APPENDIX C-1
TODD ENGINEERS REVIEW OF GROUNDWATER ISSUES

TODD ENGINEERS

2200 Powell Street, Suite 225
Emeryville, CA 94608
(510) 595-2120

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MEMORANDUM

Transmitted via Email

To: Stephen Lilburn, Lilburn Corporation

From: Iris Priestaf, PhD and Maureen Reilly, PE, Todd Engineers
Michael Maley, RG, CHg, PE, Kennedy/Jenks Consultants

Re: Review of Groundwater Issues,
Draft EIR/EIS for US Gypsum Expansion/Modernization Project

This memorandum presents an independent review of groundwater issues regarding the Draft EIR/EIS for US Gypsum Expansion/Modernization Project. The independent review focused on the hydrogeologic setting of the Ocotillo/Coyote Wells Groundwater Basin, including the water balance and the influence of faults and other geologic structures on groundwater flow and quality. The independent review also addressed the numerical groundwater flow model developed to assess potential impacts on groundwater of the proposed US Gypsum project. Documents reviewed included the Draft EIR/EIS, public comment letters, and relevant references (see reference list at the end of this memorandum). Public comment letters were reviewed to identify key groundwater issues.

Hydrogeology and Groundwater

Several public comments request clarification of the influence of faults and other geologic structures on the flow of groundwater and the distribution of water quality in the Ocotillo/Coyote Wells Groundwater Basin, especially with regard to evaluation of the potential impacts of US Gypsum (USG) pumping on basin water quality.

<u>Background.</u> The current understanding of the interactions of the groundwater flow, aquifer properties and water quality make up the *hydrogeological conceptual model*. A summary is provided here of the current hydrogeological conceptual model for the Ocotillo/Coyote Wells Groundwater Basin[1]. This conceptual model is represented in the numerical groundwater model

[1] The local groundwater basin has been defined and designated differently by different agencies and researchers for different purposes. The Ocotillo/Coyote Wells Groundwater Basin described in the Draft EIR/EIS (Section 3.3.2.1), represented in the numerical model, and discussed here corresponds to the current definition of the Coyote Wells Valley Groundwater Basin by the California Department of Water Resources in Bulletin 118.

that was applied to relevant issues in the Draft EIR/EIS. Much of the conceptual model is based on the geologic interpretation of the distribution of the geologic units and locations of geologic structures such as faults and folds.

Geologic units in the Ocotillo/Coyote Wells Groundwater Basin can be grouped as follows:

- Recent and Older Alluvium, composed of poorly consolidated older alluvial fan deposits and sand, underlies much of the basin floor and extends locally into large canyons of the surrounding mountains. Most wells drilled in the Ocotillo area are completed within the alluvium. The alluvial wells are noted for high yields and relatively good water quality.
- The Palm Springs Formation is composed of fluvial and deltaic sand, silt, and clay deposits deposited by the ancestral Colorado River during the early Pleistocene. Thicknesses can range up to several thousand feet. No pumping test data were found for the Palm Springs Formation, but the aquifer properties (e.g., transmissivity and specific yield) are believed to be similar to that of the Imperial Formation.
- The Late Miocene to Pliocene Imperial Formation is generally described as a series of interbedded claystone and sandstone of dominantly marine origin. The Imperial Formation has an exposed thickness of over 1,500 feet in Yuha Basin. Wells drilled into the Imperial Formation typically have low yields and produce poor quality water.

Significant differences have been noted in the hydrogeologic properties, water levels, and water quality between the area near the community of Ocotillo and the area to the east. Near Ocotillo, transmissivities (aquifer properties describing the ease with which groundwater flows through the aquifer) have been noted as significantly higher than those to the east. Transmissivities have been measured in the range of 5,800 to 6,700 ft^2/day near Ocotillo, whereas transmissivities of 34 to 957 ft^2/day have been noted in the eastern region.

These variations are reflected in groundwater gradients: shallower (flatter) hydraulic gradients have been mapped in the Ocotillo area and steeper hydrologic gradients have been mapped in the area east of Ocotillo. Similarly, total dissolved solids (TDS) concentrations vary from east to west. Near Ocotillo, TDS concentrations typically range from 300 to 600 milligrams per liter (mg/l). East of Ocotillo, TDS concentrations are significantly higher and range from 600 to 4,000 mg/l.

<u>Early Geologic Interpretation.</u> The geologic interpretation developed by Skrivan (1977) for the development of a numerical groundwater model of the basin is shown in **Figure 1**. This relatively simple interpretation assumes that the basin is composed of a relatively uniform thickness of alluvium (shown as valley fill) over the entire groundwater basin. The Palm Springs and Imperial formations were considered to underlie the water-bearing alluvial deposits (shown as consolidated rocks). Wells penetrating the aquifer are all considered to be completed within the alluvium and not within the Palm Springs or Imperial formations.

To account for variations in measured transmissivities (based on aquifer tests) and water quality data, Skrivan (1977) theorized that the Elsinore and Laguna Salada fault extends into the Ocotillo/Coyote Wells Groundwater Basin and represents a hydraulic barrier with distinct water levels and water quality on either side of the fault. In this interpretation, the alluvial deposits on the west side of the fault (near Ocotillo) had significantly higher transmissivities and lower TDS concentrations than those on the east side.

The primary weakness of this geologic interpretation is that it does not explain why the alluvial sediments vary so significantly on either side of the fault. A fault can cause a hydraulic barrier that can potentially restrict the flow of groundwater; however, other geologic differences are neeed to explain both the variations of transmissivity and water quality.

Current Geologic Interpretation. The geologic interpretation used in the 2004 Bookman-Edmonston study consists of a two-layer aquifer system in the basin rather than the single alluvial layer used in the previous interpretation. The upper layer (Layer 1) consists of the alluvial deposits and the lower layer (Layer 2) is composed of the Palm Springs and Imperial formations. **Figure 2** shows the locations of two cross sections (**Figure 3A** and **Figure 3B**) illustrating the current geologic interpretation.

The revised geological interpretation is based on work by Dr. Thomas Rockwell, Ph.D. of San Diego State University. Through a series of master's theses and other work, the conclusion of this body of work is that the Elsinore and Laguna Salada faults are not continuous beneath the basin. Instead, the Elsinore and Laguna Salada faults are offset by zones of northeast-trending left-lateral faults. As a result of the complex interactions of these faults, the Palm Springs and Imperial formations have been uplifted in the area east of Ocotillo.

Accordingly, the Palm Springs and Imperial formations are relatively near the ground surface in the areas east of Ocotillo (**Figure 3A**). Therefore, the lower transmissivities obtained from aquifer tests from wells located east of Ocotillo are the result of these wells actually being completed in the lower-permeability Palm Springs and Imperial formations. The steeper hydraulic gradients are the result of groundwater flow through the relatively low-permeability Palm Springs and Imperial formations. The presence of the Palm Springs and Imperial formations also explains the higher TDS concentrations as these formations are noted for higher TDS concentrations. Additional discussion of water quality is provided below in the section "Water Quality."

Based on this interpretation, the observed variations in groundwater can be more readily explained by variable thicknesses and depths to the Palm Springs and Imperial formations. In addition, it is recognized that a portion of the groundwater production is from the Palm Springs and Imperial formations rather than solely the alluvium.

Using the revised geologic interpretation, the water-bearing alluvial deposits (Layer 1) are primarily restricted to the center of the basin. The alluvial thickness can be 550 feet or greater in the Ocotillo area. The alluvial deposits thin toward the margins of the basin where they become unsaturated. Along the basin margins, the saturated zones occur in the Palm Springs and Imperial formations.

Groundwater flow through the alluvium is generally towards the south. An anticline (a geologic fold in the form of an arch) has been mapped south of Ocotillo near Yuha Estates. This anticline causes the Palm Springs and Imperial formations to occur closer to the ground surface near the center of the anticline, as shown in **Figure 3B**. As a result, the alluvial aquifer is relatively narrow to the southwest of Yuha Estates and there is a restriction in the groundwater flow through the alluvium from north to south.

The wells in the Yuha Estates area are interpreted as being completed in the less permeable Palm Springs and Imperial formations. This provides an explanation for the more significant drawdown from pumping in these wells than those in the Ocotillo area.

Water Quality. Several comments request recent water quality data. The USGS continues to monitor five wells in the Ocotillo-Coyote Wells Groundwater Basin for water quality in addition to 20 wells for water levels. Four of the five wells are located near Ocotillo and are screened in the alluvium; the other well is located near Yuha Estates. These wells are monitored on an annual basis for physical properties (pH, specific conductance, and temperature), general minerals (chloride, sodium, sulfate, etc.), iron, and manganese. In the USGS National Water Information System (NWIS), a total of 46 wells have available water quality data in the Ocotillo/Coyote Wells Groundwater Basin. **Table 1** summarizes the period of record for these wells and **Figure 4** shows the locations of the wells. Wells that continue to be monitored are shaded purple.

Figure 5 shows the specific conductance for the wells currently monitored by the USGS. Specific conductance is a general indicator of the total dissolved solids in a water quality sample. TDS can be estimated as 75 percent of the specific conductance value. Aside from wells 25K2 and 30R1, specific conductance in the area appears to be fairly steady with a possible decrease in conductance over recent years (indicating improving water quality).

Well 25K2 is a pumping well and the variable water quality in the well may be affected by the amount of pumping. The increase in specific conductance in 25K2 in the early 1980's is linked to the increased pumping of Well 25K2 from 1974 to 1981 for export to Mexico. Well 30R1 shows an increase in specific conductance peaking in the late 1980s and subsequent decrease. The cause of this change in water quality in Well 30R1 is not known, but the available water quality data do not correlate to pumping of 25K2. In addition, no correlation is apparent to USG pumping. Bookman-Edmonston (1996) indicates that the well is relatively shallow (100 feet deep). The shallow depth of the well and short-term groundwater quality changes suggest a short-term surface or near-surface source of water quality degradation near to Well 30R1.

A few of the comments referred to the differences in water quality between the areas near Ocotillo and the area to the east. To supplement the discussion of groundwater quality in the Draft EIR/EIS (starting on page 3.3-17), a brief independent analysis was performed using readily available data from the NWIS. **Table 2** shows the concentration of various general mineral constituents for wells in the east, wells near Ocotillo, and wells located in between these areas (herein termed the transition zone). **Figure 6** shows the concentrations of boron, chloride, sodium, and sulfate for these wells. Wells located on the east have significantly higher concentrations than wells near Ocotillo. The difference is most likely due to the different geologic formations, as discussed previously and consistent with the hydrogeologic conceptual model. The high concentrations of chloride, sodium, and boron are indicative of the low-permeability Layer 2 (Palm Springs and Imperial) formations.

Water Levels. A number of comments on the Draft EIR/EIS refer to the limited discussion of observed long term water level trends and the lack of recent water level data. Water levels are discussed in Section 3.3.3.3 of the Draft EIR/EIS. Comments highlight the differences in water levels trends between various wells in the basin and note the continuing water level declines at some wells. Comments concerning the lack of recent data inquire into what data are available and if additional data could verify the model's predictions. The groundwater numerical model used available data through 2002 and predicted impacts to 2082.

The USGS currently monitors 20 wells in the Ocotillo/Coyote Wells Groundwater Basin. The wells are summarized in **Table 3** and the locations of these wells are shown on **Figure 7**. A useful distinction for monitored wells is the hydrogeologic unit that is represented in the well. As discussed previously, the hydrogeology of the groundwater basin can be represented by two geologic units: the alluvium and the Palm Springs/Imperial formations. The Palm Springs/Imperial formations underlie the alluvium in the area around the USG wells and extend to the ground surface in the north and east portions of the basin.

In the numerical model used for the Draft EIR/EIS, the alluvium was represented as Layer 1 and the Palm Springs/Imperial formations were represented as Layer 2. Because these two units have different hydrologic properties, the current USGS monitoring wells are distinguished according to Layer 1 and Layer 2. In **Figure 7**, wells screened in Layer 1 are shown in light orange and Layer 2 wells are shown in dark red. Hydrographs for wells in Layer 1 and Layer 2 are shown on **Figures 8** and **9**, respectively.

<u>Water Level Trends.</u> As shown on **Figures 8** and **9**, water levels in the both Layer 1 and Layer 2 are generally characterized by little or no fluctuation over time, even though rainfall in the region is flashy both seasonally and annually. **Figure 10** illustrates the highly variable annual precipitation, as measured at the California Irrigation Management Information Systems (CIMIS) station in Seeley east of the study area. The lack of water level response to precipitation may reflect a significant lag time between rainfall events and recharge to the water table resulting from the distance from the washes to the monitored wells and in some areas, the significant thickness of the unsaturated (vadose) zone. The result is a fairly constant inflow from precipitation. This was simulated in the numerical model by using a constant annual rate for recharge into the model.

Some comments refer to the rate of water level decline in the basin. In the Draft EIR/EIS text two general estimates are given, one foot every five years and one foot every eight years. To clarify the range of water level declines in the alluvium (Layer 1), the water level data were examined from wells currently monitored by the USGS. For these, the average rate of decline from 1975 to 2007 was calculated at 0.266 feet per year (or one foot every four years). However, using a single value to describe the water table over the entire basin oversimplifies the issue, because declines are not uniform. The water levels in Layer 1 are chiefly controlled by pumping. Specifically, monitored wells located closer to the pumping wells experience larger and less constant drawdown, for example well 36H1 shown on **Figure 8**. This drawdown is most likely the local effect of the pumping well rather than a regional response. The average rate of decline ranges from 0.4 feet per year or 1 foot every 2.5 years (well 36H1) to 0.13 feet per year or 1 foot every 7.7 years (well 34B1, not shown). By way of comparison, over the same time period, the numerical model predicts a range of declines from 1 foot every 4.4 years to 1 foot every 8 years.

Additional comments highlight differences between water levels in individual wells used in the numerical model calibration process. These wells are shown in **Figure 11**; wells in Layer 1 are shown in white and wells in Layer 2 are shown in dark gray. Specific comments address the difference in water levels between wells 29H1 and 29L1, which are shown on **Figure 11** as bracketing the boundary between Layer 1 and Layer 2. This boundary was conceptualized as a fault zone in previous studies, but currently is considered as the contact between the different formations. The different aquifer properties of these hydrogeologic formations (layers) have a significant influence on groundwater levels. As shown in **Figure 12**, wells in Layer 1 (e.g., 29 L1) generally show a greater decline in water levels (due to pumping in Layer 1) while wells in Layer 2 (e.g., 29H1) show a slower decline (**Figure 12**; see also **Figures 8** and **9**).

Figure 12 also illustrates the relatively higher groundwater levels in Layer 1 relative to Layer 2 in the Ocotillo area. This indicates a potential downward vertical gradient, with leakage from Layer 1 to Layer 2. However, continuation of the Layer 1 declines theoretically presents the potential for groundwater levels in Layer 1 to decline below groundwater levels in Layer 2. If a reversal in relative groundwater levels were to occur at some point in the future, this would change the direction of vertical groundwater flow from downward to upward. In such a case, relatively poor Layer 2 water could potentially migrate upward into Layer 1.

Groundwater Level Responses to Pumping. The differences in hydrologic properties of the two layers, specifically between the Ocotillo and Yuha Estates areas, can also be demonstrated by the two wells pumped for export to Mexico. One well was located in Ocotillo, 25K2 (Layer 1) and the other well was in Yuha Estates 11G 4 (Layer 2). Pumping in these wells was increased sharply by 85 acre-feet per year (AFY) and 143 AFY for 25K2 and 11G4 respectively. Water levels in both wells responded quickly with a drawdown of more than 50 feet over five years.

In Ocotillo, water levels in nearby wells like 25Q1 decreased slightly: 2 feet over the period of pumping. The steep drawdown in well 25K2 and muted response in nearby wells indicate that the water levels in 25K2 reflect the pumping water level and not the static level of the aquifer. In contrast, wells located near the Yuha Estates well (11G4) also show a steep drawdown presumably also from localized pumping of wells 11G1 and 11H4.

In addition, the recovery of water levels in these two areas highlights the hydrogeologic differences. Water levels in the Ocotillo well, 25K2, recovered quickly after pumping was suspended; specifically, water levels recovered over 50 feet in less than two years. However, water levels in 11G4 near Yuha Estates have recovered much more slowly and still (30 years later) have not reached pre-pumping levels.

In summary, the alluvial aquifer near Ocotillo is considerably more permeable than the older Palm Springs/Imperial formations in Yuha Estates. Accordingly, drawdown impacts due to pumping in the alluvial aquifer (e.g., near Ocotillo) are more localized and recover much faster than comparable drawdown impacts in the older formations near Yuha Estates.

Recent Water Level Data. In general, groundwater levels from 2002-2006 maintained the same trends observed in previous years. Wells screened in Layer 1 continue to decrease at the same rate as 1975-2002. Well 36H1, located close to USG pumping, exhibited a steep decline of approximately 10 feet from 1995-2005, but has recently begun to recover. The past decline may be the result of localized pumping rather than a regional occurrence, as the trend is not shown in any other nearby wells. Wells screened in Layer 2 in general show steady to increasing groundwater levels. Wells located in the Yuha Estates area (e.g., 11G1) continue to recover from the intense groundwater pumping in the early 1980's for export to Mexico.

The water levels predicted by the model generally track with the long term trends of regional water levels. The difference between the recent observed data and the model predicted water levels is similar to the differences shown during calibration. Although the additional data is valuable to confirm the continuation of regional trends, it provides no new information to adjust the conceptual model of the basin.

Summary. The current hydrogeologic conceptual model of the Ocotillo/Coyote Valley Groundwater Basin provides an improved explanation of the significant differences in hydrogeologic properties, water levels, and water quality between the area near Ocotillo and the area to the east, and between Ocotillo and Yuha Estates. In brief, the alluvial Layer 1 aquifer near Ocotillo is generally characterized by greater permeability, better water quality, and more rapid recovery from pumping. The less permeable Layer 2 (Palm Springs/Imperial formations) east of Ocotillo and in the Yuha Estates area is characterized by relatively poor water quality and greater, more persistent impacts from pumping. In the Ocotillo area, groundwater levels in Layer 1 are higher than those in Layer 2. However, continued groundwater level declines in Layer 1—at more rapid rates than those in Layer 2—present the potential for reversal of that vertical gradient. In that case, relatively poor groundwater from Layer 2 could migrate into Layer 1, resulting in water quality deterioration in Layer 1. The current hydrogeologic conceptual model supports the Draft EIR/EIS finding regarding the potential significant effects of the proposed project.

Water Balance

Many comments refer to the water balance of the Ocotillo/Coyote Wells Groundwater Basin and how it was applied in the revised numerical groundwater model of the basin (Bookman-Edmonston, 2004). Specific concerns have been raised regarding the amount and distribution of recharge, the flow across the US/Mexico border, and historical pumping in the basin.

The water balance for a groundwater basin examines the inflows and outflows of the groundwater system and change in groundwater storage (inflow - outflow = change in storage). Developing a water balance is fundamental to the conceptual model and helps quantify the understanding of the basin systems. Comments address the need to compare the current model's water balance to previous studies. These studies can provide a range of reasonable estimates and illustrate the level of uncertainty in the water balance.

Table 4 shows the estimated water balances for four previous studies as well as the numerical model used to predict impacts in the Draft EIR/EIS. The previous studies include USGS Water Resources Investigation (WRI) 77-30 by J. A. Skrivan (1977), a master's thesis by David Mark (1987), an unpublished report prepared by D. Huntley (1979), and the previous numerical model prepared by Bookman-Edmonston (1996). The water balance presented in the Draft EIR/EIS reflects the calibrated results of the 2004 Bookman-Edmonston model.

The main inflow into the Ocotillo/Coyote Wells basin is recharge of runoff from precipitation in the surrounding watersheds. The main outflows include pumping (USG and others), subsurface outflows (across the US/Mexico border, across faults, and to the east), and losses from evapotranspiration (ET). Although the water balance estimates represent a range of values for recharge and outflow, all studies show a declining change in storage over the past 30 years. While the inflow (recharge) and subsurface outflow values in the 2004 revised numerical model are lower than previous estimates, the 2004 revised numerical model reflects a similar change in storage as the previous estimates, a decline of approximately 500 AFY. The water balance components are discussed below.

<u>Inflow</u>. As shown in **Table 4**, estimates of inflow into the basin range from 1,077 to 2,631 AFY. In the Skrivan 1977 study, the total recharge to the basin was estimated using the methodology based on USGS Professional Paper 486-B. This methodology results in an estimate of annual runoff from the mountains in the area ranging from 0.02 inches to 0.50 inches per year. Skrivan estimated the total recharge to the basin as equal to 0.22 inches per year over the drainage area of 225 square miles. The total estimated recharge was 2,600 AFY. This represents less than 5

percent of precipitation. The 1996 Bookman-Edmonston report used the same method with the same result.

However, Huntley (1979) and Mark (1988) both concluded this methodology was too simplistic and used different estimates. Mark estimated recharge from precipitation using three different methods: rainfall-runoff curve, runoff-area correlation, and the Maxey-Eakin method. Using these methods, his estimates ranged from 536 AFY (rainfall-runoff) to 1,650 AFY (Maxey-Eakin). Mark concluded that the Maxey-Eakin method was the most reliable to predict areal recharge based on available data. An additional 10 percent of recharge (170 AFY) was added to the water balance as groundwater inflow, but no explanation was included in the report.

The watershed areas defined by Mark (1988) and Huntley (1977) were a fraction of the size (40 square miles as compared to 225 square miles) as that used by Skrivan. The isohyetal map used in Mark's recharge analysis was not presented in his thesis. However, a table was included that equated an elevation with an isohyetal contour. Based on this table and others included in the report, the percent of precipitation percolating the groundwater aquifer was approximately six percent, slightly higher than Skrivan's estimate of five percent. However, comparison of the documented isohyets/elevations with the isohyetal map produced by PRISM[2] indicates the total precipitation may have been overestimated and the percentage of precipitation recharging the basin may be higher than six percent.

Huntley (1979) did not prepare an independent estimate for recharge; instead he calculated the total inflow as the unknown the water balance equation (outflow – change in storage = inflow). The resulting estimate, 2,631 AFY, was similar to Skrivan's estimate 2,600 AFY. This similarity is mostly likely due to the fact that the other elements of the water balance (outflow and change in storage) were estimated with the same methodology and the same data used in the Skrivan report.

The current Bookman-Edmonston numerical model's estimate of average annual recharge, 1,077 AFY is lower than previous estimates. For the 2004 study, the contributing watershed for the washes in the area was estimated to be 76 square miles, within the range of previous estimates. The specific drainage areas and the average precipitation are not described in the report. However, based on the locations of the washes, the amount of contributing area documented in the report, and an isohyetal map from PRISM, the average rainfall for the tributary areas is approximately 5 inches per year (20,266 AFY over the watershed). Accordingly the estimated recharge (1,077 AFY) is about five percent of total recharge, the same relationship Skrivan used in the WRI 77-30.

In the current numerical model, recharge remains constant over the study period, reflecting an annual average. An average was used rather than annual data as the lag time between precipitation and recharge is unknown.

