Appendix A
Evaluation of Groundwater Conditions in Borrego Valley

FINAL

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April 2010

DPLU

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A.1 INTRODUCTION

The objectives of this report are (1) to provide a basic understanding of the groundwater overdraft condition in Borrego Valley, and (2) provide mitigation and alternatives to reduce or minimize predicted significant unavoidable impacts to groundwater resources.

Desert basins account for approximately 14% of the unincorporated area of the County and are located in the extreme eastern portions of the County as shown on Figure 1. Desert basins are characterized by extremely limited groundwater recharge, but typically large storage capacities. Based on these characteristics, groundwater pumping that exceeds the rate of recharge results in a groundwater overdraft condition, which is not sustainable for long-term groundwater use.

The Borrego Valley aquifer (Figure 2), which is completely groundwater dependent, has a well documented groundwater overdraft condition where year after year groundwater extraction exceeds the amount of groundwater that is recharged back into the aquifer. Groundwater extraction exceeds 20,000 acre-feet per year whereas average groundwater recharge is estimated at approximately 5,000 acre-feet per year. The aquifer holds a large amount of groundwater in storage, estimated to be approximately 1.6-million acre-feet of useable groundwater. Water levels have been declining for decades as a result of the overdraft condition and groundwater production at current rates is not sustainable.

Plans to import water from the Colorado River are currently improbable based on the cost and competition from other jurisdictions; and importation of saline groundwater from nearby basins would require a local desalination plant which is likely to be cost prohibitive. Therefore, the County of San Diego assumes, for long-term planning, that development in Borrego Valley will not have access to supplemental imported water, and therefore must prove long-term groundwater adequacy independent of imported water.

A.2 EXISTING CONDITIONS

A.2.1 Topographic Setting

Borrego Valley covers an area of approximately 110 square miles and ranges in elevation from approximately 1,100 to 1,200 ft MSL around the margins of the aquifer to approximately 450 ft MSL within the vicinity of Borrego Sink (see Figure 2). Approximately 400 square miles of tributary watershed from multiple intermittent creeks and streams drain from the mountains into Borrego Valley, which provide the primary source of groundwater recharge to the Borrego Valley aquifer. The largest surface water inflow occurs along the Coyote Creek drainage entering into the northern portion of Borrego Valley, and another important drainage is Borrego Palm Canyon, where surface water enters into the western portion of the valley.

A.2.2 Climate

Borrego Valley has an arid climate with precipitation averaging approximately 3 to 6 inches in the center of the valley and 6 to 9 inches along the western margins of the valley. Precipitation in the mountainous regions located west of Borrego Valley average from 15 to over 21 inches annually. On average, over 75 percent of the annual precipitation occurs between November and May, and less than 25 percent of the annual precipitation occurs from summer rain and thunderstorms that typically occur from July through September. Temperatures are very hot during the summers with average high temperatures exceeding 105 degrees F, and winters are cool with average lows below 40 degrees F.

Monthly reference evapotranspiration (ETo), which is a measure of potential evapotranspiration (PET) from a known surface such as grass or alfalfa, has been estimated for Borrego Valley to be approximately 71.6 inches per year (DWR, 1999). The ETo rates are highest in July at 9.6 inches, and are lowest in December at 2.2 inches.

A.2.3 Land Use

The land uses in Borrego Valley primarily include residential, agricultural, recreational, and commercial uses. Most of the land is owned by private individuals or corporations. The majority of agricultural lands are located in the northern portion of Borrego Valley. The Anza Borrego Desert State Park and other parkland cover some of the margins of Borrego Valley and the mountain regions above Borrego Valley. Borrego Springs is completely surrounded and encompassed by State park land which also includes Indian, private, and National forest land.

Existing Residential Land Use: As of 2005, there were roughly 2,500 existing residential units in Borrego Valley. From January 2001 through June 2008, the County processed 318 residential building permits for manufactured homes and stick built homes (both custom and mass produced). During that time, an average of 42 residential building permits was processed per year. As of January 2007, there were approximately 3,725 existing, private unbuilt parcels in Borrego Valley. Of these, roughly 85% (approximately 3,166 parcels) are estimated to have legal lot status (County of San Diego, 1999). Having a legally created lot which meets Zoning requirements still may not be buildable due to a number of factors such as floodplain issues, having legal access to roadways, having access to sewer or water, etc. Building permits are granted on a case-by-case basis by the County, and it is not possible to accurately estimate the number of legally buildable parcels in Borrego Valley. However, the significant inventory of existing unbuilt lots could possibly provide up to an additional 3,000+ future residential units without any additional subdivision.

Current GP and GP Update Residential Land Use: Below is a table which provides the maximum allowable additional residential units permitted by the current GP as well as those proposed by the GP Update Referral Map and Environmentally Superior Map:

Current GP Map	GP Update Referral Map	GP Update Environmentally Superior Map
19,466	8,689	6,515

A.2.4 Hydrogeologic Units

The United States Geological Survey (USGS) estimates that Borrego Valley is underlain with up to 2,400 feet of consolidated to unconsolidated sediments resting on basement granitic rocks. In 1982, the USGS estimated at steady-state groundwater conditions (in the year 1945), the Borrego Valley groundwater basin contained approximately 5.5 million acre-feet of water in storage. Further, the USGS identified three Hydrogeologic units: an upper, middle, and lower aquifer (Moyle and others, 1982; Mitten and others, 1988). In 1988, the USGS prepared a numerical model of the aquifer. The results of the model suggest that the specific yield of the upper, middle, and lower aquifers are 14%, 7%, and 3%, respectively.

Based upon subsequent study by Dr. David Huntley, the majority of readily available water to existing well users in the Borrego Valley exists in the upper and middle aquifer. The amount of groundwater within these two aquifers was estimated to be approximately 2,131,000 acre-feet in 1945 and 1,900,500 acre-feet in 1979 (Huntley, 1993). The remaining water located within the lower aquifer is more difficult and costly to extract due to its low specific yield (estimated to be approximately 3%), its depth, and low specific capacity (estimated to be 5 gallons per minute/foot of drawdown or less). The Borrego Water District estimated that in 1999 the water remaining in the upper and middle aquifers was approximately 1,685,000 acre-feet (BWD, 2001).

The USGS is conducting a new phase of groundwater investigative work in Borrego Valley projected to be completed in 2010. The objective is to refine their 1980s groundwater flow model to take advantage of flow modeling tools not available in their 1988 numerical model. The model will be used as a predictive tool to estimate the amount of time left before the groundwater table drops below the pump intake in production wells currently being used in Borrego Valley. This should provide a more specific estimation of future groundwater impacts than previous studies conducted.

A.2.5 Water Quality

In general, water quality has historically been good within Borrego Water District's wells with total dissolved solids at concentrations of less than 500 mg/L (BWD, 2001). Historical nitrate impacts have been noted as evidenced by wells taken out of production including Borrego Water District ID-4 wells 1 & 4, and the Roadrunner Mobile Home Park well.

High salinity, poor quality connate water is thought to occur in deeper formational materials of the aquifer as well as shallow groundwater in the vicinity of the Borrego Sink in the southern portion of the Borrego Valley. Since there have been no comprehensive studies of water quality within Borrego Valley, it is difficult to assess the amount of potable groundwater still available in Borrego Valley. Water quality impacts may occur as decreased water levels may induce flow of poor quality water found in deeper formational materials of the aquifer. This may eventually necessitate additional expensive treatment of groundwater to make the water suitable as a drinking water supply.

Drilling of a dual screened monitoring well by DWR in the southern portion of Borrego Valley (northeast of Borrego Sink) provides confirmation of poor water quality in shallow groundwater and deteriorating with depth (DWR, 2007). Water analyzed from the upper completion (45 to 155 feet below ground surface) indicated total dissolved solids (TDS) of 1,300 mg/L. Water analyzed from the lower completion (200 to 345 feet below ground surface) indicated TDS of 2,300 mg/L. The high TDS content in both screened intervals of this well (as well as high sulfate content) make the water unsuitable for a drinking water supply without expensive treatment.

A.2.6 Groundwater Recharge

Estimated Recharge

Estimated annual recharge to the Borrego Valley aquifer was initially estimated by the USGS to be approximately 4,800 acre-feet per year (Mitten and others, 1988). The source of recharge was estimated to come primarily from three major drainages: Coyote Creek (approximately 65%), Borrego Palm Canyon and San Felipe Creek (approximately 35% combined). Little recharge, if any from San Felipe Creek benefits users in Borrego Springs as the majority exits Borrego Valley and flows toward Ocotillo Wells.

In a thesis by Netto in 2001, it was estimated that from 1945 to 2000, recharge from groundwater underflow, stream recharge, and bedrock recharge is approximately on average 5,670 acre-feet per year. In a thesis by Henderson in 2001, it was estimated that recharge from 1945 to 2000 averaged approximately 6,170 acre-feet per year. Both estimates showed that recharge had a very large range due to the extremes in rainfall, from very little during dry years to recharge above 50,000 acre-feet in the wettest year.

Age of Groundwater from Borrego Water District Wells

The Borrego Water District in 2001 obtained the age of the water being pumped in two of their pumping wells, well ID 4-11 and well ID 4-18. Analytical results from water sampled from well ID 4-11 indicated the water to be 873 years old (+- 42 years), and results from water sampled from well ID 4-18 indicated the water to be 1,982 years old (+- 54 years). The results indicate that water in these wells was from not from recent groundwater recharge, but rather from water that percolated and was recharged many hundreds of years ago.

A.2.7 Groundwater Demand

The Borrego Water District has estimated the amount of water used within Borrego Valley from 1950 to 2007. While groundwater demand more than doubled from 1978 to 1999, it appears that overall water usage may have leveled off between 1999 and 2007.

Year	Municipal (AFY)	Agricultural (AFY)	Golf Course and Landscape (AFY)	Total (AFY)
1950	170	11,435	190	11,795
1958	225	22,455	790	23,470
1962	265	13,455	1,725	15,820
1968	475	7,260	1,720	9,455
1972	530	5,320	2,270	8,120
1978	600	5,705	2,050	8,355
1980	430	10,600	2,100	13,130
1999	2,272	15,590	4,435	22,297
2007	1,920	14,650	5,240	21,810

AFY – Acre-feet per Year

A.2.8 Groundwater Levels

Groundwater levels in Borrego Valley were originally monitored by the USGS as far back as the 1940s. The County of San Diego has been collecting groundwater level data since the early 1980s. Water levels in Borrego Valley have been declining since 1945, indicating a long-term overdraft condition. Between 1945 and 1980, water levels declined by as much as 100 feet, due to more water being extracted than was being replenished (USGS, 1982). To provide an understanding of water level trends since the 1980s, water levels from eight wells monitored by the County are summarized in the table below (Figure 3).

Well	Period of Monitoring	Cumulative Drawdown (feet)	Average Change in Water Levels (feet per year)		
			1980s	1990 to 1997	Since 1998
BOR-10	1983-2002	30.6	-1.1	-1.7	-2.3
BOR-36	1987-2006	47.2	-1.5	-2.3	-3.2
BOR-37	1983-2006	55.6	-0.6	-3.4	-3.1
BOR-42	1986-2005	38.9	-1.0	-2.2	-2.4
BOR-54	1987-2006	49.8	-2.4	-2.2	-3.3
BOR-56	1985-2006	26.7	-1.2	-0.5	-2.1
BOR-57	1984-2006	24.0	-1.3	-0.5	-2.1
BOR-58	1983-2001	15.3	-0.9	-0.7	-1.1
AVERAGE OF ALL WELLS			**-1.2**	**-1.7**	**-2.4**

Since the 1980s, water level declines in the 8 wells have ranged from 15.3 feet (BOR-58 well) to 55.6 feet (BOR-37 well). From 1998 to 2006, water level declines have averaged 2.4 feet per year, which is roughly twice the rate of decline measured in the 1980s. This is likely due to the increased extraction rates that are occurring compared to extraction in the 1980s.

It has been estimated that the volume of groundwater in storage decreases with depth in Borrego Valley. Therefore, it is estimated that basin-wide rates of water level decline will increase with ongoing groundwater mining, even without any change in the deficit between groundwater extraction and recharge.

A.2.9 <u>Groundwater Overdraft Condition</u>

Since 1945, water levels in Borrego Valley have continually declined in some cases by as much as over 150 feet. Groundwater has and is continuing to be extracted at rates that exceed recharge, which has caused an apparent long-term overdraft condition, also known as groundwater mining. In the past 20 years, rates of decline have increased sharply likely in response to new development and additional groundwater extraction. Dr. Tim Ross of the California Department of Water Resources has estimated the overall rate of overdraft in the aquifer through time as follows:

1980-1989: -4,200 acre-feet per year
1989-2000: -9,100 acre-feet per year
1998-2005: -14,300 acre-feet year
It was estimated that a total of 550,000 acre-feet of water was permanently removed from the aquifer from 1945 to 2005 (Ross, 2006).

The Borrego Water District estimated that in 1999 the water remaining in the upper and middle aquifers was approximately 1,685,000 acre-feet (Borrego Water District, 2001). Based upon this estimation of groundwater storage in 1999, if the overdraft condition continues at the estimated rate of 14,300 acre-feet of water per year, the upper and middle aquifers may be 50% depleted in approximately 50 years, and may be completely depleted in approximately 100 years. These numbers, however, should be used with extreme caution, as there are a number of factors that are not fully known regarding the Borrego Valley aquifer. Groundwater pumping has more than tripled since the 1980s, and continued development without groundwater mitigation measures in Borrego Valley will exacerbate the existing overdraft conditions estimated by Dr. Ross.

It should be understood that groundwater impacts from the overdraft condition are already occurring and will continue to worsen as mining of groundwater continues. Current impacts include dry wells, decreased well efficiency and increased pumping costs as water levels continue to decline. This will continue and more wells will need to be replaced as water levels drop below perforated levels. Also, water quality impacts may occur as decreased water levels may induce flow of high salinity, poor quality connate water found in deeper formational materials of the aquifer. This may eventually necessitate additional expensive treatment of groundwater to make the water suitable as a drinking water supply.

The General Plan Update Referral Map (project) would allow for up to 8,689 additional residential units which would be anticipated to use approximately 8255 acre-feet of groundwater per year (0.95 acre-feet per residential unit). Without mitigation, this would increase the overdraft condition to over 22,000 acre-feet per year and the aquifer would be depleted in far less time compared to existing conditions groundwater use. However, based on recent development trends, buildout in the 21st century is unlikely, unless development trends in Borrego Valley change drastically. Between January 2001 and June 2008, approximately 42 residential building permits were processed per year by the County. At this rate of development, it would take approximately 200 years for buildout of the project to occur.

A.2.10 <u>Groundwater Dependent Habitat</u>

The mesquite bosque, a rare and sensitive groundwater-dependent habitat, is believed by many experts to be desiccating in portions of Borrego Valley, even though their taproots can reach down to 150 feet for water. The habitat covers an approximate four-square mile area (Figure 4). Recent groundwater levels from wells adjacent to the main mapped habitat range from approximately 55 to 134 feet below the ground surface. With the exception of the southernmost mapped habitat where recent groundwater levels have been relatively static, groundwater levels been declining at a rate of approximately 1 to nearly 3 feet per year. It is likely that as groundwater levels continue to drop, portions of the mesquite bosque will not be able to adequately adapt and habitat will be permanently lost. Potential secondary affects could also negatively impact local residents, plants, and wildlife from dust storms resulting from topsoil that is left exposed when plants die off.

A.3 GROUNDWATER MANAGEMENT IN BORREGO VALLEY

There are three basic methods available for managing local groundwater resources in California, which include: 1) local water agencies, 2) local groundwater ordinances, and 3) basin adjudication, in which a court determines allocation of groundwater resources (CDWR, 2003). No law requires that any specific form of management be applied to a particular basin. Groundwater in Borrego Valley is currently managed through local water agencies (the Borrego Water District and the Borrego Springs Park Community Services District), and the County Groundwater Ordinance (as well as application of CEQA for land use discretionary applications). In the case of Borrego Valley, the basin has not been adjudicated. Therefore, individual well users are not limited in the amount of groundwater they can extract.

A.3.1 Local Water Agencies

In 1962, the Borrego Water District (BWD) was formed as a landowner-voter district under the provisions of the California Water District Act to protect the water rights in Borrego Valley. However, the District was inactive until 1979 when the San Diego Local Agency Formation Commission (LAFCO) sanctioned the District to exercise its latent water authority. The BWD now provides approximately 4,100 acre-feet of groundwater annually to nearly 2,000 residential and commercial customers from 11 wells tapping the Borrego Valley aquifer. The water district service area is approximately 6,130 acres, and excludes the area served by the Borrego Springs Park Community Services District (BSPCSD). The BSPCSD is much smaller than the BWD and serves less than 200 customers within a 1,200-acre service area. The BSPCSD is in process of a merger to become part of the BWD.

While the majority of residences and commercial entities in Borrego Valley receive their water from the BWD, there are private property owners within the BWD service area that utilize private wells. The vast majority of the water supplied to agricultural users within Borrego Valley comes from privately owned wells within the BWD service area. The BWD has water rights under some residential areas within its service area.

A.3.1.1 Groundwater Management Plan (GMP)

In 2002, the BWD adopted a GMP which allowed the District to become the groundwater management agency for the Borrego Valley aquifer as allowed under State Statute AB 3030. The adoption of the GMP thus placed the BWD as the responsible agency for the stewardship of the aquifer and resolution of the overdraft. The GMP contained a summary of the Borrego overdraft condition, projections of future groundwater demand, and identification of potential groundwater overdraft mitigation measures. Specifically, it set out goals to achieve including: (1) development of programs to assist in stabilizing the overdraft of the aquifer, (2) seek programs to provide a long-term supply of water for the valley, (3) continue to expand the knowledge of the water resources of the aquifer, (4) development and implementation of conservation programs, (5) work with state and county agencies to try to minimize any adverse impact new land uses would have on groundwater resources, (6) develop the ability to obtain funding for acquisition of actively irrigated agricultural land, and (7) evaluate the feasibility of acquiring land in adjacent basins and exploring for such water to be transported for use in Borrego Valley.

A.3.1.2 Groundwater Replenishment District

As part of the groundwater management plan that was adopted in 2002, the BWD obtained the authority as a groundwater replenishment district, which provides BWD specific groundwater management authority including: (1) the ability to buy and sell water, (2) exchange water, (3) distribute water in exchange for ceasing or reducing groundwater extraction, (4) recharge the basin, and (5) build necessary works to achieve groundwater replenishment.

A.3.1.3 Integrated Water Resources Management Plan

The State has initiated funding of projects as a result of Proposition 50 (and subsequently Proposition 84) such as a proposed importation water pipeline, but it requires that any agencies wishing to benefit from funding participate in an Integrated Water Resources Management Plan (IWRMP). This plan requires that an agency develop a water management plan for incorporation in a regional process to integrate its plan with other agencies having responsibilities for water management. The BWD is in the process of preparing an IWRMP which is meant to provide an update on the BWD efforts to mitigate the overdraft condition of the Borrego aquifer, and to present alternatives for the BWD to further evaluate as it strives to provide a sustainable water supply for its customers (BWD, 2008).

As outlined in the draft IWRMP, a number of programs have since been implemented to achieve the goals contained within the GMP including:

1. Groundwater Preservation Fee: By resolution, the BWD implemented a groundwater mitigation program that requires all new development in Borrego Valley that proposes to utilize water from the BWD to implement mitigation measures which would “retire existing demands on a 2:1 basis.” The BWD will accept an in-lieu payment for the required reduction of demand in which fees could be used for various overdraft mitigation programs including: (1) purchase actively irrigated agricultural land for fallowing, (2) construction of artificial recharge basins for capturing storm events, (3) development of groundwater extraction and conveyance systems to convey water to Borrego Valley from nearby areas.

2. Irrigated Agricultural Land Purchase: In 2007 and 2008, the BWD concluded the purchase of water easements over approximately 46 acres of farmland, which resulted in the permanent fallowing of approximately 175 acre-feet per year of water use.

3. Conservation Management Program (Tiered Water Rates): In June 2008, the BWD adopted tiered water rates, which encourages water conservation and penalizes high water use. Funds received from higher tiers of water use are intended to be earmarked for a rebate program to encourage customers to purchase water conserving devices such as low-flow toilets, low-flow washing machines, turf removal, and water-efficient irrigation systems.

4. Water Recycling: Water recycling has been proposed for irrigation of the golf course at Rams Hill (now known as Montesoro). The wastewater treatment system for the development was designed to meet California Department of Public Health Services

requirements for landscape irrigation. Current sewage flows into the treatment plant have been insufficient to provide a supply for the golf course and are primarily lost to evaporation. The BWD has applied for grant funding under Proposition 50 to conduct a feasibility study for connecting all residences to a central collection and conveyance system to send the wastewater to the existing wastewater treatment plant. Treated effluent flows could then be used for landscape irrigation at the golf course.

5. Artificial Recharge: In 1984, DWR conducted a brief study of constructing artificial recharge facilities to capture and recharge storm waters emanating from the Coastal range mountains on the west side of the Borrego aquifer. Dike systems were envisioned at the terminus of several canyons including Borrego Palm Canyon, Henderson, and Coyote canyons. DWR estimated that an additional 300 to 500 afy might be expected through catchment basins in exceptionally wet years. A planned residential development, known as the Viking Ranch, is proposing the first such project by proposing to incorporate channels within the development which would recharge Coyote Creek storm water. Additionally, the De Anza Country Club excavated a storm water detention basin located immediately up-stream of their development which has since become filled with sediment. This sediment has hindered its ability to provide flood protection. The BWD is interested in investigating the potential for a cooperative use of the storm water detention basin as both a flood retarding and water conservation basin.

6. Defining the Reliability of Groundwater Supply: As summarized below, the BWD has a number of ongoing data-gathering projects which will provide tools to further the understanding of the Borrego Valley aquifer:

   USGS Numerical Model: The amount of usable groundwater in storage is not well defined and therefore the amount of time the aquifer can continue to supply groundwater users in Borrego Valley is not fully known. The BWD has recently requested that the USGS develop a working numerical model of the basin based on more-current data collected in the basin by DWR and others. The model will provide estimations regarding future impacts on the basin from various development and extraction scenarios. This model will be useful in defining impacts in order to develop a timeline for alternative water management strategies for the basin.

   DWR Local Assistance Program: In 2004, DWR began assisting the BWD with groundwater assessment. DWR constructed groundwater elevation maps for several years, and providing estimations of changes of groundwater in storage with time for several periods. Currently, DWR is preparing to perform a well inventory and to obtain and analyze groundwater samples from selected pumping wells. The work is being coordinated with the USGS for use in their numerical model.

   Construction of Monitoring Wells: Recognizing that the data collected on the characterization of the groundwater basin were obtained solely from well completion reports submitted by drillers, the BWD obtained funding for construction of four monitoring wells in 2003 and 2005. The wells were professionally logged by DWR geologists.

Geographical Information System (GIS): The BWD is in the process of developing a GIS system to incorporate all available groundwater data such as historical water levels, water quality, groundwater contour maps, land use, water extractions, groundwater recharge, etc. The system is a necessary component for the USGS numeric model.

Depth Dependent Aquifer Data: There is a concern of possible upwelling of poor-quality water from deeper portions of the Borrego aquifer as water levels continue to fall. The BWD is pursuing grant funding for construction of a 'nested' well (four small diameter wells within the same borehole) that could provide data on potential water quality differences with depth at a strategic location.

Ongoing Water Level Monitoring: The BWD, DWR, and County continue a collective effort to monitor water levels from a series of wells in Borrego Valley. Monitoring by the County began in 1981, and the monitoring well network provides long-term data to assess the downward trends in water levels in various areas within Borrego Valley.

As outlined in the draft IWRMP, there are several non-local water supply opportunities that the BWD is exploring as summarized below:

1. Importation of Groundwater from Nearby Basins: Three groundwater sources near Borrego Valley were investigated to determine if additional water from these basins could be imported for use by the BWD. This included the Clark Dry Lake basin, the Dr. Nel property (located southeast of Borrego Valley along San Felipe Creek), and the Allegretti Farms (located southeast of Ocotillo Wells). Rough estimations based on very limited hydrogeological information indicate that potential groundwater production for the three projects range from 2,000 acre-feet per year each from the Clark Dry Lake and Dr. Nel property, and upwards of 6,000 acre-feet per year for the Allegretti Farms property. Both Clark Dry Lake and Allegretti farms have high TDS that may require treatment if it is to be used for domestic purposes. Costs in the IRWMP indicate it may require grant money and/or an increased base of BWD customers.

2. Importation Pipeline Projects from Imperial Irrigation District (IID) or Coachella Valley Water District (CVWD): Since the quantity and quality of water that may be available from nearby groundwater basins is not well defined due to the lack of hydrogeologic data, the BWD included the potential of obtaining a source of water from the Colorado River, State Water Project, or other sources. Costs associated are likely currently prohibitive but may become feasible as Borrego Springs continues to grow and grant money could augment other funds available to the BWD.

3. Groundwater Storage and Recovery Project: The Borrego Valley aquifer may be a good candidate as an aquifer storage and recovery (ASR) project, which involves

injecting imported water into the aquifer through wells or by surface spreading and infiltration and then pumping it out when needed. The aquifer essentially functions as a water bank. Deposits are made in times of surplus, and withdrawals occur when available water falls short of demand. As water agencies throughout the State continue to diversify their water portfolios, ASR is becoming an increasingly viable alternative to surface water reservoirs to increase water storage capacity for use during extended droughts. The IID or CVWD would be the two most likely water agencies that could potentially utilize the Borrego Valley aquifer for ASR. It is estimated that more than 500,000 acre-feet of groundwater have been removed from storage from Borrego Valley since the 1940s. As water levels continue to decline, nearly 15,000 acre-feet of groundwater is continuing to be removed each year. This continues to create additional storage space within the aquifer. The draft IRWMP does not include a feasibility study and cost benefit analysis but indicates that all costs associated would be requested from the partnering agency.

A.3.2 County Groundwater Ordinance and CEQA

The County of San Diego has regulatory control over proposed land uses but does not actively manage groundwater resources in Borrego Valley. All management of groundwater resources in Borrego Valley is the responsibility of the BWD, other entities, and individual well owners who utilize groundwater. However, the County does have regulations to review anticipated future groundwater demand through the County Groundwater Ordinance (Ordinance #9826, N.S.) and application of CEQA to proposed discretionary permits. The Groundwater Ordinance does not limit the number of wells or the amount of groundwater extraction by existing landowners. However, the Groundwater Ordinance has a specific section for Borrego Valley (Section 67.720) which imposes requirements on projects of more than 100 acres, projects requiring a General Plan Amendment, and projects with an annual demand of more than 20 acre-feet of water. In any of these cases, the Groundwater Ordinance requires that a finding be made that groundwater resources are adequate to meet the groundwater demands of the project.

Proposed discretionary permits proposing the use of groundwater in Borrego are also subject to the DPLU Policy Regarding CEQA Cumulative Analyses for Borrego Valley Groundwater Use, which is included as an attachment to this document. The policy which first went into effect in 2004 requires evaluation of potential cumulative impacts to groundwater resources in Borrego Valley which is guided by the following principles:

1. Applicants for projects using groundwater resources in Borrego Valley are encouraged to include with their projects, offsetting groundwater use reduction measures which will make up for the project's proposed groundwater use and result in "no net gain" in the overall rate or amount of extraction of groundwater.

2. For projects where offsetting groundwater use reduction measures are not proposed as part of the project, except as provided in sections 3 and 4 below, an EIR will generally be required to be prepared, to analyze the significance of cumulative impacts to

groundwater resources, to propose mitigation measures, and to consider project alternatives.

3. For projects with previously approved environmental documents, the project must be assessed per the requirements of Section 15162 of the State CEQA Guidelines (summarized at paragraph A.2.b above). If the project proposes to use more groundwater than initially proposed, then offsetting groundwater use reduction measures may be proposed and included in this analysis. If such measures are not included, the Section 15162 analysis may lead to a requirement to prepare a supplemental or subsequent EIR.

4. Proponents of some small projects may be able to demonstrate that potential cumulative impacts to groundwater resources are not significant, because the project's incremental additional groundwater demand is not "cumulatively considerable."

Mitigation is typically achieved by a project (e.g., a tentative map or other discretionary permit) by recording an easement on off-site land that has been continuously used for agriculture or golf course purposes for at least the past five years and is being irrigated with at least the same amount of groundwater annually of which the project will consume. The easement is then granted to the County of San Diego and it prohibits the use, extraction, storage, distribution, or diversion of water from the Borrego Valley aquifer on the land subject to the easement. Recording easements has proven to be an effective, albeit cumbersome, process and the County is now coordinating with the BWD to create a water credits program. The water credits program would allow farmers or any other owners of water intensive uses in Borrego Valley to permanently fallow their land and in turn the BWD would issue "water entitlement certificates" in standard increments. The certificates could then potentially be applied towards meeting both BWD and County requirements for groundwater mitigation.

A.3.3 Basin Adjudication

When the demand for groundwater exceeds its supply, landowners can turn to the courts to determine how much groundwater each user can rightfully extract. There are 19 court adjudications for groundwater basins in California. This court-directed process can be lengthy and costly, with the longest adjudication taking 24 years (DWR, 2003). Currently, groundwater users in Borrego Valley have an adequate water supply to meet their current needs and there has been no action to bring about court adjudication of the Borrego Valley aquifer. As the overdraft condition continues there may come a time when court adjudication becomes necessary. Since the County does not actively manage groundwater resources in Borrego Valley, it is not in the position to initiate a court adjudication of the basin. Thus, the BWD and/or other groundwater users in Borrego Valley would be plaintiffs or litigants to initiate an adjudication of the basin.

A.4 GROUNDWATER IMPACT ANALYSIS

This section evaluates impacts of the proposed GP Update land uses in Borrego Valley on groundwater quantity. The following question listed in the CEQA Guidelines, Appendix G., VIII. Hydrology and Water Quality must be considered:

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 or 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)?

A.4.1 Impacts Prior to Mitigation

The Borrego Valley aquifer has a well documented groundwater overdraft condition, where year after year groundwater extraction exceeds the amount of groundwater that is recharged back into the aquifer. In the long-term, this situation is not sustainable. It is the cumulative impact of all users that has resulted in the overdraft condition and additional groundwater extraction to support new development will further contribute to this cumulative impact. Any additional development requiring groundwater in Borrego Valley without mitigation would have a potentially significant impact to groundwater resources.

Current impacts include dry wells, decreased well efficiency and increased pumping costs as water levels continue to decline. This will continue and more wells will need to be replaced as water levels drop below perforated intervals. Also, water quality impacts may occur as decreased water levels may induce flow of high salinity, poor quality connate water found in deeper formational materials of the aquifer. This may eventually necessitate additional expensive treatment of groundwater to make the water suitable as a drinking water supply.

A.4.2 Potential Mitigation Measures

Below is a discussion of potential mitigation measures and alternatives which could reduce or minimize potentially significant impacts to groundwater resources as the result of implementation of the General Plan Update. At the present time, there is an adequate groundwater supply to meet current groundwater demand in Borrego Valley. As the groundwater overdraft condition continues increasingly aggressive mitigation measures will likely be required to assure a long-term water supply for Borrego Valley. Unfortunately, there is no single answer or approach to take to mitigate the effects of the groundwater overdraft. The County has no active groundwater management authority in Borrego Valley beyond its land use authority. The primary groundwater management agency for the Borrego Valley aquifer is the BWD. The BWD has developed a comprehensive multi-faceted approach to address the groundwater overdraft situation in Borrego Valley as outlined in Section 3.1. The following mitigation measures could be implemented by the County using its land use authority versus measures that the BWD is currently or potentially could implement using its groundwater management authority:

A.4.2.1 County of San Diego

1. Groundwater Offsetting Measures: As discussed in Section 3.2, new discretionary projects which are proposing the use of groundwater in Borrego Valley are strongly encouraged to include with their projects, offsetting groundwater use reduction measures which will make up for the project's proposed groundwater use and result in "no net gain" in the overall amount of extraction of groundwater. As one example of such a measure, land could be purchased or an easement could be placed over the land which currently has groundwater use associated with it. If the water use on this land were reduced by an amount equivalent to the water demand of the proposed project, then there would be "no net gain" in the amount of water extracted from the aquifer, and thus the overdraft condition would not be made worse by the proposed project. The applicant would have to propose a legally enforceable mechanism to the satisfaction of the County for achieving the reduction on the other land. An example would be taking agricultural or golf course land permanently out of production. For tentative maps or tentative parcel maps, the County requires the mitigation to be implemented prior to approval of the final map. This mitigation measure is feasible and is currently being implemented by DPLU.

The County's CEQA policy for Borrego Valley does not apply to pre-existing legally buildable lots or for projects with previously approved environmental documents (unless the given project is proposing more groundwater than was initially proposed). Currently, in these cases no mitigation is required. While not required under CEQA, the County could adopt measures through the Groundwater Ordinance to require groundwater offsetting measures for all potential water uses which would include ministerial permits such as a building permit or projects with previously approved environmental documents.

The County could potentially implement a mitigation ratio higher than 1:1. The BWD has implemented a groundwater mitigation policy which has a mitigation ratio of 2:1. To illustrate the effectiveness of implementation of higher mitigation ratios, two scenarios have been analyzed in the following table assuming a baseline overdraft condition of 14,300 acre-feet per year in the year 2008, and 1,685,000 acre-feet of groundwater in storage as of 1999. This assumes that all new development in Borrego Valley is required to mitigate its groundwater use at the prescribed ratios.

Scenario	Additional Residential Units in Next 30 Years	Rough Estimate of Years Until Upper and Middle Aquifers are 50% Depleted		
		No Mitigation	1:1	2:1
1. Building Moratorium, No Change in Overdraft	0	50	50	50
2. Development at Current Rate of Construction (42 residential units per year)	1260	47	50	54
3. Accelerated Development at Double Current Rate of Construction (84 residential units per year)	2520	44	50	60
4. Accelerated Development at Triple Current Rate of Construction (126 residential units per year)	4780	39	50	71

As of November 2008, there were 11 subdivisions in Borrego Valley in process with the County which are proposing a combined total of nearly 1,000 acre-feet of water use per year. If all of these projects are approved by the County, this would result in offsetting groundwater measures to occur prior to finalization of each map. So, until the last parcel is built out, the mitigation ratio is higher than 1:1. At a current development rate of approximately 42 residential units per year, these new developments could take 50 to 100 years before being built out. Therefore, if 1,000 acre-feet of overdraft was removed from the aquifer right now, this would give the aquifer more time than what is indicated in the table above.

2. Landscape Conservation: Having recognized the large impact that landscape irrigation has on water supplies and wanting to further reduce waste of water, recent legislation has mandated that the California Department of Water Resources (DWR) update its Model Water Efficient Landscape Ordinance (MWELO) on January 1, 2009. All local agencies, including the County of San Diego, are required to adopt the updated Model Ordinance or adopt their own local landscape ordinance that is at least as effective as the updated Model Ordinance by January 1, 2010. The updated MWELO would be mandated to reflect improvements in landscape and irrigation design plans, irrigation technologies, and water management with the goal of achievable water savings.

The estimated average groundwater use per single-family residence in Borrego Valley is approximately 0.95 acre-feet per year based on analysis of four years of water use data from over 1,300 homes in Borrego Valley (BWD, 2006). The average water use of a single-family residence within the CWA is approximately 0.5 acre-feet per year (CWA, 2006). The relatively high water demand per residence in Borrego Valley can be attributed to the high evapotranspiration rates associated with outdoor landscaping. By reducing or eliminating water intensive landscaping such as lawns and tropical landscaping and replacing those with xeriscape/desert landscaping could significantly reduce the overall water demand per residence in Borrego Valley. The updated MWELO could be the mechanism for implementation of stringent landscape conservation measures in Borrego Valley to achieve needed water savings.

3. Environmentally Superior Alternative: The GP Update Environmentally Superior Alternative could be selected to reduce future development potential in Borrego Valley. The Environmentally Superior Alternative would result in a reduction at buildout of over 2,000 residential units when compared with the Referral Map (project) alternative. This is a feasible mitigation measure. However, the Environmentally Superior Alternative proposes significant reductions in densities over actively irrigated agricultural land. Potential conversion of intensely irrigated agricultural land to residential lands would be discouraged by selecting the Environmentally Superior Alternative, which could be counter to reducing water use in Borrego Valley.

4. Building Moratorium: 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 the Borrego Valley aquifer. There are obvious socioeconomic impacts that would occur as the result of a building moratorium in Borrego Valley. There is no conclusive scientific data available that indicates an imminent groundwater supply shortage for Borrego Valley within the next 20 to 30 years. As such, a moratorium against new development appears unwarranted.

A.4.2.2Borrego Water District

1. Groundwater Preservation Fee: The BWD has implemented a groundwater mitigation program in which all new development in Borrego Valley that proposes to utilize water from the BWD must implement mitigation measures which would retire existing water demands on a 2:1 basis. A Groundwater Preservation Fee is accepted by the BWD as an in-lieu payment for the required reduction of demand which could then be used for various overdraft mitigation programs including:

   i. Irrigated Agricultural Land Purchase: BWD has permanently fallowed approximately 175 acre-feet per year of water use and additional lands are intended to be purchased as funds become available through groundwater preservation fee collection.

   ii. Importation of Groundwater from Nearby Basins: The BWD is evaluating three groundwater sources near Borrego Valley that could potentially be imported for use by the BWD.

   iii. Importation Pipeline Projects from Imperial Irrigation District (IID) or Coachella Valley Water District (CVWD): The BWD is evaluating potentially obtaining a source of water from the Colorado River, State Water Project, or other sources through an importation pipeline project from the IID or CVWD into

Borrego Valley. This is likely infeasible at this time due to the costs associated.

iv. Artificial Recharge: The BWD is interested in investigating the potential for a cooperative use of a storm water detention basin as both a flood retarding and water conservation basin.

2. Conservation Management Program (Tiered Water Rates): BWD adopted tiered water rates in an effort to encourage water conservation and penalize high water use. Additional fees received will be applied to a rebate program to encourage customers to purchase low-flush toilets, low-water-use washing machines, turf removal, and water-efficient irrigation systems.

3. Water Recycling: The BWD could potentially connect all residences sewage to an existing wastewater treatment plant at Rams Hill (now known as Montesoro) golf course for re-use as landscape irrigation.

4. Groundwater Storage and Recovery Project: The Borrego Valley aquifer may be a good candidate as an aquifer storage and recovery (ASR) project, which involves injecting imported water into the aquifer through wells or by surface spreading and infiltration and then pumping it out when needed. The IID or CVWD would be the two most likely water agencies that could potentially utilize the Borrego Valley aquifer for ASR.

5. Basin Adjudication: When the demand for groundwater exceeds its supply, landowners can turn to the courts to determine how much groundwater each user can rightfully extract. There are 19 court adjudications for groundwater basins in California. This court-directed process can be lengthy and costly, with the longest adjudication taking 24 years (DWR, 2003). Currently, groundwater users in Borrego Valley have an adequate water supply to meet their current needs and there has been no action to bring about court adjudication of the Borrego Valley aquifer. However, the overextraction is not sustainable and as the overdraft condition continues there may come a time when court adjudication becomes necessary. Since the County does not actively manage groundwater resources in Borrego Valley, it is not in the position to initiate a court adjudication of the basin. Thus, the BWD and/or other groundwater users in Borrego Valley would be responsible parties to initiate an adjudication of the basin.

6. Projects Outside of the BWD: For projects which do not choose to receive water from the BWD, they could drill private domestic wells or form a County or State-regulated water system in which public supply wells would provide water to the project. In such cases, these projects would not provide any economic benefit to the BWD in its efforts to secure a long-term water supply through its various overdraft mitigation programs. As possible mitigation, these projects could be required to pay a groundwater preservation fee to the BWD in addition to providing groundwater offsetting measures. The County would need

to initiate such an action and the money would need to be earmarked specifically towards BWD mitigation programs that the County would consider to be legally enforceable if used for purposes of CEQA mitigation.

A.5 LIMITATIONS

The information in this report was prepared based on best available information from groundwater investigations conducted by the USGS, DWR, and others. Future hydrogeological investigations conducted in Borrego Valley (such as the current USGS investigation) may result in revisions to previous estimates made of the estimated groundwater remaining in storage and the overall rate of overdraft occurring. At the current rate of overdraft estimated by DWR and especially if overdraft conditions increase as it has within the past 25 years, the decline in water levels will continue to result in increasing costs to pump water and dry wells. It is possible that impacts including, but not limited to, dry wells and potential water quality degradation from high salinity water within deeper formational deposits may occur in Borrego Valley within the next 20 to 30 years.

A.6 REFERENCES

Borrego Water District (BWD), 2002. Borrego Water District Groundwater Management Plan, September 25, 2002

BWD, 2006. Groundwater Use Data from 1,328 Single-Family Homes, August 2002 through July 2006.

BWD, 2008. Borrego Water District Integrated Water Resources Management Plan, Draft No.4, October, 2008.

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

DWR, 2003, Bulletin 118, California's Groundwater, Update 2003.

County of San Diego, 1999. Legal Lot Study of Various Areas in San Diego County, General Plan Update Research Study, April 1999.

County of San Diego, 2007. DPLU Policy Regarding CEQA Cumulative Impact Analyses for Borrego Valley Groundwater Use, revised January 2007.

Henderson, T.W., 2001. Hydrogeology and Numerical Modeling of the Borrego Valley Aquifer System. Masters Thesis, San Diego State University, Fall 2001.

Huntley, David, 1993. Letter to DPLU Regarding Groundwater Situation in Borrego Valley, San Diego State University, January 26, 1993.

Mitten, H.t., G.C. Lines, C. Berenbrock, and T.J. Durbvin, 1988. Water Resources of Borrego Valley and Vicinity, San Diego County, California: Phase 2--Development of a Groundwater-Water Model. U.S. Geological Survey Water-Resources Investigations Report 87-4199.

Moyle, Jr., W.R., 1982. Water Resources of Borrego Valley and Vicinity, Phase 1-- Definition of Geologic and Hydrologic Characteristics of Basin, U.S. Geological Survey Open-File Report 82-855.

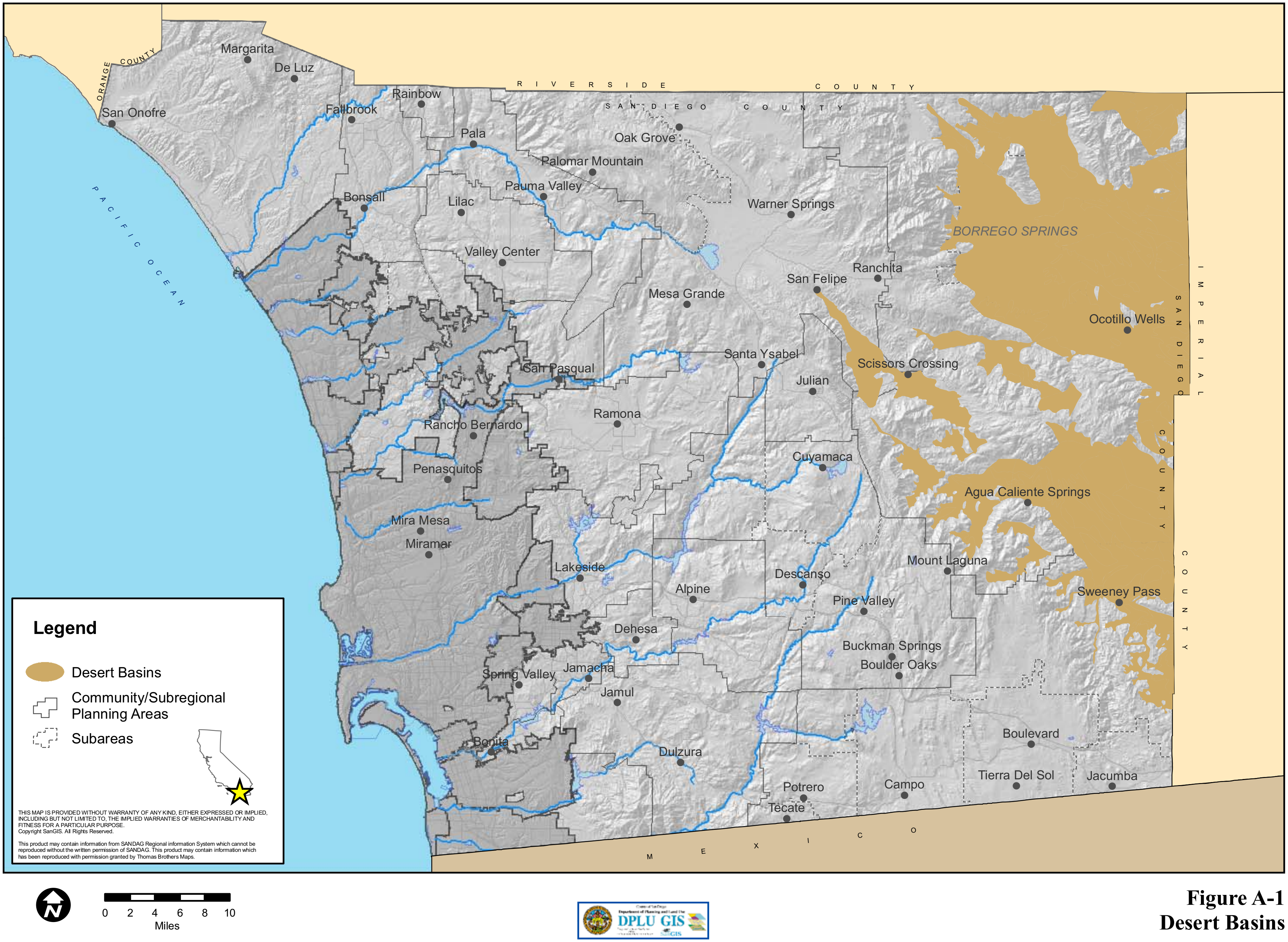
Netto, S.P., 2001. Water Resources of Borrego Valley San Diego County, California. Masters Thesis, San Diego State University, Fall 2001.

Ross, Timothy, 2006. Characterizing Water Resources of Borrego Valley Groundwater Basin Presentation, California Department of Water Resources, September 2006.

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

San Diego County. Groundwater Monitoring Program Data. Department of Planning and Land Use. Data from 1980 through 2006.

San Diego County Groundwater Ordinance (#9826, N.S.).



DPLU GIS

Figure A-1
Desert Basins

K:\groundwater\borrego_groundwater\borrego\mxd\Regional.mxd Date: 10/28/2008

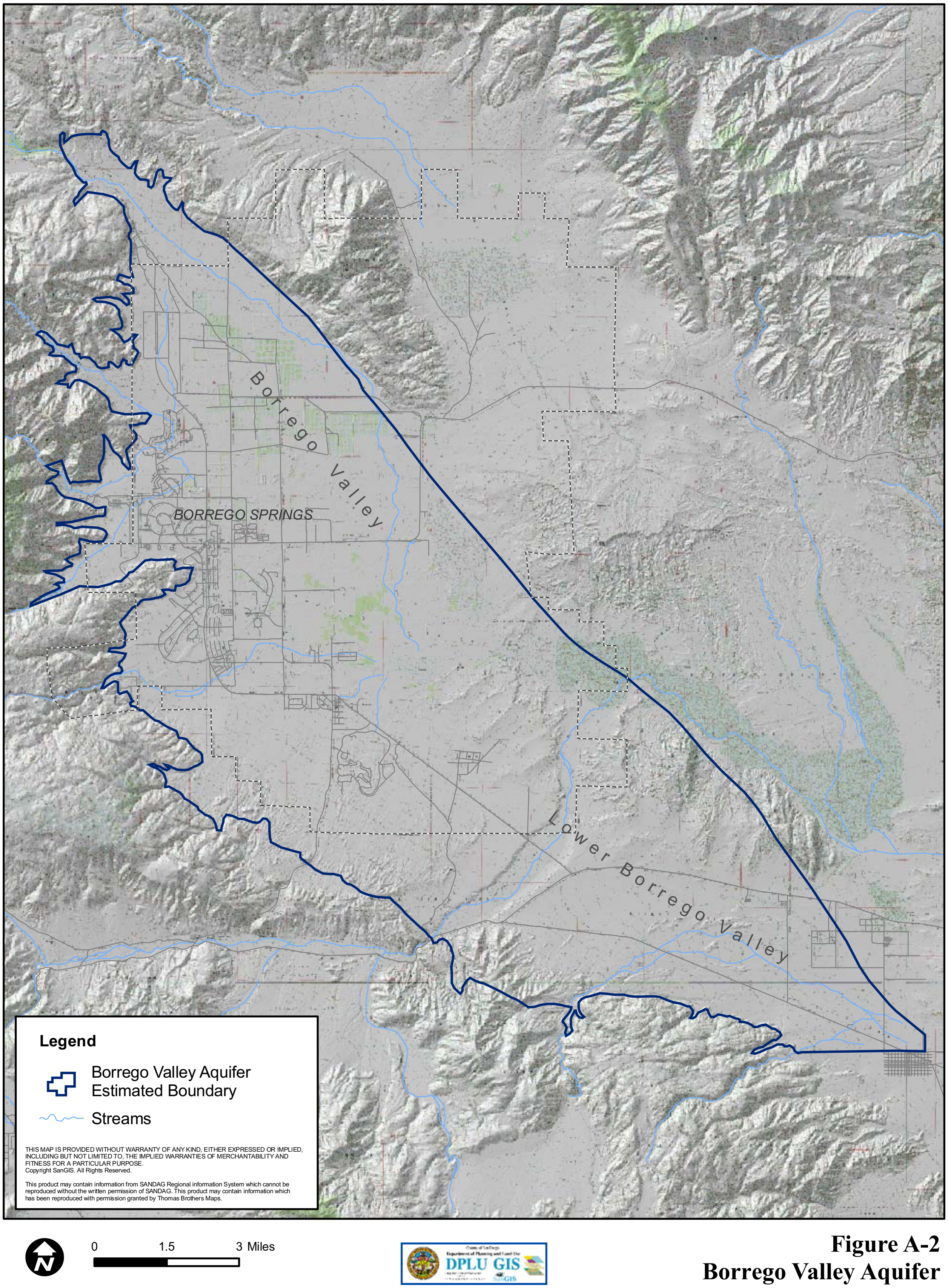
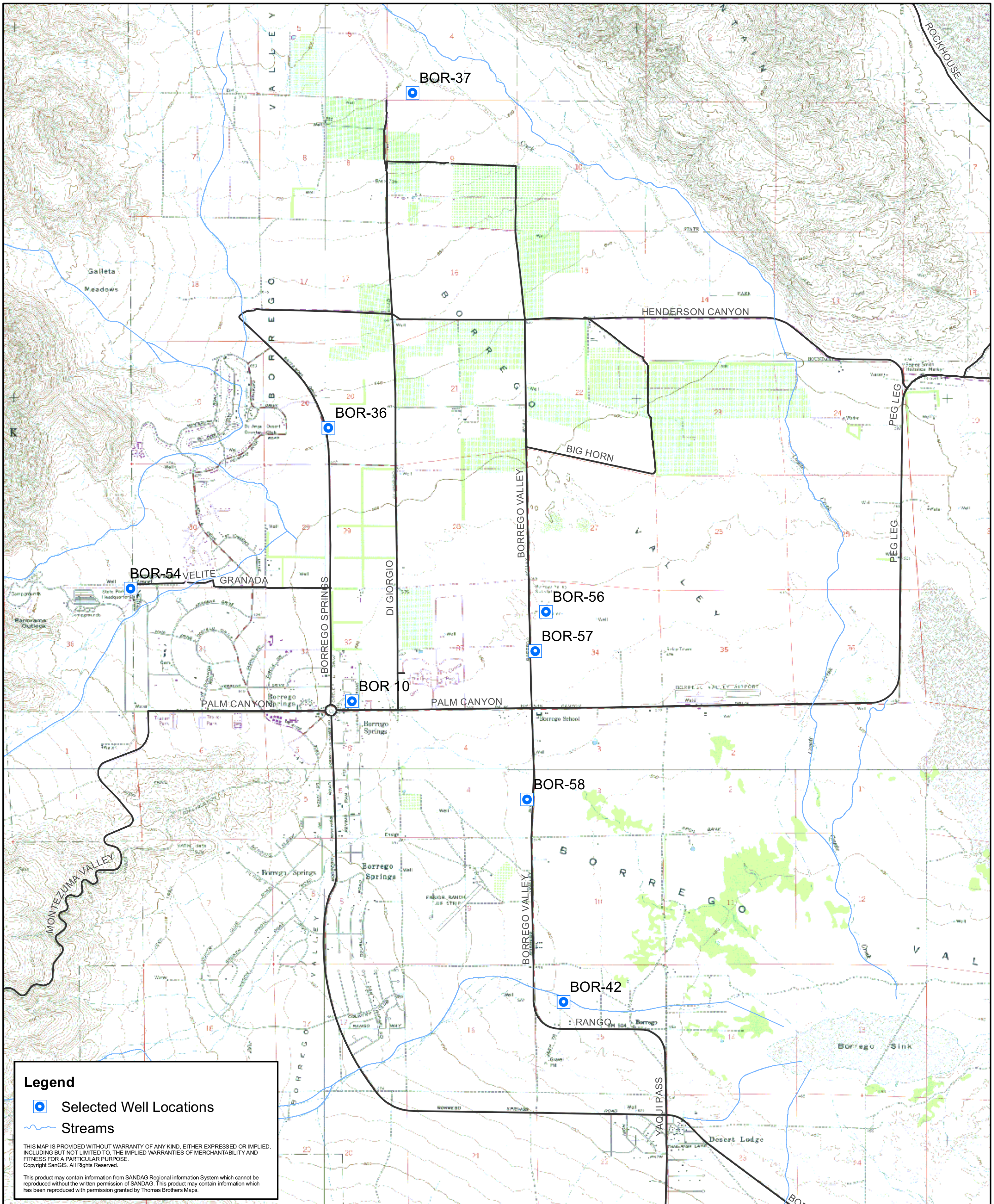


Figure A-2
Borrego Valley Aquifer

File:K:\groundwater\borrego_groundwater\borrego\mxd\aquifer.mxd Date: 10/28/2008



Miles
0 0.5 1

DPLU GIS

County Monitoring Wells
Borrego Valley
Figure A-3

File:K:\groundwater\borrego_groundwater\borrego\mxd\wellpoints_borrego2.mxd Date: 10/2/2007

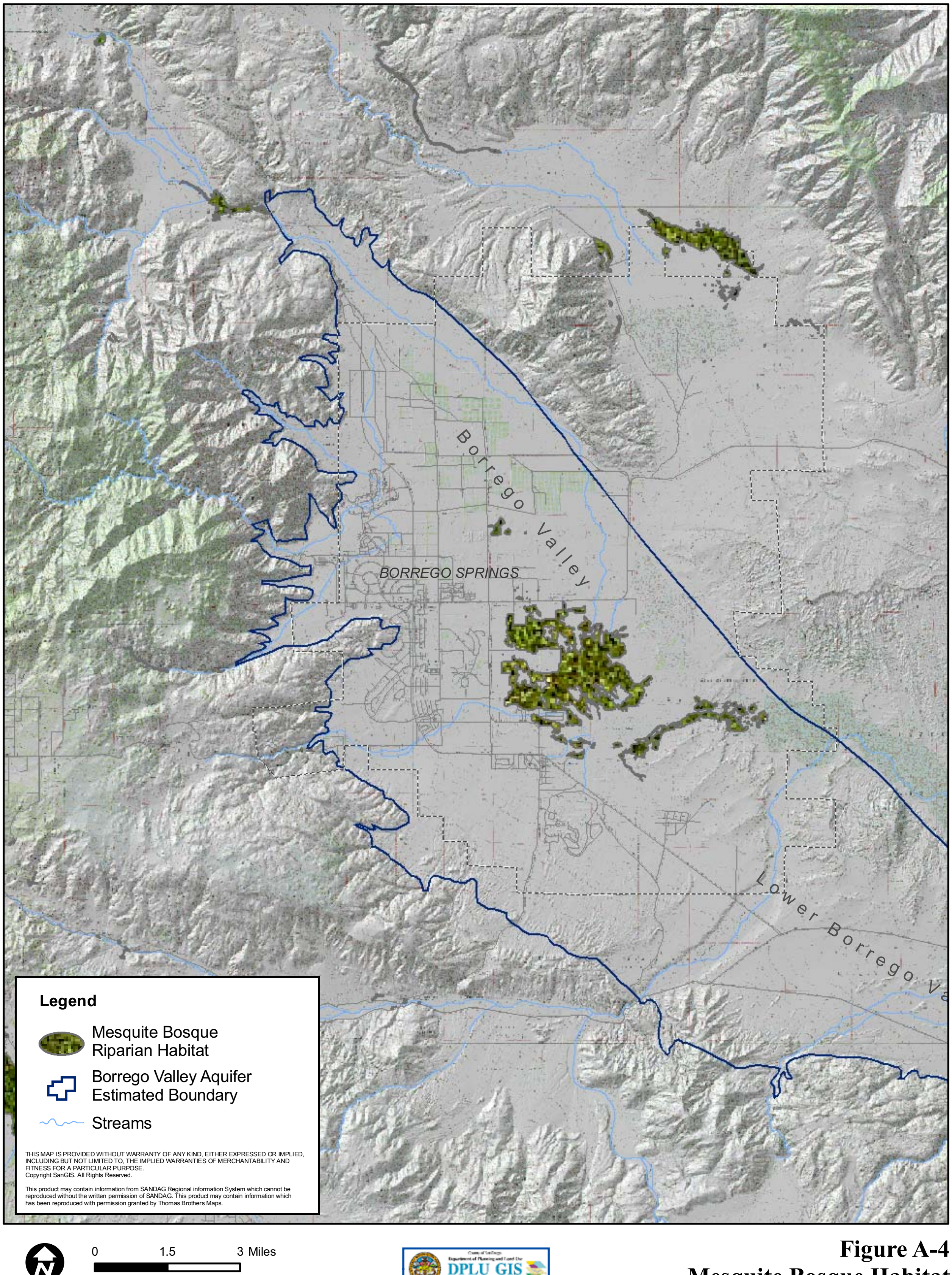


Figure A-4
Mesquite Bosque Habitat

K:\groundwater\borrego_groundwater\borrego\mxd\MesquiteBosque.mxd Date: 10/28/2008

Appendix B
Computer Code for Calculation of Long-Term Groundwater Availability

```
/* GW.AML – CALCULATE GROUNDWATER STUDY STATISTICS BY SUB-BASIN
/* Needed grids: pet%month%, precip, romax, smc_min, smc_mean, sval
/* May 2006
/* Gary Ross, County of San Diego, Department of Planning & Land Use

&severity &error &routine bail

&set .routine init
&set runno [date -tag]

&call setup
&call recharge

&do cur &list [show cursors]
  cursor %cur% close
  cursor %cur% remove
&end
cursor wshed declare %basins% polygon ro code > 0
cursor wshed open
cursor wshed first
&do &while %:wshed.aml$next%
  &set ws %:wshed.code%
  &call output
  cursor wshed next
&end
cursor wshed close
cursor wshed remove

&return


/*********************************************************
&routine setup
&set .routine setup

&set path1 c:\gw08\sourcedata\
&set path2 c:\gw08\
&set path3 c:\gw08\run%runno%\

&workspace %path2%run%runno%

&set basins %path1%basins_gw

&set year_start 1
&set year_end   34
&set mo_start   1
&set mo_end     12

&set storagemax %path1%storagemax

/*recharge variables
&set pval_table %path1%precip_fract.info
&set et_table   %path1%etfraction.info
&set rofract    0.5 /* previously 0.8 10/16/06
&set petfract   1
&set smcvalue   mean
/*&set buffdist 3
```

```
&set smc        %path1%smc_%smcvalue%

&return


/**************************************************************
&routine recharge
&set .routine recharge

&do year = %year_start% &to %year_end%
  &do mo = %mo_start% &to %mo_end%
    &if %mo% < 10 &then
      &set month = 0%mo%
    &else
      &set month = %mo%

    /* Set up grid tag and previous tag
    &set tag = %year%%month%
    &if %mo% = 1 &then
      &set ptag = [calc %year% - 1]12
    &else
      &if %mo% < 11 &then
        &set ptag = %year%0[calc %mo% - 1]
      &else
        &set ptag = %year%[calc %mo% - 1]

    &type Working on recharge year %year%, month %month%...

    /* Get precip percentage
    cursor c declare %pval_table% info ro tag = %tag% /*[quote %tag%]
    cursor c open
    cursor c first
    &set ppct = %:c.frac%
    cursor c close
    cursor c remove

    /* Get ET percentage
    cursor e declare %et_table% info ro month = [quote %month%]
    cursor e open
    cursor e first
    &set etpct = 1
    cursor e close
    cursor e remove

    /* Delete old grids
    grid
    &do g &list r%tag%1 r%tag% ro%tag% ro%tag%1 ro totloss test s%tag%~
                s%tag%1 sm%tag% sm%tag%1 p%tag%
      &if [exists %path3%%g% -grid] &then
        kill %path3%%g% all
    &end

    /* Get precip values
    %path3%p%tag% = %path1%precip * %ppct%


    /* Set water loss
```

```
    %path3%ro%tag%1 = (sqr(%path3%p%tag% - (0.2 * %path1%sval))) / ~
                      (%path3%p%tag% + (0.8 * %path1%sval))
    %path3%ro%tag% = con(%path3%p%tag% < .5, %path3%ro%tag%1 * 0, ~
                         %path3%ro%tag%1 * %rofract%)
    %path3%totloss = (%path1%pet%month% * %etpct% * %petfract%) + ~
                      %path3%ro%tag%

    /* Tests for existing soil moisture
    %path3%test = %path3%p%tag% - %path3%totloss

    /* con1: soil saturated at beginning of month
    /* con2: no recharge in previous month but some this month
    /* con3: no recharge in previous month and none this month
    &if %tag% ne 101 &then &do
      %path3%sm%tag% = con(%path3%r%ptag% > 0, ~
        %smc%, con(%path3%test >= 0, ~
        %path3%p%tag% - %path3%totloss + %path3%sm%ptag%, ~
        %path3%sm%ptag% * exp((%path3%p%tag% - ~
        (%path1%pet%month% * %etpct% * %petfract%)) / %smc%)))
      %path3%sm%tag%1 = con (%path3%sm%tag% >= %smc%, %smc%, ~
        %path3%sm%tag%)
      %path3%s%tag% = %path3%sm%tag%1 - %path3%sm%ptag%1
    &end
    &else &do
      %path3%s%tag% = %smc% * 0 /*smc_%smcvalue% * 0
      %path3%sm%tag% = %smc% * 1 /*smc_%smcvalue% * 1
      %path3%sm%tag%1 = %smc% * 1 /*smc_%smcvalue% * 1
    &end
    %path3%r%tag%1 = %path3%p%tag% - %path3%ro%tag% - ~
      (%path1%pet%month% * %etpct% * %petfract%) - %path3%s%tag%
    %path3%r%tag% = con(%path3%r%tag%1 < 0, 0, %path3%r%tag%1)
    quit /* grid

    &do g &list ro%tag%1 s%tag% r%tag%1
      &if [exists %path3%%g% -grid] &then
        kill %path3%%g% all
    &end

  &end
&end

&return


/***************************************************************
&routine output
&set .routine output

&set output stats.info

&if not [exists %output% -info] &then
  copyinfo %path1%%output%

tables
select %output%
purge
yes
```

```
quit

&if [exists tempcov -cover] &then
  kill tempcov all
&if [exists mask -grid] &then
  kill mask all
&if [exists mask1 -grid] &then
  kill mask1 all

arcedit
ec %basins% poly
select code = %ws%
put tempcov
quit
build tempcov

polygrid tempcov mask1
300
yes

grid
setmask %path1%studyareamask
setwindow %path1%studyareamask
mask = mask1 * 1
quit

statistics mask.vat mask.stat
sum count
end
cursor cnt declare mask.stat info
cursor cnt open
cursor cnt first
&set cellcount %:cnt.sum-count%
cursor cnt close
cursor cnt remove

&do year = %year_start% &to %year_end%
  &do mo = %mo_start% &to %mo_end%
    &if %mo% < 10 &then
      &set month = 0%mo%
    &else
      &set month = %mo%
    &set tag = %year%%month%
    &if %mo% = 1 &then
      &set ptag = [calc %year% - 1]12
    &else
      &if %mo% < 11 &then
        &set ptag = %year%0[calc %mo% - 1]
      &else
        &set ptag = %year%[calc %mo% - 1]

    &set theyear = %year% + 1970
    &if %mo% > 6 &then
      &set theyear = %theyear% + 1
    &set themonth = %mo% + 6
    &if %themonth% > 12 &then
      &set themonth = %themonth% - 12
```

```
grid
setmask mask

/*recharge
&if [exists outgrid -grid] &then
  kill outgrid all
outgrid = %path3%r%tag% * 1
&describe outgrid
&set rmin %grd$zmin%
&set rmax %grd$zmax%
&set rmean %grd$mean%

/*precipitation
&if [exists outgrid -grid] &then
  kill outgrid all
outgrid = %path3%p%tag% * 1
&describe outgrid
&set pmin %grd$zmin%
&set pmax %grd$zmax%
&set pmean %grd$mean%

/*runoff
&if [exists outgrid -grid] &then
  kill outgrid all
outgrid = %path3%ro%tag% * 1
&describe outgrid
&set romin %grd$zmin%
&set romax %grd$zmax%
&set romean %grd$mean%

/*soil moisture
&if [exists outgrid -grid] &then
  kill outgrid all
&if %tag% = 101 &then
  outgrid = %smc% * 1
&else
  outgrid = %path3%sm%tag%1 * 1
&describe outgrid
&set smmin %grd$zmin%
&set smmax %grd$zmax%
&set smmean %grd$mean%

&if %tag% = 101 &then &do /* only determine demand for first month
  /*storage
  &if [exists outgrid -grid] &then
    kill outgrid all
  outgrid = storage1 * 1
  &describe outgrid
  &set stmin %grd$zmin%
  &set stmax %grd$zmax%
  &set stmean %grd$mean%


  /* demand from existing conditions
  &if [exists outgrid -grid] &then
    kill outgrid all
```

```
outgrid = %path1%demandtot0 * 1
&describe outgrid
&set dem0min %grd$zmin%
&set dem0max %grd$zmax%
&set dem0mean %grd$mean%

/* demand from existing gen plan buildout
&if [exists outgrid -grid] &then
  kill outgrid all
outgrid = %path1%demandtot1 * 1
&describe outgrid
&set dem1min %grd$zmin%
&set dem1max %grd$zmax%
&set dem1mean %grd$mean%

/* demand from Referral buildout
&if [exists outgrid -grid] &then
  kill outgrid all
outgrid = %path1%demandtot19 * 1
&describe outgrid
&set dem19min %grd$zmin%
&set dem19max %grd$zmax%
&set dem19mean %grd$mean%

/* demand from Draft Land Use buildout
&if [exists outgrid -grid] &then
  kill outgrid all
outgrid = %path1%demandtot20 * 1
&describe outgrid
&set dem20min %grd$zmin%
&set dem20max %grd$zmax%
&set dem20mean %grd$mean%

/* demand from Hybrid buildout
&if [exists outgrid -grid] &then
  kill outgrid all
outgrid = %path1%demandtot21 * 1
&describe outgrid
&set dem21min %grd$zmin%
&set dem21max %grd$zmax%
&set dem21mean %grd$mean%

/* demand from Enviro Superior buildout
&if [exists outgrid -grid] &then
  kill outgrid all
outgrid = %path1%demandtot22 * 1
&describe outgrid
&set dem22min %grd$zmin%
&set dem22max %grd$zmax%
&set dem22mean %grd$mean%

/* demand from Cumulative buildout
&if [exists outgrid -grid] &then
  kill outgrid all
outgrid = %path1%demandtot23 * 1
&describe outgrid
&set dem23min %grd$zmin%
```

```
        &set dem23max %grd$zmax%
        &set dem23mean %grd$mean%

      &end
      quit

      cursor c declare %output% info rw
      cursor c open
      cursor c insert
      &set :c.year        %theyear%
      &set :c.month       %themonth%
      &set :c.rechge_min  %rmin%
      &set :c.rechge_max  %rmax%
      &set :c.rechge_mean %rmean%
      &set :c.precip_min  %pmin%
      &set :c.precip_max  %pmax%
      &set :c.precip_mean %pmean%
      &set :c.ro_min      %romin%
      &set :c.ro_max      %romax%
      &set :c.ro_mean     %romean%
      &set :c.sm_min      %smmin%
      &set :c.sm_max      %smmax%
      &set :c.sm_mean     %smmean%
      &set :c.store_min   %stmin%
      &set :c.store_max   %stmax%
      &set :c.store_mean  %stmean%
      &set :c.cellcount   %cellcount%
      &set :c.dem0_min    %dem0min%
      &set :c.dem0_max    %dem0max%
      &set :c.dem0_mean   %dem0mean%
      &set :c.dem1_min    %dem1min%
      &set :c.dem1_max    %dem1max%
      &set :c.dem1_mean   %dem1mean%
      &set :c.dem19_min   %dem19min%
      &set :c.dem19_max   %dem19max%
      &set :c.dem19_mean  %dem19mean%
      &set :c.dem20_min   %dem20min%
      &set :c.dem20_max   %dem20max%
      &set :c.dem20_mean  %dem20mean%
      &set :c.dem21_min   %dem21min%
      &set :c.dem21_max   %dem21max%
      &set :c.dem21_mean  %dem21mean%
      &set :c.dem22_min   %dem22min%
      &set :c.dem22_max   %dem22max%
      &set :c.dem22_mean  %dem22mean%
      &set :c.dem23_min   %dem23min%
      &set :c.dem23_max   %dem23max%
      &set :c.dem23_mean  %dem23mean%
      &set :c.storage [calc %stmean% * %cellcount% * 2.06611570248 / 12]
      cursor c close
      cursor c remove
    &end
  &end

  infodbase %output% stats%runno%_%ws%.dbf

  &return
```

```
/**************************************************************
&routine bail

&watch &off
&ec &off
&type Cursors: [show cursors]
&do cur &list [show cursors]
  cursor %cur% close
  cursor %cur% remove
&end
&lv
&type Routine %.routine%
&messages &on
&type ERROR...
&stop

&return
```

Code Description (Execution Order)

Line(s)	Description
11	Go to setup routine.
36-38	Setup variables—paths to data.
40	Setup workspace.
42	Setup variable—sub-basins of the study area.
44-45	Setup variable—year 1 to year 34.
46-47	Setup variable—month 1 to month 12.
49	Setup variable—storage grid location.
52	Setup variable—precipitation monthly fraction table (408 values).
53	Setup variable—evapotranspiration monthly fraction table (12 values).
54	Setup variable—runoff factor.
55	Setup variable—potential evapotranspiration factor.
56	Setup variable—soil moisture type (i.e., mean, maximum).
58	Setup variable—soil moisture content grid location.
12	Go to recharge routine.
67	Loop through each of the 34 years of recharge studied.
68	Loop through each month of the above years.
75	Setup variable—tag used to identify month and year (4 digits; 2 for month and 2 for year).
77	Setup variable—tag for previous month (when it occurred in previous year).
80 or 82	Setup variable—tag for previous month.
87	Lookup precipitation percentage for specific month and year.
90	Setup variable—precipitation percentage from line 87.
98	Setup variable—evapotranspiration factor.
103	Enter ESRI grid.
104-108	Cleanup temporary datasets.
111	Create grid of precipitation for specific month and year.
115-116	Create preliminary grid of runoff using SCS Curve Number Method.
117-118	Adjust runoff in cells where precipitation is less than a ½ inch.
119-120	Create grid of total loss (evapotranspiration and runoff) from the system for each cell.
123	Create temporary grid to see if net gain or loss of groundwater for specific month and year.
129-133	Create grid (sm%tag%) of soil moisture for specific month and year: If the soil is saturated from previous month (r%ptag%>0), then soil moisture is set to the soil moisture capacity; If there was more precipitation that what is lost in a specific month.
134-135	Create grid (sm%tag%1) to limit soil moisture to the soil moisture capacity for specific month and year.
136	Create grid (s%tag%) with soil moisture change from previous month.
139-141	Create grids for July 1971 (1st month of study); start with completely saturated soil.
143-144	Create grid for recharge for specific month and year (r%tag%1) as calculated:

(precipitation for current month) – (runoff for current month) – (potential evapotranspiration) – (change of soil moisture from previous month).

146 Exit out of ESRI grid and return to ESRI arc.

148-151 Clean up temporary datasets.

153 Go back to line 68 and repeat for the next month until month 12.

154 Go back to line 67 and repeat for the next year until year 34.

14-17 Memory clean up.

18-20 Create list of sub-basins for which to create statistics.

21 Loop through those sub-basins.

23 Go to output routine.

163 Set variable—ESRI INFO file to populate for statistics table.

165-166 If the table does not already exist in the current workspace, copy it from another one.

168 Enter ESRI tables.

169 Select the appropriate output table.

170 Erase all existing entries from table (from a previous sub-basin).

171 Required verification of erasing command.

172 Exit out of ESRI tables and return to ESRI arc.

174-179 Data clean up.

181 Enter ESRI arcedit.

182 Set edit coverage to sub-basin dataset and edit feature polygon.

183 Select sub-basin of interest.

184 Create coverage of sub-basin of interest.

185 Exit out of ESRI arcedit and return to ESRI arc.

186 Make sure topology is correct on coverage created at line 184.

188 Create grid from coverage to clip datasets to current sub-basin.

189 Set cell size to 300 feet.

190 Required verification of grid creation.

192 Enter ESRI grid.

193 Set mask to study area.

194 Set window of interest to study area.

195 Clip grid created at line 188 to the study area.

196 Exit ESRI grid and return to ESRI arc.

198 Set up statistics to go to specified table.

199 Get the number of cells in sub-basin of interest.

200 Get out of the statistics.

201-206 Populate the output statistics table with the cell count of sub-basin.

208 Loop through each of the 34 years of recharge studied.

209 Loop though each month of the above years.

210-214 Setup variable—tag used to identify month and year (4 digits; 2 for month and 2 for year).

215-221 Setup variable—tag for previous month.

223 Setup variable—translate tag year to calendar year.

224-225 Adjust calendar year if needed (due to the fact that month 01 is July).

226	Setup variable—translate tag month to calendar month.
227-228	Adjust calendar month if needed.
230	Enter ESRI grid.
231	Set mask to study area.
234-235	Data set clean up.
236	Create grid of recharge for sub-basin for specific month and year.
237	Get statistical information on grid created at line 236.
238	Get minimum recharge for sub-basin.
239	Get maximum recharge for sub-basin.
240	Get mean recharge for sub-basin.
243-244	Data set clean up.
245	Create grid of precipitation for sub-basin for specific month and year.
246	Get statistical information on grid created at line 245.
247	Get minimum precipitation for sub-basin.
248	Get maximum precipitation for sub-basin.
249	Get mean precipitation for sub-basin.
252-253	Data set clean up.
254	Create grid of runoff for sub-basin for specific month and year.
255	Get statistical information on grid created at line 254.
256	Get minimum runoff for sub-basin.
257	Get maximum runoff for sub-basin.
258	Get mean runoff for sub-basin.
261-262	Data set clean up.
263-266	Create grid of soil moisture for sub-basin for specific month and year.
267	Get statistical information on grid created at line 264 or 266.
268	Get minimum soil moisture for sub-basin.
269	Get maximum soil moisture for sub-basin.
270	Get mean soil moisture for sub-basin.
272	Check to allow those statistics that do not change over time (i.e., maximum groundwater storage and build out demands).
274-275	Data set clean up.
276	Create grid of groundwater storage for sub-basin for specific month and year.
277	Get statistical information on grid created at line 276.
278	Get minimum groundwater storage for sub-basin.
279	Get maximum groundwater storage for sub-basin.
280	Get mean groundwater storage for sub-basin.
284-285	Data set clean up.
286	Create grid of existing groundwater demand for sub-basin for specific month and year.
287	Get statistical information on grid created at line 286.

288 Get minimum existing groundwater demand for sub-basin.
289 Get maximum existing groundwater demand for sub-basin.
290 Get mean existing groundwater demand for sub-basin.
293-294 Data set clean up.
295 Create grid of existing general plan build out demand for sub-basin for specific month and year.
296 Get statistical information on grid created at line 295.
297 Get minimum existing general plan build out demand for sub-basin.
298 Get maximum existing general plan build out demand for sub-basin.
299 Get mean existing general plan build out demand for sub-basin.

302-303 Data set clean up.
304 Create grid of referral build out demand for sub-basin for specific month and year.
305 Get statistical information on grid created at line 304.
306 Get minimum referral build out demand for sub-basin.
307 Get maximum referral build out demand for sub-basin.
308 Get mean referral build out demand for sub-basin.

311-312 Data set clean up.
313 Create grid of draft land use build out demand for sub-basin for specific month and year.
314 Get statistical information on grid created at line 313.
315 Get minimum draft land use build out demand for sub-basin.
316 Get maximum draft land use build out demand for sub-basin.
317 Get mean draft land use build out demand for sub-basin.

320-321 Data set clean up.
322 Create grid of hybrid build out demand for sub-basin for specific month and year.
323 Get statistical information on grid created at line 322.
324 Get minimum hybrid build out demand for sub-basin.
325 Get maximum hybrid build out demand for sub-basin.
326 Get mean hybrid build out demand for sub-basin.

