groundwater, or (4) the potential interception/enhanced recharge of surface water flows due to changes in groundwater levels. However, the calibrated results for the long-term groundwater availability analysis resulted in substantial overestimation of surface water runoff, which provides additional water as outflow for parameters within the water balance that are not explicitly quantified. Since data does not exist in which to more accurately quantify these parameters, runoff calculated for each basin is subject to substantial uncertainty.

6 REFERENCES

Barnett T., Malone R., Pennell W., Stammer D., Semtner B., Washington W. The Effects of Climate Change on Water Resources in the West: Introduction and Overview. Climatic Change 62: 1-11, 2004.

California Department of Water Resources (DWR).

California Water Plan Update. Sacramento: Dept. of Water Resources State of California, 1998.

Land Use Survey of San Diego County, 1998.

CIMIS Reference Evapotranspiration, California Department of Water Resources, 1999.

Water Facts, No. 8, August 2000.

Bulletin 118 (Public Review Draft), April 2003.

CIMIS ET Overview, 2005. **http://www.cimis.water.ca.gov/cimis/infoEtoOverview.jsp**

Progress on Incorporating Climate Change into Planning and Management of California's Water Resources (Technical Memorandum Report), July 2006.

California Geological Survey (CGS), California Geologic Data Map No. 2, 1:750,000.

California Public Resources Code
California Environmental Quality Act (PRC §21000-21178).

Civiltec Engineering, Inc. Report on the Need for Emergency Water Supply. Prepared for the Barona Tribal Water Authority. May 28, 2002.

County of San Diego

Department of Environmental Health (DEH). Inventory of Open and Closed Leaking Underground Fuel Tanks in San Diego County. June 21, 2008.

DEH. Confidential Well Log Data.

DEH. Water Well Sharing Guidelines, Land Use and Water Quality Division, April 23, 2008.

Department of Planning and Land Use (DPLU), Historical Groundwater Monitoring Database, 1982-2008.

DPLU, Groundwater Limitations Map (on file with the Clerk of the Board of Supervisors as Document No. 195172), Adopted April 2004.

DPLU, Groundwater Ordinance #9826

DPLU, Guidelines for Determining Significance and Report Format and Content Requirements, Groundwater March 19, 2007

DPLU, Preliminary Identification of Four Areas Considered for Designation as Groundwater Impacted Basins, Groundwater Ordinance #7994 (N.S.), September 25, 1992.

Dettinger, M., Cayan D, Meyer, M, Jeton A.. Simulated Hydrologic Response to Climate Variations and Change in the Merced, Carson, and American River Basins, Sierra Nevada, California, 1900-2099. Climatic Change 62: 283-317, 2004.

Dettinger, M., 2005. From Climate Change Spaghetti to Climate Change Distributions for 21st Century California. San Francisco Estuary and Watershed Science. Vol. 3, Issue 1, March 2005.,

Dettinger, M. and Earman, S., 2007. Western Ground Water and Climate Change – Pivotal to Supply Sustainability or Vulnerable in its Own Right? NGWA Groundwater News and Views, Volume 4, No. 1, June 2007.

Domenico, P. A. Concepts and Models in Groundwater Hydrology, McGraw-Hill, New York, 1972.

Environmental Protection Agency (EPA), Onsite Wastewater Treatment Systems Manual, February 2002, pages 3-7 to 3-9.

Freeze, A. and Cherry, J.A. Groundwater, Prentice-Hall, Inc., New Jersey. 1979.

Hanson, R.T., Martin P., Koczot, K.M., Simulation of Ground-Water/Surface-Water Flow in the Santa Clara–Calleguas Ground-Water Basin, Ventura County, California, United States Geological Survey, Water-Resources Investigations Report 02-4136, 2003.

Heath, R.C. Basic Ground-Water Hydrology, United States Geological Survey Water-Supply Paper; 2220, 1991.

Huntley, D. Technical Report, Review of Subsurface Wastewater Disposal Policy, San Diego Regional Water Quality Control Board. September 30, 1987.

Kazmann, R.G. Modern Hydrology, 2nd ed., Harper & Row, New York, 1972

Kaehler, C.A. and Hsieh, P.A., Hydraulic Properties of a Fractured-Rock Aquifer, Lee Valley, San Diego County, California. United States Geological Survey, Open-File Report 90-592, 1991.

Kiparsky, M. and Gleick, P., Climate Change and California Water Resources: A Survey and Summary of the Literature, Prepared for the California Energy Commission, July, 2003.

National Oceanic and Atmospheric Administration (NOAA). Cold and Warm Episodes by Season, 2008. http://www.cpc.noaa.gov/products/analysis_monitoring/ensostuff/ensoyears.shtml

Norris, R.M., and Webb, R.W. Geology of California, Second Edition. John Wiley & Sons, Inc., New York, 1990.

Parsons Transportation Group, Final Report San Diego Region-Baja California Cross-Border Transportation Study, Prepared for San Diego Association of Governments, November 1, 2000.

San Diego County Water Authority (CWA), 2006. Drought Management Plan, prepared by the CWA Water Resources Department, March 23, 2006.

Soil Conservation Service (SCS), National Engineering Handbook, Section 4: Hydrology, Soil Conservation Source, USDA, Washington DC, 1985.

Shah, N., Nachabe, M., and Ross, M., 2007. Extinction Depth and Evapotranspiration from Ground Water under Selected Land Covers, Groundwater Journal Vol. 45, No. 3, May-June, 2007.

State Water Resources Control Board (SWRCB), Hydrologic Units for Region 9. http://www.swrcb.ca.gov/sandiego/water_issues/programs/basin_plan/docs/sdrwqcb_basinplanmap.pdf

SWRCB, Hydrologic Units for Region 7. http://www.waterboards.ca.gov/coloradoriver/publications_forms/publications/docs/rwgcbbasin_1986.pdf

Sweeney, J.P., 2007. Barona may get water aid from Congress, San Diego Union Tribune (Copley News Service), October 11, 2007.

Thornthwaite, C. W., An Approach Toward a Rational Classification of Climate. Geographic Review 38:55-94, 1948.

Thornthwaite, C.W. and Mather, J.W., The Water Balance of the Earth, Publications in Climatotogy., Vol. 8, No. 1, pp. 1-104, 1955.

Todd, D.K. Ground Water Hydrology, John Wiley & Sons, New York, 1959.

Tuğrul, Atiye, 2004. The Effect of Weathering on Pore Geometry and Compressive

Strength of Selected Rock Types from Turkey, Department of Geological Engineering, Istanbul University, Avcılar, Istanbul, Turkey, July 31, 2004.

United States Census Bureau. 2000 Population Estimate of San Diego County, 2000.

United States Department of Agriculture (USDA). Soil Conservation Service and Forest Service, Soil Survey, San Diego Area, California. 1973

USDA, 1986. Urban Hydrology for Small Watersheds, Technical Release No. 55. June 1986.

Van Rheenen, N., Wood, A., Palmer, R., Lettenmaier, D. Potential Implications of PCM Climate Change Scenarios for Sacramento-San Joaquin River Basin Hydrology and Water Resources. Climate Change 62: 257-281, 2004.

Walawender, M. The Peninsular Ranges – A Geological Guide to San Diego's Back Country, Kendall/Hunt Publishing Company, Dubuque, Iowa, 2000.

Tables

Table 3-1
Yearly and Monthly Precipitation Fractions

Precipitation Year	Yearly Fraction of 30-Year Average Precipitation	Monthly Fraction of Annual Precipitation											
		Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
1971-1972	0.49	0.00	0.03	0.02	0.16	0.03	0.54	0.00	0.03	0.00	0.03	0.05	0.10
1972-1973	1.11	0.00	0.00	0.02	0.07	0.18	0.12	0.15	0.18	0.26	0.01	0.01	0.00
1973-1974	0.62	0.00	0.02	0.00	0.00	0.21	0.02	0.49	0.01	0.20	0.04	0.01	0.00
1974-1975	0.90	0.02	0.00	0.01	0.13	0.02	0.14	0.03	0.11	0.32	0.19	0.01	0.01
1975-1976	0.80	0.00	0.00	0.02	0.02	0.11	0.05	0.01	0.46	0.16	0.14	0.01	0.00
1976-1977	0.88	0.04	0.00	0.20	0.04	0.07	0.09	0.23	0.03	0.12	0.01	0.17	0.00
1977-1978	1.90	0.00	0.08	0.00	0.02	0.01	0.11	0.29	0.19	0.24	0.05	0.01	0.00
1978-1979	1.43	0.00	0.00	0.04	0.01	0.15	0.15	0.28	0.12	0.23	0.00	0.01	0.00
1979-1980	1.78	0.01	0.01	0.00	0.04	0.01	0.01	0.37	0.31	0.15	0.06	0.03	0.00
1980-1981	0.68	0.01	0.00	0.00	0.03	0.00	0.08	0.15	0.23	0.39	0.07	0.04	0.00
1981-1982	1.03	0.00	0.00	0.01	0.02	0.09	0.04	0.31	0.10	0.34	0.06	0.01	0.01
1982-1983	1.74	0.00	0.01	0.03	0.01	0.14	0.10	0.10	0.18	0.34	0.09	0.01	0.00
1983-1984	0.58	0.00	0.10	0.05	0.08	0.31	0.31	0.04	0.01	0.01	0.08	0.00	0.01
1984-1985	0.87	0.07	0.04	0.01	0.03	0.14	0.43	0.07	0.10	0.09	0.03	0.00	0.00
1985-1986	1.17	0.02	0.00	0.02	0.02	0.33	0.09	0.05	0.21	0.23	0.03	0.00	0.00
1986-1987	0.76	0.02	0.01	0.10	0.09	0.09	0.12	0.18	0.16	0.15	0.04	0.01	0.01
1987-1988	1.03	0.00	0.01	0.03	0.18	0.11	0.17	0.15	0.10	0.04	0.19	0.01	0.00
1988-1989	0.50	0.01	0.03	0.01	0.00	0.16	0.34	0.10	0.15	0.17	0.01	0.02	0.00
1989-1990	0.59	0.00	0.01	0.03	0.04	0.02	0.02	0.36	0.18	0.09	0.10	0.06	0.08
1990-1991	0.97	0.00	0.01	0.00	0.00	0.06	0.05	0.07	0.19	0.60	0.01	0.00	0.00
1991-1992	1.05	0.03	0.01	0.02	0.04	0.01	0.13	0.16	0.28	0.28	0.02	0.02	0.00
1992-1993	1.74	0.00	0.02	0.00	0.02	0.00	0.14	0.51	0.22	0.05	0.00	0.01	0.02
1993-1994	0.83	0.00	0.00	0.00	0.01	0.10	0.07	0.09	0.33	0.25	0.12	0.01	0.00
1994-1995	1.53	0.00	0.01	0.00	0.01	0.04	0.05	0.38	0.11	0.29	0.06	0.03	0.02
1995-1996	0.53	0.01	0.01	0.01	0.00	0.02	0.07	0.22	0.34	0.24	0.06	0.01	0.00
1996-1997	0.79	0.01	0.00	0.01	0.09	0.19	0.17	0.42	0.08	0.00	0.02	0.00	0.01
1997-1998	1.79	0.00	0.00	0.06	0.00	0.07	0.09	0.11	0.39	0.13	0.08	0.06	0.00
1998-1999	0.63	0.02	0.02	0.02	0.02	0.15	0.12	0.20	0.09	0.09	0.24	0.00	0.03
1999-2000	0.54	0.04	0.01	0.02	0.00	0.00	0.05	0.10	0.52	0.15	0.10	0.01	0.01
2000-2001	0.75	0.00	0.02	0.02	0.09	0.04	0.00	0.26	0.34	0.10	0.12	0.01	0.00
2001-2002	0.30	0.01	0.02	0.01	0.00	0.23	0.23	0.12	0.04	0.21	0.13	0.00	0.00
2002-2003	0.96	0.00	0.01	0.02	0.01	0.13	0.17	0.01	0.35	0.14	0.12	0.04	0.00
2003-2004	0.58	0.02	0.04	0.01	0.00	0.11	0.14	0.05	0.46	0.08	0.09	0.00	0.00
2004-2005	1.75	0.00	0.00	0.00	0.24	0.04	0.13	0.24	0.24	0.07	0.03	0.01	0.00

Note: Yearly and monthly precipitation fractions are based on data obtained and averaged from 89 government sanctioned precipitation stations in San Diego County west of desert areas. The fractions were applied to the 30-year average precipitation in each 300-foot by 300-foot cell used to calculate recharge within the groundwater study area. The 30-year average precipitation value within each cell is based on the period July 1971 to June 2001 as was calculated in creation of the Groundwater Limitations Map on file with the Clerk of the Board of Supervisors as Document 195172. Applying the fractions produced 408 unique monthly precipitation values (for each cell) from July 1971 to June 2005.

Table 3-2
Linking Land Uses and Hydrologic Soil Groups to Soil Curve Number

Cover Code	Hydrologic Soil Group and Associated Curve Numbers				SANDAG Land Use Code	SANDAG Land Use Description
	A	B	C	D		
Open space (parks/golf), 50% to 75% cover	49	69	79	84	7204	Golf Course
					7606	Landscape Open Space
Paved parking lots	98	98	98	98	4116	Park and Ride Lot
					4119	Other Transportation
Paved roads (including right-of-way)	83	89	92	93	4112	Freeway
					4104	Airstrip
					4118	Road Right of Way
Commercial	89	92	94	95	1501	Hotel/Motel (Low-Rise)
					1503	Resort
					4113	Communications and Utilities
					5005	Specialty Commercial
					5007	Arterial Commercial
					5009	Other Retail Trade and Strip
					6002	Office (Low-Rise)
					6003	Government Office/Civic Center
					6101	Cemetary
					6102	Religious Facility
					6103	Library
					6104	Post Office
					6105	Fire/Police Station
					6108	Mission
					6109	Other Public Services
					6509	Other Health Care
					6701	Military Use
					6804	Senior High School
					6806	Elementary School
					6807	School District Office
					7205	Golf Course Club House
					7209	Casino
Industrial	81	88	91	93	1401	Jail/Prison
					1409	Other Group Quarters Facility
					2103	Light Industry-General
					2104	Warehousing
					2201	Extractive Industry
					2301	Junkyard/Dump/Landfill
Field Crops	72	81	88	91	8501	Agriculture
					8504	Agriculture
Pasture	68	79	86	89	8003	Field Crops
					9202	Lake/Reservoir/Large Pond
Brush-weed-grass mix	48	67	77	83	6702	Military Training
					7210	Other Recreation-High
					7603	Open Space Park or Preserve
					7607	Residential Recreation
					9101	Vacant and Undeveloped Land
Woods-grass mix	57	73	82	86	8001	Orchard or Vineyard
					8002	Intensive Agriculture
					8502	Agriculture
					8503	Agriculture

Table 3-2
Linking Land Uses and Hydrologic Soil Groups to Soil Curve Number

Cover Code	Hydrologic Soil Group and Associated Curve Numbers				SANDAG Land Use Code	SANDAG Land Use Description
	A	B	C	D		
Residential: 8 du/ac	77	85	90	92	1000	Spaced Rural Residential
					1100	Residential
					1200	Multi-Family Residential
Residential: 4 du/ac	61	75	83	87	1000	Spaced Rural Residential
					1100	Residential
					1300	Mobile Home Park
Residential: 3 du/ac	57	72	81	86	1000	Spaced Rural Residential
					1100	Residential
Residential: 2 du/ac	54	70	80	85	1000	Spaced Rural Residential
					1100	Residential
Residential: 1 du/ac	51	68	79	84	1000	Spaced Rural Residential
					1100	Residential
Residential: 0.5 du/ac	46	65	77	82	1000	Spaced Rural Residential
					1100	Residential
Residential: 0.2 du/ac	39	60	74	80	1000	Spaced Rural Residential
					1100	Residential

Note: Cover codes, hydrologic soil groups, and associated curve numbers were obtained from the United States Department of Agriculture, Soil Conservation Service,*Urban Hydrology for Small Watersheds, Technical Release No. 55,* June 1986.

SANDAG - San Diego Association of Governments
du - dwelling unit
ac - acre

Table 3-3
Reference Evapotranspiration

CIMIS Zone	Monthly ETo (inches)												Total
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
1	0.93	1.4	2.48	3.3	4.03	4.5	4.65	4.03	3.3	2.48	1.2	0.62	32.92
4	1.86	2.24	3.41	4.5	5.27	5.7	5.89	5.58	4.5	3.41	2.4	1.86	46.62
6	1.86	2.24	3.41	4.8	5.58	6.3	6.51	6.2	4.8	3.72	2.4	1.86	49.68
9	2.17	2.8	4.03	5.1	5.89	6.6	7.44	6.82	5.7	4.03	2.7	1.86	55.14
16	1.55	2.52	4.03	5.7	7.75	8.7	9.3	8.37	6.3	4.34	2.4	1.55	62.51
18	2.48	3.36	5.27	6.9	8.68	9.6	9.61	8.68	6.9	4.96	3	2.17	71.61

CIMIS - California Irrigation Management Information System
ETo - Reference Evapotranspiration

Table 3-4
Soil Properties Summary

Soil Type	Soil Moisture Capacity Range	Mean Soil Moisture Capacity	Hydrologic Soil Group
AcG	**-**	***0.1**	D
AtC	5.5-7	6.25	D
AtD	4-6	5	D
AtD2	4-5	4.5	D
AtE	3.5-5.5	4.5	D
AtE2	3-4	3.5	D
AtF	3.5-5	4.25	D
AuC	3.5-5	4.25	A
AuF	3-5	4	A
AvC	3.5-5	4.25	C
AwC	7-9	8	D
AwD	5.5-9	7.25	D
AyE	2-4	3	D
BaG	**-**	***1**	D
BbE	3.5-6	4.75	C
BbE2	3.5-6	4.75	C
BbG	3.5-5	4.25	C
BbG2	3.5-5	4.25	C
BeE	3-5	4	D
BgE	3.5-3.5	3.5	D
BgF	3.5-3.5	3.5	D
BlC	4.5-5	4.75	D
BlC2	4-5	4.5	D
BlD2	4.5	4.5	D
BmC	5-6	5.5	D
BnB	4-5.5	4.75	D
BoC	5-8	6.5	C
BoE	4.5-7.5	6	C
BrE	3-6.5	4.75	C
BrG	3-6.5	4.75	C
BsC	5-6	5.5	D
BsD	3.5-4.5	4	D
BsE	2.5-4.5	3.5	D
BtC	3-5	4	D
BuB	6-7.5	6.75	C
BuC	6-7.5	6.75	C
BuD2	6-7.5	6.75	C
BuE2	6-7.5	6.75	C
CaB	4.5-6.5	5.5	B
CaC	4.5-6.5	5.5	B
CaC2	4.5-5.5	5	B
CaD2	4.5-5.5	5	B
CbB	4-4.5	4.25	C
CbC	4-4.5	4.25	C
CbD	3.5-5.5	4.5	C
CbE	3-4.5	3.75	C
CcC	**-**	***1**	D
CcE	**-**	***1**	D
CeC	1.5-3	2.25	A
CfB	3.5-5	4.25	D

Table 3-4
Soil Properties Summary

Soil Type	Soil Moisture Capacity Range	Mean Soil Moisture Capacity	Hydrologic Soil Group
CfC	2.5-5	3.75	D
CfD2	2.5-4.5	3.5	D
CgC	**-**	***1**	D
ChA	9.5-11	10.25	C
ChB	9.5-11	10.25	C
CkA	7.5-10	8.75	C
ClD2	1-2	1.5	B
ClE2	1-2	1.5	B
ClG2	1-2	1.5	B
CmE2	1-1.5	1.25	B
CmrG	1-1.5	1.25	B
CnE2	3-5	4	B
CnG2	3-5	4	B
Co	-	***10**	D
Cr	**-**	***5**	A
CsB	3.7-5	4.35	A
CsC	3.7-5	4.35	A
CsD	3.7-5	4.35	A
CtE	4.5-7.5	6	B
CtF	4-6	5	B
CuE	3.5-5.5	4.5	B
CuG	3.5-5.5	4.5	B
CvG	3.5-4.5	4	B
DaC	5-6	5.5	D
DaD	4-5.5	4.75	D
DaE	4-5	4.5	D
DaE2	3.5-4.5	4	D
DaF	3.5-4	3.75	D
DcD	**-**	***1**	D
DcF	**-**	***1**	D
DoE	2-5.5	3.75	D
DRAINAGE	**-**	***5**	***B**
EdC	5-7.5	6.25	B
EsC	4-5.5	4.75	C
EsD2	3-5.5	4.25	C
EsE2	3-5.5	4.25	C
EvC	5.5-9	7.25	C
ExE	**-**	***5**	D
ExG	1-2	1.5	D
FaB	5-8	6.5	C
FaC	4.5-8	6.25	C
FaC2	4.5-7.5	6	C
FaD2	4.5-7.5	6	C
FaE2	4.5-6	5.25	C
FaE3	3.5-4.5	4	C
FeC	3-5	4	C
FeE	3-5	4	C
FeE2	3-5	4	C
FvD	4-5.5	4.75	C
FvE	3.5-5.5	4.5	C

Table 3-4
Soil Properties Summary

Soil Type	Soil Moisture Capacity Range	Mean Soil Moisture Capacity	Hydrologic Soil Group
FwF	1-2	1.5	D
FxE	0.5-1.5	1	D
FxG	0.5-1.5	1	D
GaE	1-2	1.5	D
GaF	1-2	1.5	D
GoA	6-8.5	7.25	B
GrA	5.5-7.5	6.5	B
GRAVEL PIT	**-**	***5**	B
GrB	5.5-7.5	6.5	B
GrC	5.5-7.5	6.5	B
GrD	5.5-6.5	6	B
HaG	2-3	2.5	D
HmD	3-7	5	C
HmE	3-7	5	C
HnE	2.5-4	3.25	C
HnG	2.5-3	2.75	C
HoC	6-9	7.5	C
HrC	4-5.5	4.75	D
HrC2	4-5	4.5	D
HrD	3.5-5.5	4.5	D
HrD2	3.5-5	4.25	D
HrE2	3.5-4.5	4	D
HuC	**-**	***1**	D
HuE	**-**	***1**	D
InA	7.5-9.5	8.5	C
InB	7.5-9.5	8.5	C
IoA	7.5-9.5	8.5	C
IsA	7.5-9.5	8.5	C
KcC	3-5.5	4.25	B
KcD2	3-5.5	4.25	B
LaE2	2-3	2.5	A
LaE3	1-2	1.5	A
LcE	1-2.5	1.75	A
LcE2	1-2	1.5	A
LcF2	1-2	1.5	A
LdE	1-2	1.5	A
LdG	1-2	1.5	A
LeC	4-5	4.5	D
LeC2	3-4	3.5	D
LeD	3-4	3.5	D
LeD2	3-4	3.5	D
LeE	2.5-3.5	3	D
LeE2	2-3	2.5	D
LeE3	2-3	2.5	D
LfC	**-**	***1**	D
LfE	**-**	***1**	D
LpB	4-6	5	D
LpC	4-6	5	D
LpC2	4-6	5	D
LpD2	4-6	5	D

Table 3-4
Soil Properties Summary

Soil Type	Soil Moisture Capacity Range	Mean Soil Moisture Capacity	Hydrologic Soil Group
LpE2	4-6	5	D
LrE	4-6	5	D
LrE2	4-6	5	D
LrG	4-6	5	D
LsE	5-7	6	C
LsF	5-7	6	C
Lu	6-9	7.5	B
LvF3	**-**	***1**	D
Md	**-**	***1**	D
MINE	**-**	***1**	***A**
MlC	4-5	4.5	A
MlE	4-5	4.5	A
MnA	5-6	5.5	B
MnB	5-6	5.5	B
MoA	6-7.5	6.75	B
MpA2	7-8	7.5	B
MrG	**-**	***1**	D
MvA	4-5	4.5	A
MvC	4-5	4.5	A
MvD	4-5	4.5	A
MxA	4-5	4.5	D
OhC	2-3	2.5	D
OhE	2-2.5	2.25	D
OhF	2-2.5	2.25	D
OkC	**-**	***1**	D
OkE	**-**	***1**	D
PeA	3-4	3.5	D
PeC	3-4	3.5	D
PeC2	3-4	3.5	D
PeD2	3-4	3.5	D
PfA	4-5	4.5	D
PfC	4-5	4.5	D
Py	-	***10**	D
RaA	8.5-10.5	9.5	C
RaB	8.5-10.5	9.5	C
RaC	8.5-10.5	9.5	C
RaC2	8.5-10.5	9.5	C
RaD2	8.5-10.5	9.5	C
RcD	7-9	8	C
RcE	7-9	8	C
RdC	1.5-2.5	2	D
ReE	1.5-2	1.75	D
RfF	1.5-2	1.75	D
RhC	**-**	***1**	D
RhE	**-**	***2**	D
RkA	7.5-9.5	8.5	B
RkB	7.5-9.5	8.5	B
RkC	7.5-9.5	8.5	B
Rm	**-**	***5**	A
RoA	3-4	3.5	A

Table 3-4
Soil Properties Summary

Soil Type	Soil Moisture Capacity Range	Mean Soil Moisture Capacity	Hydrologic Soil Group
RrC	3-4	3.5	A
RsA	3-4	3.5	A
RsC	3-4	3.5	A
RsD	3-4	3.5	A
RuG	**-**	***1**	D
SbA	10-11.5	10.75	C
SbC	10-11.5	10.75	C
ScA	7.5-10	8.75	C
ScB	7.5-10	8.75	C
SmE	2.5-3	2.75	D
SnG	1-3	2	D
SpE2	2-3	2.5	C
SpG2	2-3	2.5	C
SrD	**-**	***1**	B
SsE	2.5-3.5	3	A
STATE PARK	**-**	***5**	***B**
StG	**-**	***1**	D
SuA	3-5	4	D
SuB	3-5	4	D
SvE	**-**	***1**	A
TeF	-	***1**	D
Tf	**-**	***5**	D
ToE2	1-2	1.5	C
ToG	1-2	1.5	C
TuB	3-4	3.5	A
Ur	**-**	***1**	D
VaA	8-9.5	8.75	B
VaB	8-9.5	8.75	B
VaC	8-9.5	8.75	B
VaD	8-9.5	8.75	B
VbB	6-8	7	B
VbC	6-8	7	B
VsC	4-6	5	B
VsD	4-6	5	B
VsD2	3.5-5.5	4.5	B
VsE	3.5-5.5	4.5	B
VsE2	3.5-5	4.25	B
VsG	3.5-5	4.25	B
VvD	2-4.5	3.25	B
VvE	2-4.5	3.25	B
VvG	2-4	3	B
WATER	**-**	***0.1**	D
WmB	9-11	10	C
WmC	9-11	10	C
WmD	9-11	10	C

Note: Soil data obtained from United States Department of Agriculture (USDA). Soil Conservation Service and Forest Service, *Soil Survey, San Diego Area, California*. 1973

***Estimated Value**

- not estimated

Table 3-5
Residential, Commerical, Industrial, and Other Land Uses Groundwater Demand Estimates

Water Demand Category	Water Demand Per Parcel or Unit (afy)	SANDAG Land Use Code	SANDAG Land Use Description	Assumptions
Single-Family Residential	0.5	1000	Spaced Rural Residential	450 gpd per residence
	0.5	1100	Single Family Residential	
Second Dwelling Units - Residential	0.25	None	Second Dwelling Units	Half the use of a single-family residence
Multi-Family Residential	0.3	1200	Multi-Family Residential	300 gpd per residence
Lower Water Use Service Related Commercial and Light Industrial	0.3	2103	Light Industry-General	300 gpd per entity or parcel
		2301	Junkyard/Dump/Landfill	
		5007	Store-Front Commercial	
		5009	Other Retail Trade And Strip Commercial	
		6104	Post Offices	
		6103	Libraries	
		2104	Warehousing & Public Storage	
Higher Water Use Offices, Religious Facilities, Heavy Industrial, and Public Facilities	1	2201	Extractive Industry	1,000 gpd per entity or parcel
		6002	Office-Low Rise	
		6003	Gov'T Office/Civic Centers	
		6101	Cemetery	
		6102	Religious Facilities	
		6509	Other Health Care	
		6105	Fire/Police Stations	
Military Facilities	3	6701	Military Use	Only one parcel with water use, Warner Springs Naval Training Facility. Approximately 1,500 people per year come in for training. Assumed 50 gpd per person with a stay of 14 days
Small Water Systems	-	1300	Mobile Home Parks	Small water systems demand estimated separately in Table 3-8
		1401	Jails/Prisons	
		1409	Other Group Quarters Facilities	
		1501	Hotel/Motel (Lo-Rise)	
		1503	Resort	
		6109	Other Public Services	
		6804	Senior High Schools	
		6806	Elementary Schools	
		6807	School District Offices	
		7207	Marinas	
		7210	Other Recreation	
		7601	Parks - Active	
Indian Reservations	-	5005	Specialty Commercial	Indian Reservations demand estimated separately in Table 3-9
		6108	Missions	
		7209	Casinos	
Agriculture	-	8001	Orchards And Vineyards	Agricultural water demand estimated separately in Table 3-6
		8002	Intensive Agriculture	
		8003	Field Crops	
Golf Courses	-	7204	Golf Courses	Golf course demand estimated separately in Table 3-7
		7205	Golf Course Clubhouses	

Table 3-5
Residential, Commerical, Industrial, and Other Land Uses Groundwater Demand Estimates

Water Demand Category	Water Demand Per Parcel or Unit (afy)	SANDAG Land Use Code	SANDAG Land Use Description	Assumptions
No Water Use	-	4104	Airstrips	No water use associated with land use
		4112	Freeways	
		4113	Communications And Utilities	
		4116	Park And Ride Lots	
		4117	Railroad Right Of Ways	
		4118	Road Right Of Ways	
		4119	Other Transportation	
		7603	Open Space Reserves, Preserves	
		7606	Landscape Open Space	
		7607	Residential Recreation	
		9101	Vacant Land	
		9202	Lakes, Reservoirs, Large Ponds	
		6702	Military Training	

Note: Water demand assumptions for commercial/industrial uses are based on typical wastewater flow rates from commercial sources within the EPA Onsite Wastewater Treatment Systems Manual, February 2002, pages 3-7 to 3-9. Additional water from outdoor use/andscaping is also assumed to produce a generalized estimate of water demand.
- no water demand estimated
afy - acre-feet per year
gpd - gallons per day
NA - Not Applicable, second dwelling units are located on spaced rural residential and single family residential parcels
SANDAG - San Diego Association of Governments

Table 3-6
Agricultural Groundwater Demand Estimates

Agricultural Water Demand Categories	Crop Type	1998	1999	2000	2001	4-Year Avg.
Field Crops Category 1	Alfalfa	3.6	3.9	5.1	4.6	4.3
	Pasture	3.2	3.6	4.7	4.1	3.9
			Average Applied Water Demand (af-acre)			**4.1**
Field Crops Category 2	Grain	0.4	1.6	1.6	1.1	1.2
	Other Field Crops (sudan hay, grain sorghum and sunflowers)	0.9	1.5	1.5	1.4	1.3
	Dry Beans	1.1	1.4	1.5	1.5	1.4
			Average Applied Water Demand (af-acre)			**1.3**
Orchards and Vineyards Category 1	Almonds and Pistachios	3.2	3.6	3.7	3.5	3.5
	Subtropicals (citrus, avocados)	2.8	3.5	3.5	3.2	3.2
	Other Deciduous (apples, prunes, figs, and walnuts, etc.)	3.0	3.5	3.6	3.2	3.3
			Average Applied Water Demand (af-acre)			**3.4**
Orchards and Vineyards Category 2	Vineyards	0.8	1.4	1.4	1.1	1.2
			Average Applied Water Demand (af-acre)			**1.2**
Truck Crops	Corn	1.5	2.2	2.2	1.9	1.9
	Tomatoes (for processing)	1.5	2.3	2.3	2.0	2.0
	Tomatoes (for fresh use)	1.9	2.3	2.0	1.9	2.0
	Cucumbers	0.7	1.3	1.4	1.2	1.2
	Onions and Garlic	2.5	1.8	2.0	1.4	1.9
	Potatoes	2.5	2.7	2.8	2.8	2.7
	Other Truck Crops (nurseries, greenhouses, Christmas tree farms, etc.)	1.9	2.2	2.2	2.1	2.1
			Average Applied Water Demand (af-acre)			**2.0**

Note: Applied water demand data was obtained from the California Department of Water Resources - Land and Water Use Section (DWR). The numbers above reflect estimated average applied water demands for coastal and inland agricultural lands of San Diego County mapped by DWR in 1998. DWR agricultural land use data was developed in 1998 using aerial photography and extensive field visits

af-acre - acre-feet of groundwater applied per acre

Table 3-7
Golf Course Groundwater Demand Estimate

Golf Course	CIMIS ETo (feet)	Crop Coefficient for Cool Season Grass	*Irrigated Area (acres)	Total Demand (Acre-feet)
Warner Springs Golf Course	5.2	0.8	146	607

CIMIS - California Irrigation Management Information System
ETo - Reference Evapotranspiration
*Irrigated acreage was estimated by analysis of spectral imagery of golf course

Sources for Estimation:

California Department of Water Resources, Water Use Efficiency Office, 1999. *"California Irrigation Management Information System (CIMIS) Reference Evapotranspiration Map."*

University of California Cooperative Extension and DWR, 2000. *"A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California."*

Table 3-8
Small Water Systems Groundwater Demand Estimates

SWS Water Demand Categories	System	Number of Connections	Population	Water Demand (AFY)
[1]Mobile Home Parks	Barrett Lake Mobilehome Park	27	150	8.1
	Butterfield Oaks Mh Park	48	80	14.4
	Heavenly Oaks	102	300	30.6
	Little Acres M/H Park	6	20	1.8
[2]Overnight Uses	1000 Trails Oakzanita Springs	114	250	14.0
	Al Bahr Shrine Camp	120	100	5.6
	Angels Landing	6	30	1.7
	Ballena Vista Farm	8	23	1.3
	Banner Small Water Co.	15	175	9.8
	Butterfield Ranch	70	350	19.6
	Calexico Lodge	23	50	2.8
	Cameron Fire Station	7	14	0.8
	Camp Cedar Glen	18	100	5.6
	Camp Denver Fox	20	200	11.2
	Camp Oliver	9	70	3.9
	Camp Stevens	17	50	2.8
	Camp Virginia	10	25	1.4
	Camp Winacka	12	250	14.0
	Cibbetts Flats Campground	24	25	1.4
	De Anza Springs Resort	225	400	22.4
	Descanso Detention Facility	22	350	19.6
	Descanso Fire Station	9	34	1.9
	Diamond Jack'S Rv Ranch	45	120	6.7
	Featherstone Canyon Chr. Camp	5	300	16.8
	Freedom Ranch	2	60	3.4
	Highland East Trailer Park	20	25	1.4
	Lake Henshaw Water Co.	101	300	16.8
	Lake Morena County Park	8	300	16.8
	Lake Morena Trailer Resort	42	60	3.4
	Lake Wohlford Resort	137	235	13.2
	Live Oak Springs Water Company	138	200	11.2
	Lux Inn	19	100	5.6
	Mastro'S Trailer Ranch	16	20	1.1
	Mataguay Scout Reservation	68	400	22.4
	Molinari Water System	3	100	5.6
	Mountain Empire Rv Park/Cpgnd	19	30	1.7
	Oak Knoll Village	53	205	11.5
	Oakvale Park	125	100	5.6
	Outdoor World Retreat	151	300	16.8
	Palomar Observatory	20	25	1.4
	Pine Valley Bible Conf. Center	33	356	19.9
	Pine Valley Trailer Park	92	375	21.0
	Pinecrest	85	70	3.9
	Pinezanita Trailer Ranch	227	400	22.4
	Potrero County Park	37	100	5.6
	Rancho Corrido Rv Resort	120	500	28.0
	Rey River Ranch Corp	42	4	0.2
	Santa Ysabel Trailer Park	9	15	0.8
	Schoepe Scout Res. Lost Valley	67	550	30.8
	Set Free Ministries	5	50	2.8
	Shady Oaks Trailer Ranch	14	25	1.4

Table 3-8
Small Water Systems Groundwater Demand Estimates

SWS Water Demand Categories	System	Number of Connections	Population	Water Demand (AFY)
[2]Overnight Uses	Skyline Ranch Rv Park & Cmpgrd	42	38	2.1
	Stagecoach Trails Resort	285	695	38.9
	Stuart Water Co.	37	250	14.0
	Twin Lakes Resort	145	200	11.2
	Vallecito County Park	44	145	8.1
	Western Horizons Ramona Canyon	130	250	14.0
	Whispering Oaks Program Center	17	250	14.0
	Whispering Winds Camp	13	160	9.0
	William Heise County Park	58	850	47.6
	Wynola Bible Conference	9	100	5.6
	Young Life Oakbridge Camp	9	220	12.3
[3]Fulltime Day Use	Barrett Honor Camp	10	50	1.1
	Camp Cuyamaca	19	300	6.7
	Campo Alternative School	3	25	0.6
	Campo Elementary School	4	300	6.7
	Clover Flat Elementary School	5	125	2.8
	Dudley's Bakery	1	100	2.2
	Julian Youth Academy	6	50	1.1
	Mt Empire High School	7	900	20.2
	Mt. Laguna Improv. Assn.	180	100	2.2
	Phoenix House	10	75	1.7
	Oak Grove Complex	36	68	1.5
	Potrero Elementary School	13	180	4.0
	Spencer Valley School	4	51	1.1
	Warner Springs Ranch	156	155	3.5
	Jacumba Valley Ranch	7	25	0.6
	Warner Unified School Dist.	15	250	5.6
	Ymca Camp Marston/Raintree	17	180	4.0
[4]Parks Day Use	El Capitan Reservoir Rec. Area	4	300	3.4
	Fry Creek / Observatory	65	200	2.2
	Jess Martin County Park	2	50	0.6
	Mt Laguna/Agua Dulce	61	500	5.6
	San Luis Rey Picnic Ground	2	100	1.1
	Sutherland Reservoir Rec. Area	4	300	3.4
	Sycamore Canyon / Goodan Ranch	2	50	0.6
[4]Restaurants	Barrett Junction Cafe, Inc.	3	25	0.3
	Campo Diner	3	50	0.6
	Chef'S Hat Restaurant	3	250	2.8
	Descanso Junction	5	50	0.6
	Dulzura Café	4	50	0.6
	La Posta Restaurant	5	25	0.3
	Salsa Lynda Restaurant	3	25	0.3
	Wynola Pizza Express	6	50	0.6
	Yoga Center Mothers Kitchen	5	100	1.1
[5]Commercial/Stores	Auerbach Farms	4	250	1.4
	Boulevard Springs	5	25	0.1
	Cameron Corners Water Sys	8	50	0.3
	Coleman Creek Village	6	50	0.3
	Erreca's Associates	2	25	0.1
	Holcomb Investments	8	50	0.3
	Muir Industries	5	70	0.4

Table 3-8
Small Water Systems Groundwater Demand Estimates

SWS Water Demand Categories	System	Number of Connections	Population	Water Demand (AFY)
[5]Commercial/Stores	Potrero General Store	1	800	4.5
	Southbay Rod And Gun Club	1	200	1.1
	Sunshine Summit General Store	3	50	0.3
	T.C. Worthy Cash & Carry, Inc.	4	25	0.1
[6]Metered Water Use	Indian Hills Camp	36	400	21.7
	KQ Ranch Camping Resort	250	400	12.4
	Narconon	2	40	5.7
	Palomar Christian Conf. Center	22	350	20
	Rancho Del Campo Water System	110	290	68.9
	Rancho L'Abri	6	52	6.7
	Thousand Trails Pio Pico	611	500	40
	Yoga Center Retreat	5	50	4.5
[7]Residential	Bailey Mutual Water Co.	41	16	ne
	Barrett Valley Water Co.	9	21	ne
	Canebrake County Water Dist.	8	12	ne
	Cuyamaca Forest Mw Co.	40	9	ne
	Cuyamaca Water District	159	200	ne
	Ellis Farms	6	18	ne
	Guatay Mutual Benefit Corp.	39	100	ne
	H & J Water Co.	24	50	ne
	Harrison Park Mutual Water Co.	12	20	ne
	Harrison Park Mw Co. 2	11	22	ne
	Lake Morena Views Mw Co.	120	350	ne
	Lakeview Spring	11	20	ne
	Lazy H Mutual Water Co.	37	70	ne
	Los Tules Mutual Water Co.	84	140	ne
	North Peak Mutual Water Co.	19	25	ne
	Palomar Mountain Mw Co.	196	70	ne
	Pauma Valley Mutual Water Co.	27	120	ne
	Rancho Corte Madera	13	35	ne
	Rancho Estates Mutual Water Co	88	200	ne
	Rancho Santa Teresa Mw Co.	37	74	ne
	Rd's Log Cabin	1	50	ne
	Richardson Beardsley Park Inc.	20	38	ne
	Robert L Hunt Water Co.	12	24	ne
	Summit Estates Mut Wtr Co.	13	25	ne
	Sunrise Estates Mw Co.	46	200	ne
	Tecate Vista Mwc	13	200	ne
	West Cuca Mutual Water Co.	8	23	ne
	Willowside Terrace Water Assoc	34	100	ne
	Wynola Water District	71	120	ne
[8]Outside the Study Area	Agua Caliente County Park	120	400	ne
	Alpine Oaks Mobile Estates	66	125	ne
	Alpine Ranger Station	5	75	ne
	Arya Bonsall	6	15	ne
	Borrego Air Ranch Mw & Imp Co.	9	50	ne
	Borrego Springs Elementary	7	246	ne
	Borrego Springs Park Csd	140	35	ne
	Chicken Little Tr/Roost	6	10	ne
	Del Dios Mutual Water Co.	131	330	ne
	Desert Ironwoods Motel	110	25	ne

Table 3-8
Small Water Systems Groundwater Demand Estimates

SWS Water Demand Categories	System	Number of Connections	Population	Water Demand (AFY)
[8]Outside the Study Area	El Monte County Park	14	25	ne
	Fallbrook Camp Retreat	26	25	ne
	Faubus Farms	17	27	ne
	Hodges Reservoir Rec. Area	3	200	ne
	Iron Door	2	50	ne
	La Casa Del Zorro	12	19	ne
	Leapin' Lizard Rv Ranch	61	70	ne
	Lemurian Fellowship	7	50	ne
	Mobiland Camper Park	99	150	ne
	Ocotillo Oasis M/H Park	55	100	ne
	Questhaven Muni Water Dist.	9	25	ne
	San Pasqual Academy	33	350	ne
	Ranch Feed & Supply	4	50	ne
	Split Mountain Trailer Park	80	25	ne
	Stelzer County Park	10	25	ne
	Sun Island Resort	91	140	ne

Note: Water demand assumptions are based on typical wastewater flow rates from commercial, institutional, and recreational facilities contained within the EPA Onsite Wastewater Treatment Systems Manual, February 2002, pages 3-7 to 3-9.

[1]Assumption of 0.3 afy per connection

[2]Assumption of 50 gpd per person for 365 days

[3]Assumption of 20 gpd per person for 365 days

[4]Assumption of 10 gpd per person for 365 days

[5]Assumption of 5 gpd per person for 365 days

[6]Based on actual metered water use reported annually to DPLU

[7]Residential water use was estimated separately at 0.5 afy per parcel

[8]No water use assumed, located outside the study area

afy - acre-feet per year
DPLU - County of San Diego Department of Planning and Land Use
gpd - gallons per day
ne - not estimated
SWS - small water system

Table 3-9
Barona Indian Reservation Groundwater Demand Estimate

Indian Reservation	Residential				Casinos, Hotels, Golf Courses				Other Existing Uses Water Demand (afy)	Total Estimated Existing Water Demand (afy)	Total Estimated Future Water Demand (afy)
	[1]Existing Reservation Housing Units, Year 2000	[2]Existing Water Demand (afy)	[1]Reservation Housing Units Forecast, Year 2030	[2]Future Water Demand (afy)	[3]Existing Uses	ExistingWater Demand (afy)	Future Uses	Future Water Demand (afy)			
Barona Reservation	162	81	181	91	300,000 sqft casino, 400 room hotel, gas station, golf course, event center, and convention center	476	300,000 sqft casino, 400 room hotel, gas station, golf course, event center, and convention center	476	0	**557**	**567**

afy - acre-feet per year
sqft - square feet
[1]Existing year 2000 and year 2030 housing units for Barona Indian Reservation were provided by San Diego Association of Governments (SANDAG)
[2]Each home was given a groundwater demand of 0.5 afy

[3]Casino and associated uses water demand estimated from the following references:

Ninyo & Moore, 2000. Second Environmental Evaluation of Off-Reservation Effects of Barona Casino Resort Expansion Project. December 2000.
Civiltec Engineering, Inc., 2002. Report on the Need for Emergency Water Supply. Prepared for Barona Tribal Water Authority. May 28, 2002

Table 3-10
Monthly Fractions of Annual Groundwater Demand

Water System Name	Date	Monthly Fraction of Annual Water Use											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Julian Community Services District	2002	5%	5%	6%	8%	8%	10%	14%	13%	6%	10%	6%	8%
	2003	6%	7%	9%	8%	12%	8%	10%	9%	8%	-	-	6%
	2004	8%	9%	8%	7%	10%	9%	12%	9%	11%	8%	5%	5%
	2005	6%	7%	6%	7%	7%	9%	10%	10%	11%	10%	10%	8%
	2002-2005 Average	**6%**	**7%**	**7%**	**7%**	**9%**	**9%**	**11%**	**10%**	**9%**	**9%**	**7%**	**7%**
Pine Valley Mutual Water Company	2001	5%	4%	5%	5%	10%	12%	13%	14%	10%	10%	7%	5%
	2002	5%	5%	5%	7%	9%	13%	14%	15%	10%	8%	6%	4%
	2003	5%	5%	5%	6%	9%	13%	14%	12%	11%	11%	6%	6%
	2004	5%	5%	6%	8%	11%	13%	12%	12%	11%	8%	4%	5%
	2005	5%	4%	5%	6%	10%	12%	13%	11%	12%	8%	7%	7%
	2001-2005 Average	**5%**	**4%**	**5%**	**6%**	**10%**	**12%**	**13%**	**13%**	**11%**	**9%**	**6%**	**5%**
Descanso Community Services District	2001	6%	4%	4%	6%	8%	11%	11%	13%	12%	11%	8%	7%
	2002	6%	6%	8%	7%	11%	12%	12%	12%	10%	7%	5%	4%
	2003	6%	6%	7%	4%	8%	9%	14%	12%	10%	12%	6%	6%
	2004	6%	5%	7%	7%	9%	11%	14%	14%	13%	7%	5%	3%
	2005	6%	4%	5%	6%	9%	9%	15%	11%	11%	9%	9%	7%
	2001-2005 Average	**6%**	**5%**	**6%**	**6%**	**9%**	**11%**	**13%**	**12%**	**11%**	**9%**	**7%**	**6%**
Overall Average from 3 Water Systems		**6%**	**5%**	**6%**	**7%**	**9%**	**11%**	**12%**	**12%**	**10%**	**9%**	**7%**	**6%**

- Not included due to Cedar Fire causing water usage to vary considerably from normal usage.