With regard to areal distribution of recharge, the recharge was applied to the model as infiltration along local washes. The locations and rate of recharge determined by the model calibration is shown on **Figure 13**. Recharge was applied over 163 cells (1,630 acres) or approximately two percent of the active model area. Approximately 65 of these recharge cells become dry over the

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[2] PRISM (Parameter-elevation Regressions on Independent Slopes Model) isohyetal maps produced by the University of Oregon (Daly and Taylor, 1998).

study period and no longer contribute to the total inflow of the model. As shown in **Figure 13**, recharge was set up to apply to both Layers 1 and 2 as Layer 2 extends to the ground surface in some locations. However, the MODFLOW model was configured to apply recharge only to Layer 1 rather than to the highest active layer. Therefore, no direct recharge was applied to Layer 2. This is a reason why the model underestimates total recharge to the groundwater basin.

Subsurface Outflow. The subsurface outflow from the basin is highly uncertain because of lack of data. Although the US/Mexico border has been used as a basin boundary in all previous studies, it is a political not a hydrologic boundary. Limited water level data in the area make estimates of the flow across the boundary difficult.

Skrivan estimated underflow to Mexico and flow eastward from the calibrated model results, finding a total outflow of 1,900 AFY. A decrease in underflow across the US/Mexico border was simulated between the 1925 and 1975 scenarios due to a decrease in water levels. Mark estimated a total subsurface outflow of 825 AFY but provided no discussion on how this value was determined. The estimate may have been the result of model calibration. Huntley estimated total subsurface outflow using the hydrologic properties presented by Skrivan for the upper sediments and Loeltz (1975) for the lower sedimentary rocks. The exact methodology is not detailed in the report but it is assumed that the calculation used Darcy's equation for groundwater flow. The resulting estimate was 1,999 AFY, similar to Skrivan's model calibrated estimate. The 1996 Bookman-Edmonston report reviewed both Skrivan's and Huntley's outflow estimates and concluded the results were reasonable. For the 1996 Bookman-Edmonston water balance, Skrivan's estimate was used.

The 2004 Bookman-Edmonston model used in the Draft EIR/EIS used the model calibrated results to determine total outflow. The result was a smaller outflow, 990 AFY, than all previous estimates. However, the total inflow from recharge was also lower than previous estimates. The net result is a similar change in storage.

To simulate the subsurface outflow along the northern and southeastern boundaries of the model, constant head cells were used. Constant heads cells assume that the groundwater level just outside the model area is known and remains at a constant elevation. The model calculates the amount of flow into or out of the model based on the difference between this fixed water level and the calculated water level just inside the model. The value of the constant heads were based on available pre-development water levels (1925) and adjusted during calibration. These values ranged from 135 feet msl to 191 feet msl and are shown on **Figure 14**.

Pumping. Another major concern addressed by the comments is the estimation of basin pumping. Pumping in the model occurs in ten locations (cells), with eight in Layer 1 and two in Layer 2. These wells are shown on **Figure 14**. The wells in Layer 1 include Ocotillo, Ocotillo Mutual, Westwind, Nomirage, Coyote, and USG wells 4, 5, and 6. The wells in Layer 2 include Yuha Estates and West Texas. Total basin pumping in the model is shown in **Figure 15** for the baseline condition.

Several comments addressed the difficulties in estimating historical pumping and impact that this uncertainty would have on the model. In the WRI 77-30 report, Skrivan estimated pumping as of 1925 and 1975. Prior to 1925, pumping was assumed to be negligible. Pumping from 1925 through 1975 was determined through review of various reports that described wells in the Coyote Wells area and their uses which included a railroad, store and post office, Ocotillo Mutual Water Company, private domestic users and the Portland Cement Company (which was purchased by US Gypsum in 1946). Data received from USG were also reviewed. The total pumping in 1975 was estimated at 880 AFY. The larger producers included USG (600 AFY), Clifford Well, Coyote Valley Mutual Water Company, and Ocotillo Mutual Water Company. USG estimated pumping for 1970 – 1980 based on wallboard production at about 400 AFY or two-thirds the USGS estimate. USG and its consultants could not reconcile the difference between USGS and USG estimates. This may be due to the changing water use in wallboard production; the amount of water needed in production has changed over the years as USG improves its water use efficiency.

For the water balance described in the Draft EIR/EIS, it is recognized that pumping rates before 1981 are estimates and that these historical pumping estimates were used to assist in calibration of the model. Specifically, in the 2004 model, Skrivan's estimates were used for 1925-1975, USG estimates were used for 1976-1980, and measured pumping data for USG wells were used for 1981- 2002. The numerical model then predicts water levels for 2002-2082. While the model was simulated from 1925 through 2082, the main objective of the model is to simulate the impact of the proposed project on groundwater levels from the present into the future. From this perspective, it is important that actual USG pumping data are available from 1981 to the present.

Summary. As documented in **Table 4**, water balances have been prepared for four previous studies as well as the numerical model used to predict impacts in the Draft EIR/EIS. While all the studies are not necessarily independent, they represent a variety of methodologies, data sets, study periods and study areas. The resulting inflow (recharge) values range from 1,077 to 2,631 AFY, with the numerical model and Draft EIR/EIS using the lowest recharge value. While outflow values are the subject of discussion and some uncertainty, the outflows range from 1,546 to 3,173 AFY, with the lowest value representing recent conditions and including measured pumping data for the major pumper (USG).

Referring to the bottom line in **Table 4**, all of the water balances representing conditions over the past 30 years indicate a negative change in storage. This finding is consistent with the sustained groundwater level declines documented in the groundwater basin. This finding also raises the issue of groundwater overdraft.

The Draft EIR/EIS acknowledges that the USGS has been collecting groundwater data from the basin since the 1970s in response to concerns regarding potential overdraft. Overdraft is defined below by the California Department of Water Resources (DWR) Bulletin 118, *California's Groundwater*:

> Groundwater overdraft is defined as the condition of a groundwater basin or subbasin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years, during which the water supply conditions approximate average conditions. Overdraft can be characterized by groundwater levels that decline over a period of years and never fully recover, even in wet years.

Application of the above definition to the Ocotillo/Coyote Wells Groundwater Basin indicates that the amount of pumping withdrawal (e.g., 2002 value of 556 AFY from **Table 4**) is *less* than the amount of recharge (e.g., 1,077 AFY). However, the sustained declines show that the existing wells do not effectively capture the available recharge and instead, depend in part upon groundwater storage. Subsurface discharge (underflow) also occurs, primarily across the southern boundary into Mexico and along the eastern boundary. The condition of overdraft is characterized in the basin by sustained groundwater level declines over the past 30 years and by the water balance studies, all of which indicate a decline in storage.

The decline in storage is gradual and small relative to the overall storage in the basin; nonetheless, the decline in storage itself is an adverse impact, representing depletion of a shared resource. This groundwater resource is used beneficially for both industrial supply (USG) and as the sole source of municipal and domestic supply. A condition of overdraft undercuts the long-term reliability of that supply. For Impact 3.3-2, Water Depletion at Plant Affecting the Groundwater Basin, the finding of a significant and unavoidable impact on the basin acknowledges the condition of overdraft and the fact that the proposed project's increased pumping would increase the overdraft over the next 80 years.

Application of the Numerical Model

Introduction. Several comments refer to the capability of the numerical groundwater model to adequately simulate groundwater flow in the Ocotillo/Coyote Wells Groundwater Basin. This section provides a summary of the model setup and calibration followed by an evaluation of the capability of the model to simulate groundwater conditions relevant to the Draft EIR/EIS.

Model Setup. The numerical groundwater model (based on the widely used MODFLOW software) went through a major update and revision for the 2004 report (Bookman-Edmonston, 2004) compared to the 1996 report (Bookman-Edmonston, 1996). The primary revision to the numerical model was to incorporate the revised geologic interpretation. The primary components of the revised geologic interpretation include:

- Identification that the groundwater basin is composed of two aquifers, an upper alluvial layer and a lower layer composed of the Palm Springs and Imperial formations.
- No Elsinore – Laguna Salada fault extension is present in the groundwater basin that forms a significant hydrologic barrier to groundwater flow.
- Variations in transmissivity and water quality are a result of the two different formation plus variations in the thickness of the alluvial aquifer and depth to the top of the lower aquifer.

The model-simulated water balance is one of the primary modeling results of interest for the Draft EIR/EIS. A review of the model setup shows that the only significant source of groundwater recharge to the model is from stream runoff along the local washes. The model assumes uniform stream recharge throughout the model run. The model setup also specifies that recharge only applies to Layer 1 and not to Layer 2. Because large portions of Layer 1 become inactive during the model simulation due to water levels below the Layer 1 bottom elevation, groundwater recharge is restricted to the center of the basin. Furthermore, this setup means that the only recharge to Layer 2 is seepage from Layer 1. Consequently, this model setup causes the model to under-represent the total groundwater recharge to the groundwater basin.

The groundwater outflow in the model is represented by subsurface flow through portions of the northeastern and southern boundaries and from groundwater pumping by wells. The subsurface outflow boundaries are simulated using a constant head boundary condition. The head values for these locations are set as steady-state values which do not change over time. The value of the constant heads were based on available pre-development water levels (1925) and adjusted during calibration. These values ranged from 135 feet msl to 191 feet msl and are shown on **Figure 14**.

Pumping for ten cells is included in the model to represent current and future pumping. Historical USG pumping amounts are discussed in the previous section on *Water Balance*; for communities in the area, pumping is based on estimated per capita water usage. For the future scenarios, the non-USG groundwater usage is based on extrapolated population projections based on population growth of 1.4% from 1980 to 1990.

Groundwater outflows in Layer 1 are through pumping wells, groundwater outflows through the southern boundary along the Mexican border, and leakage to Layer 2. Groundwater outflows from Layer 2 primarily consist of subsurface outflows through the northeastern and southern boundaries. Only minor groundwater pumping is included in Layer 2.

Model Calibration. The groundwater model was calibrated to measured groundwater levels for fifteen wells in the basin. Of these calibration wells, nine wells represent Layer 1 and six wells represent Layer 2. The model calibration consisted on comparing simulated to observed groundwater levels. A statistical evaluation of the model results produces the following statistical parameters provided in **Table 5**.

The observed groundwater levels used for model calibration are averages of the two measurements collected for each year. Averages were used because the model stress periods are one year in length, so the model does not have the capability to evaluate seasonal changes. In most cases, the annual variation in water levels is minor with seasonal variations of less than one foot.

It should be noted that some degree of difference or residual between the observed and simulated groundwater elevations is expected. Residuals may be due in part to localized effects or data quality issues. For example, residuals can result from using groundwater elevations from pumping wells as calibration targets. MODFLOW also does not take into account the impact of well efficiency on groundwater elevations at pumping wells. In addition, the timing of the observed groundwater elevations does not exactly match the model stress periods.

The water levels in Well 25K2 have an atypical response to pumping compared to the other Layer 1 wells. Water levels in 25K2 my represent pumping water levels which can be significantly lower than those representing regional aquifer conditions. Most of the Layer 1 statistical error is generated from this one well. Removing initial Well 25K2 data would reduce the mean error to 1.5 and the standard deviation to 3.5 for Layer 1.

Equally important is evaluating whether the model is representing the appropriate trend or response to stresses (e.g., pumping) in the aquifer. Matching these trends is important to demonstrate that the model has the capability to simulate historical changes in groundwater elevations, and is therefore capable of forecasting future changes in groundwater elevations.

The nine calibration wells completed in Layer 1 are all clustered in the central portion of the basin near Ocotillo. **Figure 16** shows the comparison of simulated to observed groundwater levels for the Layer 1 wells. These results show that in general the calibration points tend to parallel the 1:1 comparison line. This indicates that the relative change in response to pumping is represented by the groundwater model. Water levels from wells 24D1, 36D2, 36H1 and 25Q1 show very close matches to the observed values. Water levels from wells 42A5, 29L1, and 29R2 show a reasonable match; however, the simulated water levels show a slight divergent trend by becoming progressively higher than the observed water levels over time.

The six calibration wells completed in Layer 2 are located in various locations in the basin. The calibration results for Layer 2 are more problematic. The trends show more significant variations between the simulated and observed groundwater levels (**Figure 17**). The Yuha Estates wells (11G1, 11G4 and 11H3) in particular show variations in both magnitude and trend. Wells 29H1, 24B1 and 36M1 show better agreement with the trend, but vary in magnitude by about 5 to 10 feet.

Because of the lack of wells and data, the model is not calibrated over its entire domain. Therefore, uncertainty remains in the model. However, the model is reasonably calibrated in the immediate vicinity of the US Gypsum wells near Ocotillo. The model shows reasonable capability to simulate groundwater level changes in response to pumping in Layer 1 near Ocotillo. Therefore, the model is useful as a tool to help in the evaluation of the impact of future groundwater pumping in the Ocotillo area, but needs to be supported by continued monitoring.

Model Scenarios. A series of modeling scenarios were presented (Bookman-Edmonston, 2004) to evaluate the effects of increased pumping on the basin. These scenarios include:

- The baseline case assumes 347 acre-feet per year (AFY) of groundwater pumping by US Gypsum and an additional 122 AFY of pumping by all other producers. These rates stay constant over the 80-year scenario.
- The 650 AFY Pumping Scenario assumes 650 AFY of groundwater pumping by US Gypsum. Pumping from other wells increases at 1.4% per year with the total pumping increasing from 122 AFY at the start of the scenario to 371 AFY at the end of the scenario. Total groundwater pumping at the end of the scenario is 1,021 AFY.
- The 767 AFY Pumping Scenario assumes 767 AFY of groundwater pumping by US Gypsum. Pumping from other wells increases at 1.4% per year with the total pumping increasing from 122 AFY at the start of the scenario to 371 AFY at the end of the scenario. Total groundwater pumping at the end of the scenario is 1,138 AFY.

The Baseline and potential future impacts from increased pumping at US Gypsum are summarized below in terms of annual decline in simulated groundwater levels:

- 0.1 to 0.2 feet per year for the Baseline case based on the results presented on Table 6-1 (Bookman-Edmonston, 2004).
- 0.2 to 0.5 feet per year for the 650 AFY Pumping Scenario based on the results presented on Table 6-2 (Bookman-Edmonston, 2004).
- 0.3 to 0.7 feet per year for the 767 AFY Pumping Scenario based on the results presented on Table 6-3 (Bookman-Edmonston, 2004)

The average rate of decline ranges from 0.4 feet per year or 1 foot every 2.5 years (Well 36H1) to 0.13 feet per year or 1 foot every 7.7 years (Well 34B1, not shown). By way of comparison, over the same time period, the numerical model predicts a range of declines from 1 foot every 4.4 years to 1 foot every 8 years. Using the wells currently monitored by the USGS, the average rate of decline from 1975 to 2007 was estimated at 0.27 feet per year. During these years, the total pumping was estimated to range from 440 to 880 AFY. These simulated annual drawdown rates are consistent with the observed groundwater level measurements. This suggests that the model does provide a reasonable estimate of the potential future drawdown.

To further evaluate model performance, a local groundwater budget was derived from the model for the active region of Layer 1 north and west of the Yuha Wells fault. This area appears to be the best calibrated area in the model, so the hydrologic budget was isolated and analyzed. **Table 6** provides a summary of the local groundwater budget for this portion of Layer 1 at the end of the 80-year scenario when the total groundwater pumping is at its maximum.

The local groundwater budget presented in **Table 6** shows that groundwater inflow is primarily derived from stream runoff represented by the MODFLOW recharge module. Other sources of inflow include leakage from Layer 2 and release from groundwater storage through the decline of groundwater levels. The outflows consist of groundwater pumping from wells, leakage from Layer 1 to Layer 2, and Layer 1 subsurface flow to the south. The increased pumping simulated in the scenarios results in more recharge and less discharge. The change in the water budget—expressed as a percent of the total change in pumping—is described below:

- 53% of the pumping volume is derived from a decline in groundwater storage.
- 24% of the pumping volume is derived from a decline in groundwater leakage from Layer 1 to Layer 2.
- 14% of the pumping volume is derived from a decline in groundwater flow through Layer 1 to the south.
- 9% of the pumping volume is derived from increased leakage from Layer 2 into Layer 1.

The percent change in the water budget elements was the same in both pumping scenarios.

Figure 18 presents a comparison of the decline in groundwater storage as a function of the total groundwater pumping at the end of the 80-year scenario. This shows a linear relationship of pumping versus storage decline for the three different scenarios. A linear regression analysis on these scenario results indicates that every 100 AFY of increase in pumping produces a 52.4 AFY decrease in groundwater storage. This is consistent with the percentages presented above. Therefore, it is assumed that the other percentages also vary linearly. Accordingly, using this assumption based on the linear regression analysis presented in **Figure 16**, every 100 AFY increase in pumping would produce a:

- 53 AFY decrease in groundwater storage.
- 24 AFY decrease in groundwater leakage from Layer 1 to Layer 2.
- 14 AFY decrease in groundwater flow through Layer 1 to the south.
- 9 AFY increase in leakage from Layer 2 into Layer 1.

The Draft EIR/EIS cites the potential for groundwater quality deterioration in the Ocotillo/Coyote Wells Groundwater Basin should the relatively poor quality Layer 2 water migrate upward into the higher quality Layer 1 water. The model results indicate that every 100 AFY increase in pumping would produce a 9 AFY leakage from Layer 2 to Layer 1. The potential leakage from Layer 2 is primarily situated in upgradient areas to the north and west, and from upward migration directly underneath the larger production wells. Deterioration of water quality, based on the model results, would not be expected to be widespread. However, it could be locally significant in the vicinity of the larger production wells.

Summary. With regard to the capabilities of the model, the calibration is strongest in the area of the USG wells near Ocotillo. Analysis of the model results show that the model simulations produce results that are comparable to the observed groundwater level data.

This model has reasonable capability to simulate groundwater conditions especially for Layer 1 in the vicinity of Ocotillo. Therefore, the future case scenarios presented in the Draft EIR/EIS should provide a reasonable estimation of the future results.

The model has limitations. Some of the model limitations noted herein include:

- There is a general lack of available hydrogeological data within the model domain. Because of this, there is an inherent degree of uncertainty since little to no data are available for significant portions of the model area.
- As noted above, the model calibration could be improved, especially for Layer 2. The Layer 2 calibration is particularly important for evaluating potential migration of lower quality water from Layer 2 to Layer 1.
- The understanding and representation of groundwater recharge is a key component of the model study. The current model allows recharge only to Layer 2 from leakage from Layer 1. However, significant portions of Layer 2 are the first saturated zone over much of the model domain. This could potentially change the overall groundwater recharge to increase from 1,077 AFY, but would not be expected to significantly change the local groundwater budget in the alluvial (Layer 1) aquifer near Ocotillo.

The groundwater model is best used as a tool to support analysis of the groundwater basin based on measured data. Specifically, the primary function of the groundwater model is to provide a hypothesis to be tested against measured data. The model can be used to project future groundwater level changes resulting from increased pumping. It also can provide a mechanism to evaluate monitoring data. With this perspective, the following steps are recommended as part of ongoing and future monitoring:

- Sensitivity analyses should be undertaken to understand the parameters with the greatest impact on the model.
- Additional calibration should be conducted prior to the monitoring program.
- Solute transport capability should be considered for future scenarios.
- The model should be updated every 3 – 5 years as new data become available.

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Table 1
Water Quality Information from the USGS National Water Information System

State Well Number	Label	Period of Record: Begin	Period of Record: End	Location: Lat	Location: Lon	No. of Sampling Events	Total No. of Measurements
Wells with Recent Data							
17S 10E 11H3	11H3	15-Sep-87	31-Mar-05	32.68812	-115.92307	17	513
16S 9E 25K2	25K2	01-Dec-72	29-Mar-05	32.74423	-115.99362	26	731
16S 10E 30R1	30R1	27-Jun-59	30-Mar-05	32.74111	-115.97111	32	1630
16S 9E 34B1	34B1	06-May-97	31-Mar-05	32.74006	-116.0239	9	285
16S 9E 36C2	36C2	08-Feb-61	29-Mar-05	32.73784	-115.99557	17	495
16S 9E 36H1	36H1	07-Feb-63	24-Mar-05	32.73534	-115.98668	29	784
Previously Monitored							
17S 10E 11G1	11G1	00-Jan-00	15-Nov-72	32.68978	-115.92557	18	108
17S 10E 11G2	11G2	15-Nov-72	10-Mar-82	32.68978	-115.92612	7	176
17S 10E 11H1	11H1	27-Jun-75	27-Jun-75	32.68728	-115.9239	1	24
17S 10E 11H2	11H2	01-Apr-83	04-Apr-86	32.68839	-115.92334	4	93
17S 11E 16J1	16J1	29-Aug-72	11-Dec-74	32.67034	-115.8539	2	37
17S 11E 18K1	18K1	14-May-75	14-May-75	32.66923	-115.89056	1	25
17S 11E 22E2	22E2	24-Jun-75	24-Jun-75	32.65951	-115.84723	1	26
16S 9E 24N1	24N1	23-Jun-75	23-Jun-75	32.75839	-116.00251	1	26
16S 9E 24R1	24R1	28-Apr-77	15-Mar-89	32.75506	-115.98835	13	314
16S 9E 25K1	25K1	15-May-59	20-Nov-74	32.74534	-115.99251	7	144
16S 9E 25M1	25M1	06-Mar-62	22-Sep-67	32.74589	-116.00057	2	44
16S 9E 25M2	25M2	20-Jan-71	04-Nov-71	32.74617	-116.00057	2	39
16S 9E 25Q1	25Q1	27-Dec-74	30-Dec-74	32.74062	-115.99418	2	10
16S 10E 27R1	27R1	24-Jun-75	24-Jun-75	32.74173	-115.93279	1	26
16S 10E 28D1	28D1	16-Dec-48	16-Dec-48	32.75284	-115.94973	1	16
16S 10E 29H1	29H1	13-May-75	13-May-75	32.7495	-115.95168	1	28
16S 10E 29K1	29K1	25-Jun-75	25-Jun-75	32.74645	-115.9564	1	26
16S 10E 29L1	29L1	29-Apr-77	17-Mar-88	32.7445	-115.96279	12	288
16S 10E 32D2	32D2	07-Feb-18	07-Feb-18	32.73978	-115.96557	1	17
16S 10E 33E 1	33E1	13-May-75	13-May-75	32.73312	-115.95084	1	28
16S 10E 34N1	34N1	24-Jun-75	24-Jun-75	32.72589	-115.9339	1	26
16S 9E 35A1	35A1	25-Jun-75	25-Jun-75	32.73895	-116.00557	1	26
16S 9E 35M1	35M1	02-Jul-62	28-Jun-75	32.72923	-116.01751	4	82

		Period of Record		Location			
State Well Number	**Label**	**Begin**	**End**	**Lat**	**Lon**	**No. of Sampling Events**	**Total No. of Measurements**
16S 9E 36C3	36C3	20-Jan-71	20-Jan-71	32.73784	-115.99557	1	25
16S 9E 36D2	36D2	26-Jun-75	10-Apr-90	32.7395	-116.00168	15	360
16S 9E 36G4	36G4	10-Jan-74	28-Jun-75	32.73367	-115.99307	2	46
16S 9E 36L2	36L2	11-Mar-69	24-Jun-75	32.73062	-115.99446	7	120
16S 9E 36R1	36R1	17-Sep-48	19-Feb-58	32.72562	-115.98779	2	47
16S 10E 41M1	41M1	12-Oct-71	28-Jun-75	32.71673	-115.9639	2	41
16S 10E 42A1	42A1	30-Dec-74	30-Dec-74	32.72395	-115.96918	1	6
16S 10E 42A2	42A2	30-Dec-74	30-Dec-74	32.72339	-115.9689	1	3
16S 10E 42A4	42A4	31-Jul-95	31-Jul-95	32.72395	-115.96835	1	30
16S 10E 42A5	42A5	30-Dec-74	23-Mar-94	32.72478	-115.9689	17	398
16S 10E 42C1	42C1	28-Jun-75	28-Jun-75	32.72284	-115.97612	1	25
16S 10E 42H1	42H1	08-Jan-76	08-Jan-76	32.72006	-115.97085	1	22
16S 11E 42L1	42L1	24-Jun-75	24-Jun-75	32.71423	-115.87362	1	25
16S 11E 42M1	42M1	18-Jan-49	23-Aug-62	32.71617	-115.87723	2	33
16S 11E 42M2	42M2	18-Jan-49	23-Aug-62	32.71617	-115.87723	2	21
16S 11E 42M4	42M4	04-Mar-58	23-Dec-74	32.71617	-115.87834	2	45
16S 11E 42M5	42M5	18-Jan-49	22-Feb-72	32.71617	-115.8789	2	27
16S 11E 42M6	42M6	14-May-75	14-May-75	32.71339	-115.87834	1	28