329-330 Data set clean up.
331 Create grid of environmentally superior build out demand for sub-basin for specific month and year.
332 Get statistical information on grid created at line 331.
333 Get minimum environmentally superior build out demand for sub-basin.
334 Get maximum environmentally superior build out demand for sub-basin.
335 Get mean environmentally superior build out demand for sub-basin.

338-339 Data set clean up.
340 Create grid of cumulative impact build out demand for sub-basin for specific month and year.

341 Get statistical information on grid created at line 340.
342 Get minimum cumulative impact build out demand for sub-basin.
343 Get maximum cumulative impact build out demand for sub-basin.
344 Get mean cumulative impact build out demand for sub-basin.
347 Exit ESRI grid.

349-351 Setup to populate summary table with values.
352 Populate calendar year.
353 Populate calendar month.
354 Populate minimum recharge for sub-basin.
355 Populate maximum recharge for sub-basin.
356 Populate mean recharge for sub-basin.
357 Populate minimum precipitation for sub-basin.
358 Populate maximum precipitation for sub-basin.
359 Populate mean precipitation for sub-basin.
360 Populate minimum runoff for sub-basin.
361 Populate maximum runoff for sub-basin.
362 Populate mean runoff for sub-basin.
363 Populate minimum soil moisture for sub-basin.
364 Populate maximum soil moisture for sub-basin.
365 Populate mean soil moisture for sub-basin.
366 Populate minimum storage for sub-basin.
367 Populate maximum storage for sub-basin.
368 Populate mean storage for sub-basin.
369 Populate number of cells for sub-basin.
370 Populate minimum existing demand for sub-basin.
371 Populate maximum existing demand for sub-basin.
372 Populate mean existing demand for sub-basin.
373 Populate minimum existing general plan build out demand for sub-basin.
374 Populate maximum existing general plan build out demand for sub-basin.
375 Populate mean existing general plan build out demand for sub-basin.
376 Populate minimum referral build out demand for sub-basin.
377 Populate maximum referral build out demand for sub-basin.
378 Populate mean referral build out demand for sub-basin.
379 Populate minimum draft land use build out demand for sub-basin.
380 Populate maximum draft land use build out demand for sub-basin.
381 Populate mean draft land use build out demand for sub-basin.
382 Populate minimum hybrid build out demand for sub-basin.
383 Populate maximum hybrid build out demand for sub-basin.
384 Populate mean hybrid build out demand for sub-basin.
385 Populate minimum environmentally superior build out demand for sub-basin.
386 Populate maximum environmentally superior build out demand for sub-basin.
387 Populate mean environmentally superior build out demand for sub-basin.
388 Populate minimum cumulative impacts build out demand for sub-basin.
389 Populate maximum cumulative impacts build out demand for sub-basin.
390 Populate mean cumulative impacts build out demand for sub-basin.

391 Populate groundwater in storage (in acre-feet).

392-393 Memory clean up.
397 Convert ESRI info file to .dbf for sub-basin.
24 Move to next sub-basin in list created at line 18.
23 Go to line 208 and repeat for new sub-basin (until all sub-basins in study are complete).

General Plan Update Population Forecast Land Use Model
Constraints Matrix for Existing General Plan

			Existing Land Use Limit. 100% Var		100% Constraints								Variable Constraints						
GP Code	General Plan Designations	Allowable Densities	Built Lands	Rural	Floodplains	Wetlands	Public Lands	Future Roads	Habitat Preserve	Alquist-Priola Faults	65 CNEL Airport Noise	Airport Hazard Zone	Forest Conservation Initiative	Slope 15 (15-25%)	Slope 25 (25-50%)	Slope 50 (>50%)	Habitat Tier 1	Habitat Tier 2	Pre-Appoved Mitigation Area
1	Residential 1du/1,2,4ac	1.000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	98%	50%	50%	75%	66%	50%	50%
2	Residential 1du/1ac	1.000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	98%	0%	50%	75%	66%	50%	50%
3	Residential 2du/ac	2.000	100%	50%	100%	100%	100%	100%	100%	100%	100%	100%	99%	0%	0%	0%	66%	50%	66%
4	Residential 2.9du/ac	2.900	100%	33%	100%	100%	100%	100%	100%	100%	100%	100%	99%	0%	0%	0%	66%	50%	66%
5	Residential 4.3du/ac	4.300	100%	0%	100%	100%	100%	100%	100%	100%	100%	100%	99%	0%	0%	0%	66%	50%	66%
6	Residential 7.3du/ac	7.300	100%	0%	100%	100%	100%	100%	100%	100%	100%	100%	100%	0%	0%	0%	66%	50%	66%
7	Residential 10.9du/ac	10.900	100%	0%	100%	100%	100%	100%	100%	100%	100%	100%	100%	0%	0%	0%	66%	50%	66%
8	Residential 14.5du/ac	14.500	100%	0%	100%	100%	100%	100%	100%	100%	100%	100%	100%	0%	0%	0%	66%	50%	66%
9	Residential 43du/ac	43.000	100%	0%	100%	100%	100%	100%	100%	100%	100%	100%	100%	0%	0%	0%	66%	50%	66%
10	Residential 24du/ac	24.000	100%	0%	100%	100%	100%	100%	100%	100%	100%	100%	100%	0%	0%	0%	66%	50%	66%
17	Estate Residential 1du/2,4ac	0.500	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	95%	0%	50%	50%	66%	50%	50%
18	Multiple Rural Use 1du/4,8,20ac	0.250	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	90%	0%	50%	75%	66%	50%	50%
19	Intensive Agriculture 1du/2,4,8ac	0.500	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	95%	0%	50%	75%	66%	50%	50%
20	Agricultural Preserve 1du/10,40ac	0.125	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	75%	0%	0%	0%	66%	50%	50%
23	USNF/State Parks 1du/4,8,20ac	0.250	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	90%	0%	50%	75%	66%	50%	50%
24	Impact Sensitive 1du/4,8,20ac	0.250	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	90%	0%	50%	75%	66%	50%	50%
21	Specific Plan Area (density varies)		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
11	Office Professional	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
12	Neighborhood Professional	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
13	General Commercial	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	Service Commercial	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
26	Visitor-Serving Commercial	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	Limited Impact Industrial	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
16	General Impact Industrial	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
22	Public/Semi-Public Land	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
35	Tribal Land	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Constraints File Name			built	rural	flood	wet	public	froads	preserve	faults	cnel	apz	fci	slope15	slope25	slope50	tier1	tier2	pama

Updated May 2005
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General Plan Update Population Forecast Land Use Model
Constraints Matrix for GP Update Maps

			Existing Land Use Limit. 100% Var.		100% Constraints								Variable Constraints					
GP Code	General Plan Description	Allowable Density	Built Lands	Rural	Floodplains	Wetlands	Public Lands	Future Roads	Habitat Preserve	Alquist-Priola Faults	65 CNEL Airport Noise	Airport Hazard Zones	Forest Conservation Initiative	Slope25 (25 - 50%)	Slope50 (>50%)	Habitat Tier 1	Habitat Tier 2	Pre-Approved Mitigation Area
1	Village Residential (VR-29) 29du/ac	29.000	100%	0%	100%	100%	100%	100%	100%	100%	100%	100%	100%	0%	0%	66%	50%	66%
2	Village Residential (VR-24) 24du/ac	24.000	100%	0%	100%	100%	100%	100%	100%	100%	100%	100%	100%	0%	0%	66%	50%	66%
40	Village Residential (VR-20) 20du/ac	20.000	100%	0%	100%	100%	100%	100%	100%	100%	100%	100%	100%	0%	0%	66%	50%	66%
3	Village Residential (VR-14.5) 14.5du/ac	14.500	100%	0%	100%	100%	100%	100%	100%	100%	100%	100%	100%	0%	0%	66%	50%	66%
4	Village Residential (VR-10.9) 10.9du/ac	10.900	100%	0%	100%	100%	100%	100%	100%	100%	100%	100%	100%	0%	0%	66%	50%	66%
5	Village Residential (VR-7.3) 7.3du/du	7.300	100%	0%	100%	100%	100%	100%	100%	100%	100%	100%	100%	0%	0%	66%	50%	66%
6	Village Residential (VR-4.3) 4.3du/ac	4.300	100%	0%	100%	100%	100%	100%	100%	100%	100%	100%	99%	0%	0%	50%	25%	66%
7	Village Residential (VR-2.9) 2.9du/ac	2.900	100%	33%	100%	100%	100%	100%	100%	100%	100%	100%	99%	0%	0%	50%	25%	66%
8	Village Residential (VR-2) 2du/ac	2.000	100%	50%	100%	100%	100%	100%	100%	100%	100%	100%	99%	0%	0%	50%	25%	66%
9	Semi-Rural Residential (SR-1) 1du/1,2,4ac	1.000	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	98%	50%	75%	50%	25%	50%
11	Semi-Rural Residential (SR-2) 1du/2,4,8ac	0.500	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	95%	50%	75%	25%	25%	50%
13	Semi-Rural Residential (SR-4) 1du/4,8,16ac	0.250	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	90%	50%	75%	25%	25%	50%
17	Semi-Rural Residential (SR-10) 1du/10,20ac	0.100	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	75%	50%	75%	0%	0%	0%
18	Rural Lands (RL-20) 1du/20ac	0.050	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	50%	0%	0%	0%	0%	0%
19	Rural Lands (RL-40) 1du/40ac	0.025	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	0%	0%	0%	0%	0%	0%
20	Rural Lands (RL-80) 1du/80ac	0.013	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	0%	0%	0%	0%	0%	0%
21	Rural Lands (RL-160) 1du/160ac	0.006	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	0%	0%	0%	0%	0%	0%
22	Specific Plan Area (density varies)		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
23	Office Professional	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
24	Neighborhood Professional	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
25	General Commercial	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
26	Service Commercial	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
27	Rural Commercial	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
28	Limited Impact Industiral	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
35	Medium Impact Industrial	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29	High Impact Industrial	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
39	Village Core Mixed Use (density varies)		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
32	Public/Semi-Public Facilities	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
33	National Forest and State Parks	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
34	Tribal Lands	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
36	Open Space (Recreation)	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
37	Open Space (Conservation)	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
38	Military Installations	0.000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Constraints File Name			built	rural	flood	wet	public	froads	preserve	faults	cnel	apz	fci	slope25	slope50	tier1	tier2	pama

Updated May 2005

H:\Projects\9. GP Update GW Study\GIS Documentation and Constraints\Copy of Constraints Matrix for May 2005 Working Copy.xls

Appendix C
Recharge and Water Balance Output

Table C-1
Ballena Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	2079
Modeled Maximum GW in Storage (AF)	1180
Modeled Average GW Recharge (AFY)	259

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	362	33%	0%
Current General Plan Buildout	379	30%	0%
Referral Map Buildout	379	30%	0%
Draft Land Use Map Buildout	371	32%	0%
Hybrid Map Buildout	376	31%	0%
Environmentally Superior Buildout	371	32%	0%
Cumulative Impacts Buildout	380	30%	0%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

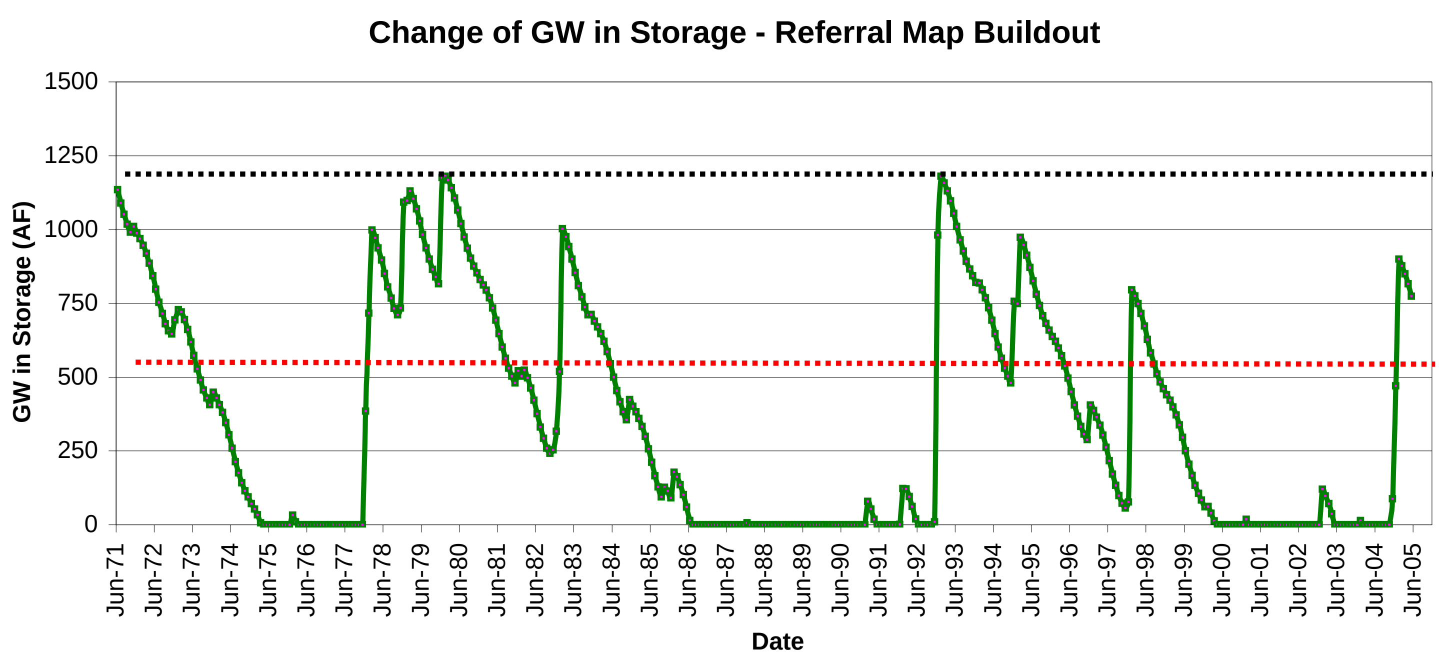


Table C-2
Barona Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	9746
Modeled Maximum GW in Storage (AF)	4383
Modeled Average GW Recharge (AFY)	1414

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	645	80%	42%
Current General Plan Buildout	874	67%	10%
Referral Map Buildout	684	78%	38%
Draft Land Use Map Buildout	684	78%	38%
Hybrid Map Buildout	684	78%	38%
Environmentally Superior Buildout	674	78%	39%
Cumulative Impacts Buildout	684	78%	38%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

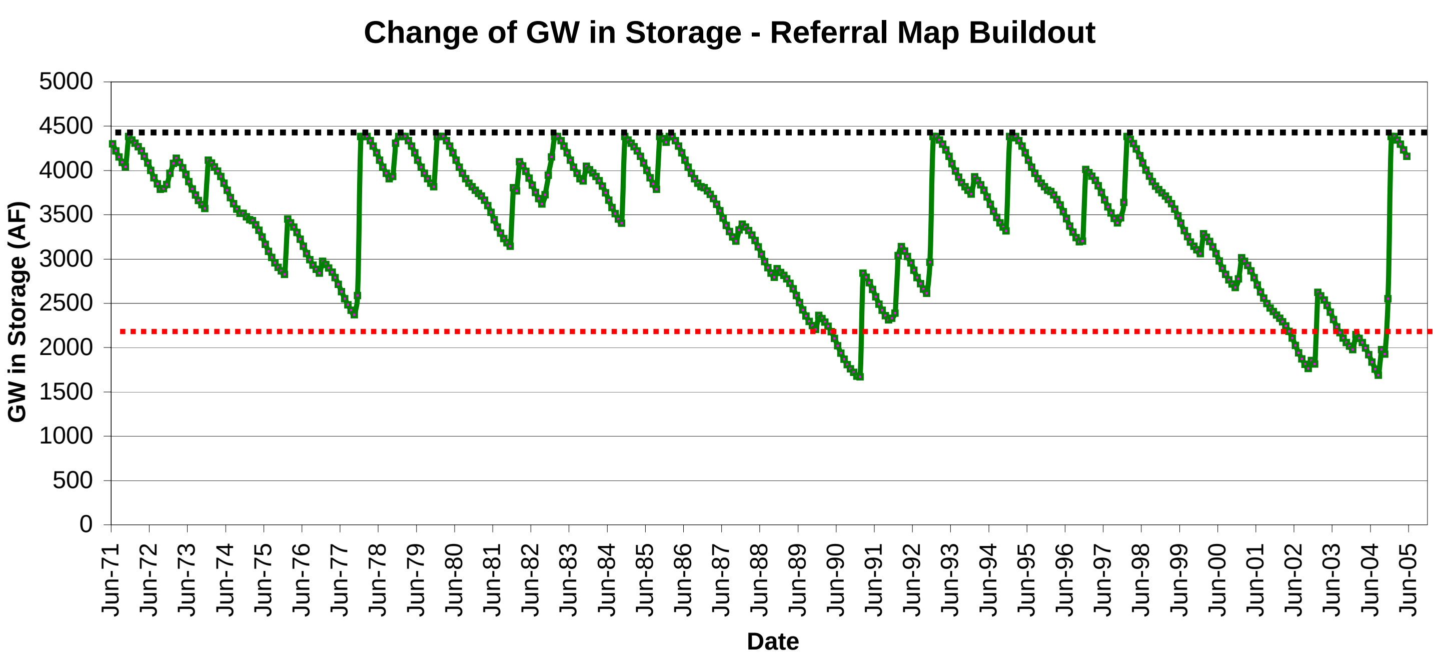


Table C-3
Barrett Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	27271
Modeled Maximum GW in Storage (AF)	6045
Modeled Average GW Recharge (AFY)	4810

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	198	99%	94%
Current General Plan Buildout	967	91%	71%
Referral Map Buildout	356	97%	89%
Draft Land Use Map Buildout	356	97%	89%
Hybrid Map Buildout	356	97%	89%
Environmentally Superior Buildout	277	98%	92%
Cumulative Impacts Buildout	358	97%	89%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

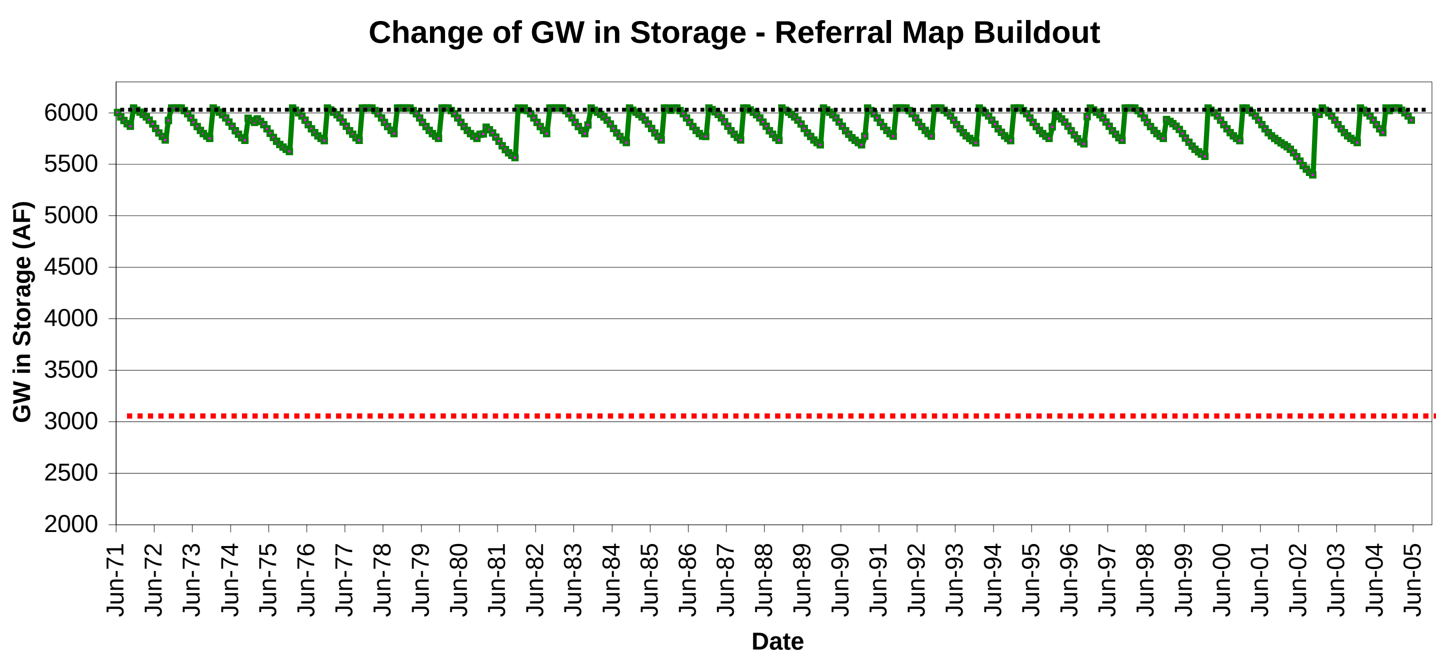


Table C-4
Barrett Lake Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	59138
Modeled Maximum GW in Storage (AF)	13411
Modeled Average GW Recharge (AFY)	13172

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	64	100%	99%
Current General Plan Buildout	205	99%	97%
Referral Map Buildout	126	100%	98%
Draft Land Use Map Buildout	126	100%	98%
Hybrid Map Buildout	126	100%	98%
Environmentally Superior Buildout	107	100%	99%
Cumulative Impacts Buildout	127	100%	98%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

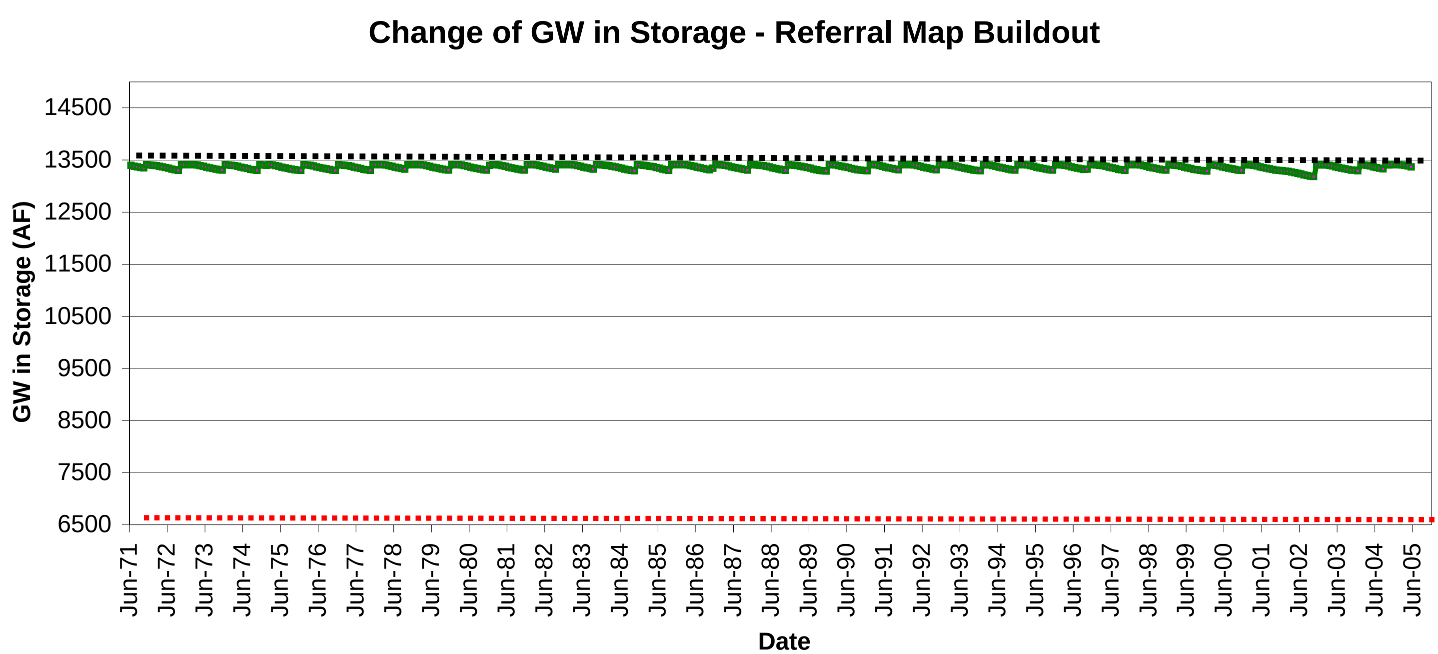


Table C-5
Bee Canyon Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	3273
Modeled Maximum GW in Storage (AF)	949
Modeled Average GW Recharge (AFY)	340

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	45	96%	89%
Current General Plan Buildout	190	64%	2%
Referral Map Buildout	88	90%	66%
Draft Land Use Map Buildout	88	90%	66%
Hybrid Map Buildout	88	90%	66%
Environmentally Superior Buildout	67	93%	77%
Cumulative Impacts Buildout	88	90%	66%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

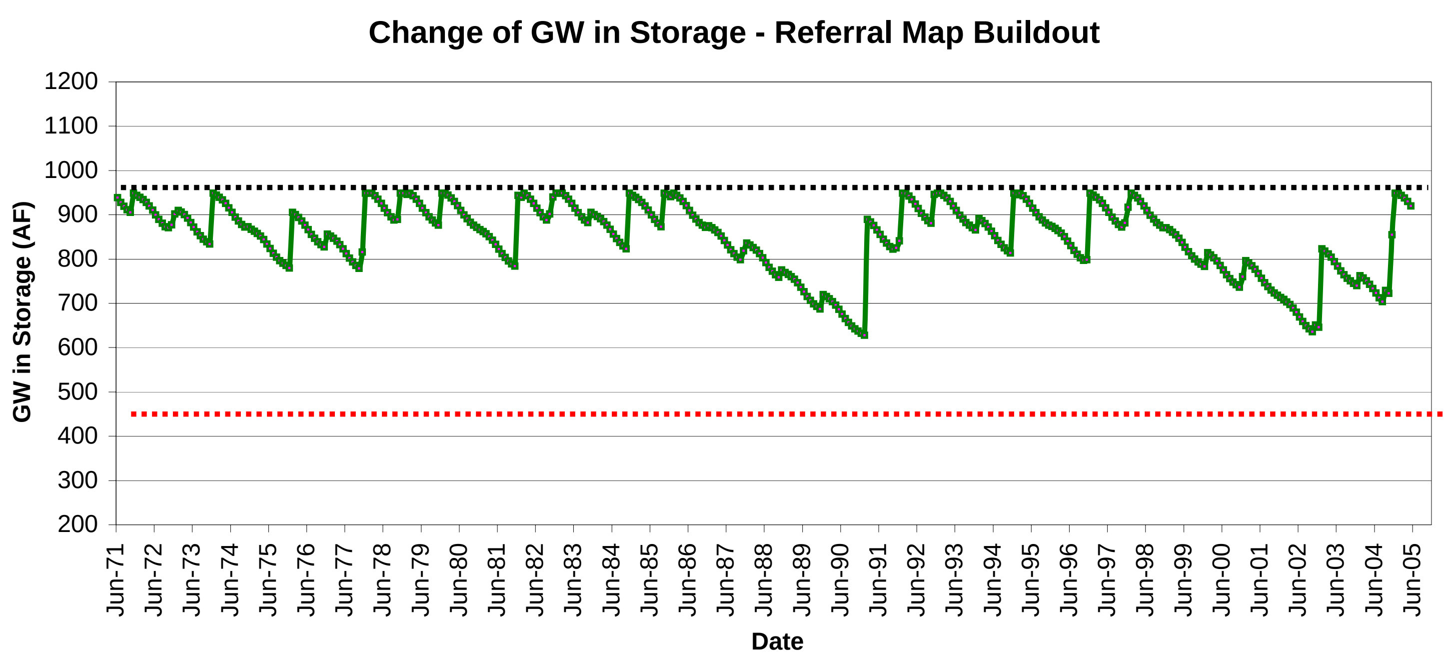


Table C-6
Boden Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	7479
Modeled Maximum GW in Storage (AF)	825
Modeled Average GW Recharge (AFY)	1003

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	15	98%	92%
Current General Plan Buildout	37	95%	80%
Referral Map Buildout	23	97%	88%
Draft Land Use Map Buildout	17	98%	91%
Hybrid Map Buildout	19	98%	90%
Environmentally Superior Buildout	17	98%	91%
Cumulative Impacts Buildout	23	97%	88%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

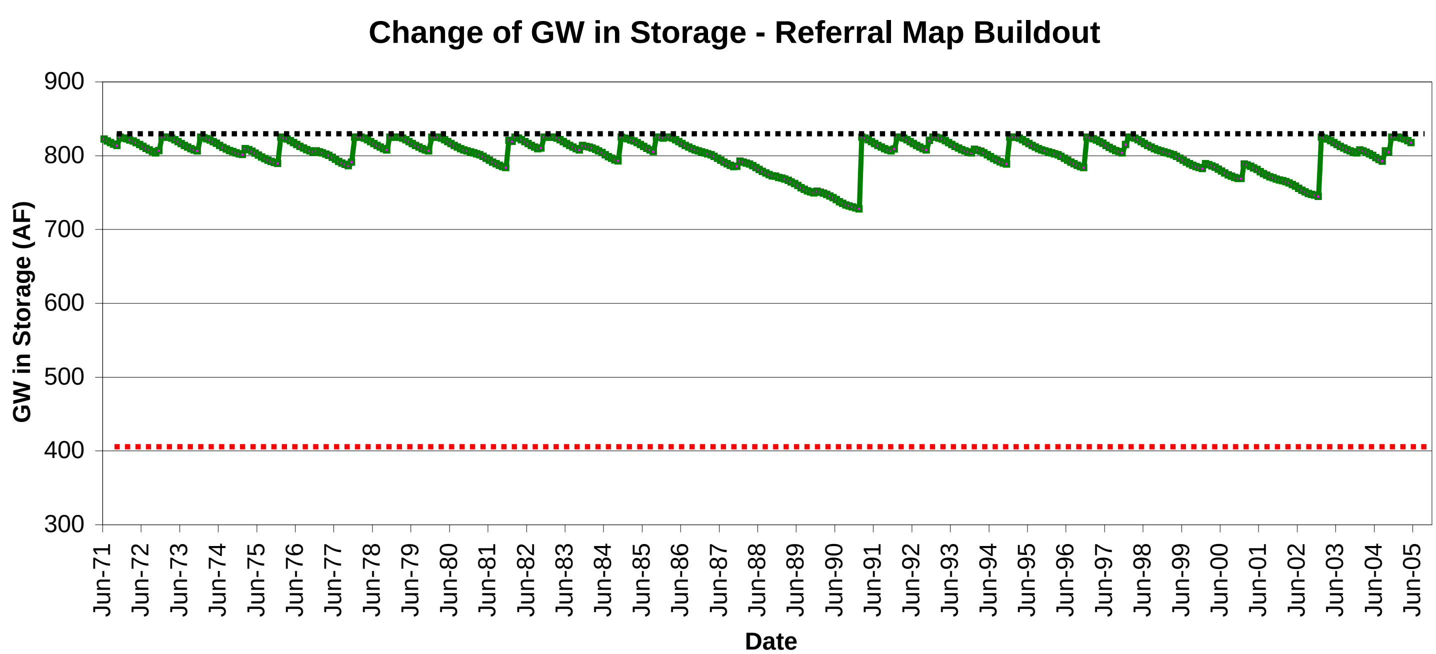


Table C-7
Borrego Sink Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	43940
Modeled Maximum GW in Storage (AF)	4957
Modeled Average GW Recharge (AFY)	614

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	2	100%	100%
Current General Plan Buildout	243	84%	51%
Referral Map Buildout	165	90%	69%
Draft Land Use Map Buildout	139	92%	74%
Hybrid Map Buildout	153	91%	71%
Environmentally Superior Buildout	40	98%	94%
Cumulative Impacts Buildout	165	90%	69%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

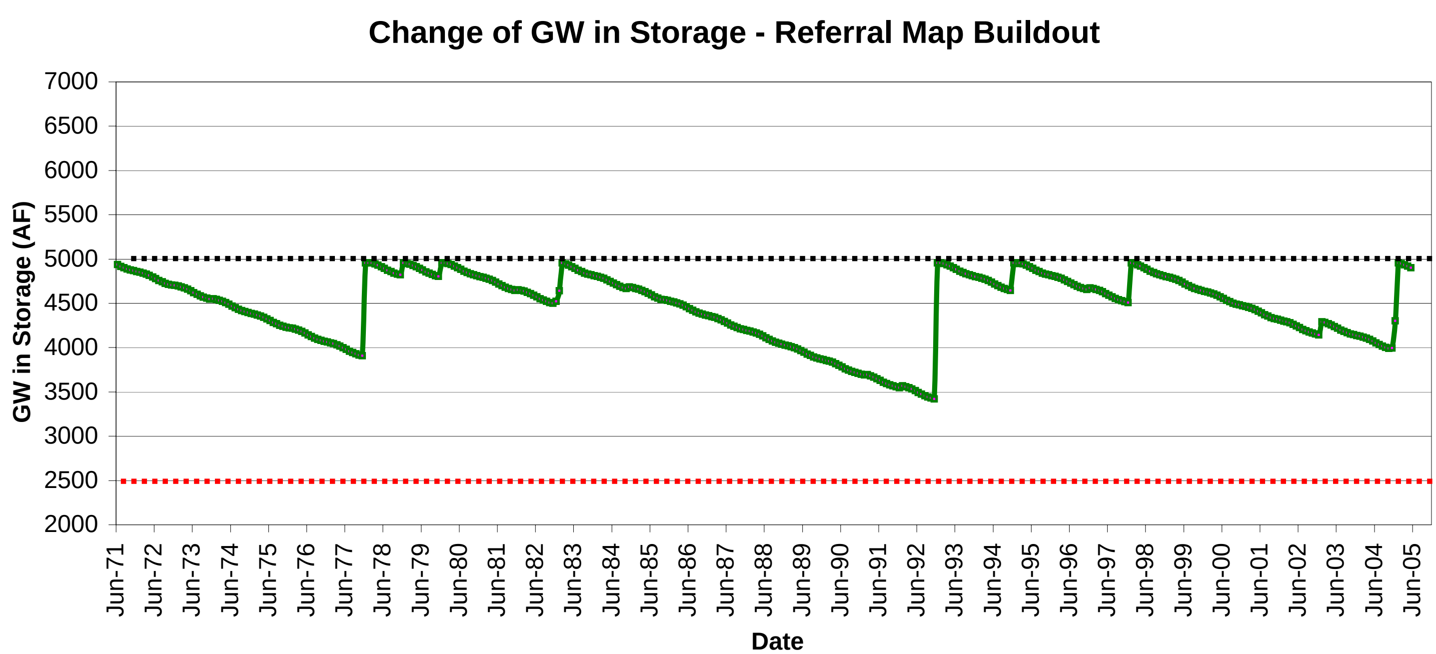


Table C-8
Cameron Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	21326
Modeled Maximum GW in Storage (AF)	8279
Modeled Average GW Recharge (AFY)	4925

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	102	99%	98%
Current General Plan Buildout	288	98%	94%
Referral Map Buildout	140	99%	97%
Draft Land Use Map Buildout	139	99%	97%
Hybrid Map Buildout	140	99%	97%
Environmentally Superior Buildout	124	99%	97%
Cumulative Impacts Buildout	141	99%	97%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

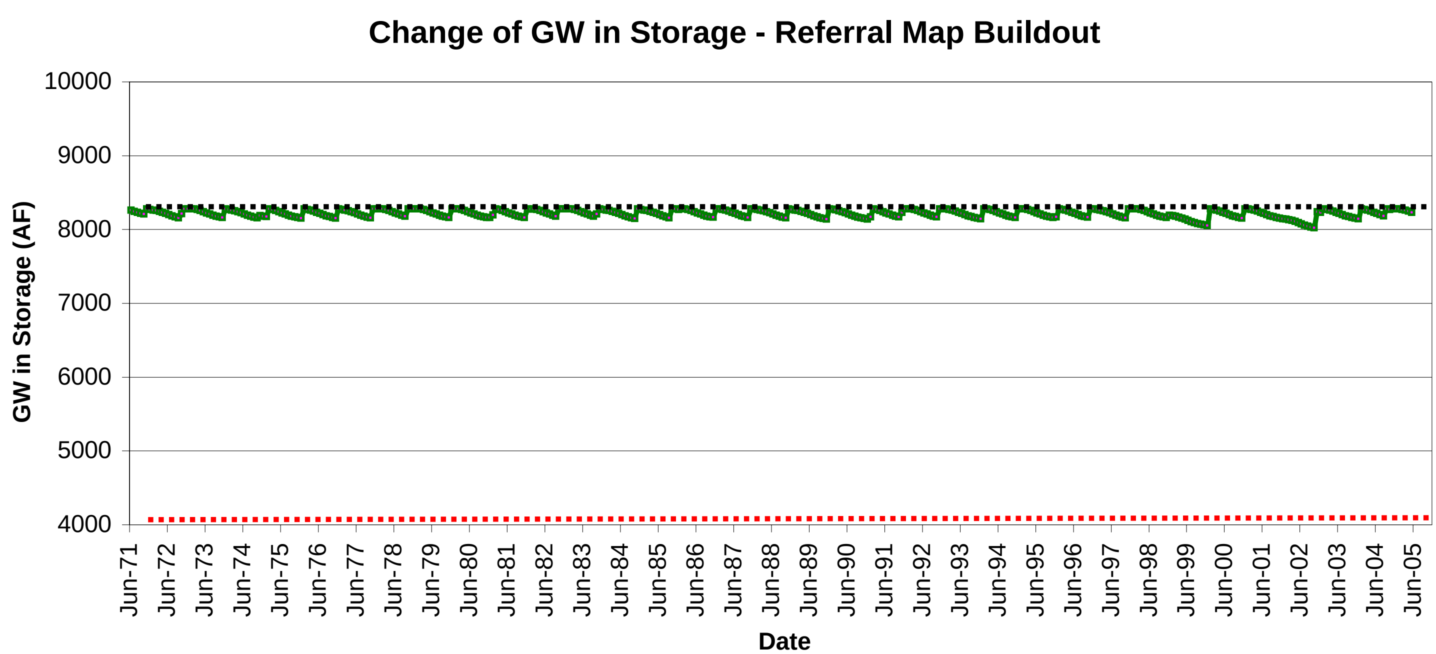


Table C-9
Cannebrake Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	5574
Modeled Maximum GW in Storage (AF)	1113
Modeled Average GW Recharge (AFY)	408

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	0	100%	100%
Current General Plan Buildout	0	100%	100%
Referral Map Buildout	0	100%	100%
Draft Land Use Map Buildout	0	100%	100%
Hybrid Map Buildout	0	100%	100%
Environmentally Superior Buildout	0	100%	100%
Cumulative Impacts Buildout	0	100%	100%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

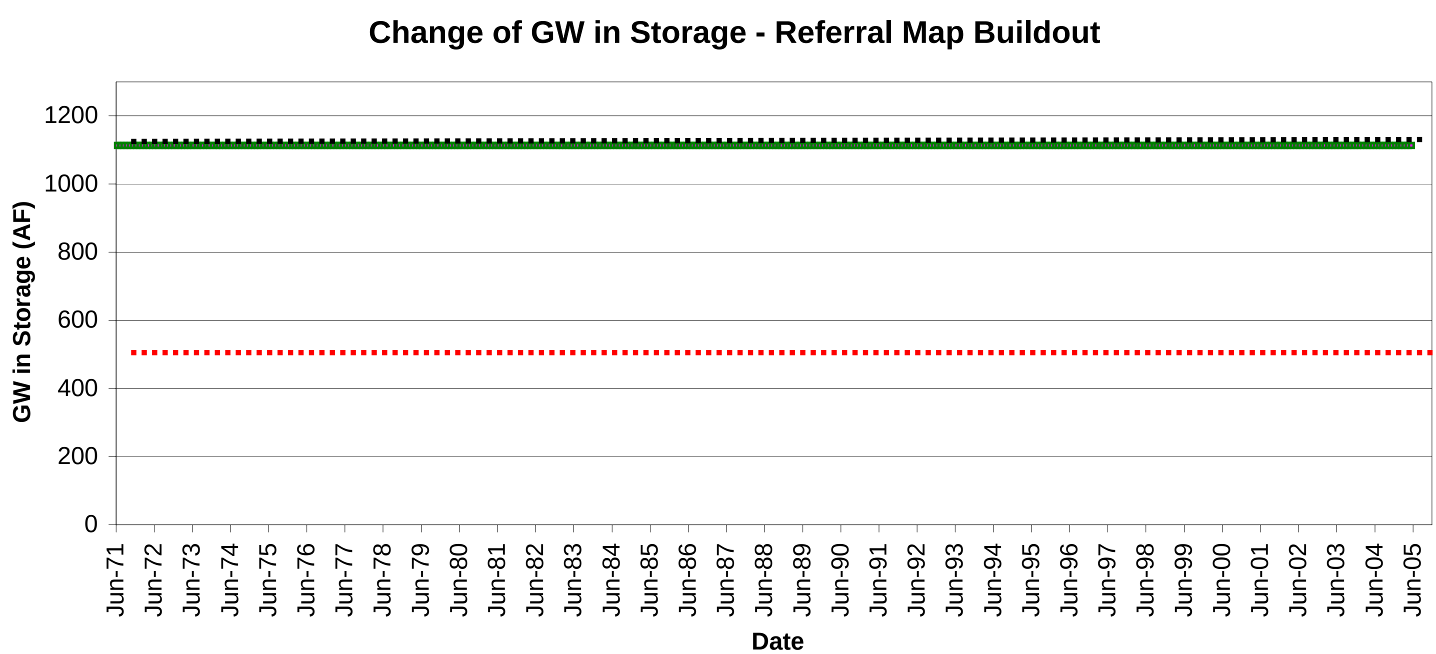


Table C-10
Canyon City Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	31194
Modeled Maximum GW in Storage (AF)	19419
Modeled Average GW Recharge (AFY)	5791

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	363	99%	97%
Current General Plan Buildout	1940	88%	60%
Referral Map Buildout	704	97%	91%
Draft Land Use Map Buildout	702	97%	91%
Hybrid Map Buildout	702	97%	91%
Environmentally Superior Buildout	553	98%	94%
Cumulative Impacts Buildout	914	96%	86%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

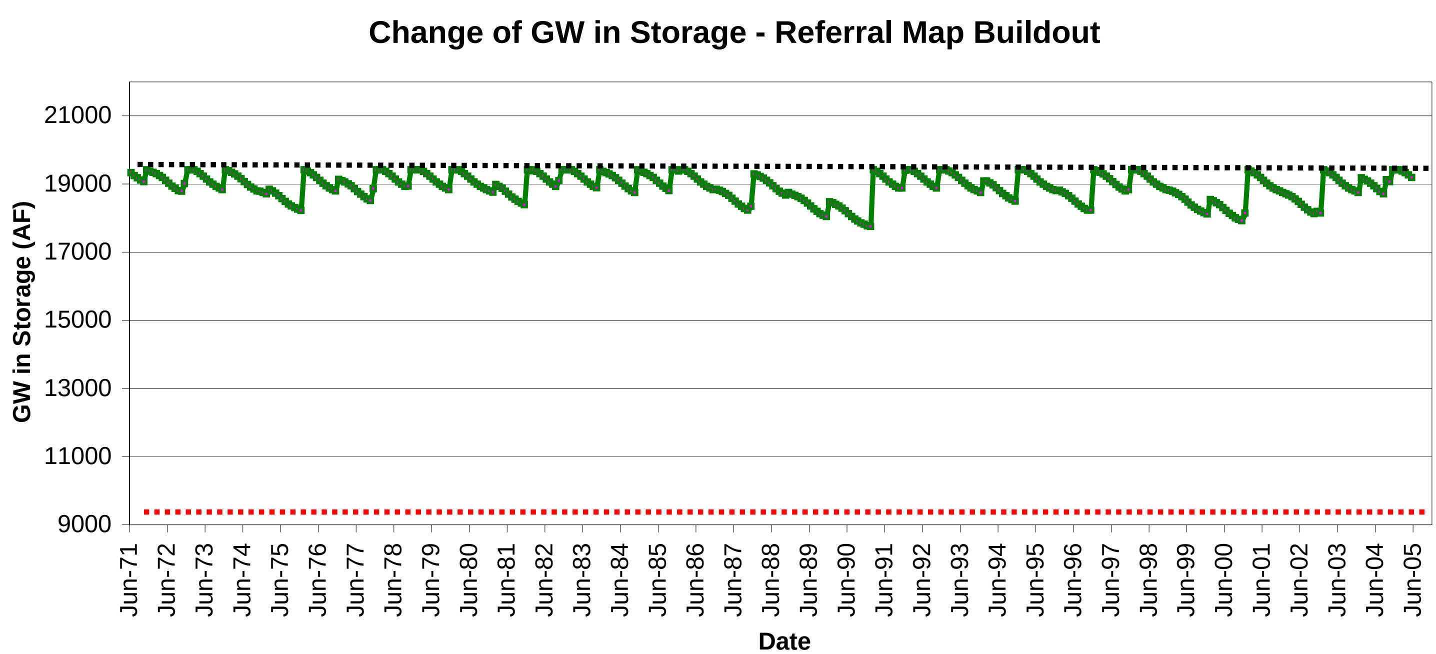


Table C-11
Carrizo Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	20438
Modeled Maximum GW in Storage (AF)	9985
Modeled Average GW Recharge (AFY)	1367

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	1	100%	100%
Current General Plan Buildout	1	100%	100%
Referral Map Buildout	8	100%	100%
Draft Land Use Map Buildout	8	100%	100%
Hybrid Map Buildout	8	100%	100%
Environmentally Superior Buildout	8	100%	100%
Cumulative Impacts Buildout	8	100%	100%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

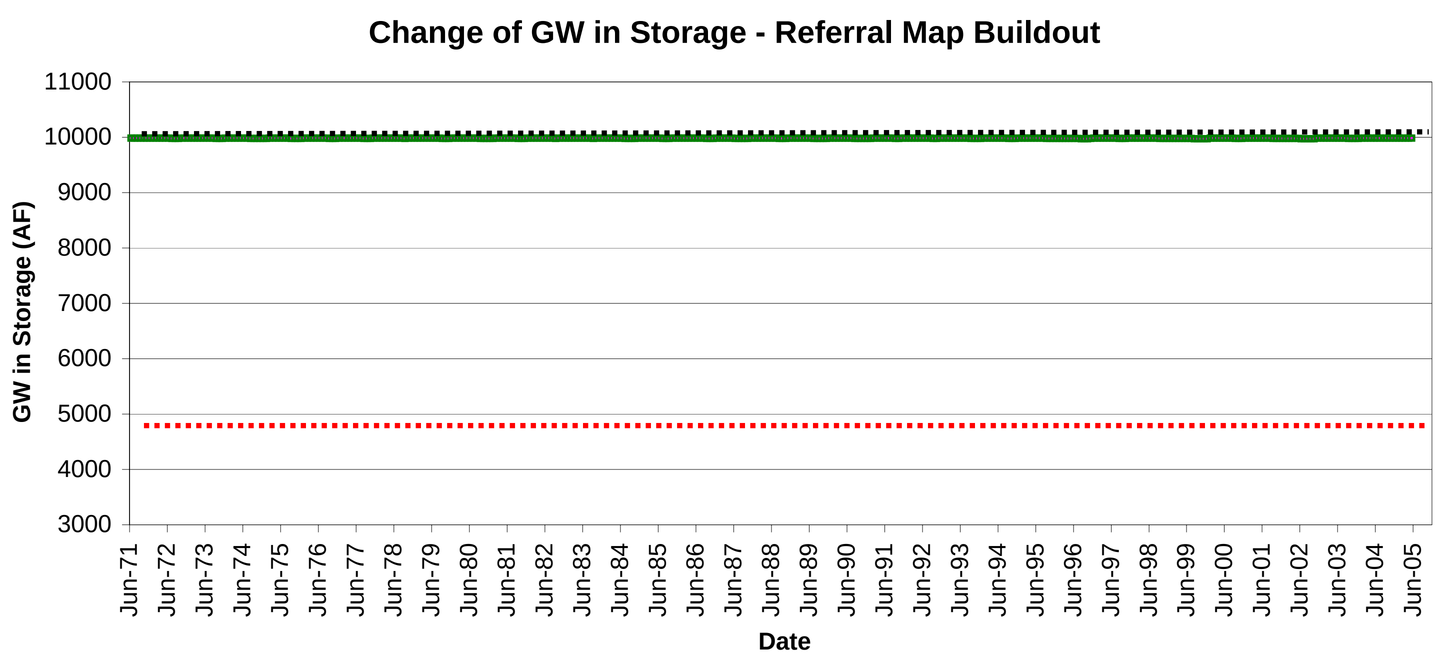


Table C-12
Chihuahua Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	5705
Modeled Maximum GW in Storage (AF)	6900
Modeled Average GW Recharge (AFY)	1752

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	69	100%	98%
Current General Plan Buildout	400	96%	84%
Referral Map Buildout	138	99%	96%
Draft Land Use Map Buildout	124	99%	97%
Hybrid Map Buildout	119	99%	97%
Environmentally Superior Buildout	104	99%	97%
Cumulative Impacts Buildout	138	99%	96%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

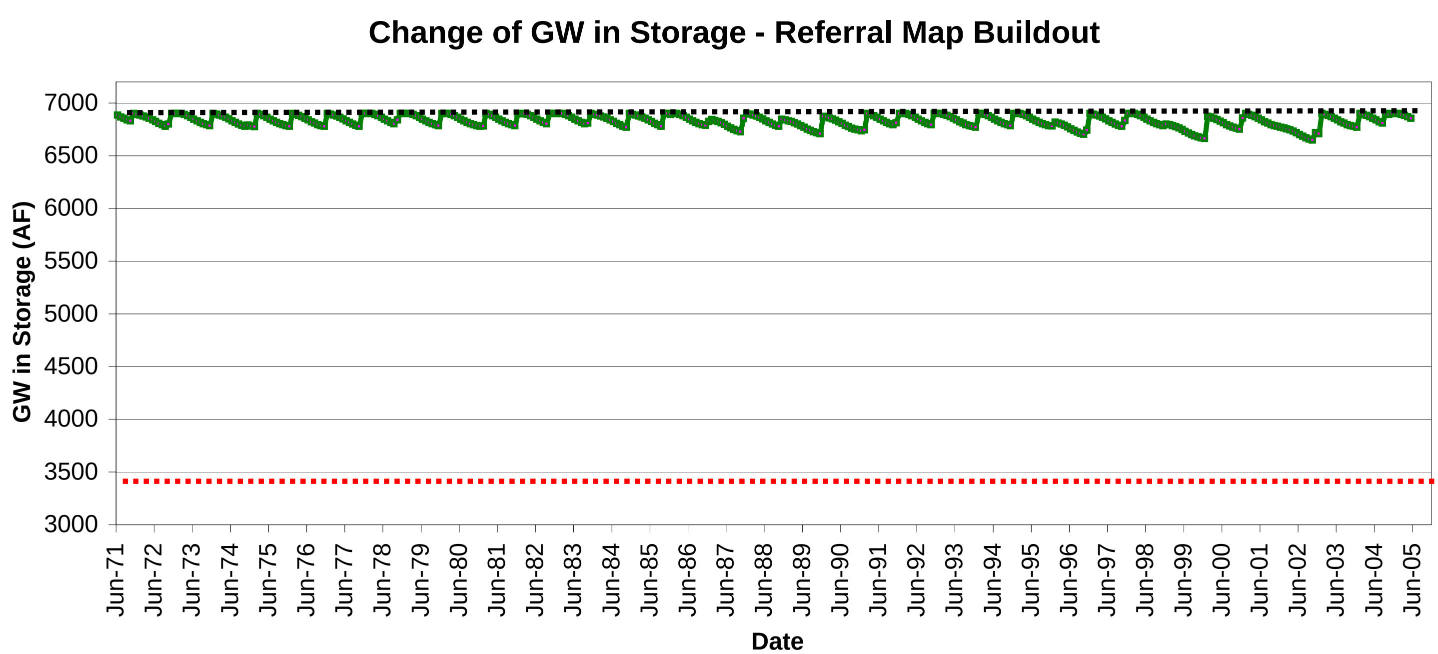


Table C-13
Clover Flat Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	9163
Modeled Maximum GW in Storage (AF)	6732
Modeled Average GW Recharge (AFY)	1865

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	26	100%	99%
Current General Plan Buildout	671	87%	60%
Referral Map Buildout	88	99%	98%
Draft Land Use Map Buildout	88	99%	98%
Hybrid Map Buildout	88	99%	98%
Environmentally Superior Buildout	80	99%	98%
Cumulative Impacts Buildout	89	99%	98%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

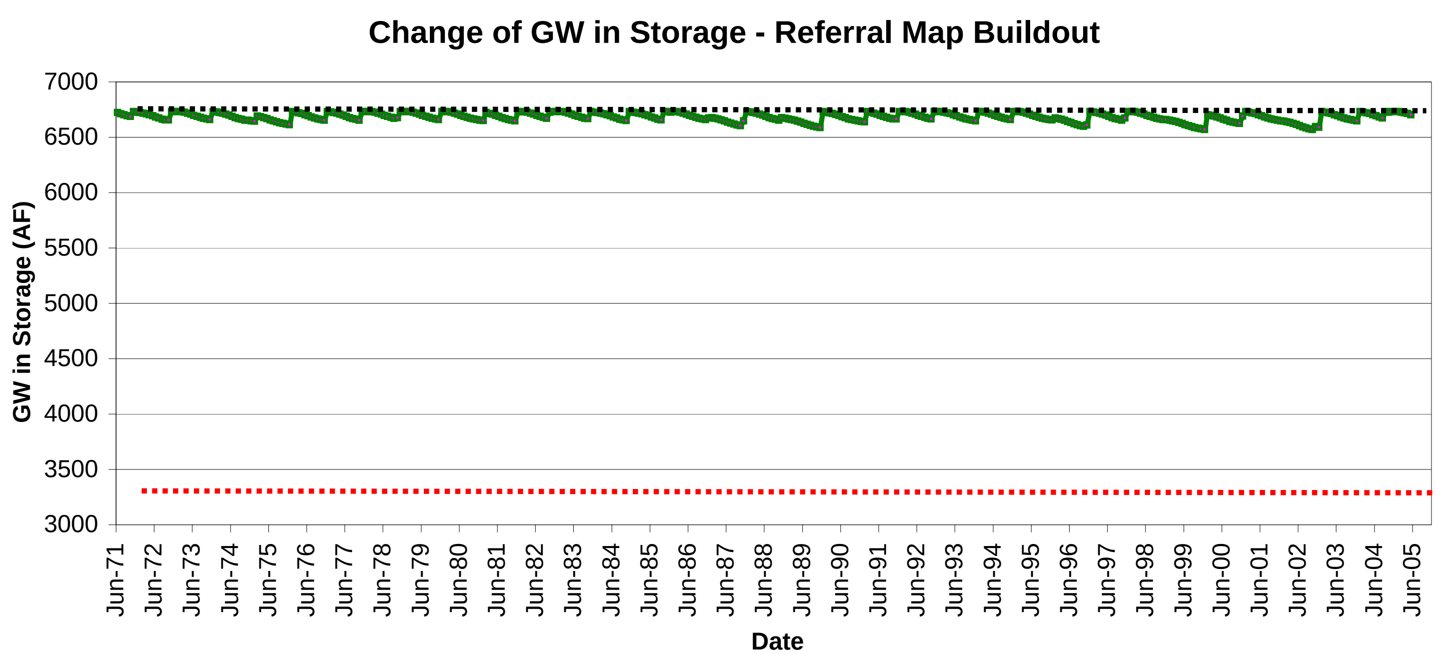


Table C-14
Collins Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	33837
Modeled Maximum GW in Storage (AF)	4146
Modeled Average GW Recharge (AFY)	676

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	1	100%	100%
Current General Plan Buildout	218	83%	47%
Referral Map Buildout	43	97%	91%
Draft Land Use Map Buildout	11	99%	98%
Hybrid Map Buildout	23	99%	95%
Environmentally Superior Buildout	11	99%	98%
Cumulative Impacts Buildout	44	97%	91%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

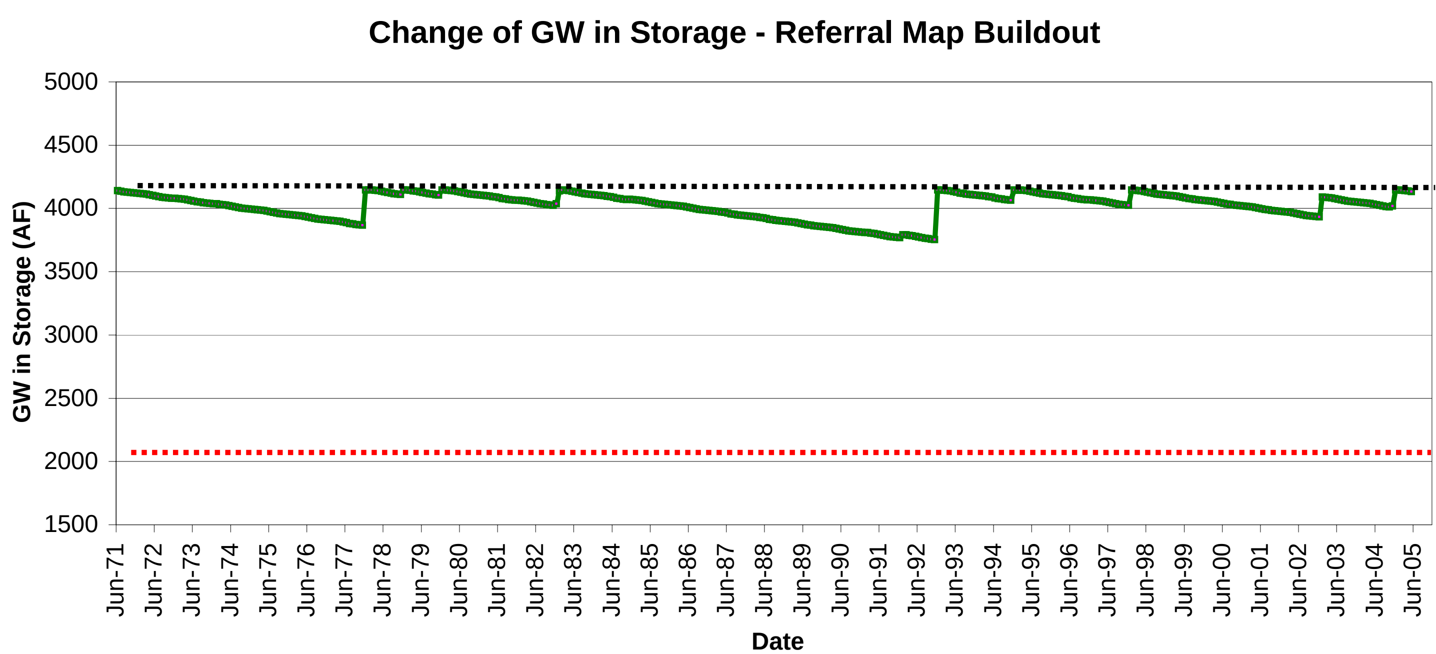


Table C-15
Combs Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	7998
Modeled Maximum GW in Storage (AF)	2899
Modeled Average GW Recharge (AFY)	2726

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	36	100%	98%
Current General Plan Buildout	343	95%	78%
Referral Map Buildout	173	98%	89%
Draft Land Use Map Buildout	63	99%	96%
Hybrid Map Buildout	60	99%	96%
Environmentally Superior Buildout	59	99%	96%
Cumulative Impacts Buildout	173	98%	89%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

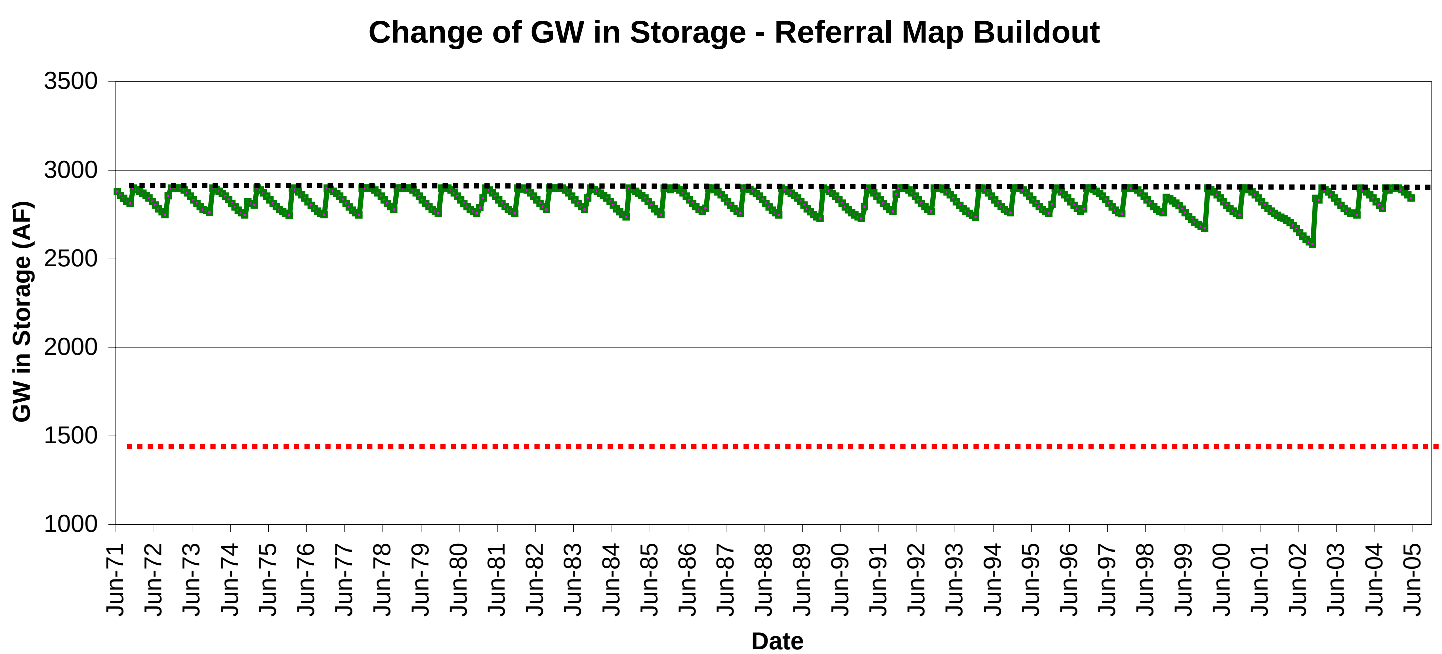


Table C-16
Conejos Creek Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	33581
Modeled Maximum GW in Storage (AF)	7183
Modeled Average GW Recharge (AFY)	5807

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	102	99%	98%
Current General Plan Buildout	229	99%	94%
Referral Map Buildout	155	99%	96%
Draft Land Use Map Buildout	155	99%	96%
Hybrid Map Buildout	155	99%	96%
Environmentally Superior Buildout	127	99%	97%
Cumulative Impacts Buildout	155	99%	96%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

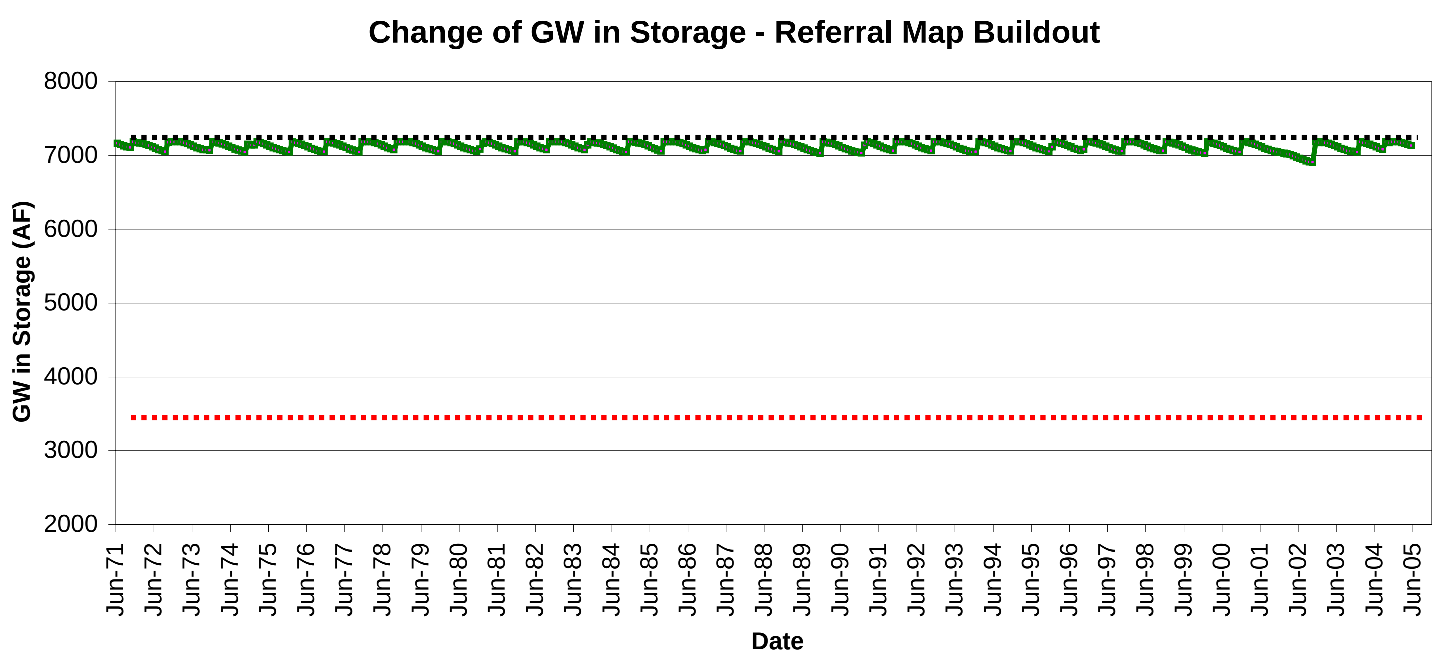


Table C-17
Cottonwood Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	27603
Modeled Maximum GW in Storage (AF)	12369
Modeled Average GW Recharge (AFY)	6188

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	74	100%	99%
Current General Plan Buildout	136	100%	98%
Referral Map Buildout	94	100%	99%
Draft Land Use Map Buildout	94	100%	99%
Hybrid Map Buildout	94	100%	99%
Environmentally Superior Buildout	94	100%	99%
Cumulative Impacts Buildout	94	100%	99%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

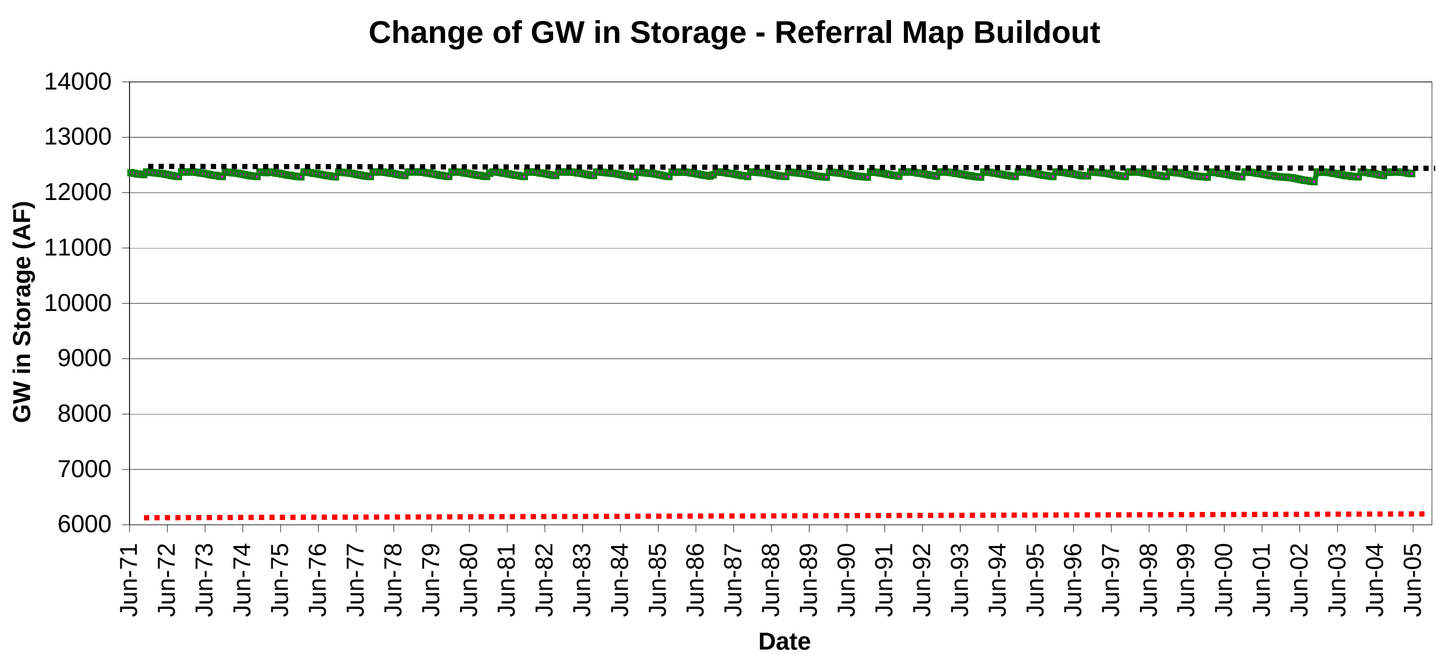


Table C-18
Coyote Wells Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	11884
Modeled Maximum GW in Storage (AF)	3010
Modeled Average GW Recharge (AFY)	377

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	1	100%	100%
Current General Plan Buildout	59	98%	93%
Referral Map Buildout	4	100%	100%
Draft Land Use Map Buildout	4	100%	100%
Hybrid Map Buildout	4	100%	100%
Environmentally Superior Buildout	4	100%	100%
Cumulative Impacts Buildout	4	100%	100%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

Change of GW in Storage - Referral Map Buildout

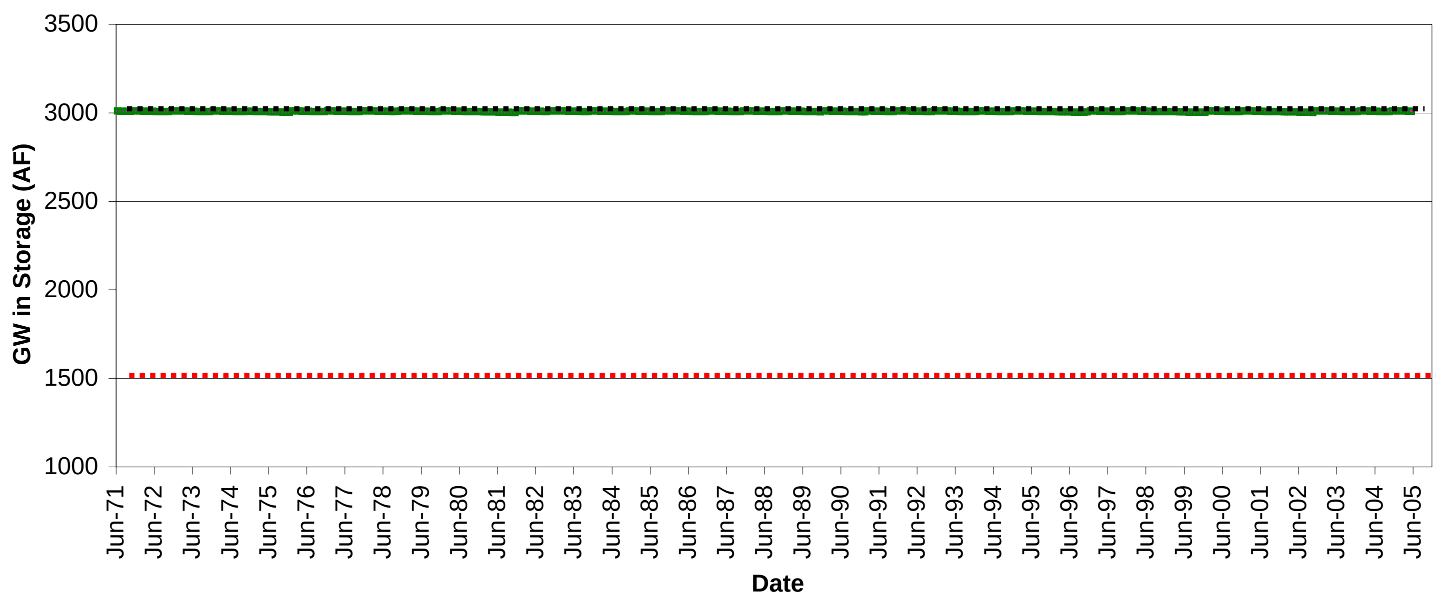


Table C-19
Cuyamaca Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	7663
Modeled Maximum GW in Storage (AF)	3180
Modeled Average GW Recharge (AFY)	2181

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	66	99%	94%
Current General Plan Buildout	167	97%	85%
Referral Map Buildout	80	98%	93%
Draft Land Use Map Buildout	79	98%	93%
Hybrid Map Buildout	80	98%	93%
Environmentally Superior Buildout	78	99%	93%
Cumulative Impacts Buildout	80	98%	93%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

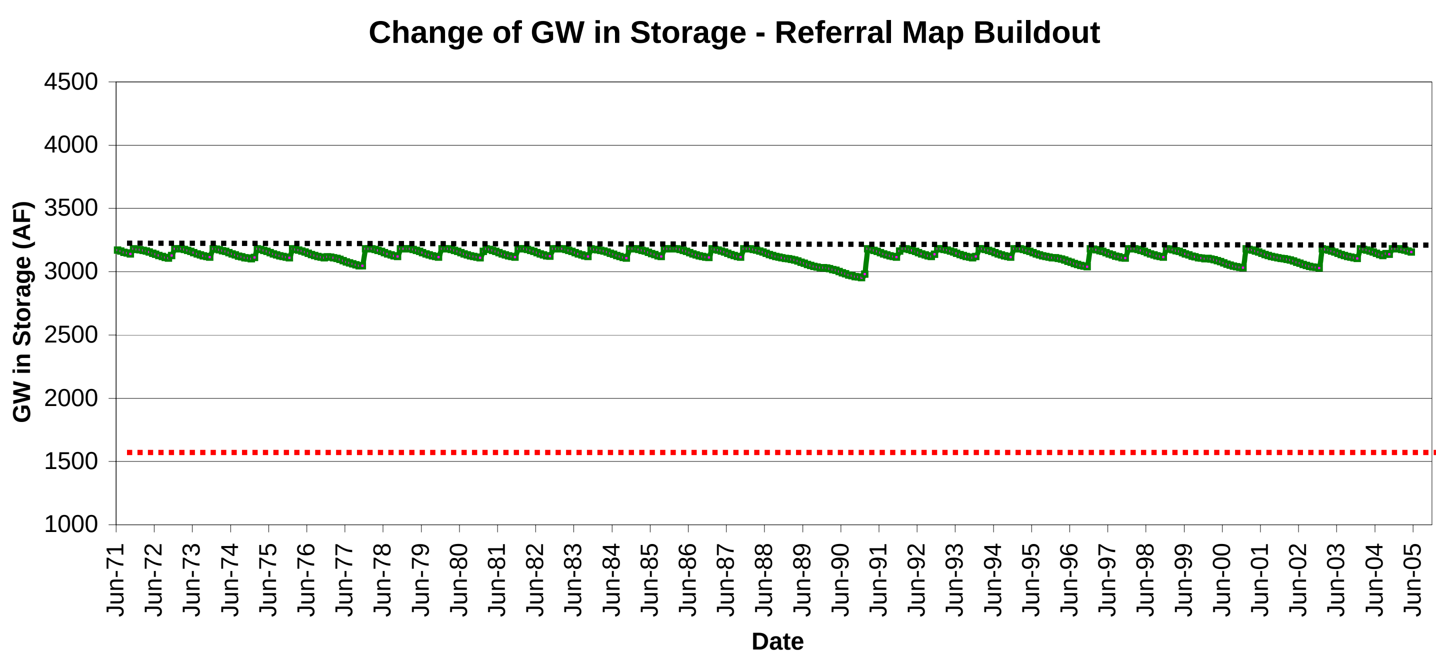


Table C-20
Descanso Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	13413
Modeled Maximum GW in Storage (AF)	4256
Modeled Average GW Recharge (AFY)	4442

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	270	98%	89%
Current General Plan Buildout	533	95%	78%
Referral Map Buildout	366	97%	85%
Draft Land Use Map Buildout	363	97%	85%
Hybrid Map Buildout	365	97%	85%
Environmentally Superior Buildout	355	97%	86%
Cumulative Impacts Buildout	370	97%	85%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

