INVESTIGATION
of
SANTA PAULA BASIN YIELD

July 2003

Prepared for
Santa Paula Basin Technical Advisory Committee

By
Santa Paula Basin Experts Group

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1. EXECUTIVE SUMMARY

The Santa Paula Basin Technical Advisory Committee established a group of experts to consider the yield of the basin and to develop a management plan for operation of the basin. This document is a summary of the group's findings and management considerations and concepts.

1.1 INTRODUCTION

By way of background and summary, the unincorporated town of Saticoy is located at the western (downstream) end of the Santa Paula basin and the City of Santa Paula is situated within the eastern (upstream) one-half of the Santa Paula basin. With the exception of these urban areas , the remainder of the basin has been essentially fully developed to irrigated agricultural uses for many years. Historically, water uses within the basin have relied on pumped groundwater, with relatively minor exceptions. Under this condition of "full" development, the basin has evidenced varying hydrologic conditions, with water levels generally falling during "dry" periods and rising during "wet" periods.

A change in this historical groundwater use was proposed by the City of Ventura when they indicated (in the early 1990s) a desire to increase their pumping of groundwater from the western portion of the Santa Paula basin. This pumping precipitated the Stipulated Judgment (entered in Ventura County Superior Court on March 7, 1996) that provides a mechanism for monitoring groundwater conditions and controlling pumping in the basin.

After consideration of various methods of determining the yield of the basin, two techniques were applied to the Santa Paula basin:

Modified Hill Method – compares annual change in groundwater levels against extractions so that an appropriate regression can be calculated. The yield is then chosen as the extraction rate that correlates with the desired water level in the basin. In the Santa Paula basin, a number of factors need to be considered.

Change in Groundwater Levels Over a Base Period – examines the change of groundwater levels over a base period that represents one or more climatic cycles. If the water levels were similar at the beginning and end of the cycle(s), then the average extraction rates would be considered to be within an appropriate yield. If groundwater levels were lower at the end of the period, then average extraction rates may have exceeded an appropriate yield.

In both techniques, other factors to consider include potential lag times between recharge and change of groundwater levels, proximity of measured wells to the river, location of measured wells in the basin, aquifer depth penetrated in measured wells, and any potential effects of changes in water level in the Santa Clara River caused by downstream mining of river gravel. In addition, both methods are based upon historic records and, therefore, do not consider potential management techniques to increase the basin yield.

The modified Hill method did not result in obvious relationships between water levels and pumpage for either of the base periods. This observation may be the result of the lack of well measurements at comparable periods from well to well (such as the spring high in groundwater levels), recharge from stream flow overriding and masking the effects of pumpage, and a variety of unconfined to confined conditions in the basin. Even when there are continuous water level data recorded in the two US Geological Survey monitoring wells, there is not a good relationship between basin pumping and water level change in single wells on a year-by-year basis.

The following sections present a summary of findings and a menu of management concepts which have resulted from this investigation by representatives of the City of San Buenaventura, the United Water Conservation District, and the Santa Paula Basin Groundwater Pumpers Association.

1.2 SUMMARY OF FINDINGS

The following is a listing of the principal findings resulting from investigation of the yield of the Santa Paula basin.

(1) The annual volume of pumped groundwater during the last 20 years (1980 through 1999) has ranged from about 16,700 acre-feet (in 1983) to 33,500 acre-feet (in 1990), and averaged about 25,900 acre-feet. Based on comparison of annual pumpage amounts for “similar” hydrologic years, there has not been any significant change in the use of groundwater (in response to hydrologic conditions) over this period.

(2) Over this period, about one-third of the pumpage in the basin has occurred in the western (or downstream) one-half, whereas about two-thirds have occurred in the eastern (or upstream) one-half.

(3) Stream flow appears to be the most significant determinant of water levels in the basin, i.e., recharge appears to largely override and mask the effects of pumpage on water levels. Groundwater levels rise during wet periods and fall during dry periods.

(4) Both precipitation and stream flow are indicators of the amount of recharge. The relatively rapid responses of water levels to recharge indicate that seepage from stream flow is the major source of recharge to groundwater in the basin. Groundwater levels generally peak in the wettest years. Conservation releases from Lake Piru and higher than average base flow following the wettest years also contribute substantially to basin recharge.

(5) Sufficient data exist to analyze changes in groundwater levels over two different base periods, 1944-1998 and 1983-1995. As used herein, “base period” refers to a period of years which reflects long-term average hydrologic conditions. Water level changes are determined in each well by comparing the highest water level in the starting year to the highest water level in the ending year. During the longer period, water level measurements for the eight wells with adequate records indicated a drop of 7 to 13 feet. During the shorter base period, water level measurements for the fourteen wells with adequate measurements indicated an average drop of 4.9 feet. The drop in water levels was most pronounced in the far west end of the basin. Excluding the far western area, the average drop in water levels was 3.0 feet.

(6) Starting in about 1950, gravel mining and possibly other factors lowered the Santa Clara River channel in the range of 10 to 20 feet. After mining ceased and the Freeman Diversion was built, the channel began refilling, particularly in the area upstream of the diversion. By 1993, the channel had already risen upstream of the Freeman Diversion to an average of less than five feet below the channel level prior to 1950. In contrast, below the Freeman Diversion, the channel in 1993 still averaged about 15 feet below that prior to 1950. The decrease in channel elevation after 1950 contributed to the water level decline that occurred during the longer base period (1944 to 1998). Another factor that contributed to this decline was a significant increase in pumping after the late 1940s. These are considered the main reasons why water levels in many wells in the basin have not recovered to the pre-1950 levels.

(7) Based on inspection of water level responses over the recent period of “average” hydrologic conditions (namely, the 1983 through 1995 period), the small amount of drop in water levels indicates that there is no apparent overdraft (i.e., long-term lowering of water levels) in the basin, with the exception of the very west end of the basin where it appears that water levels have fallen somewhat over the period which was considered.

(8) Water levels in the west end of the basin behave differently than water levels in the remainder of the basin. In particular, well interference problems and long-term water-level declines have occurred. This part of the basin could

be subject to different groundwater management considerations than the rest of the basin.

(9) The slight drop in water levels over the base period 1983-1995 may indicate that the yield of the basin is close to historical pumping amounts, which averaged about 26,000 acre-feet per year over the last 20 years. This yield is based on historical patterns and is subject to future changes if the basin is operated differently. It is possible to increase the yield of the basin through a combination of operational and physical means.

(10) With significant history of reliance on pumped groundwater and the observed response of the groundwater system over that history, pumping at historical levels should not adversely affect the basin. However, changed conditions present now or in the future could affect the basin. Potential changed conditions include demand for pumped groundwater to support growth of the City of Santa Paula (to the extent that it increases the total demand for pumped groundwater in the basin), demand for pumped groundwater to supplement other supplies available to the City of Ventura, increased reliance on pumped groundwater in areas upstream of the basin and adjacent to the Santa Clara River (River), increased/decreased discharge of treatment plant effluent to upstream reaches of the River, and water quality changes and/or changes in water quality standards. This observation emphasizes the importance of monitoring both inside and outside of the basin.

(11) Most of the water pumped from the basin has been suitable for the overlying land uses; irrigated agriculture and urban. With proper design and construction, domestic wells are capable of producing water meeting all primary drinking water quality standards; however, secondary water quality standards can only be met with the removal of iron and manganese. The blended total dissolved solids concentration in the City of Santa Paula system during 2000 was about 940 parts per million. There has not been any apparent significant degradation in groundwater quality over the period of record.

1.3 CONCLUSIONS

The 13-year period extending from 1983 through 1995 exhibits “average” hydrologic conditions and includes relatively good records of groundwater pumping. Over this period, groundwater pumping averaged approximately 26,000 acre-feet annually. With relatively stable or small declines in water levels over this same period, it is concluded that extractions of 26,000 acre-feet per year (under existing conditions of development inside and outside the basin) are sustainable. Thus, continued pumping at this annual rate should not adversely affect the basin. If pumping in the basin is increased in the future upward towards the assumed initial yield of 33,500 acre-feet, the basin should be monitored carefully to assess the resulting effect in the basin. Accordingly, it is concluded that the Technical Advisory Committee should not make any recommendation to the Court to change the basin yield at this time.

It is possible that the yield of the basin could be increased by various management actions, including (i) changing the distribution of pumping, (ii) adding pumping in certain areas, and (iii) increasing diversions from Santa Paula Creek. However, through development outside the basin (principally in upstream areas; the main source of recharge), it is possible that the yield of the basin could be decreased. The latter observation emphasizes the importance of monitoring activities both inside and outside the basin. Several water management considerations and concepts have been identified in the course of this investigation and are presented in the following sub-section. To confirm these management considerations and concepts, additional study and monitoring will be required.

1.4 MANAGEMENT CONSIDERATIONS AND CONCEPTS

There follows a listing of observations respecting management of the basin, along with specific management concepts. Included in this listing are methods of increasing the yield or utility of the basin which may be considered in response to increasing demand for pumped groundwater from the basin and/or to maintain historical levels of use in response to changed conditions outside the basin which, if left unchecked, would have an adverse effect on basin yield.

(1) Control of groundwater pumping, which is provided in the 1996 Judgment, is considered an "advantage" respecting basin management. With control of groundwater pumping, it is unlikely that long-term "damage" to the basin would result from changed operation of the basin. In other words, the Judgment provides a "safety net" in the form of monitoring and control of groundwater pumping, which should make it easier to consider implementation of alternative management concepts.

(2) The yield of the basin may change over time because of changed conditions outside of the basin that influence inflow to and/or outflow from the basin. Monitoring of water development and waste disposal activities in adjacent and upstream areas which may affect the quantity and/or quality of the flow into and/or out of the basin is included in the AB 3030 Groundwater Management Plan for the Piru/Fillmore basins and in the Memorandum of Understanding on groundwater monitoring for the upstream groundwater

basins in Los Angles County. Coordination with these management efforts is necessary.

(3) Changes in the operation of the basin could result in changes in adjacent areas. For example, if the recharge of River water within the basin is increased through implementation of a given management practice, then less River water would be available downstream of the basin. This could have an impact on the overdrafted basins of the Oxnard Plain.

(4) There is potential to enhance recharge to the basin by the following operations:

a) Intentionally lower water levels near the Santa Clara River and possibly tributaries such as Santa Paula Creek. This would provide more storage space for recharge during subsequent late periods of stream flow.

b) Intentionally lower water levels in the upper part of the basin, thereby increasing groundwater inflow from the Fillmore Basin.

c) Investigate the possibility of intentionally lowering water levels in the lower part of the basin, to decrease flow to the Santa Clara River and to decrease groundwater outflow.

Recharge could be undertaken by increasing the area of the wetted channel, and also by off-stream recharge basins.

(5) There is also the potential to increase recharge to the basin by increasing diversions from Santa Paula Creek. These diversions could be used for in-lieu delivery or as direct recharge into spreading basins.

(6) The City of Santa Paula should be encouraged to continue their investigation into providing Title 22 tertiary treatment of their wastewater, which would make it useable for landscape and agricultural irrigation in lieu of pumping groundwater or for use in a regional water conservation project.

(7) Imported State Water Project (SWP) water could be used in lieu of groundwater pumping and/or for direct recharge. Potential arrangements involving SWP water include the following:

a) Augment water level recovery during “wet” periods by delivering available SWP water down the Santa Clara River in a manner that would maximize recharge to the basin.

b) Deliver SWP water down the Santa Clara River to the Freeman Diversion for recharge in the Oxnard Forebay basin. This would allow the cities of Santa Paula and Ventura to receive groundwater from the Oxnard Forebay and decrease pumping of Santa Paula basin wells. (This would require construction of regional conveyance facilities.)

c) Wheel SWP water to the Calleguas Municipal Water District system for delivery to the Fox Canyon Groundwater Management Agency users, with a like amount pumped from the Oxnard Forebay by the cities of Santa Paula and Ventura. (This would require construction of regional conveyance facilities.)

d) Construct a regional pipeline from Lake Piru to Ventura, along with a surface water treatment plant for delivery of domestic water all along the Santa Clara River and potentially to users on the Oxnard Plain in lieu of groundwater pumping.

(8) Water levels take measurably longer to recover in some areas of the basin in comparison to other areas; accordingly, consider minimizing production from the areas with relatively longer recovery times in favor of production from areas with shorter recovery times.

(9) To the extent that it is "necessary" to increase groundwater production from the basin over historical levels, maximize groundwater production in areas that have evidenced relatively small (historical) fluctuations in groundwater levels and/or in areas that tend to recover relatively quickly, such as areas within the eastern portion of the basin. This may require water exchanges to accommodate a mismatch between the location of the end user and the location of an area targeted for increased groundwater production; such exchanges should be encouraged. The Farmers Irrigation Company has historically produced over 50 percent of their water at the east end of the basin for delivery in the west end of the basin and there is the potential to do more of the same through use of existing conveyance facilities.

(10) For reasons described in item (9) related to exchanges, and for other reasons, it may be desirable to consider construction of a physical interconnection between the distribution systems of the City of Ventura and the City of Santa Paula. Such an interconnection would allow for the movement of water in either direction.

(11) Some of the measures previously listed include changes to the historical operation of the basin. In these instances, monitoring will be critical to evaluate the effectiveness of the given measure and to safeguard against long-term "damage" to the basin. Also, while most of the concepts have been put forward in the context of the "regional" (or basin) view, "local" drawdown impacts of some of the management concepts must be considered and monitored. The anticipation or evidence of local impacts

should not, by itself, preclude implementation of, or terminate, a given management concept until the feasibility of mitigation of those impacts is adequately considered.

Respecting the above-listed management considerations and concepts as they relate to the lower or west end of the basin, it is noted that there is an "apparent" conflict between observations presented in item 4(c) and item 8. In particular, item 4(c) suggests that an increase in pumping has the potential to enhance recharge to the basin, whereas item 8 implies that a reduction in pumping in the west end of the basin may be considered inasmuch as water levels in the area appear to take relatively longer to recover than in other parts of the basin. In this regard, it is further noted that the subsurface geologic conditions in the area of the west end of the basin are complex; accordingly, the movement of groundwater and the interpretation of water levels is also complex and therefore not well understood (based on presently available data). As noted in item 4(c), the possibility of lowering water levels in the west end of the basin would need to be "investigated". It is possible that an increase in pumping in the "shallow" zone would have the effect of enhancing recharge as referenced in item 4, and that a reduction in pumping of lower zones may be consistent with the concept set forth in item 8. Accordingly, a plan of field investigation and testing would have to be developed and implemented in order to evaluate the technical feasibility of these concepts. Such a plan could include "shallow" borings, the development of "shallow" observation wells and cluster monitoring wells, the construction of a "shallow" pilot well, and aquifer testing. Also included would be the review of existing geological cross sections and the development of new cross sections.

2. BACKGROUND

In March 1996, the Superior Court of the State of California for the County of Ventura filed a stipulated Judgment for the Santa Paula basin (adjudication boundaries shown in Figure 1). The parties to the Judgment are the Santa Paula Basin Pumpers Association, the City of San Buenaventura, and United Water Conservation District. The stipulated Judgment provided for a Technical Advisory Committee (TAC), with equal representation from the three parties: the United Water Conservation District, the City of San Buenaventura, and the Santa Paula Basin Pumpers Association. The Judgment recognized that all of the parties have an interest in the Santa Paula basin, and in the proper management and protection of both the quantity and quality of this important groundwater supply. Members of the Santa Paula Basin Pumpers Association and the City of San Buenaventura exercise rights to pump water from the basin for reasonable and beneficial use. The United Water Conservation District does not produce water from the basin, but the basin is located within its boundaries and the District is authorized to engage in groundwater management and replenishment activities and to commence actions to protect the water supplies that are of common benefit to the lands within the District or its inhabitants.

The TAC is charged with establishing a program to monitor conditions in the basin, including but not necessarily limited to verification of future pumping amounts, measurements of groundwater levels, estimates of inflow to and outflow from the basin, increases and decreases in groundwater storage, and the analyses of groundwater quality.

Under the Judgment, the TAC has various responsibilities, including review of the previously assumed initial yield (33,500 acre-feet) and seeking Court approval for any changes that may be necessary. Accordingly, the TAC initiated this yield study in 1999 to develop consensus on any potential changes that may be necessary respecting basin yield. To carry out this study, the committee established a group of professionals in groundwater management to investigate the basin yield and determine how the basin should be operated to protect the groundwater supplies for all users. Each participant in the group was selected by one of the parties to the Judgment, as shown below:

City of San Buenaventura
Tom Stetson, PE

Santa Paula Basin Pumpers Association
Ken Schmidt, PhD, RG, CHG
Ron Eid, PE

United Water Conservation District
Steven Bachman, PhD, RG
Ken Turner, RG, CHG

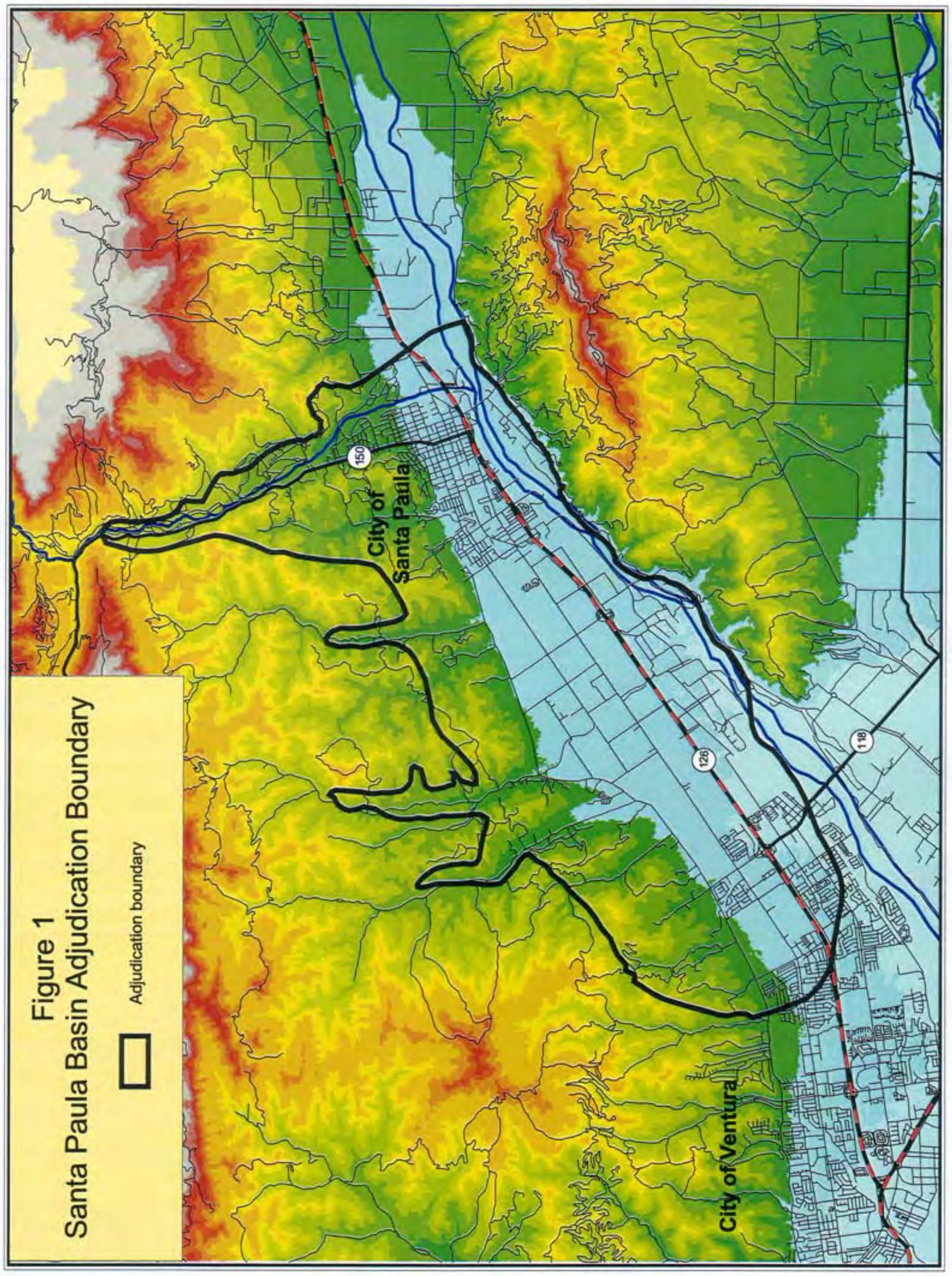


Figure 1
Santa Paula Basin Adjudication Boundary

In addition, Pete Dal Pozzo (P.HG.) of the Groundwater Department of United Water Conservation District provided significant analysis, data acquisition, and support for this investigation.

These technical representatives of the parties formulated databases of hydrologic information and collectively evaluated and applied techniques for estimating the yield of the basin. The findings and conclusions of this investigation are presented in Section 1.2. Subsequent sections of this report document the investigation. .

3. TECHNIQUES FOR EVALUATING BASIN YIELD

As used in this report, *yield* refers to "an" (not necessarily "the") amount of groundwater that can be pumped, on average over the long term, without long-term water level declines. This report evaluates whether historical pumping is within this definition of *yield* for the hydrologic conditions and basin operations that existed during the study period. Six different potential techniques were identified for evaluating the yield of the Santa Paula basin. These included:

<u>Hydrologic balance</u> – A good technique if the various inputs and outputs to the balance can be determined with some accuracy. Potential problems for the Santa Paula basin include uncertainty in groundwater inflow/outflow and the amount of river infiltration. The uncertainties in these factors (especially the volume of river infiltration) make this technique problematic for the basin, and the technique was not used to develop yield.

<u>Correlation of groundwater levels and extractions</u> – Although this technique has been unsuccessfully attempted for the basin in a simple correlation, it was agreed among the experts that this technique should be tried again, addressing potential time lags.

<u>Change in groundwater levels over an average hydrologic base period</u> – This technique was also favored by the experts. Choice of which wells to include and the appropriate base period are important factors.

<u>Calculation of groundwater flow into and out of the basin</u> – It was agreed that there are inadequate data to use this technique.

<u>Change of storage vs. extractions</u> – There was agreement that there are inadequate constraints on storage coefficients and aquifer geometry to use this technique.

<u>Groundwater modeling</u> – There was agreement that the US Geological Survey model (or any other model) cannot adequately resolve difficult

questions of underflow, recharge, conductivity, and storage changes to constrain the basin yield to the degree necessary for the Settlement.

Two of the techniques were chosen to evaluate the yield of the basin. Results from the two techniques were compared in determining the yield of the basin.

Technique #1 – Correlation of groundwater levels, extractions, and recharge: This technique compares annual changes in groundwater levels against extractions so that an appropriate regression can be calculated. The yield is then chosen as the extraction rate that correlates with the desired water level in the basin. For the Santa Paula basin, this comparison of water levels against extractions cannot be done simply as a comparison of the same-year extractions and water levels; a number of factors need to be considered (discussed below).

Technique #2 – Change in groundwater levels over a base period: This technique examines the change of groundwater levels over a base period that represents one or more climatic cycles. If the water levels were similar at the beginning and end of the cycle(s), then the average extraction rates would be considered to be within an appropriate yield. If groundwater levels were lower at the end of the period, then average extraction rates may have exceeded an appropriate yield.

An alternative to Technique #2 identifies two different times when water in the basin were at their shallowest levels (e.g., 1998 and 1978), then compares the amount of stream flow and precipitation against pumping during that time period. Stream flow and precipitation departures would be compared during the extent of the period. If departures were much higher at the end of the period than at the beginning of the period, this might indicate above-normal recharge was required to return the basin to previous groundwater levels. If departures were similar at the end of the period, this might indicate that recharge and pumping are balanced in the basin.

Factors to consider in all techniques: These factors include potential lag times between recharge and change of groundwater levels, proximity of measured wells to the river, location of measured wells in the basin, aquifer depth penetrated in measured wells, and any potential effects of changes in water level in the Santa Clara River caused by downstream mining of river gravel.

4. DATA USED

A range of data is needed to apply the techniques for determining the yield of the Santa Paula basin. These data include historical rainfall and stream flow records, information from wells in the basin such as construction details, historical groundwater levels, and historical water quality measurements, historical groundwater extractions from wells, the presence of phreatophytes as water users, and changes in the depth of the Santa Clara River channel that might affect groundwater discharge into or from the basin.

4.1 RAINFALL

Monthly rainfall data from the Santa Paula rainfall station (presently located on the roof of United Water Conservation District headquarters) were used in the study. The data exist from 1890 to present (Figure 2).

Rainfall Stations	Period of Record	Average Annual Rainfall
Santa Paula	1890 through 1999	17.45 Inches
Upper Ojai	1925 through 1999	23.73 Inches
Government Center	1926 through 1999	15.93 Inches
Oxnard Water Department	1903 through 1999	16.29 Inches
Piedra Blanco	1950 through 1999	24.53 Inches

4.2 STREAM FLOW

Monthly stream flow data were acquired for Santa Paula Creek and Sespe Creek for the years 1900 to 1999. Ventura County Flood Control operates Santa Paula Creek and Sespe Creek gauging stations. The years of record for each stream system are shown in Figure 3.

In addition, daily effluent flow data from 1988 to 1998 were acquired for the Santa Paula Water Reclamation Plant.

Stream Flow Stations	Period of Record	Average Annual Discharges (Acre-feet)
Santa Clara River at County Line	1953 to 1997 *	39,000
Sespe Creek near Fillmore	1928 to 1999 *	90,000
Santa Paula Creek	1928 to 1998	18,000
Santa Clara River at Montalvo	1928 to 1999	128,000

*With some interruptions.

Figure 2. Annual rainfall in Santa Paula

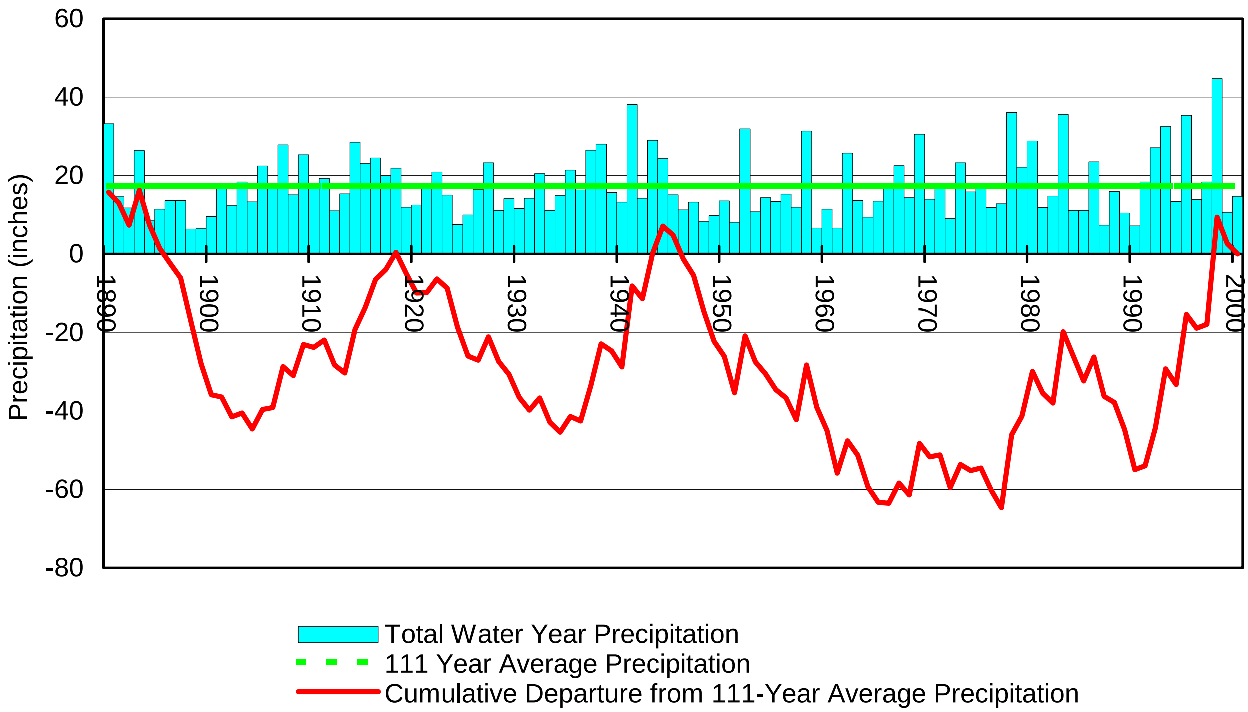
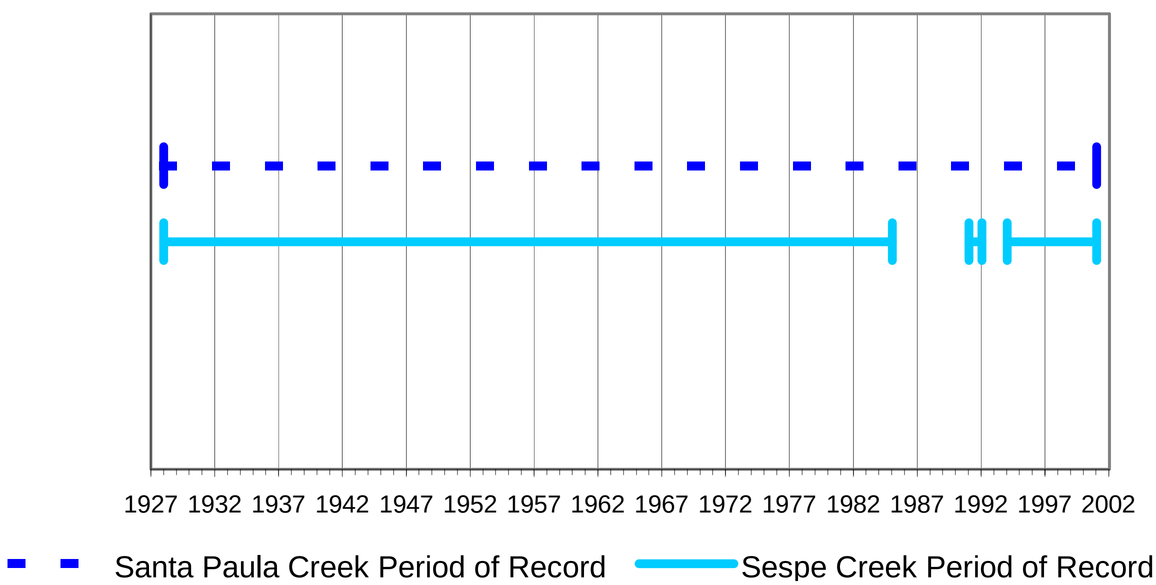


Figure 3. Period of record for stream flow in Santa Paula and Sespe Creeks



4.3 SELECTED WELL DATA

Not all the wells in the Santa Paula basin have adequate sampling of water levels and/or water quality to be useful in determining the yield of the basin. Therefore, a subset of wells was selected to use in this study. The selection criteria included length and quantity of sampling, representative range of depth of perforations, and areal distribution in the basin.

After determining the period of record of historical sampling, wells were identified that had adequate water level data for a long-term hydrologically average period (1944 to 1998) and for a short-term hydrologically average period (1983 to 1995). The determination of these periods was based on zero cumulative departure for precipitation and stream flow, and is discussed in the *Data Analysis* section.

The wells with an appropriate period of record were then classified as to depth of production. Using the depth of the top perforation and the middle of the perforation interval, the following classifications were made:

Shallow Well	
Top Perforation	0 feet to 120 feet
Middle of Perforated Interval	Less than 200 feet
Intermediate Well	
Top Perforation	121 feet to 300 feet
Middle of Perforated Interval	200 feet to 400 feet
Deep Well	
Top Perforation	Greater than 400 feet
Composite Well	
Large perforated interval precludes depth classification.	

An effort was made to factor in known stratigraphic trends. In the vicinity of the river, younger alluvial sediments rest upon older alluvium. A few wells perforated at relatively shallow depths within the extent of the younger alluvium were included in the study.

An effort was also made to distribute wells evenly across the basin. Wells were selected that represented a geographic distribution in an east to west axial direction within the basin (Figures 4 and 5). Selection of wells at various distances away from the river was also a consideration.

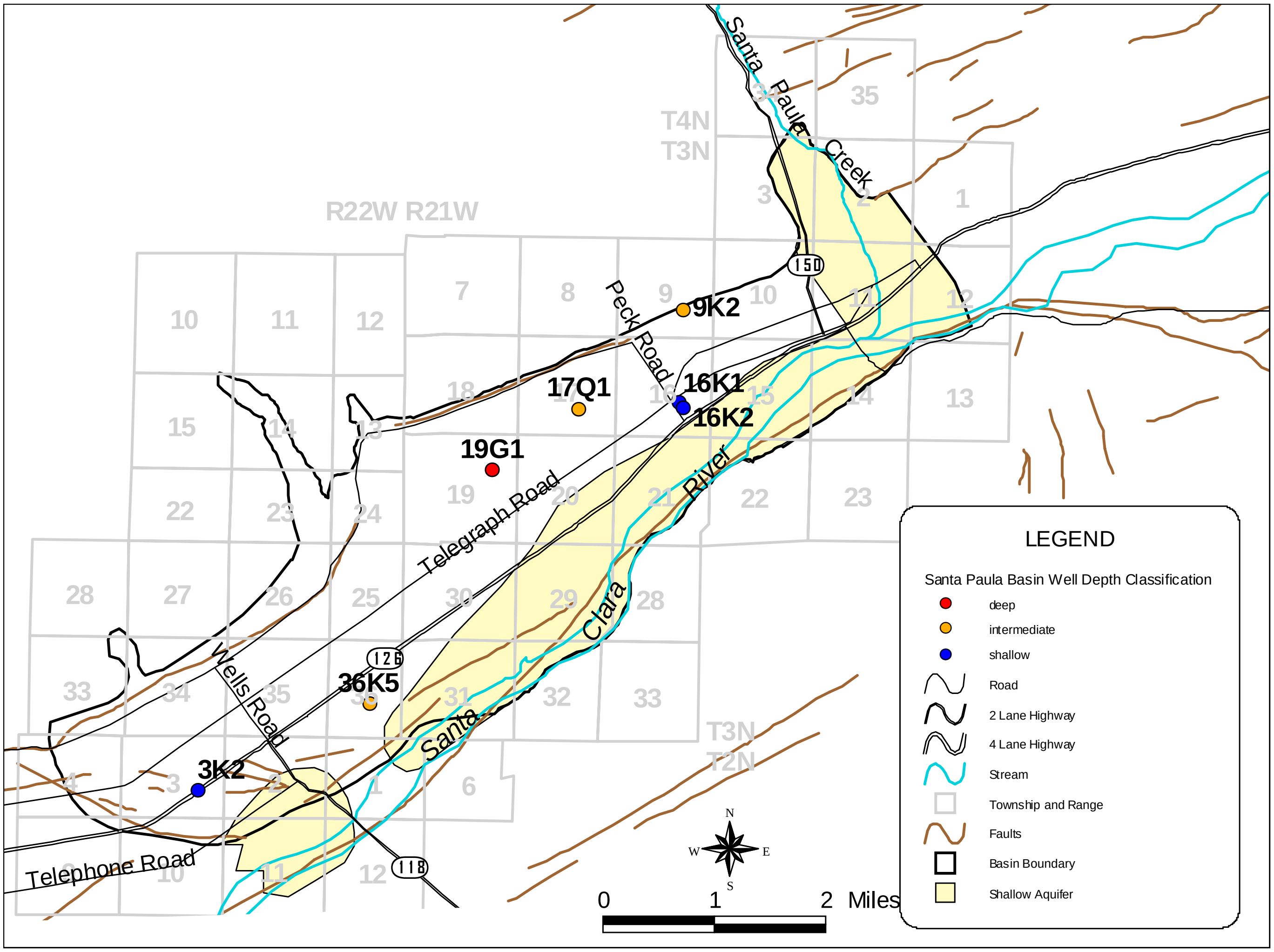


Figure 4. Location of selected wells with water level data from 1944-1998

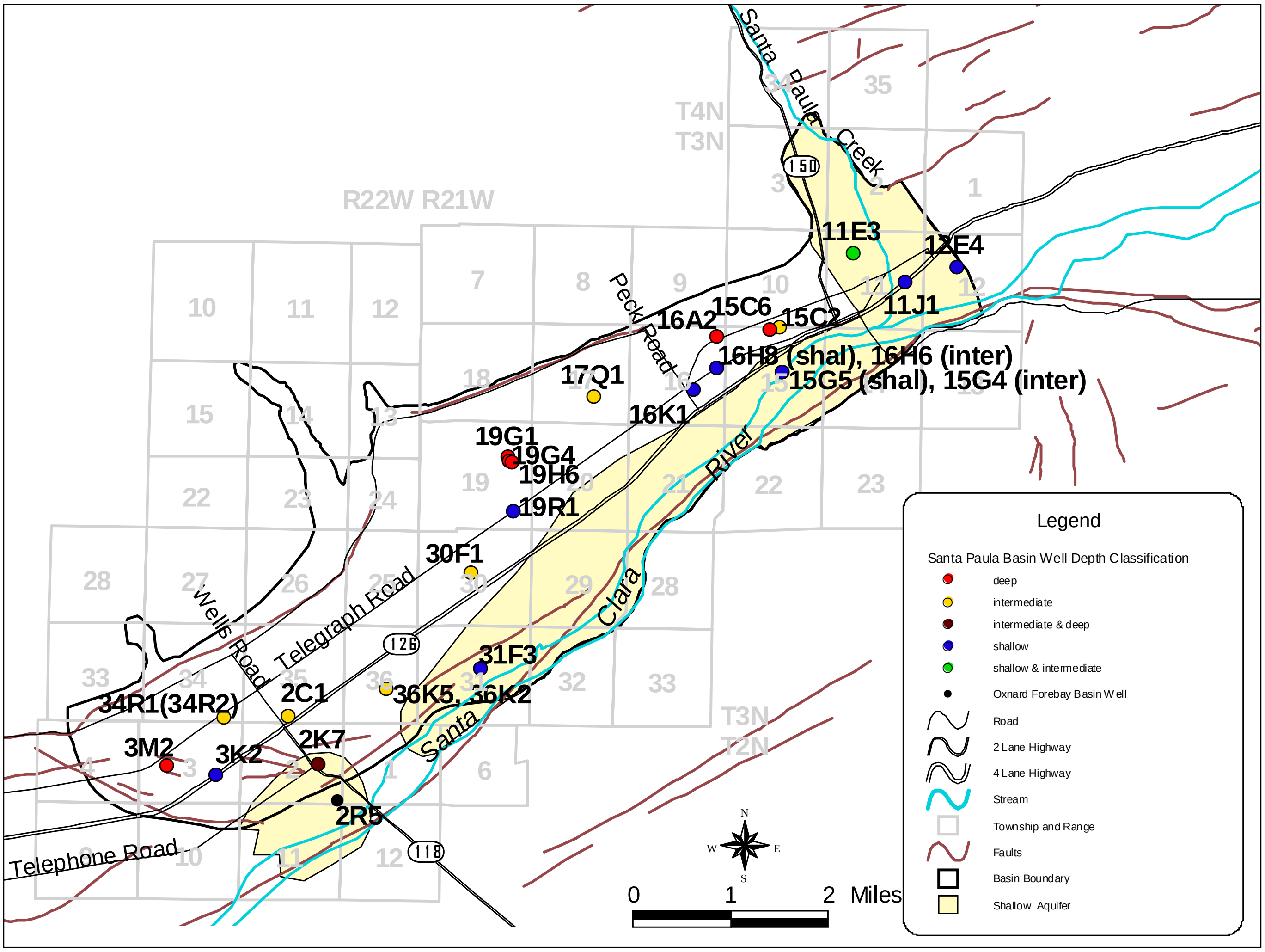


Figure 5. Locations of selected wells with water level data from 1983-1995

4.4 GROUNDWATER LEVELS

Groundwater levels are monitored primarily by United Water, Ventura County Water Resources, Farmers Irrigation Company and the City of Santa Paula. Groundwater level data from the various agencies are entered into a United Water's Microsoft Access database.

A database query for the Santa Paula basin to see which wells had historical groundwater level data available was conducted. A Microsoft Excel spreadsheet was formulated that contained perforation, depth, and frequency of monitoring information for each well that had historical groundwater level data (Appendix A). The groundwater elevation data for each well were entered into a Microsoft Excel spreadsheet for hydrograph evaluation.

ArcView GIS was used to create location maps that showed state well numbers and perforations for all wells for which groundwater elevation data were available.

Technique 1, in which change in annual groundwater level highs were correlated with pumpage, it was necessary for the well to have spring groundwater levels for the base period from 1983 to 1995. Technique 1 was not applied to the base period from 1944 to 1998 because of the absence of extraction data from 1944 to 1979.

4.5 GROUNDWATER QUALITY

A database query was conducted from United Water's Microsoft Access water quality database on historical groundwater quality within the Santa Paula Basin. The queried water quality data were entered into a Microsoft Excel spreadsheet. The spreadsheet contains information on well construction, frequency of monitoring and groundwater quality constituent concentrations. The groundwater quality data were grouped in three categories: 1) wells with the last groundwater quality data in the pre-1980s; 2) wells with the last groundwater quality data in the 1980s; and 3) wells with last groundwater quality data in the 1990s.

4.6 EXTRACTIONS

Extraction data were acquired from United Water's finance department. The extraction data are what individual well owners within United Water and the Santa Paula Basin report on a six-month, calendar-year basis for purposes of paying pump charges to United Water. The extraction data can be reported from: 1) water meter, 2) crop factor, or 3) electric meter. The extraction data exist from 1980 to 2001. The extraction data are stored in a Microsoft Access database and imported into Microsoft Excel spreadsheets for graphing (Figure 6) and ArcView GIS for mapping.

For technique 1, extractions were correlated with change in groundwater levels for the period 1980-1999. The analysis of this correlation is discussed in the data analysis chapter. For technique 2**,** average extractions over the base period of 1983 to 1995 were used.

4.7 PHREATOPHYTE OCCURRENCE

Phreatophytes growing along river channels can potentially use significant amounts of water. Changing patterns of phreatophyte growth, therefore, could change water use in the basin and affect groundwater levels in the basin. Phreatophyte patterns were studied to determine if they are extensive enough to affect the water balance in the basin.

The areal extent of phreatophytes has likely changed over time; however, it was agreed (among the consultants) to initially rely on the vegetation mapping which was conducted as part of the *Santa Clara River Enhancement and Management Plan Study*. Volume I of the Biological Resources report describes the mapping effort and the vegetation categories/types and Volume III includes a series of figures which present the maps of "existing" vegetation at a scale of one inch equals 800 feet. Whereas these volumes were published in March of 1996, the vegetation mapping is understood to have relied on 1993 aerial photographs, supplemented by field surveys conducted in 1995. Accordingly, "existing" refers to the vegetation as it existed for a hybrid of the years 1993 and 1995.

Efforts were made to obtain the electronic version of the mapping from the County of Ventura; however, it was determined that it could not be released until the overall study effort is complete[1]. Therefore, the areas were "strong armed" from the applicable figures. In particular, the boundary of the Santa Paula Basin (from maps supplied by UWCD) was superimposed on the boundaries of the different vegetation categories. Faulting was not considered in overlaying these boundaries.

[1] Personal communication, Jayme Laber, March 16, 2000

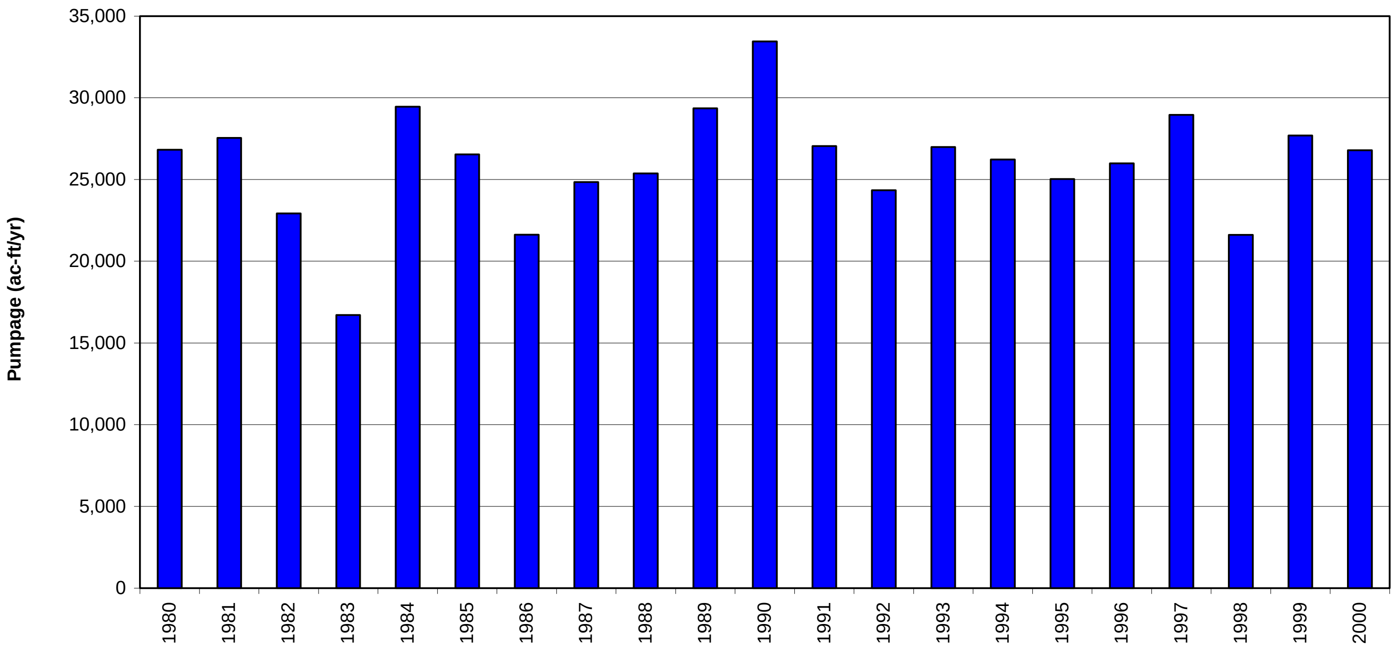


Figure 6. Santa Paula basin pumpage.

4.8 CHANGES IN SANTA CLARA RIVER CHANNEL DEPTH

Changes in the channel depth of the Santa Clara River over time could alter the elevation at which groundwater would spill back into the river channel. As a result, long-term water levels in the Santa Paula basin could also be altered. The primary cause of changing channel depths is historical gravel mining in the river channel. The gravel mining lowers the depth of the channel, not only at the point of mining, but also upstream as the base level of the river drops and upstream channel deposits are eroded. Depending upon the river system, it may take decades of winter floods to restore the mined channel deposits and re-equilibrate the depth of the channel.

RIVER CHANNEL – HISTORICAL GRAVEL MINING

Simons, Li & Associates (1983) prepared a report on changes in elevation of the Santa Clara River channel in Ventura County. This report attributed most of the channel changes between 1950 and 1980 to sand and gravel mining activities in the area. The Envicom Corporation evaluated channel elevation changes between 1957-79, based on topographic maps. There had been a channel lowering of about 20 feet as of 1979. Since 1979, the channel degradation caused by gravel mining activities has decreased, because of controls imposed by the County of Ventura. Also, the Freeman Diversion Structure was built by United Water in 1991, which has stabilized the base level of the river and resulted in a rise in channel elevation upstream.

RIVER CHANNEL – CHANNEL DEPTH

Channel profiles were prepared for the Santa Clara River Enhancement Management Plan. These profiles were obtained electronically, converted to ArcView coverages, and color-coded for ease of use (Appendix C). These profiles allowed determination of historical changes in channel elevations adjacent to wells with long-term water-level hydrographs.

Stream channel elevations are available for 1949 to 1993, and these thus approximate those during the long-term base period. Above the Freeman Diversion, the stream channel was from 2 to 8 feet lower, and an average of about 4 feet lower in 1993 than in 1949. Below the Freeman Diversion, much greater channel declines occurred between 1949 and 1993. These ranged from 10 to 20 feet and averaged about 15 feet.

5. DATA ANALYSIS

In this section, the data discussed in the previous section are analyzed to determine: 1) appropriate base periods for groundwater level trend analysis; 2) how groundwater levels changed in the basin with time, depth of wells, and location in the basin; 3) the effects on groundwater levels from changing channel depths in the Santa Clara River; 4) historical pumping trends; and 5) how phreatophyte water uptake, crop water use, agricultural return flows, and effluent discharges affect the basin water balance.

5.1 ANALYSIS –BASE PERIODS FROM RAINFALL AND STREAM FLOW

In order to attempt to establish an acceptable base period for determining the yield of the basin, analyses were made of the several rainfall stations and several stream flow stations in Ventura County indicated in the *Data Used* section. The cumulative departures for rainfall and stream flow were plotted for the various stations. An appropriate base period is one in which the cumulative departure is similar at the beginning and end of the period. Although the beginning of the period can theoretically be any place along the cumulative departure curve, we used the peak of a wet cycle as the beginning of the period, and examined the curves to determine the appropriate year for the end of the period. Two base periods were chosen (Figure 7), a shorten one (1983-1995) and a longer one (1944-1998).

5.2 ANALYSIS – WATER LEVEL HYDROGRAPHS

A series of well hydrographs was constructed from the wells selected for analysis. These wells were initially grouped into one of the two base periods, 1944-1998 or 1983-1995, for which there were water level measurements available. Eight wells had measurements that extend back to at least 1944. Seventeen wells had measurements that extend back to at least 1983. These two groupings of well hydrographs were then further subdivided by whether the well was perforated in shallow, intermediate, or deep aquifer depths.

Each of the selected hydrographs was examined to determine whether water levels in the wells returned to original levels as climatic conditions varied from wet to dry and back to wet during the two base periods 1944-1998 and 1983-1995. Figure 8 illustrates the technique used in calculating change in water levels over a base period. The highest water level elevation is used at the beginning and end of each base period to compare like periods during which pumping is minimized and water level recovery from recharge is maximized. The change in water level over

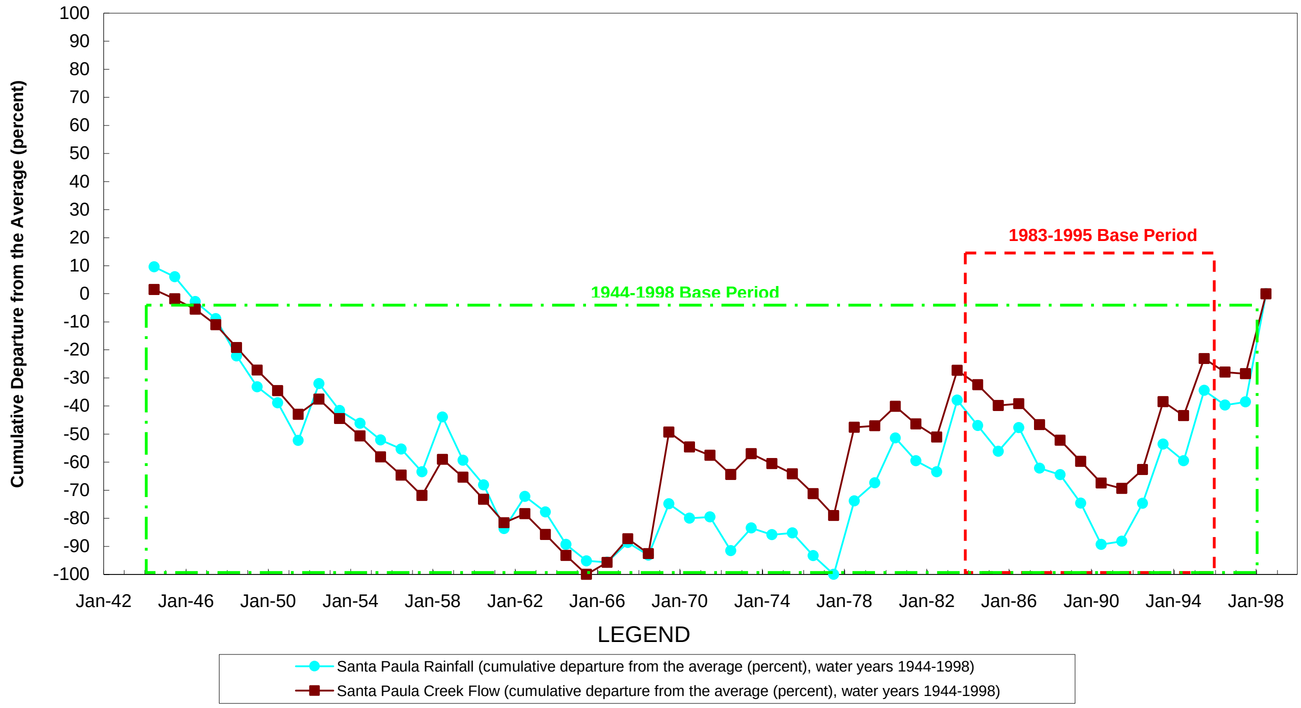


Figure 7. Base periods indicated on cumulative departure plots for rainfall and stream flow

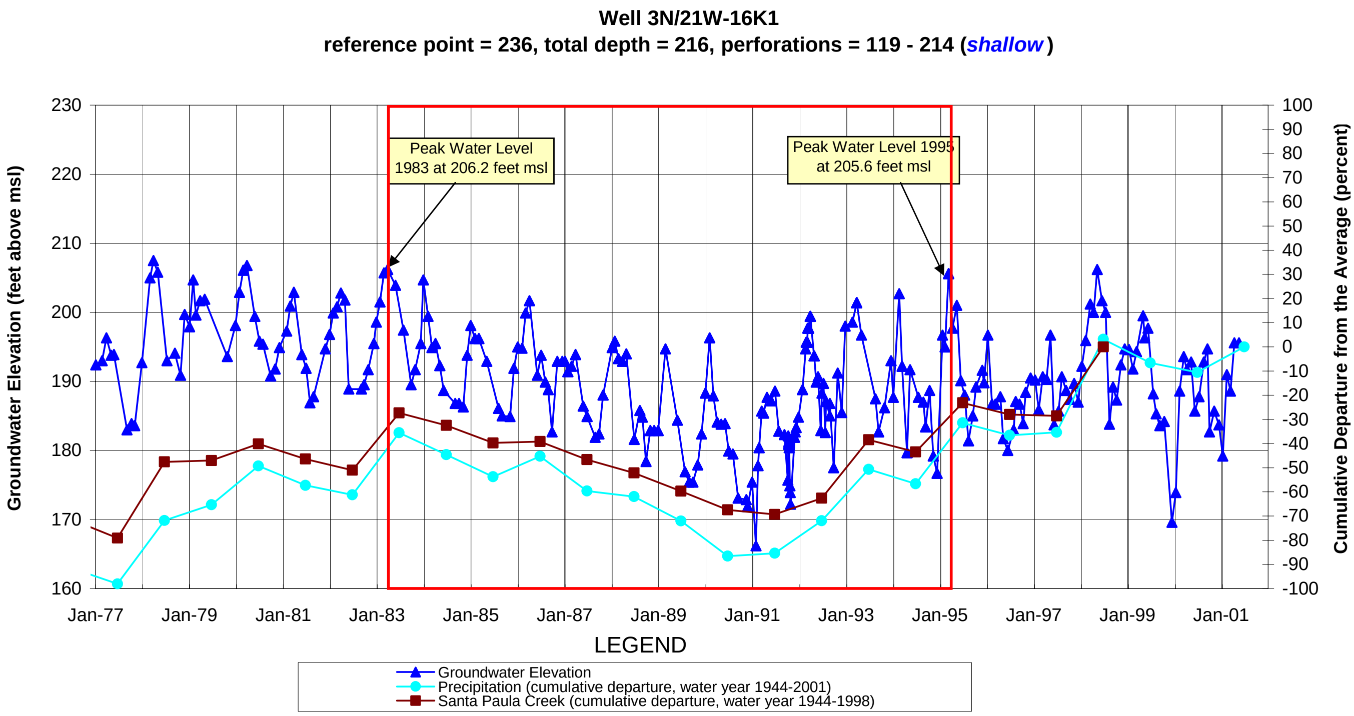


Figure 8. Hydrograph demonstrating technique of measuring water level change over the 1983-1995 base period (in red box)

the base periods for all wells with appropriate length of record was then plotted on two maps, one for each base period (Figures 9 and 10).

There was a relatively uniform drop in water levels at all well depths across the base period 1944-1998 (Figure 9). This water level drop varied from 7 to 13 feet across the basin. There was more variation in water level change during the 1983-1995 base period as more water level data became available for that period (Figure 10). Water levels generally dropped in the basin from less than a foot to as much as 22 feet during the 1983-1995 base period, although water levels rose in one well.

HYDROGRAPHS – ANALYSIS BY DEPTH OF WELL PERFORATIONS

There is no obvious pattern of differing water level changes with depth of well perforations. Wells perforated in the same depth range vary among themselves as much as between wells with differing perforations (i.e., wells in section 19, T3N R21W, Figure 10).

HYDROGRAPHS – ANALYSIS BY LOCATION IN BASIN

During base period 1944-1998, water levels in wells varied with no regard to the location of the wells within the basin (Figure 9). However, during the base period 1983-1995 when more data were available, water levels dropped significantly more in the western portion of the basin than in the mid and eastern portions of the basin (Figure 10). East of section 20, T3N R21W, water level changes were small during the period (3-foot drop to 3-foot rise). In the far western portion of the basin, water levels dropped by 7 to 22 feet over the base period 1983-1995.

COMPARISON OF HYDROGRAPHS AND CHANNEL DEPTHS

There have been significant changes in elevation of the Santa Clara River channel during the past several decades. In areas where groundwater levels are shallow and near the channel level, changes in channel elevation can influence depth to water in nearby wells. Of particular interest are the shallowest water levels, because these are commonly used to evaluate groundwater overdraft. In this evaluation, water-level hydrographs are carefully examined, and shallow water level elevations are compared to adjacent channel elevations. Changes in shallow water levels are then compared to changes in channel elevations.

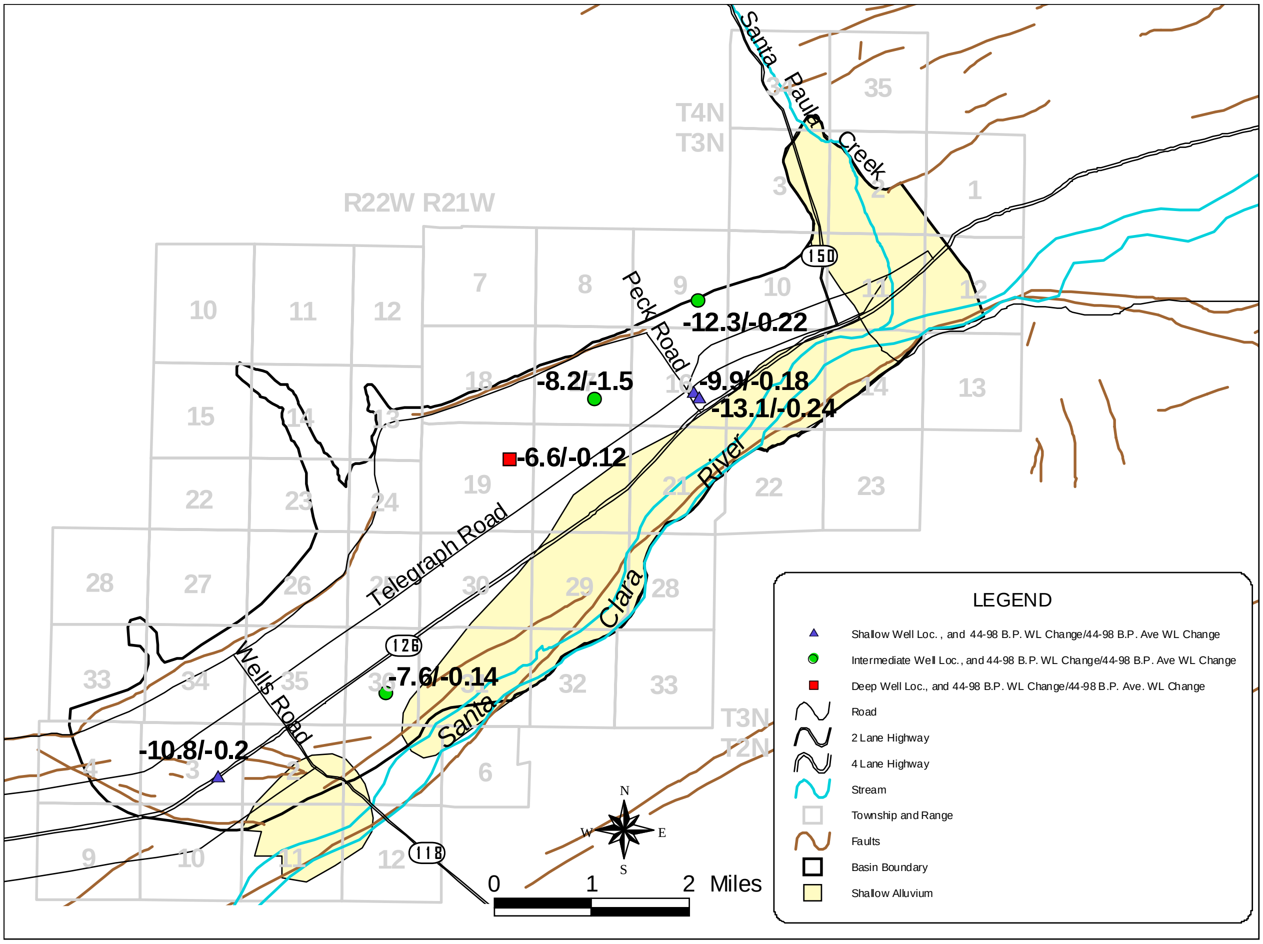


Figure 9. Water level changes over 1944-1998 base period

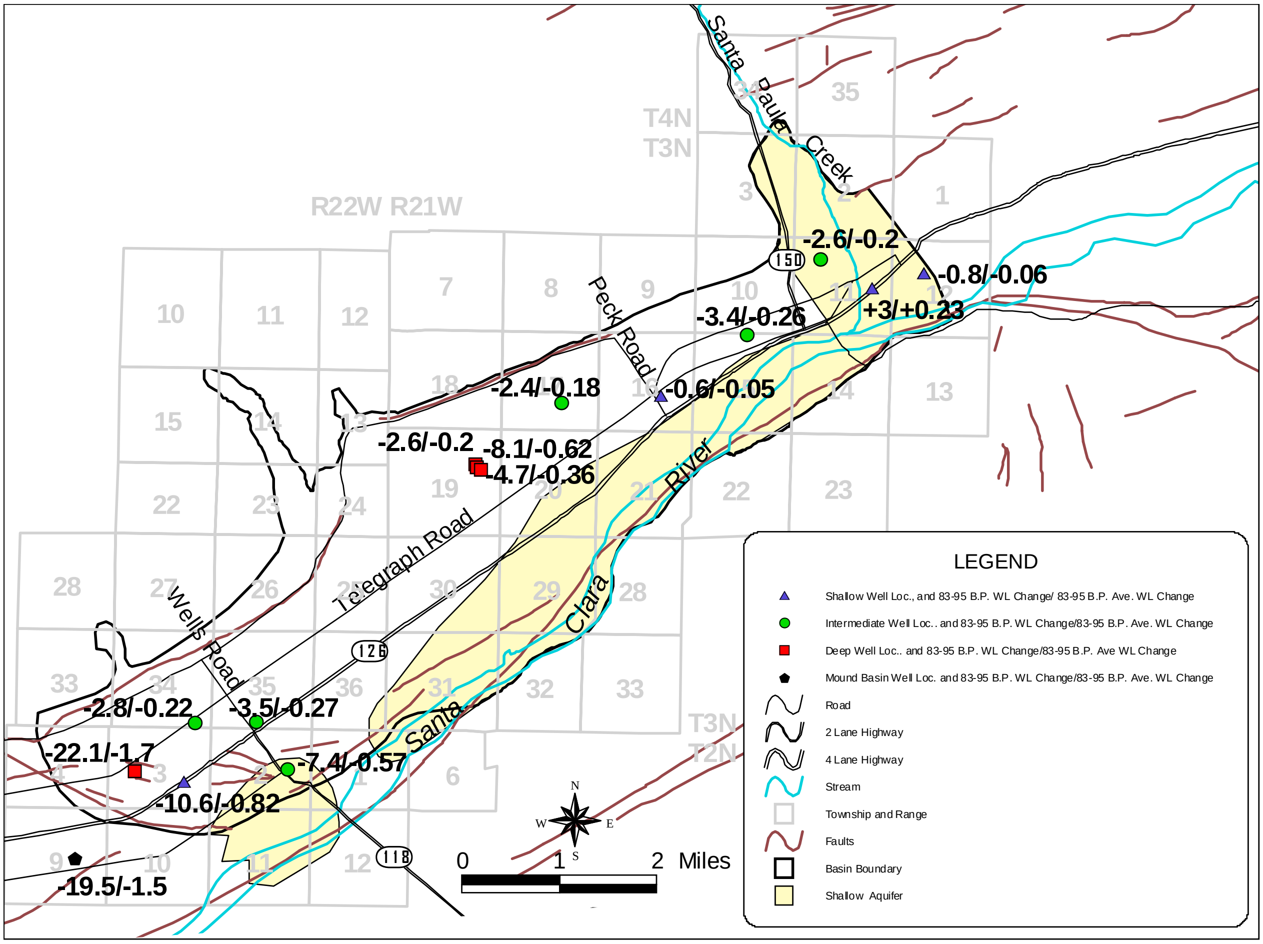


Figure 10. Water level changes over 1983-1995 base period

Water-Level Hydrographs

United Water provided water-level hydrographs for a number of wells in the study area with long-term records and the map location of the Recent River Alluvium.

For the purpose of this analysis, a depth of 250 feet was used to separate shallow and deep wells. The hydrographs were separated into the following categories:

Shallow wells in the Recent Alluvium

Deep wells in the Recent Alluvium

Shallow wells outside of the Recent Alluvium

Deep wells outside of the Recent Alluvium.

If the channel level controls the depth to water in the adjacent well when the water level is shallow, then the shallowest recorded water-level depths may be influenced by changes in the elevation of the stream channel. For example, if the channel is 10 feet lower at a certain time compared to previously, then the shallowest water level in the well may be 10 feet lower than previously. Water-level hydrographs were examined for the four groups of wells. Following are the results of the evaluation.