Source: USGS NWIS

Table 2. Comparison of Water Quality by Well Location

Area		East of Ocotillo			Transition		Near Ocotillo
Well Name		**29H1**	**29D1**	**27R1**	**34N1**	**29L1**	**36H1**
Parameter	**Units**	**Results**					
Bicarbonate, unfiltered, field	MG/L	763	1060	159	151	170	125
Boron	UG/L	15000	1900	3800	300	400	200
Calcium	MG/L	140	3	16	170	13	20
Carbonate, unfiltered, field	MG/L	0	288	12		0	0
Chloride	MG/L	26000	2510	1700	280	230	66
Fluoride	MG/L	5		0.9	0.6	0.7	0.7
Iron, filtered	UG/L	80			<10	47	
Magnesium	MG/L	240	14	23	61	3.6	4.3
pH, field		7.3		9	7.8	8.6	8
Potassium	MG/L	72		17		5	3.9
Sodium	MG/L	21000	3140	1400	270	250	78
Specific conductance, field	uS/cm	74000		6000	2100	1360	525
Sulfate	MG/L	6300	1520	510	720	120	33
Sample Date		M-75	D-48	J-75	J-75	A-77	A-77

Table 3. Wells Monitored for Water Levels by the USGS since 2002

State Well Number	Label	Period of Record Begin	Period of Record End	Number of Data Points	Hydrogeology Layer
17S 10E 11B1	11B1	Jun-75	Mar-07	60	2
17S 10E 11G1	11G1	Apr-67	Mar-07	67	2
17S 10E 11G4	11G4	Jul-78	Mar-07	54	2
17S 10E 11H3	11H3	Oct-87	Oct-06	39	2
17S 11E 16J1	16J1	May-70	Mar-07	64	2
17S 11E 22E2	22E2	May-75	Mar-07	66	2
16S 10E 27R1	27R1	May-75	Mar-07	66	2
16S 10E 28D1	28D1	Dec-74	Mar-07	11	2
16S 10E 29H1	29H1	May-75	Mar-07	62	2
16S 9E 35M1	35M1	Jul-62	Mar-07	31	2
16S 9E 35N2	35N2	Jun-75	Mar-07	17	2
16S 9E 25M2	25M2	Apr-91	Mar-07	32	1
16S 9E 26F1	26F1	Nov-98	Mar-07	18	1
16S 10E 31B1	31B1	Sep-93	Mar-07	28	1
16S 10E 32P1	32P1	Oct-92	Mar-07	30	1
16S 9E 34B1	34B1	Mar-98	Mar-07	16	1
16S 9E 36C3	36C3	Jun-75	Oct-06	16	1
16S 9E 36D2	36D2	Jun-75	Mar-07	65	1
16S 9E 36H1	36H1	Mar-54	Mar-07	65	1
16S 11E 42L1	42L1	May-75	Mar-07	52	2

Table 4
Comparison of Previous Water Balances

All Units in AFY (annual average)	USGS(Skrivan) 1977		Huntley 1979	Mark 1988	Bookman-Edmonston 1996		Bookman-Edmonston 2004
Study Period	1925	1975	1976-1978	1976	1976	1995	2002
Watershed Area	225 mi^2		40 mi^2	40 mi^2	225 mi^2		76 mi^2
Inflows							
Total Inflow	2,600	2,600	2,631	1,820	2,600	2,600	1,077
Infiltration of Precipitation	*2,600*	*2,600*		*1,650*	*2,600*	*2,600*	*1,077*
Subsurface Inflow				*170*			
TOTAL INFLOWS	**2,600**	**2,600**	**2,631**	**1,820**	**2,600**	**2,600**	**1,077**
Outflows							
Total Pumping	0	900	924	1,002	711	511	556
USG Pumping		*600*			*413*	*400*	*434*
Urban Use		*300*			*85*	*111*	*122*
Export to Mexico					*213*	*0*	
Total Groundwater Outflow	1,950	1,900	1,999	825	1,900	1,900	990
Underflow to Mexico	*1,500*	*1,450*	*1,245*		*1,450*	*1,450*	*515*
Underflow across Faults	*450*	*450*	*754*		*450*	*450*	
Underflow to East							*475*
ET Outflow	650	300	250		250	250	
TOTAL OUTFLOWS	**2,600**	**3,100**	**3,173**	**1,827**	**2,861**	**2,661**	**1,546**
Change in Storage	**0**	**-500**	**-542**	**-7**	**-261**	**-61**	**-469**

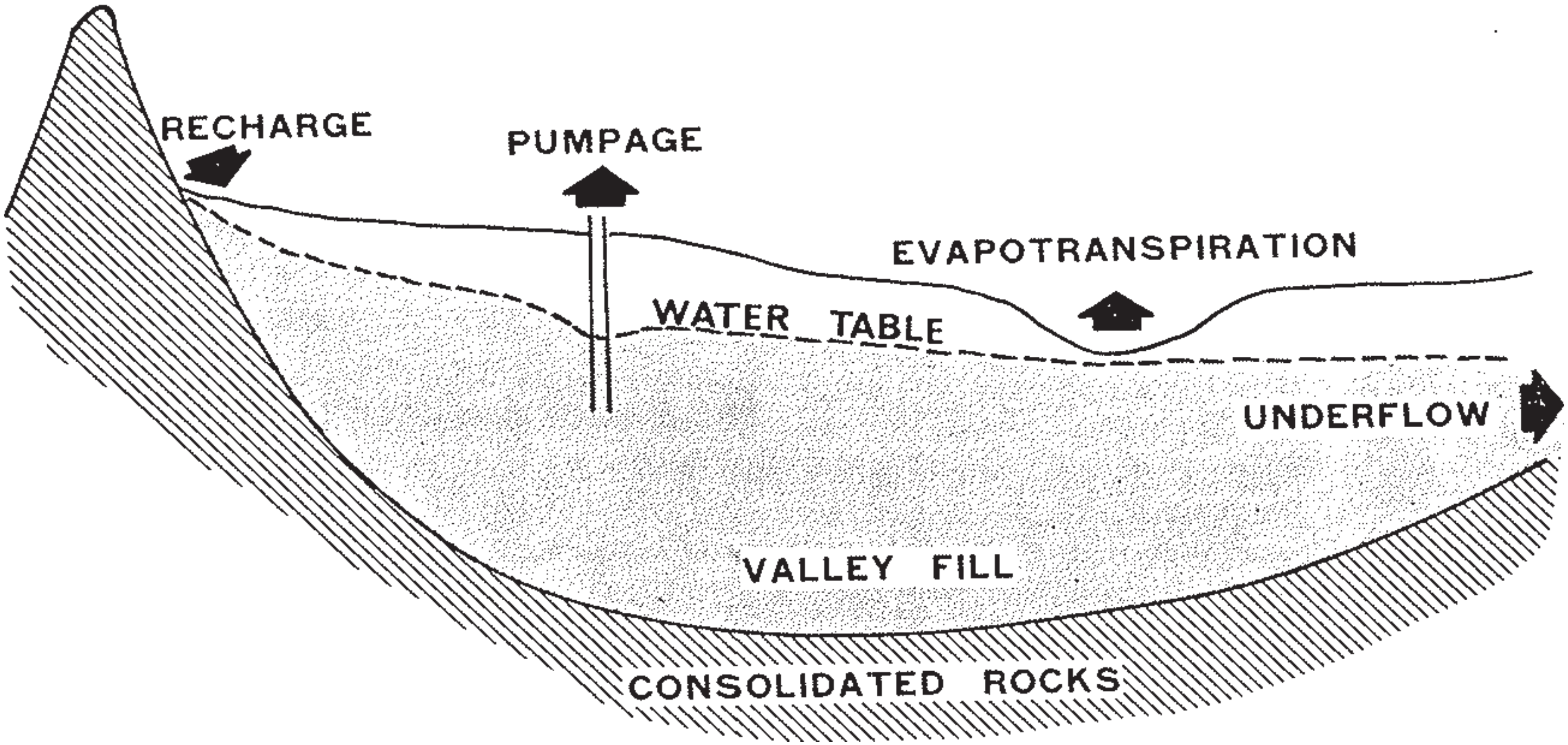
Table 5. Summary of Model Calibration Statistics

Statistical Measure	Layer 1 Calibration Wells	Layer 2 Calibration Wells
Number of Wells	9	6
Number of Observations	185	134
Mean Error	2.2	9
Root Mean Square Error	5.6	16.5
Standard Deviation	5.2	13.9

Table 6. Subregional Groundwater Budget for Layer 1 in the Ocotillo Area

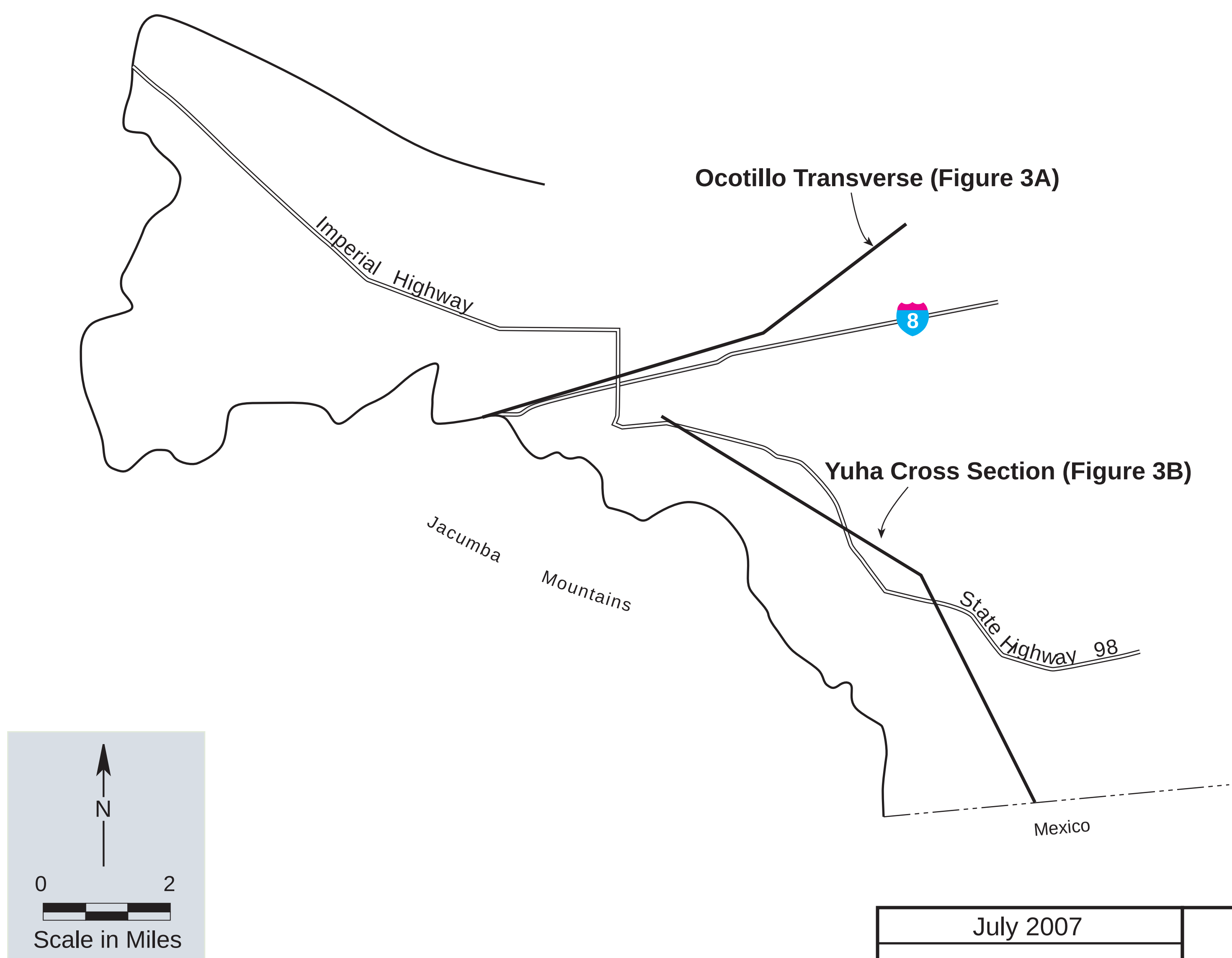
	Baseline	650 AFY Pumping Scenario	767 AFY Pumping Scenario
Inflow (in AFY)			
Recharge	1,018	1,018	1,018
Leakage from Layer 2	13	61	75
Decline in Groundwater Storage	140	434	488
Total Inflow	1,171	1,513	1,581
Outflow (in AFY)			
Wells	469	1,021	1,138
Layer 1 Outflow	265	187	166
Leakage to Layer 2	437	305	277
Total Outflow	1,171	1,513	1,581

*At the end of the 80-year scenario when total groundwater pumping is at its maximum.



Source: Skrivan, Figure 1, 1977.

July 2007	**Figure 1**
TODD ENGINEERS Emeryville, California	**Conceptual Cross Section (1977)**



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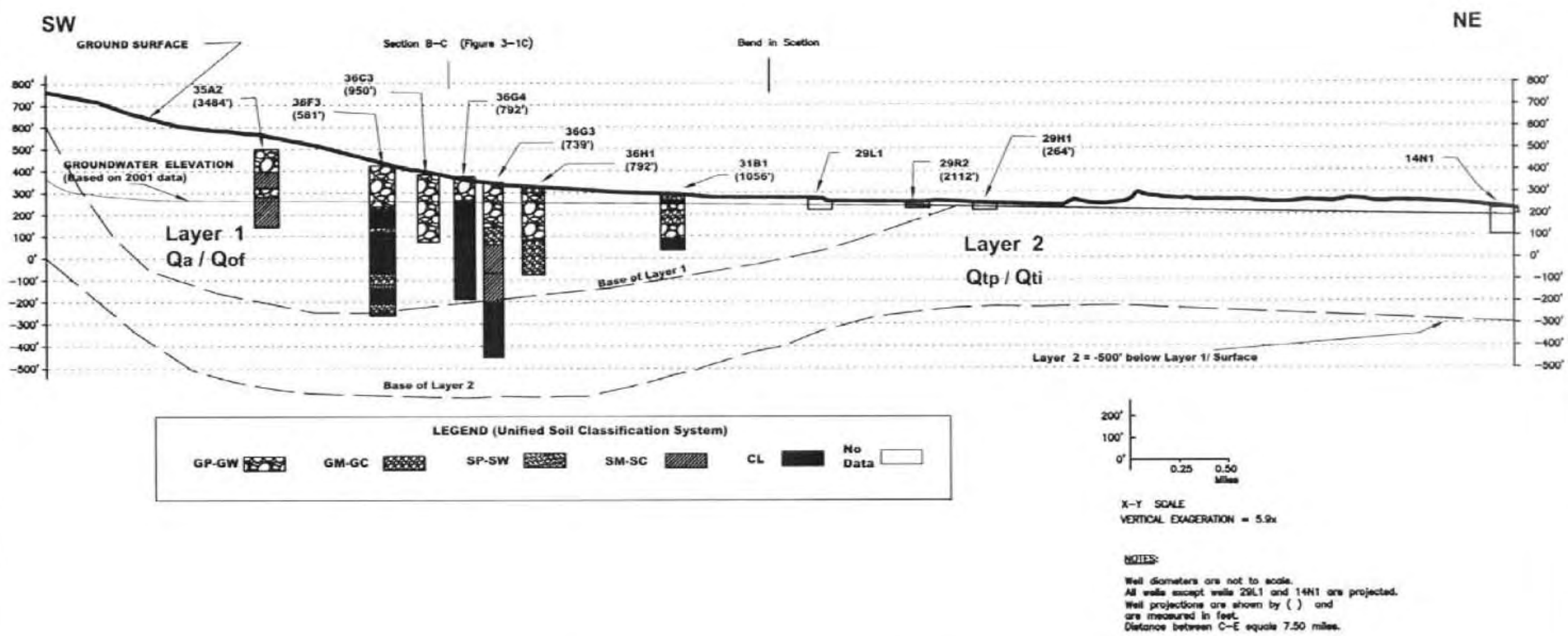
Emeryville, California

Figure 2
Cross Section Locations

OCOTILLO GEOLOGIC CROSS-SECTION (TRANSVERSE)



Bookman-Edmonston
A Division of GEI Consultants, Inc.

Ocotillo/Coyote Wells Groundwater Study
Geologic Cross-Section (Ocotillo-Transverse)
U.S. Gypsum Company

9/24/03

FIGURE 3-1E

PROJECT NUMBER 33890

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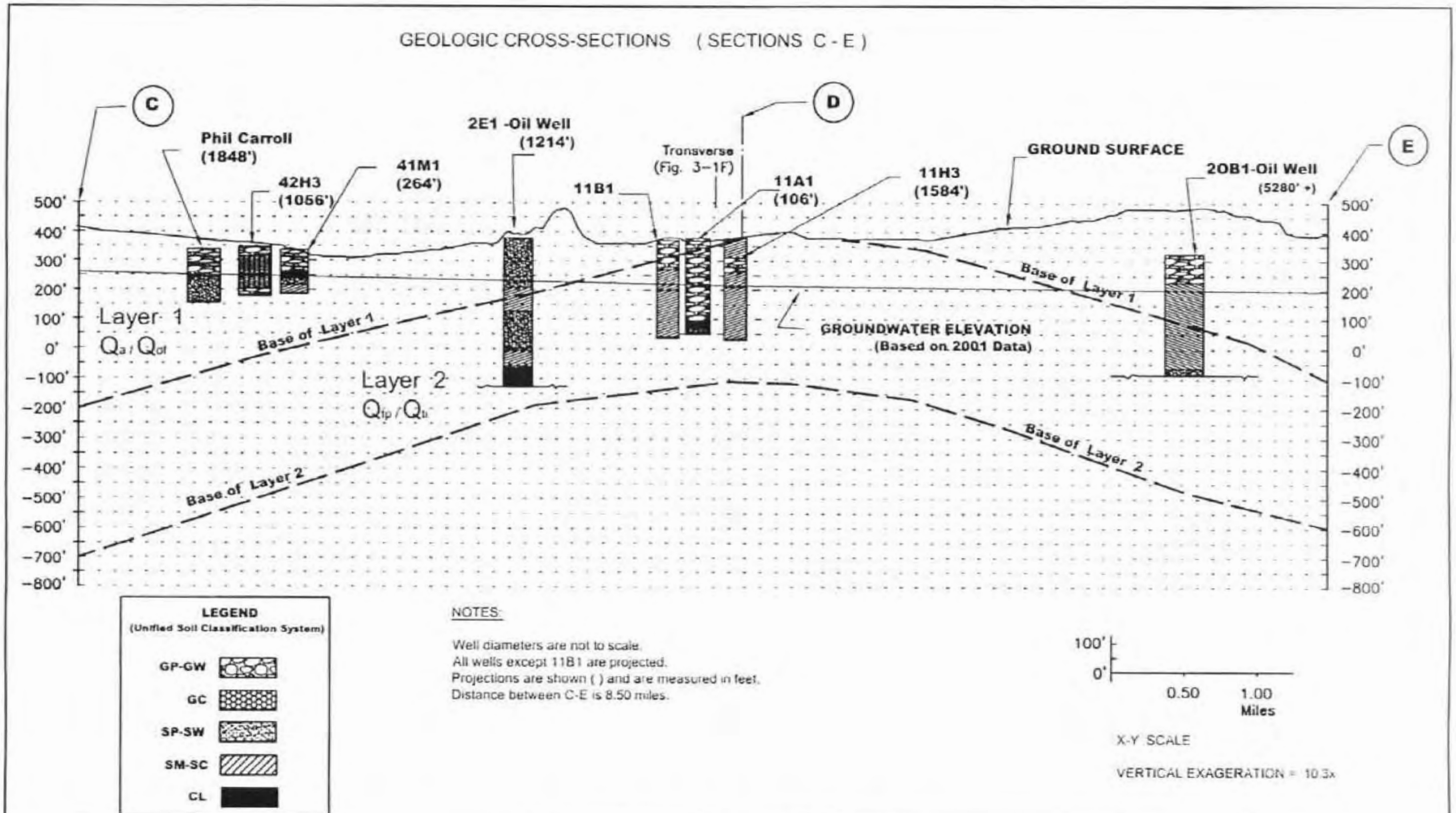
Figure 3A
Cross Section near Ocotillo



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Ocotillo/Coyote Wells Groundwater Study
Geologic Cross-Section
U.S. Gypsum Company

9/24/03

FIGURE 3-1D

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Figure 3B
Cross Section near Yuha Estates