Table 3-11
Groundwater Storage Capacity Estimates

Hydrogeologic Unit	Estimated Specific Yield	Assumed Saturated Thickness (feet)
Moderately Fractured Crystalline Rock	0.1%	500
Slightly Fractured Crystalline Rock	0.01%	500
Residuum (decomposed granite)	5%	varies, see figure 3-7
Alluvial River Valleys and Basins	10%	varies, see figure 3-7
Coastal Marine and non-Marine Sedimentary Formations	5%	100

Table 3-12
Long-Term Groundwater Availability Results

Basin Name	Estimated Minimum Groundwater in Storage						
	Existing Conditions	Current GP	Referral Map Buildout	Draft Land Use Buildout	GP Update Hybrid Map Buildout	GP Update Environmentally Superior Buildout	Cumulative Impacts Buildout
Ballena	0%	0%	0%	0%	0%	0%	0%
Barona	42%	10%	38%	38%	38%	39%	38%
Barrett	94%	71%	89%	89%	89%	92%	89%
Barrett Lake	99%	97%	98%	98%	98%	99%	98%
Bee Canyon	89%	2%	66%	66%	66%	77%	66%
Boden	92%	80%	88%	91%	90%	91%	88%
Borrego Sink	100%	51%	69%	74%	71%	94%	69%
Cameron	98%	94%	97%	97%	97%	97%	97%
Cannebrake	100%	100%	100%	100%	100%	100%	100%
Canyon City	97%	60%	91%	91%	91%	94%	86%
Carrizo	100%	100%	100%	100%	100%	100%	100%
Chihuahua	98%	84%	96%	97%	97%	97%	96%
Clover Flat	99%	60%	98%	98%	98%	98%	98%
Collins	100%	47%	91%	98%	95%	98%	91%
Combs	98%	78%	89%	96%	96%	96%	89%
Conejos Creek	98%	94%	96%	96%	96%	97%	96%
Cottonwood	99%	98%	99%	99%	99%	99%	99%
Coyote Wells	100%	93%	100%	100%	100%	100%	100%
Cuyamaca	94%	85%	93%	93%	93%	93%	93%
Descanso	89%	78%	85%	85%	85%	86%	85%
Devils Hole	100%	99%	99%	99%	99%	99%	99%
Dodge	99%	87%	98%	98%	98%	98%	98%
East Santa Teresa	94%	89%	89%	92%	90%	92%	85%
El Monte	99%	84%	95%	95%	95%	97%	95%
Engineer Springs	26%	0%	0%	0%	0%	9%	0%
Escondido	93%	5%	74%	74%	74%	84%	74%
Fernbrook	92%	62%	87%	87%	87%	89%	87%
Garnet	100%	93%	99%	99%	99%	99%	99%
Gower	95%	82%	91%	92%	91%	92%	90%
Guatay	0%	0%	0%	0%	0%	0%	0%
Guejito	98%	84%	86%	95%	92%	96%	86%
Hidden	99%	69%	82%	82%	82%	91%	82%
Hill	90%	7%	83%	83%	83%	86%	82%

Table 3-12
Long-Term Groundwater Availability Results

Basin Name	Estimated Minimum Groundwater in Storage						
	Existing Conditions	Current GP	Referral Map Buildout	Draft Land Use Buildout	GP Update Hybrid Map Buildout	GP Update Environmentally Superior Buildout	Cumulative Impacts Buildout
Hipass	92%	**29%**	89%	89%	89%	89%	89%
Hollenbeck	91%	56%	77%	77%	77%	80%	77%
Inaja	75%	**48%**	62%	65%	65%	66%	62%
Jacumba Valley	99%	**1%**	74%	74%	74%	81%	74%
Jamacha	86%	**0%**	60%	64%	64%	73%	60%
Jamul	95%	78%	81%	81%	81%	83%	81%
Japatul	94%	86%	87%	87%	87%	90%	87%
Kimball	95%	89%	93%	93%	93%	93%	93%
La Jolla Amago	94%	86%	88%	91%	91%	91%	88%
Las Lomas Muertas	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
Lee	**36%**	**0%**	**16%**	**16%**	**16%**	**26%**	**17%**
Long Potrero	94%	65%	89%	89%	89%	92%	89%
Loveland	94%	92%	92%	92%	92%	93%	92%
Lower Culp	78%	**4%**	71%	74%	74%	74%	71%
Lower Hatfield	73%	63%	64%	68%	65%	69%	64%
Lyon	78%	**18%**	**50%**	**50%**	**50%**	64%	**50%**
Marron	100%	96%	99%	99%	99%	100%	99%
Mason	100%	89%	99%	99%	99%	99%	99%
McCain	99%	74%	96%	96%	96%	98%	96%
Morena	100%	99%	99%	99%	99%	99%	99%
Morena South	**37%**	**1%**	**0%**	**0%**	**0%**	**0%**	**0%**
Mount Laguna	98%	98%	98%	98%	98%	98%	98%
Otay Valley	100%	98%	99%	99%	99%	99%	99%
Pala	87%	84%	86%	86%	86%	86%	80%
Pamo	99%	74%	95%	97%	97%	97%	95%
Pauma	88%	81%	86%	87%	86%	87%	86%
Pine North	94%	92%	93%	93%	93%	94%	93%
Pine South	63%	**35%**	**37%**	**37%**	**37%**	**43%**	**33%**
Poway	67%	**17%**	55%	55%	55%	61%	55%
Previtt Canyon	95%	70%	93%	94%	94%	94%	93%
Proctor	100%	100%	100%	100%	100%	100%	100%
Ramona	88%	60%	78%	82%	80%	83%	77%

Table 3-12
Long-Term Groundwater Availability Results

Basin Name	Estimated Minimum Groundwater in Storage						
	Existing Conditions	Current GP	Referral Map Buildout	Draft Land Use Buildout	GP Update Hybrid Map Buildout	GP Update Environmentally Superior Buildout	Cumulative Impacts Buildout
Redec	99%	98%	98%	98%	98%	98%	98%
Reed	97%	**0%**	75%	81%	81%	89%	75%
Round Potrero	100%	90%	98%	98%	98%	99%	98%
San Felipe North	98%	**3%**	84%	91%	91%	91%	84%
San Felipe South	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
Santee	99%	96%	99%	99%	99%	99%	99%
Savage	100%	100%	100%	100%	100%	100%	100%
Spencer	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**	**0%**
Sutherland	99%	93%	94%	97%	96%	97%	94%
Tecate	92%	**0%**	80%	83%	83%	86%	82%
Tule Creek	100%	97%	99%	99%	99%	99%	99%
Upper Hatfield	86%	79%	79%	83%	80%	83%	77%
Vail	100%	100%	100%	100%	100%	100%	100%
Vallecito	99%	92%	99%	99%	99%	99%	99%
Viejas	76%	72%	73%	73%	73%	74%	**50%**
Vineyard	84%	54%	63%	79%	74%	79%	63%
Warner	96%	95%	96%	96%	96%	96%	96%
Wash Hollow	95%	89%	89%	93%	91%	93%	89%
West Santa Teresa	88%	76%	76%	82%	82%	82%	75%
Witch Creek	93%	84%	83%	89%	87%	89%	83%
Wolf	100%	100%	100%	100%	100%	100%	100%

Notes:

1. Future predicted change in the amount of groundwater in storage for scenarios is based upon historical precipitation from July 1971 to June 2005. Scenarios with estimated groundwater in storage at or below 50% (highlighted in red) at any time are considered a potentially significant impact to groundwater resources.

2. The results presented are a screening level analysis of each basin and should not be relied upon for any purposes other than the General Plan Update EIR. Please refer to Section 5.2 of this study for limitations associated with these results. Site-specific hydrogeologic investigations are required to evaluate localized impacts to groundwater resources within each basin.

Table 3-13
GP Update Land Uses Adjacent to Other Jurisdictions

Adjacent Entity	General Plan Update Referral Map Land Uses
North of County - Riverside County	National Forest and State Parks
	Rural Lands (RL-40)1 du/40 ac with Forest Conservation Initiative Overlay
	Rural Lands (RL-40) 1du/40 ac
	Open Space (Conservation)
East of County - Imperial County	National Forest and State Parks
	Rural Lands (RL-80), 1du/80 ac
	Rural Lands (RL-40), 1 du/40 ac
	Open Space (Conservation).
South of County - Mexico	**Tecate:** Medium Impact Industrial, General Commercial, Neighborhood Commerical, Rural Lands (RL-40), 1du/40 ac.
	Jacumba: Rural Lands (RL-40), 1du/40 ac, Semi-Rural Residential (SR-1), 1 du/1, 2, 4 ac, Neighborhood Commercial, Public/Semi-Public Facilities.
	All Other Areas: Open Space (Conservation), Rural Lands (RL-40), 1 du/40 ac, Rural Lands (RL-80), 1 du/80 ac.

Table 3-14
GP Update Land Uses Adjacent to Indian Reservations

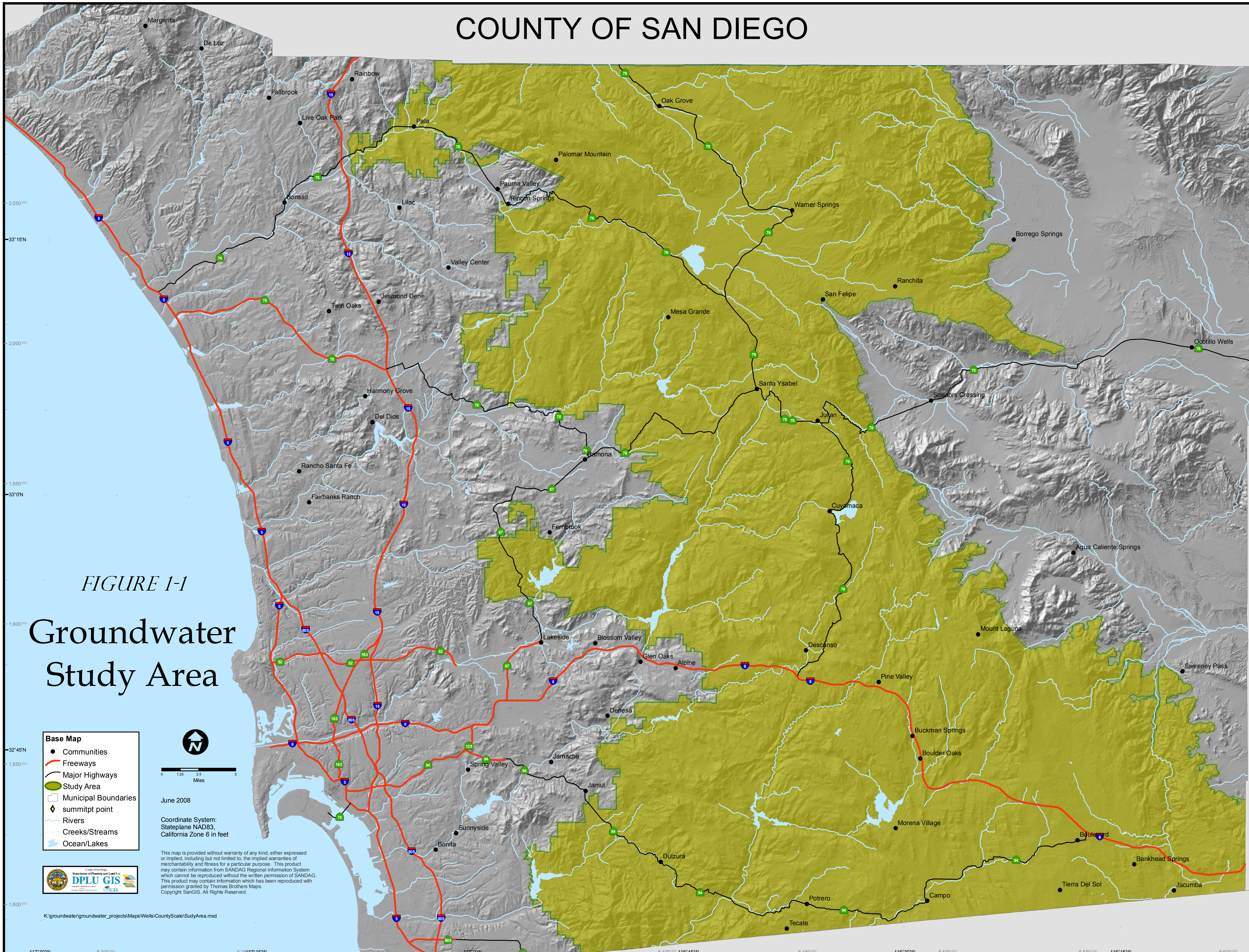
Indian Reservation	General Plan Update Referral Map Land Uses			
	North of Reservation	**South of Reservation**	**West of Reservation**	**East of Reservation**
Barona Reservation	Mainly served by CWA, Semi-rural Residential (SR-4), 1 du/4,8,16 ac, Open Space (Conservation), Village Residential (VR-2), 2du/ac.	Rural Lands (RL-40), 1 du/40 ac, Open Space (Conservation).	Mainly served by CWA, Semi-rural Residential (SR-10), 1 du/10,20 ac and Rural Lands (RL-40) 1 du/40 ac.	Semi-rural Residential (SR-10), 1 du/10,20 ac, Open Space (Conservation), Rural Lands (RL-80) 1 du/80 ac with Forest Conservation Initiative Overlay, Rural Lands (RL-40), 1 du/40 ac.
Campo Reservation	Rural Lands (RL-80), 1 du/80 ac, Rural Lands (RL-20), 1 du/20 ac, Rural Lands (RL-40), 1 du/40 ac.	Rural Lands (RL-80), 1 du/80 ac, Semi-rural Residential (SR-10), 1 du/10,20 ac., Semi-Rural (RL-4), 1 du/4, 8, 16 ac.	Rural Lands (RL-80), 1 du/80 ac, Rural Lands (RL-20), 1 du/20 ac, Rural Lands (RL-40), 1 du/40 ac, Open Space (Conservation).	Rural Lands, (RL-80) 1 du/80 ac, Rural Lands, (RL-40) 1 du/40 ac.
Capitan Grande Reservation	**Section 1**: National Forest and State Parks, Open Space (Conservation). **Section 2:** National Forest and State Parks, Open Space (Conservation), Rural Lands, (RL-80), 1 du/80 ac.	**Section 1:** Open Space (Conservation). **Section 2:** National Forest and State Parks, Open Space (Conservation), Rural Lands (RL-40), 1 du/40 ac.	**Section 1:** National Forest and State Parks, Open Space (Conservation), Rural Lands (RL-80), 1 du/80 ac with Forest Conservation Initiative Overlay. **Section 2:** Rural Lands (RL-80), 1 du/80 ac, National Forest and State Parks, Open Space (Conservation).	**Section 1:** Open Space (Conservation), National Forest and State Parks. **Section 2:** National Forest and State Parks, Rural Lands (RL-80), 1 du/80 ac.
Cuyapaipe Reservation	National Forest and State Parks, Rural Lands (RL-80), 1 du/80 ac.	Open Space (Conservation), National Forest and State Parks, Rural Lands, (RL-80) with Forest Conservation Initiative Overlay, Rural Lands, (RL-80), 1 du/80 ac.	Rural Lands (RL-80), 1 du/80 ac, National Forest and State Parks.	Open Space, (Conservation), Rural Lands, (RL-80), National Forest and State Parks.
Inaja-Cosmit Indian Reservation	Rural Lands (RL-40), 1 du/40 ac with Forest Conservation Initiative Overlay	Rural Lands (RL-80), 1 du/80 ac with Forest Conservation Initiative Overlay	Rural Lands (RL-80), 1 du/80 ac with Forest Conservation Initiative Overlay, National Forest and State Parks.	Rural Lands (RL-80), 1 du/80 ac with Forest Conservation Initiative Overlay, National Forest and State Parks.
La Jolla Reservation	National Forest and State Parks, Rural Lands (RL-40), 1 du/40 ac with Forest Conservation Initiative Overlay, Rural Lands (RL-40), 1 du/40 ac, Semi-rural Residential (SR-10), 1 du/10,20 ac, Rural Lands (RL-20), 1 du/20 ac.	Rural Lands (RL-40), 1 du/40 ac, Open Space (Conservation).	Rural Lands (RL-40), 1 du/40 ac, Semi-rural Residential (SR-10), 1 du/10,20 ac, National Forest and State Parks.	Rural Lands (RL-40), 1 du/40 ac with Forest Conservation Initiative Overlay, Rural Lands (RL-40), 1 du/40 ac, National Forest and State Parks, Semi-rural Residential (SR-10), 1 du/10,20 ac.
La Posta Reservation	Rural Lands (RL-20), 1 du/20 ac, Rural Lands (RL-80), 1 du/80 ac with Forest Conservation Initiative Overlay, Rural Lands (RL-80), 1 du/80 ac, National Forest and State Parks.	Rural Lands (RL-80), 1 du/80 ac, Rural Lands (RL-40), 1 du/40 ac, National Forest and State Parks.	Rural Lands (RL-20), 1 du/20 ac, Rural Lands (RL-40), 1 du/40 ac, Rural Lands (RL-40), 1 du/40 ac with Forest Conservation Initiative Overlay, National Forest and State Parks.	Rural Lands (RL-80), 1 du/80 ac.

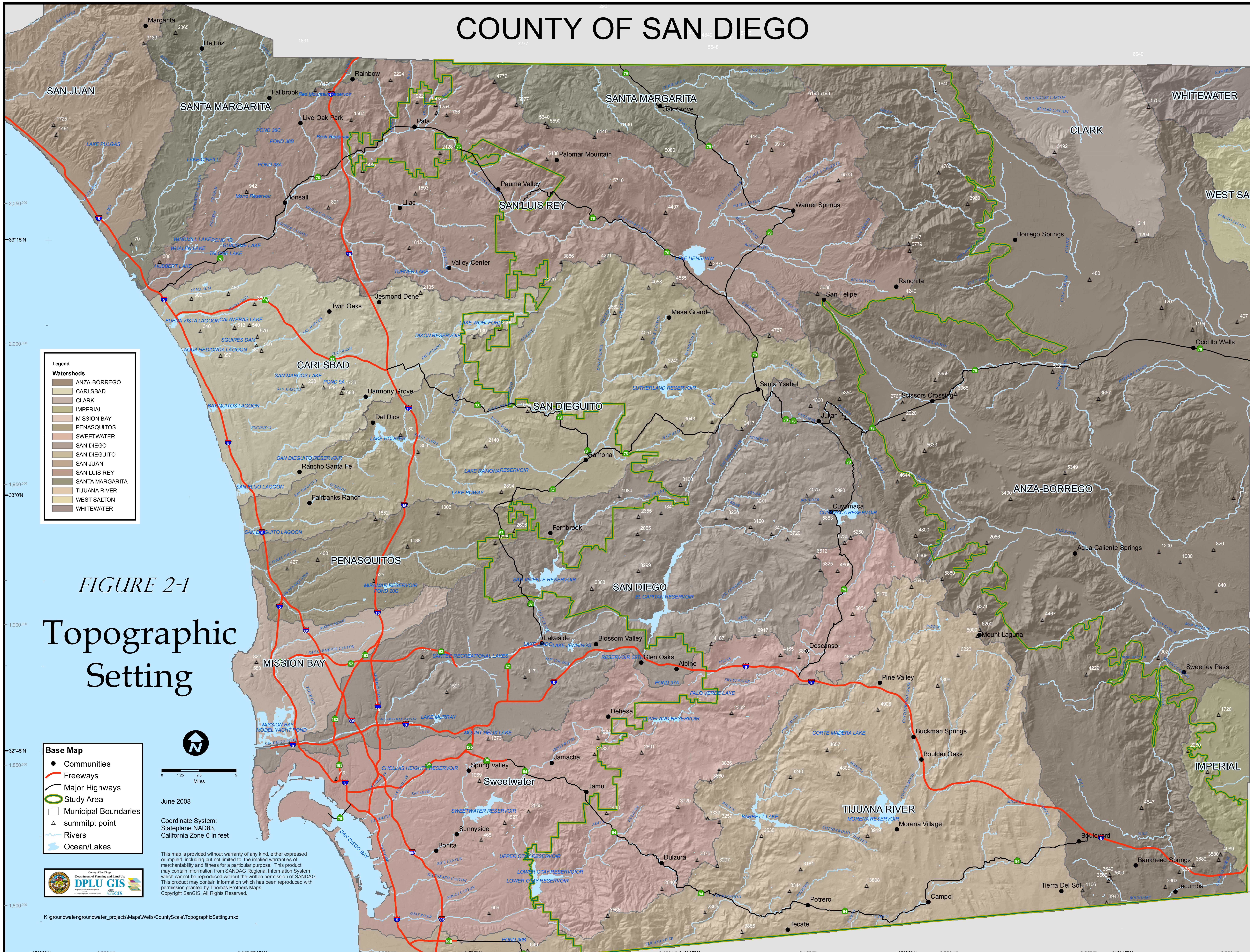
Table 3-14
GP Update Land Uses Adjacent to Indian Reservations

Indian Reservation	General Plan Update Referral Map Land Uses			
	North of Reservation	South of Reservation	West of Reservation	East of Reservation
Los Coyotes Reservation	National Forest and State Parks, Rural Lands (RL-40), 1 du/40 ac.	Rural Lands (RL-40), 1 du/40 ac, Open Space (Conservation), Rural Lands (RL-20), 1 du/20 ac, Specific Plan Area	National Forest and State Parks, Village Residential (VR-2.9), 2.9 du/ac, Specific Plan Area	Rural Lands (RL-40), 1 du/40 ac, National Forest and State Parks.
Manzanita Reservation	Open Space (Conservation)	Rural Lands (RL-80), 1 du/80 ac.	National Forest and State Parks, R ural Lands (RL-80), 1 du/80 ac, Rural Lands (RL-80), 1 du/80 ac with Forest Conservation Initiative Overlay	Rural Lands (RL-80), 1 du/80 ac.
Mesa Grande Reservation	**Section 1:** Rural Lands (RL-40), 1 du/40ac, Semi-rural Residential (SR-10), 1 du/10,20 ac. **Section 2:** Rural Lands (RL-40), 1 du/40 ac. **Section 3:** Rural Lands, (RL-40), 1 du/40ac, Open Space (Conservation).	**Section 1:** Rural Lands (RL-40), 1 du/40 ac, Open Space (Conservation). **Section 2:** Rural Lands (RL-40), 1 du/40 ac, Open Space (Conservation). **Section 3:** Rural Lands (RL-40), 1 du/40 ac.	**Section 1:** Rural Lands (RL-40), 1 du/40 ac. **Section 2**: Rural Lands (RL-40), 1 du/40 ac, Open Space (Conservation). **Section 3:** Rural Lands (RL-40), 1 du/40 ac, Open Space (Conservation).	**Section 1:** Rural Lands (RL-40), 1 du/40 ac, Semi-rural Residential (SR-10), 1 du/10,20 ac. **Section 2:** Rural Lands (RL-40), 1 du/40 ac, Open Space (Conservation). **Section 3:** Rural Lands (RL-40), 1 du/40 ac.
Pala Reservation	Mainly Served by CWA, Rural Lands (RL-40), 1 du/40 ac, Rural Lands (RL-20), 1 du/20 ac, Open Space (Conservation).	Mainly Served by CWA, Rural Lands (RL-40), 1 du/40 ac, Open Space, (Conservation).	Mainly Served by CWA, National Forest and State Parks, Rural Lands (RL-40), 1 du/40 ac, Open Space (Conservation), Rural Lands (RL-20), 1 du/20 ac.	Rural Lands (RL-40), 1 du/40 ac, Rural Lands (RL-20), 1 du/20 ac.
Pauma and Yuma Reservation	National Forest and State Parks, Rural Lands (RL-40), 1 du/40 ac.	Portion Served by CWA, National Forest and State Parks, Rural Lands (RL-40), 1 du/40 ac, Rural Lands (RL-40), 1 du/40 ac with Forest Conservation Initiative Overlay, Semi-rural Residential (SR-10), 1 du/10,20 ac.	Rural Lands (RL-40), 1 du/40 ac, Rural Lands (RL-40), 1 du/40 ac with Forest C onservation Initiative Overlay, Semi-rural Residential, (SR-10), 1 du/10, 20 ac.	National Forest and State Parks, Rural Lands (RL-40), 1 du/40 ac with Forest Conservation Initiative Overlay.
Rincon Reservation	Mainly Served by CWA, Rural Lands (RL-40), 1 du/40 ac., Semi-rural Residential (SR-10), 1 du/10,20 ac.	Mainly Served by CWA, Open Space (Conservation).	Mainly Served by CWA, Rural Lands (RL-40), 1 du/40 ac.	Rural Lands (RL-40), 1 du/40 ac, Open Space (Conservation).
Santa Ysabel Reservation	Rural Lands (RL-40), 1 du/40 ac, Open Space (Conservation).	Rural Lands (RL-40), 1 du/40 ac, Open Space (Conservation).	Rural Lands (RL-40), 1 du/40 ac, Open Space (Conservation).	Rural Lands (RL-40), 1 du/40 ac, Open Space (Conservation).
Viejas Reservation	National Forest and State Parks, Rural Lands (RL-40), 1 du/40 ac, with Forest Conservation Initiative Overlay, Rural Lands, (RL-40), 1 du/40 ac.	Rural Lands (RL-40), 1 du/40 ac, with Forest Conservation Initiative Overlay.	Rural Lands (RL-40), 1 du/40 ac, Rural Lands, (RL-40), 1 du/40 ac, with Forest Conservation Initiative Overlay, National Forest and State Parks.	Rural Lands, (RL-40), 1 du/40 ac, with Forest Conservation Initiative Overlay, National Forest and State Parks.

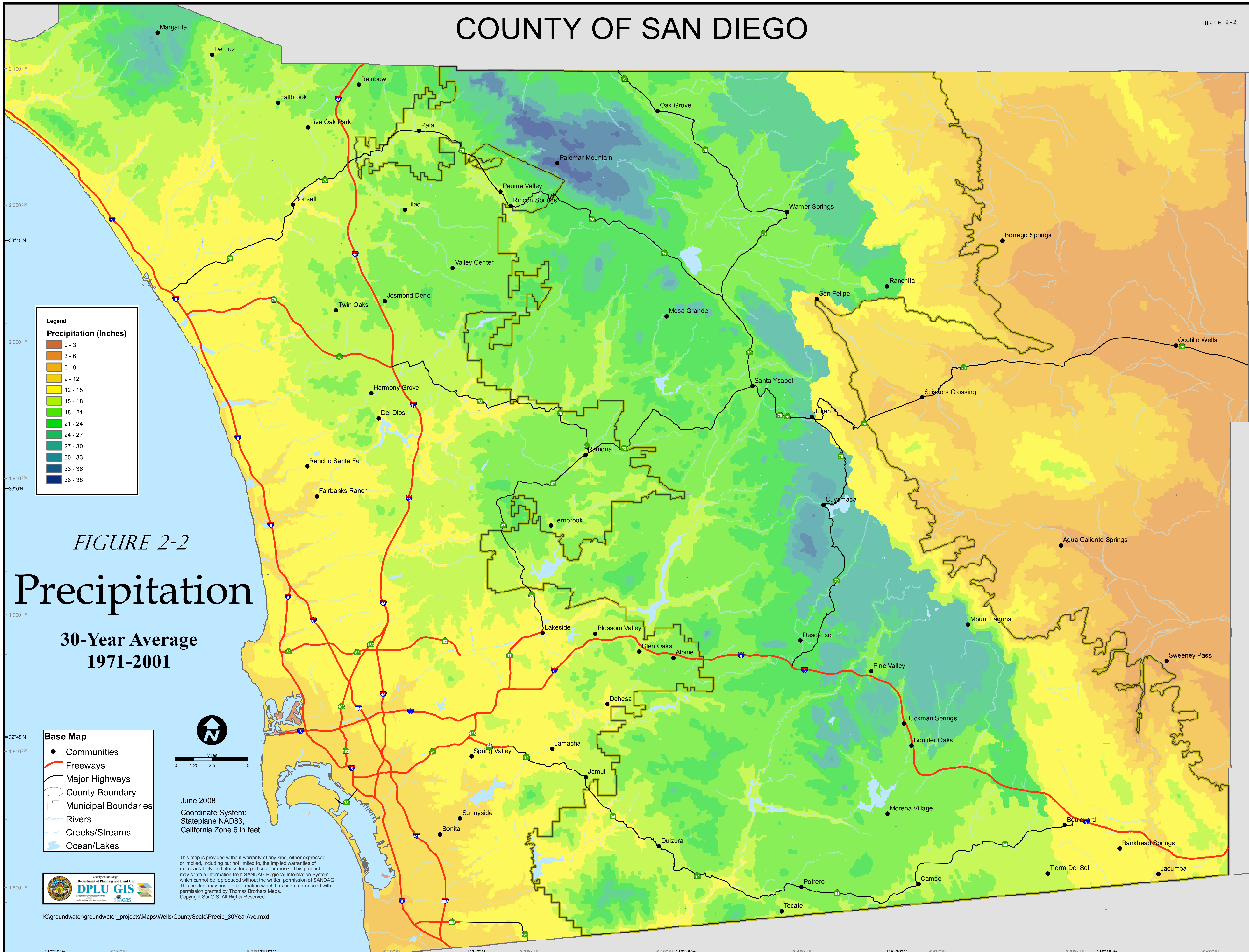
CWA - County Water Authority

Figures


COUNTY OF SAN DIEGO
FIGURE 1-1
Groundwater Study Area
Base Map
Communities
Freeways
Major Highways
Study Area
Municipal Boundaries
summitpt point
Rivers
Creeks/Streams
Ocean/Lakes
N
0 1.25 2.5 5
Miles
June 2008
Coordinate System:
Stateplane NAD83,
California Zone 6 in feet
This map is provided without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose. This product may contain information from SANDAG Regional Information System which cannot be reproduced without the written permission of SANDAG. This product may contain information which has been reproduced with permission granted by Thomas Brothers Maps.
Copyright SanGIS. All Rights Reserved.
County of San Diego
Department of Planning and Land Use
DPLU GIS
SanGIS
K:\groundwater\groundwater_projects\Maps\Wells\CountyScale\SudyArea.mxd
Margarita
De Luz
Rainbow
Fallbrook
Live Oak Park
Pala
Palomar Mountain
Oak Grove
Pauma Valley
Rincon Springs
Bonsall
Lilac
Warner Springs
Borrego Springs
Valley Center
Ranchita
San Felipe
Jesmond Dene
Twin Oaks
Mesa Grande
Ocotillo Wells
Santa Ysabel
Scissors Crossing
Harmony Grove
Del Dios
Julian
Ramona
Rancho Santa Fe
Fairbanks Ranch
Cuyamaca
Fernbrook
Agua Caliente Springs
Mount Laguna
Lakeside
Blossom Valley
Descanso
Glen Oaks
Alpine
Sweeney Pass
Pine Valley
Dehesa
Buckman Springs
Boulder Oaks
Jamacha
Spring Valley
Jamul
Morena Village
Sunnyside
Bonita
Boulevard
Dulzura
Bankhead Springs
Tierra Del Sol
Jacumba
Potrero
Campo
Tecate
33°15'N
33°0'N
32°45'N
117°30'W
117°15'W
117°0'W
116°45'W
116°30'W
116°15'W

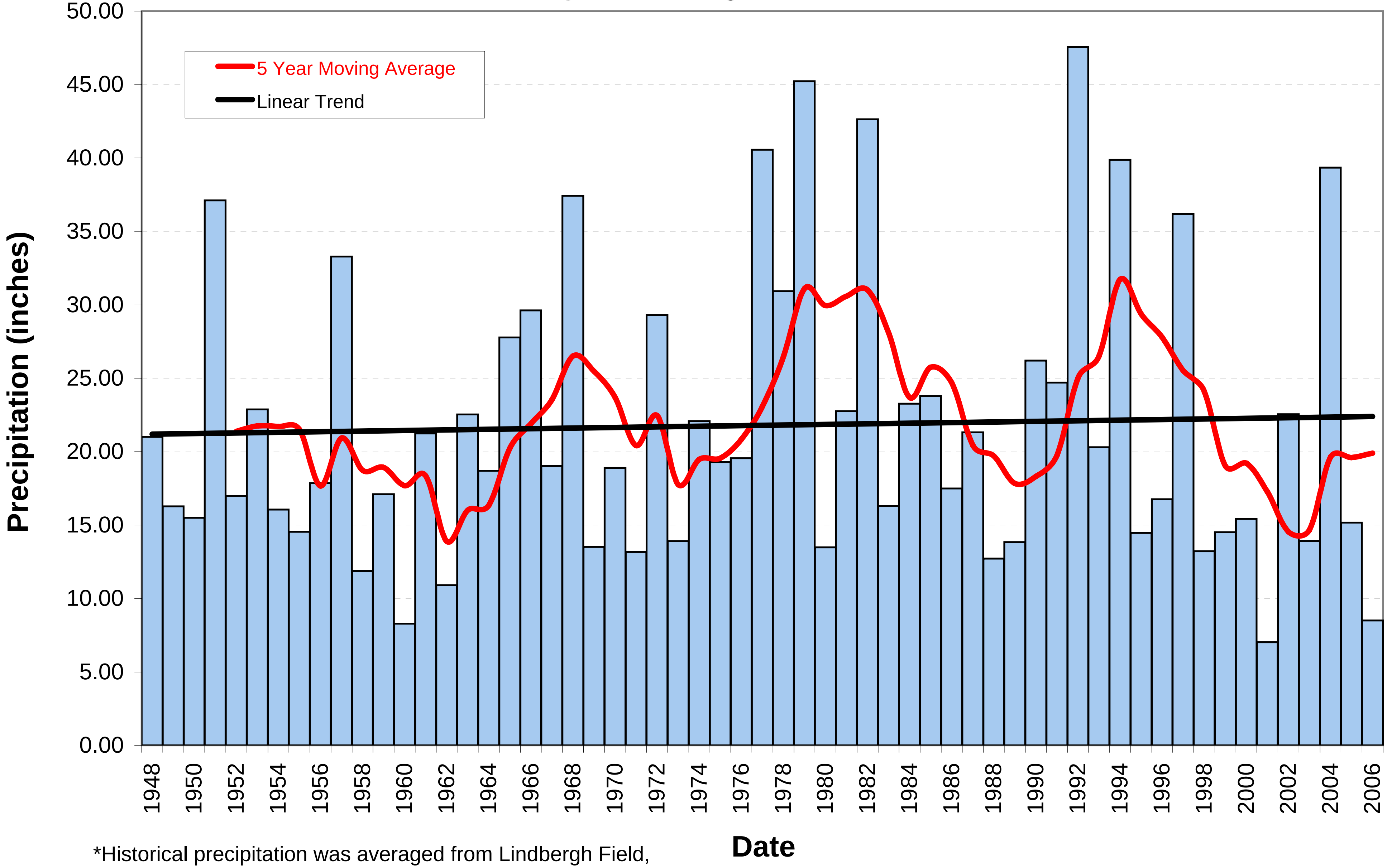


COUNTY OF SAN DIEGO
FIGURE 2-1
Topographic Setting
Legend
Watersheds
ANZA-BORREGO
CARLSBAD
CLARK
IMPERIAL
MISSION BAY
PENASQUITOS
SWEETWATER
SAN DIEGO
SAN DIEGUITO
SAN JUAN
SAN LUIS REY
SANTA MARGARITA
TIJUANA RIVER
WEST SALTON
WHITEWATER
Base Map
Communities
Freeways
Major Highways
Study Area
Municipal Boundaries
summitpt point
Rivers
Ocean/Lakes
0 1.25 2.5 5
Miles
June 2008
Coordinate System:
Stateplane NAD83,
California Zone 6 in feet
This map is provided without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose. This product may contain information from SANDAG Regional Information System which cannot be reproduced without the written permission of SANDAG. This product may contain information which has been reproduced with permission granted by Thomas Brothers Maps.
Copyright SanGIS. All Rights Reserved.
County of San Diego
Department of Planning and Land Use
DPLU GIS
SanGIS
K:\groundwater\groundwater_projects\Maps\Wells\CountyScale\TopographicSetting.mxd
SAN JUAN
SANTA MARGARITA
SAN LUIS REY
CARLSBAD
SAN DIEGUITO
PENASQUITOS
MISSION BAY
SAN DIEGO
Sweetwater
TIJUANA RIVER
ANZA-BORREGO
CLARK
WHITEWATER
WEST SALT
IMPERIAL



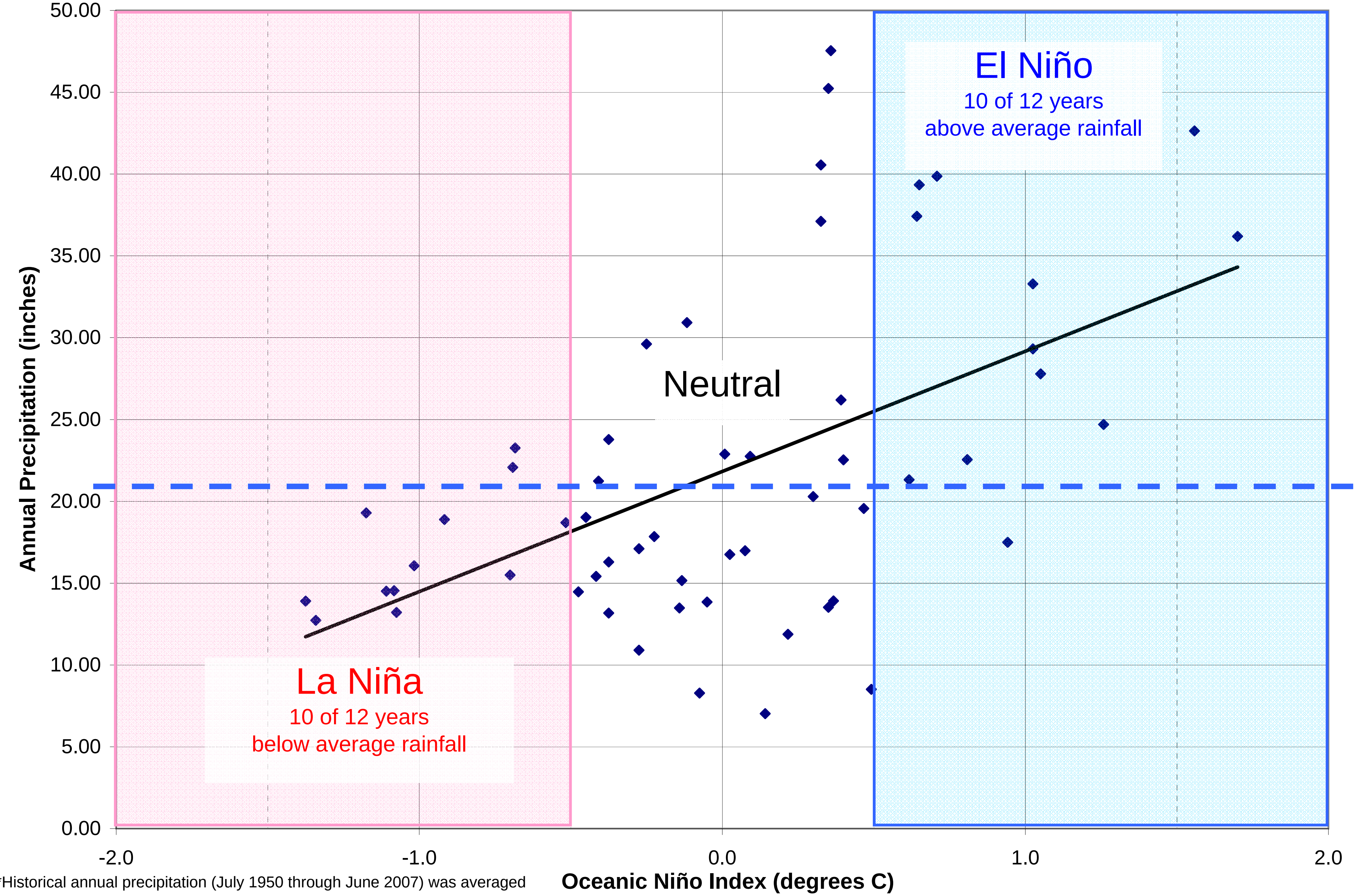
COUNTY OF SAN DIEGO
Figure 2-2
FIGURE 2-2
Precipitation
30-Year Average
1971-2001
Legend
Precipitation (Inches)
0 - 3
3 - 6
6 - 9
9 - 12
12 - 15
15 - 18
18 - 21
21 - 24
24 - 27
27 - 30
30 - 33
33 - 36
36 - 38
Base Map
Communities
Freeways
Major Highways
County Boundary
Municipal Boundaries
Rivers
Creeks/Streams
Ocean/Lakes
Miles
0
1.25
2.5
5
June 2008
Coordinate System:
Stateplane NAD83,
California Zone 6 in feet
This map is provided without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose. This product may contain information from SANDAG Regional Information System which cannot be reproduced without the written permission of SANDAG. This product may contain information which has been reproduced with permission granted by Thomas Brothers Maps.
Copyright SanGIS. All Rights Reserved.
DPLU GIS
K:\groundwater\groundwater_projects\Maps\Wells\CountyScale\Precip_30YearAve.mxd
Margarita
De Luz
Rainbow
Fallbrook
Live Oak Park
Pala
Oak Grove
Palomar Mountain
Pauma Valley
Rincon Springs
Bonsall
Lilac
Warner Springs
Borrego Springs
Valley Center
Ranchita
San Felipe
Jesmond Dene
Twin Oaks
Mesa Grande
Ocotillo Wells
Santa Ysabel
Harmony Grove
Scissors Crossing
Del Dios
Julian
Ramona
Rancho Santa Fe
Fairbanks Ranch
Cuyamaca
Fernbrook
Agua Caliente Springs
Lakeside
Blossom Valley
Mount Laguna
Descanso
Glen Oaks
Alpine
Sweeney Pass
Pine Valley
Dehesa
Buckman Springs
Boulder Oaks
Jamacha
Spring Valley
Jamul
Sunnyside
Morena Village
Bonita
Boulevard
Dulzura
Bankhead Springs
Tierra Del Sol
Jacumba
Potrero
Campo
Tecate
33°15'N
33°0'N
32°45'N
117°30'W
117°15'W
117°0'W
116°45'W
116°30'W
116°15'W

Figure 2-3
***Annual Precipitation**
July 1948 through June 2007

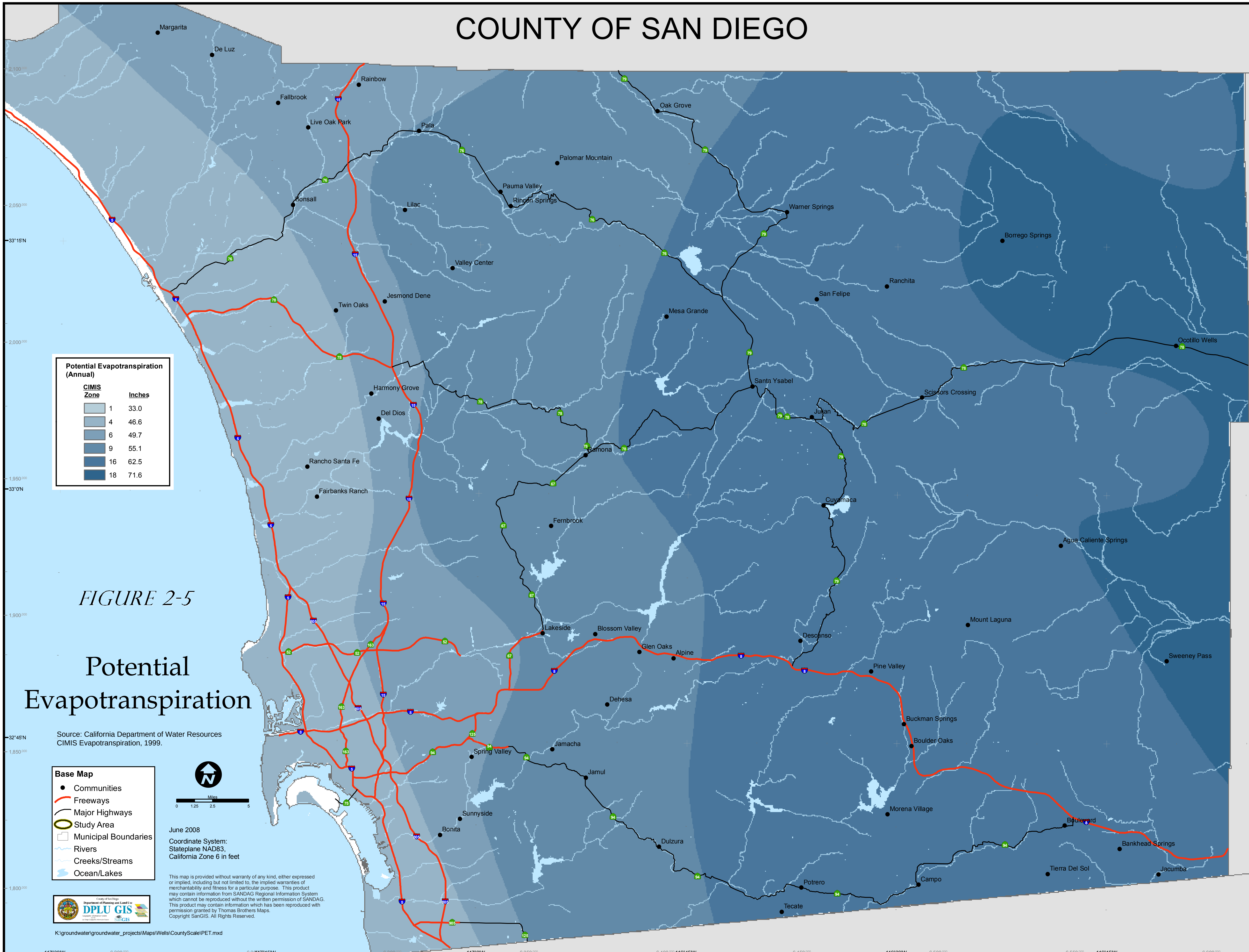


*Historical precipitation was averaged from Lindbergh Field, Lake Henshaw, Cuyamaca, Campo, and Palomar Observatory rainfall stations

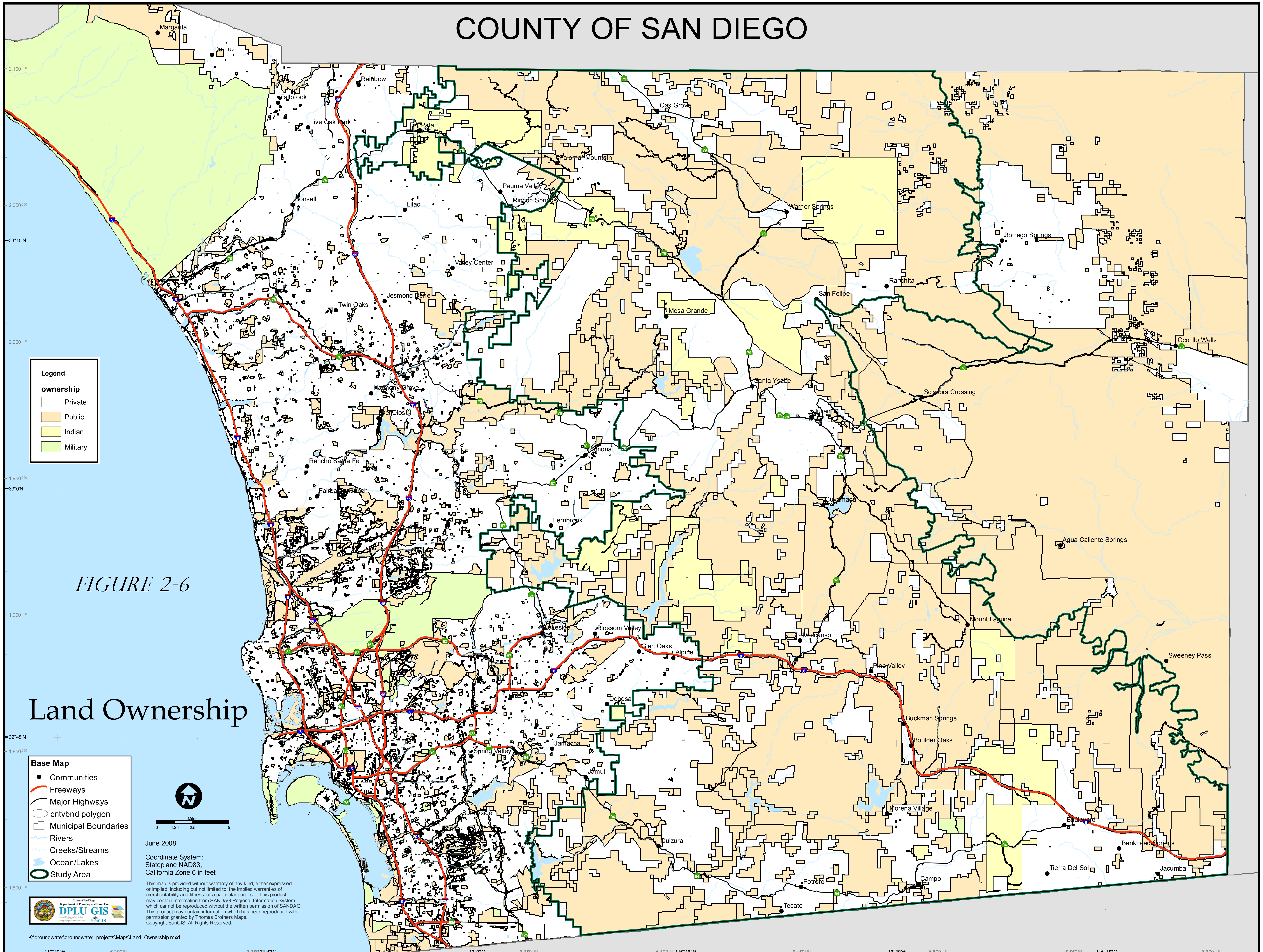
Figure 2-4: Comparison of El Niño/La Niña Cycles to *Annual Precipitation

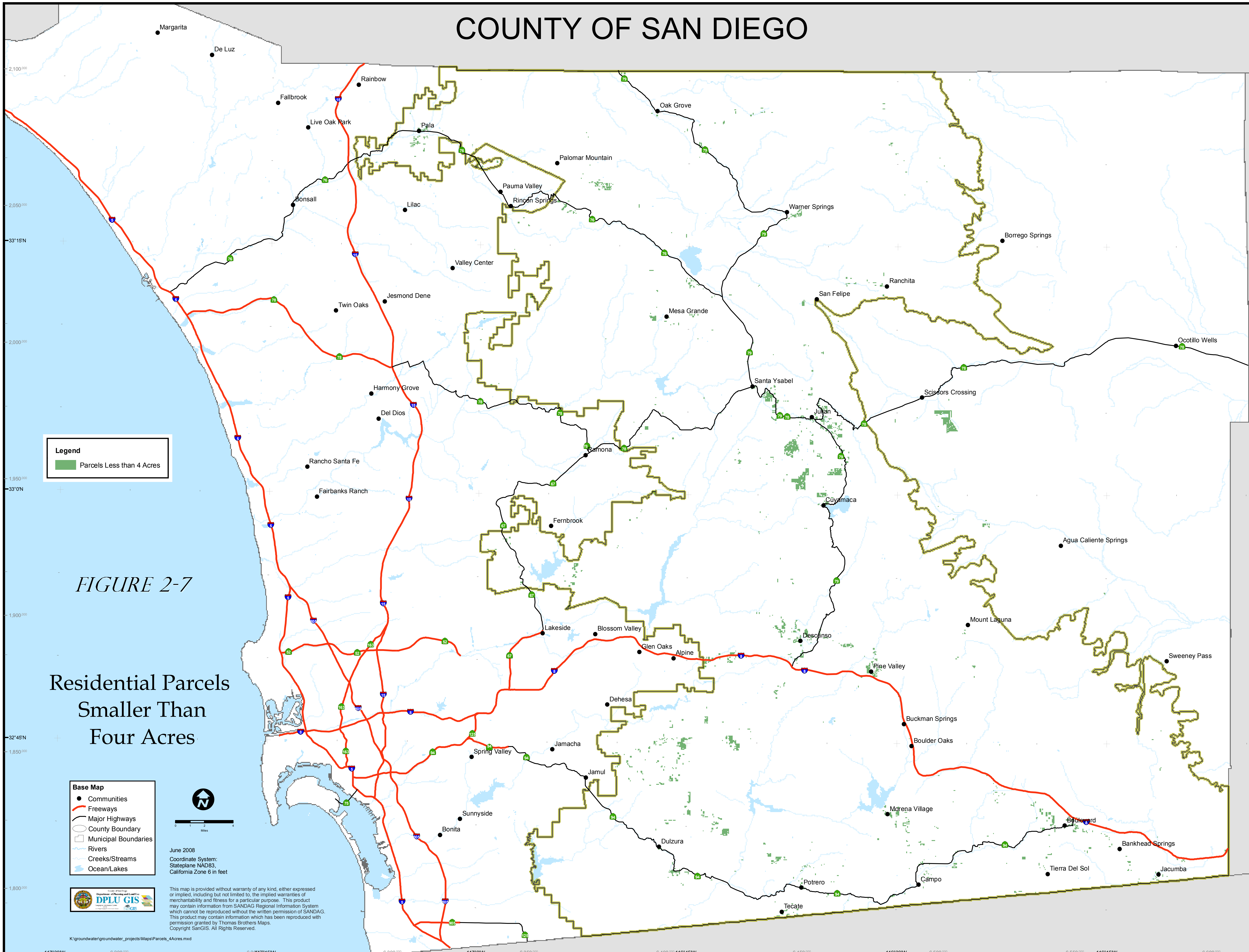


*Historical annual precipitation (July 1950 through June 2007) was averaged from Lindbergh Field, Lake Henshaw, Cuyamaca, Campo, and Palomar Observatory rainfall stations.