<u>Shallow wells in Recent alluvium</u>

This group of wells is considered the most likely to show an influence caused by changes in channel elevation. Water-level hydrographs for seven such wells are available. Two of these wells are closer to Santa Paula Creek than the Santa Clara River, and were apparently not influenced by changes in channel elevation. For the remaining five wells, the shallowest water levels were close to the adjoining channel elevations. For four of these wells, changes in channel elevation were accompanied by changes in water level. The water-level changes ranged from about 50 to 80 percent of the channel changes.

<u>Deep wells in Recent alluvium</u>

Water-level hydrographs are available for four wells in this category. One of these wells was closer to Santa Paula Creek than the Santa Clara River, and the shallow water levels didn’t respond to changes in channel elevation. The shallowest water levels in the remaining wells were not near the adjoining channel elevations. Water levels in all of the wells in this group did not show any response to changes in channel elevations. This can likely be explained by one or more confining beds between the shallow and deep strata in this area.

Shallow wells out of Recent alluvium

Water-level hydrographs are available for six wells in this category. For four of these wells, the shallowest groundwater level was near the channel elevation. Hydrographs for four of the wells indicated no response in shallow water levels to changes in channel elevations. For two wells that showed such an influence, the water-level change was greater than the channel elevation change. This indicates that other influences, such as pumping patterns, affected the shallowest water levels more than channel elevation changes. This is likely because of the greater distance from the channel, compared to the closer wells which were previously evaluated.

Deep wells out of Recent alluvium

Water-level hydrographs are available for eleven wells in this category. The shallowest water levels for only three of these wells were near the adjoining channel elevations. Shallow water levels in four of the eleven wells appeared to respond to changes in channel elevation.

Effect of Channel on Water Levels

Changes in groundwater levels caused by lowered channel elevations would be most evident over the longer base period 1944-98 because most of this channel lowering occurred between 1950 and 1980. The channel lowering ranged from about 10 to 20 feet, and was generally greater in the westerly part of the basin. The wells with water levels most likely influenced by channel lowering are primarily ones that tap the Recent alluvium. In these wells, water-level declines ranged from about 50 to 80 percent of the stream channel change. Thus a lowered channel elevation of 10 feet could produce a resulting water-level decline of from 5 to 8 feet. A lowered channel elevation of 20 feet could produce a resulting water-level decline of from 10 to 18 feet.

Actual water-level declines between 1944 and 1998 in the wells completed in the Recent alluvium ranged from 0 to 8 feet. In only one case, for an intermediate well (T3N/R21W-17Q1), was the water-level decline greater than could be caused by the channel lowering. The effect of channel lowering is unlikely to extend to wells completed at deeper depths, such as well T3N/R21W-19G1. However, it is reasonable to conclude that a considerable portion of the observed water-level declines in the basin between 1948 and 1998 were due to stream channel lowering, most of which occurred prior to 1986.

Table 1 is a list of wells showing an influence in shallow water levels due to changes in Santa Clara River channel elevation. Figure 11 is a map showing locations of the wells that had shallow water levels that apparently responded to changes in channel elevation. These wells are generally located in two areas. The largest is between Santa Paula Creek and extends to the southwest past Briggs

TABLE 1

LIST OF WELLS WITH WATER LEVELS APPARENTLY INFLUENCED BY STREAM CHANNEL CHANGES

In Recent Alluvium

Well	Perforated Interval (feet)
T3N/R21W-21B1	40 T.D.
31B1	Depth unknown
31F4	17-37
31F5	102 T.D.

Out of Recent Alluvium

Well	Perforated Interval (feet)
T3N/R21W-16K2	92-243
17Q1	183-243
15C2	176-322
16G1	175-350
19H6	459-694

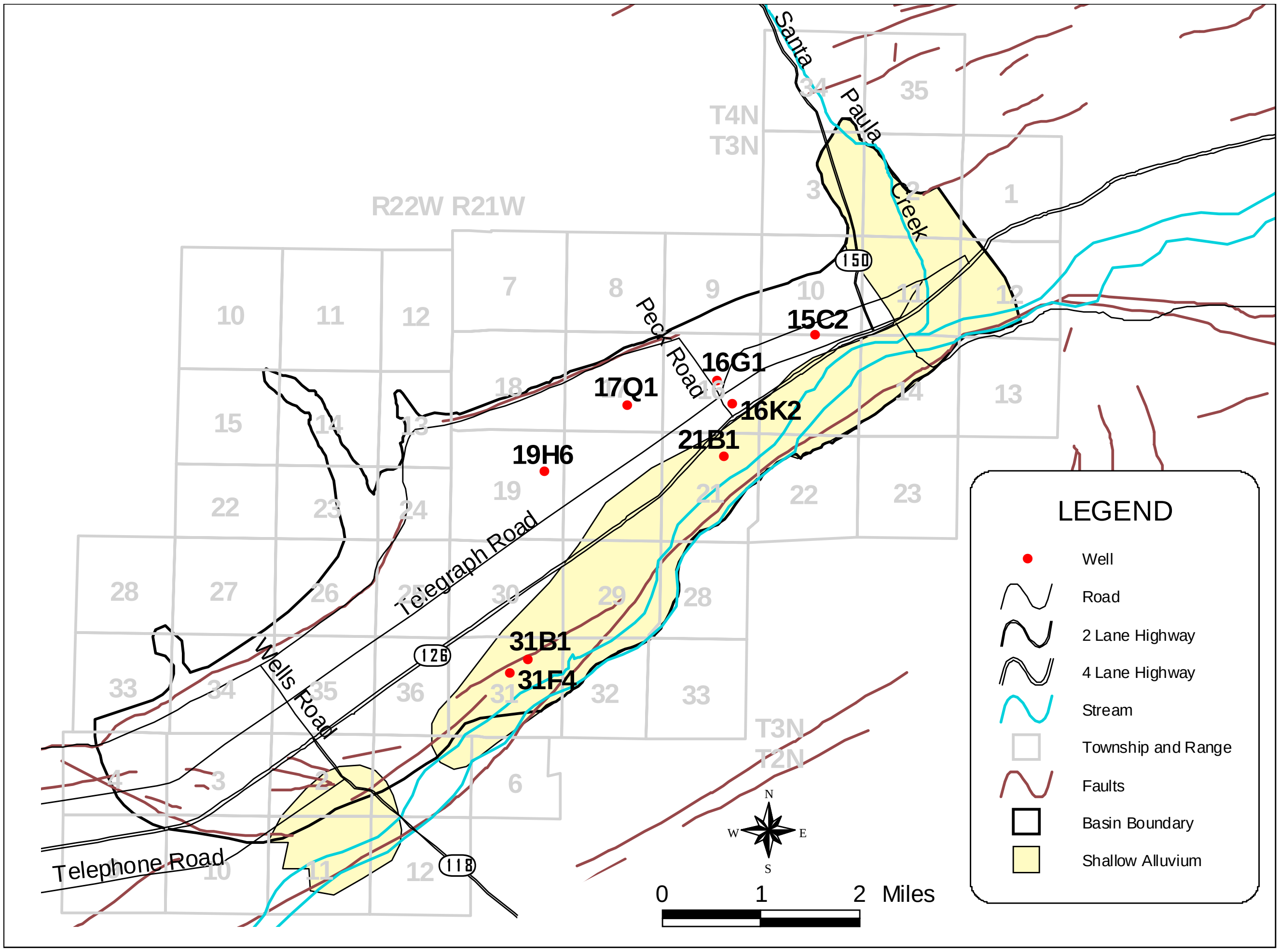


Figure 11. Location of shallow wells affected by gravel mining

Road. In the larger area, some of the wells showing an influence are more than a mile and a half from the river channel. The second is a much smaller area near the Freeman Diversion.

5.3 ANALYSIS – WATER QUALITY

The *Santa Paula Basin Annual Report*, prepared each year by United Water for the Santa Paula Basin Technical Advisory Committee, contains graphs and maps of key water quality constituents. Inorganic chemical constituents in the aquifer, particularly sulfate, result in relatively high total dissolved solids (TDS) in groundwater. TDS concentrations in the basin currently range from around 800 to over 2,000 mg/L. Sulfate concentrations range from 400 to over 1,000 mg/L. Although these concentrations generally are acceptable to agriculture, they exceed the upper limit of secondary drinking water standards that are based on taste and odor; these standards are 1,000 mg/L for TDS and 500 mg/L for sulfate. The City of Santa Paula generally serves water to its customers that is in the range of 790 to 1,000 mg/L. The weighted average TDS for water in the Farmers Irrigation Company was 1,100 mg/L in 2000. Any appreciable increases in TDS could cause the need for additional treatment or management for urban (drinking water) purposes.

Nitrate concentrations, which have a primary (health effects) drinking water standard of 45 mg/L as NO_3, are generally low in the basin. However, local areas in the basin have concentrations up to the drinking water standard. It will be necessary to monitor for any expansion of these areas to protect drinking water supplies.

Water hardness is caused by calcium and magnesium in the water. Calcium carbonate hardness ranges from 24-34 mg/L. These hardness concentrations result in the widespread use of water softeners. Those homes and businesses using self-generating softeners add to the salt loading problems at the City of Santa Paula's Wastewater Treatment Plant, thereby diminishing the value of this water for reclaimed purposes.

There are vertical differences in water quality in the basin, although depth-dependent data are limited. In the SP-2 cluster monitoring wells in the eastern portion of the basin, TDS is higher in the shallowest and deepest portions of the aquifers. In the west end of the basin, TDS is higher in the shallow portion of the aquifer, whereas iron and manganese are higher in the deeper portions of the aquifer.

5.4 ANALYSIS – EXTRACTIONS

The average annual pumpage for the Santa Paula Basin for the base period 1983-1995 was about 25,900 acre-feet. The basin had a maximum pumpage total in 1990 of about 33,500 acre-feet and a minimum pumpage total in 1983 of about 16,700 acre-feet (Figure 12).

The Santa Paula basin was also divided in half (Figure 13) to determine how pumping trends varied from the eastern portion of the basin where water level changes were small during the 1983-1995 base period to the western portion where water level drops were more pronounced. The basin was divided at the point where the Santa Clara River crosses south of the Oakridge fault, west of which the Santa Clara River no longer overlies the sediments of the Santa Paula basin and where basin recharge from the river is not likely to occur. For simplicity, the division of the basin follows section boundaries.

The pumping in the western half of the basin averaged about 9,000 acre-feet per year during the 1983-1995 base period, whereas the eastern half averaged about 17,000 acre-feet per year. When cumulative departure of pumping in each half of the basin is compared to cumulative departure of rainfall (Figures 14 and 15), pumping in the eastern half of the basin follows the expected relationship – pumping increases during dry periods. In the west half of the basin, however, pumping generally increased in the 1990s regardless of whether the year was wet or dry (Figure 15). This increased pumping during the post drought years was primarily from the City of San Buenaventura's well coming on line.

5.5 ANALYSIS – PHREATOPHYTE WATER USE

True phreatophytes draw their supply of water directly from the groundwater table, i.e., the roots tap the water table. The total acreage of phreatophytes in and along the Santa Clara River, and within the Santa Paula groundwater basin, was estimated at almost 290 acres (circa 1993/1995), with a corresponding annual water use estimated at 1,150 acre-feet (based on unit water use corresponding to the reference ET and assuming that the availability of water is not a constraint on water use). It is noteworthy that the water use attributable to 141 acres of giant cane and to plants growing within the *active channel* is not included in this estimate, as they were not considered to be true phreatophytes. For illustrative purposes, if 25 percent of the *active channel* area supported water-using vegetation (also at a rate corresponding to the reference ET), then the water use of this vegetation and the giant cane would total another 1,000 acre-feet annually. Finally, it is noted that these estimates have been made without data respecting the depth to groundwater in the areas where the plants have been mapped and the estimates are for one point in time, i.e., the condition existing circa 1993/1995.

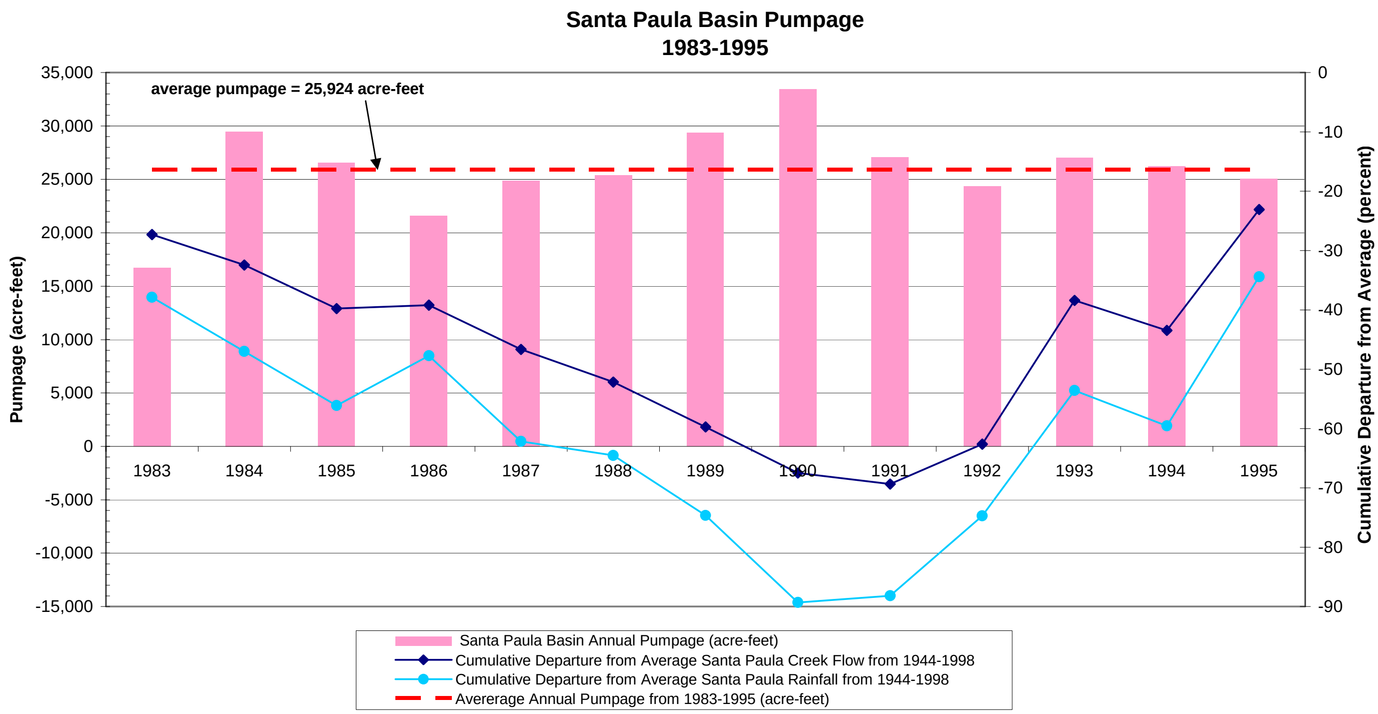


Figure 12. Santa Paula basin pumpage with cumulative departure of stream flow and rainfall (1983-1995)

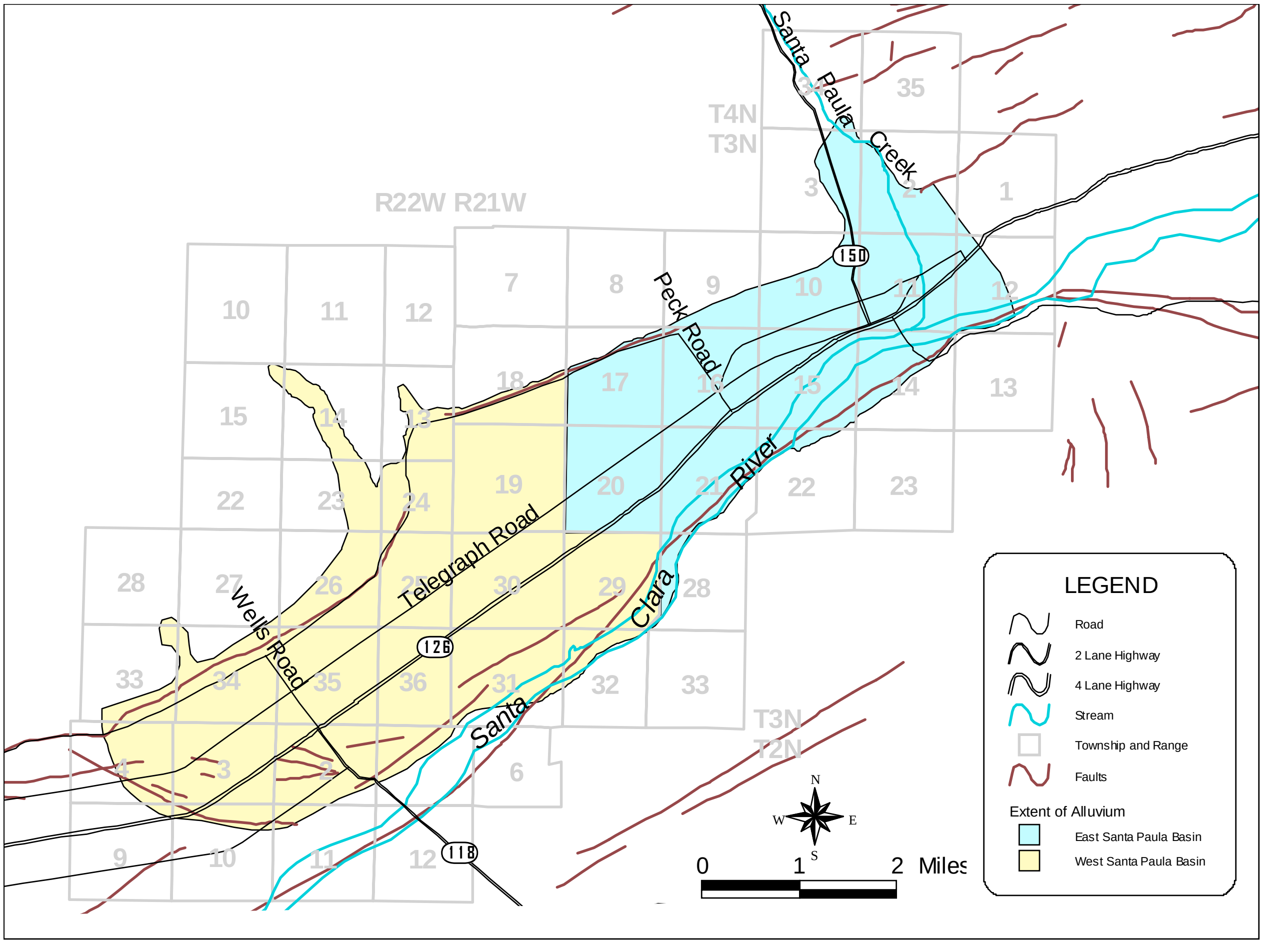


Figure 13. Santa Paula basin showing East-West division

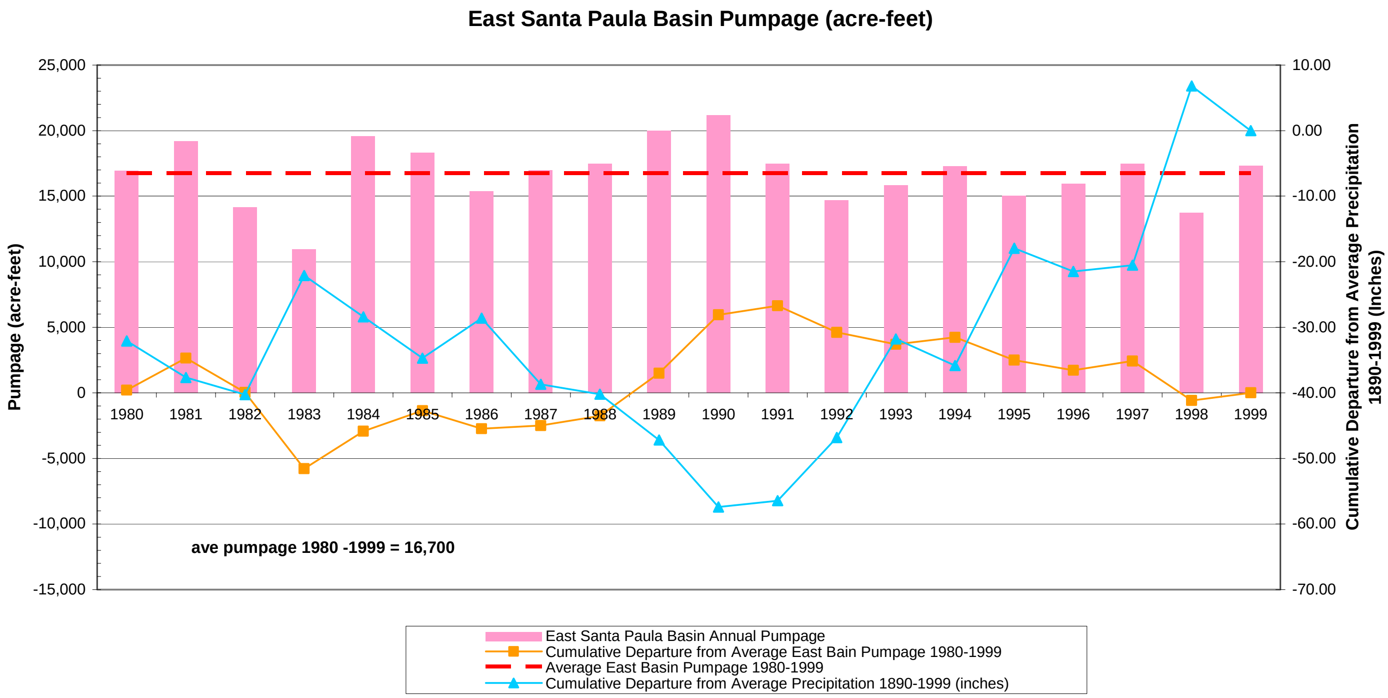


Figure 14. East Santa Paula basin pumpage shown with cumulative departure from average east basin pumpage

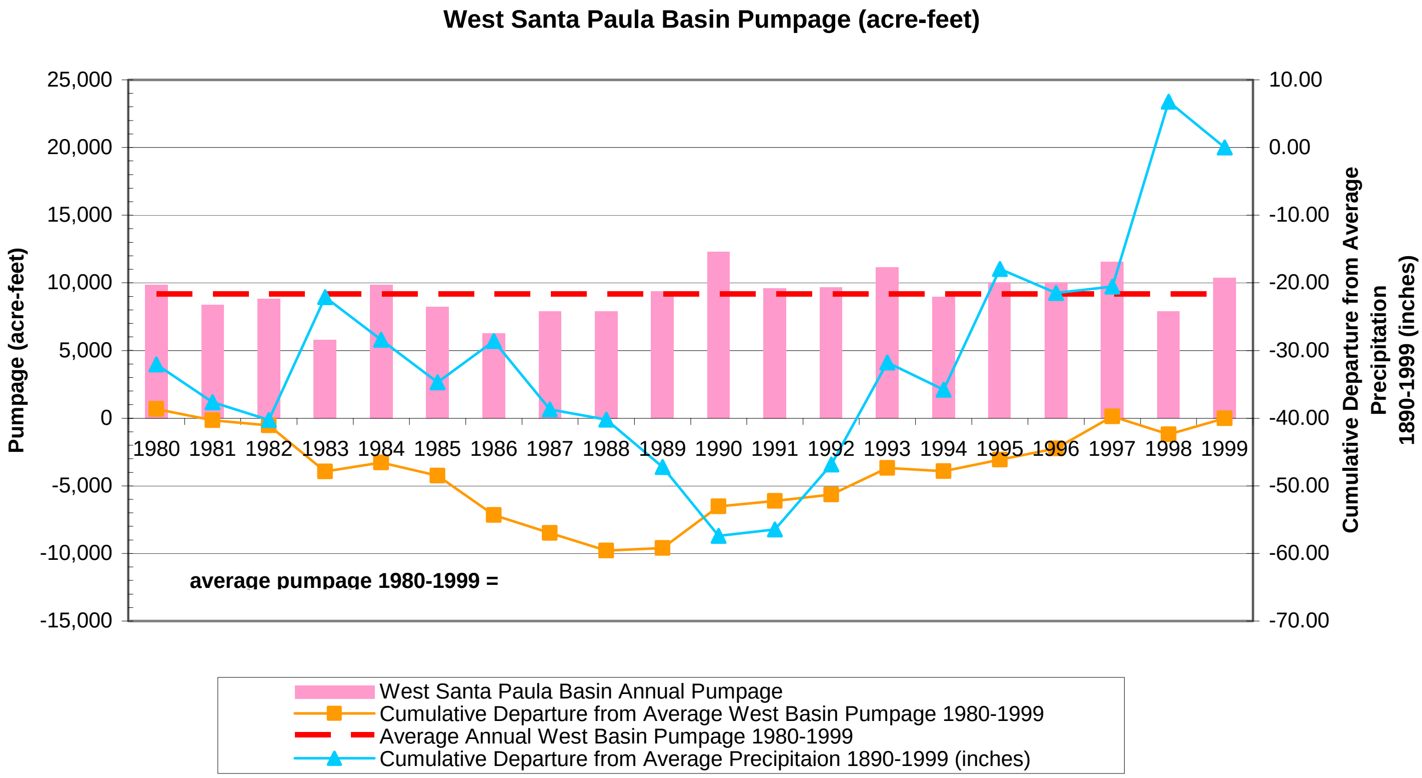


Figure 15. West Santa Paula basin pumpage shown with cumulative departure from average west basin pumpage

Because the potential water use of phreatophytes along the Santa Paula basin portion of the Santa Clara River is not large in the overall water budget, changes in phreatophyte water use during either base period are not likely to be significant. Therefore, phreatophyte use was not considered a factor in examining changing groundwater levels in the Santa Paula basin.

5.6 ANALYSIS – CROP WATER USE, AGRICULTURAL RETURN FLOWS

As with phreatophytes, a change in the efficiency of irrigation would affect the water balance in the Santa Paula basin. For instance, in the largely hydraulically unconfined Santa Paula basin, an increase in irrigation efficiency produces less return flow of irrigated water to the aquifer. As long as all other factors remain constant, then lower return flows equate to a reduction in recharge to the basin. However, an increase in irrigation efficiency generally leads to less pumping in the basin, which more than balances the reduction in recharge in the basin water budget.

Bulletin 12 (DWR, 1953) estimated irrigation efficiency to vary from 70% to 95% for row crops and citrus, the main agriculture in the Santa Paula basin, equating to a return flow of about 5% to 30%. Agricultural return flow was estimated to be 25% along the Santa Clara River in Bulletin 147-4 (DWR, 1967).

To determine changes in irrigation efficiency in the Santa Paula basin that may have affected the basin water balance, specific studies would need to be conducted. For instance, a study in the adjacent basins within the boundaries of the Fox Canyon Groundwater Management Agency used the set of GMA evapotranspiration-weather stations to determine changes in irrigation efficiencies over the 1990s (Bachman, 2001). In this study, agricultural efficiency had improved over the study period, with return flows reduced to 5-15%. Until such a study is done in the Santa Paula basin, it is premature to factor any potential changes in agricultural efficiency in calculating the yield of the basin.

5.7 ANALYSIS – EFFLUENT DISCHARGE

Changes in effluent discharge could affect the water balance in the Santa Paula basin. However, the effluent discharge of about 2,500 acre-feet per year enters the Santa Clara River downstream of potential areas of recharge into the basin, making it unlikely that effluent plays a significant role in the current water balance of the Santa Paula basin.

6. EVALUATIONS OF HISTORICAL WATER LEVEL TRENDS

The Work Plan for the subject investigation included consideration of two "techniques" for the evaluation of historical trends: (1) correlation of groundwater levels, extractions, and recharge, and (2) change in groundwater levels over a base period. These techniques were selected to provide insights respecting "overdraft" and the "yield" of the Santa Paula groundwater basin. This section summarizes the application of these techniques.

6.1 TECHNIQUE #1 - CORRELATION OF GROUNDWATER LEVELS, EXTRACTIONS AND RECHARGE

This technique, as set forth in the work plan for the experts' group evaluating the yield of the Santa Paula basin, includes:

"This technique compares annual change in groundwater levels against extractions so that an appropriate regression can be calculated. The yield is then chosen as the extraction rate that correlates with the desired water level in the basin. For the Santa Paula basin, this comparison of water levels against extractions cannot be done simply as a comparison of the same-year extractions and water levels; a number of factors need to be considered."

Pumping records do not exist prior to 1980, so comparisons of extractions and water levels are only possible over this shorter time period. Based on comparison of annual pumpage amounts for "similar" hydrologic years, there has not been any significant change in the use of groundwater (in response to hydrologic conditions) over the last 20 years.

For the purpose of considering the areal distribution of pumping, the basin has been divided into a west (or downstream) half and an east (or upstream) half (discussed in section *Data Analysis – Extractions* and indicated on Figure 13). Over the last 20 years, about one-third of the pumpage in the basin has occurred in the west half, whereas about two-thirds have occurred in the east half. Since 1992, there has been an apparent increase in the percentage pumped in the west half of the basin (on the order of 5 percent relative to the pre-1992 period), with a commensurate decrease in the contribution of the east half of the basin.

There are definite concentrations of pumpage within the basin. On average over the last 20 years, almost 19 percent of the total annual basin pumpage has occurred in Section 12, T3N R21W, at the extreme eastern (or upstream) end of the basin. One-half of the annual basin pumpage has occurred in four sections; Sections 12, 15, 16, and 19 (all in T3N R21W).

GROUNDWATER LEVELS COMPARED TO PUMPAGE

There are different methods of relating groundwater levels to pumpage. The Hill Method is one such method, and involves plotting the annual change in water levels against the annual pumpage for the basin. In the ideal case, the points could be approximated fairly well by a straight line, with the pumpage corresponding to zero change in water level being an indicator of "yield". In these ideal cases, pumping is the major factor in water levels changes and the annual recharge to the basin does not vary significantly.

For the Santa Paula basin, water levels and pumpage were compared for the years 1980-1999. The water level used for each year was the maximum late winter-early spring water level measurement. This water level was compared against the previous year's pumping because this previous pumping created the water level low prior to winter-spring recharge. Pumping that occurred in the same year as the water level measurement could not be used because this pumping largely occurred after the high winter-spring groundwater levels were measured.

Charts were prepared that compared water levels measured from a central well against pumping in the entire basin (e.g., Figure 16), a western well against pumping in the western portion of the basin (e.g., Figure 17), and an eastern well against pumping in the eastern portion of the basin (e.g., Figure 18). Specific observations include:

1) There is poor correlation between pumping and water level changes in all of the charts. Straight-line correlations yielded R^2 values of less than 0.1. The plotted points evidenced considerable scatter at best. Variations used to plot the data included use of moving averages to smooth out the data, but correlations did not improve appreciably.

2) It is noteworthy that the annual changes in water levels are relatively small, typically on the order of a few feet. The month-to-month fluctuation of water levels at a given well in the spring months can also be of this same order of magnitude. Accordingly, the number and timing of the water level measurements at a given well become critical to an accurate assessment of the change in water level from one year to the next. In other words, there is the potential for a relatively large error in the determination of the annual change in water levels.

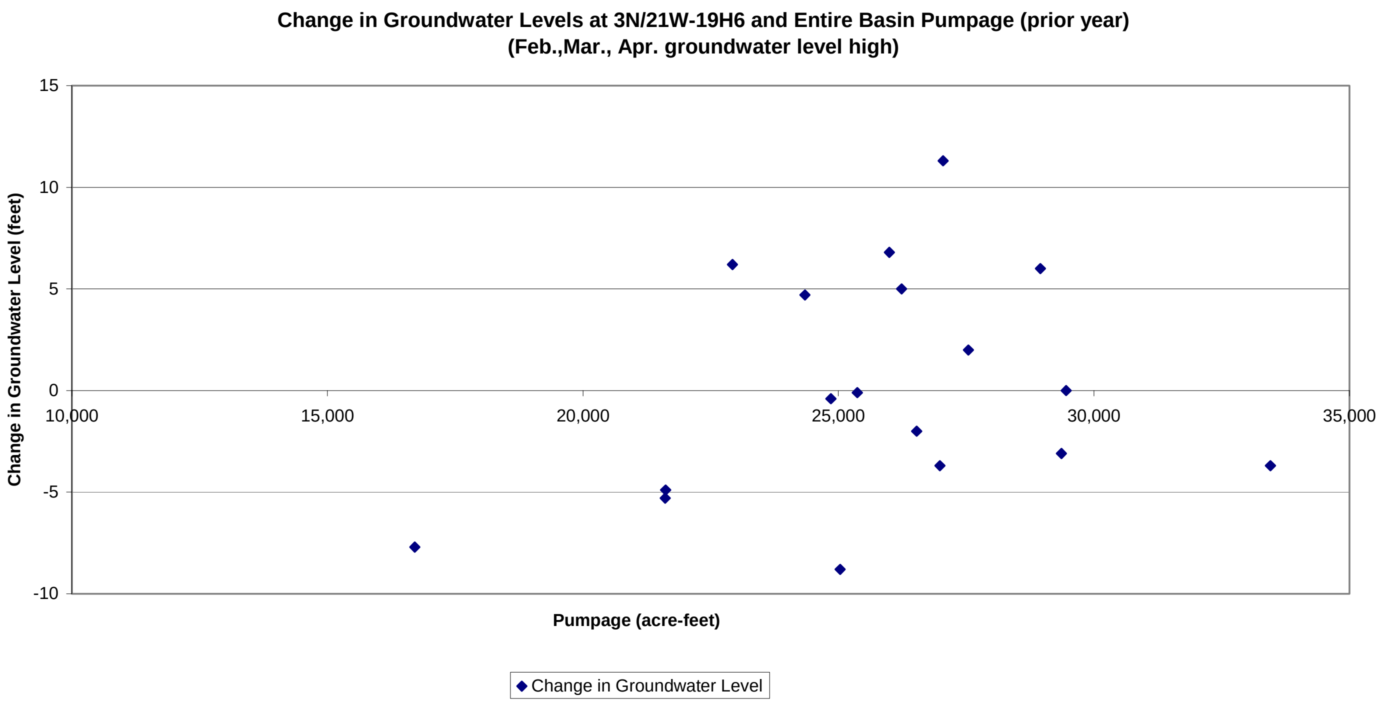


Figure 16. Hill Method, central well vs. entire basin pumping

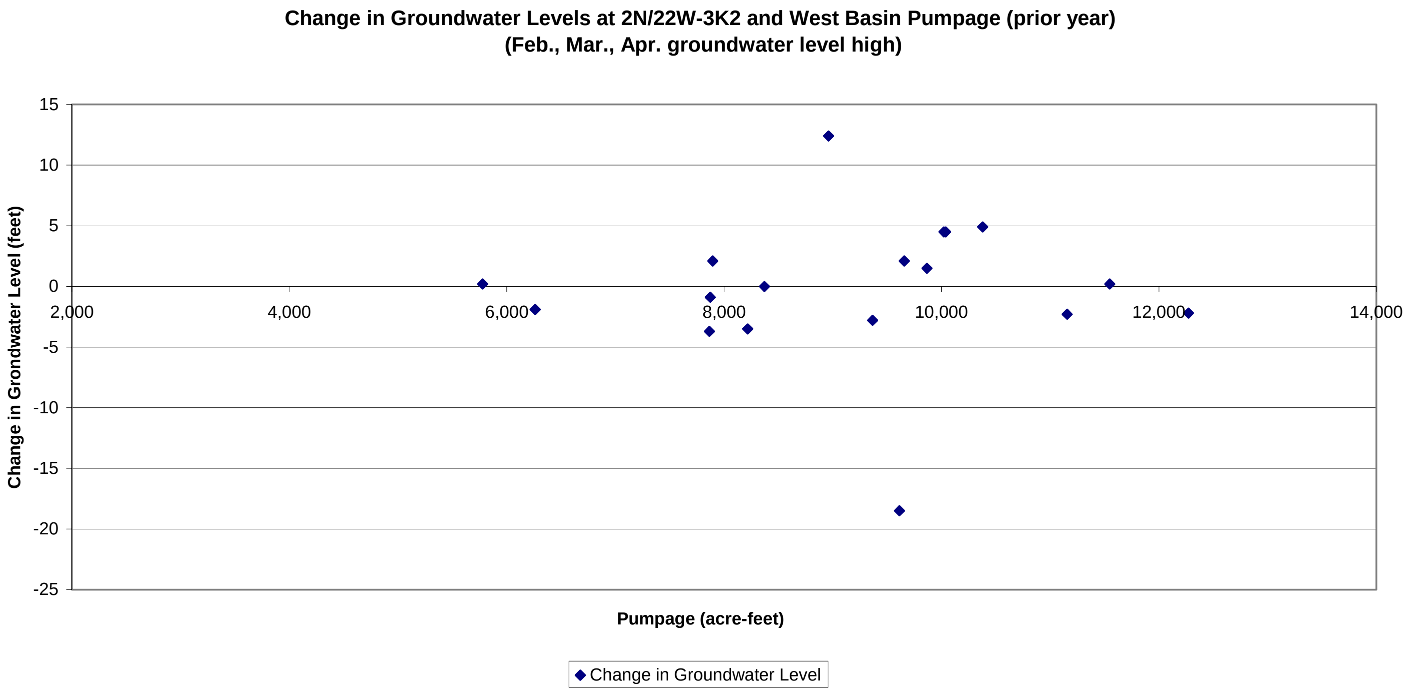


Figure 17. Hill Method, western well vs. pumping in western portion of basin

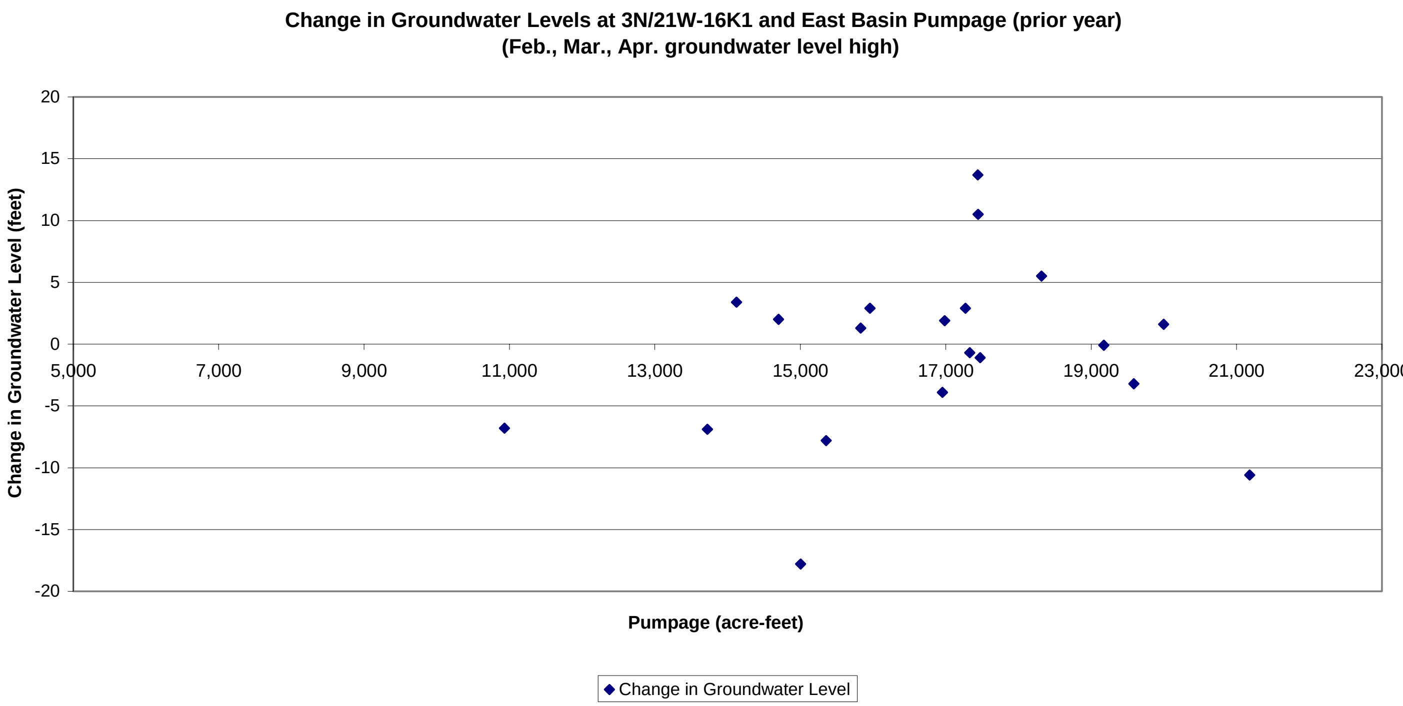


Figure 18. Hill Method, eastern well vs. pumping in eastern portion of basin

3) The Hill Method assumes that the water supply to the basin is reasonably constant (Todd, 1967). As illustrated elsewhere in this report, the rainfall and runoff in the area are highly variable, with the latter (represented by the Santa Clara River and Santa Paula Creek) capable of varying by over two orders of magnitude from year to year. Accordingly, a "reasonably constant" water supply to the basin is not a good assumption.

4) Setting aside the potential difficulty in accurately assessing annual changes in water levels for use in the Hill Method, the results from application of the Hill Method indirectly suggest that recharge (stream flow) is a significant factor in annual changes in water levels. There was little relationship between pumpage and annual changes in water levels, so recharge appears to largely override and mask the effects of pumpage on water levels.

GROUNDWATER LEVELS COMPARED TO RECHARGE

The amount of recharge to the basin is unknown; however, there are hydrologic indicators which can be used to identify relatively "dry" or "wet" conditions, which relate to periods of relatively less than average or more than average recharge, respectively. In particular, records of rainfall for the City of Santa Paula and records of runoff for Santa Paula Creek were used to identify such periods through the use of cumulative departure curves (Figure 12). The cumulative departure curves for these two sources track each other very closely, as would be expected. Over the 1983-1995 base period, the departure curves suggest a generally dryer than average series of years during the first half of the base period, followed by a generally wetter than average series of years. These cumulative departure curves were related to water levels at individual wells throughout the basin and specific observations follow.

1) As a generalization, water levels at individual wells are shown to be falling during the "dry" sequence of years and rising during the "wet" sequence of years (e.g., Figure 19); in fact, the visual correlation is generally quite good. This correlation suggests a relatively strong relationship between water levels and recharge.

2) The correlation between water levels and recharge (based on the hydrologic indicators of rainfall and runoff) which is indicated for the 13-year base period appears to also be supported by inspection of available data back into the early 1940s.

3) One exception to the correlation of water levels and recharge occurs in Section 12, T3N R21W, at the extreme east (or upstream) end of the basin. In this area adjacent to the Santa Clara River, water levels are likely influenced by both the river and subsurface flows from the Fillmore basin.

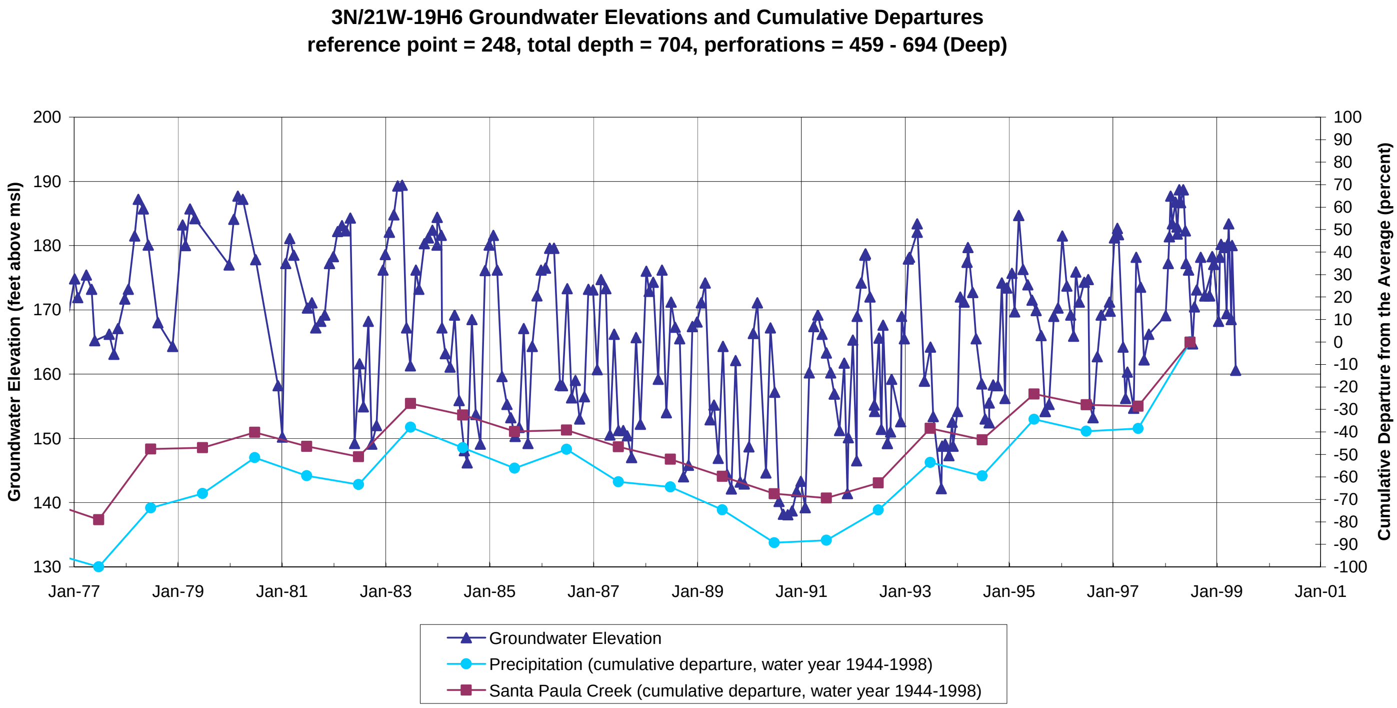


Figure 19. Correlation between groundwater levels and cumulative departures for recharge (stream flow or rainfall)

SUMMARY OF TECHNIQUE #1

The correlation between pumpage and water levels in the basin is poor, largely because recharge to the basin appears to overwhelm pumping effects in any single year. Therefore, this method is not appropriate to for determining the yield of the basin.

The correlation between recharge and water levels is good, as evidenced by water levels rising in almost every well during wet periods and water levels dropping during dry periods. This correlation is valuable in technique 2, where changing water levels are examined over both base periods.

6.2 TECHNIQUE #2 – CHANGE IN GROUNDWATER LEVELS OVER A BASE PERIOD

This technique, as set forth in the work plan for the experts' group evaluating the yield of the Santa Paula basin, includes:

"This technique examines the change of groundwater levels over a base period that represents one or more climatic cycles. If the water levels were similar at the beginning and end of the cycle(s), then average extraction rates would be considered to be within an appropriate yield. If groundwater levels were lower at the end of the period, then average extraction rates may have exceeded an appropriate yield."

This technique was applied over the two base periods for this study, 1944-1998 and 1983-1995.

GROUNDWATER LEVEL ANALYSIS

Hydrographs of water level fluctuations at individual wells were prepared for each of the two periods of analysis (see discussion in section *Data Analysis-Water Level Hydrographs*). Since few wells have regular water level measurements going back 50 years, more water level hydrographs are available for the more recent and shorter period (1983 through 1995) as compared to the longer period (1944 through 1998). The hydrographs represent water level fluctuations in different parts of the basin and in wells which vary in construction (i.e., some are perforated relatively shallow, some deep, and some intermediate). For the period 1944-1998, eight wells had sufficient data to be included in the analysis. For the period 1983-1995, seventeen wells were used. An example of how beginning and ending water levels were selected during a base period is shown in Figure 8. Hydrographs for each of the wells used in the analysis are in Appendix D.

The results of this analysis were discussed in section *Data Analysis-Water Level Hydrographs.* During the base period 1944-1998, water levels dropped between 7 and 13 feet across the basin (Figure 9). During the 1983-1995 base period, water levels varied in the basin from slightly up in one well to as much as 22 feet lower in another well, with the drop most pronounced in the far western portion of the basin (Figure 10).

The hydrographs were also used to determine whether water levels peaked during the wettest years and reached their lowest during the driest month. This was done to determine if there was a rapid response in the basin to recharge or if there was a delay between recharge events and changing water levels in the basin (a delay in response could change the way peak water levels were chosen at the beginning and end of base periods). For this analysis, daily flows in the Santa Clara River (calculated at the present position of the Freeman Diversion), Lake Piru releases, and daily rainfall at Santa Paula were plotted with water levels (e.g., Figure 20; remaining wells in Appendix D).

From this analysis, the following general observations can be made:

1) Peak water levels in wells for any year coincide with the end of both precipitation and high runoff;

2) Water levels recover at the beginning of significant stream flow and rainfall;

3) Following a wet year, there is slightly less year-to-year decline in water levels in the west basin than in the east basin;

4) Sustained Santa Clara River flows (1983,1993,1995, 1998) and Santa Felicia dam releases (1993,1995,1998), and mid-year and late year rainfall in wet years keep water levels high in the fall and as a result water levels in subsequent years are higher than they might otherwise be;

5) No well consistently shows water levels peaking in the year(s) following a high precipitation/runoff year – that is, there is no consistent lag in water level response following a wet year;

6) Frequency and timing of monitoring is critical to determining peak water levels – wells that have been monitored at least quarterly provide the most accurate information and wells that have been monitored bi-monthly during the late winter and early spring provide the best information;

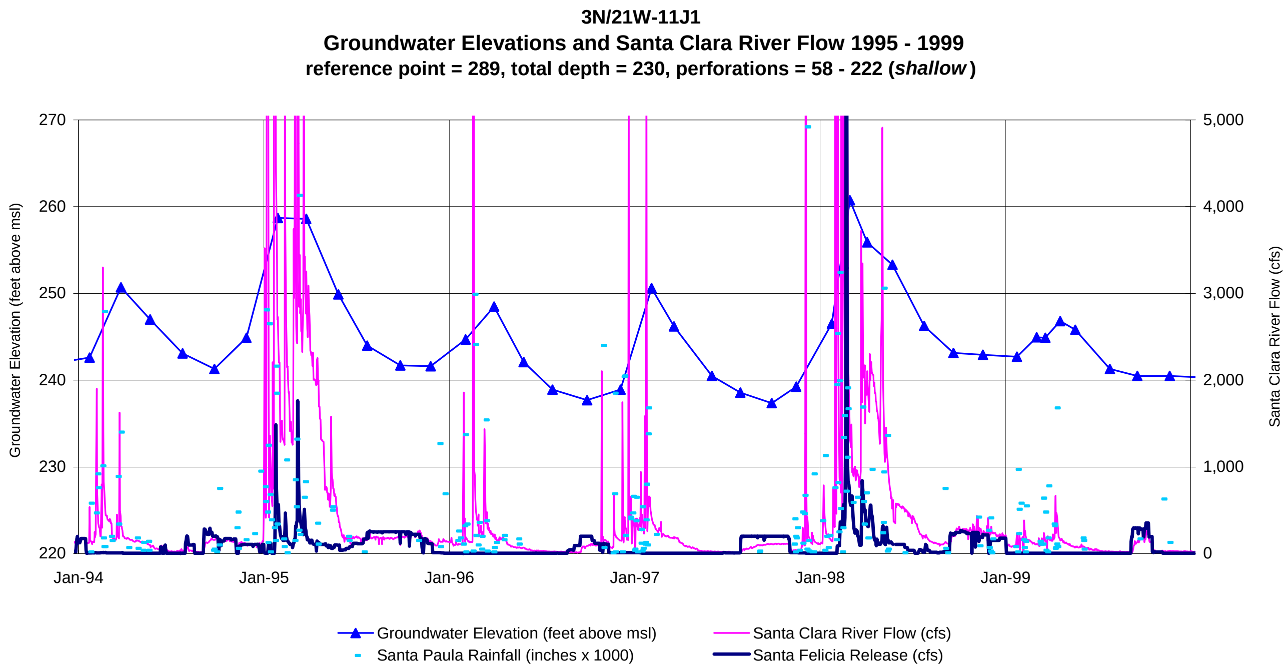


Figure 20. Example of recharge events (stream flow, conservation release, rainfall) plotted on hydrograph for well 3N/21W-11J1

7) Well interference may be a factor in water levels for wells 19G4, 19G1, 3K2, 2K7 and 12E4;

8) Water level lows consistently occurred during 1990 or 1991, at the end of the drought.

In a few wells within the basin, water level peaks are in years following wet years. However, no single well consistently shows water levels peaking in the year(s) following the wet years 1983, 1993, 1995, and 1998.

Table 2 indicates the water level response to wet and dry years. For instance, in the wet year 1983 (column 1 of Table 2), the highest late winter-early spring water levels were measured in 1983 in all but one well (column 2); water levels were the same as the wet year peak in two other years. Following the wet year in 1993, of the 18 wells evaluated, 6 wells peaked in 1994 and 12 wells peaked in 1993. The three most southwesterly wells (2K7, 3K2, 3M2) were included in this group of six wells, located in the area where water levels have decreased the most over the 1983-1995 base period. Only one of these wells showed a delayed peak in 1998 (Table 2). The 1993 wet year is somewhat anomalous because sources of recharge were spread across a longer period than normal; there were sustained high flows in the Santa Clara River and large releases from Lake Piru across the entire 1993-94 period.

Following the 1995 and 1998 wet years, only one well each year showed a higher peak water level in the following year. Part of this better correlation between wet years and peak water levels might be explained by the expanded and increased frequency of monitoring of water levels in these later years.

SUMMARY OF TECHNIQUE #2

The change in groundwater levels over a base period appears to be a viable method of determining how the groundwater basin has responded to historical pumping. The water level changes are relatively systematic within the basin, with the largest drops in water levels in the far western portion of the basin during both the 1944-1998 and the 1983-1995 base periods.

This technique is sensitive to water level measurements being made in sufficient frequency that the highest water levels at the beginning and end of each base period are appropriately measured. If the highest water levels at the beginning or end of a base period are missed in the monitoring schedule, then individual wells may appear to reach their highest water levels in the following year. When there is sufficient frequency of monitoring, the highest groundwater levels are reached at the peak of a wet cycle.

Groundwater Level Response

Well	Wet 1983	1984	Dry 1990	1991	1992	Wet 1993	1994	Wet 1995	1996	1997	Wet 1998	1999	Perforated Interval	Comments
T3N/21W-12E04	**high**		**low**				**high**	**high**			**high**		120 - 204	1992 & 1994 level slightly higher than 1993
T3N/21W-11J01	**high**		**low**		**high**			**high**			**high**		58 - 222	Adjacent to Santa Paula Creek
T3N/21W-11E03	**high**		limited data			**high**		**high**			ND		100 - 453	
T3N/21W-15C02	**high**		**low**			**high**		**high**			ND		176 - 322	Data gap mid 1983 to late 1985
T3N/21W-15C06	ND		**low**			**high**		**high**			**high**		452 - 653	Limited data in 1990, 1991,1993,1996
T3N/21W-15G04	ND		ND			ND		**high**			**high**		240 - 280	USGS SP#1 Intermediate
T3N/21W-15G05	ND		ND			ND		**high**			**high**		40 - 100	USGS SP#1 Shallow
T3N/21W-16A02	ND		limited data			**high**	same	ND			**high**		430 - 580	
T3N/21W-16H06	ND		ND			ND		**high**			**high**		270 - 330	USGS SP#2 Intermediate
T3N/21W-16H08	ND		ND			ND		**high**			**high**		40 - 110	USGS SP#2 Shallow
T3N/21W-16K01	**high**			**low**			**high**	**high**			**high**		119 - 214	UWCD released water for most of 1993
T3N/21W-17Q01	**high**			**low**		**high**		**high**			**high**		183 - 243	
T3N/21W-19G01	**high**		**low**			**high**		**high**			**high**		456 - 566	1997 similar high as 1998
T3N/21W-19G04	**high**		**low**				**high**		**high**		**high**		450 - 720	1997 similar high as 1998
T3N/21W-19R01	**high**			**low**		**high**		ND			**high**		160 - 205	1982 & 1984 similar highs as 1983
T3N/21W-30F01	**high**		**low**			**high**		ND			**high**		260 - 424	
T3N/21W-31F03	ND		ND			**high**	same	**high**			**high**	same	117 - 137	
T3N/22W-36K05 (36K02)	**high**			**low**		**high**		limited data			**high**		175 - 265	
T3N/22W-34R01 (34R02)	**high**		**low**			**high**	same	**high**			**high**		300 - 343	1981 and 1982 high as 1983
T2N/22W-2C01	**high**	same		**low**		**high**	same	**high**			**high**		190 - 225	
T2N/22W-2K07	**high**		**low**				**high**	**high**			**high**	same	168 - 698	1997 high exceeds 1996,1995, &1994
T2N/22W-2R05	ND		ND			ND		ND			**high**		106 - 520	
T2N/22W-3K02	**high**	same			**low**		**high**	ND				**high**	xxx - 164	
T2N/22W-3M02		**high**	**low**				**high**	no peak			**high**		468 - 528	

same represents similar water level high as the previous wet year
ND no data
high high water level
low low water level

Table 2 Groundwater Level Response to Wet and Dry Years

6.3 CONCLUSIONS – HISTORICAL TRENDS

Of the two techniques used to evaluate historical water level trends in the Santa Paula basin, determining groundwater level trends over a base period (Technique #2) is the most appropriate method for this basin.

Comparing pumpage to water-level trends (Technique #1) cannot be feasibly used to determine the basin yield, because recharge (stream flow) is a more predominant factor influencing groundwater levels. Both precipitation and stream flow are indicators of the amount of recharge. The relatively rapid response of water levels to recharge indicates that seepage from stream flow is the major source of recharge to groundwater in Santa Paula Basin.

The effect of recharge (stream flow) is evident when considering groundwater level changes over a base period (Technique #2). Groundwater levels largely tracked the key indicators of recharge (rainfall and stream flow). The two selected base periods each provide information on the basin. During the base period 1944-1998, groundwater levels dropped 7 to 13 feet. Much of this drop may be accounted for by lowered stream levels. Starting in about 1950, gravel mining and possibly other factors lowered the Santa Clara River channel in the range of 10 to 20 feet. After mining ceased and the Freeman Diversion was built, the channel began refilling. By 1993, the channel had already risen upstream of the Freeman Diversion to an average of less than five feet below the channel level prior to 1950. In contrast, below the Freeman Diversion, the channel in 1993 still averaged about 15 feet below pre-mining levels. .

The shorter base period, 1983-1995, is unlikely to have been affected by lowered stream channels because the drop in channel elevation occurred prior to the beginning of the period. During this shorter base period, water levels in the basin varied from a slight increase in one well to as much as 22 feet lower in another well. The largest water level drop occurred in the far western portion of the basin and the smallest drop occurred in the eastern portion of the basin.

These observed trends in water levels can be used in evaluating the yield of the Santa Paula basin. The eastern portion of the basin is being pumped within its ability to recharge during the wet portion of wet/dry cycles, with water levels in most wells recovering to previous wet-year conditions. However, in the far western portion of the basin, water levels generally didn't recover to pre-existing levels, indicating that this portion of the basin is being pumped above its ability to recharge.