Change of GW in Storage - Referral Map Buildout

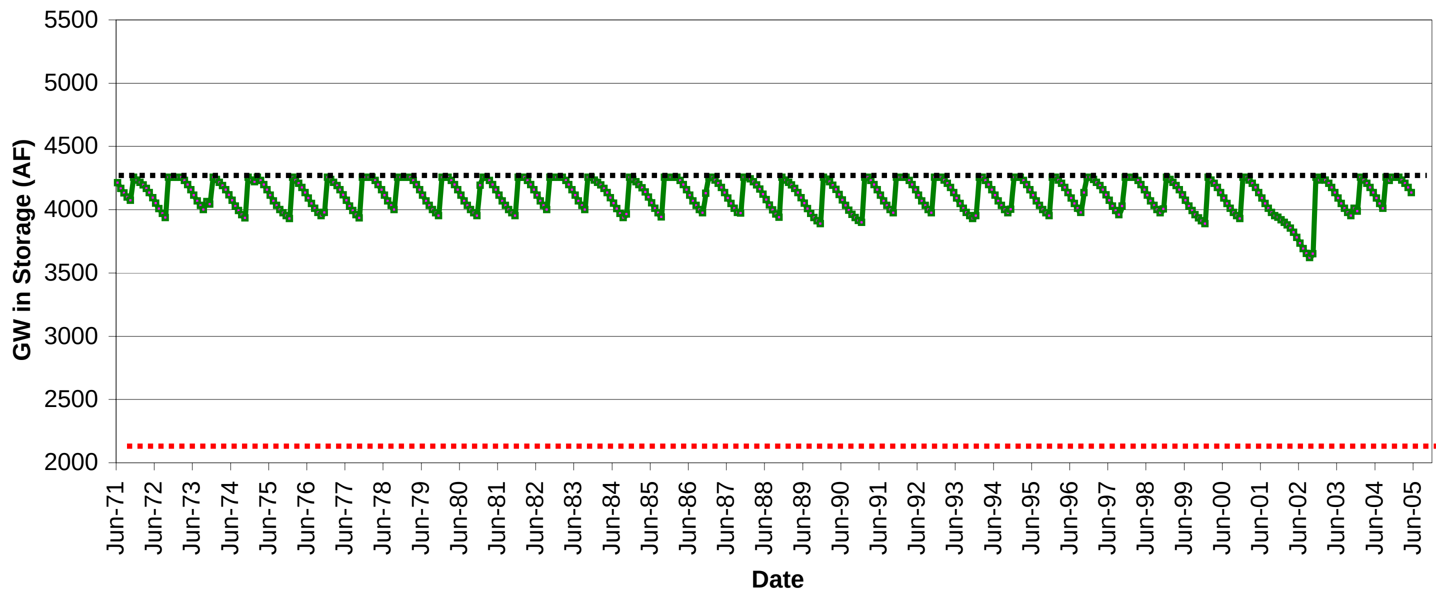


Table C-21
Devils Hole Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	4816
Modeled Maximum GW in Storage (AF)	620
Modeled Average GW Recharge (AFY)	1825

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	1	100%	100%
Current General Plan Buildout	4	100%	99%
Referral Map Buildout	3	100%	99%
Draft Land Use Map Buildout	2	100%	99%
Hybrid Map Buildout	2	100%	99%
Environmentally Superior Buildout	2	100%	99%
Cumulative Impacts Buildout	3	100%	99%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

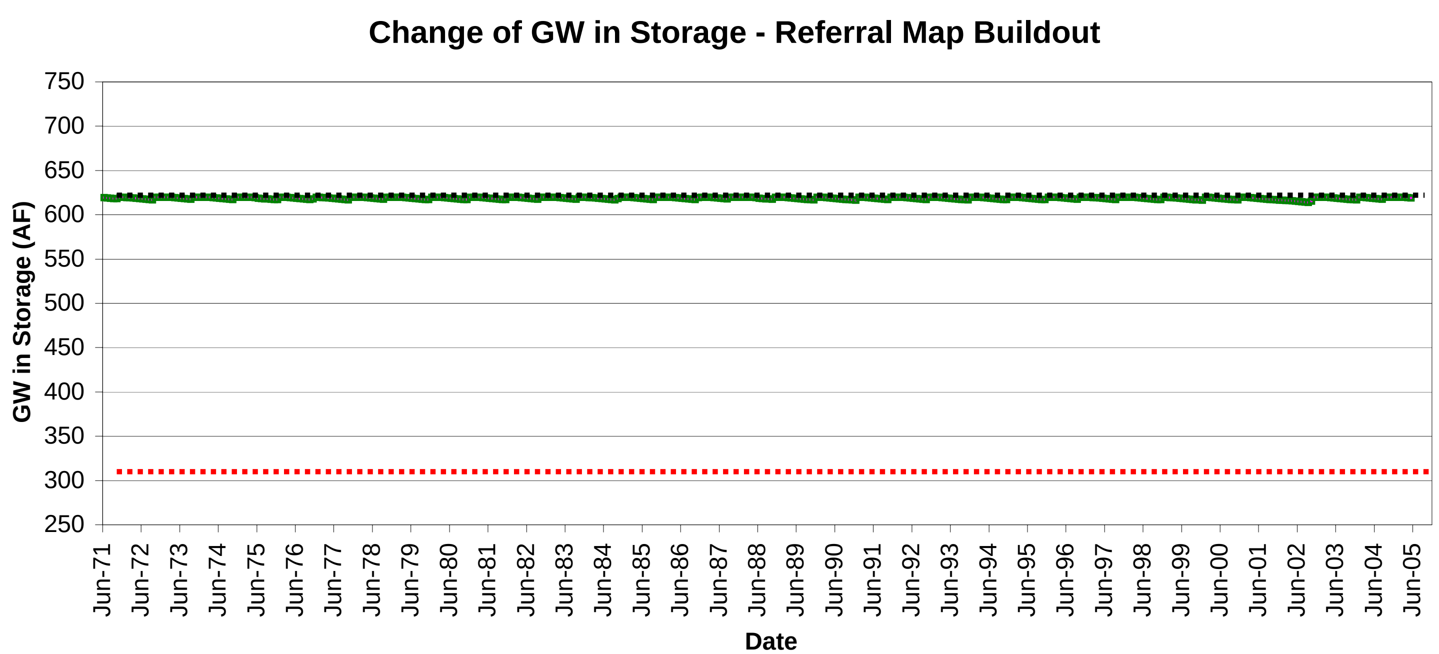


Table C-22
Dodge Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	7159
Modeled Maximum GW in Storage (AF)	5874
Modeled Average GW Recharge (AFY)	1688

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	40	100%	99%
Current General Plan Buildout	220	97%	87%
Referral Map Buildout	75	99%	98%
Draft Land Use Map Buildout	66	99%	98%
Hybrid Map Buildout	66	99%	98%
Environmentally Superior Buildout	61	99%	98%
Cumulative Impacts Buildout	75	99%	98%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

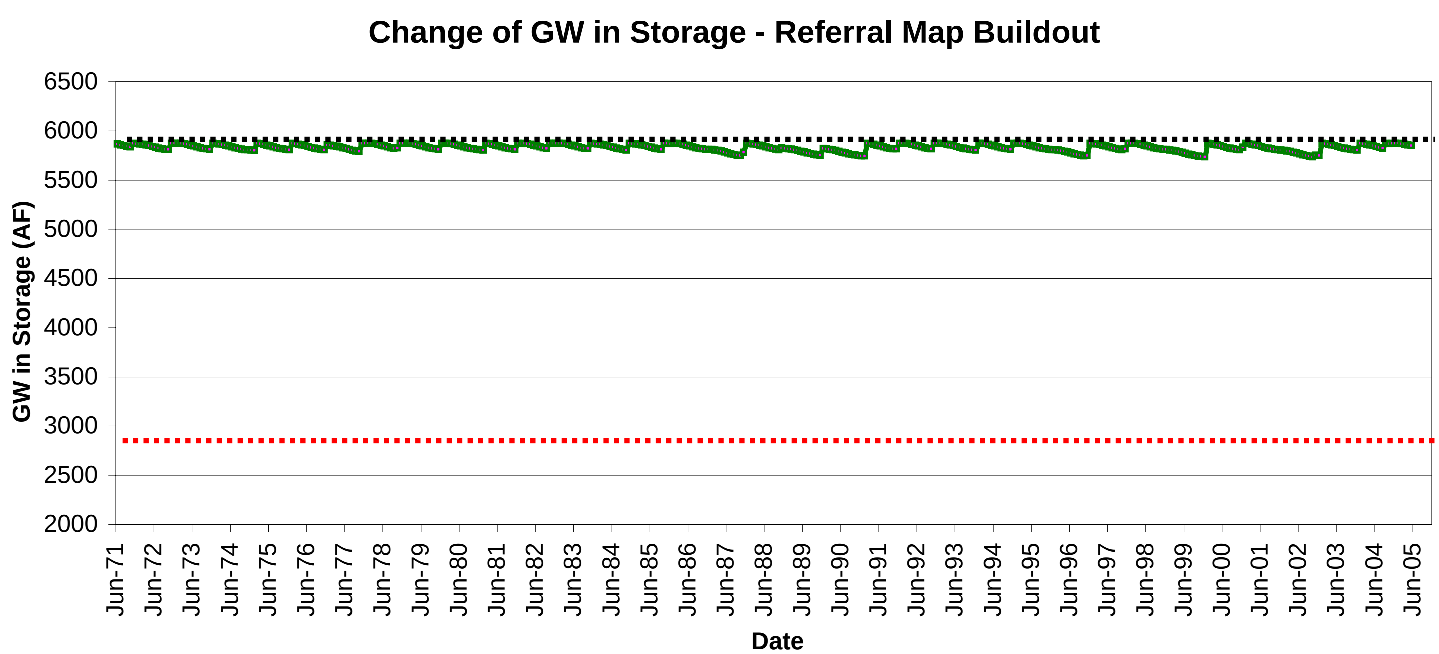


Table C-23
East Santa Teresa Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	880
Modeled Maximum GW in Storage (AF)	743
Modeled Average GW Recharge (AFY)	110

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	14	98%	94%
Current General Plan Buildout	20	97%	89%
Referral Map Buildout	20	97%	89%
Draft Land Use Map Buildout	17	98%	92%
Hybrid Map Buildout	19	97%	90%
Environmentally Superior Buildout	17	98%	92%
Cumulative Impacts Buildout	27	95%	85%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

Change of GW in Storage - Referral Map Buildout

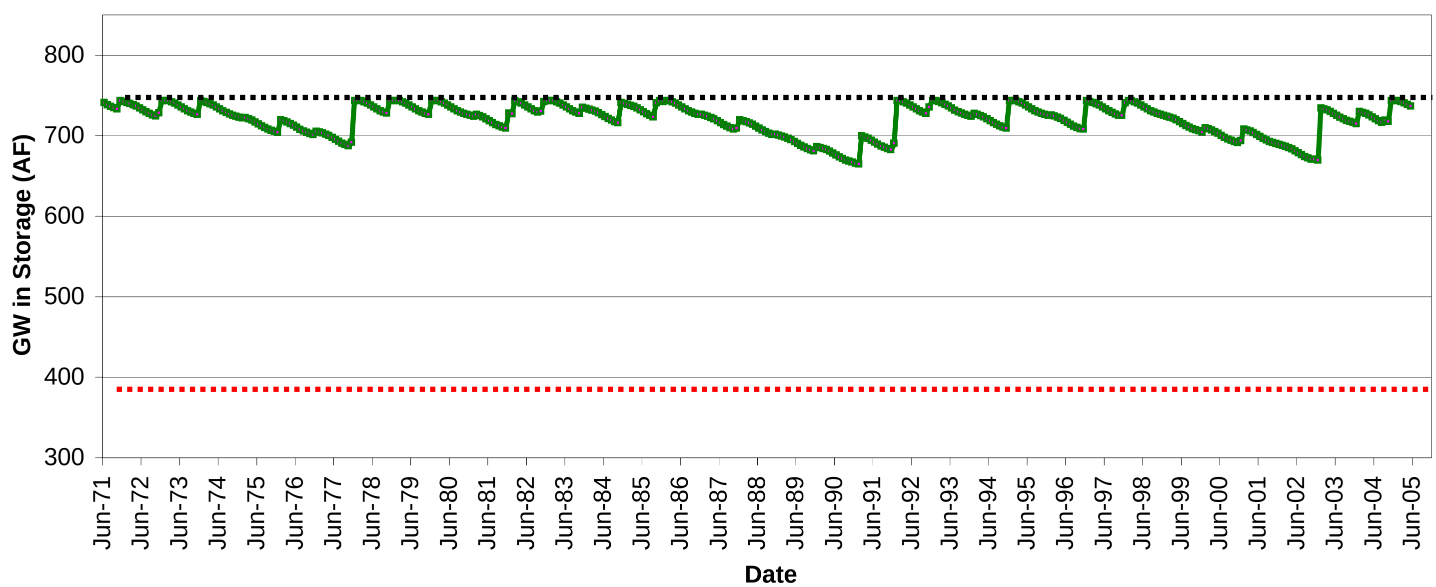


Table C-24
El Monte Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	5045
Modeled Maximum GW in Storage (AF)	813
Modeled Average GW Recharge (AFY)	980

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	4	100%	99%
Current General Plan Buildout	72	96%	84%
Referral Map Buildout	20	99%	95%
Draft Land Use Map Buildout	20	99%	95%
Hybrid Map Buildout	20	99%	95%
Environmentally Superior Buildout	14	99%	97%
Cumulative Impacts Buildout	21	99%	95%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

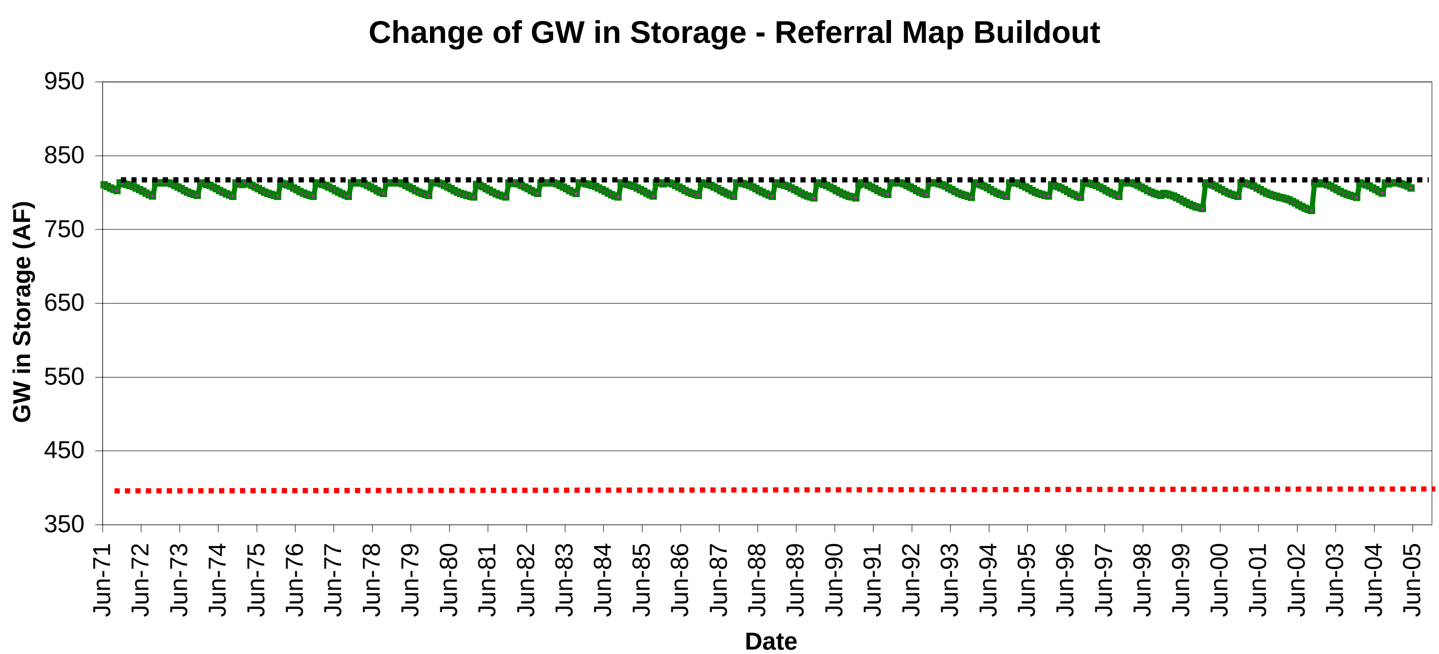


Table C-25
Engineer Springs Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	1233
Modeled Maximum GW in Storage (AF)	302
Modeled Average GW Recharge (AFY)	91

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	40	71%	26%
Current General Plan Buildout	82	42%	0%
Referral Map Buildout	52	60%	0%
Draft Land Use Map Buildout	52	60%	0%
Hybrid Map Buildout	52	60%	0%
Environmentally Superior Buildout	47	65%	9%
Cumulative Impacts Buildout	52	59%	0%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

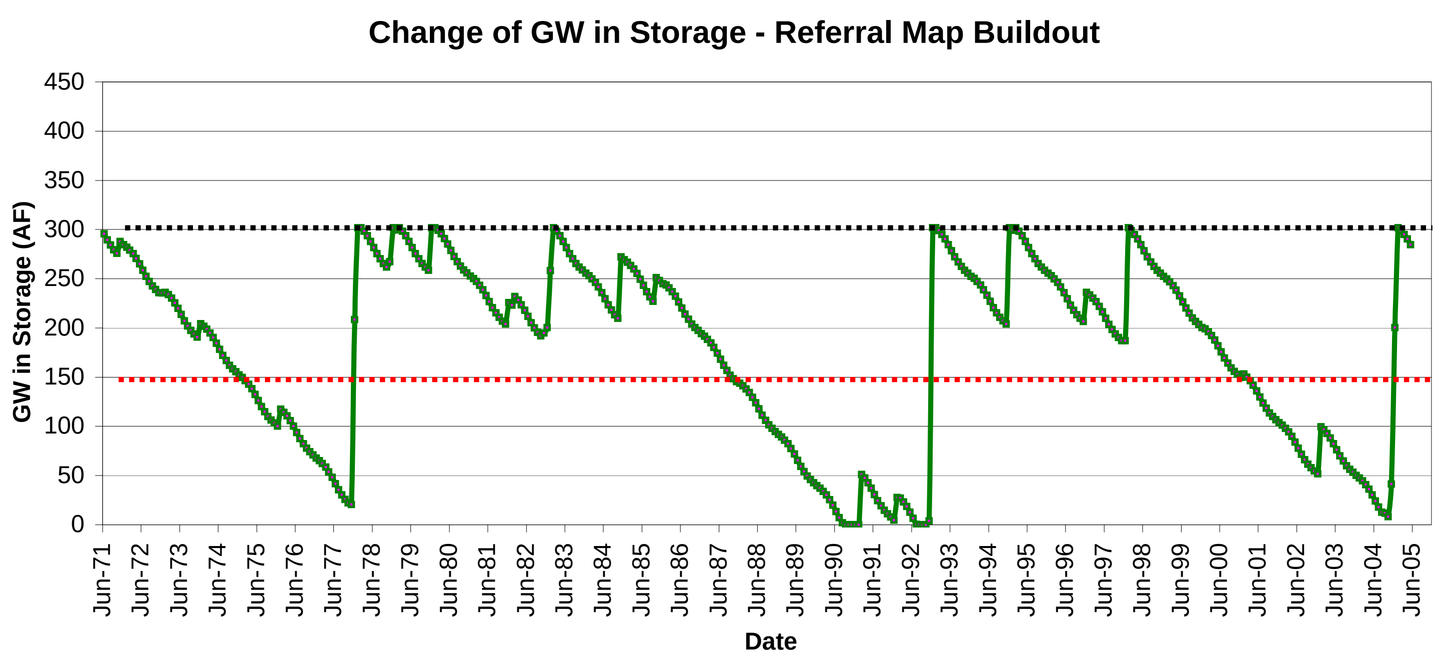


Table C-26
Escondido Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	932
Modeled Maximum GW in Storage (AF)	186
Modeled Average GW Recharge (AFY)	116

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	6	98%	93%
Current General Plan Buildout	39	71%	5%
Referral Map Buildout	13	94%	74%
Draft Land Use Map Buildout	13	94%	74%
Hybrid Map Buildout	13	94%	74%
Environmentally Superior Buildout	9	96%	84%
Cumulative Impacts Buildout	13	94%	74%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

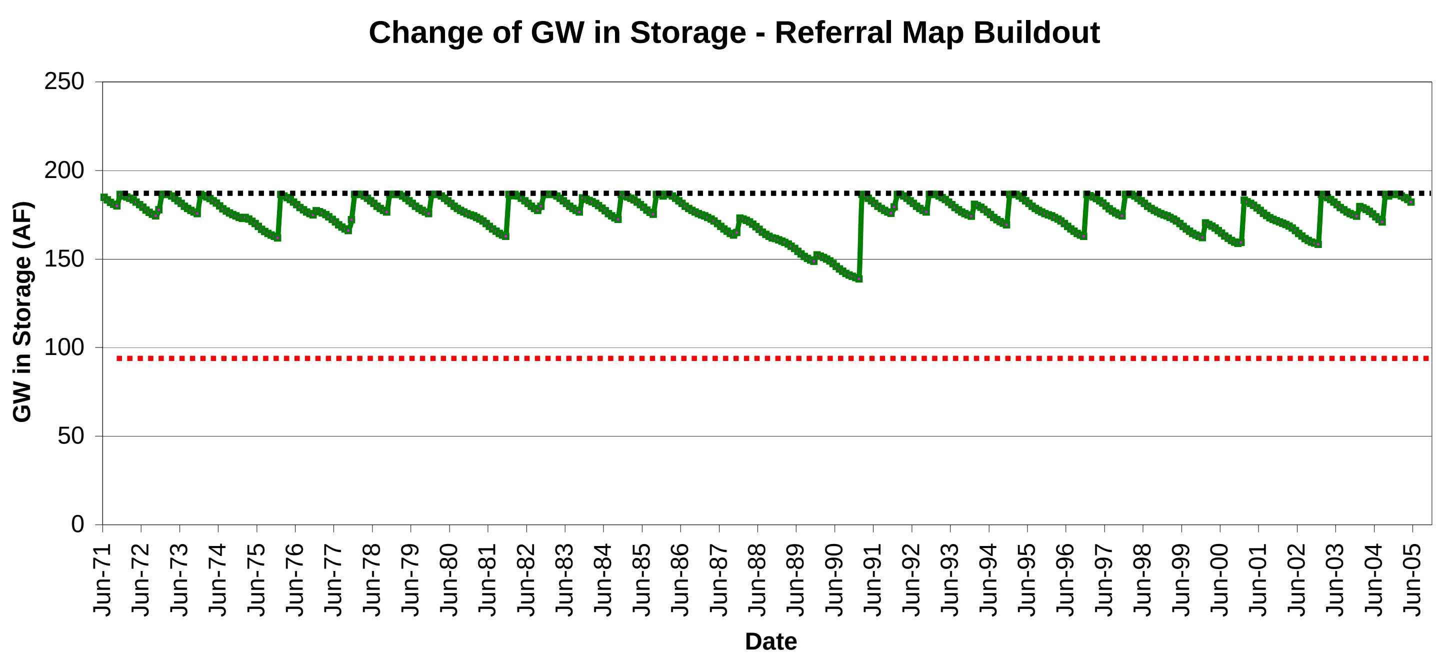


Table C-27
Fernbrook Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	9700
Modeled Maximum GW in Storage (AF)	3482
Modeled Average GW Recharge (AFY)	1377

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	83	98%	92%
Current General Plan Buildout	294	90%	62%
Referral Map Buildout	119	97%	87%
Draft Land Use Map Buildout	119	97%	87%
Hybrid Map Buildout	119	97%	87%
Environmentally Superior Buildout	102	98%	89%
Cumulative Impacts Buildout	120	97%	87%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

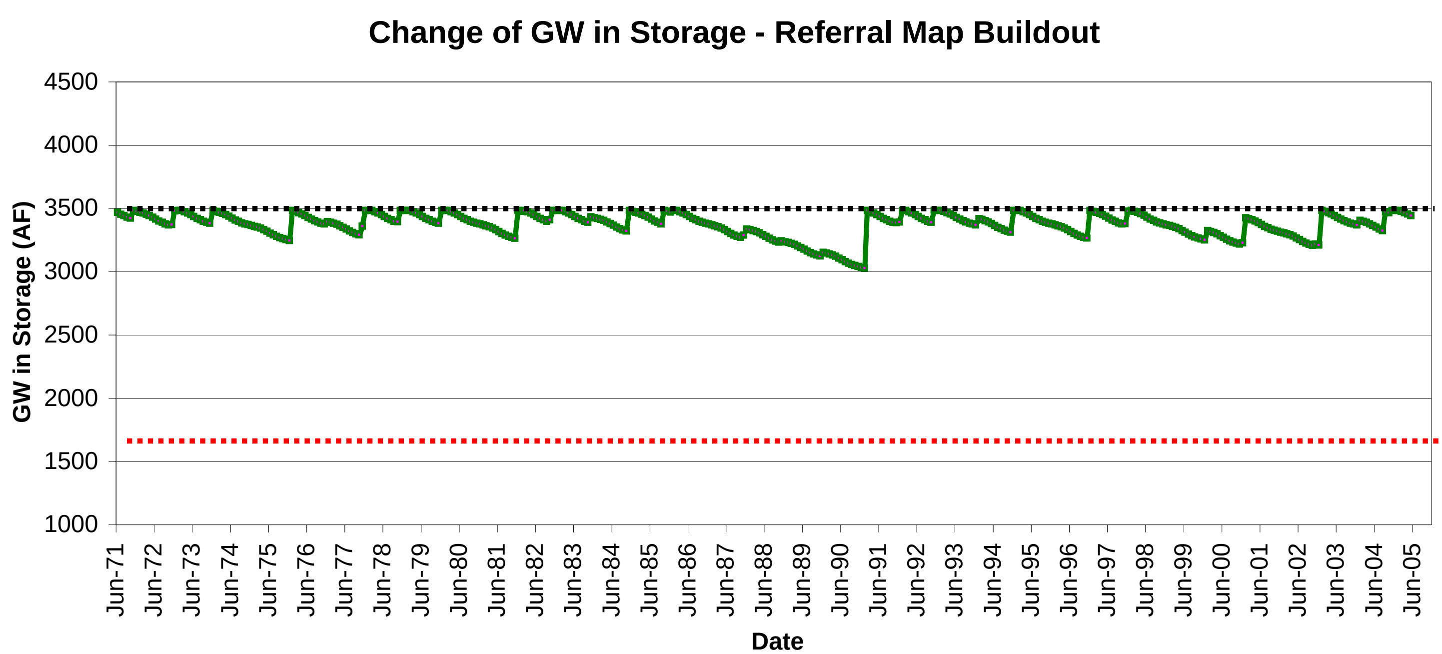


Table C-28
Garnet Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	13893
Modeled Maximum GW in Storage (AF)	3008
Modeled Average GW Recharge (AFY)	5429

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	8	100%	100%
Current General Plan Buildout	110	98%	93%
Referral Map Buildout	17	100%	99%
Draft Land Use Map Buildout	17	100%	99%
Hybrid Map Buildout	17	100%	99%
Environmentally Superior Buildout	17	100%	99%
Cumulative Impacts Buildout	17	100%	99%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

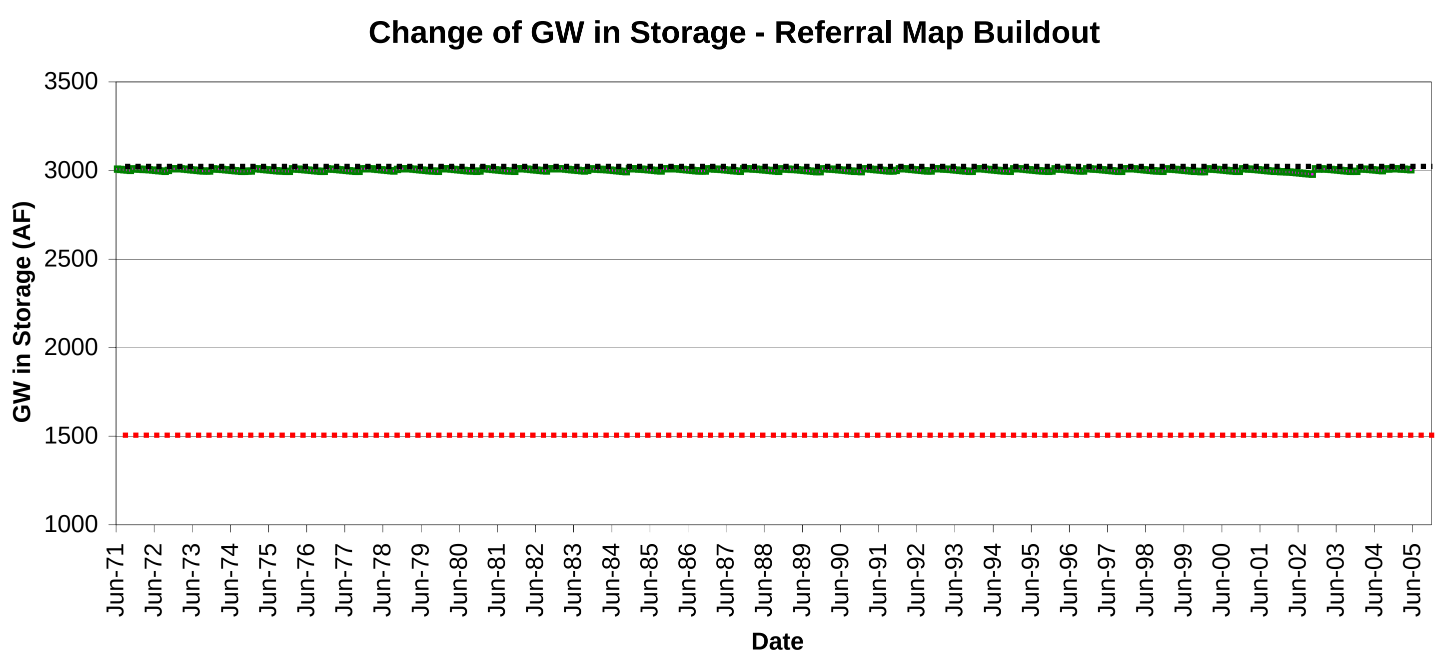


Table C-29
Gower Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	8975
Modeled Maximum GW in Storage (AF)	4820
Modeled Average GW Recharge (AFY)	1460

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	129	99%	95%
Current General Plan Buildout	331	95%	82%
Referral Map Buildout	240	97%	91%
Draft Land Use Map Buildout	220	97%	92%
Hybrid Map Buildout	230	97%	91%
Environmentally Superior Buildout	199	98%	92%
Cumulative Impacts Buildout	257	97%	90%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

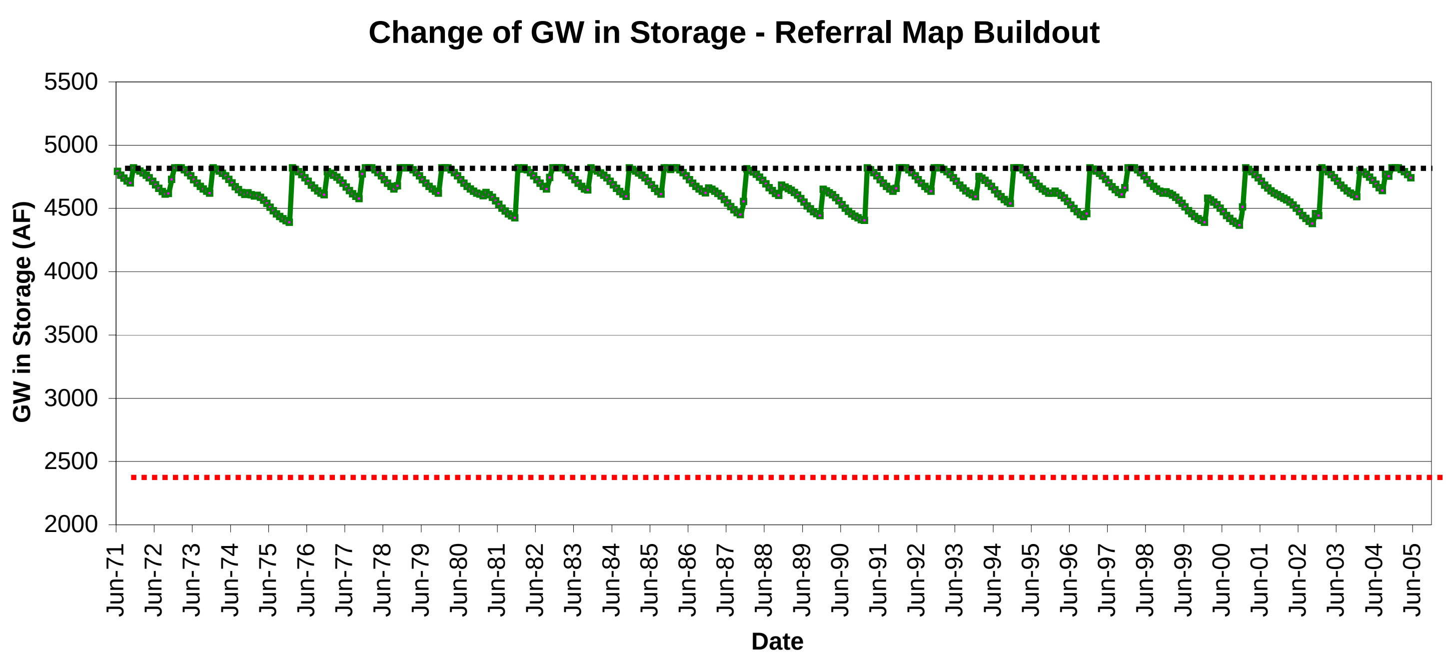


Table C-30
Guatay Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	924
Modeled Maximum GW in Storage (AF)	267
Modeled Average GW Recharge (AFY)	170

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	89	42%	0%
Current General Plan Buildout	137	28%	0%
Referral Map Buildout	102	38%	0%
Draft Land Use Map Buildout	102	38%	0%
Hybrid Map Buildout	102	38%	0%
Environmentally Superior Buildout	99	38%	0%
Cumulative Impacts Buildout	102	38%	0%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

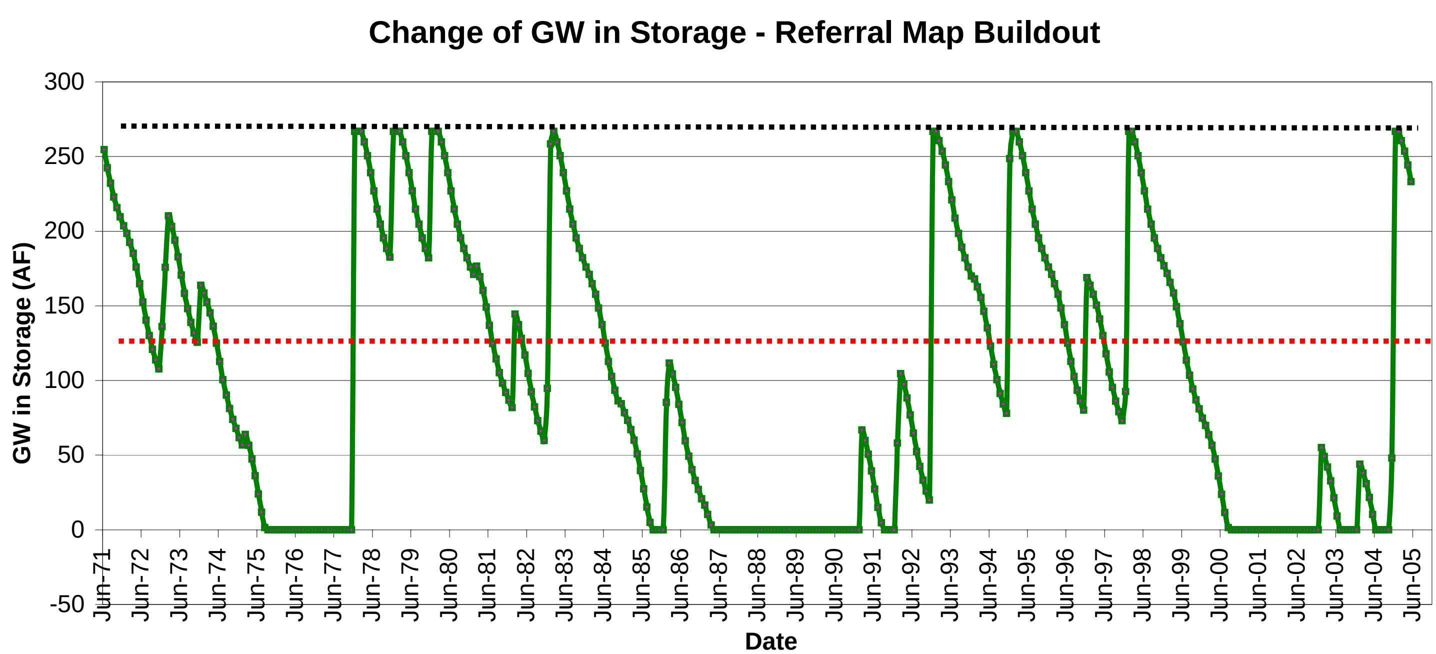


Table C-31
Guejito Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	12167
Modeled Maximum GW in Storage (AF)	4920
Modeled Average GW Recharge (AFY)	1120

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	51	99%	98%
Current General Plan Buildout	196	95%	84%
Referral Map Buildout	179	96%	86%
Draft Land Use Map Buildout	89	99%	95%
Hybrid Map Buildout	122	98%	92%
Environmentally Superior Buildout	84	99%	96%
Cumulative Impacts Buildout	179	96%	86%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

Change of GW in Storage - Referral Map Buildout

Table C-32
Hidden Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	483
Modeled Maximum GW in Storage (AF)	256
Modeled Average GW Recharge (AFY)	33

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	1	100%	99%
Current General Plan Buildout	10	90%	69%
Referral Map Buildout	6	94%	82%
Draft Land Use Map Buildout	6	94%	82%
Hybrid Map Buildout	6	94%	82%
Environmentally Superior Buildout	3	97%	91%
Cumulative Impacts Buildout	6	94%	82%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

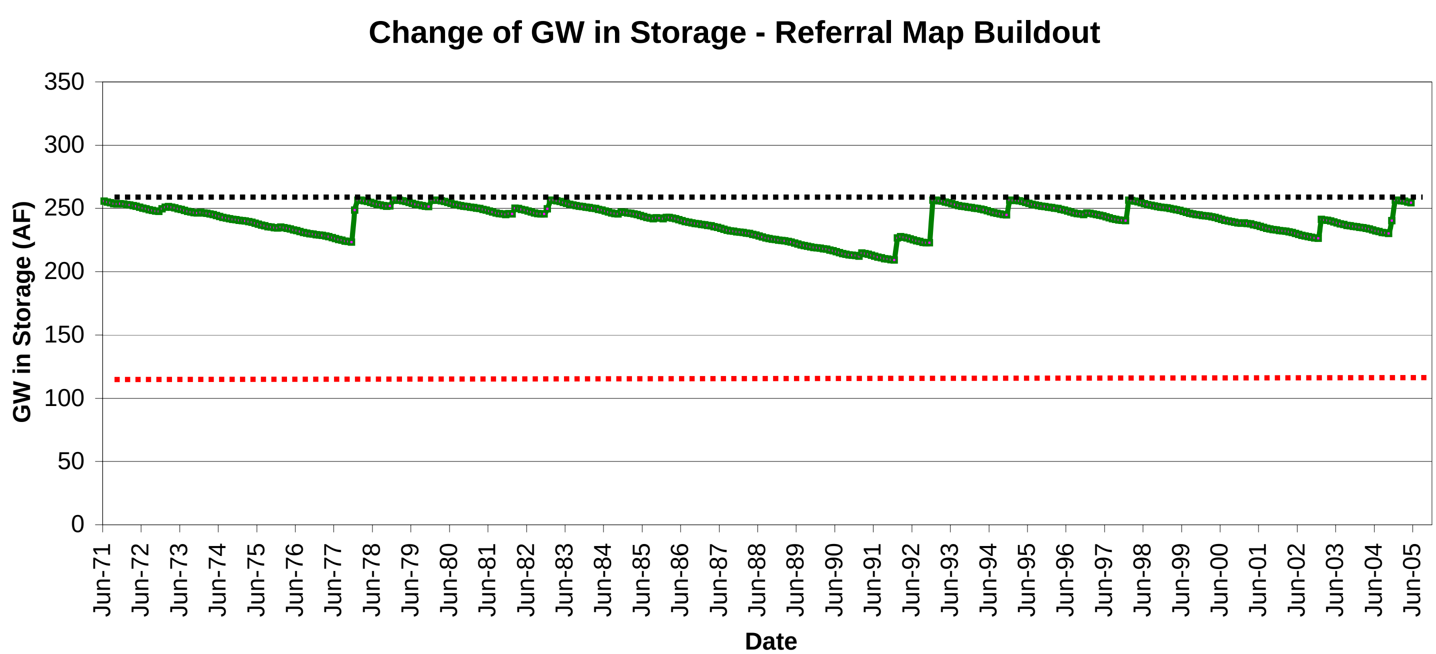


Table C-33
Hill Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	4591
Modeled Maximum GW in Storage (AF)	3392
Modeled Average GW Recharge (AFY)	712

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	91	97%	90%
Current General Plan Buildout	522	65%	7%
Referral Map Buildout	139	95%	83%
Draft Land Use Map Buildout	139	95%	83%
Hybrid Map Buildout	139	95%	83%
Environmentally Superior Buildout	121	96%	86%
Cumulative Impacts Buildout	145	95%	82%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

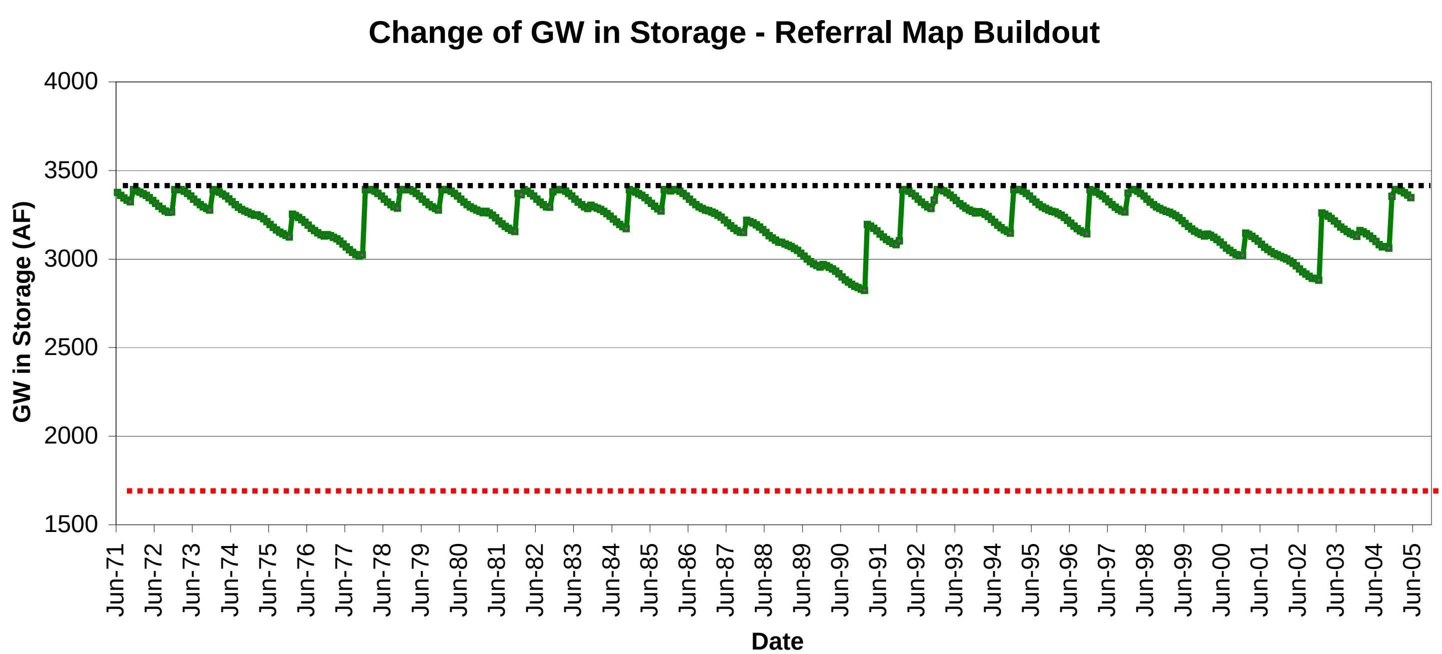


Table C-34
Hipass Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	5905
Modeled Maximum GW in Storage (AF)	7238
Modeled Average GW Recharge (AFY)	719

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	141	98%	92%
Current General Plan Buildout	690	72%	29%
Referral Map Buildout	183	96%	89%
Draft Land Use Map Buildout	183	96%	89%
Hybrid Map Buildout	183	96%	89%
Environmentally Superior Buildout	181	96%	89%
Cumulative Impacts Buildout	183	96%	89%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

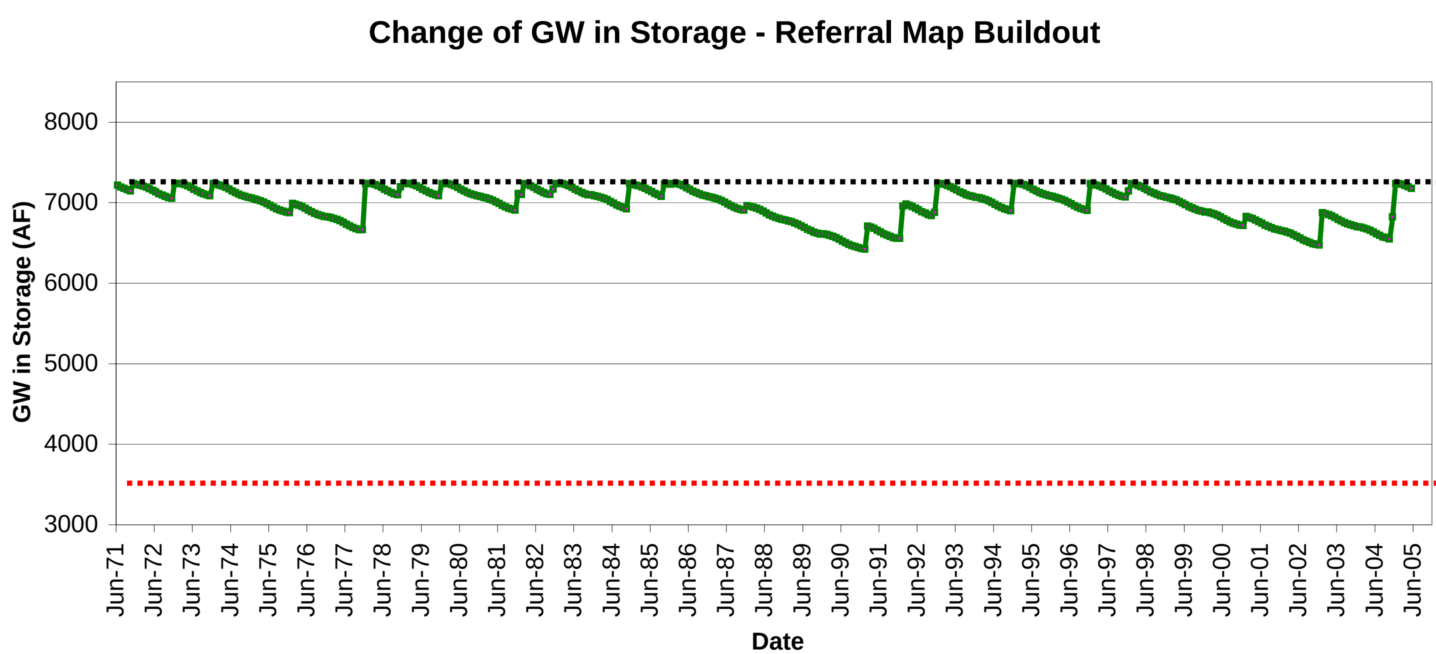


Table C-35
Hollenbeck Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	31723
Modeled Maximum GW in Storage (AF)	10615
Modeled Average GW Recharge (AFY)	3483

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	361	97%	91%
Current General Plan Buildout	1123	85%	56%
Referral Map Buildout	661	94%	77%
Draft Land Use Map Buildout	659	94%	77%
Hybrid Map Buildout	661	94%	77%
Environmentally Superior Buildout	594	95%	80%
Cumulative Impacts Buildout	663	94%	77%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

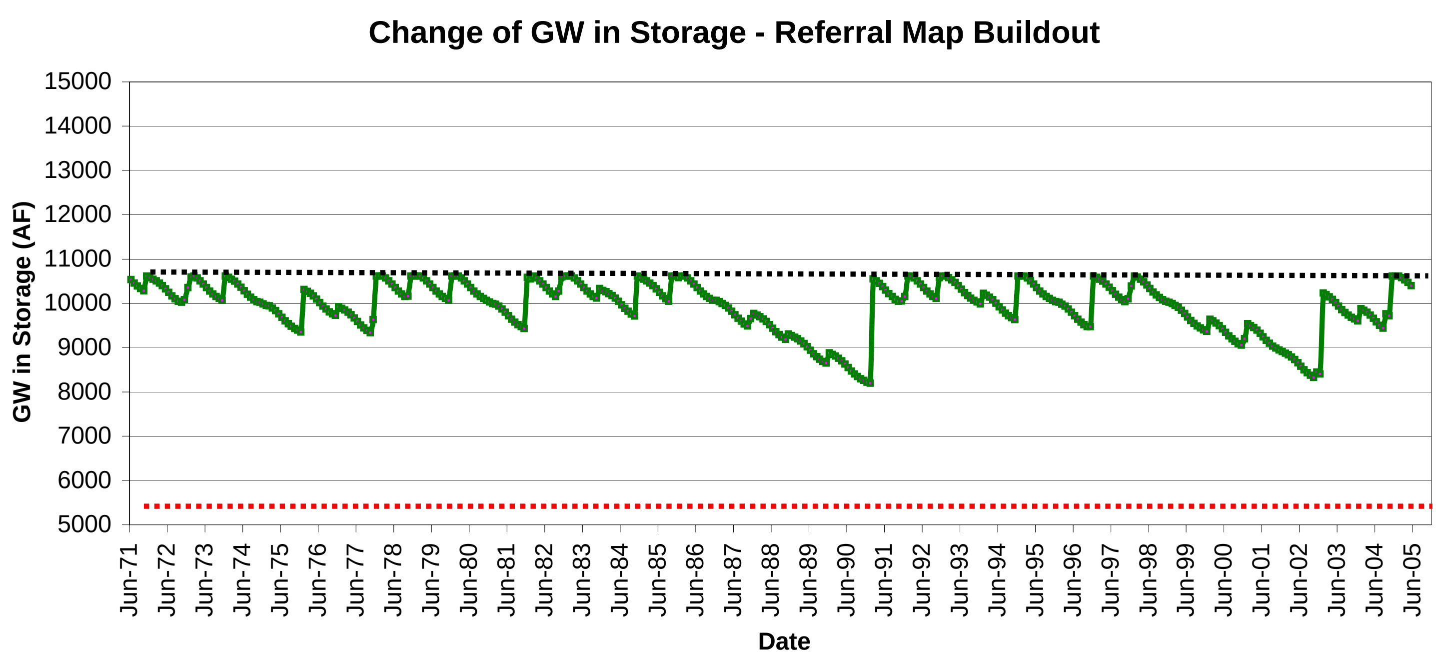


Table C-36
Inaja Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	51105
Modeled Maximum GW in Storage (AF)	10877
Modeled Average GW Recharge (AFY)	9624

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	958	93%	75%
Current General Plan Buildout	1543	86%	48%
Referral Map Buildout	1234	90%	62%
Draft Land Use Map Buildout	1163	91%	65%
Hybrid Map Buildout	1173	91%	65%
Environmentally Superior Buildout	1151	91%	66%
Cumulative Impacts Buildout	1233	90%	62%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

Change of GW in Storage - Referral Map Buildout

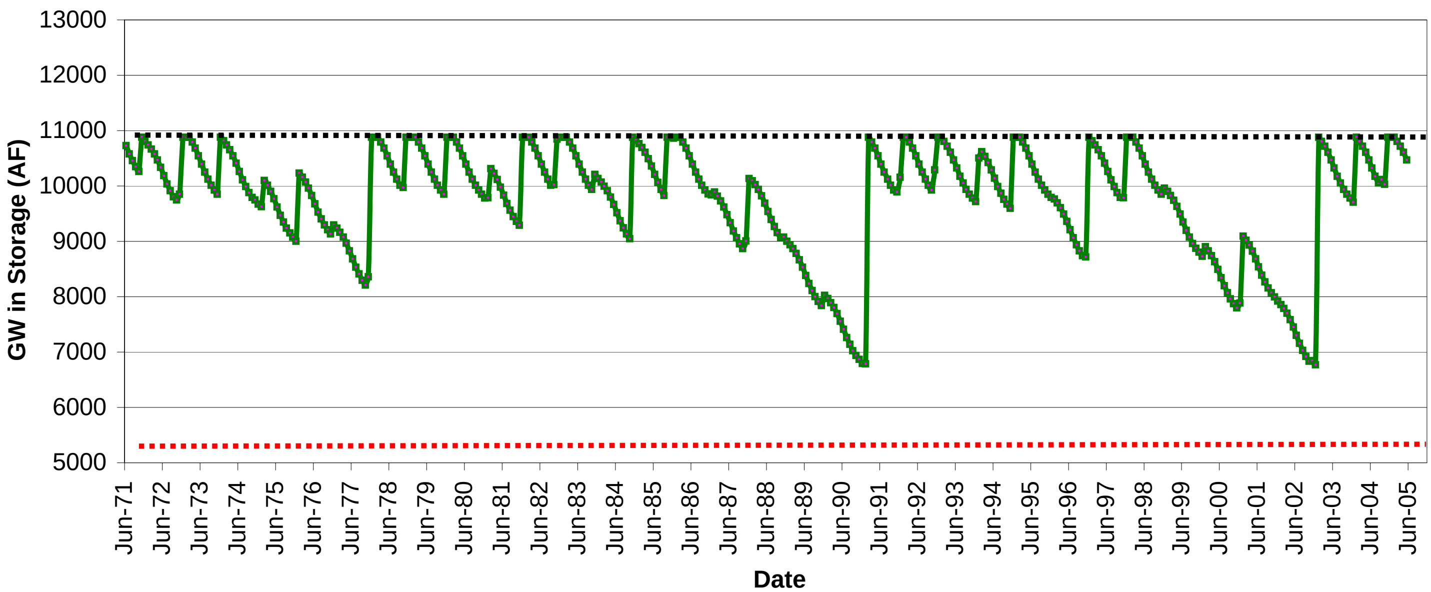


Table C-37
Jacumba Valley Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	16039
Modeled Maximum GW in Storage (AF)	32601
Modeled Average GW Recharge (AFY)	1456

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	165	100%	99%
Current General Plan Buildout	2295	54%	1%
Referral Map Buildout	1259	91%	74%
Draft Land Use Map Buildout	1258	91%	74%
Hybrid Map Buildout	1258	91%	74%
Environmentally Superior Buildout	1008	93%	81%
Cumulative Impacts Buildout	1258	91%	74%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources. 600 Units were not on the GP Update Map for Specific Plan Area (included additional 300 afy manually in the calculations).

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

Change of GW in Storage - Referral Map Buildout

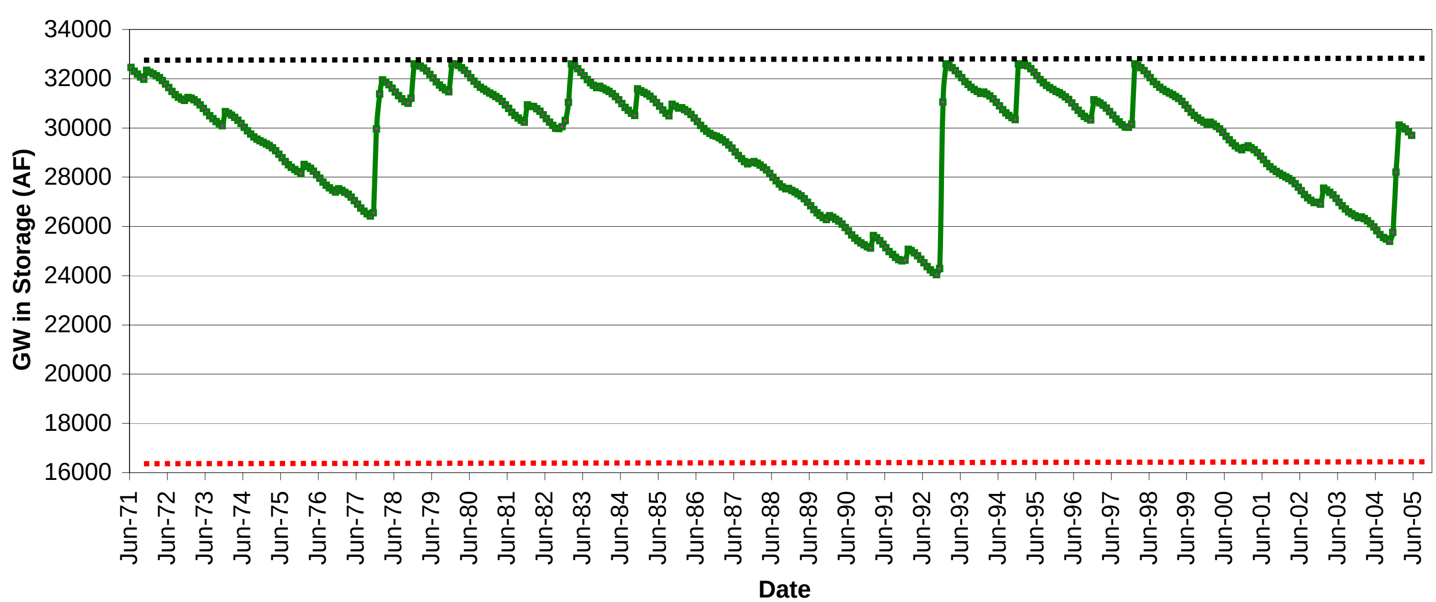


Table C-38
Jamacha Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	14238
Modeled Maximum GW in Storage (AF)	3515
Modeled Average GW Recharge (AFY)	2197

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	237	96%	86%
Current General Plan Buildout	902	64%	0%
Referral Map Buildout	418	90%	60%
Draft Land Use Map Buildout	393	91%	64%
Hybrid Map Buildout	393	91%	64%
Environmentally Superior Buildout	327	93%	73%
Cumulative Impacts Buildout	421	90%	60%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

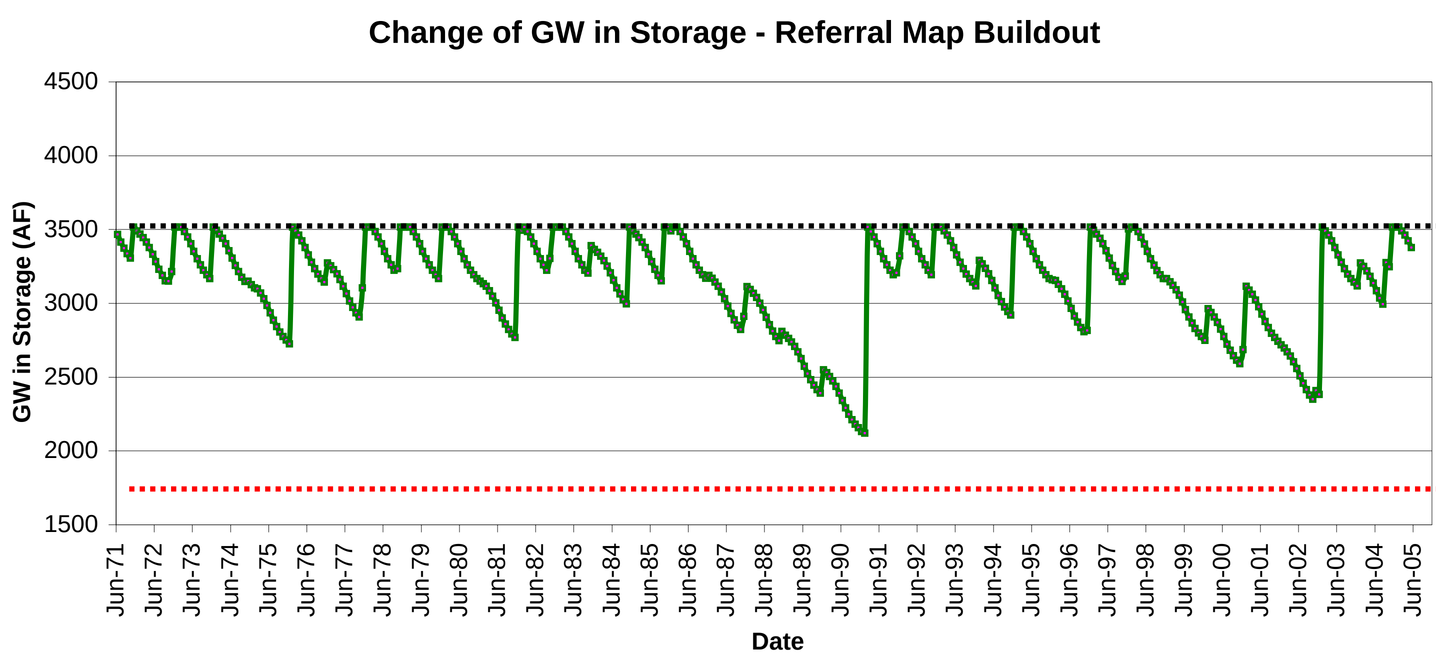


Table C-39
Jamul Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	4413
Modeled Maximum GW in Storage (AF)	1987
Modeled Average GW Recharge (AFY)	280

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	23	99%	95%
Current General Plan Buildout	87	92%	78%
Referral Map Buildout	77	93%	81%
Draft Land Use Map Buildout	77	93%	81%
Hybrid Map Buildout	77	93%	81%
Environmentally Superior Buildout	70	94%	83%
Cumulative Impacts Buildout	77	93%	81%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

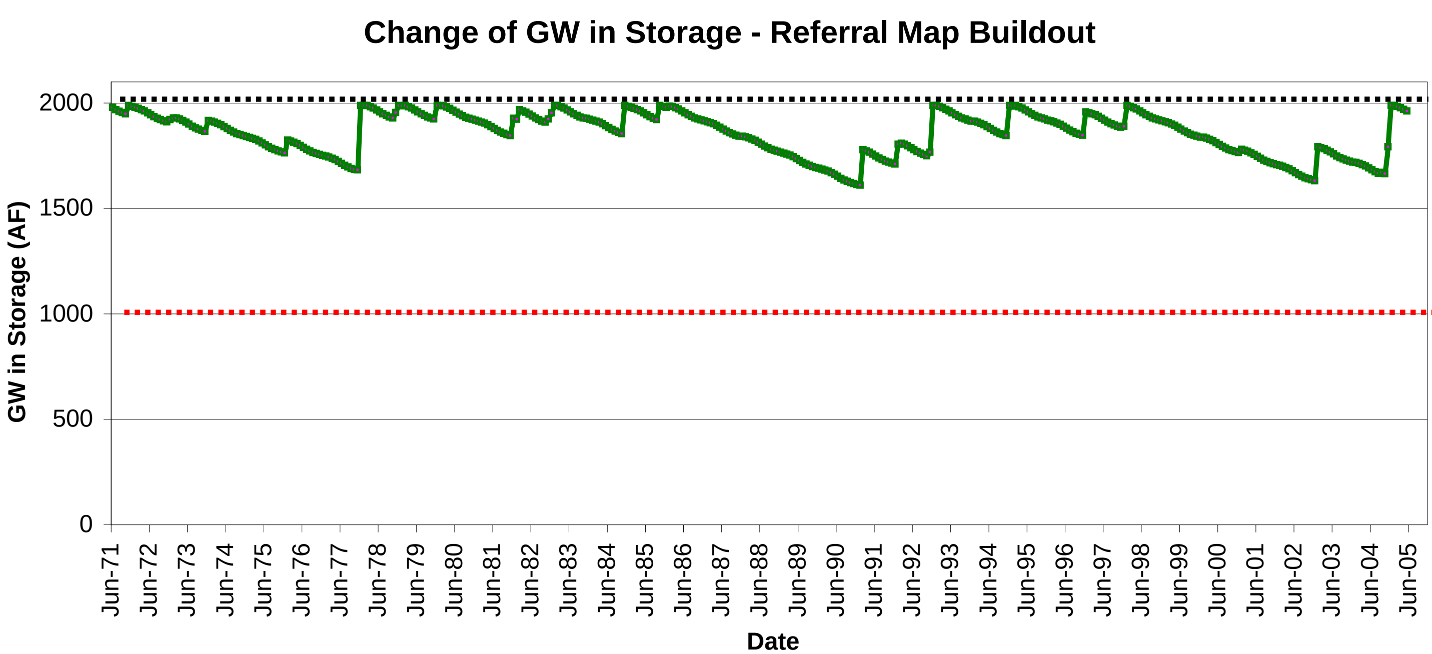


Table C-40
Japatul Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	1486
Modeled Maximum GW in Storage (AF)	749
Modeled Average GW Recharge (AFY)	206

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	25	98%	94%
Current General Plan Buildout	36	96%	86%
Referral Map Buildout	34	96%	87%
Draft Land Use Map Buildout	34	96%	87%
Hybrid Map Buildout	34	96%	87%
Environmentally Superior Buildout	31	97%	90%
Cumulative Impacts Buildout	35	96%	87%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

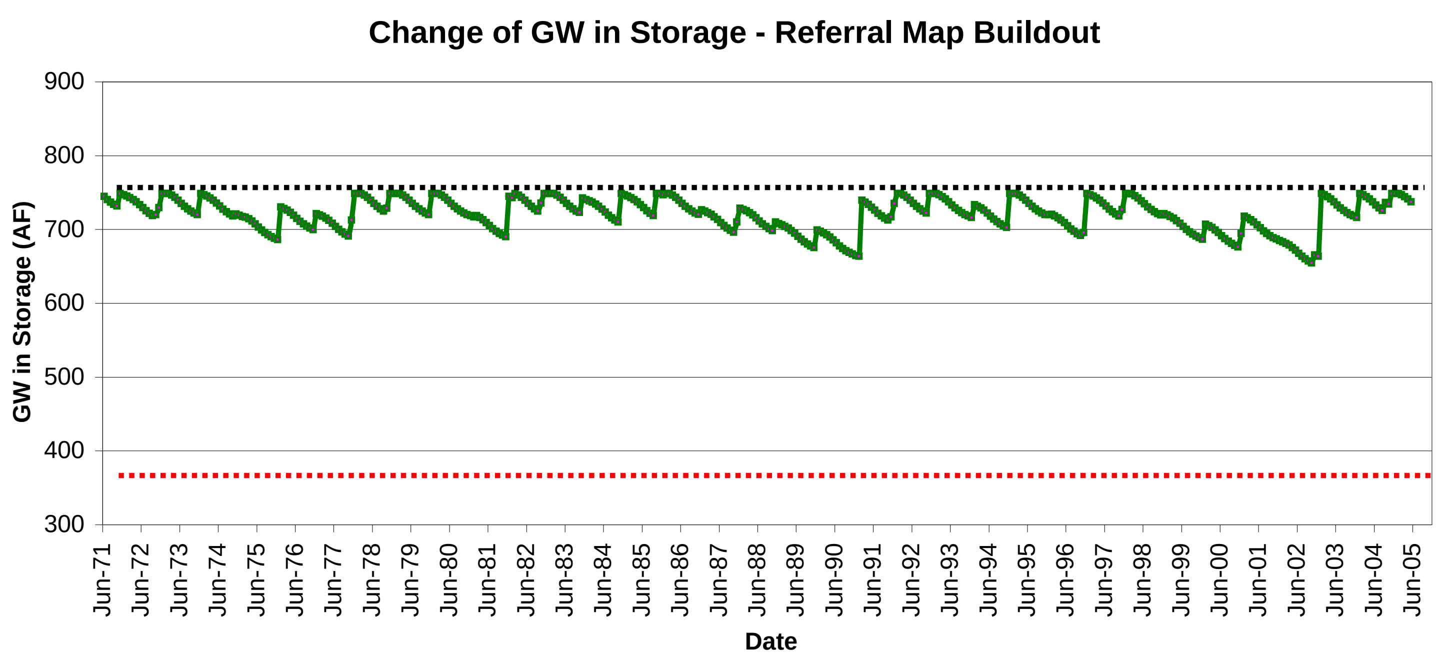


Table C-41
Kimball Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	1023
Modeled Maximum GW in Storage (AF)	647
Modeled Average GW Recharge (AFY)	113

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	9	99%	95%
Current General Plan Buildout	17	97%	89%
Referral Map Buildout	12	98%	93%
Draft Land Use Map Buildout	12	98%	93%
Hybrid Map Buildout	12	98%	93%
Environmentally Superior Buildout	11	98%	93%
Cumulative Impacts Buildout	12	98%	93%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

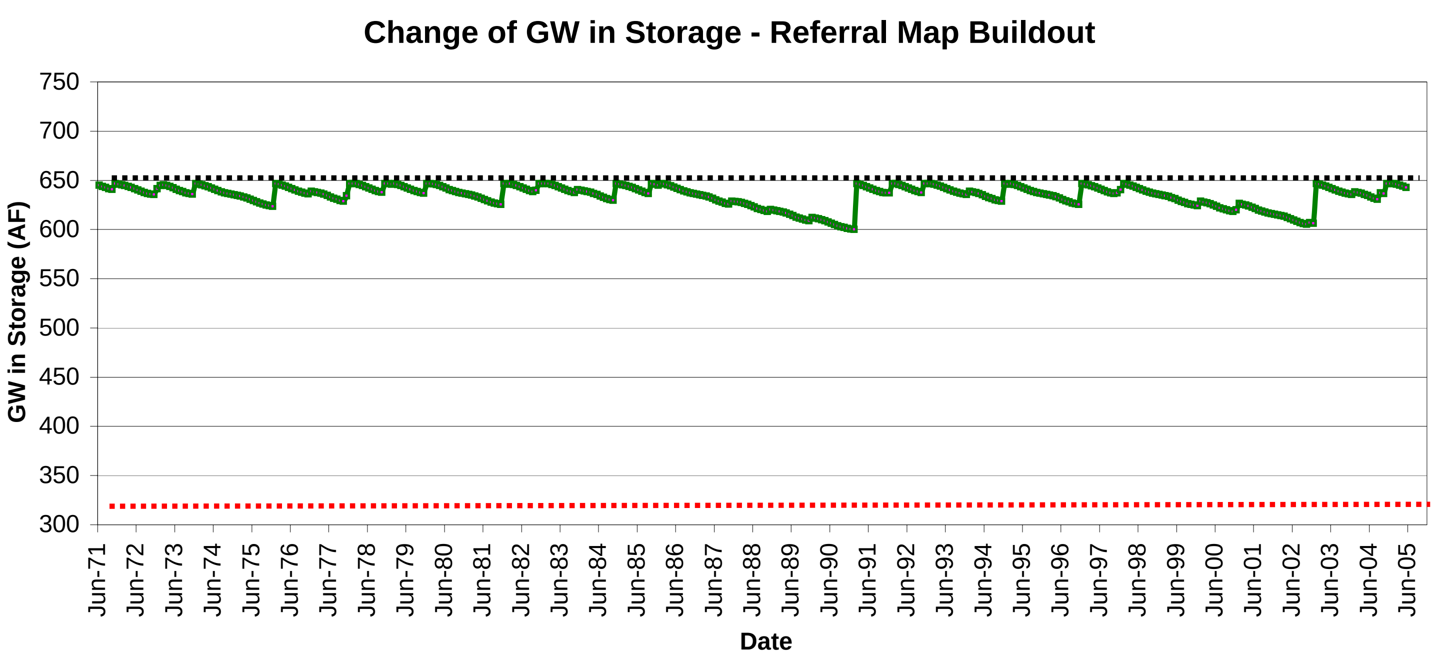


Table C-42
La Jolla Amago Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	11907
Modeled Maximum GW in Storage (AF)	2075
Modeled Average GW Recharge (AFY)	2399

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	69	99%	94%
Current General Plan Buildout	152	96%	86%
Referral Map Buildout	134	96%	88%
Draft Land Use Map Buildout	99	98%	91%
Hybrid Map Buildout	103	98%	91%
Environmentally Superior Buildout	97	98%	91%
Cumulative Impacts Buildout	135	96%	88%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

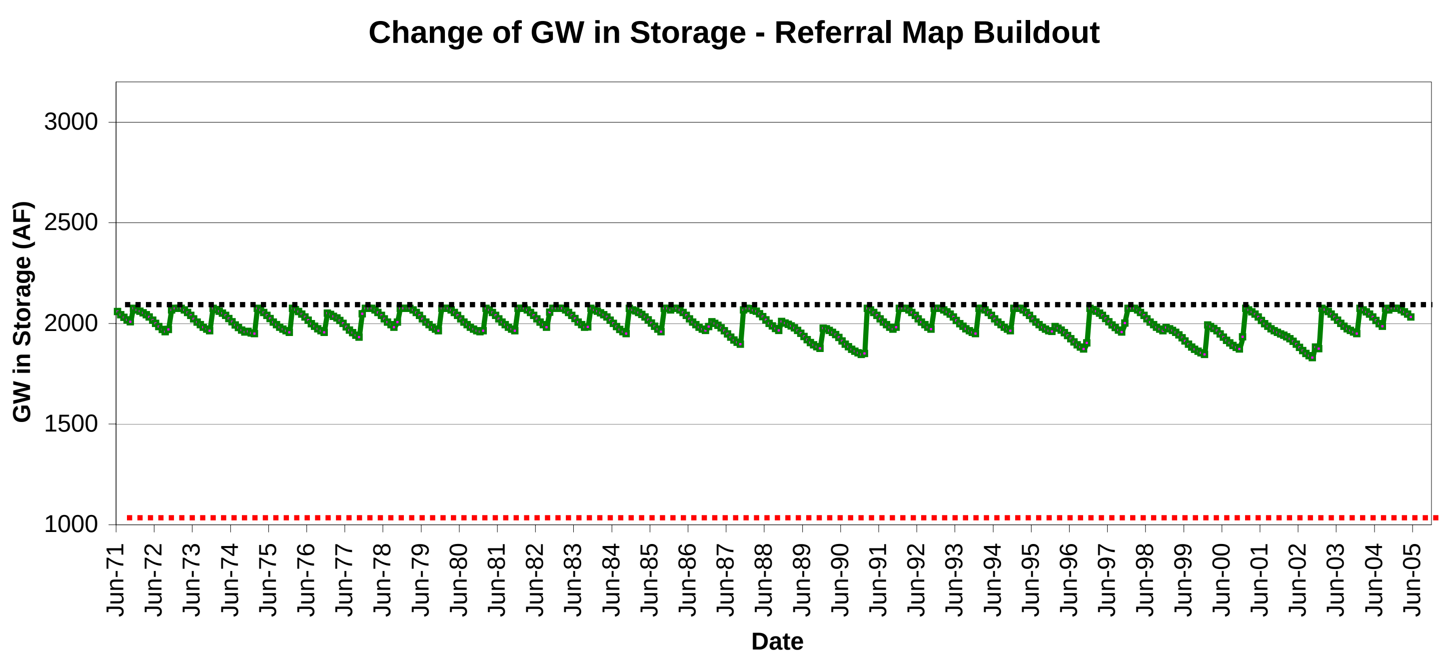


Table C-43
Las Lomas Muertas Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	7843
Modeled Maximum GW in Storage (AF)	1044
Modeled Average GW Recharge (AFY)	825

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	467	31%	0%
Current General Plan Buildout	785	20%	0%
Referral Map Buildout	639	24%	0%
Draft Land Use Map Buildout	534	28%	0%
Hybrid Map Buildout	535	28%	0%
Environmentally Superior Buildout	502	29%	0%
Cumulative Impacts Buildout	639	24%	0%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