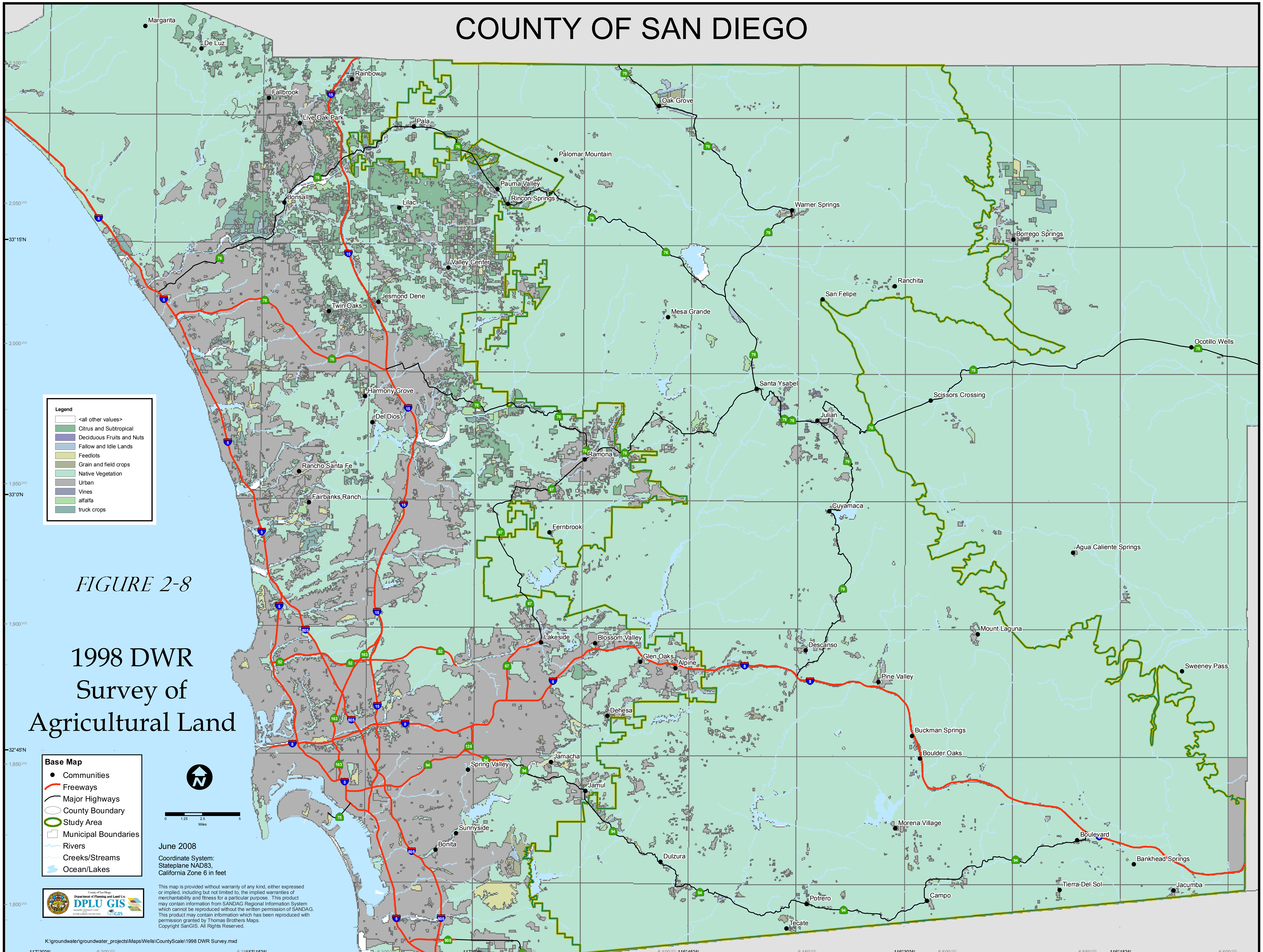


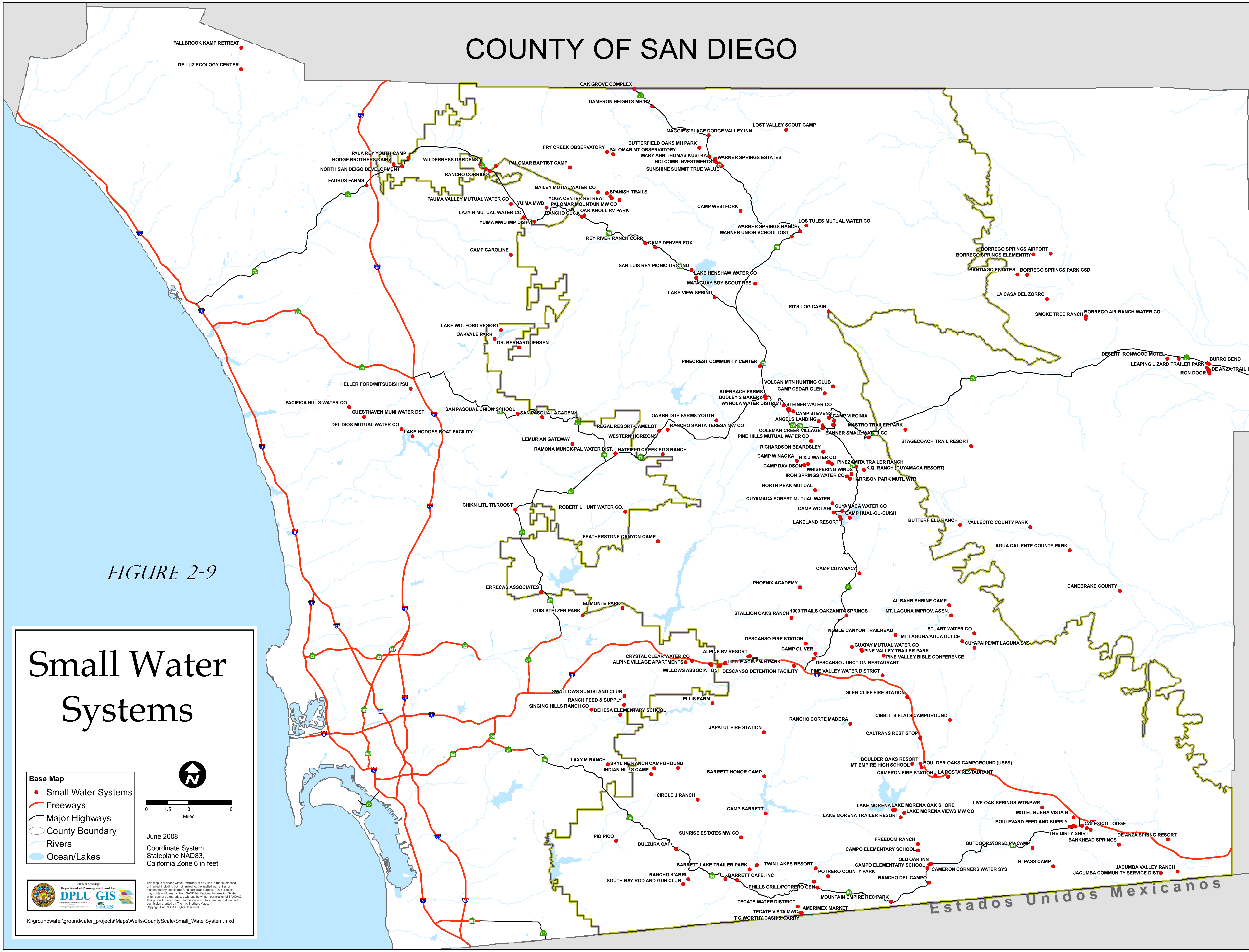
COUNTY OF SAN DIEGO
FIGURE 2-5
Potential Evapotranspiration
Potential Evapotranspiration (Annual)
CIMIS Zone
Inches
1 33.0
4 46.6
6 49.7
9 55.1
16 62.5
18 71.6
Source: California Department of Water Resources
CIMIS Evapotranspiration, 1999.
Base Map
Communities
Freeways
Major Highways
Study Area
Municipal Boundaries
Rivers
Creeks/Streams
Ocean/Lakes
Miles
0 1.25 2.5 5
June 2008
Coordinate System:
Stateplane NAD83,
California Zone 6 in feet
This map is provided without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose. This product may contain information from SANDAG Regional Information System which cannot be reproduced without the written permission of SANDAG. This product may contain information which has been reproduced with permission granted by Thomas Brothers Maps.
Copyright SanGIS. All Rights Reserved.
County of San Diego
Department of Planning and Land Use
DPLU GIS
SanGIS
K:\groundwater\groundwater_projects\Maps\Wells\CountyScale\PET.mxd
Margarita
De Luz
Rainbow
Fallbrook
Live Oak Park
Pala
Oak Grove
Palomar Mountain
Pauma Valley
Rincon Springs
Bonsall
Lilac
Warner Springs
Borrego Springs
Valley Center
Ranchita
Jesmond Dene
Twin Oaks
San Felipe
Mesa Grande
Ocotillo Wells
Santa Ysabel
Scissors Crossing
Harmony Grove
Julian
Del Dios
Ramona
Rancho Santa Fe
Fairbanks Ranch
Cuyamaca
Fernbrook
Agua Caliente Springs
Mount Laguna
Lakeside
Blossom Valley
Descanso
Glen Oaks
Alpine
Sweeney Pass
Pine Valley
Dehesa
Buckman Springs
Boulder Oaks
Jamacha
Spring Valley
Jamul
Morena Village
Sunnyside
Boulevard
Bonita
Dulzura
Bankhead Springs
Tierra Del Sol
Jacumba
Campo
Potrero
Tecate
117°30'W
117°15'W
117°0'W
116°45'W
116°30'W
116°15'W
33°15'N
33°0'N
32°45'N


COUNTY OF SAN DIEGO
FIGURE 2-6
Land Ownership
Legend
ownership
Private
Public
Indian
Military
Base Map
Communities
Freeways
Major Highways
cntybnd polygon
Municipal Boundaries
Rivers
Creeks/Streams
Ocean/Lakes
Study Area
June 2008
Coordinate System:
Stateplane NAD83,
California Zone 6 in feet
This map is provided without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose. This product may contain information from SANDAG Regional Information System which cannot be reproduced without the written permission of SANDAG. This product may contain information which has been reproduced with permission granted by Thomas Brothers Maps.
Copyright SanGIS. All Rights Reserved.
DPLU GIS
K:\groundwater\groundwater_projects\Maps\Land_Ownership.mxd
Margarita
De Luz
Rainbow
Fallbrook
Live Oak Park
Pala
Oak Grove
Palomar Mountain
Pauma Valley
Rincon Springs
Bonsall
Lilac
Warner Springs
Borrego Springs
Valley Center
Ranchita
San Felipe
Jesmond Dene
Twin Oaks
Mesa Grande
Ocotillo Wells
Santa Ysabel
Harmony Grove
Scissors Crossing
Del Dios
Julian
Ramona
Rancho Santa Fe
Fairbanks Ranch
Cuyamaca
Fernbrook
Agua Caliente Springs
Mount Laguna
Lakeside
Blossom Valley
Glen Oaks
Alpine
Descanso
Pine Valley
Sweeney Pass
Dehesa
Buckman Springs
Boulder Oaks
Jamacha
Spring Valley
Jamul
Morena Village
Boulevard
Bankhead Springs
Dulzura
Tierra Del Sol
Jacumba
Campo
Potrero
Tecate
117°30'W
117°15'W
117°0'W
116°45'W
116°30'W
116°15'W
33°15'N
33°0'N
32°45'N



COUNTY OF SAN DIEGO
FIGURE 2-7
Residential Parcels Smaller Than Four Acres
Legend
Parcels Less than 4 Acres
Base Map
Communities
Freeways
Major Highways
County Boundary
Municipal Boundaries
Rivers
Creeks/Streams
Ocean/Lakes
Miles
June 2008
Coordinate System:
Stateplane NAD83,
California Zone 6 in feet
This map is provided without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose. This product may contain information from SANDAG Regional Information System which cannot be reproduced without the written permission of SANDAG. This product may contain information which has been reproduced with permission granted by Thomas Brothers Maps. Copyright SanGIS. All Rights Reserved.
DPLU GIS
K:\groundwater\groundwater_projects\Maps\Parcels_4Acres.mxd
Margarita
De Luz
Rainbow
Fallbrook
Live Oak Park
Pala
Oak Grove
Palomar Mountain
Pauma Valley
Rincon Springs
Bonsall
Lilac
Warner Springs
Borrego Springs
Valley Center
Ranchita
San Felipe
Jesmond Dene
Twin Oaks
Mesa Grande
Ocotillo Wells
Santa Ysabel
Harmony Grove
Scissors Crossing
Del Dios
Julian
Ramona
Rancho Santa Fe
Fairbanks Ranch
Cuyamaca
Fernbrook
Agua Caliente Springs
Lakeside
Blossom Valley
Mount Laguna
Descanso
Glen Oaks
Alpine
Sweeney Pass
Pine Valley
Dehesa
Buckman Springs
Boulder Oaks
Jamacha
Spring Valley
Jamul
Sunnyside
Morena Village
Bonita
Boulevard
Dulzura
Bankhead Springs
Tierra Del Sol
Jacumba
Potrero
Campo
Tecate
33°15'N
33°0'N
32°45'N
117°30'W
117°15'W
117°0'W
116°45'W
116°30'W
116°15'W


COUNTY OF SAN DIEGO
FIGURE 2-8
1998 DWR Survey of Agricultural Land
Legend
<all other values>
Citrus and Subtropical
Deciduous Fruits and Nuts
Fallow and Idle Lands
Feedlots
Grain and field crops
Native Vegetation
Urban
Vines
alfalfa
truck crops
Base Map
Communities
Freeways
Major Highways
County Boundary
Study Area
Municipal Boundaries
Rivers
Creeks/Streams
Ocean/Lakes
Miles
June 2008
Coordinate System:
Stateplane NAD83,
California Zone 6 in feet
This map is provided without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose. This product may contain information from SANDAG Regional Information System which cannot be reproduced without the written permission of SANDAG. This product may contain information which has been reproduced with permission granted by Thomas Brothers Maps.
Copyright SanGIS. All Rights Reserved.
County of San Diego
Department of Planning and Land Use
DPLU GIS
SanGIS
K:\groundwater\groundwater_projects\Maps\Wells\CountyScale\1998 DWR Survey.mxd
Margarita
De Luz
Rainbow
Fallbrook
Live Oak Park
Pala
Oak Grove
Palomar Mountain
Pauma Valley
Rincon Springs
Bonsall
Lilac
Warner Springs
Borrego Springs
Valley Center
Ranchita
Jesmond Dene
San Felipe
Twin Oaks
Mesa Grande
Ocotillo Wells
Santa Ysabel
Scissors Crossing
Harmony Grove
Julian
Del Dios
Ramona
Rancho Santa Fe
Fairbanks Ranch
Cuyamaca
Fernbrook
Agua Caliente Springs
Mount Laguna
Lakeside
Blossom Valley
Descanso
Glen Oaks
Alpine
Sweeney Pass
Pine Valley
Dehesa
Buckman Springs
Boulder Oaks
Jamacha
Spring Valley
Jamul
Morena Village
Sunnyside
Boulevard
Bonita
Dulzura
Bankhead Springs
Tierra Del Sol
Jacumba
Potrero
Campo
Tecate
117°30'W
117°15'W
117°0'W
116°45'W
116°30'W
116°15'W
33°15'N
33°0'N
32°45'N



COUNTY OF SAN DIEGO
FIGURE 2-9
Small Water Systems
Base Map
Small Water Systems
Freeways
Major Highways
County Boundary
Rivers
Ocean/Lakes
0
1.5
3
6
Miles
June 2008
Coordinate System:
Stateplane NAD83,
California Zone 6 in feet
DPLU GIS
SanGIS
K:\groundwater\groundwater_projects\Maps\Wells\CountyScale\Small_WaterSystem.mxd
Estados Unidos Mexicanos
FALLBROOK KAMP RETREAT
DE LUZ ECOLOGY CENTER
OAK GROVE COMPLEX
DAMERON HEIGHTS MH/RV
LOST VALLEY SCOUT CAMP
MAGGIE'S PLACE DODGE VALLEY INN
BUTTERFIELD OAKS MH PARK
FRY CREEK OBSERVATORY
PALOMAR MT OBSERVATORY
MARY ANN THOMAS KUSTKA
WARNER SPRINGS ESTATES
HOLCOMB INVESTMENTS
SUNSHINE SUMMIT TRUE VALUE
PALA REY YOUTH CAMP
HODGE BROTHERS DAIRY
WILDERNESS GARDENS
PALOMAR BAPTIST CAMP
NORTH SAN DEIGO DEVELOPMENT
RANCHO CORRIDO
FAUBUS FARMS
BAILEY MUTUAL WATER CO
SPANISH TRAILS
PAUMA VALLEY MUTUAL WATER CO
YOGA CENTER RETREAT
YUIMA MWD
PALOMAR MOUNTAIN MW CO
CAMP WESTFORK
LAZY H MUTUAL WATER CO
RANCHO CUCA
OAK KNOLL RV PARK
YUIMA MWD IMP DIST A
LOS TULES MUTUAL WATER CO
WARNER SPRINGS RANCH
WARNER UNION SCHOOL DIST.
REY RIVER RANCH CORP
CAMP DENVER FOX
CAMP CAROLINE
BORREGO SPRINGS AIRPORT
BORREGO SPRINGS ELEMENTRY
SAN LUIS REY PICNIC GROUND
LAKE HENSHAW WATER CO
SANTIAGO ESTATES
BORREGO SPRINGS PARK CSD
MATAGUAY BOY SCOUT RES.
LAKE VIEW SPRING
LA CASA DEL ZORRO
RD'S LOG CABIN
SMOKE TREE RANCH
BORREGO AIR RANCH WATER CO
LAKE WOLFORD RESORT
OAKVALE PARK
DR. BERNARD JENSEN
DESERT IRONWOOD MOTEL
BURRO BEND
LEAPING LIZARD TRAILER PARK
DE ANZA TRAIL INN
IRON DOOR
PINECREST COMMUNITY CENTER
HELLER FORD/MITSUBISHI/SU
VOLCAN MTN HUNTING CLUB
CAMP CEDAR GLEN
AUERBACH FARMS
DUDLEY'S BAKERY
PACIFICA HILLS WATER CO
WYNOLA WATER DISTRICT
STEINER WATER CO
SAN PASQUAL UNION SCHOOL
QUESTHAVEN MUNI WATER DST
SAN PASQUAL ACADEMY
CAMP STEVENS
OAKBRIDGE FARMS YOUTH
CAMP VIRGINIA
ANGELS LANDING
DEL DIOS MUTUAL WATER CO
REGAL RESORT-CAMELOT
RANCHO SANTA TERESA MW CO
MASTRO TRAILER PARK
LAKE HODGES BOAT FACILITY
COLEMAN CREEK VILLAGE
BANNER SMALL WATER CO
WESTERN HORIZONS
PINE HILLS MUTUAL WATER CO
LEMURIAN GATEWAY
STAGECOACH TRAIL RESORT
RICHARDSON BEARDSLEY
RAMONA MUNCICPAL WATER DIST.
HATFIELD CREEK EGG RANCH
CAMP WINACKA
H & J WATER CO
PINEZAMITA TRAILER RANCH
CAMP DAVIDSON
WHISPERING WINDS
K.Q. RANCH (CUYAMACA RESORT)
IRON SPRINGS WATER CO
HARRISON PARK MUTL WTR
NORTH PEAK MUTUAL
CUYAMACA FOREST MUTUAL WATER
CHIKN LITL TR/ROOST
ROBERT L HUNT WATER CO.
CUYAMACA WATER CO
CAMP WOLAHI
CAMP HUAL-CU-CUISH
LAKELAND RESORT
BUTTERFIELD RANCH
VALLECITO COUNTY PARK
FEATHERSTONE CANYON CAMP
AGUA CALIENTE COUNTY PARK
CAMP CUYAMACA
PHOENIX ACADEMY
CANEBRAKE COUNTY
ERRECAS ASSOCIATES
AL BAHR SHRINE CAMP
EL MONTE PARK
LOUIS STELZER PARK
STALLION OAKS RANCH
1000 TRAILS OAKZANITA SPRINGS
MT. LAGUNA IMPROV. ASSN.
NOBLE CANYON TRAILHEAD
STUART WATER CO
DESCANSO FIRE STATION
MT LAGUNA/AGUA DULCE
CUYAPAIPE/MT LAGUNA SYS
GUATAY MUTUAL WATER CO
CAMP OLIVER
PINE VALLEY TRAILER PARK
ALPINE RV RESORT
PINE VALLEY BIBLE CONFERENCE
CRYSTAL CLEAR WATER CO
ALPINE VILLAGE APARTMENTS
LITTLE ACRE M/H PARK
DESCANSO JUNCTION RESTAURANT
WILLOWS ASSOCIATION
DESCANSO DETENTION FACILITY
PINE VALLEY WATER DISTRICT
GLEN CLIFF FIRE STATION
SWALLOWS SUN ISLAND CLUB
RANCH FEED & SUPPLY
ELLIS FARM
SINGING HILLS RANCH CO
DEHESA ELEMENTARY SCHOOL
CIBBITTS FLATS CAMPGROUND
RANCHO CORTE MADERA
JAPATUL FIRE STATION
CALTRANS REST STOP
BOULDER OAKS RESORT
MT EMPIRE HIGH SCHOOL
BOULDER OAKS CAMPGROUND (USFS)
LAXY M RANCH
SKYLINE RANCH CAMPGROUND
INDIAN HILLS CAMP
BARRETT HONOR CAMP
CAMERON FIRE STATION
LA POSTA RESTAURANT
CIRCLE J RANCH
LAKE MORENA LAKE MORENA OAK SHORE
LIVE OAK SPRINGS WTR/PWR
CAMP BARRETT
LAKE MORENA VIEWS MW CO
MOTEL BUENA VISTA BL
LAKE MORENA TRAILER RESORT
BOULEVARD FEED AND SUPPLY
CALEXICO LODGE
SUNRISE ESTATES MW CO
THE DIRTY SHIRT
DE ANZA SPRING RESORT
PIO PICO
FREEDOM RANCH
OUTDOOR WORLD RV CAMP
BANKHEAD SPRINGS
DULZURA CAFE
CAMPO ELEMENTARY SCHOOL
OLD OAK INN
HI PASS CAMP
BARRETT LAKE TRAILER PARK
TWIN LAKES RESORT
CAMPO ELEMENTARY SCHOOL
CAMERON CORNERS WATER SYS
JACUMBA VALLEY RANCH
POTRERO COUNTY PARK
JACUMBA COMMUNITY SERVICE DIST
RANCHO K'ABRI
BARRETT CAFE, INC
RANCHO DEL CAMPO
SOUTH BAY ROD AND GUN CLUB
PHILLS GRILL/POTRERO GEN
MOUNTAIN EMPIRE REC PARK
TECATE WATER DISTRICT
AMERIMEX MARKET
TECATE VISTA MWC
T C WORTHY CASH & CARRY

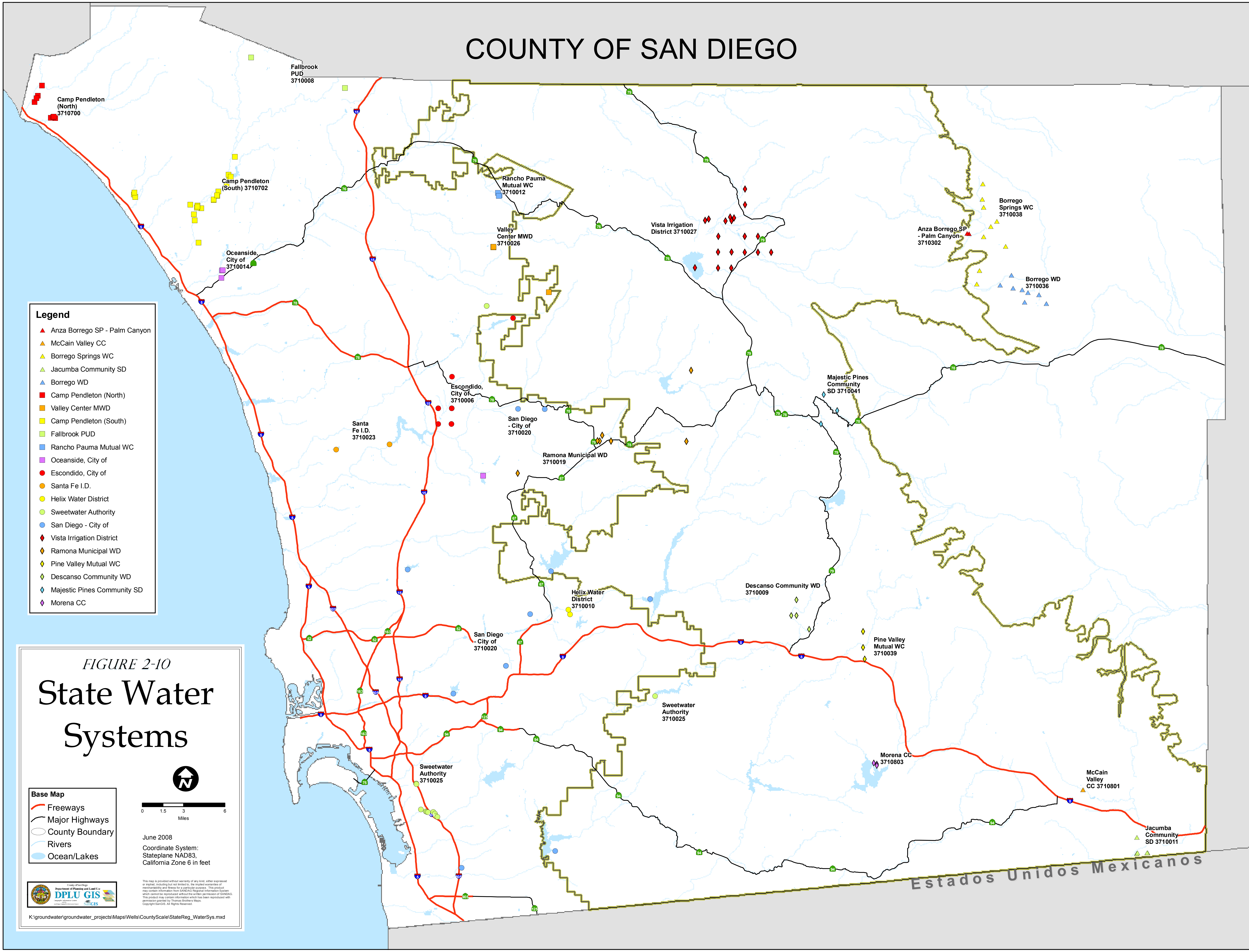
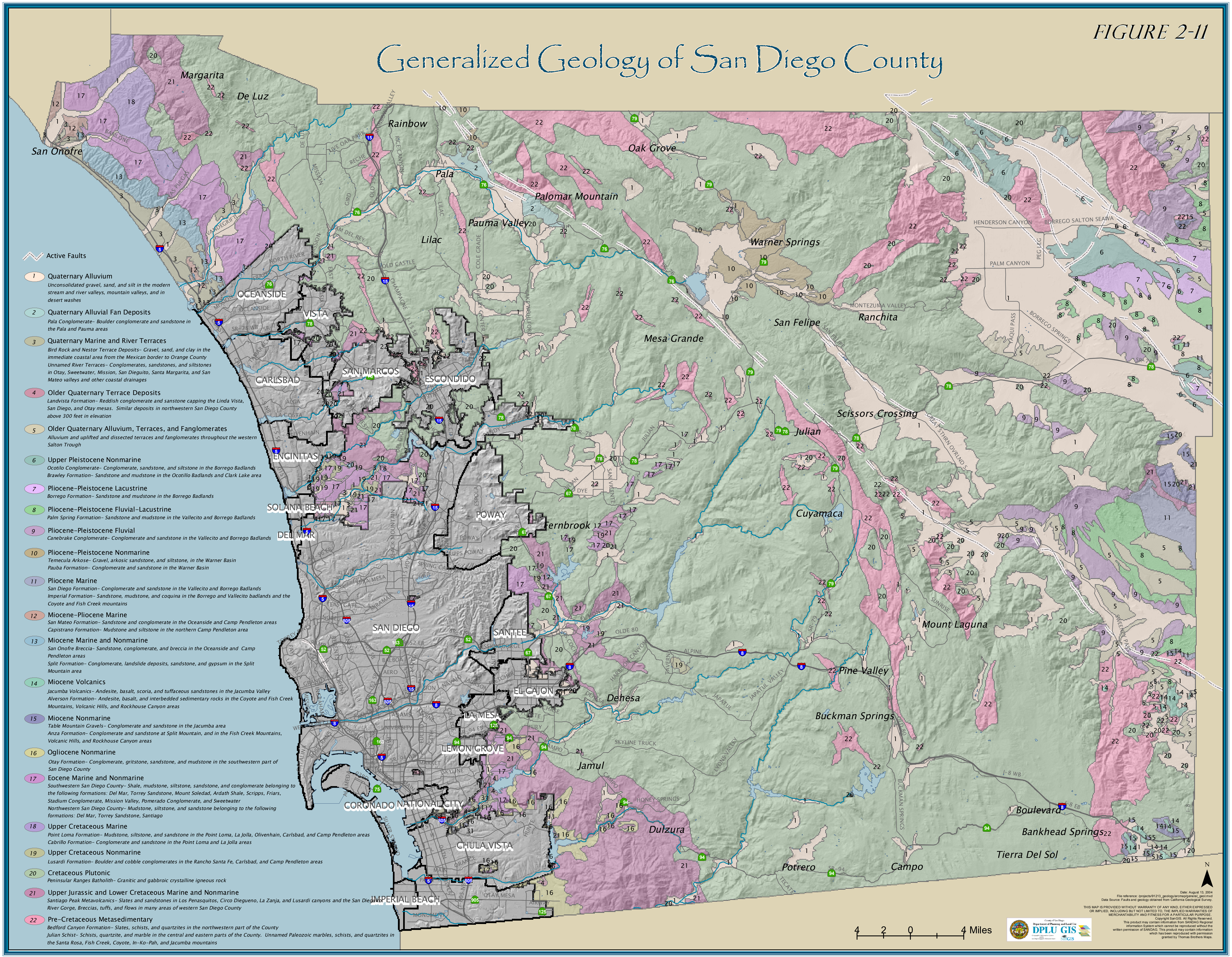
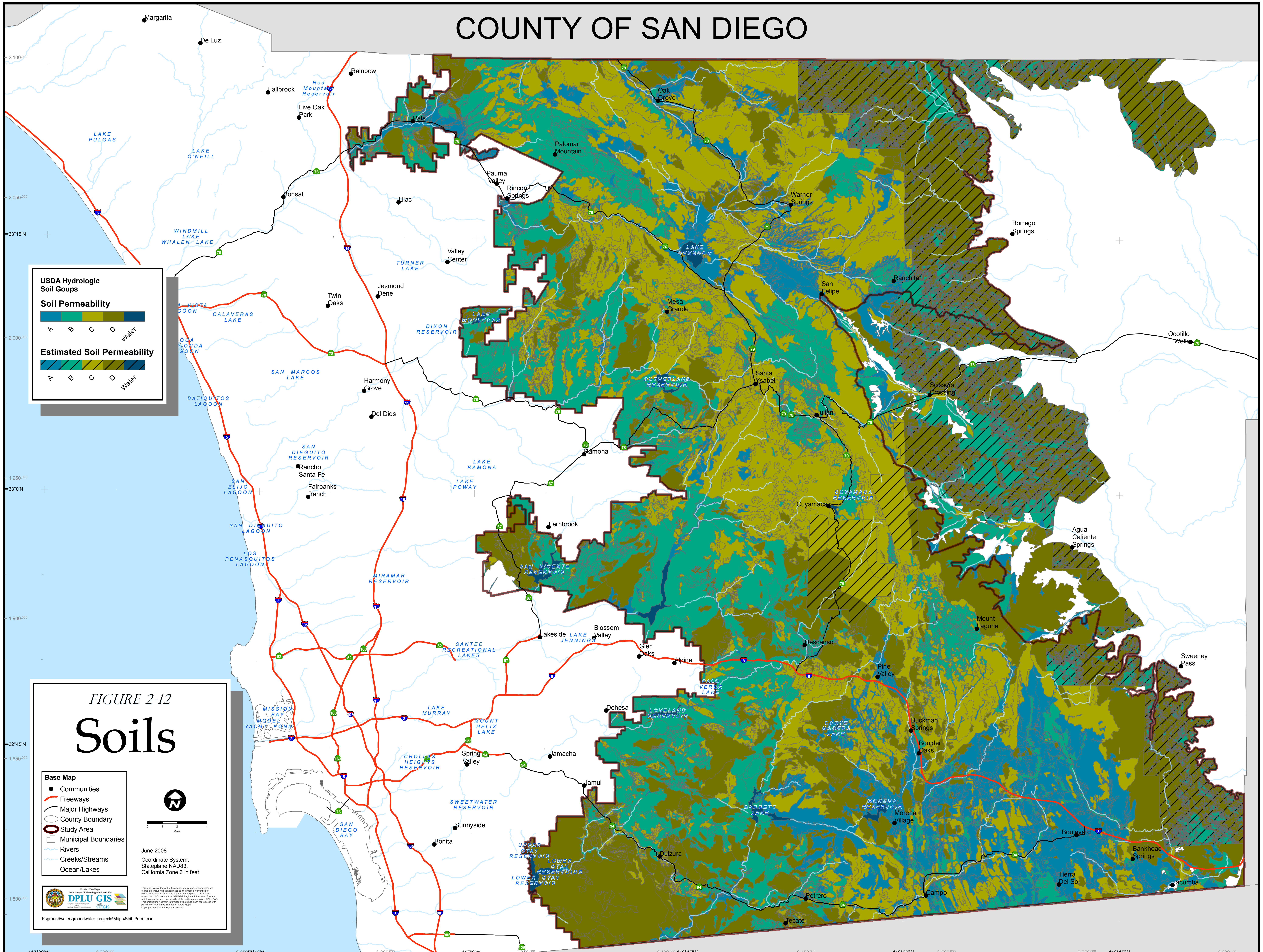
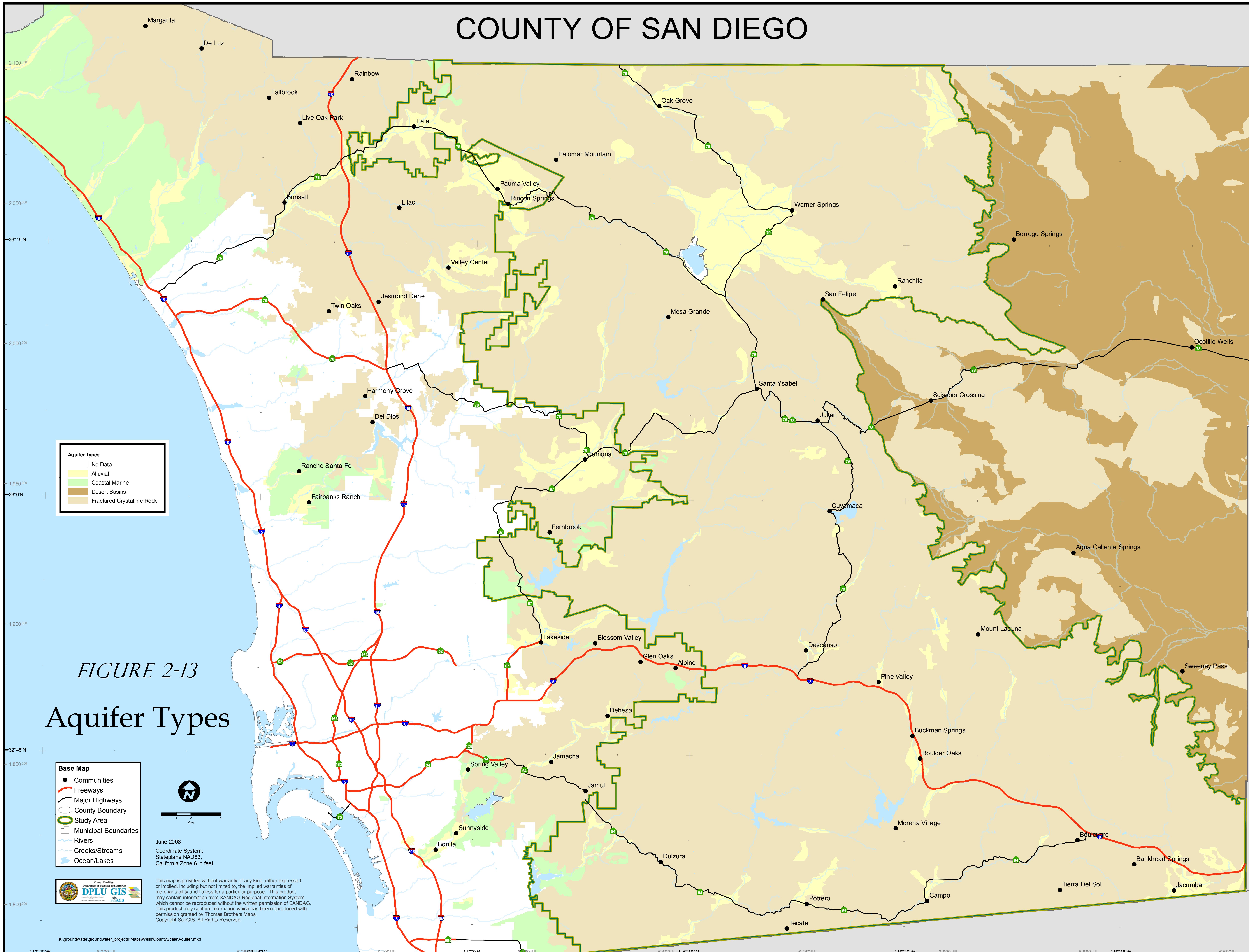

COUNTY OF SAN DIEGO
Camp Pendleton (North) 3710700
Fallbrook PUD 3710008
Camp Pendleton (South) 3710702
Oceanside, City of 3710014
Rancho Pauma Mutual WC 3710012
Valley Center MWD 3710026
Vista Irrigation District 3710027
Anza Borrego SP - Palm Canyon 3710302
Borrego Springs WC 3710038
Borrego WD 3710036
Majestic Pines Community SD 3710041
Escondido, City of 3710006
Santa Fe I.D. 3710023
San Diego - City of 3710020
Ramona Municipal WD 3710019
Helix Water District 3710010
Descanso Community WD 3710009
Pine Valley Mutual WC 3710039
Sweetwater Authority 3710025
Morena CC 3710803
McCain Valley CC 3710801
Jacumba Community SD 3710011
Estados Unidos Mexicanos
Legend
Anza Borrego SP - Palm Canyon
McCain Valley CC
Borrego Springs WC
Jacumba Community SD
Borrego WD
Camp Pendleton (North)
Valley Center MWD
Camp Pendleton (South)
Fallbrook PUD
Rancho Pauma Mutual WC
Oceanside, City of
Escondido, City of
Santa Fe I.D.
Helix Water District
Sweetwater Authority
San Diego - City of
Vista Irrigation District
Ramona Municipal WD
Pine Valley Mutual WC
Descanso Community WD
Majestic Pines Community SD
Morena CC
FIGURE 2-10
State Water Systems
Base Map
Freeways
Major Highways
County Boundary
Rivers
Ocean/Lakes
0 1.5 3 6
Miles
June 2008
Coordinate System:
Stateplane NAD83,
California Zone 6 in feet
DPLU GIS
K:\groundwater\groundwater_projects\Maps\Wells\CountyScale\StateReg_WaterSys.mxd

FIGURE 2-11

Generalized Geology of San Diego County




COUNTY OF SAN DIEGO
USDA Hydrologic Soil Goups
Soil Permeability
A B C D Water
Estimated Soil Permeability
A B C D Water
FIGURE 2-12
Soils
Base Map
Communities
Freeways
Major Highways
County Boundary
Study Area
Municipal Boundaries
Rivers
Creeks/Streams
Ocean/Lakes
Miles
June 2008
Coordinate System: Stateplane NAD83, California Zone 6 in feet
DPLU GIS
K:\groundwater\groundwater_projects\Maps\Soil_Perm.mxd
Margarita
De Luz
Rainbow
Fallbrook
Red Mountain Reservoir
Live Oak Park
Pala
Oak Grove
Palomar Mountain
Pauma Valley
Rincon Springs
Bonsall
Lilac
Warner Springs
Borrego Springs
Valley Center
Lake Henshaw
Ranchita
Jesmond Dene
Twin Oaks
San Felipe
Mesa Grande
Lake Wohlford
Dixon Reservoir
Calaveras Lake
Ocotillo Wells
San Marcos Lake
Harmony Grove
Santa Ysabel
Sutherland Reservoir
Scissors Crossing
Julian
Batiquitos Lagoon
Del Dios
San Dieguito Reservoir
Rancho Santa Fe
Ramona
Lake Ramona
Lake Poway
Fairbanks Ranch
San Elijo Lagoon
Cuyamaca
Cuyamaca Reservoir
Fernbrook
San Dieguito Lagoon
Agua Caliente Springs
Los Penasquitos Lagoon
San Vicente Reservoir
Miramar Reservoir
Mount Laguna
Lakeside
Lake Jennings
Blossom Valley
Santee Recreational Lakes
Glen Oaks
Alpine
Descanso
Sweeney Pass
Pine Valley
Lake Murray
Mission Bay
Model Yacht Pond
Dehesa
Loveland Reservoir
Mount Helix Lake
Cuyamaca
Buckman Springs
Corte Madera Lake
Boulder Oaks
Chollas Heights Reservoir
Spring Valley
Jamacha
Jamul
Sweetwater Reservoir
Barrett Lake
Morena Reservoir
Morena Village
San Diego Bay
Sunnyside
Bonita
Boulevard
Upper Otay Reservoir
Lower Otay Reservoir
Dulzura
Bankhead Springs
Tierra Del Sol
Jacumba
Campo
Potrero
Tecate
Lake Pulgas
Lake O'Neill
Windmill Lake
Whalen Lake
Turner Lake
117°30'W
117°15'W
117°0'W
116°45'W
116°30'W
116°15'W
33°15'N
33°0'N
32°45'N



COUNTY OF SAN DIEGO
FIGURE 2-13
Aquifer Types
Aquifer Types
No Data
Alluvial
Coastal Marine
Desert Basins
Fractured Crystalline Rock
Base Map
Communities
Freeways
Major Highways
County Boundary
Study Area
Municipal Boundaries
Rivers
Creeks/Streams
Ocean/Lakes
0
1
2
4
Miles
June 2008
Coordinate System:
Stateplane NAD83,
California Zone 6 in feet
This map is provided without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose. This product may contain information from SANDAG Regional Information System which cannot be reproduced without the written permission of SANDAG. This product may contain information which has been reproduced with permission granted by Thomas Brothers Maps.
Copyright SanGIS. All Rights Reserved.
County of San Diego
Department of Planning and Land Use
DPLU GIS
SanGIS
K:\groundwater\groundwater_projects\Maps\Wells\CountyScale\Aquifer.mxd
Margarita
De Luz
Rainbow
Fallbrook
Live Oak Park
Pala
Oak Grove
Palomar Mountain
Pauma Valley
Rincon Springs
Bonsall
Lilac
Warner Springs
Borrego Springs
Valley Center
Ranchita
San Felipe
Jesmond Dene
Twin Oaks
Mesa Grande
Ocotillo Wells
Santa Ysabel
Harmony Grove
Scissors Crossing
Julian
Del Dios
Ramona
Rancho Santa Fe
Fairbanks Ranch
Cuyamaca
Fernbrook
Agua Caliente Springs
Mount Laguna
Lakeside
Blossom Valley
Descanso
Glen Oaks
Alpine
Sweeney Pass
Pine Valley
Dehesa
Buckman Springs
Boulder Oaks
Jamacha
Spring Valley
Jamul
Morena Village
Sunnyside
Boulevard
Bonita
Dulzura
Bankhead Springs
Tierra Del Sol
Jacumba
Potrero
Campo
Tecate
117°30'W
117°15'W
117°0'W
116°45'W
116°30'W
116°15'W
33°15'N
33°0'N
32°45'N