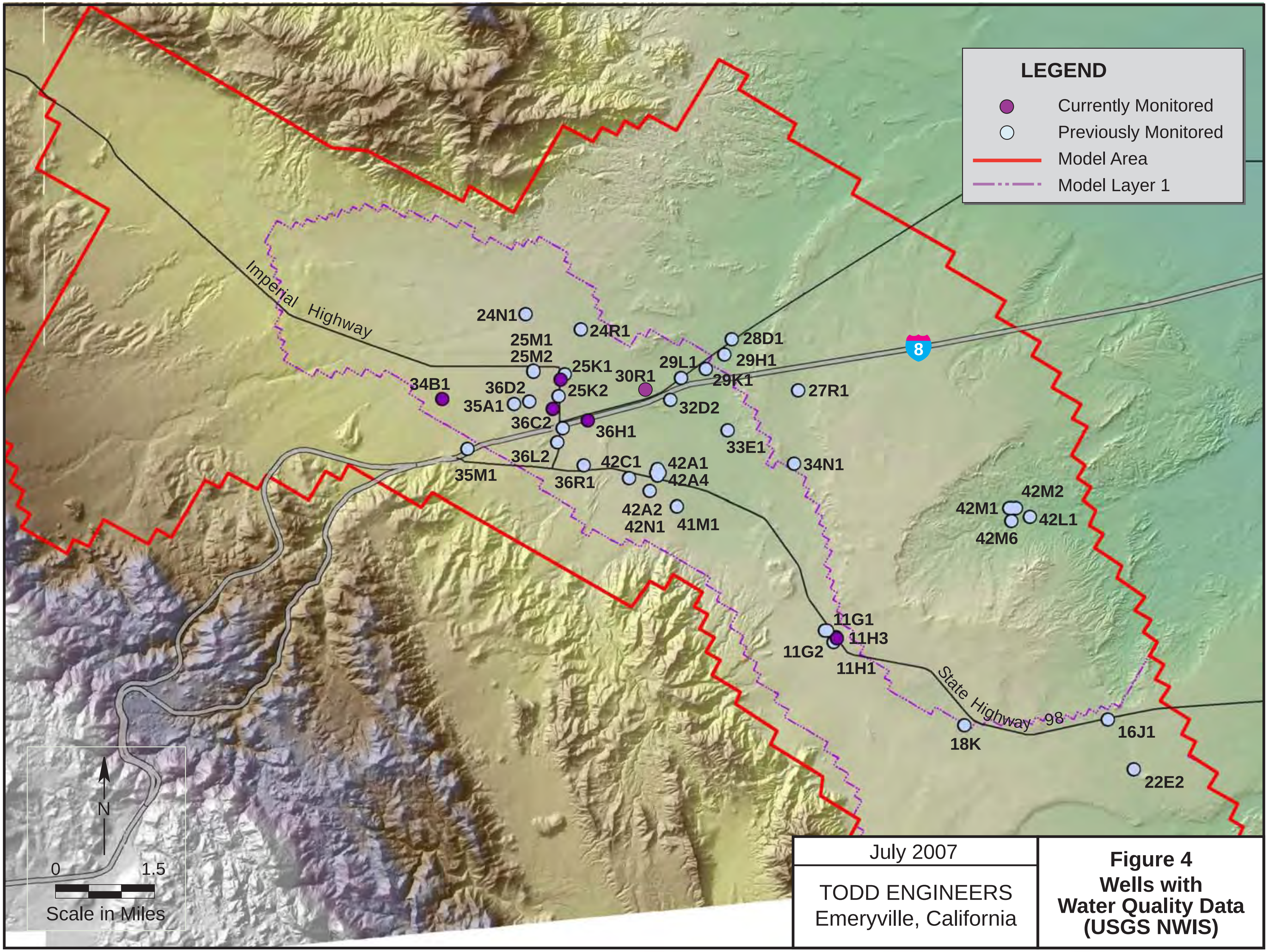

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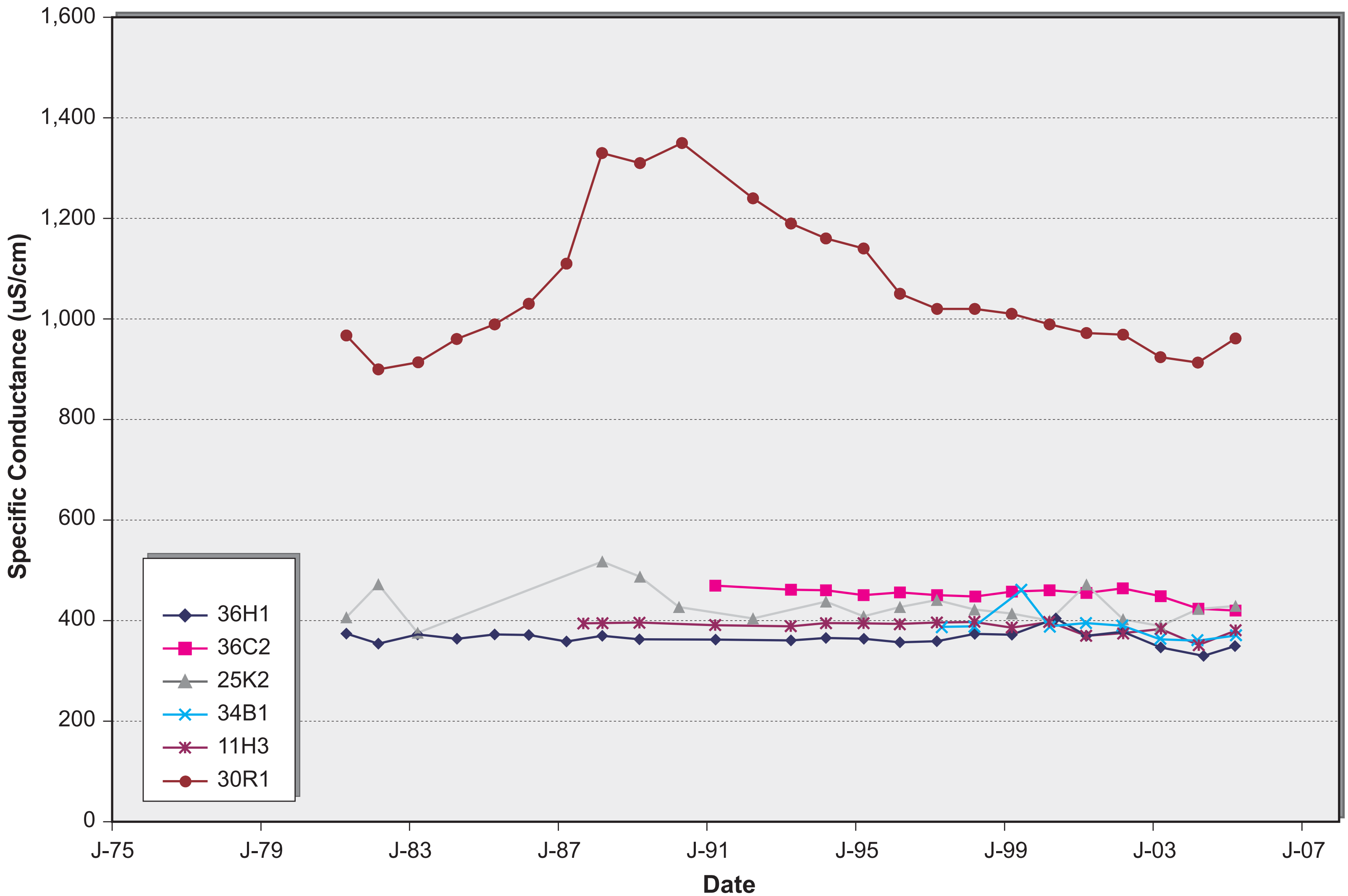
Figure 4
Wells with Water Quality Data (USGS NWIS)



Source: USGS NWIS.

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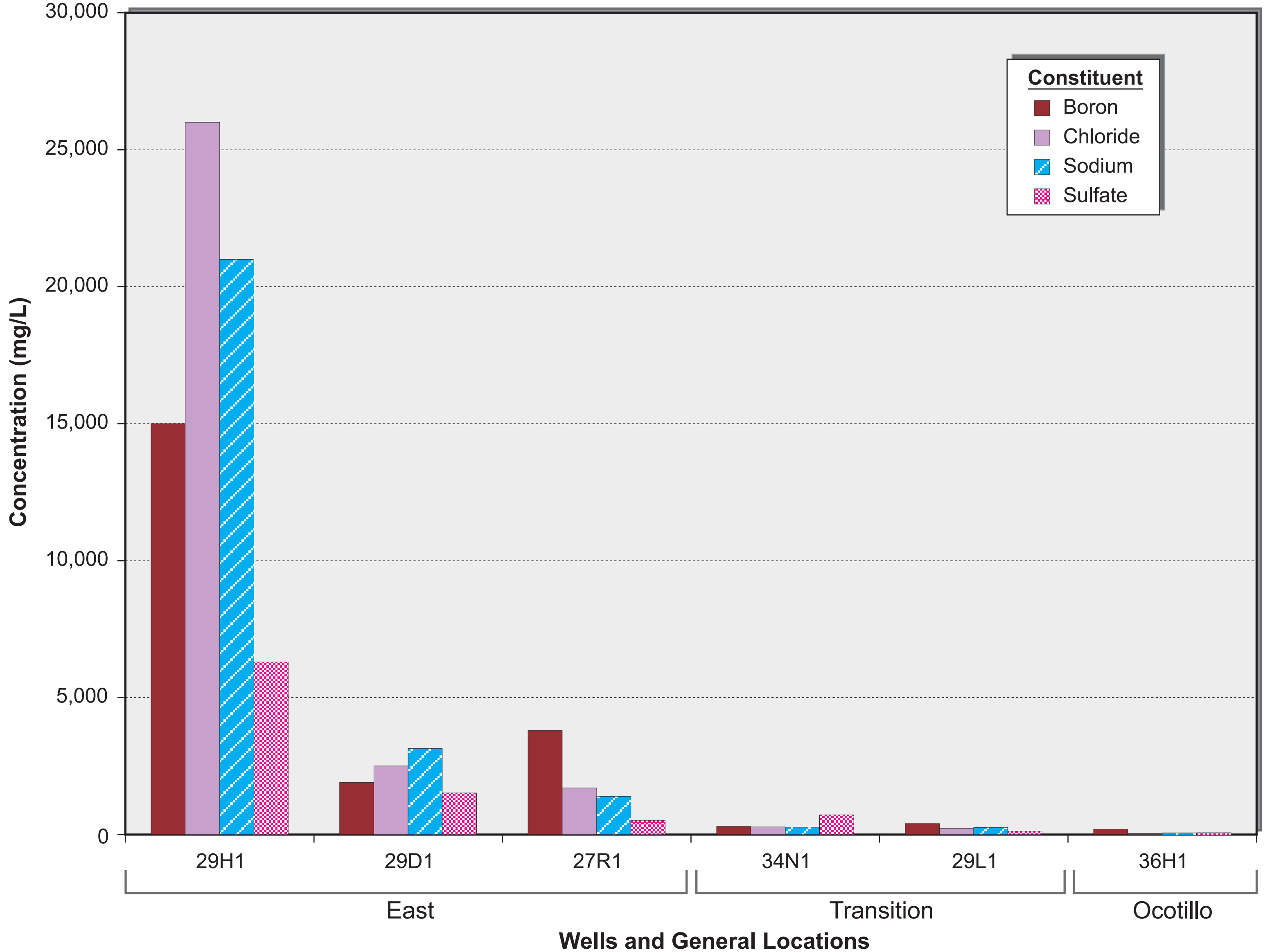
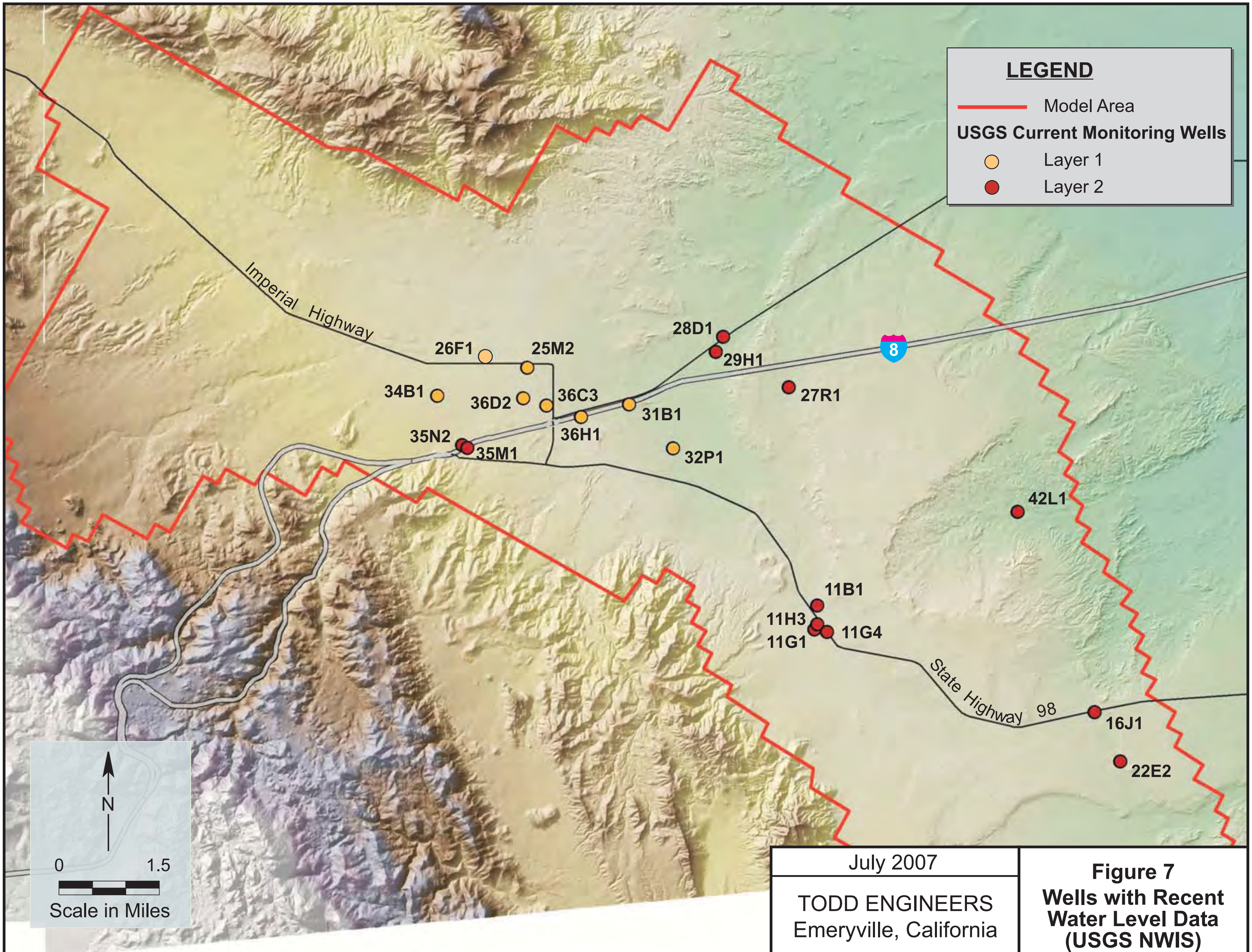
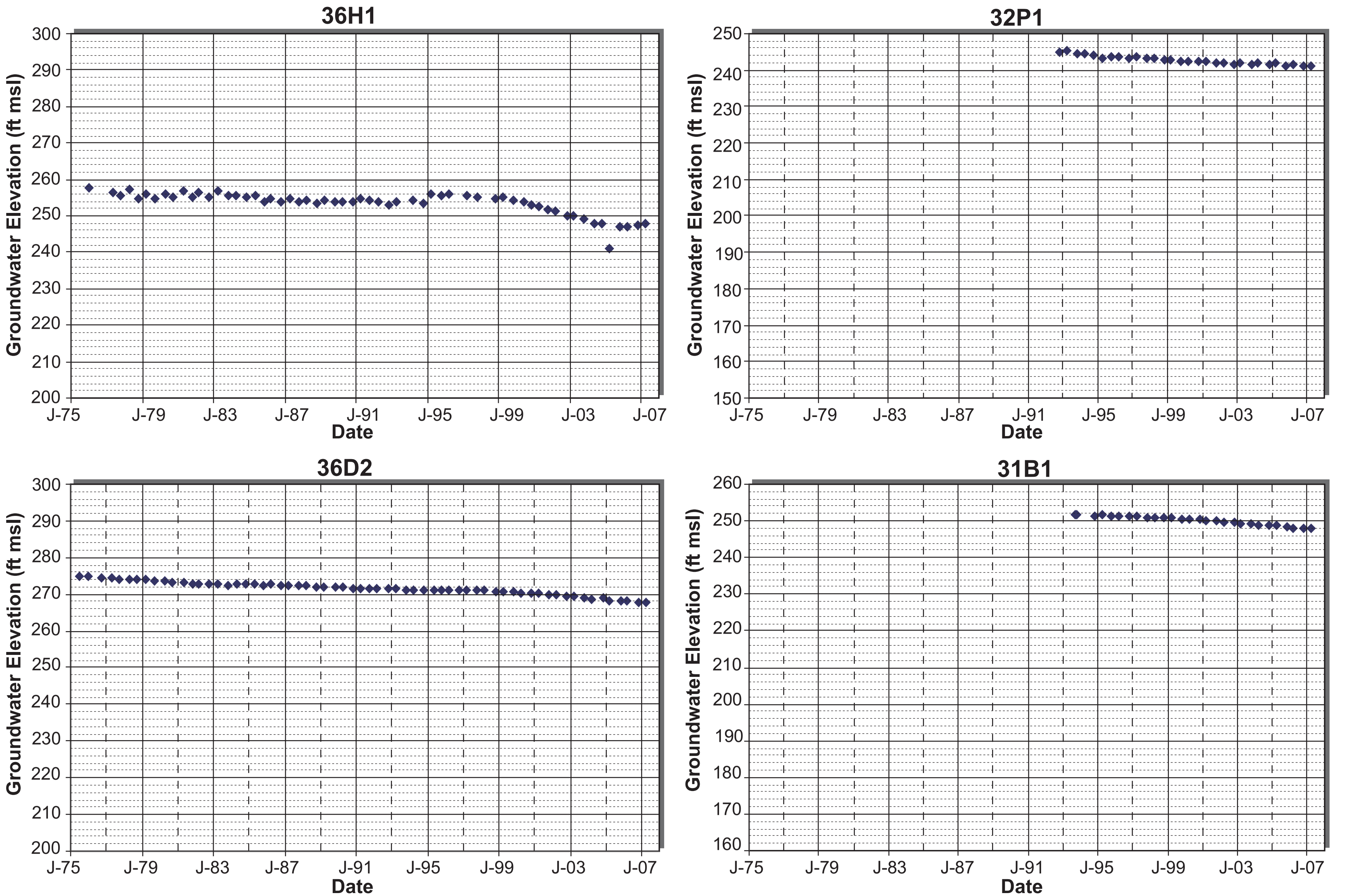
Figure 5
Wells with Recent NWIS Water Quality Data



July 2007	**Figure 6**
TODD ENGINEERS Emeryville, California	**Water Quality Trend Differences by Area**



July 2007	**Figure 7**
TODD ENGINEERS Emeryville, California	**Wells with Recent Water Level Data (USGS NWIS)**



Source: USGS NWIS.

July 2007	Figure 8 Hydrographs Layer 1 Ocotillo
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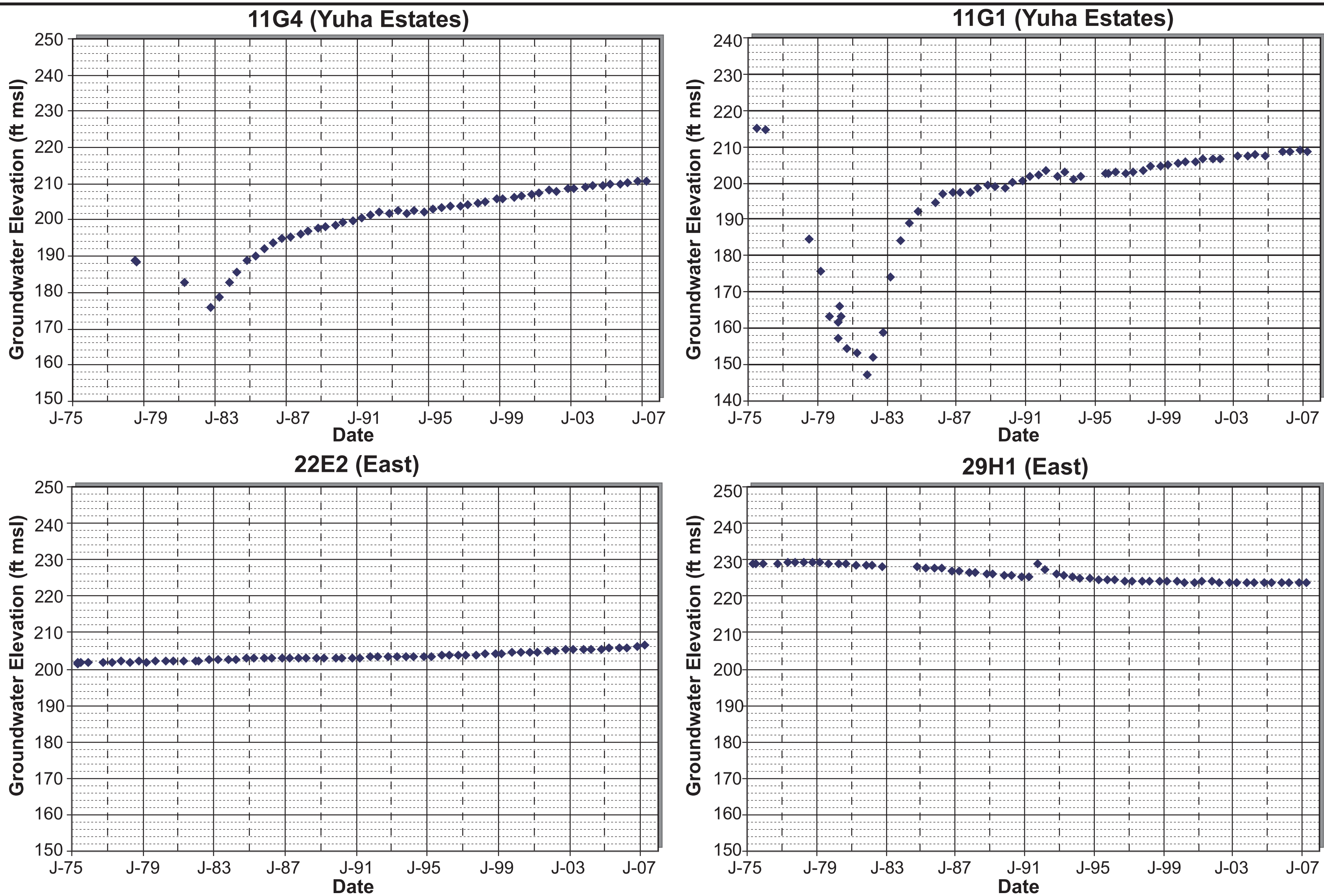

Source: USGS NWIS.

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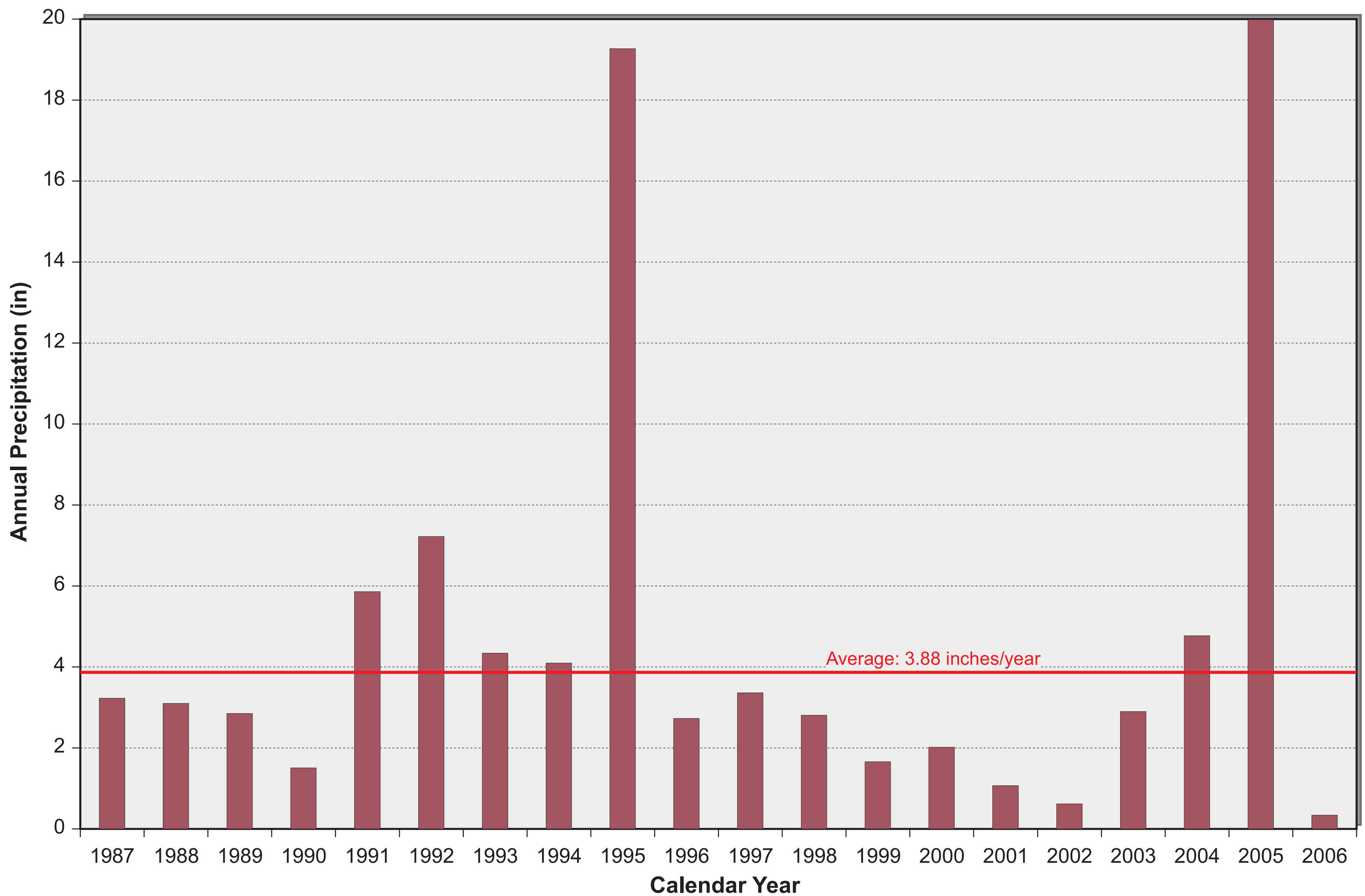
Figure 9
Hydrographs
Layer 2



Source: CIMIS.