7. REFERENCES

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APPENDIX A – TABLES

Santa Paula Basin Groundwater Quality Monitoring

WELLID	Count	Type	First Sam. Date	Last Sam. Date	Years	Top Perf.	Btm Perf.	Well Depth	Casing Depth	Year of Cons.	Agency	Current Freq.	WQ Constit.
03N21W16H02S	1	UNKNOWN	2/24/2023	2/24/2023	pre-eighties	0	0	0					
03N21W20M01S	37	AG	7/13/1931	2/24/2023	pre-eighties	40	129	173		1912			
03N21W12E01S	40	UNKNOWN	10/5/2028	3/3/2023	pre-eighties	0	0	0					
02N22W02A01S	1	UNKNOWN	11/5/2029	11/5/2029	pre-eighties	0	0	0	0	1930			
03N21W16Q01S	8	UNKNOWN	5/11/2029	6/30/1931	pre-eighties	0	0	0	0				
02N22W02C01S	1	UNKNOWN	10/14/1934	10/14/1934	pre-eighties	190	225	226	226	1935			
03N21W09K01S	1	UNKNOWN	1/3/1936	1/3/1936	pre-eighties	0	0	0					
03N21W21A02S	1	UNKNOWN	5/13/1938	5/13/1938	pre-eighties	0	0	0	0				
03N21W16E01S	3	AG	4/29/1938	5/24/1938	pre-eighties	222	258	276	276	1938			
03N21W03H01S	2	UNKNOWN	9/5/2028	3/15/1949	pre-eighties	0	0	0	0				
02N22W02R02S	1	UNKNOWN	9/2/1949	9/2/1949	pre-eighties	70	246	254	0	1946			
02N22W02K01S	3	UNKNOWN	4/12/1948	1/4/1951	pre-eighties	0	0	0	0	1950			
03N21W17D01S	1	UNKNOWN	3/15/1951	3/15/1951	pre-eighties	0	0	0	0				
03N21W12E02S	2	UNKNOWN	4/17/1933	11/6/1951	pre-eighties	0	0	0					
02N22W03Q02S	1	AG	7/15/1952	7/15/1952	pre-eighties	230	248	248	0				
03N21W09Q01S	1	UNKNOWN	7/15/1952	7/15/1952	pre-eighties	0	0	0	0				
03N22W35P01S	1	UNKNOWN	7/15/1952	7/15/1952	pre-eighties	0	0	0	0				
03N21W28M01S	2	UNKNOWN	5/14/1938	7/16/1952	pre-eighties	0	0	0	0				
03N21W31C01S	1	UNKNOWN	7/16/1952	7/16/1952	pre-eighties	0	0	0	0				
02N22W02K02S	1	AG	8/27/1952	8/27/1952	pre-eighties	92	113	263	0	1944			
03N21W16H01S	2	UNKNOWN	11/9/1951	8/27/1952	pre-eighties	0	0	0					
02N22W03M01S	3	UNKNOWN	12/19/1936	8/24/1953	pre-eighties	185	280	407	0	1923			
02N22W02E03S	1	AG	1/12/1956	1/12/1956	pre-eighties	185	210	212	0	1953			
02N22W02J03S	1	AG	7/9/1956	7/9/1956	pre-eighties	94	154	162	162	1955			
03N21W14C04S	1	UNKNOWN	7/31/1956	7/31/1956	pre-eighties	0	0	0	0				
02N22W03M02S	7	AG	11/8/1946	6/26/1957	pre-eighties	468	528	544	544	1946			
03N21W09Q02S	1	UNKNOWN	7/10/1957	7/10/1957	pre-eighties	0	0	0	0				
03N21W20P03S	2	UNKNOWN	7/6/1957	7/16/1957	pre-eighties	0	0	0	0				
02N22W03P01S	1	UNKNOWN	7/25/1957	7/25/1957	pre-eighties	279	575	587	575	1956			
03N21W12E03S	1	UNKNOWN	8/10/1959	8/10/1959	pre-eighties	0	0	0					
03N21W16E02S	1	AG	3/27/1961	3/27/1961	pre-eighties	180	320	450	0	1932			
02N22W03F02S	3	UNKNOWN	9/5/1952	5/31/1961	pre-eighties	0	0	0	0				
03N21W09K03S	2	AG	11/22/1938	7/5/1962	pre-eighties	296	324	335	335	1925			
03N21W16F02S	4	UNKNOWN	9/14/1956	7/5/1962	pre-eighties	0	0	0	0				
03N21W17P01S	3	UNKNOWN	5/2/1949	7/5/1962	pre-eighties	0	0	0	0				

Santa Paula Basin Groundwater Quality Monitoring

WELLID	Count	Type	First Sam. Date	Last Sam. Date	Years	Top Perf.	Btm Perf.	Well Depth	Casing Depth	Year of Cons.	Agency	Current Freq.	WQ Constit.
03N22W34H02S	3	UNKNOWN	6/9/1947	7/6/1962	pre-eighties	0	0	0	0				
03N22W35R01S	2	UNKNOWN	6/9/1934	7/6/1962	pre-eighties	0	0	0	0				
03N21W28F01S	1	UNKNOWN	7/10/1962	7/10/1962	pre-eighties	0	0	0	0				
03N21W16R02S	14	UNKNOWN	5/2/1932	8/9/1962	pre-eighties	0	0	0					
03N21W02B01S	1	UNKNOWN	7/18/1963	7/18/1963	pre-eighties	0	0	0	0				
02N22W01M01S	9	UNKNOWN	6/25/1954	10/7/1965	pre-eighties	70	107	116		1947			
02N22W03M03S	9	AG	4/22/1959	11/10/1965	pre-eighties	354	568	604	0	1949			
03N21W17Q01S	2	AG	5/7/2028	7/29/1966	pre-eighties	183	243	243	243				
03N21W31E01S	15	UNKNOWN	4/25/1960	5/5/1967	pre-eighties	0	0	0	0				
03N21W29L01S	1	UNKNOWN	11/22/1968	11/22/1968	pre-eighties	0	0	0	0				
03N21W29R01S	6	UNKNOWN	5/18/1937	11/22/1968	pre-eighties	0	0	0	0				
03N21W30B02S	2	UNKNOWN	10/8/1957	11/30/1968	pre-eighties	0	0	0	0				
03N21W12D03S	2	UNKNOWN	11/15/1945	6/9/1969	pre-eighties	0	0	0	0				
03N21W15C01S	6	UNKNOWN	7/13/1953	6/28/1969	pre-eighties	0	0	0					
03N21W12E07S	2	UNKNOWN	8/28/1964	11/20/1969	pre-eighties	257	292	300	300	1963			
03N21W01N01S	6	AG	11/15/1945	8/26/1970	pre-eighties	112	138	138	138	1965			
03N21W02R01S	2	UNKNOWN	4/9/1968	8/27/1970	pre-eighties	278	314	381	381	1918			
03N21W21F02S	14	UNKNOWN	7/16/1952	2/20/1972	pre-eighties	60	124	172	172	1945			
02N22W02R01S	19	UNKNOWN	2/23/2028	5/7/1972	pre-eighties	20	200	214	0	1912			
03N21W21F01S	16	M&I	3/1/1944	5/18/1972	pre-eighties	200	212	224	224	1944			
03N22W24R01S	5	AG	9/13/1948	8/8/1972	pre-eighties	0	0	230	0	1940			
03N21W09R03S	28	UNKNOWN	9/6/1945	12/5/1972	pre-eighties	0	0	411	411	1929			
03N21W19L01S	4	AG	9/13/1948	5/9/1973	pre-eighties	0	0	830	0	1943			
03N22W25H02S	2	UNKNOWN	7/20/1972	5/9/1973	pre-eighties	0	0	0	0				
03N21W30F01S	16	AG	6/14/1946	11/20/1974	pre-eighties	260	424	440	440	1958			
03N21W20F01S	4	AG	5/22/1931	5/14/1975	pre-eighties	0	0	211	211				
03N21W20J02S	3	M&I	7/16/1952	5/14/1975	pre-eighties	70	155	159	159				
03N22W33A02S	2	M&I	5/14/1974	5/14/1975	pre-eighties	520	720	720	720	1972			
03N21W12F05S	1	UNKNOWN	5/14/1975	5/14/1975	pre-eighties	0	0	0	0				
03N21W15C05S	28	UNKNOWN	6/13/1960	10/8/1975	pre-eighties	0	0	0					
03N21W29K01S	1	M&I	7/2/1976	7/2/1976	pre-eighties	28	58	68	68	1971			
03N21W02P01S	5	AG	5/10/1973	5/30/1978	pre-eighties	220	466	486	486	1970			
03N21W21E01S	23	AG, M&I		6/14/1978	pre-eighties	117	157	145		1932			
03N21W19H06S	36	AG	7/25/1951	10/8/1980	eighties	459	694	704	704	1951			
03N21W31G03S	2	MONITOR	1/29/1982	4/26/1982	eighties	0	0	86		1977			

Santa Paula Basin Groundwater Quality Monitoring

WELLID	Count	Type	First Sam. Date	Last Sam. Date	Years	Top Perf.	Btm Perf.	Well Depth	Casing Depth	Year of Cons.	Agency	Current Freq.	WQ Constit.
03N21W12E09S	1	UNKNOWN	9/25/1982	9/25/1982	eighties	85	105	105	105	1976			
03N21W31A02S	3	MONITOR	1/29/1982	7/27/1983	eighties	0	0	62		1977			
03N21W31F05S	2	MONITOR	9/24/1982	7/27/1983	eighties	0	0	102	0				
03N21W10A01S	43	M&I	9/11/2029	11/3/1983	eighties	0	0	390					
03N21W31F03S	3	MONITOR	9/24/1982	2/17/1984	eighties	117	137	137	0				
02N22W02G01S	5	M&I	8/20/1980	7/13/1984	eighties	72	121	136	136	1941			
03N21W29B01S	32	M&I	1/9/1958	9/10/1985	eighties	25	99	110	110	1956			
03N21W15M01S	1	UNKNOWN	1/31/1986	1/31/1986	eighties	0	0	0	0				
03N21W29K03S	1	M&I	6/3/1986	6/3/1986	eighties	50	120	120		1972			
03N21W29C02S	4	AG	7/24/1959	6/4/1986	eighties	51	123	123	123	1961			
03N21W29K02S	20	M&I	11/22/1968	7/17/1986	eighties	30	60	70	70	1971			
03N21W31B01S	4	M&I	6/24/1943	7/17/1986	eighties	0	0	0		1927			
03N21W17R01S	12	AG	6/1/1937	8/5/1986	eighties	180	285	290		1930			
03N21W02Q01S	19	AG	11/18/2029	8/14/1986	eighties	0	0	520	520				
03N21W19R01S	16	AG	4/27/1931	8/14/1987	eighties	160	205	210	210				
03N21W21B03S	5	AG	8/15/1985	8/25/1987	eighties	80	280	280	280	1980			
03N21W31L01S	3	AG	7/28/1983	9/24/1987	eighties	137	157	157		1977			
02N22W02Q01S	1	M&I	10/19/1987	10/19/1987	eighties	0	0	0	0				
03N21W16Q02S	1	AG	10/19/1987	10/19/1987	eighties	0	0	0	0				
02N22W03K02S	1	AG	6/3/1988	6/3/1988	eighties	0	164	164	164	1915			
03N22W34R02S	3	AG	6/15/1972	6/3/1988	eighties	0	0	0	0				
03N21W21F03S	5	AG, M&I	9/10/1981	6/7/1988	eighties	72	176	200	200	1981			
03N21W21E03S	12	AG, M&I	7/2/1976	6/22/1988	eighties	60	100	100	100	1972			
03N22W34Q02S	1	AG	6/29/1988	6/29/1988	eighties	0	0	0	0				
02N22W03R02S	1	AG	7/12/1988	7/12/1988	eighties	0	0	205	205	1920			
03N21W21D01S	1	AG, M&I	8/9/1988	8/9/1988	eighties	26	84	100	100	1977			
03N21W21E02S	2	AG, M&I	8/8/1972	10/11/1988	eighties	80	100	100	100	1969			
02N22W02K03S	2	UNKNOWN	6/2/1952	6/22/1989	eighties	107	147	360	0	1920			
02N22W02J04S	2	UNKNOWN	7/24/1956	7/6/1989	eighties	94	154	162	0	1955			
03N21W21E04S	10	M&I	7/2/1976	8/16/1989	eighties	69	86	102	102	1974			
03N22W35Q01S	9	UNKNOWN	7/13/1962	8/1/1990	nineties	232	724	724	724	1961			
03N21W29B02S	7	M&I	11/15/1985	8/22/1990	nineties	60	100	100	100	1970			
03N21W30H07S	3	AG	8/13/1985	9/11/1990	nineties	195	695	695	695	1981			
03N21W02R02S	10	AG	6/21/1968	10/3/1990	nineties	202	360	377	377	1968			
03N21W19H07S	1	AG	5/6/1991	5/6/1991	nineties	450	720	197	197				

Santa Paula Basin Groundwater Quality Monitoring

WELLID	Count	Type	First Sam. Date	Last Sam. Date	Years	Top Perf.	Btm Perf.	Well Depth	Casing Depth	Year of Cons.	Agency	Current Freq.	WQ Constit.
02N22W01M04S	1	AG	1/22/1992	1/22/1992	nineties	0	0	0	0				
02N22W02G02S	5	UNKNOWN	5/20/1987	6/23/1992	nineties	85	165	170	0	1986			
02N22W03E01S	17	AG	6/13/1972	6/23/1992	nineties	266	723	730	730	1947			
03N21W09K02S	3	AG	1/21/1966	6/24/1992	nineties	233	338	342	342	1935			
03N21W21G02S	16	UNKNOWN	4/7/1976	6/24/1992	nineties	60	100	100	100	1972			
03N21W29F02S	8	UNKNOWN	8/31/1976	6/24/1992	nineties	0	0	0	0				
03N21W17P02S	4	AG	11/6/1985	8/5/1992	nineties	523	780	850	780	1976			
03N21W10A02S	11	M&I	7/15/1981	8/10/1992	nineties	0	0	0	0				
03N22W34R01S	8	UNKNOWN	6/15/1972	8/26/1992	nineties	300	343	354	354	1944			
03N22W23F02S	12	AG	5/1/1953	10/16/1992	nineties	1015	1410	0					
02N22W02R04S	33	AG, M&I	6/8/1972	2/24/1993	nineties	106	501	590	526	1967			
03N21W03R02S	45	M&I	12/4/1953	4/14/1993	nineties	238	524	800	560	1953			
03N21W19M01S	37	AG	9/13/1948	8/5/1993	nineties	0	0	197					
03N21W21B01S	53	M&I	8/24/1953	8/5/1993	nineties	0	0	40		1929			
03N21W30H03S	21	UNKNOWN	7/10/1957	8/5/1993	nineties	62	132	218	216	1956			
03N22W35N01S	10	AG	10/21/1965	8/9/1993	nineties	278	308	318	318	1947			
03N21W20J04S	1	AG	9/8/1993	9/8/1993	nineties	60	180	200	200	1980			
03N21W21E07S	1	AG, M&I	9/14/1993	9/14/1993	nineties	110	210	210	210	1990			
03N21W29F01S	16	AG	8/10/1972	9/14/1993	nineties	60	125	125	125	1972			
03N21W17D03S	2	M&I	10/16/1992	11/2/1993	nineties	120	380	400	400	1980			
02N22W01N02S	4	UNKNOWN	7/25/1988	6/16/1994	nineties	80	200	245	200	1985			
02N22W02G03S	2	UNKNOWN	9/8/1993	6/16/1994	nineties	0	0	0	0				
03N21W16G01S	45	M&I	6/17/1953	7/12/1994	nineties	175	350	480	480	1956			
03N21W29B03S	1	AG	7/26/1994	7/26/1994	nineties	120	400	0	0				
03N21W16P03S	1	AG	8/4/1994	8/4/1994	nineties	194	264	282	282	1960			
03N21W16P01S	6	AG	11/30/1934	10/3/1994	nineties	119	168	169	169	1935			
03N21W21E05S	9	AG	12/11/1987	10/3/1994	nineties	60	200	200	200	1987			
03N21W30E01S	4	AG	10/27/1993	10/5/1994	nineties	160	240	240	240	1981			
02N22W03L01S	7	AG	10/17/1990	10/6/1994	nineties	175	400	415	400	1988			
03N21W31E03S	35	AG, M&I	9/1/1967	10/12/1994	nineties	162	232	224	224	1967			
03N22W35Q02S	3	AG	6/29/1994	10/12/1994	nineties	222	366	402	402	1961			
02N22W01M02S	4	AG	7/25/1962	10/17/1994	nineties	83	109	113	113	1961			
03N21W09K04S	5	AG	11/3/1993	10/17/1994	nineties	260	402	413	403	1988			
03N21W29G02S	4	AG	11/8/1993	10/17/1994	nineties	100	300	306	300	1984			
03N21W30H04S	19	AG	1/22/1975	10/17/1994	nineties	100	400	500	500	1975			

Santa Paula Basin Groundwater Quality Monitoring

WELLID	Count	Type	First Sam. Date	Last Sam. Date	Years	Top Perf.	Btm Perf.	Well Depth	Casing Depth	Year of Cons.	Agency	Current Freq.	WQ Constit.
02N22W03B01S	5	AG	7/16/1952	10/19/1994	nineties	208	268	271		1946			
03N21W20A01S	4	AG	11/8/1993	10/19/1994	nineties	115	215	215	215	1986			
02N22W02K06S	10	M&I	7/2/1959	6/5/1995	nineties	110	290	290	290	1957			
03N21W09R05S	1	M&I	12/6/1995	12/6/1995	nineties	400	670	894	690	1995			
03N21W15G04S	9	MONITOR	6/15/1994	10/7/1997	nineties	260	280	280	280	1994	UWCD	6 months	Gen Min
03N21W19G02S	31	AG, M&I	6/4/1973	9/8/1998	nineties	550	630	658	658	1973	Limoneira	none	
03N21W15C06S	43	AG, M&I	11/10/1976	11/1/1998	nineties	452	653	670	670	1976	City of Santa Paula	3 years	Gen Min
03N21W16A02S	48	M&I	8/16/1971	11/5/1998	nineties	430	580	600	600	1971	City of Santa Paula	12 months	Gen Min
03N21W09R04S	31	AG	5/14/1966	12/9/1998	nineties	360	756	814	780	1966	Farmer's Irrigation	12 months	Gen Min
03N21W15C02S	75	AG, M&I	7/6/1951	12/9/1998	nineties	176	322	350	350	1951	Farmer's Irrigation	12 months	Gen Min
03N21W15C04S	82	AG	8/10/2028	12/9/1998	nineties	112	253	284	284		Farmer's Irrigation	12 months	Gen Min
03N21W16K01S	56	AG	11/19/1948	12/9/1998	nineties	119	214	216	216	1923	Farmer's Irrigation	12 months	Gen Min
03N21W16K02S	37	AG	11/16/1950	12/9/1998	nineties	92	243	243	243	1923	Farmer's Irrigation	12 months	Gen Min
03N21W16K03S	30	AG	8/23/1962	12/9/1998	nineties	672	760	795	795	1962	Farmer's Irrigation	12 months	Gen Min
03N21W19G04S	10	AG	11/13/1997	12/9/1998	nineties	450	720	794	720	1981	Farmer's Irrigation	12 months	Gen Min
03N21W12E04S	40	AG	4/9/1954	12/9/1998	nineties	120	204	300	300	1954	Farmer's Irrigation	12 months	Gen Min
03N21W12E08S	24	AG	6/13/1967	12/9/1998	nineties	120	285	300	300	1967	Farmer's Irrigation	12 months	Gen Min
03N21W12F03S	40	AG	4/15/1954	12/9/1998	nineties	120	284	302	302	1954	Farmer's Irrigation	12 months	Gen Min
02N22W02K07S	16	AG, M&I	4/24/1963	2/22/1999	nineties	168	698	698	0	1963	Alta Mutual	12 months	Gen Min
02N22W02R05S	21	AG	8/24/1984	2/22/1999	nineties	106	520	520	0	1984	Alta Mutual	12 months	Gen Min
02N22W02K09S	100	M&I	1/15/1984	8/9/1999	nineties	300	400	420	0	1987	City of Ventura	1 month	Gen Min
03N21W15G01S	8	MONITOR	6/14/1994	10/11/1999	nineties	660	680	680	680	1994	UWCD	6 months	Gen Min
03N21W15G05S	8	MONITOR	6/14/1994	10/11/1999	nineties	60	80	80	80	1994	UWCD	6 months	Gen Min
03N21W16H05S	8	MONITOR	6/16/1994	10/11/1999	nineties	530	550	550	550	1994	UWCD	6 months	Gen Min
03N21W16H06S	8	MONITOR	6/16/1994	10/11/1999	nineties	290	310	310	310	1994	UWCD	6 months	Gen Min
03N21W16H07S	8	MONITOR	6/16/1994	10/11/1999	nineties	150	170	170	170	1994	UWCD	6 months	Gen Min
03N21W16H08S	8	MONITOR	6/15/1994	10/11/1999	nineties	50	70	70	70	1994	UWCD	6 months	Gen Min
03N21W15G02S	8	MONITOR	6/14/1994	10/12/1999	nineties	520	540	540	540	1994	UWCD	6 months	Gen Min
03N21W15G03S	8	MONITOR	6/15/1994	10/12/1999	nineties	370	390	390	390	1994	UWCD	6 months	Gen Min
03N21W29MW1	2	MONITOR	5/21/1999	11/15/1999	nineties	13	33	33	33		V.C. Water Works District	6 months	Gen Min
03N21W29MW11	2	MONITOR	5/21/1999	11/15/1999	nineties	9	29	29	0		V.C. Water Works District	6 months	Gen Min
03N21W29MW17	2	MONITOR	5/21/1999	11/15/1999	nineties	16	36	36	0		V.C. Water Works District	6 months	Gen Min
03N21W29MW8	2	MONITOR	5/21/1999	11/15/1999	nineties	15	35	15	0		V.C. Water Works District	6 months	Gen Min

Santa Paula Basin Groundwater Level Monitoring

UWCD Index Wells

State Well No.	Begin Record	End Record	UWCD Freq	County Freq	Farmer's Irr. Freq	City of S.P. Freq	City of Ven Freq	No. of records	T. Perf	B. Perf	T. Depth	C. Depth	Yr Dr.	Type	Condition
3N/21W 12E4	1978	Pres	1 mo					170	120	204	300	300	1954	AG	Active
3N/21W 15C4	1975	Pres	1 mo					214	112	253	284	284		AG	Active
3N/21W 16K1	1923	Pres			1 mo			666	119	214	216	216	1923	AG	Active
3N/21W 17Q1	1930	Pres	1 mo	2 mo				368	183	243	243	243		AG	Active
3N/21W 19H6	1952	1999	1 mo	2 mo	1 mo			426	459	694	704	704	1951	AG	Destroyed
3N/21W 19G4	1982	Pres			1 mo			129	450	720	794	720	1981	AG	Active
3N/21W 30F1	1972	Pres	1 mo	2 mo				132	260	424	440	440	1958	AG	Active
2N/22W 2C1	1972	Pres	1 mo	2 mo				182	190	225	226	226	1935	AG	Non-Active
3N/22W 34R1(R2)	1972	Pres	1 mo	2 mo				188	300	343	354	354	1944	AG	Active
2N/22W 3K2	1927	Pres	1 mo	2 mo				369	n.a.	164	164	164	1915	AG	Active
2N/22W 3M2	1972	Pres	1 mo	2 mo				180	468	528	544	544	1946	AG	Non-Active

Other Wells Monitored by UWCD, County or Monitored by UWCD and County

State Well No.	Begin Record	End Record	UWCD Freq	County Freq	Farmer's Irr. Freq	City of S.P. Freq	City of Ven Freq	No. of records	T. Perf	B. Perf	T. Depth	C. Depth	Yr Dr.	Type	Condition
3N/21W															
9K2	1936	Pres	6 mo	2 mo				197	233	338	342	342	1935	AG	Active
11B1	1980	Pres		2 mo				106	n.a	n.a	n.a.	n.a		AG	Non-Active
11H3	1971	Pres	2 mo					192	n.a.	n.a.	230	n.a		AG	Active

Santa Paula Basin Groundwater Level Monitoring

State Well No.	Begin Record	End Record	UWCD Freq	County Freq	Farmer's Irr. Freq	City of S.P. Freq	City of Ven Freq	No. of records	T. Perf	B. Perf	T. Depth	C. Depth	Yr Dr.	Type	Condition
11J1	1930	Pres	2 mo					198	58	222	230	230		AG	Active
12B1	1962	Pres	2 mo					795	n.a.	n.a.	n.a.	n.a.		M&I	Non-Active
15G1-15G5 (USGS)	1994	Pres	1 wk & Data logger					87	see below	see below	see below		1994	MONITOR	Non-Active
16E2	1991	Pres	6 mo					16	180	320	450	n.a	1932	AG	Active
16H5-16H8 (USGS)	1994	Pres	1 wk & Data logger					93	see below	see below	see below		1994	MONITOR	Non-Active
16P1	1991	1993	6 mo					4	119	168	169	169	1935	AG	Active
19M1	1991	Pres	6 mo					21	n.a.	n.a.	197	n.a		AG	Active
19R1	1972	Pres	6 mo	2 mo				153	160	205	210	210		AG	Active
20J3	1996	Pres	6 mo					10	489	717	720	717	1967	AG	Active
21B1	1929	Pres	2 mo					433	n.a.	n.a.	40	n.a	1929	AG	Non-Active
29B3	1992	Pres	6 mo					20	120	400	n.a.	n.a.		AG	Active
29K1	1997	Pres	1 mo					23	28	58	68	68	1971	M&I	Non-Active
30E1	1991	Pres	1 mo					35	160	240	240	240	1981	AG	Active
30H4	1975	Pres		2 mo				99	100	400	500	500	1975	AG	Active
31A2	1978	1993	2 mo					39	n.a.	n.a.	62	n.a.	1977	MONITOR	Non-Active
31B1	1928	Pres	2 mo					326	n.a.	n.a.	n.a	n.a.	1927	MONITOR	Non-Active
31F3	1976	Pres	2 mo					95	117	137	137	n.a.		MONITOR	Non-Active
31F4	1976	Pres	2 mo					93	17	37	38	n.a.		MONITOR	Non-Active
31F5	1976	Pres	2 mo					131	n.a.	n.a.	102	n.a.		MONITOR	Non-Active
31G3	1976	Pres	2 mo					83	n.a.	n.a.	86	n.a.	1977	MONITOR	Non-Active
31L1	1977	Pres	2 mo					90	137	157	157	n.a.	1977	AG	Non-Active
32C-a	1991	Pres	2 mo					57	12	32	n.a	n.a.		MONITOR	Non-Active
32C-b	1991	Pres	2 mo					52	17	37	n.a	n.a.		MONITOR	Non-Active
32C-c	1991	Pres	2 mo					51	17	37	n.a	n.a.		MONITOR	Non-Active
3N/22W															
26P1	1991	Pres	1 mo					26	225	385	408	385	1981	M&I	Active
33A2	1991	1998	6 mo					5	520	720	720	720	1972	M&I	Destroyed
35Q2	1991	Pres	6 mo					21	222	366	402	402	1961	AG	Active
36H1	1991	Pres	6 mo					23	226	442	751	442	1961	M&I	Active
36K5	1992	Pres	6 mo	2 mo				46	175	265	278	278	1947	AG	Active
23Q1	1999	Pres	6 mo					3	345	445	445	445	1982	AG	Active
2N/22W															
1M2	1999	Pres	1 mo					7	83	109	113	113	1961	AG	Active

Santa Paula Basin Groundwater Level Monitoring

State Well No.	Begin Record	End Record	UWCD Freq	County Freq	Farmer's Irr. Freq	City of S.P. Freq	City of Ven Freq	No. of records	T. Perf	B. Perf	T. Depth	C. Depth	Yr Dr.	Type	Condition
2J3	1992	1994	6 mo					5	94	154	162	162	1955	AG	Active
2K7	1964	Pres	1 mo & Data logger					88	168	698	698	n.a.	1963	AG	Active
2K8	1992	1994	6 mo					6	n.a	240	240	240	1970	AG	Active
2N1	1991	1995	6 mo					11	n.a	n.a	396	396		AG	Destroyed
2N4	1992	Pres	6 mo					21	n.a	n.a	n.a.	n.a.		M&I	Active
2R5	1991	Pres	6 mo					19	106	520	520	n.a.	1984	AG	Active
3E1	1991	1996	6 mo					11	266	723	730	730	1947	AG	Active
3K3	1992	1999	1 mo					24	160	420	440	440	1997	M&I	Active
3L1	1992	1996	6 mo					11	175	400	415	400	1988	AG	Active
3M3	1992	Pres	6 mo					21	354	568	604	n.a.	1949	AG	Active
3Q2	1992	1993	6 mo					3	230	248	248	n.a.	1923	AG	Destroyed
3Q1	1991	Pres	6 mo					22	n.a.	n.a.	n.a.	n.a.		AG	Active
9K4	1948	Pres	1 mo					580	n.a	n.a.	548	548	1935	AG	Non-Active
10C2	1956	1997	6 mo	2 mo				228	279	575	587	575	1956	AG	Destroyed
10N2	1992	1993	6 mo					4	200	354	374	n.a.	1953	AG	Active
11C3	1992	1994	6 mo					8	180	470	500	490	1971	AG	Destroyed

Other Wells Monitored by Farmers Irrigation

State Well No.	Begin Record	End Record	UWCD Freq	County Freq	Farmer's Irr. Freq	City of S.P. Freq	City of Ven Freq	No. of records	T. Perf	B. Perf	T. Depth	C. Depth	Yr Dr.	Type	Condition
3N/21W 2R2	1992	Pres			1 mo			79	202	360	377	377	1968	AG	Active
3N/21W 9R4	1971	Pres			1 mo			202	360	756	814	780	1966	AG	Active
3N/21W 11E3	1973	Pres			1 mo			196	100	453	478	478	1956	AG	Active
3N/21W 11F3	1970	Pres			1 mo			215	153	518	540	540	1958	AG	Active
3N/21W 12E8	1974	Pres			1 mo			127	120	285	300	300	1967	AG	Active
3N/21W 12F3	1972	Pres			1 mo			201	120	284	302	302	1954	AG	Active
3N/21W 15C2	1976	Pres			1 mo			150	176	322	350	350	1951	AG	Active
3N/21W 16K2	1923	Pres			1 mo			758	92	243	243	243	1923	AG	Active
3N/21W 16K3	1980	Pres			1 mo			182	672	760	795	795	1962	AG	Active
3N/21W 19G1	1932	Pres			1 mo			650	456	566	576	576	1931	AG	Non-Active

Santa Paula Basin Groundwater Level Monitoring

State Well No.	Begin Record	End Record	UWCD Freq	County Freq	Farmer's Irr. Freq	City of S.P. Freq	City of Ven Freq	No. of records	T. Perf	B. Perf	T. Depth	C. Depth	Yr Dr.	Type	Condition
3N/21W 2Q2	1987	Pres			1 mo			75	n.a.	n.a	n.a	n.a		AG	unknown
3N21W 2Q1	1929	1979			2 mo			121	n.a.	n.a	520	520		AG	Non-Active

Wells Monitored by City of Santa Paula

State Well No.	Begin Record	End Record	UWCD Freq	County Freq	Farmer's Irr. Freq	City of S.P. Freq	City of Ven Freq	No. of records	T. Perf	B. Perf	T. Depth	C. Depth	Yr Dr.	Type	Condition
3N/21W 9R5	1996	Pres				1 mo		22	400	670	894	690	1995	M&I	Active
3N/21W 11J2	1993	Pres				1 mo		43	260	700	1070	n.a.	1991	M&I	Active
3N/21W 15C3	1981	Pres				1 mo		203	n.a.	n.a	272	272	1912	M&I	Active
3N/21W 15C6	1977	Pres				1 mo		59	452	653	670	670	1976	M&I	Active
3N/21W 16A2	1972	Pres				1 mo		110	430	580	600	600	1971	M&I	Active
3N/21W 16G1	1972	Pres				1 mo		103	175	350	480	480	1956	M&I	Non-Active
3N21W 10A1	1983	1984				1 mo		5	n.a.	n.a	390	n.a.		M&I	Active
3N21W 10A2	1983	1995				1 mo		107	n.a.	n.a	n.a.	n.a.		M&I	Non-Active
														M&I	Non-Active

Wells Monitored by City of Ventura

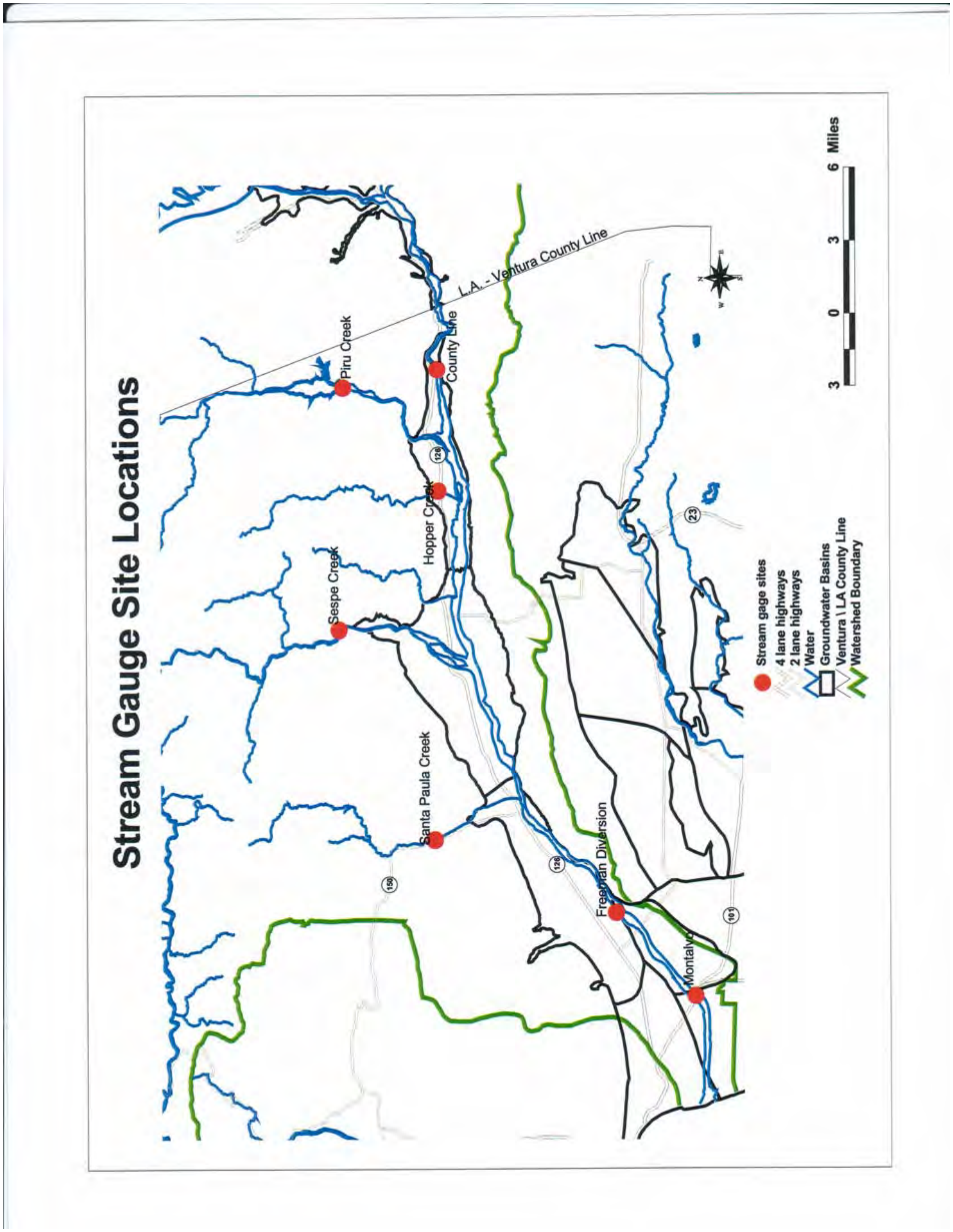
State Well No.	Begin Record	End Record	UWCD Freq	County Freq	Farmer's Irr. Freq	City of S.P. Freq	City of Ven Freq	No. of records	T. Perf	B. Perf	T. Depth	C. Depth	Yr Dr.	Type	Condition
2N/22W 2K9	1998	Pres	1 wk					46	300	400	420	n.a.	1987	M&I	Active

USGS Nested Monitor Well Perf Information

Santa Paula Basin Groundwater Level Monitoring

State Well No.	Begin Record	End Record	UWCD Freq	County Freq	Farmer's Irr. Freq	City of S.P. Freq	City of Ven Freq	No. of records	T. Perf	B. Perf	T. Depth	C. Depth	Yr Dr.	Type	Condition
	Perforation Interval				**Sand Pack Interval**										
	Top	**Bot**			**Top**	**Bot**									
3N/21															
15G1	660	680			640	700									
15G2	520	540			500	560									
15G3	370	390			350	410									
15G4	260	280			240	300									
15G5	60	80			40	100									
16H5	530	550			508	600									
16H6	290	310			270	330									
16H7	150	170			130	190									
16H8	50	70			40	110									

APPENDIX B – MAPS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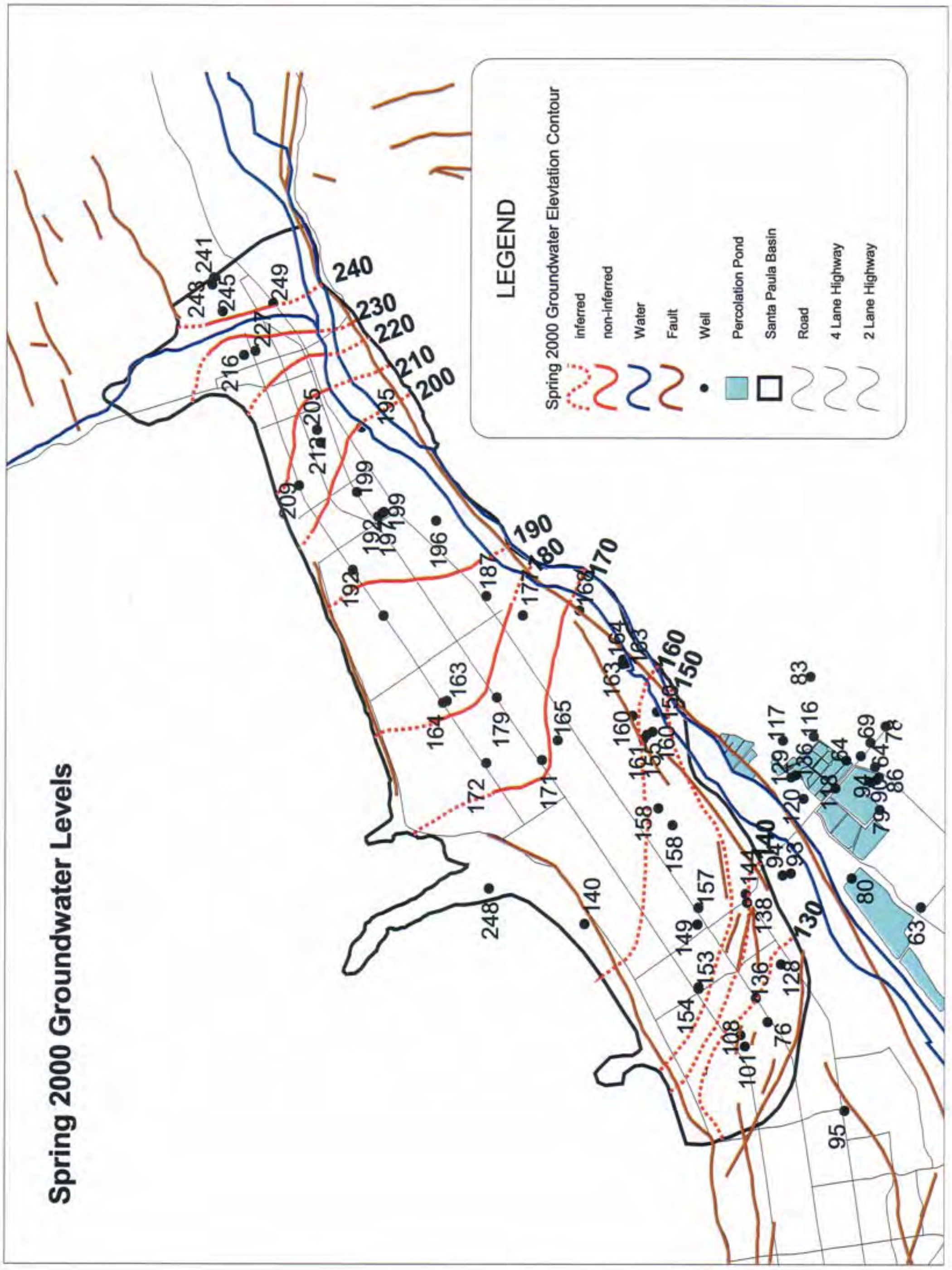
L.A. - Ventura County Line
Hopper Creek
Sespe Creek
Santa Paula Creek
Freeman Diversion
Montalvo
126
150
101
23
Stream gage sites
4 lane highways
2 lane highways
Water
Groundwater Basins
Ventura \ LA County Line
Watershed Boundary
3
0
3
6 Miles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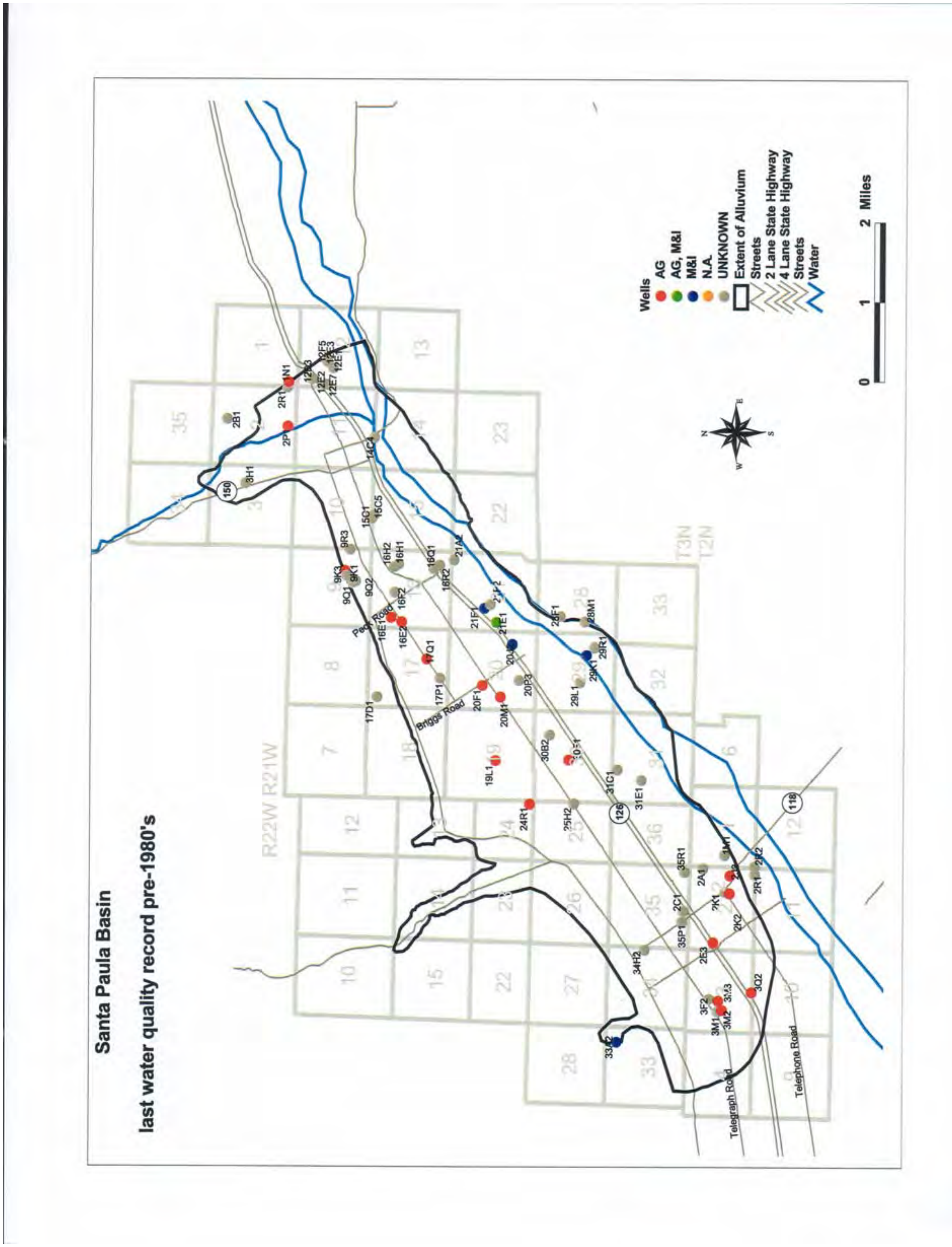
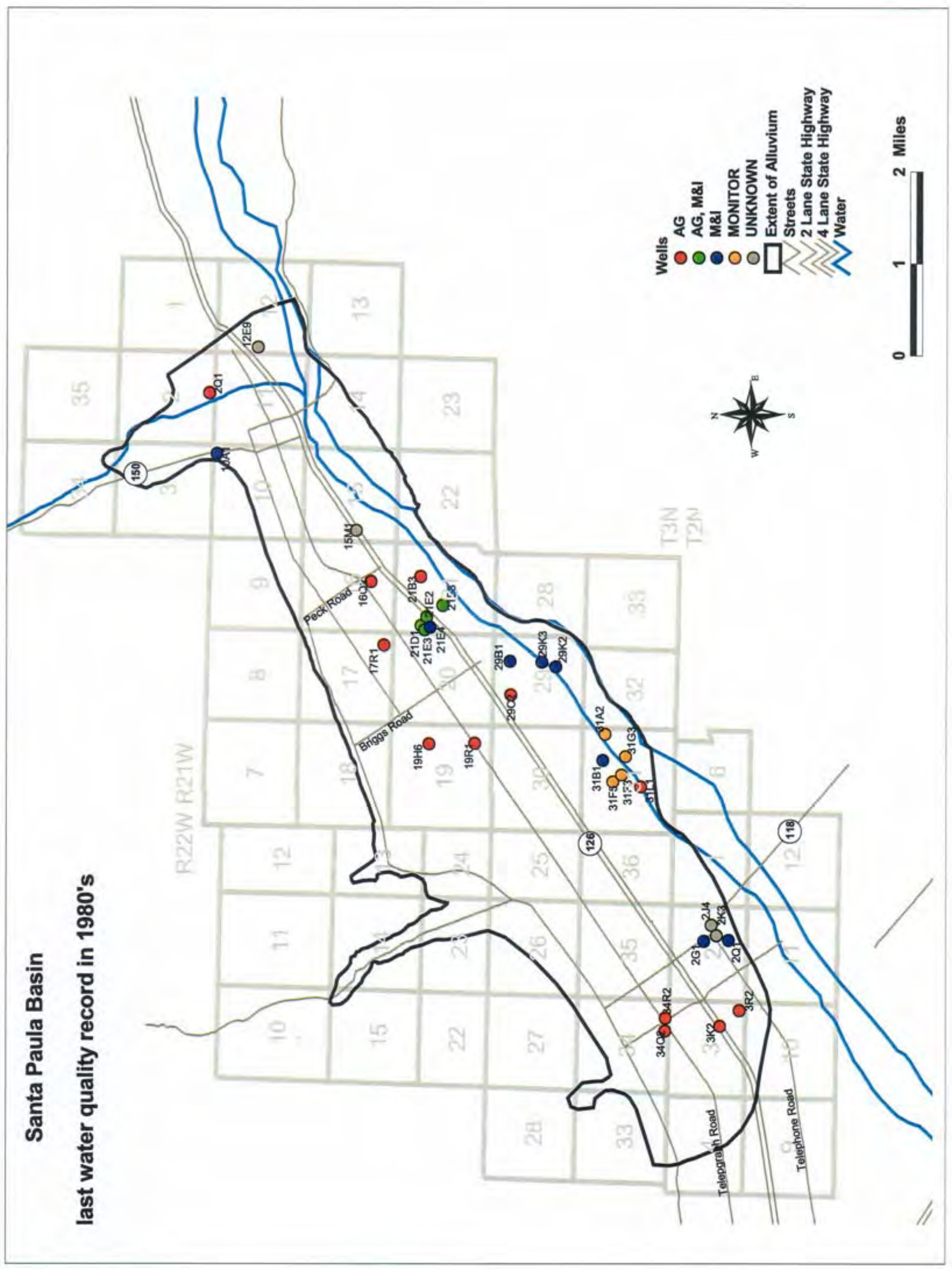
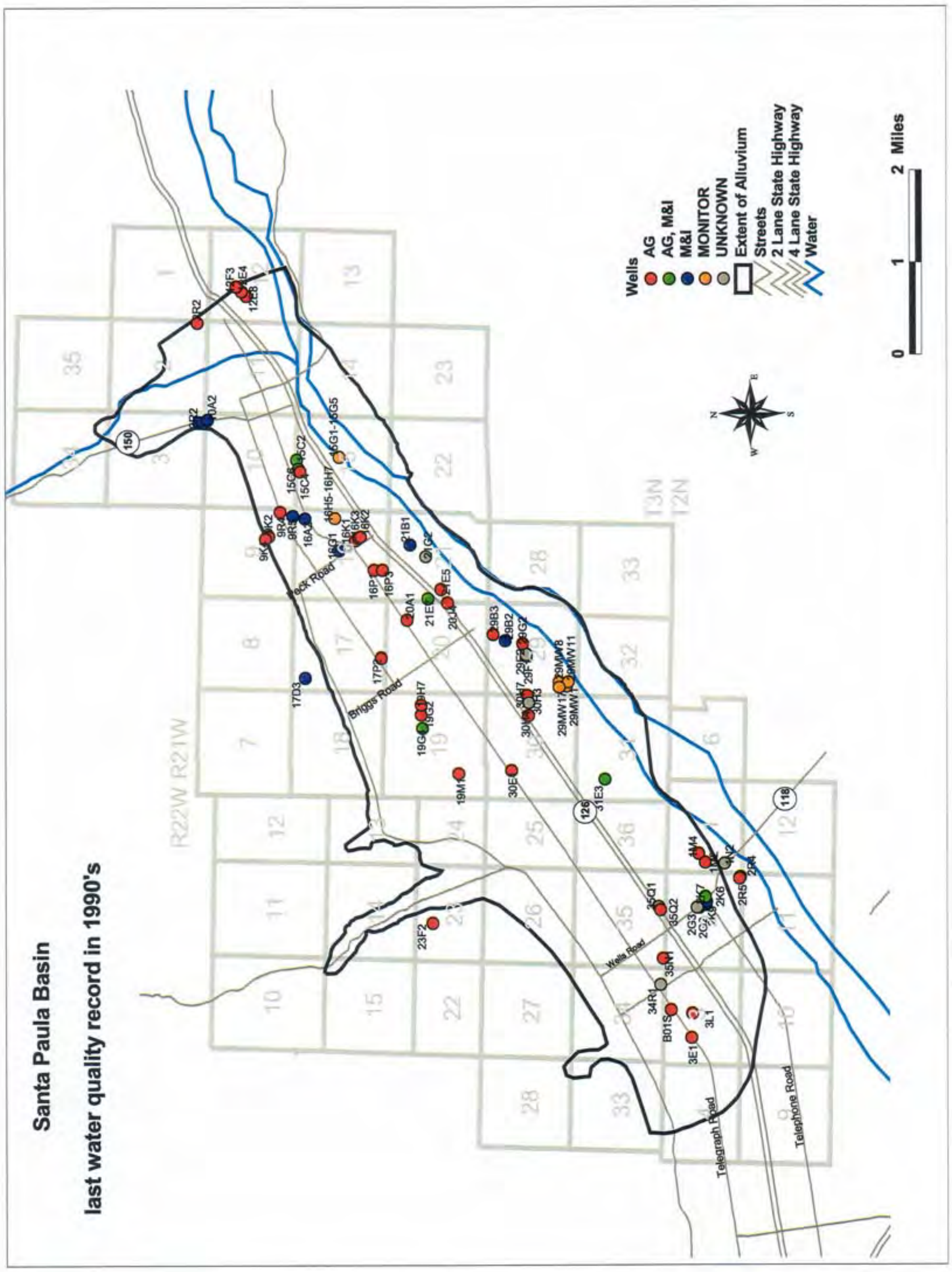
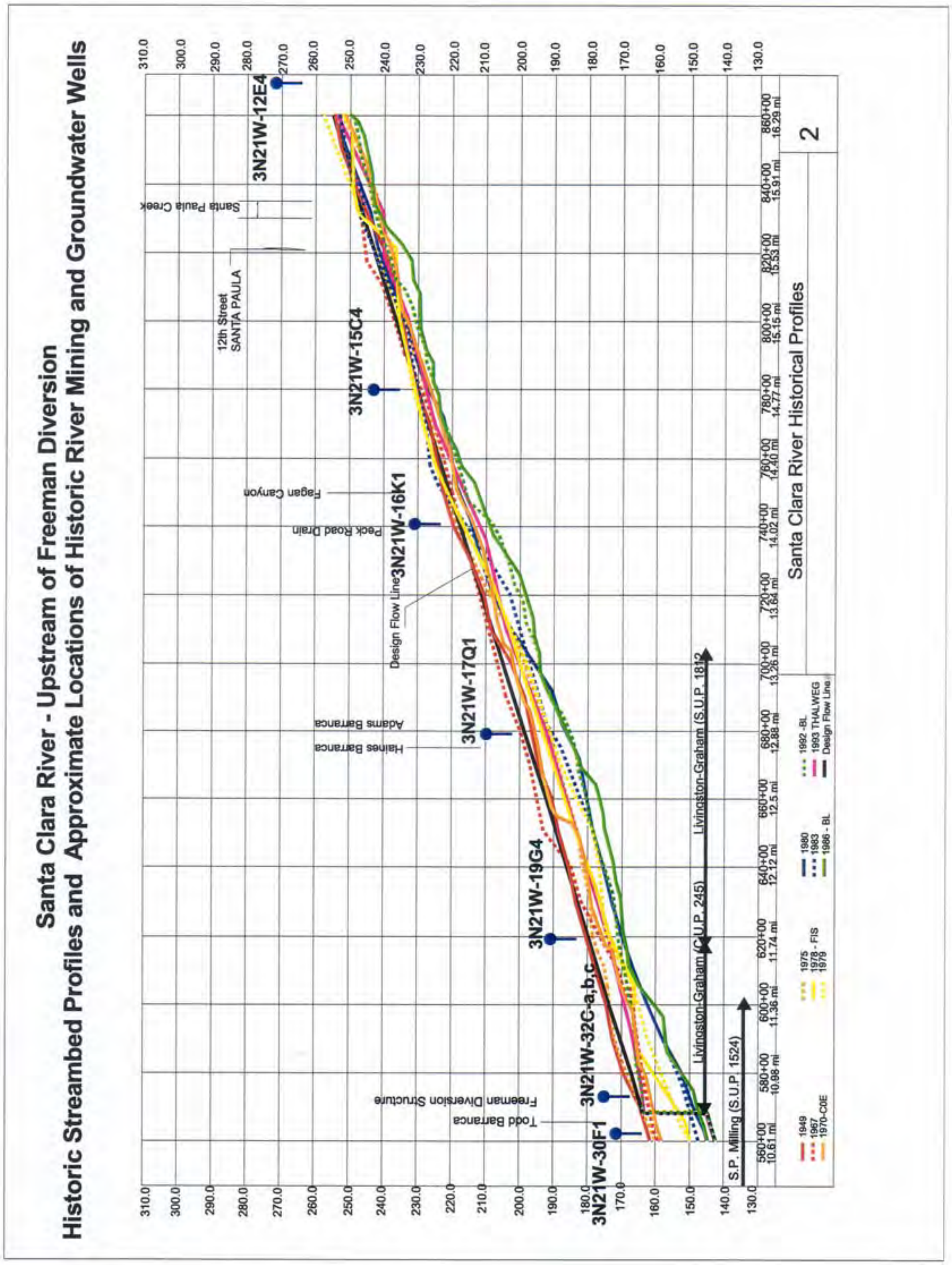
LEGEND
Spring 2000 Groundwater Elevtation Contour
inferred
non-inferred
Water
Fault
Well
Percolation Pond
Santa Paula Basin
Road
4 Lane Highway
2 Lane Highway

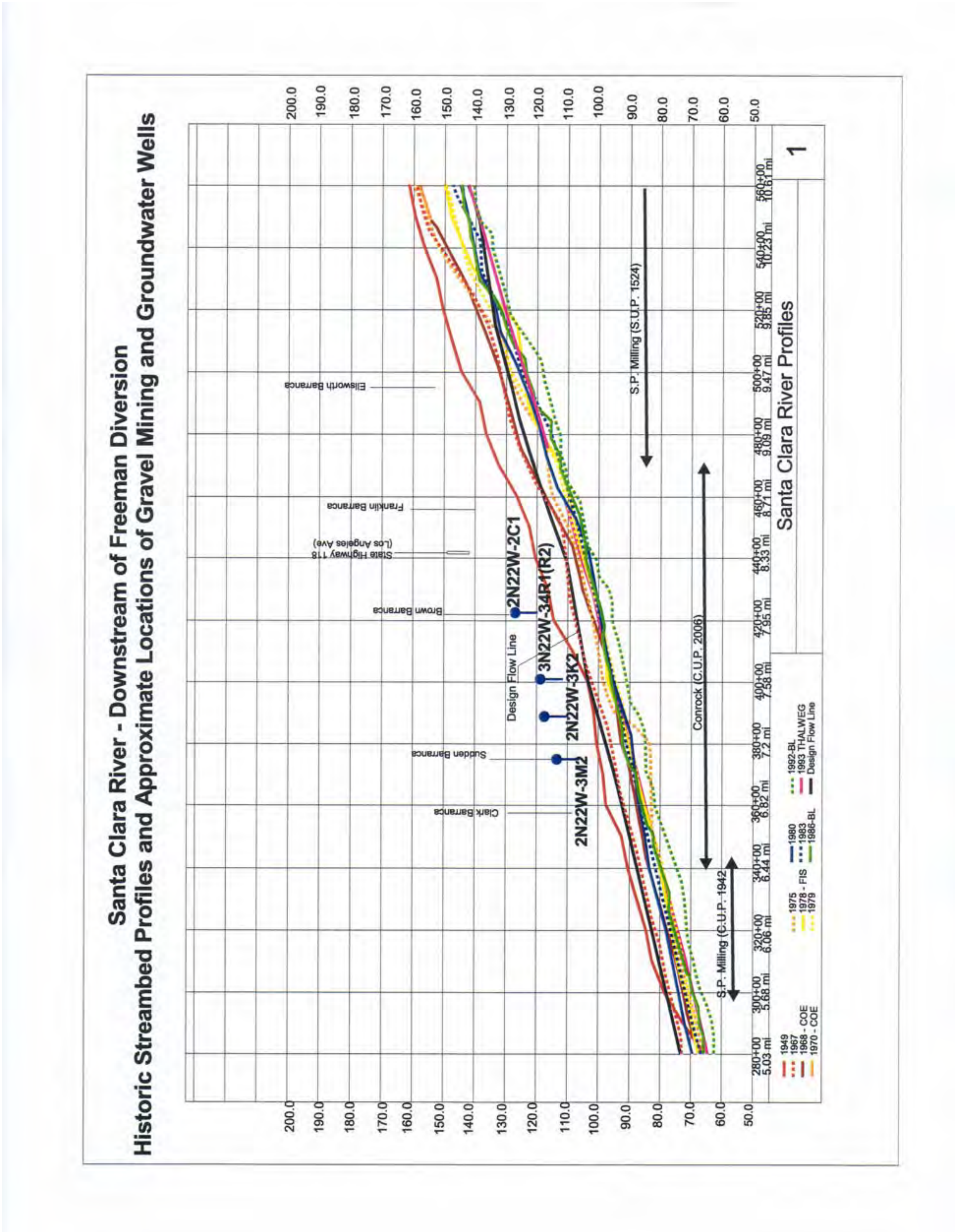

Santa Paula Basin
last water quality record pre-1980's
Wells
AG
AG, M&I
M&I
N.A.
UNKNOWN
Extent of Alluvium
Streets
2 Lane State Highway
4 Lane State Highway
Streets
Water
0
1
2 Miles
R22W R21W
T3N
T2N
Peck Road
Briggs Road
Telegraph Road
Telephone Road

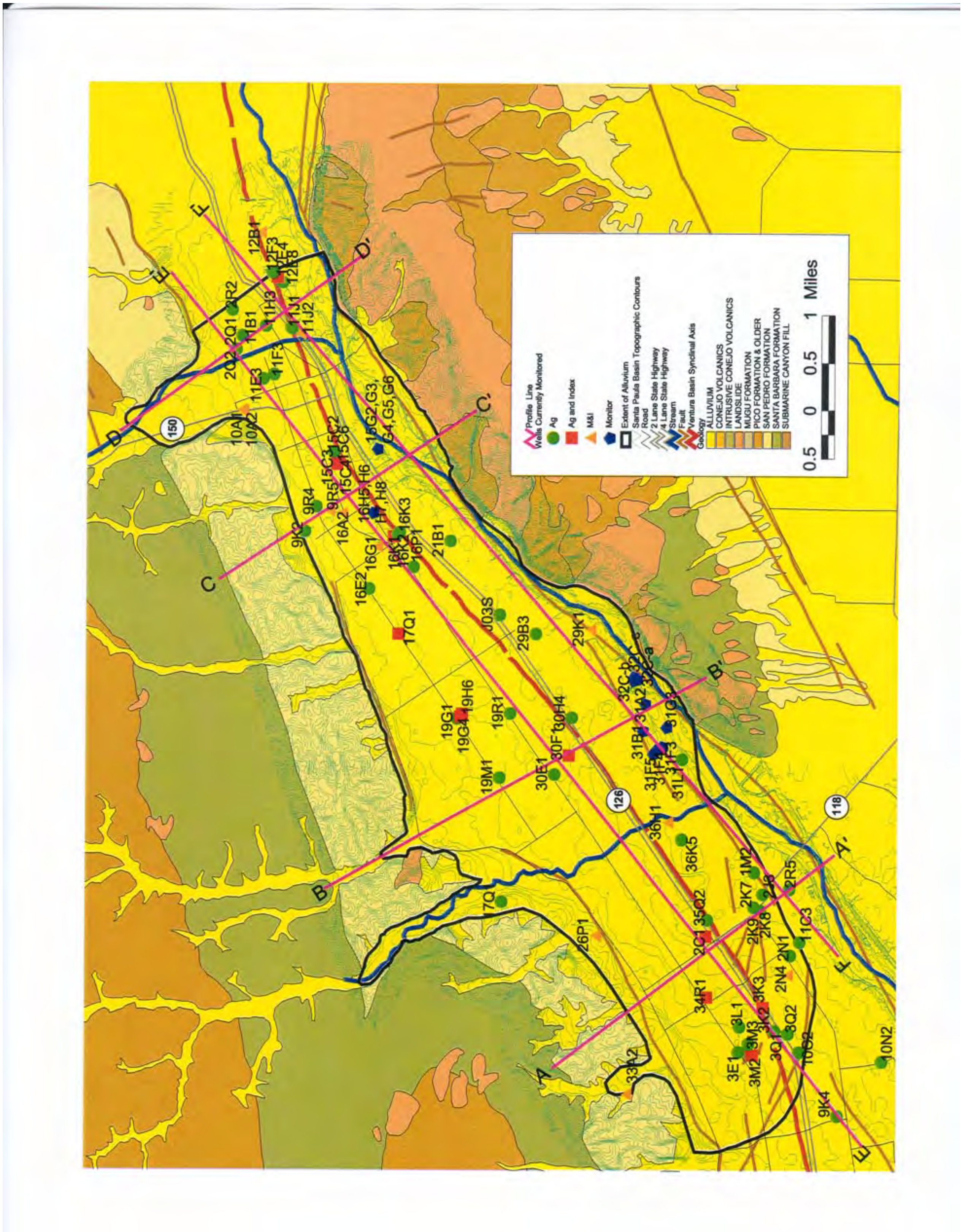

Santa Paula Basin
last water quality record in 1980's
Wells
AG
AG, M&I
M&I
MONITOR
UNKNOWN
Extent of Alluvium
Streets
2 Lane State Highway
4 Lane State Highway
Water
0
1
2 Miles
Peck Road
Briggs Road
Telegraph Road
Telephone Road
R22W R21W
T3N
T2N
150
126
118

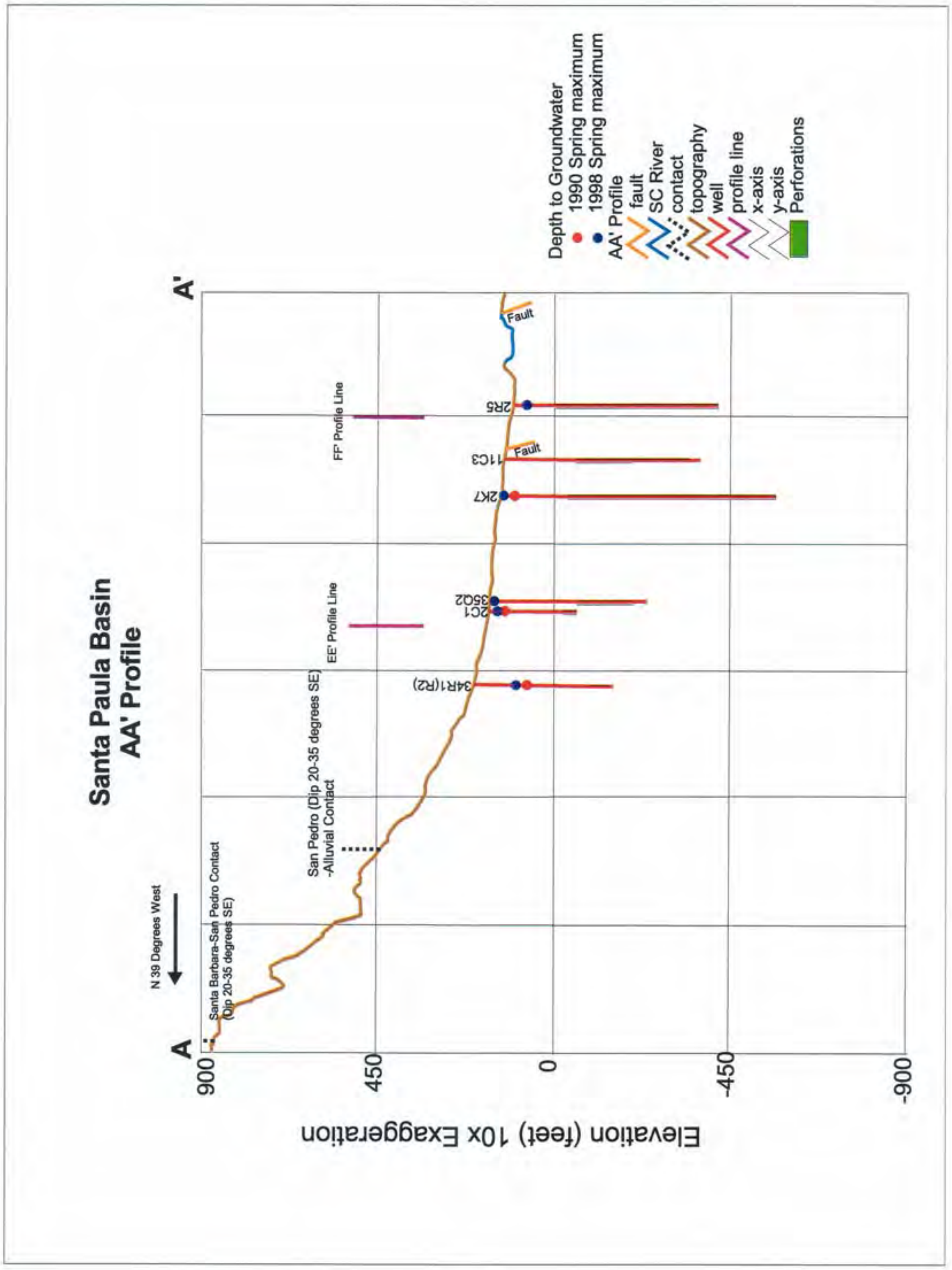

Santa Paula Basin
last water quality record in 1990's
Wells
AG
AG, M&I
M&I
MONITOR
UNKNOWN
Extent of Alluvium
Streets
2 Lane State Highway
4 Lane State Highway
Water
0
1
2 Miles
Peck Road
Briggs Road
Wells Road
Telegraph Road
Telephone Road
R22W R21W
T3N
T2N
150
126
118

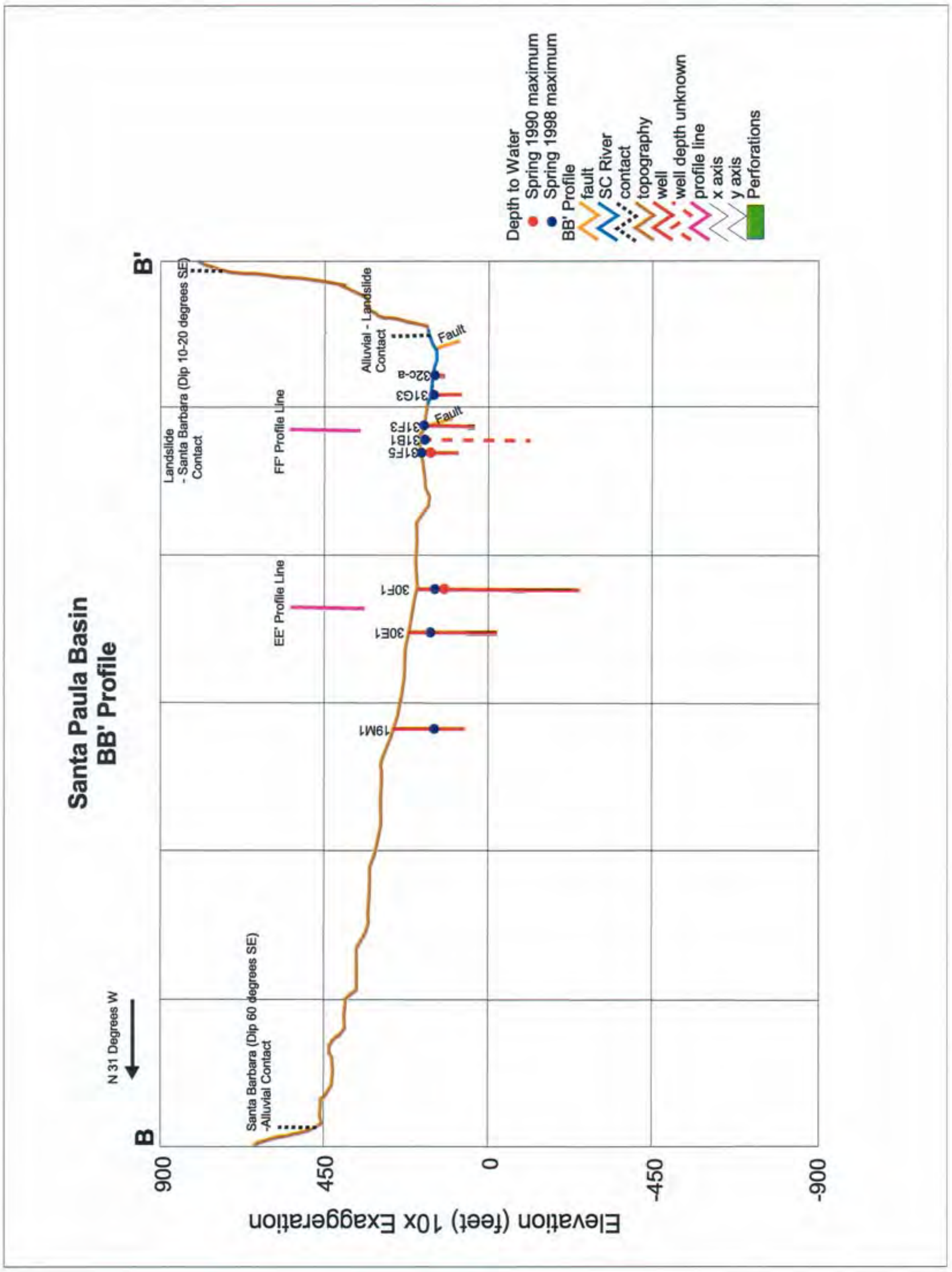
APPENDIX C – RIVER AND BASIN PROFILES

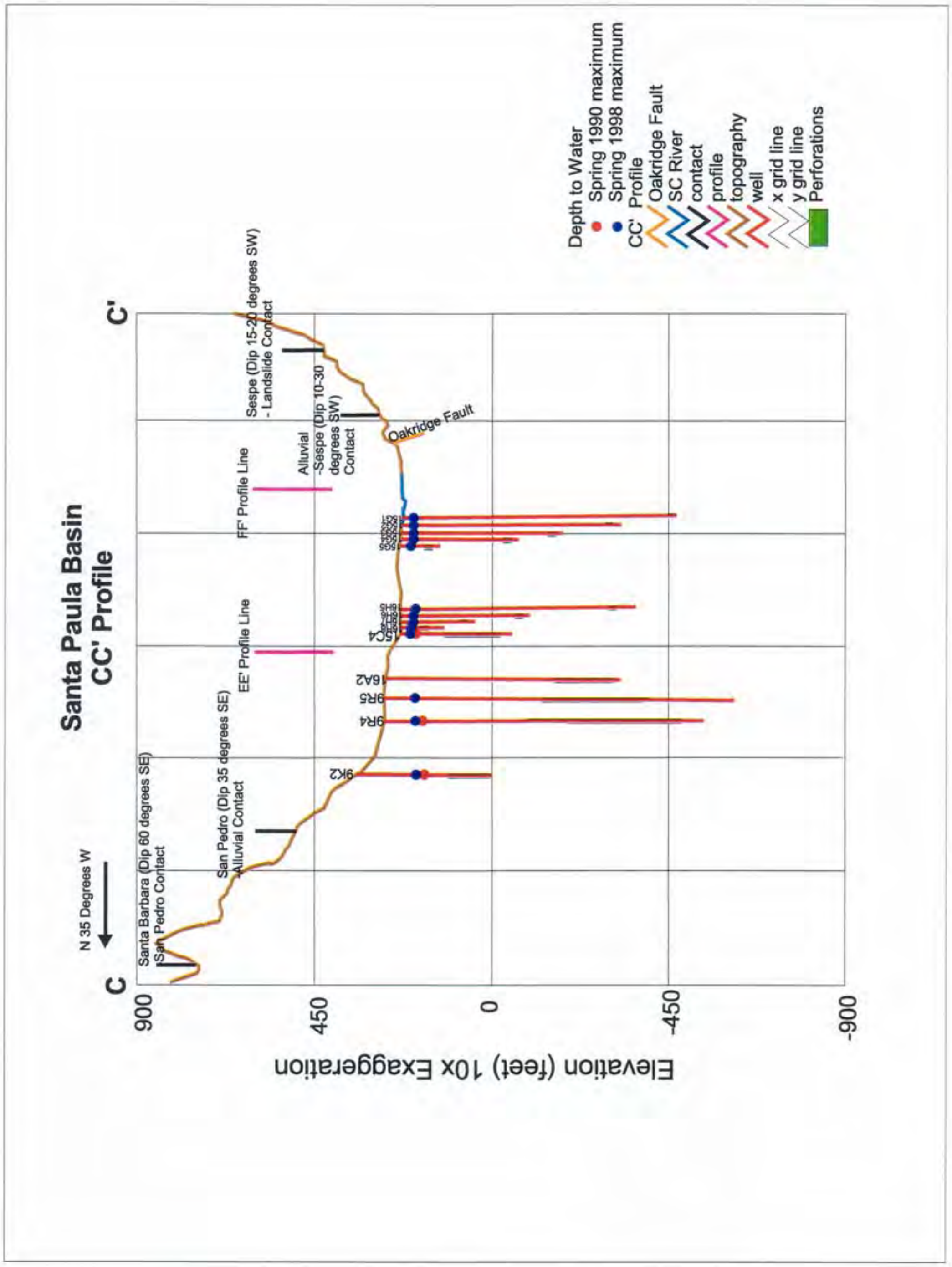

Santa Clara River - Upstream of Freeman Diversion
Historic Streambed Profiles and Approximate Locations of Historic River Mining and Groundwater Wells
3N21W-12E4
3N21W-15C4
3N21W-16K1
3N21W-17Q1
3N21W-19G4
3N21W-32C-a,b,c
3N21W-30F1
Santa Paula Creek
12th Street SANTA PAULA
Fagan Canyon
Peck Road Drain
Design Flow Line
Adams Barranca
Haines Barranca
Freeman Diversion Structure
Todd Barranca
S.P. Milling (S.U.P. 1524)
Livingston-Graham (C.U.P. 245)
Livingston-Graham (S.U.P. 1812)
Santa Clara River Historical Profiles
2