Figure 2-14: Variability of Well Production in Fractured Rock Aquifers

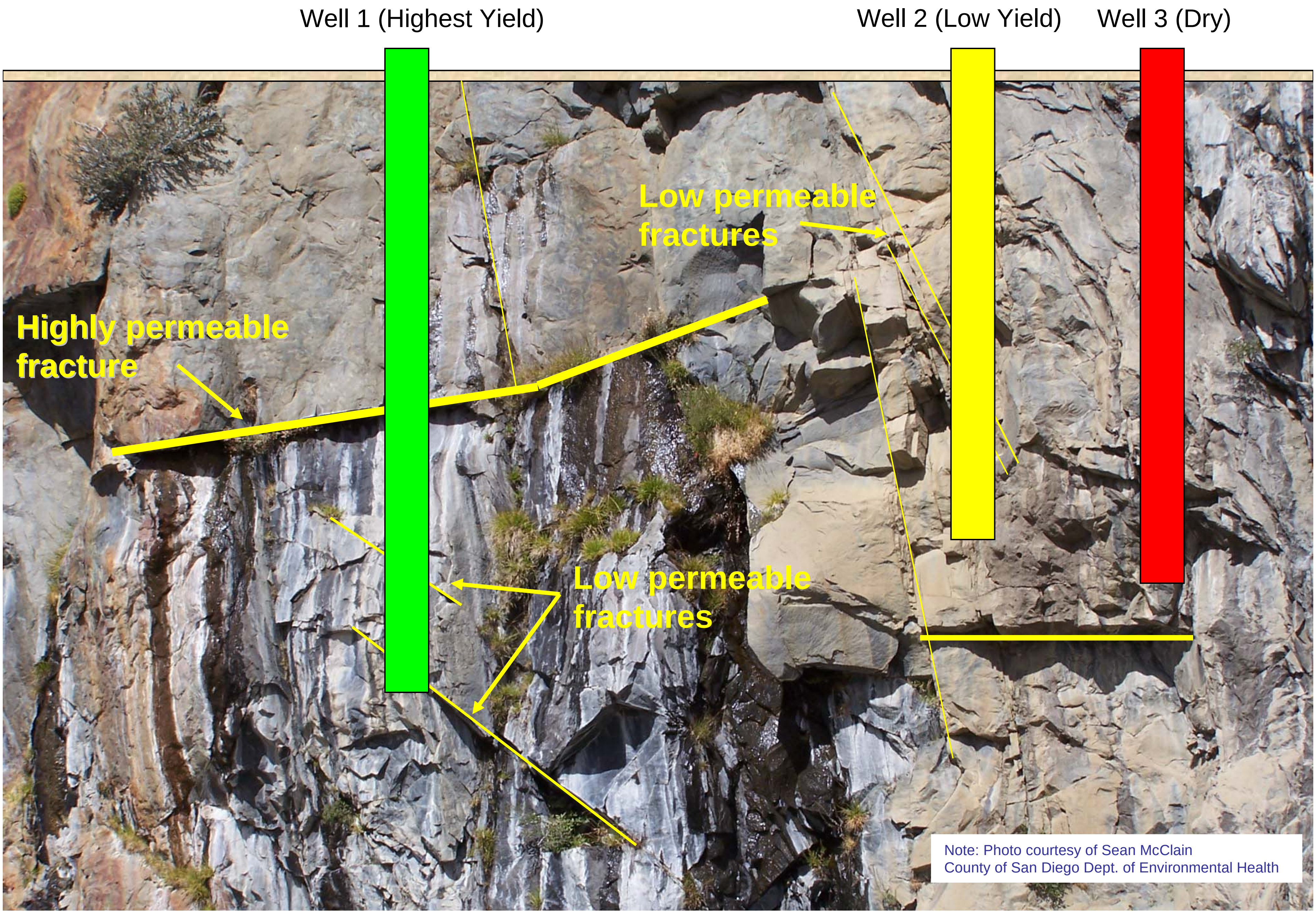
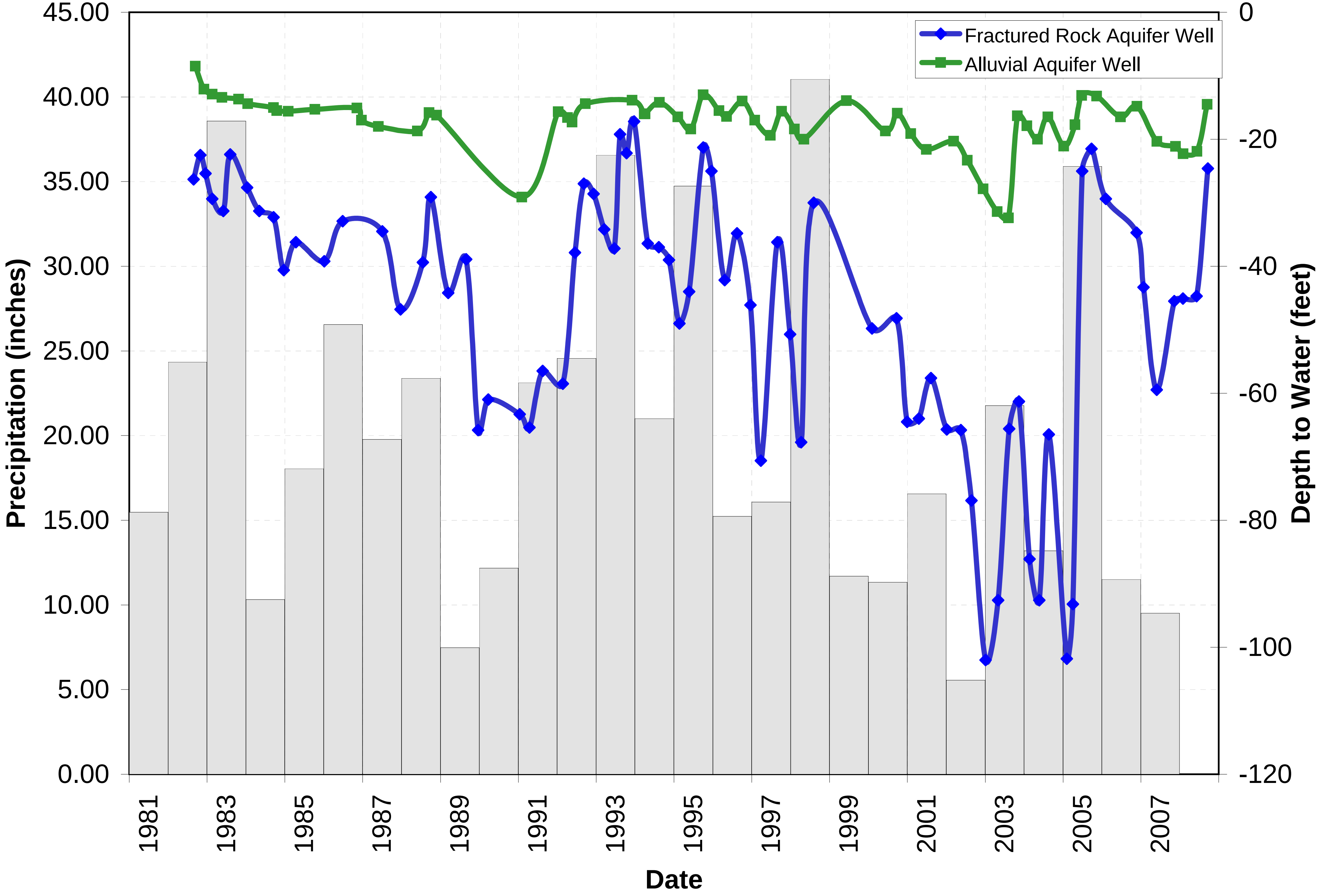
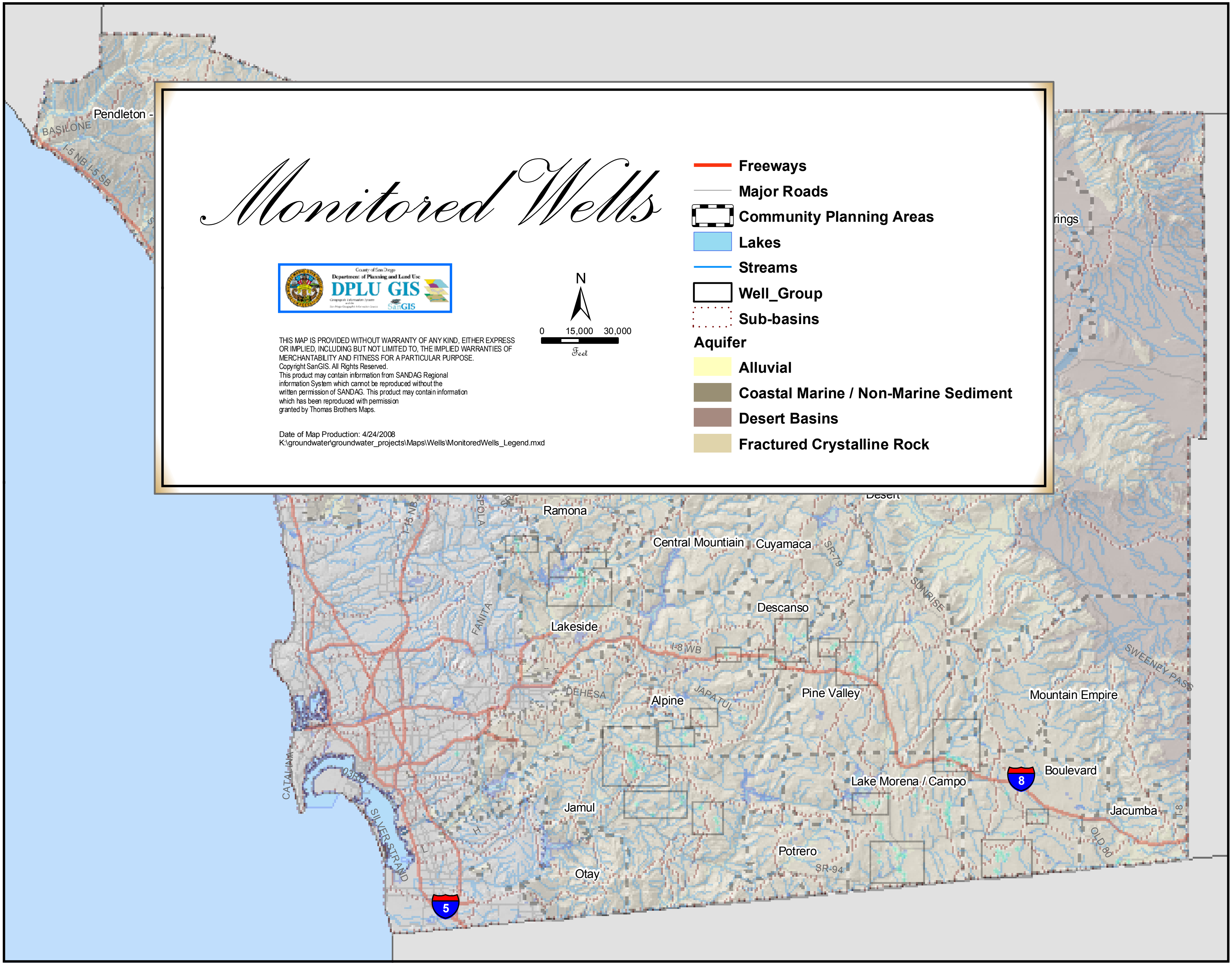
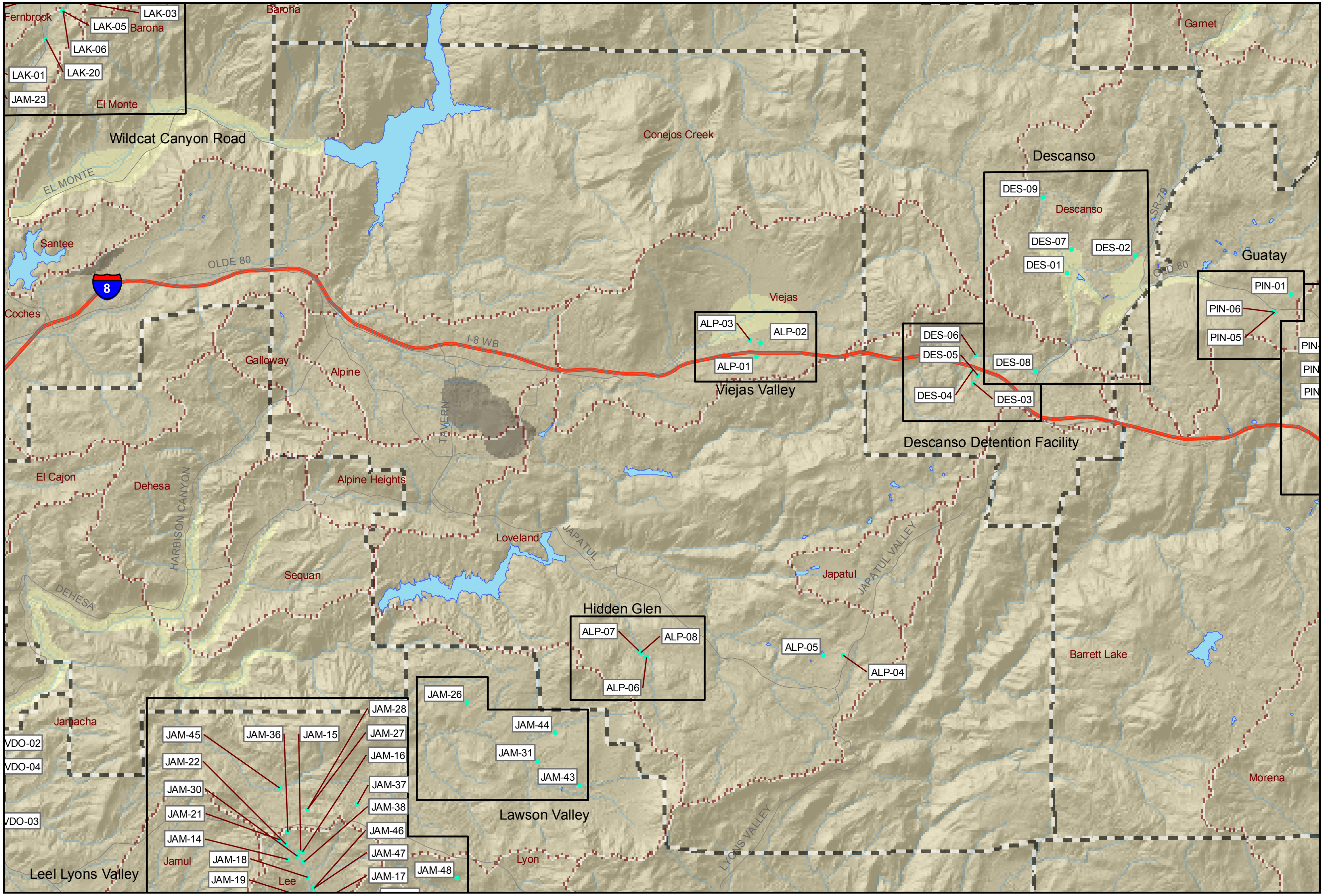


Figure 2-15: Seasonal Water Level Variations
Fractured Rock Well vs. Alluvial Well





Monitored Wells
County of San Diego
Department of Planning and Land Use
DPLU GIS
SanGIS
N
0
15,000
30,000
Feet
THIS MAP IS PROVIDED WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.
Copyright SanGIS. All Rights Reserved.
This product may contain information from SANDAG Regional information System which cannot be reproduced without the written permission of SANDAG. This product may contain information which has been reproduced with permission granted by Thomas Brothers Maps.
Date of Map Production: 4/24/2008
K:\groundwater\groundwater_projects\Maps\Wells\MonitoredWells_Legend.mxd
Freeways
Major Roads
Community Planning Areas
Lakes
Streams
Well_Group
Sub-basins
Aquifer
Alluvial
Coastal Marine / Non-Marine Sediment
Desert Basins
Fractured Crystalline Rock
Pendleton
BASILONE
I-5 NB
I-5 SB
Ramona
Central Mountiain
Cuyamaca
SR-79
SUNRISE
I-15 NB
FANITA
Lakeside
Descanso
I-8 WB
DEHESA
Alpine
JAPATUL
Pine Valley
Mountain Empire
SWEENEY PASS
Boulevard
Lake Morena / Campo
8
Jacumba
OLD 80
Jamul
Potrero
SR-94
Otay
SILVER STRAND
CATALINA
5

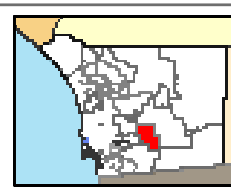


County of San Diego
Department of Planning and Land Use
DPLU GIS
SanGIS

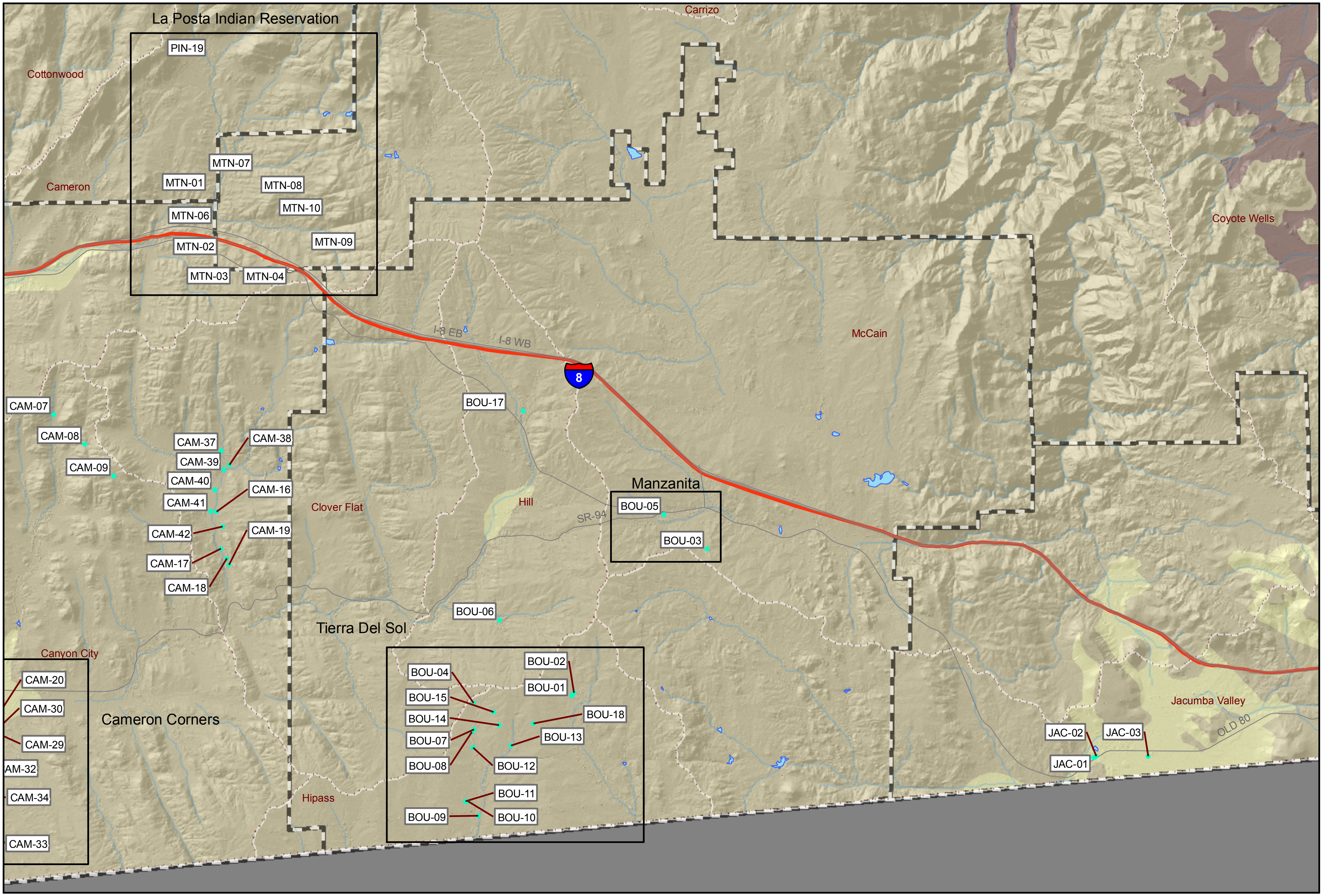
Date of Map Production: 4/24/2008
K:\groundwater\groundwater_projects\Maps\Wells\MonitoredWells_Alpine.mxd

Monitored Wells - Alpine

Figure 2-16



N
0 3,250 6,500
Feet

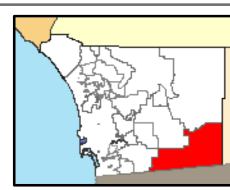


County of San Diego
Department of Planning and Land Use
DPLU GIS
Geographic Information System and the San Diego Geographic Information Source
SanGIS

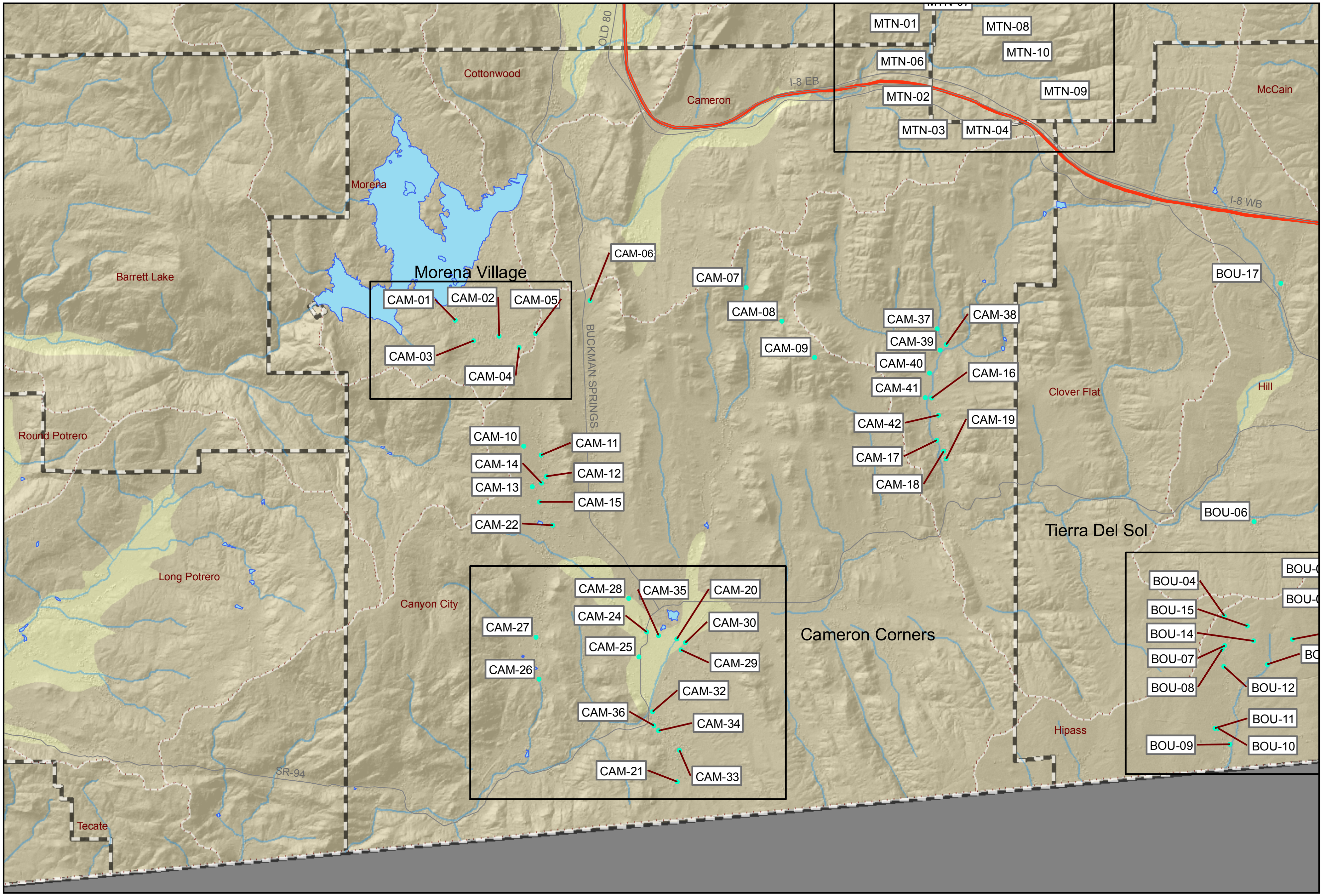
Date of Map Production: 11/18/2008
K:\groundwater\groundwater_projects\Maps\Wells\MonitoredWells_Boulevard.mxd

Monitored Wells - Boulevard

FIGURE 2-17



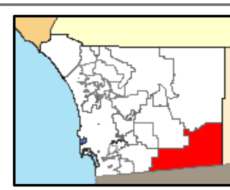
N
0 5,000 10,000
Feet



County of San Diego
Department of Planning and Land Use
DPLU GIS
SanGIS

Monitored Wells - Campo

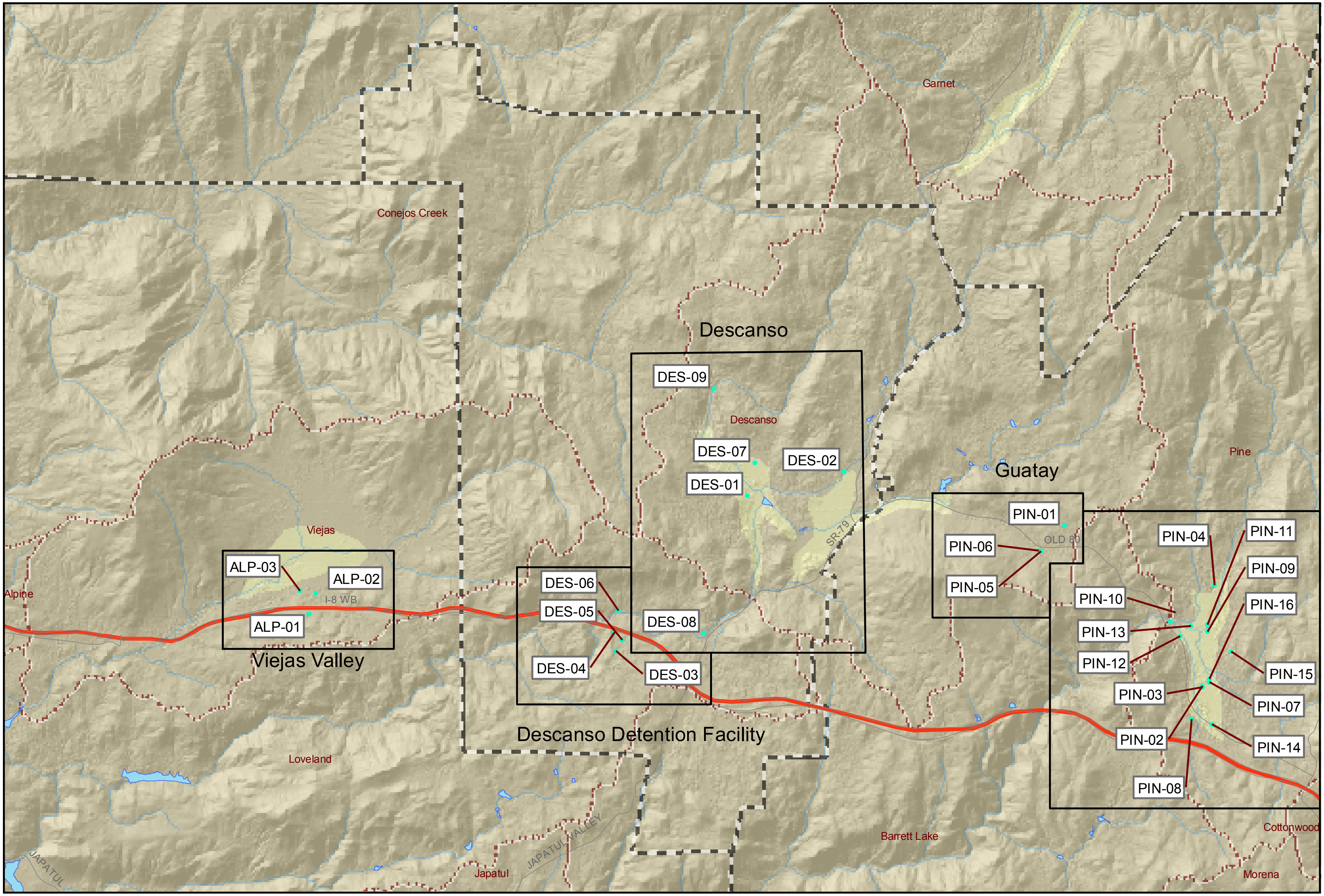
FIGURE 2-18



N

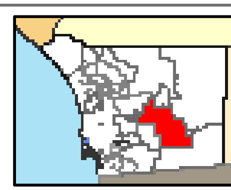
0 5,000 10,000
Feet

Date of Map Production: 11/18/2008
K:\groundwater\groundwater_projects\Maps\Wells\MonitoredWells_Campo.mxd



Monitored Wells - Descanso

Figure 2-19



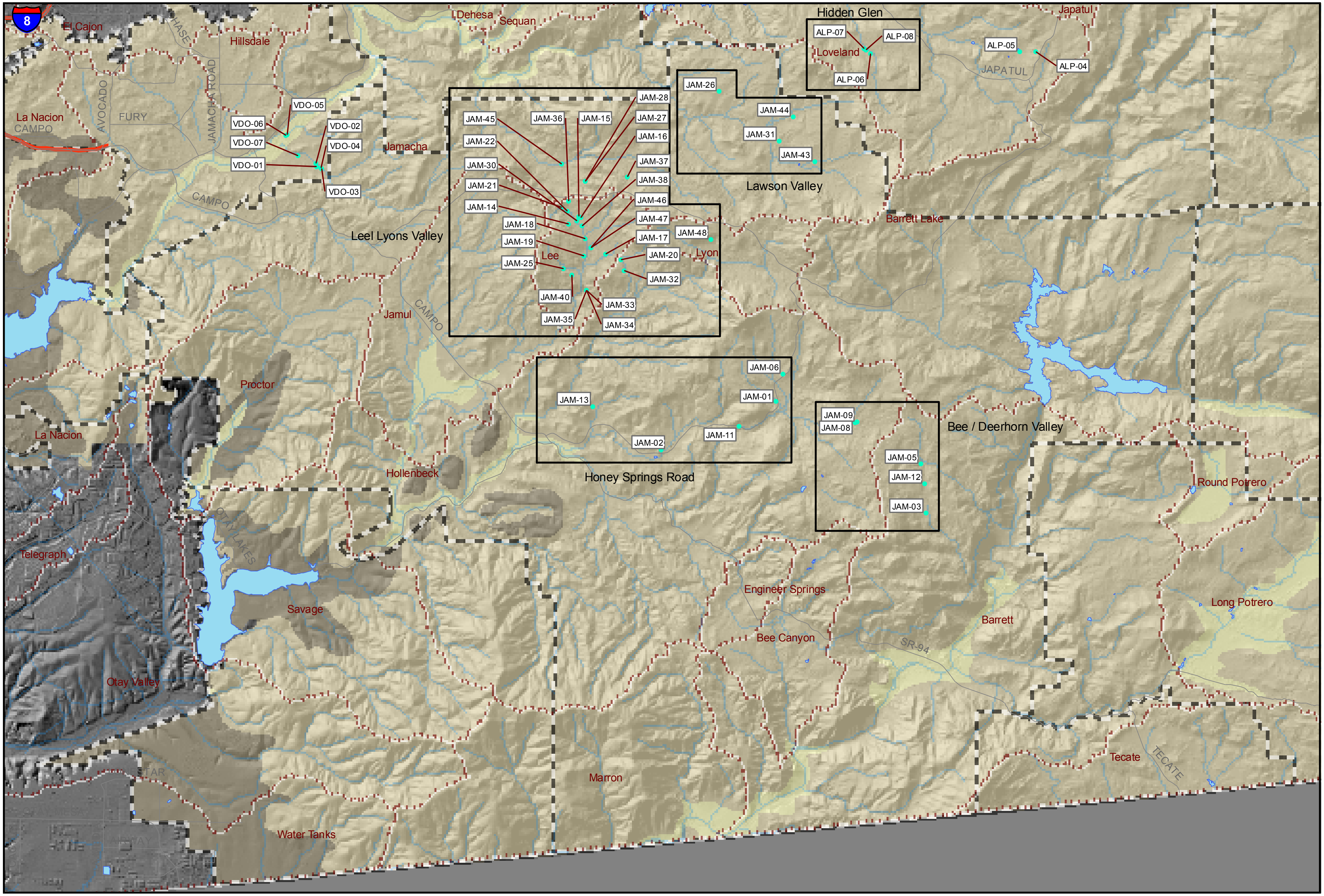
N

0 2,300 4,600

Feet

County of San Diego
Department of Planning and Land Use
DPLU GIS
SanGIS

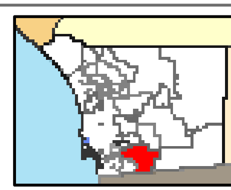
Date of Map Production: 4/24/2008
K:\groundwater\groundwater_projects\Maps\Wells\MonitoredWells_Descanso.mxd



County of San Diego
Department of Planning and Land Use
DPLU GIS
SanGIS

Monitored Wells - Jamul

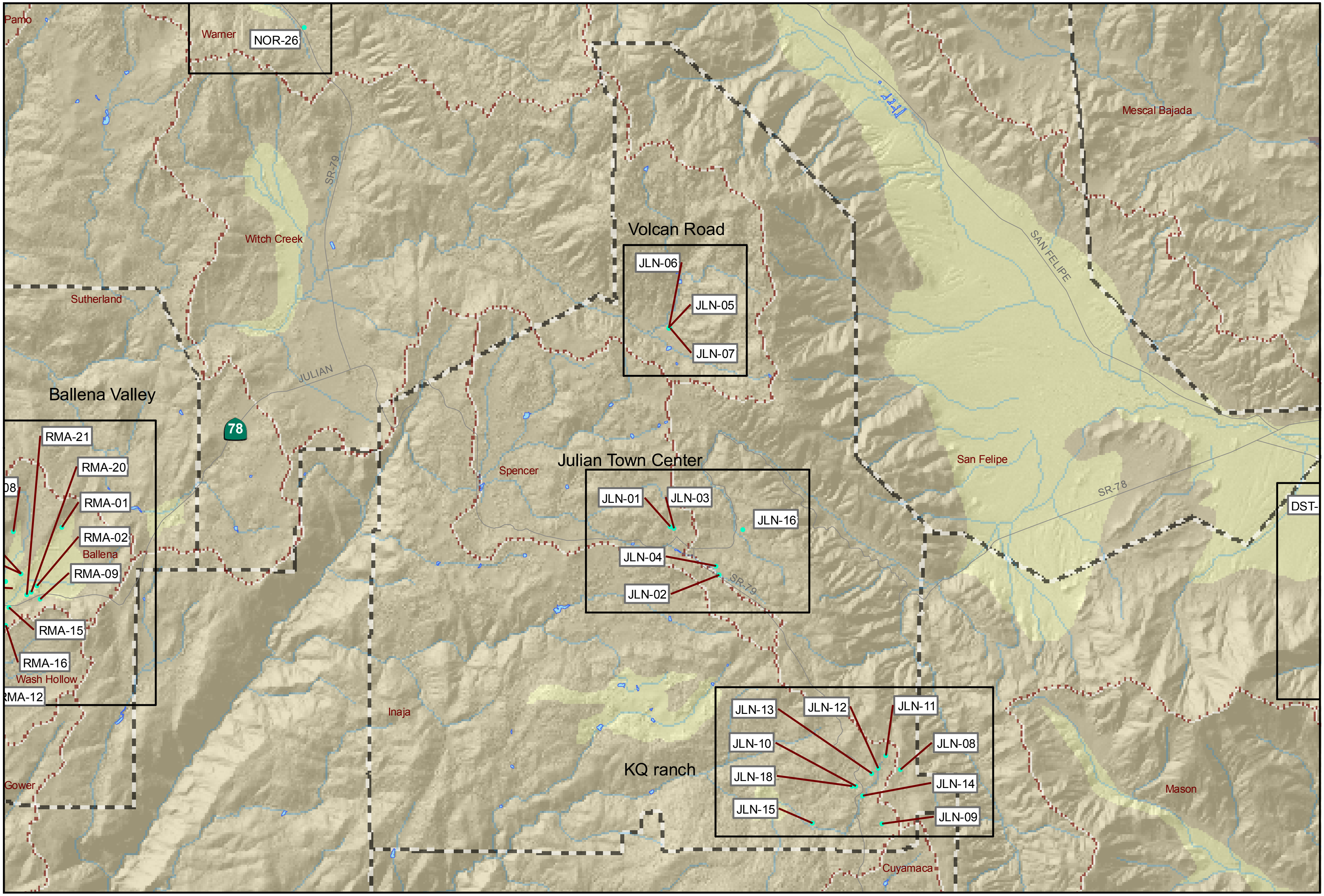
Figure 2-20



N

0 3,800 7,600
Feet

Date of Map Production: 4/24/2008
K:\groundwater\groundwater_projects\Maps\Wells\MonitoredWells_Jamul.mxd

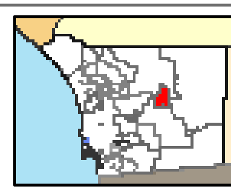


County of San Diego
Department of Planning and Land Use
DPLU GIS
Geographic Information System
SanGIS

Date of Map Production: 4/24/2008
K:\groundwater\groundwater_projects\Maps\Wells\MonitoredWells_Julian.mxd

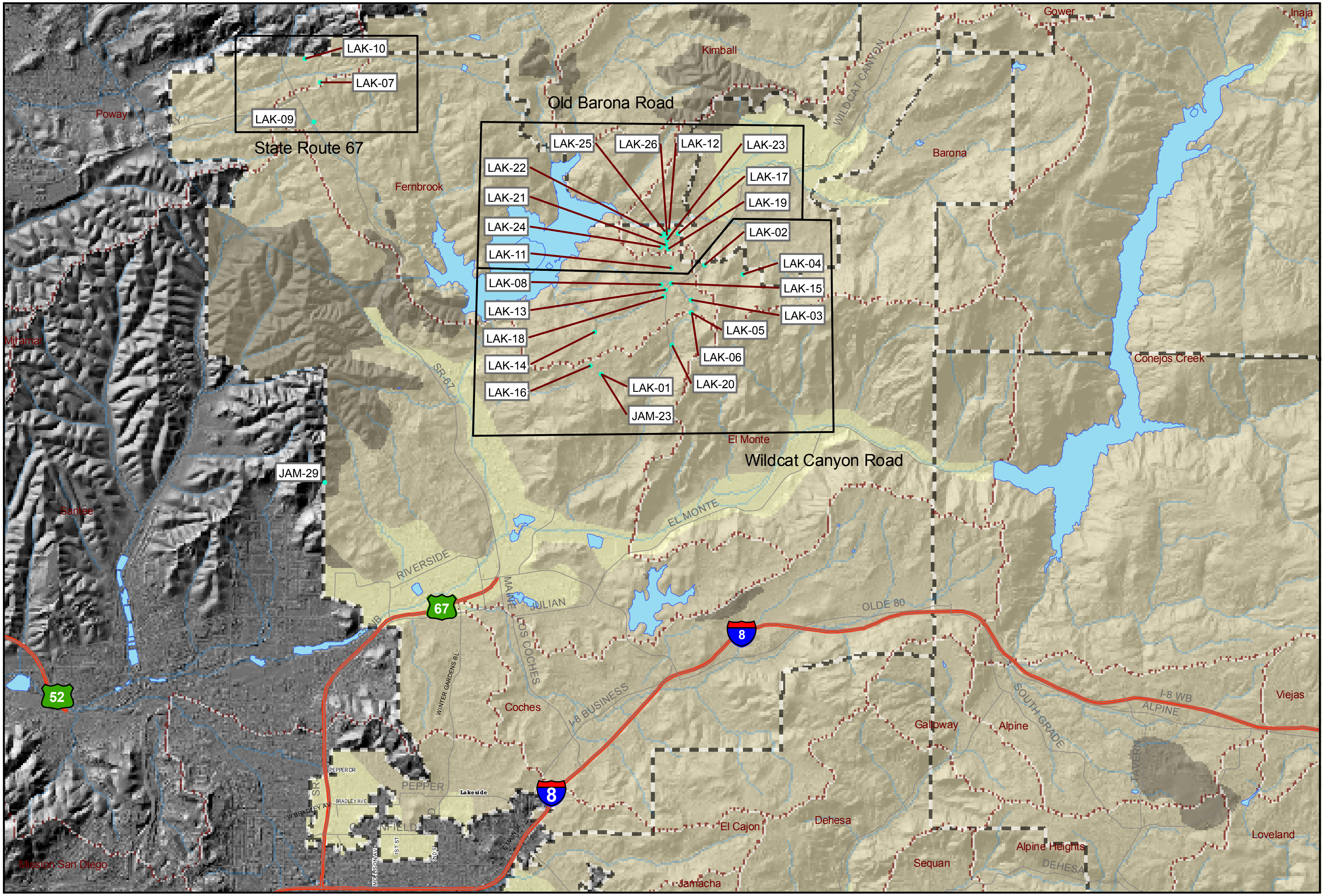
Monitored Wells - Julian

Figure 2-21



N

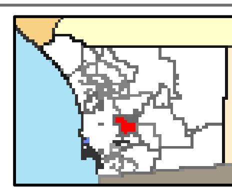
0 2,700 5,400
Feet



County of San Diego
Department of Planning and Land Use
DPLU GIS
SanGIS

Monitored Wells - Lakeside

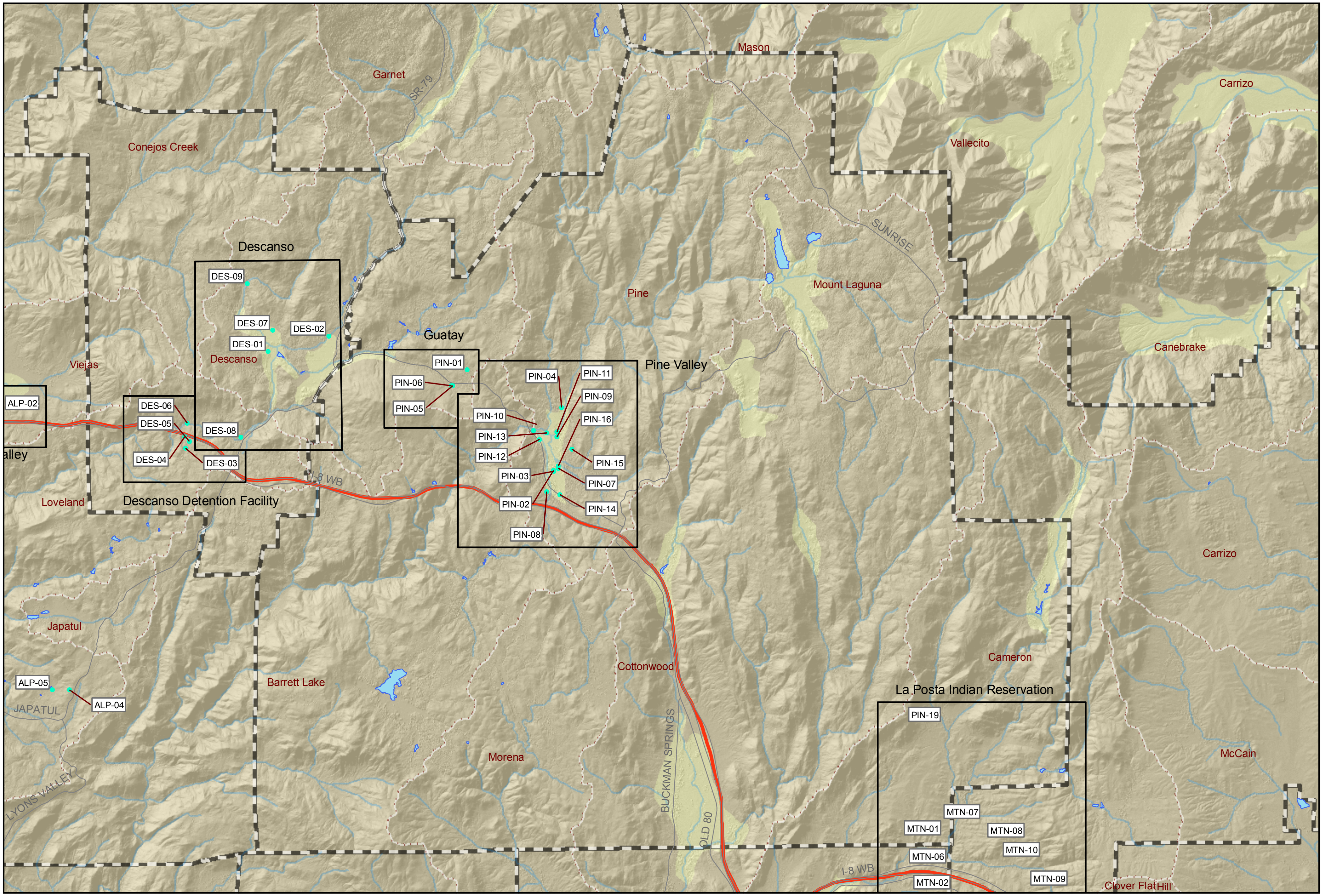
Figure 2-22



N

0 2,800 5,600
Feet

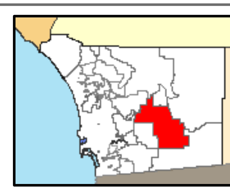
Date of Map Production: 4/24/2008
K:\groundwater\groundwater_projects\Maps\Wells\MonitoredWells_Lakeside.mxd



County of San Diego
Department of Planning and Land Use
DPLU GIS
Geographic Information System and the San Diego Geographic Information Source
SanGIS