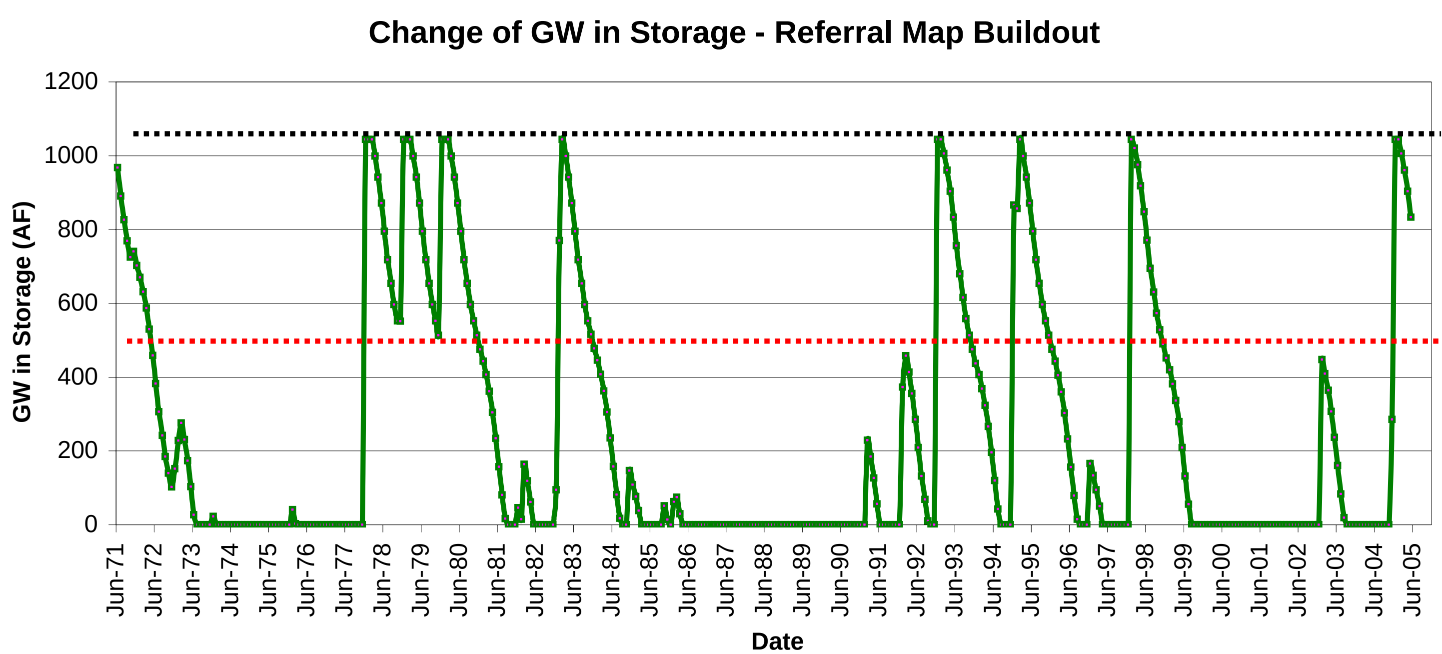


Table C-44
Lee Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	2081
Modeled Maximum GW in Storage (AF)	720
Modeled Average GW Recharge (AFY)	281

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	98	79%	36%
Current General Plan Buildout	199	48%	0%
Referral Map Buildout	125	71%	16%
Draft Land Use Map Buildout	125	71%	16%
Hybrid Map Buildout	125	71%	16%
Environmentally Superior Buildout	114	74%	26%
Cumulative Impacts Buildout	124	71%	17%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

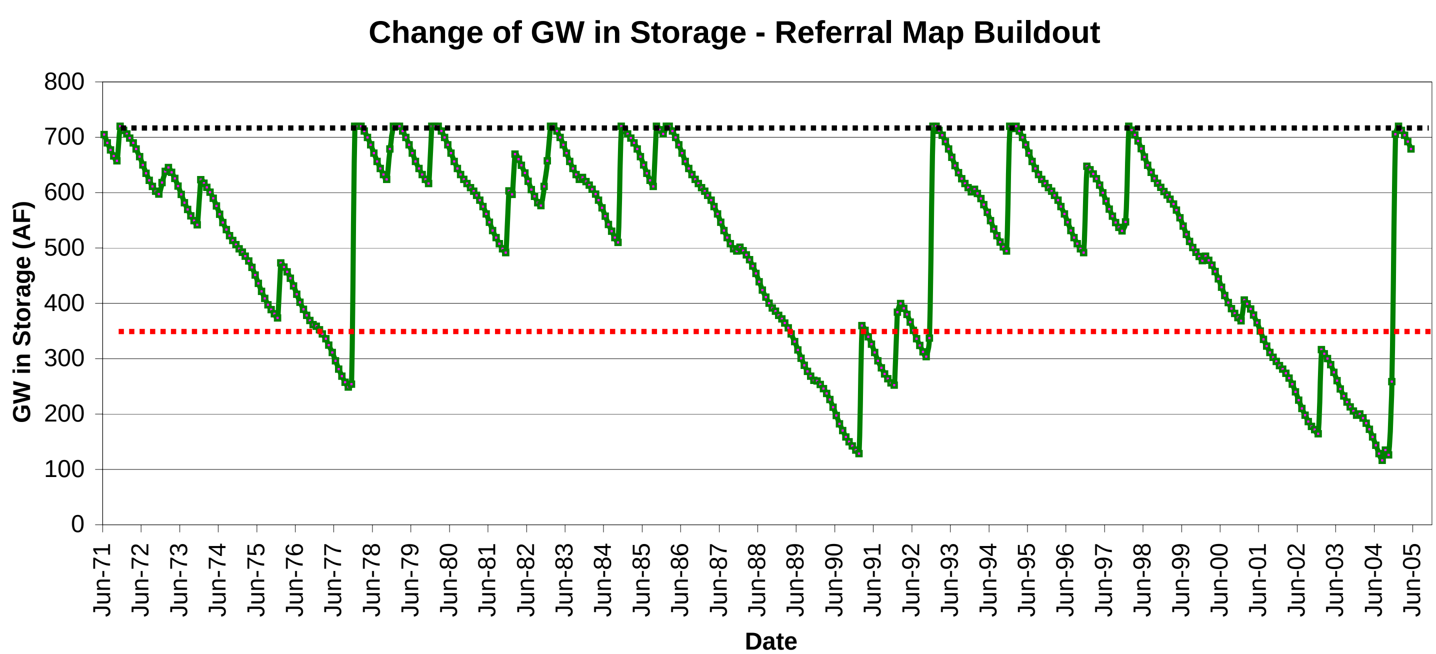


Table C-45
Long Potrero Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	11236
Modeled Maximum GW in Storage (AF)	6335
Modeled Average GW Recharge (AFY)	2121

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	212	98%	94%
Current General Plan Buildout	662	89%	65%
Referral Map Buildout	337	97%	89%
Draft Land Use Map Buildout	335	97%	89%
Hybrid Map Buildout	335	97%	89%
Environmentally Superior Buildout	283	97%	92%
Cumulative Impacts Buildout	340	97%	89%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

Change of GW in Storage - Referral Map Buildout

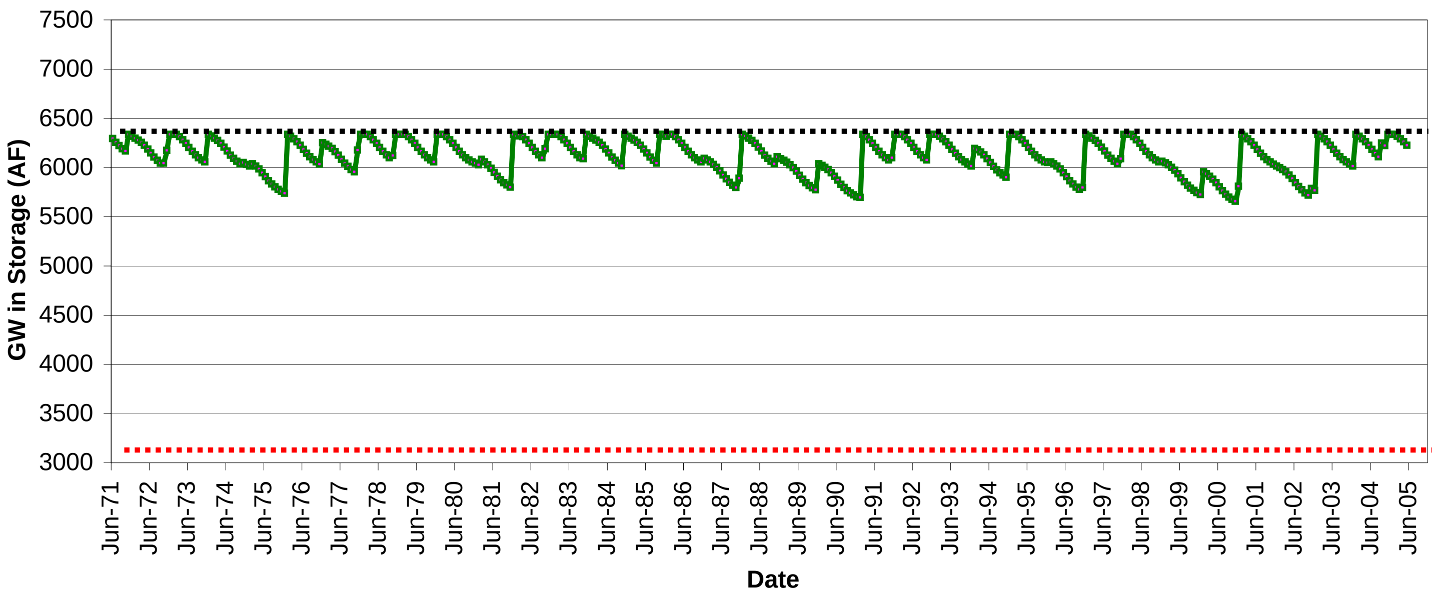


Table C-46
Loveland Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	22717
Modeled Maximum GW in Storage (AF)	6287
Modeled Average GW Recharge (AFY)	4044

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	210	98%	94%
Current General Plan Buildout	290	98%	92%
Referral Map Buildout	272	98%	92%
Draft Land Use Map Buildout	272	98%	92%
Hybrid Map Buildout	272	98%	92%
Environmentally Superior Buildout	250	98%	93%
Cumulative Impacts Buildout	272	98%	92%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

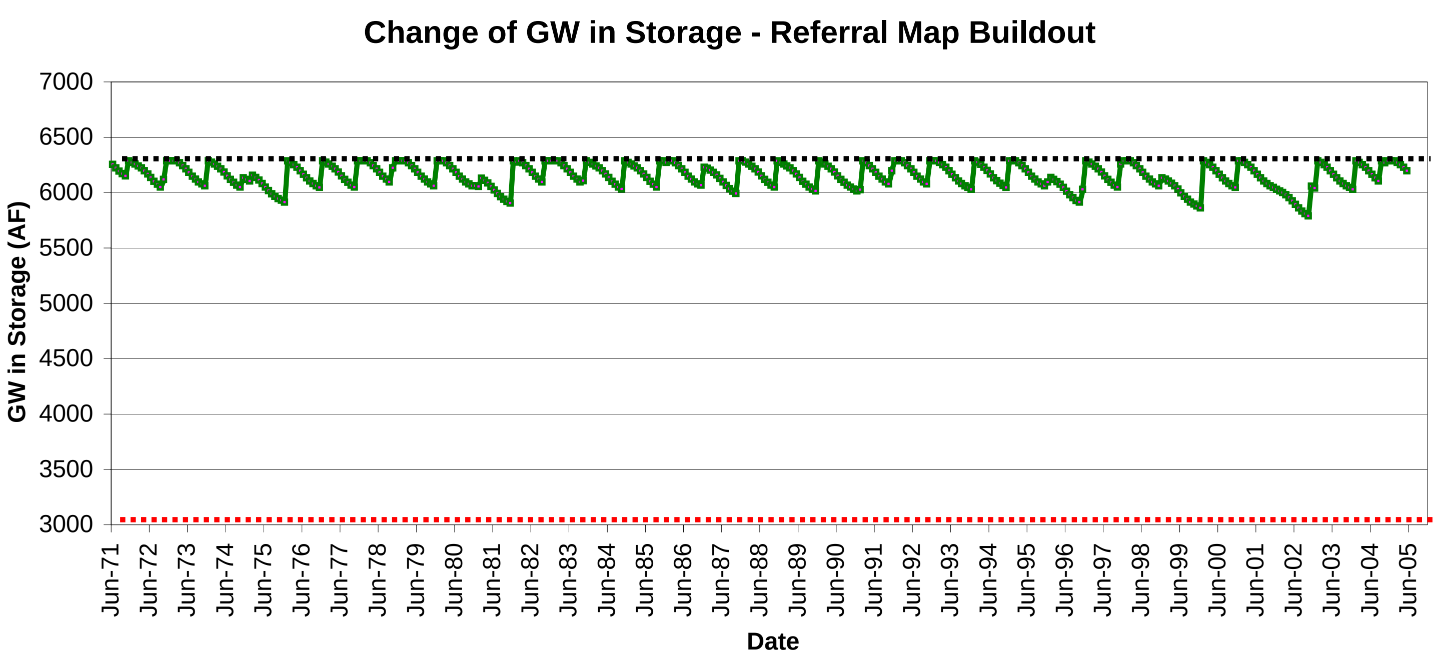


Table C-47
Lower Culp Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	4659
Modeled Maximum GW in Storage (AF)	2193
Modeled Average GW Recharge (AFY)	729

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	143	94%	78%
Current General Plan Buildout	426	63%	4%
Referral Map Buildout	176	91%	71%
Draft Land Use Map Buildout	160	93%	74%
Hybrid Map Buildout	160	93%	74%
Environmentally Superior Buildout	160	93%	74%
Cumulative Impacts Buildout	176	91%	71%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

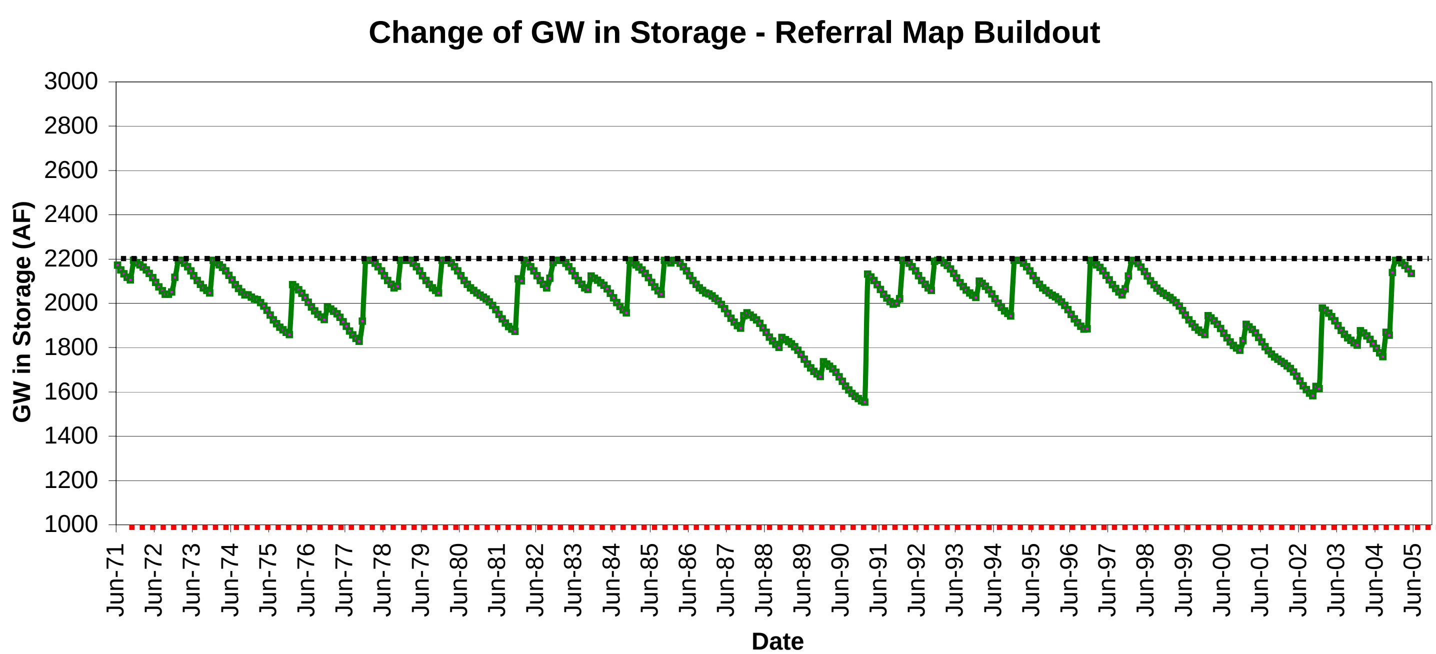


Table C-48
Lower Hatfield Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	2568
Modeled Maximum GW in Storage (AF)	933
Modeled Average GW Recharge (AFY)	396

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	72	93%	73%
Current General Plan Buildout	92	89%	63%
Referral Map Buildout	88	90%	64%
Draft Land Use Map Buildout	81	91%	68%
Hybrid Map Buildout	87	90%	65%
Environmentally Superior Buildout	81	91%	69%
Cumulative Impacts Buildout	88	90%	64%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

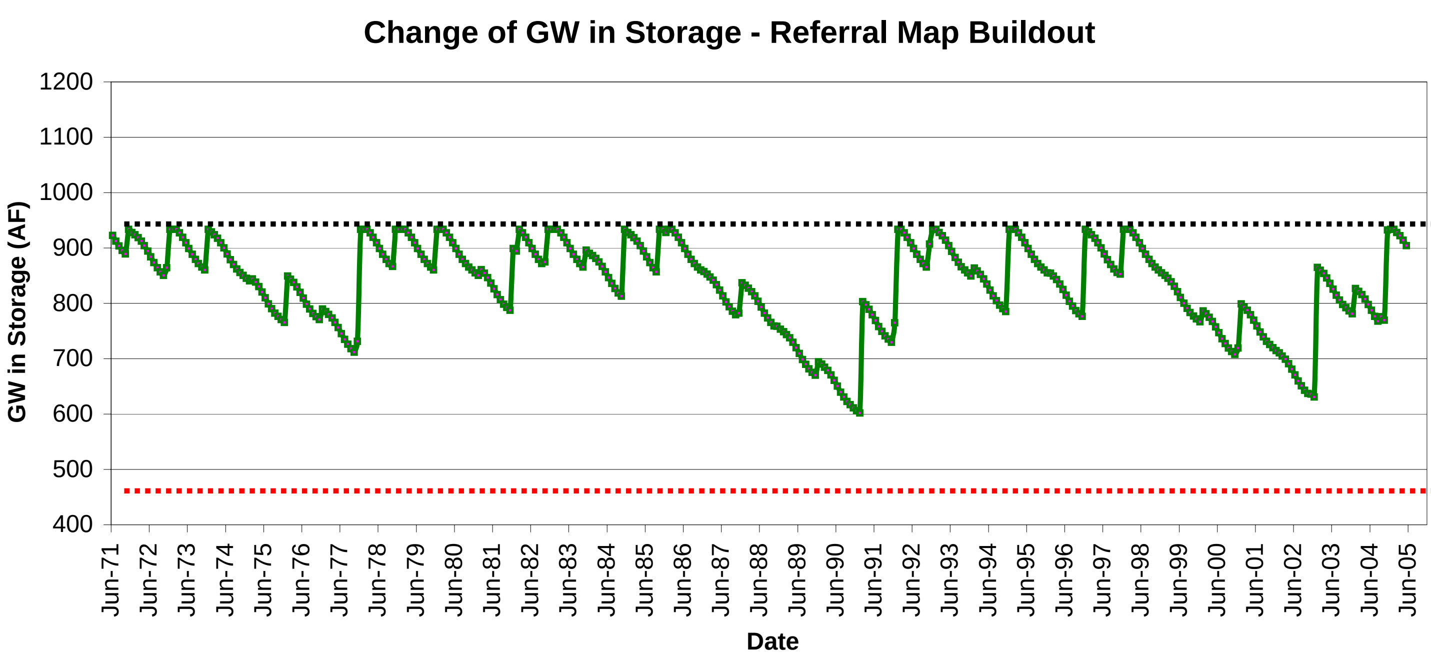


Table C-49
Lyon Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	2079
Modeled Maximum GW in Storage (AF)	461
Modeled Average GW Recharge (AFY)	392

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	54	93%	78%
Current General Plan Buildout	117	77%	18%
Referral Map Buildout	87	86%	50%
Draft Land Use Map Buildout	87	86%	50%
Hybrid Map Buildout	87	86%	50%
Environmentally Superior Buildout	74	89%	64%
Cumulative Impacts Buildout	87	86%	50%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

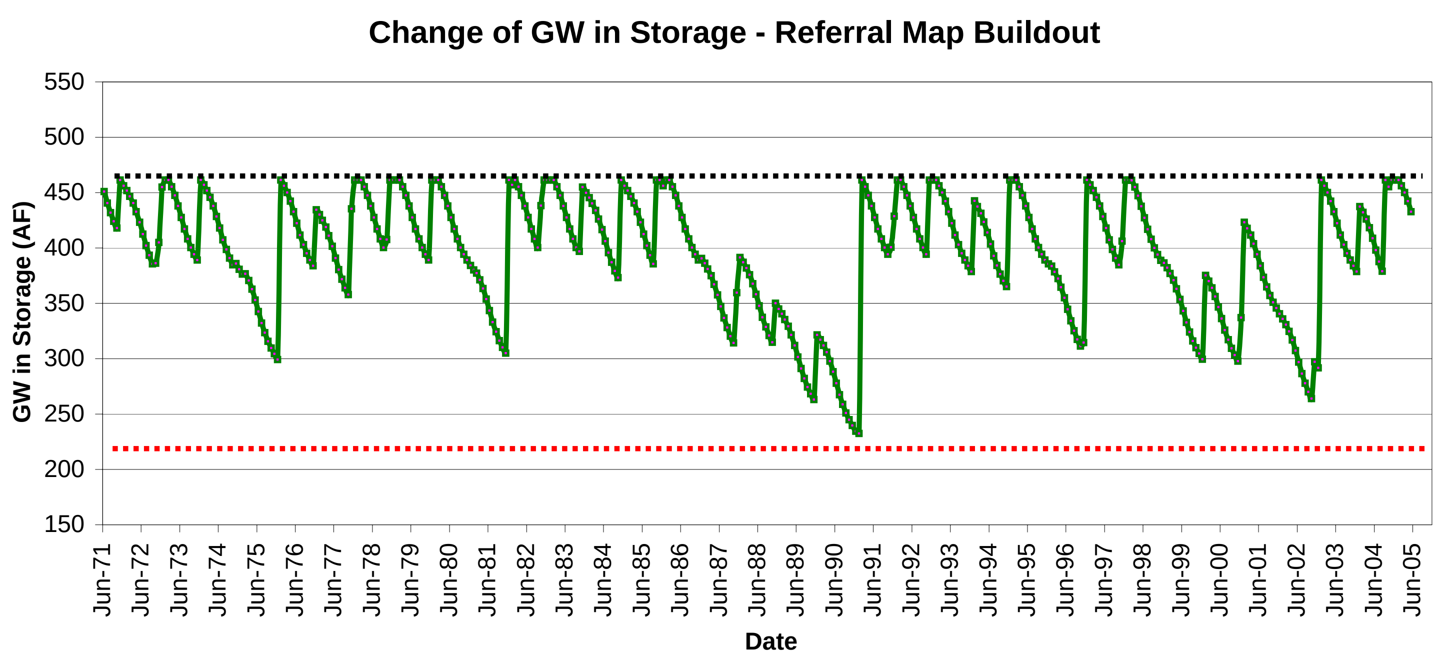


Table C-50
Marron Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	9800
Modeled Maximum GW in Storage (AF)	1183
Modeled Average GW Recharge (AFY)	1366

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	0	100%	100%
Current General Plan Buildout	25	99%	96%
Referral Map Buildout	5	100%	99%
Draft Land Use Map Buildout	5	100%	99%
Hybrid Map Buildout	5	100%	99%
Environmentally Superior Buildout	3	100%	100%
Cumulative Impacts Buildout	5	100%	99%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

Change of GW in Storage - Referral Map Buildout

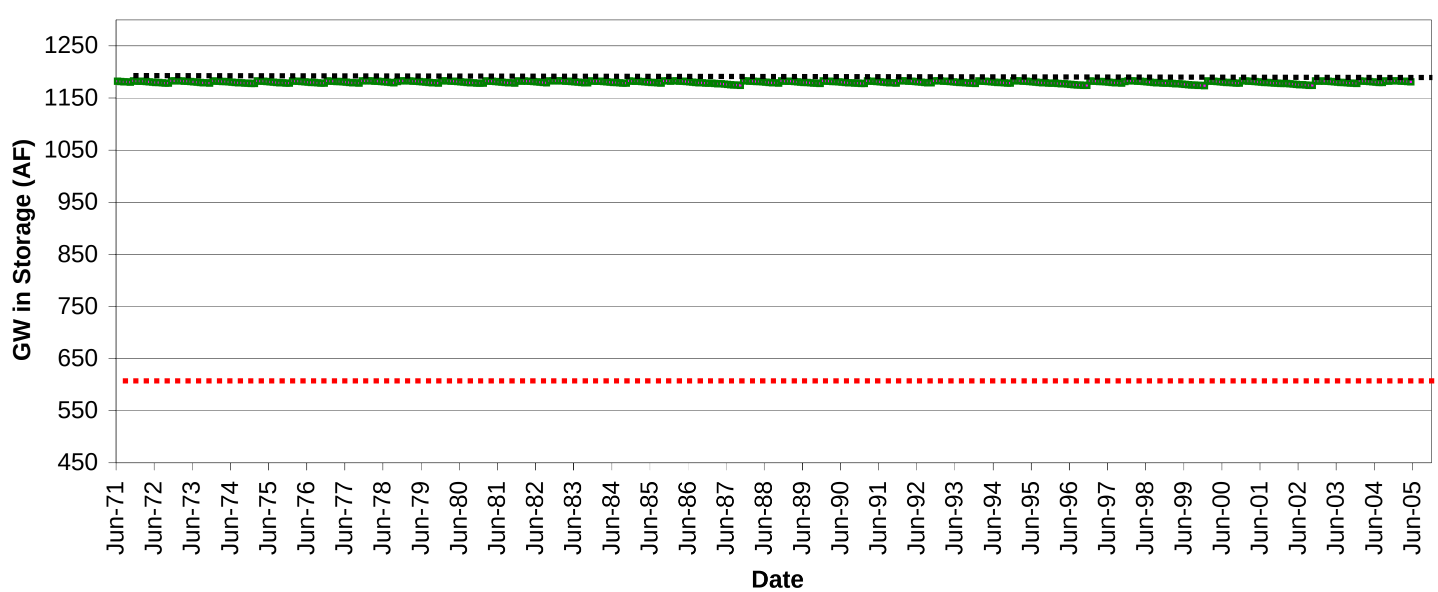


Table C-51
Mason Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	11806
Modeled Maximum GW in Storage (AF)	1886
Modeled Average GW Recharge (AFY)	685

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	0	100%	100%
Current General Plan Buildout	41	97%	89%
Referral Map Buildout	4	100%	99%
Draft Land Use Map Buildout	4	100%	99%
Hybrid Map Buildout	4	100%	99%
Environmentally Superior Buildout	4	100%	99%
Cumulative Impacts Buildout	4	100%	99%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

Change of GW in Storage - Referral Map Buildout

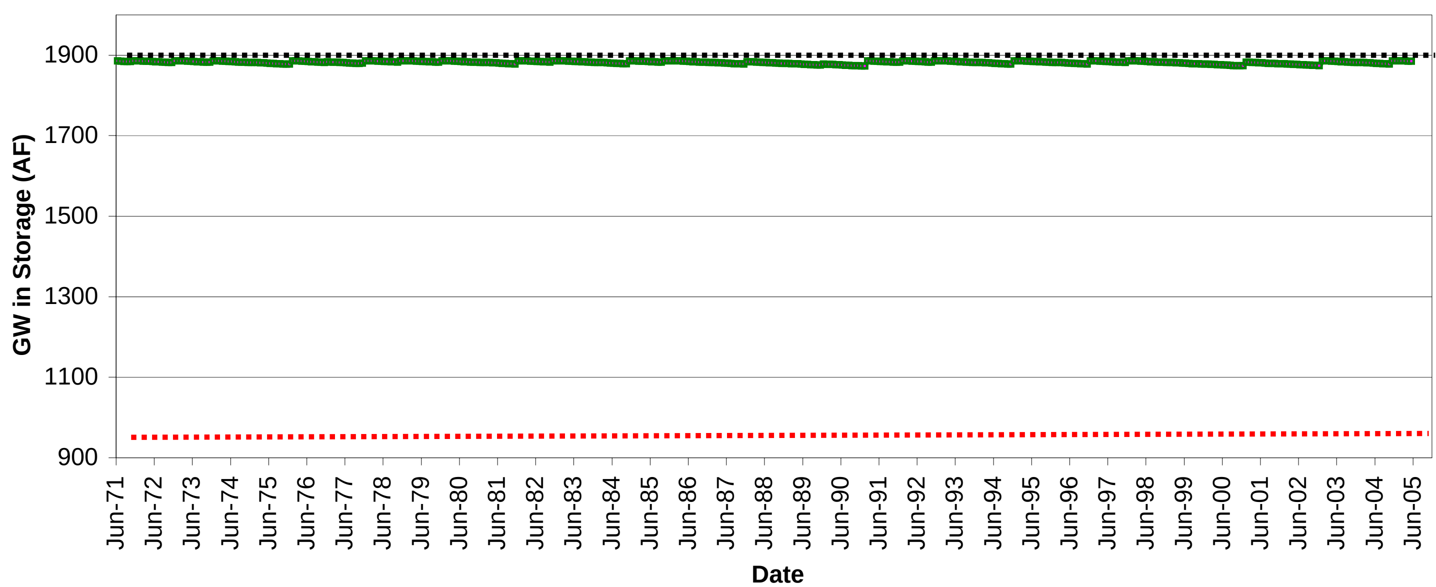


Table C-52
McCain Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	66779
Modeled Maximum GW in Storage (AF)	34741
Modeled Average GW Recharge (AFY)	5485

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	179	100%	99%
Current General Plan Buildout	1941	91%	74%
Referral Map Buildout	488	99%	96%
Draft Land Use Map Buildout	456	99%	96%
Hybrid Map Buildout	456	99%	96%
Environmentally Superior Buildout	345	99%	98%
Cumulative Impacts Buildout	461	99%	96%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

Change of GW in Storage - Referral Map Buildout

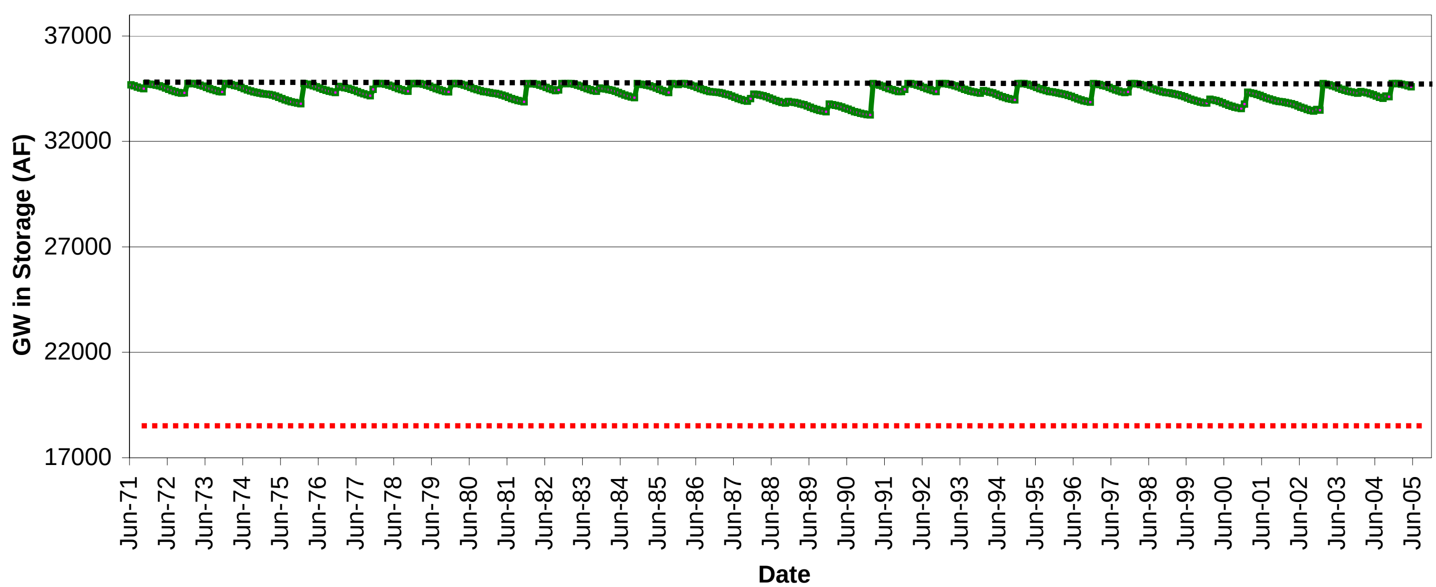


Table C-53
Morena Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	14298
Modeled Maximum GW in Storage (AF)	5035
Modeled Average GW Recharge (AFY)	3417

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	4	100%	100%
Current General Plan Buildout	33	100%	99%
Referral Map Buildout	19	100%	99%
Draft Land Use Map Buildout	19	100%	99%
Hybrid Map Buildout	19	100%	99%
Environmentally Superior Buildout	18	100%	99%
Cumulative Impacts Buildout	19	100%	99%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

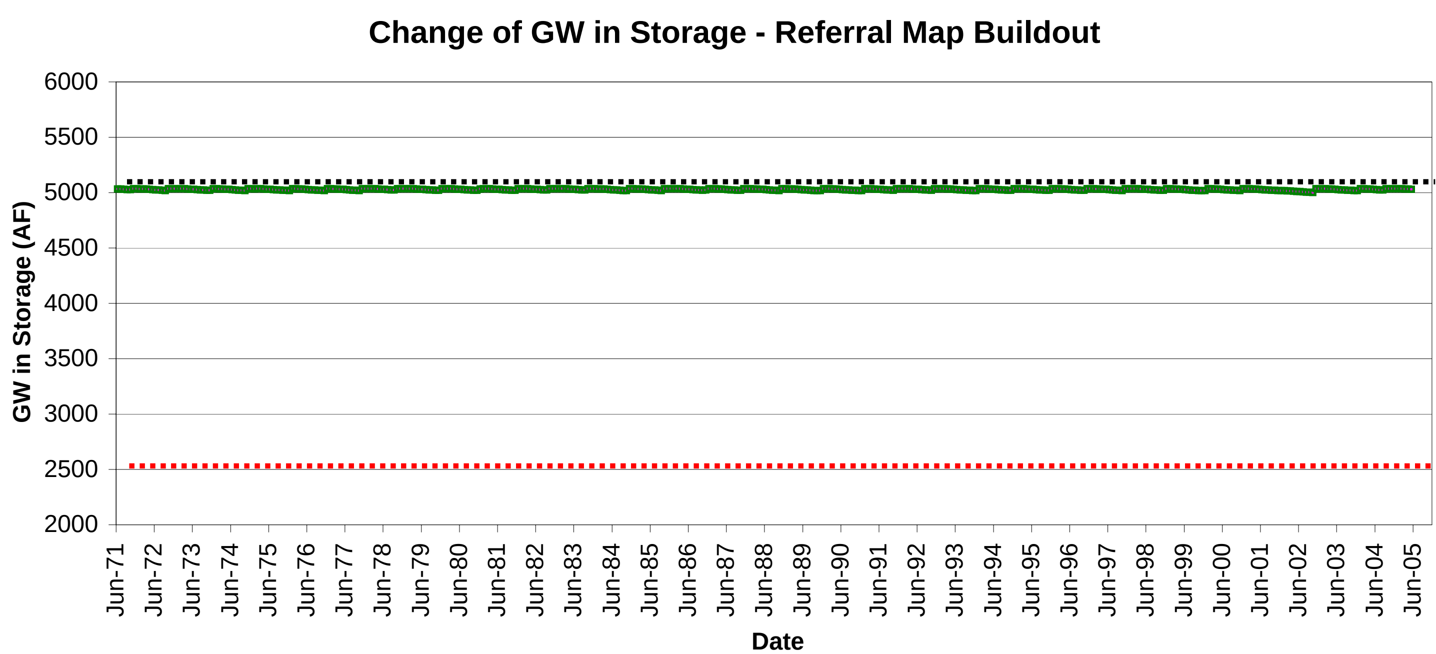


Table C-54
Morena South Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	1376
Modeled Maximum GW in Storage (AF)	1354
Modeled Average GW Recharge (AFY)	346

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	198	78%	37%
Current General Plan Buildout	266	63%	1%
Referral Map Buildout	270	62%	0%
Draft Land Use Map Buildout	270	62%	0%
Hybrid Map Buildout	270	62%	0%
Environmentally Superior Buildout	269	62%	0%
Cumulative Impacts Buildout	271	62%	0%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

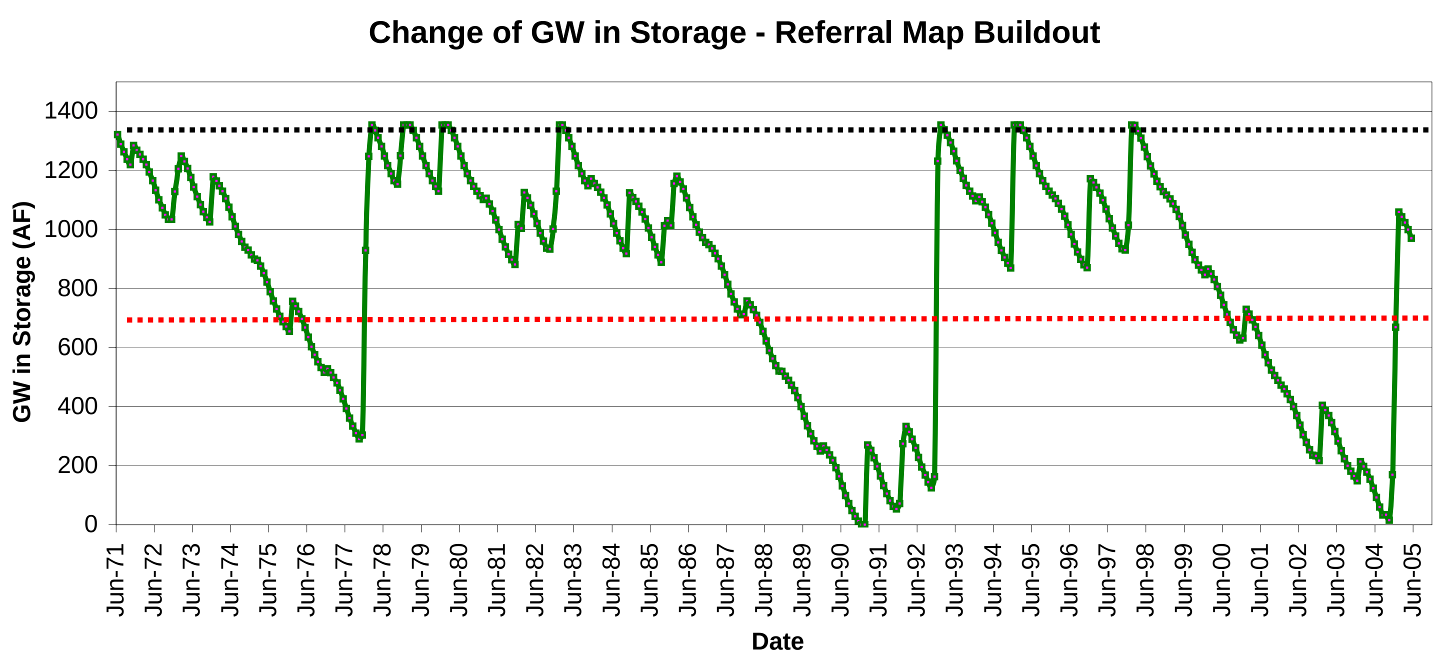


Table C-55
Mount Laguna Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	5326
Modeled Maximum GW in Storage (AF)	3097
Modeled Average GW Recharge (AFY)	1377

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	25	99%	98%
Current General Plan Buildout	26	99%	98%
Referral Map Buildout	25	99%	98%
Draft Land Use Map Buildout	25	99%	98%
Hybrid Map Buildout	25	99%	98%
Environmentally Superior Buildout	25	99%	98%
Cumulative Impacts Buildout	25	99%	98%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

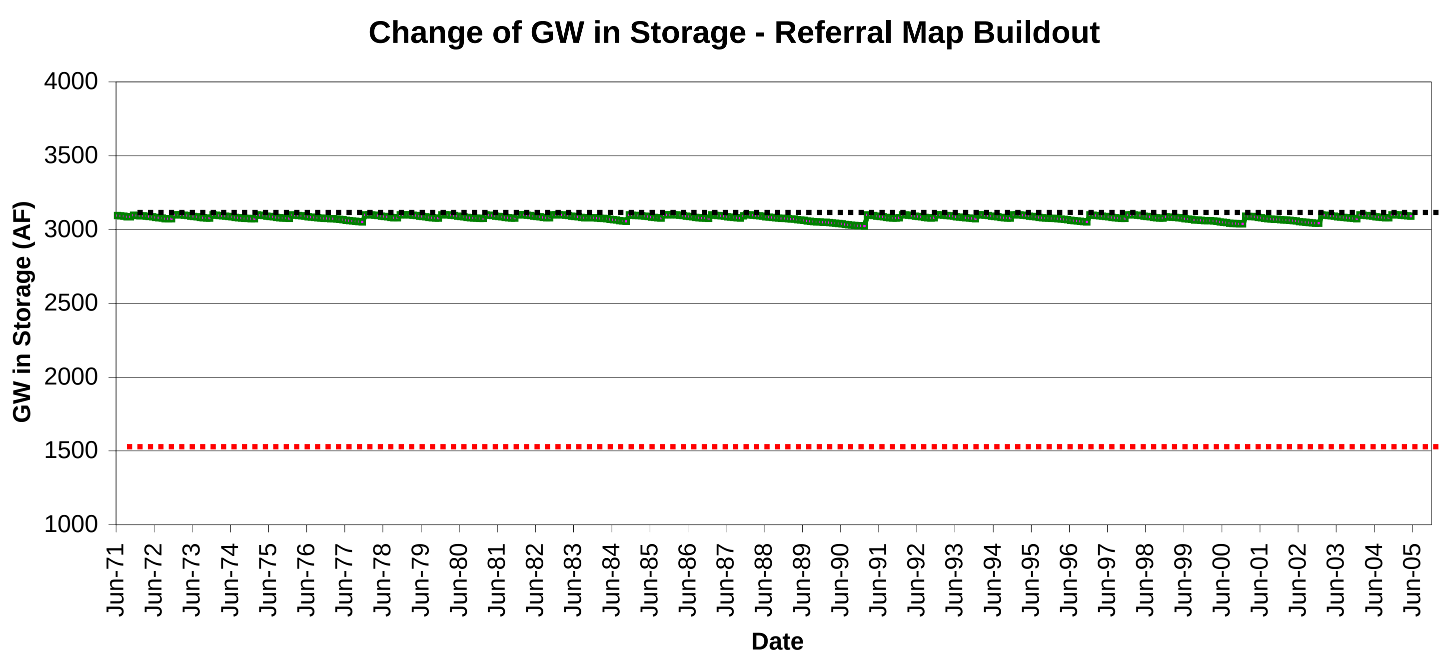


Table C-56
Otay Valley Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	3120
Modeled Maximum GW in Storage (AF)	283
Modeled Average GW Recharge (AFY)	363

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	0	100%	100%
Current General Plan Buildout	3	99%	98%
Referral Map Buildout	1	100%	99%
Draft Land Use Map Buildout	1	100%	99%
Hybrid Map Buildout	1	100%	99%
Environmentally Superior Buildout	1	100%	99%
Cumulative Impacts Buildout	1	100%	99%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

Change of GW in Storage - Referral Map Buildout

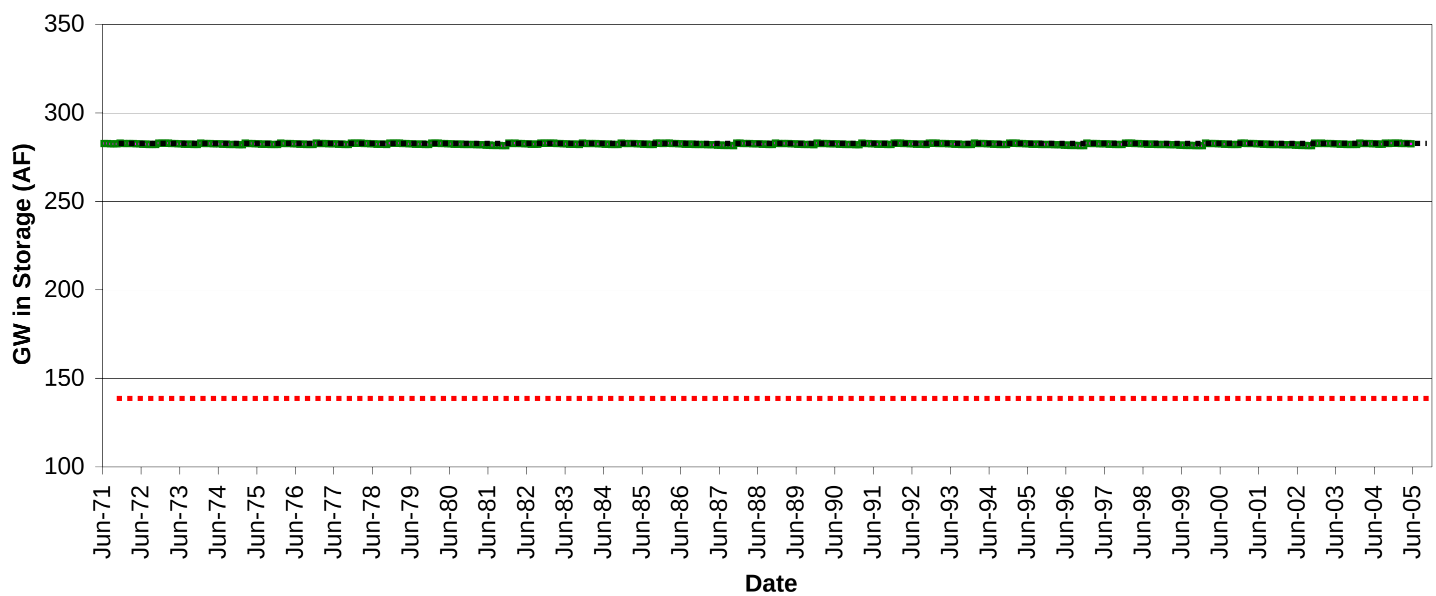


Table C-57
Pala Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	10345
Modeled Maximum GW in Storage (AF)	39946
Modeled Average GW Recharge (AFY)	2165

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	1212	95%	87%
Current General Plan Buildout	1348	94%	84%
Referral Map Buildout	1253	95%	86%
Draft Land Use Map Buildout	1249	95%	86%
Hybrid Map Buildout	1249	95%	86%
Environmentally Superior Buildout	1235	95%	86%
Cumulative Impacts Buildout	1591	92%	80%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

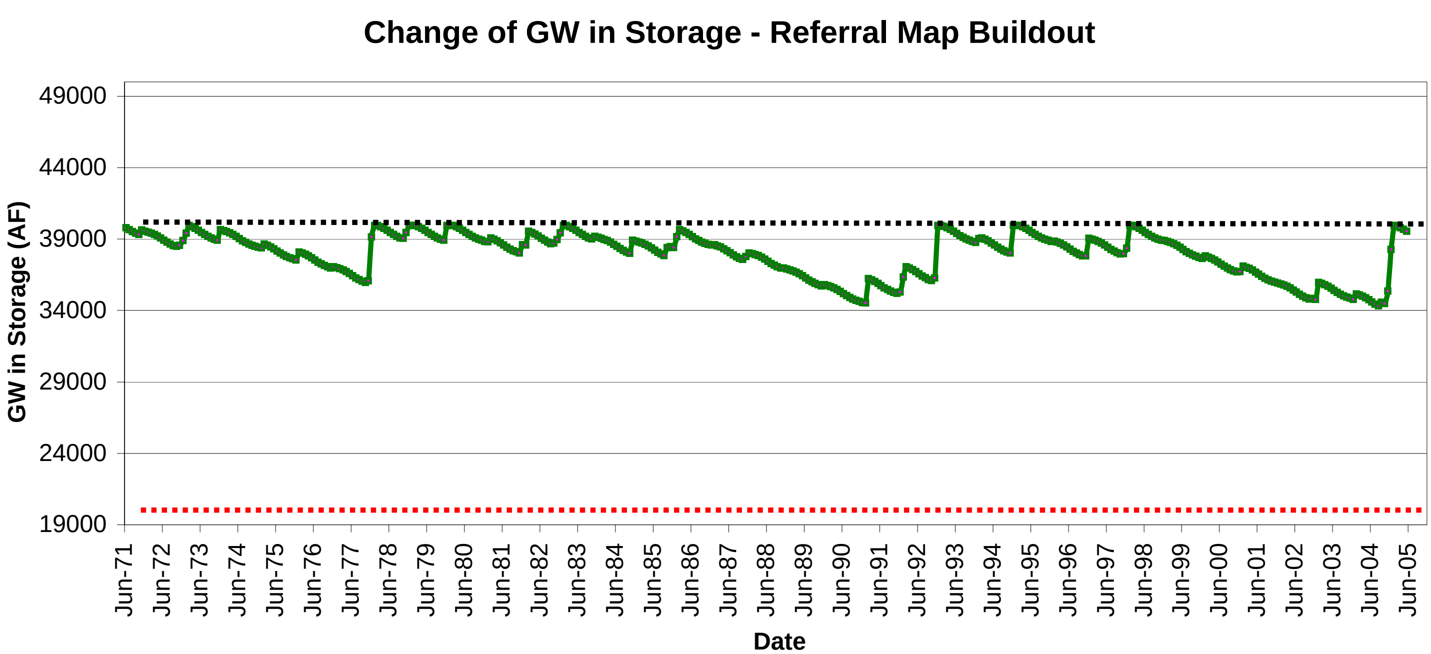


Table C-58
Pamo Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	34341
Modeled Maximum GW in Storage (AF)	5270
Modeled Average GW Recharge (AFY)	4210

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	33	100%	99%
Current General Plan Buildout	401	93%	74%
Referral Map Buildout	157	98%	95%
Draft Land Use Map Buildout	89	99%	97%
Hybrid Map Buildout	97	99%	97%
Environmentally Superior Buildout	89	99%	97%
Cumulative Impacts Buildout	157	98%	95%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

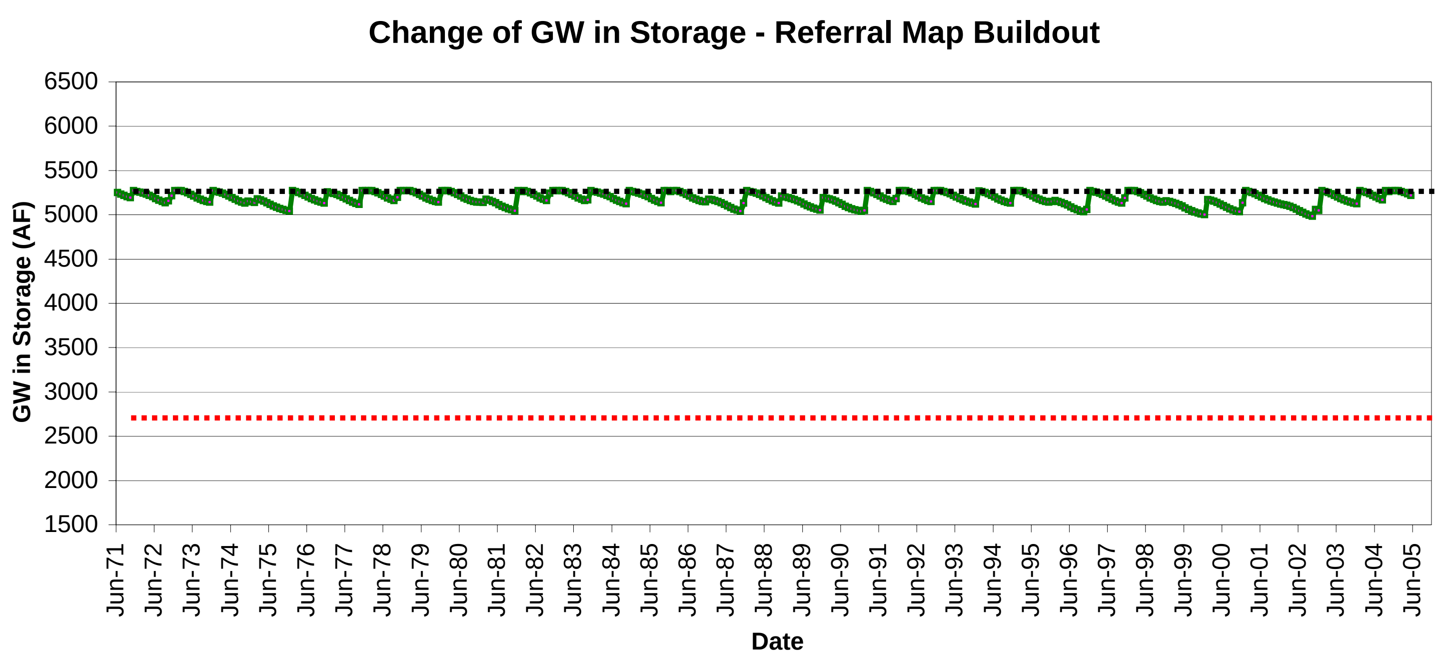


Table C-59
Pauma Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	19153
Modeled Maximum GW in Storage (AF)	26013
Modeled Average GW Recharge (AFY)	5825

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	1133	97%	88%
Current General Plan Buildout	1489	95%	81%
Referral Map Buildout	1253	96%	86%
Draft Land Use Map Buildout	1213	97%	87%
Hybrid Map Buildout	1224	97%	86%
Environmentally Superior Buildout	1184	97%	87%
Cumulative Impacts Buildout	1269	96%	86%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

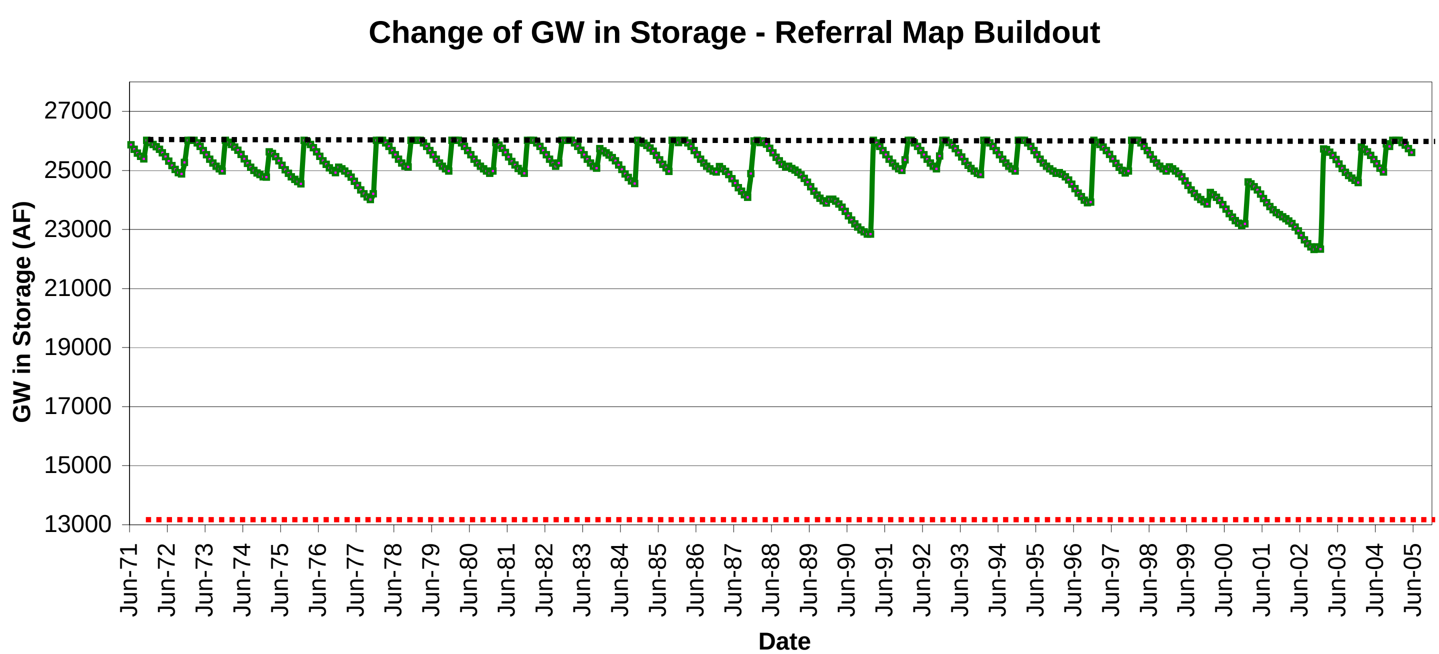


Table C-60
Pine North Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	15189
Modeled Maximum GW in Storage (AF)	2694
Modeled Average GW Recharge (AFY)	4462

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	86	99%	94%
Current General Plan Buildout	112	98%	92%
Referral Map Buildout	99	99%	93%
Draft Land Use Map Buildout	99	99%	93%
Hybrid Map Buildout	99	99%	93%
Environmentally Superior Buildout	96	99%	94%
Cumulative Impacts Buildout	103	99%	93%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

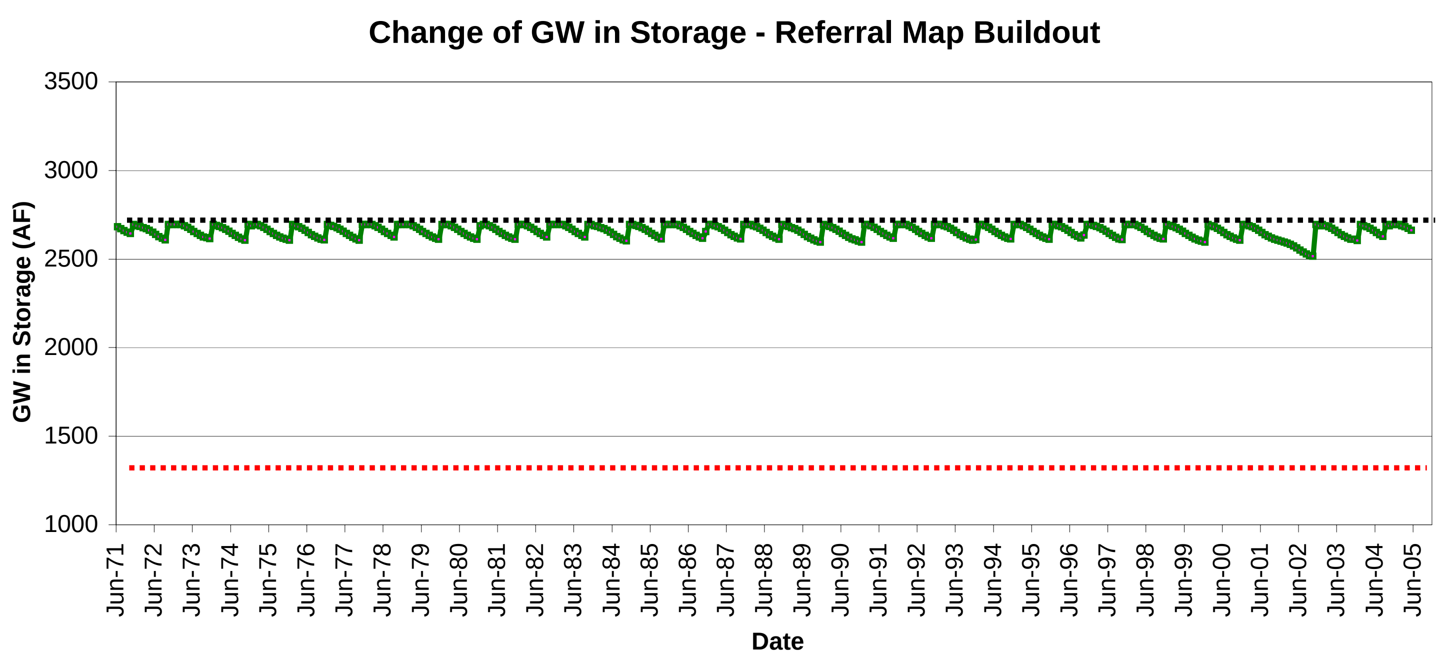


Table C-61
Pine South Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	3615
Modeled Maximum GW in Storage (AF)	2138
Modeled Average GW Recharge (AFY)	963

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	287	89%	63%
Current General Plan Buildout	410	78%	35%
Referral Map Buildout	399	80%	37%
Draft Land Use Map Buildout	399	80%	37%
Hybrid Map Buildout	399	80%	37%
Environmentally Superior Buildout	376	82%	43%
Cumulative Impacts Buildout	418	78%	33%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

Change of GW in Storage - Referral Map Buildout

Table C-62
Poway Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	1717
Modeled Maximum GW in Storage (AF)	399
Modeled Average GW Recharge (AFY)	184

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	28	91%	67%
Current General Plan Buildout	64	71%	17%
Referral Map Buildout	37	87%	55%
Draft Land Use Map Buildout	37	87%	55%
Hybrid Map Buildout	37	87%	55%
Environmentally Superior Buildout	33	89%	61%
Cumulative Impacts Buildout	37	87%	55%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

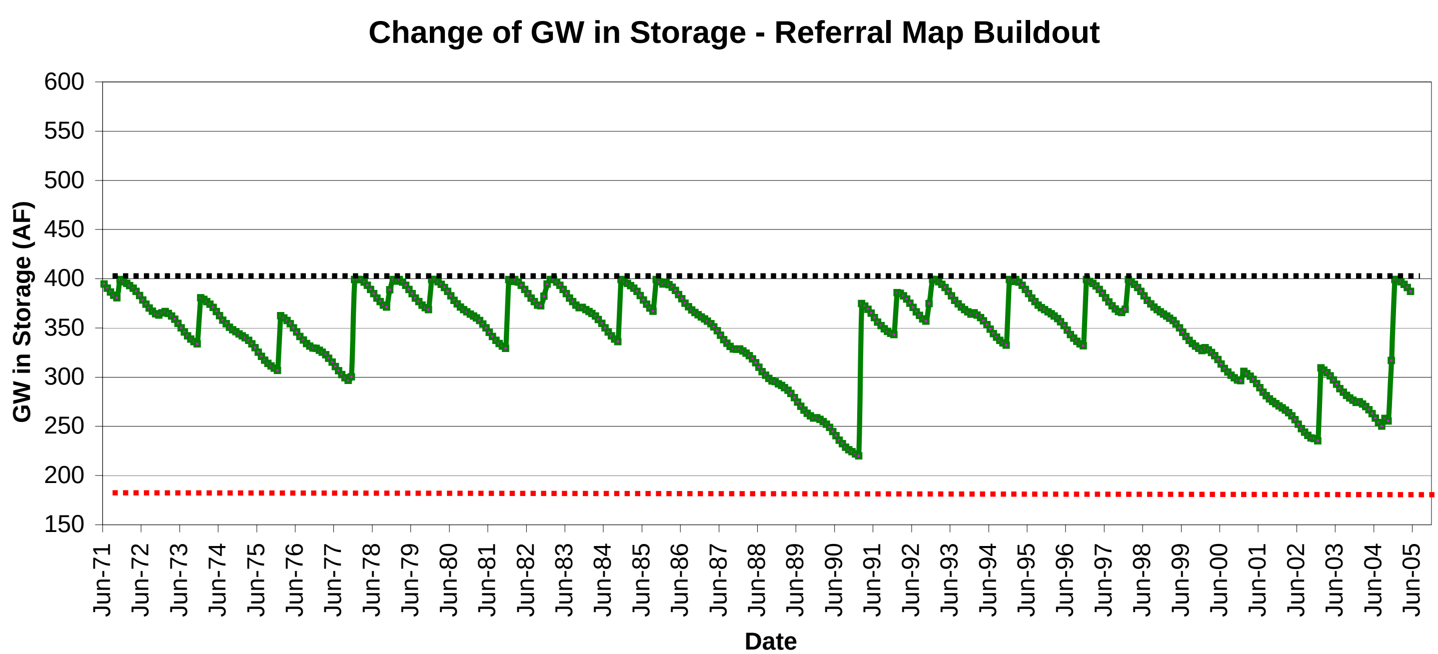


Table C-63
Previtt Canyon Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	18314
Modeled Maximum GW in Storage (AF)	9065
Modeled Average GW Recharge (AFY)	4144

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	235	99%	95%
Current General Plan Buildout	901	92%	70%
Referral Map Buildout	322	98%	93%
Draft Land Use Map Buildout	282	98%	94%
Hybrid Map Buildout	282	98%	94%
Environmentally Superior Buildout	281	98%	94%
Cumulative Impacts Buildout	323	98%	93%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

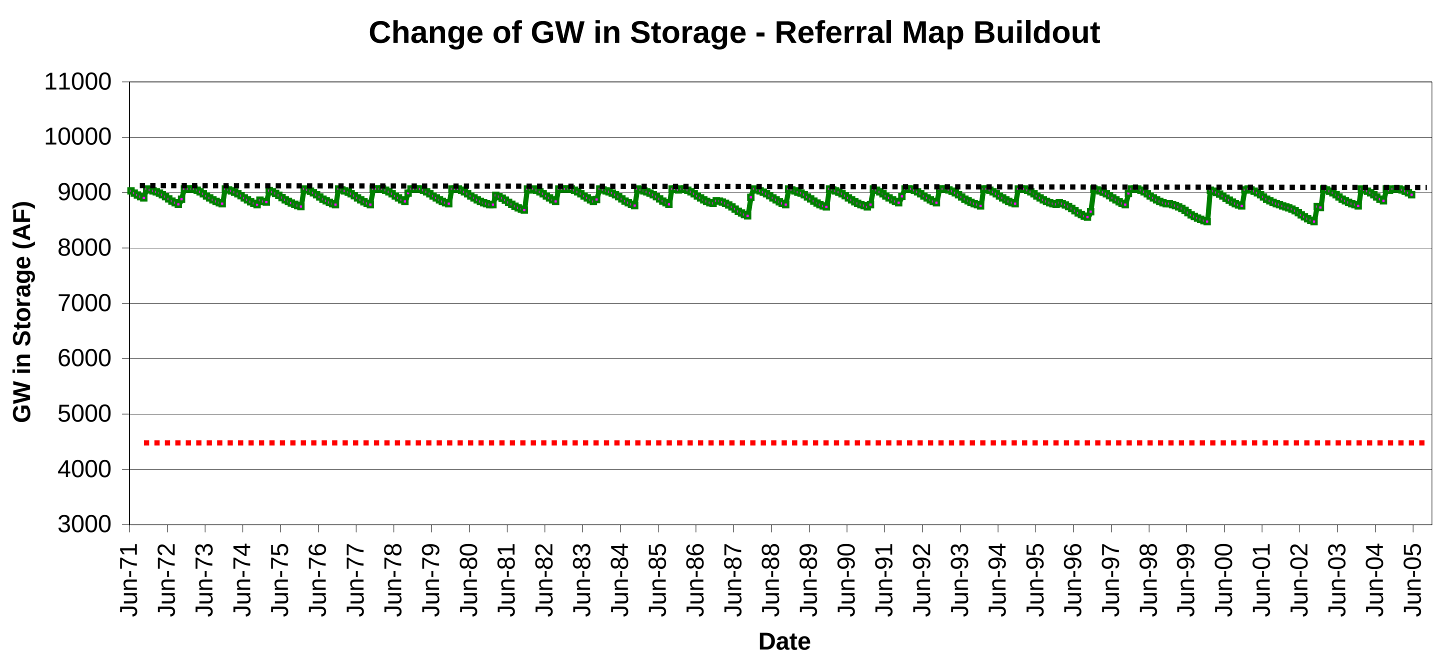


Table C-64
Proctor Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	1236
Modeled Maximum GW in Storage (AF)	770
Modeled Average GW Recharge (AFY)	115

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	0	100%	100%
Current General Plan Buildout	0	100%	100%
Referral Map Buildout	0	100%	100%
Draft Land Use Map Buildout	0	100%	100%
Hybrid Map Buildout	0	100%	100%
Environmentally Superior Buildout	0	100%	100%
Cumulative Impacts Buildout	0	100%	100%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

Change of GW in Storage - Referral Map Buildout

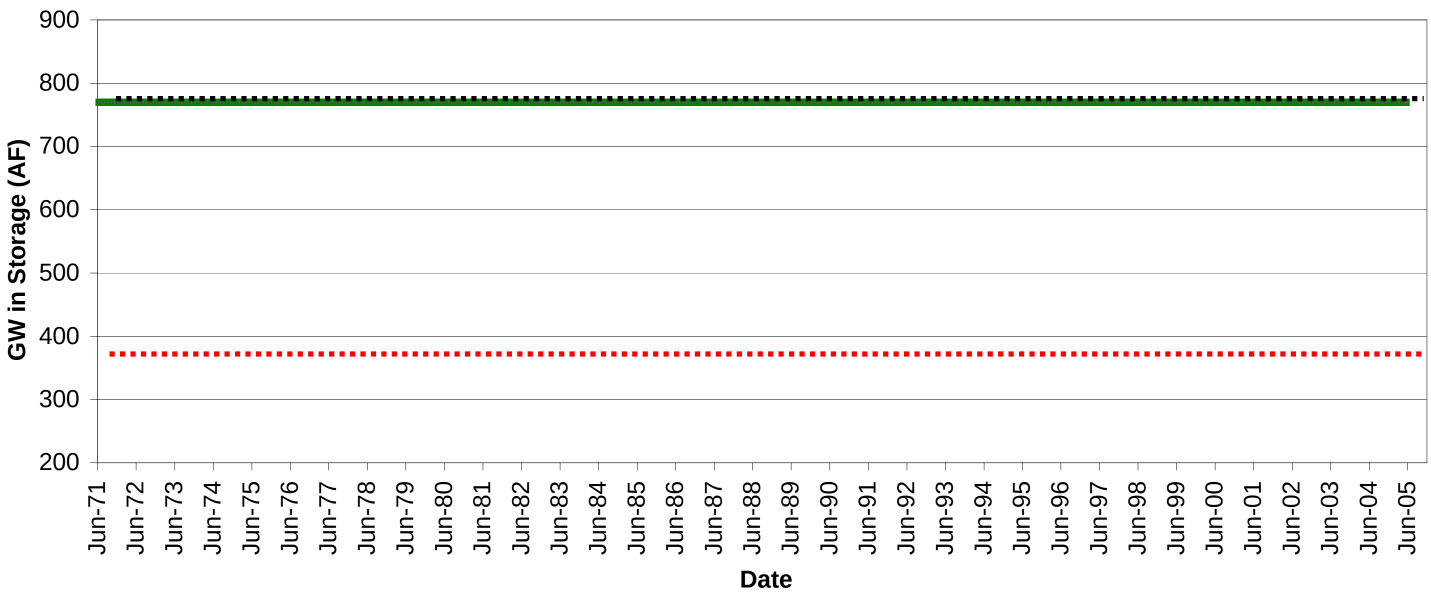


Table C-65
Ramona Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	3663
Modeled Maximum GW in Storage (AF)	1609
Modeled Average GW Recharge (AFY)	686

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	88	96%	88%
Current General Plan Buildout	187	88%	60%
Referral Map Buildout	128	93%	78%
Draft Land Use Map Buildout	113	95%	82%
Hybrid Map Buildout	119	94%	80%
Environmentally Superior Buildout	110	95%	83%
Cumulative Impacts Buildout	132	93%	77%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

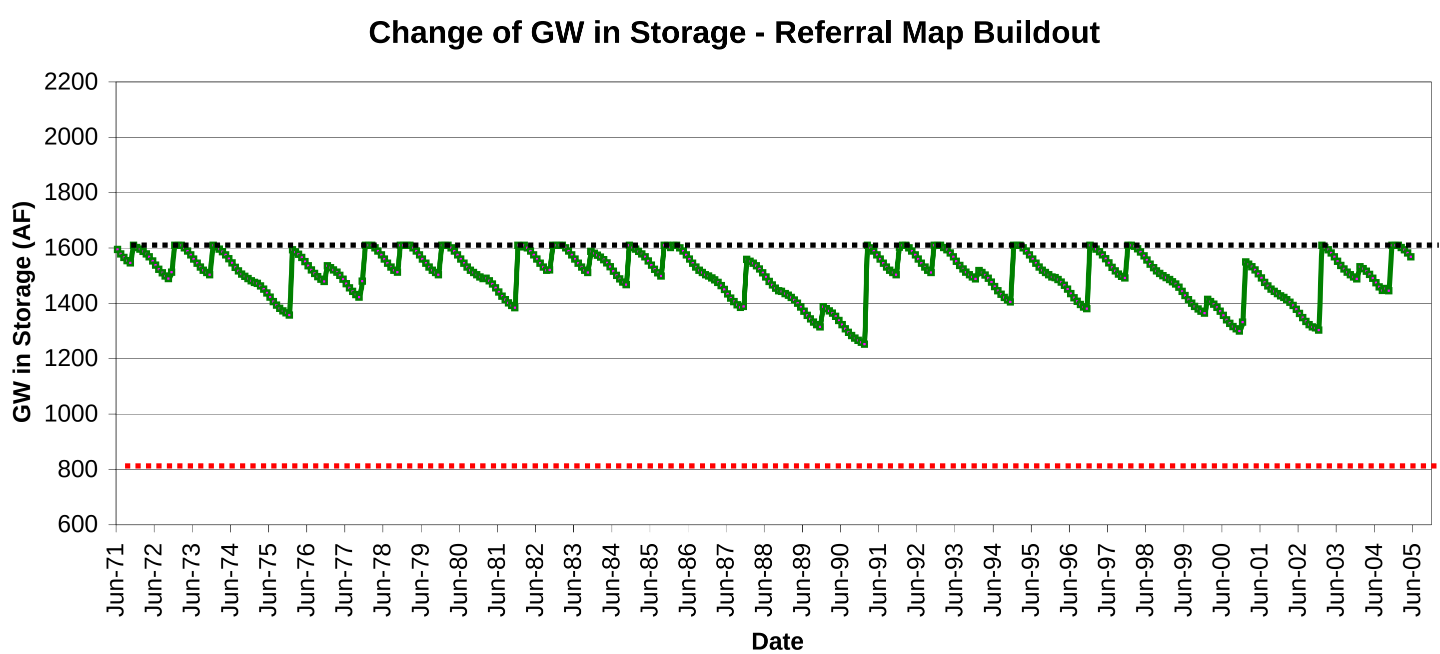


Table C-66
Redec Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	9318
Modeled Maximum GW in Storage (AF)	1348
Modeled Average GW Recharge (AFY)	2894

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	5	100%	99%
Current General Plan Buildout	14	100%	98%
Referral Map Buildout	18	99%	98%
Draft Land Use Map Buildout	12	100%	98%
Hybrid Map Buildout	12	100%	98%
Environmentally Superior Buildout	12	100%	98%
Cumulative Impacts Buildout	18	99%	98%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

Change of GW in Storage - Referral Map Buildout

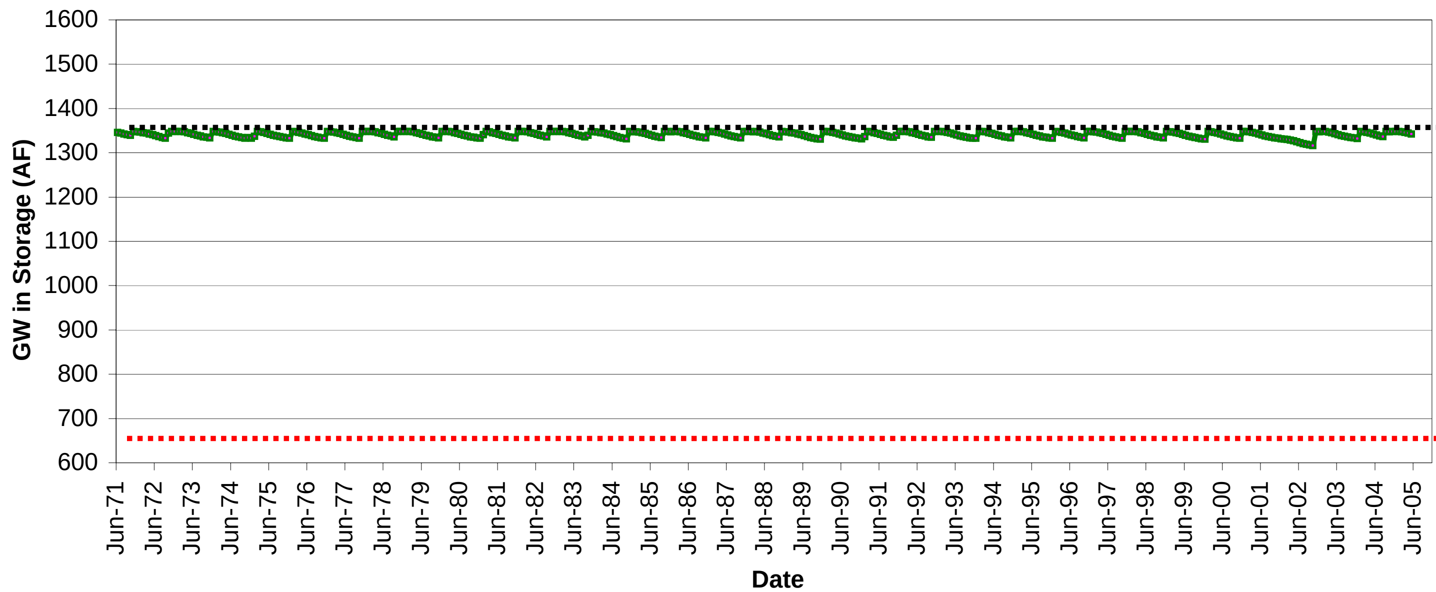


Table C-67
Reed Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	1548
Modeled Maximum GW in Storage (AF)	206
Modeled Average GW Recharge (AFY)	254