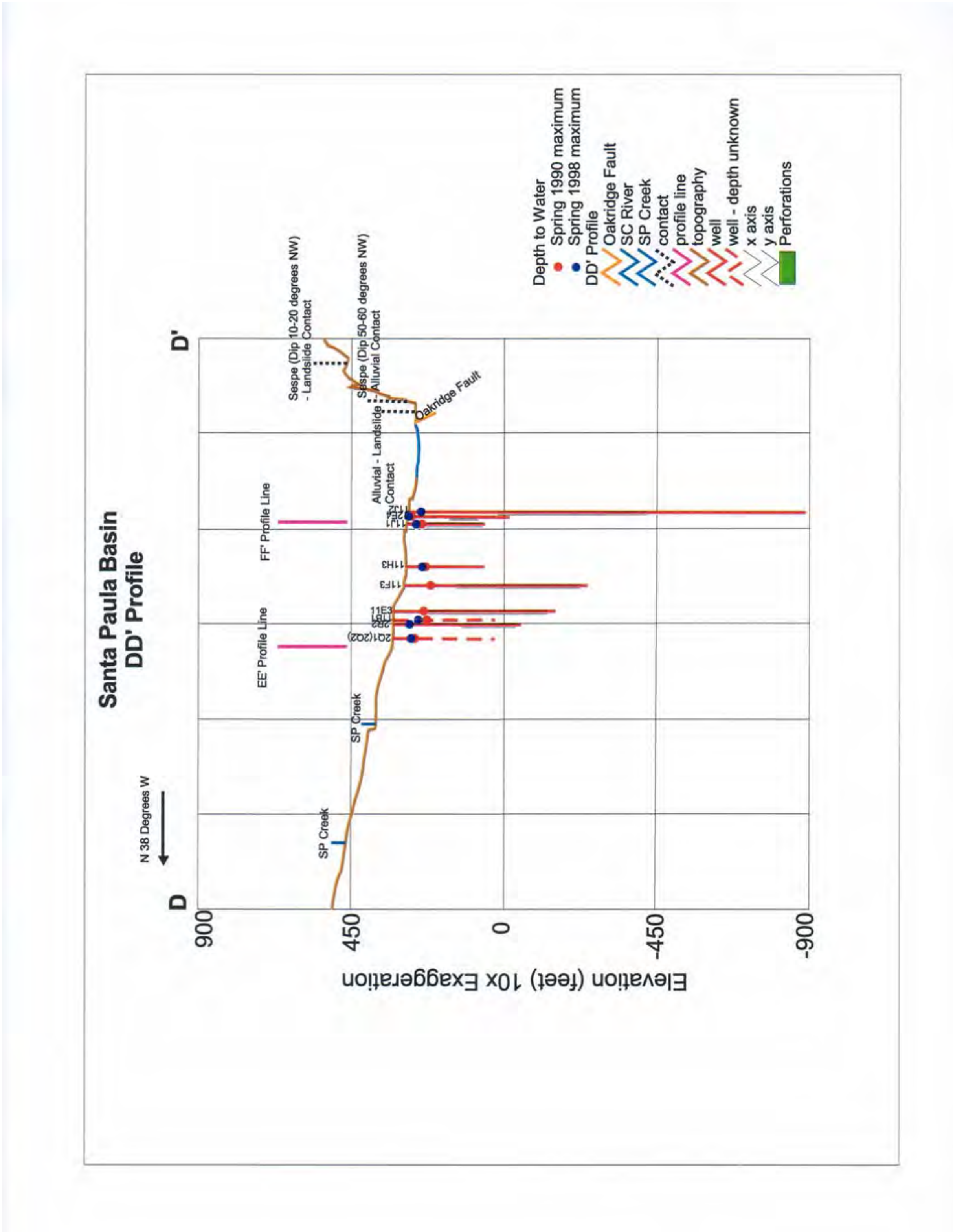

Santa Clara River - Downstream of Freeman Diversion
Historic Streambed Profiles and Approximate Locations of Gravel Mining and Groundwater Wells
Santa Clara River Profiles
1
Ellsworth Barranca
Franklin Barranca
State Highway 118
(Los Angeles Ave)
Brown Barranca
Sudden Barranca
Clark Barranca
2N22W-2C1
3N22W-34R1(R2)
2N22W-3K2
2N22W-3M2
Design Flow Line
S.P. Milling (S.U.P. 1524)
Conrock (C.U.P. 2006)
S.P. Milling (C.U.P. 1942)
280+00 5.03 mi
300+00 5.68 mi
320+00 6.06 mi
340+00 6.44 mi
360+00 6.82 mi
380+00 7.2 mi
400+00 7.58 mi
420+00 7.95 mi
440+00 8.33 mi
460+00 8.71 mi
480+00 9.09 mi
500+00 9.47 mi
520+00 9.85 mi
540+00 10.23 mi
560+00 10.61 mi
1949
1967
1968 - COE
1970 - COE
1975
1978 - FIS
1979
1980
1983
1986-BL
1992-BL
1993 THALWEG
Design Flow Line

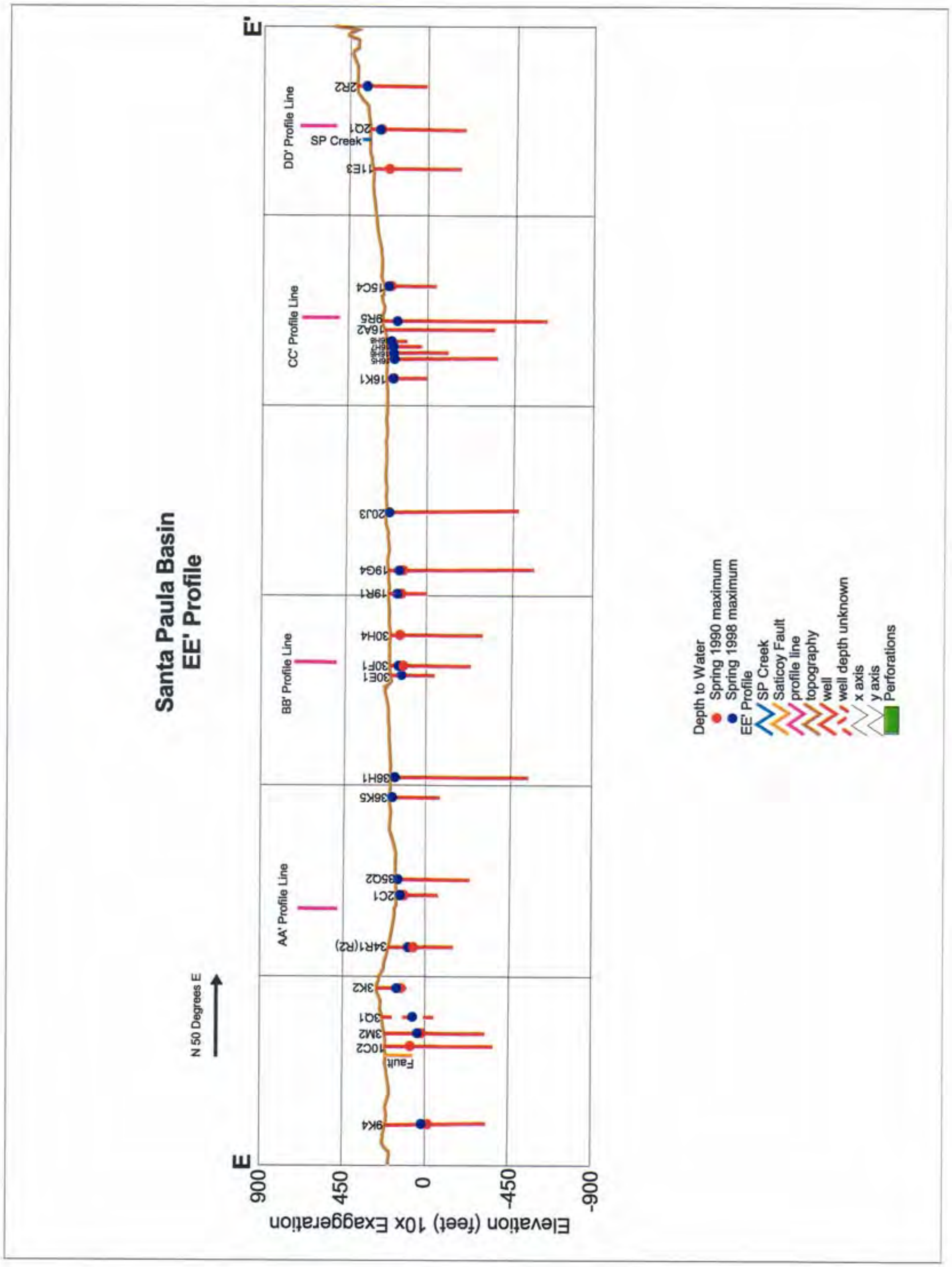

Profile Line
Wells Currently Monitored
Ag
Ag and Index
M&I
Monitor
Extent of Alluvium
Santa Paula Basin Topographic Contours
Road
2 Lane State Highway
4 Lane State Highway
Stream
Fault
Ventura Basin Synclinal Axis
Geology
ALLUVIUM
CONEJO VOLCANICS
INTRUSIVE CONEJO VOLCANICS
LANDSLIDE
MUGU FORMATION
PICO FORMATION & OLDER
SAN PEDRO FORMATION
SANTA BARBARA FORMATION
SUBMARINE CANYON FILL
0.5 0 0.5 1 Miles

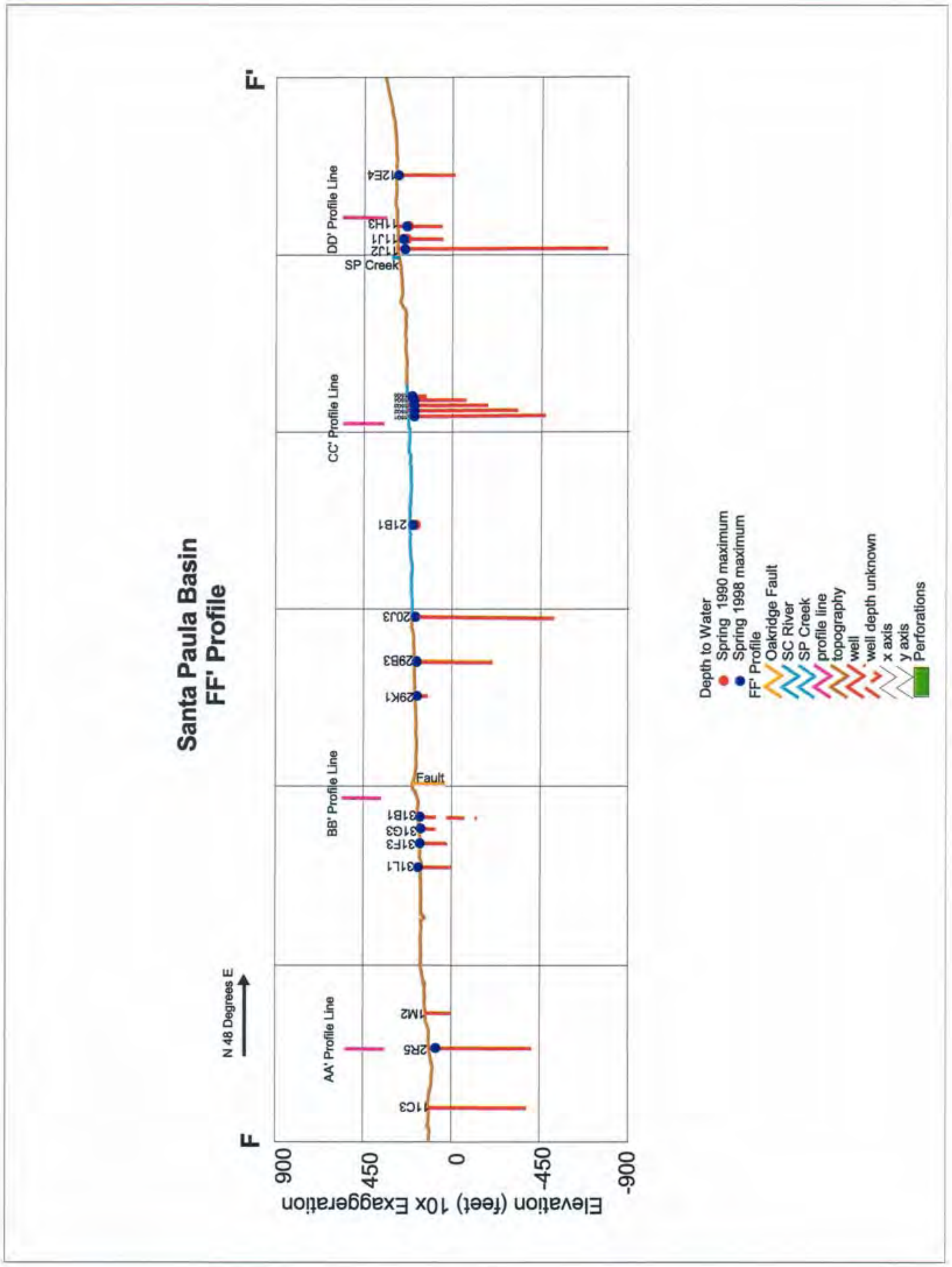

Santa Paula Basin
AA' Profile
A
A'
N 39 Degrees West
Santa Barbara-San Pedro Contact (Dip 20-35 degrees SE)
San Pedro (Dip 20-35 degrees SE) -Alluvial Contact
EE' Profile Line
FF' Profile Line
34R1(R2)
2C1
35Q2
2K7
11C3
2R5
Fault
Fault
Elevation (feet) 10x Exaggeration
900
450
0
-450
-900
Depth to Groundwater
1990 Spring maximum
1998 Spring maximum
AA' Profile
fault
SC River
contact
topography
well
profile line
x-axis
y-axis
Perforations

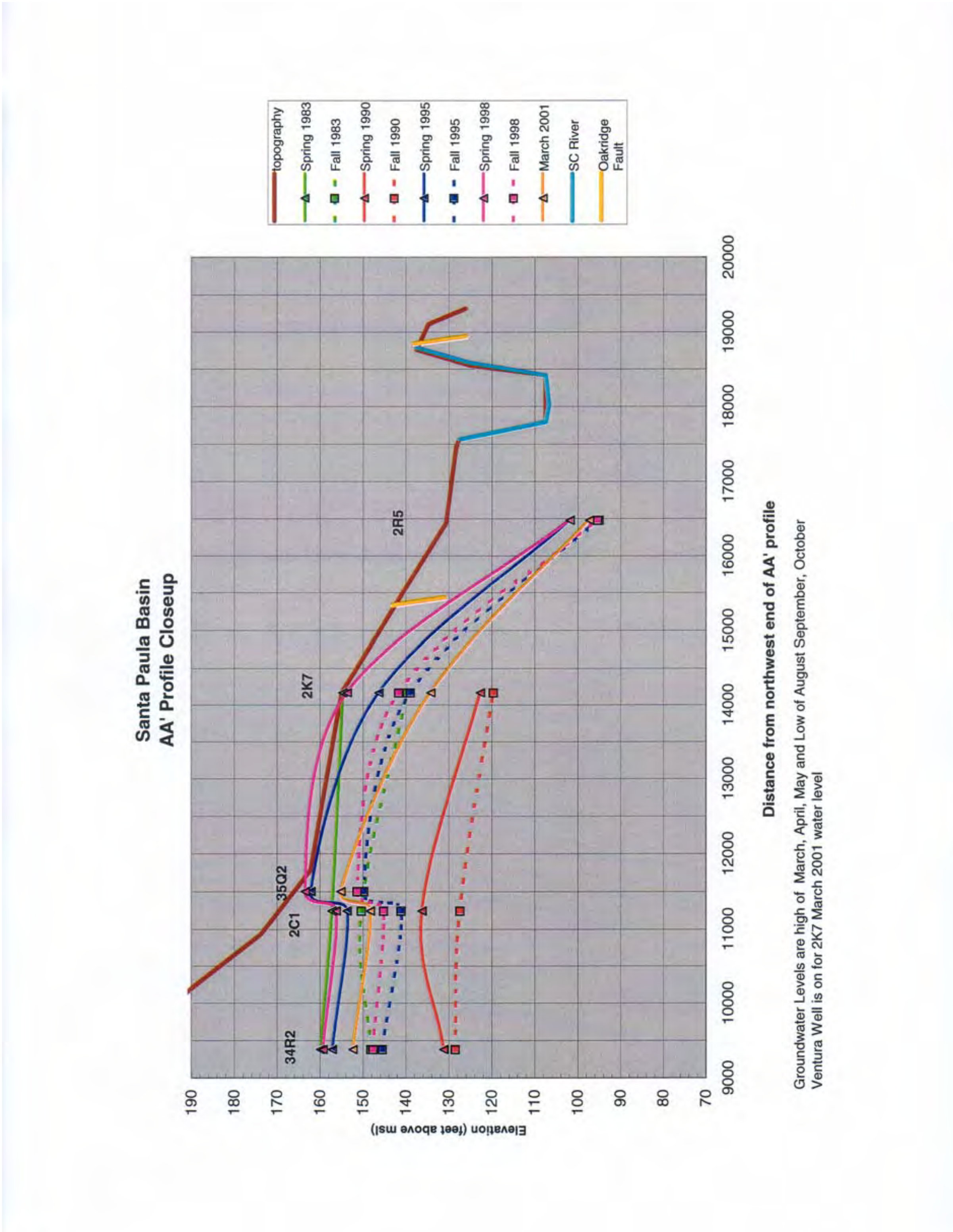

Santa Paula Basin
BB' Profile
B
B'
N 31 Degrees W
Elevation (feet) 10x Exaggeration
900
450
0
-450
-900
Santa Barbara (Dip 60 degrees SE)
-Alluvial Contact
Landslide
- Santa Barbara (Dip 10-20 degrees SE)
Contact
Alluvial - Landslide
Contact
Fault
FF' Profile Line
EE' Profile Line
19M1
30E1
30F1
31F5
31B1
31F3
31G3
32C-a
Depth to Water
Spring 1990 maximum
Spring 1998 maximum
BB' Profile
fault
SC River
contact
topography
well
well depth unknown
profile line
x axis
y axis
Perforations

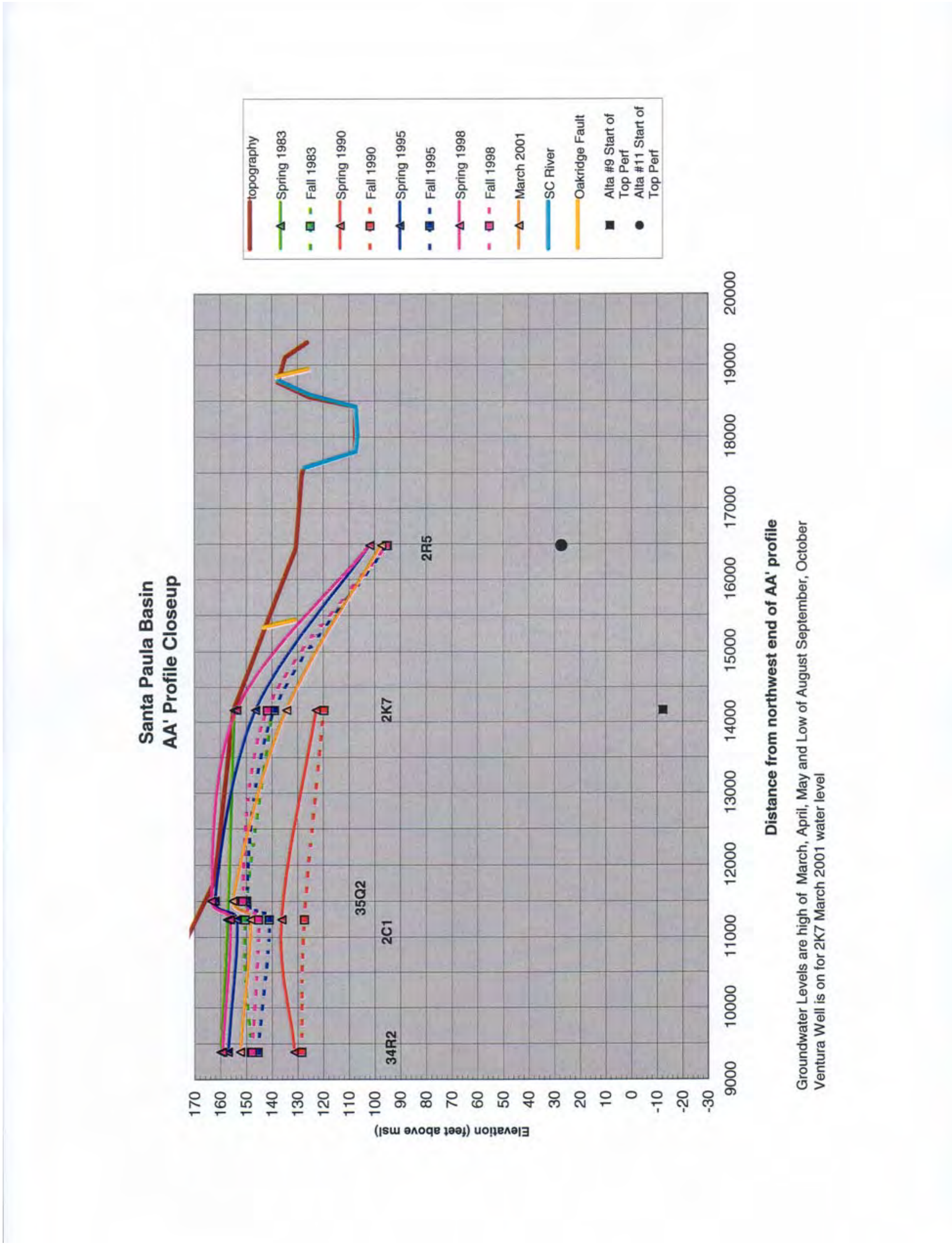

Santa Paula Basin
CC' Profile
N 35 Degrees W
C
C'
Elevation (feet) 10x Exaggeration
900
450
0
-450
-900
Santa Barbara (Dip 60 degrees SE)
San Pedro Contact
San Pedro (Dip 35 degrees SE)
Alluvial Contact
EE' Profile Line
FF' Profile Line
Alluvial
-Sespe (Dip 10-30 degrees SW)
Contact
Sespe (Dip 15-20 degrees SW)
- Landslide Contact
Oakridge Fault
9K2
9R4
9R5
16A2
15C4
Depth to Water
Spring 1990 maximum
Spring 1998 maximum
CC' Profile
Oakridge Fault
SC River
contact
profile
topography
well
x grid line
y grid line
Perforations

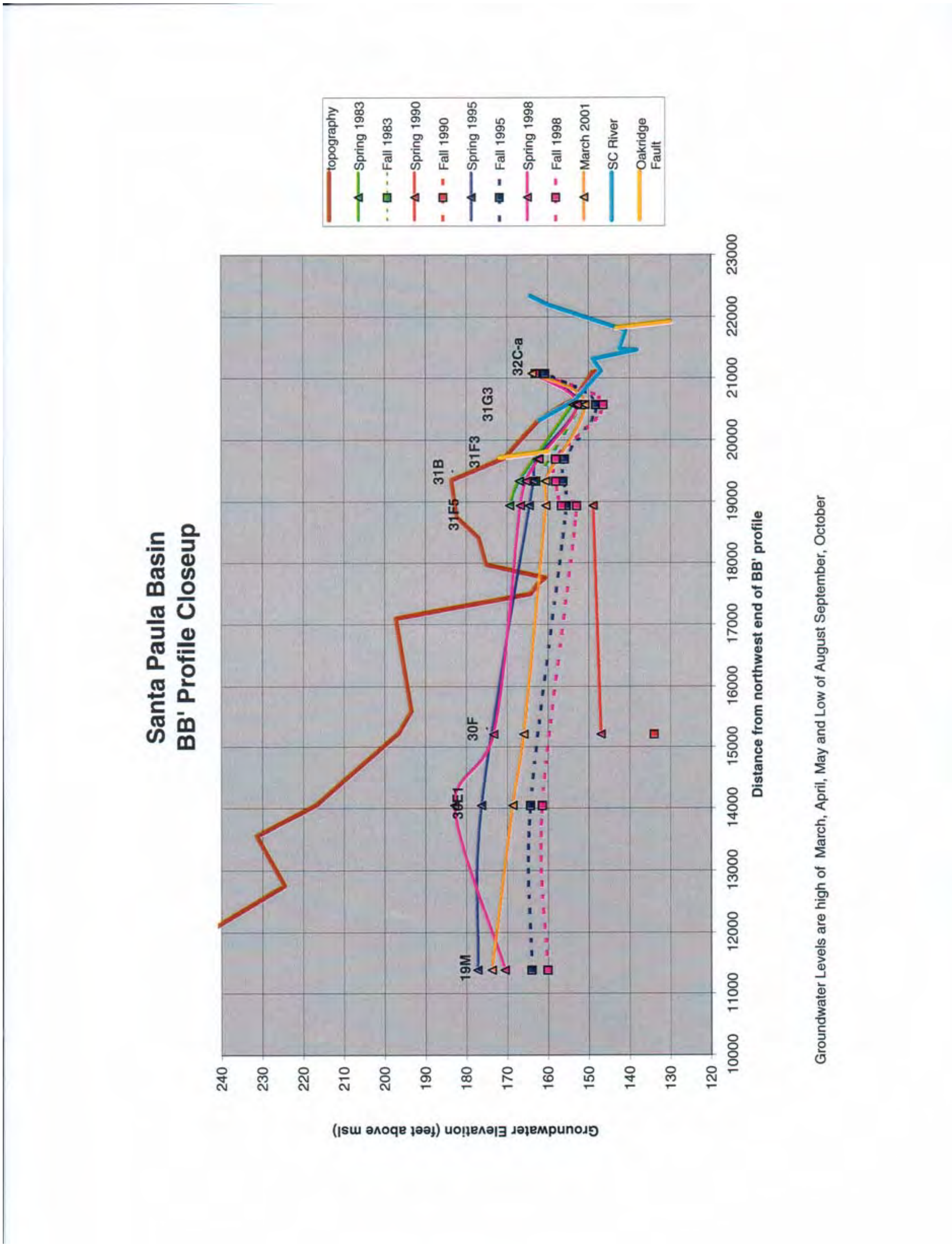

Santa Paula Basin
DD' Profile
Elevation (feet) 10x Exaggeration
900
450
0
-450
-900
D
D'
N 38 Degrees W
SP Creek
SP Creek
EE' Profile Line
FF' Profile Line
Alluvial - Landslide Contact
Sespe (Dip 10-20 degrees NW) - Landslide Contact
Sespe (Dip 50-60 degrees NW) Alluvial Contact
Oakridge Fault
11F3
11H3
Depth to Water
Spring 1990 maximum
Spring 1998 maximum
DD' Profile
Oakridge Fault
SC River
SP Creek
contact
profile line
topography
well
well - depth unknown
x axis
y axis
Perforations

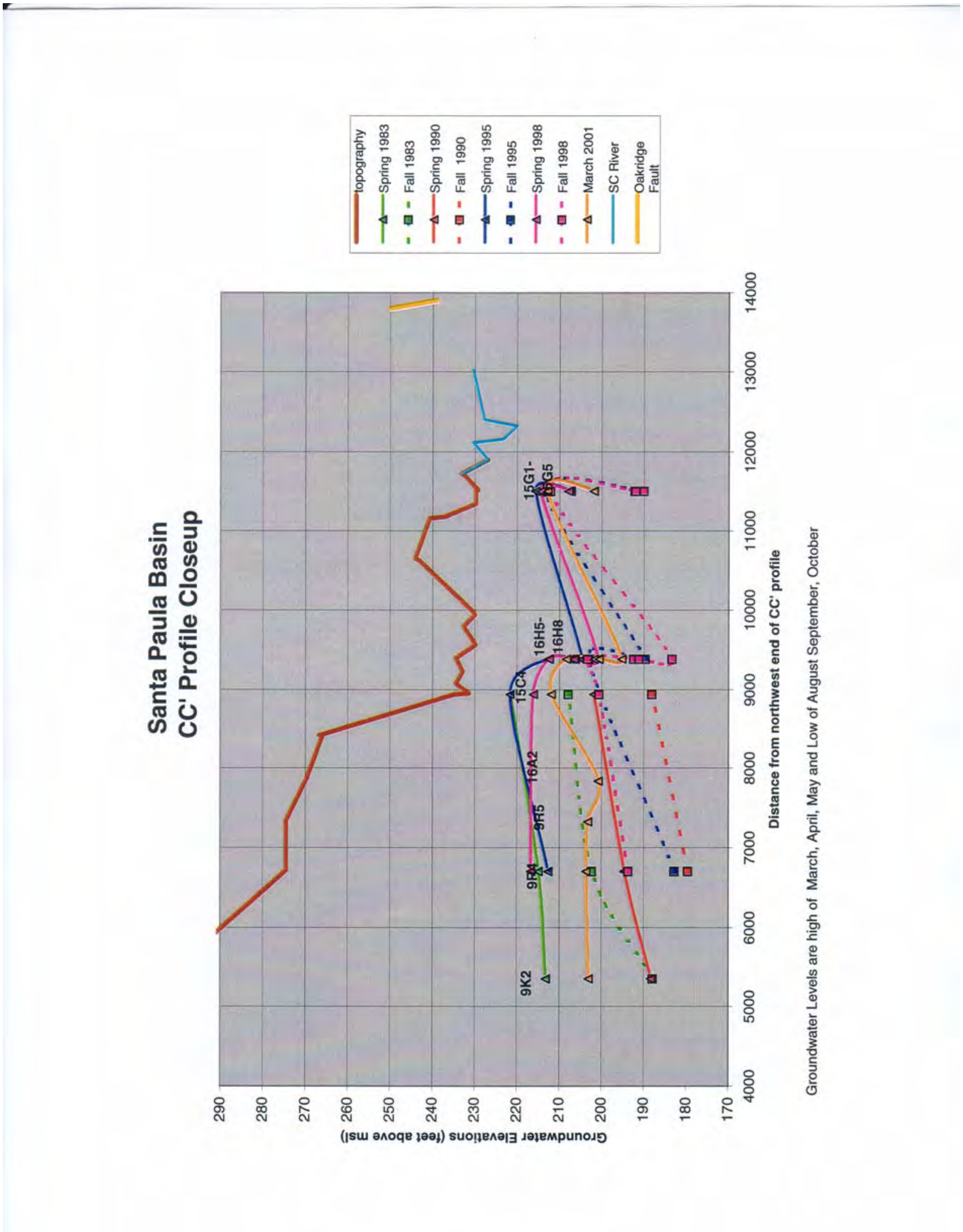

Santa Paula Basin
EE' Profile
N 50 Degrees E
Elevation (feet) 10x Exaggeration
900
450
0
-450
-900
E
E'
AA' Profile Line
BB' Profile Line
CC' Profile Line
DD' Profile Line
SP Creek
Fault
9K4
10C2
3M2
3Q1
3K2
34R1(R2)
2C1
35Q2
36K5
36H1
30E1
30F1
30H4
19R1
19G4
20J3
16K1
16A2
9R5
15C4
11E3
2Q1
2R2
Depth to Water
Spring 1990 maximum
Spring 1998 maximum
EE' Profile
SP Creek
Saticoy Fault
profile line
topography
well
well depth unknown
x axis
y axis
Perforations

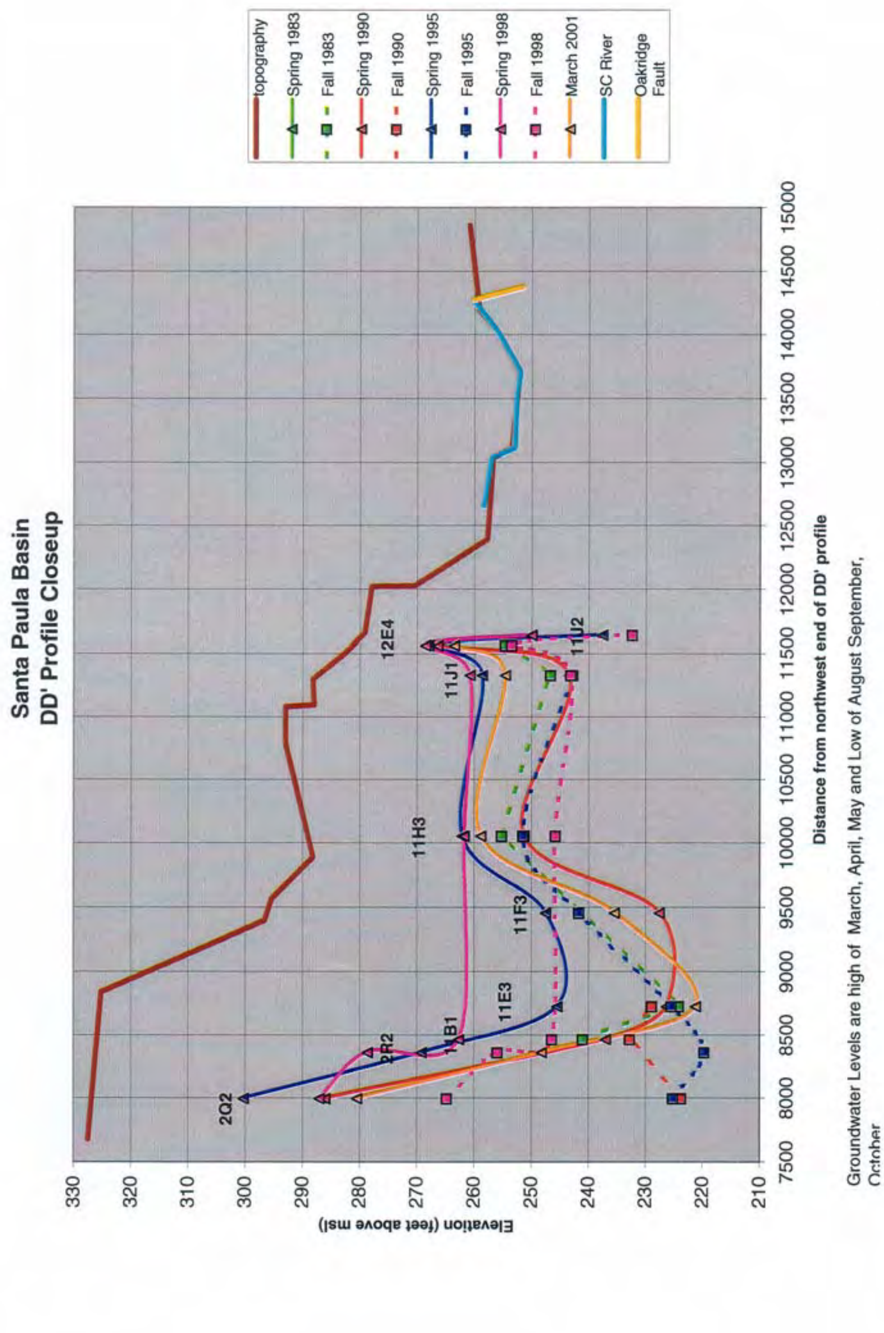

Santa Paula Basin
FF' Profile
F
F'
N 48 Degrees E
Elevation (feet) 10x Exaggeration
900
450
0
-450
-900
AA' Profile Line
BB' Profile Line
CC' Profile Line
DD' Profile Line
1C3
2R5
1M2
31L1
31F3
31G3
31B1
Fault
29K1
29B3
20J3
21B1
SP Creek
11J2
11J1
11H3
12E4
Depth to Water
Spring 1990 maximum
Spring 1998 maximum
FF' Profile
Oakridge Fault
SC River
SP Creek
profile line
topography
well
well depth unknown
x axis
y axis
Perforations


Santa Paula Basin
AA' Profile Closeup
topography
Spring 1983
Fall 1983
Spring 1990
Fall 1990
Spring 1995
Fall 1995
Spring 1998
Fall 1998
March 2001
SC River
Oakridge Fault
34R2
2C1
35Q2
2K7
2R5
Elevation (feet above msl)
190
180
170
160
150
140
130
120
110
100
90
80
70
9000
10000
11000
12000
13000
14000
15000
16000
17000
18000
19000
20000
Distance from northwest end of AA' profile
Groundwater Levels are high of March, April, May and Low of August September, October
Ventura Well is on for 2K7 March 2001 water level


Santa Paula Basin
AA' Profile Closeup
topography
Spring 1983
Fall 1983
Spring 1990
Fall 1990
Spring 1995
Fall 1995
Spring 1998
Fall 1998
March 2001
SC River
Oakridge Fault
Alta #9 Start of Top Perf
Alta #11 Start of Top Perf
34R2
2C1
35Q2
2K7
2R5
Elevation (feet above msl)
Distance from northwest end of AA' profile
Groundwater Levels are high of March, April, May and Low of August September, October
Ventura Well is on for 2K7 March 2001 water level


Santa Paula Basin
BB' Profile Closeup
Groundwater Elevation (feet above msl)
Distance from northwest end of BB' profile
topography
Spring 1983
Fall 1983
Spring 1990
Fall 1990
Spring 1995
Fall 1995
Spring 1998
Fall 1998
March 2001
SC River
Oakridge Fault
19M
30E1
30F
31F5
31B
31F3
31G3
32C-a
Groundwater Levels are high of March, April, May and Low of August September, October


Santa Paula Basin
CC' Profile Closeup
Groundwater Elevations (feet above msl)
Distance from northwest end of CC' profile
topography
Spring 1983
Fall 1983
Spring 1990
Fall 1990
Spring 1995
Fall 1995
Spring 1998
Fall 1998
March 2001
SC River
Oakridge Fault
9K2
9R4
9R5
16A2
15C4
16H5-
16H8
15G1-
15G5
Groundwater Levels are high of March, April, May and Low of August September, October


Santa Paula Basin
DD' Profile Closeup
Elevation (feet above msl)
Distance from northwest end of DD' profile
Groundwater Levels are high of March, April, May and Low of August September, October
topography
Spring 1983
Fall 1983
Spring 1990
Fall 1990
Spring 1995
Fall 1995
Spring 1998
Fall 1998
March 2001
SC River
Oakridge Fault
2Q2
2R2
11B1
11E3
11F3
11H3
11J1
12E4
11J2

APPENDIX D – WELL-BY-WELL ANALYSIS

APPENDIX D – WELL-BY-WELL ANALYSIS

East Basin Wells

East basin wells are those wells located east of well 3N/21W-19R1 in Santa Paula. There was a total of 16 east basin wells evaluated.

3N/21W-12E4

The change in peak water level elevation from 1983 to 1995 for this well is negative 2.3 feet. Water levels for this well peak in the wet years of 1983, 1995 and 1998. The peak water level in the wet year of 1993 is below the peak water level in 1994. The lowest high during the drought occurred in 1991.

3N/21W-11J1

The change in peak water level elevation from 1983 to 1995 for this well is positive 5 feet. Water levels peaked in the wet years 1983, 1993, 1995 and 1998. The lowest water level from the end of the drought, 1990-1991, to 1994 is in 1990 before the "March Miracle".

3N/21W-11E3

The change in peak water level elevation from 1983 to 1995 is negative 2.6 feet. Water levels for this well peak in the wet years 1983, 1993, and 1995. There are no data for 1998. There is limited data for the years 1984 to 1987. The data for 1999 to 2001 show water levels lower than drought levels. The lowest water level from the end of the drought, 1990-1991, to 1994, is in 1991 before the "March Miracle". There are limited data in 1990.

3N/21-16A2

The change in peak water level elevation from 1983 to 1995 cannot be calculated, as there are no data in 1983. Water levels for this well peak in the wet year of 1998. There are no data in 1983. The 1993 peak water level is slightly below the 1994 peak water level. The absence of monthly water level data in 1993 may have resulted in not capturing the "absolute" peak water level. There are essentially no data in 1995. Early 1995 data appear to be pumping levels. The lowest water level from the end of the drought, 1990-1991, to 1994, is in 1990 before the 'March Miracle". There are limited data in 1990 through 1992.

3N/21-16K1

The change in peak water level elevation from 1983 to 1995 is negative 0.6 feet. Water levels for this well peak in the wet years 1983, 1995 and 1998. The peak water level in 1983 is just slightly above the peak water level in 1984. The absence of May 1983 water level data may have caused a miss in the "absolute" peak water level. The water level peak for 1993 is slightly below the water level peak for 1994. The lowest water level from the end of the drought, 1990-1991, to 1994, is in 1991 before the "March Miracle".

3N/21W-15C2

The change in peak water level elevation from 1983 to 1995 is negative 4.4 feet. Water levels for this well peak in the wet years 1983, 1993, and 1995. There are no data in 1998. There are no data in 1984 and most of 1985. The lowest water level from the end of the drought, 1990-1991, to 1994, is in 1990, before the "March Miracle".

3N/21W-15C6

The change in peak water level elevation from 1983 to 1995 cannot be calculated, as there are no data in 1983. Water levels for this well peak in the wet years 1993, 1995, and 1998. There are no data in 1983. The lowest water level from the end of the drought, 1990-1991, to 1994, is in 1990. There are limited data in 1990, 1991, 1993 and 1996.

3N/21W-15G4

The change in peak water level elevation from 1983 to 1995 cannot be calculated, as there are no data in 1983. This is a USGS monitor well that was drilled in 1994. Water levels for this well peak in the wet years 1995 and 1998.

3N/21W-15G5

The change in peak water level elevation from 1983 to 1995 cannot be calculated, as there are no data in 1983. This is a USGS monitor well that was drilled in 1994. Water levels for this well peak in the wet years 1995 and 1998.

3N/21W-16H6

The change in peak water level elevation from 1983 to 1995 cannot be calculated, as there are no data in 1983. This is a USGS monitor well that was drilled in 1994. Water levels for this well peak in the wet years 1995 and 1998.

3N/21W-16H8

The change in peak water level elevation from 1983 to 1995 cannot be calculated, as there are no data in 1983. This is a USGS monitor well that was drilled in 1994. Water levels for this well peak in the wet years 1995 and 1998.

3N/21W-17Q1

The change in peak water level elevation from 1983 to 1995 is negative 2.4 feet. Water levels for this well peak in the wet years 1983, 1993, 1995, and 1998. The lowest water level from the end of the drought, 1990-1991, to 1994, is in 1991.

3N/21W-19G1

The change in peak water level elevation from 1983 to 1995 is negative 3.2 feet. Water levels for this well peak in the wet years 1983, 1993, 1995, and 1998. The 1997 peak water level for this well is the same as the 1998 peak water level. The data show the lowest water level from the end of the drought, 1990-1991, to 1994, is in 1990. Even though the 1997 water year is an average rainfall year the rainfall from October to December 1996 is far above average.

3N/21W-19G4

The change in peak water level elevation from 1983 to 1995 is negative 9.1 feet. Water levels for this well peak in the wet years 1983 and 1998. The 1994 peak water level is slightly higher than the 1993 peak water level. The 1995 peak water level is below the 1996 peak water level and the 1997 peak water level. The 1997 peak water level is above the 1996 peak water level. Well 19G4 is perforated the same as well 3N/21W-19H6 which is located close to 19G4. Well 19H6 water levels track with the precipitation hydrology while 19G4 does not track (see hydrograph in Appendix). Well 19G4 was actively pumped during this time while 19H6 was inactive. The data show the lowest water level from the end of the drought, 1990-1991, to 1994, is in 1990 before the “March Miracle”. Even though the 1997 water year is an average rainfall year the rainfall from October to December 1996 is far above average.

3N/21W-19H6

The change in peak water level elevation from 1983 to 1995 is negative 4.7 feet. Water levels for this well peak in the wet years 1983, 1993, 1995 and 1998. The data show the lowest water level from the end of the drought, 1990-1991, to 1994, is in 1990 before the “March Miracle”. This well was destroyed in 1999.

3N/21W-19R1

The change in peak water level elevation from 1983 to 1995 cannot be monitored, as there are no data in 1995. Water levels for this well peak in the wet years 1983, 1993 and 1998. There are no data for 1995. The 1982 peak water level and a December 1983 water level are similar to the peak water level in early 1983. There is no March, April and May data for 1983 and thus the “absolute” high water level may not have been captured. The data show the lowest water level from the end of the drought, 1990-1991, to 1994, is in 1991 after the “March Miracle”.

West Basin Wells

West basin wells are those wells located west of well 03N/21W-19R1. There were a total of 8 west basin wells evaluated and a Forebay basin well evaluated.

3N21W-30F1

The change in peak water level elevation from 1983 to 1995 cannot be calculated, as there are no data in 1995. Water levels for this well peak in the wet years 1983, 1993 and 1998. There are no data in 1995. The data show the lowest water level from the end of the drought, 1990-1991, to 1994, is in 1990 before the "March Miracle".

3N/21W-31F3

The change in peak water level elevation from 1983 to 1995 cannot be calculated, as there are no data in 1983. Water levels for this well peak in the wet year of 1995. Water level peaks in 1993 and 1994 are the same. Water level peaks in 1998 and 1999 are the same. This is a shallow monitor well locate near the river where water level variation is subdued. Bimonthly monitoring limits the ability to observe the "absolute" high water level in any one year. From 1983 to 1988, and 1995, 1996 and 1997 the monitoring is less than bimonthly. The data show the lowest water level from the end of the drought, 1990-1991, to 1994, is in 1991 after the "March Miracle". There are no data in 1990 and limited data in 1991.

3N/22W-36K5(36K2)

The change in peak water level elevation from 1983 to 1995 cannot be calculated because of the limited data in 1995 (only one data point in September). Water levels for this well peak in the wet years 1983, 1993 and 1998. The 1983 peak water level is only slightly above the 1982 and 1984 peak water levels. The 1998 peak water level is only slightly above the 1999 peak water level. The data show the lowest water level from the end of the drought, 1990-1991, to 1994, is in 1991 after the "March Miracle". The water level low in 1990 is similar to the water level low in 1991.

3N/22W-34R1(34R2)

The change in water level elevation from 1983 to 1995 is negative 2.8 feet. Water levels for this well peak in the wet years 1983, 1993, 1995 and 1998. The peak water level in 1993 is only slightly above the peak water level in 1994. The peak water level in 1998 is only slightly above the peak water level in 1999. There was only biannual monitoring in 1995. The data show the lowest water level from the end of the drought, 1990-1991, to 1994, is in 1990 before the "March Miracle".

2N/22W-2C1

The change in water level elevation from 1983 to 1995 is negative 3.4 feet. Water levels for this well peak in the wet years 1983, 1993, 1995 and 1998. The 1983 peak water level is just slightly above the 1984 peak water level, the 1993 peak water level is just slightly above the 1994 peak water level and the 1998 peak water level is just slightly above the 1999 peak water level. The data show equal low water levels in 1990 and 1991 before and after the "March Miracle". However, the lowest high water level was in 1991. This well is currently inactive.

2N/22W-2K7

The change in water level elevation from 1983 to 1995 is negative 7.4 feet. Water levels for this well peak in the wet years 1983, 1995 and 1998. The 1993 peak water level is below the 1994 peak water level. The 1995 peak water level is only slightly above the 1996 peak water level and is less than the 1997 peak water level. The 1997 peak water level exceeds the 1994, 1995 and 1996 peak water level. The 1998 and 1999 peak water levels are the same. The pumping of the City of Ventura's Saticoy #2 well may be a factor on the water levels in well 2K7. The data show the lowest water level from the end of the drought, 1990-1991, to 1994, is in 1990 before the "March Miracle". Even though the 1997 water year is an average rainfall year the rainfall from October to December 1996 is far above average.

2N/22W-2R5

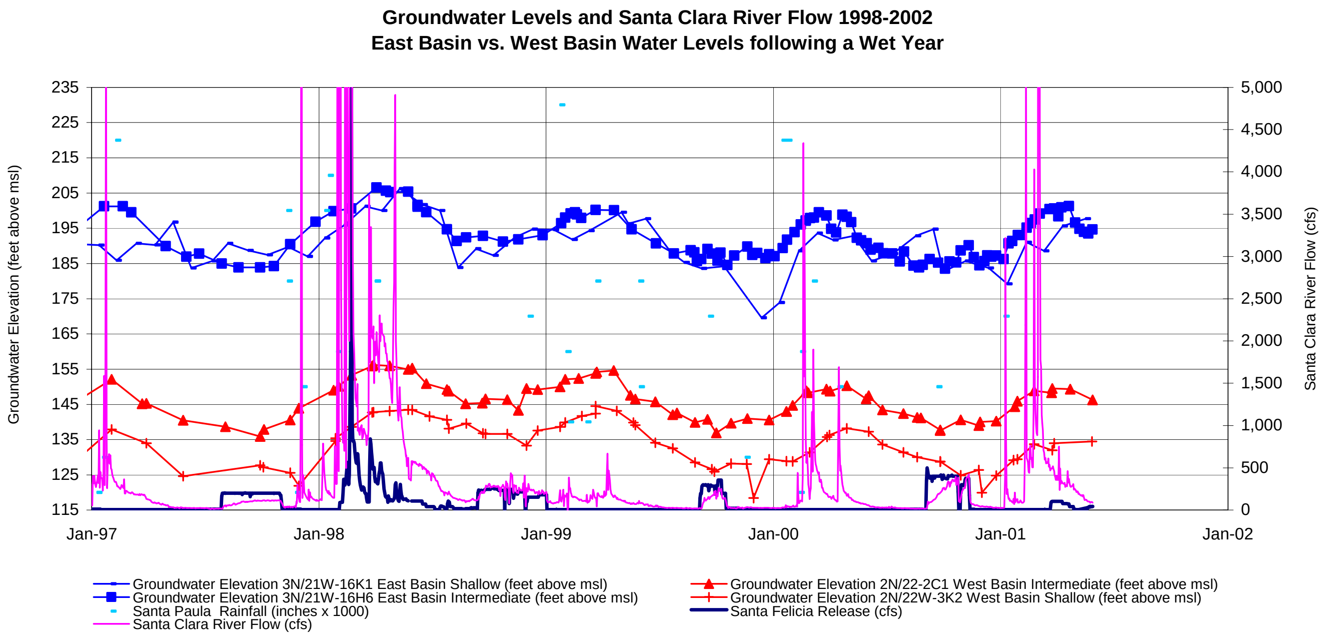
The change in water level elevation from 1983 to 1995 cannot be calculated, as there are no data for 1983. Water levels for this well peak in the wet years 1995 and 1998. The peak water level in 1993 is slightly less than the peak water level in 1994. The peak water levels in 1996 and 1997 are slightly less than the peak water level for 1995. The peak water level for 1999 is slightly less than 1998. The peak water levels for 1995 and 1999 are the same and there appears to be a flat topping of water levels during the peak in 1998. Overall the variation in peak water levels are less for this well compared to other wells in the Santa Paula Basin. This well is located just outside the basin boundaries in the Oxnard Forebay basin south of the Oakridge Fault. There are no data at the end of the drought 1990-1991.

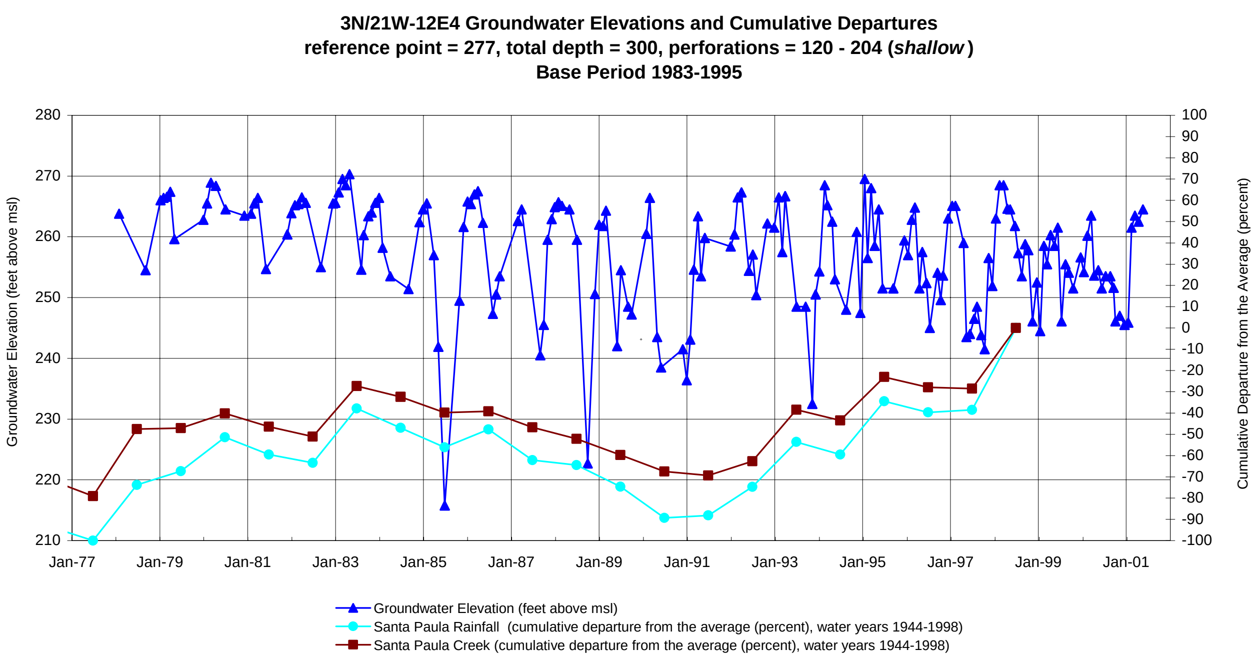
2N22W-3K2

The change in water level elevation from 1983 to 1995 is negative 10.6 feet using water level data for well 2N/22W-3K3 for 1995. Water levels for this well peak in the wet year 1983. The 1983 peak water level is just above the peak water level for 1984. The 1994 peak water level is greater than the 1993 peak water level. The 1995 peak water level is equal to the 1996 peak water level. The 1998 peak water level is slightly less than the 1999 peak water level. The biannual monitoring in 1995 may have resulted in not capturing the "absolute" peak water level for this year. Well 2N/22W-3K2 is located approximately 30 feet from well 2N/22WW-3K3 which went online in 1992. These wells have similar construction and are both active. The data show the lowest water level from the end of the drought, 1990-1991, to 1994, is in March 1992 after the "March Miracle". This water level is during the rainy season and peak Santa Clara River flow and thus may be a pumping level. The next lowest water level is in September 1991 after the “March Miracle”.

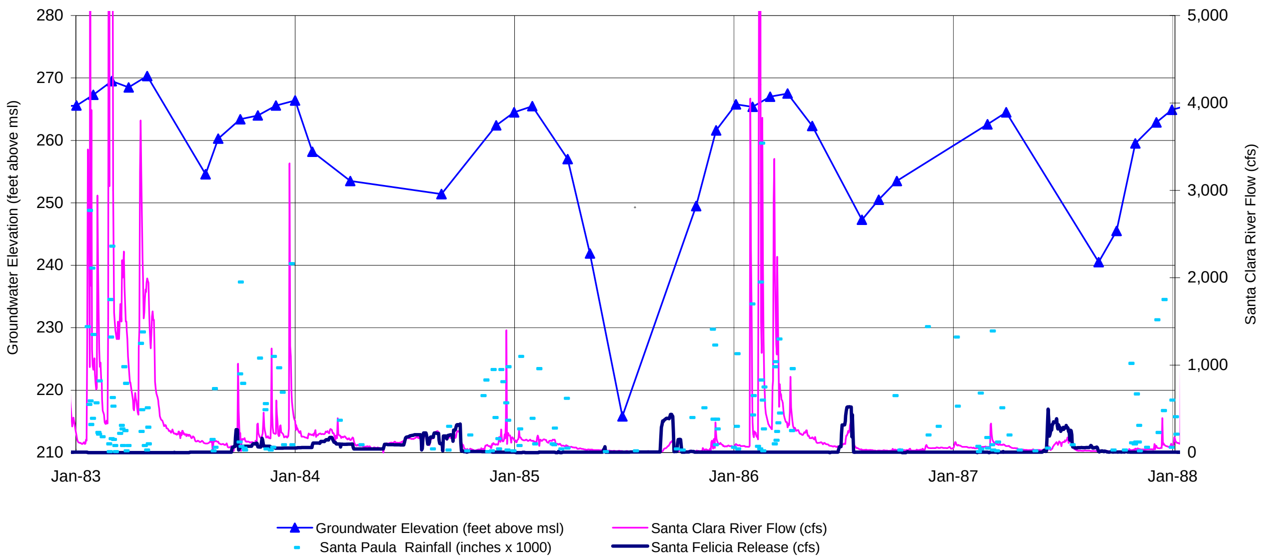
2N/22W-3M2

The change in water level elevation from 1983 to 1995 is greater than negative 22.4 feet. The only wet year that the water levels in this well peak are in 1998. The 1983 and 1984 peak water levels are essentially equal. The 1993 peak water level is substantially less than the 1994 peak water level. The 1995 peak water level is substantially less than the 1996 peak water level. The biannual monitoring in 1995 may have resulted in not capturing the “absolute” peak water level for this year. The data show the lowest water level from the end of the drought, 1990-1991, to 1994, is in 1991 after the “March Miracle”. Since May 1991 the annual variation in water levels for this well has dropped off considerably. This well is currently inactive.