Monitored Wells - Pine Valley

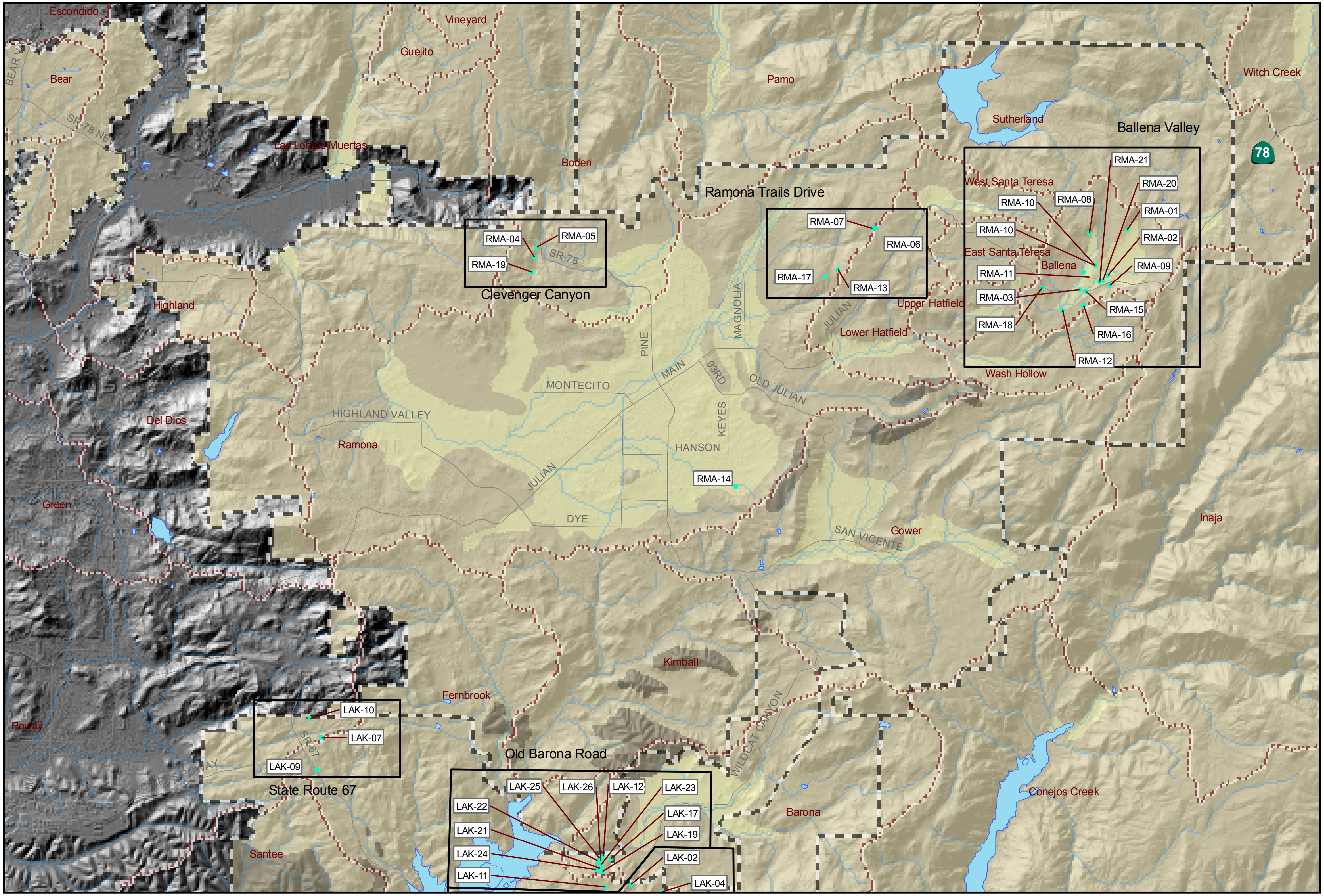
FIGURE 2-23



N

0 5,000 10,000
Feet

Date of Map Production: 11/18/2008
K:\groundwater\groundwater_projects\Maps\Wells\MonitoredWells_PineValley.mxd

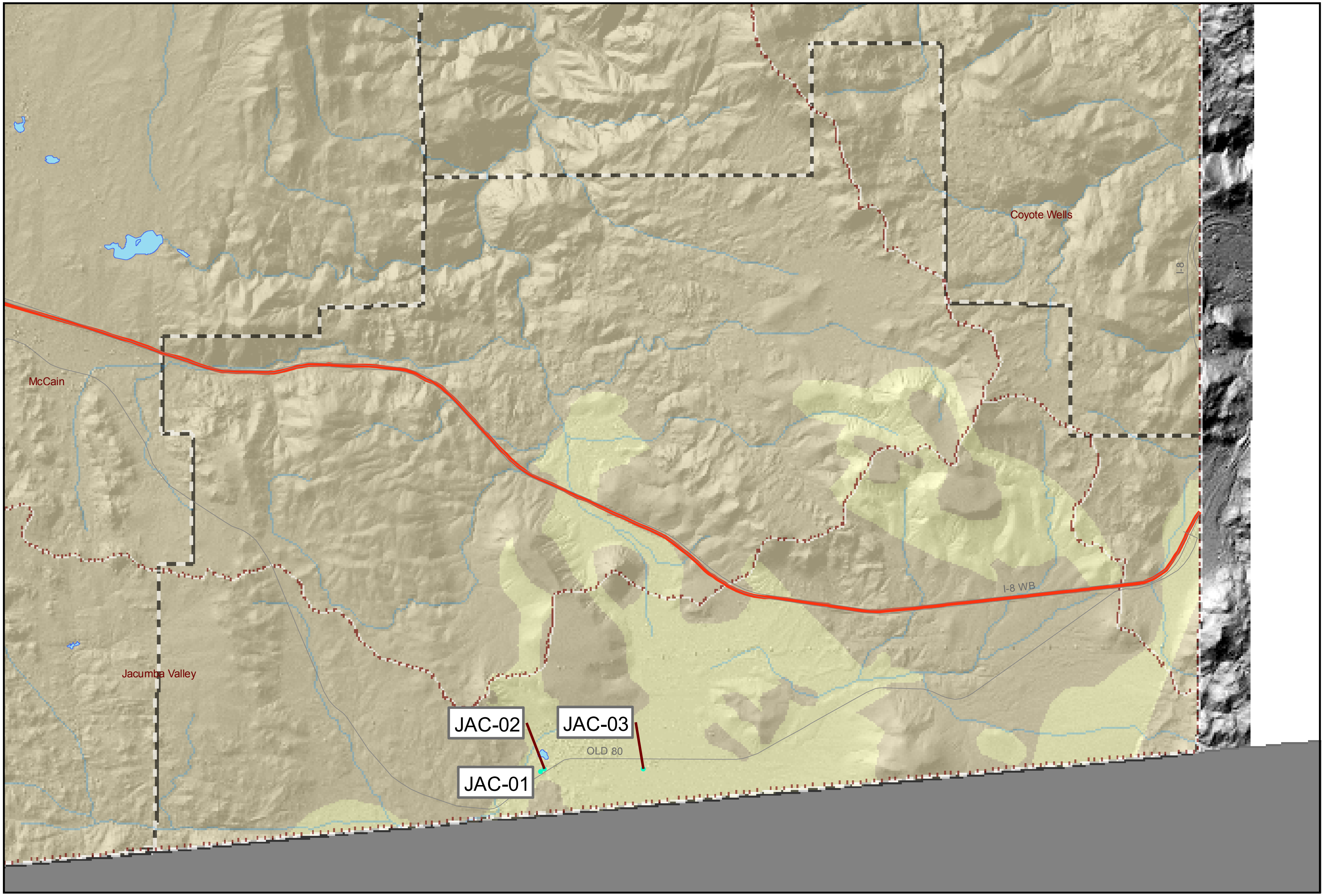


County of San Diego
Department of Planning and Land Use
DPLU GIS
SanGIS

Monitored Wells - Ramona

Figure 2-24

Date of Map Production: 4/24/2008
K:\groundwater\groundwater_projects\Maps\Wells\MonitoredWells_Ramona.mxd

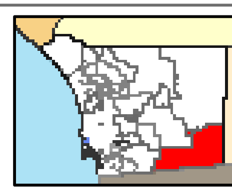


County of San Diego
Department of Planning and Land Use
DPLU GIS
SanGIS

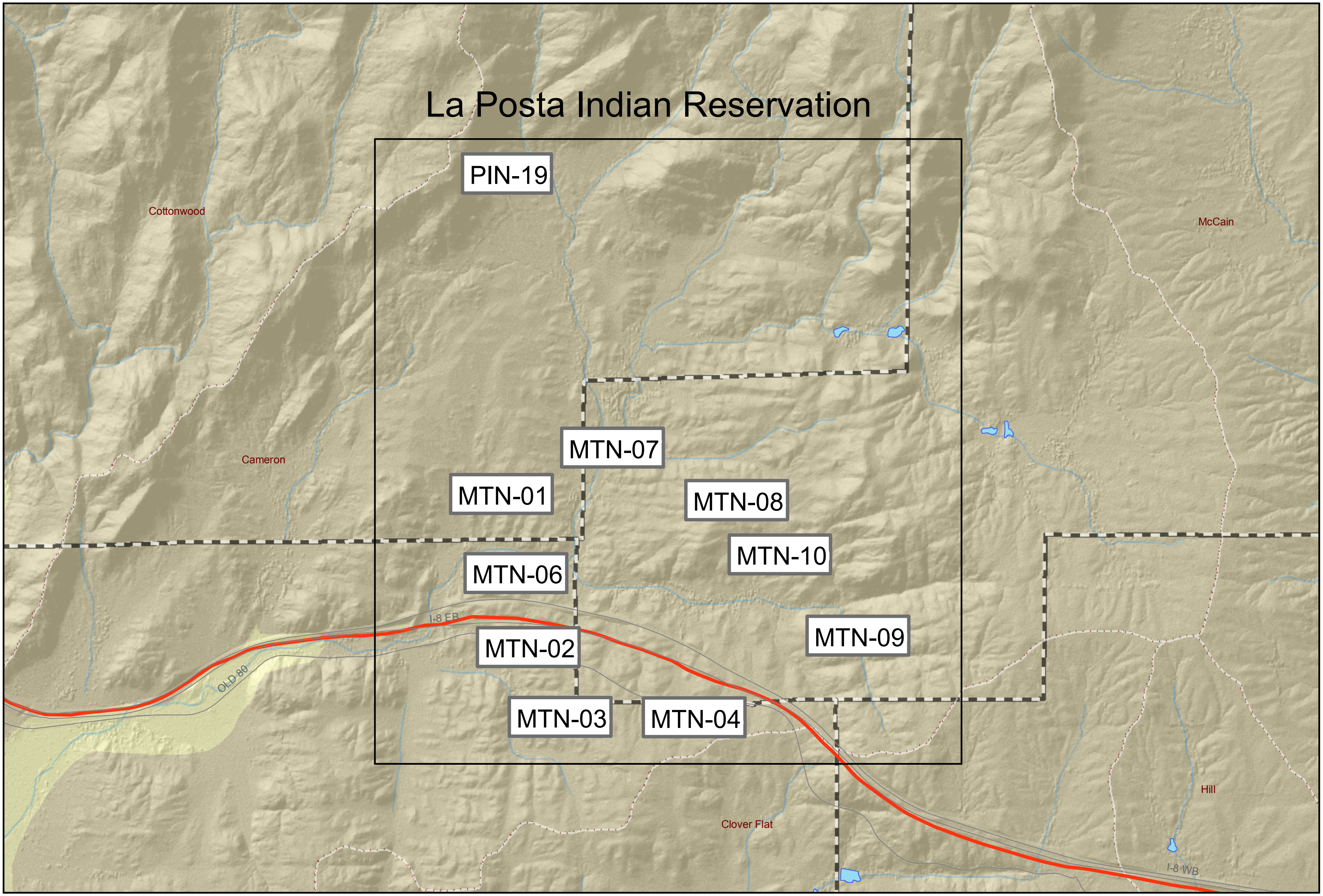
Date of Map Production: 4/24/2008
K:\groundwater\groundwater_projects\Maps\Wells\MonitoredWells_Jacumba.mxd

Monitored Wells - Jacumba

Figure 2-25



N
0 1,700 3,400
Feet



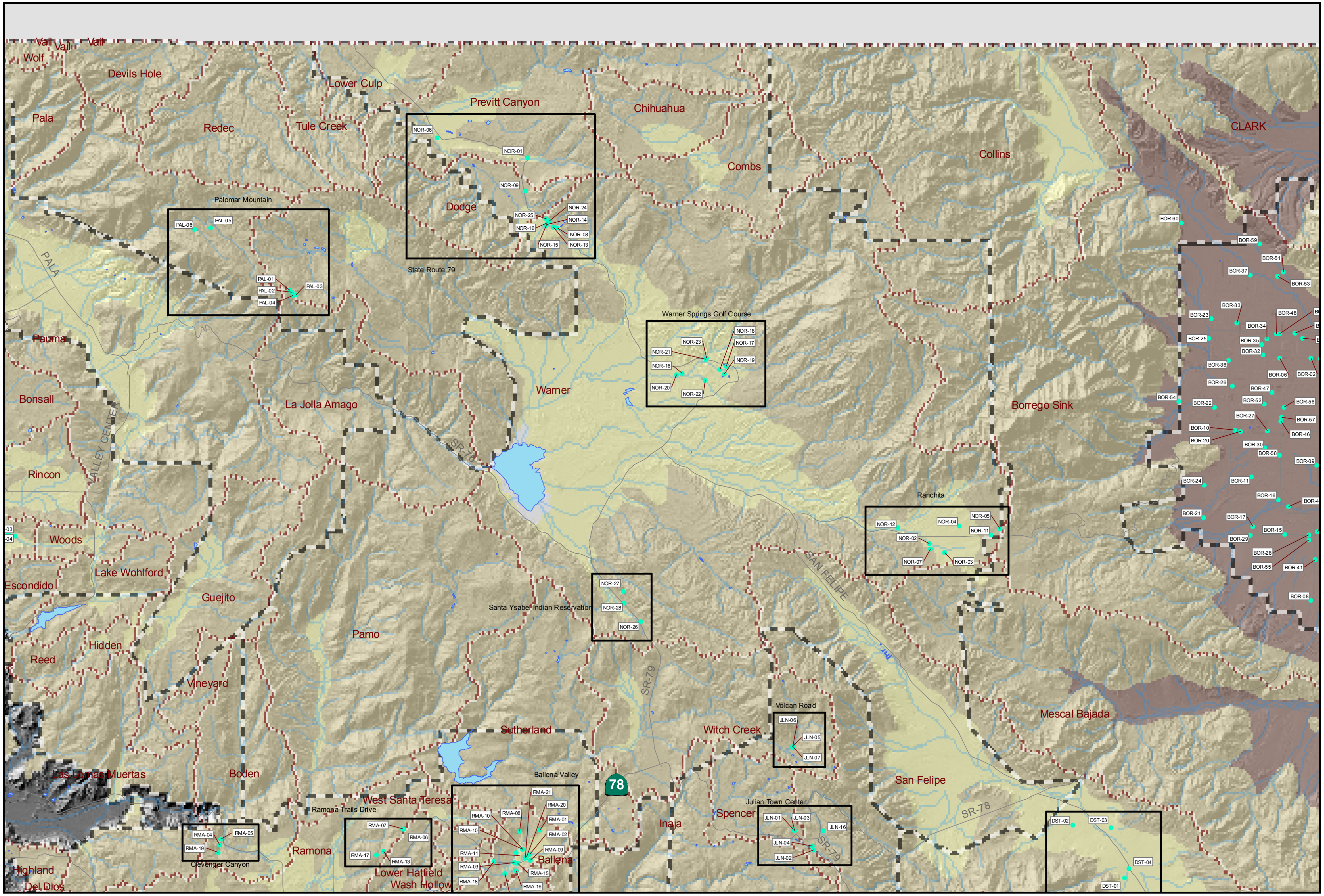
County of San Diego
Department of Planning and Land Use
DPLU GIS
Geographic Information System and the San Diego Geographic Information Source
SanGIS

Monitored Wells - Mountain Empire
La Posta Indian Reservation

FIGURE 2-26

Date of Map Production: 11/18/2008
K:\groundwater\groundwater_projects\Maps\Wells\MonitoredWells_Mountain Empire.mxd

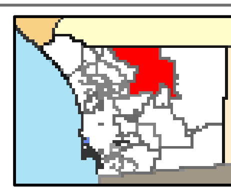
N
0 2,500 5,000
Feet



County of San Diego
Department of Planning and Land Use
DPLU GIS
SanGIS

Monitored Wells - North Mountain

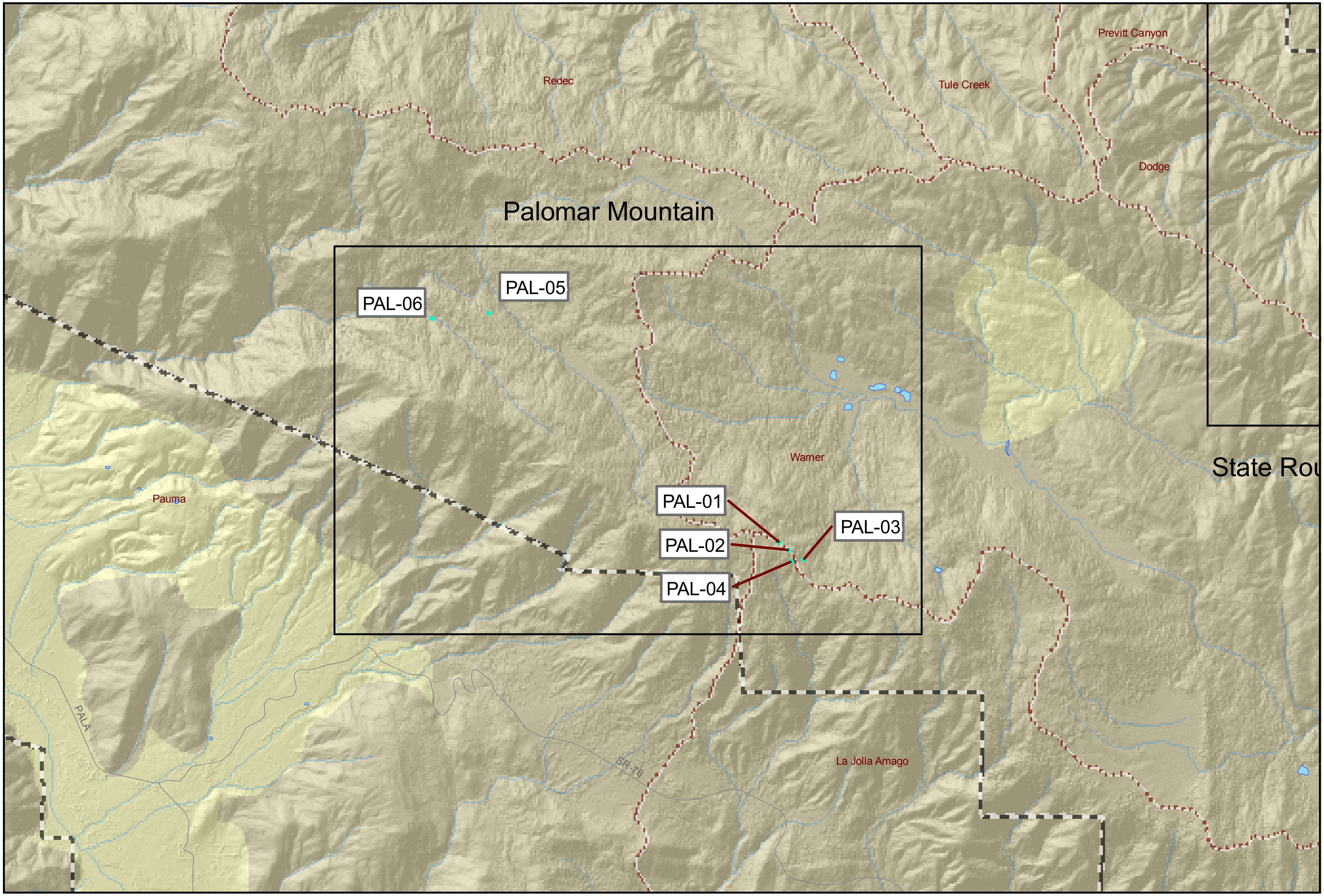
Figure 2-27



N

0 7,750 15,500
Feet

Date of Map Production: 4/24/2008
K:\groundwater\groundwater_projects\Maps\Wells\MonitoredWells_NorthMountain.mxd

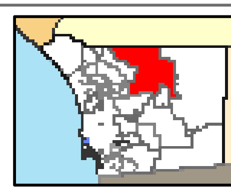


County of San Diego
Department of Planning and Land Use
DPLU GIS
Geographic Information System
SanGIS

Monitored Wells - North Mountain
Detail 1

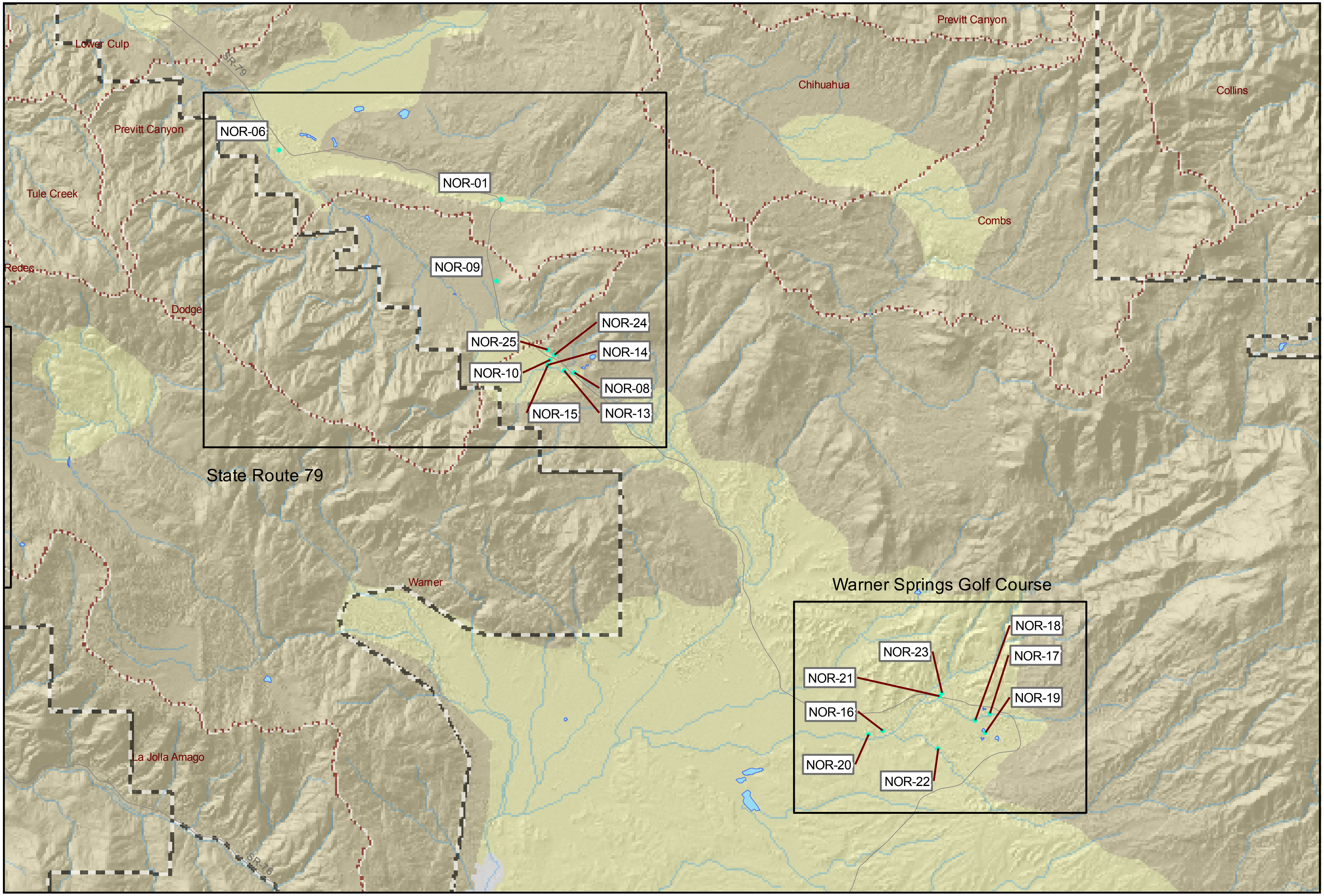
Figure 2-28

Date of Map Production: 4/24/2008
K:\groundwater\groundwater_projects\Maps\Wells\MonitoredWells_NorthMountain.mxd



N

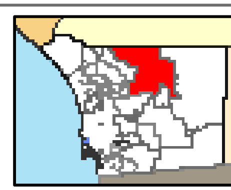
0 2,100 4,200
Feet



County of San Diego
Department of Planning and Land Use
DPLU GIS
SanGIS

Monitored Wells - North Mountain
Detail 2

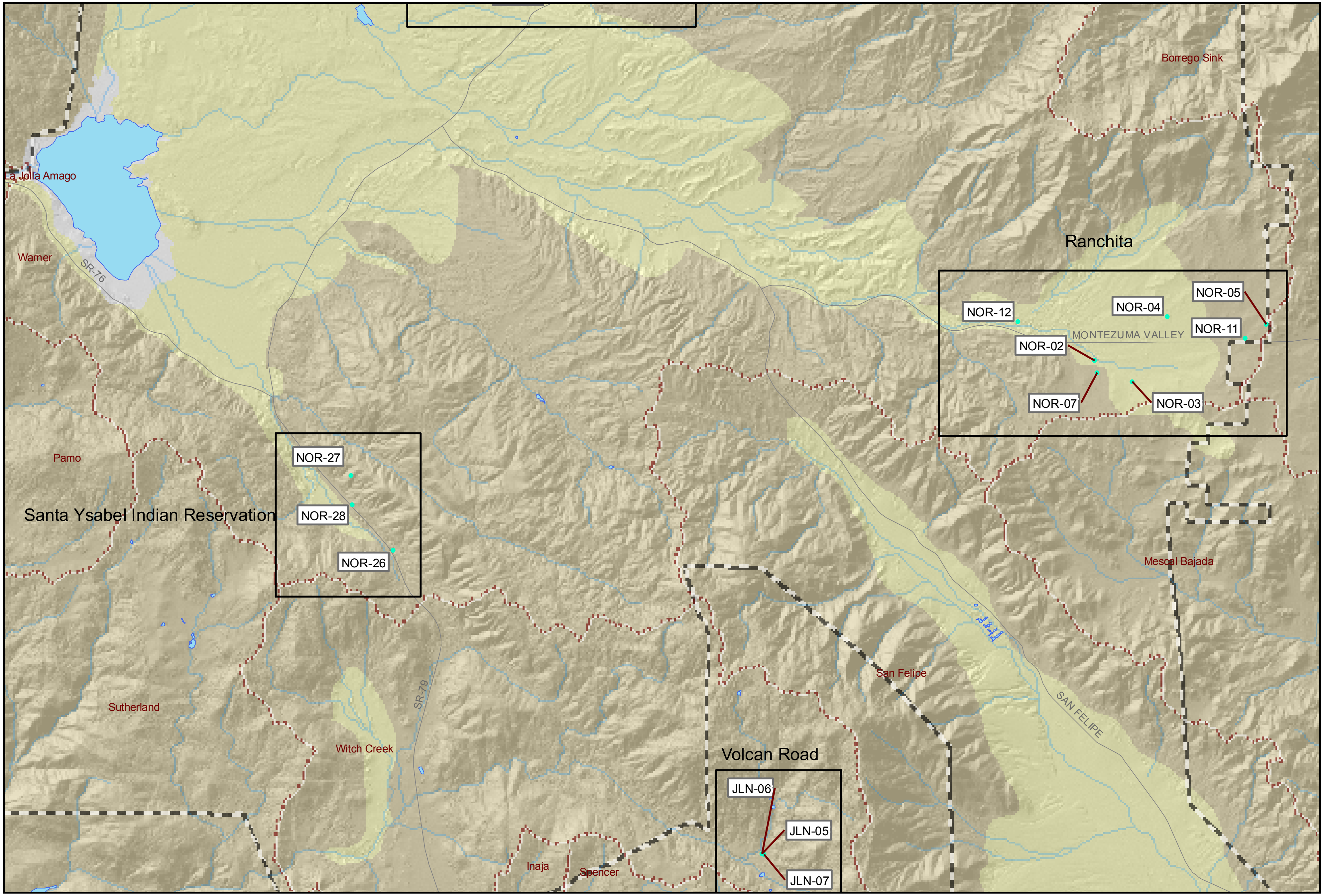
Figure 2-29



N

0 3,300 6,600
Feet

Date of Map Production: 4/24/2008
K:\groundwater\groundwater_projects\Maps\Wells\MonitoredWells_NorthMountain.mxd



County of San Diego
Department of Planning and Land Use
DPLU GIS
SanGIS

Monitored Wells - North Mountain
Detail 3

Figure 2-30

N
0 3,500 7,000
Feet

Date of Map Production: 4/24/2008
K:\groundwater\groundwater_projects\Maps\Wells\MonitoredWells_NorthMountain.mxd

**Figure 2-31: Alpine Community Planning Group
Hidden Glen Well Hydrographs**

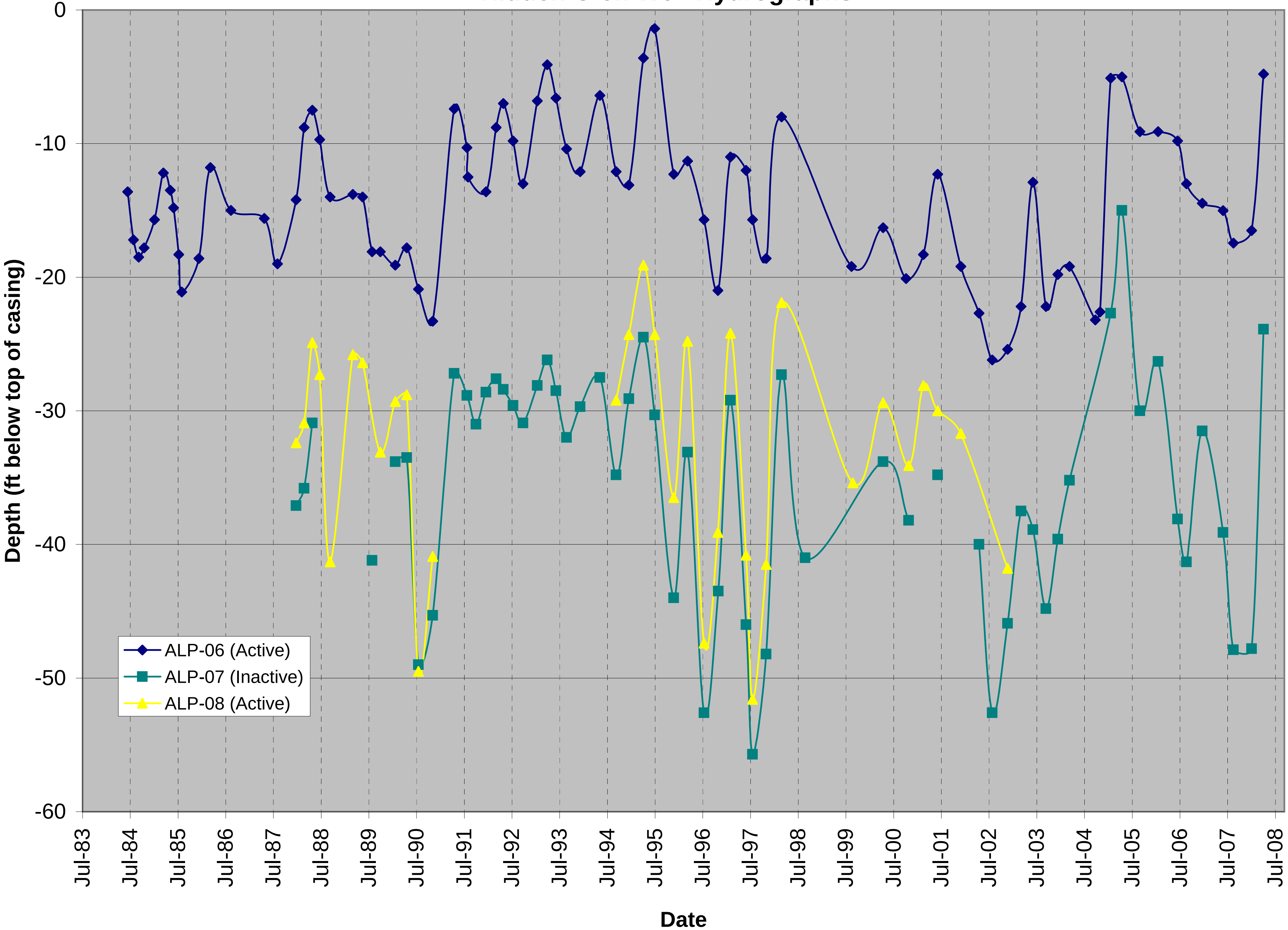


Figure 2-32: Alpine Community Planning Group Viejas Valley Well Hydrographs

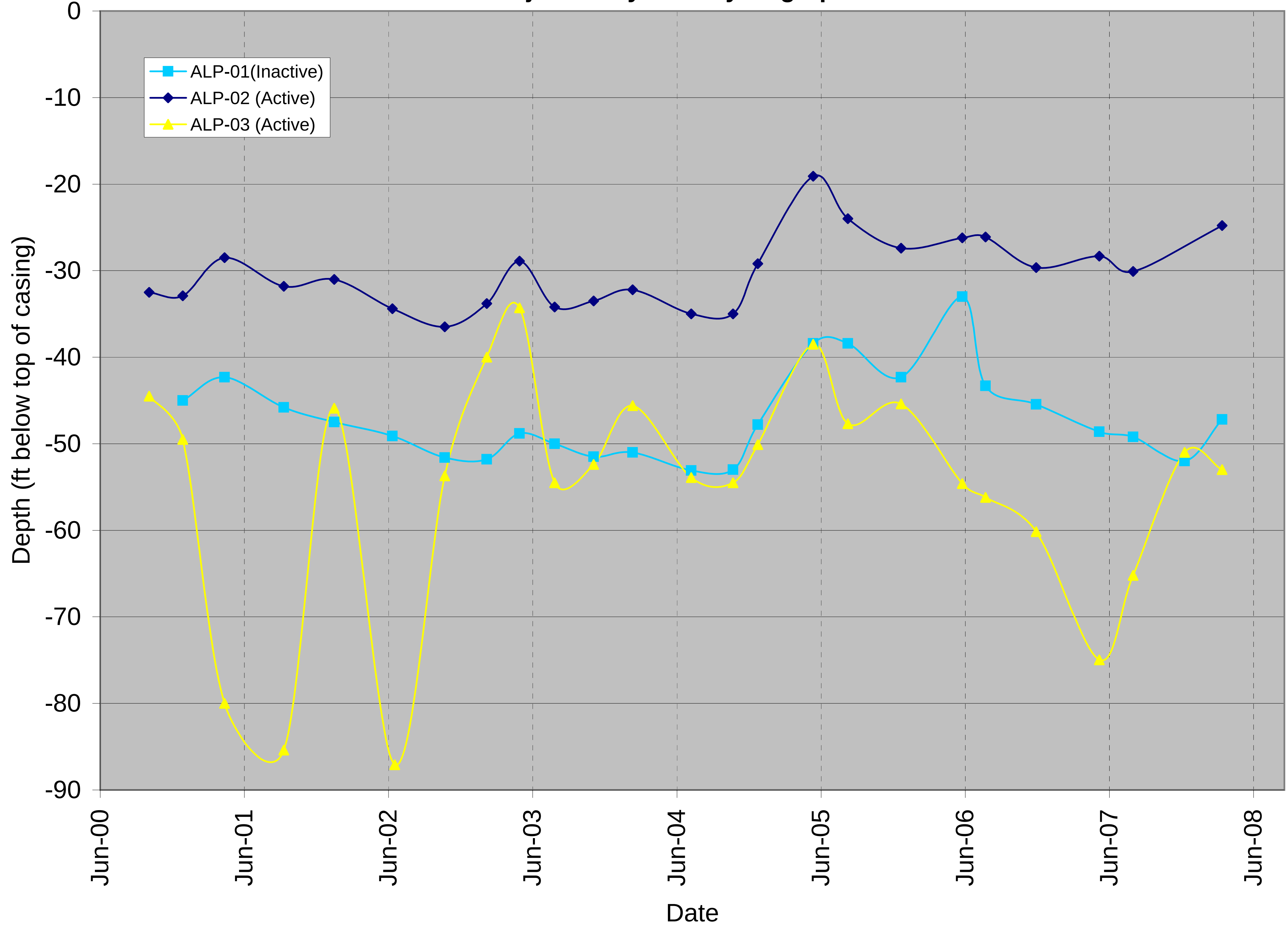


Figure 2-33: Boulevard Community Planning Group Manzanita Well Hydrographs

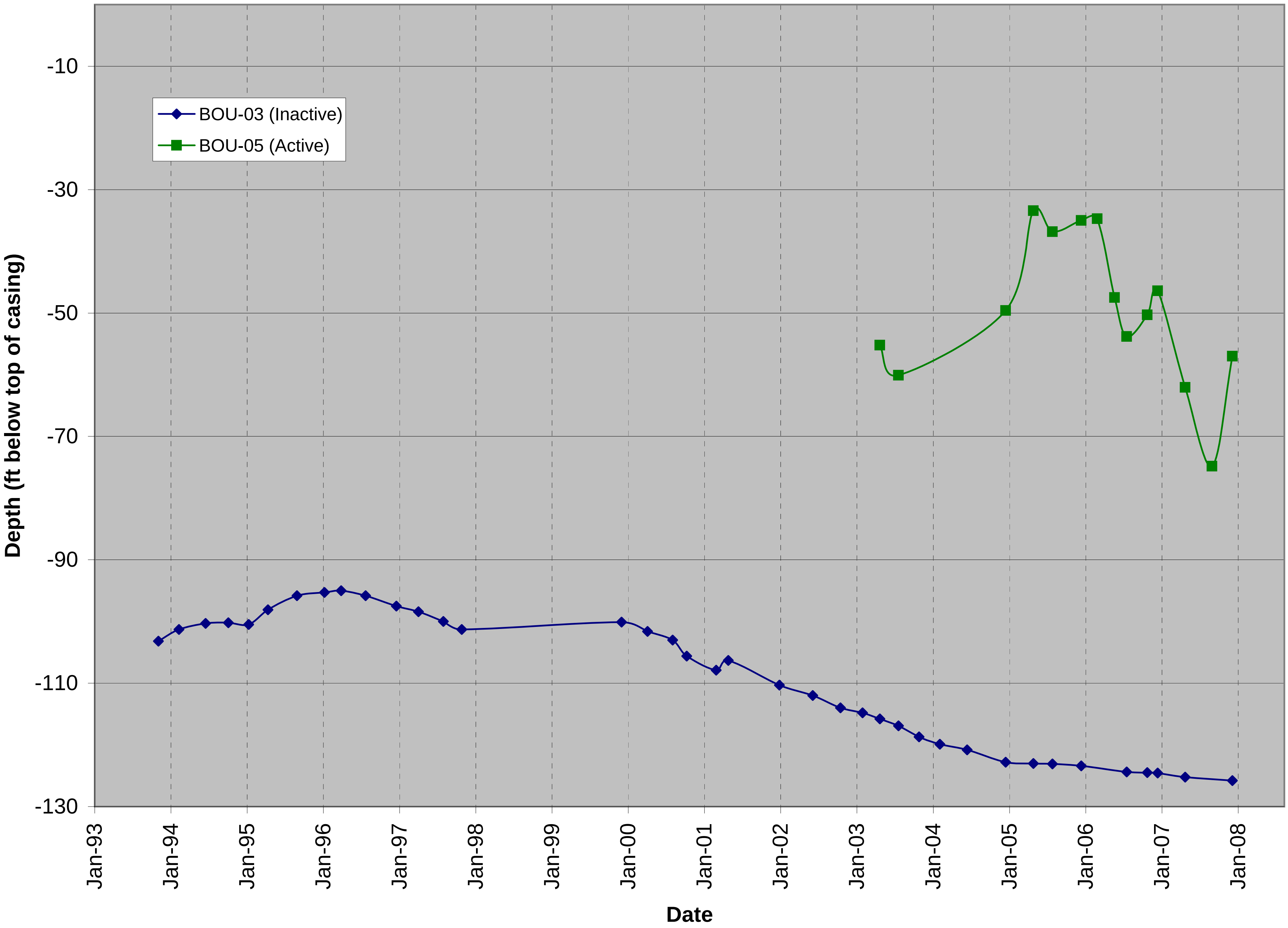


Figure 2-34: Boulevard Community Planning Group
Tierra Del Sol Well Hydrographs

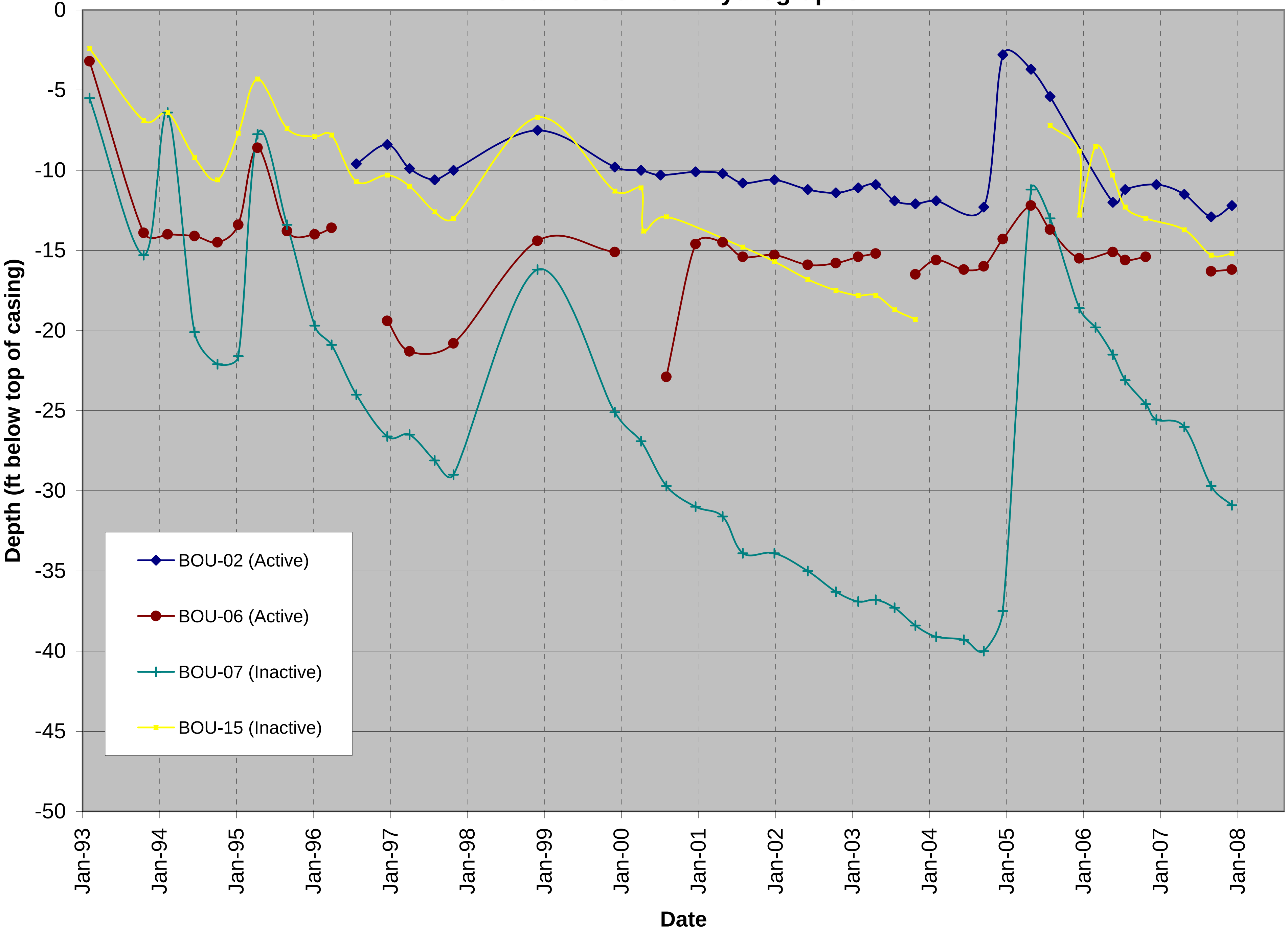


Figure 2-35: Campo-Lake Morena Community Planning Group
Cameron Corners Well Hydrographs

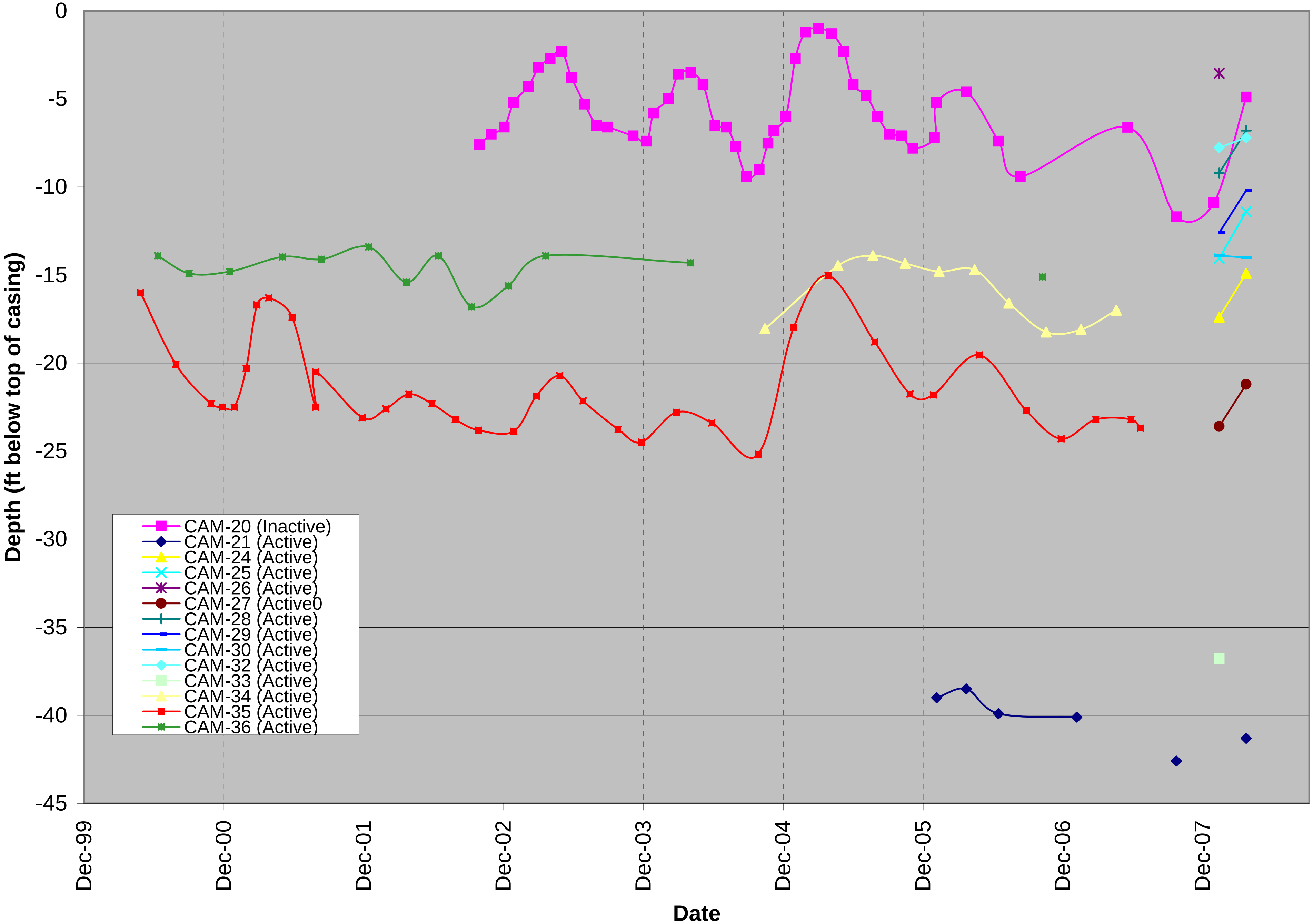


Figure 2-36: Campo-Lake Morena Community Planning Group
Morena Village Well Hydrographs