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	3	99%	97%
Current General Plan Buildout	105	47%	0%
Referral Map Buildout	23	92%	75%
Draft Land Use Map Buildout	20	94%	81%
Hybrid Map Buildout	20	94%	81%
Environmentally Superior Buildout	12	97%	89%
Cumulative Impacts Buildout	23	92%	75%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

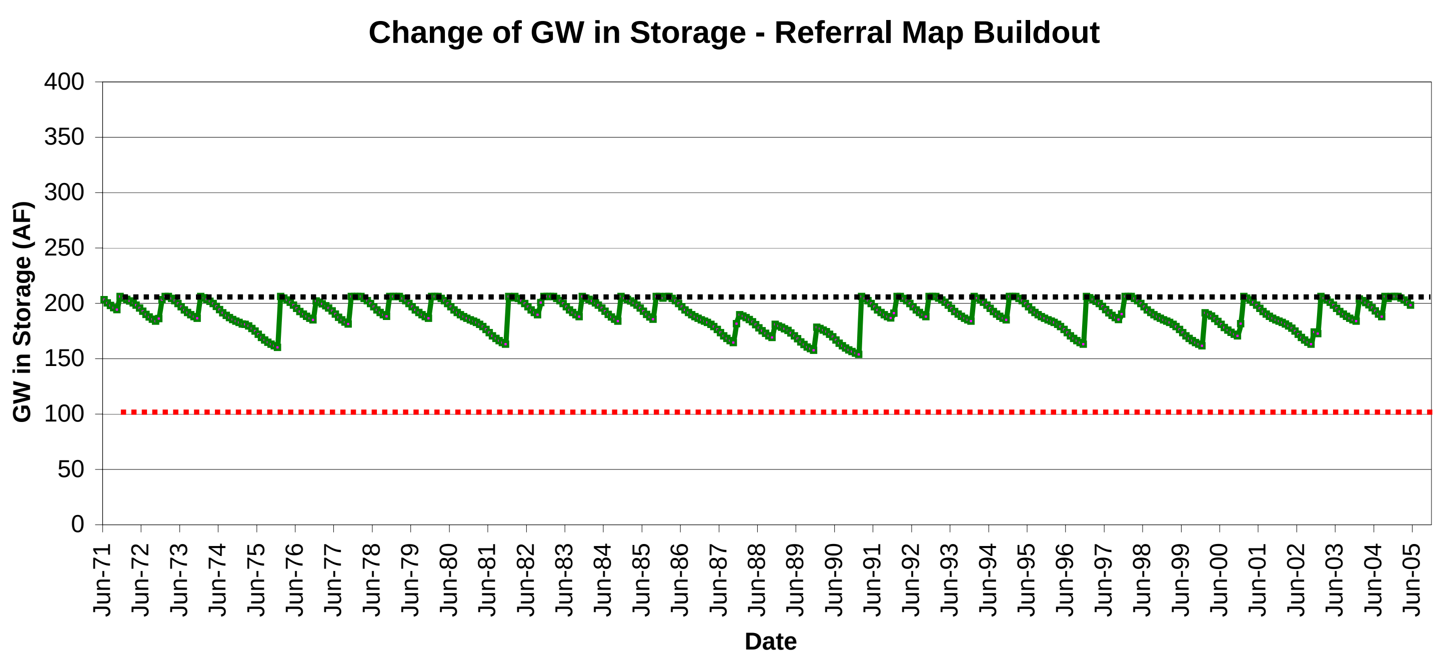


Table C-68
Round Potrero Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	1969
Modeled Maximum GW in Storage (AF)	1006
Modeled Average GW Recharge (AFY)	411

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	1	100%	100%
Current General Plan Buildout	56	97%	90%
Referral Map Buildout	12	100%	98%
Draft Land Use Map Buildout	12	100%	98%
Hybrid Map Buildout	12	100%	98%
Environmentally Superior Buildout	7	100%	99%
Cumulative Impacts Buildout	12	100%	98%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

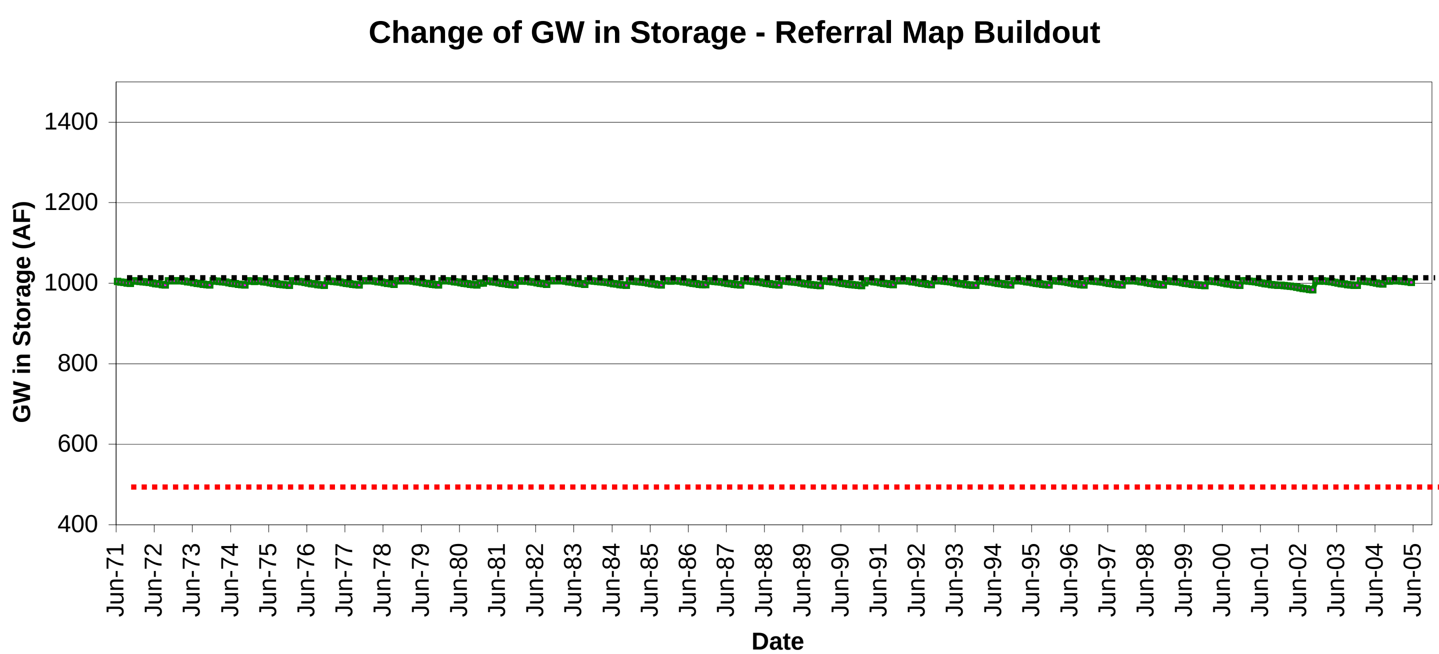


Table C-69
San Felipe North Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	11335
Modeled Maximum GW in Storage (AF)	1409
Modeled Average GW Recharge (AFY)	485

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	13	99%	98%
Current General Plan Buildout	186	67%	3%
Referral Map Buildout	54	95%	84%
Draft Land Use Map Buildout	34	97%	91%
Hybrid Map Buildout	35	97%	91%
Environmentally Superior Buildout	34	97%	91%
Cumulative Impacts Buildout	54	95%	84%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

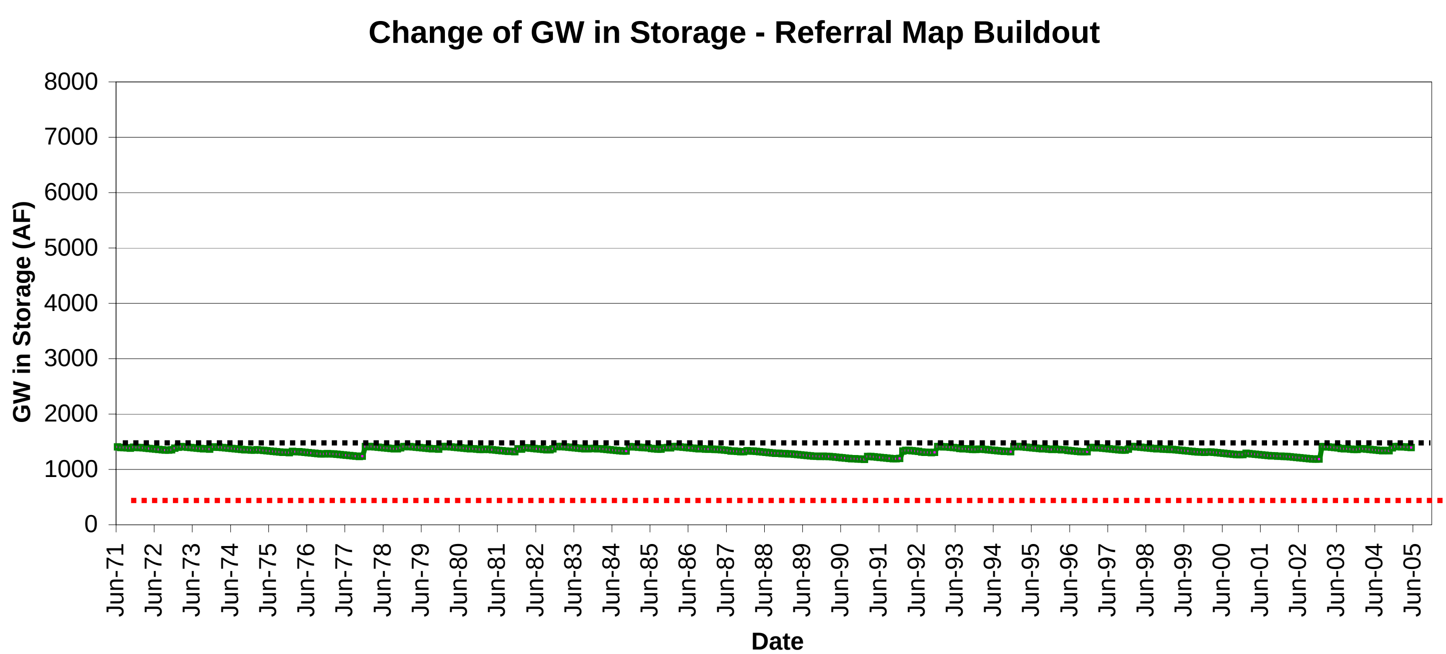


Table C-70
San Felipe South Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	10310
Modeled Maximum GW in Storage (AF)	1503
Modeled Average GW Recharge (AFY)	389

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	502	28%	0%
Current General Plan Buildout	686	21%	0%
Referral Map Buildout	612	23%	0%
Draft Land Use Map Buildout	604	23%	0%
Hybrid Map Buildout	612	23%	0%
Environmentally Superior Buildout	602	24%	0%
Cumulative Impacts Buildout	613	23%	0%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

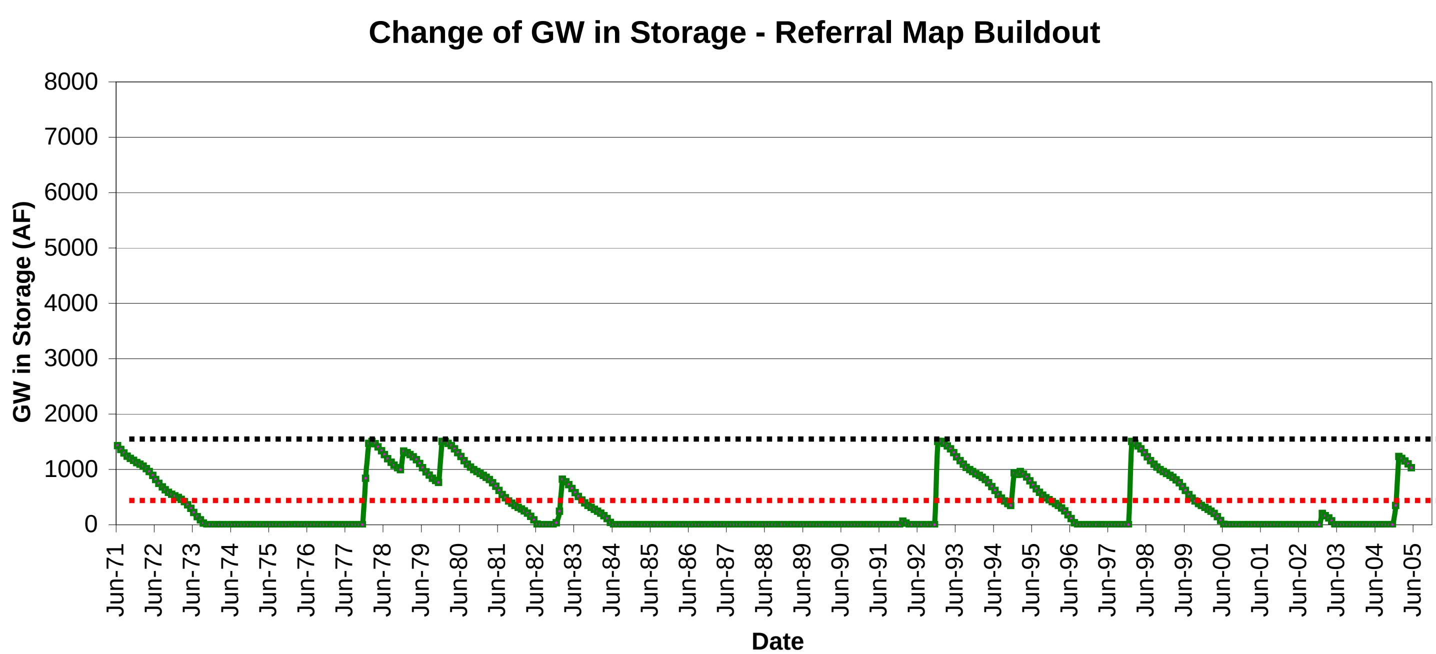


Table C-71
Santee Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	4915
Modeled Maximum GW in Storage (AF)	14328
Modeled Average GW Recharge (AFY)	415

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	23	100%	99%
Current General Plan Buildout	131	98%	96%
Referral Map Buildout	45	100%	99%
Draft Land Use Map Buildout	45	100%	99%
Hybrid Map Buildout	45	100%	99%
Environmentally Superior Buildout	36	100%	99%
Cumulative Impacts Buildout	45	100%	99%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

Change of GW in Storage - Referral Map Buildout

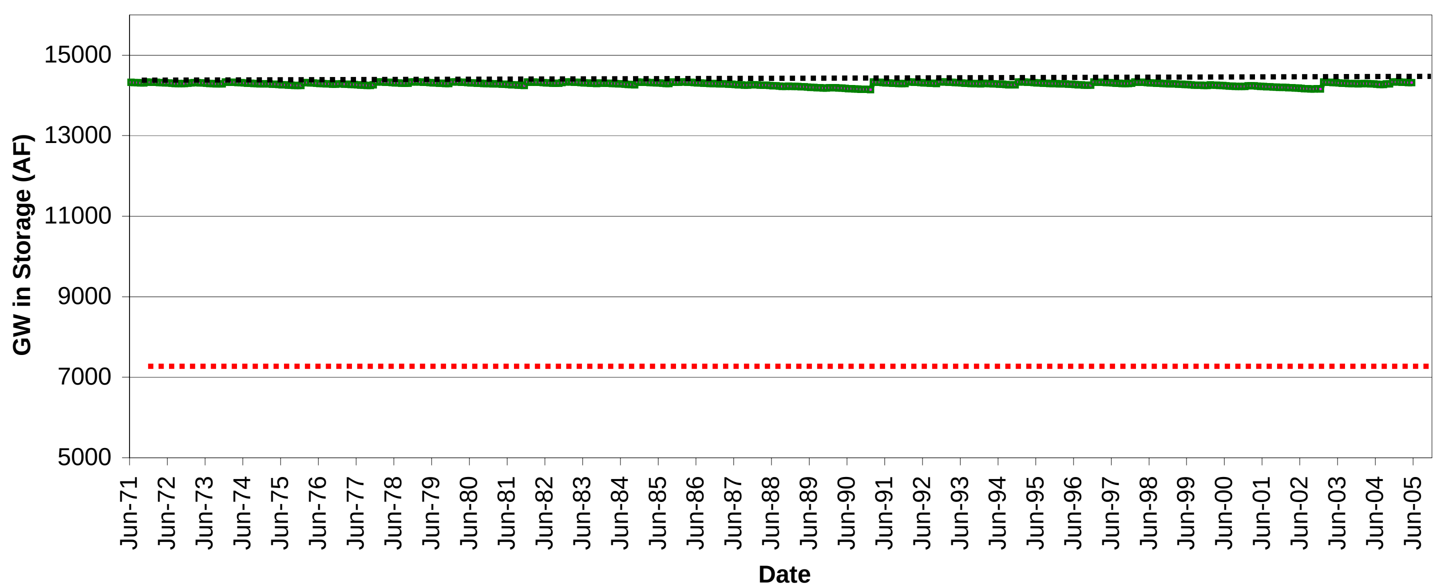


Table C-72
Savage Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	9781
Modeled Maximum GW in Storage (AF)	13882
Modeled Average GW Recharge (AFY)	696

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	0	100%	100%
Current General Plan Buildout	6	100%	100%
Referral Map Buildout	0	100%	100%
Draft Land Use Map Buildout	0	100%	100%
Hybrid Map Buildout	0	100%	100%
Environmentally Superior Buildout	0	100%	100%
Cumulative Impacts Buildout	0	100%	100%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

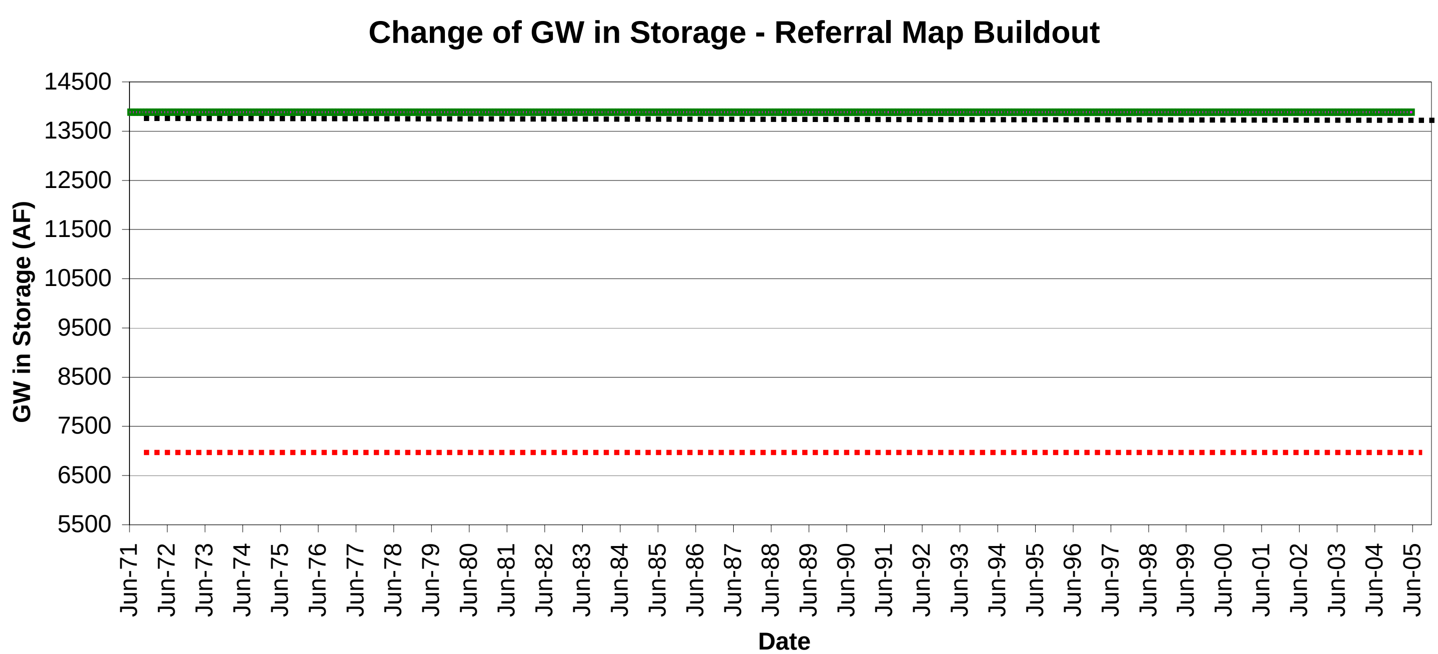


Table C-73
Spencer Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	4760
Modeled Maximum GW in Storage (AF)	1825
Modeled Average GW Recharge (AFY)	1034

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	668	43%	0%
Current General Plan Buildout	994	28%	0%
Referral Map Buildout	735	39%	0%
Draft Land Use Map Buildout	722	40%	0%
Hybrid Map Buildout	725	40%	0%
Environmentally Superior Buildout	713	40%	0%
Cumulative Impacts Buildout	734	39%	0%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

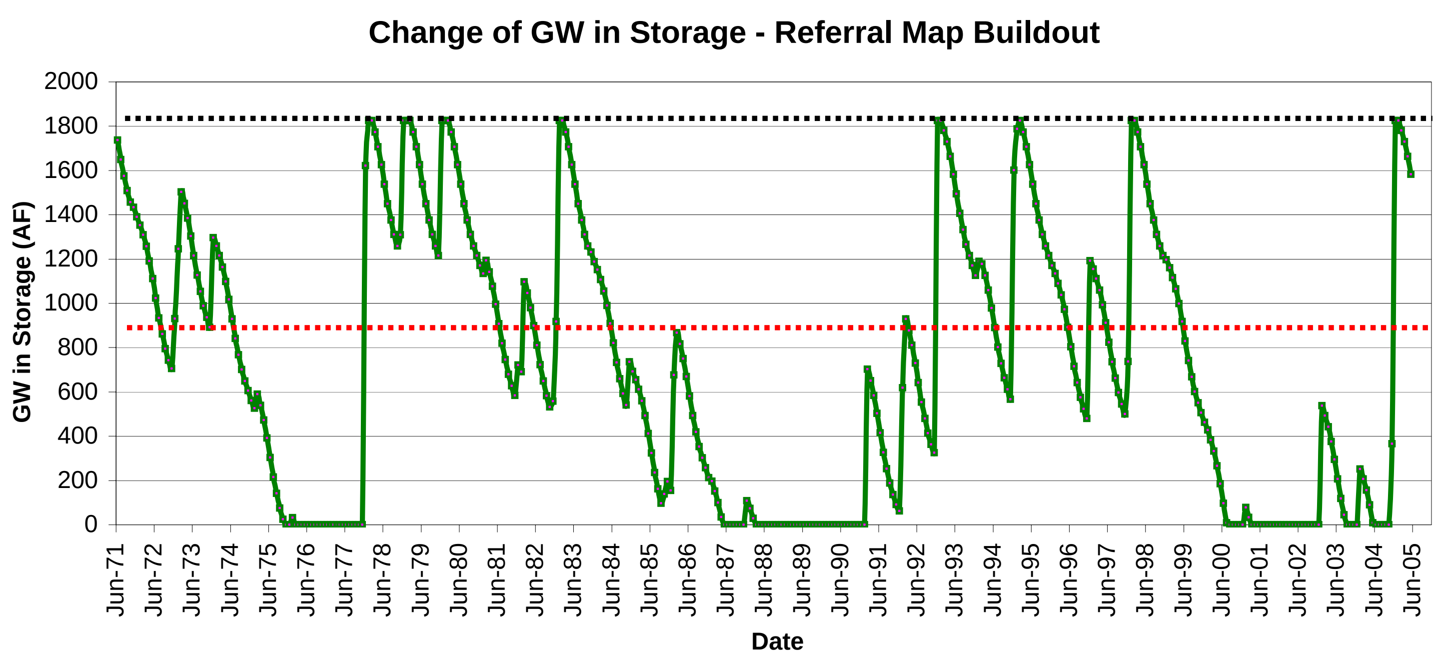


Table C-74
Sutherland Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	14019
Modeled Maximum GW in Storage (AF)	4112
Modeled Average GW Recharge (AFY)	2236

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	26	100%	99%
Current General Plan Buildout	150	98%	93%
Referral Map Buildout	135	98%	94%
Draft Land Use Map Buildout	70	99%	97%
Hybrid Map Buildout	83	99%	96%
Environmentally Superior Buildout	70	99%	97%
Cumulative Impacts Buildout	135	98%	94%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

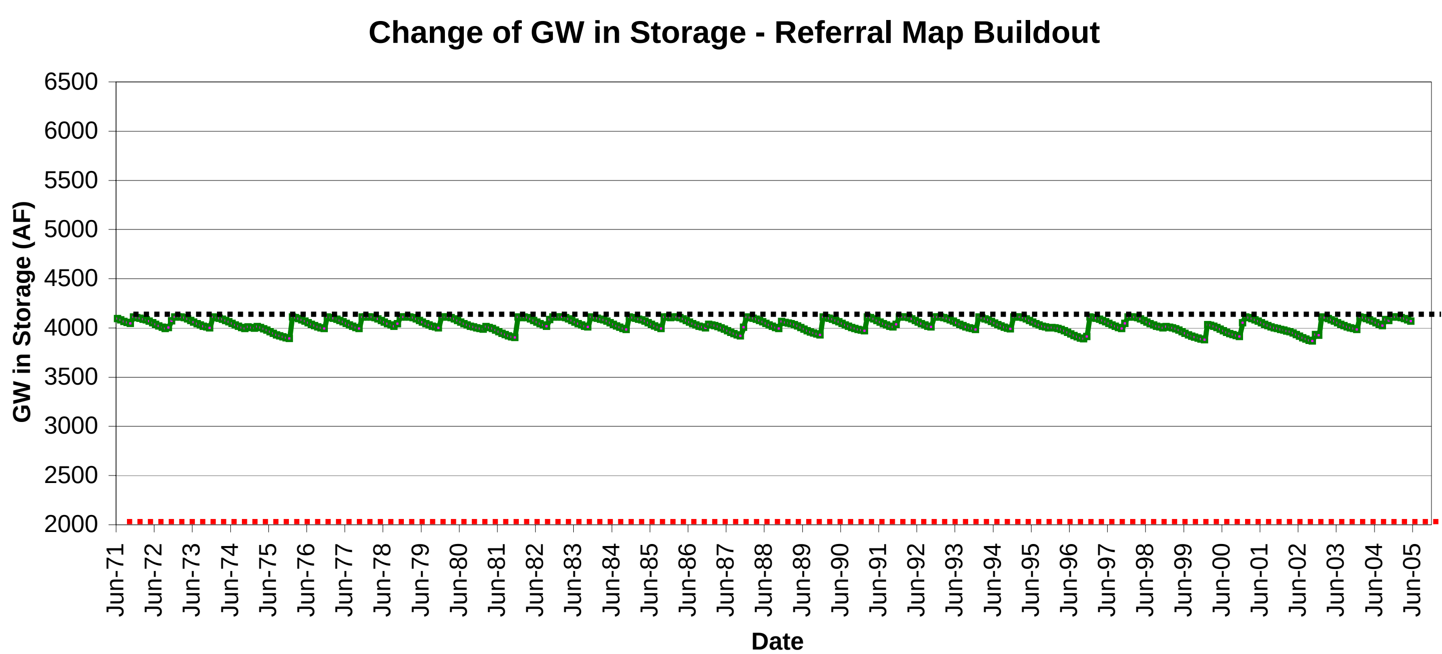


Table C-75
Tecate Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	5262
Modeled Maximum GW in Storage (AF)	1350
Modeled Average GW Recharge (AFY)	834

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	56	98%	92%
Current General Plan Buildout	486	56%	0%
Referral Map Buildout	146	94%	80%
Draft Land Use Map Buildout	125	95%	83%
Hybrid Map Buildout	125	95%	83%
Environmentally Superior Buildout	103	96%	86%
Cumulative Impacts Buildout	132	95%	82%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

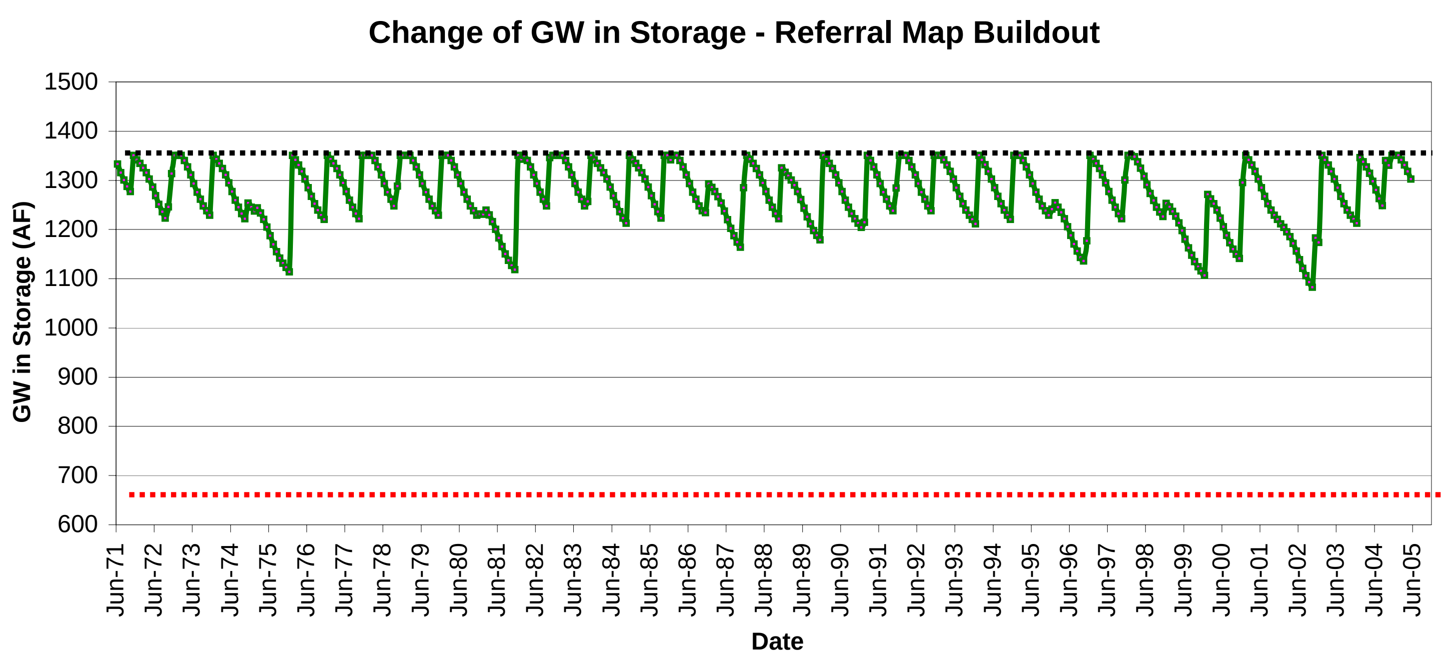


Table C-76
Tule Creek Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	4514
Modeled Maximum GW in Storage (AF)	287
Modeled Average GW Recharge (AFY)	1194

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	0	100%	100%
Current General Plan Buildout	4	99%	97%
Referral Map Buildout	2	100%	99%
Draft Land Use Map Buildout	1	100%	99%
Hybrid Map Buildout	1	100%	99%
Environmentally Superior Buildout	1	100%	99%
Cumulative Impacts Buildout	2	100%	99%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

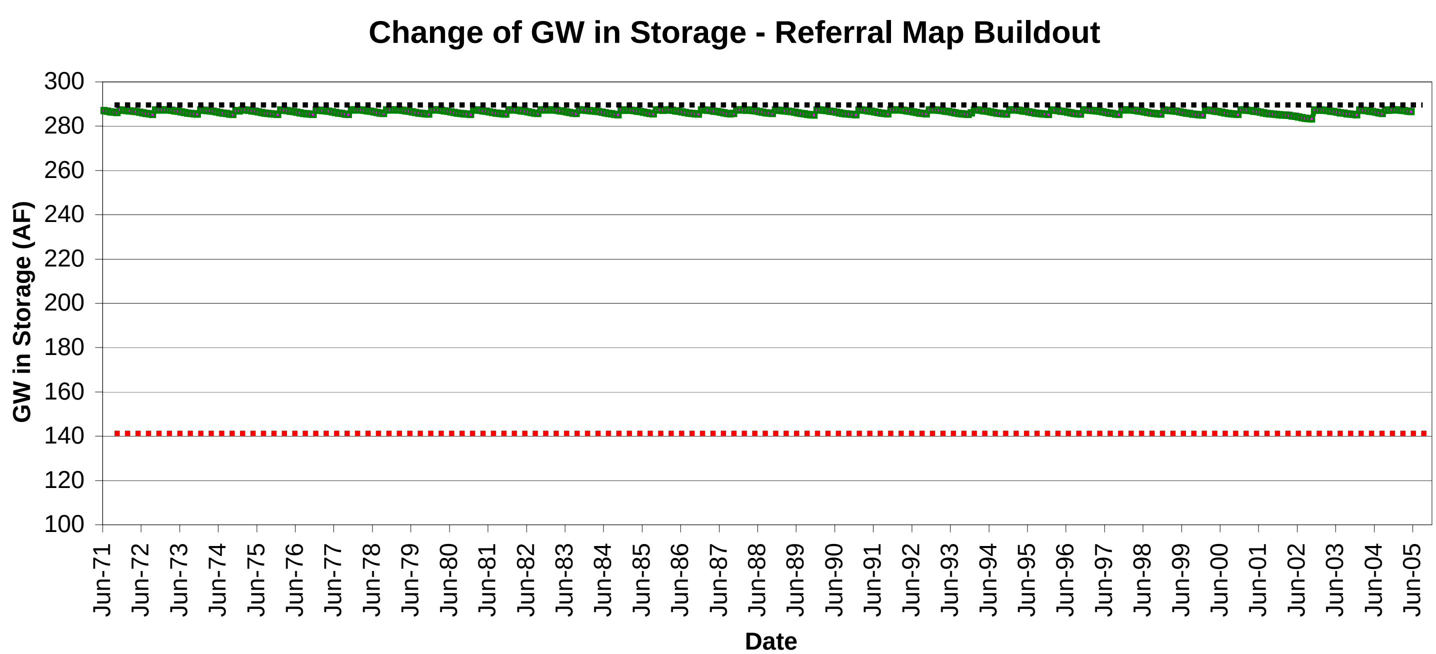


Table C-77
Upper Hatfield Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	1019
Modeled Maximum GW in Storage (AF)	284
Modeled Average GW Recharge (AFY)	191

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	22	95%	86%
Current General Plan Buildout	29	93%	79%
Referral Map Buildout	29	93%	79%
Draft Land Use Map Buildout	25	94%	83%
Hybrid Map Buildout	29	93%	80%
Environmentally Superior Buildout	25	94%	83%
Cumulative Impacts Buildout	31	93%	77%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

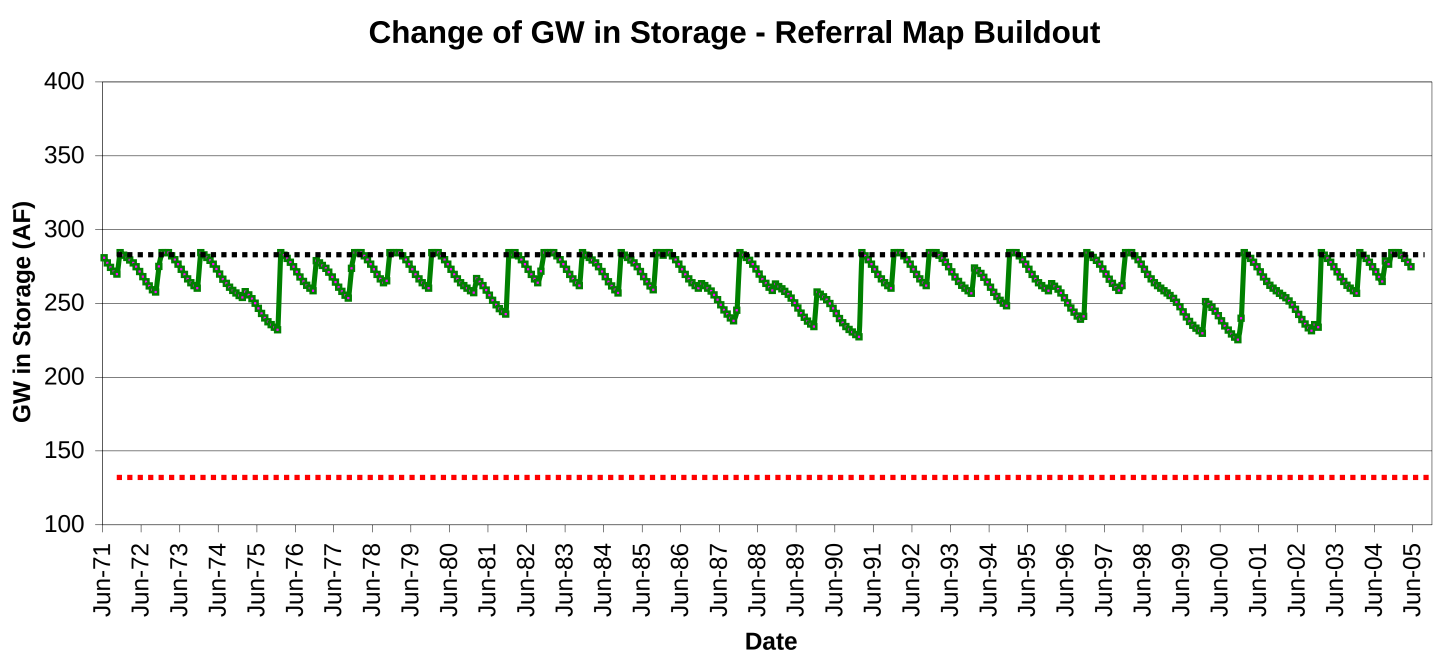


Table C-78
Vail Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	167
Modeled Maximum GW in Storage (AF)	10
Modeled Average GW Recharge (AFY)	121

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	0	100%	100%
Current General Plan Buildout	0	100%	100%
Referral Map Buildout	0	100%	100%
Draft Land Use Map Buildout	0	100%	100%
Hybrid Map Buildout	0	100%	100%
Environmentally Superior Buildout	0	100%	100%
Cumulative Impacts Buildout	0	100%	100%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

Change of GW in Storage - Referral Map Buildout

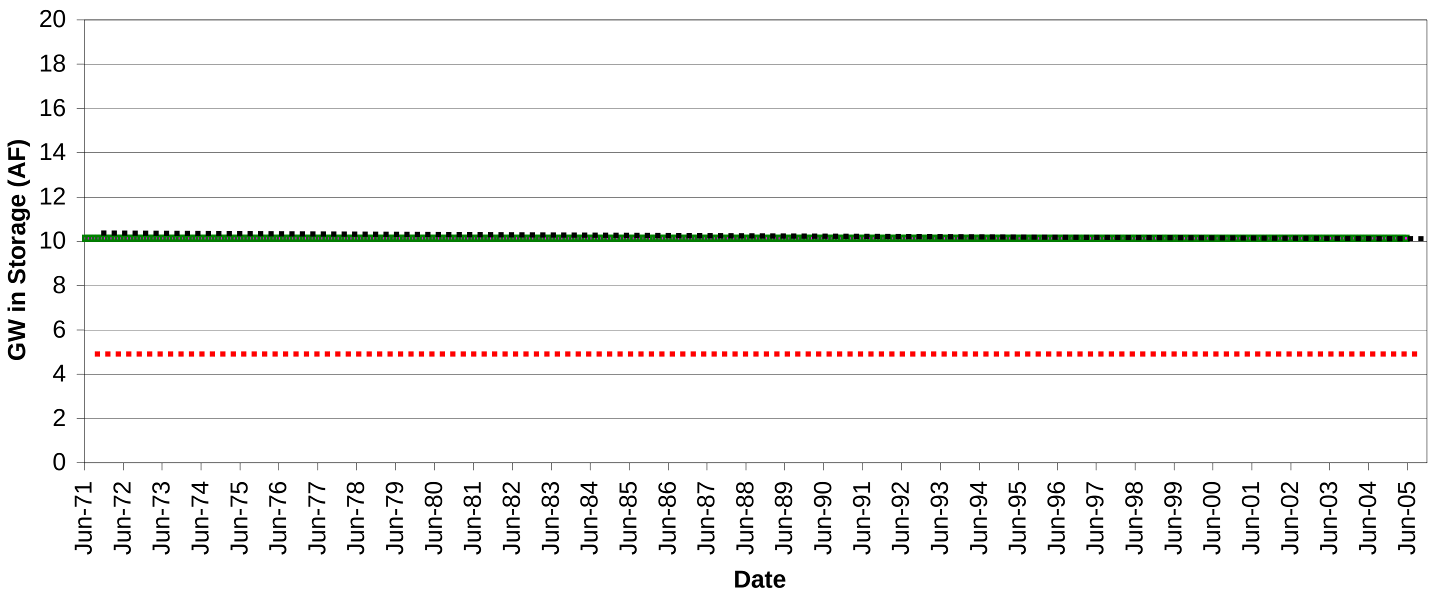


Table C-79
Vallecito Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	10370
Modeled Maximum GW in Storage (AF)	1626
Modeled Average GW Recharge (AFY)	741

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	6	100%	99%
Current General Plan Buildout	41	98%	92%
Referral Map Buildout	7	100%	99%
Draft Land Use Map Buildout	7	100%	99%
Hybrid Map Buildout	7	100%	99%
Environmentally Superior Buildout	7	100%	99%
Cumulative Impacts Buildout	7	100%	99%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

Change of GW in Storage - Referral Map Buildout

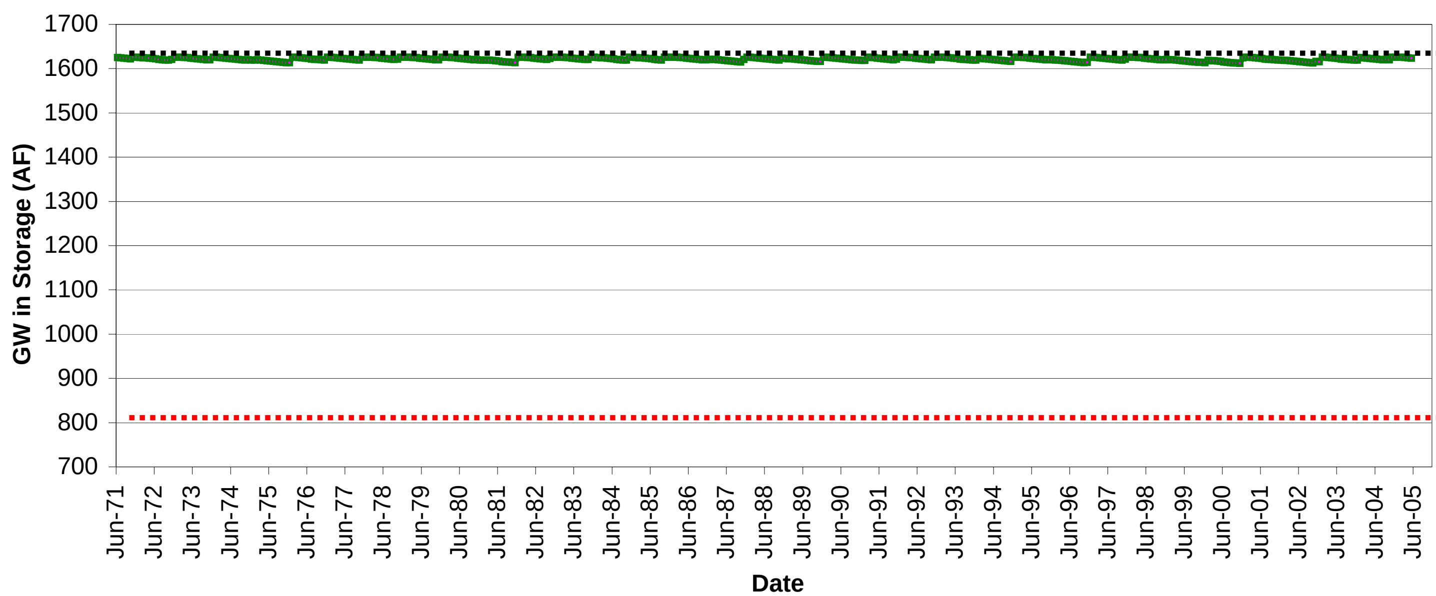


Table C-80
Viejas Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	5791
Modeled Maximum GW in Storage (AF)	2224
Modeled Average GW Recharge (AFY)	816

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	156	93%	76%
Current General Plan Buildout	173	91%	72%
Referral Map Buildout	171	92%	73%
Draft Land Use Map Buildout	171	92%	73%
Hybrid Map Buildout	171	92%	73%
Environmentally Superior Buildout	164	92%	74%
Cumulative Impacts Buildout	270	82%	50%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

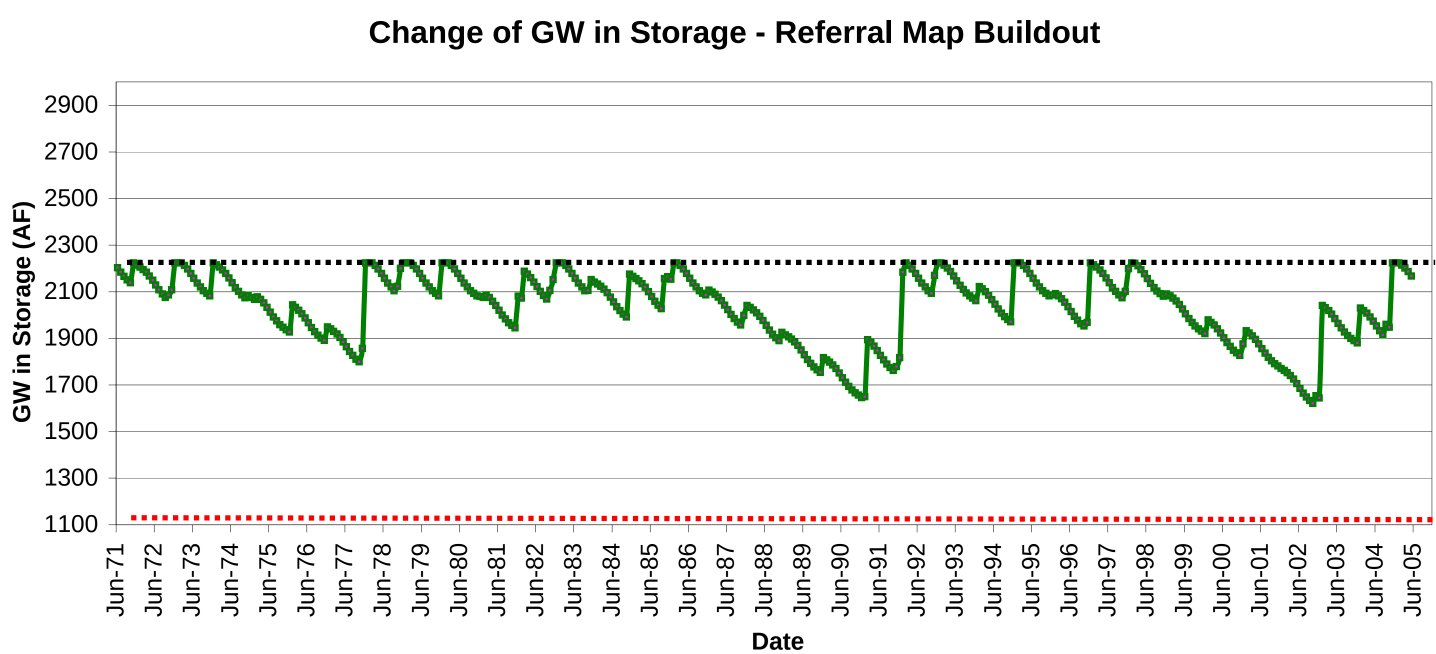


Table C-81
Vineyard Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	1793
Modeled Maximum GW in Storage (AF)	647
Modeled Average GW Recharge (AFY)	142

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	18	95%	84%
Current General Plan Buildout	41	84%	54%
Referral Map Buildout	34	88%	63%
Draft Land Use Map Buildout	22	93%	79%
Hybrid Map Buildout	27	91%	74%
Environmentally Superior Buildout	22	93%	79%
Cumulative Impacts Buildout	34	88%	63%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

Change of GW in Storage - Referral Map Buildout

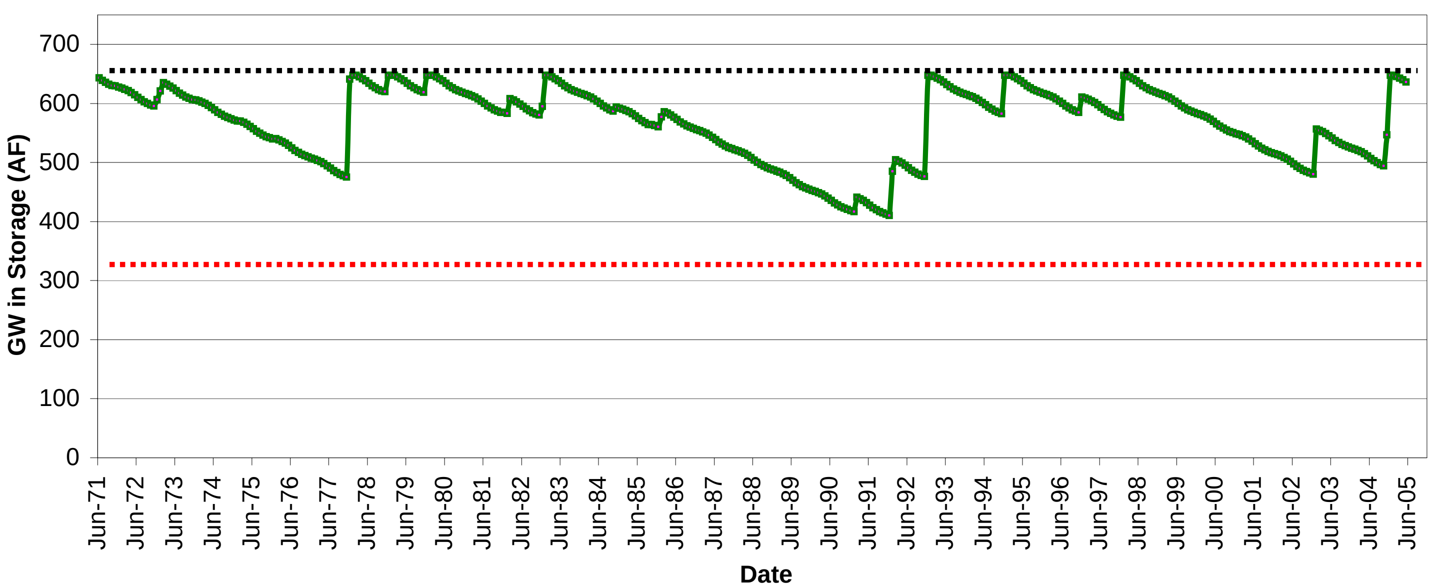


Table C-82
Warner Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	102835
Modeled Maximum GW in Storage (AF)	697382
Modeled Average GW Recharge (AFY)	20244

Included 6,300 AFY for pumping from Vista Irrigation District well field east of Lake Henshaw

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	7266	99%	96%
Current General Plan Buildout	8563	98%	95%
Referral Map Buildout	7726	99%	96%
Draft Land Use Map Buildout	7617	99%	96%
Hybrid Map Buildout	7648	99%	96%
Environmentally Superior Buildout	7645	99%	96%
Cumulative Impacts Buildout	7731	99%	96%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

Change of GW in Storage - Referral Map Buildout

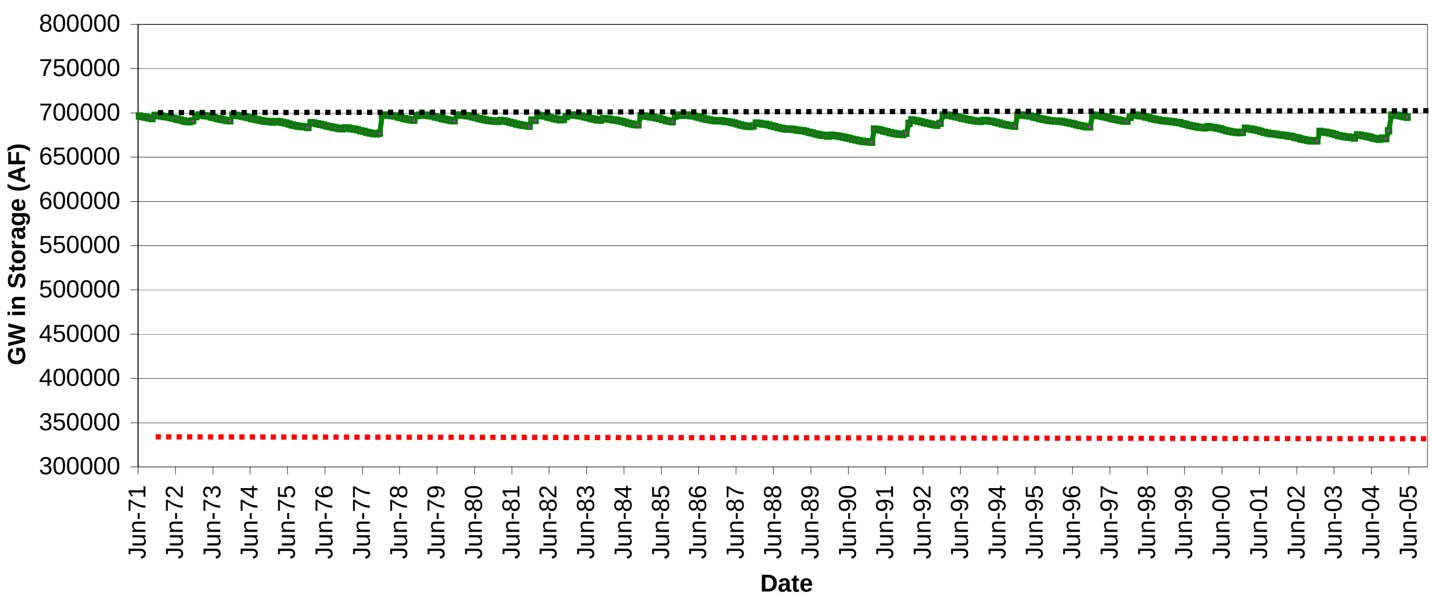


Table C-83
Wash Hollow Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	2326
Modeled Maximum GW in Storage (AF)	889
Modeled Average GW Recharge (AFY)	398

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	22	99%	95%
Current General Plan Buildout	46	97%	89%
Referral Map Buildout	46	97%	89%
Draft Land Use Map Buildout	34	98%	93%
Hybrid Map Buildout	40	97%	91%
Environmentally Superior Buildout	34	98%	93%
Cumulative Impacts Buildout	46	97%	89%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

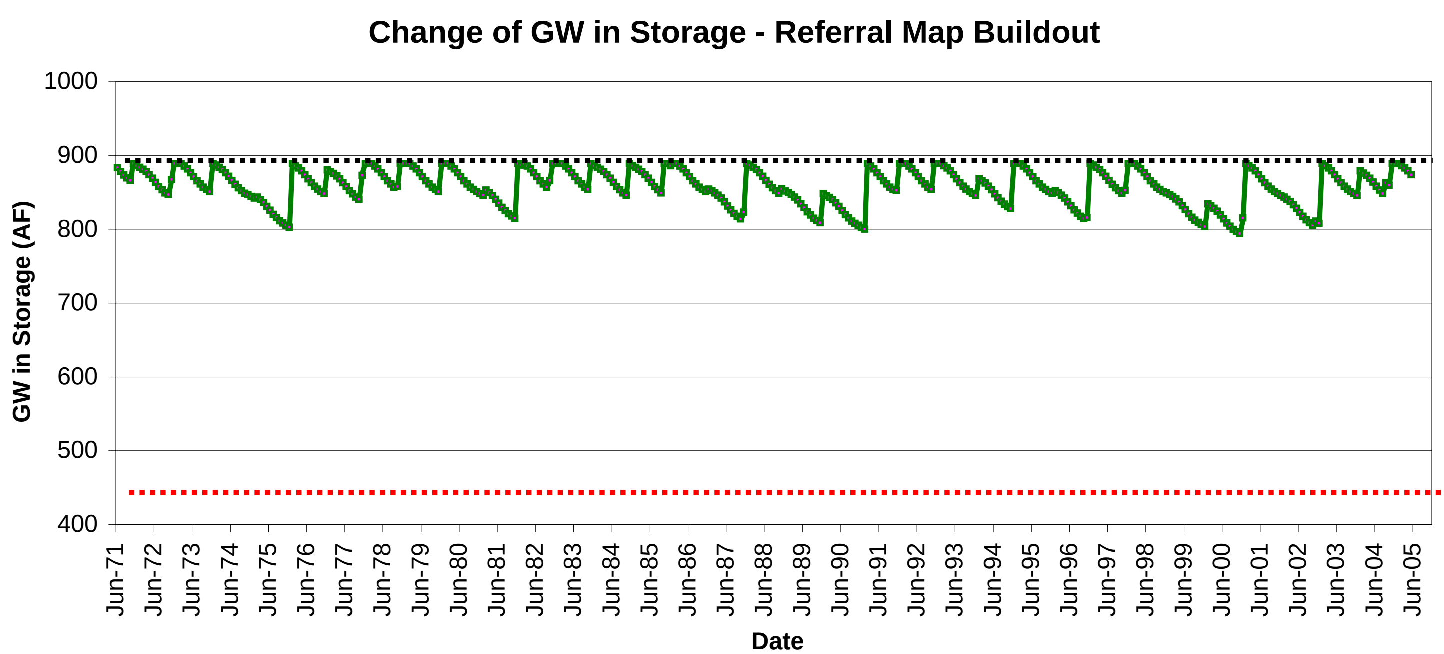


Table C-84
West Santa Teresa Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	1095
Modeled Maximum GW in Storage (AF)	353
Modeled Average GW Recharge (AFY)	176

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	18	96%	88%
Current General Plan Buildout	28	93%	76%
Referral Map Buildout	28	93%	76%
Draft Land Use Map Buildout	23	95%	82%
Hybrid Map Buildout	23	95%	82%
Environmentally Superior Buildout	23	95%	82%
Cumulative Impacts Buildout	28	93%	75%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.

AF - Acre-Feet

AFY- Acre-Feet Per Year

GW - Groundwater

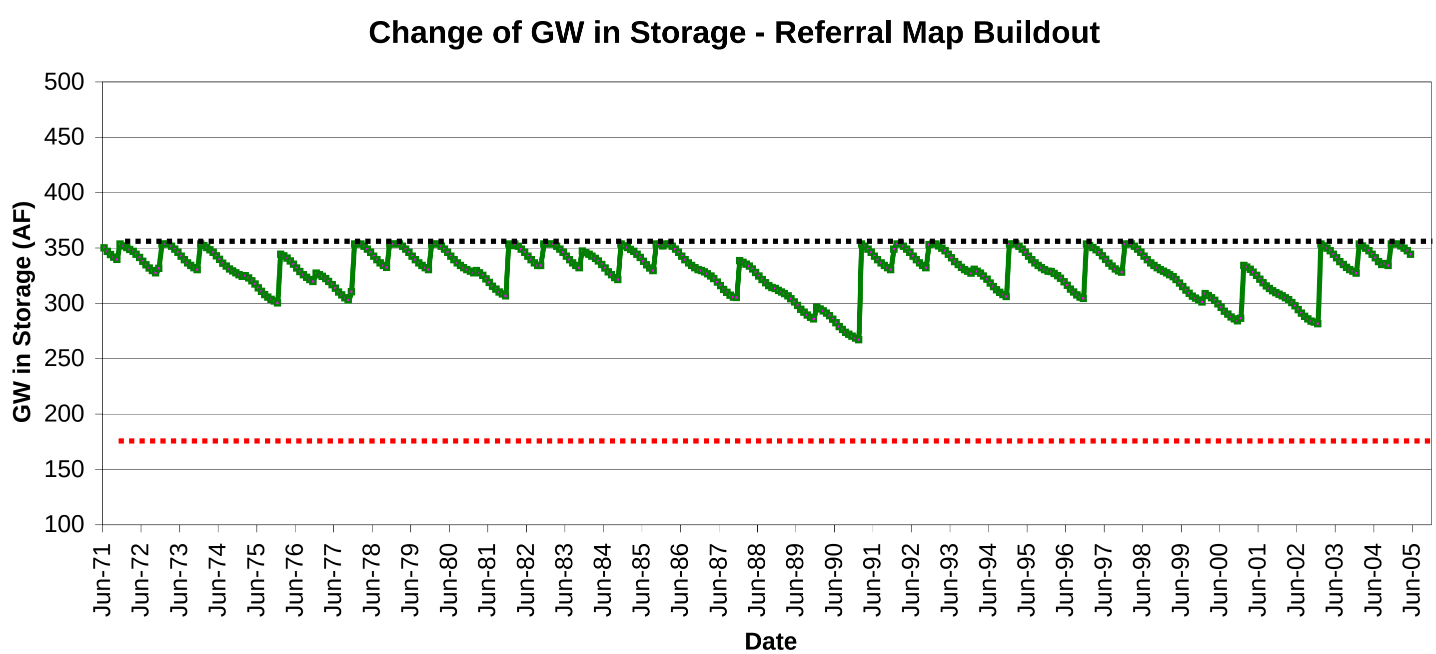


Table C-85
Witch Creek Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	12413
Modeled Maximum GW in Storage (AF)	2784
Modeled Average GW Recharge (AFY)	2249

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	63	99%	93%
Current General Plan Buildout	149	96%	84%
Referral Map Buildout	156	96%	83%
Draft Land Use Map Buildout	103	97%	89%
Hybrid Map Buildout	117	97%	87%
Environmentally Superior Buildout	102	97%	89%
Cumulative Impacts Buildout	155	96%	83%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

Change of GW in Storage - Referral Map Buildout

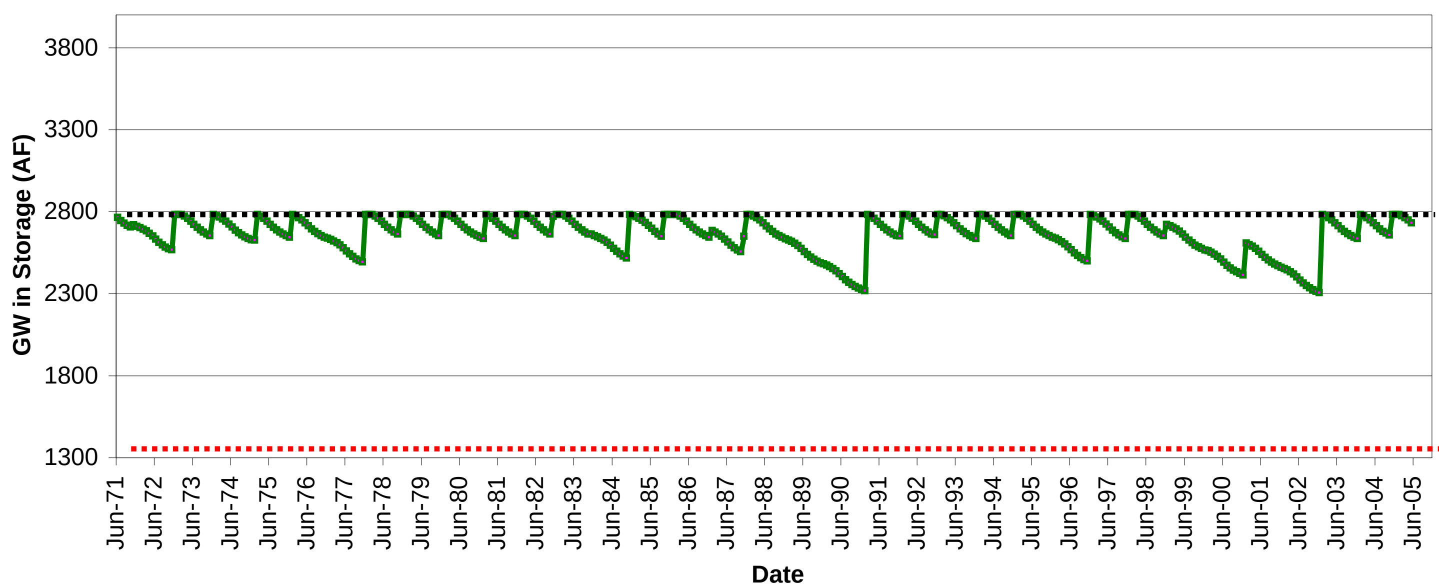


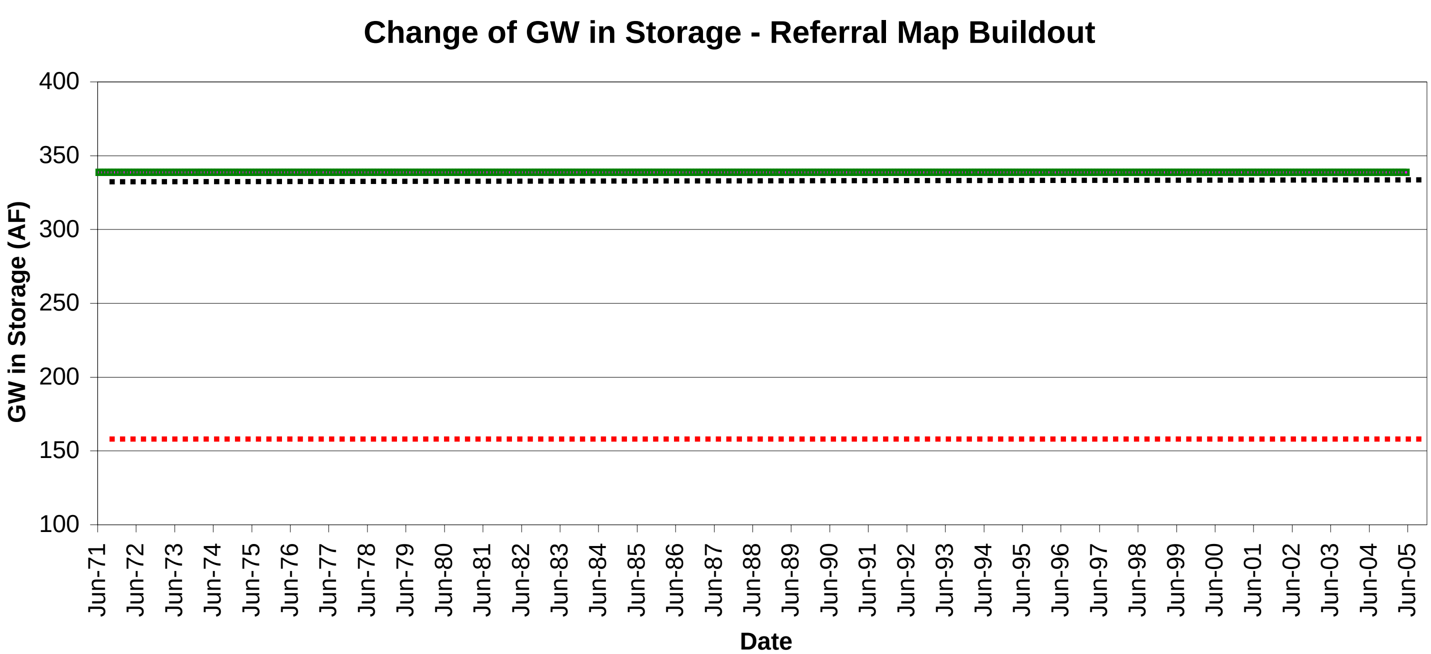
Table C-86
Wolf Basin
Groundwater in Storage Calculations

Important Note: The results presented are a screening level analysis of the 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 this basin.

Size (Acres)	1025
Modeled Maximum GW in Storage (AF)	339
Modeled Average GW Recharge (AFY)	431

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	0	100%	100%
Current General Plan Buildout	0	100%	100%
Referral Map Buildout	0	100%	100%
Draft Land Use Map Buildout	0	100%	100%
Hybrid Map Buildout	0	100%	100%
Environmentally Superior Buildout	0	100%	100%
Cumulative Impacts Buildout	0	100%	100%

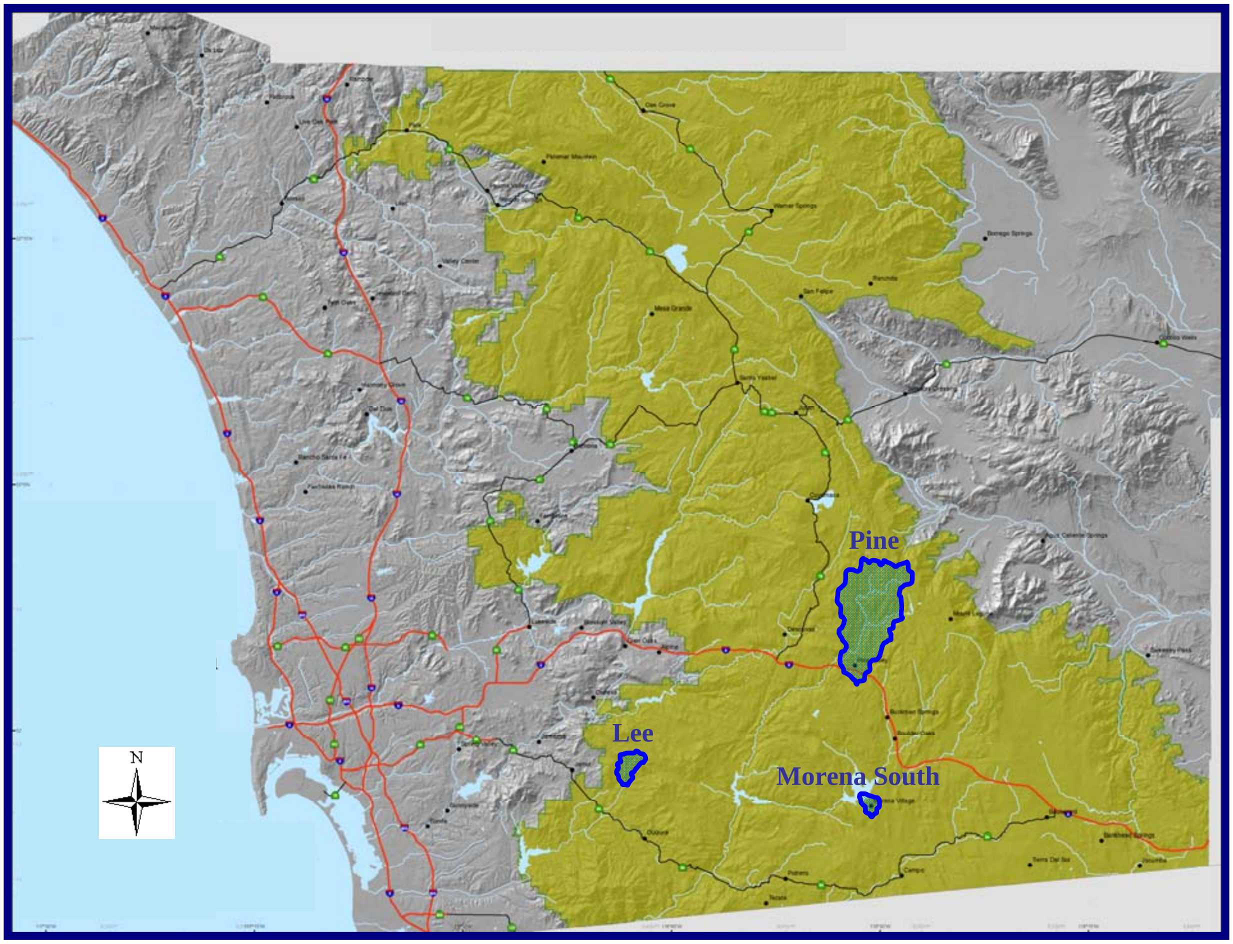
Note: Future predicted change in the amount of groundwater in storage for scenarios is based upon historical precipitation from July 1971 to June 2005. Scenarios with estimated groundwater in storage at or below 50% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater



Appendix D
Calibration and Sensitivity Analysis

FINAL

Appendix D
Calibration and Sensitivity Analysis



April 2010

DPLU

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FIGURES

D.1 CALIBRATION

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. Estimation of groundwater recharge required data compilation to estimate monthly precipitation, runoff, potential evapotranspiration, and soil moisture capacity. Of these parameters, runoff is the least known and most uncertain value of the recharge parameters used in this analysis. Runoff from stream gauging stations provides the most accurate measurement of runoff occurring within a given watershed. Since long-term runoff records are unavailable for nearly all watersheds within the study area, runoff was estimated by using the Soil Conservation Service (SCS) Curve Number Method. The long-term groundwater availability analysis is more accurately an analysis of recharge compared to potential changes in groundwater storage. Due to the data limitations associated with this effort, the groundwater availability analysis does not directly examine (1) groundwater discharge between various basins (it assumes each basin is a closed system where inflows = outflows), (2) groundwater evapotranspiration (GWET) from phreatophyte consumption, (3) potential surface water base flow supported by groundwater, nor (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 a substantial overestimation of surface water runoff, which indirectly incorporates elements of the water balance that are not explicitly quantified.

The long-term groundwater availability results were calibrated by taking the initial results of groundwater in storage through time for the Lee basin and comparing them to the static groundwater levels from a representative well within Lee Valley. The initial calculated runoff was adjusted to provide a relative match of groundwater in storage through time with actual historical groundwater levels. It should be noted that the relationship between calculated groundwater in storage through time to water levels is not linear since there can be significantly more groundwater in storage [from residuum and/or alluvium] in the shallow portions of a given aquifer system. As an example, the change in water levels within the saturated residuum portion of an aquifer would be much less than the water level change for an equivalent volume of water obtained from underlying bedrock. However, the relative relationship does provide a useful qualitative comparison of actual groundwater trends within the Lee basin to the groundwater in storage results. The calibrated results would then indicate recharge (or lack of recharge) through time at rates relative to the actual change of water levels. After calibration was completed for the Lee basin, Pine Valley and Morena Village were selected to test the calibrated results in basins with different physical and geohydrologic characteristics.

To fully evaluate localized groundwater conditions within each of the 86 basins evaluated within the GP Update GW Study, some of the basins would require further subdivision into smaller hydrologic areas. This would likely result in hundreds of individual sub-basins, which is well beyond the time and resources allocated to this study. However, this study did include subdivision of basins in which there was data that indicated the potential for localized groundwater problems (Guatay, Morena Village, and Julian) or to aid in the calibration process (Pine Valley). Site-specific groundwater investigations will continue to be necessary for future groundwater-dependent discretionary permits in which the specific project's tributary basin would be analyzed.

D.1.1 Calibration – Lee Valley

The Lee Valley (Lee) hydrologic sub-area (basin) covers an area of approximately 3.25 square-miles (Figure D-1). This basin was selected for calibration since DPLU has monitored water levels in this basin since the 1980s, and its groundwater hydrologic characteristics are typical of many of the basins in the study area. The entire basin is groundwater dependent which derives its water from a fractured rock aquifer. Groundwater users include residences on private wells, irrigated agriculture, an RV park, and a Bible camp. The valley floor is located in the north half of the basin and trends northwestwardly with Jamul Creek running towards the south. Ground elevations in the Lee basin range from approximately 1,080 feet above mean sea level (msl) at the southern discharge point to approximately 2,760 feet msl at an unnamed summit along the eastern boundary of the basin. Above the valley floor are sloping mountainous granitic and gabbroic outcrops. The basin average annual precipitation is about 18.5 inches per year (based on the period of record from July 1971 to June 2005).

D.1.1.1 Estimated Groundwater in Storage

The following table provides the existing estimated groundwater in storage within the Lee basin.

Hydrogeologic Unit	Estimated Groundwater in Storage (acre-feet)
Moderately Fractured Rock (areas with 0 to 25% slopes)	307
Slightly Fractured Rock (areas greater with >25% slopes)	82
Residuum (based on review of drillers well logs)	331
Total:	**720**

D.1.1.2 Estimated Existing Groundwater Demand

The following table provides the existing estimated groundwater demand within the Lee basin.

Groundwater Use Type	Estimated Groundwater Demand (acre-feet per year)
97 Single-Family Residences	48.5
7 Second Dwelling Units	1.8
Agricultural Irrigation	19
Small Water Systems (RV Park and Camp)	29
Total:	**98**

D.1.1.3 Initial Results

Groundwater recharge was estimated month by month through a 34-year period (July 1971 through June 2005) for the Lee basin using the methodology outlined in Section 3.1 of the GP Update Groundwater Study. The recharge was then applied as inflow to groundwater in storage, and existing groundwater demand was applied as outflow from groundwater in storage on a month by month basis through the 34-year period. The initial results shown annually are provided in Figure D-2. The initial recharge calculations account for 100% of the runoff as calculated by the SCS Curve Number Method. The initial recharge calculated was 0.8% of total precipitation on average through the 34-year period, with estimated runoff calculated at 44% of total precipitation. It is clear that this number is an overestimation of runoff, and recharge was underestimated. A study conducted by the USGS calculated approximately 7% of precipitation recharged to the Lee basin during 1987-1988 (Kaehler and Hsieh, 1991). Based on stream gauging conducted in Lee Valley, the USGS further estimated that approximately 8 acre-feet (less than 0.1% of precipitation) left the basin as runoff during the 1987-1988 rainfall year. Precipitation that occurred in 1987-1988 was slightly above average.