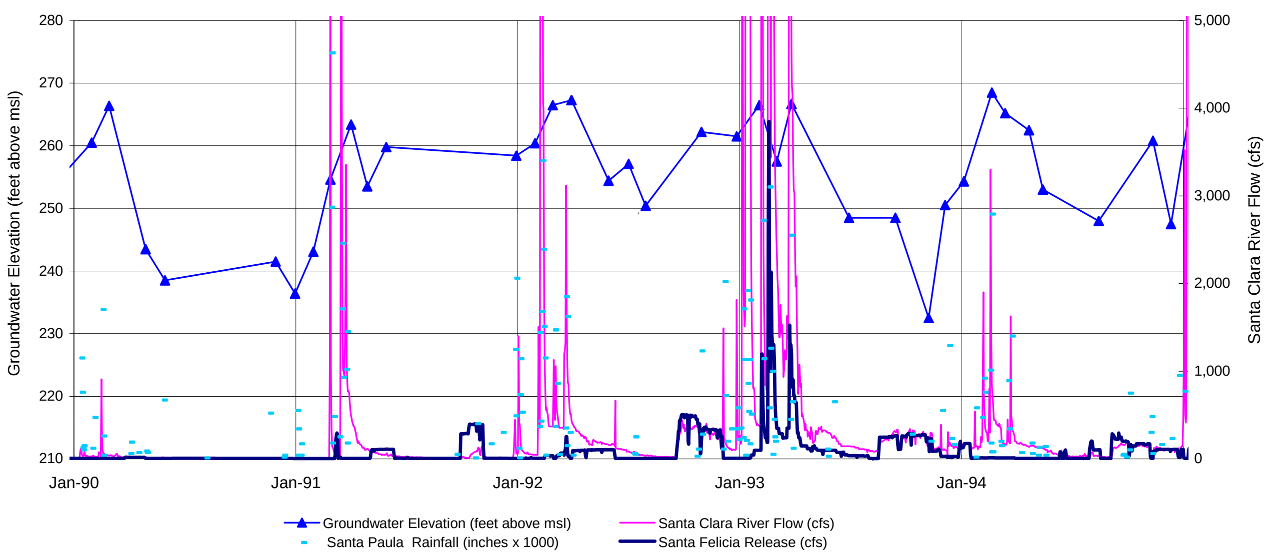

Groundwater Levels and Santa Clara River Flow 1998-2002
East Basin vs. West Basin Water Levels following a Wet Year
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
235
225
215
205
195
185
175
165
155
145
135
125
115
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Groundwater Elevation 3N/21W-16K1 East Basin Shallow (feet above msl)
Groundwater Elevation 3N/21W-16H6 East Basin Intermediate (feet above msl)
Santa Paula Rainfall (inches x 1000)
Santa Clara River Flow (cfs)
Groundwater Elevation 2N/22-2C1 West Basin Intermediate (feet above msl)
Groundwater Elevation 2N/22W-3K2 West Basin Shallow (feet above msl)
Santa Felicia Release (cfs)


3N/21W-12E4 Groundwater Elevations and Cumulative Departures
reference point = 277, total depth = 300, perforations = 120 - 204 (shallow)
Base Period 1983-1995
Groundwater Elevation (feet above msl)
Cumulative Departure from the Average (percent)
280
270
260
250
240
230
220
210
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-77
Jan-79
Jan-81
Jan-83
Jan-85
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Groundwater Elevation (feet above msl)
Santa Paula Rainfall (cumulative departure from the average (percent), water years 1944-1998)
Santa Paula Creek (cumulative departure from the average (percent), water years 1944-1998)

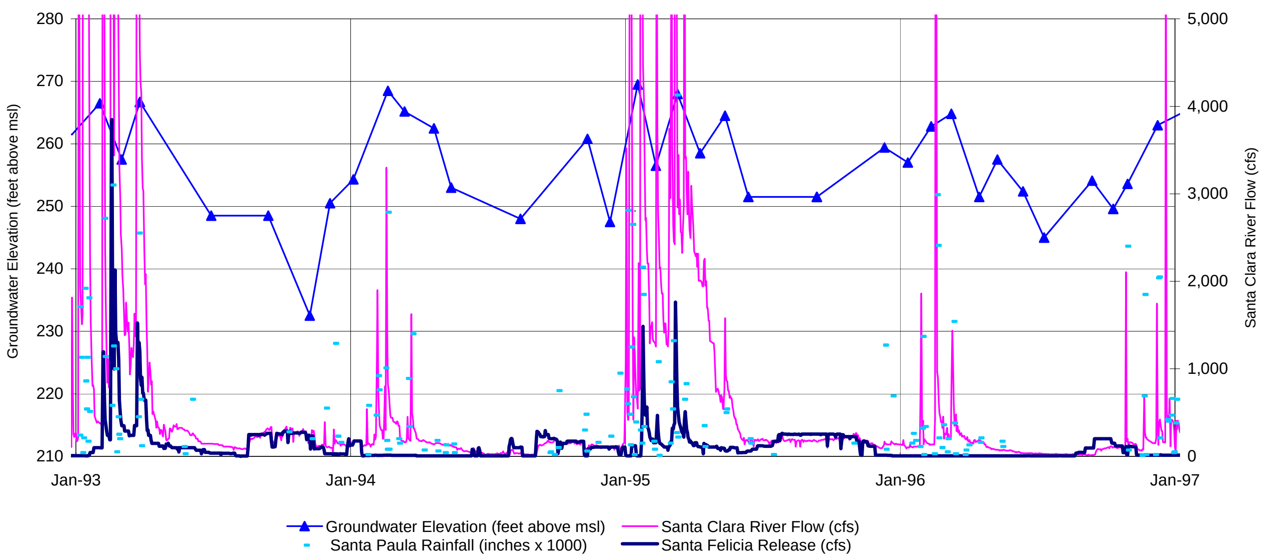
3N/21W-12E4
Groundwater Elevations and Santa Clara River Flow 1983-1987
reference point = 277, total depth = 300, perforations = 120 - 204 (*shallow*)



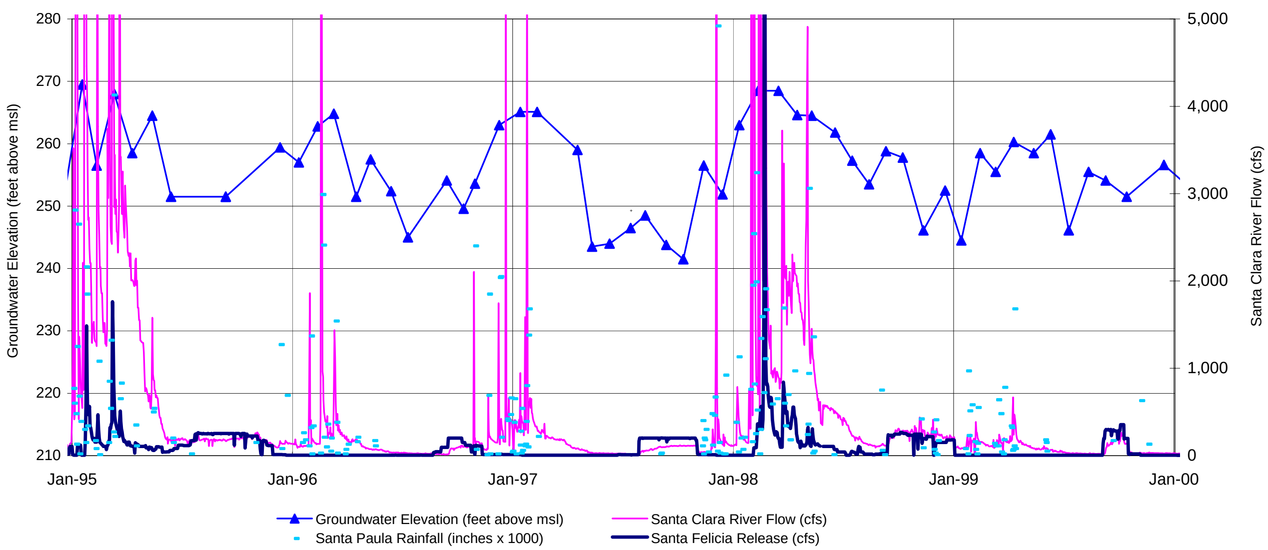
3N/21W-12E4
Groundwater Elevations and Santa Clara River Flow 1990-1994
reference point = 277, total depth = 300, perforations = 120 - 204 (*shallow*)

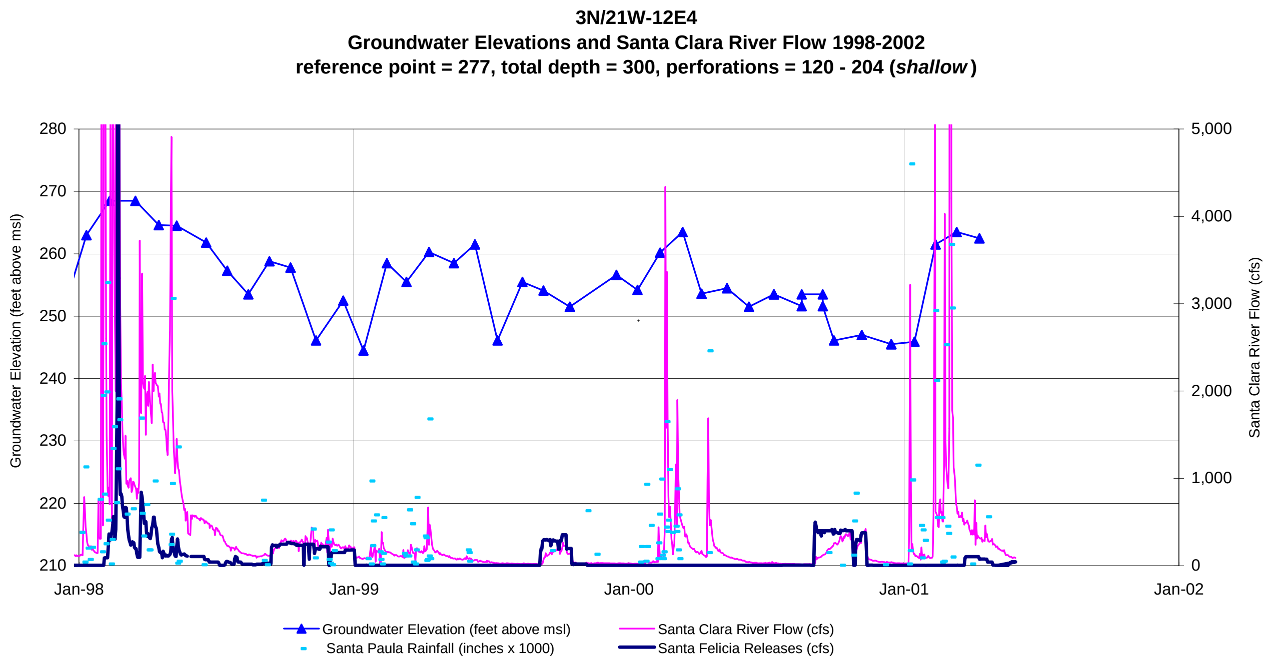


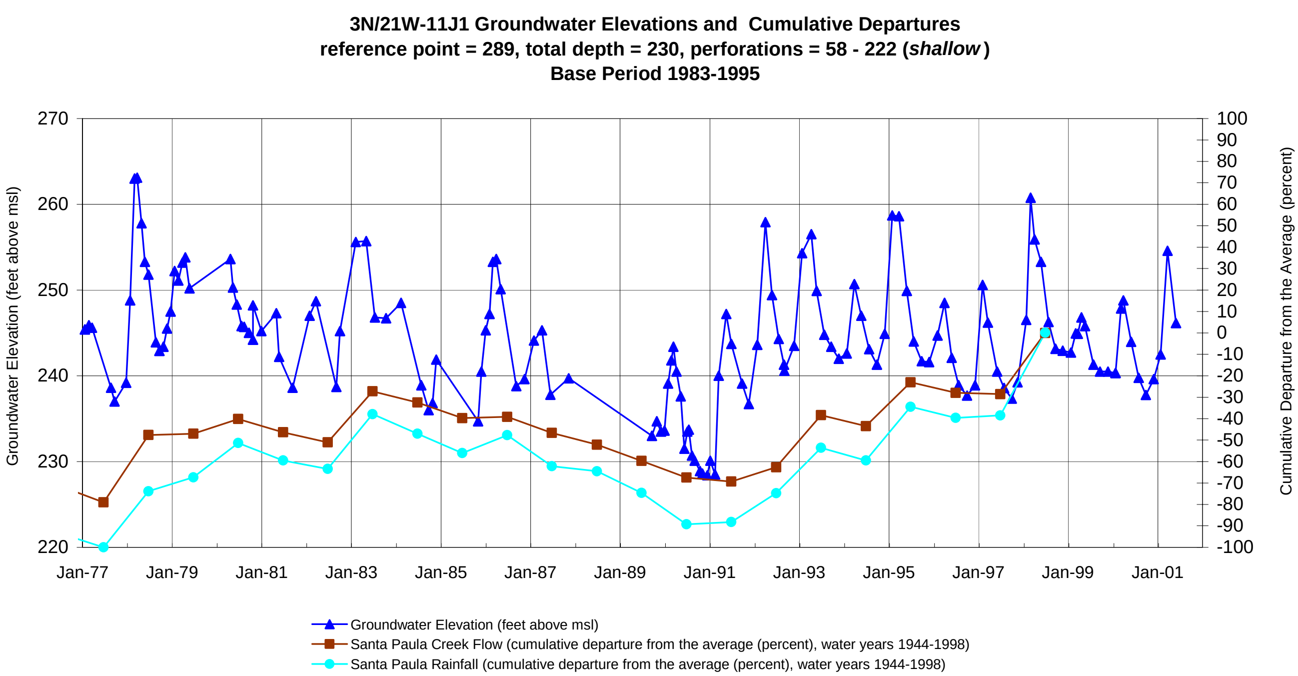
3N/21W-12E4
Groundwater Elevations and Santa Clara River Flow 1993-1997
reference point = 277, total depth = 300, perforations = 120 - 204 (*shallow*)



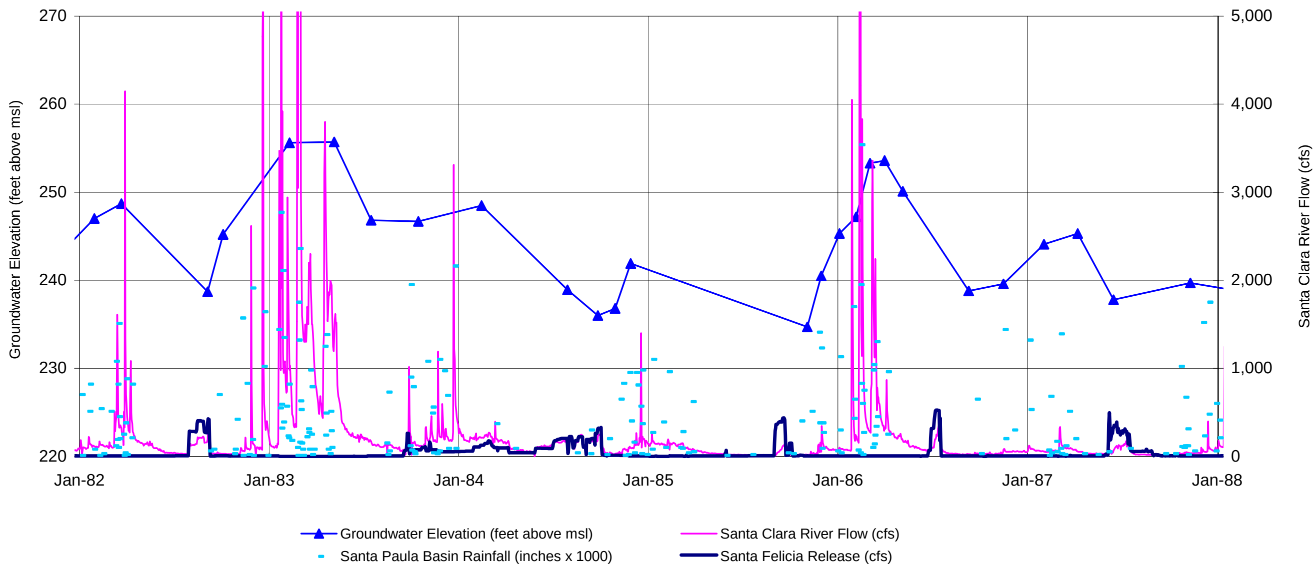
3N/21W-12E4
Groundwater Elevations and Santa Clara River Flow 1995-1999
reference point = 277, total depth = 300, perforations = 120 - 204 (*shallow*)



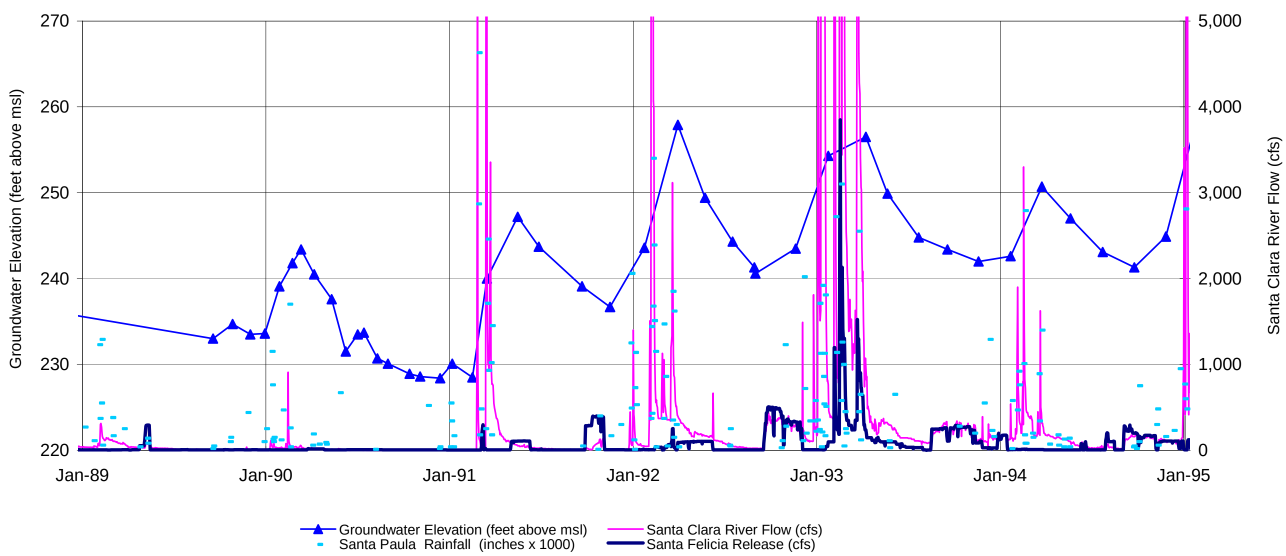

3N/21W-12E4
Groundwater Elevations and Santa Clara River Flow 1998-2002
reference point = 277, total depth = 300, perforations = 120 - 204 (shallow)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
280
270
260
250
240
230
220
210
5,000
4,000
3,000
2,000
1,000
0
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Groundwater Elevation (feet above msl)
Santa Paula Rainfall (inches x 1000)
Santa Clara River Flow (cfs)
Santa Felicia Releases (cfs)


3N/21W-11J1 Groundwater Elevations and Cumulative Departures
reference point = 289, total depth = 230, perforations = 58 - 222 (shallow)
Base Period 1983-1995
Groundwater Elevation (feet above msl)
Cumulative Departure from the Average (percent)
270
260
250
240
230
220
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-77
Jan-79
Jan-81
Jan-83
Jan-85
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Groundwater Elevation (feet above msl)
Santa Paula Creek Flow (cumulative departure from the average (percent), water years 1944-1998)
Santa Paula Rainfall (cumulative departure from the average (percent), water years 1944-1998)

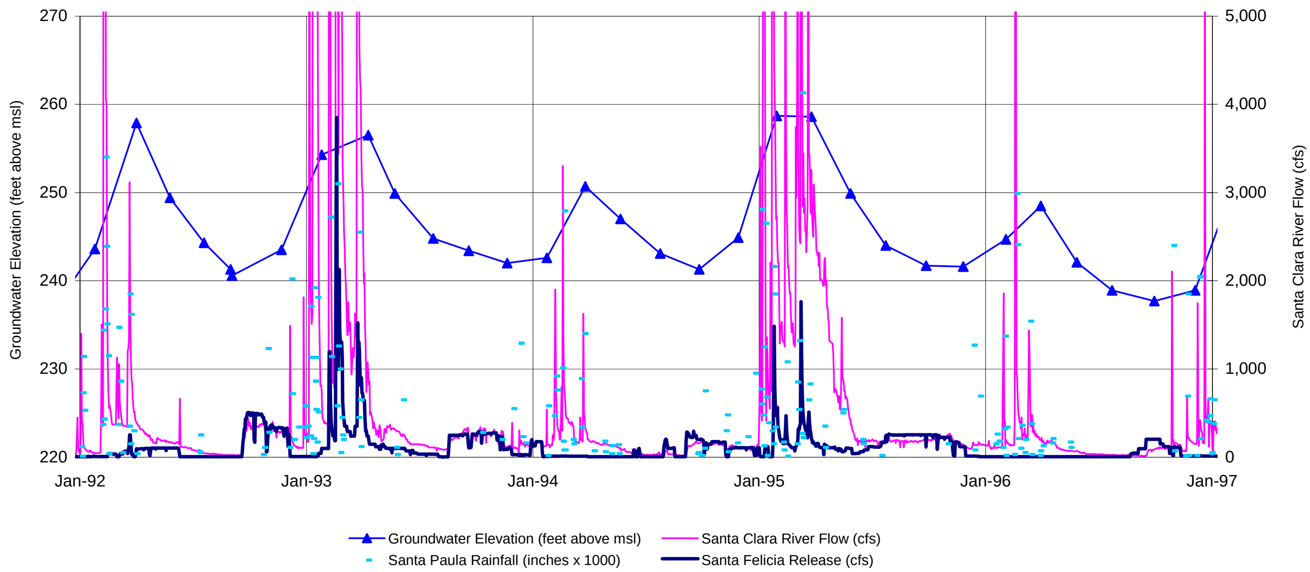
3N/21W-11J1
Groundwater Elevations and Santa Clara River Flow 1983 - 1987
reference point = 289, total depth = 230, perforations = 58 - 222 (*shallow*)



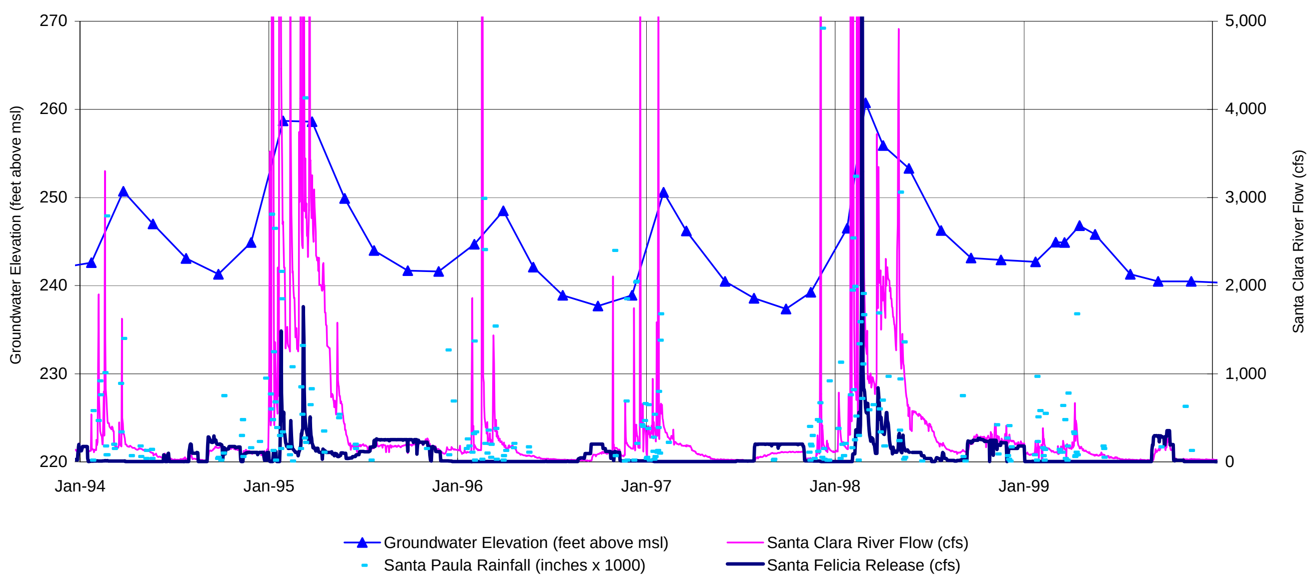
3N/21W-11J1
Groundwater Elevations and Santa Clara River Flow 1990 - 1994
reference point = 289, total depth = 230, perforations = 58 - 222 (*shallow*)



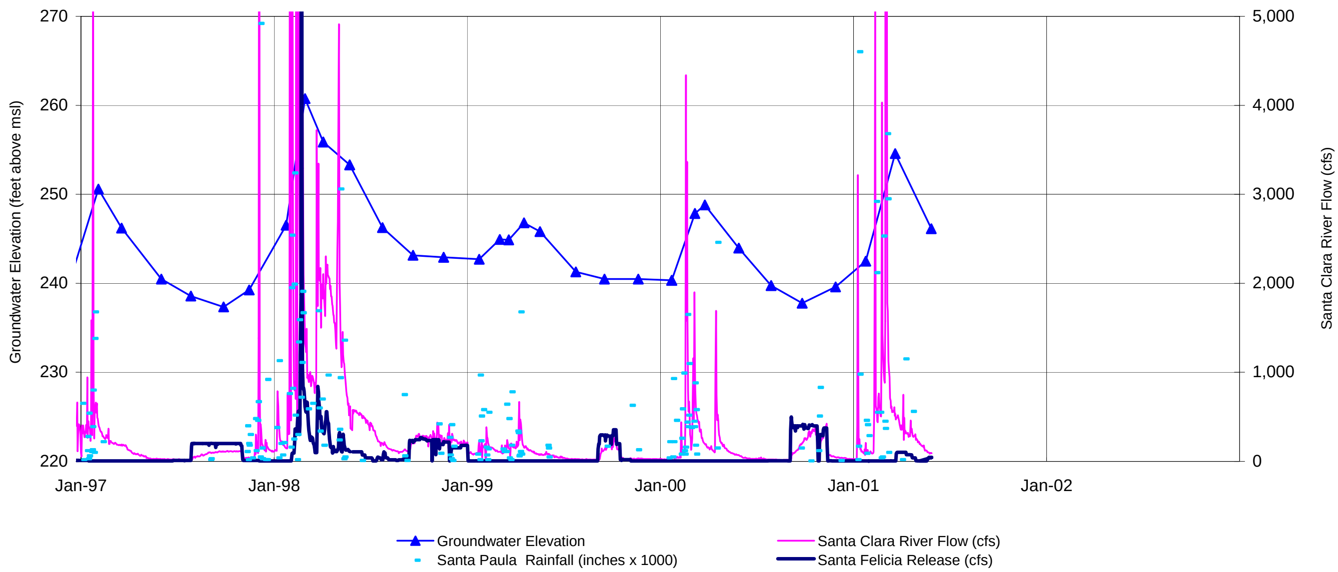
3N/21W-11J1
Groundwater Elevations and Santa Clara River Flow 1993 - 1997
reference point = 289, total depth = 230, perforations = 58 - 222 (*shallow*)



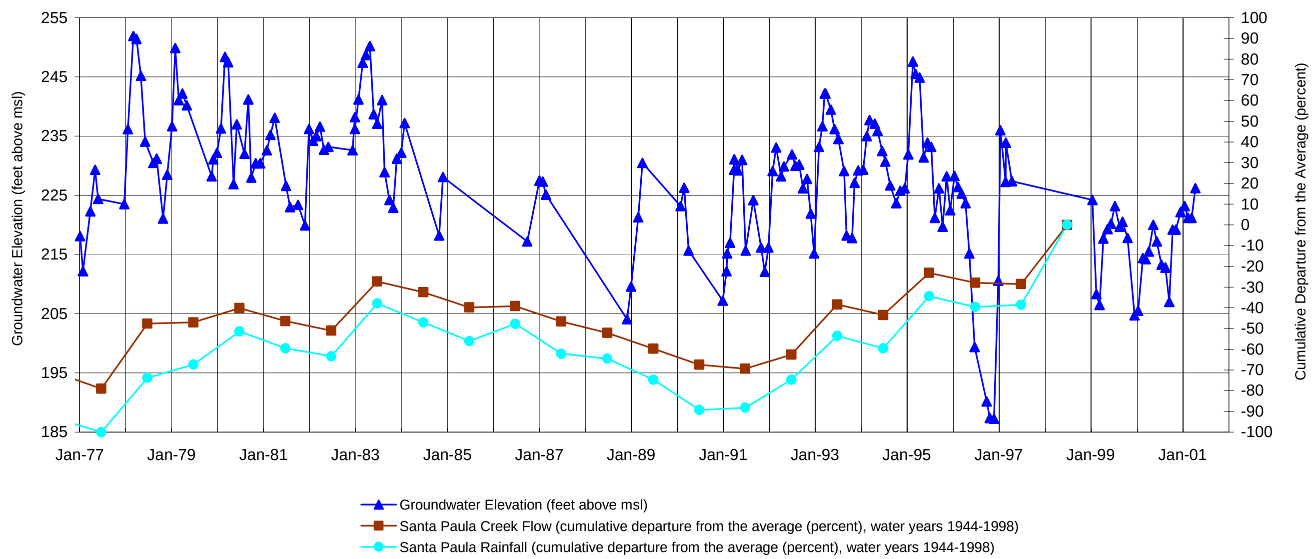
3N/21W-11J1
Groundwater Elevations and Santa Clara River Flow 1995 - 1999
reference point = 289, total depth = 230, perforations = 58 - 222 (*shallow*)

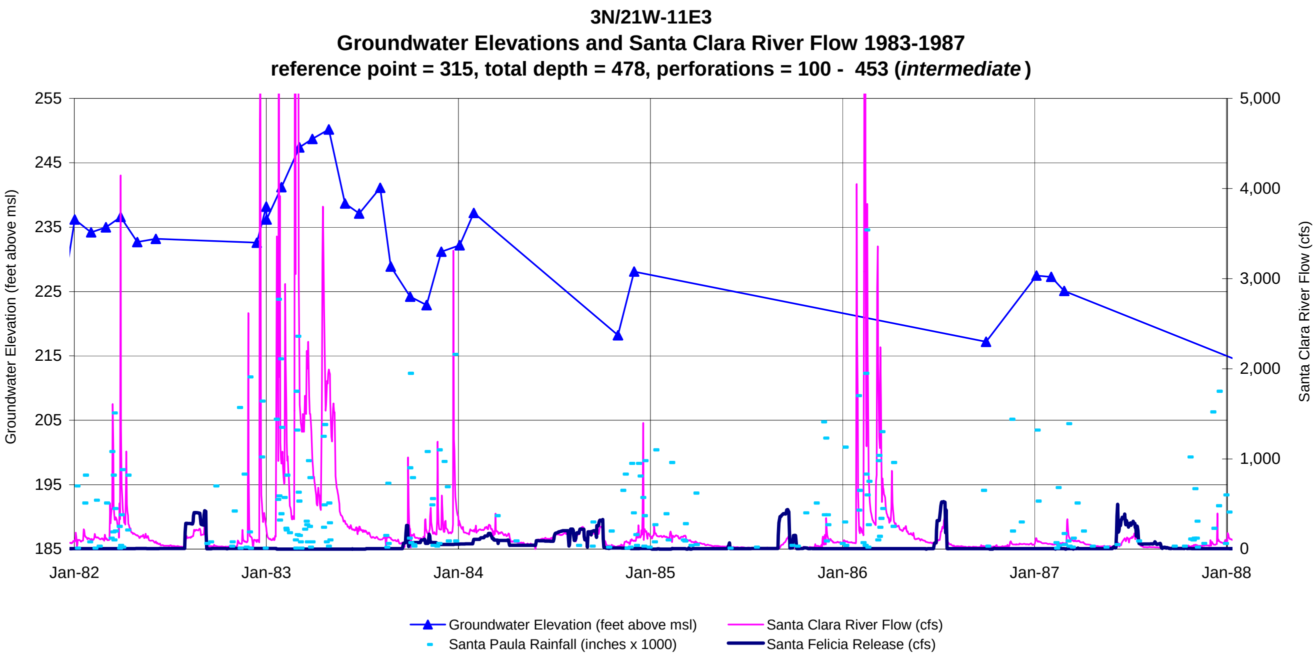


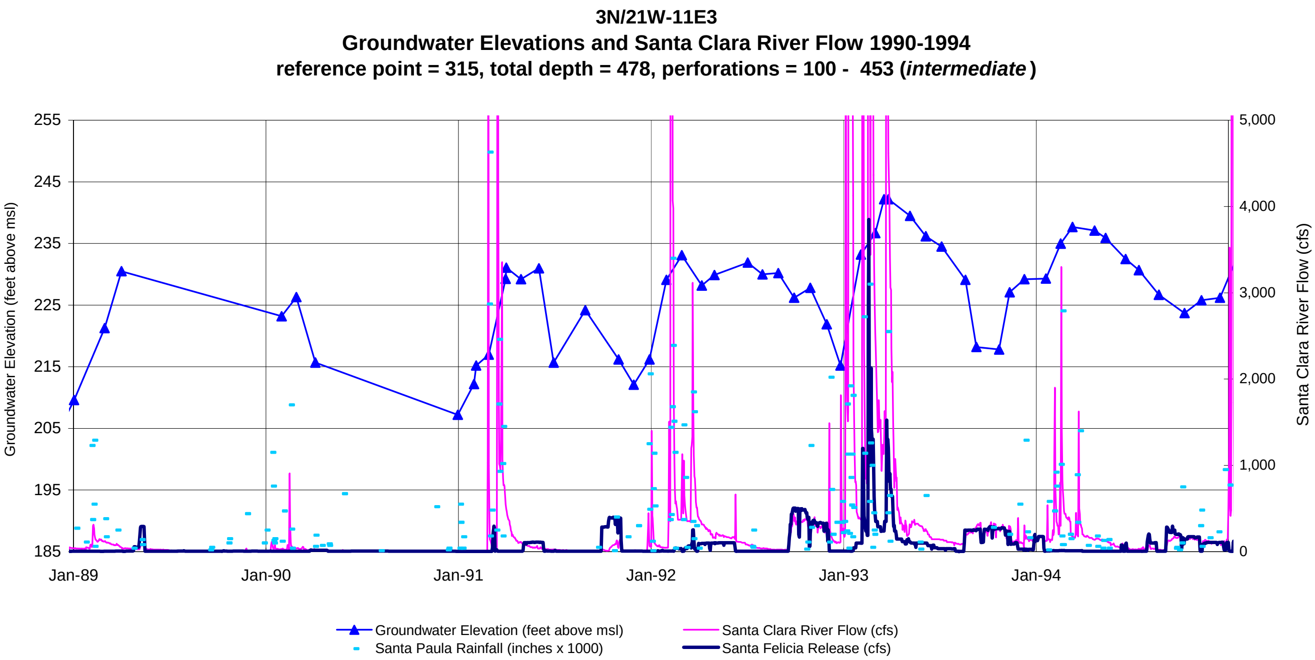
3N/21W-11J1
Groundwater Elevations and Santa Clara River Flow 1998 - 2002
reference point = 289, total depth = 230, perforations = 58 - 222 (*shallow*)



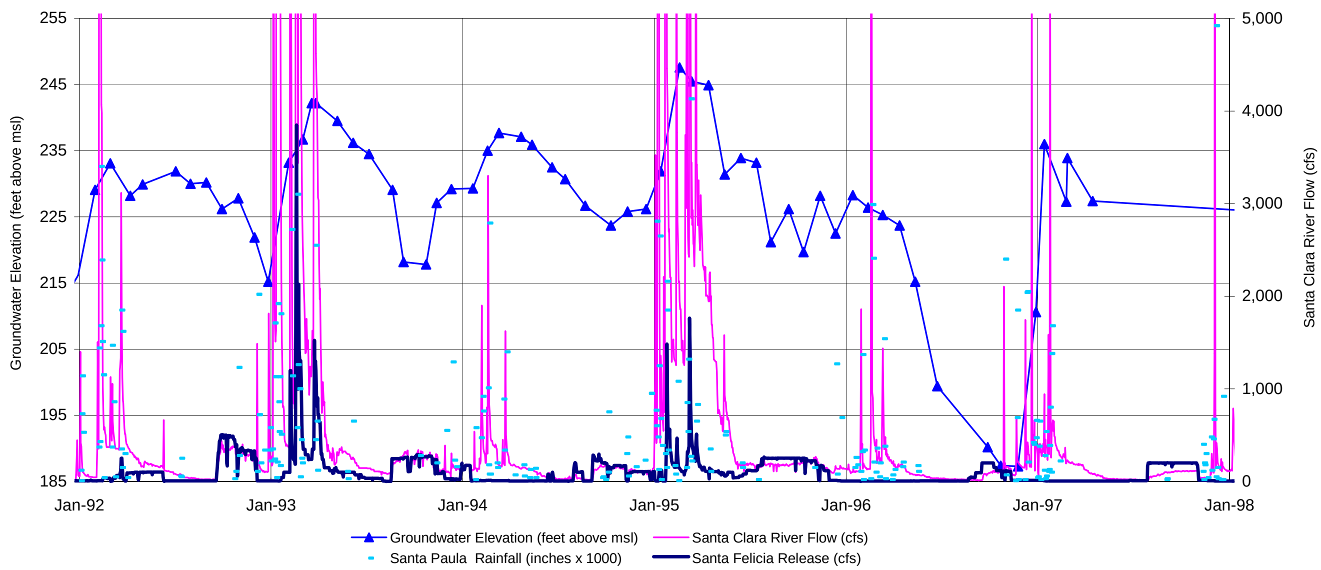
3N/21W-11E3
Groundwater Elevations and Cumulative Departures
reference point = 315, total depth = 478, perforations = 100 - 453 (*intermediate*)
Base Period 1983 -1985



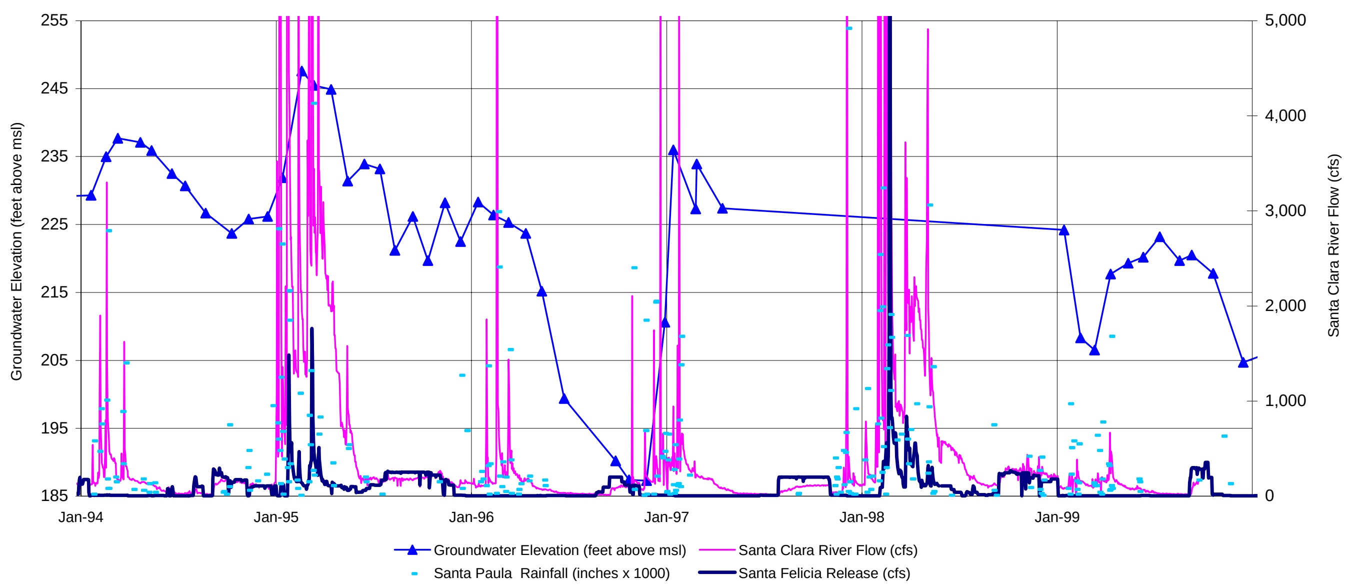

3N/21W-11E3
Groundwater Elevations and Santa Clara River Flow 1983-1987
reference point = 315, total depth = 478, perforations = 100 - 453 (intermediate)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
255
245
235
225
215
205
195
185
5,000
4,000
3,000
2,000
1,000
0
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Release (cfs)

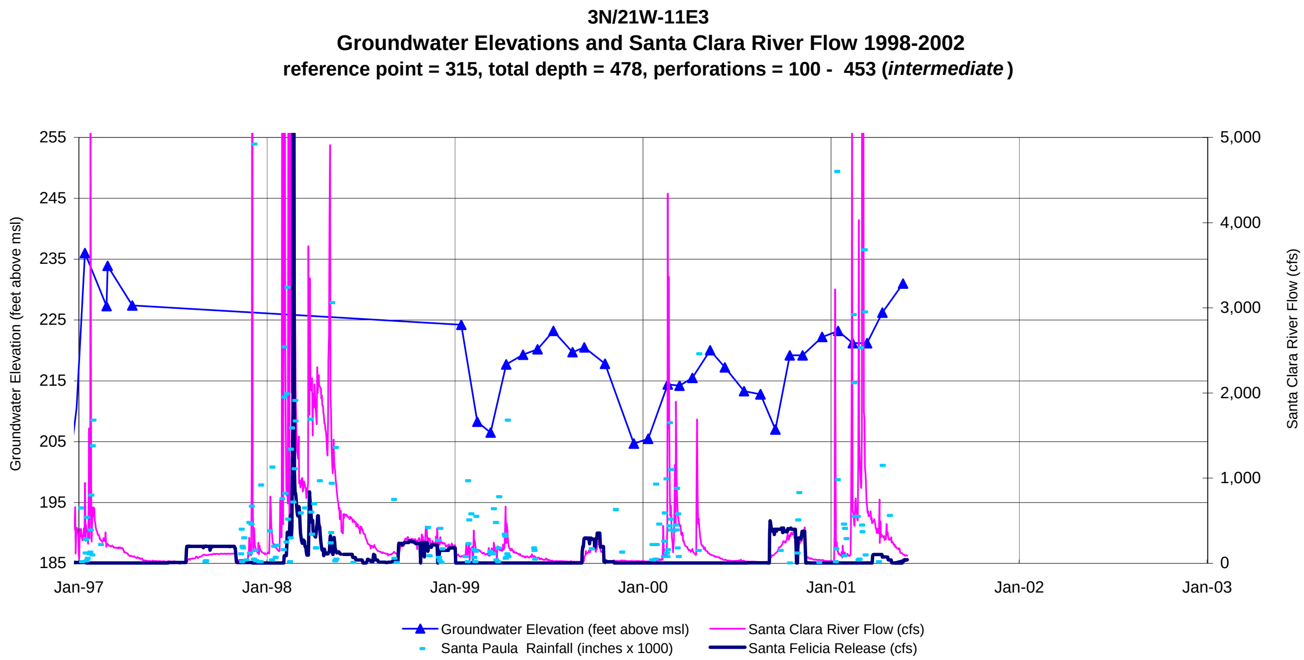

3N/21W-11E3
Groundwater Elevations and Santa Clara River Flow 1990-1994
reference point = 315, total depth = 478, perforations = 100 - 453 (intermediate)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
255
245
235
225
215
205
195
185
5,000
4,000
3,000
2,000
1,000
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Release (cfs)

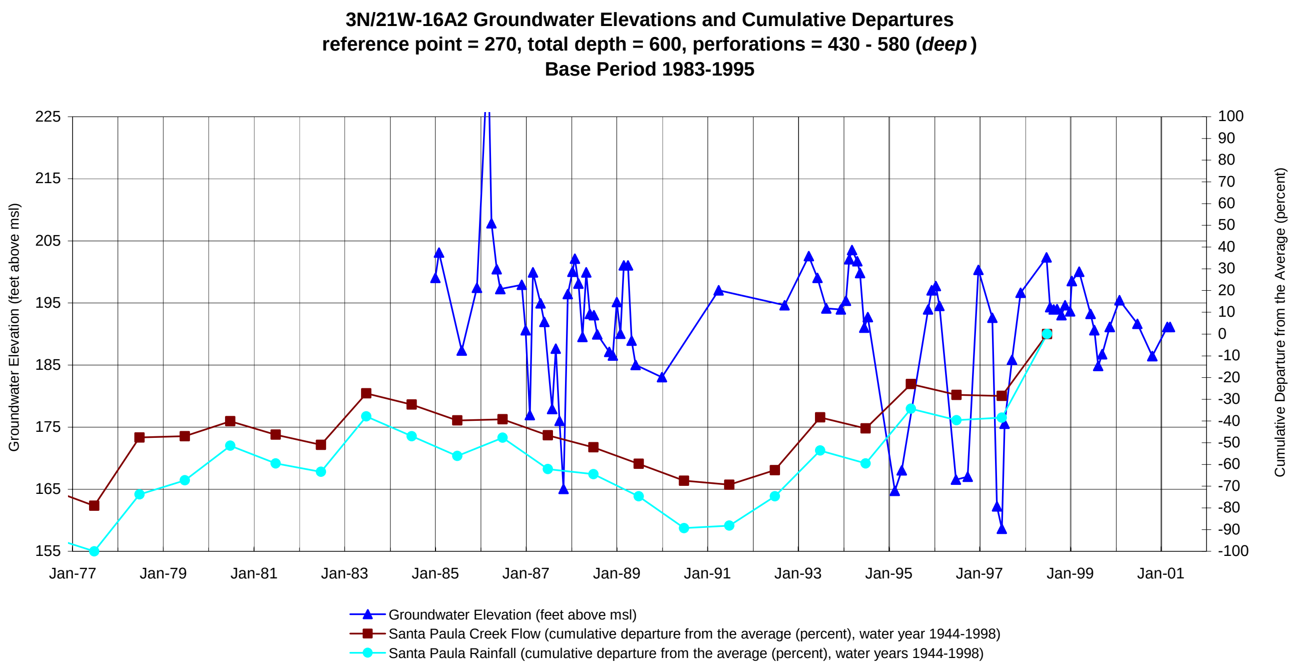
3N/21W-11E3
Groundwater Elevations and Santa Clara River Flow 1993-1997
reference point = 315, total depth = 478, perforations = 100 - 453 (*intermediate*)

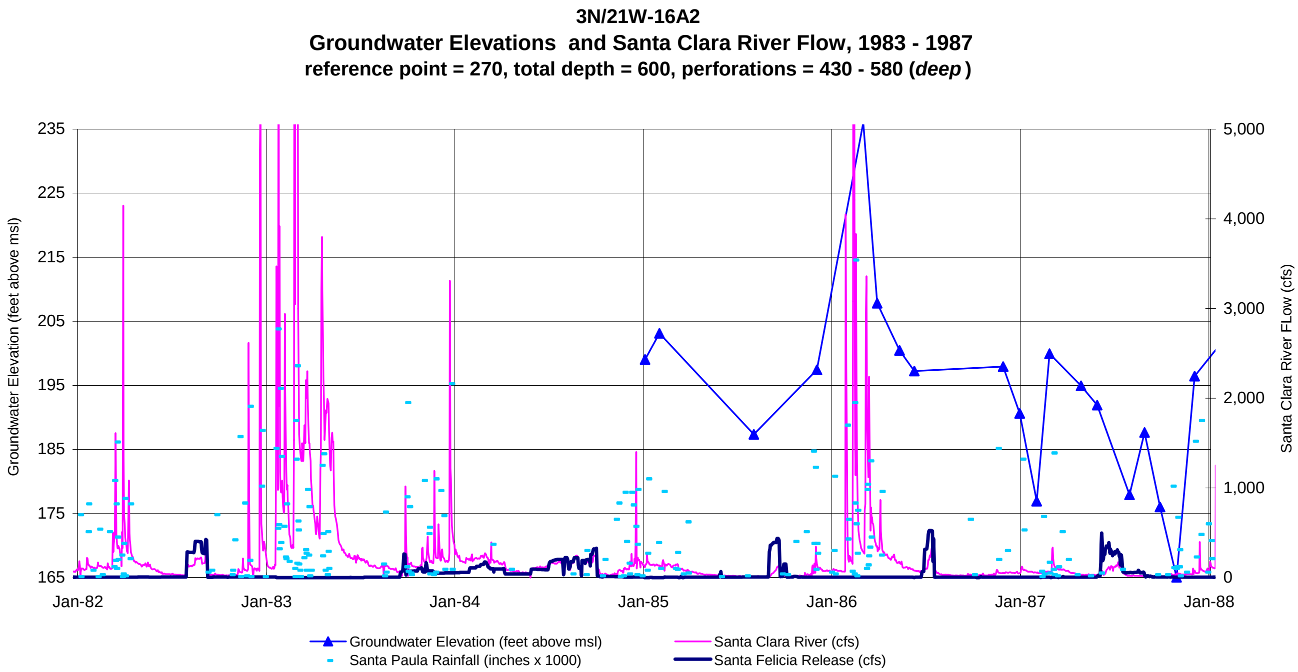


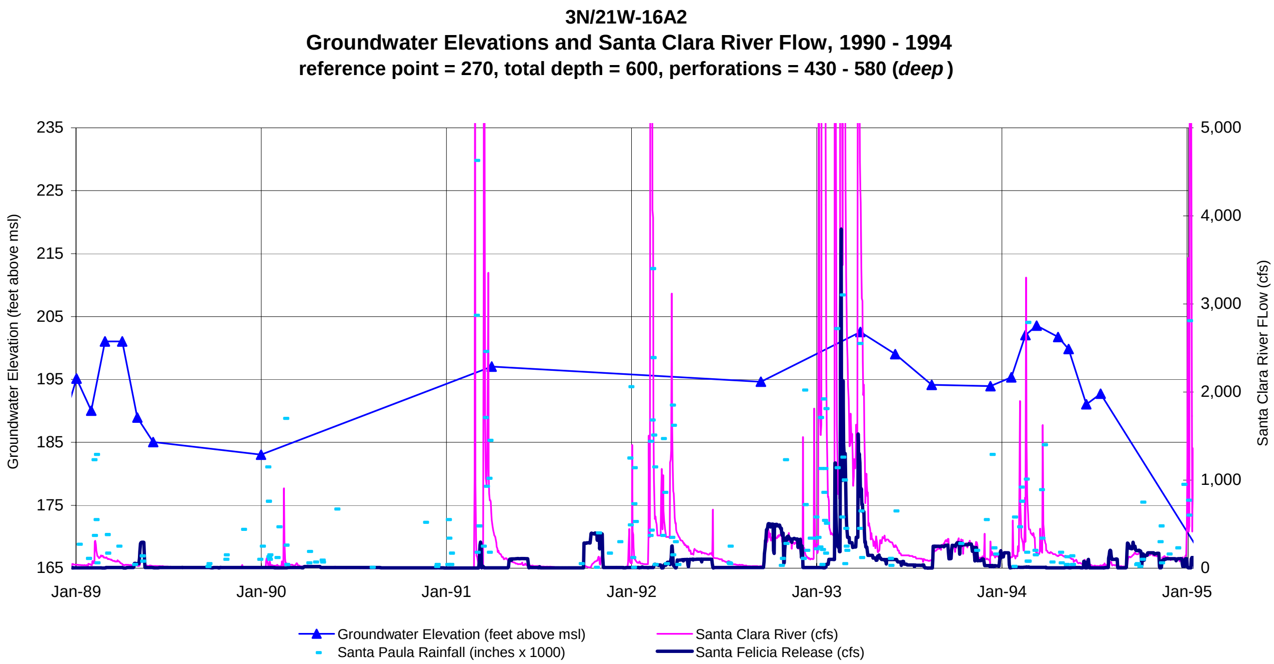
3N/21W-11E3
Groundwater Elevations and Santa Clara River Flow 1995-1999
reference point = 315, total depth = 478, perforations = 100 - 453 (*intermediate*)



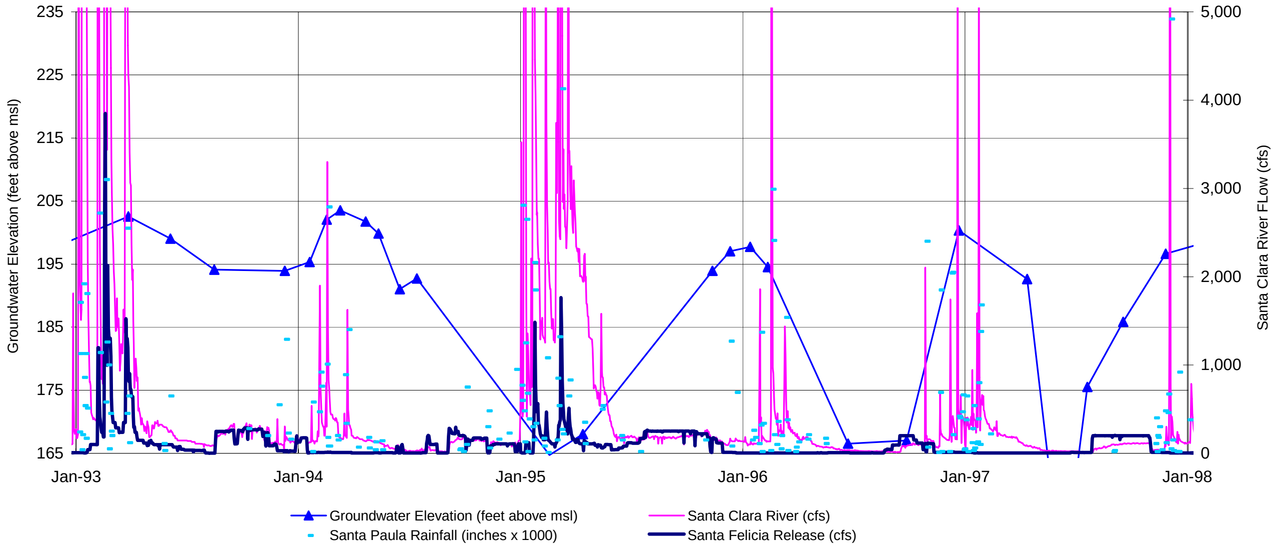

3N/21W-11E3
Groundwater Elevations and Santa Clara River Flow 1998-2002
reference point = 315, total depth = 478, perforations = 100 - 453 (intermediate)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
255
245
235
225
215
205
195
185
5,000
4,000
3,000
2,000
1,000
0
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Release (cfs)


3N/21W-16A2 Groundwater Elevations and Cumulative Departures
reference point = 270, total depth = 600, perforations = 430 - 580 (deep)
Base Period 1983-1995
Groundwater Elevation (feet above msl)
Cumulative Departure from the Average (percent)
225
215
205
195
185
175
165
155
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-77
Jan-79
Jan-81
Jan-83
Jan-85
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Groundwater Elevation (feet above msl)
Santa Paula Creek Flow (cumulative departure from the average (percent), water year 1944-1998)
Santa Paula Rainfall (cumulative departure from the average (percent), water years 1944-1998)

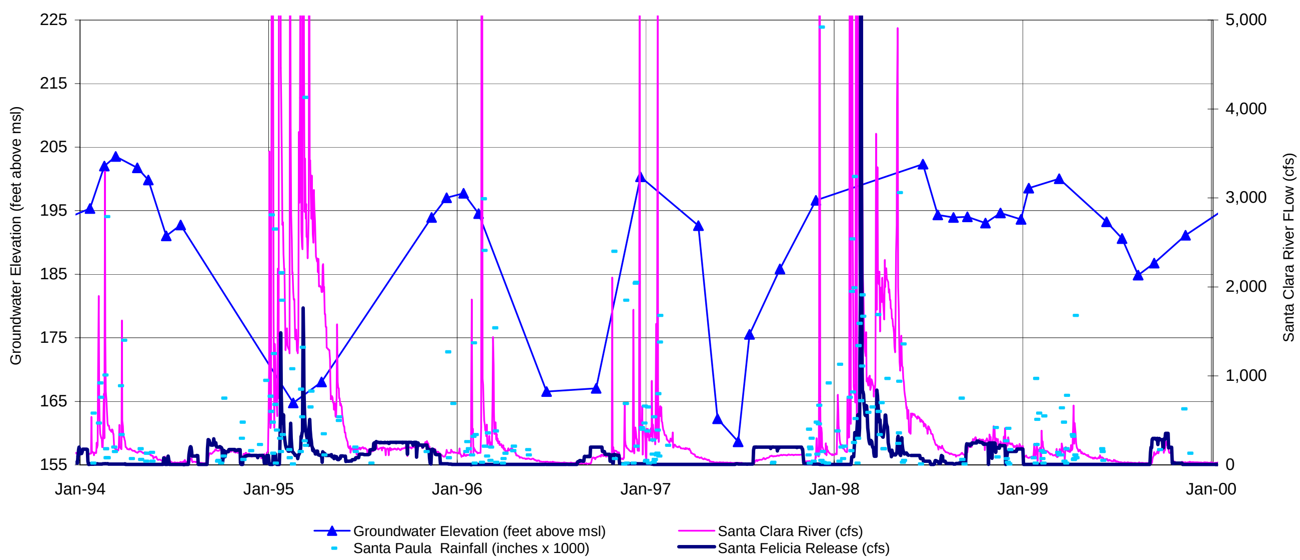

3N/21W-16A2
Groundwater Elevations and Santa Clara River Flow, 1983 - 1987
reference point = 270, total depth = 600, perforations = 430 - 580 (deep)
Groundwater Elevation (feet above msl)
235
225
215
205
195
185
175
165
Santa Clara River FLow (cfs)
5,000
4,000
3,000
2,000
1,000
0
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Groundwater Elevation (feet above msl)
Santa Paula Rainfall (inches x 1000)
Santa Clara River (cfs)
Santa Felicia Release (cfs)


3N/21W-16A2
Groundwater Elevations and Santa Clara River Flow, 1990 - 1994
reference point = 270, total depth = 600, perforations = 430 - 580 (deep)
Groundwater Elevation (feet above msl)
235
225
215
205
195
185
175
165
Santa Clara River FLow (cfs)
5,000
4,000
3,000
2,000
1,000
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Groundwater Elevation (feet above msl)
Santa Paula Rainfall (inches x 1000)
Santa Clara River (cfs)
Santa Felicia Release (cfs)

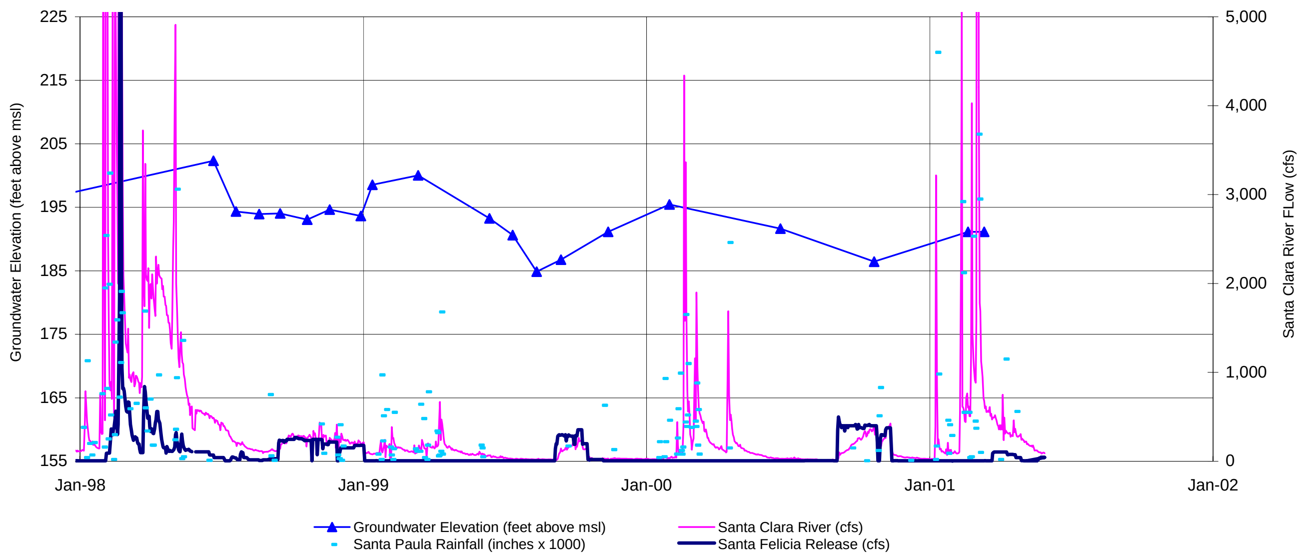
3N/21W-16A2
Groundwater Elevations and Santa Clara River Flow, 1993 - 1997
reference point = 270, total depth = 600, perforations = 430 - 580 (*deep*)



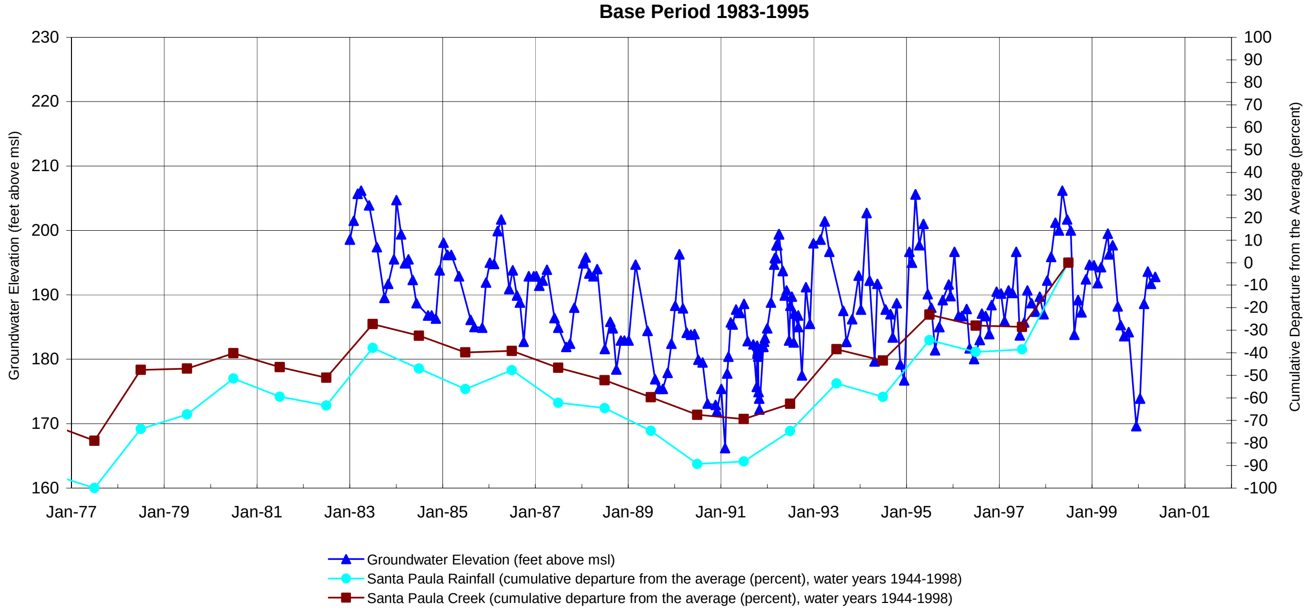
3N/21W-16A2
Groundwater Elevations and Santa Clara River Flow, 1995 - 1999
reference point = 270, total depth = 600, perforations = 430 - 580 (*deep*)

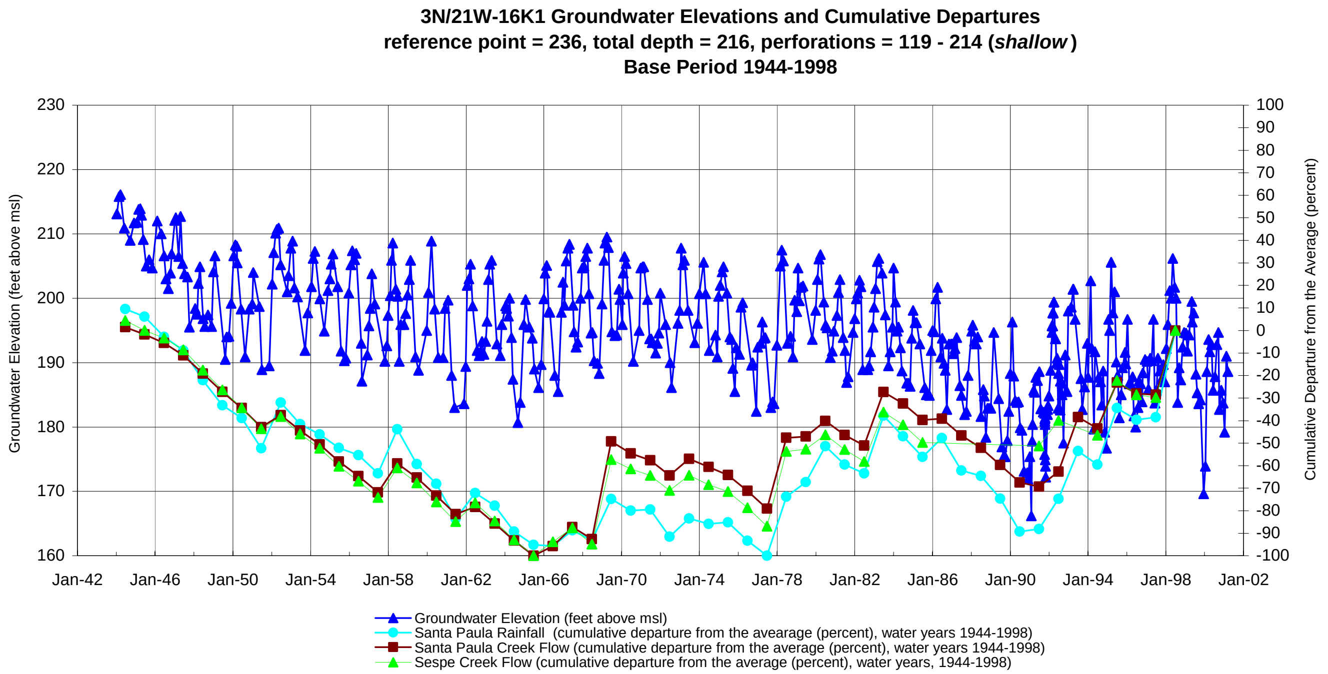


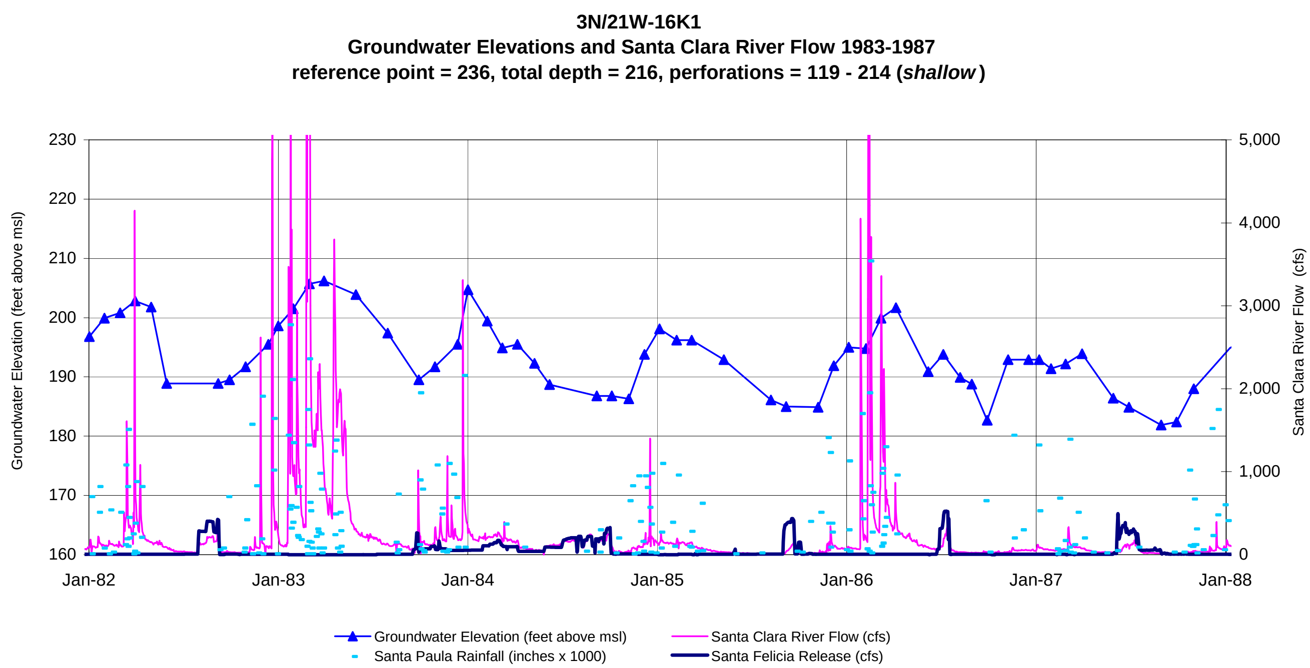
3N/21W-16A2
Groundwater Elevations and Santa Clara River Flow, 1998 - 2002
reference point = 270, total depth = 600, perforations = 430 - 580 (*deep*)



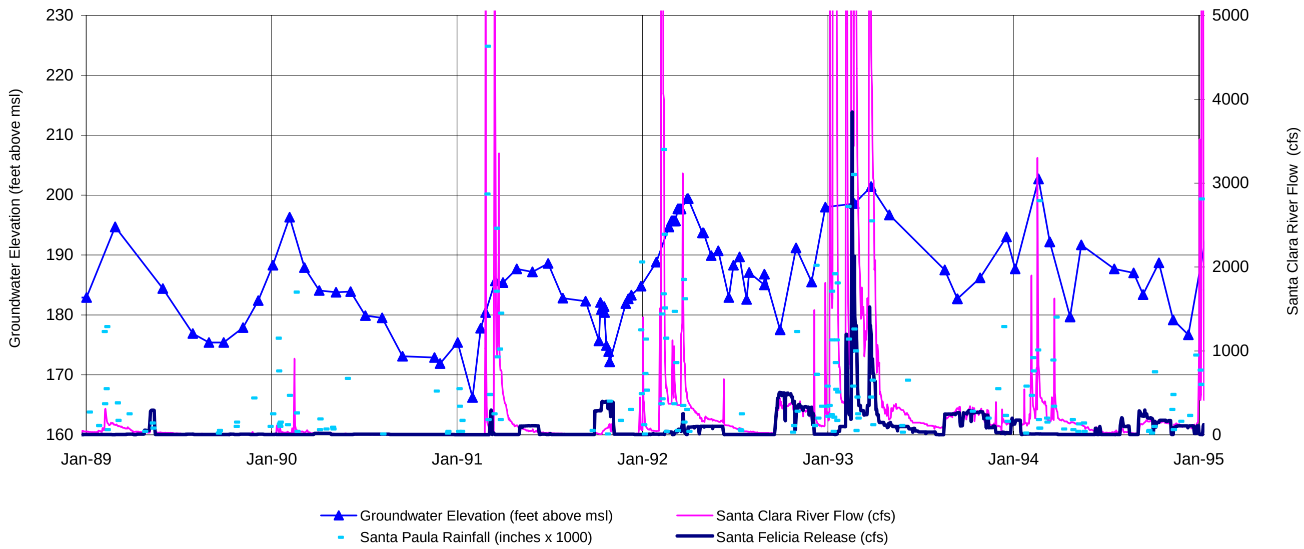
3N/21W-16K1 Groundwater Elevations and Cumulative Departures
reference point = 236, total depth = 216, perforations = 119 - 214 (*shallow*)
Base Period 1983-1995