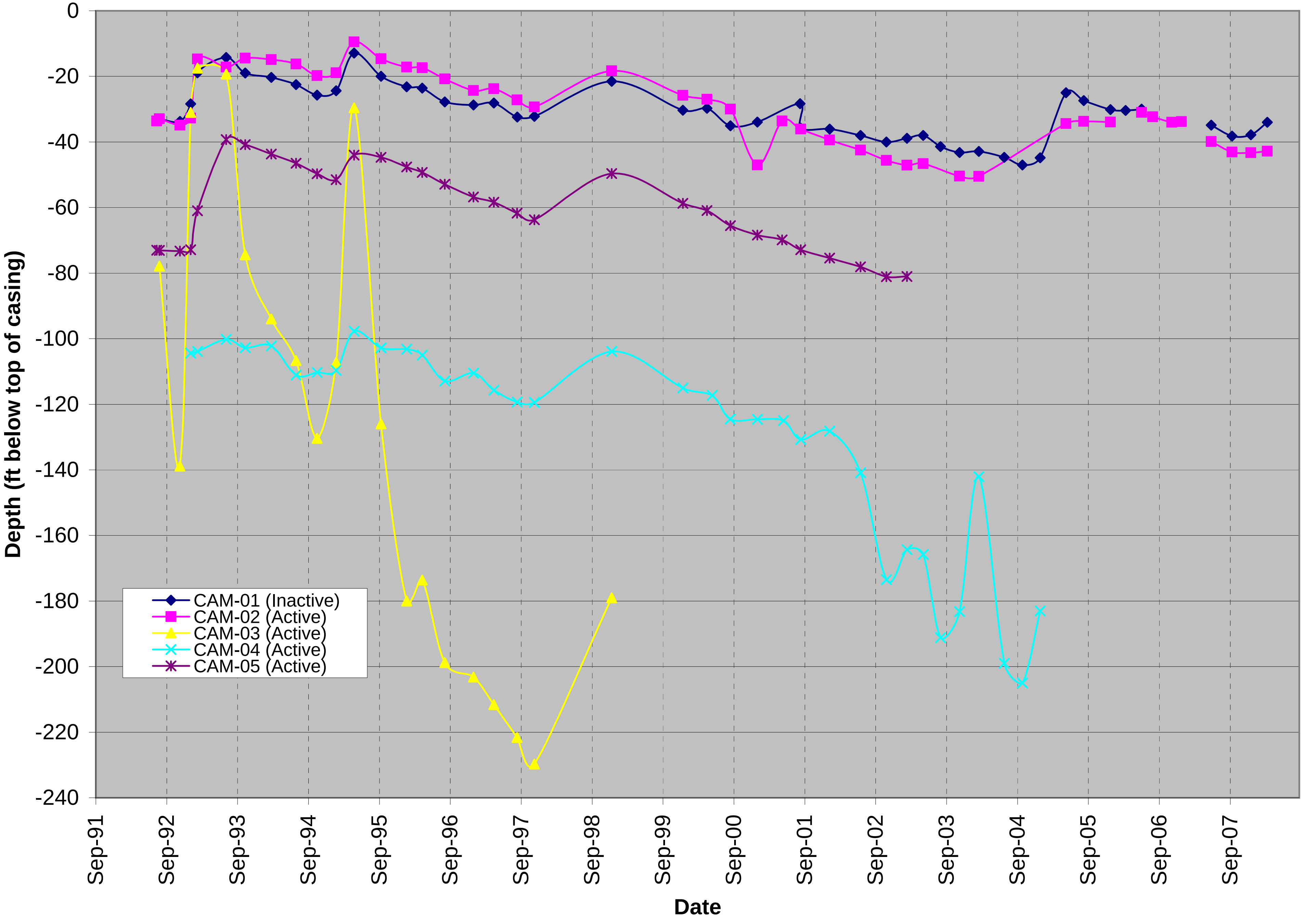


Figure 2-37: Campo-Lake Morena Community Planning Group
Other Areas of Campo Well Hydrographs

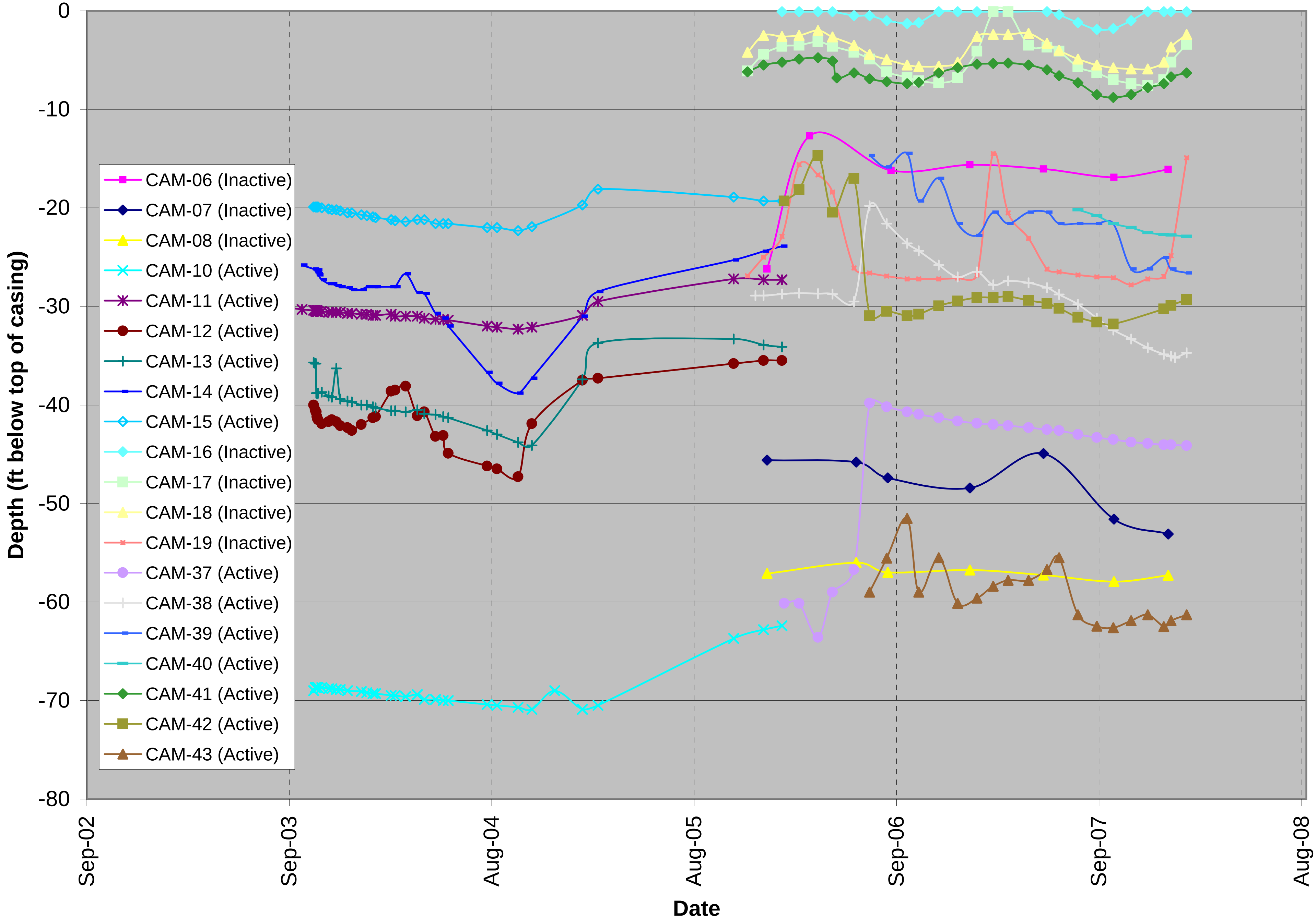


Figure 2-38: Descanso Community Planning Group
Descanso Community Well Hydrographs

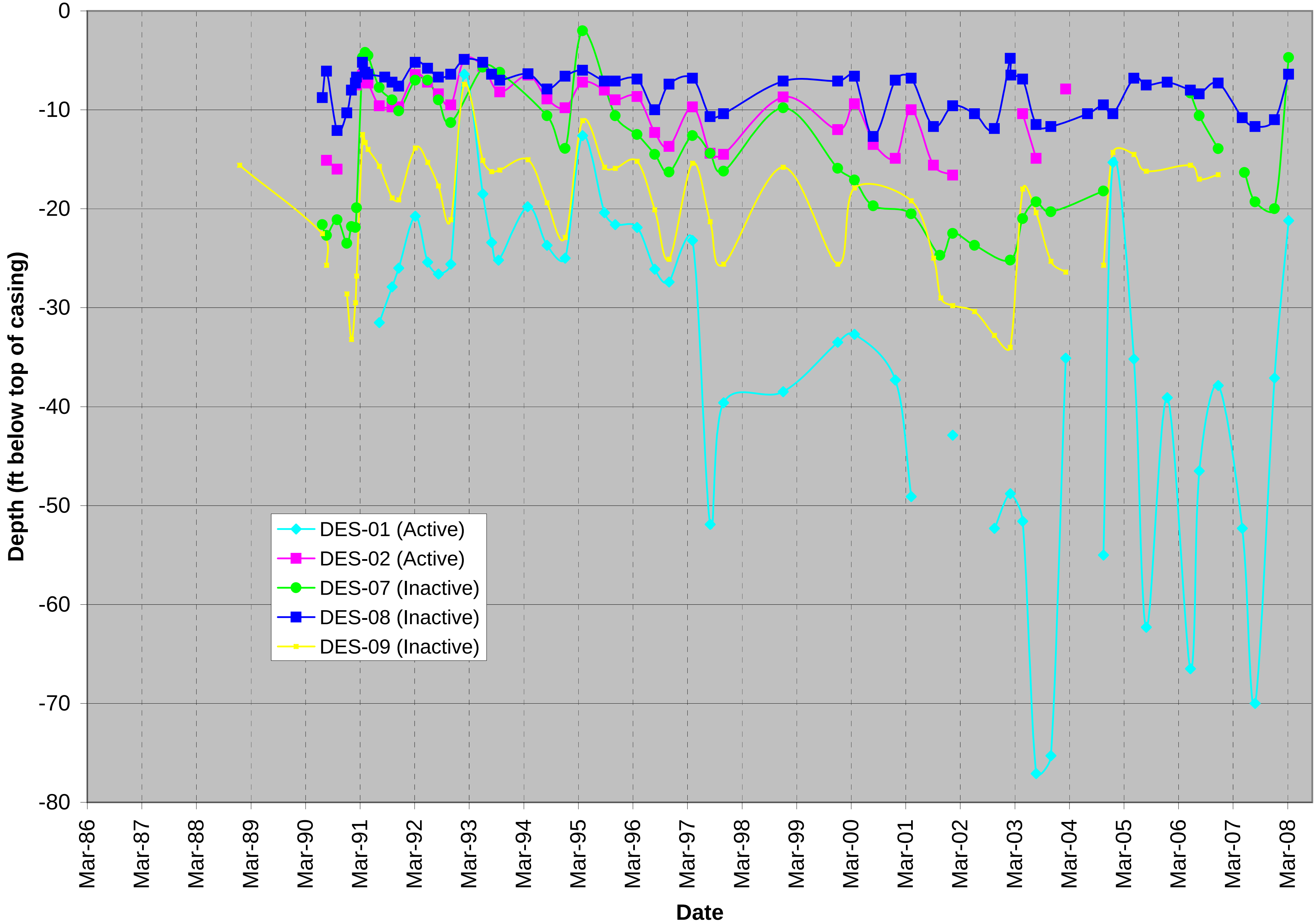


Figure 2-39: Descanso Community Planning Group
Descanso Detention Facility Well Hydrograph

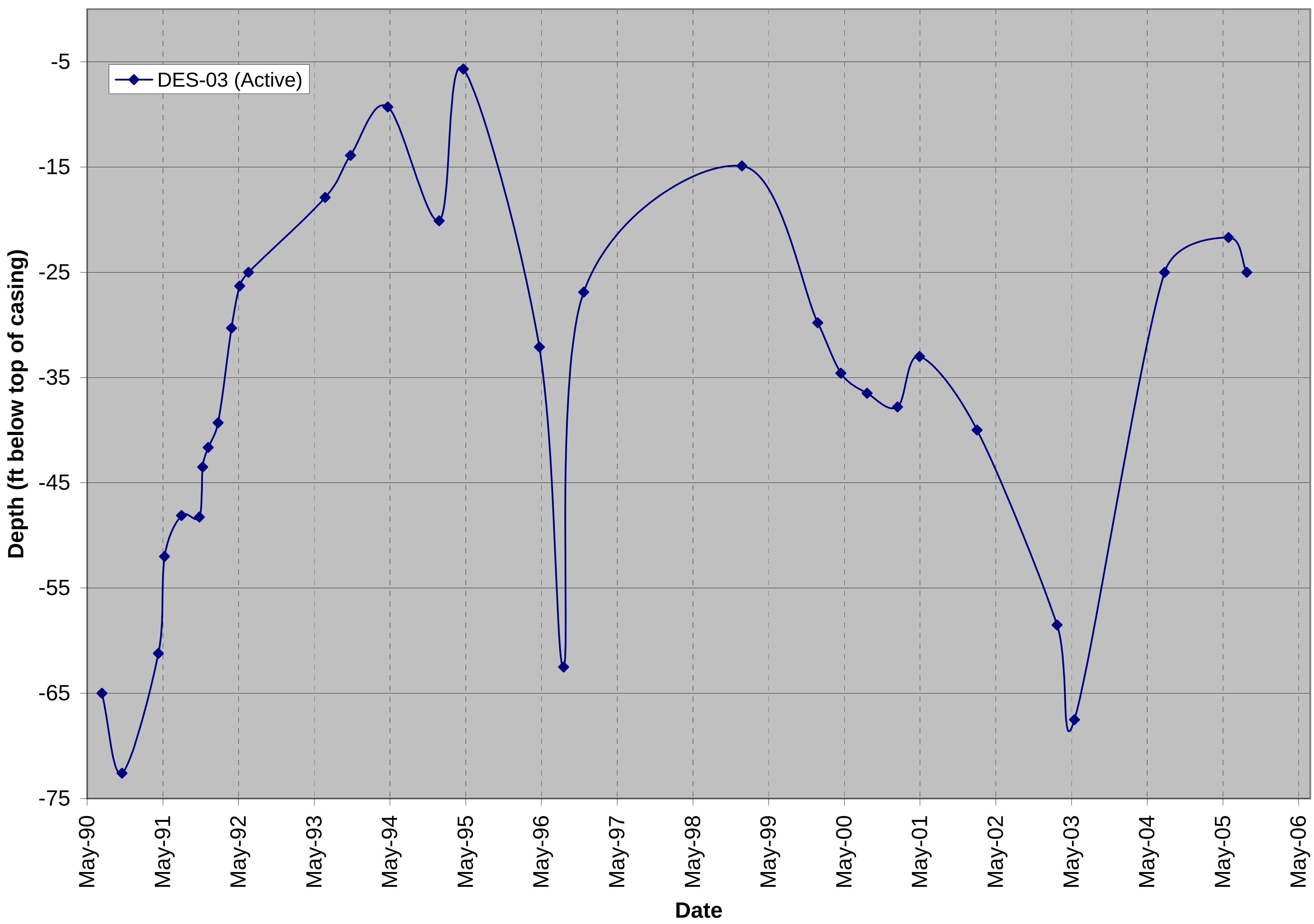


Figure 2-40: Jamul-Dulzura Community Planning Group
Bee Valley/ Deerhorn Valley Well Hydrographs

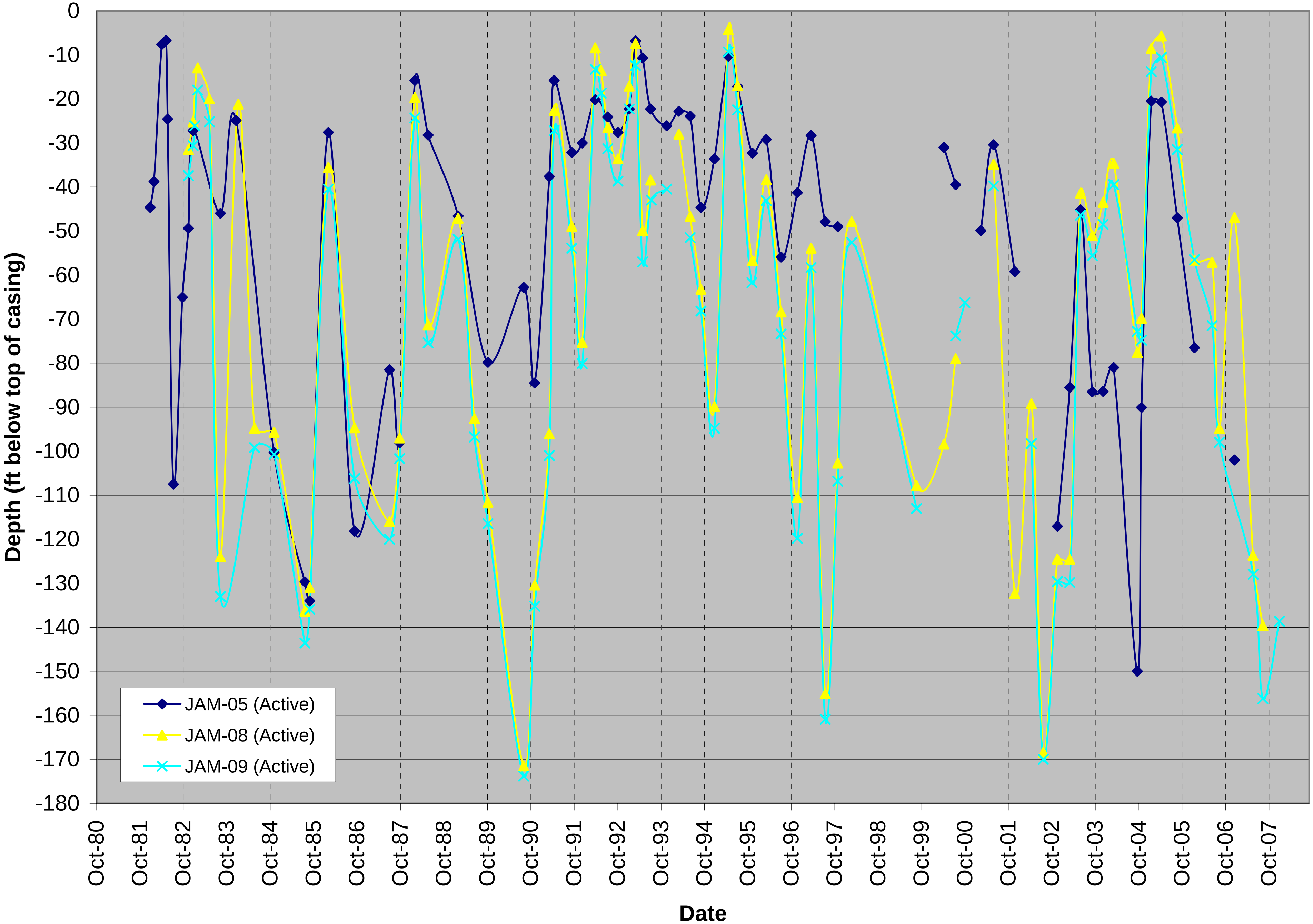


Figure 2-41: Jamul-Dulzura Community Planning Group
Honey Springs Road Well Hydrographs

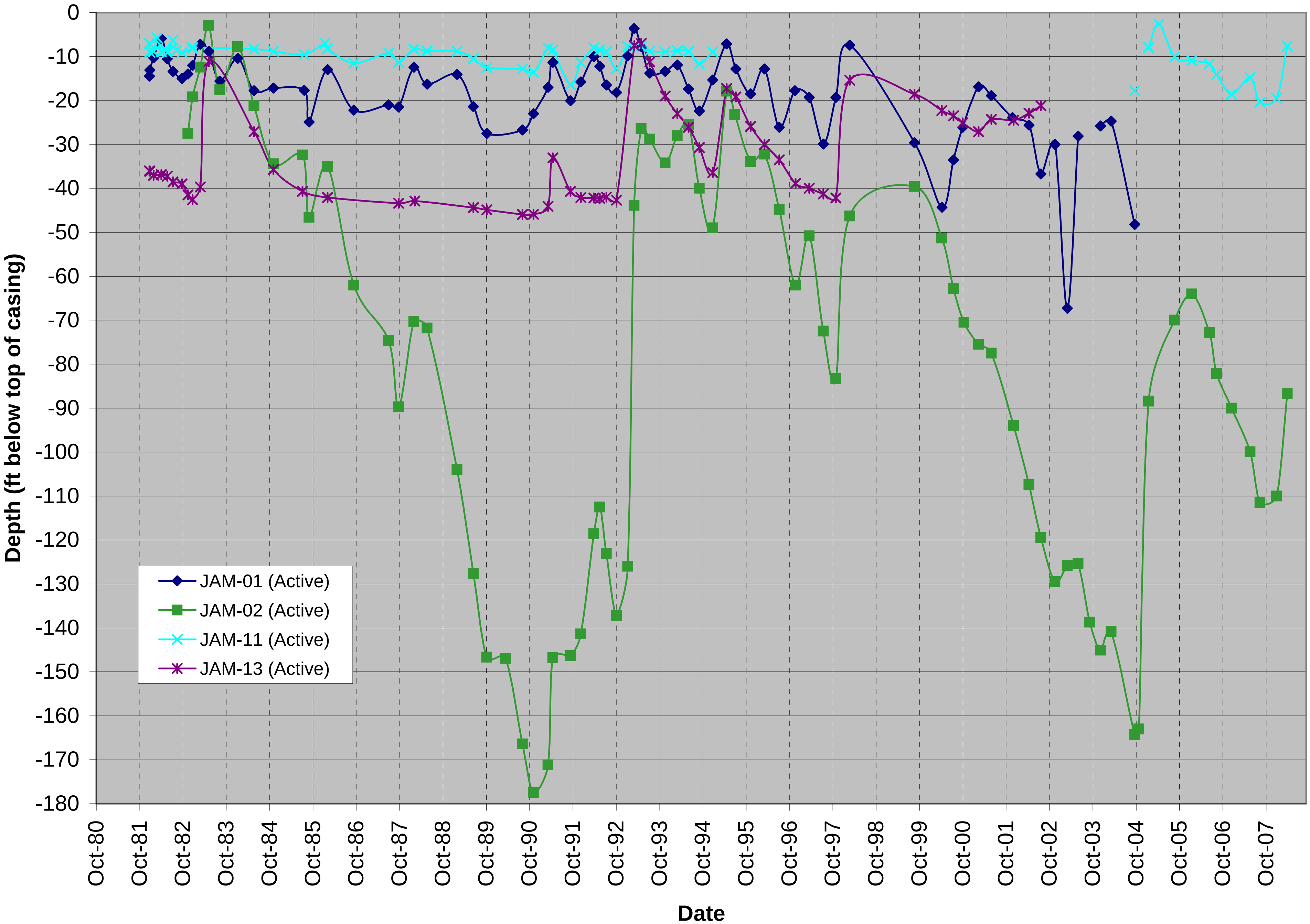
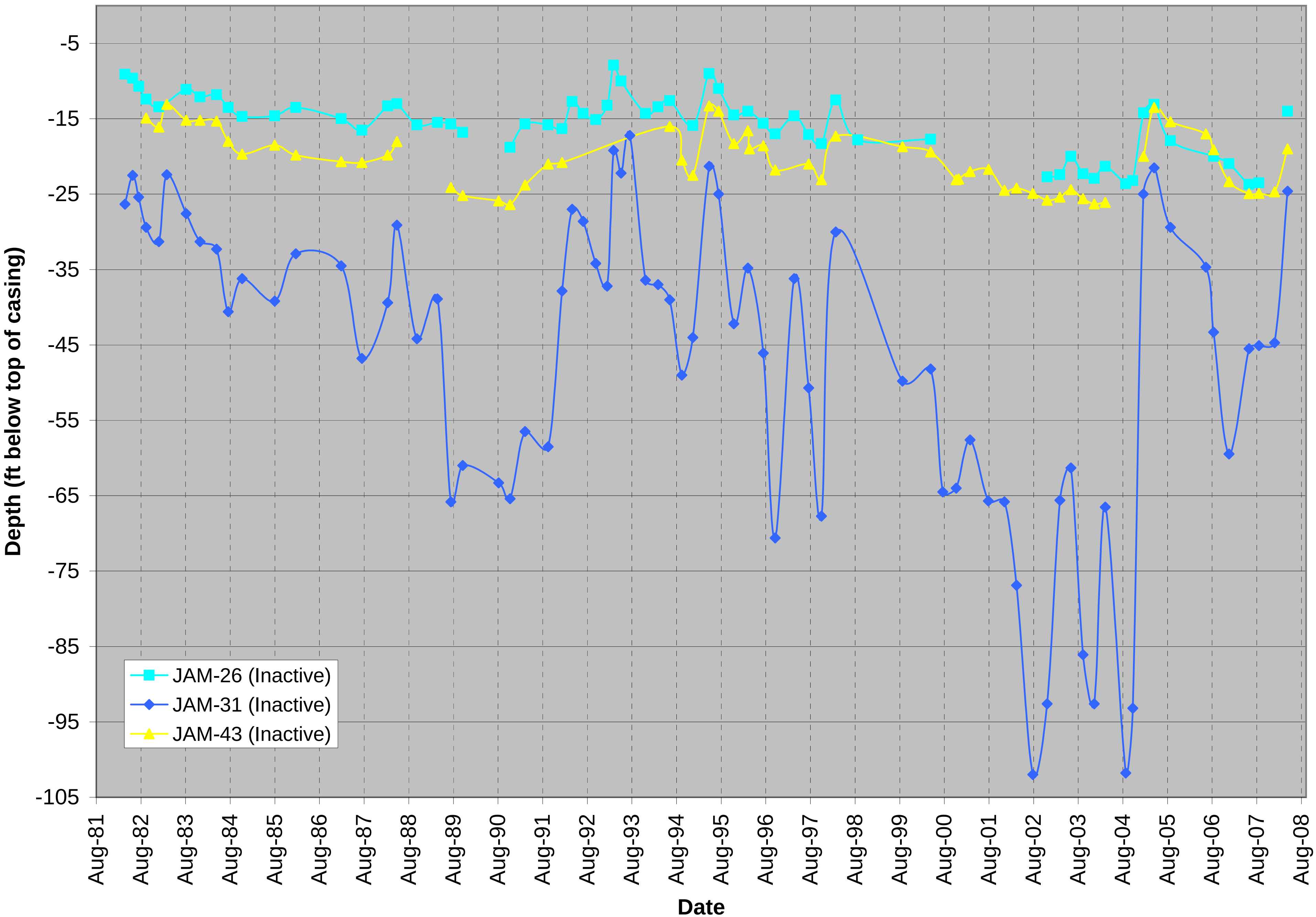


Figure 2-42: Jamul-Dulzura Community Planning Group
Lawson Valley Well Hydrographs



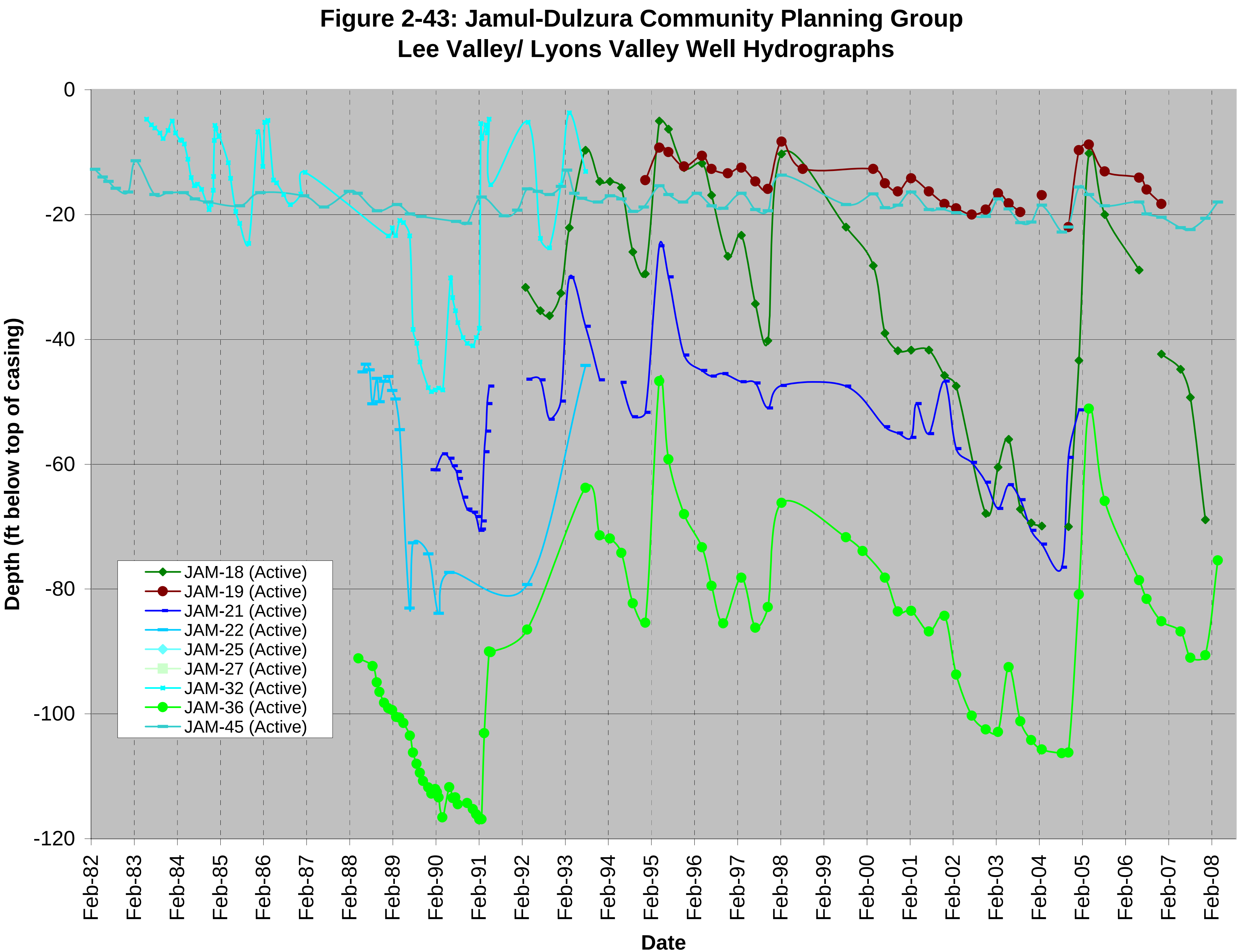


Figure 2-43: Jamul-Dulzura Community Planning Group
Lee Valley/ Lyons Valley Well Hydrographs
Depth (ft below top of casing)
0
-20
-40
-60
-80
-100
-120
Date
Feb-82
Feb-83
Feb-84
Feb-85
Feb-86
Feb-87
Feb-88
Feb-89
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Feb-05
Feb-06
Feb-07
Feb-08
JAM-18 (Active)
JAM-19 (Active)
JAM-21 (Active)
JAM-22 (Active)
JAM-25 (Active)
JAM-27 (Active)
JAM-32 (Active)
JAM-36 (Active)
JAM-45 (Active)

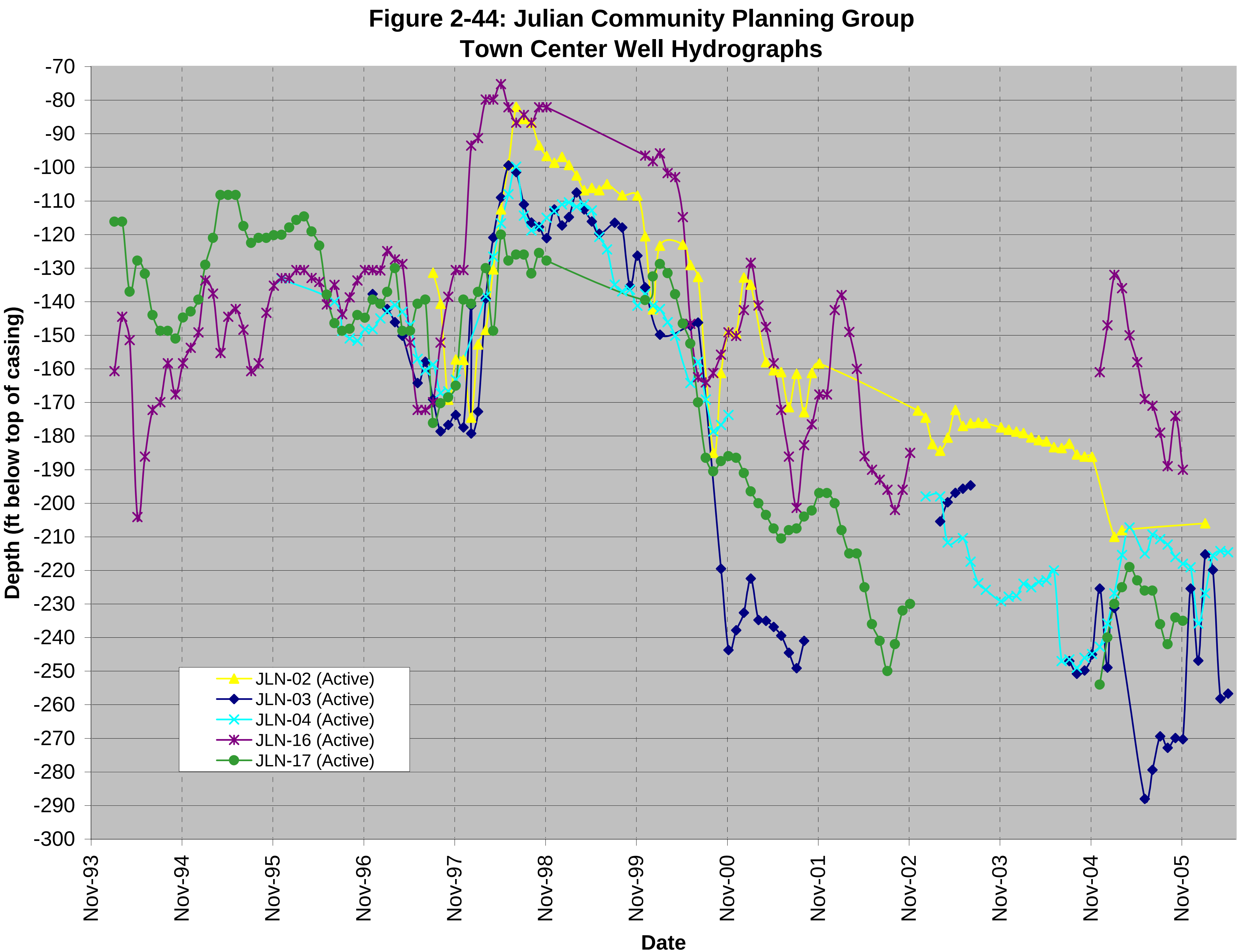


Figure 2-44: Julian Community Planning Group
Town Center Well Hydrographs
Depth (ft below top of casing)
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
-220
-230
-240
-250
-260
-270
-280
-290
-300
Nov-93
Nov-94
Nov-95
Nov-96
Nov-97
Nov-98
Nov-99
Nov-00
Nov-01
Nov-02
Nov-03
Nov-04
Nov-05
Date
JLN-02 (Active)
JLN-03 (Active)
JLN-04 (Active)
JLN-16 (Active)
JLN-17 (Active)

Figure 2-45: Julian Community Planning Group
KQ Ranch Well Hydrographs

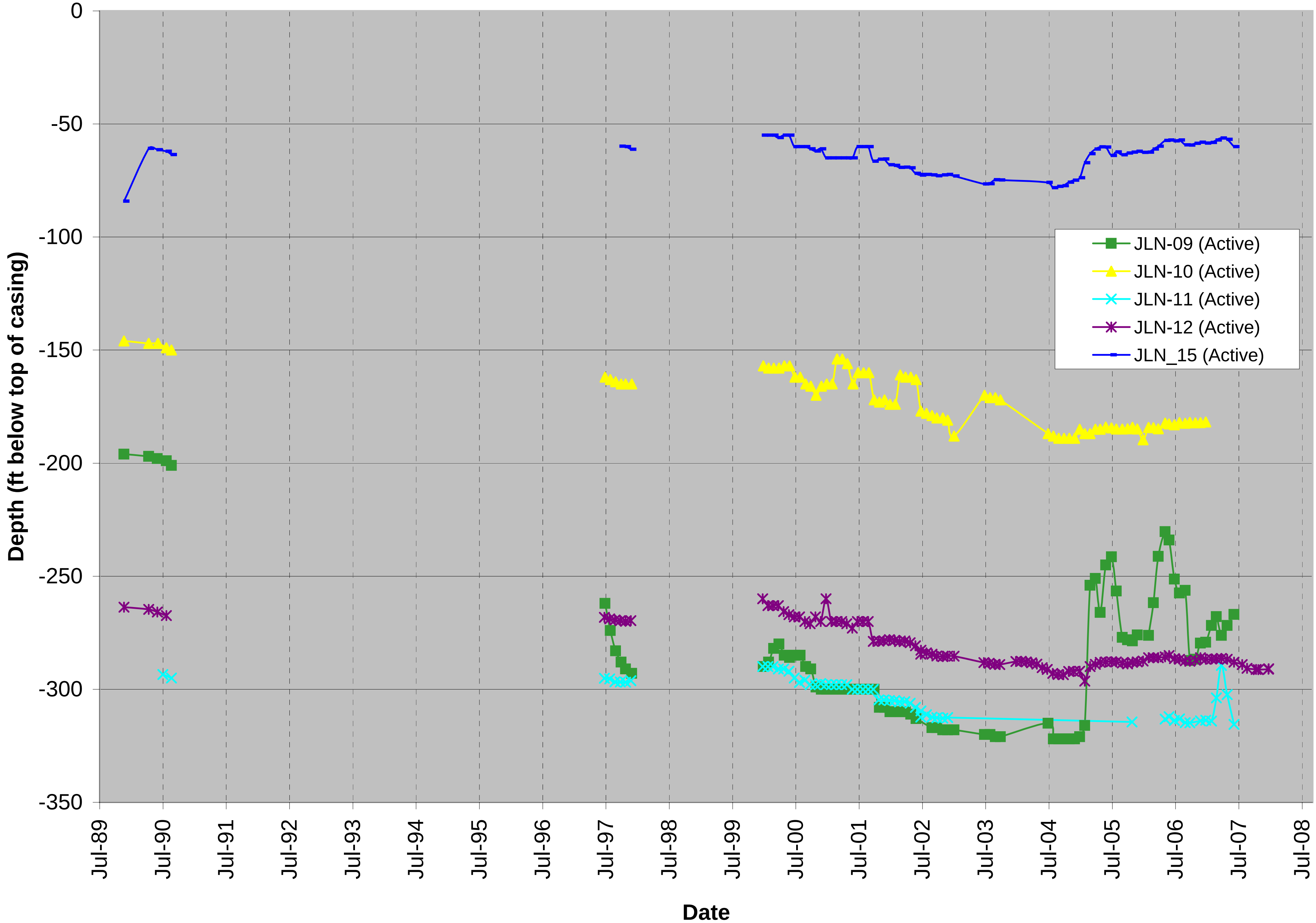


Figure 2-46: Julian Community Planning Group Volcan Road Well Hydrographs

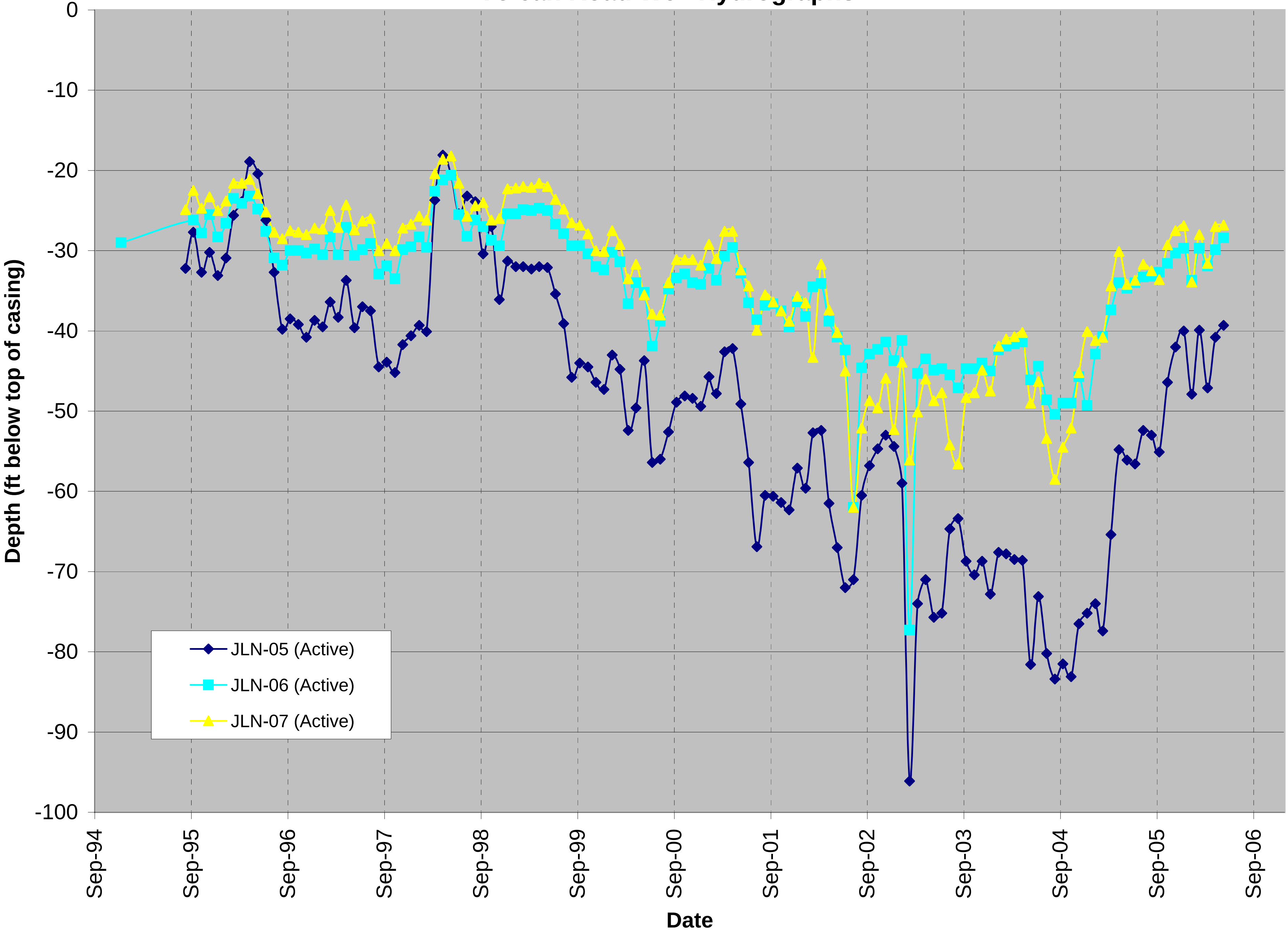
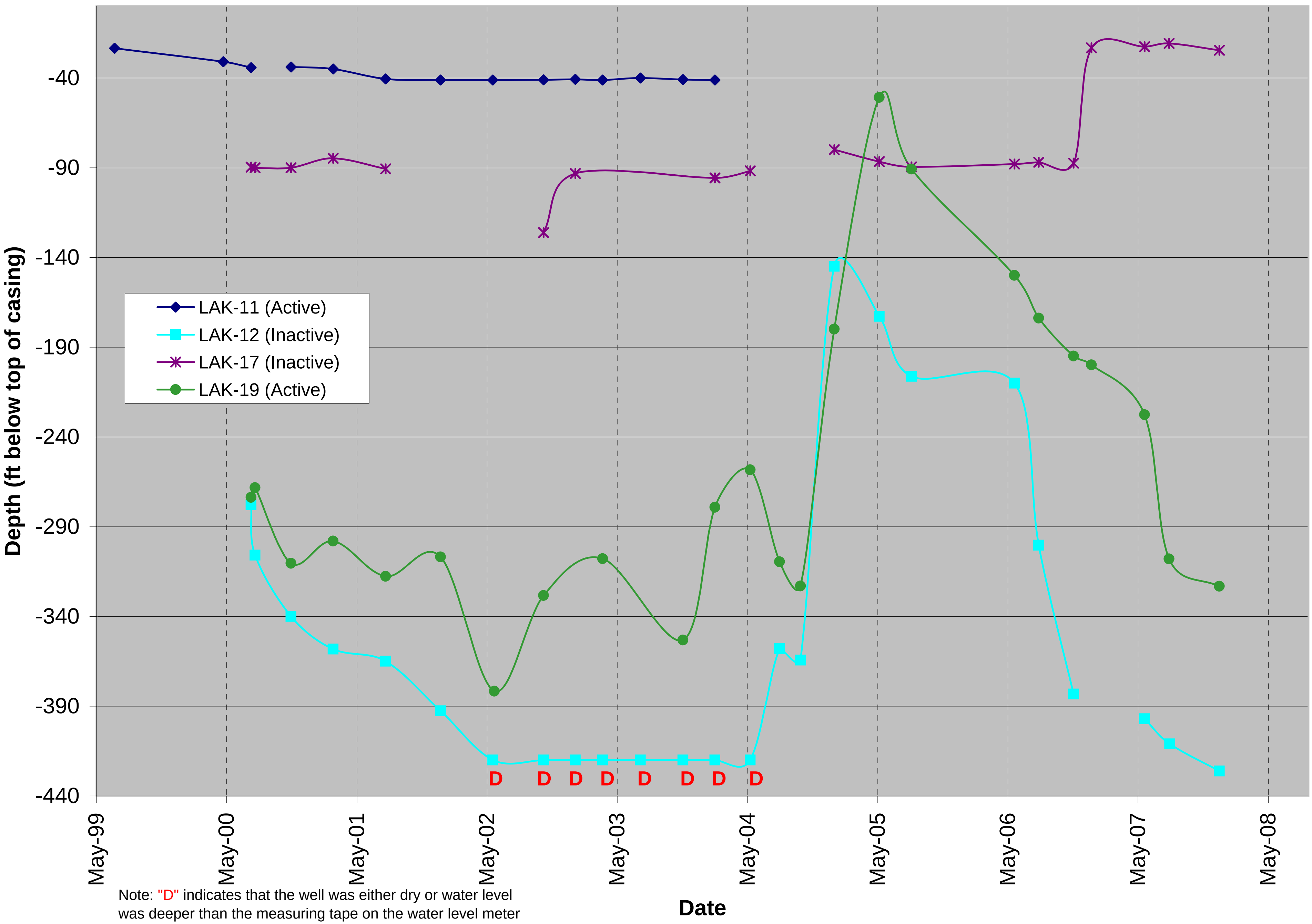
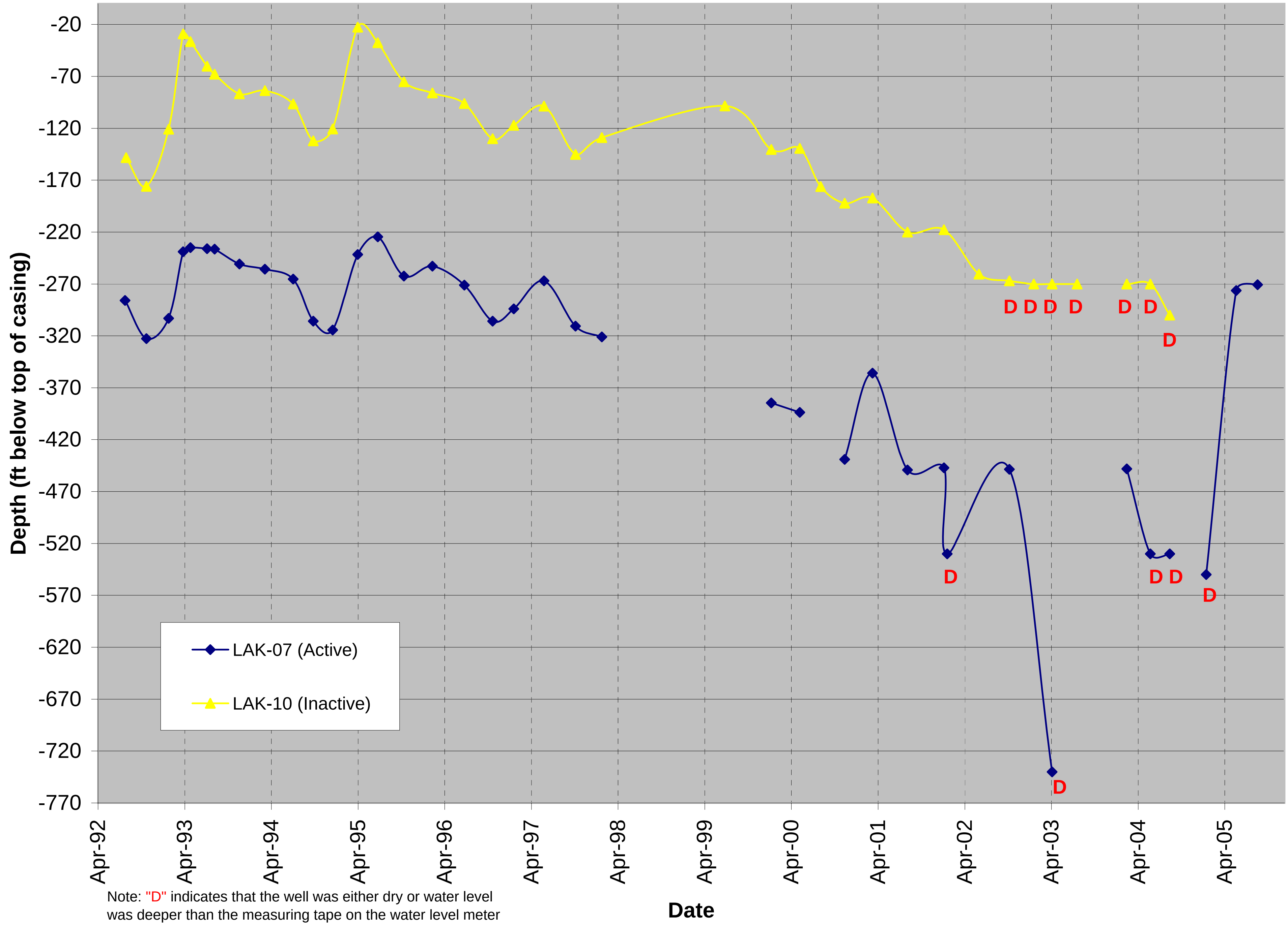