July 2007 TODD ENGINEERS Emeryville, California	**Figure 10** **Annual Precipitation at Seeley, CA**

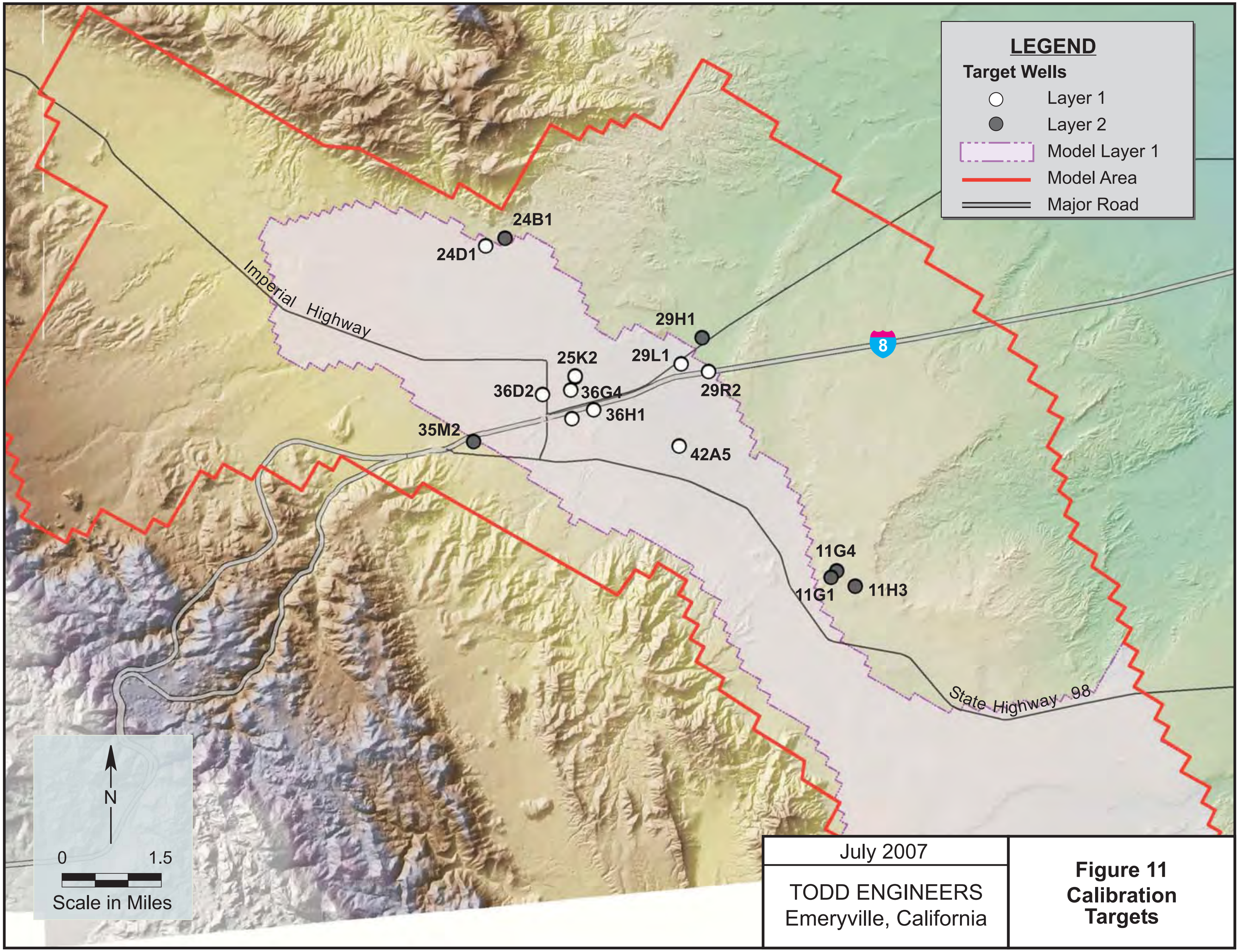


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Figure 11
Calibration Targets

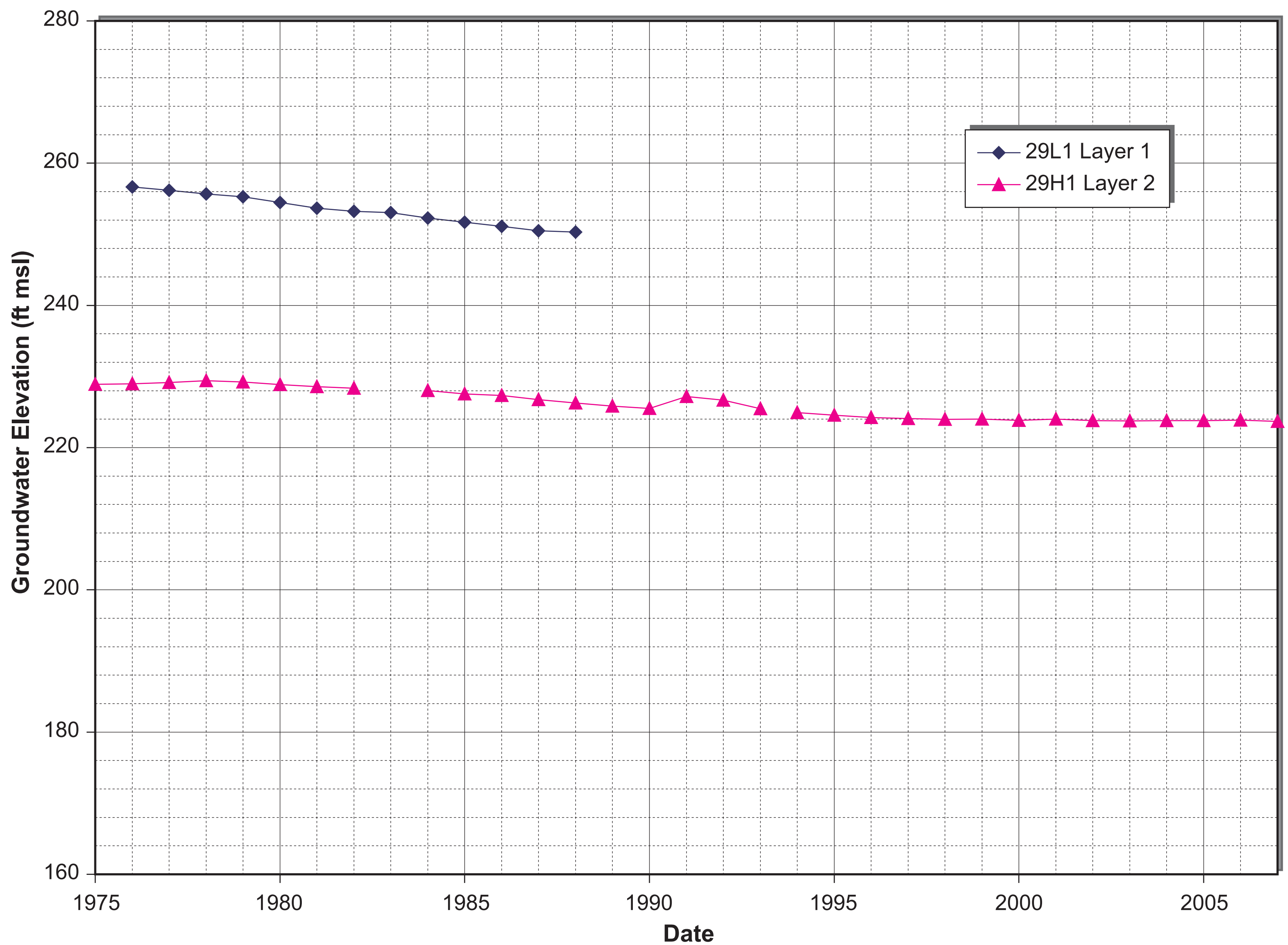

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Figure 12
Water Levels in Wells 29L1 and 29H1

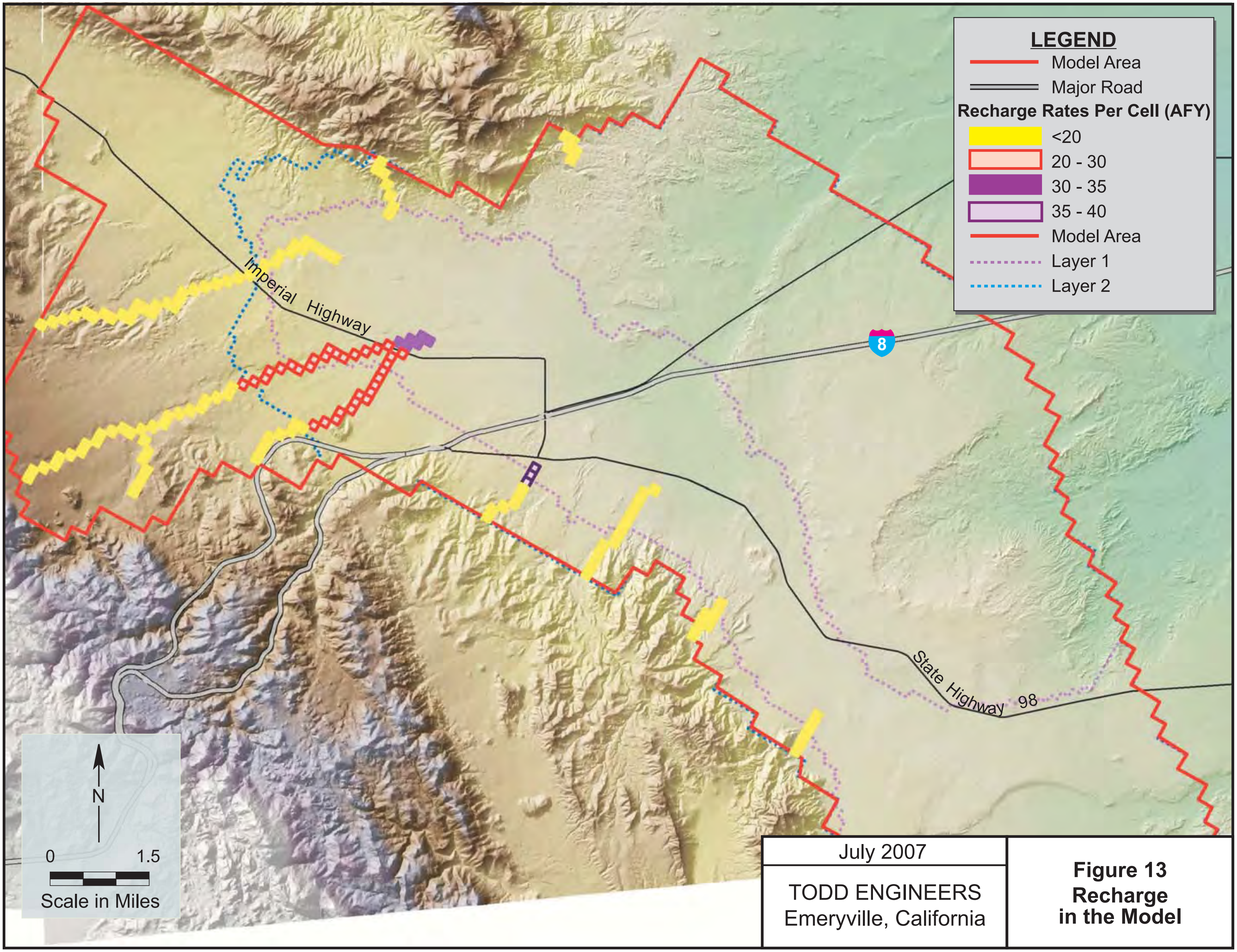

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Figure 13
Recharge in the Model

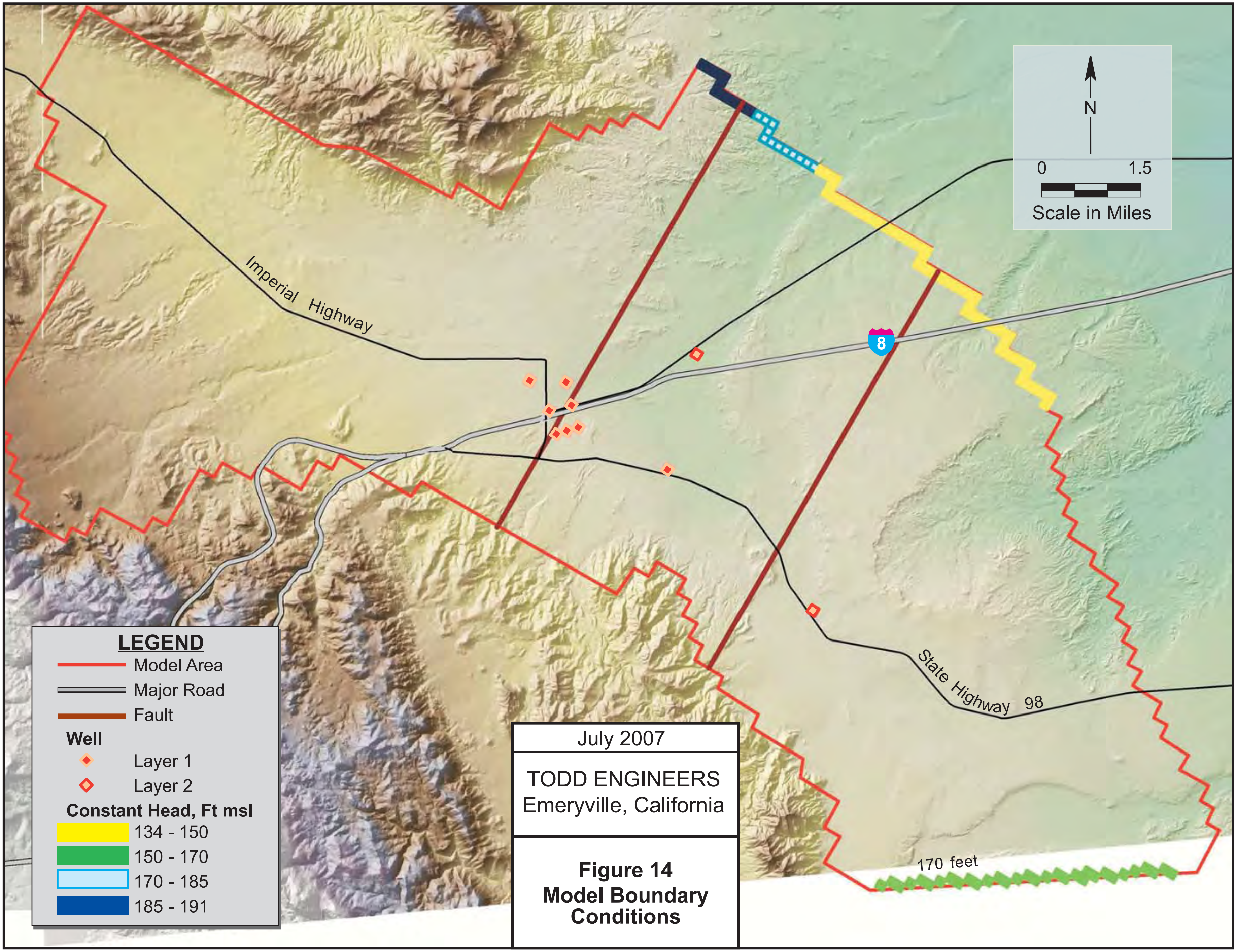

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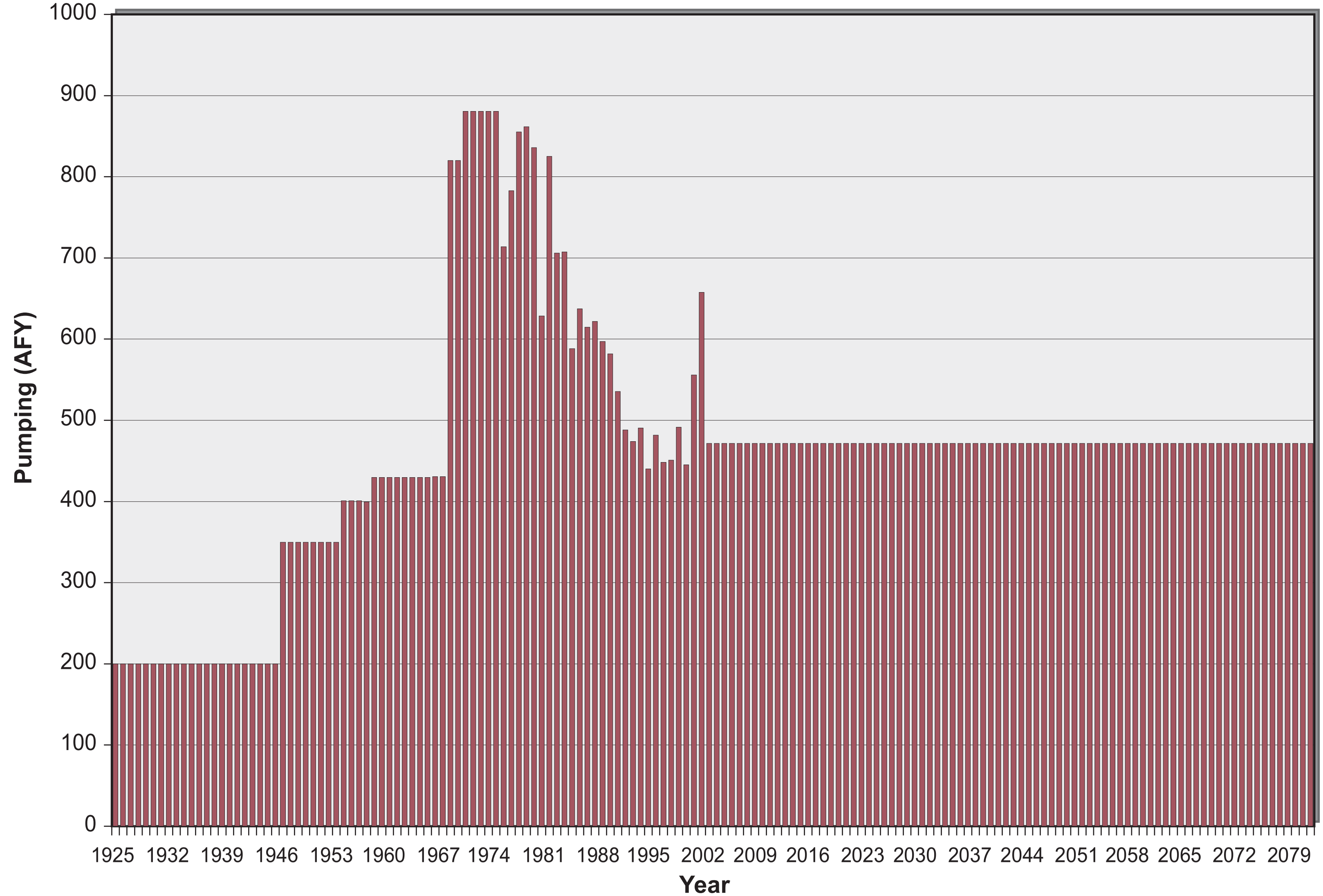
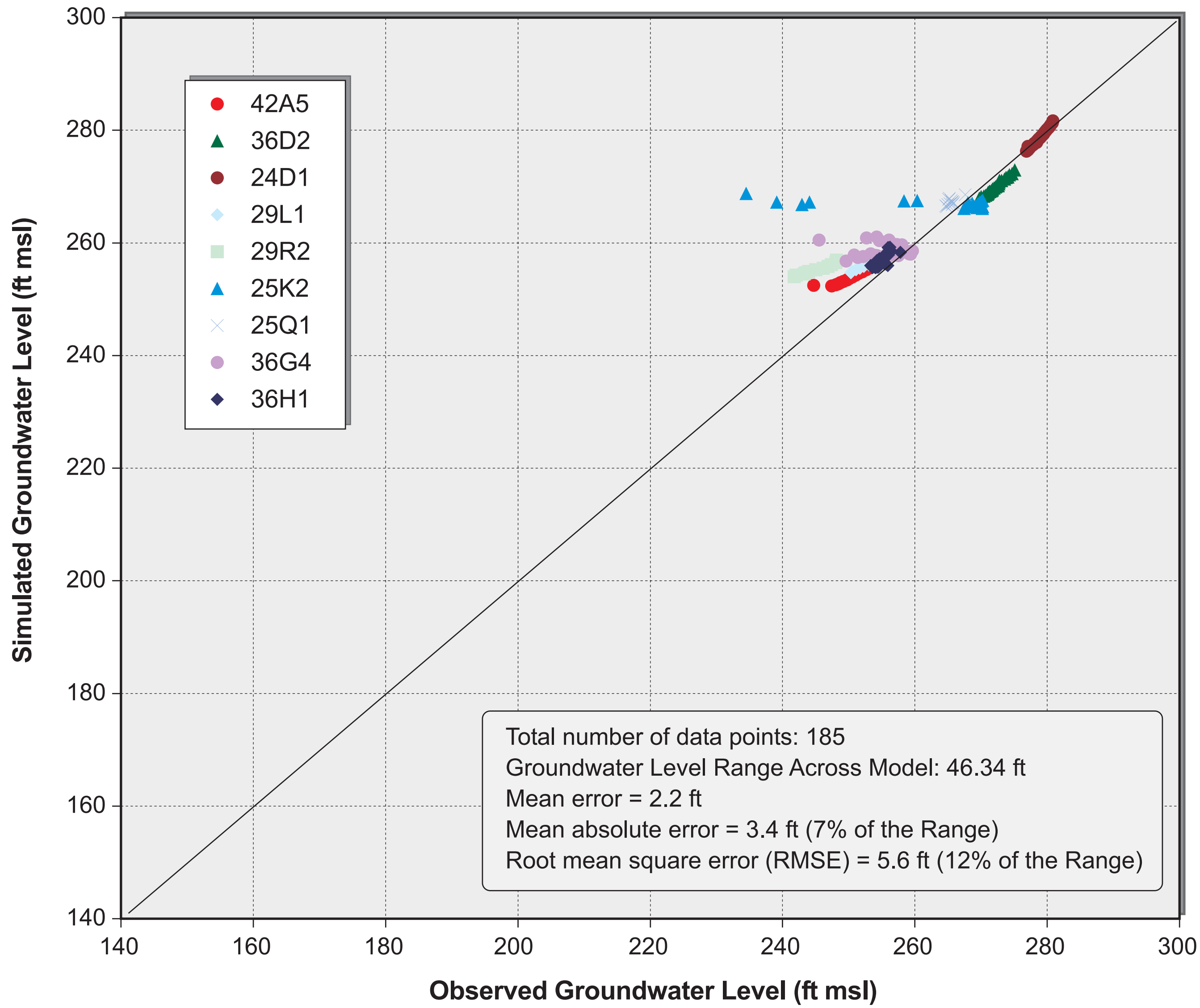
Figure 14
Model Boundary Conditions