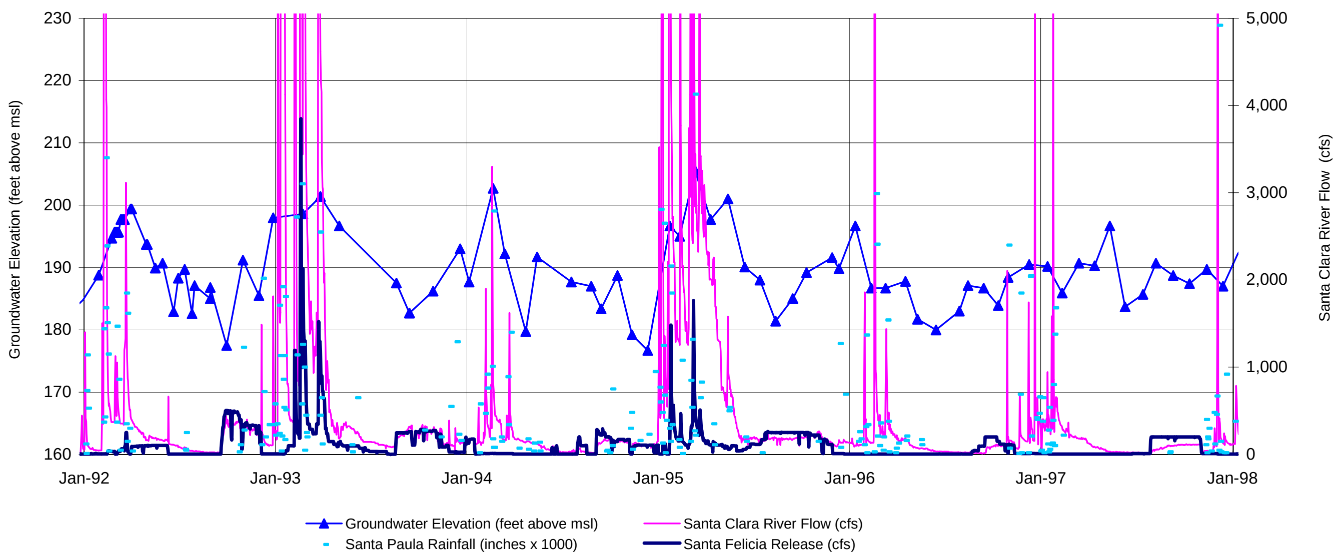

3N/21W-16K1 Groundwater Elevations and Cumulative Departures
reference point = 236, total depth = 216, perforations = 119 - 214 (shallow)
Base Period 1944-1998
Groundwater Elevation (feet above msl)
Cumulative Departure from the Average (percent)
230
220
210
200
190
180
170
160
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-42
Jan-46
Jan-50
Jan-54
Jan-58
Jan-62
Jan-66
Jan-70
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94
Jan-98
Jan-02
Groundwater Elevation (feet above msl)
Santa Paula Rainfall (cumulative departure from the avearage (percent), water years 1944-1998)
Santa Paula Creek Flow (cumulative departure from the average (percent), water years 1944-1998)
Sespe Creek Flow (cumulative departure from the average (percent), water years, 1944-1998)

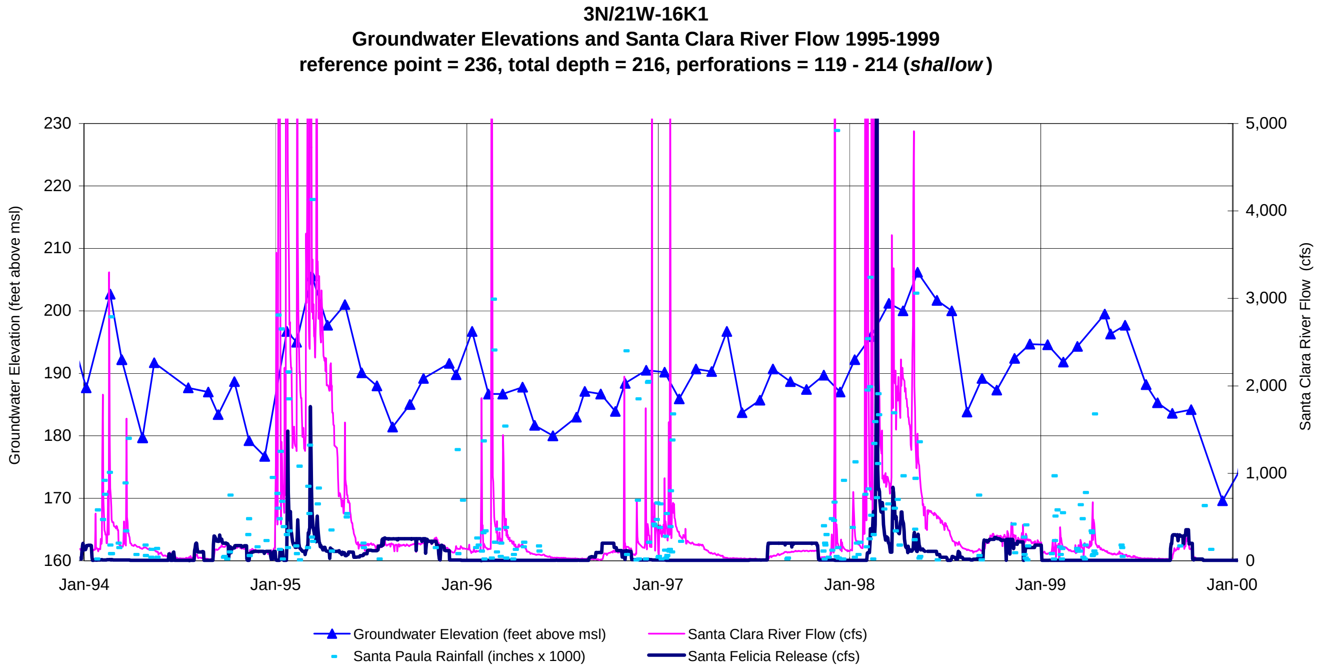

3N/21W-16K1
Groundwater Elevations and Santa Clara River Flow 1983-1987
reference point = 236, total depth = 216, perforations = 119 - 214 (shallow)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
230
220
210
200
190
180
170
160
5,000
4,000
3,000
2,000
1,000
0
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Groundwater Elevation (feet above msl)
Santa Paula Rainfall (inches x 1000)
Santa Clara River Flow (cfs)
Santa Felicia Release (cfs)

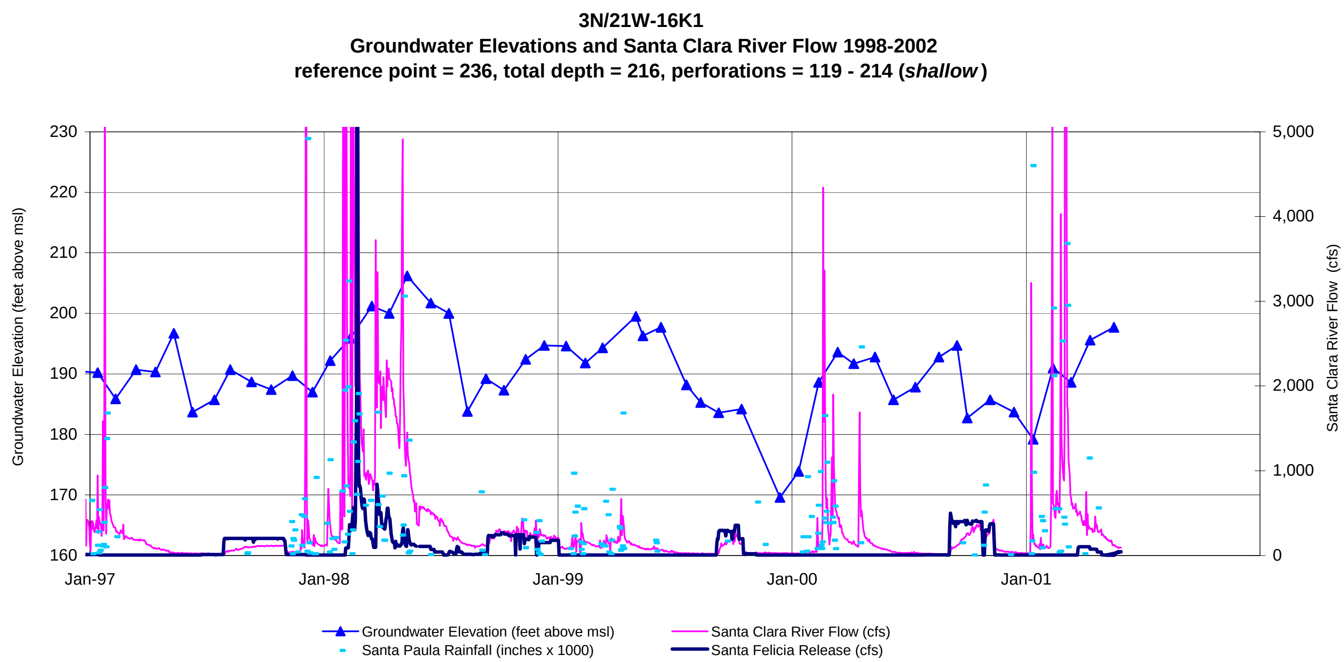
3N/21W-16K1
Groundwater Elevations and Santa Clara River Flow 1990-1994
reference point = 236, total depth = 216, perforations = 119 - 214 (*shallow*)

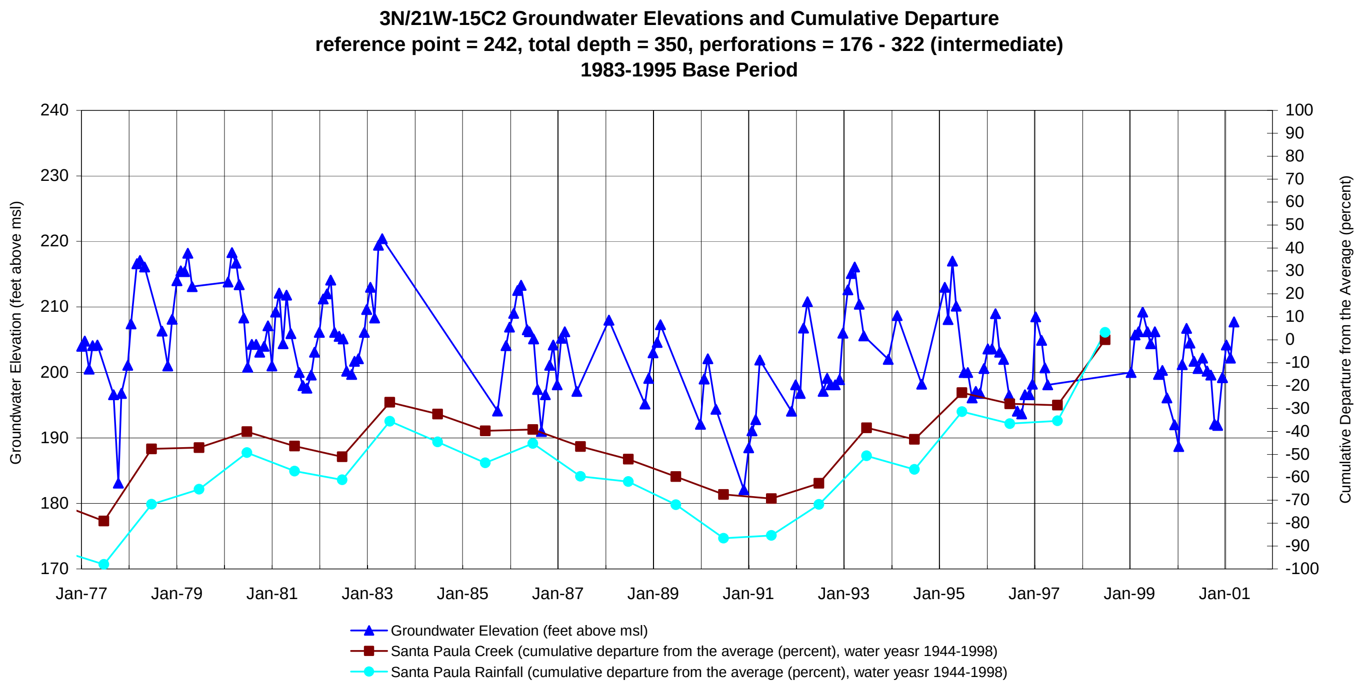


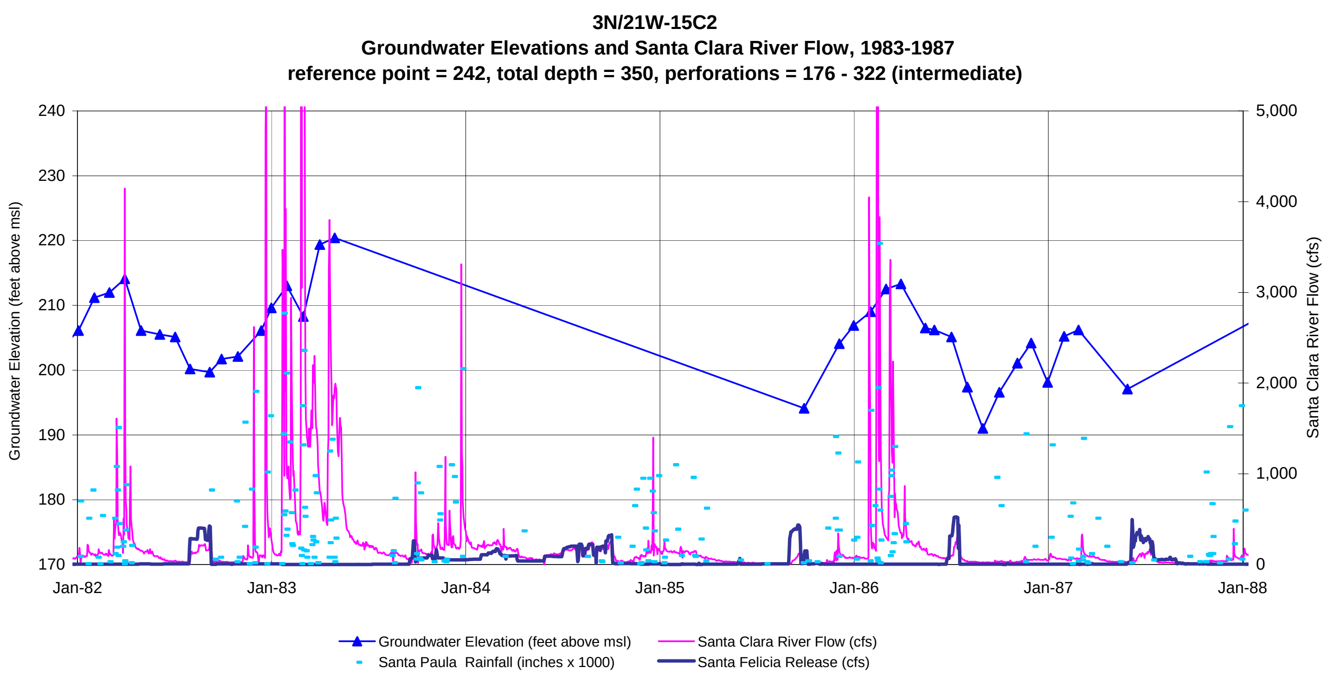
3N/21W-16K1
Groundwater Elevations and Santa Clara River Flow 1993-1998
reference point = 236, total depth = 216, perforations = 119 - 214 (*shallow*)



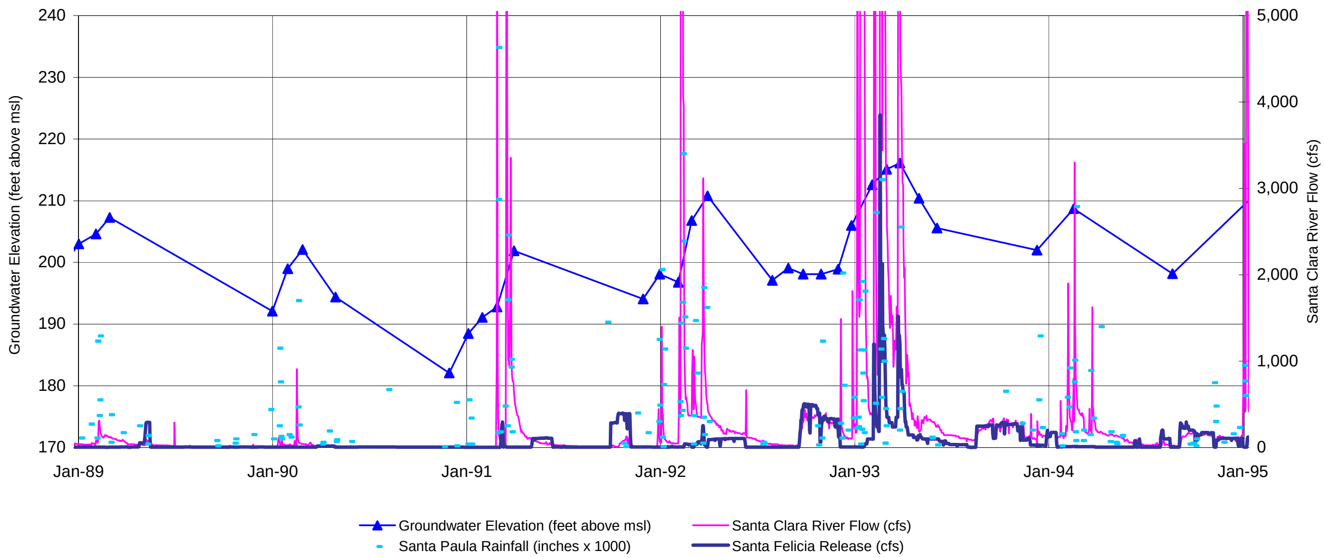

3N/21W-16K1
Groundwater Elevations and Santa Clara River Flow 1995-1999
reference point = 236, total depth = 216, perforations = 119 - 214 (shallow)
230
220
210
200
190
180
170
160
Groundwater Elevation (feet above msl)
5,000
4,000
3,000
2,000
1,000
0
Santa Clara River Flow (cfs)
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Release (cfs)


3N/21W-16K1
Groundwater Elevations and Santa Clara River Flow 1998-2002
reference point = 236, total depth = 216, perforations = 119 - 214 (shallow)
230
220
210
200
190
180
170
160
Groundwater Elevation (feet above msl)
5,000
4,000
3,000
2,000
1,000
0
Santa Clara River Flow (cfs)
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Release (cfs)

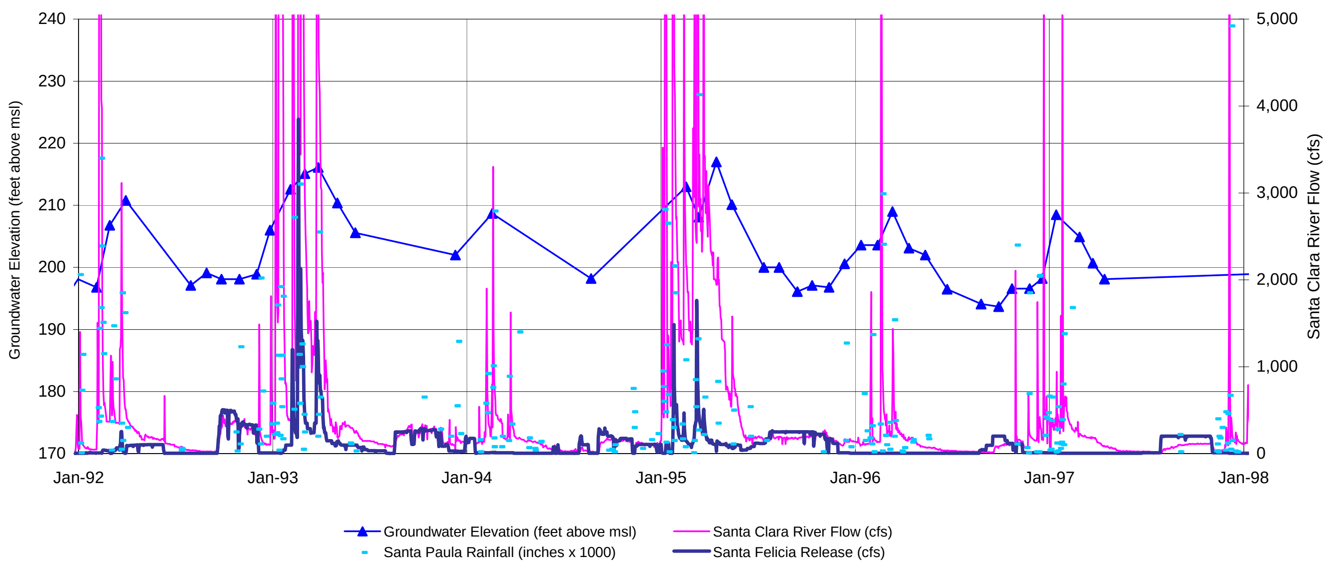

3N/21W-15C2 Groundwater Elevations and Cumulative Departure
reference point = 242, total depth = 350, perforations = 176 - 322 (intermediate)
1983-1995 Base Period
Groundwater Elevation (feet above msl)
Cumulative Departure from the Average (percent)
240
230
220
210
200
190
180
170
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-77
Jan-79
Jan-81
Jan-83
Jan-85
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Groundwater Elevation (feet above msl)
Santa Paula Creek (cumulative departure from the average (percent), water yeasr 1944-1998)
Santa Paula Rainfall (cumulative departure from the average (percent), water yeasr 1944-1998)

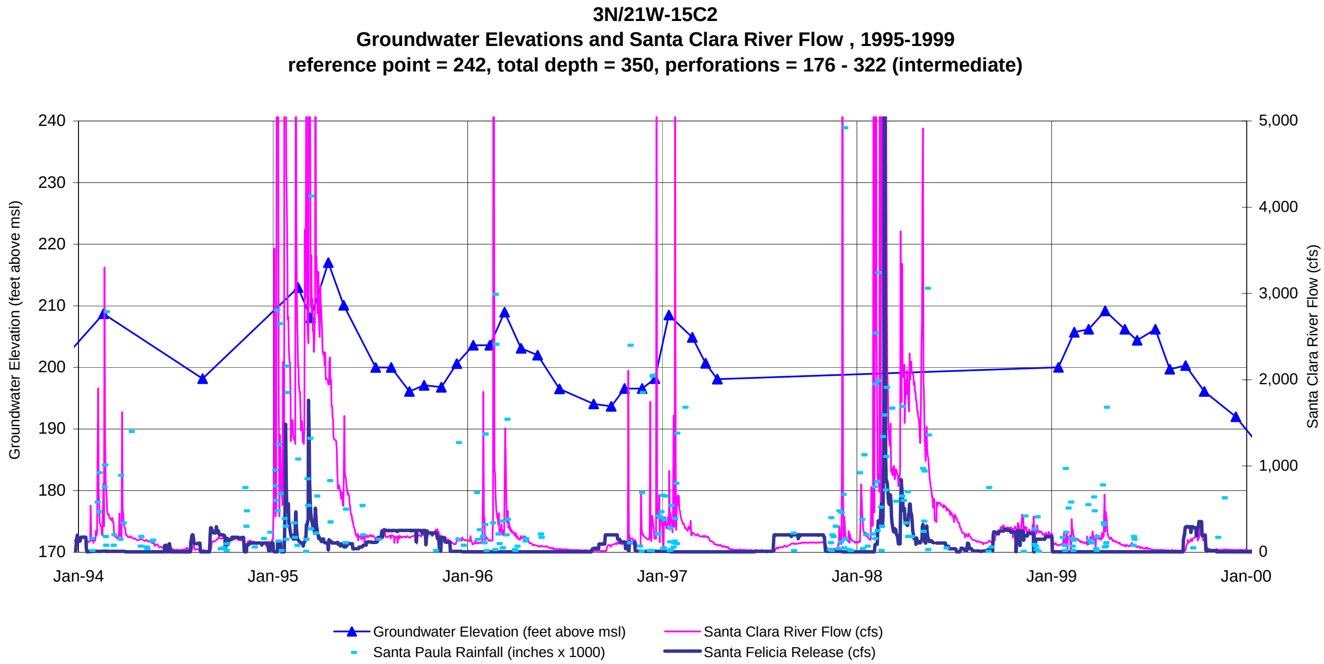

3N/21W-15C2
Groundwater Elevations and Santa Clara River Flow, 1983-1987
reference point = 242, total depth = 350, perforations = 176 - 322 (intermediate)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
240
230
220
210
200
190
180
170
5,000
4,000
3,000
2,000
1,000
0
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Release (cfs)

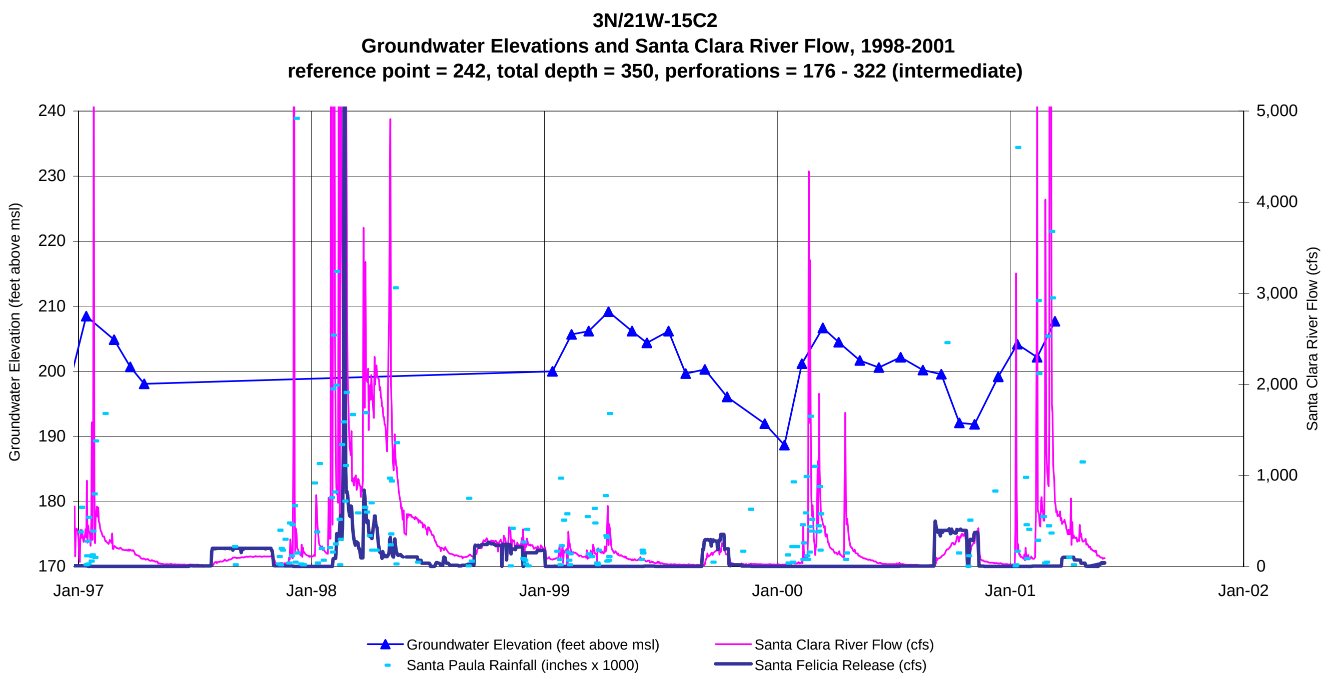
3N/21W-15C2
Groundwater Elevations and Santa Clara River Flow, 1990-1994
reference point = 242, total depth = 350, perforations = 176 - 322 (intermediate)

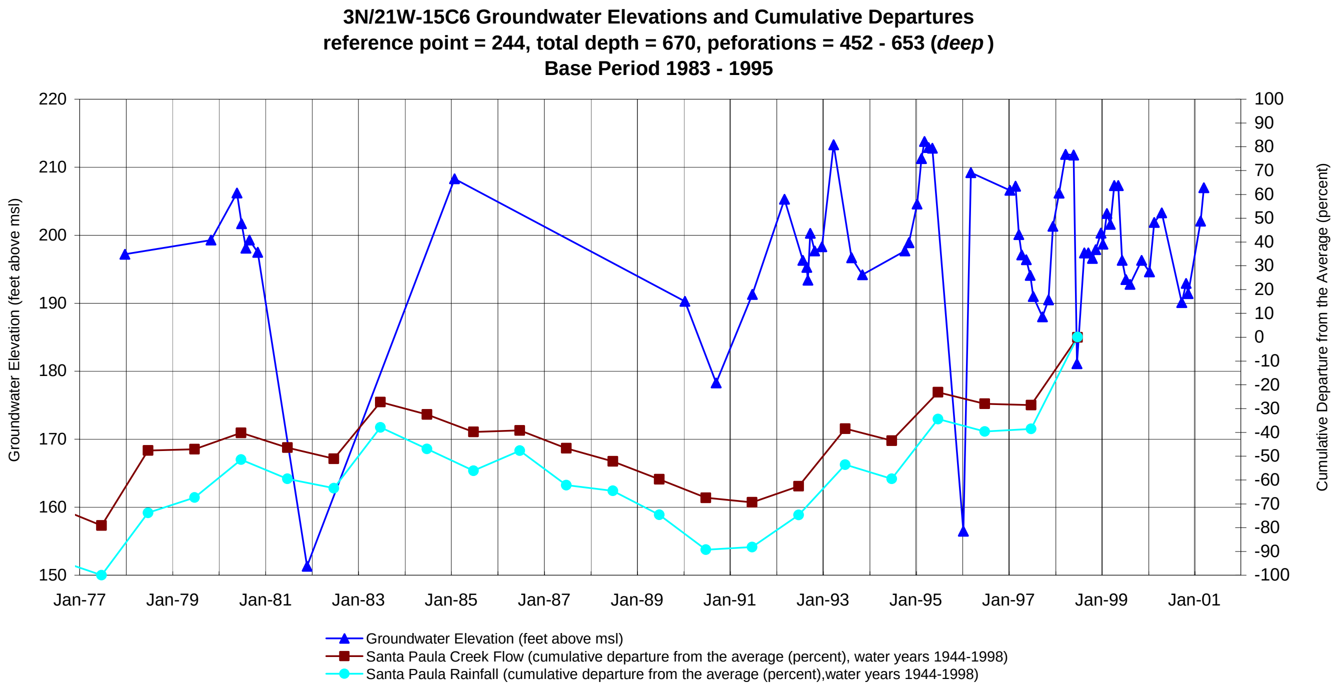


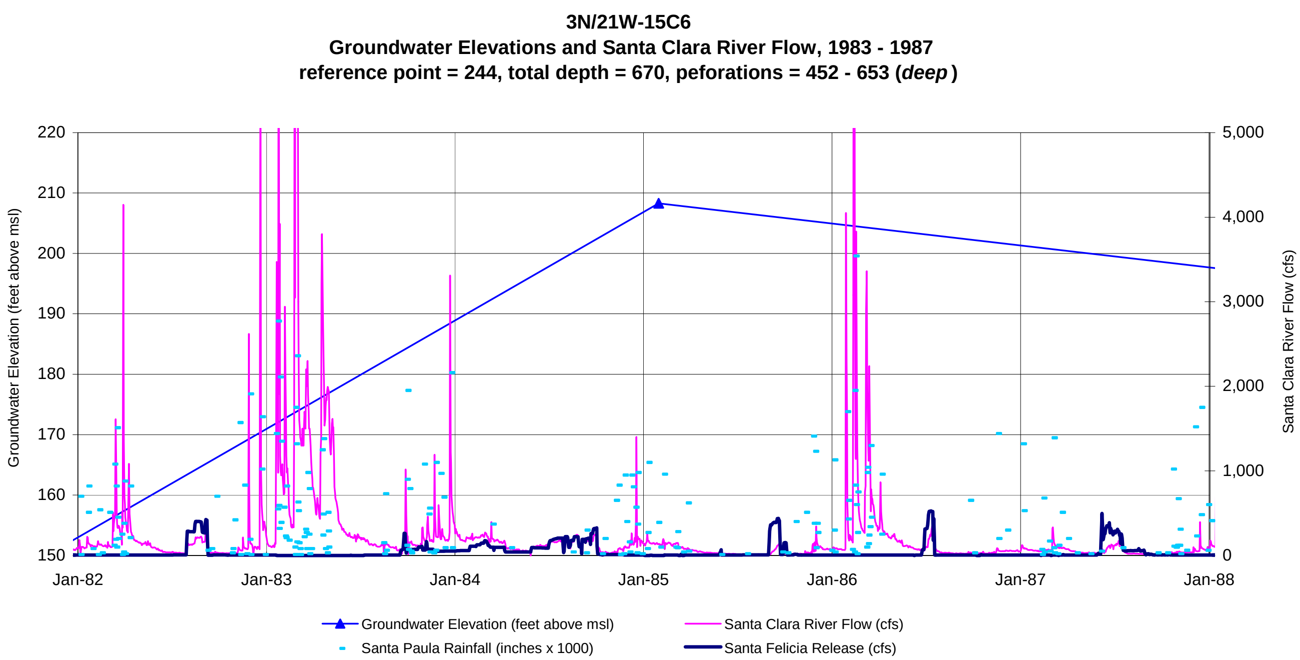
3N/21W-15C2
Groundwater Elevations and Santa Clara River Flow, 1993-1997
reference point = 242, total depth = 350, perforations = 176 - 322 (intermediate)



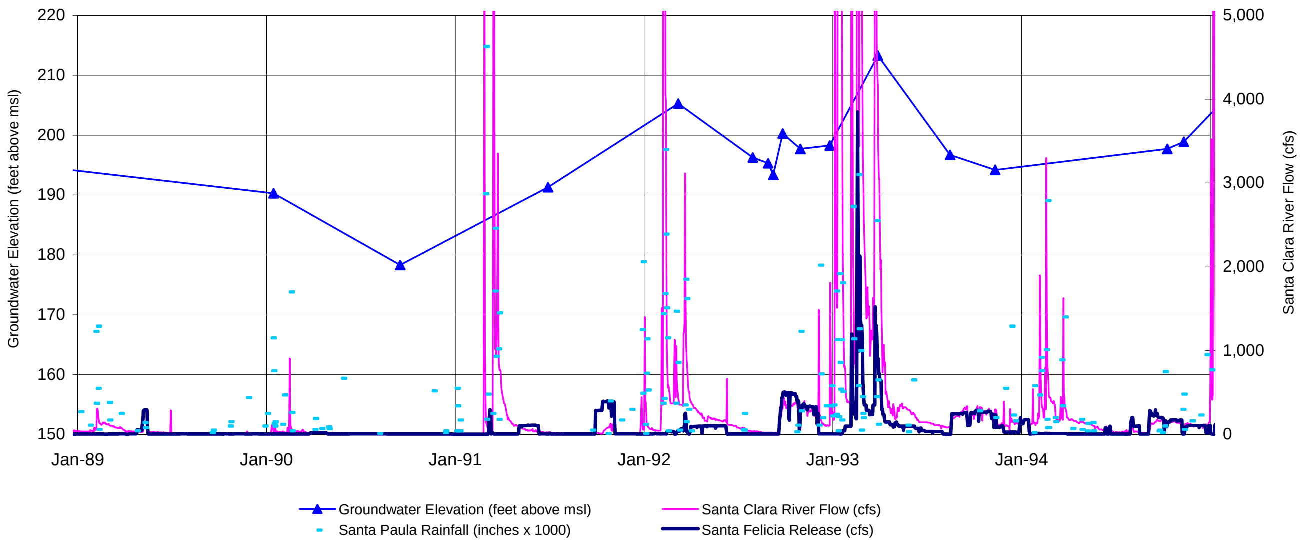

3N/21W-15C2
Groundwater Elevations and Santa Clara River Flow , 1995-1999
reference point = 242, total depth = 350, perforations = 176 - 322 (intermediate)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
240
230
220
210
200
190
180
170
5,000
4,000
3,000
2,000
1,000
0
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Release (cfs)


3N/21W-15C2
Groundwater Elevations and Santa Clara River Flow, 1998-2001
reference point = 242, total depth = 350, perforations = 176 - 322 (intermediate)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
240
230
220
210
200
190
180
170
5,000
4,000
3,000
2,000
1,000
0
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Release (cfs)

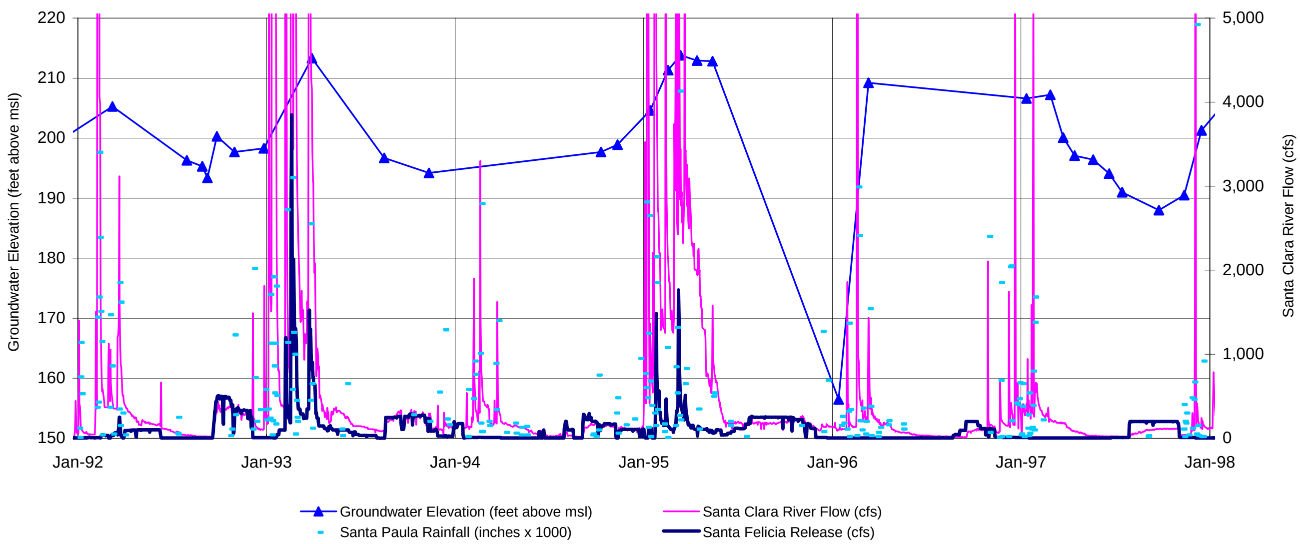

3N/21W-15C6 Groundwater Elevations and Cumulative Departures
reference point = 244, total depth = 670, peforations = 452 - 653 (deep)
Base Period 1983 - 1995
Groundwater Elevation (feet above msl)
Cumulative Departure from the Average (percent)
Jan-77
Jan-79
Jan-81
Jan-83
Jan-85
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Groundwater Elevation (feet above msl)
Santa Paula Creek Flow (cumulative departure from the average (percent), water years 1944-1998)
Santa Paula Rainfall (cumulative departure from the average (percent),water years 1944-1998)


3N/21W-15C6
Groundwater Elevations and Santa Clara River Flow, 1983 - 1987
reference point = 244, total depth = 670, peforations = 452 - 653 (deep)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Release (cfs)

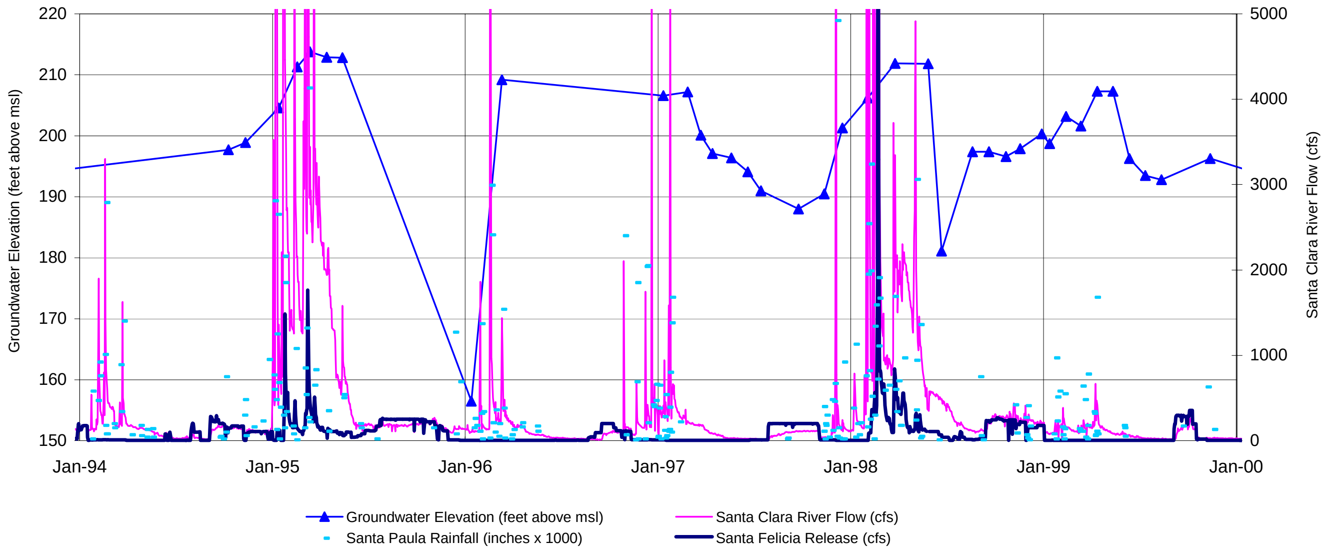
3N/21W-15C6
Groundwater Elevations and Santa Clara River Flow, 1990 - 1994
reference point = 244, total depth = 670, peforations = 452 - 653 (*deep*)



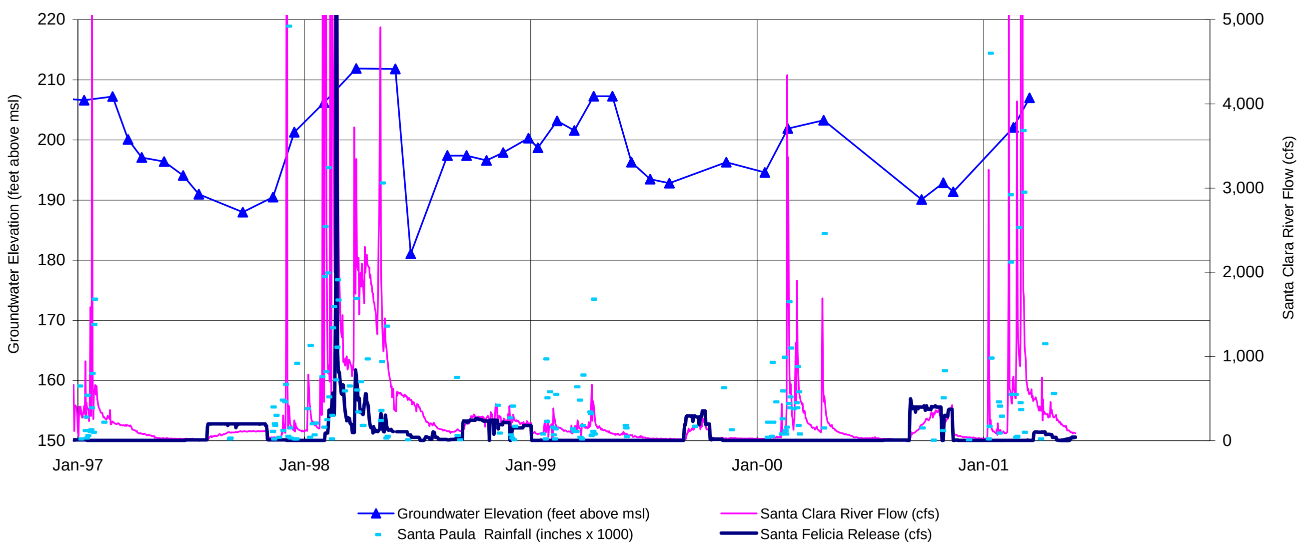
3N/21W-15C6
Groundwater Elevations and Santa Clara River Flow, 1993 - 1997
reference point = 244, total depth = 670, peforations = 452 - 653 (*deep*)

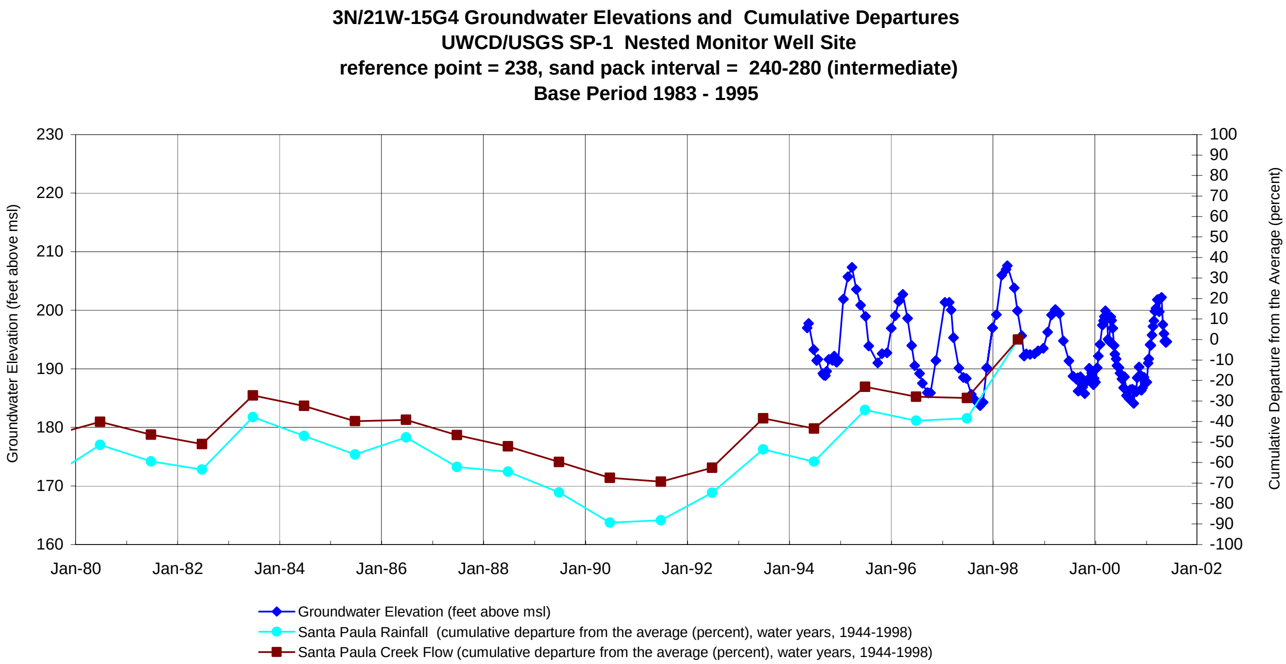


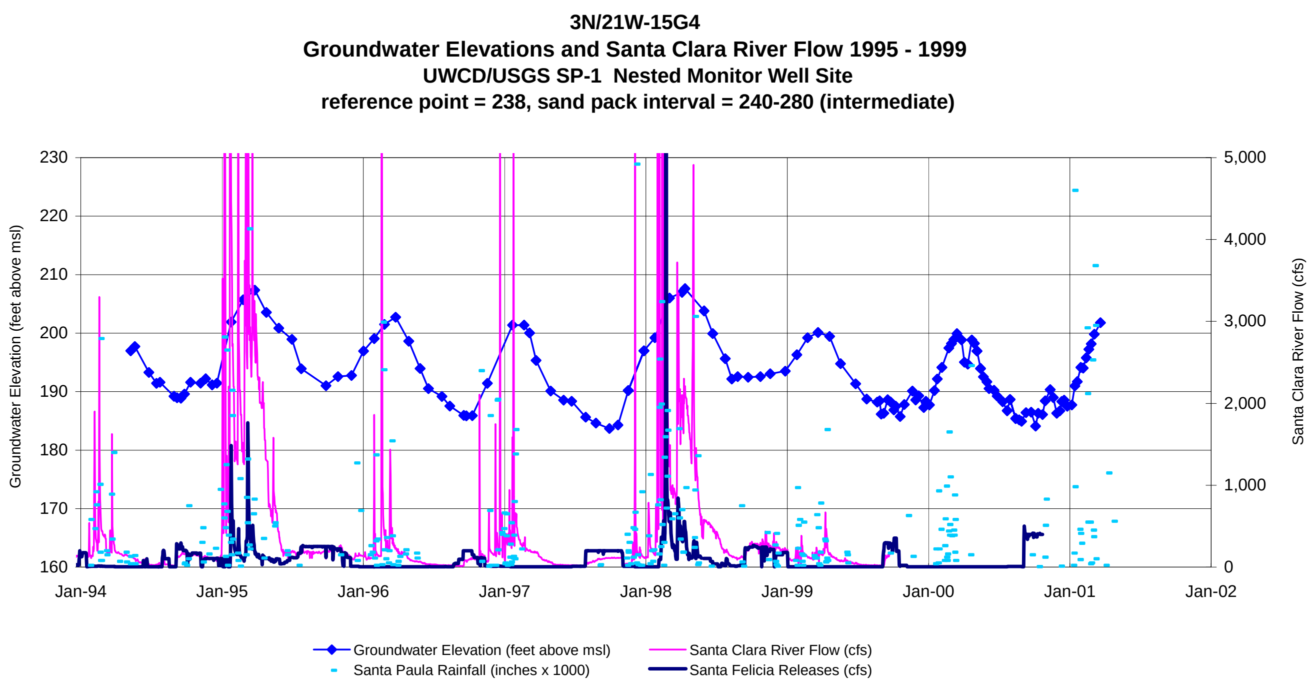
3N/21W-15C6
Groundwater Elevations and Santa Clara River Flow, 1995 - 1999
reference point = 244, total depth = 670, peforations = 452 - 653 (*deep*)



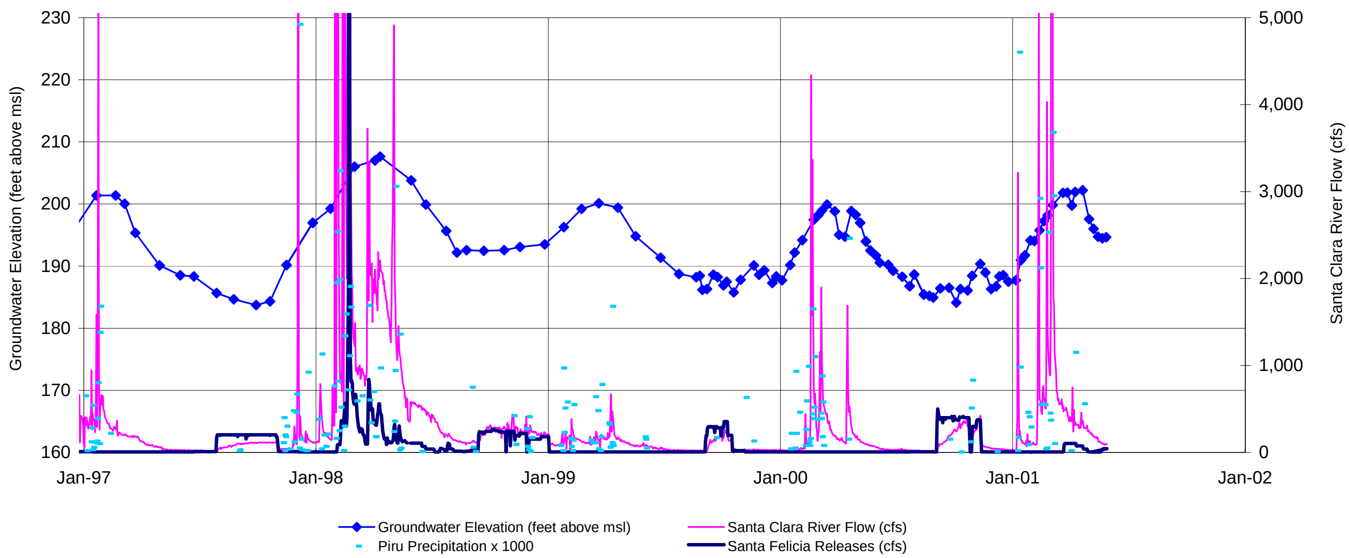
3N/21W-15C6
Groundwater Elevations and Santa Clara River Flow, 1998 - 2001
reference point = 244, total depth = 670, peforations = 452 - 653 (*deep*)



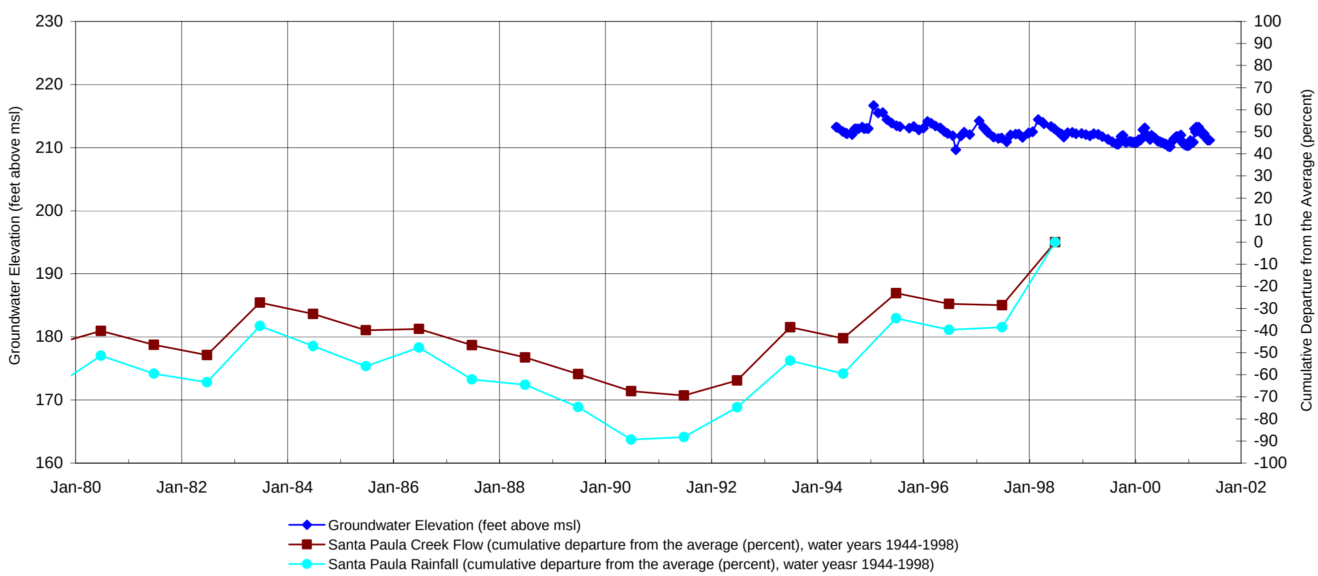

3N/21W-15G4 Groundwater Elevations and Cumulative Departures
UWCD/USGS SP-1 Nested Monitor Well Site
reference point = 238, sand pack interval = 240-280 (intermediate)
Base Period 1983 - 1995
Groundwater Elevation (feet above msl)
Cumulative Departure from the Average (percent)
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Groundwater Elevation (feet above msl)
Santa Paula Rainfall (cumulative departure from the average (percent), water years, 1944-1998)
Santa Paula Creek Flow (cumulative departure from the average (percent), water years, 1944-1998)


3N/21W-15G4
Groundwater Elevations and Santa Clara River Flow 1995 - 1999
UWCD/USGS SP-1 Nested Monitor Well Site
reference point = 238, sand pack interval = 240-280 (intermediate)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Releases (cfs)

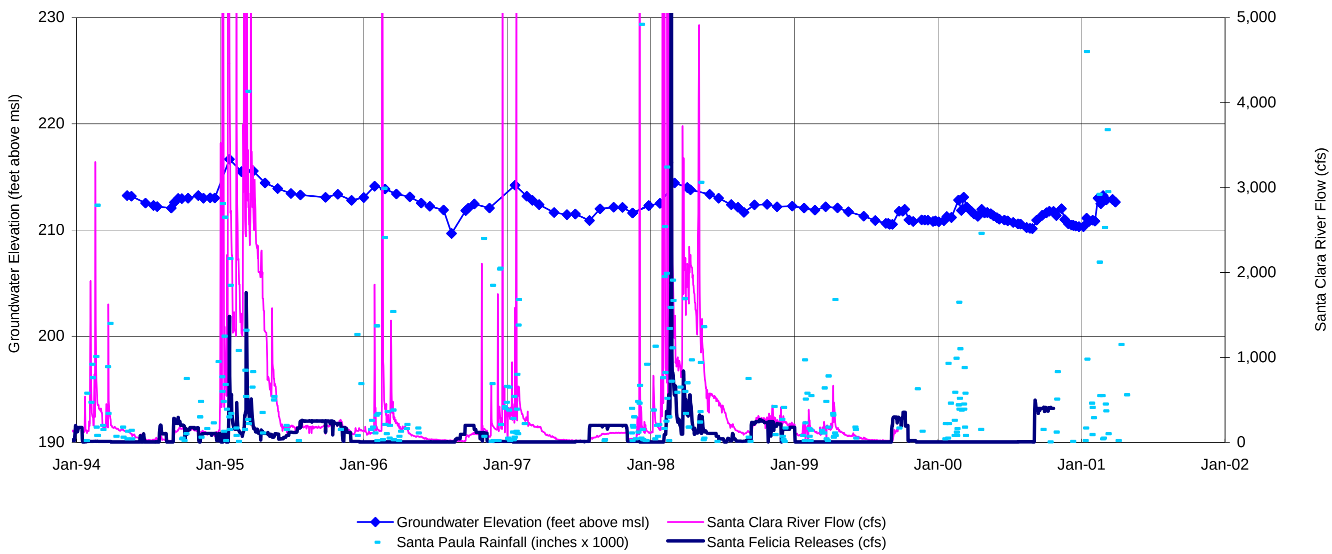
3N/21W-15G4
Groundwater Elevations and Santa Clara River Flow 1998 - 2002
UWCD/USGS SP-1 Nested Monitor Well Site
reference point = 238, sand pack interval = 240-280 (intermediate)



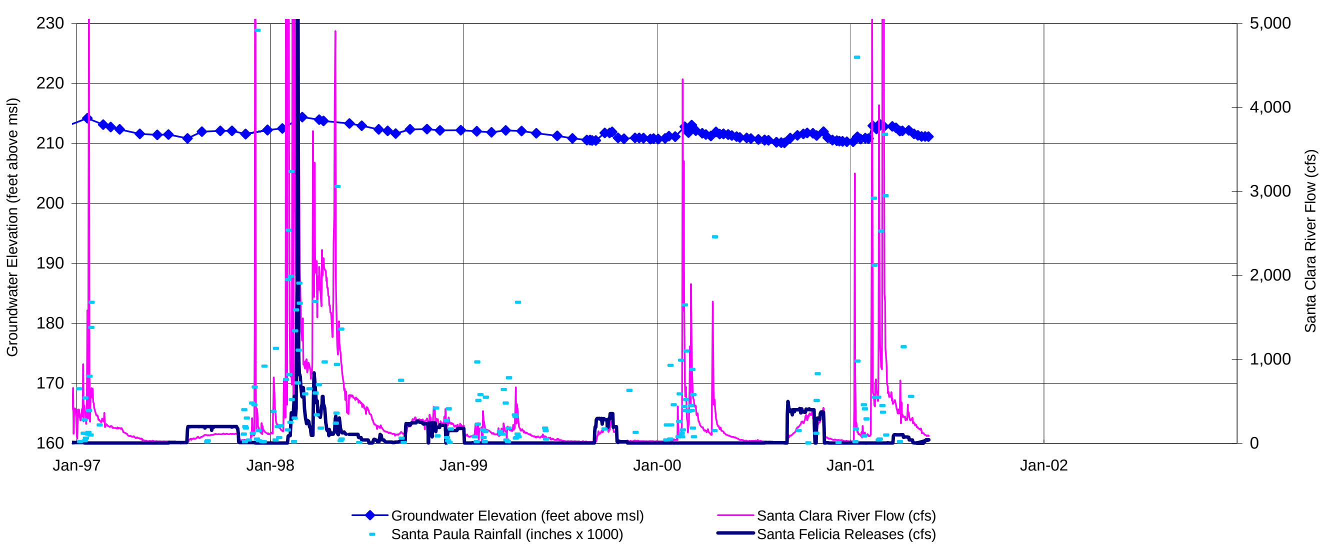
3N/21W-15G5 Groundwater Elevations and Cumulative Departures
UWCD/USGS SP-1 Nested Monitor Well Site
reference point = 238, sand pack interval = 40-100 (*shallow*)
Base Period 1983 - 1995



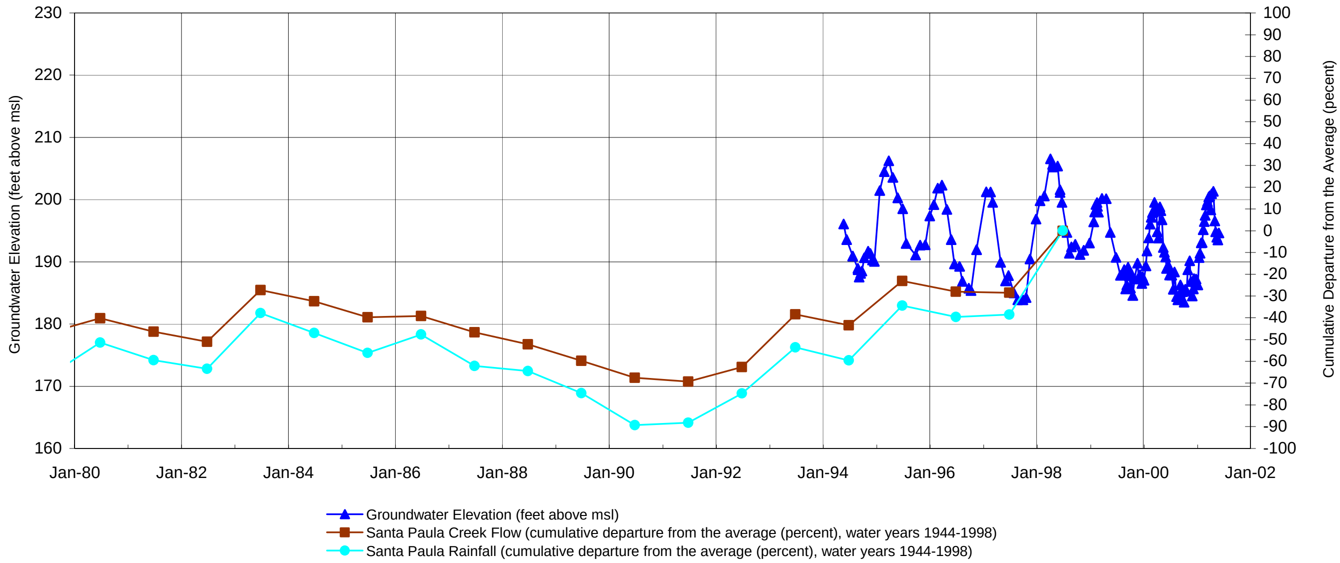
3N/21W-15G5
Groundwater Elevations and Santa Clara River Flow 1995-1999
UWCD/USGS SP-1 Nested Monitor Well Site
reference point = 238, sand pack interval = 40-100 (*shallow*)



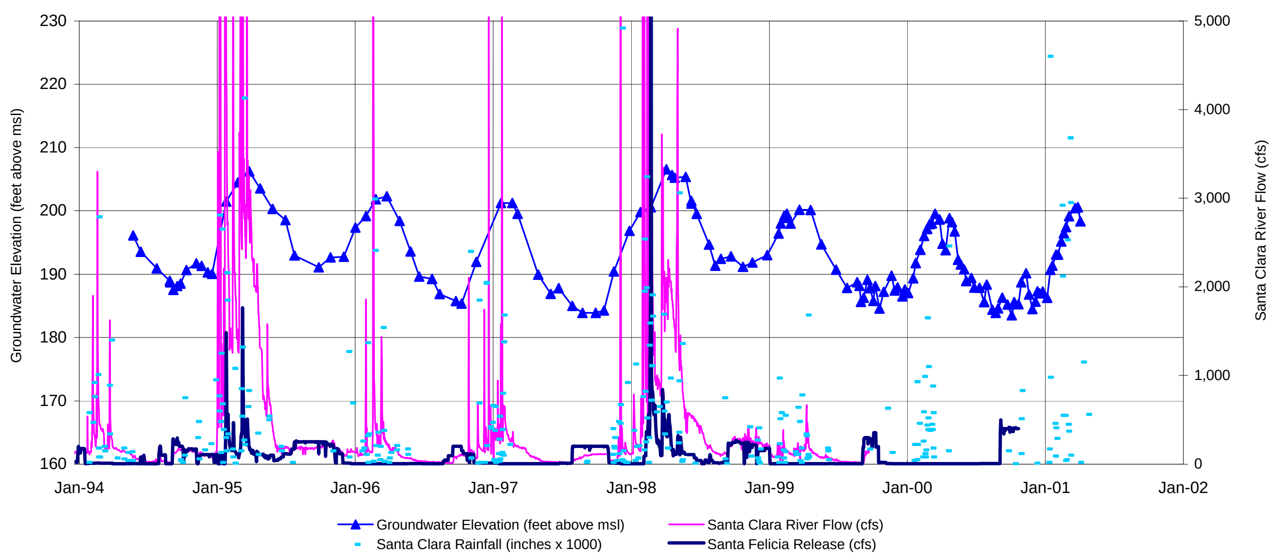
3N/21W-15G5
Groundwater Elevations and Santa Clara River Flow 1998 - 2002
UWCD/USGS SP-1 Nested Monitor Well Site
reference point = 238, sand pack interval = 40-100 (*shallow*)