Figure 2-47: Lakeside Community Planning Group
Old Barona Road Well Hydrographs



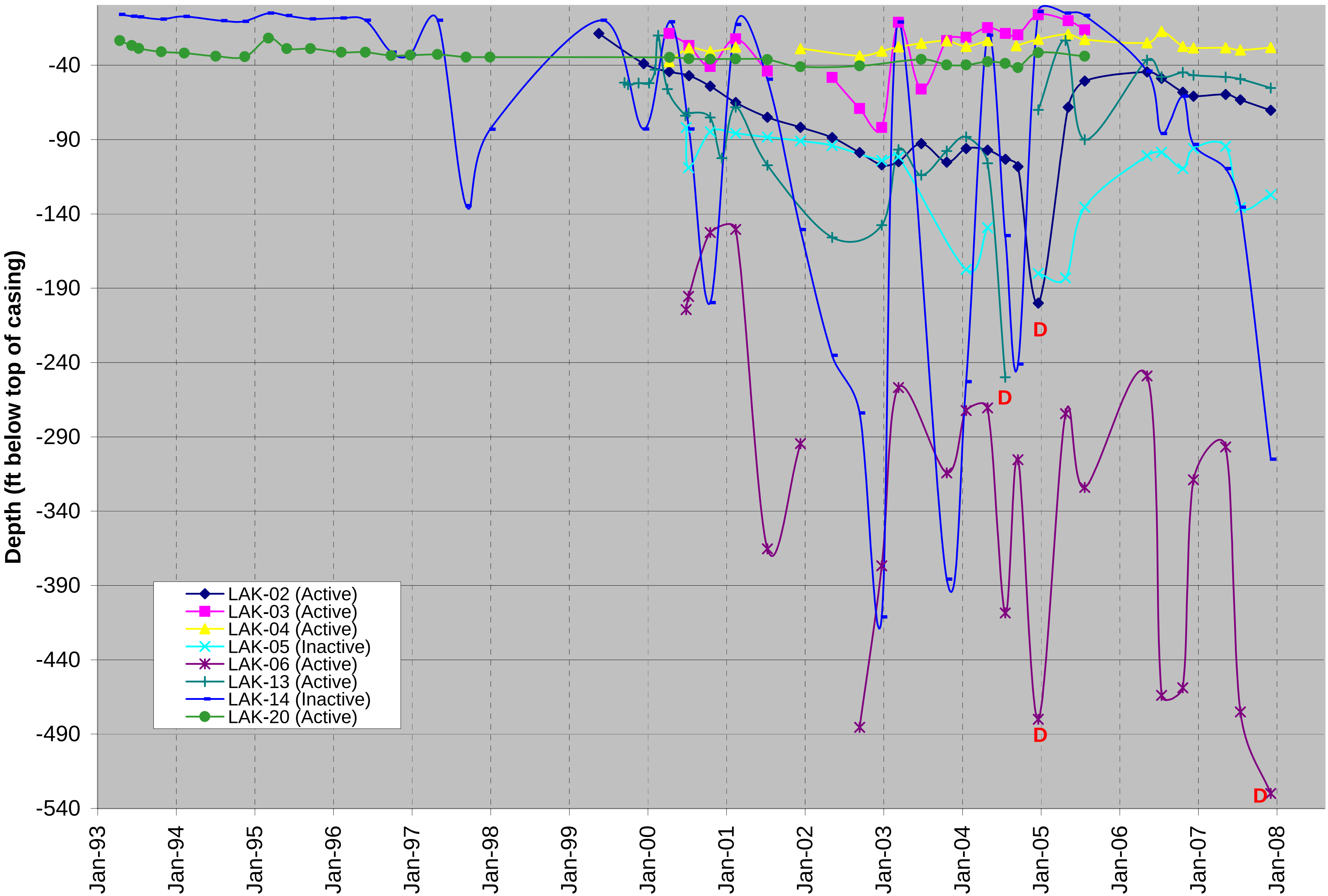
Note: "D" indicates that the well was either dry or water level was deeper than the measuring tape on the water level meter

Figure 2-48: Lakeside Community Planning Group
State Route 67 Well Hydrographs



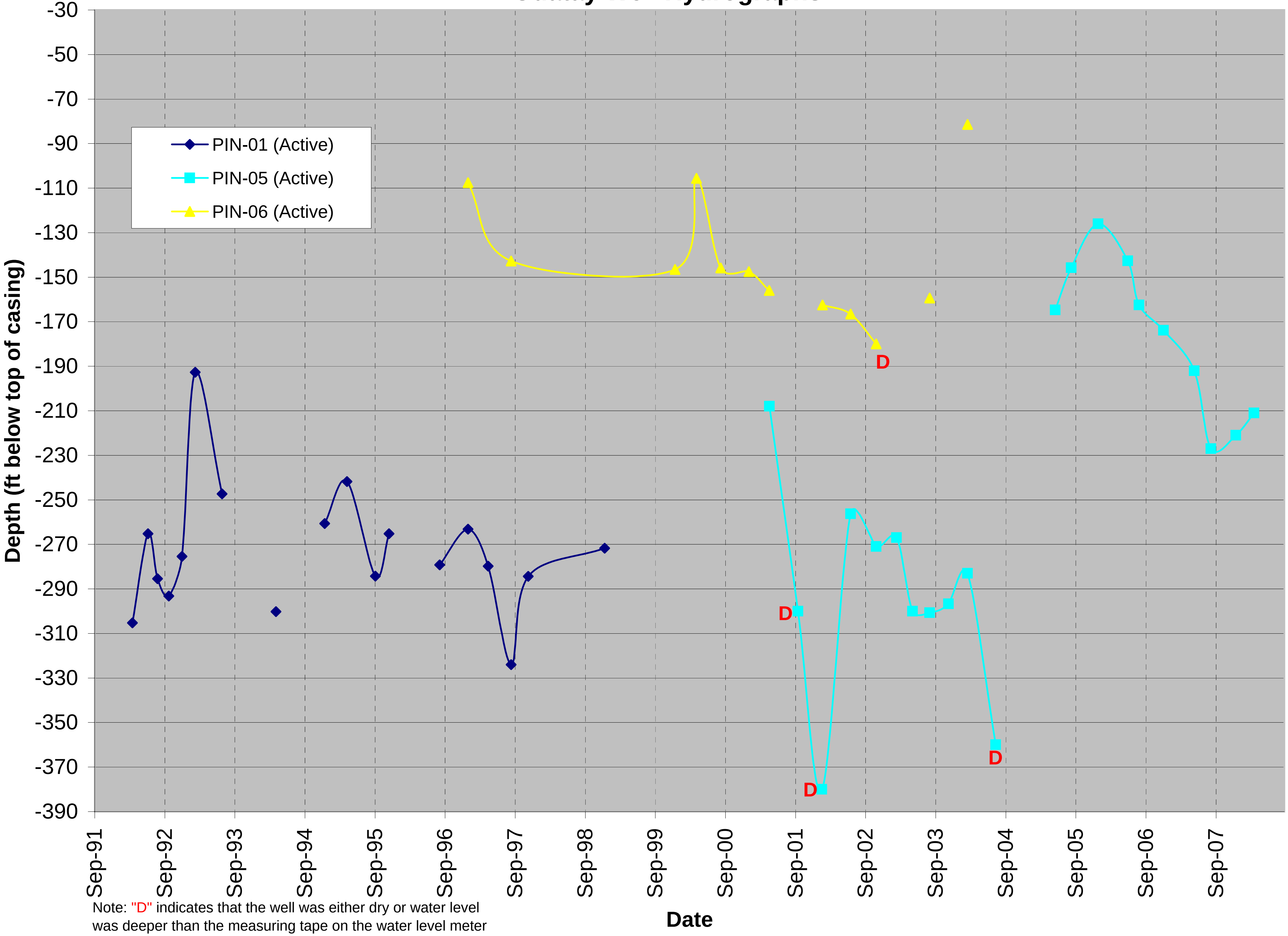
Note: "D" indicates that the well was either dry or water level was deeper than the measuring tape on the water level meter

Figure 2-49: Lakeside Community Planning Group
Wildcat Canyon Road Well Hydrographs



Note: "D" indicates that the well was either dry or water level was deeper than the measuring tape on the water level meter

**Figure 2-50: Pine Valley Community Planning Group
Guatay Well Hydrographs**



Note: "D" indicates that the well was either dry or water level was deeper than the measuring tape on the water level meter

Figure 2-51: Pine Valley Community Planning Group
Pine Valley Area 1 Well Hydrographs

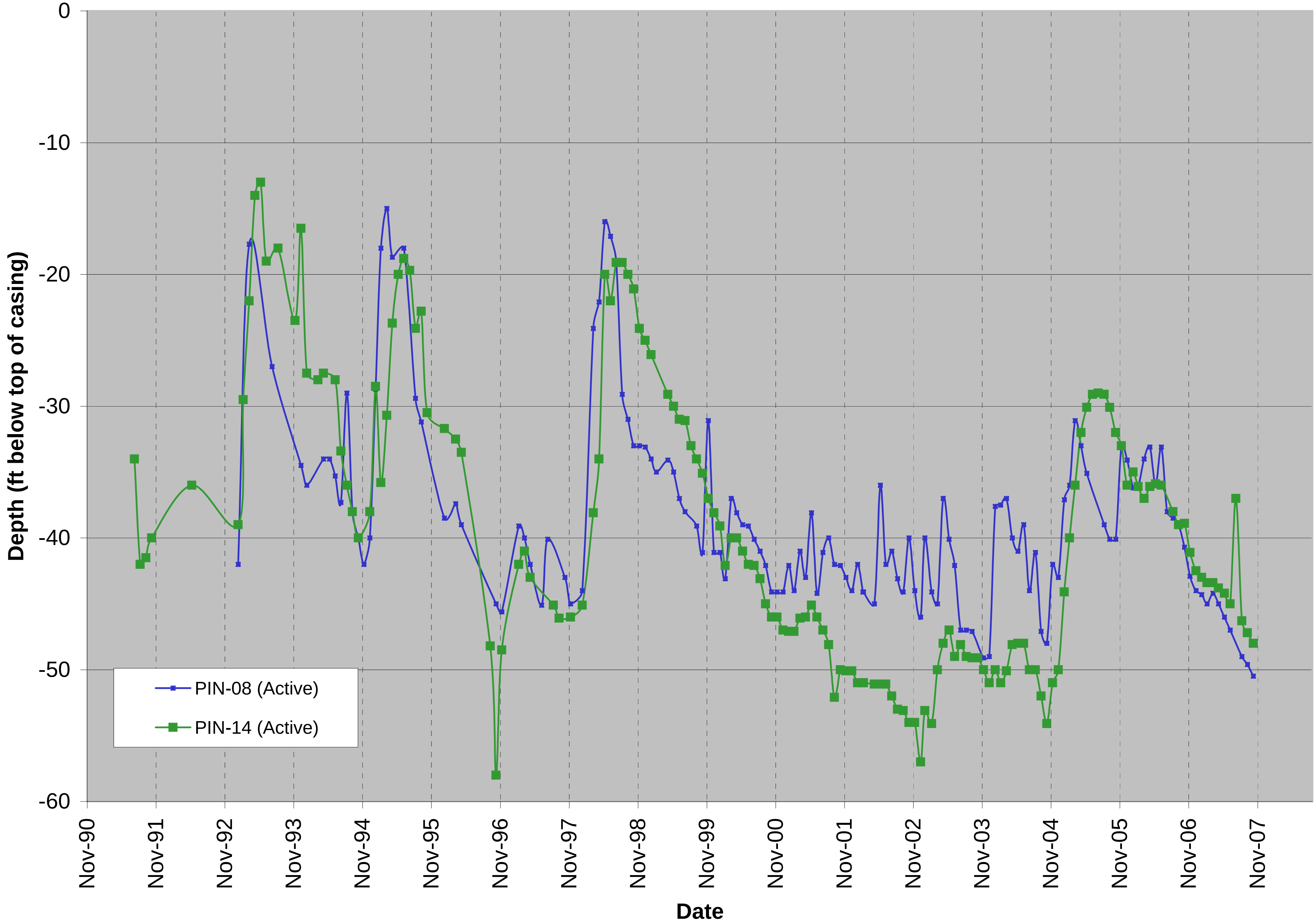


Figure 2-52: Pine Valley Community Planning Group
Pine Valley Area 2 Well Hydrographs

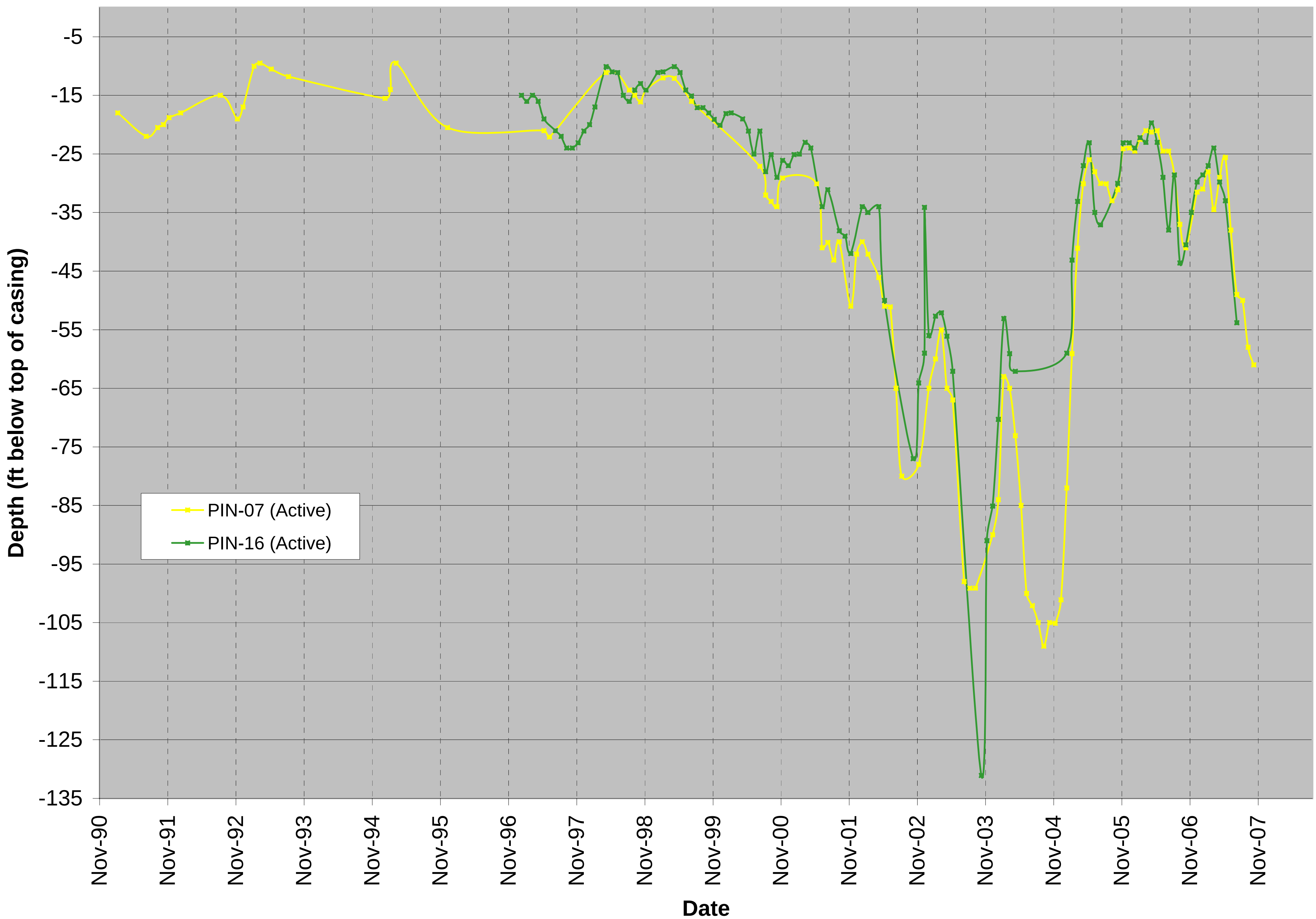


Figure 2-53: Pine Valley Community Planning Group
Pine Valley Area 3 Well Hydrographs

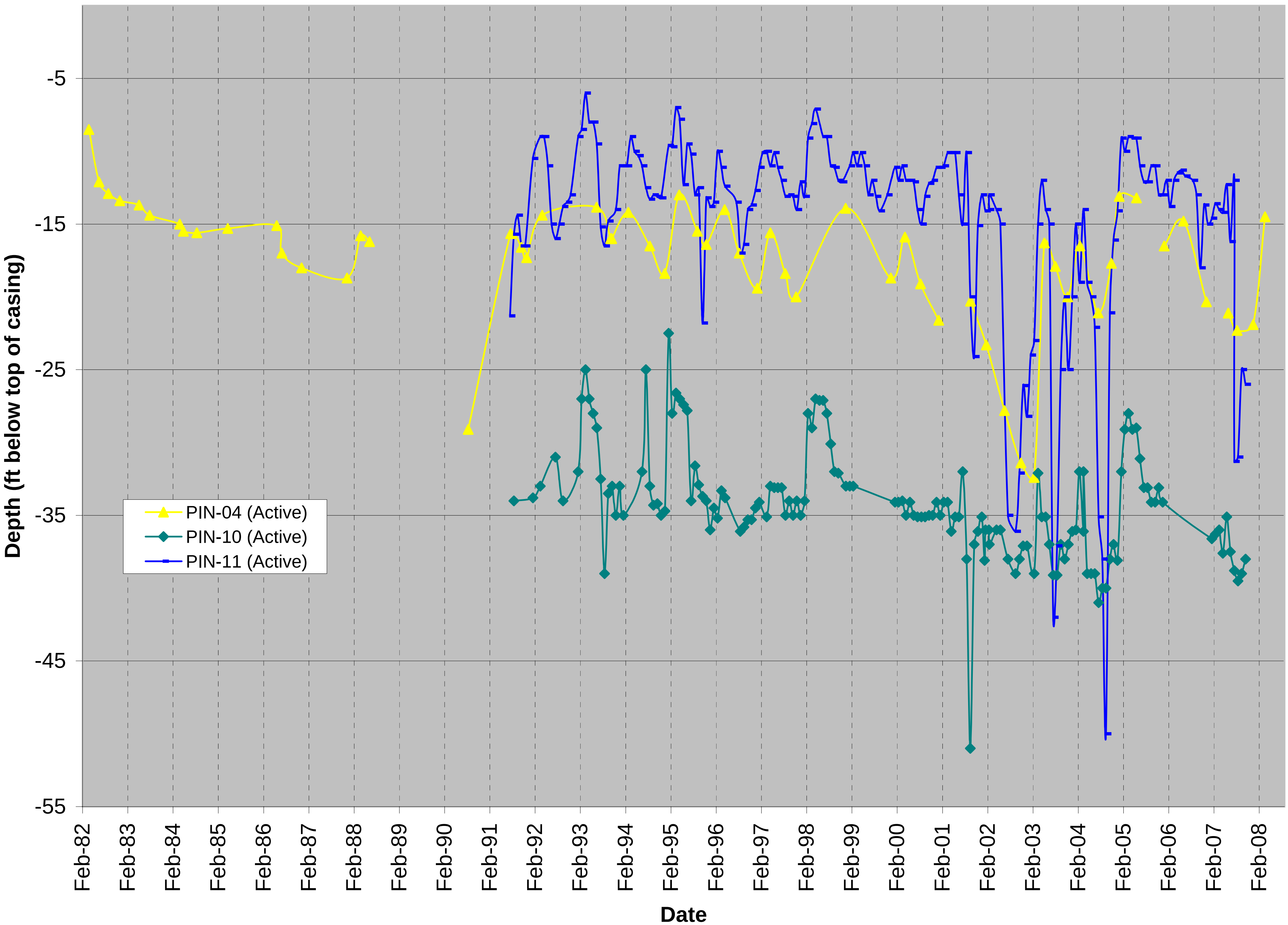
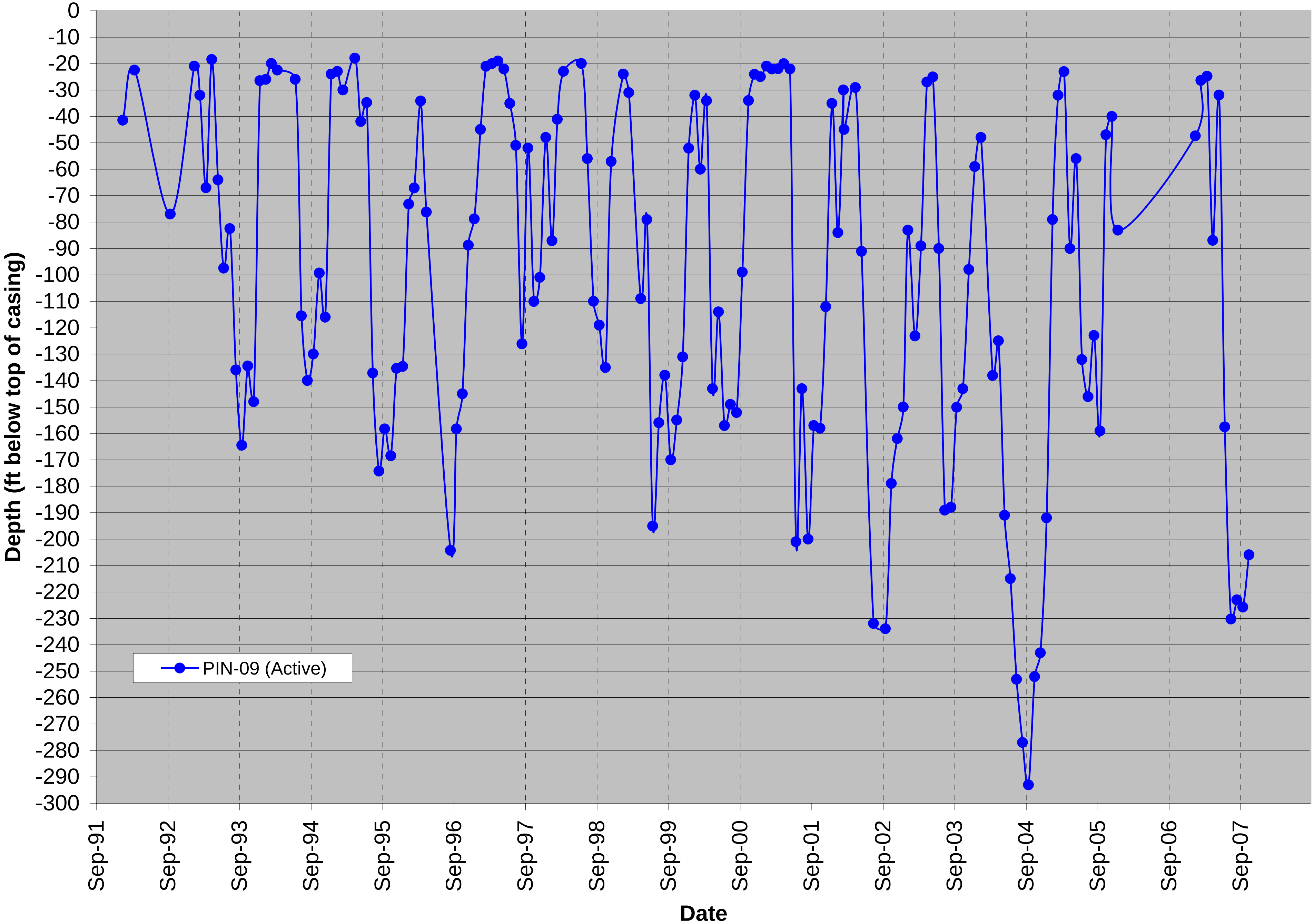
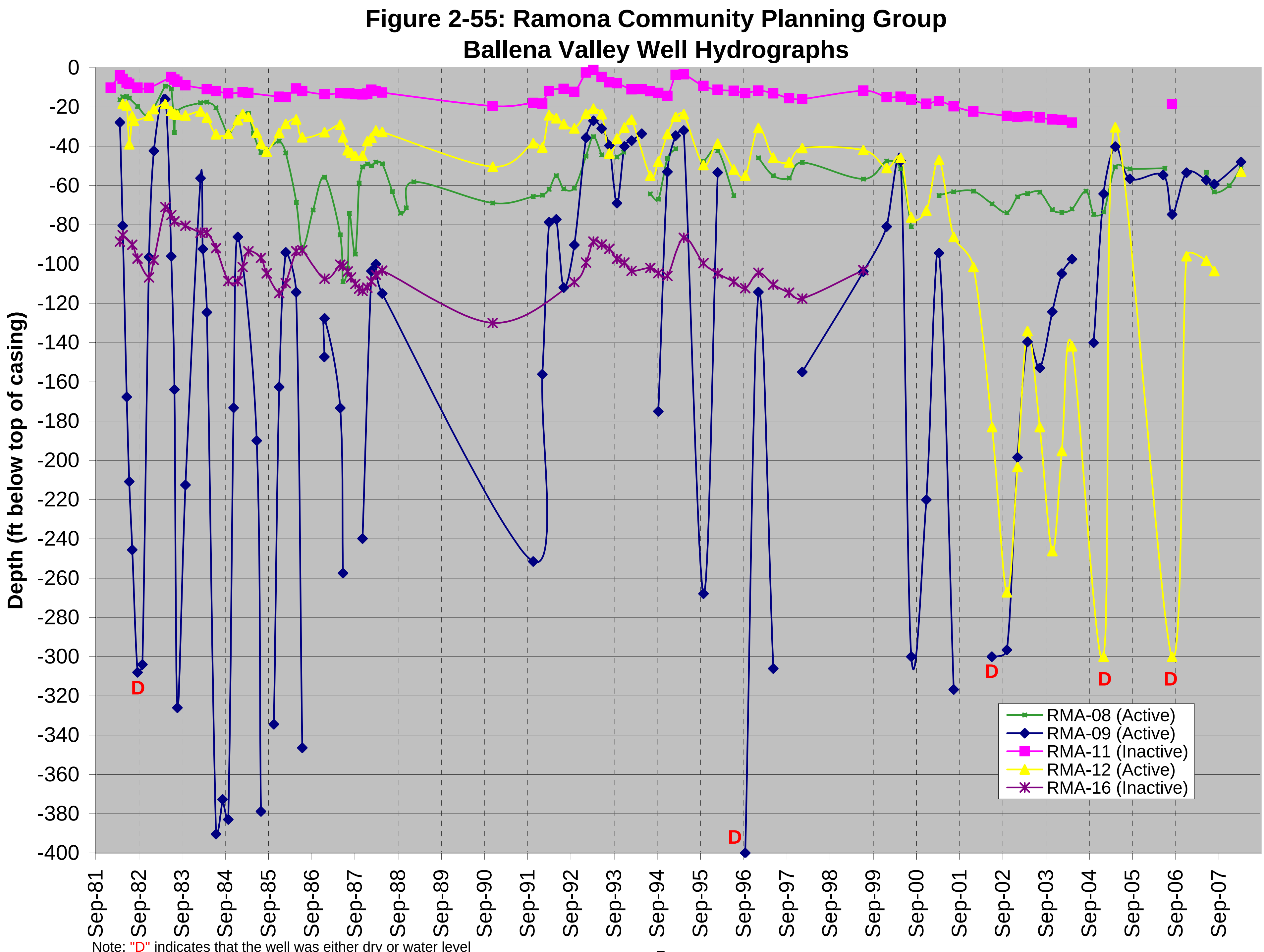


Figure 2-54: Pine Valley Community Planning Group
Pine Valley Area 4 Well Hydrographs





Note: "D" indicates that the well was either dry or water level was deeper than the measuring tape on the water level meter

Figure 2-56: Ramona Community Planning Group
Clevenger Canyon Well Hydrographs

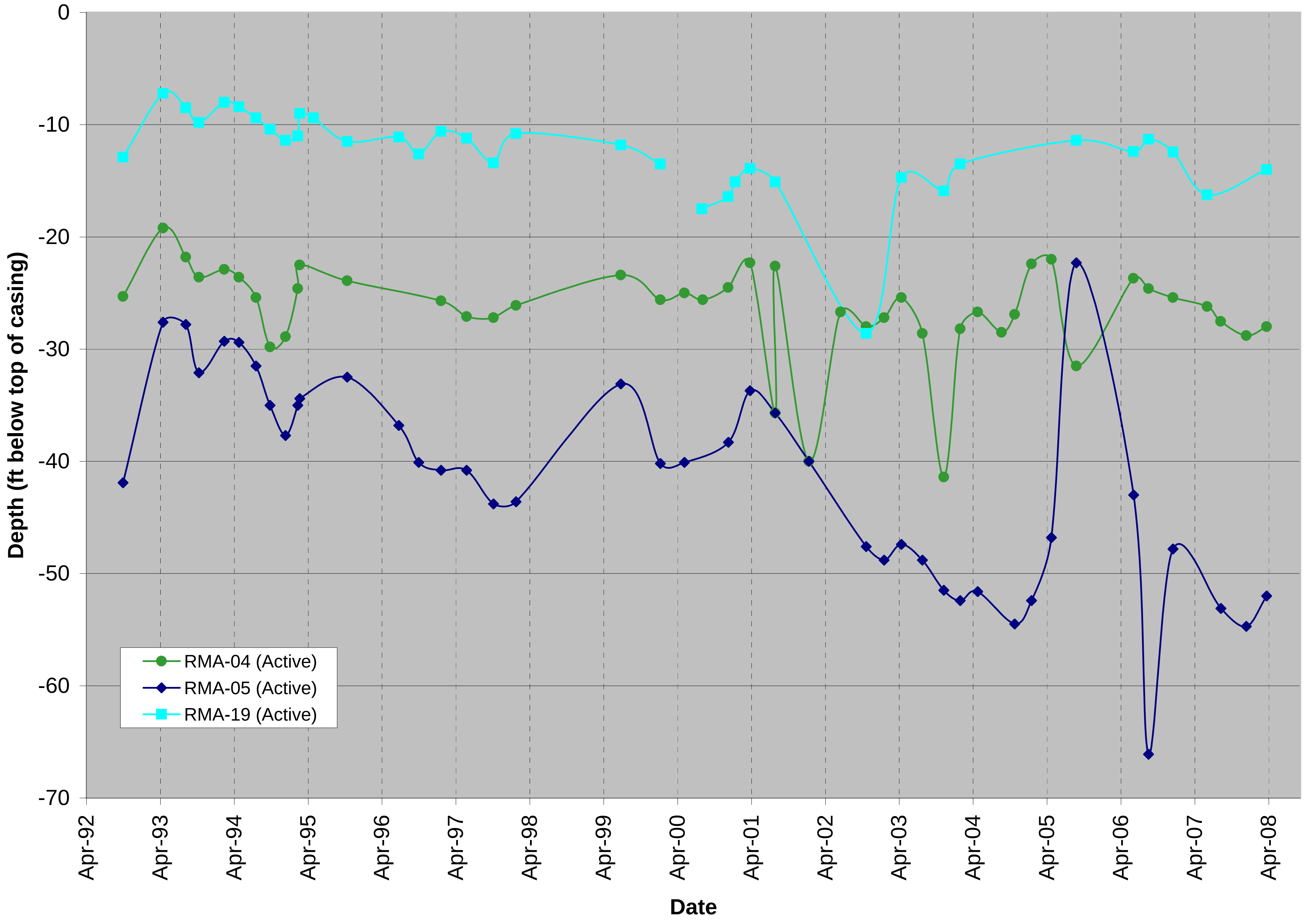
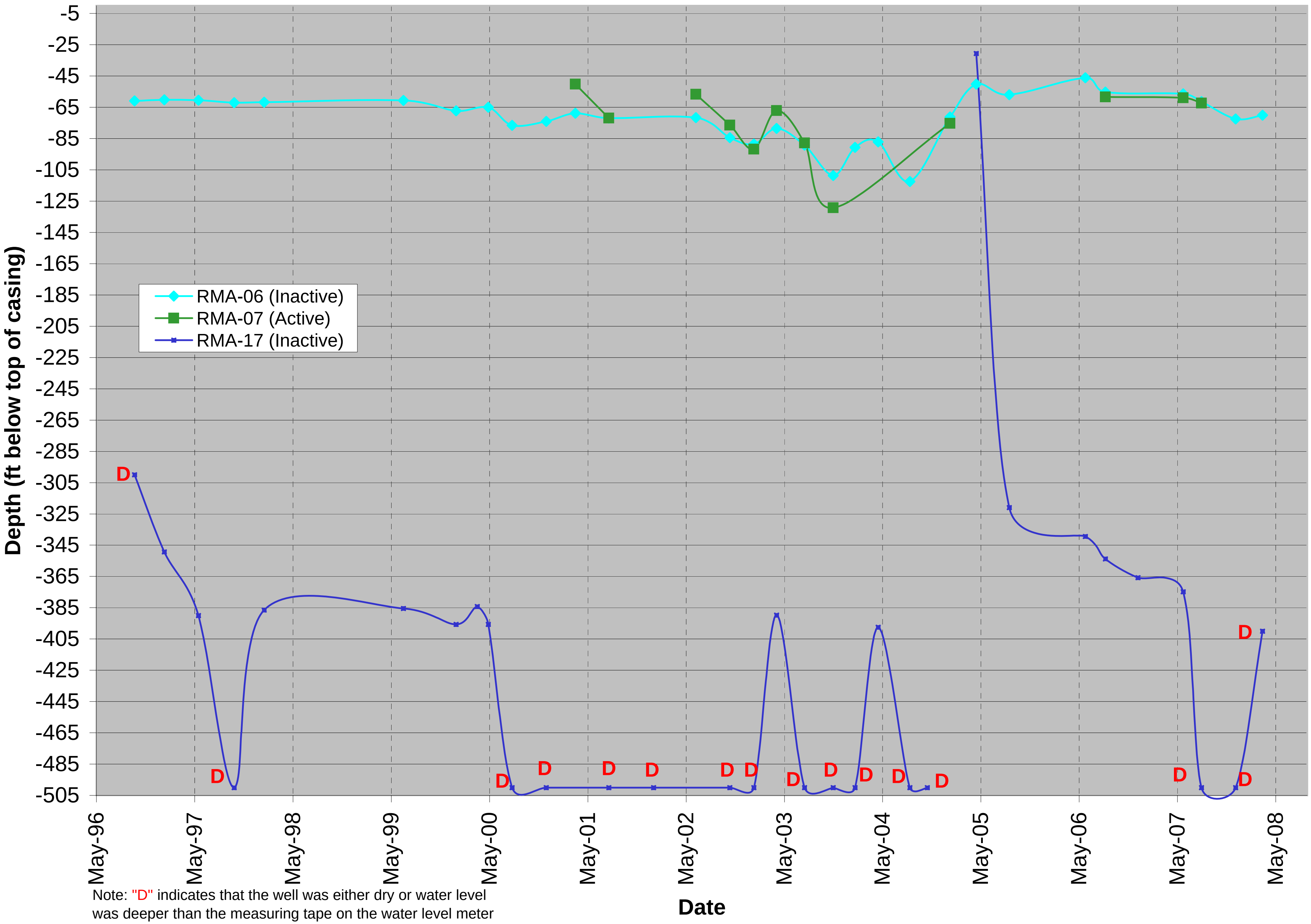
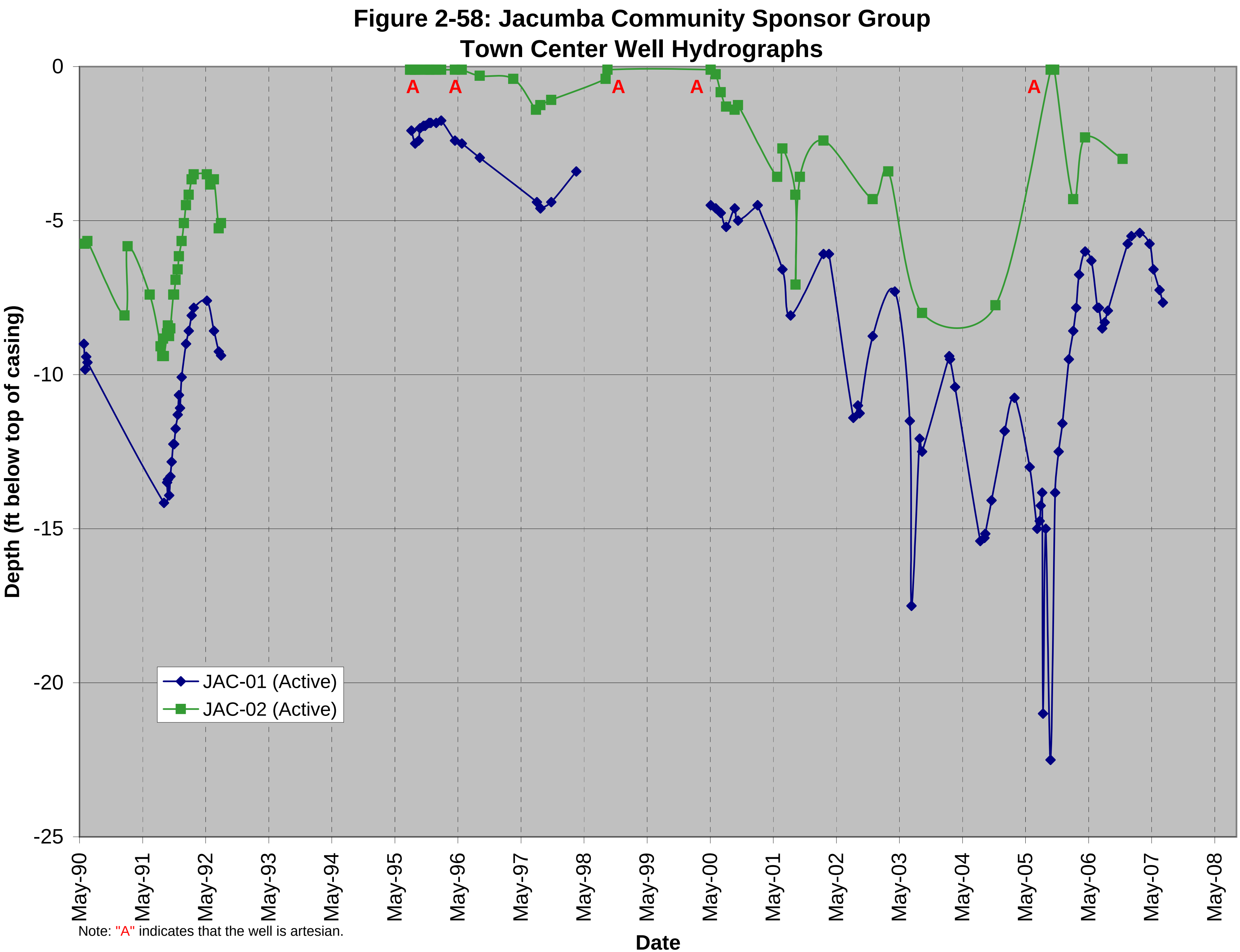


Figure 2-57: Ramona Community Planning Group
Ramona Trails Drive Well Hydrographs

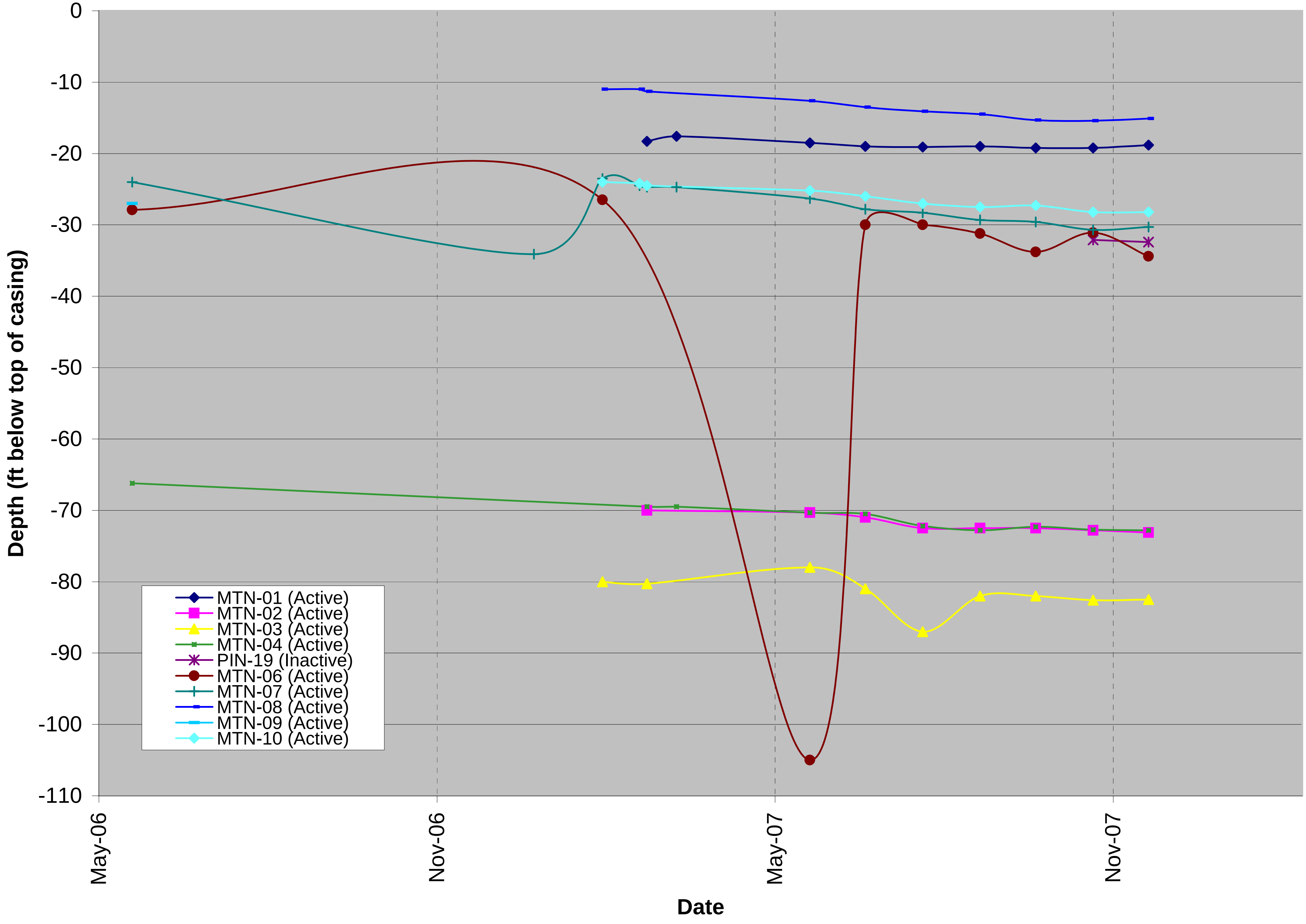


Note: "D" indicates that the well was either dry or water level was deeper than the measuring tape on the water level meter



Note: "A" indicates that the well is artesian.