D.1.1.4 Calibration of Groundwater Results to Groundwater Hydrograph

Figure D-1 shows the wells in Lee Valley in which DPLU has historical water level records. Well JAM-18, located in the center of the valley floor was selected for calibration after reviewing all historical water level records from wells in this area. The well exhibits water level responses that are typical of wells in Lee Valley, and has remained unpumped through its period of record from 1992 to 2005. This provides a 13-year period of record in which to be used to calibrate the monthly groundwater in storage results.

Comparison to Hydrograph: Figure D-2 shows the initial comparison of the monthly groundwater in storage results to well JAM-18 hydrograph. It is readily apparent that the amount of runoff calculated was grossly overestimated, which limited the amount of groundwater recharge. As a result, change in groundwater in storage decreased over time until reaching and remaining at or near 0 acre-feet.

The long-term groundwater availability analysis was then run by using 75%, 60%, 50%, 40%, 25%, and 0% of calculated runoff, and then compared well JAM-18 hydrograph. The change of groundwater in storage results provided the closest match relative to the water levels using 50% of calculated runoff (Figure D-3).

Evaluation of Recharge Calculated: Since the change of groundwater in storage results are in acre-feet, and the groundwater levels are in feet, the comparison is qualitative and indicates that change in storage matches groundwater levels in relative terms. To provide a secondary check, the recharge results using 50% of calculated runoff were compared to recharge results estimated by the USGS in Lee Valley. The USGS estimated 7% recharge in a year with approximately 21-inches of precipitation. The average amount of recharge as a percentage of average precipitation over the 34-year period (using 50% of calculated runoff) was approximately 8.8%, which varies annually depending on the amount of rainfall. Based on the best statistical fit of recharge versus precipitation depicted in Figure D-4, it is estimated that approximately 5.7% recharge would occur in a year with 21-inches of precipitation. This is a close match to the USGS methodology considering the level of uncertainty of the parameters used to calculate recharge using the USGS approach versus this study's methodology. However, it should also be mentioned that limitations in the ability of the watershed to store groundwater recharge, particularly in high rainfall years, results in some potential groundwater recharge being rejected as runoff simply because the aquifer is full. Hence, the average effective recharge rate (as a percentage of average precipitation) after accounting for groundwater storage limitations was 2.4% of average annual precipitation.

Evaluation of Runoff Calculated: The recharge calculations estimated that 22% of precipitation that fell was runoff on average through 34 years which is clearly an overestimation. The USGS estimated that 8 acre-feet (less than 0.1% of precipitation) left the basin as runoff during the 1987-1988 rainfall year (a slightly above average year for precipitation).

The water balance calculations consider potential evapotranspiration in the recharge calculations (which is based on losses from evaporation and transpiration in the unsaturated zone.), but does not directly take into consideration other potential losses to the system including (1) groundwater discharge between various basins (it assumes each basin is a closed system where inflows = outflows), (2) groundwater evapotranspiration (GWET) from phreatophyte consumption, or (3) potential surface water base flow supported by groundwater. While not explicitly identified, the calibration indirectly accounted for these processes by adjusting runoff to provide a best fit between calculated changes of groundwater in storage to actual water level changes through time in Lee Valley. The calibrated average runoff of 22% of precipitation to the basin results in an average annual loss to the system of about 687 acre-feet. Coast live oaks (*Quercus Agrifolia*) grow densely along the main branch of the Jamul Creek and several smaller drainages, and likely consume considerable amounts of groundwater. The basin lies within the California Irrigation Management Information System (CIMIS) Zone 9, with a yearly reference evapotranspiration rate of approximately 4.6 feet. Based on a review of 2002 infrared imagery of the basin, there are roughly 50 acres of oak trees along streambeds. By applying the CIMIS reference evapotranspiration rate of 4.6 feet, 230 acre-feet per year of groundwater demand is estimated for the oak trees. This is likely an overestimation, since the CIMIS value is applied entirely to groundwater demand while some of this is offset by moisture within the unsaturated zone. Regardless, this is a considerable amount of additional loss to the system, which on average appears to be indirectly accounted for by the overestimation of runoff for the basin.

To provide further analysis of runoff calculations utilized in this study, actual annual runoff data was obtained from the Descanso stream gauging station and compared to calculated runoff rates from this study from the 45.3 square mile tributary watershed above the gauging station. The Garnet basin and Descanso basin make up nearly the entire tributary watershed of the gauging station. The calculated annual runoff as a percentage of annual rainfall was plotted versus annual rainfall for each of the 34 years analyzed for the Garnet and Descanso basins. This relationship was compared to a similar plot of the measured annual runoff at the Descanso gauging station and annual rainfall measured at the Descanso Ranger rainfall station (Figure D-5). The rainfall for the Descanso Ranger station was adjusted to account for approximately 5% more rainfall on average that occurs in the tributary watershed as compared to the actual data from the rainfall station. The plots show that calculated runoff utilized in this study was greater than measured runoff in all but the wettest years where the datasets converge. From 1971 to 2005, the Descanso gauging station average annual runoff was approximately 9% of precipitation as compared to calculated values of 21% for the Garnet basin and 26% for the Descanso basin. As can be concluded for the Lee basin, runoff was substantially overestimated in the Garnet and Descanso basins when compared to actual runoff data from long-term stream gauging.

D.1.2 Comparison of Initial Calibration - Pine Valley

The Pine Valley (Pine) hydrologic sub-area (basin) was chosen as the first comparison area due to several physical and geohydrologic characteristics which contrast those of the Lee basin. The Pine basin covers an area of approximately 29.3 square-miles, nearly 10 times larger than the Lee basin. Three primary drainages occur within the basin; Pine Valley Creek, Noble Canyon, and Scove Canyon. The majority of the groundwater is pumped from the southern portion of the basin, which lies within the Scove Canyon watershed. Since the majority of the water from the Pine Valley Creek and Noble Canyon are not readily available to the groundwater users in the Scove Canyon watershed, the basin was subdivided into "Pine South" basin and "Pine North" basin (Figure D-5). The Pine South basin, a 5.6 square-mile area, consists of the Scove Canyon tributary watershed. Pine North basin, a 23.7 square-mile area, consists of the Pine Creek and Noble Canyon tributary watersheds. The community of Pine Valley is groundwater dependent and derives its water from saturated alluvium and/or residuum overlying a fractured rock aquifer. The Pine Valley Mutual Water Company (PVMWC) provides groundwater to nearly 700 residences and commercial entities. There are also a few residences on private wells as well as a Bible camp. Surrounded by the Cleveland National Forest, the unincorporated community of Pine Valley is bounded to the east and north by the Laguna Mountains and on the west by the Cuyamaca Mountains. The town center lies mostly within the Pine South basin, and encompasses an area of 1.8 square miles at elevations ranging from approximately 3,650 to 3,800 feet msl. The elevation at the head of Scove Canyon is approximately 5,220 feet msl, and the head of Pine Valley Creek and Noble Canyon are approximately 5,400 to 5,600 feet msl. Average annual precipitation (from July 1971 to June 2005) for the Pine South and Pine North basins are about 24 and 26.5 inches per year, respectively. Stream-flow infiltration is likely a very important contributor to groundwater recharge in Pine Valley. The soil moisture balance methodology assumes spatially distributed recharge and does not provide a direct measure of stream-flow infiltration that occurs in Pine Valley.

D.1.2.1 Pine North

Figure D-6 shows the wells in Pine Valley in which DPLU has historical water level records. Well PIN-04 (100-feet deep) located on the valley floor a few hundred feet from Pine Valley Creek was selected as the well to be compared to the long-term groundwater availability results in the Pine North basin. It provides the closest representation of "static" groundwater conditions in the Pine North basin, since the other wells with long-term water level records are heavily pumped by the PVMWC. This well is used for domestic use for a single-family residence, and water levels were monitored when the well was not pumping.

Figure D-7 shows the comparison of the monthly groundwater in storage results for the Pine North basin (using 50% of calculated runoff) to well PIN-04 hydrograph. The comparison was limited to the period of 1992 to 2005, since existing demand as used in the long-term groundwater availability analysis is based on 2007 estimated demand. Since actual water demand through time has slowly increased through the years, the difference between actual demand and demand used in the long-term availability analysis increases the further back in time in which the comparison is made.

The comparison indicates a reasonable fit in the estimated change of groundwater in storage relative to actual water level changes. In the 1990s, the estimated change of groundwater in storage provided larger relative swings when compared to actual water level conditions, which may be due to estimated demand being based on 2007 estimated groundwater demand.

By the year 2000, the results and the water levels converge, and closely mimic each other, and in both cases, the historic low was reached during the summer of 2002.

D.1.2.2 Pine South

The wells in the Pine South basin in which DPLU has long-term historical water level records have all been heavily pumped by the PVMWC with the exception of wells PIN-08 and PIN-14. Between 1999 and 2005, PVMWC's highest annual production was 311 acre-feet in 2002 (approximately 0.45 acre-feet per service connection), and averaged approximately 274 acre-feet per year. The PVMWC usually collects static water levels for their wells after at least a 24-hour rest period. Heavily pumped wells can take many days to weeks to recover to true static water level conditions. Therefore, the wells selected for comparison are likely not always representative of true "static" groundwater conditions. Figure D-7 shows the comparison of the monthly groundwater in storage results for the Pine South basin (using 50% of calculated runoff) to all six PVMWC wells (Wells PIN-07,-08,-12,-14,-15, and -16) located throughout the valley of the Pine South basin. Together, these wells produced approximately 81% (221 acre-feet per year) of PVMWC total water demand between 1999 and 2005. Wells PIN-07 and PIN-16 are located within 200 feet of one another, and wells PIN-08 and PIN-14 are both in the southern end of the valley approximately 1,200 feet apart. The water levels from these two sets of wells were first averaged together before being averaged with the other two wells, PIN-12 and PIN-15. This was to ensure not overweighting the water level trends to a particular area. The resultant well hydrograph on Figure D-8 provides averaged water levels from four separate areas in the Pine South basin.

The comparison on Figure D-8 indicates a reasonable fit of estimated change of groundwater in storage relative to averaged actual water level changes from 1997 to January 2003. In February 2003, the estimated change in storage rises in response to a calculated value of groundwater recharge of 515 acre-feet. The averaged actual water level changes rose during this same time period, but only about less than half in relative terms to the calculated change in storage. When looking at the graph beyond February 2003, this difference causes the two datasets to permanently diverge from one another. However, the rises and drops indicated from February 2003 to June 2005 are still similar between the two datasets. In the winter of 2004-2005, the estimated change in storage indicated storage as full from the well above average rainfall. The water table rose in the wells, but not to the levels estimated by the analysis.

D.1.3 <u>Comparison of Initial Calibration - Morena Village</u>

The Morena hydrologic sub-area (basin) was chosen as the second comparison area (Figure D-9). The Morena basin covers an area of approximately 22.3 square-miles. Nearly all of the groundwater pumping in the basin is within Morena Village, located on the southeast shore of Morena Reservoir. Its tributary watershed area is approximately 2.2 square miles. Since the vast majority of the water from the Morena basin is not readily available to the groundwater users in Morena Village, the basin was subdivided into "Morena South" basin for the Morena Village area and the "Morena" basin for the rest of the basin (Figure D-8). 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 large amounts of groundwater from only a few wells. The elevation in the Morena South basin ranges from approximately 2,960 feet msl at the shore of Morena Reservoir to nearly 3,500 feet msl at an unnamed ridgeline along the southwest boundary of the basin. The basin average annual precipitation (from July 1971 to June 2005) is about 19.3-inches per year.

Figure D-9 shows the wells in Morena Village in which DPLU has historical water level records. Wells CAM-01 and CAM-02 were selected for comparison after reviewing all historical water level records from wells in this area. These wells remained unpumped through their periods of record from 1992 to 2005.

Figure D-10 shows the comparison of the monthly groundwater in storage results for the Morena South basin (using 50% of calculated runoff) to wells CAM-01 and CAM-02 hydrographs. The comparison indicates a reasonable fit of estimated change of groundwater in storage relative to actual water level changes with exceptions noted in 1997 and 2004-2005. In the winter of 1997, the estimated change in storage indicated recharge, while the water levels did not show the recharge event. In the winter of 2004-2005, the estimated change in storage indicated storage as full from the above well average rainfall. The water table rose in both wells, but not to the levels estimated by the analysis. It should be mentioned that between November 1997 and December 1999, groundwater monitoring was conducted only on an annual basis which resulted in data gaps through that period. This likely explains why no recharge was indicated in 1997-1998.

D.1.4 Calibration Conclusions

The long-term groundwater availability results were calibrated for the Lee basin by comparing groundwater in storage calculations through time to static historical groundwater levels from a representative well. A reasonable relative match of groundwater in storage through time to actual historical groundwater levels was obtained by applying 50% of the runoff as calculated by the SCS Curve Method. The calibrated results indicate a substantial overestimation of runoff when compared to runoff calculated for the basin by the USGS. This was further confirmed by comparing calculated runoff in the Garnet and Descanso basins to the Descanso gauging station. Runoff as quantified in this study as discussed is in reality is a lumped parameter, which indirectly accounts for elements not explicitly quantified due to the lack of data available.

The comparison of groundwater in storage results to groundwater levels in the Pine North and Morena South basins indicate a reasonable relative fit, with some minor differences noted. Based on this comparison, no changes to the initial calibration appeared warranted. The comparison of groundwater in storage results to groundwater levels in the Pine South basin provided relative similarities with differences noted especially in February 2003. As was expected, the groundwater in storage results in the Pine South basin did not provide as tight of a fit as the relatively unpumped wells used for comparison in the Pine North and Morena South basins.

The Countywide long-term groundwater availability results are being conducted based on hydrologic sub-areas as mapped by the State Water Resources Control Board. In two of the three areas evaluated as part of the calibration exercise, it was necessary to subdivide the hydrologic sub-areas (basins) into smaller sub-basins to accurately compare the output from the water balance to groundwater level conditions in the wells. It is well beyond the time, resources, and data available to evaluate each basin and possibly subdivide them into smaller sub-basins. However, the GP Update Groundwater Study did include subdivision of basins in which there was data that indicated the potential for localized groundwater problems (Guatay, Morena Village, and Julian). It then further identified specific problem areas in each hydrologic sub-area (basin) by application of three other guidelines for determining significance including (1) identifying generally susceptible areas of the County that could be impacted by the resultant drawdown of existing well(s), (2) identifying areas of the County which have a high frequency of wells with low well yield, and (3) identifying areas where there is a potential for water quality impacts.

D.2 SENSITIVITY ANALYSIS

A sensitivity analysis is typically performed in modeling studies to evaluate the sensitivity of model results to changes in the various input parameters. The analysis is performed by varying only one parameter at a time and observing how the model results vary as a result of changes to the one variable. The results of the sensitivity analysis indicate how sensitive the model results are to variations in individual input parameters and can be helpful in refining future data collection to reduce uncertainty in parameters for which the model is most sensitive.

Input variables that were evaluated in the sensitivity analysis included those for groundwater recharge (precipitation, potential evapotranspiration, runoff, and soil moisture capacity), groundwater storage capacity, and groundwater demand. The results for the groundwater recharge parameters show the average groundwater recharge estimated through the 34-year period analyzed. The results for the groundwater storage capacity and demand parameters show the average groundwater in storage estimated through the 34-year period analyzed. The sensitivity analysis was performed on parameters from the Lee Basin.

Groundwater Recharge: For precipitation and evapotranspiration, a simulation was run that reduced each parameter to 75% of the base case and a second simulation in which each parameter was increased to 125% over the base case value. For runoff, a simulation was run that reduced it to 50% or the base case and a second simulation in which the parameter was increased to 150% over the base case value. For soil moisture capacity, the USDA provides a minimum and maximum value for each soil type. The base case value used the mean value of each soil type. A simulation was run that used minimum values of the range reported by the USDA, and a second simulation was run using the maximum values of the range reported by the USDA. The results of the sensitivity analyses (presented as average groundwater recharge) of the groundwater recharge parameters are shown on Figure D-11. The results of the analysis indicate that the model is least sensitive to changes in soil moisture capacity and most sensitive to changes in the precipitation.

Storage Capacity and Groundwater Demand: For fractured rock aquifers, the storage capacity can range over several orders of magnitude. A simulation was run in which the fractured rock portion of the total storage capacity was reduced to 10% (one order of magnitude) of the base case value. A second simulation was in which the fractured rock portion of the total storage capacity was increased to 1000% (one order of magnitude) over the base case value. For the overall groundwater demand, a simulation was run that reduced groundwater demand to 50% of the base case value and a second simulation in which the parameter was increased to 150% of the base case value. The results of the sensitivity analyses (presented as average groundwater in storage through the 34 year period analyzed) for storage capacity is shown on Figure D-12. The results of the analysis indicate that the model is very sensitive to changes in the fractured rock portion of the storage capacity and less sensitive to changes in groundwater demand.

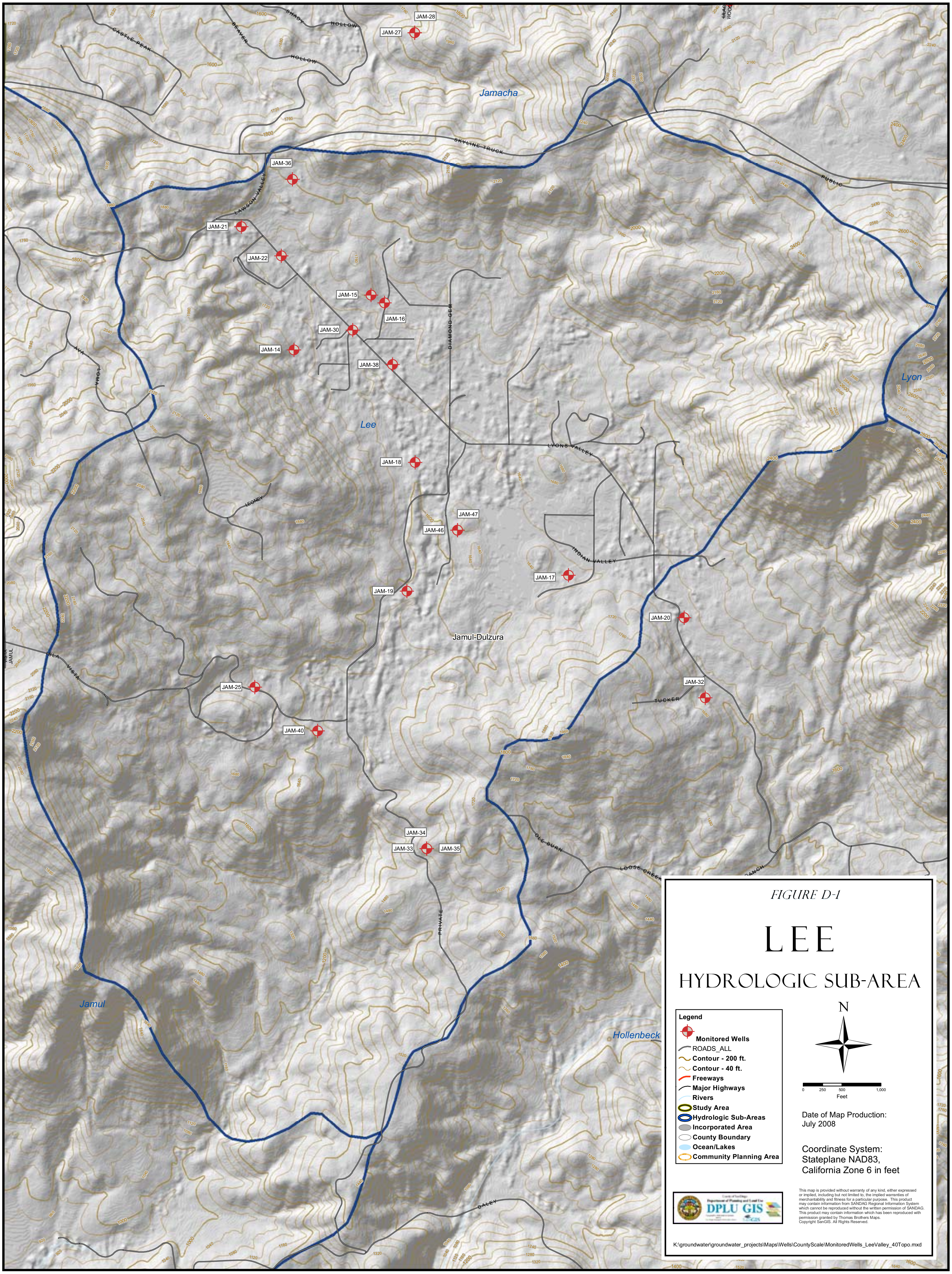
FIGURE D-1
LEE
HYDROLOGIC SUB-AREA
Legend
Monitored Wells
ROADS_ALL
Contour - 200 ft.
Contour - 40 ft.
Freeways
Major Highways
Rivers
Study Area
Hydrologic Sub-Areas
Incorporated Area
County Boundary
Ocean/Lakes
Community Planning Area
N
0 250 500 1,000
Feet
Date of Map Production:
July 2008
Coordinate System:
Stateplane NAD83,
California Zone 6 in feet
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DPLU GIS
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Jamacha
Lee
Lyon
Jamul-Dulzura
Jamul
Hollenbeck
JAM-27
JAM-28
JAM-36
JAM-21
JAM-22
JAM-15
JAM-16
JAM-30
JAM-14
JAM-38
JAM-18
JAM-47
JAM-46
JAM-17
JAM-19
JAM-20
JAM-25
JAM-32
JAM-40
JAM-34
JAM-33
JAM-35
CASTLE PEAK
BEAVER HOLLOW
SHADY HOLLOW
SKYLINE TRUCK
PUBLIC
LAWSON VALLEY
DIAMOND GEM
LYONS VALLEY
INDIAN VALLEY
LEONEY
ISLA VISTA
TUCKER
OLE BURN
LOOSE CREEK
PRIVATE
DALEY

Figure D-2
Lee Valley –Estimated Groundwater in Storage (100% of Runoff Calculated) vs. Groundwater Levels

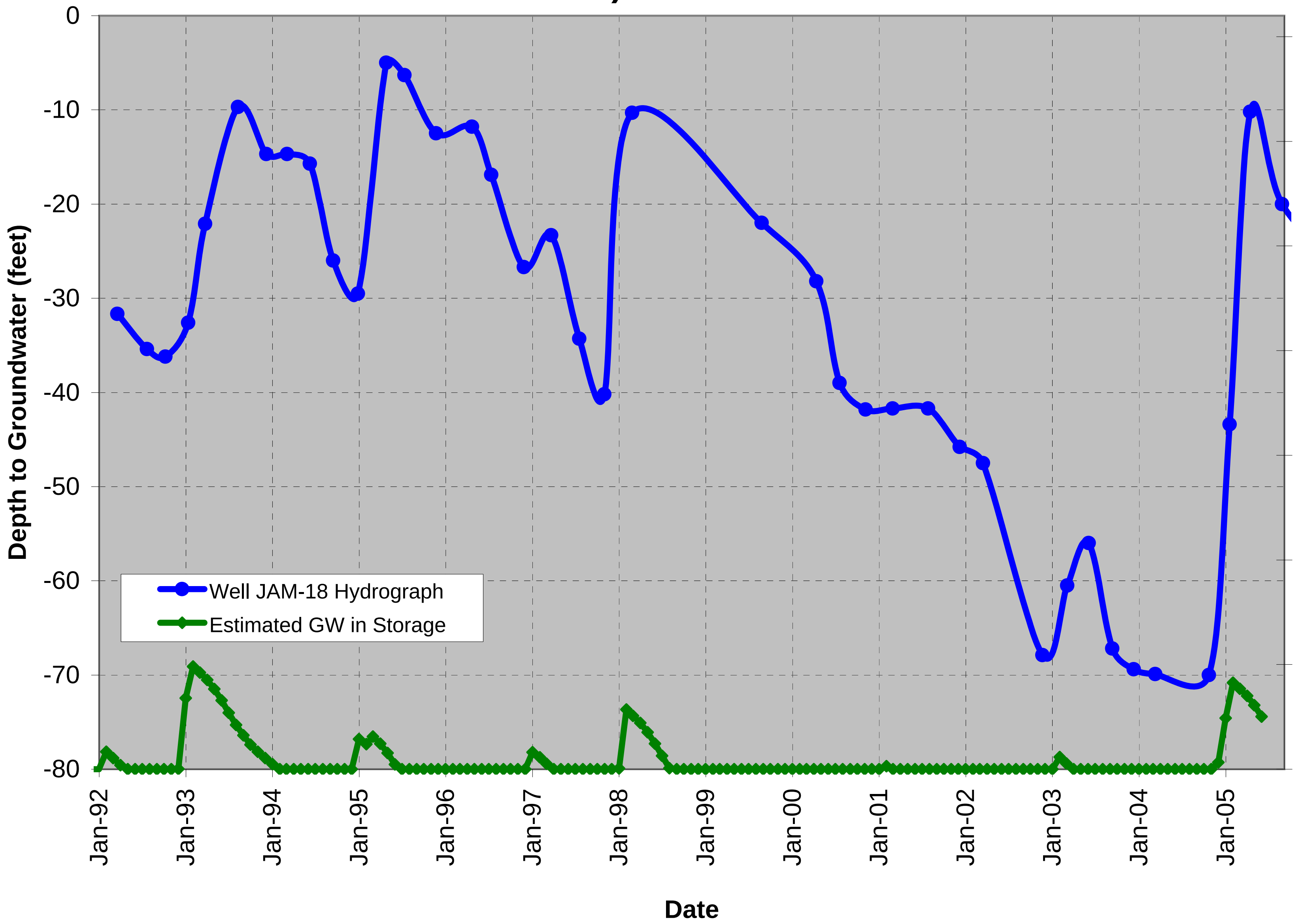


Figure D-3
Lee Valley –Estimated Groundwater in Storage (50% of Runoff Calculated) vs. Groundwater Levels

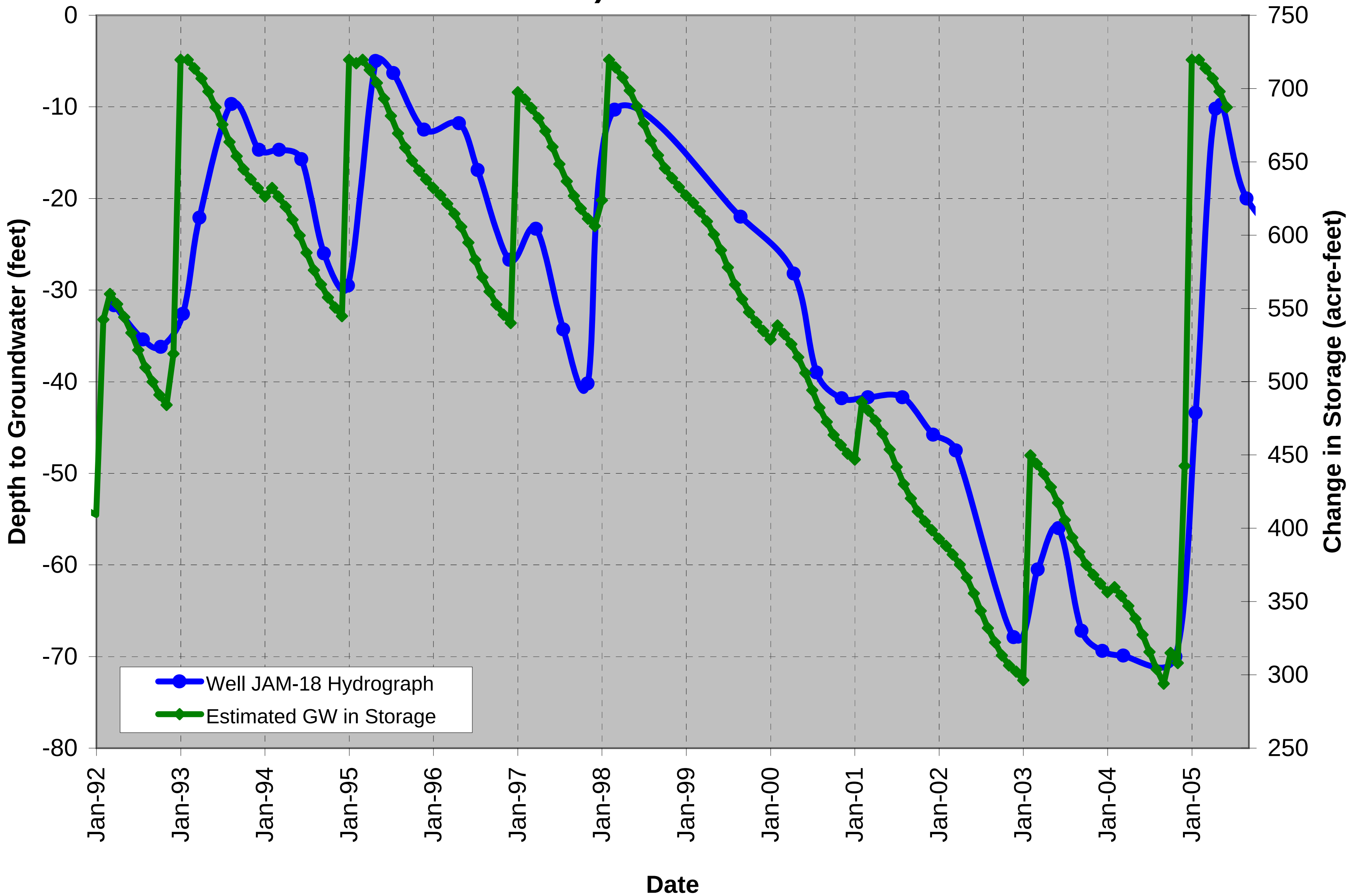


Figure D-4: Recharge Efficiency - Calibrated Lee Valley Results

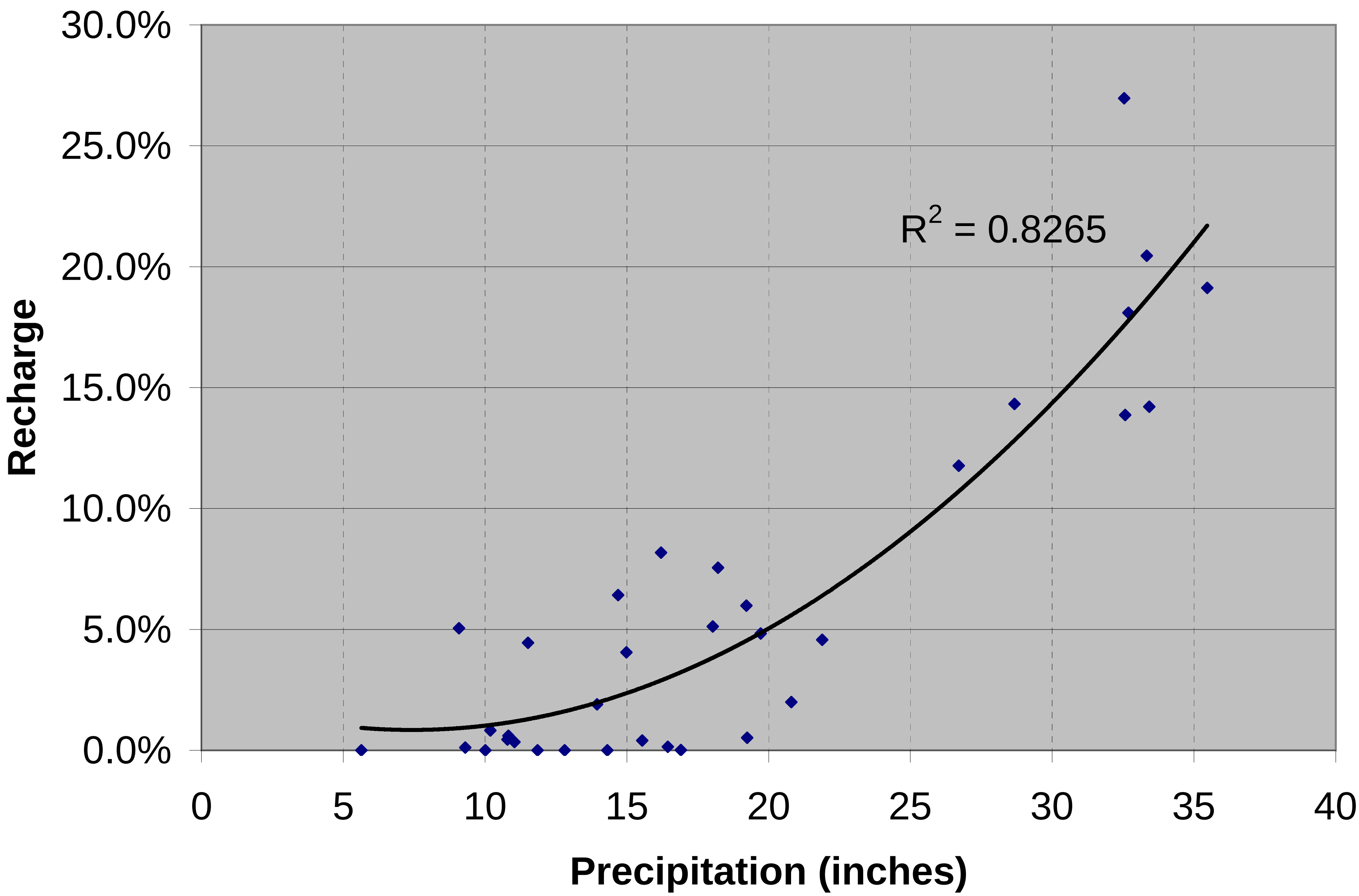
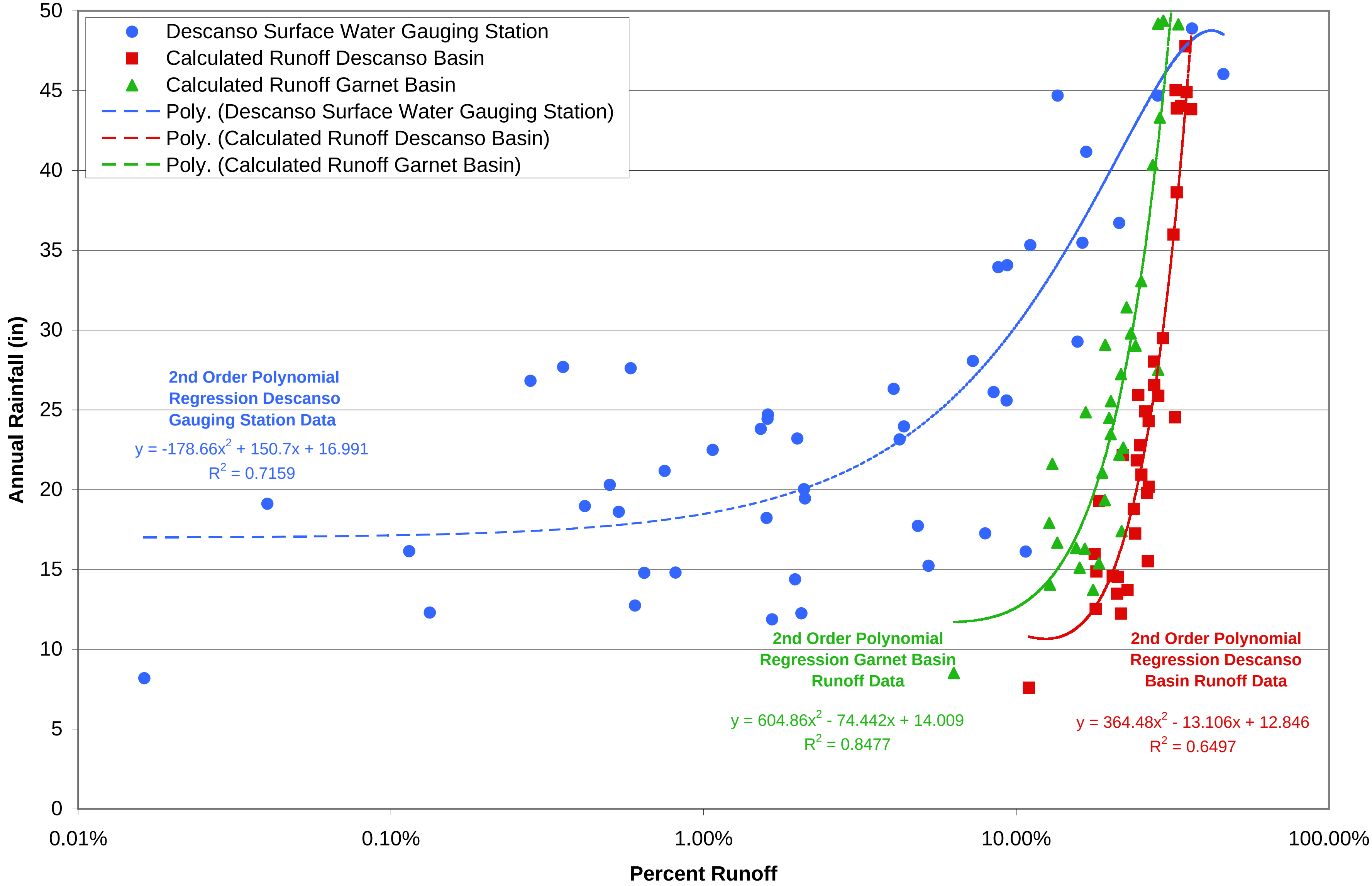


FIGURE D-5
Annual Rainfall vs Percent of Runoff
Descanso Gauging Station and Calculated Runoff For Descanso and Garnet Basins



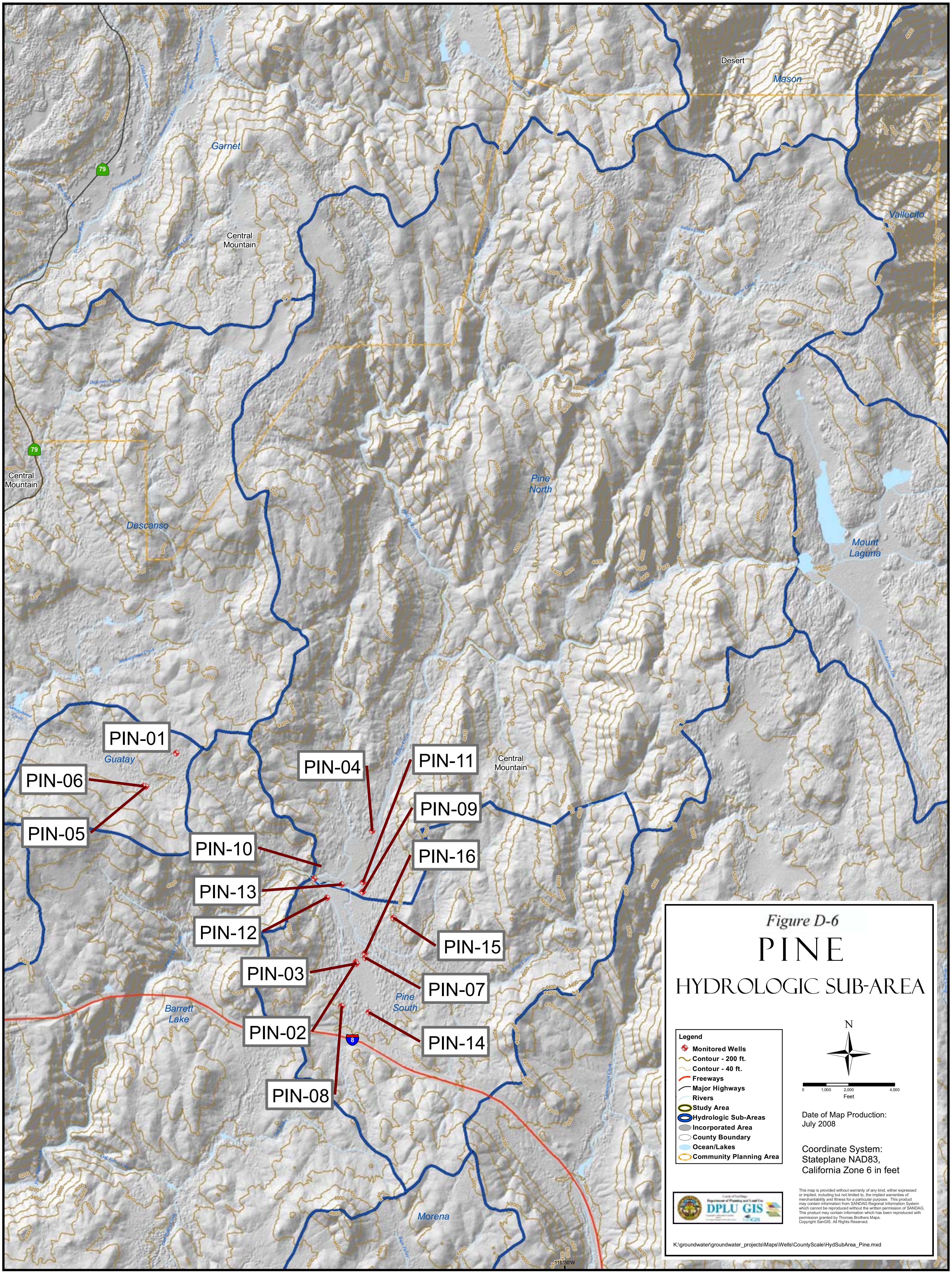


Figure D-6
PINE
HYDROLOGIC SUB-AREA
Desert
Mason
Garnet
Central Mountain
Vallecito
Central Mountain
Descanso
Pine North
Mount Laguna
PIN-01
Guatay
PIN-06
PIN-05
PIN-04
PIN-11
PIN-09
Central Mountain
PIN-10
PIN-16
PIN-13
PIN-12
PIN-15
PIN-03
PIN-07
Pine South
Barrett Lake
PIN-02
PIN-14
PIN-08
Morena
79
8
Legend
Monitored Wells
Contour - 200 ft.
Contour - 40 ft.
Freeways
Major Highways
Rivers
Study Area
Hydrologic Sub-Areas
Incorporated Area
County Boundary
Ocean/Lakes
Community Planning Area
N
0 1,000 2,000 4,000
Feet
Date of Map Production:
July 2008
Coordinate System:
Stateplane NAD83,
California Zone 6 in feet
DPLU GIS
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Figure D-7
Pine North Basin
Estimated Groundwater in Storage vs. Groundwater Levels

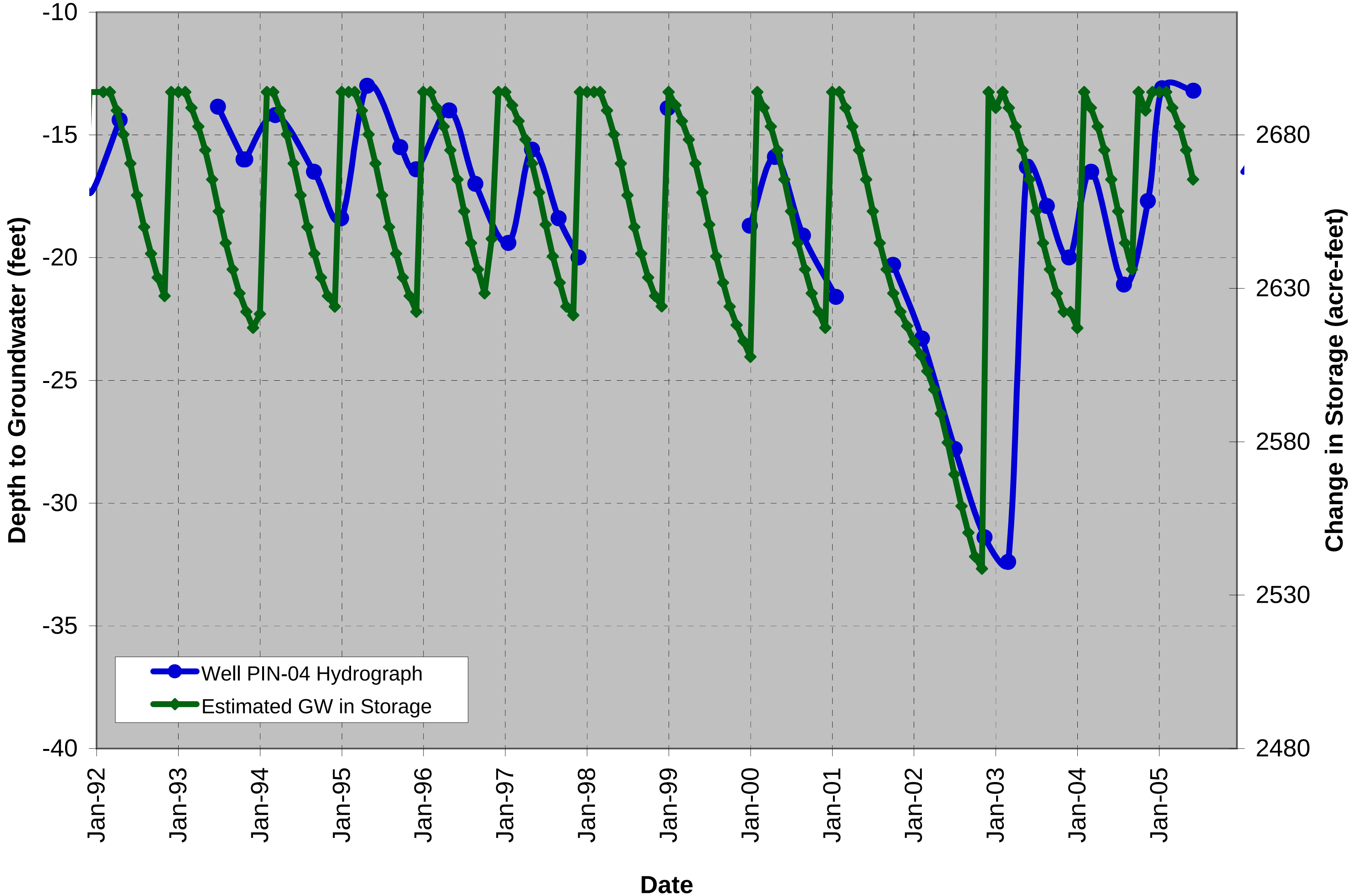
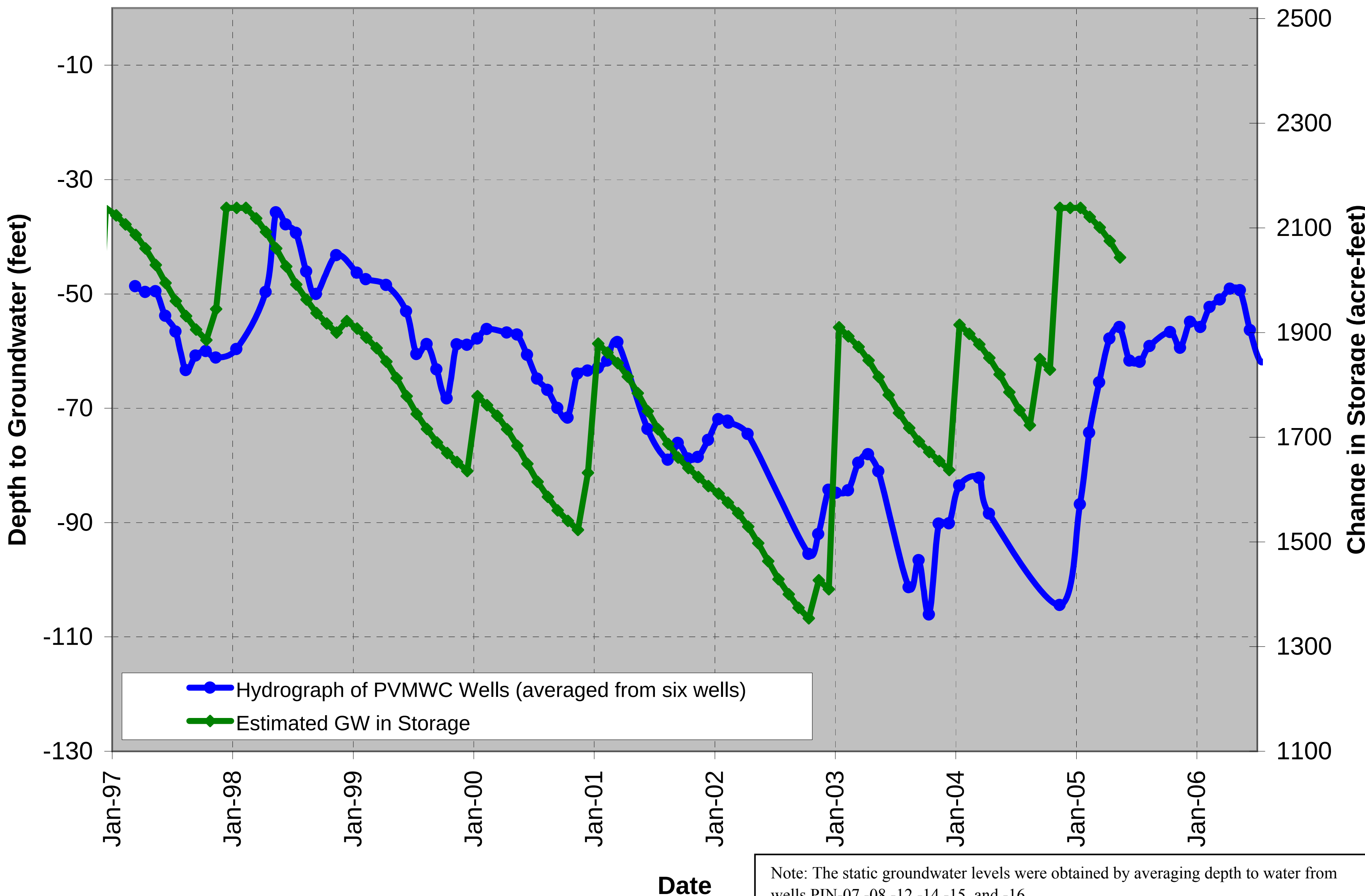


Figure D-8
Pine South Basin
Estimated Groundwater in Storage vs. Groundwater Levels



Note: The static groundwater levels were obtained by averaging depth to water from wells PIN-07,-08,-12,-14,-15, and -16

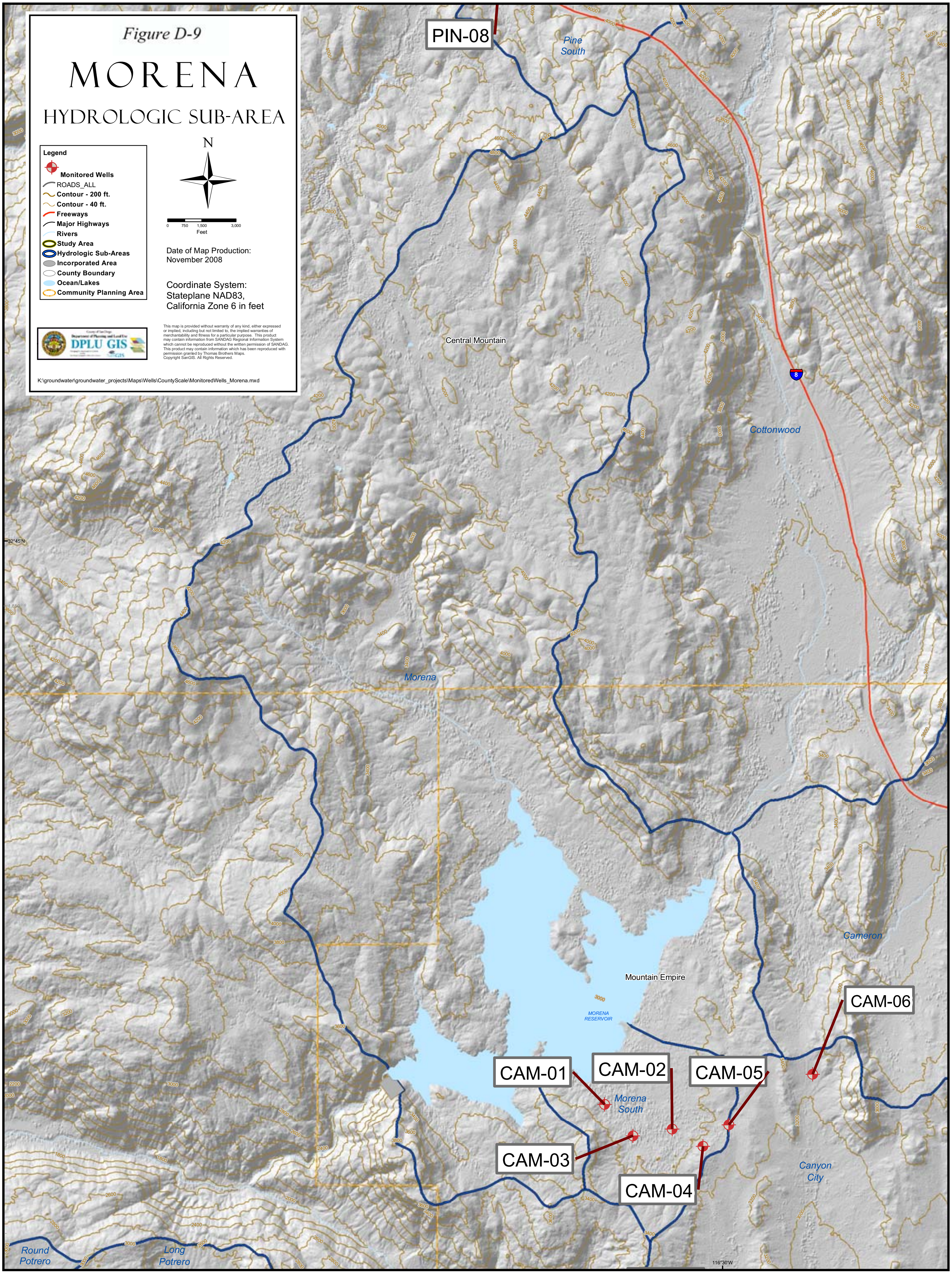


Figure D-9
MORENA
HYDROLOGIC SUB-AREA
Legend
Monitored Wells
ROADS_ALL
Contour - 200 ft.
Contour - 40 ft.
Freeways
Major Highways
Rivers
Study Area
Hydrologic Sub-Areas
Incorporated Area
County Boundary
Ocean/Lakes
Community Planning Area
N
0 750 1,500 3,000
Feet
Date of Map Production:
November 2008
Coordinate System:
Stateplane NAD83,
California Zone 6 in feet
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PIN-08
Pine
South
Central Mountain
8
Cottonwood
Morena
Mountain Empire
MORENA
RESERVOIR
Cameron
CAM-01
CAM-02
CAM-05
CAM-06
Morena
South
CAM-03
CAM-04
Canyon
City
Round
Potrero
Long
Potrero
32°45'N
116°30'W

Figure D-10
Morena South Basin
Estimated Groundwater in Storage vs. Groundwater Levels

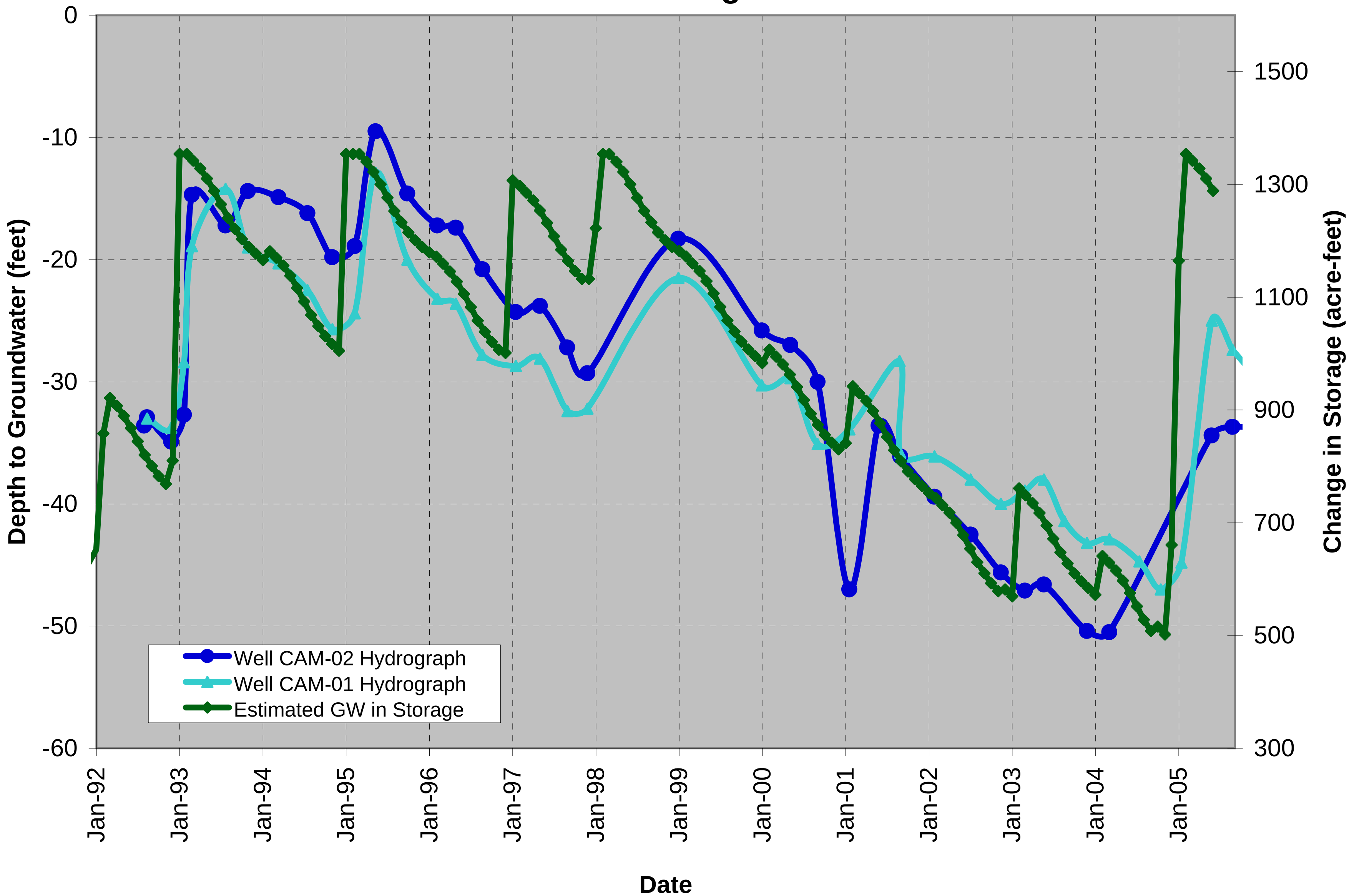


Figure D-11
Sensitivity Analysis -
Groundwater Recharge Parameters

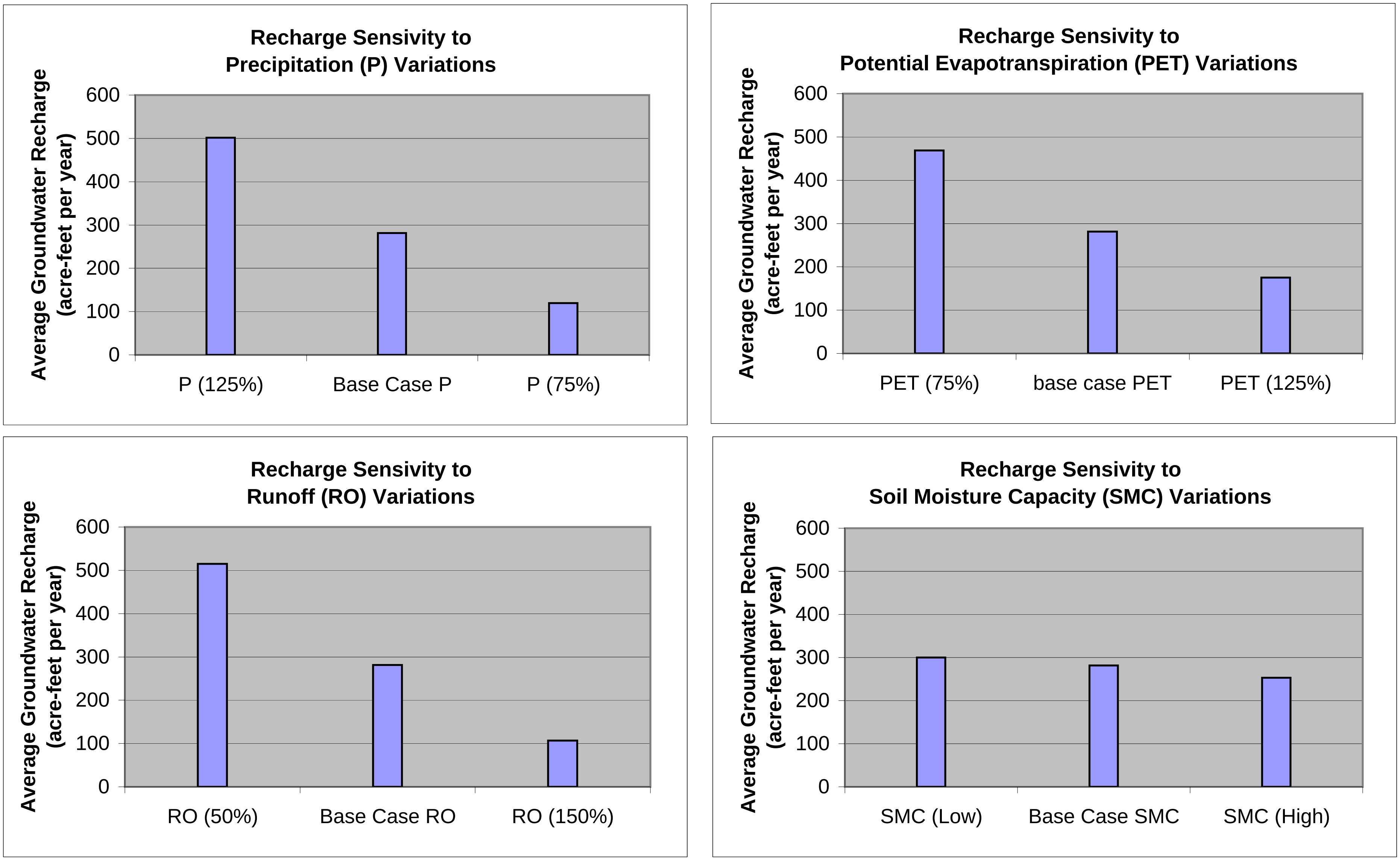
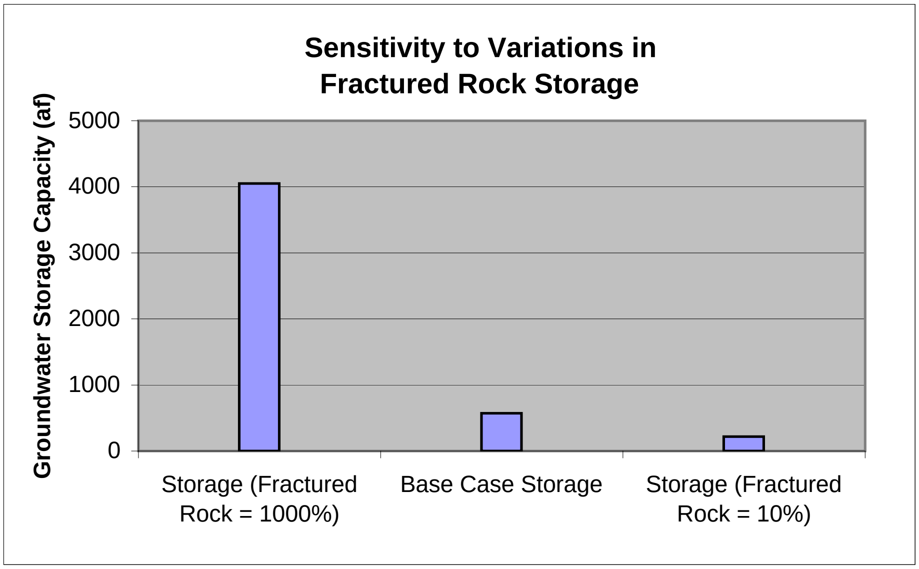
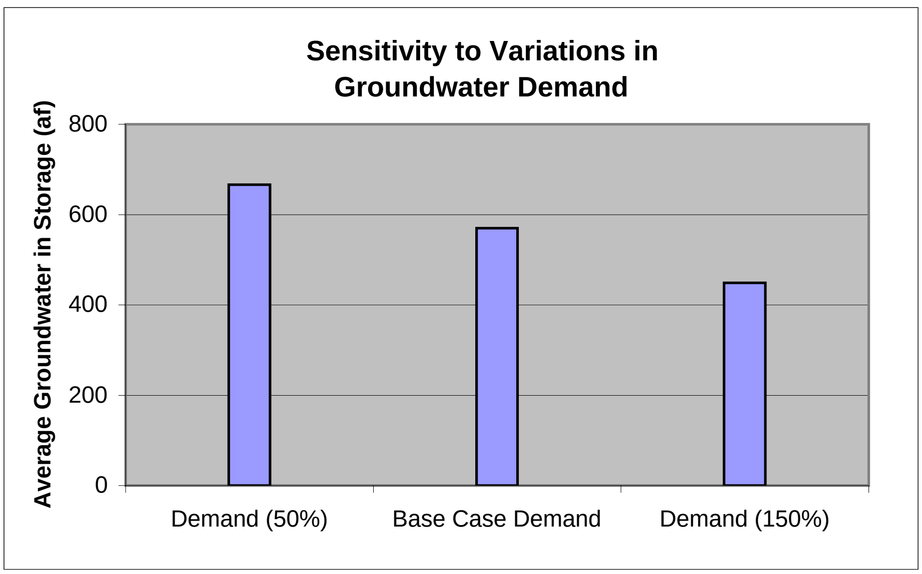


Figure D-12
Sensitivity Analysis
Groundwater in Storage and Groundwater Demand





Appendix E
Pine Valley Cumulative Groundwater Study

FINAL

County of San Diego
Department of Planning and Land Use
Pine Valley Cumulative
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
Pine Valley Cumulative 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

TABLE OF CONTENTS

TABLES

FIGURES

ATTACHMENT

LIST OF ACRONYMS

afy	acre-feet per year
bgs	below the ground surface
CEQA	California Environmental Quality Act
CIMIS	California Irrigation Management Information System
CWA	San Diego County Water Authority
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
ft	feet
GIS	Geographical Information Systems
GP	General Plan
GPEIR	General Plan Environmental Impact Report
gpm	Gallons per Minute
GWET	Groundwater Evapotranspiration

msl	Mean Sea Level
PVMWC	Pine Valley Mutual Water Company
USDA	United States Department of Agriculture

1 INTRODUCTION

On May 21, 2003, on motion of Supervisor Jacob, and seconded by Supervisor Horn, the County of San Diego Board of Supervisors unanimously directed the Chief Administrative Officer to conduct a comprehensive groundwater study for the Pine Valley area. This directive was part of confirmation of direction for staff's activities being conducted on the General Plan 2020 (now known as the General Plan Update). This groundwater study has been prepared to satisfy that request. The report evaluates the impacts of existing and proposed land uses on groundwater resources within Pine Valley, a groundwater dependent unincorporated community of San Diego County (Figure 1).

1.1 Objectives

The objectives of this report are to:

1) Evaluate current impacts to groundwater resources from existing land uses in Pine Valley;

2) Evaluate the impacts to groundwater resources from the maximum build-out of the current General Plan (GP) and the proposed GP Update in Pine Valley;

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

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 Pine Valley. This includes a discussion of topography, climate, land use, groundwater demand, geology, soils, aquifer types, hydrologic inventory, well inventory, and historical groundwater levels.

2) Application 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, additional demand from current discretionary permits in process at the County of San Diego Department of Planning and Land Use (DPLU), 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 in basins which serve Pine Valley;

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 (1) existing land uses, (2) existing land uses plus groundwater demand from discretionary permits currently in process, (3) land uses proposed under the current GP, and (4) land uses proposed under the GP Update. Each of the two evaluated basins 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 of two basins in Pine Valley under the various land-use scenarios: existing groundwater demand, proposed groundwater demand under the current GP, and proposed groundwater demand under the GP update. 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; and

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

1.3 Study Boundaries

The Pine Valley study area comprises approximately 29.3 square miles which is entirely groundwater dependent. The study area contains two separate basins which are referred to in this study as “Pine North” and “Pine South” (Figure 2). The community of Pine Valley is surrounded by the Cleveland National Forest. The study area is bounded by the Laguna Mountains to the east, and Guatay Mountain and the Cuyamaca Mountains to the west. 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 San Diego County Water Authority (CWA) boundaries further to the east.

2 EXISTING CONDITIONS

The following subsections include details describing the physical, geologic, and hydrogeologic characteristics of the Pine Valley study area. This includes a discussion of topography, climate, land use, groundwater demand, geology, soils, aquifer types, well inventory, and historical groundwater levels.

2.1 Topographic Setting

The study area lies within the Peninsular Ranges Physiographic Province of Southern California, which is characterized by mountainous ridges and hills interspersed by intermountain valleys and basins. According to the State Water Resources Control Board (SWRCB), Pine Valley lies within the Pine Hydrologic sub-area of the Monument Hydrologic area of the Tijuana Hydrologic Unit. For this groundwater study, the 29.3 square-mile Pine hydrologic sub-area was further subdivided into two basins (Pine North and Pine South) to assess local groundwater conditions at maximum build out in Pine Valley (Figure 2). The subdivision between the two basins was aligned with Pine Valley Creek, and then follows a local ridge line eastward until it encounters the regional watershed ridge line of the Laguna Mountains. The 1.8 square-mile community of Pine Valley lies within an intermountain valley with land surface elevations ranging from approximately 3,650 feet mean sea level (ft msl) to 3,800 ft msl. The discharge point of the two basins along Pine Valley Creek is at an elevation of approximately 3,628 ft msl. Ridge line elevations exceed 5,600 ft msl in the northern and eastern headwaters of Pine North basin, and exceed 5,200 ft msl in the northeastern headwaters of Pine South basin.

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 known as the Groundwater Limitations Map on file with the Clerk of the Board of Supervisors as Document No. 195172 (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 (Pine Valley area of map, Figure 3). 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

Based on the County Groundwater Limitations Map, the Pine North and Pine South basins receive on average approximately 26.5 inches and 24 inches per year of precipitation respectively (Figure 3). Average annual precipitation within the country town boundaries of the community of Pine Valley ranges between 21 and 24 inches per year, while upper elevations receive between 24 to 30 inches per year on average. The higher precipitation in the mountainous regions is attributed to the orographic effect created by the relatively high elevation of the Laguna and Cuyamaca Mountains, which raises and cools moist marine air as it moves inland over the mountains. Most rainfall occurs between the months of November and April, with infrequent precipitation events occurring in the summer, often as thunderstorms.

There are no long-term government sanctioned precipitation records available within the study area. Precipitation values were simulated for the Pine North and South basins results by taking the 30-year average rainfall estimate as calculated on the County Groundwater Limitations Map and utilizing data from nearby government sanctioned precipitation stations to fractionalize the data into yearly and monthly values. Looking at these simulated annual precipitation values in Pine Valley from 1971 to 2005, it is readily apparent that year-to-year rainfall has been highly variable (Figure 4). In only a few years precipitation approximated average rainfall, with most years either above or below-average. The current below average rainfall period 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. The dry period between 1998 and 2004 has included at least two of the driest years on record for the region since 1948. This below average period is similar to conditions in the late 1950s to early 1960s, which included three of the driest years on record in the County in the past 60 years.

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. No direct measurements of evapotranspiration occur within the watershed. 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 various zones in San Diego County by CIMIS. As would be expected, the lowest ETo rates are typically during the cooler and wet winter months and highest during the summer.

Both Pine North and Pine South basins lay within CIMIS Zone 16 in which average monthly ETo rates are as follows:

CIMIS Zone 16 ETo rates (inches/month)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1.55	2.52	4.03	5.70	7.75	8.70	9.30	8.37	6.30	4.34	2.40	1.55

2.3 Water Demand

An estimation of existing groundwater demand is provided below for Pine South and Pine North basins based on the current land uses known to utilize groundwater within each basin:

Pine South Existing Conditions Water Demand

Land Use	Quantity	Water Demand Per Unit or Acre (afy)	Total Water Demand (afy)
Single-Family Residential	530	0.5	265
Second Dwelling Units	8	0.25	2
Commercial Uses	12	0.3	4
County Park	5.2 acres	3.1	16.1
Total Existing Estimated Water Demand			287

Pine North Existing Conditions Water Demand

Land Use	Quantity	Water Demand Per Unit (afy)	Total Water Demand (afy)
Single-Family Residential	125	0.5	62.5
Second Dwelling Units	1	0.25	0.25
Pine Valley Bible Conference Center	1	19.9	19.9
United State Forest Service Cabins	37	0.1	3.7
Total Existing Estimated Water Demand			86

2.4 Geology and Soils

2.4.1 Geology

The study area is located within the Peninsular Ranges Province of Southern California, a geomorphic province with a long and active geologic history. 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.

Intrusive rocks within the study area consist largely of granitic and gabbroic rocks, along with a wide band of older metasedimentary rocks (Figure 5).

The Peninsular Ranges were subject to regional uplift and erosion throughout the Tertiary Period. Continued erosion and down cutting 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 and the valley area within the study area 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 floor within 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.

2.4.2 Soils

The United States Department of Agriculture Soil Conservation Service (USDA, 1973) mapped 44 soil types within the Pine South and Pine North basins (Figure 6). Soil moisture capacities are shown for each of the soil types.

2.5 Hydrogeologic Units

Water is stored within four different hydrogeologic units within the study area. These include: 1) moderately fractured rocks, 2) slightly fractured rocks 3) alluvium, and 4) residuum (Figure 7). To estimate groundwater in storage for each hydrogeologic unit, estimates of specific yield, the potential saturated thickness, and the areal extent of each unit were required. 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. Estimates of groundwater in storage for Pine South and Pine North basins are provided below along with a discussion of each hydrogeologic unit.

Pine South Estimated Maximum Groundwater in Storage

Hydrogeologic Unit	Estimated Area (acres)	Estimated Specific Yield	Assumed Saturated Thickness (feet)	Maximum Storage Capacity (acre-feet)
Moderately Fractured Crystalline Rock	1,129	0.1%	500	565
Slightly Fractured Crystalline Rock	2,486	0.01%	500	124
Alluvium	268	10%	28.4	761
Residuum - underlying alluvium	268	5%	45	603
Residuum (outside of alluvium)	85	5%	20	85
Estimated Maximum Groundwater Storage Capacity (acre-feet)				**2,138**

Pine North Estimated Maximum Groundwater in Storage

Hydrogeologic Unit	Estimated Area (acres)	Estimated Specific Yield	Assumed Saturated Thickness (feet)	Maximum Storage Capacity (acre-feet)
Moderately Fractured Crystalline Rock	3,636	0.1%	500	1,818
Slightly Fractured Crystalline Rock	11,553	0.01%	500	578
Alluvium	186	10%	10	186
Residuum - underlying alluvium	186	5%	10	93
Residuum - (outside of alluvium)	37	5%	10	19
Estimated Maximum Groundwater Storage Capacity (acre-feet)				**2,694**

<u>Moderately Fractured Crystalline Rock (Figure 7):</u> The entire study area is underlain by fractured bedrock. The areal extent of this unit was limited to areas underlain by fractured rock with slopes less than 25%. While the actual range of 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 moderately fractured rock aquifers in the County.

<u>Slightly Fractured Crystalline Rock (Figure 7):</u> The areal extent of this unit was limited to areas underlain by fractured rock with slopes greater than 25%. 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 the County.

<u>Alluvium (see Attachment, and Figures 8 & 9):</u> Recent alluvial deposits overlie both residuum and granitic rock. The alluvium is largely confined to active drainage channels and the valley floor. Woodward, Clyde, Sherard, and Associates (WCSA, 1961) collected core samples from borings drilled through the alluvium. The porosity of the sediment from 10 samples collected from four borings ranged from 31 to 38%. An analysis of the site-specific porosity measurements by WCSA from three borings and a van Genuchten curve fit of moisture content and soil sample height above the water table, indicate that the alluvium has a specific

yield of approximately 29% (Wiedlin, 2006). Though this approach is technically valid, the site-specific data is limited to only a few areas and it may potentially provide specific values that are biased high relative to specific yield measurements derived from aquifer pumping tests. Aquifer pumping tests are the industry standard for measuring specific yield. In the absence of basin-specific aquifer test data, a specific yield of 10% for alluvium was used for this study.

Based on eighteen test borings logged by WCSA (WCSA, 1961), the alluvium consists of loose silty sands, sandy silts, and locally gravelly sands (see Attachment). The test borings indicated that the maximum thickness of the alluvium ranges from 30 to 60 feet. WCSA prepared a structure contour map depicting the bottom of the alluvium based on their exploratory drilling (See Attachment).

Pine South Basin: The volume of saturated alluvium was estimated for the Pine South basin by comparing the WCSA structure contour map (See Attachment) and groundwater elevations prepared by DPLU from spring 1998 groundwater data collected by the Pine Valley Mutual Water Company (PVMWC) (Figure 8). The two surfaces were digitized and the volume between the two surfaces was calculated using Geographic Information Systems (GIS) software. An isopach contour map was produced to visually represent the results of the estimated saturated thickness of alluvium (Figure 9). Based on this calculation, the storage capacity of the alluvium (using a specific yield of 10%) under the high groundwater conditions existing in the spring of 1998 was approximately 761 acre-feet within the 268-acre area underlain by alluvium in the Pine South basin. The average saturated alluvium thickness is estimated to be approximately 28.4 feet within the Pine South basin.