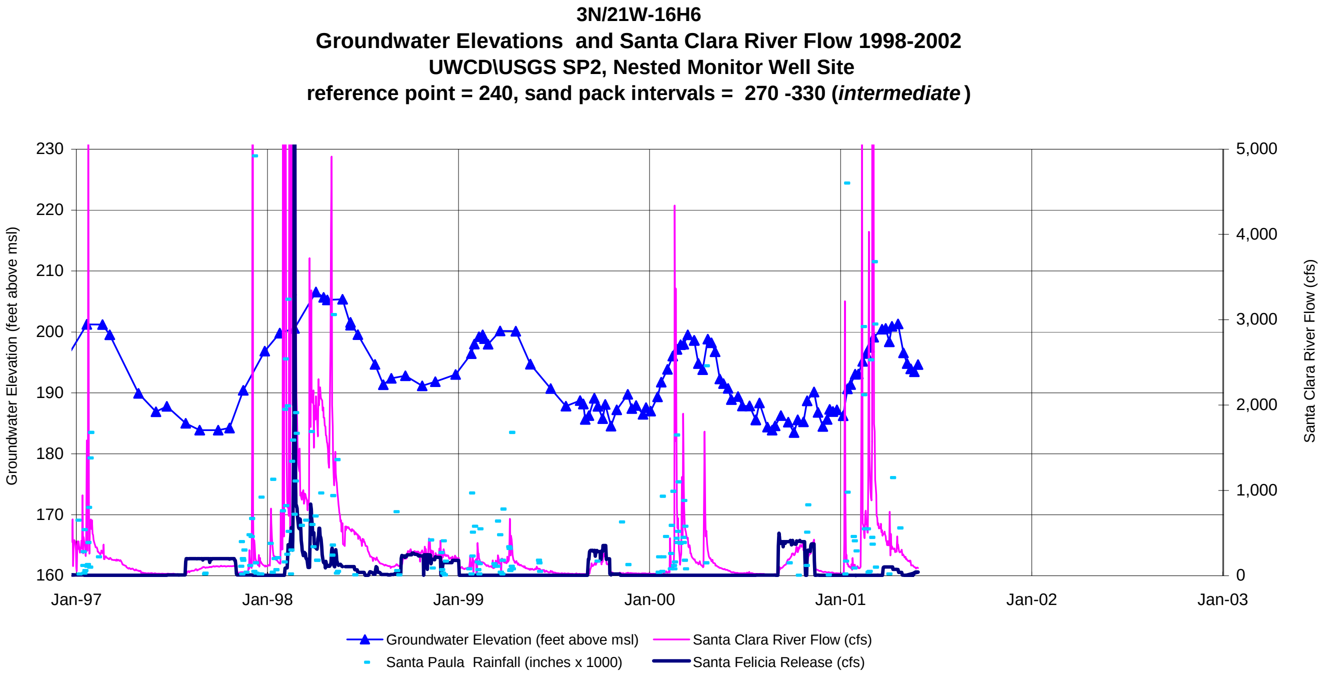


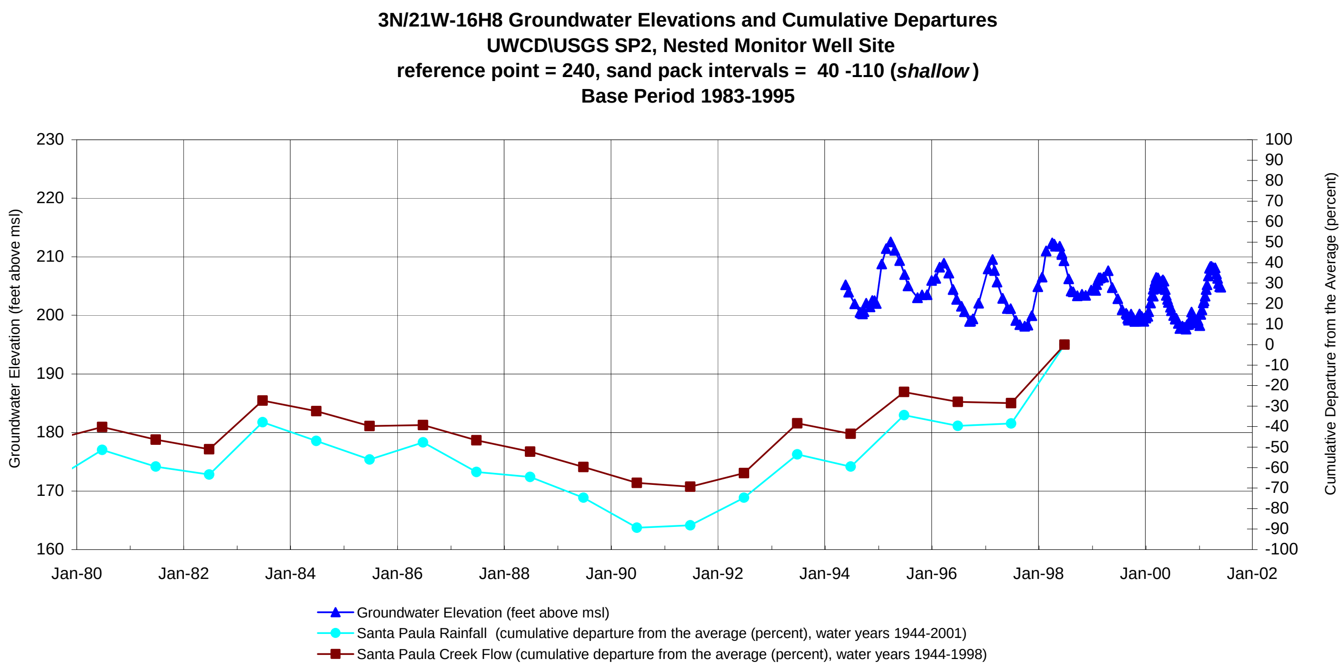
3N/21W-16H6 Groundwater Elevations and Cumulative Departures
UWCD\USGS SP2, Nested Monitor Well Site
reference point = 240, sand pack intervals = 270 -330 (*intermediate*)
Base Period 1983 - 1995

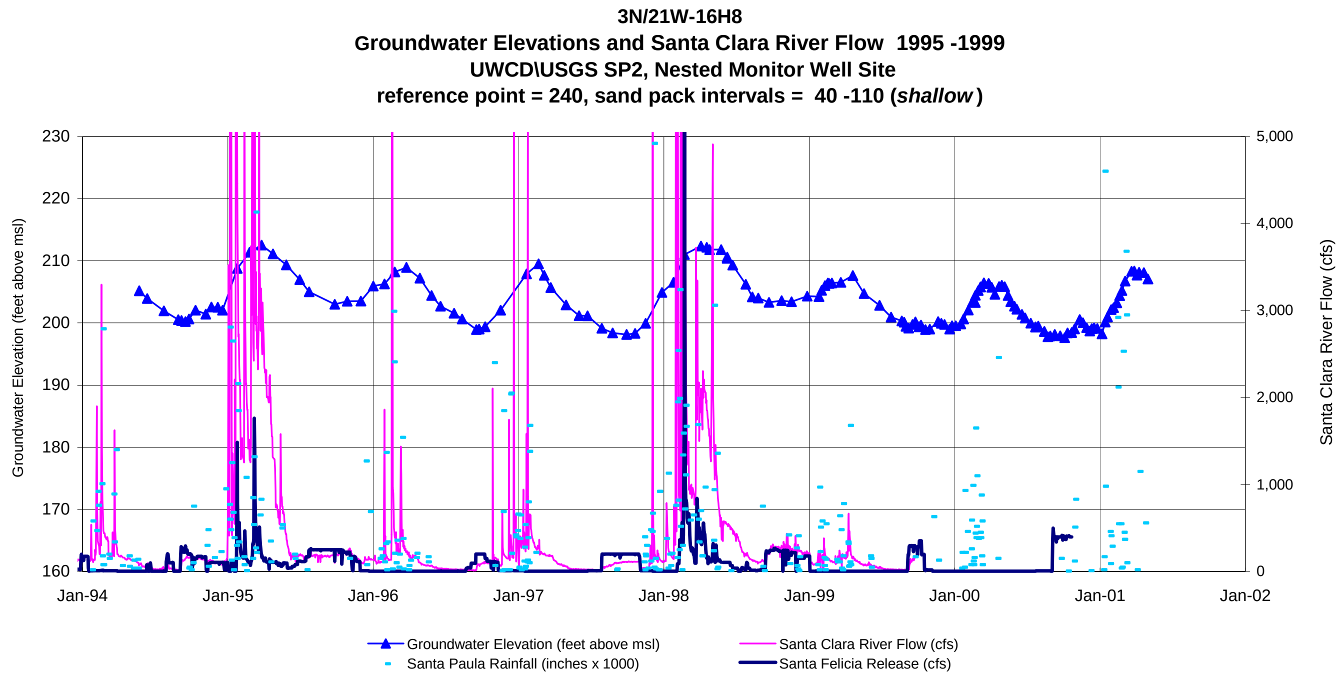


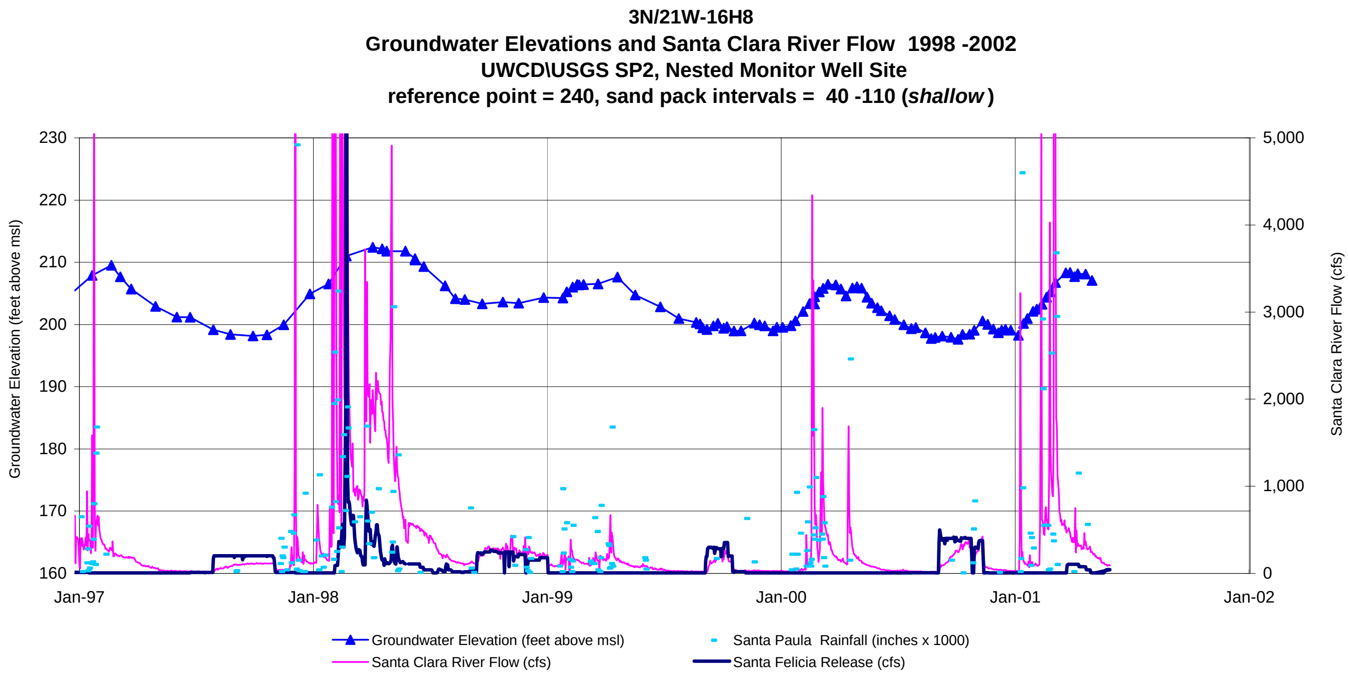
3N/21W-16H6
Groundwater Elevations and Santa Clara River Flow 1995-1999
UWCD\USGS SP2, Nested Monitor Well Site
reference point = 240, sand pack intervals = 270 -330 (*intermediate*)



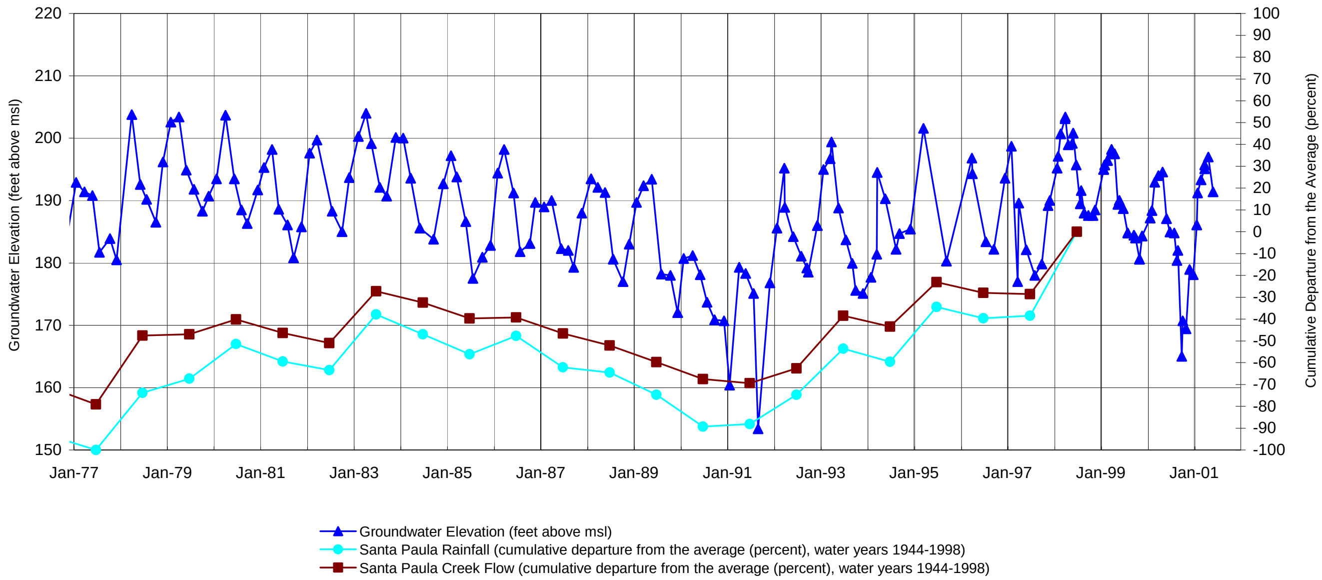

3N/21W-16H6
Groundwater Elevations and Santa Clara River Flow 1998-2002
UWCD\USGS SP2, Nested Monitor Well Site
reference point = 240, sand pack intervals = 270 -330 (intermediate)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Release (cfs)


3N/21W-16H8 Groundwater Elevations and Cumulative Departures
UWCD\USGS SP2, Nested Monitor Well Site
reference point = 240, sand pack intervals = 40 -110 (shallow)
Base Period 1983-1995
Groundwater Elevation (feet above msl)
Cumulative Departure from the Average (percent)
Jan-80
Jan-82
Jan-84
Jan-86
Jan-88
Jan-90
Jan-92
Jan-94
Jan-96
Jan-98
Jan-00
Jan-02
Groundwater Elevation (feet above msl)
Santa Paula Rainfall (cumulative departure from the average (percent), water years 1944-2001)
Santa Paula Creek Flow (cumulative departure from the average (percent), water years 1944-1998)

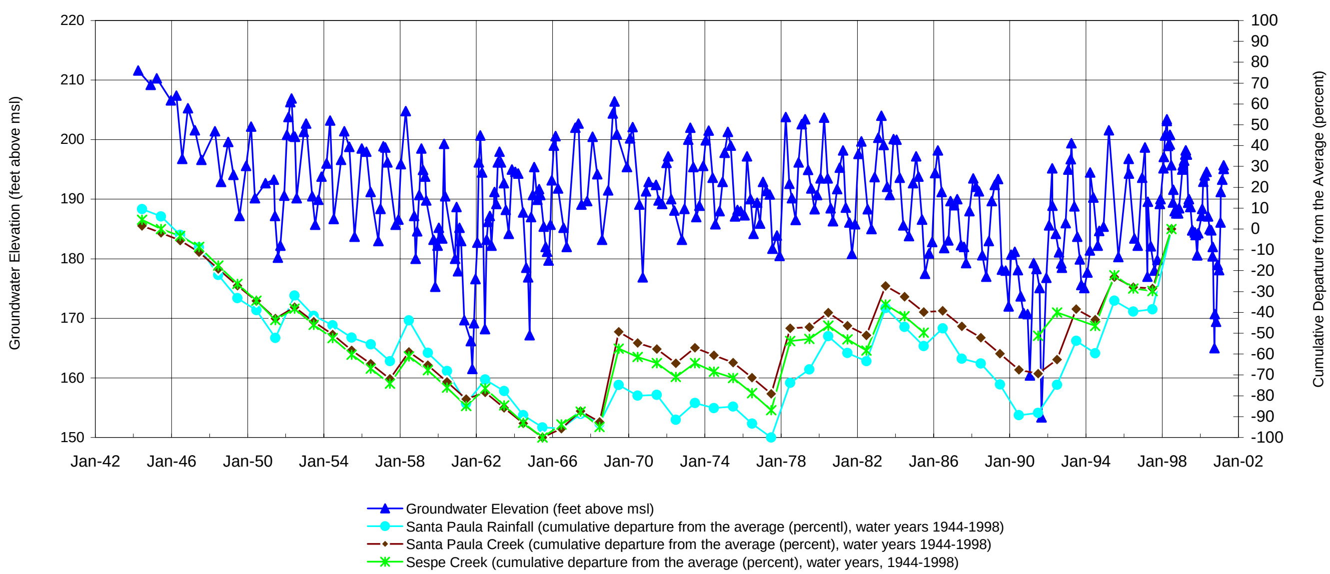

3N/21W-16H8
Groundwater Elevations and Santa Clara River Flow 1995 -1999
UWCD\USGS SP2, Nested Monitor Well Site
reference point = 240, sand pack intervals = 40 -110 (shallow)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
230
220
210
200
190
180
170
160
5,000
4,000
3,000
2,000
1,000
0
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Groundwater Elevation (feet above msl)
Santa Paula Rainfall (inches x 1000)
Santa Clara River Flow (cfs)
Santa Felicia Release (cfs)


3N/21W-16H8
Groundwater Elevations and Santa Clara River Flow 1998 -2002
UWCD\USGS SP2, Nested Monitor Well Site
reference point = 240, sand pack intervals = 40 -110 (shallow)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
230
220
210
200
190
180
170
160
5,000
4,000
3,000
2,000
1,000
0
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Groundwater Elevation (feet above msl)
Santa Paula Rainfall (inches x 1000)
Santa Clara River Flow (cfs)
Santa Felicia Release (cfs)

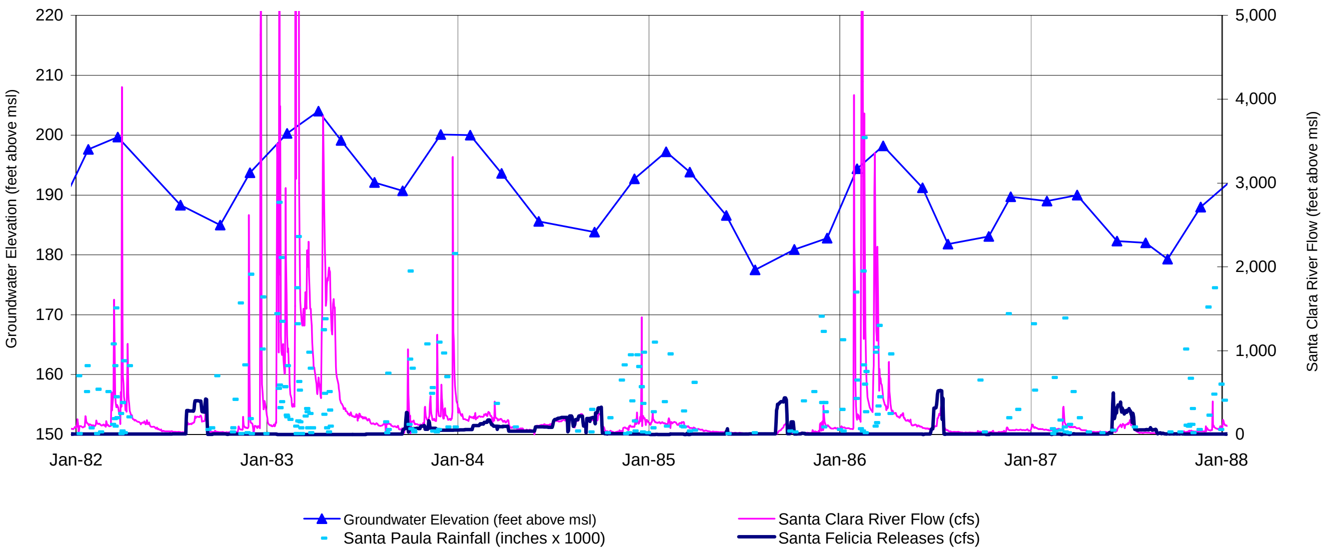
3N/21W-17Q1 Groundwater Elevations and Cumulative Departures
reference point = 285, total depth = 243, perforations = 183 - 243 (*intermediate*)
Base Period 1983 -1995



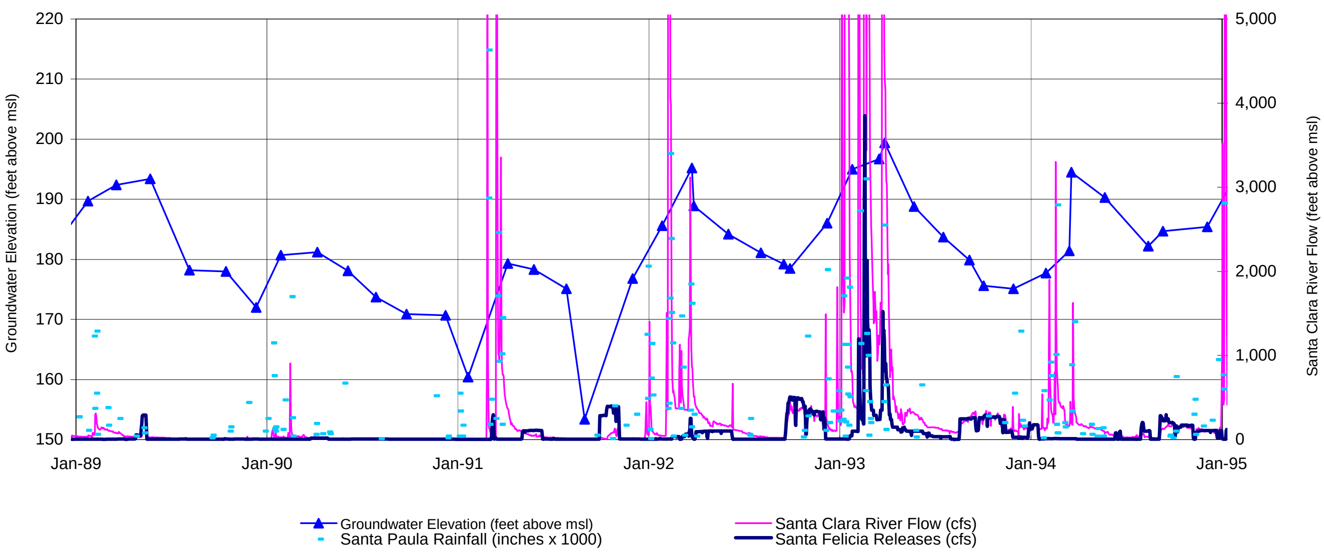
3N/21W-17Q1 Groundwater Elevations and Cumulative Departures
reference point = 285, total depth = 243, perforations = 183 - 243 (*intermediate*)
Base Period 1944 - 1998



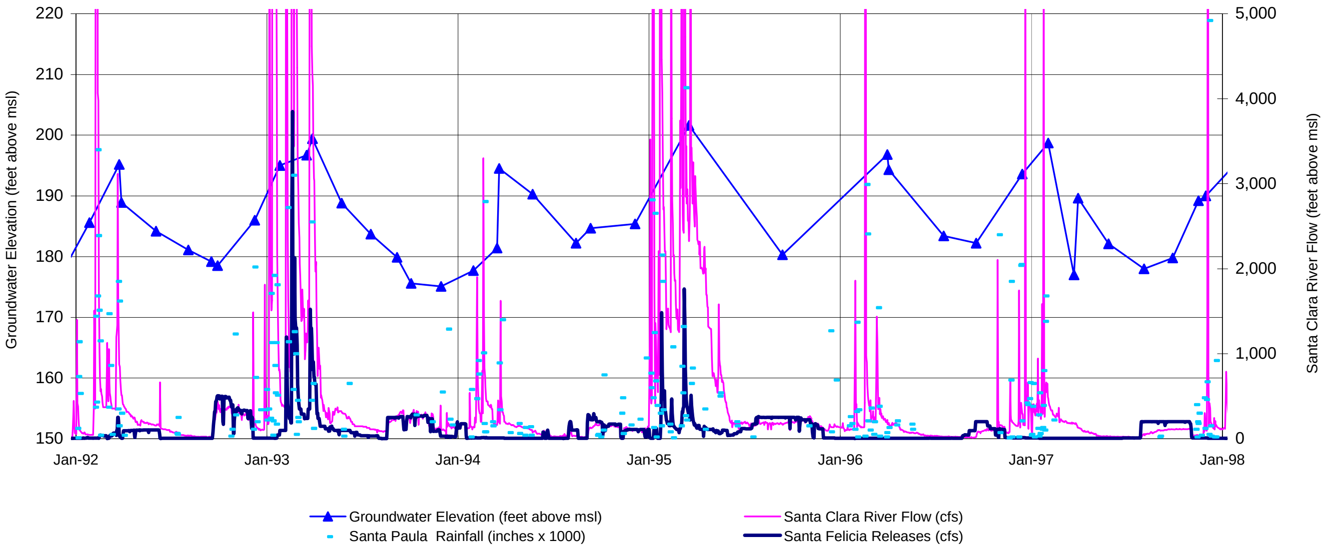
3N/21W-17Q1
Groundwater Elevations and Santa Clara River Flow, 1983-1987
reference point = 285, total depth = 243, perforations = 183 - 243 (*intermediate*)



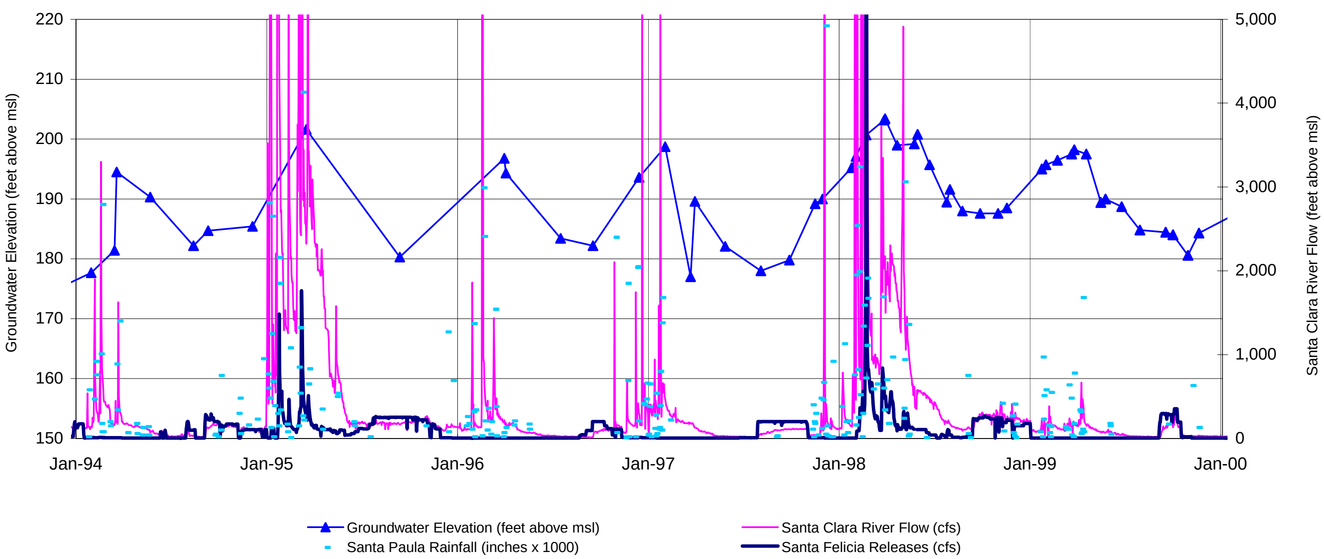
3N/21W-17Q1
Groundwater Elevations and Santa Clara River Flow, 1990-1994
reference point = 285, total depth = 243, perforations = 183 - 243 (*intermediate*)



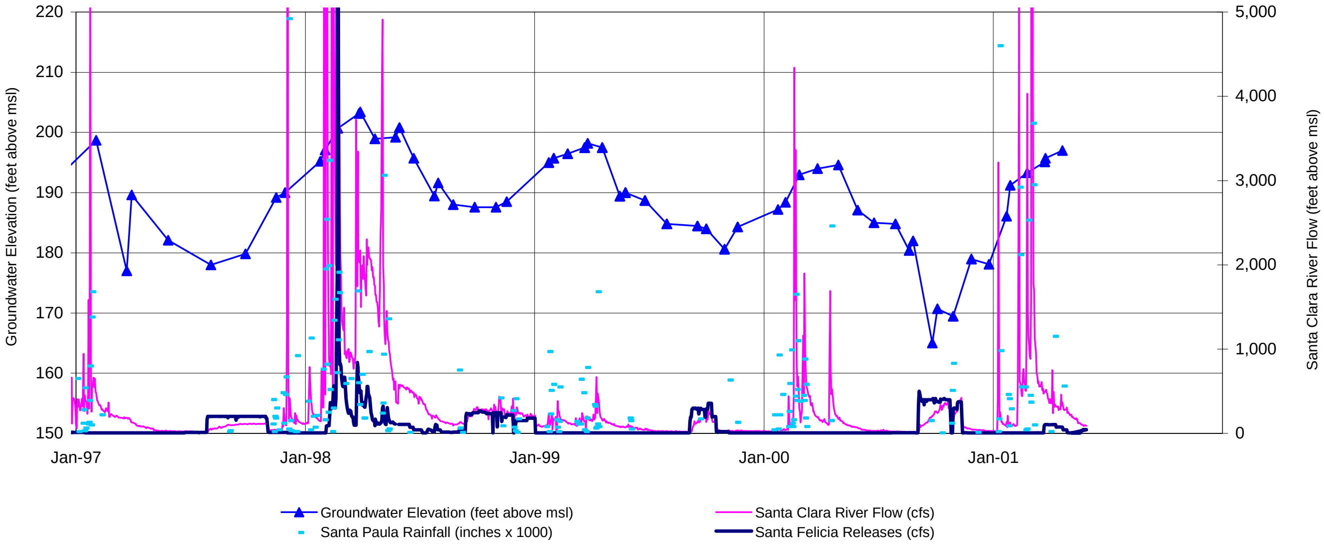
3N/21W-17Q1
Groundwater Elevations and Santa Clara River Flow, 1993-1997
reference point = 285, total depth = 243, perforations = 183 - 243 (*intermediate*)



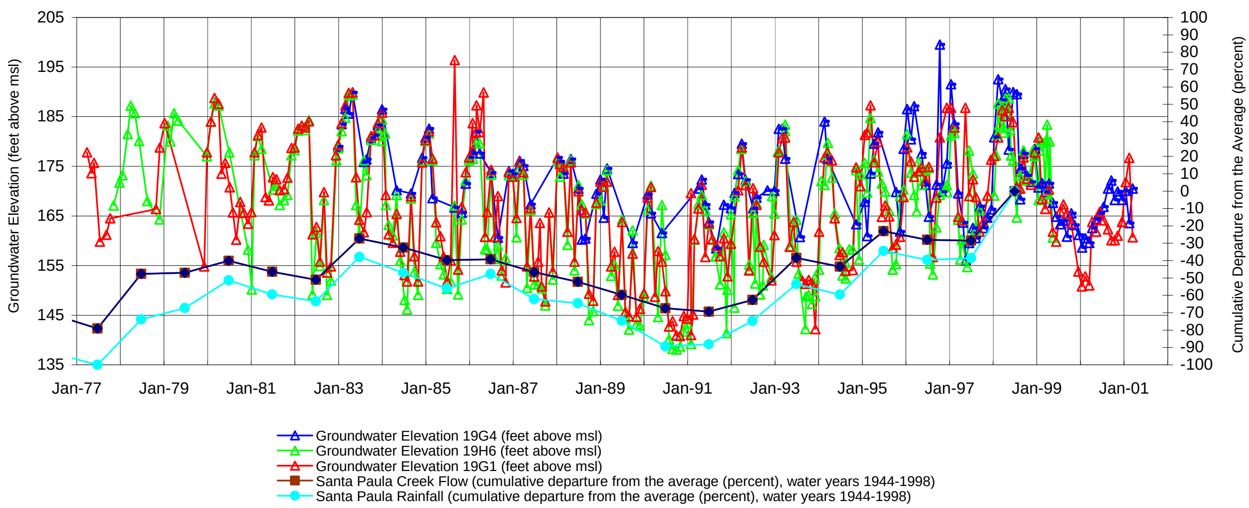
3N/21W-17Q1
Groundwater Elevations and Santa Clara River Flow, 1995-1999
reference point = 285, total depth = 243, perforations = 183 - 243 (*intermediate*)



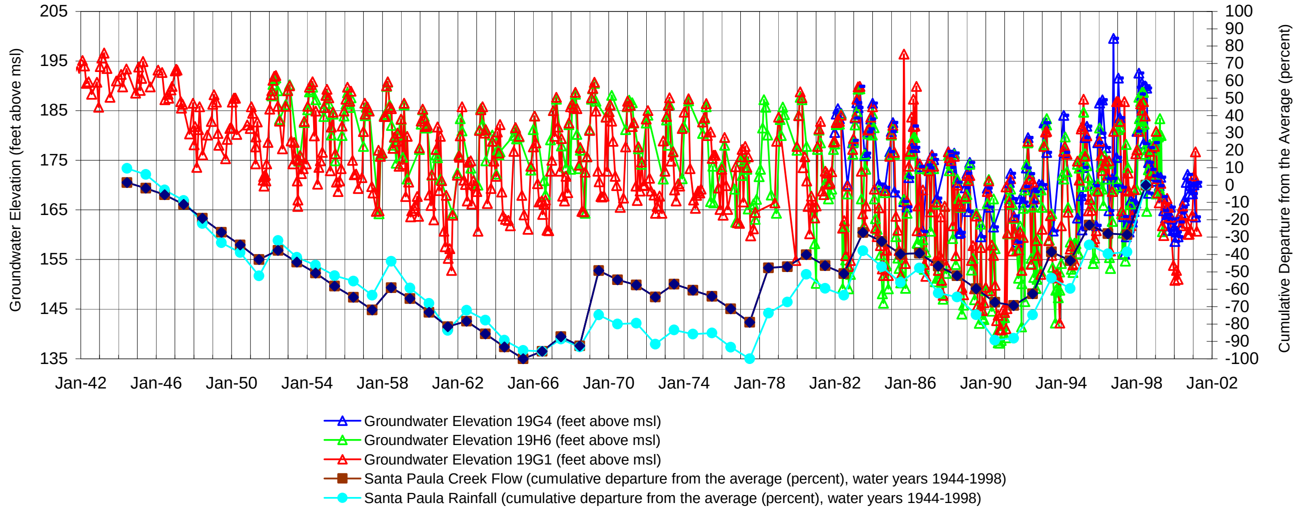
3N/21W-17Q1
Groundwater Elevations and Santa Clara River Flow, 1998- 2002
reference point = 285, total depth = 243, perforations = 183 - 243 (*intermediate*)



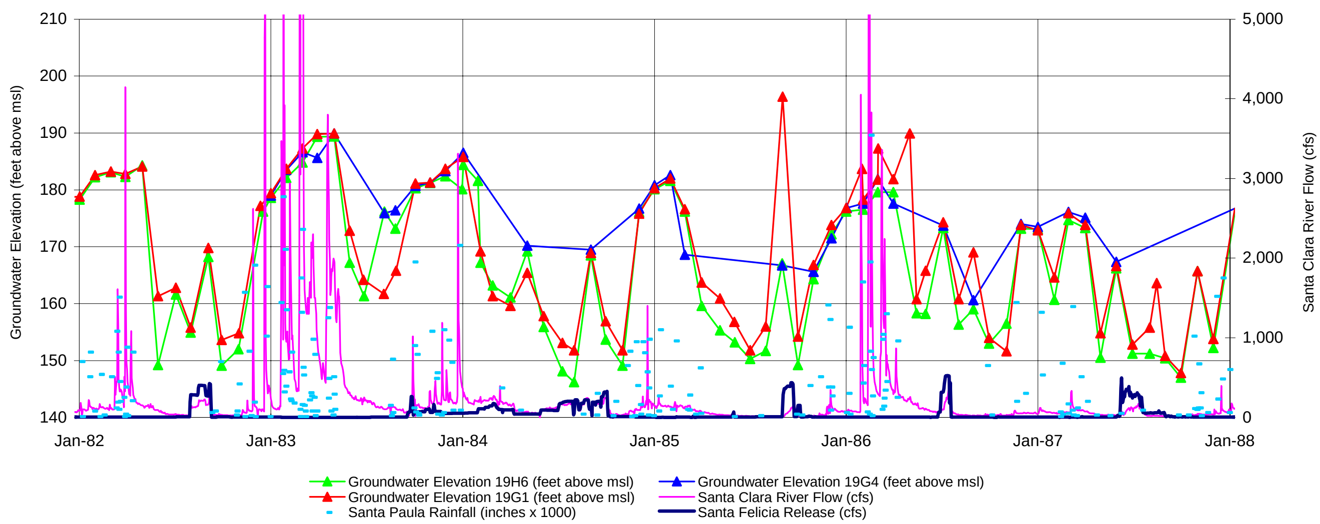
Olivelands Wells
Groundwater Elevations and Cumulative Departures
3N/21W-19G4 (450-720, RP 251)
3N/21W-19G1 (456-566, RP 249)
3N/21W-19H6 (459-694, RP 248)
Base Period 1983-1995

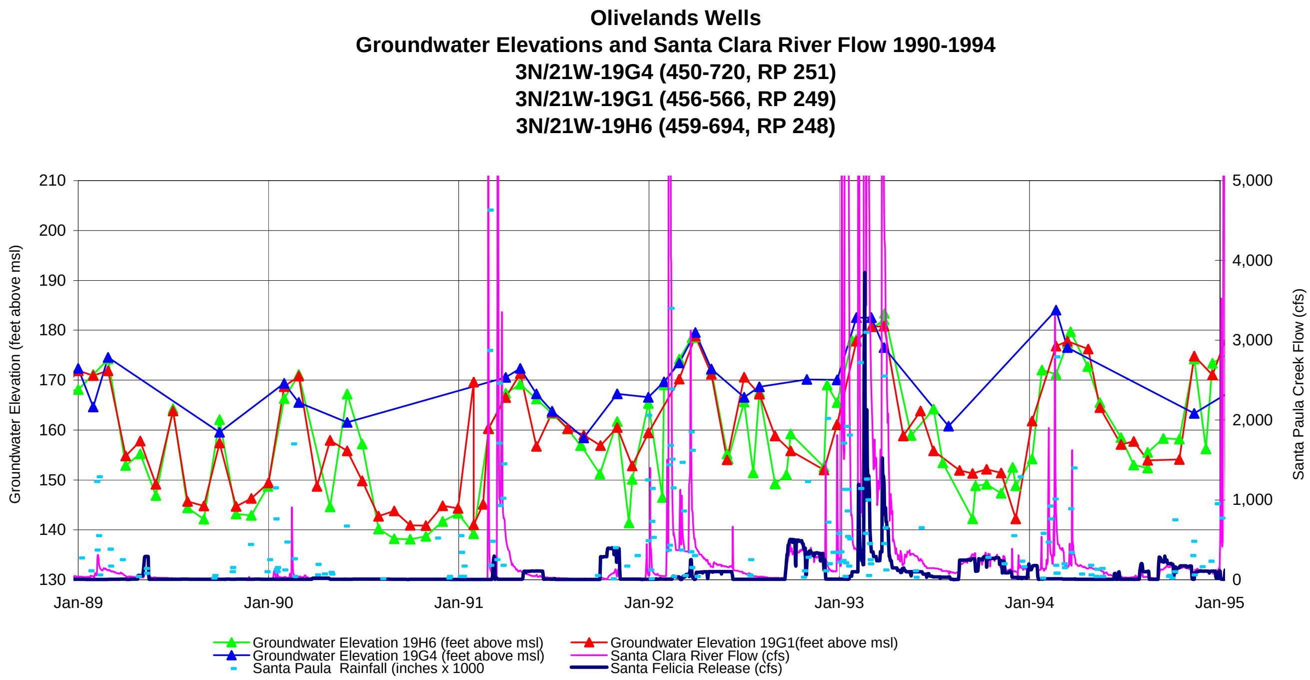


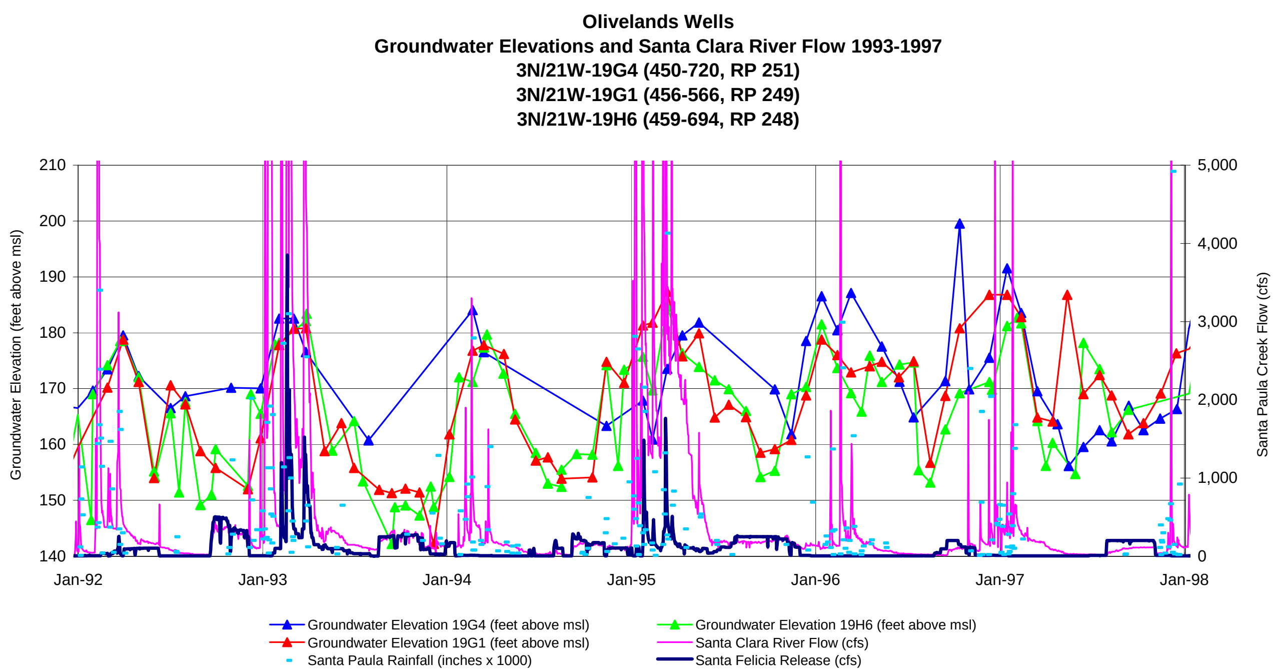
Olivelands Wells
Groundwater Elevations and Cumulative Departures
3N/21W-19G4 (450-720, RP 251)
3N/21W-19G1 (456-566, RP 249)
3N/21W-19H6 (459-694, RP 248)
Base Period 1944-1998



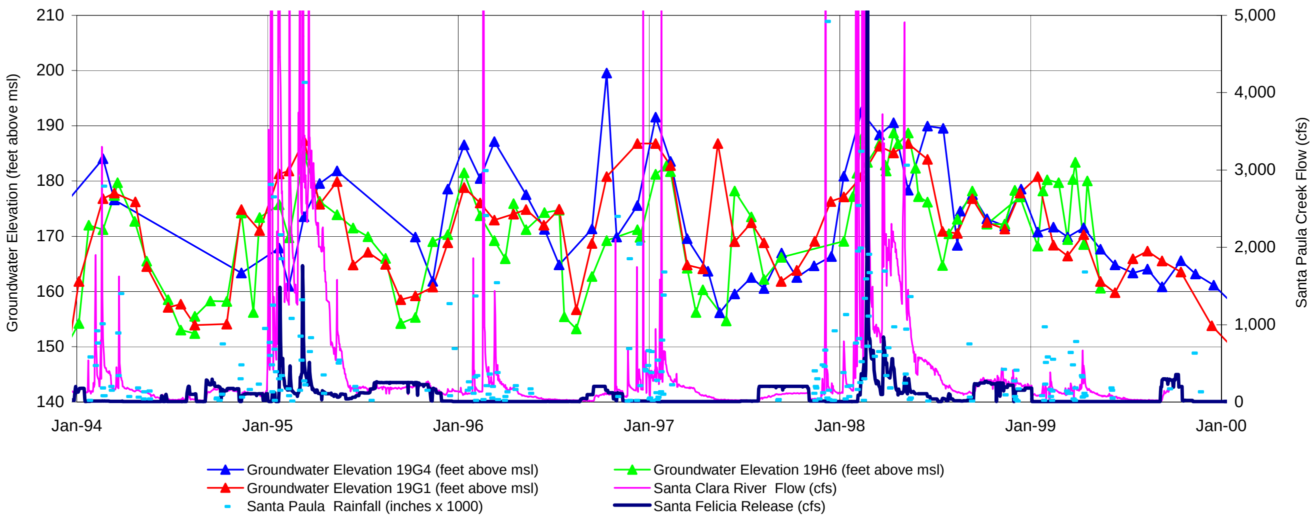
Olivelands Wells
Groundwater Elevations and Santa Clara River Flow 1983-1987
3N/21W-19G4 (450-720, RP 251)
3N/21W-19G1 (456-566, RP 249)
3N/21W-19H6 (459-694, RP 248)



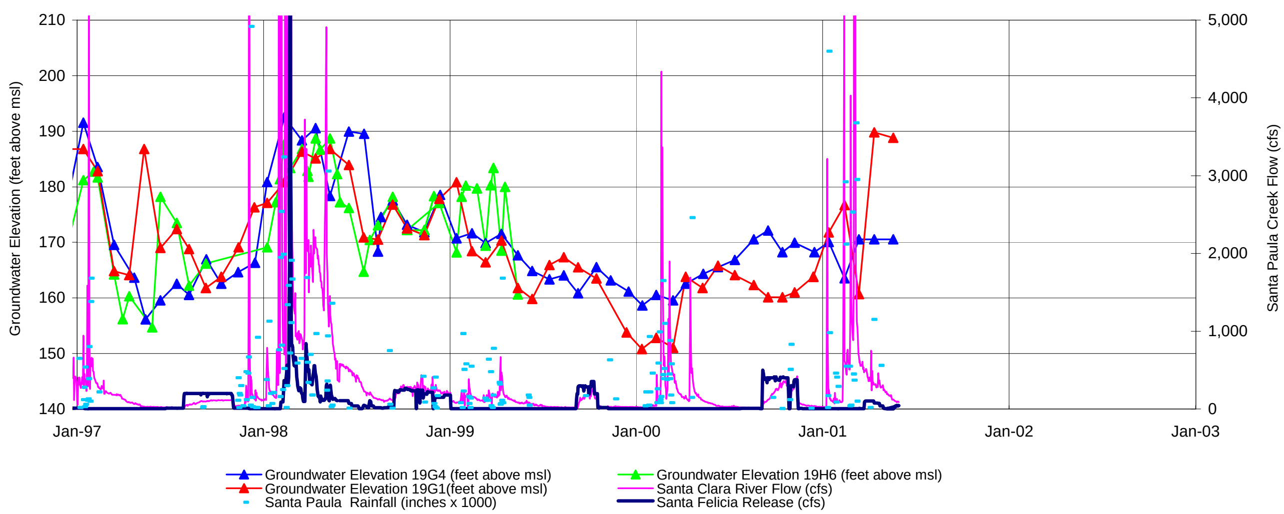

Olivelands Wells
Groundwater Elevations and Santa Clara River Flow 1990-1994
3N/21W-19G4 (450-720, RP 251)
3N/21W-19G1 (456-566, RP 249)
3N/21W-19H6 (459-694, RP 248)
Groundwater Elevation (feet above msl)
Santa Paula Creek Flow (cfs)
210
200
190
180
170
160
150
140
130
5,000
4,000
3,000
2,000
1,000
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Groundwater Elevation 19H6 (feet above msl)
Groundwater Elevation 19G4 (feet above msl)
Santa Paula Rainfall (inches x 1000
Groundwater Elevation 19G1(feet above msl)
Santa Clara River Flow (cfs)
Santa Felicia Release (cfs)

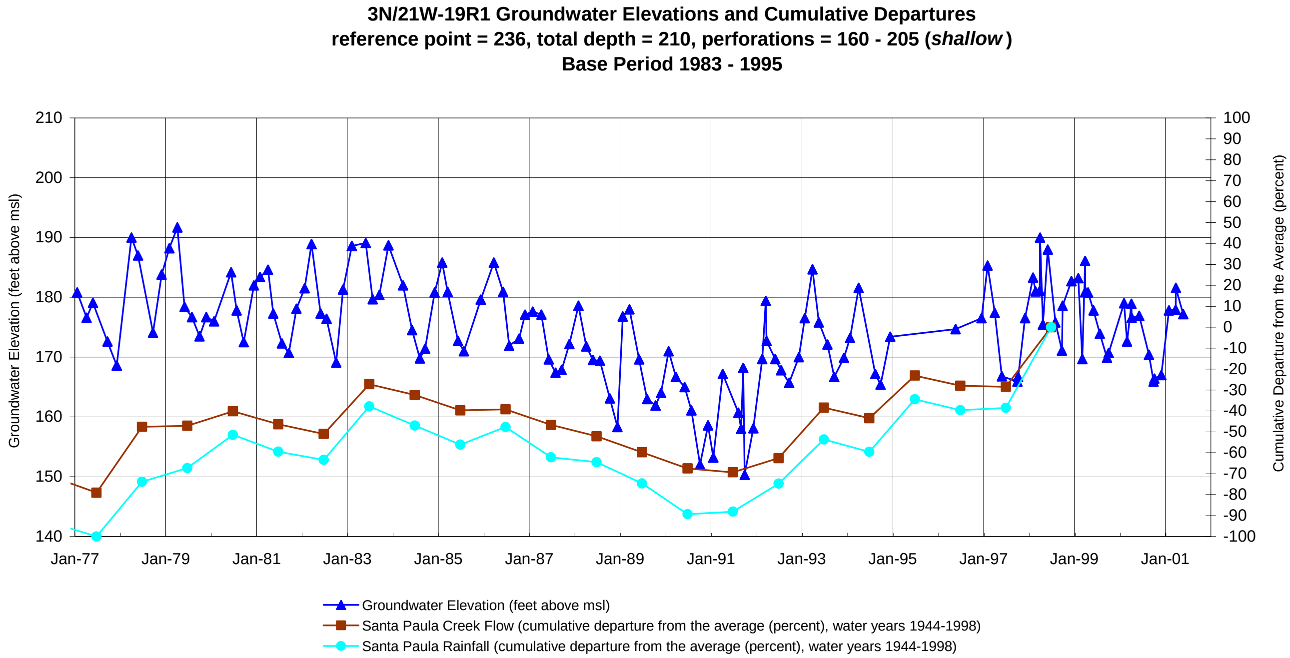

Olivelands Wells
Groundwater Elevations and Santa Clara River Flow 1993-1997
3N/21W-19G4 (450-720, RP 251)
3N/21W-19G1 (456-566, RP 249)
3N/21W-19H6 (459-694, RP 248)
Groundwater Elevation (feet above msl)
Santa Paula Creek Flow (cfs)
210
200
190
180
170
160
150
140
5,000
4,000
3,000
2,000
1,000
0
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Groundwater Elevation 19G4 (feet above msl)
Groundwater Elevation 19G1 (feet above msl)
Santa Paula Rainfall (inches x 1000)
Groundwater Elevation 19H6 (feet above msl)
Santa Clara River Flow (cfs)
Santa Felicia Release (cfs)

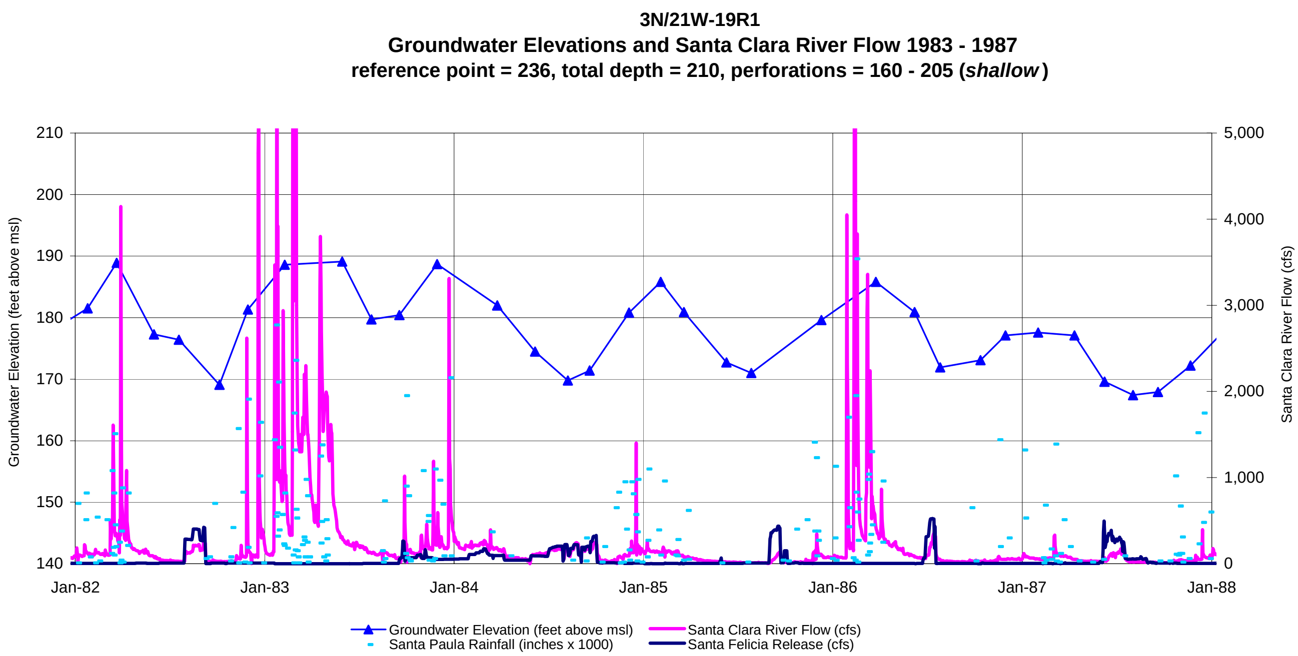
Olivelands Wells
Groundwater Elevations and Santa Clara River Flow 1995-1999
3N/21W-19G4 (450-720, RP 251)
3N/21W-19G1 (456-566, RP 249)
3N/21W-19H6 (459-694, RP 248)

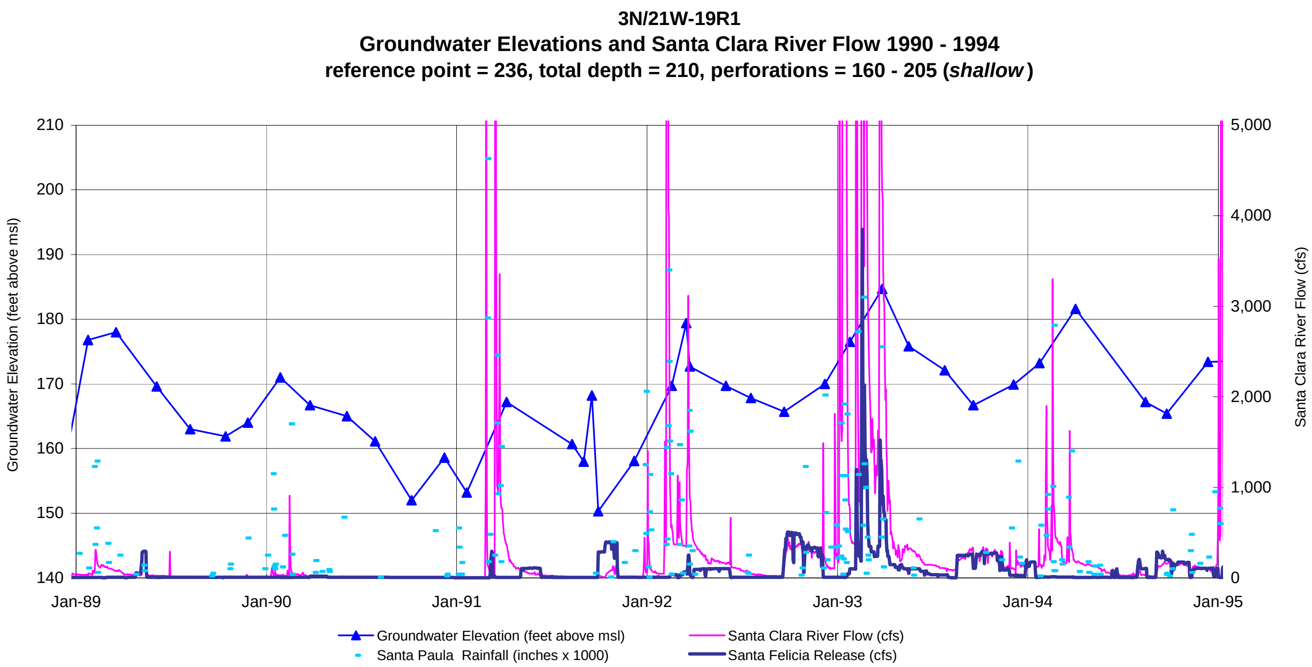


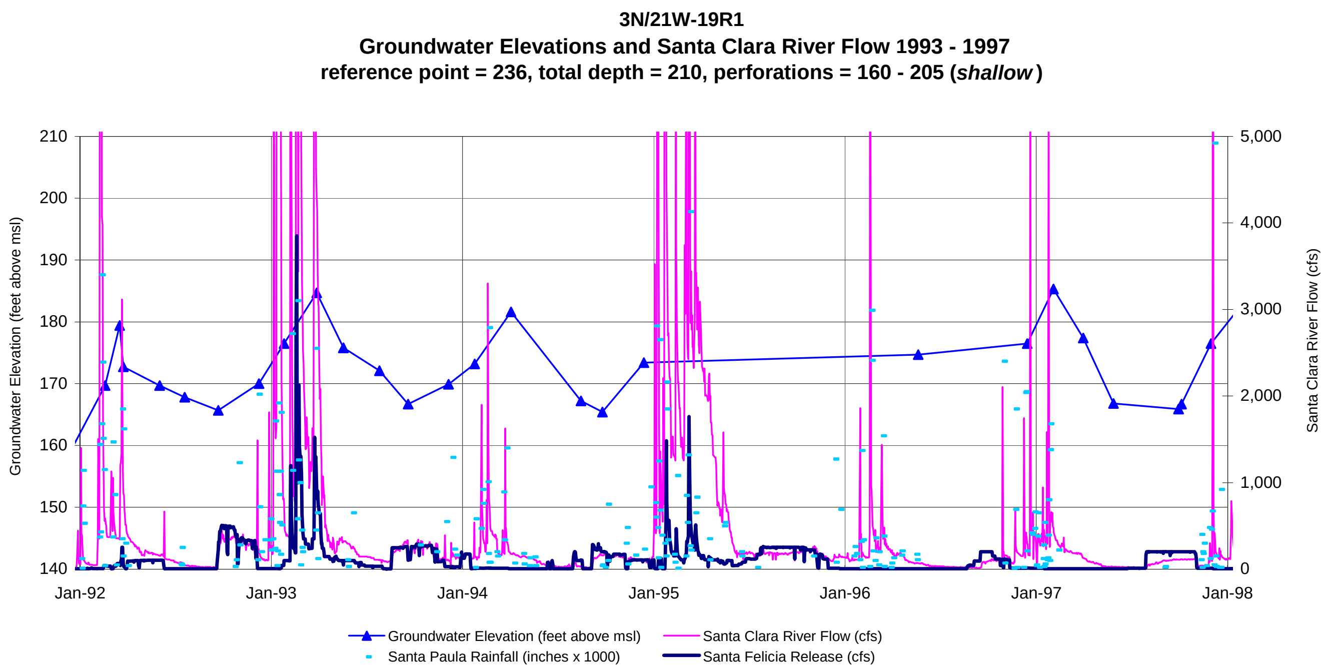
Olivelands Wells
Groundwater Elevations and Santa Clara River Flow 1998-2002
3N/21W-19G4 (450-720, RP 251)
3N/21W-19G1 (456-566, RP 249)
3N/21W-19H6 (459-694, RP 248)



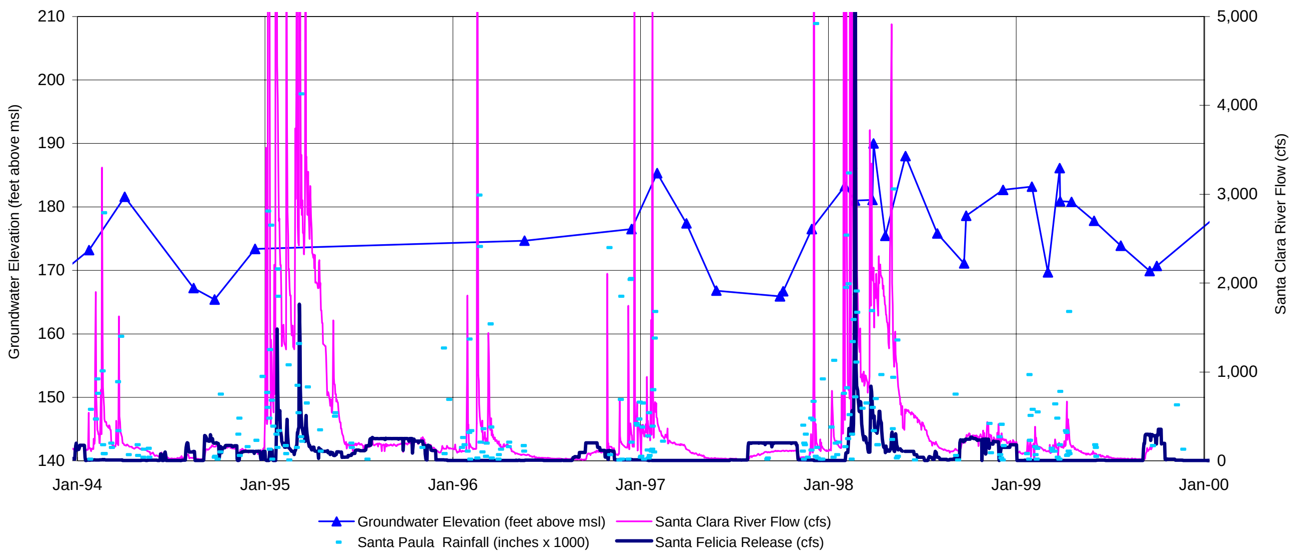

3N/21W-19R1 Groundwater Elevations and Cumulative Departures
reference point = 236, total depth = 210, perforations = 160 - 205 (shallow)
Base Period 1983 - 1995
Groundwater Elevation (feet above msl)
Cumulative Departure from the Average (percent)
Groundwater Elevation (feet above msl)
Santa Paula Creek Flow (cumulative departure from the average (percent), water years 1944-1998)
Santa Paula Rainfall (cumulative departure from the average (percent), water years 1944-1998)


3N/21W-19R1
Groundwater Elevations and Santa Clara River Flow 1983 - 1987
reference point = 236, total depth = 210, perforations = 160 - 205 (shallow)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Groundwater Elevation (feet above msl)
Santa Paula Rainfall (inches x 1000)
Santa Clara River Flow (cfs)
Santa Felicia Release (cfs)

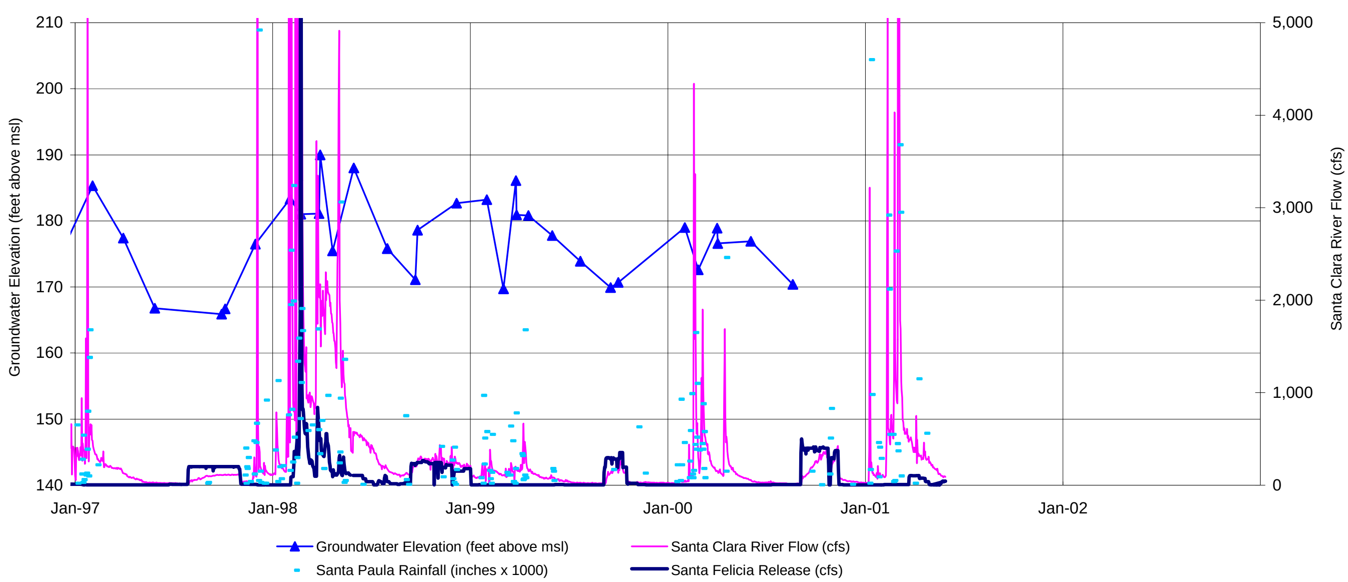

3N/21W-19R1
Groundwater Elevations and Santa Clara River Flow 1990 - 1994
reference point = 236, total depth = 210, perforations = 160 - 205 (shallow)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Release (cfs)


3N/21W-19R1
Groundwater Elevations and Santa Clara River Flow 1993 - 1997
reference point = 236, total depth = 210, perforations = 160 - 205 (shallow)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Release (cfs)

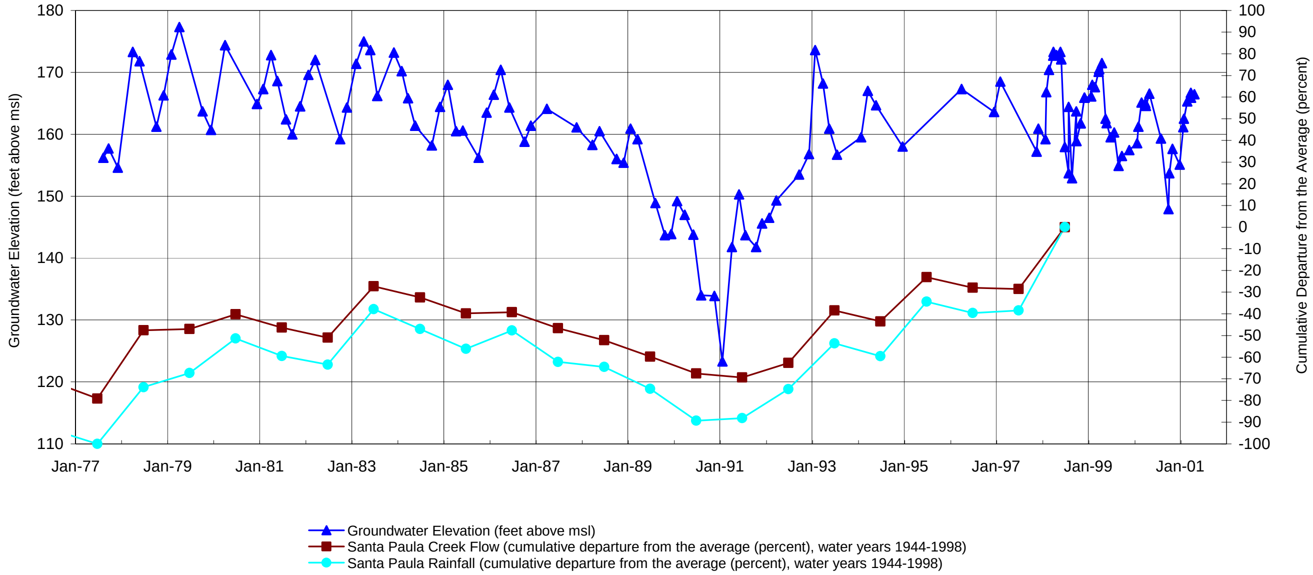
3N/21W-19R1
Groundwater Elevations and Santa Clara River Flow 1995 - 1999
reference point = 236, total depth = 210, perforations = 160 - 205 (*shallow*)