Figure 2-59: Mountain Empire Community Planning Area
La Posta Indian Reservation Well Hydrographs



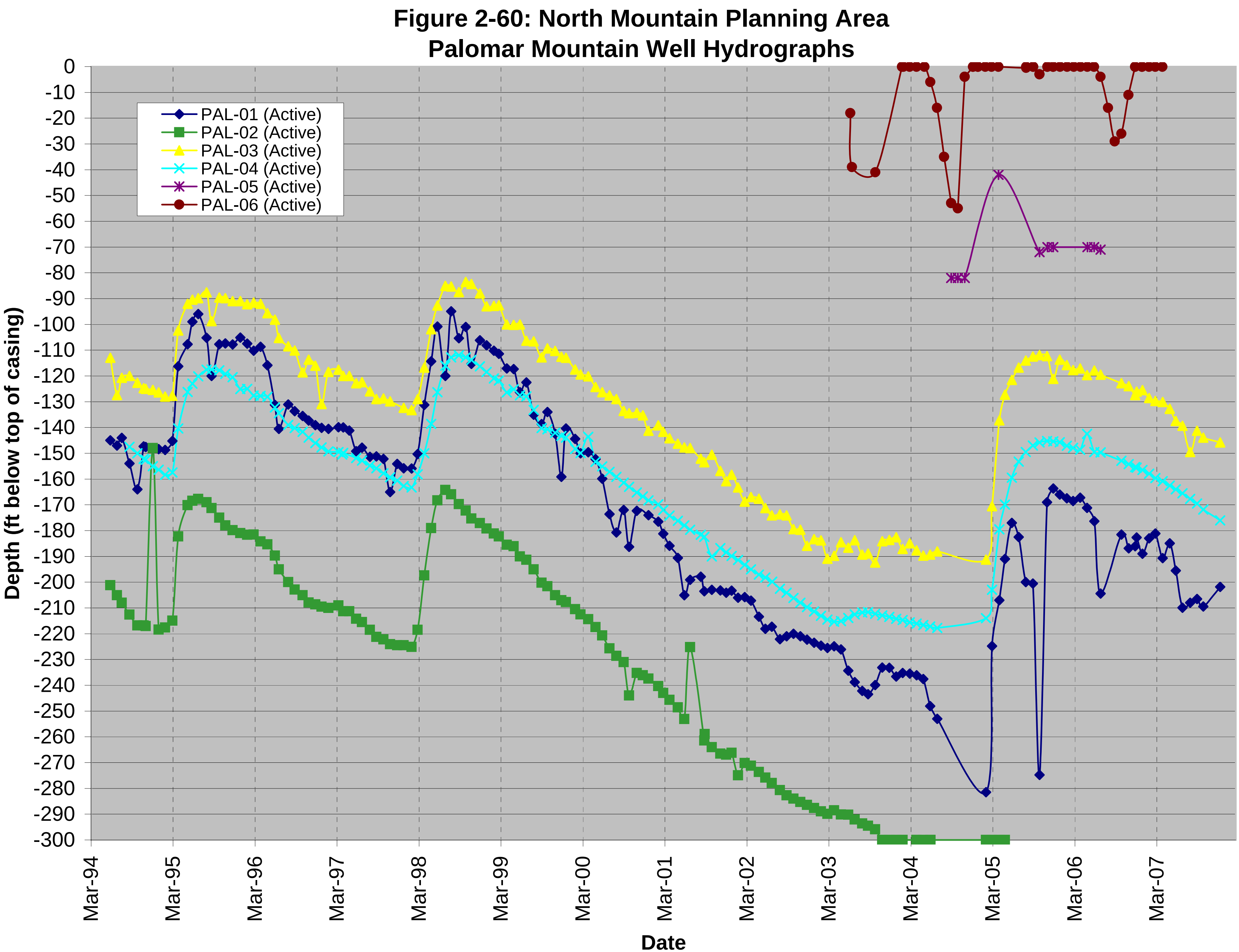


Figure 2-60: North Mountain Planning Area
Palomar Mountain Well Hydrographs
PAL-01 (Active)
PAL-02 (Active)
PAL-03 (Active)
PAL-04 (Active)
PAL-05 (Active)
PAL-06 (Active)
Depth (ft below top of casing)
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-170
-180
-190
-200
-210
-220
-230
-240
-250
-260
-270
-280
-290
-300
Mar-94
Mar-95
Mar-96
Mar-97
Mar-98
Mar-99
Mar-00
Mar-01
Mar-02
Mar-03
Mar-04
Mar-05
Mar-06
Mar-07
Date

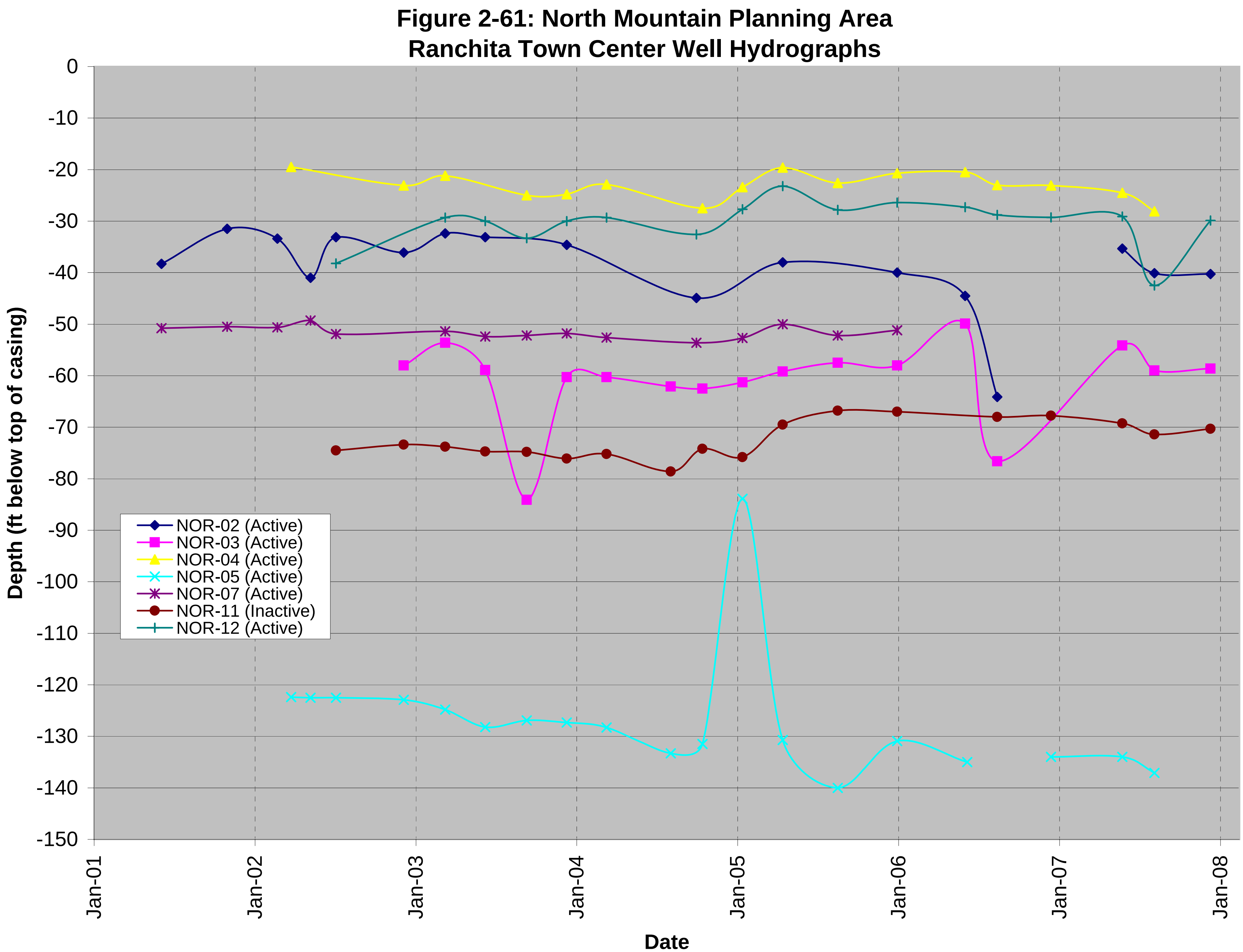


Figure 2-61: North Mountain Planning Area
Ranchita Town Center Well Hydrographs
Depth (ft below top of casing)
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
Jan-01
Jan-02
Jan-03
Jan-04
Jan-05
Jan-06
Jan-07
Jan-08
Date
NOR-02 (Active)
NOR-03 (Active)
NOR-04 (Active)
NOR-05 (Active)
NOR-07 (Active)
NOR-11 (Inactive)
NOR-12 (Active)

Figure 2-62: North Mountain Planning Area
Santa Ysabel Indian Reservation Well Hydrographs

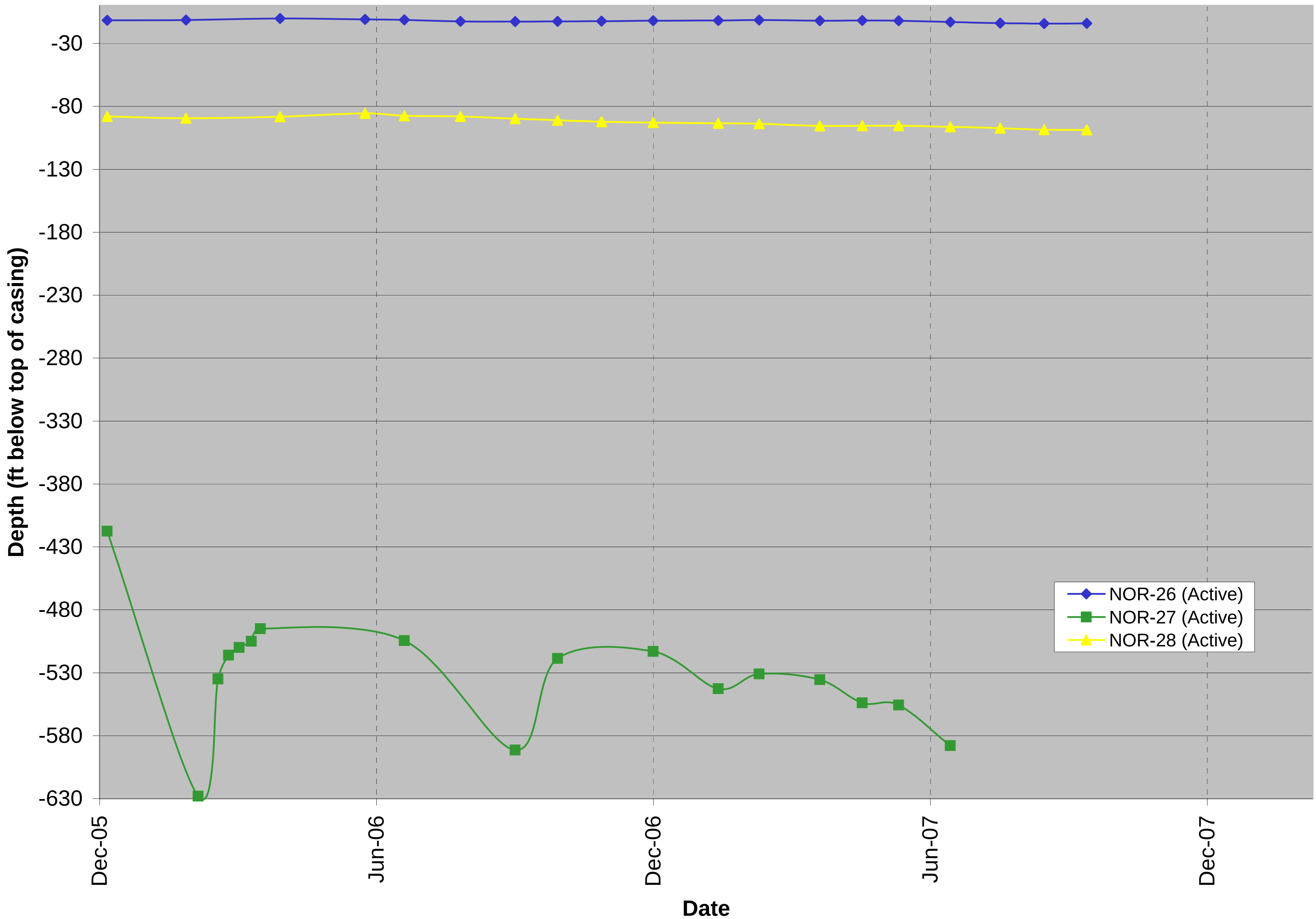


Figure 2-63: North Mountain Planning Area
State Route 79 Well Hydrographs

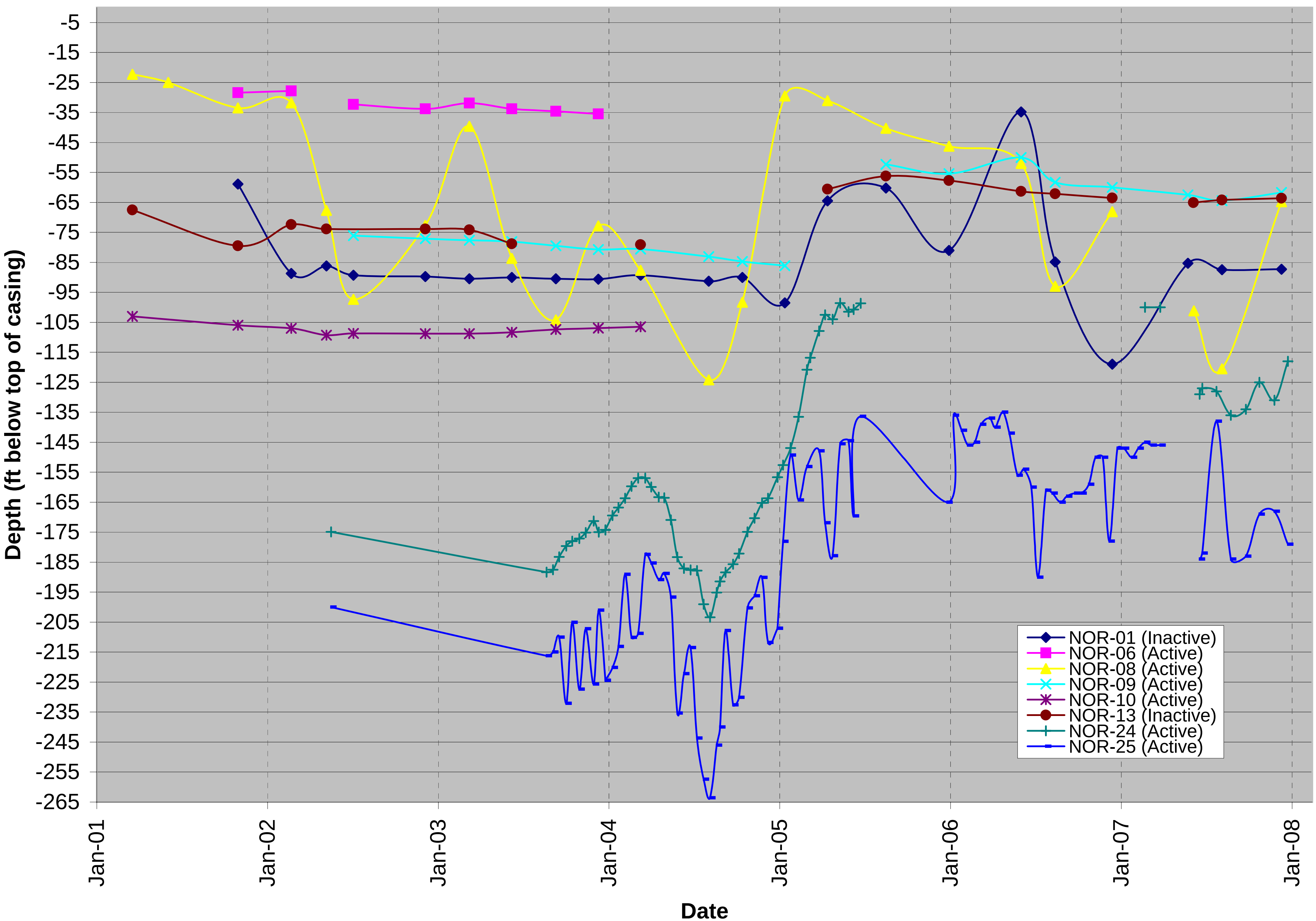
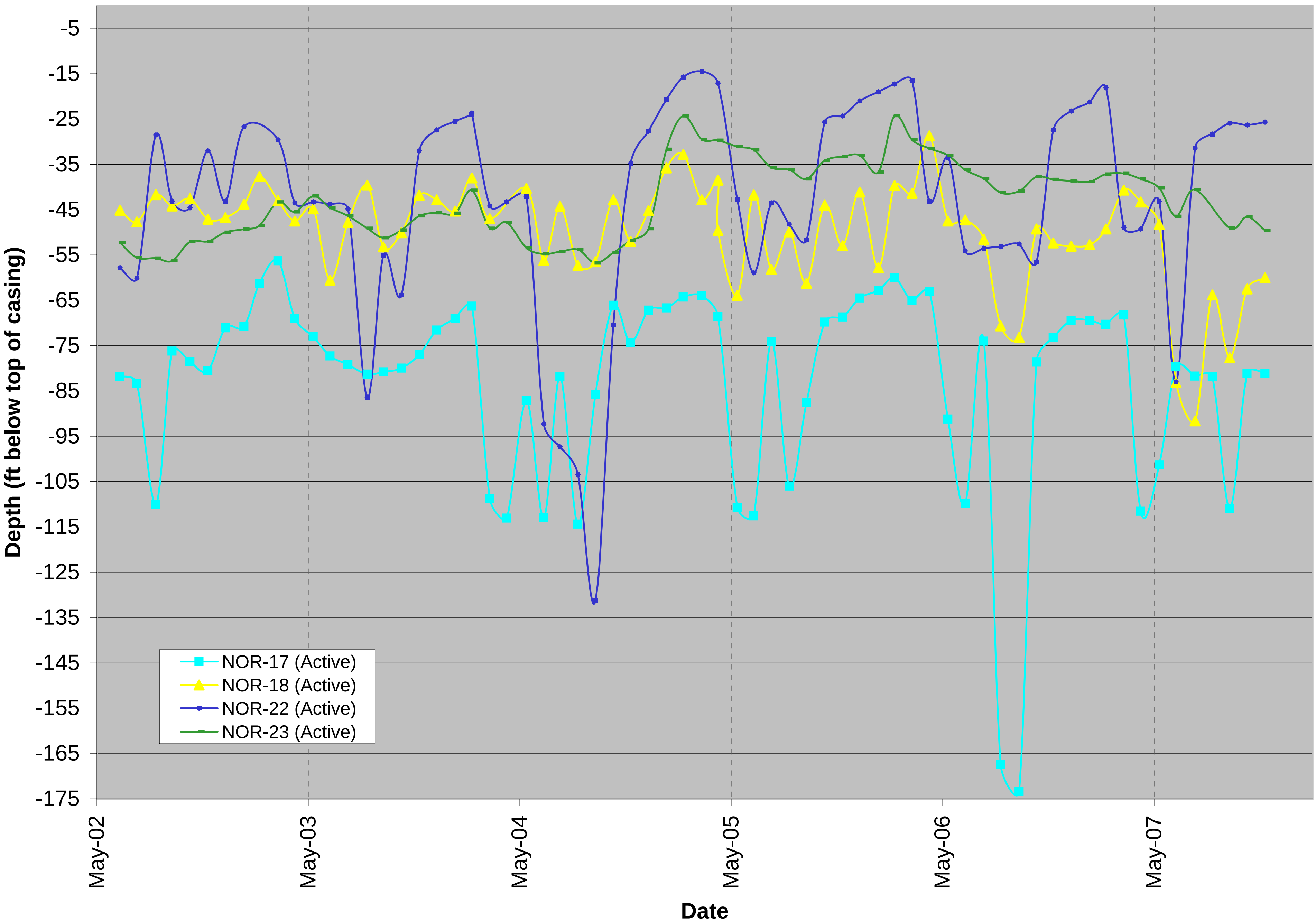
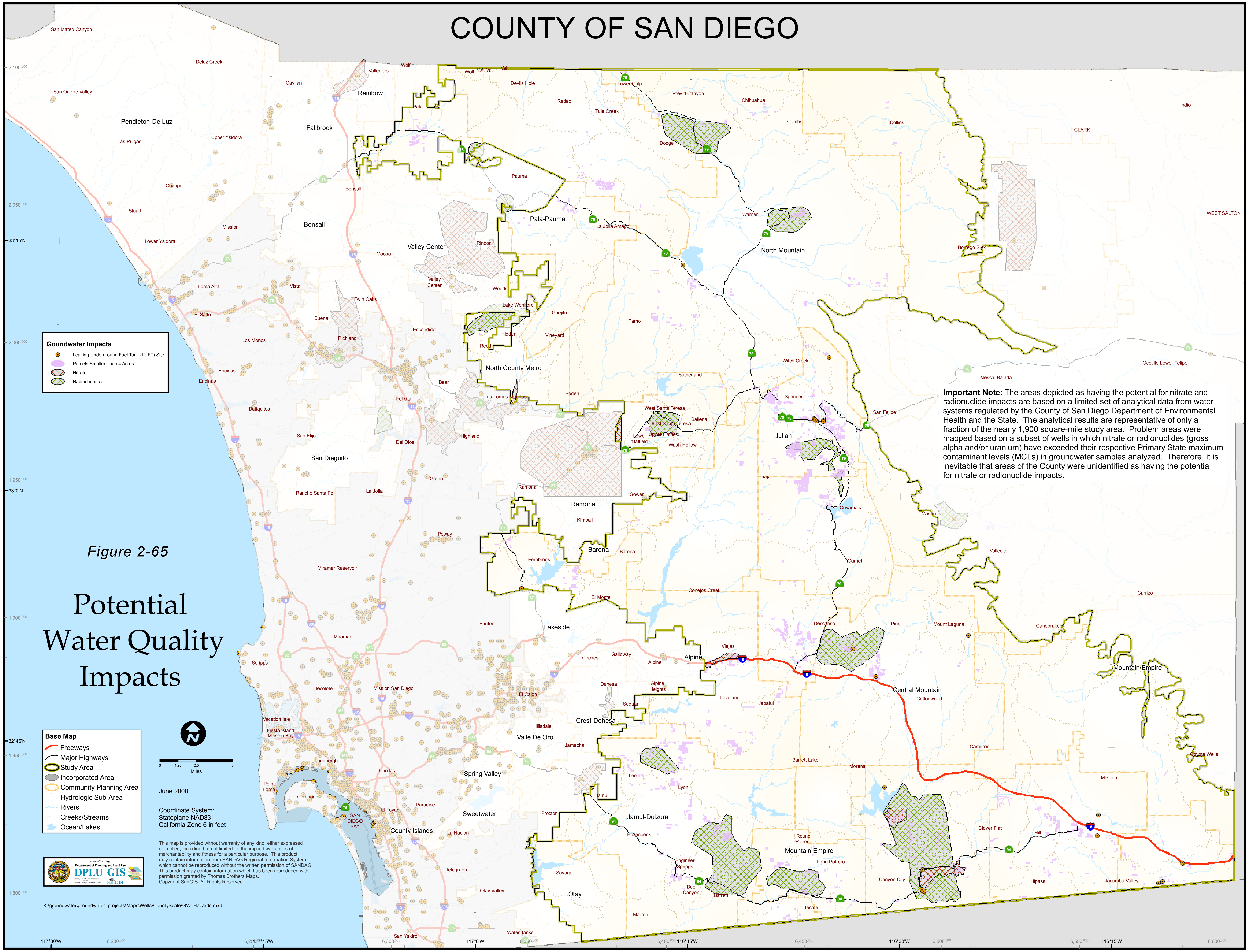


Figure 2-64: North Mountain Planning Area
Warner Springs Ranch Golf Course Well Hydrographs





COUNTY OF SAN DIEGO
Figure 2-65
Potential Water Quality Impacts
Goundwater Impacts
Leaking Underground Fuel Tank (LUFT) Site
Parcels Smaller Than 4 Acres
Nitrate
Radiochemical
Important Note: The areas depicted as having the potential for nitrate and radionuclide impacts are based on a limited set of analytical data from water systems regulated by the County of San Diego Department of Environmental Health and the State. The analytical results are representative of only a fraction of the nearly 1,900 square-mile study area. Problem areas were mapped based on a subset of wells in which nitrate or radionuclides (gross alpha and/or uranium) have exceeded their respective Primary State maximum contaminant levels (MCLs) in groundwater samples analyzed. Therefore, it is inevitable that areas of the County were unidentified as having the potential for nitrate or radionuclide impacts.
Base Map
Freeways
Major Highways
Study Area
Incorporated Area
Community Planning Area
Hydrologic Sub-Area
Rivers
Creeks/Streams
Ocean/Lakes
0
1.25
2.5
5
Miles
June 2008
Coordinate System:
Stateplane NAD83,
California Zone 6 in feet
This map is provided without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose. This product may contain information from SANDAG Regional Information System which cannot be reproduced without the written permission of SANDAG. This product may contain information which has been reproduced with permission granted by Thomas Brothers Maps.
Copyright SanGIS. All Rights Reserved.
County of San Diego
Department of Planning and Land Use
DPLU GIS
K:\groundwater\groundwater_projects\Maps\Wells\CountyScale\GW_Hazards.mxd
Pendleton-De Luz
Fallbrook
Rainbow
Bonsall
Pala-Pauma
Valley Center
North Mountain
North County Metro
San Dieguito
Julian
Ramona
Barona
Lakeside
Alpine
Crest-Dehesa
Valle De Oro
Spring Valley
Sweetwater
Jamul-Dulzura
Mountain Empire
Central Mountain
Otay
County Islands

ORANGE COUNTY
RIVERSIDE COUNTY
SAN DIEGO COUNTY
Residential 14.5 du/acre
Residential 24 du/acre
Residential 43 du/acre
Office Professional
Neighborhood Commercial
General Commercial
Service Commercial
Visitor Serving Commercial
Limited Impact Industrial
High Impact Industrial
Estate Residential 1 du/2,4 acres
Multiple Rural Use 1 du/4,8,20 acres
Intensive Agriculture 1 du/2,4,8 acres
General Agriculture 1 du/10,40 acres
Specific Plan Area (SPA) (values are the General Plan approved densities expressed as dwelling units per acre)
VACANT SPA = Expired or Withdrawn SPA
ACTIVE SPA = Developed, Vested, or Pending SPA
Public/Semi-Public Lands
National Forest and State Parks
Impact Sensitive 1 du/4,8,20 acres
Telecommunications
Tribal Lands
Fallbrook Village Mixed Use
Forest Conservation Initiative Overlay
County Water Authority Boundary
Community Plan Area Boundary
Sponsor Group Boundary
Jurisdictional Boundary
1280
Acres
MILES
0 1 2 4 6 8
Map Prepared By:
DPLU GIS
Map Coordinates: Stateplane NAD83 Feet, Zone 3401
This map is provided without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose. This product may contain information from SANDAG Regional Information System which cannot be reproduced without the written permission of SANDAG. This product may contain information which has been reproduced with permission granted by Thomas Brothers Maps.
Copyright SanGIS. All Rights Reserved.
File: /data1/gp/amls/gpmapper_eps.aml gp
Printed 06 Dec 06
Solana Beach
Del Mar
Poway
San Diego
Santee
El Cajon
La Mesa
Lemon Grove
Coronado
National City
Chula Vista
Imperial Beach
Estados Unidos Mexicanos / Baja California

Figure 3-1


COUNTY OF SAN DIEGO
GENERAL PLAN UPDATE
ORANGE COUNTY
RIVERSIDE COUNTY
SAN DIEGO COUNTY
Village Residential (VR-2), 2 du/ac
Semi-rural Residential (SR-0.5), 1 du/0.5 ac
Semi-rural Residential (SR-1), 1 du/1,2,4 ac
Semi-rural Residential (SR-2), 1 du/2,4,8 ac
Semi-rural Residential (SR-4), 1 du/4,8,16 ac
Semi-rural Residential (SR-10), 1 du/10,20 ac
Rural Lands (RL-20), 1 du/20 ac
Rural Lands (RL-40), 1 du/40 ac
Rural Lands (RL-80), 1 du/80 ac
Rural Lands (RL-160), 1 du/160 ac
Specific Plan Area (densities indicated in italics)
Office Professional
Neighborhood Commercial
General Commercial
Rural Commercial
Limited Impact Industrial
Medium Impact Industrial
High Impact Industrial
Village Core Mixed Use
Public/Semi-Public Facilities
National Forest and State Parks
Tribal Lands
Open Space (Recreation)
Open Space (Conservation)
Military Installations
Forest Conservation Initiative Overlay
County Water Authority Boundary
Community Plan Area Boundary
Sponsor Group Boundary
Jurisdictional Boundary
1280
Acres
MILES
0 1 2 4 6 8
N
Map Prepared By:
County of San Diego
Department of Planning and Land Use
DPLU GIS
SanGIS
Coordinates: Stateplane NAD83 Feet, Zone 3401
This map is provided without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose. This product may contain information from SANDAG Regional Information System which cannot be reproduced without the written permission of SANDAG. This product may contain information which has been reproduced with permission granted by Thomas Bros. Maps. Copyright SanGIS. All Rights Reserved.
This is a draft map and should be destroyed upon submittal of subsequent versions.
Source: /gp/scenarios/alt19
File: /data1/gp/amls/gpmapper.aml gp5
Printed 14 May 08
Solana Beach
Del Mar
Poway
San Diego
Santee
El Cajon
La Mesa
Lemon Grove
Coronado
National City
Chula Vista
Imperial Beach
Glen Oaks
Buckman Springs
Boulder Oaks
Bankhead Springs
Jacumba
Estados Unidos Mexicanos/Baja California
NOTES
1: The type and intensity of development depicted on the map must be implemented in accordance with General Plan goals and policies and other County regulations which may further affect the type and intensity of use.
2: Land Use Element, Table LU-1 indicates the applicable Regional Category for each designation.
3: Maximum development intensity for non-residential designations is provided in Land Use Element, Table LU-1.
4: Refer to Community Plan for land uses allowed in Specific Plan Area (SPA).

Figure 3-2

COUNTY OF SAN DIEGO

GENERAL PLAN UPDATE

Figure 3-3

COUNTY OF SAN DIEGO
GENERAL PLAN UPDATE
ORANGE COUNTY
RIVERSIDE COUNTY
SAN DIEGO COUNTY
Village Residential (VR-2), 2 du/ac
Semi-rural Residential (SR-0.5), 1 du/0.5 ac
Semi-rural Residential (SR-1), 1 du/1,2,4 ac
Semi-rural Residential (SR-2), 1 du/2,4,8 ac
Semi-rural Residential (SR-4), 1 du/4,8,16 ac
Semi-rural Residential (SR-10), 1 du/10,20 ac
Rural Lands (RL-20), 1 du/20 ac
Rural Lands (RL-40), 1 du/40 ac
Rural Lands (RL-80), 1 du/80 ac
Rural Lands (RL-160), 1 du/160 ac
Specific Plan Area (densities indicated in italics)
Office Professional
Neighborhood Commercial
General Commercial
Rural Commercial
Limited Impact Industrial
Medium Impact Industrial
High Impact Industrial
Village Core Mixed Use
Public/Semi-Public Facilities
National Forest and State Parks
Tribal Lands
Open Space (Recreation)
Open Space (Conservation)
Military Installations
Forest Conservation Initiative Overlay
County Water Authority Boundary
Community Plan Area Boundary
Sponsor Group Boundary
Jurisdictional Boundary
1280
Acres
MILES
0 1 2 4 6 8
Map Prepared By:
County of San Diego
Department of Planning and Land Use
DPLU GIS
SanGIS
Coordinates: Stateplane NAD83 Feet, Zone 3401
This map is provided without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose. This product may contain information from SANDAG Regional Information System which cannot be reproduced without the written permission of SANDAG. This product may contain information which has been reproduced with permission granted by Thomas Bros. Maps. Copyright SanGIS. All Rights Reserved.
This is a draft map and should be destroyed upon submittal of subsequent versions.
Source: /gp/scenarios/alt21
File: /data1/gp/amls/gpmapper.aml gp5
Printed 06 May 08
Solana Beach
Del Mar
Poway
San Diego
Santee
El Cajon
La Mesa
Lemon Grove
National City
Coronado
Chula Vista
Imperial Beach
Glen Oaks
Estados Unidos Mexicanos / Baja California
MEXICO
UNITED STATES
NOTES
1: The type and intensity of development depicted on the map must be implemented in accordance with General Plan goals and policies and other County regulations which may further affect the type and intensity of use.
2: Land Use Element, Table LU-1 indicates the applicable Regional Category for each designation.
3: Maximum development intensity for non-residential designations is provided in Land Use Element, Table LU-1.
4: Refer to Community Plan for land uses allowed in Specific Plan Area (SPA).

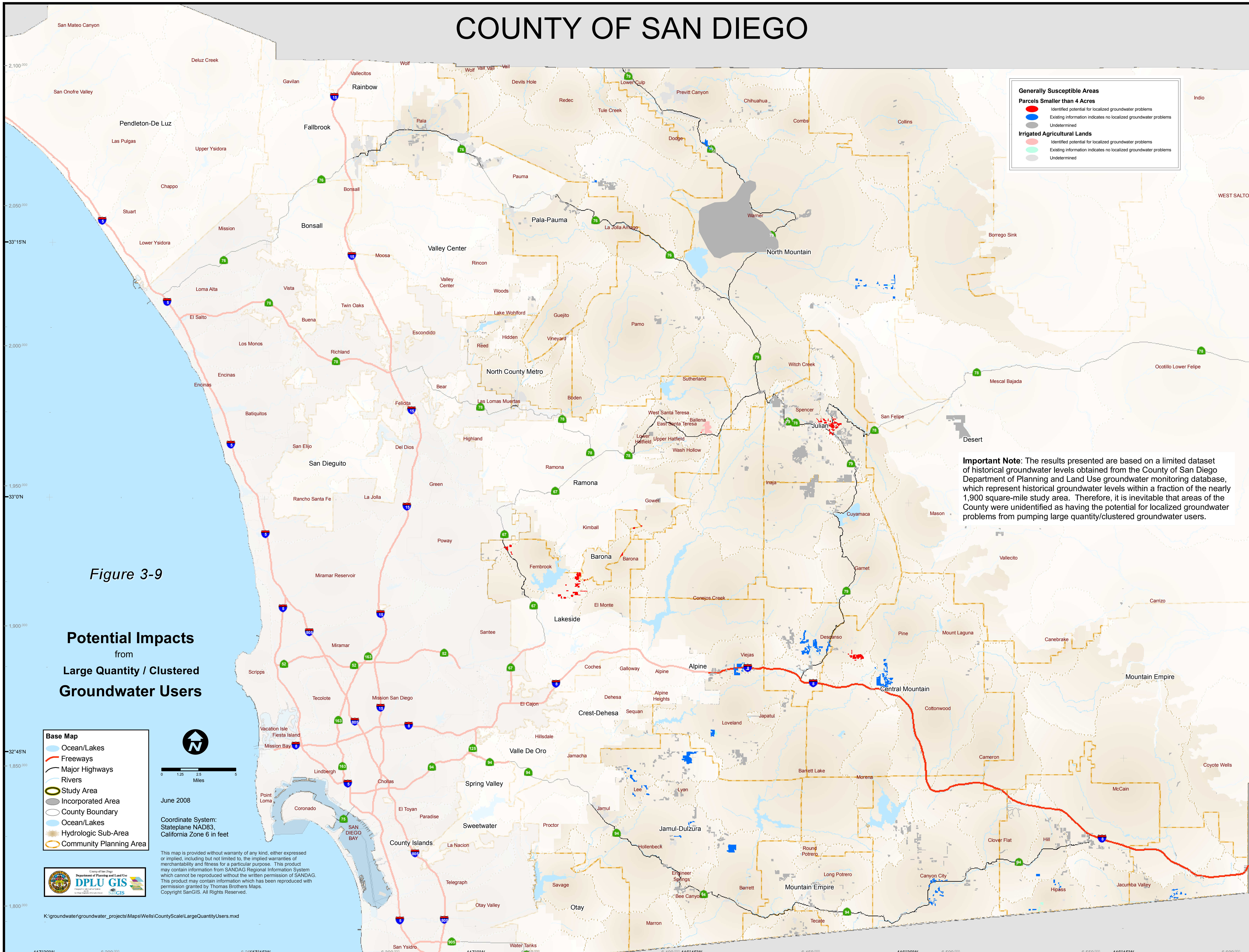
Figure 3-4


COUNTY OF SAN DIEGO
GENERAL PLAN UPDATE
GENERAL PLAN UPDATE
Figure 3-5
RIVERSIDE COUNTY
SAN DIEGO COUNTY
ORANGE COUNTY
Village Residential (VR-2), 2 du/ac
Semi-rural Residential (SR-0.5), 1 du/0.5 ac
Semi-rural Residential (SR-1), 1 du/1,2,4 ac
Semi-rural Residential (SR-2), 1 du/2,4,8 ac
Semi-rural Residential (SR-4), 1 du/4,8,16 ac
Semi-rural Residential (SR-10), 1 du/10,20 ac
Rural Lands (RL-20), 1 du/20 ac
Rural Lands (RL-40), 1 du/40 ac
Rural Lands (RL-80), 1 du/80 ac
Rural Lands (RL-160), 1 du/160 ac
Specific Plan Area (densities indicated in italics) 4
Office Professional 3
Neighborhood Commercial 3
General Commercial 3
Rural Commercial 3
Limited Impact Industrial 3
Medium Impact Industrial 3
High Impact Industrial 3
Village Core Mixed Use
Public/Semi-Public Facilities 3
National Forest and State Parks
Tribal Lands
Open Space (Recreation)
Open Space (Conservation)
Military Installations
Forest Conservation Initiative Overlay
County Water Authority Boundary
Community Plan Area Boundary
Sponsor Group Boundary
Jurisdictional Boundary
1280
Acres
MILES
0 1 2 4 6 8
N
Map Prepared By:
County of San Diego
Department of Planning and Land Use
DPLU GIS
SanGIS
Coordinates: Stateplane NAD83 Feet, Zone 3401
This map is provided without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose. This product may contain information from SANDAG Regional Information System which cannot be reproduced without the written permission of SANDAG. This product may contain information which has been reproduced with permission granted by Thomas Bros. Maps. Copyright SanGIS. All Rights Reserved.
This is a draft map and should be destroyed upon submittal of subsequent versions.
Source: /gp/scenarios/alt22
File: /data1/gp/amls/gpmapper.aml gp5
Printed 25 Apr 08
Solana Beach
Del Mar
Poway
San Diego
Santee
El Cajon
La Mesa
Lemon Grove
Coronado
National City
Chula Vista
Imperial Beach
Glen Oaks
Bankhead Springs
Jacumba
UNITED STATES
Estados Unidos Mexicanos/Baja California
MEXICO
NOTES
1: The type and intensity of development depicted on the map must be implemented in accordance with General Plan goals and policies and other County regulations which may further affect the type and intensity of use.
2: Land Use Element, Table LU-1 indicates the applicable Regional Category for each designation.
3: Maximum development intensity for non-residential designations is provided in Land Use Element, Table LU-1.
4: Refer to Community Plan for land uses allowed in Specific Plan Area (SPA).

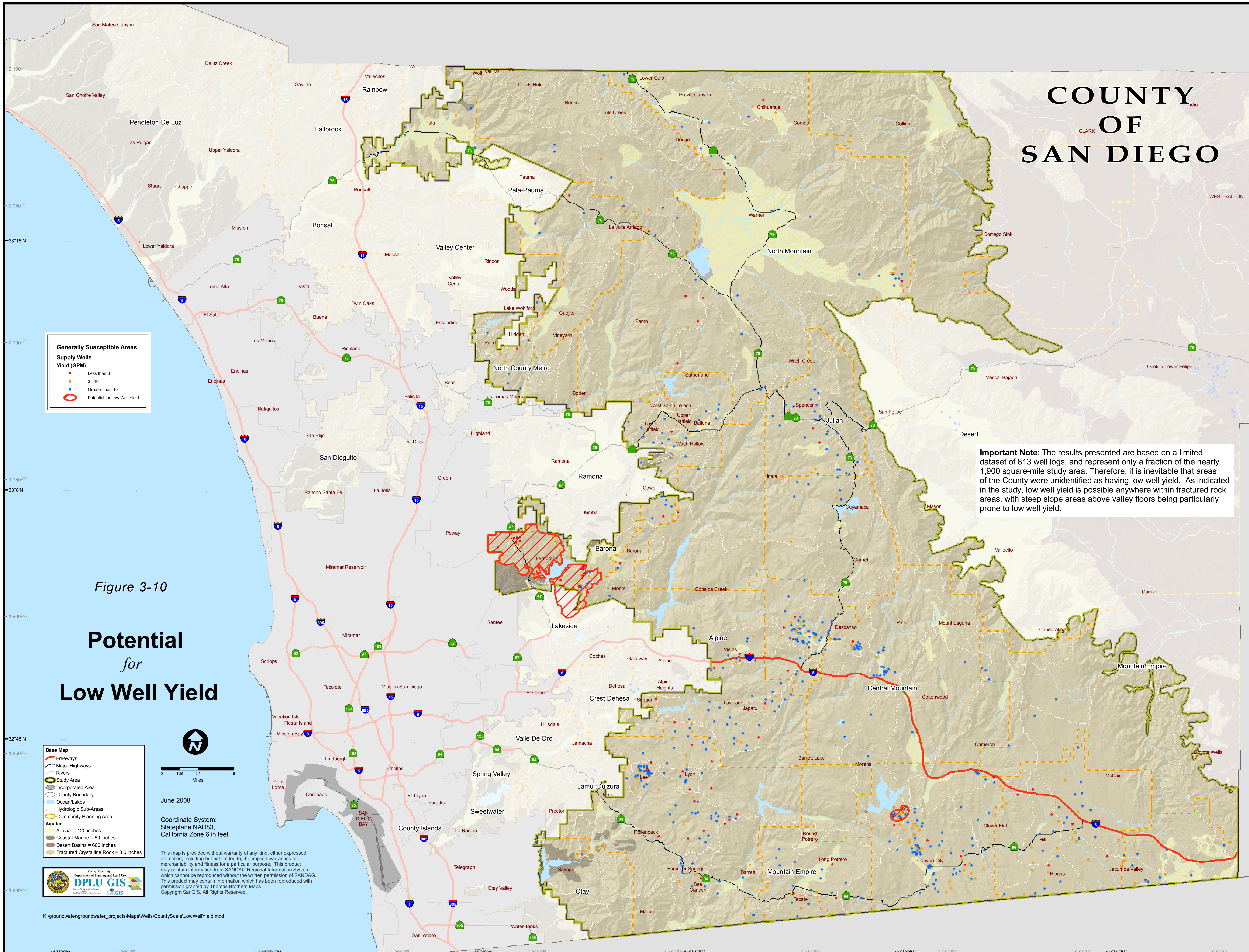

COUNTY
OF
SAN DIEGO
FIGURE 3-6
Fractured Rock
&
Marine / Non-marine
Sediments
Aquifer Types
Coastal Marine / Non-marine Sediments
Moderately Fractured Crystalline Rock
Slightly Fractured Crystalline Rock
Base Map
Freeways
Major Highways
Study Area
Hydrologic Sub-Area
Community Planning Area
County Boundary
Municipal Boundaries
Rivers
Ocean/Lakes
Miles
June 2008
Coordinate System:
Stateplane NAD83,
California Zone 6 in feet
This map is provided without warranty of any kind, either expressed
or implied, including but not limited to, the implied warranties of
merchantability and fitness for a particular purpose. This product
may contain information from SANDAG Regional Information System
which cannot be reproduced without the written permission of SANDAG.
This product may contain information which has been reproduced with
permission granted by Thomas Brothers Maps.
Copyright SanGIS. All Rights Reserved.
DPLU GIS
SanGIS
K:\groundwater\groundwater_projects\Maps\Wells\CountyScale\Aquifer_FracRock_Marine.mxd
Rainbow
Fallbrook
Pendleton - De Luz
Palomar Mountain
Valley Center
Twin Oaks
Hidden Meadows
Pala - Pauma
North Mountain
Borrego Springs
North County Metro
San Dieguito
Ramona
Julian
Desert
Central Mountain
Cuyamaca
Baronia
Lakeside
Descanso
Alpine
Crest - Dehesa
Pine Valley
Mountain Empire
Valle De Oro
Spring Valley
Sweetwater
Jamul
County Islands
Lake Morena Campo
Potrero
Boulevard
Jacumba


COUNTY OF SAN DIEGO
Figure 3-7
Alluvium and Residuum
Aquifer Types
ALLUVIUM
10
11 - 15
16 - 20
21 - 30
31 - 35
36 - 50
51 - 100
101 - 150
151 - 250
alluvium_maks
RESIDUUM
5
6 - 10
11 - 15
16 - 20
21 - 25
26 - 30
31 - 35
36 - 40
41 - 50
51 - 60
61 - 100
ALLUVIUM, RESIDUUM
Overlapping Area
Base Map
Freeways
Major Highways
Study Area
Community Planning Area
Hydrologic Sub-Area
County Boundary
Municipal Boundaries
Rivers
Creeks/Streams
Ocean/Lakes
alluvium_maks
0
1.5
3
6
Miles
May 2009
Coordinate System:
Stateplane NAD83,
California Zone 6 in feet
This map is provided without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose. This product may contain information from SANDAG Regional Information System which cannot be reproduced without the written permission of SANDAG. This product may contain information which has been reproduced with permission granted by Thomas Brothers Maps.
Copyright SanGIS. All Rights Reserved.
County of San Diego
Department of Planning and Land Use
DPLU GIS
SanGIS
K:\groundwater\groundwater_projects\Maps\Wells\CountyScale\Aquifer_Alluvium_Residuum.mxd
K:\groundwater\groundwater_projects\Maps\Wells\CountyScale\Aquifer_Alluvium_Residuum20090928.pdf
Important Note Regarding Mapping of Alluvium: The saturated thickness of this unit was estimated based on a review of 813 well logs, and previous groundwater studies. In cases where no site-specific information was available for a mapped area, a conservative default value of 10 feet of saturated thickness was assumed. The areal extent of this unit was limited to areas mapped by the California Geological Survery at a scale of 1:750,000 and a few additional areas based on well logs and previous groundwater studies reviewed. It is likely that saturated alluvium exists in drainages throughout the study area at a detail beyond the generalized geologic mapping used for this study.
Important Note Regarding Mapping of Residuum: The saturated thickness of this unit was estimated based on a review of 813 well logs. Saturated residuum, which provides a substantial amount of additional groundwater in storage to fractured rock aquifer areas, was very conservatively unmapped in vast portions of the study area where well log data was not available.
Pendleton - De Luz
Fallbrook
Rainbow
Palomar Mountain
Bonsall
Valley Center
Pala - Pauma
Twin Oaks
Hidden Meadows
North Mountain
Borrego Springs
North County Metro
Ramona
San Dieguito
Julian
Central Mountain
Cuyamaca
Barona
Lakeside
Descanso
Alpine
Pine Valley
Crest - Dehesa
Valle De Oro
Spring Valley
Jamul
Mountain Empire
Lake Morena / Campo
Boulevard
Jacumba
Potrero
Tecate
Otay
Sweetwater
County Islands
Mountain Empire


Regional Long-Term
Groundwater Availability
County Water
Authority
Desert Basins
Figure 3.8
Estimated Minimum Groundwater in Storage
GP Update Referral Map Alternative
Existing Conditions - XX%
Referral Map Buildout - XX%
Cumulative Impacts Buildout - XX%
0% - 25%
26% - 50%
51% - 60%
61% - 70%
71% - 80%
81% - 90%
91% - 100%
Base Map
Freeways
Major Highways
Freeways
Major Highways
County Boundary
Study Area
Community Planning Area
Hydrologic Sub-Area
Study Area Mask - Indian Reservations
N
W
E
S
0
1.25
2.5
5
Miles
Date of Map Production:
May 2009
Coordinate System:
Stateplane NAD83,
California Zone 6 in feet
This map is provided without warranty of any kind, either expressed
or implied, including but not limited to, the implied warranties of
merchantability and fitness for a particular purpose. This product
may contain information from SANDAG Regional Information System
which cannot be reproduced without the written permission of SANDAG.
This product may contain information which has been reproduced with
permission granted by Thomas Brothers Maps.
Copyright SanGIS. All Rights Reserved.
DPLU GIS
K:\groundwater\groundwater_projects\Maps\Wells\CountyScale\ModelResults.mxd
K:\groundwater\groundwater_projects\Maps\Wells\CountyScale\ModelResults20090928.pdf
Important Note: The results presented are a screening level analysis of each basin
and should not be relied upon for any purposes other than the County of San Diego
General Plan Update Environmental Impact Report. Please refer to Section 5.2 of this
study for limitations associated with these results. Site-specific hydrogeologic investigations
are required to evaluate localized impacts to groundwater resources within each basin.



COUNTY OF SAN DIEGO
Figure 3-9
Potential Impacts
from
Large Quantity / Clustered
Groundwater Users
Generally Susceptible Areas
Parcels Smaller than 4 Acres
Identified potential for localized groundwater problems
Existing information indicates no localized groundwater problems
Undetermined
Irrigated Agricultural Lands
Identified potential for localized groundwater problems
Existing information indicates no localized groundwater problems
Undetermined
Important Note: The results presented are based on a limited dataset of historical groundwater levels obtained from the County of San Diego Department of Planning and Land Use groundwater monitoring database, which represent historical groundwater levels within a fraction of the nearly 1,900 square-mile study area. Therefore, it is inevitable that areas of the County were unidentified as having the potential for localized groundwater problems from pumping large quantity/clustered groundwater users.
Base Map
Ocean/Lakes
Freeways
Major Highways
Rivers
Study Area
Incorporated Area
County Boundary
Ocean/Lakes
Hydrologic Sub-Area
Community Planning Area
0
1.25
2.5
5
Miles
June 2008
Coordinate System:
Stateplane NAD83,
California Zone 6 in feet
This map is provided without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose. This product may contain information from SANDAG Regional Information System which cannot be reproduced without the written permission of SANDAG. This product may contain information which has been reproduced with permission granted by Thomas Brothers Maps.
Copyright SanGIS. All Rights Reserved.
County of San Diego
Department of Planning and Land Use
DPLU GIS
SanGIS
K:\groundwater\groundwater_projects\Maps\Wells\CountyScale\LargeQuantityUsers.mxd
Pendleton-De Luz
Fallbrook
Rainbow
Bonsall
Pala-Pauma
Valley Center
North Mountain
North County Metro
San Dieguito
Ramona
Julian
Desert
Barona
Lakeside
Alpine
Central Mountain
Mountain Empire
Crest-Dehesa
Valle De Oro
Spring Valley
Sweetwater
County Islands
Jamul-Dulzura
Otay
117°30'W
117°15'W
117°0'W
116°45'W
116°30'W
116°15'W
33°15'N
33°0'N
32°45'N



COUNTY OF SAN DIEGO
Figure 3-10
Potential for Low Well Yield
Generally Susceptible Areas
Supply Wells
Yield (GPM)
Less than 3
3 - 10
Greater than 10
Potential for Low Well Yield
Important Note: The results presented are based on a limited dataset of 813 well logs, and represent only a fraction of the nearly 1,900 square-mile study area. Therefore, it is inevitable that areas of the County were unidentified as having low well yield. As indicated in the study, low well yield is possible anywhere within fractured rock areas, with steep slope areas above valley floors being particularly prone to low well yield.
Base Map
Freeways
Major Highways
Rivers
Study Area
Incorporated Area
County Boundary
Ocean/Lakes
Hydrologic Sub-Areas
Community Planning Area
Aquifer
Alluvial = 120 inches
Coastal Marine = 60 inches
Desert Basins = 600 inches
Fractured Crystalline Rock = 3.6 inches
0 1.25 2.5 5
Miles
June 2008
Coordinate System:
Stateplane NAD83,
California Zone 6 in feet
This map is provided without warranty of any kind, either expressed or implied, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose. This product may contain information from SANDAG Regional Information System which cannot be reproduced without the written permission of SANDAG. This product may contain information which has been reproduced with permission granted by Thomas Brothers Maps.
Copyright SanGIS. All Rights Reserved.
County of San Diego
Department of Planning and Land Use
DPLU GIS
SanGIS
K:\groundwater\groundwater_projects\Maps\Wells\CountyScale\LowWellYield.mxd