Pine North Basin: The volume of saturated alluvium was estimated for the Pine North basin by taking the area WCSA structure contour map (See Attachment) and conservatively assuming a saturated thickness of 10 feet would occur under high groundwater conditions within the 186- acre area of alluvium underlying the Pine North basin. Based on this estimate, the storage capacity of the alluvium (using a conservative specific yield of 10%) is approximately 186 acre-feet within the Pine North basin.

<u>Residuum (Figure 10):</u> Differential weathering of bedrock, due to non-uniform fracturing and differences in mineralogy, produce an undulating contact between unweathered bedrock and decomposed granite (residuum). Due to these factors, it is not possible to accurately predict the thickness of residuum underlying a specific region without site-specific information such as boring or well logs.

In borings advanced by WCSA, two residuum samples had porosity values of 26 and 31%. Specific yield values within this unit were not estimated by WCSA. As is the case with alluvium, there is no site-specific aquifer test data available to verify the specific yield of the residuum within Pine Valley. In the absence of site-specific aquifer test data, a specific yield of 5% for residuum was used for this study.

Pine South Basin: Over 1,100 acres of land is located in valley areas with slopes less than 25%, which is more likely to contain appreciable thicknesses of residuum when compared to the nearly 2,500 acres of steep slope area within the Pine South basin. For this study, the areal extent of potentially saturated residuum is assumed to be limited to (1) the same 268-acre area as the alluvial deposits, and (2) an approximately 85-acre area to the southwest of the alluvial deposits in which data was available to document that amount of residuum that occurs below the water table.

The estimate of saturated residuum underlying the 268-acre alluvial aquifer was evaluated by inspecting well and boring logs. Figure 10 shows the locations of the wells reviewed and the estimated thickness of saturated residuum at each location. The saturated thickness, based on high groundwater levels documented in the spring of 1998, ranged from 49 to 74 feet. Based on this review, a saturated thickness of 45 feet was conservatively applied to residuum underlying the alluvial aquifer.

Data was compiled from three drilling logs within an approximately 85-acre area to the southwest of the alluvial deposits. The saturated thickness of three wells reviewed in this area ranged from 15 to 40 feet. Based on this review, a saturated thickness of 20 feet was applied to residuum in this 85-acre area.

Since no data is available over the rest of the Pine South basin to substantiate saturated residuum, the rest of the basin is assumed to have no saturated residuum. This is conservative and likely results in an underestimation of the amount of groundwater in storage. As an example, if there was a potential of 10 to 20 feet of saturated residuum underlying the rest of the 750+ acres of valley areas in the Pine South basin, this would result in an additional 375 to 750 acre-feet of groundwater in storage which was unaccounted for in this study.

Pine North Basin: The areal extent of potentially saturated residuum is assumed to be limited to (1) the same 186-acre area as the alluvial deposits, and (2) 37 acres along the alignment of Pine Creek further to the north of the documented alluvial deposits. Both areas were confined to 10 feet saturated thickness.

2.6 Inventory of Wells

Water well information within Pine Valley was identified through information provided by the Pine Valley Mutual Water Company (PVMWC), the DPLU groundwater level records database, and the County of San Diego Department of Environmental Health (DEH) database of parcels with permitted water wells (Figure 11).

The PVMWC owns 10 water supply wells within their service area which are spread throughout the Pine South and Pine North basins (Figure 11). Eight of these wells are currently in operation. Two wells (Well No.s 2 and 8) are not in production due to an underground fuel storage tank (LUFT) release at a local service station. As of 2008, the water company provided water service to approximately 695 service connections, of which 675 were residential users and 20 were commercial entities including a County park with 5.2 acres of irrigated grass. It appears that nearly all residences within Pine Valley have water service from the PVMWC, although a small number of homeowners also may be utilizing groundwater to supplement their water obtained by the PVMWC. There are records of 19 domestic well permits in the Pine South basin, and 10 permits recorded within the Pine North basin. Between 1999 and 2005, PVMWC's highest annual production was 311 acre-feet in 2002 (approximately 0.45 acre-feet per service connection), and averaged approximately 274 acre-feet per year (approximately 0.39 acre-feet per service connection). There has been a slow increase per service connection demand that has occurred through this time period. According to PVWMC personnel, this increase may be attributable to more residences going to full-time use as more people make home in Pine Valley their permanent residence. Approximately 19% (average of 52 acre-feet per year, maximum of 59 acre-feet per year) came from wells located in the Pine North basin, and approximately 81% (average of 222 acre-feet per year, maximum of 252 acre-feet in 2002) came from wells located in the Pine South basin. The land-use-based water demand estimate in Section 2.3 estimated that the Pine North basin currently uses approximately 63 acre-feet per year from residential uses. This is approximately 20% more water than that drawn on average by the PVMWC. For the Pine South basin, the demand from the land use based analysis estimated approximately 287 acre-feet per year of demand. This is approximately 29% more water than that drawn on average by the PVMWC. It can be concluded that the estimation of water demand in Section 2.3 accounts for more than the water demand of the PVMWC within each basin. Since there are private domestic wells being utilized in each basin by residences as shown on Figure 11, the additional water estimated by the land use based method allows for additional unaccounted water use by these private well users.

One other notable groundwater user in the study area is the Pine Valley Bible Conference Center in the Pine North basin. No records of groundwater wells or production from the facility are available. According to County DEH records, there is an average of 356 guests year-round at the facility. Assuming 50 gallons per day per guest results in a groundwater demand estimate of approximately 19.9 acre-feet per year, which will be used to estimate demand for this facility in this study. As shown on Figure 11, since 1983 the County has monitored a well designated as "PIN-04" 200 feet east of the Bible Center. Depth to groundwater in the well has fluctuated between 6 and 30 feet below the ground surface (bgs), with the most recent water level recorded in April 2009 at 12.3 feet bgs.

2.7 Historical Groundwater Levels

Well Hydrographs

To provide an understanding of groundwater level trends, well hydrographs have been generated from wells monitored by the PVMWC and DPLU. Figure 11 depicts locations of wells with historical water level data. 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.

Figures 12 through 16 depict groundwater levels from 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. The water level trends from the five figures provide a more detailed understanding of groundwater conditions within different hydrogeologic settings in Pine Valley.

Figure 12 depicts groundwater levels of PVMWC Well Nos 2 and 8 in the southern end of the valley. These wells are underlain by 35 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 LUFT. The water levels have varied between 13 and 58 feet bgs, with lows reached in 1996, 2002, and 2007. Groundwater levels were shallowest during each of the three well-above-average rainfall years in the 1990s. Water levels in the spring of 2005 following the above-average precipitation in 2004-2005 rebounded 17 and 25 feet respectively, but were still about 10 to 15 feet below water levels recorded in the spring of 1998.

Figure 13 depicts groundwater levels of wells PVMWC Well No.s 1 and 10, which recently have accounted for approximately 65% of PVMWC well production. These wells are underlain by 75 to 80 feet of alluvium and residuum overlying fractured bedrock. The water levels have varied between 10 and 131 feet bgs, with historic lows reached in 2003 and 2004. Water levels rebounded in 2005 and 2006 in response to well above-average rainfall in the rainfall season of 2004-2005. Overall, the water levels show the stress of pumping large amounts of groundwater from these wells during the extended drought period from 1998 to 2004. Water levels in early 2006 were at approximately 20 feet bgs, which is approximately 10 feet deeper than historic shallow groundwater levels recorded in the spring of 1998. This indicates that the wells have shown a significant recovery of the water table from one above-average rainfall season in 2004-2005.

Figure 14 depicts groundwater levels of PVMWC Well No.s 4 and 5. Well No. 4 is located at the discharge point of the Pine watershed near Pine Creek. Well No. 5 is also located near Pine Creek within the Pine North basin. These two wells have recently accounted for approximately 15% of PVMWC well production and 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 bgs, with historic lows reached between 2002 and 2004. The water levels show the stress of pumping of groundwater from these wells during the extended drought period from 1998 to 2004. However, recharge was evident during each wet season through the dryer years of 1998-2004. This is likely due to the wells proximity to Pine Creek. Water levels in early 2005 were at approximately 27 and 7.1 feet bgs in Well No. 4 and 5, which is approximately 1 to 2 feet deeper than historic shallow groundwater levels recorded in the spring of 1998. The wells have shown nearly a full recovery of the water table from one above-average rainfall season in 2004-2005.

Figure 15 depicts groundwater levels of PVMWC Well No. 3. This well is underlain by fractured bedrock with likely very little (if any) saturated alluvium/residuum. PVMWC Well No.7 and Well No.9 (not shown as well hydrographs) are located near PVMWC Well No.3 and are also underlain by fractured bedrock with little to no saturated alluvium/residuum. Well No.7 has had similar historic water level patterns, although Well No.9 has had much less drawdown relative to drawdown seen in Well No.3. The water levels in Well No.3 have varied between 18 and 293 feet bgs, with historic lows reached in 2004. Water levels rebounded approximately 270 feet in March 2005 to 23 feet bgs. 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 bgs. The three PVMWC wells in this area are heavily pumped and draw from a fractured rock aquifer with little saturated sediments. 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.

Figure 16 depicts groundwater levels of well PIN-04. Well PIN-04 is a private domestic well which provides water for a single-family residence across the street from the Pine Valley Bible Conference Center in the Pine North basin. Water levels have varied between 6 and 30 feet bgs. The shallowest groundwater levels were recorded in 1982, 1995, and 2005 in response to above average rainfall in those years. Historic lows were reached in 1990 and 2003.

Spring 1998 Groundwater Elevations

Using static groundwater depths from the spring of 1998 which are representative of shallow groundwater conditions within Pine Valley, DPLU prepared a groundwater contour map of groundwater elevations in map view (Figure 8). It should be noted that nearly all the points used are data from actively pumped wells and water levels may be at various degrees from achieving complete static equilibrium. These data indicate that from the southern portion of Pine Valley, groundwater flows from south to north toward the Pine Creek outlet on the west side of the valley, where it crosses US 80. Limited water level data were obtained outside of the PVMWC service area. However, from this data it can be reasonably inferred that groundwater in the northern portion of Pine Valley flows from north to south towards the same point. Hence groundwater flow is converging toward the center of the valley and exits to the west.

Summer/Fall 2004 Groundwater Drawdown

In the spring of 1998, groundwater levels could be considered to be close to representative of full groundwater storage capacity for Pine Valley. From 1999 through the fall of 2004, a six year drought occurred and resulted in a progressive increase in drawdown of wells throughout the valley each year. Some groundwater recharge was in evidence during the winter months of each year. The recharge however occurred at a rate less than the groundwater production rate. To depict groundwater drawdown at the peak of the six-year drought DPLU prepared a groundwater drawdown map for the summer/fall of 2004 (Figure 17), which was plotted in reference to the high groundwater conditions that occurred in the Spring of 1998 (Figure 9).

The worst area of drawdown in the summer/fall of 2004 centers around PVMWC Well No.s 3 and 7, which have contributed only 7% of PVMWC's total production, respectively. Each summer, drawdown at these two wells peaked, ranging from over 100 feet at the beginning of the drought cycle, to nearly 300 feet toward the end of the drought cycle. However, water levels recovered each winter and drawdown would often be near zero during the winter despite below average rainfall seasons that occurred (Figure 15). These water level recoveries may be attributable to their proximity to Pine Creek. The low production capacity of these two wells and their wide fluctuations of water levels are attributable to the wells being installed within fractured bedrock with little to no saturated sediments unlike most other wells utilized by the PVMWC.

PVMWC Well No.s 1, 9, and 10, which have contributed approximately 77% of PVWMC's total production, all have similar drawdown of over 100 feet in 2004, with Well No. 9 having the most (over 140 feet of drawdown).

PVWMWC Well No.s 4, 5, and 6, which have contributed approximately 16% of PVMWC's total production, experienced the least amount of drawdown of the producing wells. Of these three wells, Well No.s 5 and 6 experienced the greatest amount of drawdown; approximately 40 feet in the summer of 2004. Well No. 4 experienced approximately 13 feet of drawdown in the summer of 2004. As in other wells in the study area, peak drawdown increased each summer of the drought leading to the summer of 2004.

PVWMWC Well No.s 2 and 8 are inactive wells that are located on the southern edge of the PVMWC service area. The drawdown in these wells is least affected by the actively pumped wells drawdown. Maximum drawdown in these wells was 30 to 35 feet.

DPLU monitors water levels at Well PIN-04 located north of the PVWMC wells in the Pine North basin. While not included on the groundwater drawdown map due to its isolated location to the north, the water level in the summer of 2004 was about 7 feet lower than the spring of 1998. These data suggest that the groundwater drawdown in the Pine South basin induced by the PVMWC well field does not measurably extend to the northern end of the valley.

Spring 2005/Spring 2006 Groundwater Drawdown

To depict groundwater drawdown following the well-above-average precipitation that occurred between October 2004 and April 2005, DPLU prepared a groundwater drawdown map for the spring of 2005/spring of 2006 (Figure 18), which was plotted in reference to the high groundwater conditions that occurred in the spring of 1998 (Figure 9). The depth to groundwater in some wells was shallower in 2006, indicating a possible delayed response to the recharge that occurred in 2004-2005. To include full recovery from this apparent delayed recharge response in some of the wells, the shallowest groundwater levels recorded during those two years was utilized in construction of the map.

Looking at all the wells, groundwater levels in the spring of 2005 and spring of 2006 were approximately 1 to 16.5 feet deeper than those recorded in the spring of 1998. It is apparent that from just one year of well above average precipitation, that the rapid rise of water levels resulted in a near full recovery of drawdown that had occurred during the six year extended drought period. PVMWC Well No.s 3 and 7, which had the worst area of drawdown in the summer/fall of 2004, recovered to within 3 feet of water levels recorded in the spring of 1998. PVMWC Well No. 9, above the valley floor had the greatest amount of drawdown compared to Spring of 1998, with water levels about 16.5 feet deeper than in the spring of 1998.

PVMWC Well Field Discussion

The six-year drought between 1999 and 2004 was among one of the worst drought periods in the past 50 years and provided a significant test on the ability for the PVMWC to supply groundwater to its 695 service connections. According to discussions with PVWMC personnel, groundwater production continued unabated through the drought with no interruptions in service or mandated conservation measures. It can be concluded that PVMWC production at its current rates is sustainable through a six-year drought. However, progressive increases in drawdown through the drought period, particularly at less productive wells (PVMWC No.s 3 and 7) are an indication that recent groundwater production rates in these wells are approaching their limit in the context of drought condition. However, with the exception of Well No.1, which has a relatively shallow depth to the bottom of the well, high production wells are less impacted by drawdown and appear to be able to continue pumping through a more extended drought period. Based on an evaluation by Wiedlin & Associates (2006) of groundwater production capacity of the PVMWC well field, it appears that Well No.s 4, 5, and 6 are underutilized and could produce additional groundwater to make up for any potential impacts to production from Well No.s 3 and 7. Additionally, Well No. 9, though subject to drawdown greater than 100 feet, also appears to have the capability to handle additional drawdown and produce additional groundwater if its pump intake were lowered. As additional development occurs and groundwater demand increases, improved well production management would likely be necessary to keep up with the increased demand. The most likely worst case scenario would be that additional wells may need to be installed to more evenly distribute the extent of drawdown across the PVMWC well field in response to increased water demand.

Several of the PVMWC wells were installed between the late 1950s and early 1970s. Water wells over time typically experience decreased well yield from chemical incrustation or bio-fouling of the well screen and the formation materials around the intake portion of the well. Infilling of the well is also possible from sedimentation. Without proper maintenance, individual well performance may be substantially reduced and cause individual wells to fail. Even with maintenance, wells have a limited practical service life and eventually require replacement to optimize production capacity. As PVMWC wells lose well production capability over time in individual wells, it is recommended that PVMWC provide routine maintenance and rehabilitation of these wells. Additionally, with increased demand and lower production capacity from its existing well field, PVMWC may need to drill additional production wells to keep up with demand.

3 LONG-TERM GROUNDWATER AVAILABILITY ANALYSIS

To evaluate the long-term groundwater availability of a given basin, the County Guidelines for Determining Significance – Groundwater Resources contains the following guideline that if met, would be considered a significant impact to groundwater resources as a result of project implementation:

For proposed projects in fractured rock basins, groundwater impacts will be considered significant if a soil moisture balance, or equivalent analysis, conducted using a minimum of 30 years of precipitation data, including drought periods, concludes that at any time groundwater in storage is reduced to a level of 50% or less as a result of groundwater extraction. (County of San Diego, 2007)

This guideline was applied to the two basins which underlie the community of Pine Valley, to evaluate whether there would be sufficient long-term groundwater supplies under the following four land use scenarios:

1. Existing Conditions
2. Existing Conditions plus all discretionary permits currently in process at DPLU
3. Current GP Buildout
4. GP Update Buildout (Referral Map alternative)

3.1 Methodology

The soil moisture balance analysis of the Pine South and Pine North basins involved estimating groundwater recharge a 34-year period, comparing monthly recharge with proposed extraction through the 34-year period, 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. 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. Such short-term changes are evident in wells monitored within Pine Valley. 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.

3.1.1 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 include the entire Pine watershed, the edges of the basin are presumed to be the topographic divides or watershed boundaries.

As discussed in Section 2.1, the 29.3 square-mile Pine hydrologic sub-area was subdivided into two basins (Pine North and Pine South) to assess local groundwater conditions at maximum build out in Pine Valley (Figure 2). The subdivision between the two basins was aligned with Pine Valley Creek, and then follows a local ridge line eastward until it encounters the regional watershed ridge line of the Laguna Mountains.

3.1.2 Groundwater Recharge

Recharge Equation

The equation used to calculate groundwater recharge using the Thornthwaite Method (soil moisture balance methodology) 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.

The recharge estimation for this study was taken from recharge calculations that were programmed into computer code and integrated with GIS software as part of the County of San Diego GP Update Groundwater Study (DPLU, 2009). Estimation of groundwater recharge required data compilation to estimate monthly precipitation, runoff, potential evapotranspiration, and soil moisture capacity. Utilizing 408 unique monthly values of precipitation from July 1971 to June 2005, groundwater recharge was estimated for each month through the 34 year period evaluated.

Recharge Processes in Pine Valley

Groundwater recharge to the study area may occur from both basin-wide rainfall infiltration, and from infiltration of surface water runoff along the creek beds that drain the watershed. Recharge from surface water runoff may be the dominant recharge process in the study area. However, because this process has not been adequately quantified through long-term stream gauging records, it is not included in the water balance calculation presented later herein.

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 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 from 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 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 gauging stations provide the most accurate depiction of runoff occurring within a given watershed. Since long-term runoff records are unavailable for Pine Valley, 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, 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. Runoff curves were developed for various combinations of hydrologic soil groups and land uses (Table 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.

As documented within Appendix D of the GP Update Groundwater Study (DPLU, 2009), the calibrated results of recharge which are being utilized in this study resulted in an overestimation of surface water runoff. For the Pine South basin, an average of 27% of all precipitation that was estimated to occur in the 34 year period was assumed to be runoff. Runoff was utilized as a lumped parameter to incorporate elements of the water balance that are not explicitly quantified (e.g., groundwater evapotranspiration [GWET] from phreatophyte consumption, potential surface water base flow supported by groundwater, and/or groundwater discharge out of the basin). Since data does not exist in which to more accurately quantify these parameters, runoff as calculated is subject to substantial uncertainty.

<u>Evapotranspiration:</u> 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 (see Section 2.2.2). 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.

<u>Soil Moisture Capacity:</u> 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 (Figure 6). 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.

3.1.3 Groundwater Demand

Groundwater demand was estimated in Pine South and Pine North basins for the four land use scenarios (existing conditions, existing conditions plus all discretionary permits currently in process at DPLU, current GP build-out, and GP Update build-out) evaluated in this study.

The current GP Map for Pine Valley is included as Figure 19 and the GP Update Referral Map is included as Figure 20. Tables 3 and 4 provide a summary of all water uses within Pine South and Pine North basins, and the estimated amount of groundwater demand for each land use scenario. Additionally, the annual demand was broken into monthly fractions to account for seasonal patterns of groundwater usage.

A number of constraints were taken into consideration to provide a more realistic expectation of future development potential under the GP scenarios. Constraints included already built lands, 100-year flood plains, wetlands, public lands, future roads, habitat preserves, forest conservation initiative lands, slopes greater than 25%, Tier I and II vegetation, and pre-approved mitigation areas.

3.1.4 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 within five hydrogeologic units as defined, quantified and discussed in detail in Section 2.5.

3.1.5 Long-Term Groundwater Availability

In order to estimate long-term groundwater availability within the project's watershed, the recharge calculations were first programmed into computer code that was integrated with GIS software. Groundwater demand for each of the four 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 the project watershed over a 34-year period. The output was an Excel spreadsheet, which indicates whether groundwater in storage will be reduced to 50% or less at any time as a result of groundwater extraction over a 34-year period. A summary of the long-term groundwater availability results for the Pine South and Pine North basins is included in Tables 5 and 6.

3.2 <u>Significance of Impacts Prior to Mitigation</u>

A summary of long-term groundwater availability results for the Pine South and Pine North basins and is provided in Tables 5 and 6. 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 scenario analyzed.

3.2.1 Pine South Basin Impacts

<u>Impacts Under Existing Conditions Plus Discretionary Permits in Process:</u> Under existing conditions, the South Pine basin is estimated to have a groundwater consumptive use of approximately 287 acre-feet per year, and would increase to 302 acre-feet per year with addition of the proposed discretionary projects currently in process at DPLU. The minimum groundwater in storage estimated during any given month under existing conditions with the

addition of the discretionary projects would be 59%, which is does not exceed the 50% threshold. The 50% threshold is not exceeded until 341 acre-feet of groundwater per year are used.

Impacts Under Current GP Buildout: Under the worst-case scenario of maximum build out of the current GP taking into consideration environmental constraints, the Pine South basin would have an estimated 247 additional homes with an estimated total consumptive use of approximately 410 acre-feet per year (assumes 0.5 acre-feet per year per each new residence). Under this scenario, the minimum groundwater in storage estimated in any given month would be 35% of maximum storage, which exceeds the 50% threshold. Therefore, cumulative impacts to the Pine South basin under theoretical maximum build out of the current GP are considered to be significant.

Impacts Under Proposed GP Update Buildout: Under the scenario of maximum build out of the proposed GP Update (Referral Map alternative), the Pine South basin would have an estimated 224 additional homes with an estimated total consumptive use of approximately 399 acre-feet per year (assumes 0.5 acre-feet per year per each new residence). Under this scenario, the minimum groundwater in storage estimated in any given month would be 37% of maximum storage, which exceeds the 50% threshold. Therefore, cumulative impacts to the project watershed under theoretical maximum build out of the proposed GP Update (Referral Map alternative) are considered to be significant.

The GP Update also includes a number of alternatives including the Environmentally Superior alternative, which provides the lowest land use densities of any of the alternatives. Under the scenario of the GP Update Environmentally Superior alternative, the Pine South basin would have an estimated 178 additional homes with an estimated total consumptive use of 376 acre-feet per year (assumes 0.5 acre-feet per year per each new residence). Under this scenario, the minimum groundwater in storage estimated in any given month would be 43% of maximum storage, which while an improvement over the GP Update Referral Map alternative, still exceeds the 50% threshold. Therefore, cumulative impacts to the Pine South basin under theoretical maximum build out of the GP Update Environmentally Superior alternative are considered significant.

3.2.2 Pine North Basin Impacts

Impacts under Existing Conditions plus Discretionary Permits in Process: Under existing conditions, the project watershed is estimated to have a groundwater consumptive use of approximately 86 acre-feet per year, and would increase to 87 acre-feet per year with addition of the one proposed discretionary project currently in process at DPLU. The minimum groundwater in storage estimated during any given month under existing conditions with the addition of the discretionary projects would be 94%, which does not exceed the 50% threshold.

Impacts Under Current GP Buildout: Under the worst-case scenario of maximum build out of the current GP taking into consideration environmental constraints, the Pine North basin would have an estimated 52 additional homes with an estimated total consumptive use of approximately 112 acre-feet per year (assumes 0.5 acre-feet per year per each new residence). Under this scenario, the minimum groundwater in storage estimated in any given month would be 92% of maximum storage, which does not exceed the 50% threshold. The average groundwater in storage through the 34 year period analyzed is estimated at approximately 98% of maximum storage of the basin. Cumulative impacts to the Pine North basin under theoretical maximum build out are considered to be less than significant.

Impacts Under Proposed GP Update Buildout: Under the scenario of maximum build out of the proposed GP Update (Referral Map alternative), the Pine North basin would have an estimated 26 additional homes with an estimated total consumptive use of approximately 100 acre-feet per year (assumes 0.5 acre-feet per year per each new residence). Under this scenario, the minimum groundwater in storage estimated in any given month would be 93% of maximum storage, which does not exceed the 50% threshold. The average groundwater in storage through the 34 year period analyzed is estimated at approximately 99% of maximum storage of the basin. Cumulative impacts to the Pine North basin under theoretical maximum build out of the proposed GP Update (Referral Map alternative) are considered to be less than significant.

3.2.3 Conclusions

Pine South: Using the soil moisture balance methodology and conservative assumptions based on data availability, the Pine South basin, which is more heavily used than the Pine North basin is calculated to have a significant cumulative impact to groundwater resources at the theoretical maximum build out of the current GP and the proposed GP Update. Under the current GP scenario, groundwater was estimated to drop below 50% of maximum storage from May 1990 to February 1991, from April 2002 to January 2003, from August 2003 to January 2004, and from June 2004 to November 2004. This equates to 32 months, or 2.7 years out of 34 years in which groundwater would exceed the 50% threshold. For the GP Update Referral Map alternative, impacts are similar but slightly less with 24 months, or 2 years out 34 years in which groundwater would exceed the 50% threshold.

The sustainable yield as calculated for Pine South basin is approximately 340 acre-feet per year. This is short of the amount of water estimated to be consumed at theoretical build out of the current GP (410 acre-feet per year), the GP Update Referral Map alternative (399 acre-feet per year), or the GP Update Environmentally Superior alternative (376 acre-feet per year). However, the current discretionary permits in process in DPLU when added to the existing conditions water use would result in a total consumptive use of 302 acre-feet per year, within the calculated sustainable yield of 340 acre-feet per year for the Pine South basin.

Pine North: Using the soil moisture balance methodology, the Pine North basin, which is less used than the Pine South basin, is calculated to have a sufficient water supply under all scenarios analyzed. Under the worst-case scenario of maximum build out of the current GP, the basin is anticipated to have on average approximately 98% of maximum storage through the 34 year period analyzed, with the minimum groundwater in storage in any month estimated at 92% of maximum storage in November 2002. As a comparison to this calculated value, the deepest water levels ever recorded in well PIN-04 were recorded in November 2002 and February 2003 (Figure 16).

Data Limitations: Due to data limitations, the following conservative assumptions were taken in the long-term groundwater availability calculations:

1. Assumed no saturated residuum or alluvium in areas where no data was available (i.e., well or boring logs).
2. In the absence of site-specific aquifer test data, a specific yield of 10% for alluvium was used.
3. Recharge from surface water runoff may be the dominant recharge process in the study area. Since this process has not been adequately quantified through long-term stream gauging records, it was not directly calculated and included in the water balance calculations.

3.3 Mitigation Measures and Alternatives

As calculated, the Pine South basin is anticipated to have a significant cumulative impact to groundwater resources before approaching maximum build out of the current GP as well as any of the alternatives proposed for the GP Update. Conversely, the Pine North basin is anticipated to have an adequate groundwater supply under all scenarios analyzed. For potentially significant cumulative impacts to a given groundwater basin, mitigation would be limited to finding a water source elsewhere to import into the basin. The one measure available to mitigate groundwater impacts to a level of less than significant in the Pine South basin would be for the PVWMC to install additional production wells in the Pine North basin for use within their service area in the Pine South basin. Under the worst-case scenario of maximum build out of the current GP, an additional 70 acre-feet of groundwater per year would be needed (approximately 43 gallons per minute) beyond the calculated sustainable yield of the Pine South basin of 340 acre-feet per year. This could likely be accommodated by one to three additional production wells in the Pine North basin.

Additionally, the GP Update Environmentally Superior alternative could be selected to minimize future development potential in the Pine South basin. Land use densities within the Environmentally Superior alternative could be revised to allow only large rural lots and thereby limit growth to within the calculated sustainable yield of the basin.

4 SUMMARY OF GROUNDWATER IMPACTS AND MITIGATION

The water balance analysis provided in the report indicates that groundwater resources are adequate in both Pine South and Pine North basins to meet the demands under existing conditions and with the addition of additional residences if all discretionary permits currently in process at DPLU were approved. The sustainable yield for the Pine South basin as calculated in this study is 340 acre-feet per year, which would be exceeded under the theoretical build out of the GP or any of the land use alternatives of the proposed GP Update. The North Pine basin under all scenarios analyzed is not anticipated to exceed its sustainable yield.

Mitigation of the potentially significant impact to groundwater resources in the Pine South basin is possible by the PVMWC potentially drilling additional production wells in the Pine North basin and distributing the water to users in the Pine South basin. This could likely be accommodated by one to three additional production wells in the Pine North basin.

The GP Update Environmentally Superior alternative could also be selected (and revised as necessary) to minimize future development potential in the Pine South basin to within the sustainable yield calculated within this study.

5 RECOMMENDATIONS AND LIMITATIONS

5.1 Recommendations to the PVMWC

The majority of Pine Valley is served by the PVMWC, which provides water to 695 service connections from eight existing wells. While groundwater resources appear adequate to meet the current demands of the Pine South and North basins, the following issues should be addressed to maximize availability of groundwater resources for the community as groundwater demand increases:

Water Conservation Measures: Water demand per service connection has increased from 1999 through 2004, which PVMWC attributes to an increase in permanent residences in the valley. Water use has been as high as 0.45 acre-feet per service connection. It is unknown and speculative to predict whether water demand per service connection will continue to increase. DPLU recommends that the PVMWC implement water conservation measures as necessary to maximize the availability of groundwater resources for the community as it continues to grow. If groundwater demand per service connection were to continue to increase unabated, future groundwater problems could develop.

Management of Well Field: In the December 22, 2006 Analysis of Pine Valley Mutual Water Company's Groundwater Resources by Wiedlin & Associates, several recommendations were made to increase the overall efficiency of the PVMWC well field. These recommendations could result in increased production abilities from the existing well field as groundwater demand increases over time.

Maintenance of Well Field: Several of the PVMWC wells were installed between the late 1950s and early 1970s. Water wells over time typically experience decreased well yield from chemical incrustation or bio-fouling of the well screen and the formation materials around the intake portion of the well. Without proper maintenance, individual well performance may be substantially reduced and cause individual wells to fail. As PVMWC wells lose well production capability over time in individual wells, it is recommended that PVMWC provide routine maintenance and rehabilitation of these wells. Additionally, with increased demand and lower production capacity from its existing well field, PVMWC may need to drill additional production wells to keep up with demand.

5.2 Limitations

Hydrogeologic studies are characterized by their uncertainties due to the non-uniformity of geologic formations, the unpredictability of precipitation magnitude and duration, and the extent of groundwater use within and beyond the study area boundaries. No guarantees regarding the performance of individual water wells and resultant water table drawdown are made herein. This study does not address the infrastructure requirements that may or may not be necessary to distribute water within the PVMWC service area.

Due to data limitations, there were a number of conservative assumptions made in the long-term groundwater availability calculations. The following items that were not possible to implement due to budgetary constraints are presented as future possibilities of better refining the knowledge of groundwater resources within Pine Valley.

- Long-term stream gauging stations in Pine Valley would greatly aid in calculating groundwater recharge from stream flow infiltration and in more accurately estimating the amount of runoff occurring. This would also aid in evaluation of elements of the water balance that were not explicitly quantified (e.g., groundwater evapotranspiration [GWET] from phreatophyte consumption, potential surface water base flow supported by groundwater, and/or groundwater discharge out of the basin). Since the data does not exist in which to more accurately quantify these parameters, runoff calculated is subject to substantial uncertainty and therefore was overestimated to indirectly account for the elements above that were not explicitly quantified.

- Long-term aquifer pumping tests are needed to provide more accurate estimates of the specific yield of the alluvium and residuum. This would likely require the drilling of new wells to evaluate each specific hydrogeologic unit.

- As new wells are drilled in Pine Valley, the well logs may provide new information to explore other valley areas where saturated residuum may be present.

6 REFERENCES

California Department of Water Resources (DWR).

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

Bulletin 118 (Public Review Draft), April 2003.

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

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

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

County of San Diego

DEH. Confidential Well Log Data.

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 of Determining Significance and Report Format and Content Requirements, Groundwater March 19, 2007

DPLU, County of San Diego DPLU General Plan Update Groundwater Study, May 18, 2009 (Public Review Draft).

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.

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

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

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

Pine Valley Mutual Water Company (PVMWC), Groundwater data from Production Wells, 1991 to 2009.

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

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

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.

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.

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

Wiedlin & Associates, Inc., 2006. Analysis of Pine Valley Mutual Water Company's Groundwater Resources, Pine Valley, San Diego County, CA. December 22, 2006.

Woodward, Clyde, Sherard, and Associates, 1961. Hydrological Study for the Potential Groundwater Supply, Pine Valley, California: Report No. 61-245.

Tables

Table 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 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 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
Pine South Basin
Estimated Groundwater Demand

Land Use Scenario	Land Use	Quantity	Water Demand Per Unit (afy)	Total Water Demand (afy)
Existing Conditions	Single-Family Residential	530	0.5	265
	Second Dwelling Units	8	0.25	2
	Commercial Uses	12	0.3	4
	County Park	5.2	3.1	16
	Total Water Demand (Existing Conditions):			**287**
Existing Conditions Plus Discretionary Projects in Process	Sum of Existing Conditions Water Demand	n/a	n/a	287
	Tentative Map 5236	3	0.5	2
	Tentative Map 5318	20	0.5	10
	Tentative Parcel Map 20765	4	0.5	2
	Tentative Parcel Map 20951	4	0.5	2
	Total Water Demand (Existing Conditions Plus Discretionary Projects):			**302**
Current General Plan Buildout	Sum of Existing Conditions Water Demand	n/a	n/a	287
	Additional Single-Family Residences at Theoretical Maximum Buildout	247	0.5	123.5
	Total Water Demand (Current General Plan Buildout)			**410**
General Plan Update Buildout	Sum of Existing Conditions Water Demand	n/a	n/a	287
	Additional Single-Family Residences at Theoretical Maximum Buildout	224	0.5	112
	Total Water Demand (General Plan Update Buildout)			**399**

Notes:
afy - acre feet per year

Table 4
Pine North Basin
Estimated Groundwater Demand

Land Use Scenario	Land Use	Quantity	Water Demand Per Unit (afy)	Total Water Demand (afy)
Existing Conditions	Single-Family Residential	125	0.5	62.5
	Second Dwelling Units	1	0.25	0.25
	Pine Valley Bible Conference Center	1	19.9	20
	Forest Service Cabins	37	0.1	4
	Total Water Demand (Existing Conditions):			**86**
Existing Conditions Plus Discretionary Projects in Process	Sum of Existing Conditions Water Demand	n/a	n/a	86
	Tentative Parcel Map 20857	2	0.5	1
	Total Water Demand (Existing Conditions Plus Discretionary Projects):			**87**
Current General Plan Buildout	Sum of Existing Conditions Water Demand	n/a	n/a	86
	Additional Single-Family Residences at Theoretical Maximum Buildout	52	0.5	26
	Total Water Demand (Current General Plan Buildout)			**112**
General Plan Update Buildout	Sum of Existing Conditions Water Demand	n/a	n/a	86
	Additional Single-Family Residences at Theoretical Maximum Buildout	26	0.5	13
	Total Water Demand (General Plan Update Buildout)			**99**

Notes:
afy - acre feet per year

Table 5
Pine South Basin
Groundwater in Storage Calculations

Size (Acres)	3615
Modeled Maximum GW in Storage (AF)	2138
Modeled Average GW Recharge (AFY)	963

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	287	89%	63%
Existing Conditions Plus Discretionary Permits	302	88%	59%
General Plan Buildout	410	78%	35%
GP Update Buildout - Referral	399	80%	37%
GP Update Buildout - Environmentally Superior	376	82%	43%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year
GW - Groundwater

Change of GW in Storage

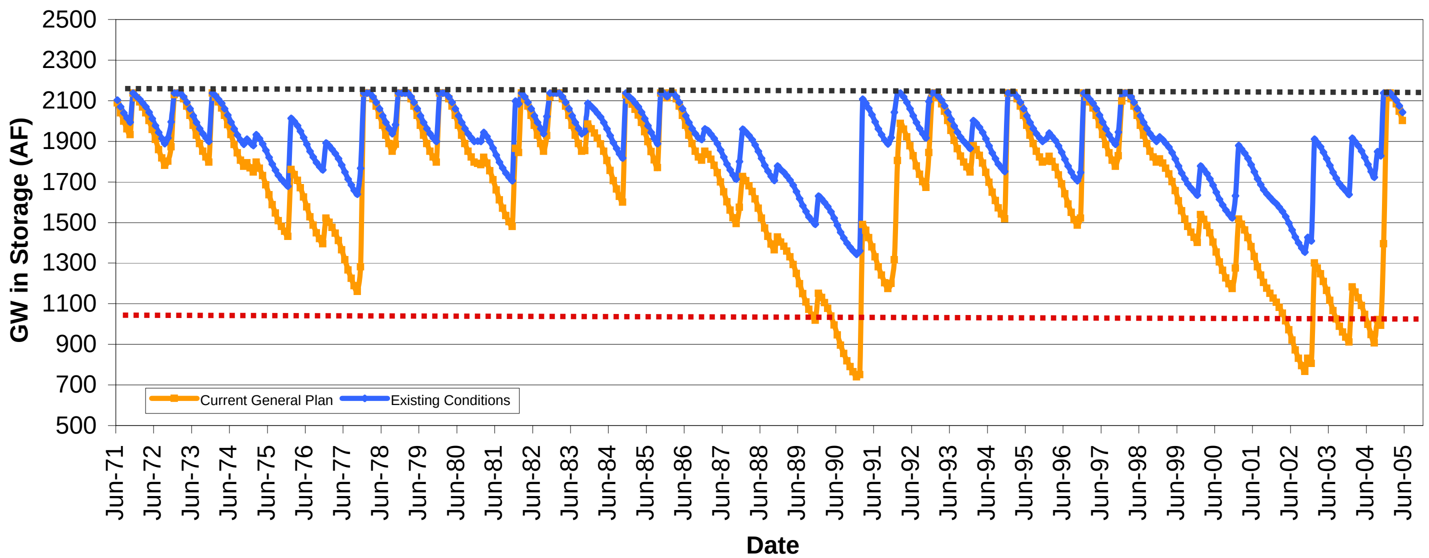


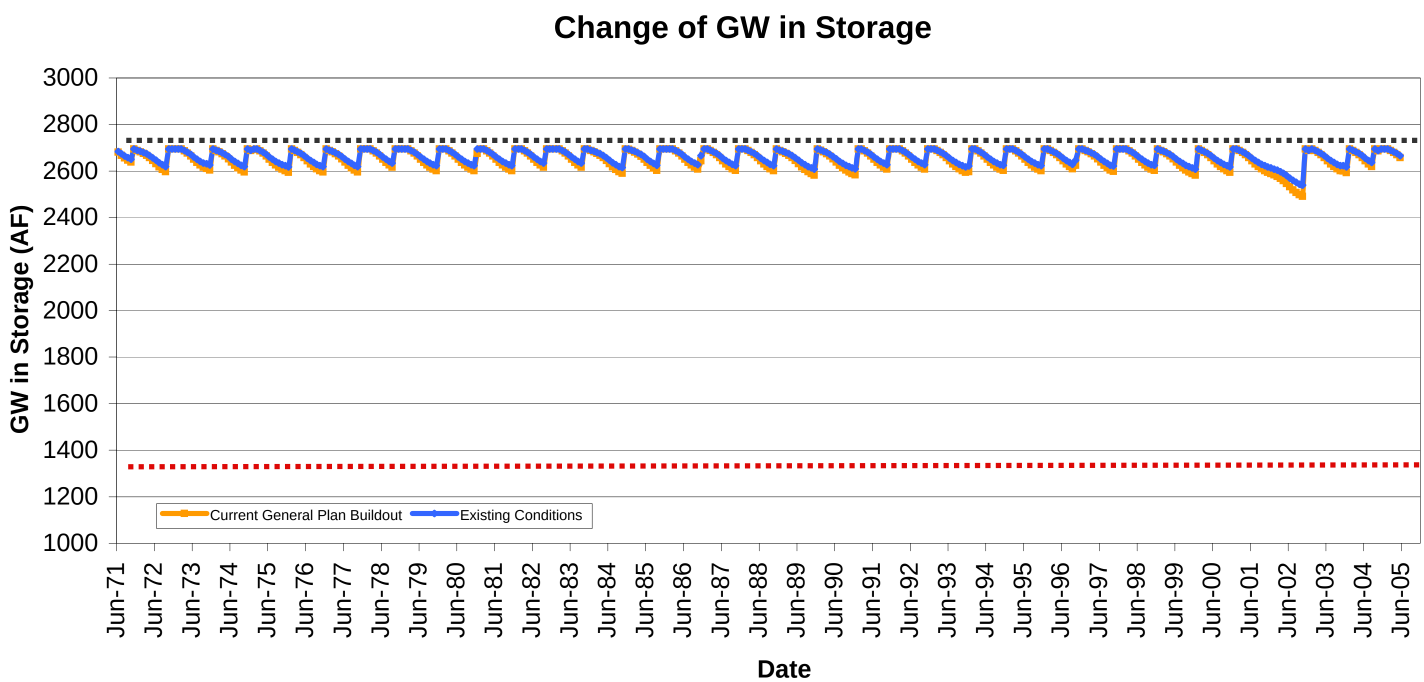
Table 6
Pine North Basin
Groundwater in Storage Calculations

Size (Acres)	15189
Modeled Maximum GW in Storage (AF)	2694
Modeled Average GW Recharge (AFY)	4462

Scenario	Estimated GW Demand (AFY)	Estimated Average GW in Storage	Estimated Minimum GW in Storage
Existing Conditions	86	99%	94%
Existing Conditions Plus Discretionary Projects	87	99%	94%
Current General Plan Buildout	112	98%	92%
Referral Map Buildout	99	99%	93%

Note: 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% at any time are considered to have a potentially significant impact to groundwater resources.
AF - Acre-Feet
AFY- Acre-Feet Per Year

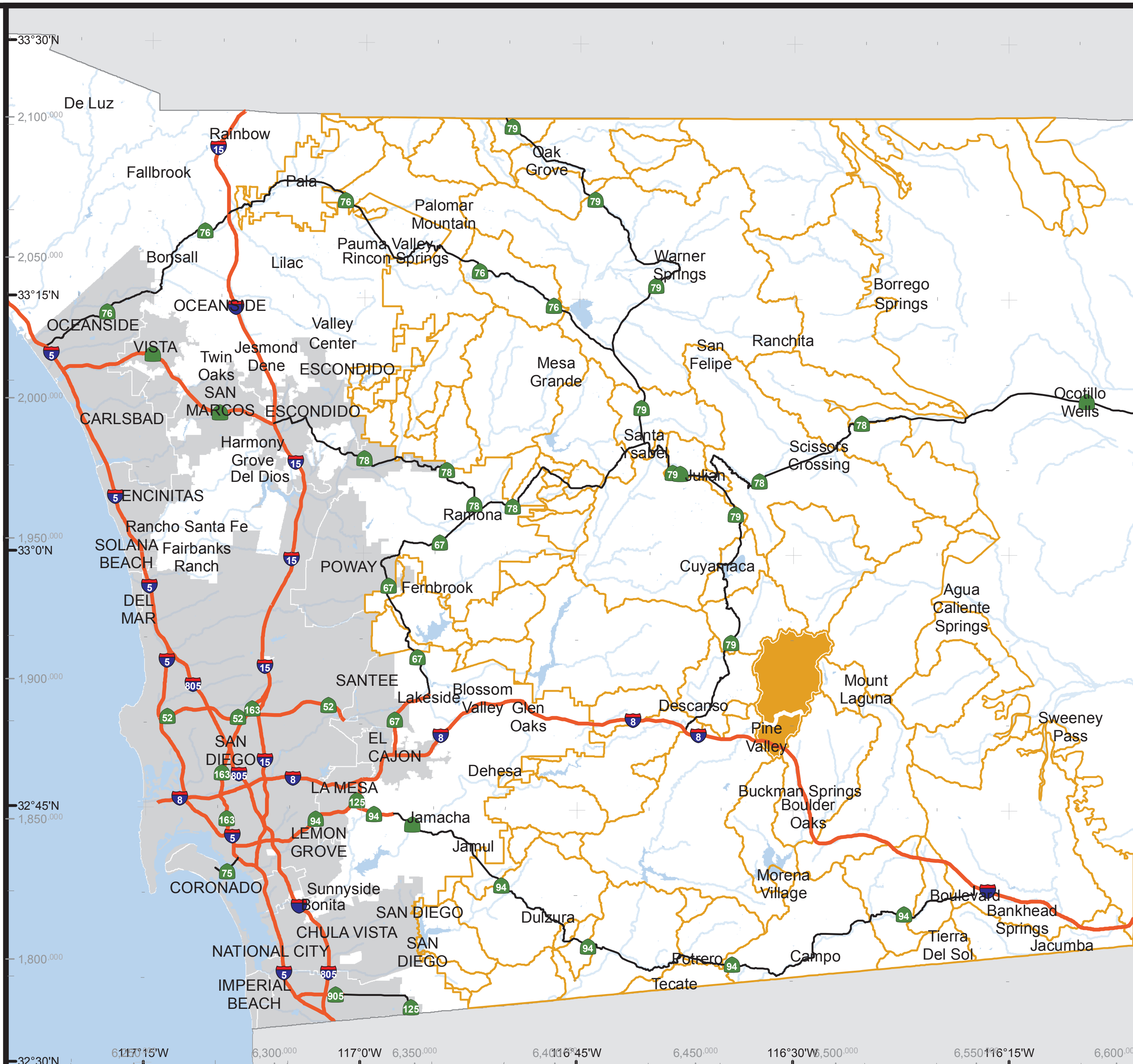
GW - Groundwater



Figures

Figure 1

Regional Location



Freeways
Major Highways
Pine Valley Watershed
Rivers
Ocean/Lakes
Incorporated Land

0 7.5 15
Miles

DPLU GIS

May 2009
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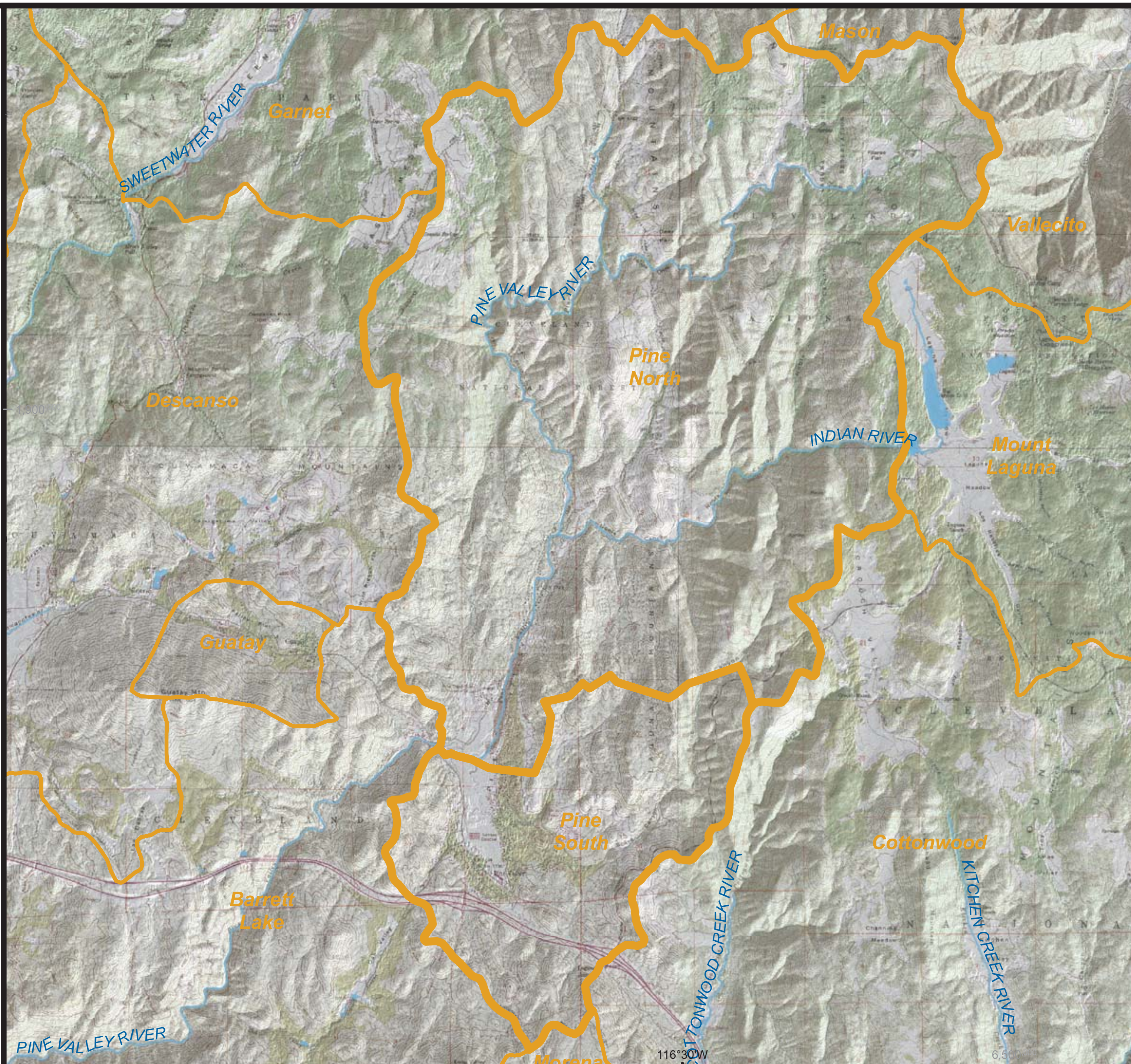
Figure 2

Groundwater Study Boundaries



Watershed Boundary
Rivers
Lakes

0 1 2
Miles

May 2009
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Figure 3

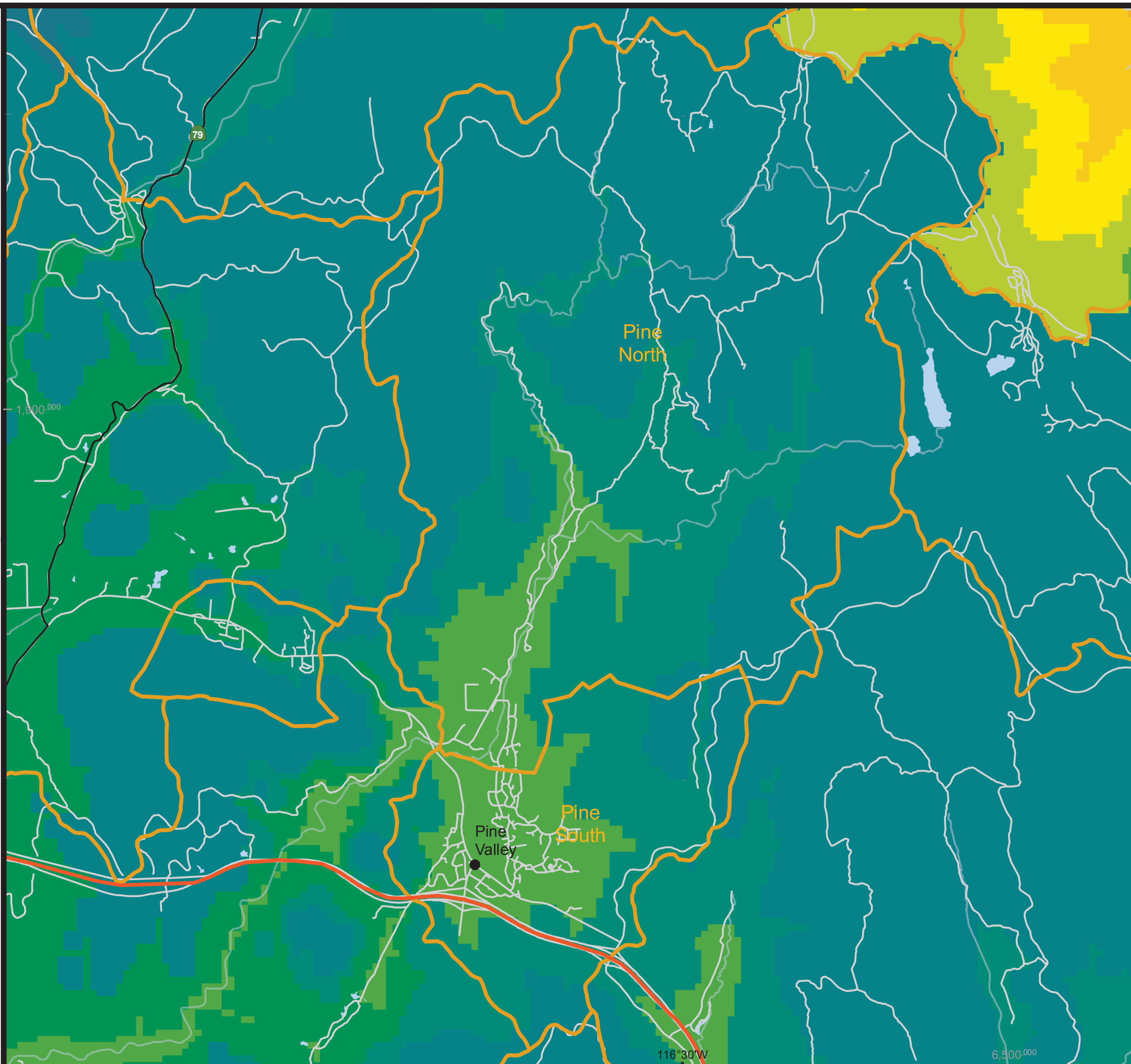
Precipitation

30-Year Average
1971-2001

Precipitation (Inches)

- 6 - 9
- 9 - 12
- 12 - 15
- 15 - 18
- 18 - 21
- 21 - 24
- 24 - 27
- 27 - 30
- 30 - 33
- Communities
- Freeways
- Major Highways
- Roads
- Watershed Boundary
- Rivers
- Ocean/Lakes

0 1 2
Miles



May 2009
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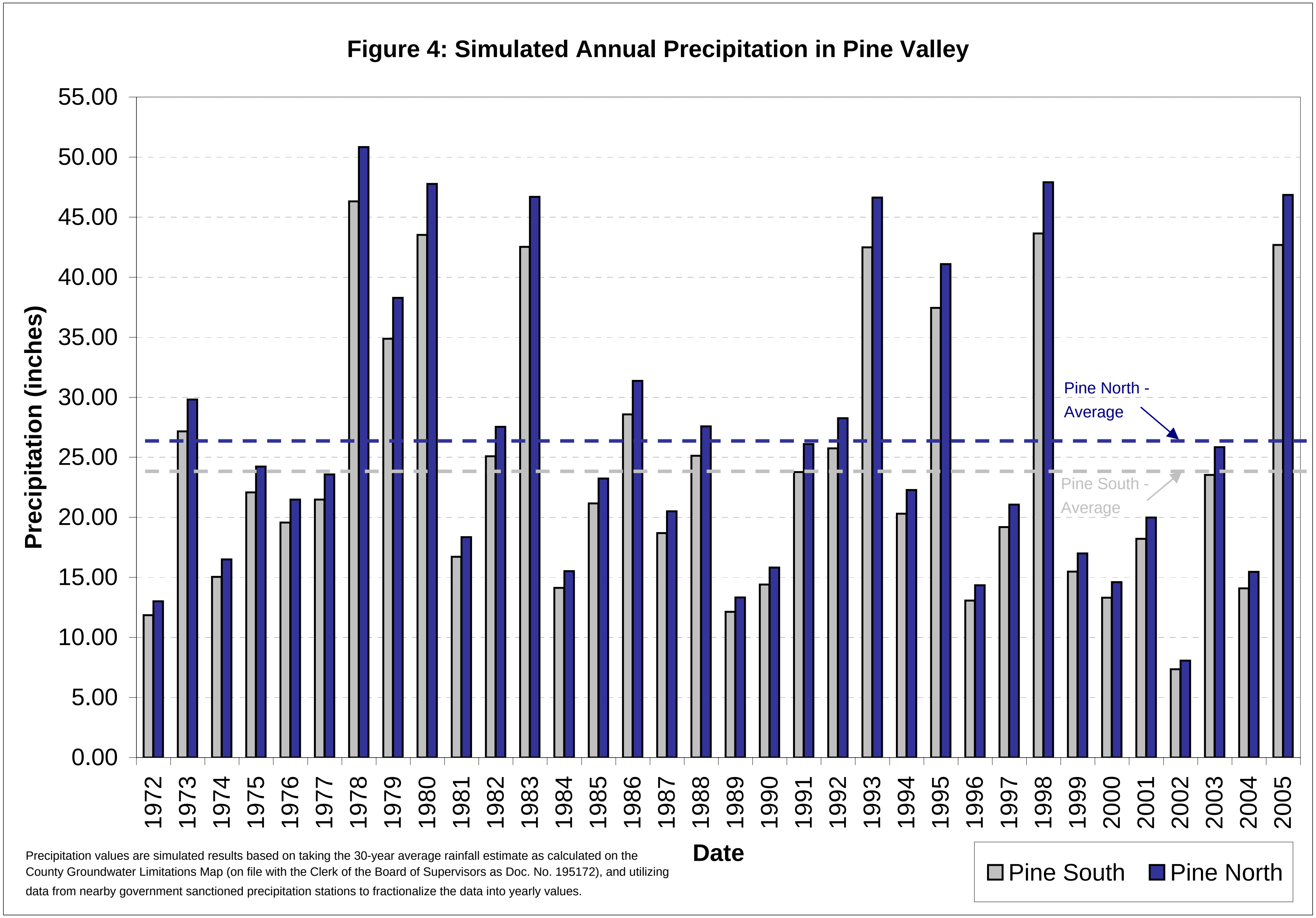
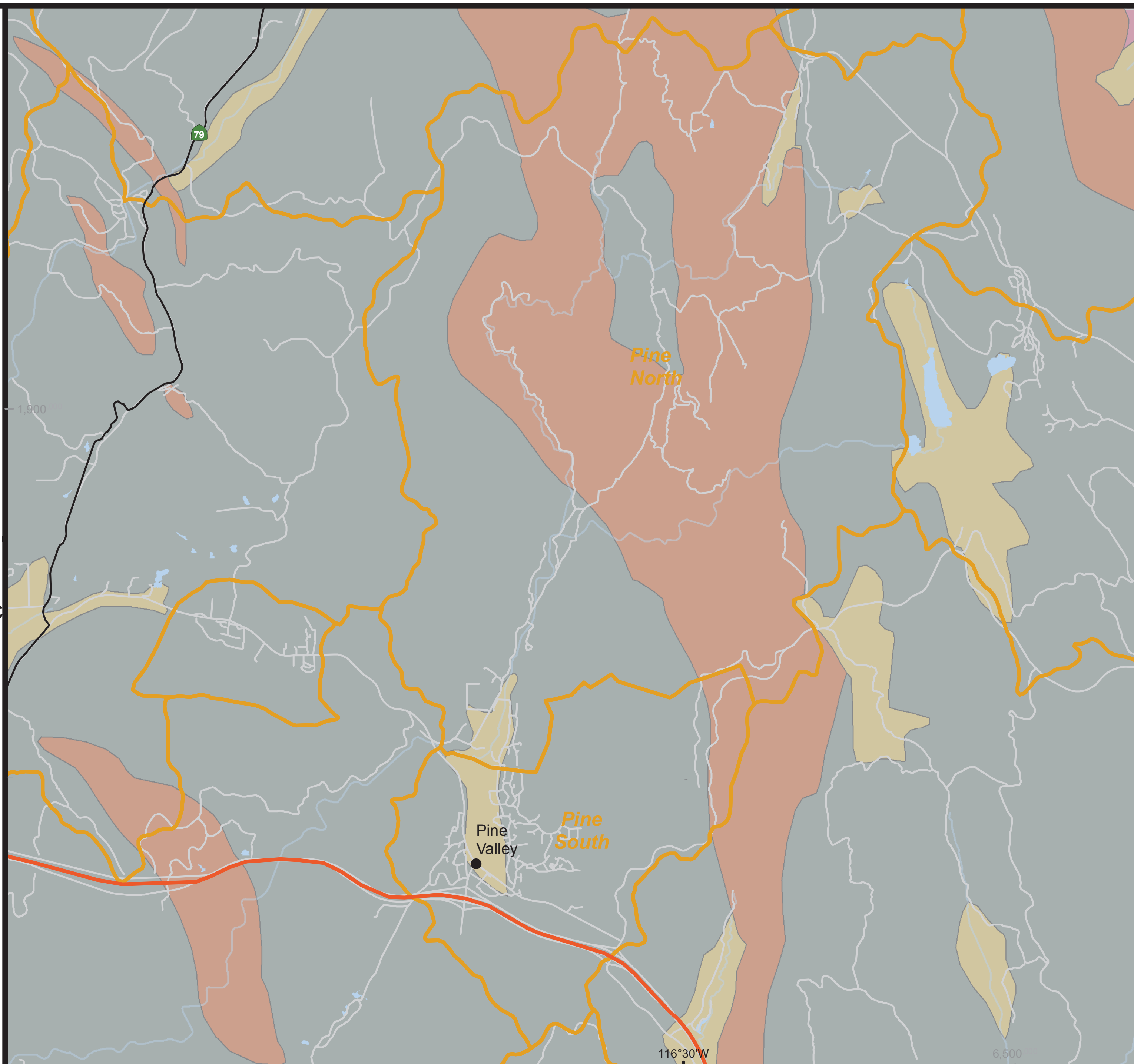


Figure 4: Simulated Annual Precipitation in Pine Valley
Precipitation (inches)
55.00
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
Date
Pine North - Average
Pine South - Average
Pine South
Pine North
Precipitation values are simulated results based on taking the 30-year average rainfall estimate as calculated on the County Groundwater Limitations Map (on file with the Clerk of the Board of Supervisors as Doc. No. 195172), and utilizing data from nearby government sanctioned precipitation stations to fractionalize the data into yearly values.

Figure 5

Generalized Geology



- Communities
- Freeways
- Major Highways
- Roads
- Watershed Boundary
- Parcles (>5ac)
- Rivers
- Ocean/Lakes

Generalized Geology

- CRETACEOUS PLUTONIC
- OLDER QUATERANARY ALLUVIUM, TERRACES AND FANGLOMERATES
- PRE-CRETACEOUS METASEDIMENTARY
- QUATERNARY ALLUVIUM

0 1 2
Miles

May 2009
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Figure 6

Soils

- ● Communities
- Freeways
- Major Highways
- Roads
- Watershed Boundary
- Parcles (>5ac)
- Rivers
- Ocean/Lakes

Soil Moisture Capacity

- 0.10" - 1.00"
- 1.50" - 3.25"
- 3.50" - 5.00"
- 5.50" - 6.75"
- 7.50" - 10.00"

0 1 2
Miles

May 2009
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Title	Description	Soil Moisture Capacity (inches)
AcG	Acid igneous rock land	0.10
BbE	Bancas stony loam, 5-30% slopes	4.75
BbE2	Bancas stony loam, 5-30% slopes, eroded	4.75
BbG	Bancas stony loam, 30-65% slopes	4.25
BbG2	Bancas stony loam, 30-65% slopes, eroded	4.25
BoC	Boomer loam, 2-9% slopes	6.50
BoE	Boomer loam, 9-30% slopes	6.00
BrE	Boomer stony loam, 9-30% slopes	4.75
BrG	Boomer stony loam, 30-65% slopes	4.75
BuC	Bull Trail sandy loam, 5-9% slopes	6.75
CaC	Calpine coarse sandy loam, 5-9% slopes	5.50
CtE	Crouch coarse sandy loam, 5-30% slopes	6.00
CtF	Crouch coarse sandy loam, 30-50% slopes	5.00
CuE	Crouch rocky coarse sandy loam, 5-30% slopes	4.50
CuG	Crouch rocky coarse sandy loam, 30-70% slopes	4.50
GrA	Greenfield sandy loam, 0-2% slopes	6.50
HmD	Holland fine sandy loam, 5-15% slopes	5.00
HmE	Holland fine sandy loam, 15-30% slopes	5.00
HnE	Holland stony fine sandy loam, 5-30% slopes	3.25
LaE2	La Posta loamy coarse sand, 5-30% slopes, eroded	2.50
LcE	La Posta rocky loamy coarse sand, 5-30% slopes	1.75
LcE2	La Posta rocky loamy coarse sand, 5-30% slopes, eroded	1.50
LcF2	La Posta rocky loamy coarse sand, 30-50% slopes, eroded	1.50
LpD2	Las Posas fine sandy loam, 9-15% slopes, eroded	5.00
LrE	Las Posas stony fine sandy loam, 9-15% slopes	5.00
LrE2	Las Posas stony fine sandy loam, 9-30% slopes, eroded	5.00
LrG	Las Posas stony fine sandy loam, 30-65% slopes	5.00
Lu	Loamy alluvial land	7.50
MrG	Metamorphic rock land	1.00
MvC	Mottsville loamy coarse sand, 2-9% slopes	4.50
RkA	Reiff fine sandy loam, 0-2% slopes	8.50
RkB	Reiff fine sandy loam, 2-5% slopes	8.50
RkC	Reiff fine sandy loam, 5-9% slopes	8.50
Rm	Riverwash	2.50
SpE2	Sheephead rocky fine sandy loam, 9-30% slopes, eroded	2.50
SpG2	Sheephead rocky fine sandy loam, 30-65% slopes, eroded	2.50
SrD	Sloping gullied land	1.00
ToE2	Tollhouse rocky coarse sandy loam, 5-30% slopes, eroded	1.50
ToG	Tollhouse rocky coarse sandy loam, 30-65% slopes	1.50
TuB	Tujunga sand, 0-5% slopes	3.50
VaA	Visalia sandy loam, 0-2% slopes	8.75
VaB	Visalia sandy loam, 2-5% slopes	8.75
VaC	Visalia sandy loam, 5-9% slopes	8.75
WmC	Wyman loam, 5-9% slopes	10.00

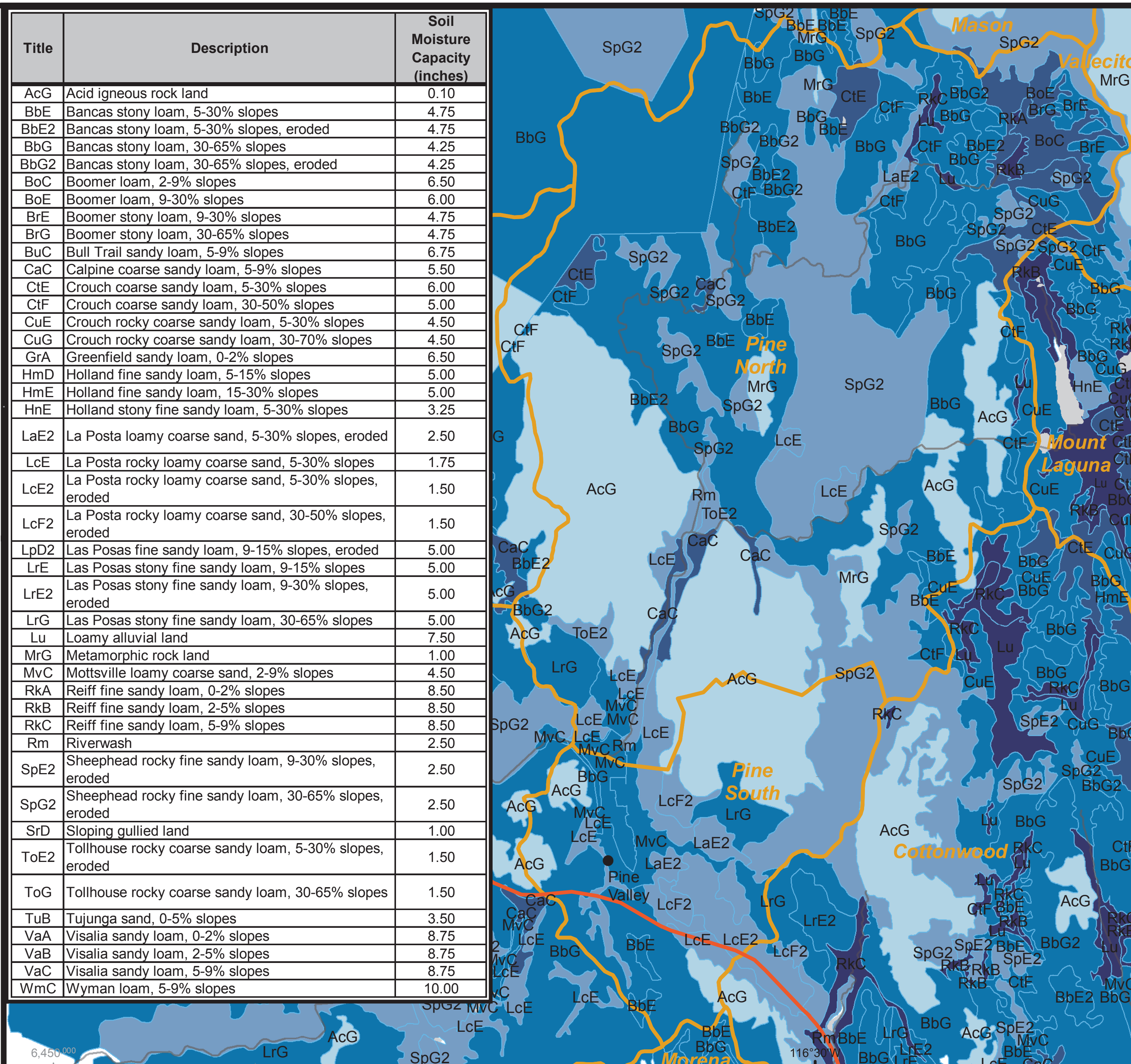
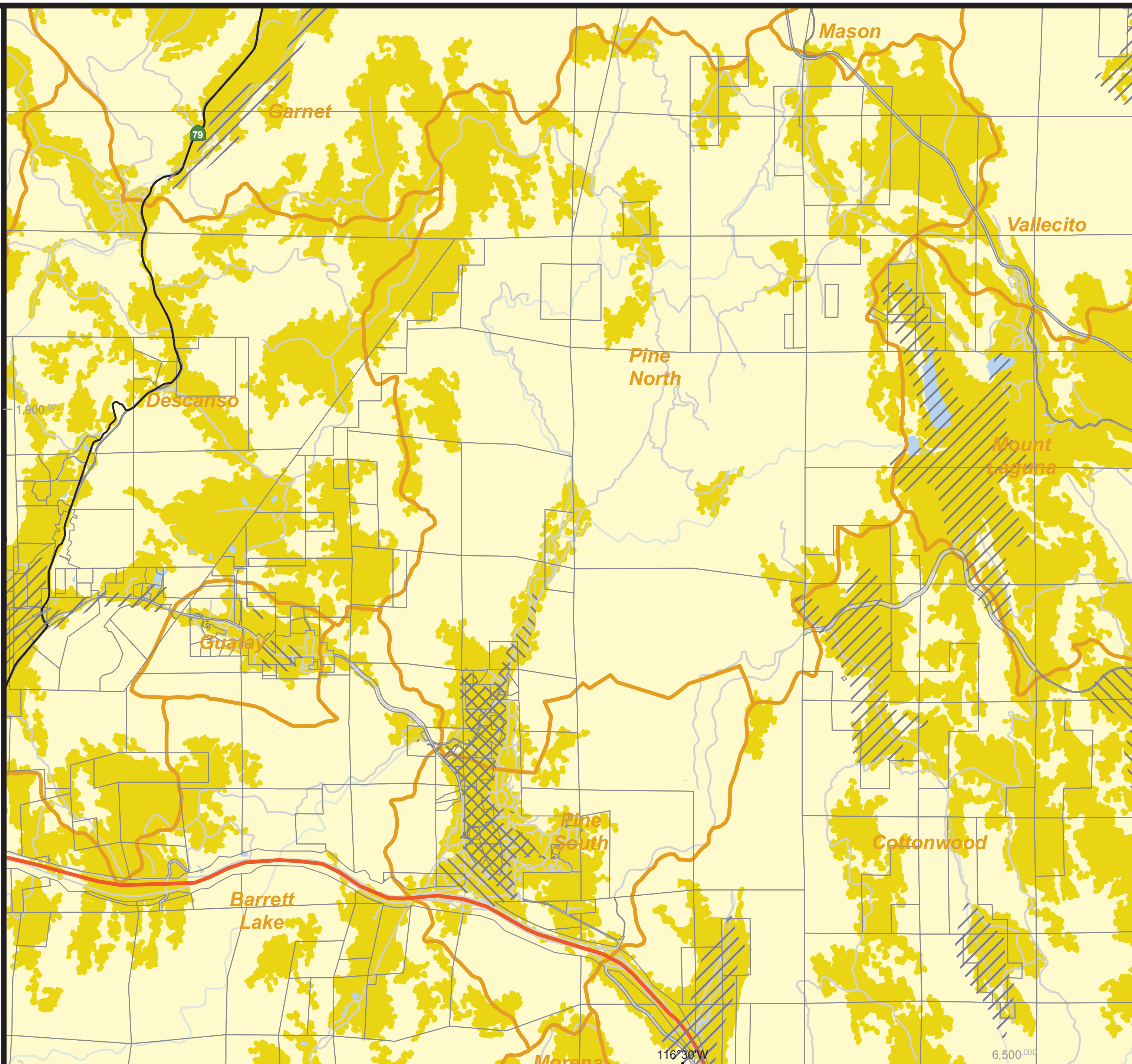


Figure 7

Hydrogeologic Units

- Communities
- Freeways
- Major Highways
- Watershed Boundary
- Parcles (>5ac)
- Rivers
- Ocean/Lakes
- Residuum
- Alluvium
- Slightly Fractured Rock
- Moderately Fractured Rock

0 1 2
Miles



May 2009
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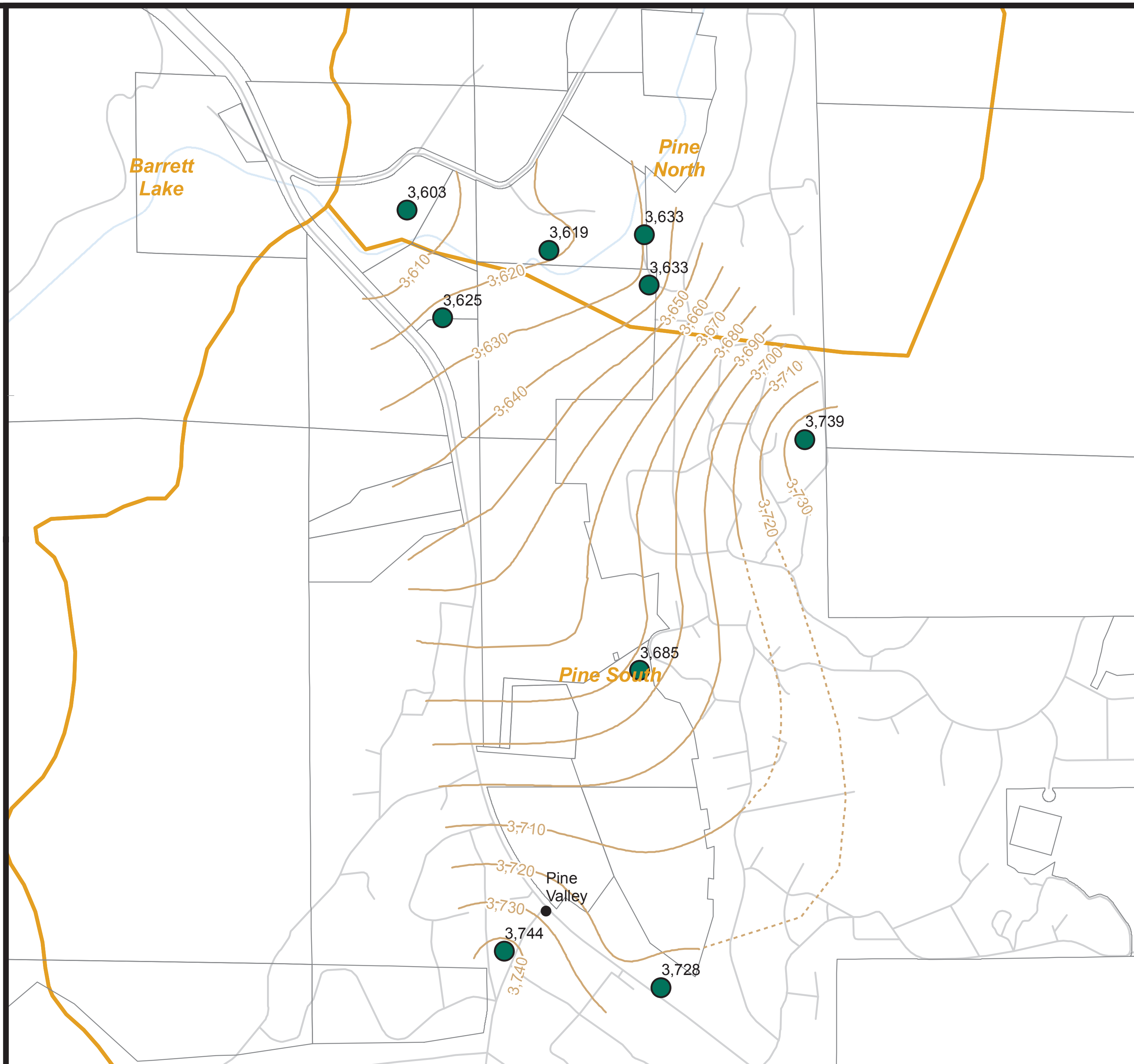
Figure 8