July 2007 TODD ENGINEERS Emeryville, California	**Figure 15** **Total Basin Pumping in the 2004 Numerical Model - Baseline**



July 2007	**Figure 16 Calibration Layer 1**
TODD ENGINEERS Emeryville, California	

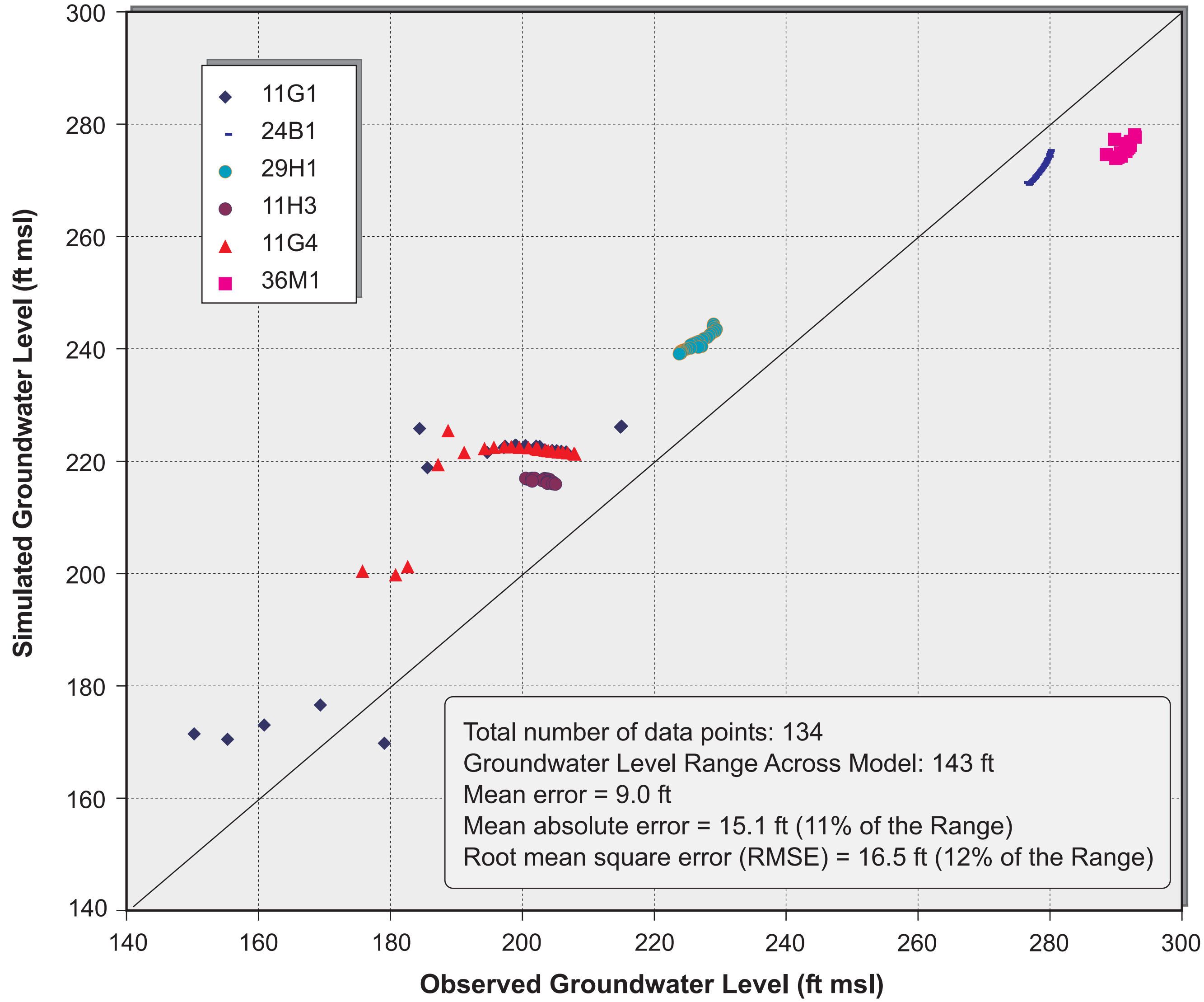


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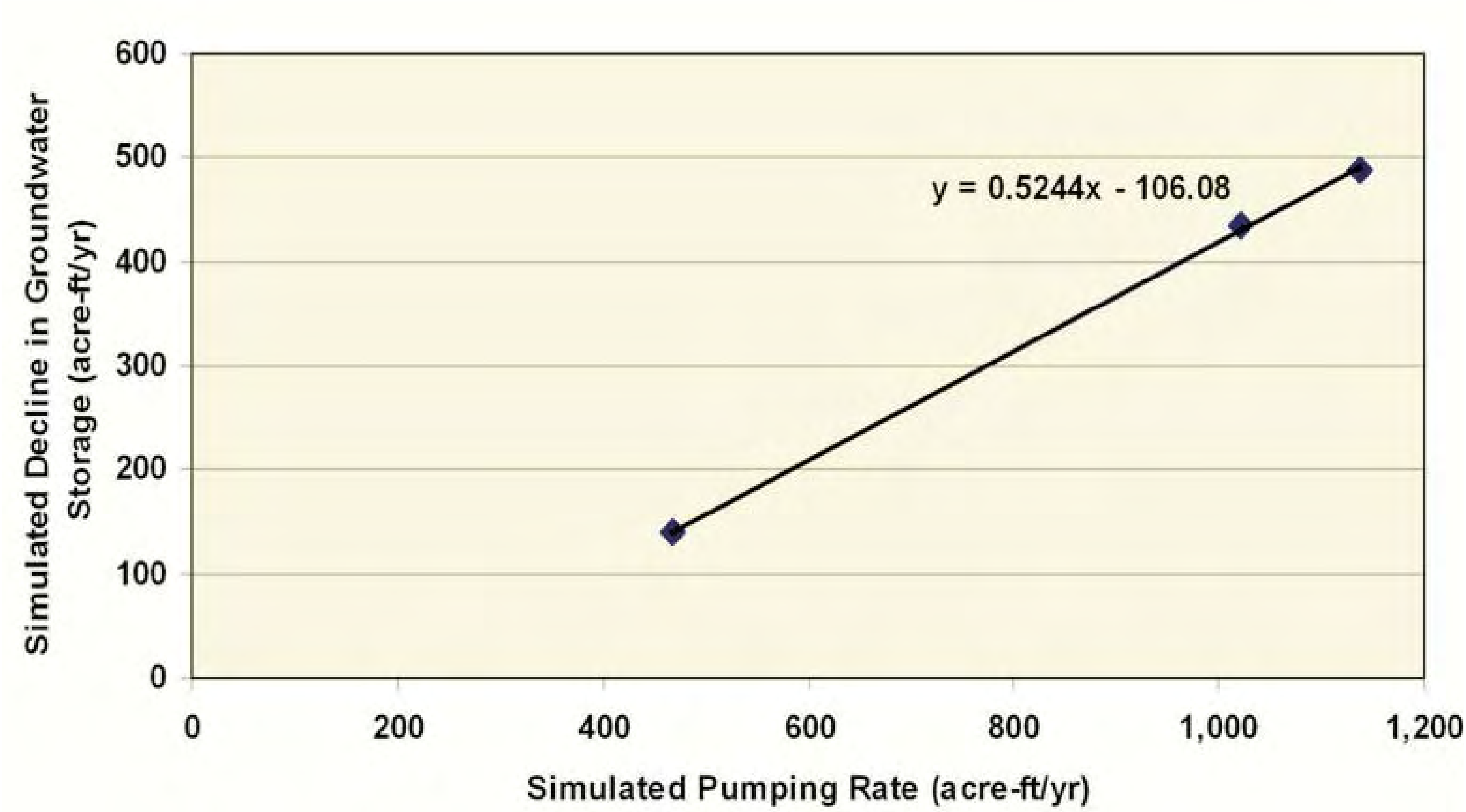
Figure 17
Calibration
Layer 2



July 2007	**Figure 18**
TODD ENGINEERS Emeryville, California	**Relationship of Simulated Decline in Storage as a Function of Pumping**

APPENDIX C-2
WATER SUPPLY ASSESSMENT

Water Supply Assessment
for
US Gypsum Expansion/Modernization Project

November 2007

Prepared for
COUNTY OF IMPERIAL
El Centro, California

Prepared by

TODD ENGINEERS

2490 Mariner Square Loop, Suite 215

Alameda, California, 94501

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INTRODUCTION

Background

The United States Gypsum (US Gypsum) Company proposes to expand and modernize its gypsum processing and wallboard manufacturing facility and quarry near Plaster City, California (the "Project"). The expansion and modernization of the plant will include replacing older, less efficient production equipment and increasing the production. This increase in production will require an adequate water supply. An Environmental Impact Report/Environmental Impact Statement (EIR/EIS) has been prepared for the Project in compliance with the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA).

The USG Plaster City Quarry is located in the western portion of Imperial County, which is characterized by a series of low mountain ranges and valleys opening to the Salton Sea and Imperial Valley, as shown on **Figure 1**. Quarrying of gypsum has been occurring at the Plaster City Quarry since 1921 and USG has been quarrying gypsum at the site since 1946. Groundwater from the Ocotillo/Coyote Wells Groundwater Basin has been the primary source of water for USG's facilities and the nearby communities of Ocotillo, West Texas, Painted Gorge, Nomirage, and Yuha Estates. The groundwater basin outline is also shown on **Figure 1**. Water for processing and manufacturing purposes at the Plaster City Plant is currently delivered via an 8-inch diameter gravity-fed pipeline from the groundwater basin.

Purpose

The California Water Code section 10910 (also termed Senate Bill 610 or SB 610) requires that a water supply assessment be prepared for a project that is subject to the California Environmental Quality Act (CEQA). The lead city or county agency for the project is mandated to identify the public water system that might provide water supply to the project and then to request a water supply assessment. If there is no water system, the Water Supply Assessment must be prepared by the lead agency. In this case, there is no water system that may supply water to the Project. Thus, to the extent that a Water Supply Assessment is required for the Project, it must be prepared by Imperial County, the lead agency for the Project under CEQA.

As defined by the Water Code a “project” is defined as the following:

(1) A proposed residential development of more than 500 dwelling units.
(2) A proposed shopping center or business establishment employing more than 1,000 persons or having more than 500,000 square feet of floor space.
(3) A proposed commercial office building employing more than 1,000 persons or having more than 250,000 square feet of floor space.
(4) A proposed hotel or motel, or both, having more than 500 rooms.
(5) A proposed industrial, manufacturing, or processing plant, or industrial park planned to house more than 1,000 persons, occupying more than 40 acres of land, or having more than 650,000 square feet of floor area.

(6) A mixed-use project that includes one or more of the projects specified in this subdivision.
(7) A project that would demand an amount of water equivalent to, or greater than, the amount of water required by a 500 dwelling unit project.

The expansion and modernization of facilities like those of USG are not covered explicitly in the above definitions. Thus, the question presented is whether the Project would demand an amount of water equivalent to, or greater than, the amount of water required by a 500 dwelling unit project (definition 7). The average household size and water use per capita can be used to estimate the amount of water required by 500 dwelling units, as follows.

The EIR/EIS estimates the total water use per capita between 60 to 250 gallons per day, depending on the community. Given the average household size of 2.04 people per dwelling unit for all types of housing (US Census), the total water use per dwelling unit in the Ocotillo area is approximately 122 to 510 gallons per day, or about 0.14 to 0.46 acre feet per year (AFY). The total demand for 500 units would therefore range from 68.6 AFY to 285.8 AFY.

USG's allowed allocation of groundwater is 767 AFY. The expansion/modernization is not expected to increase water demand above this amount. Because the Project will not "demand" more water than USG is currently permitted to use, it is unclear whether a Water Supply Assessment is required under the Water Code. However, the proposed maximum water usage of 767 AFY is 420 AFY more than the baseline defined in the EIR/EIS. The baseline represents average pumping from 1994-1998, or 347 AFY. Based on the conservative assumption that the Project will increase actual water use by an additional 420 AFY above the stated baseline, the Project can be said to use an amount of water that exceeds the amount of water required by a 500 dwelling unit project (as calculated above).

This Water Supply Assessment documents sources of water supply, quantifies water demands, evaluates drought impacts, and provides a comparison of water supply and demand that is the basis for an assessment of water supply sufficiency. If the assessment concludes that water supplies are or will be insufficient, then the public water system or lead agency must provide plans for acquiring the additional water. If the lead agency decides that the water supply is insufficient, the lead agency may still approve the project, but must include that determination in its findings and must include substantial evidence to support its approval of the project.

The purpose of this Water Supply Assessment is to document the existing and future water supplies of US Gypsum and compare them to the build-out water demands put forth in the Draft EIR/EIS for the US Gypsum Expansion/Modernization Project. This comparison, conducted for both normal and drought conditions, is the basis for an assessment of water supply sufficiency in accordance with the requirements of California Water Code section 10910 (Senate Bill 610). This Water Supply Assessment uses the Department of Water Resources (DWR) *Guidebook for Implementation of Senate Bills 610 and 221* for guidance and table templates, plus project-specific information provided by Lilburn Associates, Imperial County, and US Gypsum.

Throughout this report, areas are shown to the nearest acre, and water budget items are shown to the nearest acre-foot (AF). As a result, large numbers may appear to be accurate to four or five digits, which may not be the case. Future water demand, water supply, and groundwater yield estimates are accurate only to two or possibly three significant digits. All digits are retained in the text and tables to preserve correct column totals in tables and to maintain as much accuracy as possible during subsequent calculations.

WATER DEMAND

This section summarizes water demands for the study area, defined here as the Ocotillo/Coyote Wells Groundwater Basin. The first part describes the factors affecting total water demand, including climate, population, and the mix of customer types, such as residential, industrial, commercial, and landscaping. The second part documents water demands not only under normal climatic conditions, but also during drought.

Climate

Table 1 summarizes representative climate data for the study area, including average monthly precipitation, temperature, and evapotranspiration (ETO). The basin has an arid climate, characterized by hot summers and warm winters. **Figure 2** is a chart of annual rainfall (by calendar year) from the Seeley CIMIS station. The precipitation in the area is highly variable. As shown on **Figure 2**, most years experience less than 4 inches of rainfall per year, but some years have experienced a fraction of an inch (e.g., 2006), while rainfall in 1995 amounted to nearly 20 inches. The average annual precipitation is 3.89 inches per year.

Population

In general, as population increases, so does water demand. **Table 2** and **Figure 3** shows projected population increases. The increases are projected through the duration of the USG project (to 2082), notwithstanding that Water Supply Assessments may be limited to a 20-year planning horizon. Nonetheless, to be cautious, this Assessment is extended to the 80 year life of the Project, or 60 years beyond a typical Assessment. This longer timeframe results in more uncertainty about future population and water demand.

Consistent with background studies used in the Draft EIR/EIS, the US Census for 1990 was used to develop base population estimates. To obtain future demand through the life of the USG project, population was assumed to increase by 1.4 percent each year from 1990 to 2082. The 1.4 percent rate of population increase was based on the observed annual population growth from 1980 to 1990. While this growth rate is reasonable on the time scale of 10 or 20 years, it likely overestimates the future population of the area when projected to 2082 when it would result in more than tripling of the population. It is noteworthy that the 2000 US Census reported a population of 290 in the Ocotillo Census Designated Place (CDP), representing a *decrease* of 9 percent from the 1990 estimate. For the purposes of the Draft EIR/EIS and this Water Supply Assessment, a future *increase* in population is conservatively assumed in order to be protective of groundwater resources.

Water Use Sectors and Water Demand

Industrial water demand for the USG facility is shown in **Table 3** from 1990 to 2025, and 2082. Pumping from the three USG wells have been monitored since 1981 and the actual water use from 1990 to 2004 is shown in the table. Future pumping is assumed to be the maximum pumping allocated to USG, 767 AFY. In addition to USG's pumping, **Table 3** shows the estimated residential water use in the groundwater basin. The residential water demand in the area is served by groundwater from unmonitored private wells and is based on projected population estimates and per capita water use estimates. The population estimates are shown in **Table 2** and the water use estimates used were 60 gallons per day (gpd) per capita for Painted Gorge and West Texas, 100 gpd/capita for Nomirage and Yuha Estates, and 250 gpd/capita for Ocotillo. **Figure 4** shows past and future water demand in the basin from 1990 through 2082.

US Gypsum has made many improvements to reduce water consumption. Most of these have focused on process water which is about 95 percent of total water use. Indoor domestic and outdoor water uses are quite limited and accordingly, typical conservation opportunities also are limited. Currently, process wastewater is collected and reused with essentially no discharge of process water from the Plant. A small amount of water is used to clean adhesives from machinery, collected and removed by a licensed hauler and handler. In the past, equipment bearings were cooled using water that was not recycled. The Plant has moved away from the use of an open water cooling system to an enclosed system with no cooling water disposal. Wash water also is treated and recycled. In addition, USG has streamlined its procedures to repair leaks along its pipeline much more quickly, so less water is lost. Most importantly, through the use of USG proprietary and patented formulation changes and raw material substitutions, USG has been able to decrease the amount of water necessary for wallboard production. USG has implemented innovative technologies to use less water in its processes and thereby use less energy and water. Other than potential future reformulation and/or process improvements, all feasible water conservation measures have already been implemented.

Water Demand in Normal and Drought Periods

The water demand in a drought is projected to remain the same as the normal year water demand. The USG facilities have already reduced water consumption through various water conservation measures. Additional short term water demand reductions are not likely to be feasible. Residential demand in the area is also projected to remain the same during drought conditions. No community wide plans are in place to mandate or encourage drought conservation at this time. In the nearby City of El Centro previous droughts have not affected water demand, as the City uses reliable Colorado River water and previous droughts did not affect the City’s water supply (El Centro, 2006). **Table 4a** presents an analysis of how water demand currently does not change in response to drought and **Table 4b** shows this steady demand will continue in the future.

WATER SUPPLY

Drinking water in the Ocotillo/Coyote Wells Groundwater Basin is currently supplied by local private groundwater production. A potential source of future water supply for the Project is imported water from the Imperial Irrigation District (IID) water system. The Draft EIR/EIS discusses two alternatives that would allow USG to obtain water from IID. These alternatives are identified in the Draft EIR/EIS as the "full use" of IID water alternative and the "partial use" of IID water alternative. As discussed in the Final EIR/EIS, the full IID alternative is considered infeasible. The partial IID alternative is being investigated actively by USG and therefore is addressed herein as a potential water supply.

Table 5 provides a summary of all existing and proposed water supply sources. The second column estimates the available supply. The next three columns on the left indicate the status of the source in terms of water rights, entitlements, and contracts. The basin has not been adjudicated, so no rights or entitlements are indicated.

Table 5 shows the available volume of groundwater as the total recharge. The “safe yield” of a basin—the volume of groundwater that may be safely withdrawn from an aquifer—is often portrayed as the total recharge into the basin. As described in the Draft EIR/EIS, recharge to the Ocotillo/Coyote Wells Groundwater Basin is from ephemeral runoff on the surrounding mountains that percolates through washes crossing the basin. The amount of recharge has been estimated in water balance studies by several investigators and through application of a numerical groundwater flow model (Bookman-Edmonston, 1996 and 2004). The current 2004 numerical model’s estimate of average annual recharge, 1,077 AFY, is lower than previous estimates. For the 2004 study, the contributing watershed for the washes in the area was estimated to be 76 square miles, within the range of previous estimates. Other previous estimates of recharge estimated a range of recharge from 1,650 AFY (Mark, 1987) to 2,600 AFY (Skrivan, 1977). These previous estimates varied depending on the size of the watershed considered.

However, local groundwater levels show long-term declines even while the amount of historical pumping is *less* than the amount of recharge. This indicates that the existing wells do not effectively capture the available recharge, a portion of which flows out of the basin as subsurface discharge, for example across the southern boundary into Mexico. As a result, the existing wells depend in part upon groundwater storage for supply.

Accordingly, the groundwater basin supply is not determined solely by recharge (safe yield) but also use of groundwater storage resulting in long-term water level declines. The sustained groundwater level declines raise the issue of groundwater overdraft. Overdraft is defined below by the California Department of Water Resources (DWR) Bulletin 118, *California’s Groundwater*:

> Groundwater overdraft is defined as the condition of a groundwater basin or subbasin in which the amount of water withdrawn by pumping exceeds the amount of water that recharges the basin over a period of years, during which the water supply conditions approximate average conditions. Overdraft can be characterized by groundwater levels that decline over a period of years and never fully recover, even in wet years.

The Draft EIR/EIS cites an overdraft of a few hundred AFY. The overdraft (as indicated by decline in storage) is gradual and small relative to the overall storage in the basin. However, it is an adverse impact, representing depletion of a shared resource that undercuts the long-term reliability of groundwater supply. This groundwater resource is used beneficially for both industrial supply (USG) and as the sole source of municipal and domestic supply.

Table 6a shows the historical and projected supply under the scenario of groundwater as the sole water supply source, while **Table 6b** shows the projected water supply under the partial IID alternative. In **Table 6a**, historical and projected groundwater supply is the same as total water demand (see **Table 3**), recognizing that historical water demand has been fulfilled by groundwater derived from a combination of recharge and storage. Future water demand also is projected to be provided by groundwater, consistent with the Draft EIR/EIS, and recognizing that a portion of the groundwater would be obtained from storage, thus continuing and increasing the overdraft condition. In **Table 6b**, IID provides 420 AFY by 2010 and groundwater pumping is correspondingly reduced. **Table 7** summarizes the projected water supply, including groundwater and the partial IID alternatives, for normal, single-dry, and multiple-dry years.

The following subsections describe the groundwater supply and Imperial Irrigation District supply, respectively, in greater detail.

Groundwater Supply

US Gypsum currently operates groundwater production wells in the groundwater basin, which is locally identified as the Ocotillo/Coyote Wells Groundwater Basin and designated by the DWR as the Coyote Wells Basin, number 7-29. As defined by DWR, Coyote Wells Basin is located in the western part of Imperial County and bounded by the Jacumba Mountains to the west, the Coyote Mountains to the northwest, and the US/Mexico border to the south. The northeastern and eastern boundaries are roughly straight lines connecting Superstition Mountain in the north to the other basin boundaries. The location of the basin boundary is provided on **Figure 1**.