Groundwater Elevation

Spring 1998



- Communities
- Freeways
- Major Highways
- Roads
- Watershed Boundary
- Parcles (>5ac)
- Rivers
- Ocean/Lakes
- Wells (Water Elevation, Feet)
- Groundwater Elevation
- Inferred Value

0 740 1,480
Feet

May 2009
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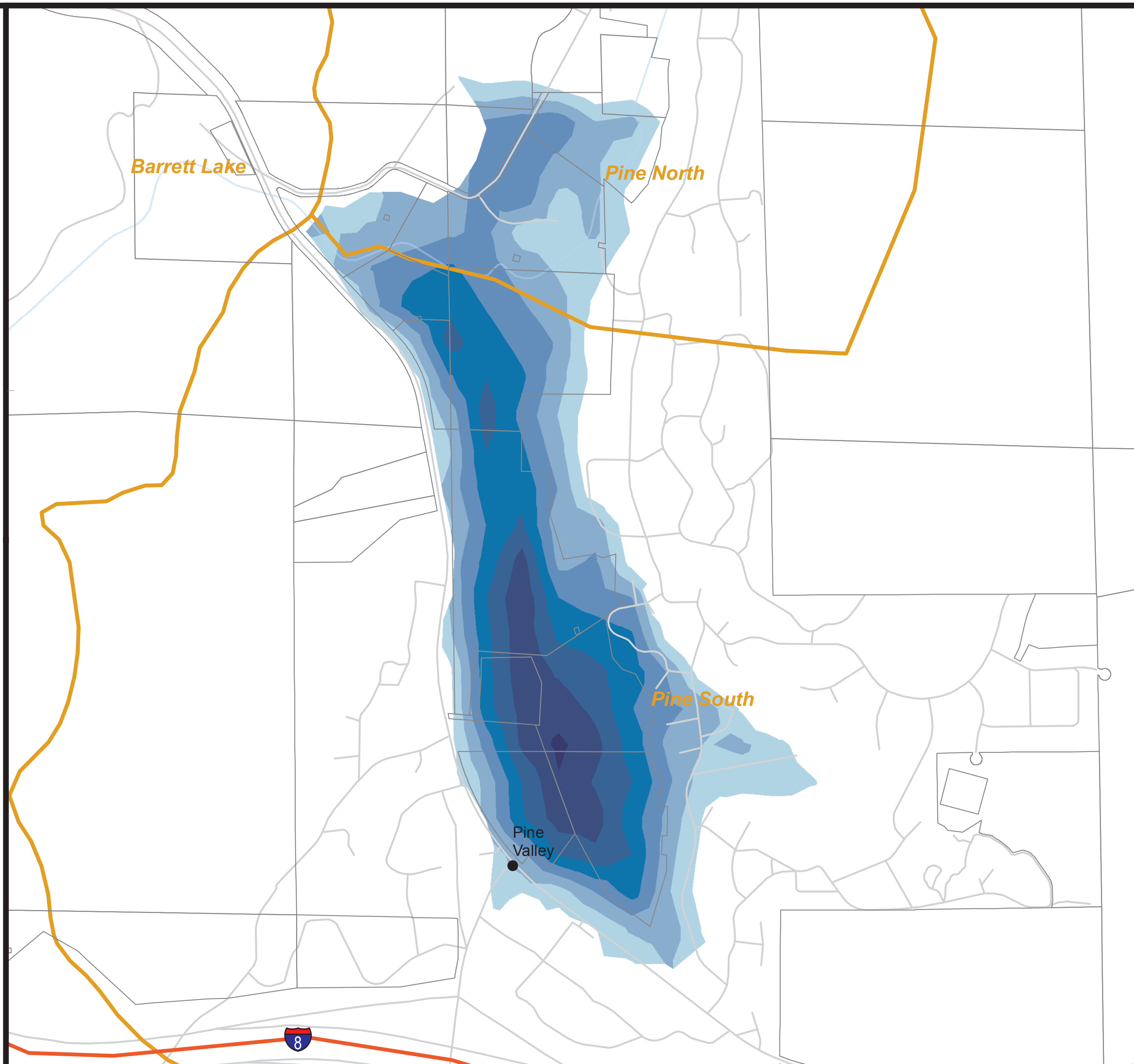
Figure 9

Saturated Alluvium Isopach



- Communities
- Freeways
- Major Highways
- Roads
- Watershed Boundary
- Parcles (>5ac)
- Rivers
- Ocean/Lakes

Saturated Alluvium (Feet)

- 5
- 6 - 15
- 16 - 25
- 26 - 35
- 36 - 45
- 46 - 55
- 56 - 62

0 800 1,600

Feet

May 2009

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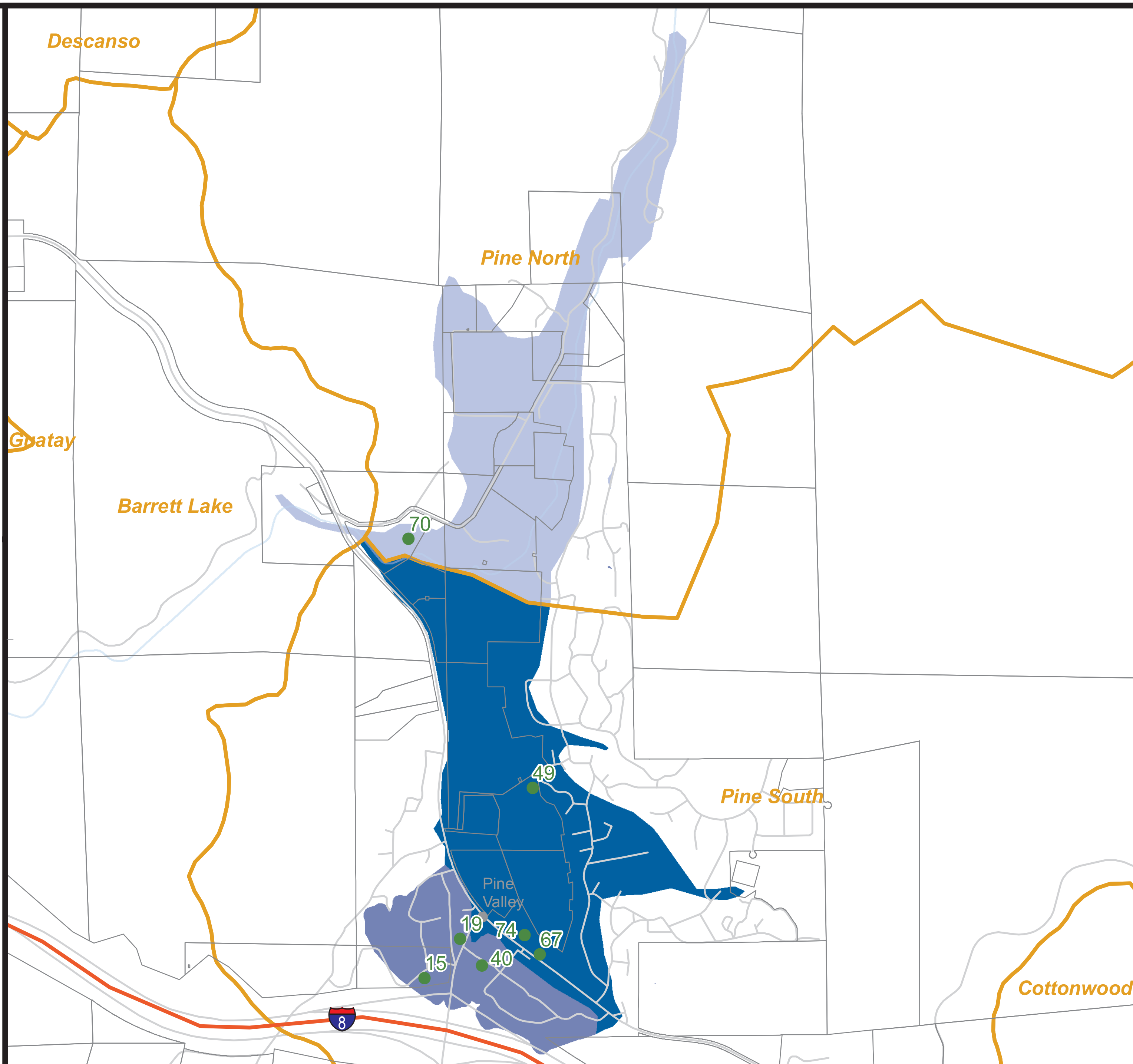
Figure 10

Saturated Residuum Thickness



- Communities
- Wells (Feet)
- Freeways
- Major Highways
- Roads
- Watershed Boundary
- Parcles (>5ac)
- Rivers
- Ocean/Lakes

Residuum Thickness (Feet)

- 10
- 20
- 45

0 1,400 2,800
Feet

May 2009
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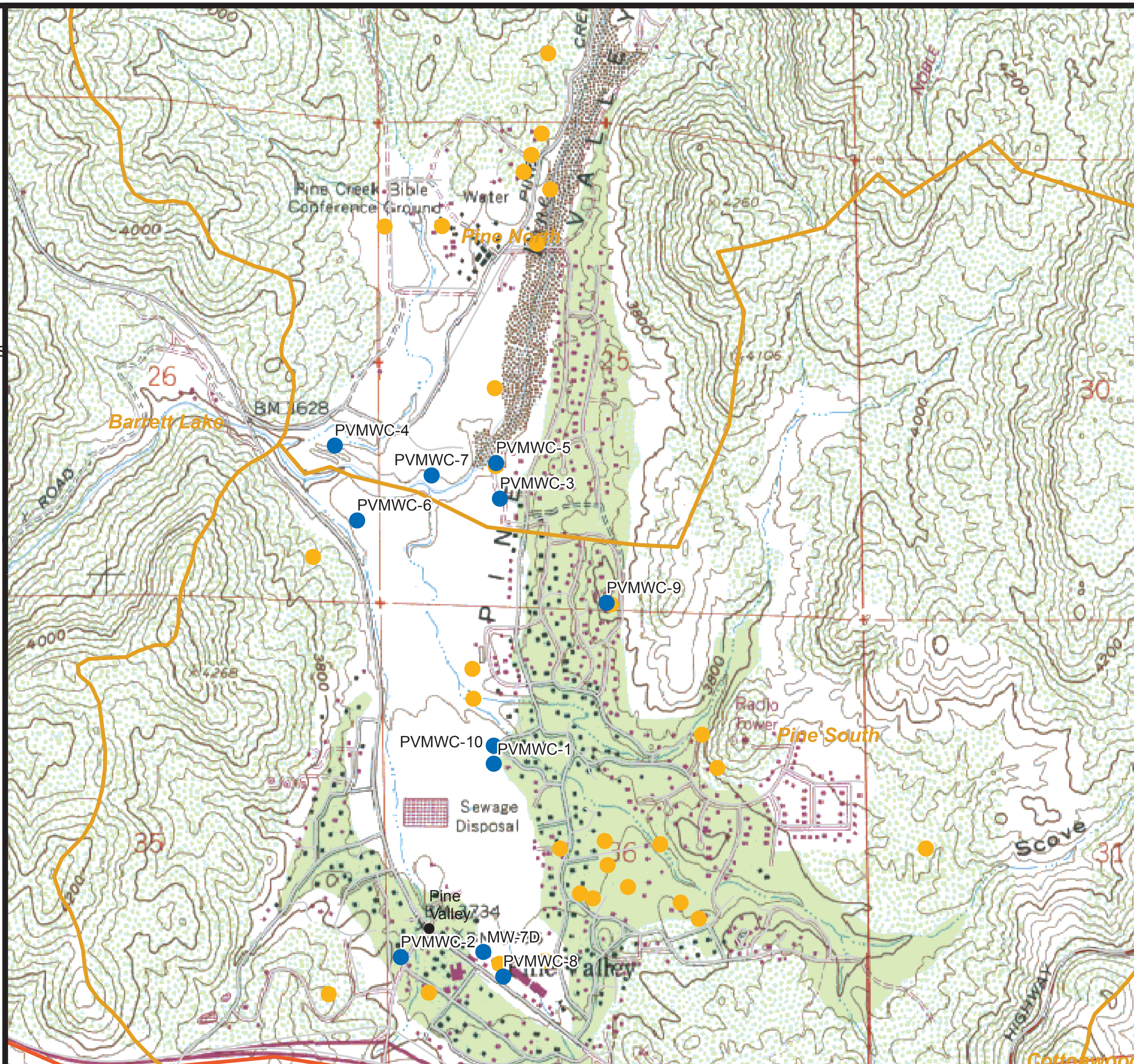
Figure 11

Well Inventory

Wells
DEH-Permitted Supply Wells
Communities
Freeways
Major Highways
Roads
Watershed Boundary
Rivers
Ocean/Lakes

0 0.25 0.5
Miles



May 2009
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Figure 12: Pine Valley Area 1 Well Hydrographs

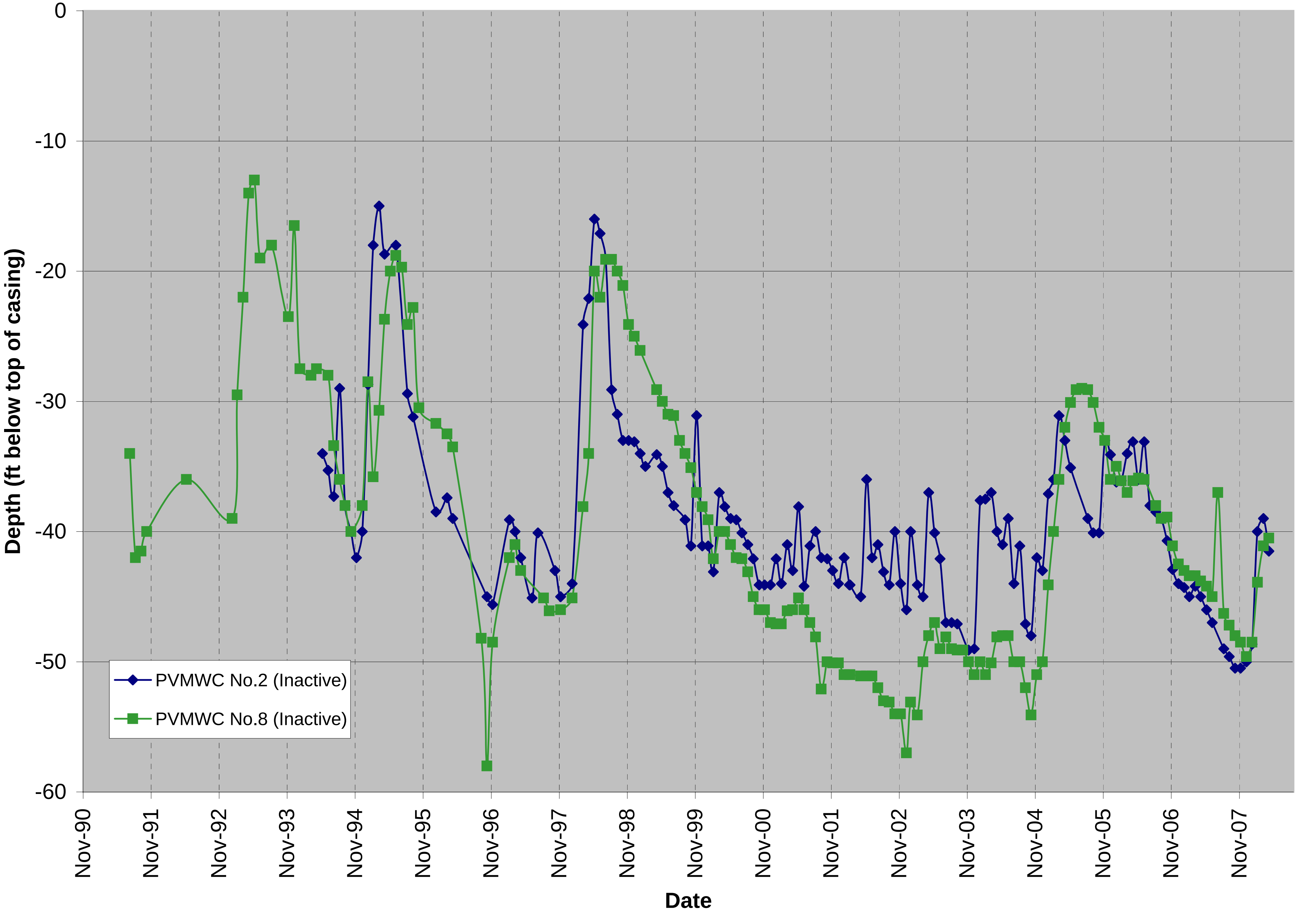


Figure 13: Pine Valley Area 2 Well Hydrographs

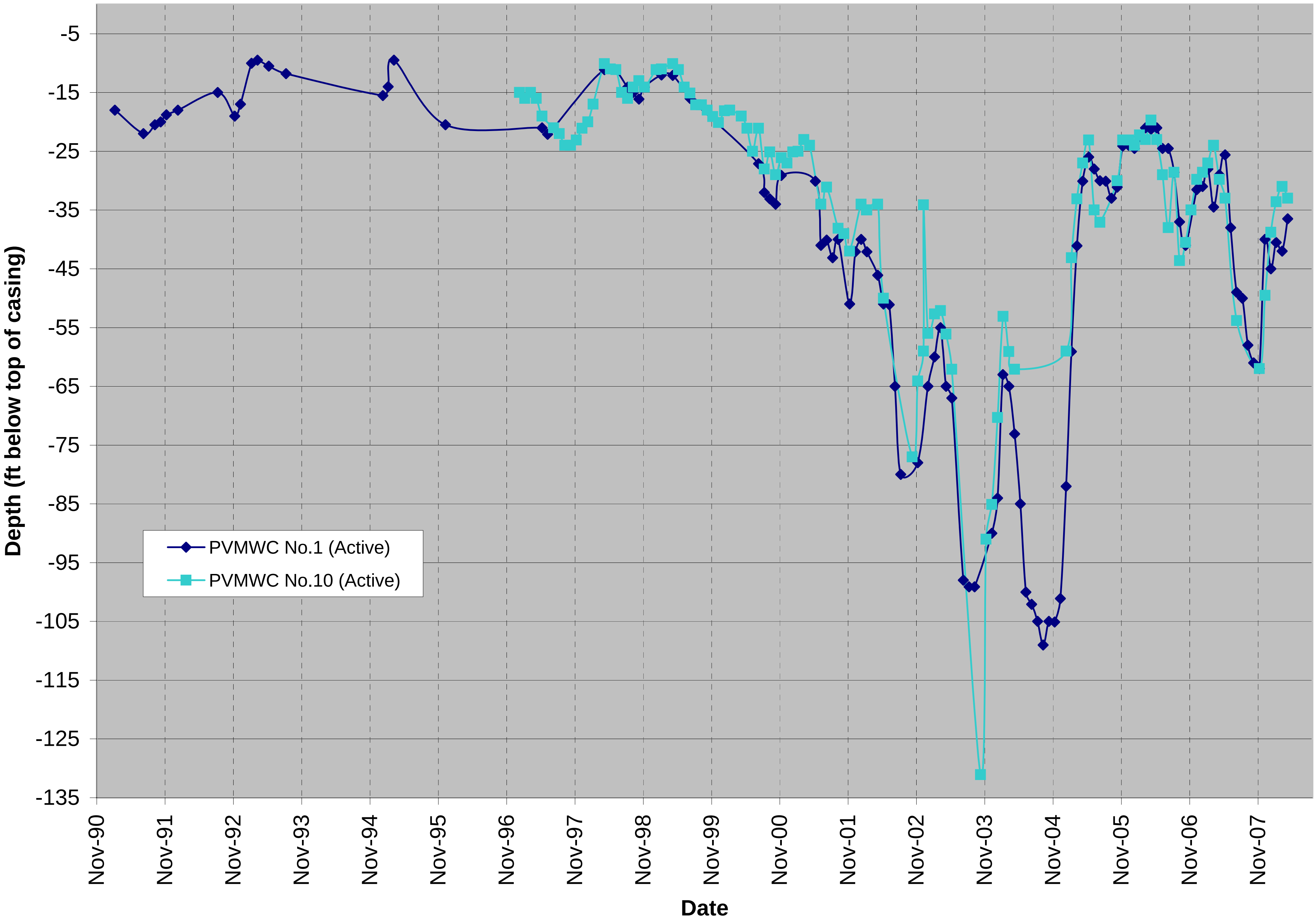


Figure 14: Pine Valley Area 3 Well Hydrographs

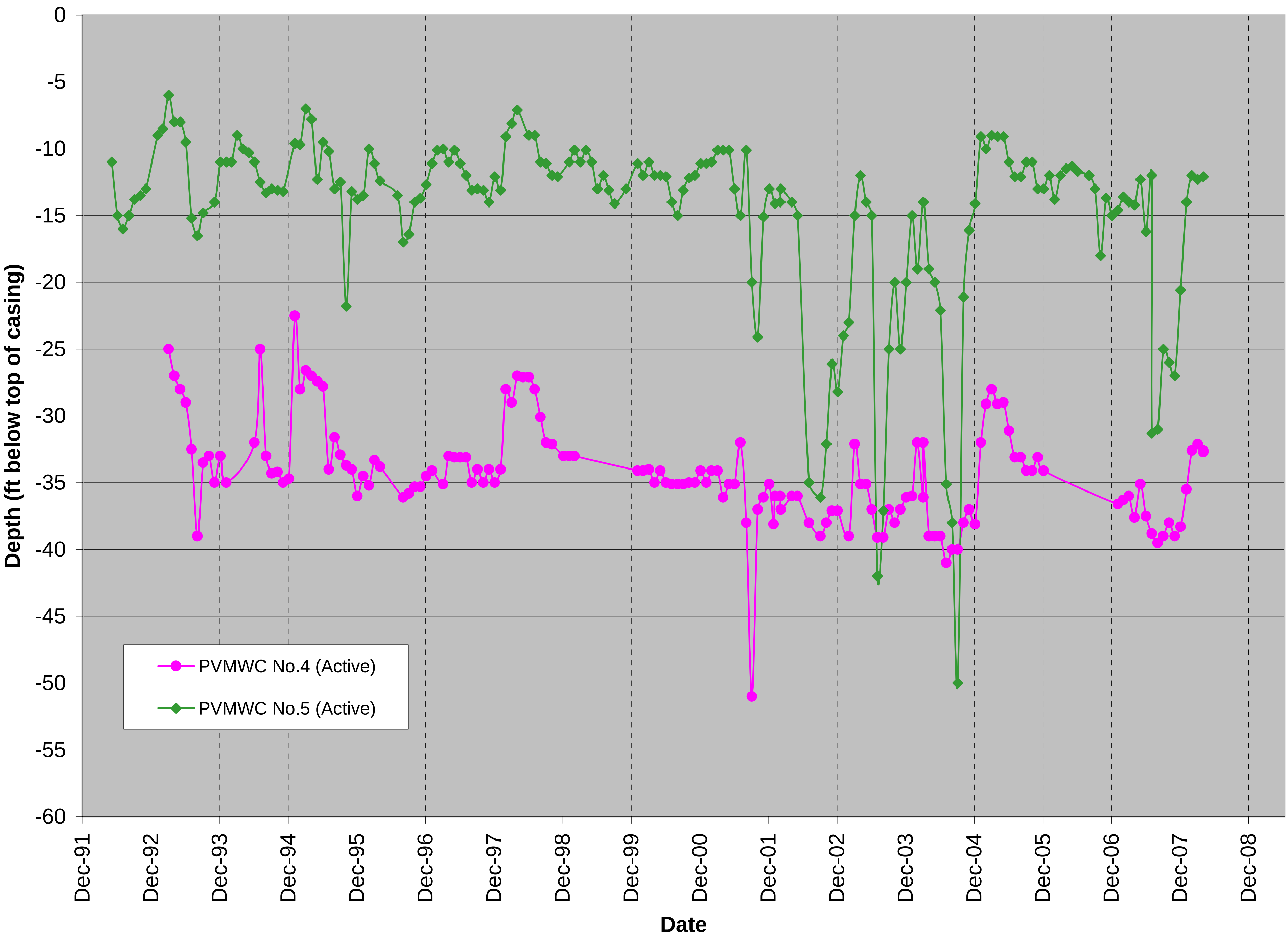
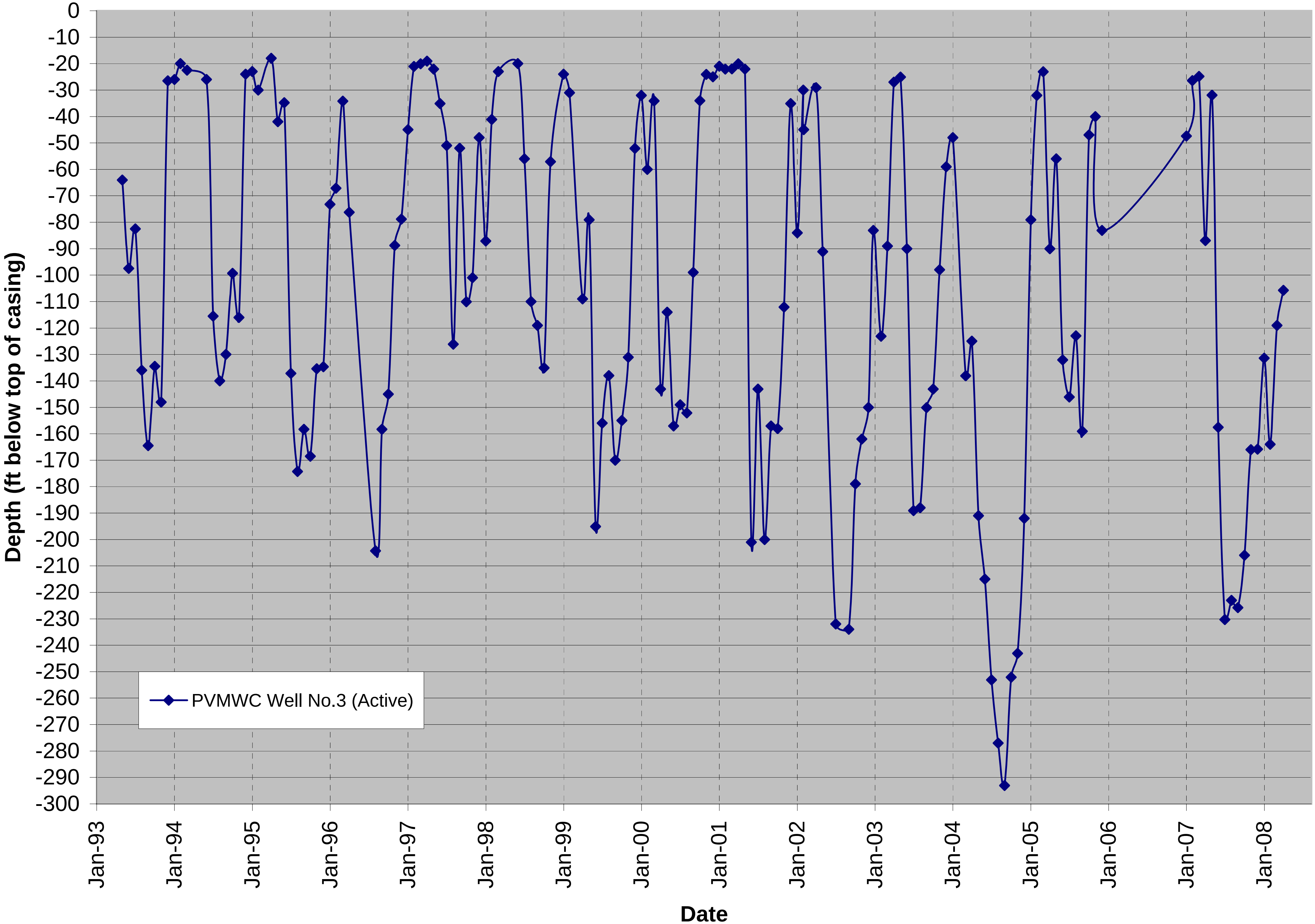


Figure 15: Pine Valley Area 4 Well Hydrographs



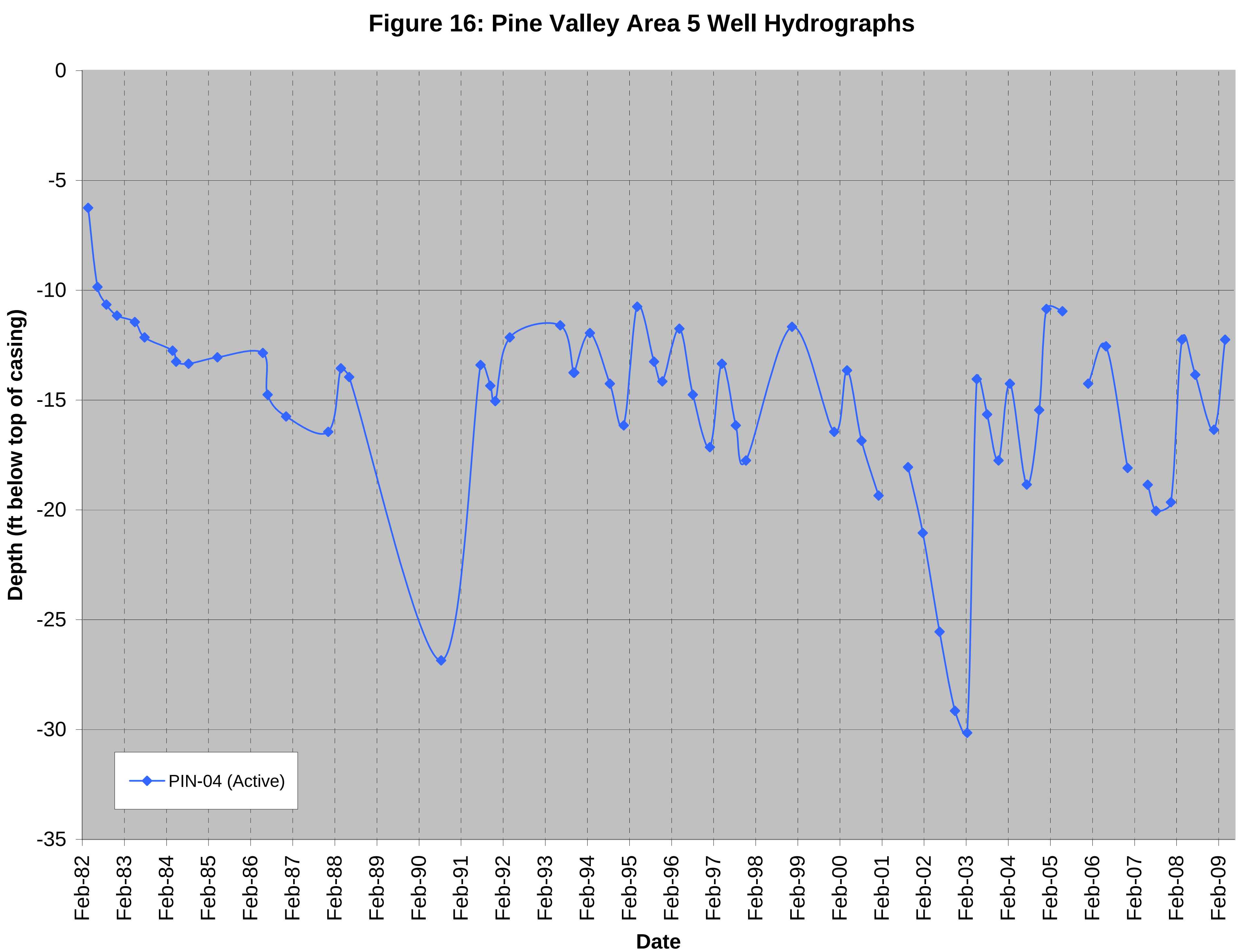


Figure 16: Pine Valley Area 5 Well Hydrographs
0
-5
-10
-15
-20
-25
-30
-35
Depth (ft below top of casing)
Feb-82
Feb-83
Feb-84
Feb-85
Feb-86
Feb-87
Feb-88
Feb-89
Feb-90
Feb-91
Feb-92
Feb-93
Feb-94
Feb-95
Feb-96
Feb-97
Feb-98
Feb-99
Feb-00
Feb-01
Feb-02
Feb-03
Feb-04
Feb-05
Feb-06
Feb-07
Feb-08
Feb-09
Date
PIN-04 (Active)

Figure 17

Groundwater Elevation Comparison

Spring 1998 to Summer/Fall 2004

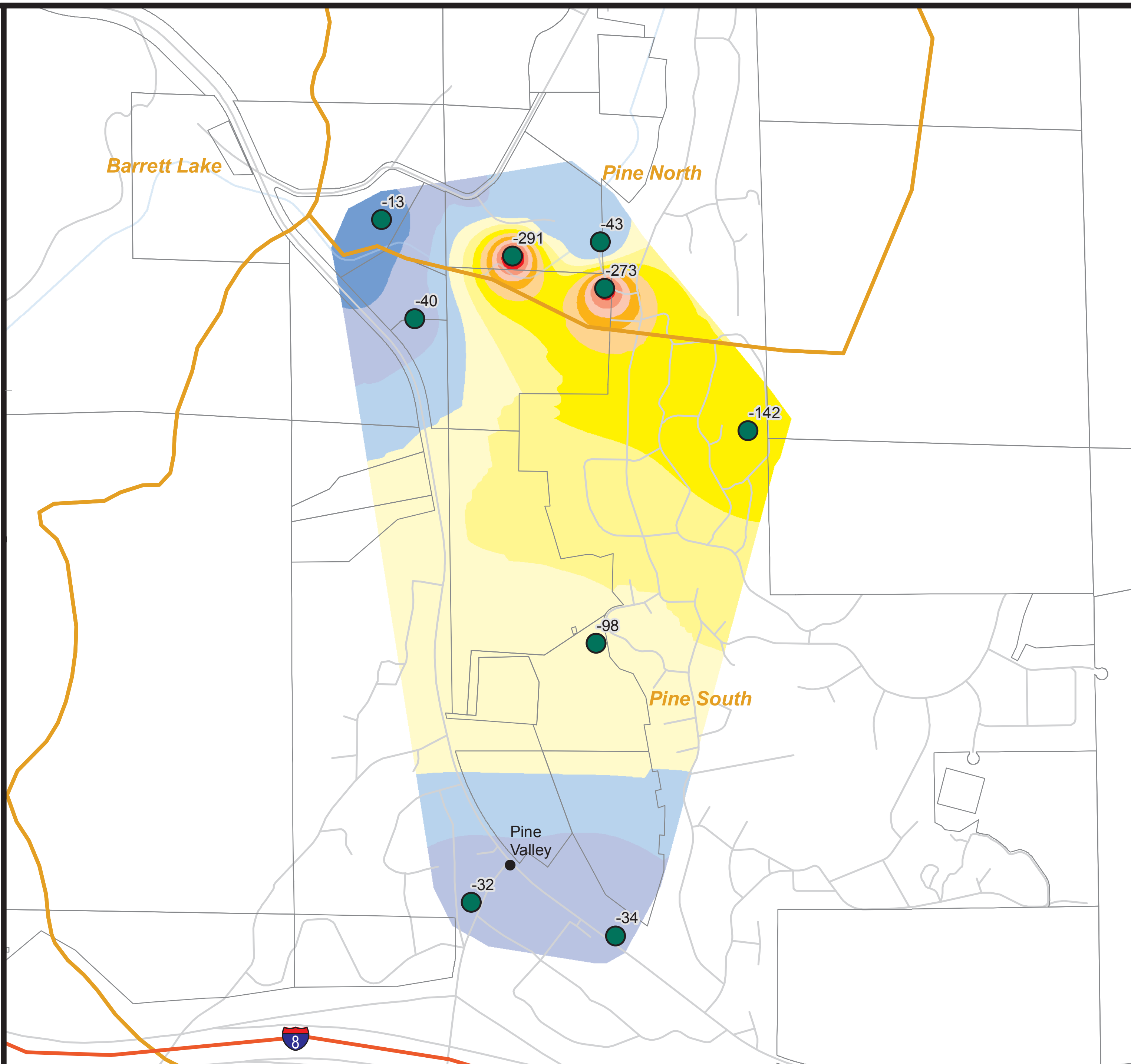
- Communities
- Freeways
- Major Highways
- Roads
- Watershed Boundary
- Parcels (>5ac)
- Rivers
- Ocean/Lakes

Groundwater Drawdown (Feet)

- 0 to -25
- -25 to -50
- -50 to -75
- -75 to -100
- -100 to -125
- -125 to -150
- -150 to -175
- -175 to -200
- -200 to -225
- -225 to -250
- -250 to -275
- -275 to -300

0 800 1,600

Feet



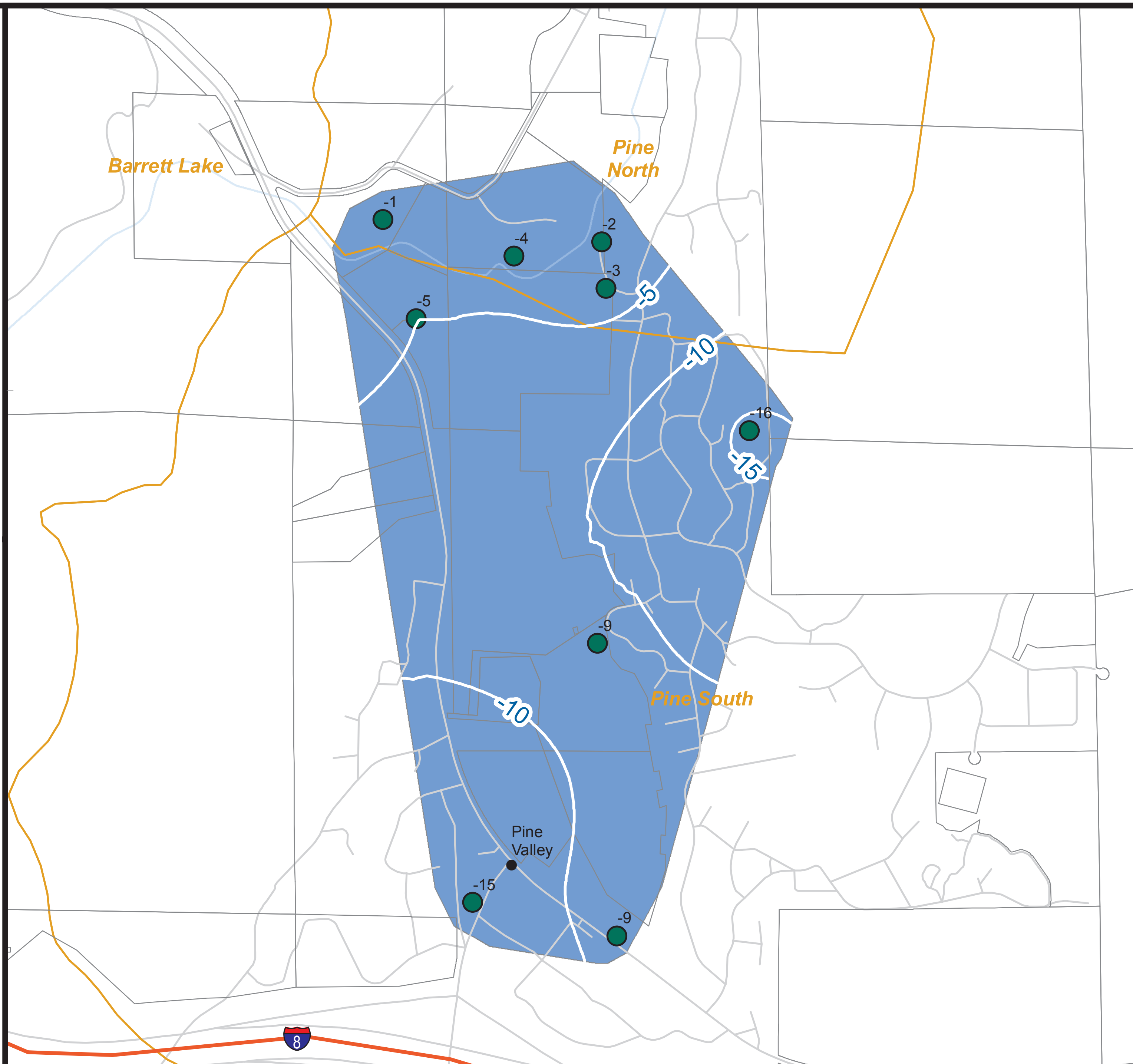
May 2009

k:\groundwater\pine_valley\maps\gw_elevation9804.mxd

Figure 18

Groundwater Elevation Comparison

Spring 1998 to
Spring 2005/2006



Communities
Freeways
Major Highways
Roads
Watershed Boundary
Parcles (>5ac)
Rivers
Ocean/Lakes
Water Elevation Difference (Feet)
Groundwater Drawdown (Feet)
0 to -25

0 800 1,600
Feet

DPLU GIS

May 2009
k:\groundwater\pine_valley\maps\gw_elevation9805.mxd

Figure 19

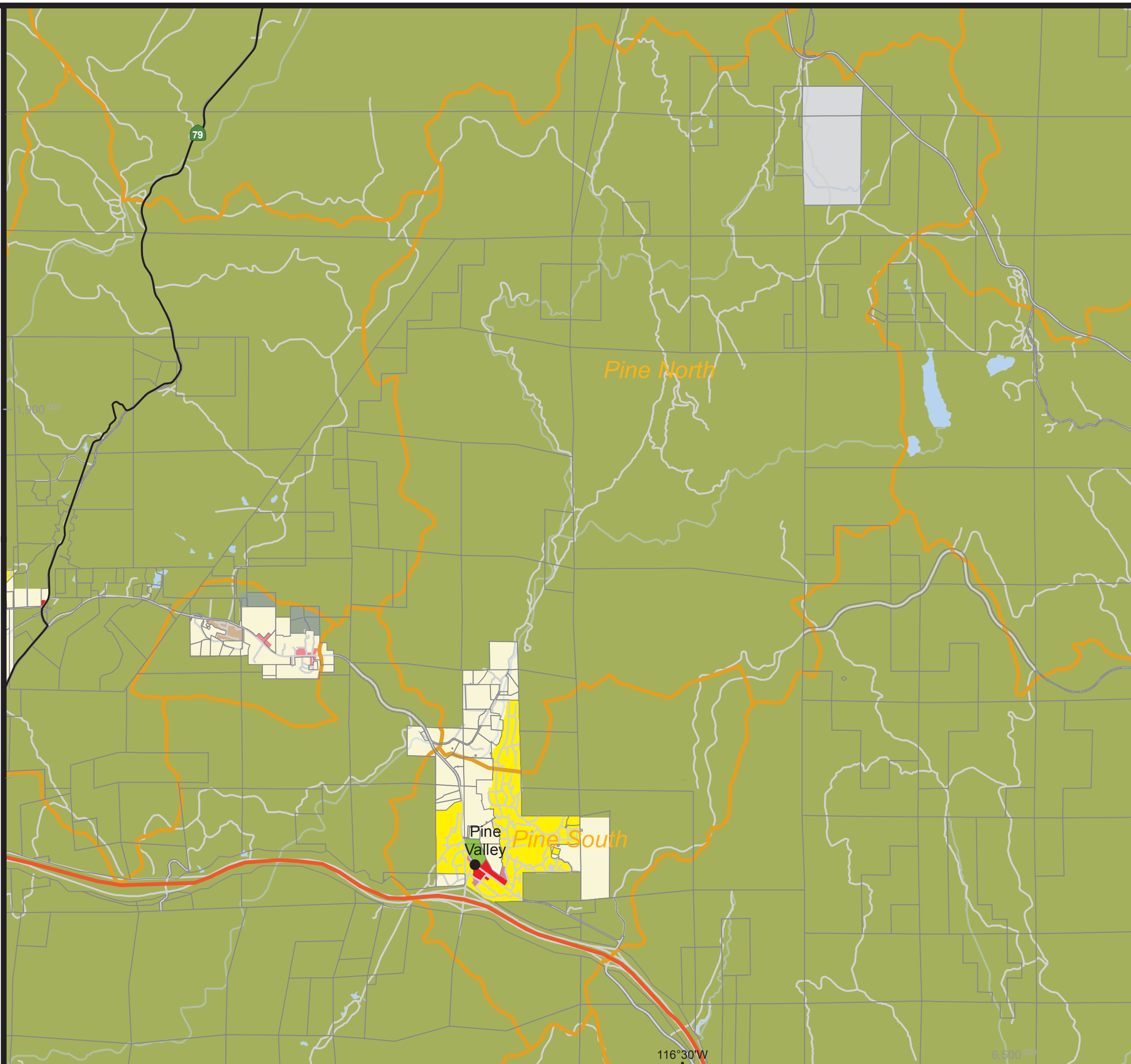
Existing General Plan

- Communities
- Freeways
- Major Highways
- Roads
- Watershed Boundary
- Parcles (>5ac)
- Rivers
- Ocean/Lakes

Existing General Plan

- Residential 1du/1,2,4 ac
- Residential 2du/ac
- Residential 4.3du/ac
- Office Professional
- Neighborhood Professional
- General Commercial
- Service Commercial
- Multiple Rural Use 1du/4,8,20ac
- Public/Semi-Public Land
- National Forest and State Park
- Indian Reservation

0 1 2
Miles



May 2009
k:\groundwater\pine_valley\maps\existing_gp.mxd

Figure 20

Referral Map
(July 2008)

- Communities
- Freeways
- Major Highways
- Roads
- Watershed Boundary
- Parcles (>5ac)
- Rivers
- Ocean/Lakes

Draft Land Use August 2006

- Village Residential (VR-4.3)
- Village Residential (VR-2)
- Semi-rural Residential (SR-1)
- Semi-rural Residential (SR-2)
- Semi-rural Residential (SR-4)
- Semi-rural Residential (SR-10)
- Rural Lands (RL-40)
- Rural Lands (RL-40)
- Office Professional
- Rural Commercial
- Medium Impact Industrial
- Public/Semi-Public Lands
- National Forest & State Parks
- Open Space (Recreation)
- Open Space (Conservation)

0 1 2
Miles

DPLU GIS

May 2009
k:\groundwater\pine_valley\maps\referral_gp.mxd

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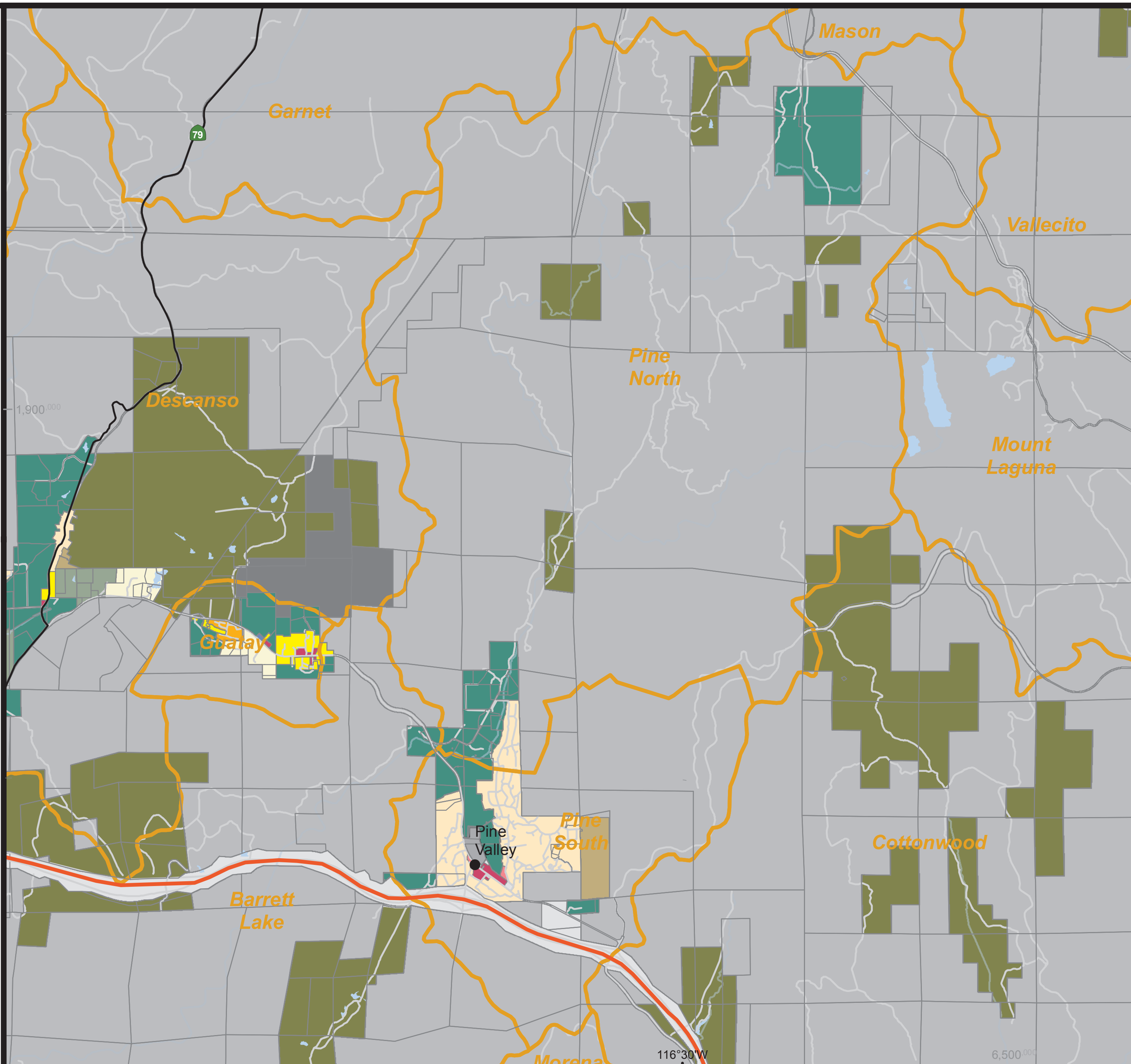
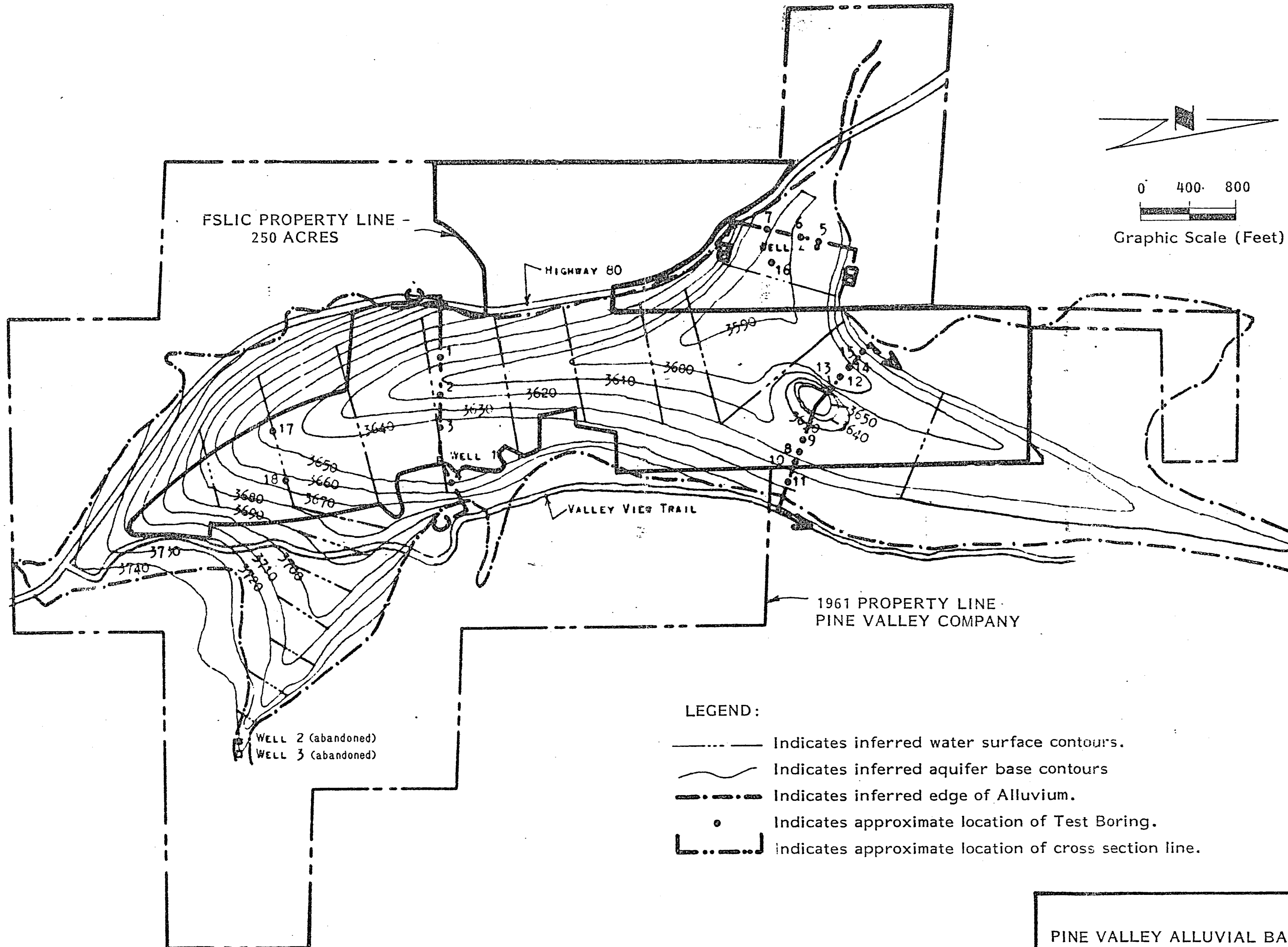


Attachment

Select Data from Woodward, Clyde, Sherard, and Associates, 1961



LEGEND:

- Indicates inferred water surface contours.
- Indicates inferred aquifer base contours
- Indicates inferred edge of Alluvium.
- Indicates approximate location of Test Boring.
- indicates approximate location of cross section line.

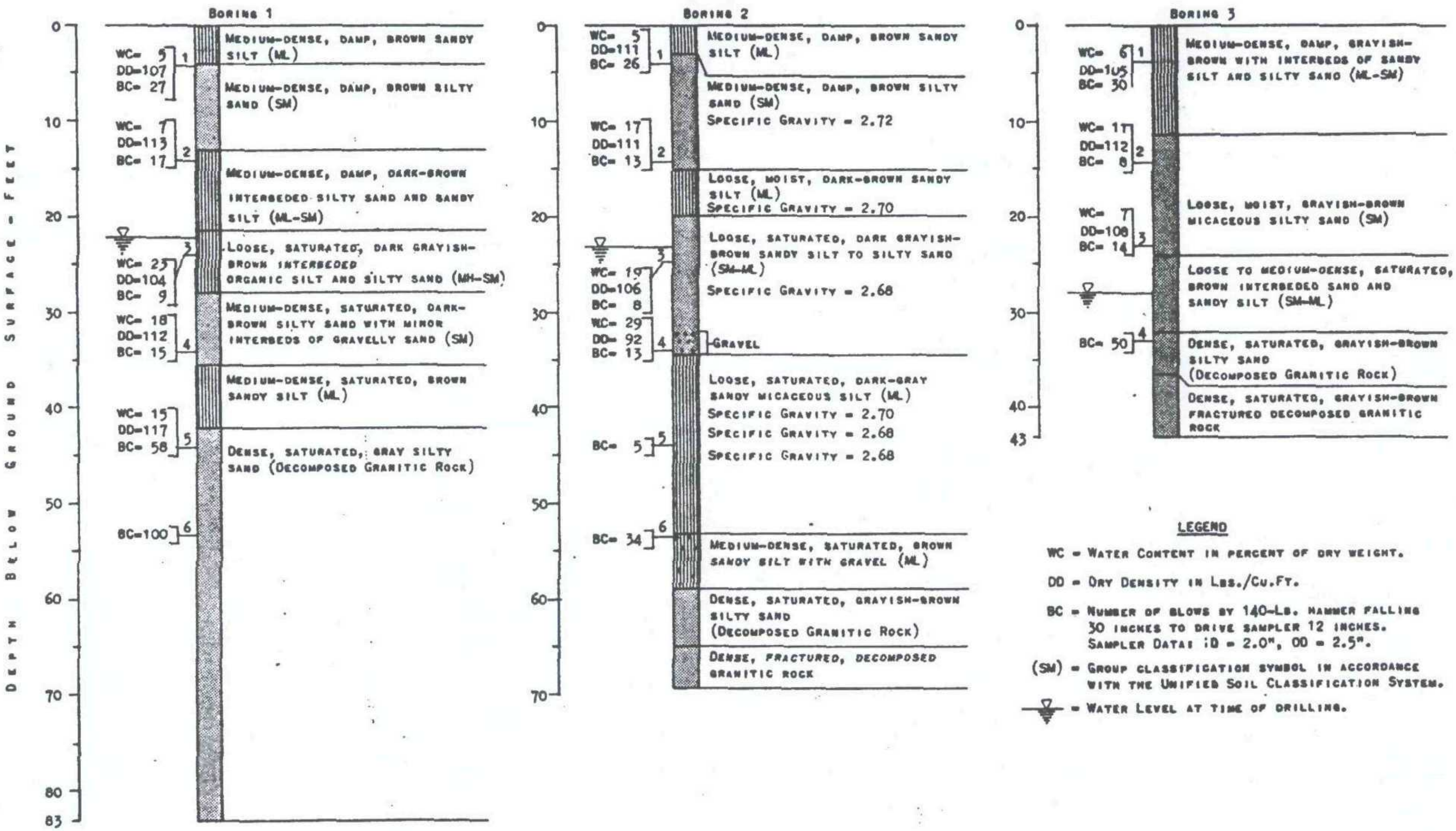
Source: Woodward, Clyde, Sherard and Associates, 1961, Job No. 61-245

PINE VALLEY ALLUVIAL BASIN CONTOUR MAP
PINE VALLEY GROUNDWATER STUDY

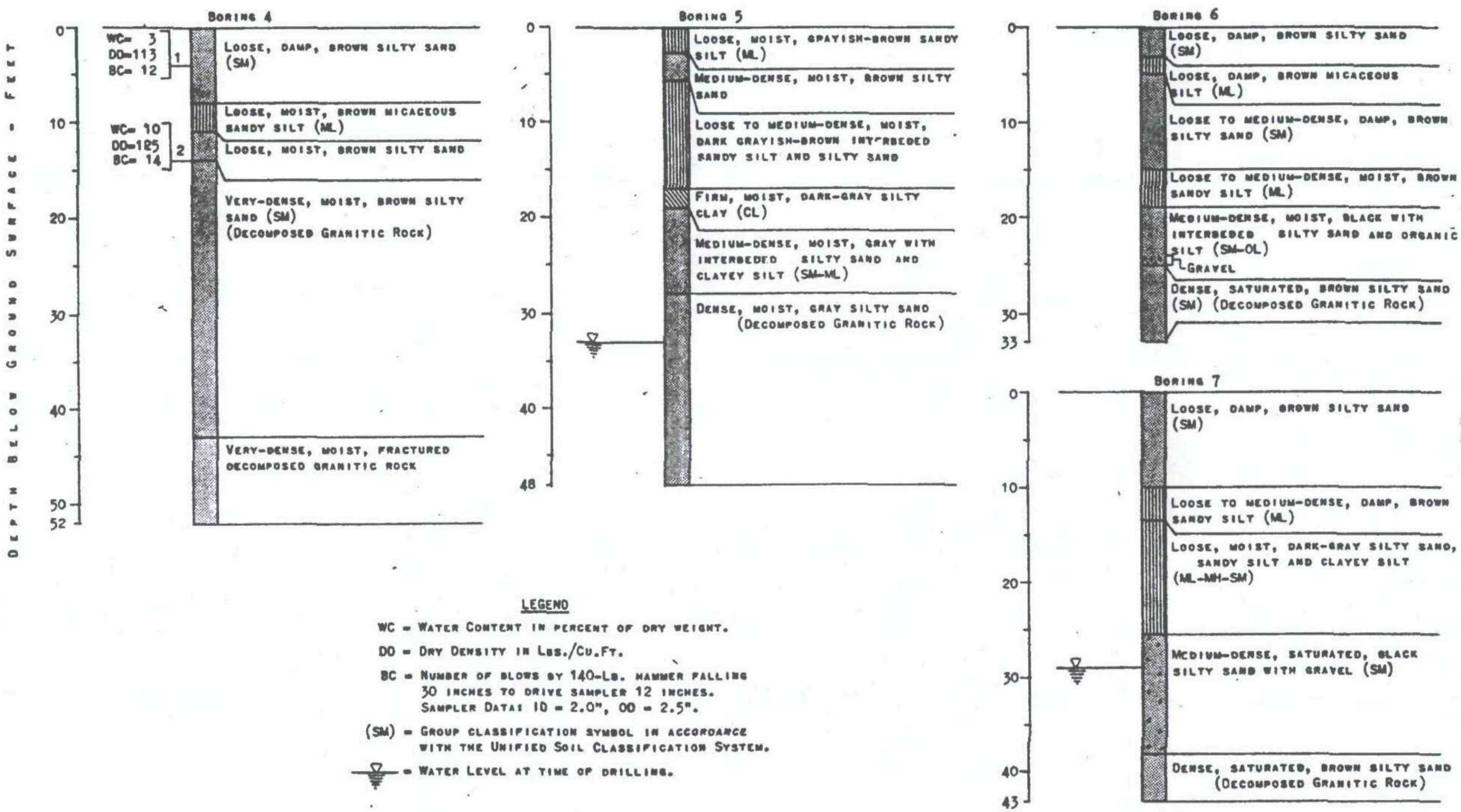
DRAWN BY: ch	CHECKED BY: KJ		FIGURE NO: 4
DATE: 3-22-85		PROJECT NO:	55105K-0004

WOODWARD-CLYDE CONSULTANTS

Fig. 3

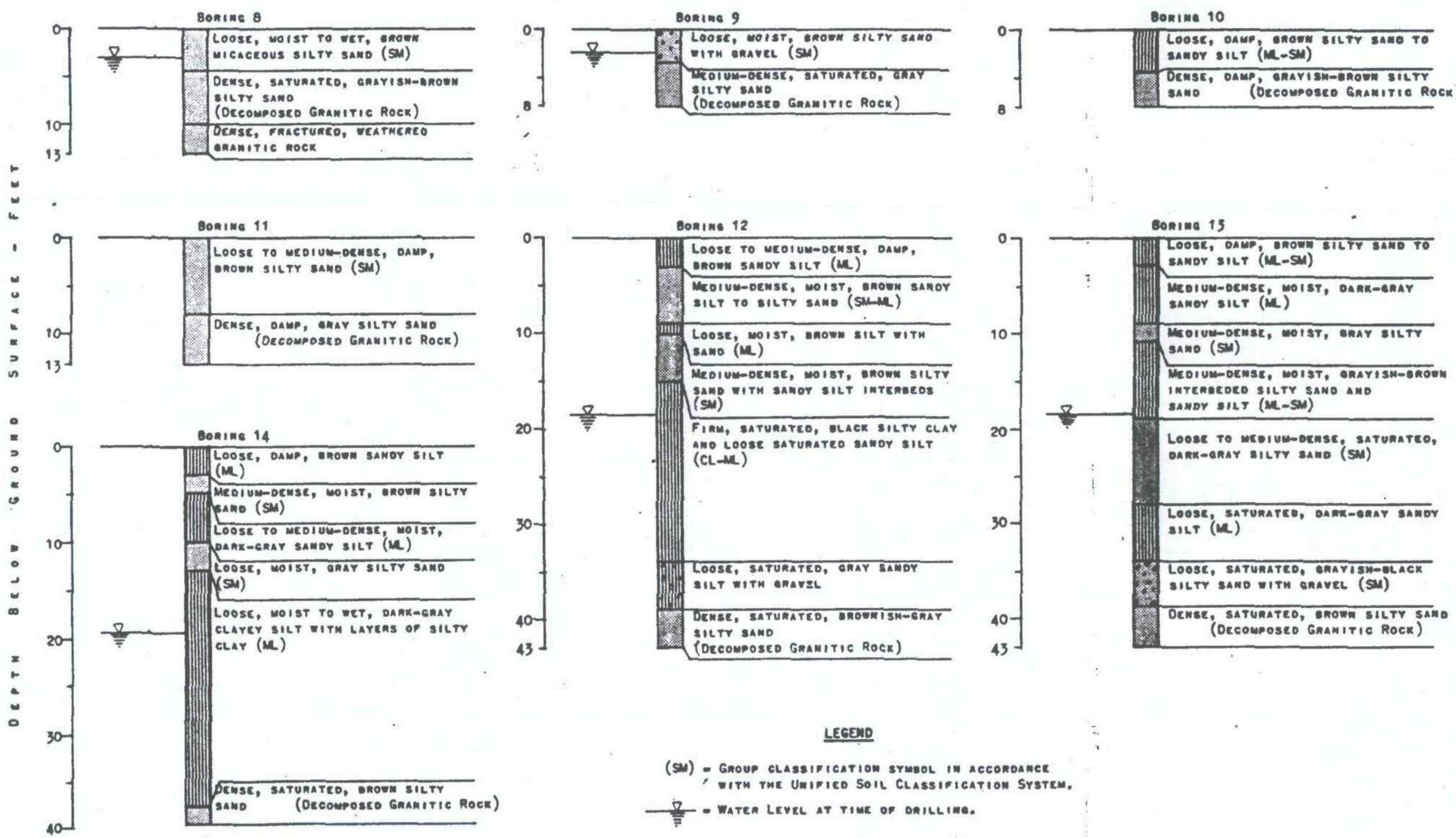


LOGS OF TEST BORINGS 1, 2 & 3
PINE VALLEY BASIN
JOB NO. 61-245



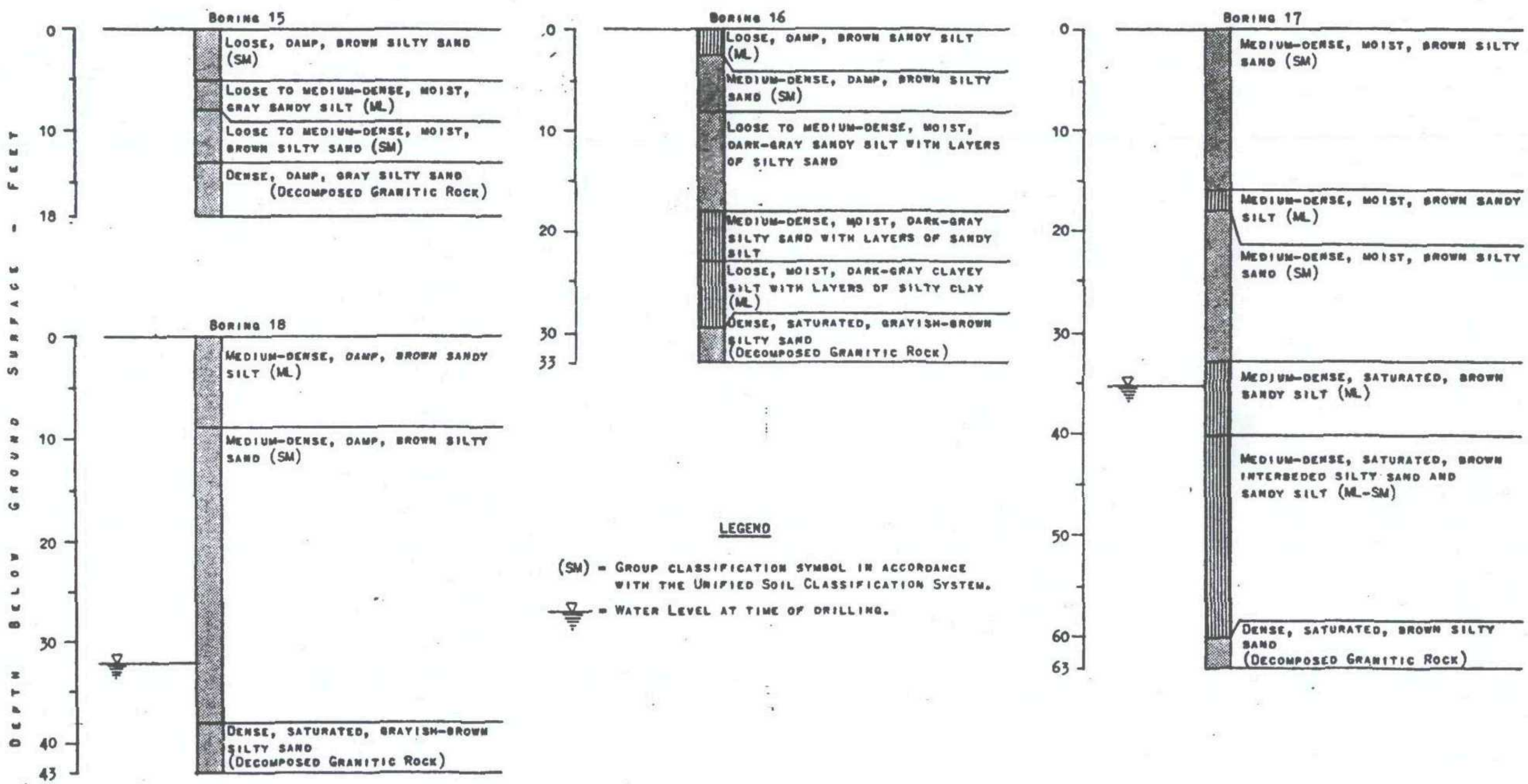
LOGS OF TEST BORINGS 4, 5, 6 & 7
PINE VALLEY BASIN
JOB NO. 61-245

Fig. 5



Logs of Test Borings 8 thru 14
Pine Valley Basin
Job No. 61-245

FIG. 6

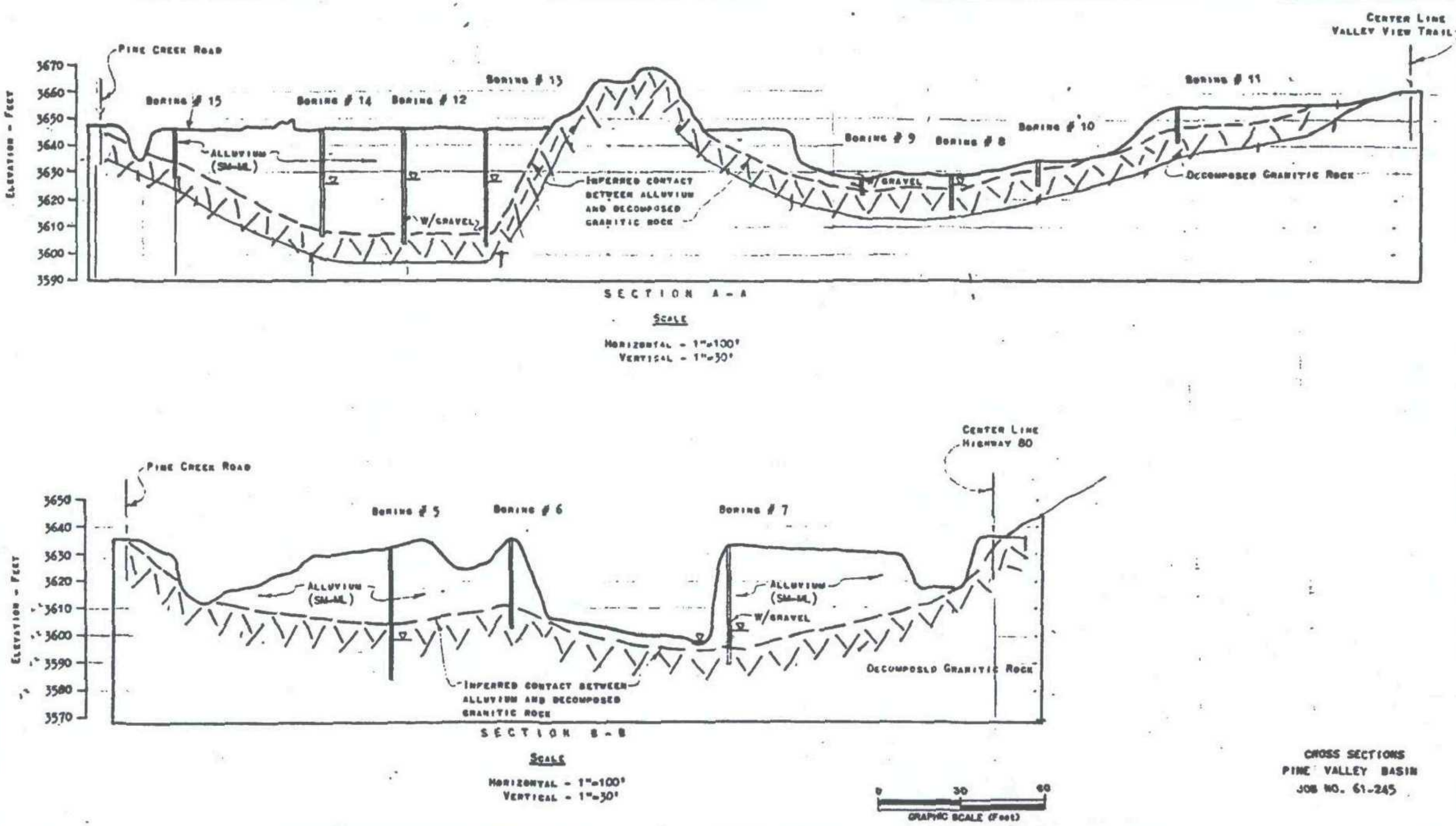


LOGS OF TEST BORINGS 15 THRU 18

PINE VALLEY BASIN

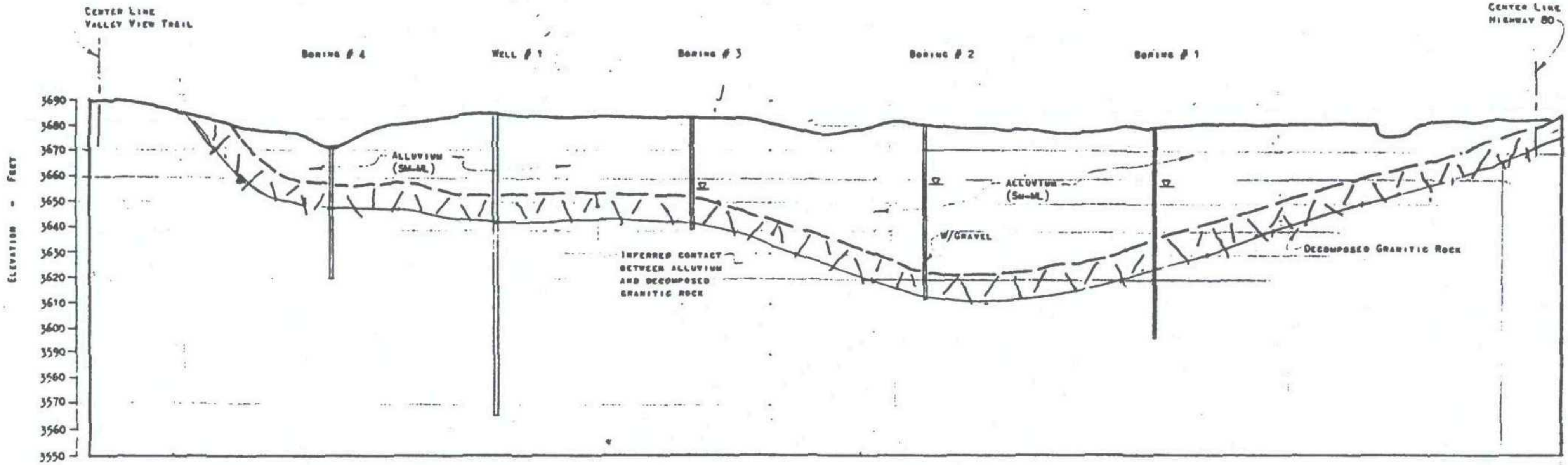
JOB NO. 61-245

Fig. 7



CROSS SECTIONS
PINE VALLEY BASIN
JOB NO. 61-245

Fig.



SECTION C-C

Scale

Horizontal - 1"=100'
Vertical - 1"=30'

0 30 60

GRAPHIC SCALE (Feet)

CROSS SECTION
PINE VALLEY BASIN
JOB NO. 61-245