USG currently pumps from three groundwater wells located near Ocotillo. These wells are shown on **Figure 1.** The long-term reliability of groundwater supply for the USG project is defined by the overall state of the groundwater basin. This is recognized by the SB610 sections of the California Water Code, which require a detailed description and analysis of the location, amount, and sufficiency of groundwater to be pumped. The following paragraphs describe the basin, its management, and existing conditions in terms of groundwater quantity and quality.

Groundwater Quantity

As described in the Final EIR/EIS, the Coyote Wells Basin is currently understood to be a two-layer aquifer system in the basin rather than the single alluvial layer used in previous interpretations. The upper layer (Layer 1) consists of the alluvial deposits and the lower layer (Layer 2) is composed of the Palm Springs and Imperial formations, which have been uplifted in the area east of Ocotillo and are relatively near the ground surface. Using the revised geologic interpretation, the water-bearing alluvial deposits (Layer 1) are primarily restricted to the center of the basin. The alluvial thickness can be 550 feet or greater in the Ocotillo area. The alluvial deposits thin toward the margins of the basin where they become unsaturated. Along the basin margins, the saturated zones occur in the Palm Springs and Imperial formations.

The USGS currently monitors 20 wells in the Ocotillo/Coyote Wells Groundwater Basin. The wells are shown on **Figure 5**. As shown on **Figures 6** and **7**, water levels in the both Layer 1 and Layer 2 generally have been declining since the 1970s. In the Draft EIR/EIS text, two general estimates of groundwater level declines are given: one foot every five years and one foot every eight years. To clarify the range of water level declines in the alluvium (Layer 1), the water level data were examined from wells currently monitored by the USGS. For these, the average rate of decline from 1975 to 2007 was calculated at 0.266 feet per year (or one foot every four years). However, the declines are not uniform. In addition, the water levels in Layer 1 are chiefly controlled by pumping. The average rate of decline ranges from 0.4 feet per year or 1 foot every 2.5 years (well 36H1) to 0.13 feet per year or 1 foot every 7.7 years (well 34B1, not shown).

While the water levels show a long term downward trend, water levels in the basin are generally characterized by little or no short term variation. Although the rainfall in the region is flashy both seasonally and annually, water levels in wells exhibit little fluctuation over time. For comparison, **Figure 2** illustrates the highly variable annual precipitation, as measured at the California Irrigation Management Information Systems (CIMIS) station in Seeley east of the study area. The lack of groundwater level response to precipitation may reflect a significant lag time between rainfall events and recharge to the water table resulting from the distance from the washes to the monitored wells and in some areas, the significant thickness of the unsaturated (vadose) zone.

Because groundwater levels in the vicinity of local communities do not respond to short-term drought events, the supply of groundwater is effectively the same through normal and drought periods. This is reflected in **Table 7**, showing the expected supply during normal and dry years. However, it should be noted that the decline in water levels will reduce the total groundwater in storage over the course of the project.

Groundwater Quality

The general quality of groundwater from the alluvium is characterized by total dissolved solids concentrations of about 400 milligrams per liter (mg/L). Water in the Palm Springs/Imperial formations is characterized by relatively poor water quality, specifically with relatively high concentrations of chloride and sodium, and total dissolved solids concentrations of about 1,000 to 4,500 mg/L. Some potential exists for future water quality deterioration in the Ocotillo area as a result of migration of groundwater from Layer 2 to Layer 1. Currently, groundwater levels in Layer 1 are higher than those in Layer 2, representing a vertical gradient that reduces upward migration of poor quality water from Layer 2 to Layer 1. However, continued groundwater level declines in Layer 1—at more rapid rates than those in Layer 2—present a potential for reversal of that vertical gradient in future decades. In that case, relatively poor groundwater from Layer 2 could migrate into Layer 1, resulting in water quality deterioration in Layer 1.

The USGS monitors five wells in the Ocotillo-Coyote Wells Groundwater Basin for water quality. Four of the five wells are located near Ocotillo and are screened in the alluvium; the other well is located near Yuha Estates. These wells are monitored on an annual basis for physical properties (pH, specific conductance, and temperature), general minerals (chloride, sodium, sulfate, etc.), iron, and manganese.

Water Resources Management

In 1998, the County adopted a comprehensive Groundwater Management Ordinance for the express purpose of preserving and managing groundwater resources within the County. The Groundwater Ordinance, codified as Chapter 1 of Title 9 of the Imperial County Code, is implemented by the Planning Commission acting upon the direction of the Board of Supervisors. The Commission is charged by the Board of Supervisors with the regulation of groundwater and can request preparation of an annual report on groundwater supplies and conditions, determine the need for and recommend groundwater management activities (see Section 92202.00), recommend groundwater extraction standards and charges, and establish standards for artificial recharge, among other things.

The Groundwater Ordinance provides the County with various regulatory tools that are designed to avoid or minimize the impact of existing and proposed groundwater extraction activities on groundwater resources and other users. For example, Section 92201.13 provides a remedy for water users who are aggrieved by well interference (defined as a substantial water level decline in a short time period in a localized area caused by extraction) or other impairment or infringement of the groundwater use caused by the extraction activities of another party. In such cases, the Commission may issue any order that it determines necessary to provide the petitioning water user with an adequate remedy.

The Groundwater Ordinance also requires that existing extraction facilities be registered with the County. On March 8, 2006, the County Planning & Development Services Director approved, with conditions, registrations for USG's three existing water wells used to extract groundwater from the Ocotillo-Coyote Wells Groundwater Basin and for the water pipeline used to transport water to the Plant. USG’s pumping is permitted at 767 acre-feet of groundwater per year (AFY).

Imperial Irrigation District – Imported Water

The Draft EIR/EIS describes a range of alternatives to the project that would avoid or substantially lessen the potential significant effects on groundwater resources. The Draft EIR/EIS discusses two alternatives that would require USG to obtain water from the Imperial Irrigation District (IID) to supply all or a portion of the water needed for Plant operations. These alternatives were identified in the Draft EIR/EIS as the "partial use" of IID water alternative and the "full use" of IID water alternative. The implementation of the full use alternative would require significant infrastructure and the fluctuating salinity of canal water over time presents technical and practical issues that cannot be overcome. Based on these environmental and technological factors, the full use alternative was determined to be infeasible. Under the partial use alternative, only a portion of the water needed for the Plant operations would be supplied by the IID. The balance (up to a maximum of approximately 347 AFY would continue to be supplied by USG's existing wells in Ocotillo. Water from IID would be blended with water from Ocotillo to achieve the level of water quality need for use in manufacturing wallboard without the need for further treatment of the process water. **Figure 8** shows the projected water supply to the area for both industrial (USG) and residential uses.

IID water supply is unlikely to be reduced during drought, as shown on **Table 7**. As stated in the Urban Water Management Plan of the nearby City of El Centro, the "Imperial Irrigation District's senior water rights are such that drought conditions have never impacted its water supply" (El Centro, 2006).

The Water Code section 10910d requires wholesale water supply information to be provided in any Water Supply Assessment. The required information is discussed below.

- **Written contracts or other proof of entitlement to an identified water supply**
  USG is currently investigating the feasibility of implementing the partial use alternative. Toward this end, representatives of USG met with IID staff to discuss a potential partnership to provide water to the Plant. In order to more fully evaluate this alternative, IID staff advised USG to file a Petition for Inclusion within the boundaries of the IID. In accordance with this advice, USG filed a Petition for Inclusion with the IID for the purpose of providing up to 1,000 AFY of IID water to be used exclusively by USG in its operations. In April 2006, the IID Board adopted a Resolution of Application requesting that the Local Agency Formation Commission of Imperial County (LAFCO) take such action as may be necessary to grant USG's application for inclusion in the IID. USG's application was subsequently accepted by LAFCO and is currently under review.
- **Copies of capital outlay program for financing the delivery of a water supply that has been adopted by the public water system**
  USG would be responsible for the capital outlay for any infrastructure required to provide IID water to the manufacturing plant.
- **Federal, State, and local permits and regulatory approvals for construction of necessary infrastructure associated with delivering the water supply and any necessary regulatory approvals that are required in order to be able to convey or deliver the water supply**
  USG would be responsible for obtaining the required regulatory approvals from Imperial County. USG or IID will also be required to follow all provisions of CEQA that apply to the development of the water supply and delivery system.

COMPARISON OF SUPPLY AND DEMAND

In accordance with the requirements of California Water Code section 10910 (Senate Bill 610), this section of the Water Supply Assessment provides a comparison of water supply and demand as the basis for an assessment of water supply sufficiency. Specifically, the Water Code requires discussion of the total projected water supplies available during normal, single dry, and multiple dry years during a 20-year projection and documentation of whether or not the supplies will meet the projected water demands associated with the proposed project in addition to existing and future uses.

As noted in the Introduction, this Water Supply Assessment makes use of suggested tables provided in the DWR *Guidebook for Implementation of Senate Bills 610 and 221.* With regard to comparison of supply and demand, the relevant tables compel the quantification and direct comparison of water supply and demand. However—when applied to the specific circumstances of Project and the Ocotillo/Coyote Wells Groundwater Basin—the tables alone do not support an informed assessment.

Table 8 compares the available supply and demand under current conditions. Groundwater supply is defined in **Table 8** as the estimated recharge (1,077 AFY, see **Table 5**). Comparison in **Table 8** of this value with the total water demand of 474 AFY indicates that supply exceeds demand. However, this simple comparison does not account for the inability of the existing network of wells to capture available recharge nor does it account for the area's sustained groundwater level declines and overdraft condition.

Similarly, **Tables 9a** and **9b** provide comparisons of water supplies and water demands in 2082 for the basin under the two supply alternatives: groundwater only and groundwater plus partial IID, respectively. **Table 9a** water supply scenario defines groundwater supply as the estimated recharge. In this future scenario, groundwater supply alone would be insufficient to meet demand in 2082, with a small estimated shortfall of 76 AFY. Note that the comparison provided here is for 2082, representing the life of the proposed project and extending far beyond the 20-year projection required in the Water Code.

As documented in the EIR/EIS, increased pumping would increase the rate of groundwater level decline and overdraft. The water supply scenario in **Table 9b** envisions 420 AFY of IID water plus 1,077 AFY of supplemental groundwater. Referring back to **Tables 6a** and **6b**, the partial IID scenario would reduce groundwater pumping and overdraft rates relative to the groundwater-only scenario in **Table 6a**, but the existing overdraft would continue.

However, an additional consideration is the availability of groundwater storage to fulfill water demands. As documented in the EIR/EIS, an ample supply of groundwater exists in the Ocotillo/Coyote Wells Groundwater Basin to serve the Project. The Project's proposed water usage of up to 767 AF/yr would represent only a small fraction of the total amount of groundwater in storage in the aquifer, which is estimated to be approximately 1.2 million AF or more. It is noteworthy that US Gypsum wells have supplied the Plant and some Quarry water needs for over 60 years. Groundwater levels and storage have declined historically and are expected to continue to decline under baseline conditions (i.e., without the project) over the next 80 years. If US Gypsum were to increase pumping as proposed, then the decline is expected to increase. Nonetheless, it should be noted that the thickness of the Basin in the Ocotillo area is approximately 460-500 feet and the expected additional drawdown is relatively minor.

Because of the overdraft condition, the sustainable groundwater supply is by definition insufficient for the proposed project. However, the water demands of the Project and other existing and future water can be supplied by available groundwater storage.

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Table 1. Climate Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
ETO (inches)	2.73	3.59	6.03	7.86	8.87	10.01	9.38	8.37	7.11	5.32	3.41	2.30	74.97
Avg precip (inches)	0.44	0.48	0.29	0.08	0.09	0.08	0.39	0.33	0.33	0.30	0.19	0.90	3.89
Avg temp (ºF)	54.33	58.41	64.35	70.19	78.00	85.26	90.33	90.22	85.04	74.09	61.14	52.61	72.00

* Source: CIMIS Station at Seeley, CA

Table 2. Population Projections

Year	1990	1995	2000	2005	2010	2015	2020	2025	2082
Painted Gorge	38	41	44	47	50	54	58	62	137
Ocotillo	319	342	367	393	421	452	484	519	1,146
Residential	10	11	11	12	13	14	15	16	36
Nomirage	83	89	95	102	110	117	126	135	298
					13	14	15	16	36
TOTAL	460	493	529	567	607	651	698	748	1,653

Source: Estimated in Model Study (BE, 2004), 1990 US Census data and a 1.4 percent annual growth rate

Table 3. Water Demand by Water Use Sectors, AFY

Customer type	1990	1995	2000	2005**	2010	2015	2020	2025	2082
Industrial	476	327	324	575	767	767	767	767	767
Residential*	103	110	118	127	136	146	156	168	357
TOTAL	579	437	442	702	903	913	923	935	1,124

*Source: Estimated in Model Study (BE, 2004)

** 2004 data used

Table 4a. Baseline Water Demand during Drought Periods, AFY

Customer type	Normal	Single dry	Multiple - 2	Multiple - 3
Industrial**	347	347	347	347
Residential*	127	127	127	127
TOTAL	474	474	474	474

* Residental demand for 2005

**Baseline USG demand 347 AFY

Table 4b. Projected 2082 Water Demand during Drought Periods, AFY

Customer type	Normal	Single dry	Multiple - 2	Multiple - 3
Industrial	767	767	767	767
Residential	386	386	386	386
TOTAL	1,153	1,153	1,153	1,153

Table 5. Water Supply Sources and Total Available Supply, AFY

Supply	AFY	Entitlement	Right	Contract	Ever used
Groundwater *	1,077				Yes
IID Water	420				No

*Groundwater supply is represented by the total annual recharge into the basin

Table 6a. Water Supply in a Normal Year, AFY, Groundwater Only

Water Supply Sources	1990	1995	2000	2005	2010	2015	2020	2025	2082
Groundwater**	579	437	442	702	903	913	923	935	1,124
TOTAL	579	437	442	702	903	913	923	935	1,124

Table 6b. Water Supply in a Normal Year, AFY, Groundwater and IID

Water Supply Sources	1990	1995	2000	2005	2010	2015	2020	2025	2082
Groundwater**	579	437	442	702	483	493	503	515	704
IID Water	0	0	0	0	420	420	420	420	420
TOTAL	579	437	442	702	903	913	923	935	1,124

** Groundwater supply is provided by recharge and storage

Table 7. Projected Water Supply in Normal and Dry Years, AFY

Source	Normal	Single Dry	Multiple - 2	Multiple - 3
Groundwater*	1,077	1,077	1,077	1,077
IID	420	420	420	420
TOTAL	1,497	1,497	1,497	1,497

*Groundwater supply is represented by the total annual recharge into the basin

Table 8. Comparison of Current Supply and Demand for Normal and Dry Years, AFY, 2005

2005 Supply and Demand	Normal	Single dry	Multiple 2	Multiple 3
Supply total*	1,077	1,077	1,077	1,077
Demand total**	474	474	474	474
Difference	603	603	603	603

Based on 2005 data

* Includes groundwater only

**Baseline USG demand 347 AFY and estimated residential use

Table 9a. Comparison of Projected Supply and Demand for Normal and Dry Years, AFY, Groundwater Only

2082 Supply & Demand	Normal	Single dry	Multiple 2	Multiple 3
Supply total*	1,077	1,077	1,077	1,077
Demand total**	1,153	1,153	1,153	1,153
Difference	-76	-76	-76	-76

* Includes groundwater only

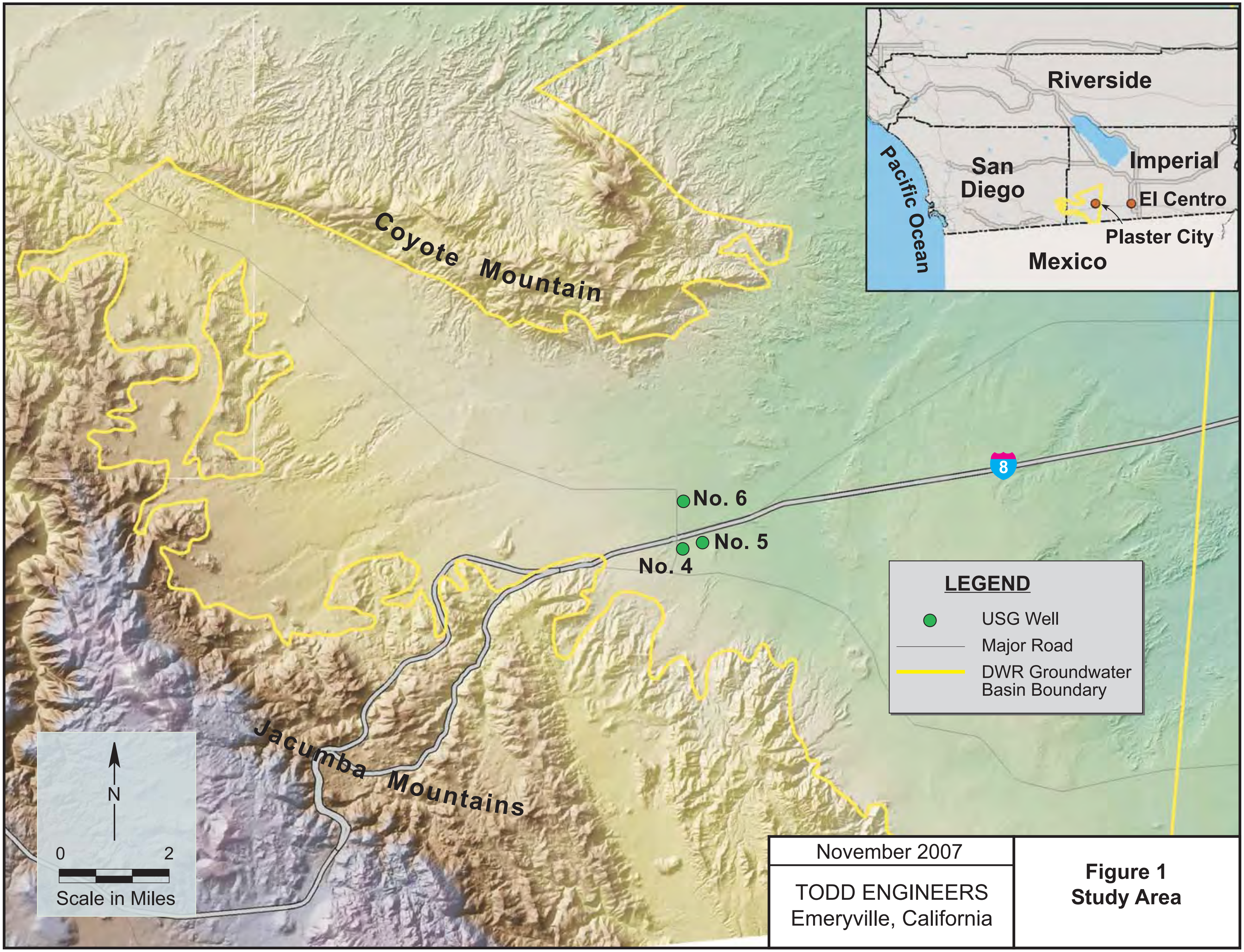
**Maximum USG demand 767 AFY and projected residential use

Table 9b. Comparison of Projected Supply and Demand for Normal and Dry Years, AFY, Groundwater and IID

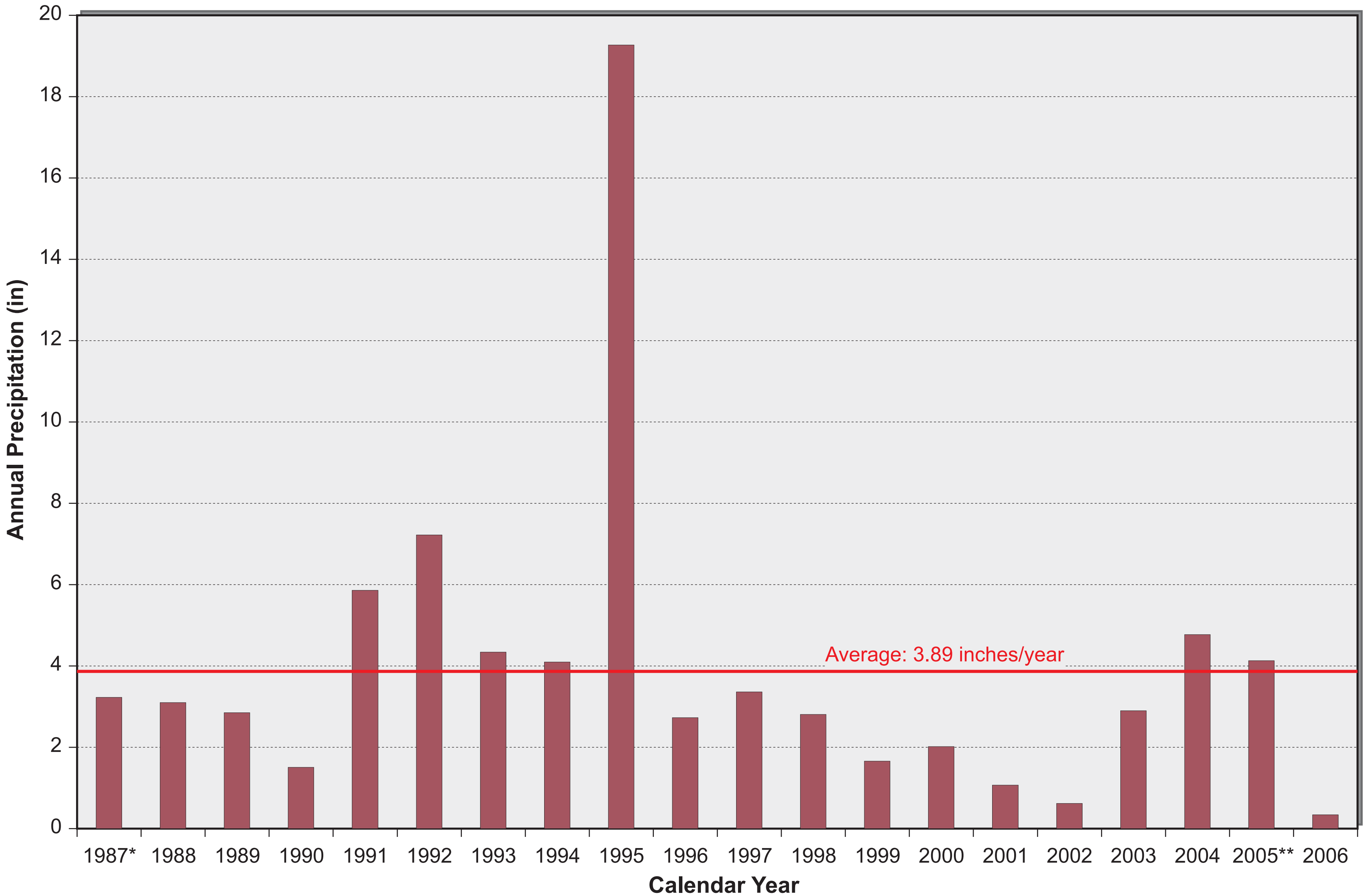
2082 Supply & Demand	Normal	Single dry	Multiple 2	Multiple 3
Supply total*	1,497	1,497	1,497	1,497
Demand total**	1,153	1,153	1,153	1,153
Difference	344	344	344	344

* Includes groundwater and IID

**Maximum USG demand 767 AFY and projected residential use



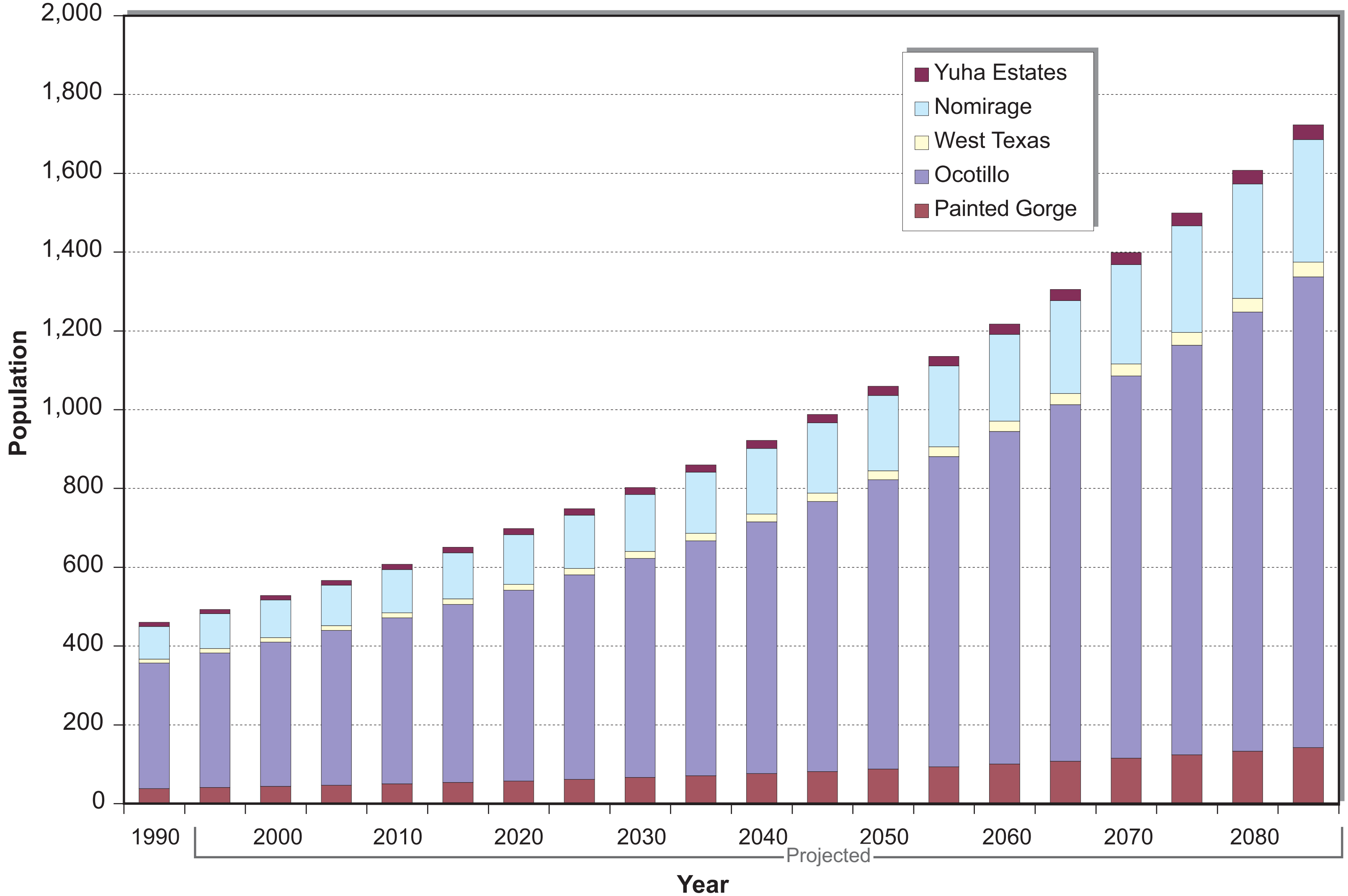
November 2007	Figure 1 Study Area
TODD ENGINEERS Emeryville, California	



Source: CIMIS, Seeley.

* Based on partial year (May - December).
** Anomalous data point removed (recorded as 113.94 on 12/31/05).

November 2007	Figure 2 Annual Precipitation at Seeley, CA
TODD ENGINEERS Emeryville, California	



November 2007

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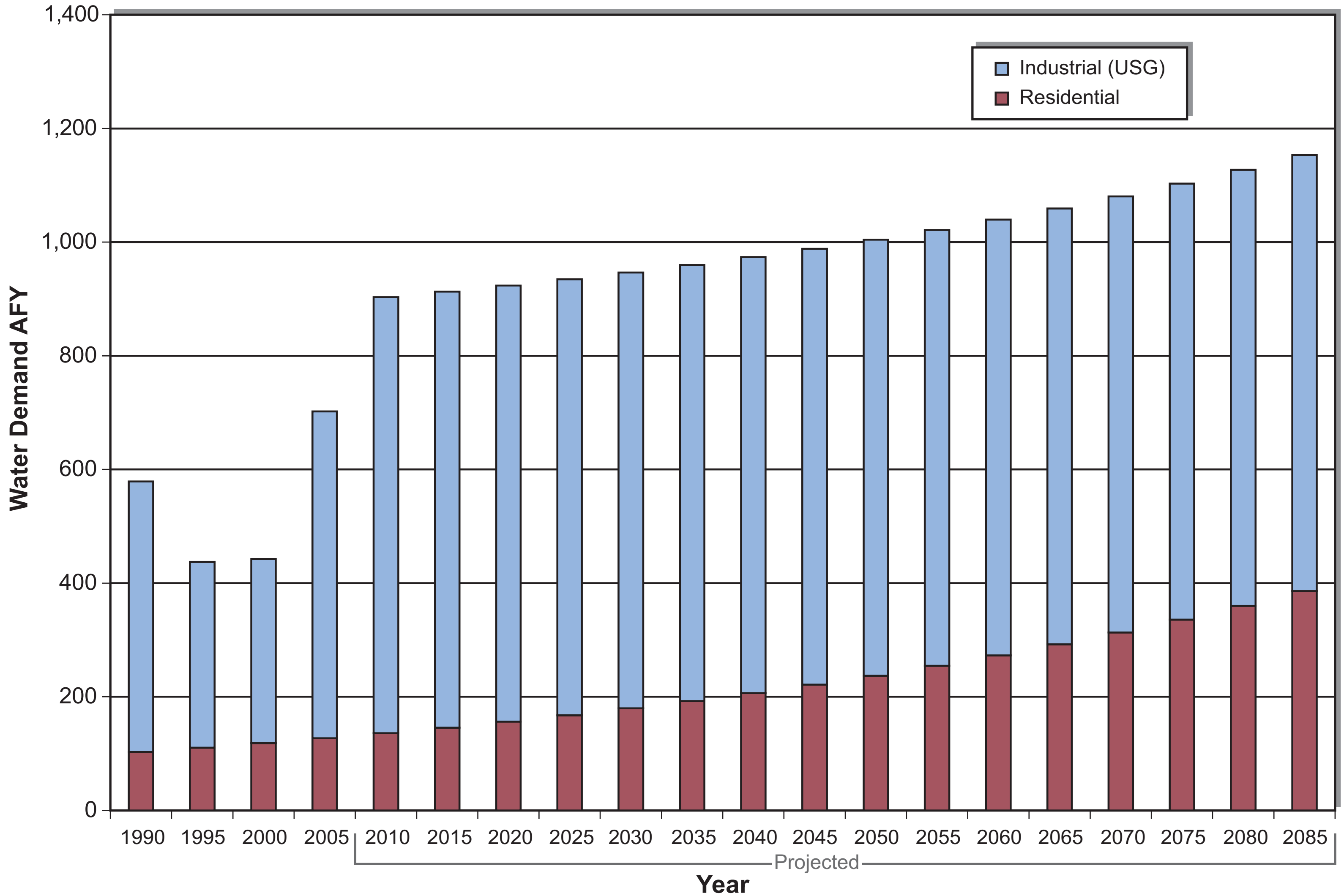
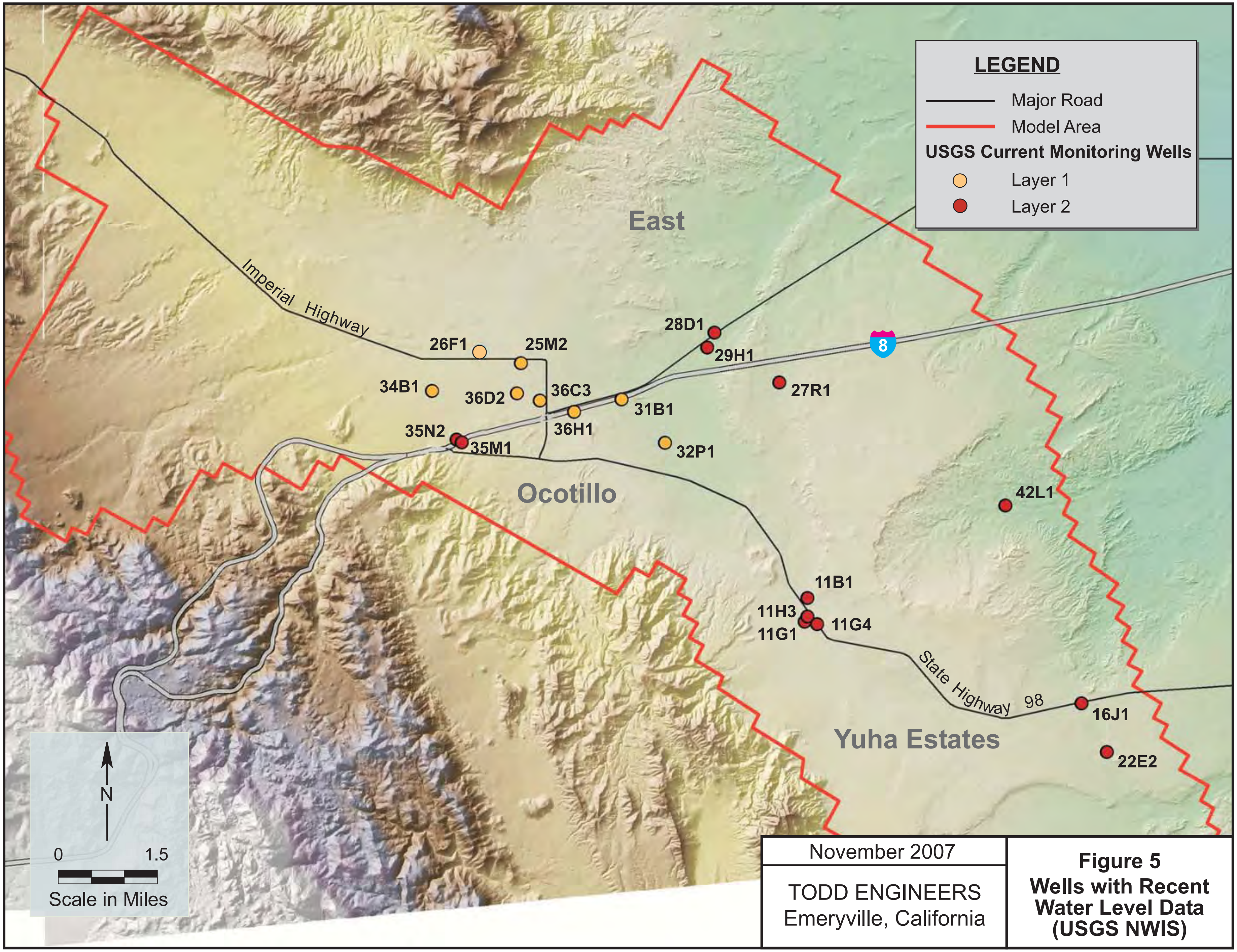
Figure 3
Population Growth by Community



November 2007	**Figure 4**
TODD ENGINEERS Emeryville, California	**Water Demand by Use**



November 2007

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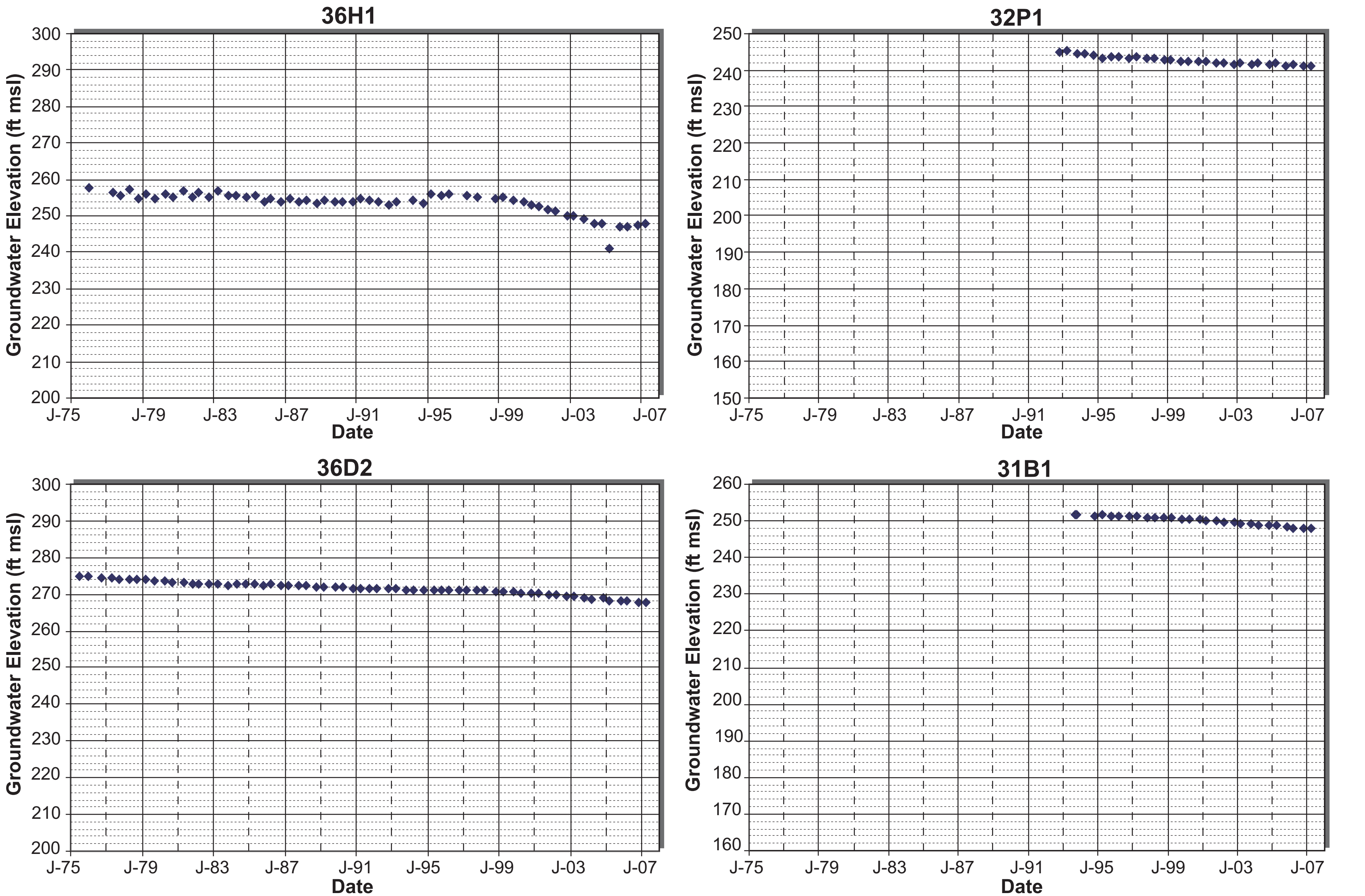
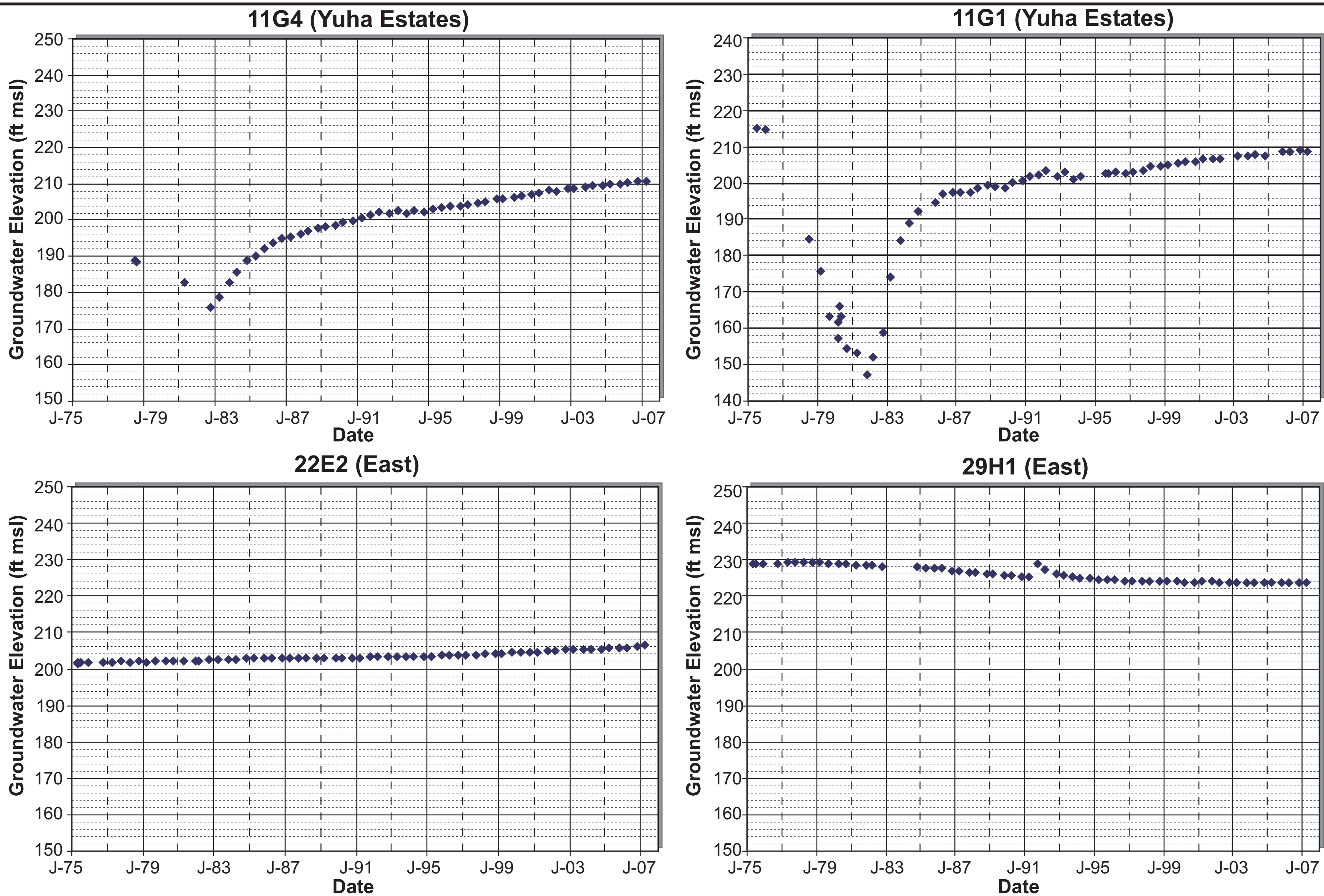
Figure 5
Wells with Recent Water Level Data (USGS NWIS)



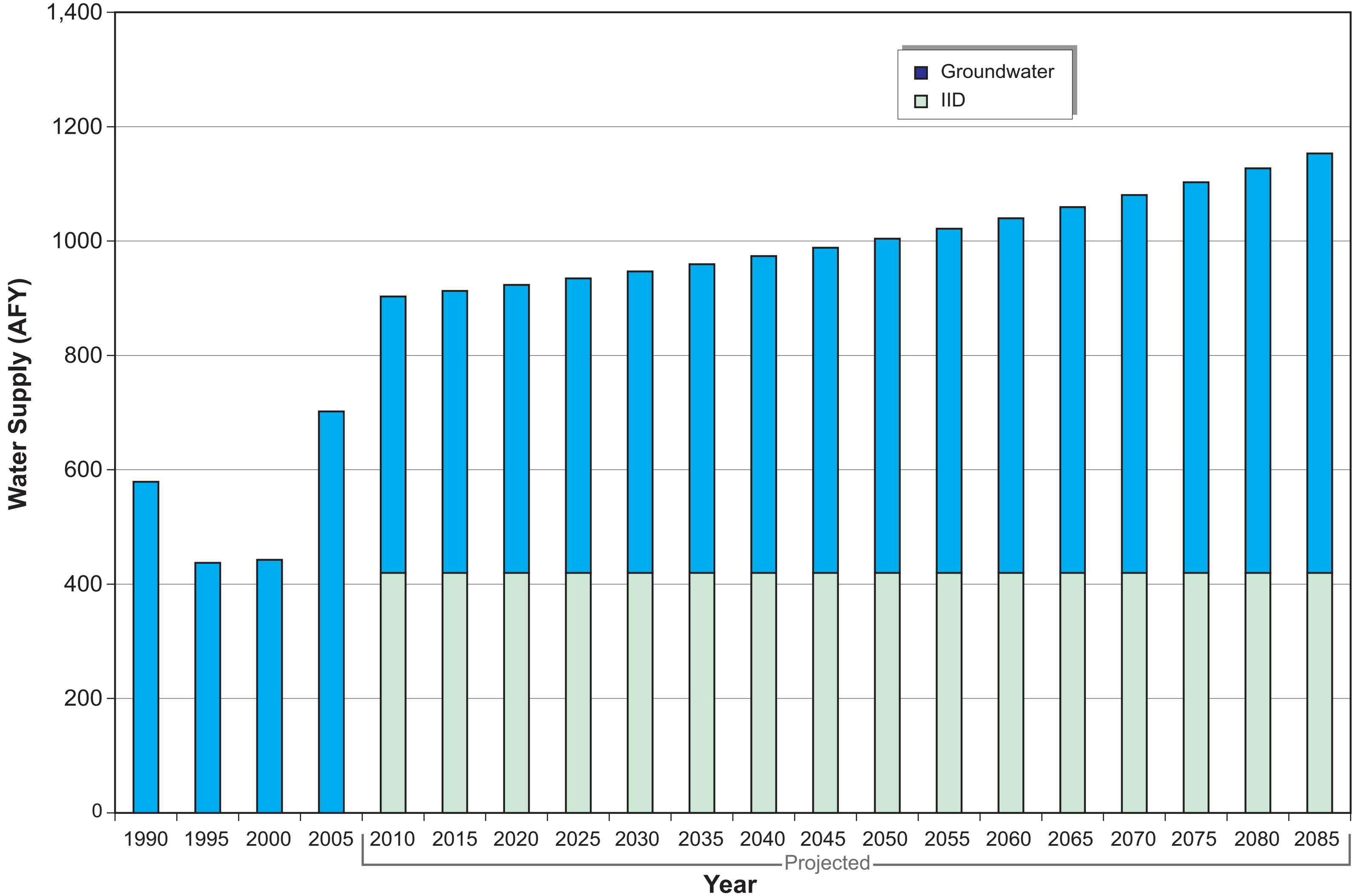
Source: USGS NWIS.

November 2007	**Figure 6**
TODD ENGINEERS Emeryville, California	**Hydrographs Layer 1 Ocotillo**



Source: USGS NWIS.

November 2007	Figure 7 Hydrographs Layer 2
TODD ENGINEERS Emeryville, California	



November 2007	Figure 8 Water Supply by Source Groundwater and IID
TODD ENGINEERS Emeryville, California	