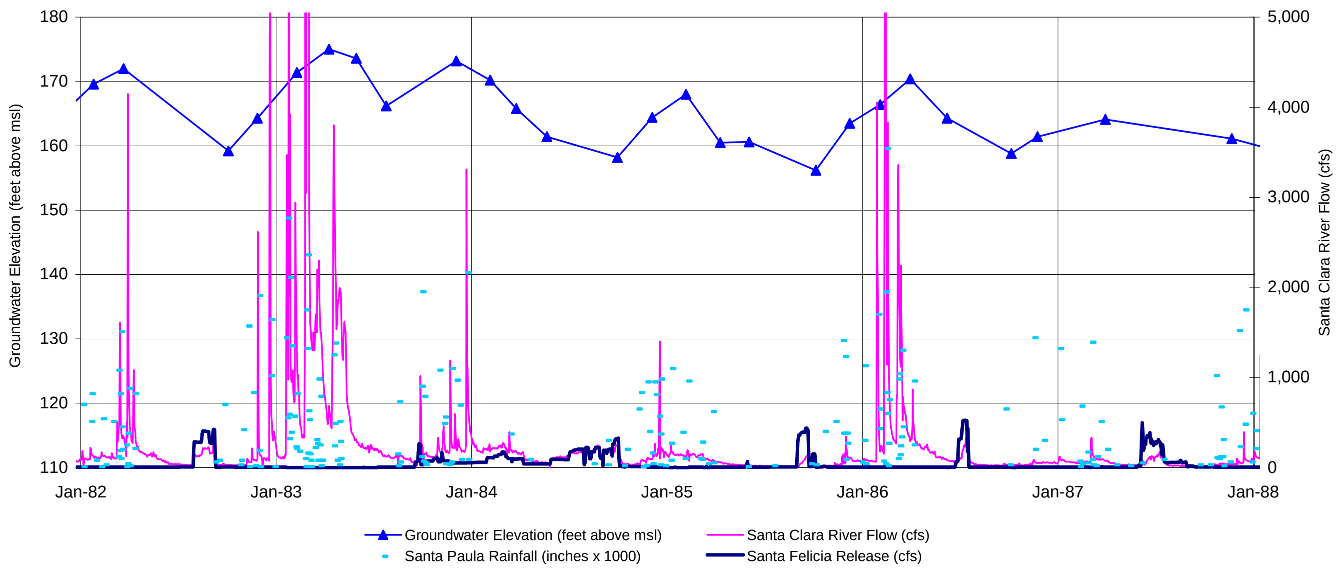
3N/21W-19R1
Groundwater Elevations and Santa Clara River Flow 1998 - 2002
reference point = 236, total depth = 210, perforations = 160 - 205 (*shallow*)

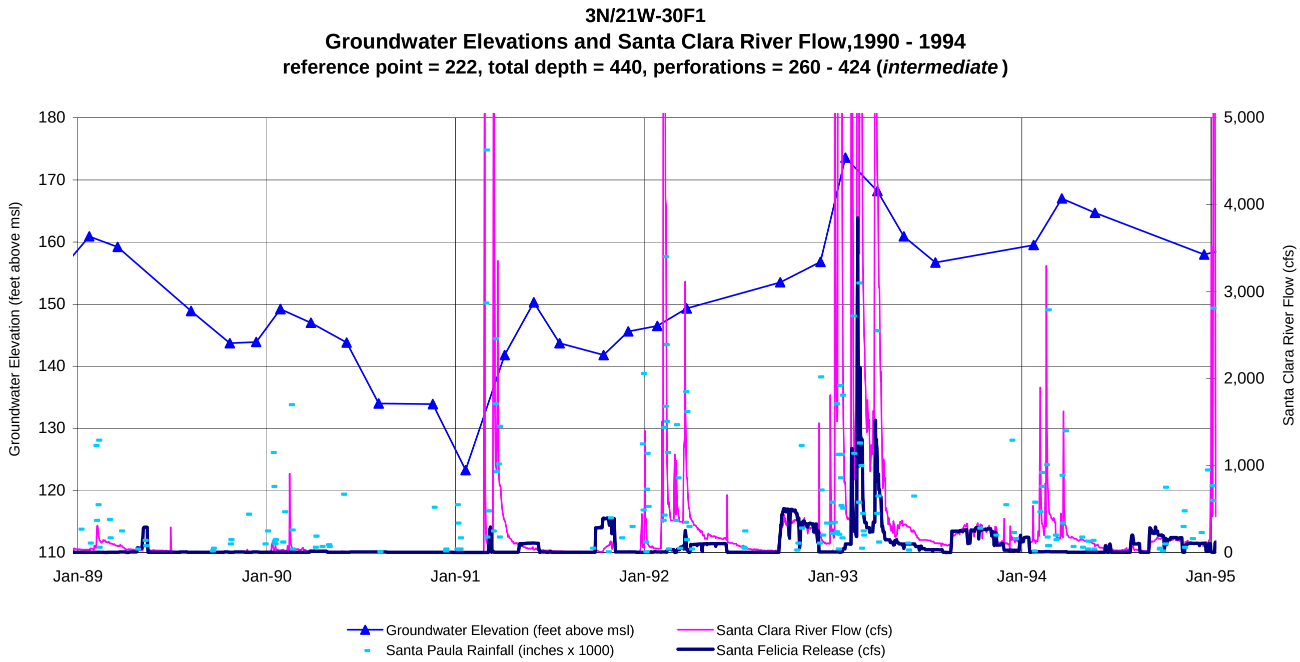


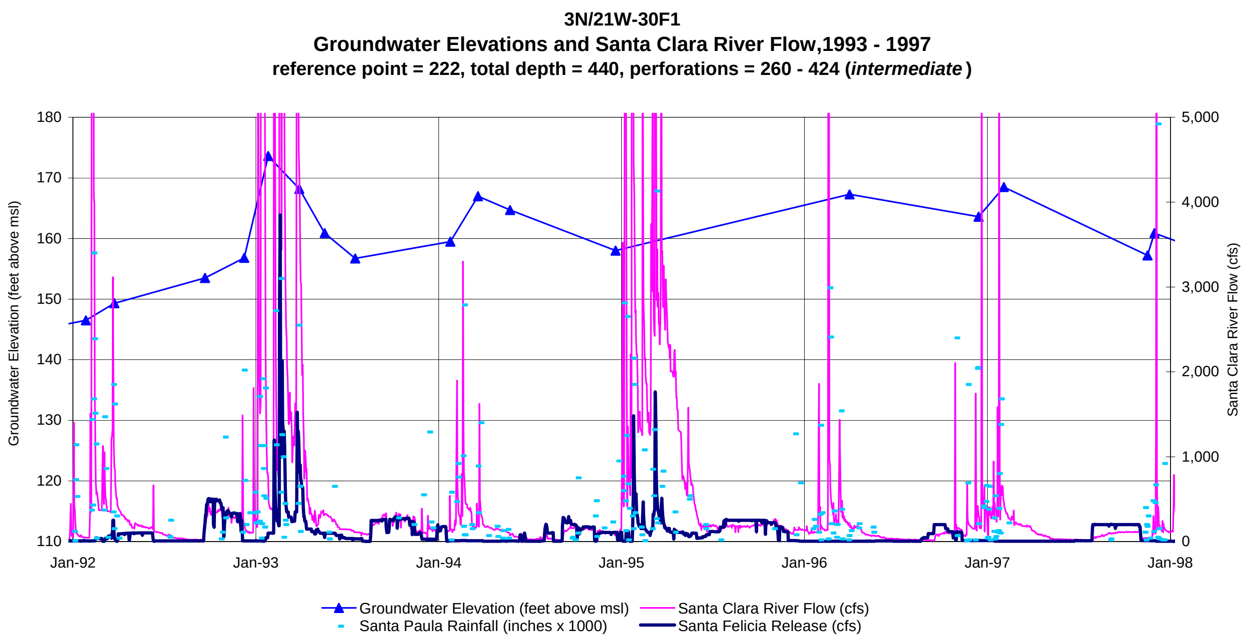
3N/21W-30F1 Groundwater Elevations and Cumulative Departures
reference point = 222, total depth = 440, perforations = 260 - 424 (*intermediate*)
Base Period 1983 - 1995

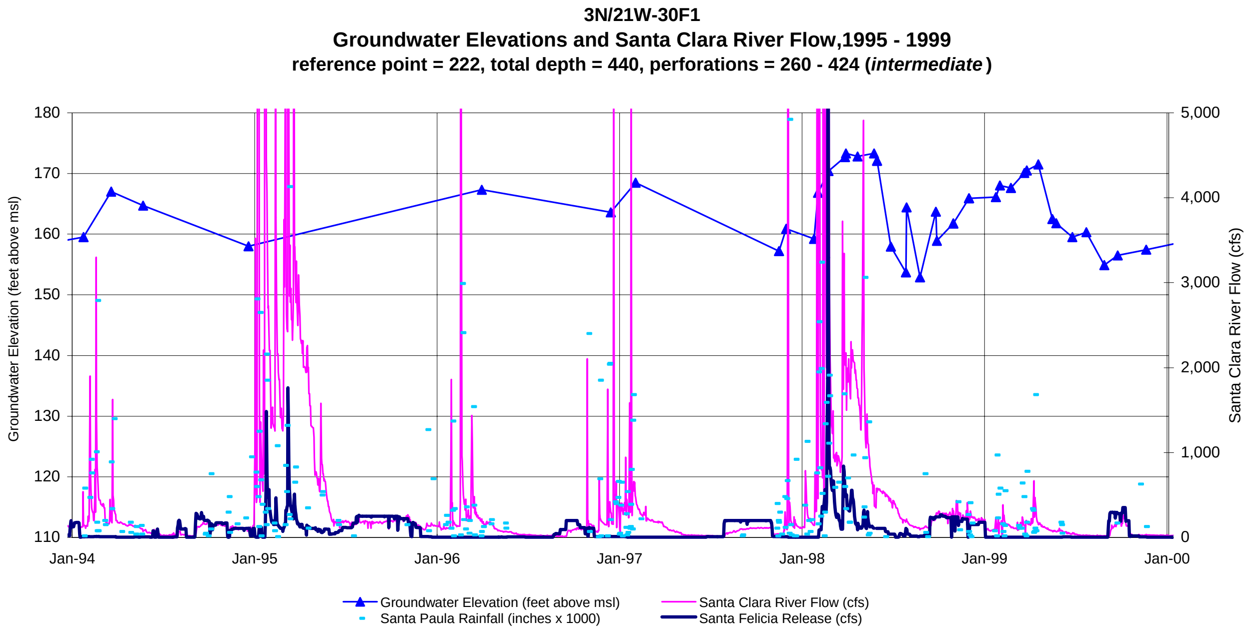


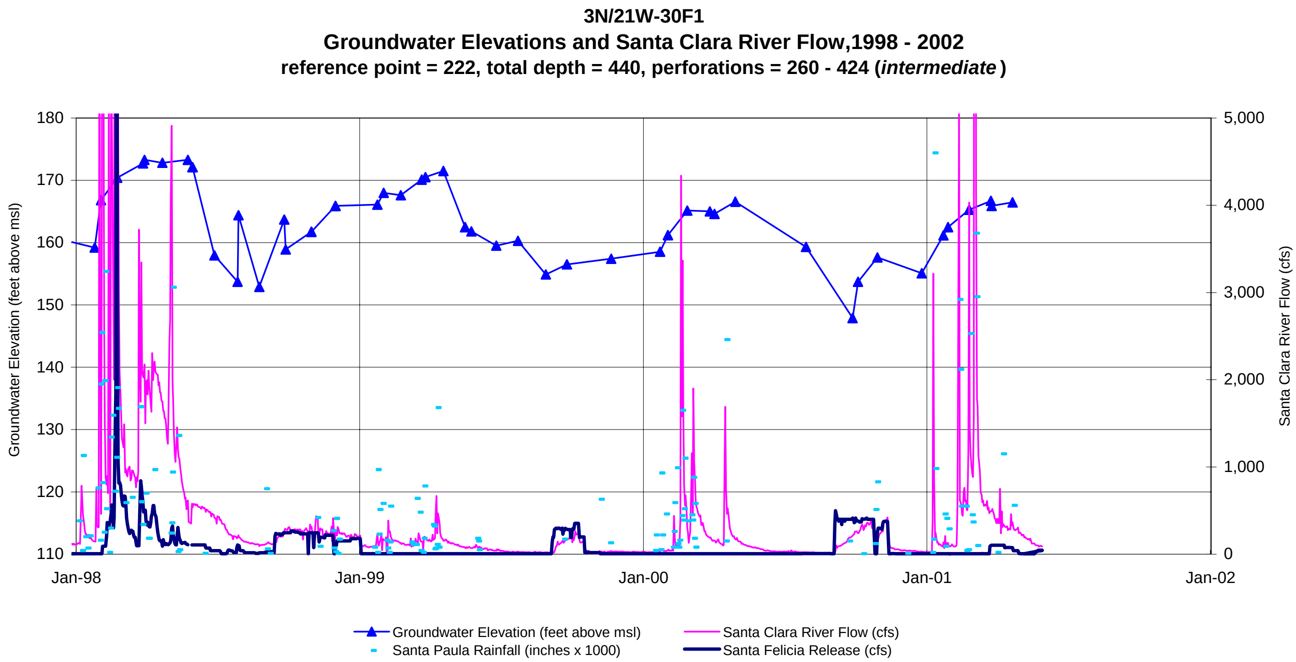
3N/21W-30F1
Groundwater Elevations and Santa Clara River Flow,1983 - 1987
reference point = 222, total depth = 440, perforations = 260 - 424 (*intermediate*)

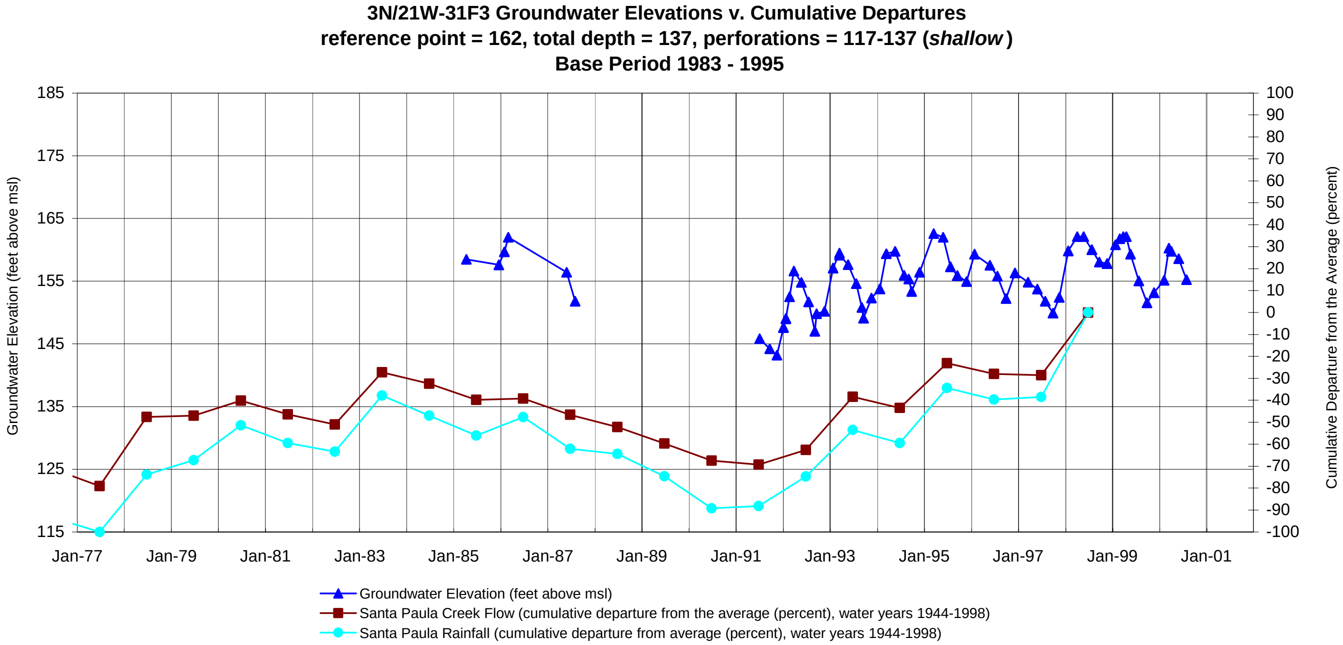


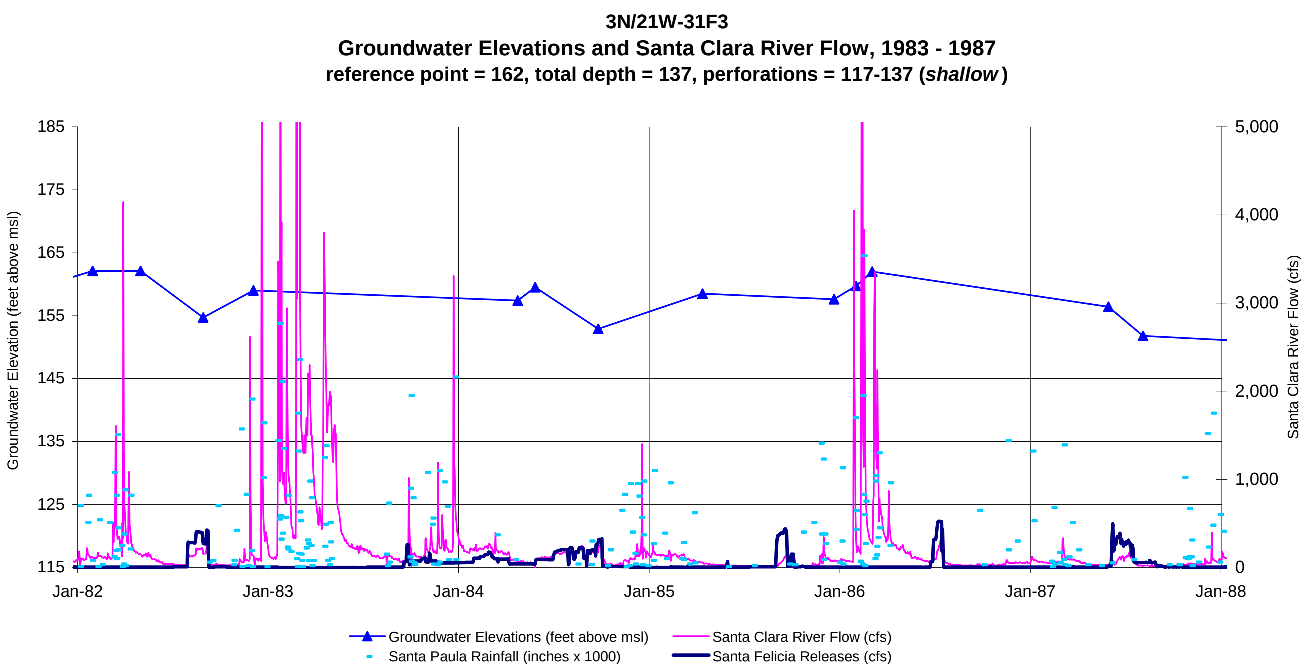

3N/21W-30F1
Groundwater Elevations and Santa Clara River Flow,1990 - 1994
reference point = 222, total depth = 440, perforations = 260 - 424 (intermediate)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
180
170
160
150
140
130
120
110
5,000
4,000
3,000
2,000
1,000
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Release (cfs)


3N/21W-30F1
Groundwater Elevations and Santa Clara River Flow,1993 - 1997
reference point = 222, total depth = 440, perforations = 260 - 424 (intermediate)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
180
170
160
150
140
130
120
110
5,000
4,000
3,000
2,000
1,000
0
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Release (cfs)

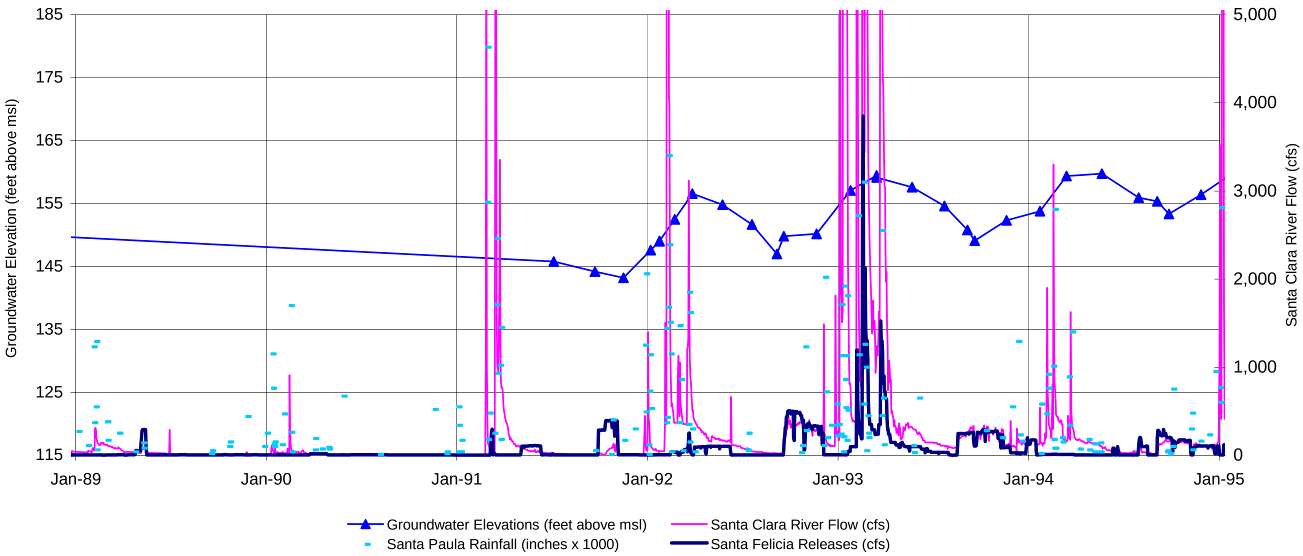

3N/21W-30F1
Groundwater Elevations and Santa Clara River Flow,1995 - 1999
reference point = 222, total depth = 440, perforations = 260 - 424 (*intermediate*)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
180
170
160
150
140
130
120
110
5,000
4,000
3,000
2,000
1,000
0
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Groundwater Elevation (feet above msl)
Santa Paula Rainfall (inches x 1000)
Santa Clara River Flow (cfs)
Santa Felicia Release (cfs)


3N/21W-30F1
Groundwater Elevations and Santa Clara River Flow,1998 - 2002
reference point = 222, total depth = 440, perforations = 260 - 424 (*intermediate*)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
180
170
160
150
140
130
120
110
5,000
4,000
3,000
2,000
1,000
0
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Groundwater Elevation (feet above msl)
Santa Paula Rainfall (inches x 1000)
Santa Clara River Flow (cfs)
Santa Felicia Release (cfs)

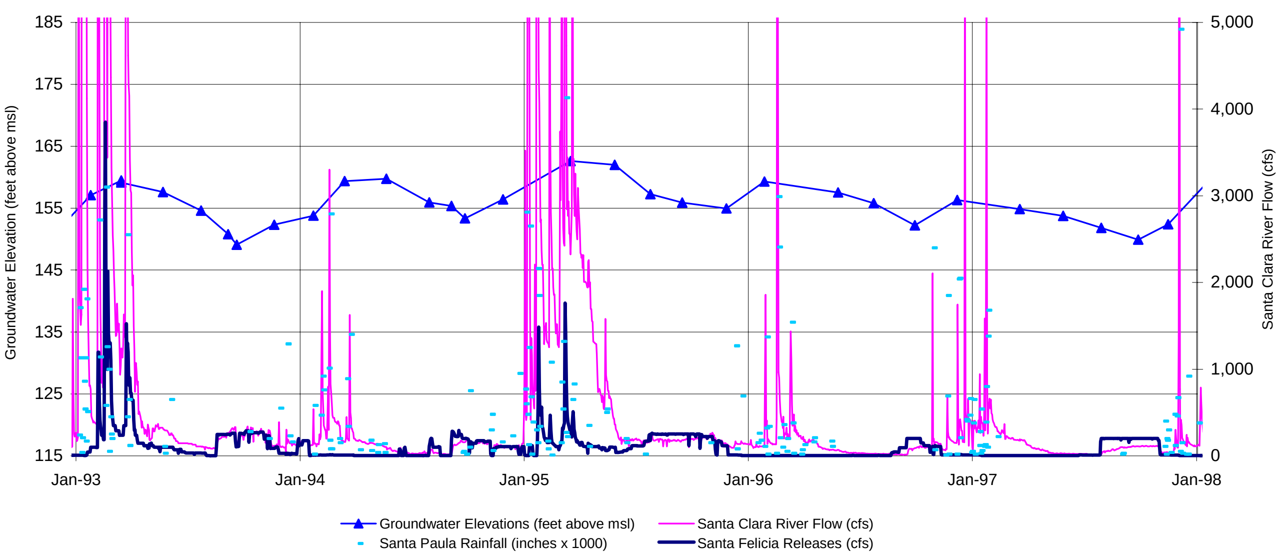

3N/21W-31F3 Groundwater Elevations v. Cumulative Departures
reference point = 162, total depth = 137, perforations = 117-137 (shallow)
Base Period 1983 - 1995
Groundwater Elevation (feet above msl)
Cumulative Departure from the Average (percent)
185
175
165
155
145
135
125
115
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-77
Jan-79
Jan-81
Jan-83
Jan-85
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Groundwater Elevation (feet above msl)
Santa Paula Creek Flow (cumulative departure from the average (percent), water years 1944-1998)
Santa Paula Rainfall (cumulative departure from average (percent), water years 1944-1998)


3N/21W-31F3
Groundwater Elevations and Santa Clara River Flow, 1983 - 1987
reference point = 162, total depth = 137, perforations = 117-137 (shallow)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
185
175
165
155
145
135
125
115
5,000
4,000
3,000
2,000
1,000
0
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Groundwater Elevations (feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Releases (cfs)

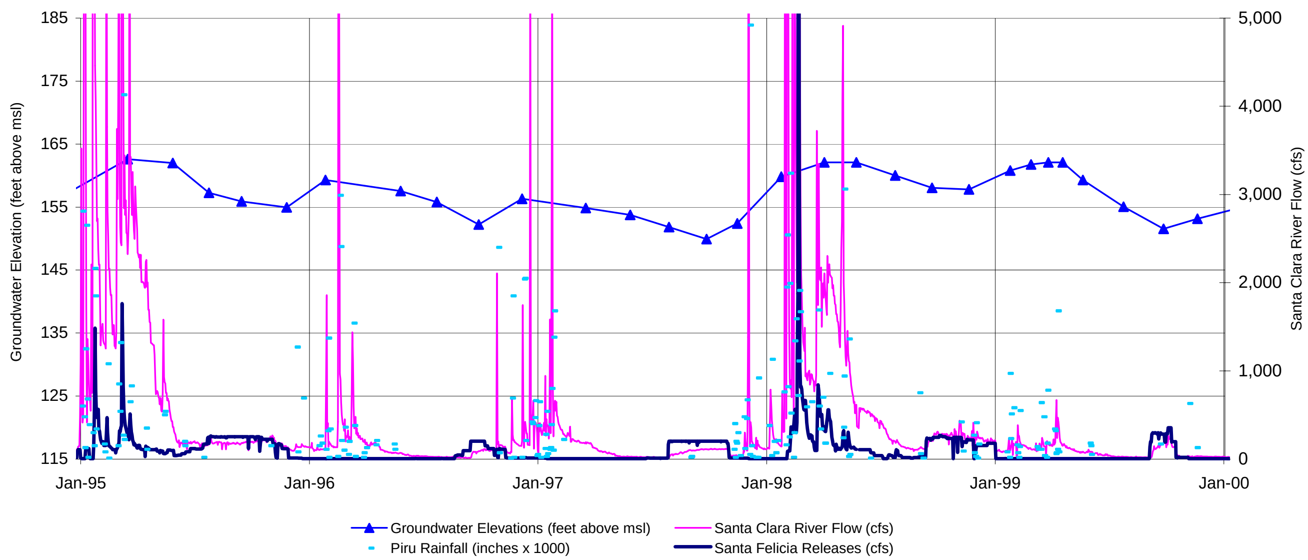
3N/21W-31F3
Groundwater Elevations and Santa Clara River Flow, 1990 - 1994
reference point = 162, total depth = 137, perforations = 117-137 (*shallow*)



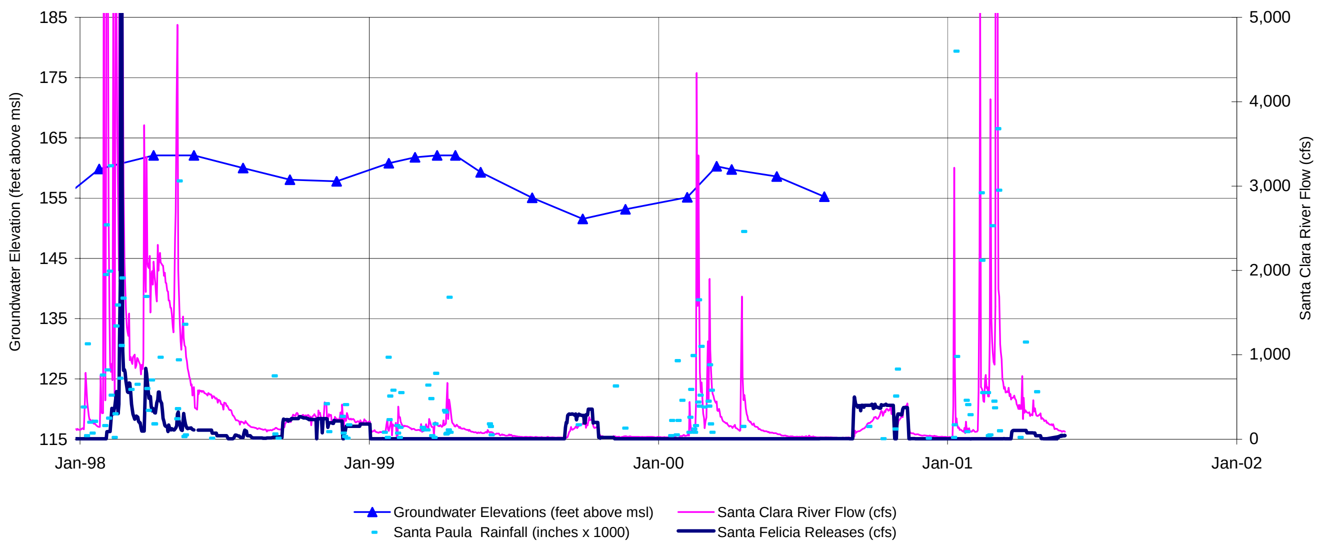
3N/21W-31F3
Groundwater Elevations and Santa Clara River Flow, 1993 - 1997
reference point = 162, total depth = 137, perforations = 117-137 (*shallow*)

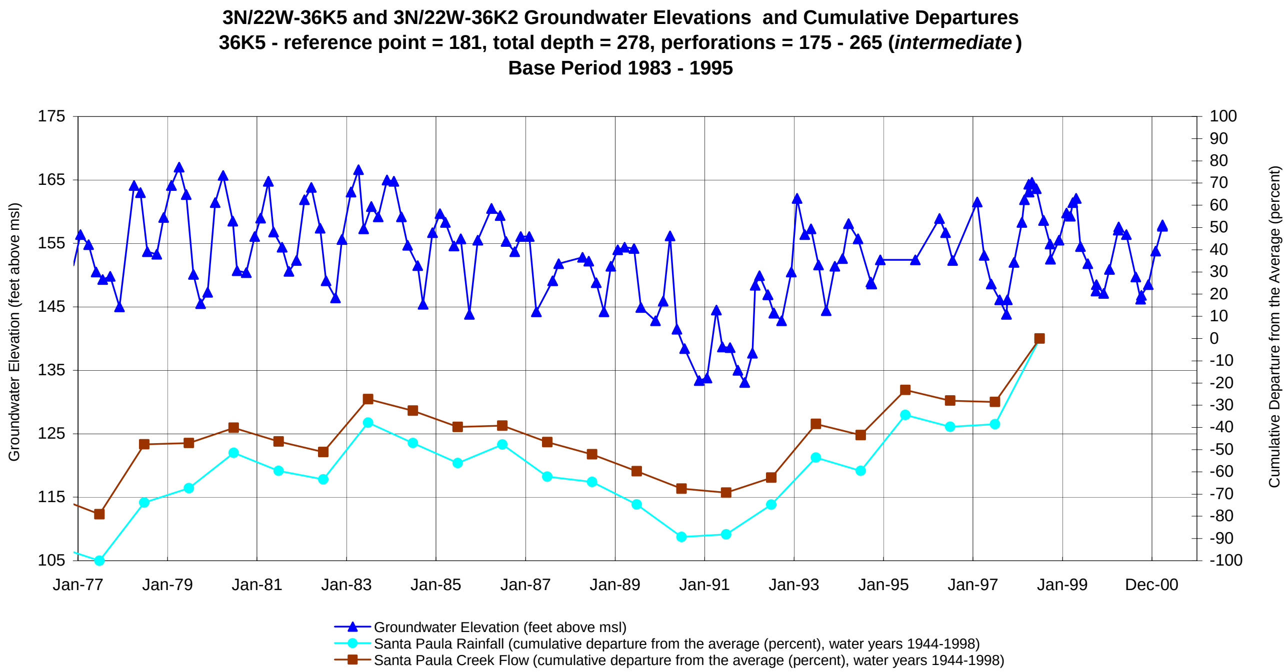


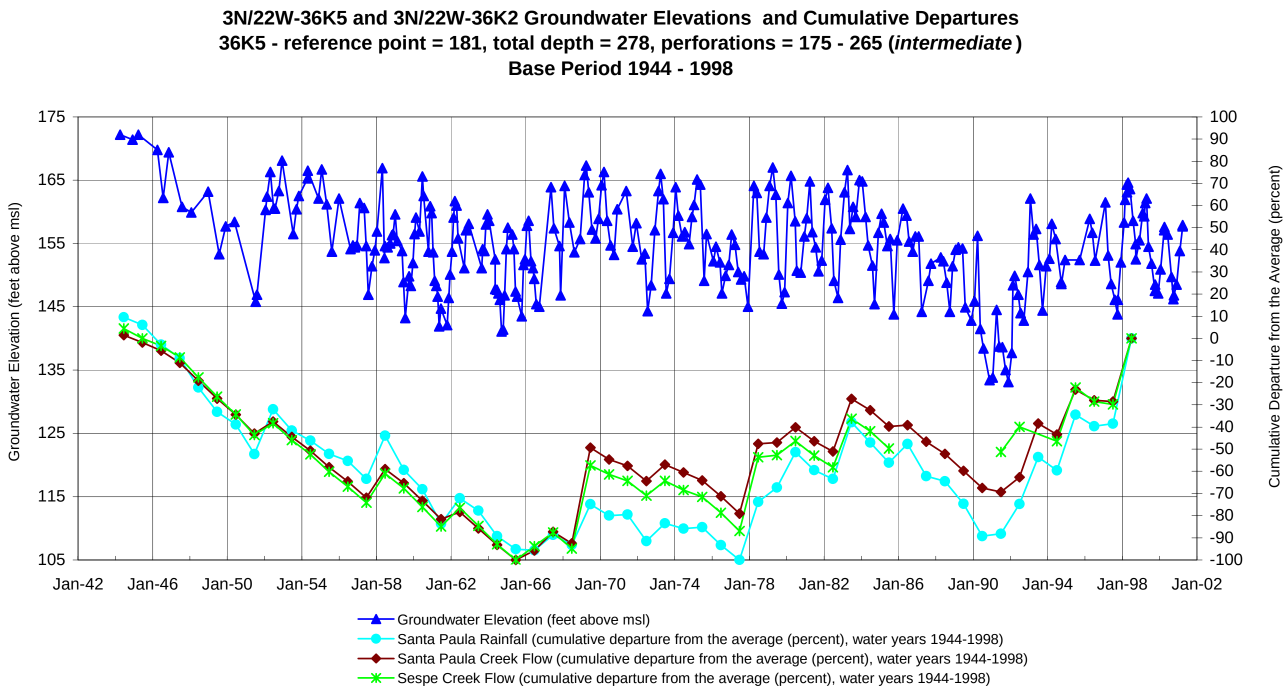
3N/21W-31F3
Groundwater Elevations and Santa Clara River Flow, 1995 - 1999
reference point = 162, total depth = 137, perforations = 117-137 (*shallow*)



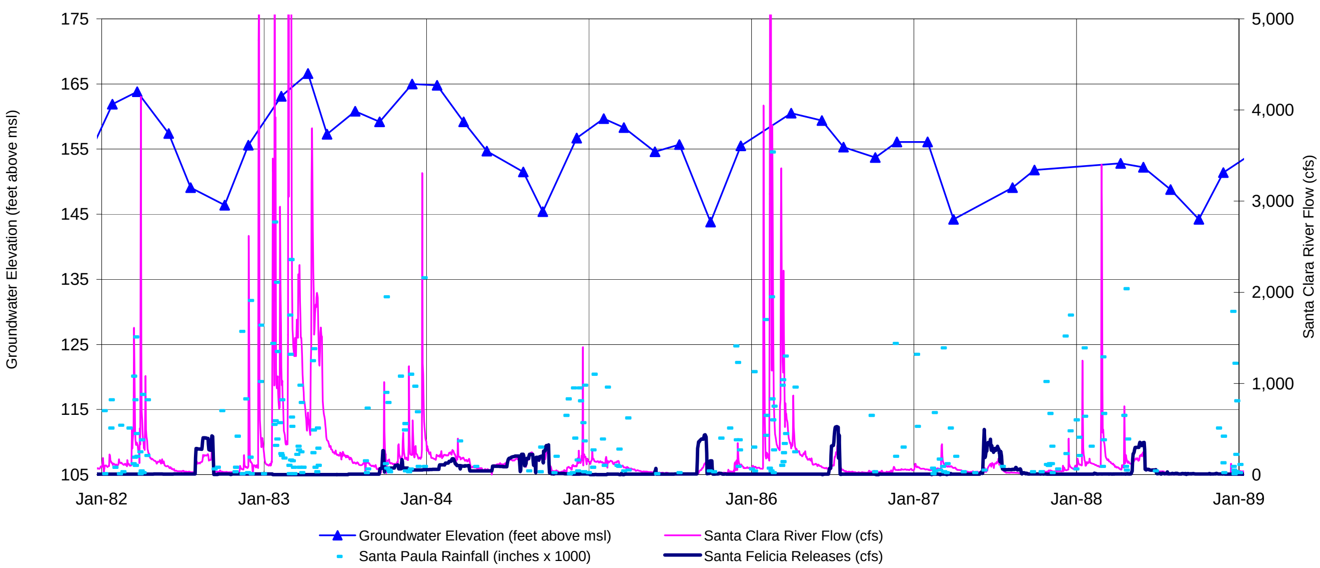
3N/21W-31F3
Groundwater Elevations and Santa Clara River Flow, 1998 - 2002
reference point = 162, total depth = 137, perforations = 117-137 (*shallow*)



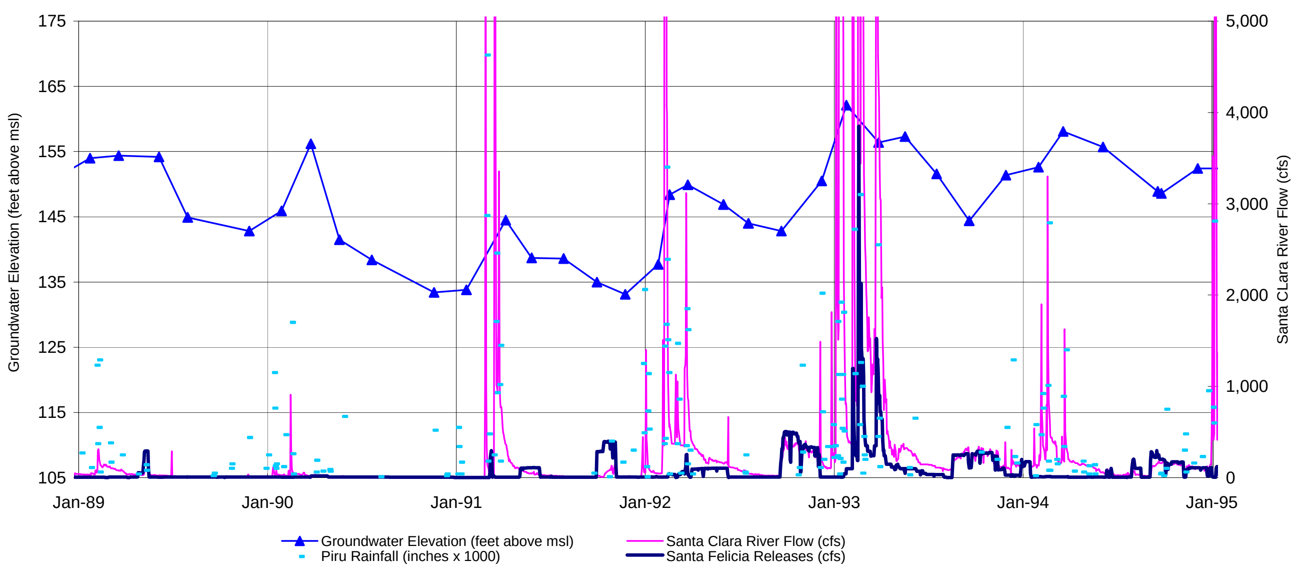

3N/22W-36K5 and 3N/22W-36K2 Groundwater Elevations and Cumulative Departures
36K5 - reference point = 181, total depth = 278, perforations = 175 - 265 (intermediate)
Base Period 1983 - 1995
Groundwater Elevation (feet above msl)
Cumulative Departure from the Average (percent)
Groundwater Elevation (feet above msl)
Santa Paula Rainfall (cumulative departure from the average (percent), water years 1944-1998)
Santa Paula Creek Flow (cumulative departure from the average (percent), water years 1944-1998)


3N/22W-36K5 and 3N/22W-36K2 Groundwater Elevations and Cumulative Departures
36K5 - reference point = 181, total depth = 278, perforations = 175 - 265 (intermediate)
Base Period 1944 - 1998
Groundwater Elevation (feet above msl)
Cumulative Departure from the Average (percent)
Groundwater Elevation (feet above msl)
Santa Paula Rainfall (cumulative departure from the average (percent), water years 1944-1998)
Santa Paula Creek Flow (cumulative departure from the average (percent), water years 1944-1998)
Sespe Creek Flow (cumulative departure from the average (percent), water years 1944-1998)

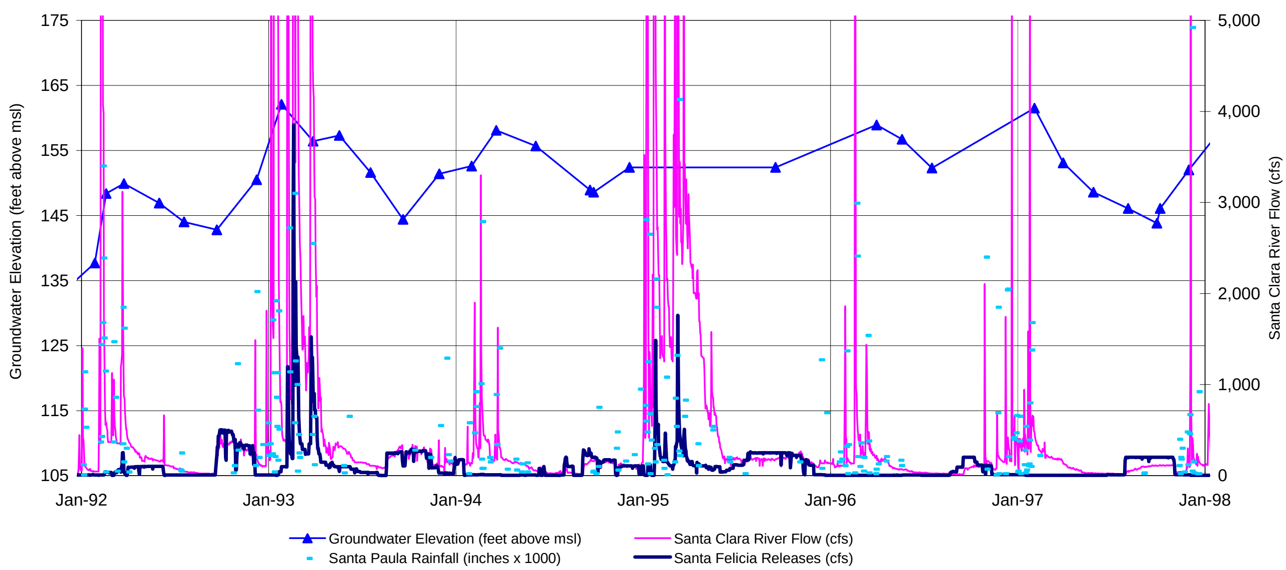
3N/22W-36K5, 3N/22W-36K2
Groundwater Elevations and Santa Clara River Flow, 1983 - 1987
36K5 - reference point = 181, total depth = 278, perforations = 175 - 265 (*intermediate*)



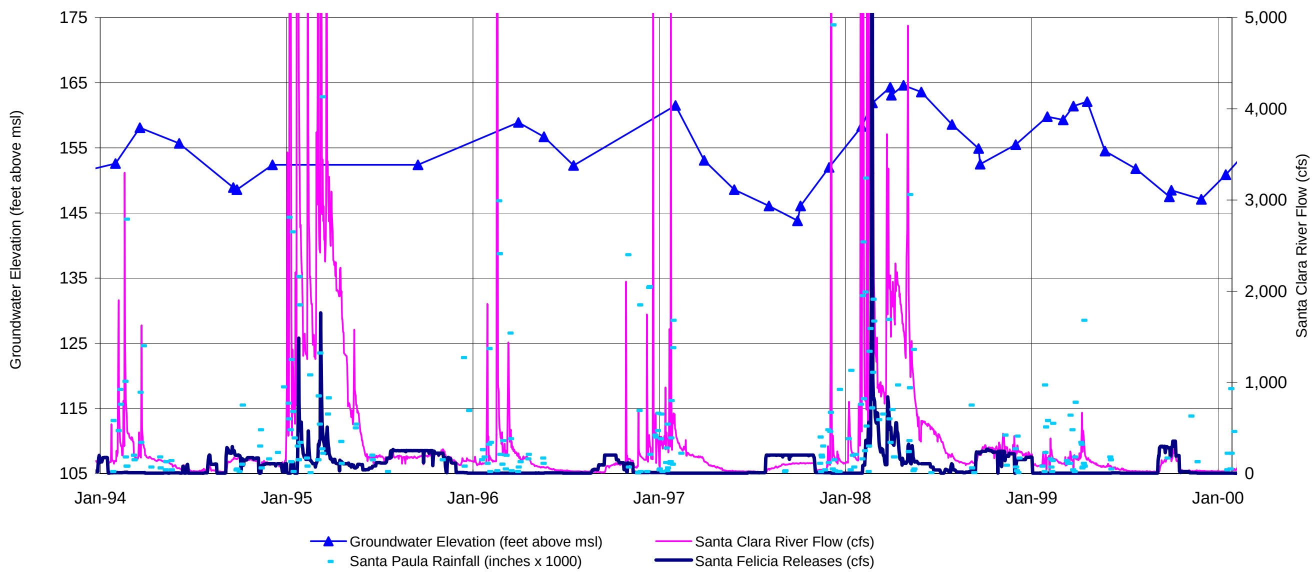
3N/22W-36K5, 3N/22W-36K2
Groundwater Elevations and Santa Clara River Flow, 1990 - 1994
36K5 - reference point = 181, total depth = 278, perforations = 175 - 265 (*intermediate*)

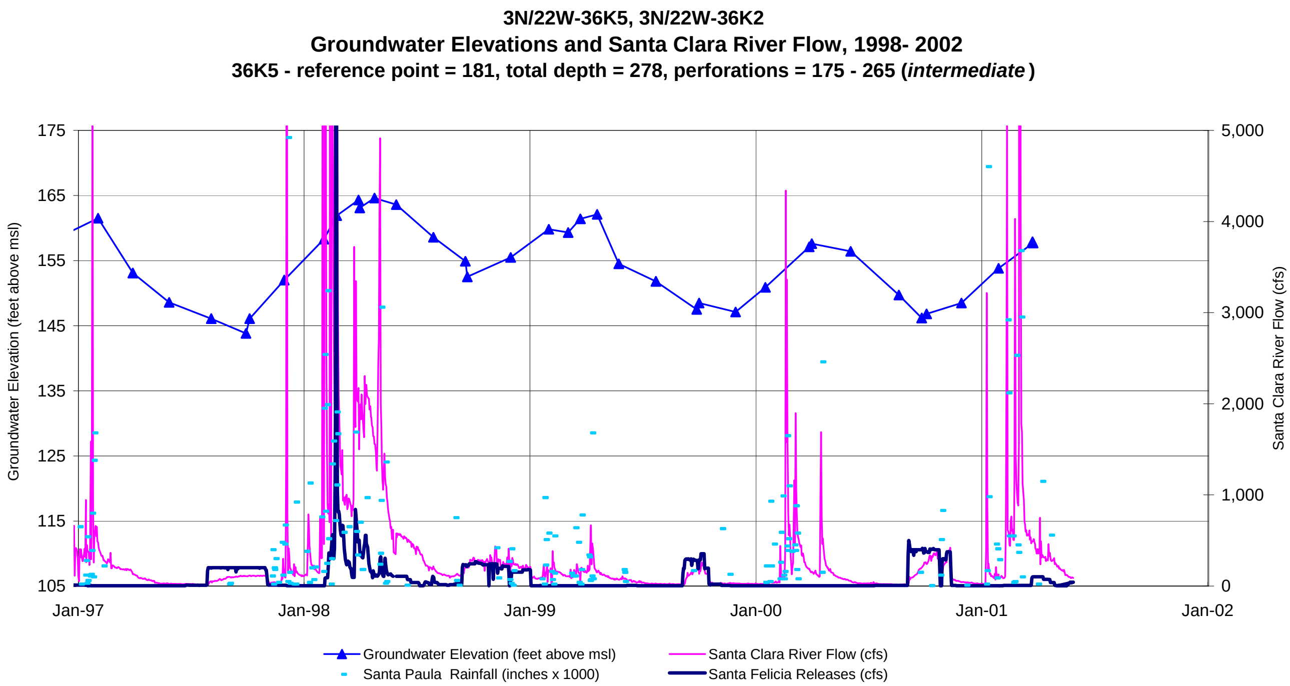


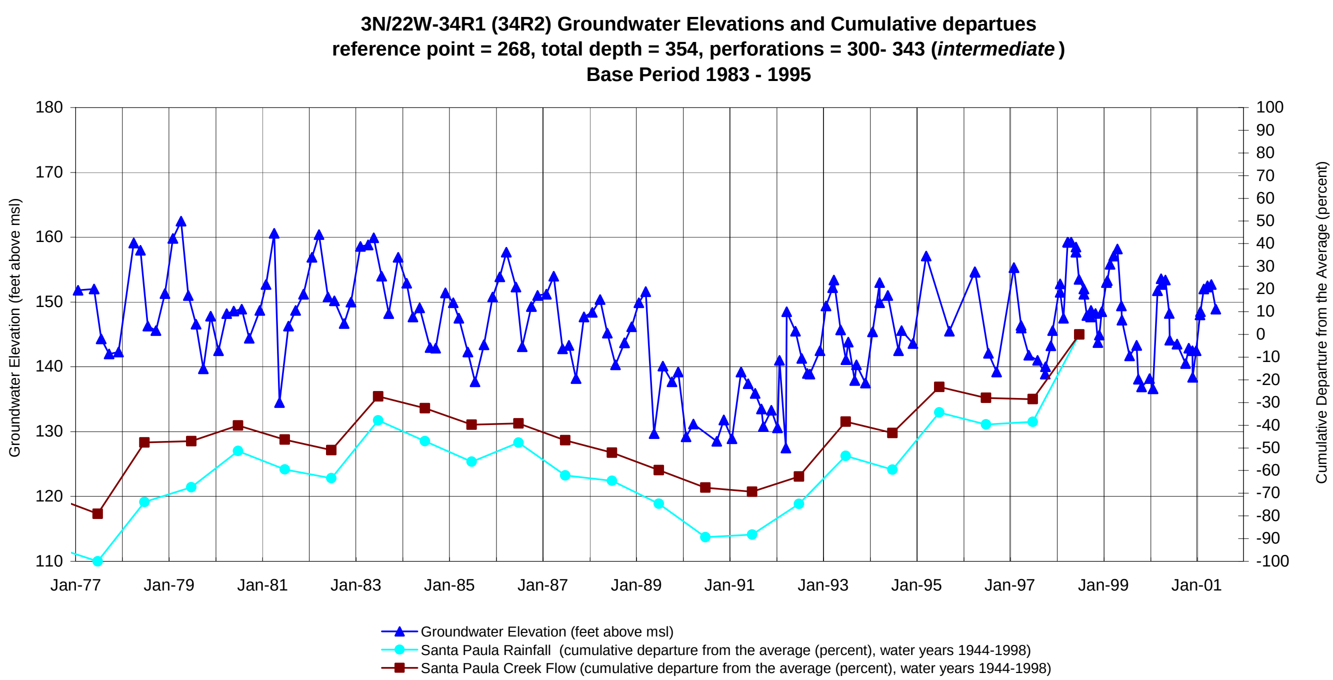
3N/22W-36K5, 3N/22W-36K2
Groundwater Elevations and Santa Clara River Flow, 1993- 1997
36K5 - reference point = 181, total depth = 278, perforations = 175 - 265 (*intermediate*)

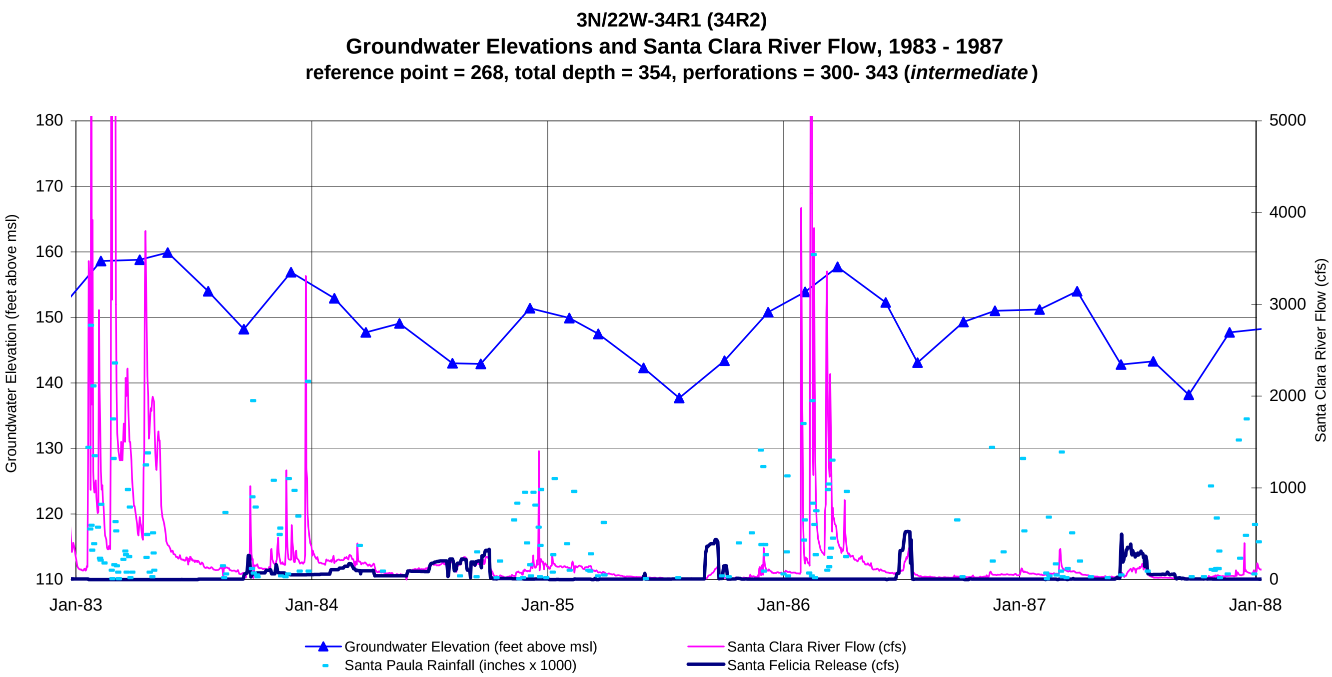


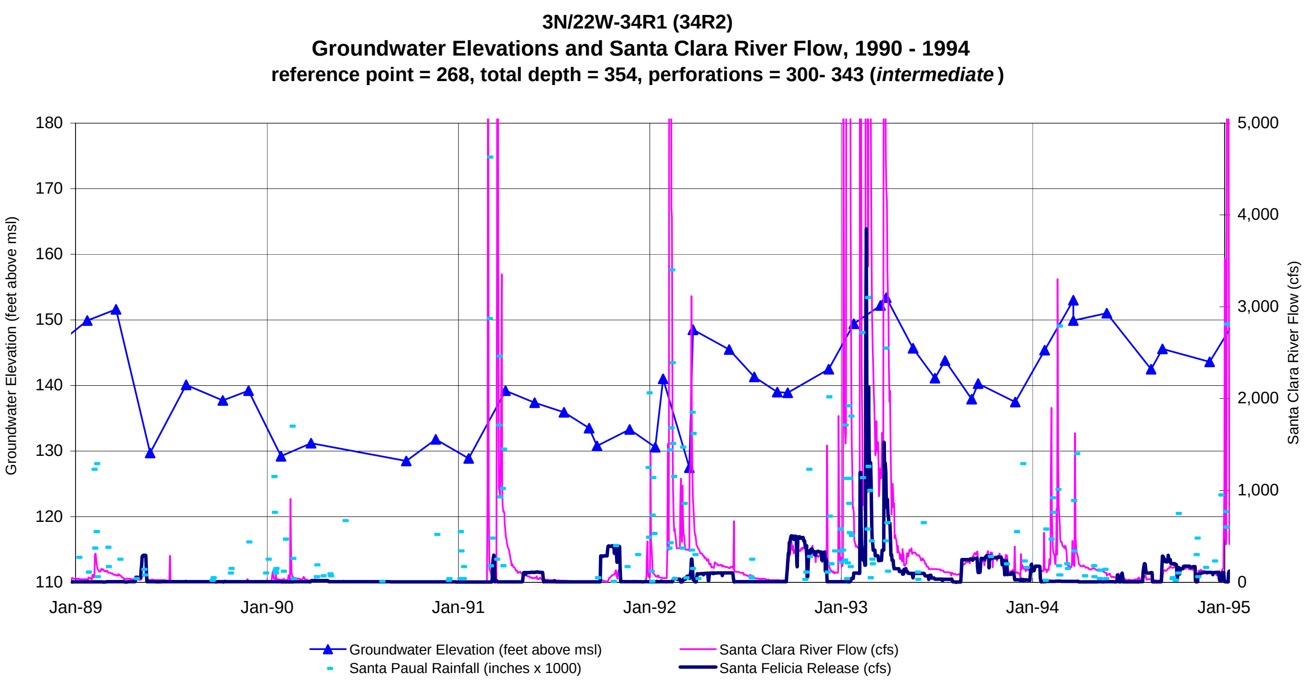
3N/22W-36K5, 3N/22W-36K2
Groundwater Elevations and Santa Clara River Flow, 1995 - 1999
36K5 - reference point = 181, total depth = 278, perforations = 175 - 265 (*intermediate*)

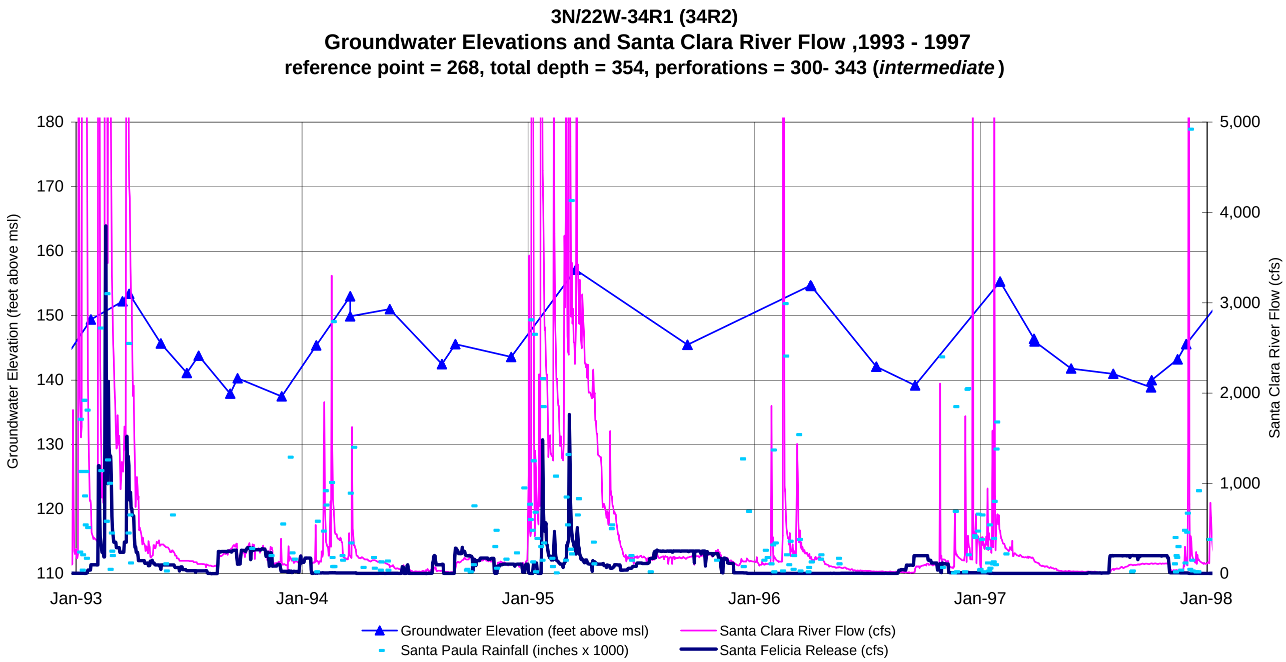


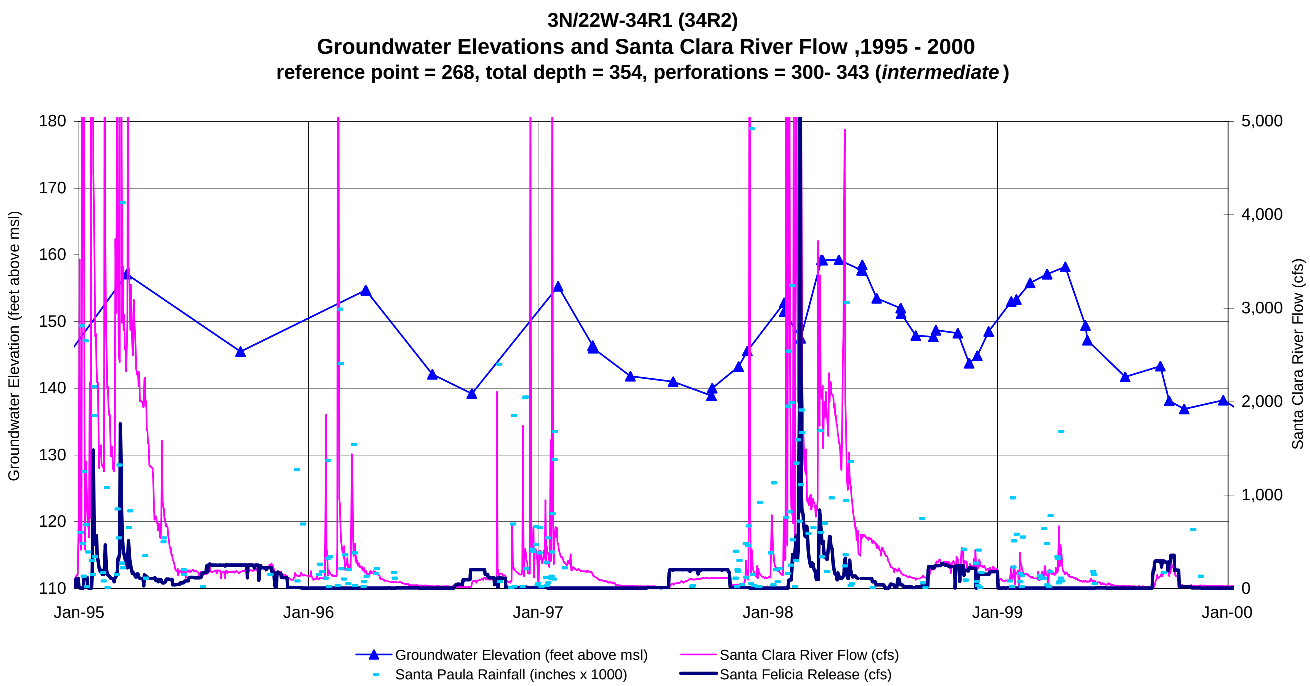

3N/22W-36K5, 3N/22W-36K2
Groundwater Elevations and Santa Clara River Flow, 1998- 2002
36K5 - reference point = 181, total depth = 278, perforations = 175 - 265 (intermediate)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
175
165
155
145
135
125
115
105
5,000
4,000
3,000
2,000
1,000
0
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Groundwater Elevation (feet above msl)
Santa Paula Rainfall (inches x 1000)
Santa Clara River Flow (cfs)
Santa Felicia Releases (cfs)

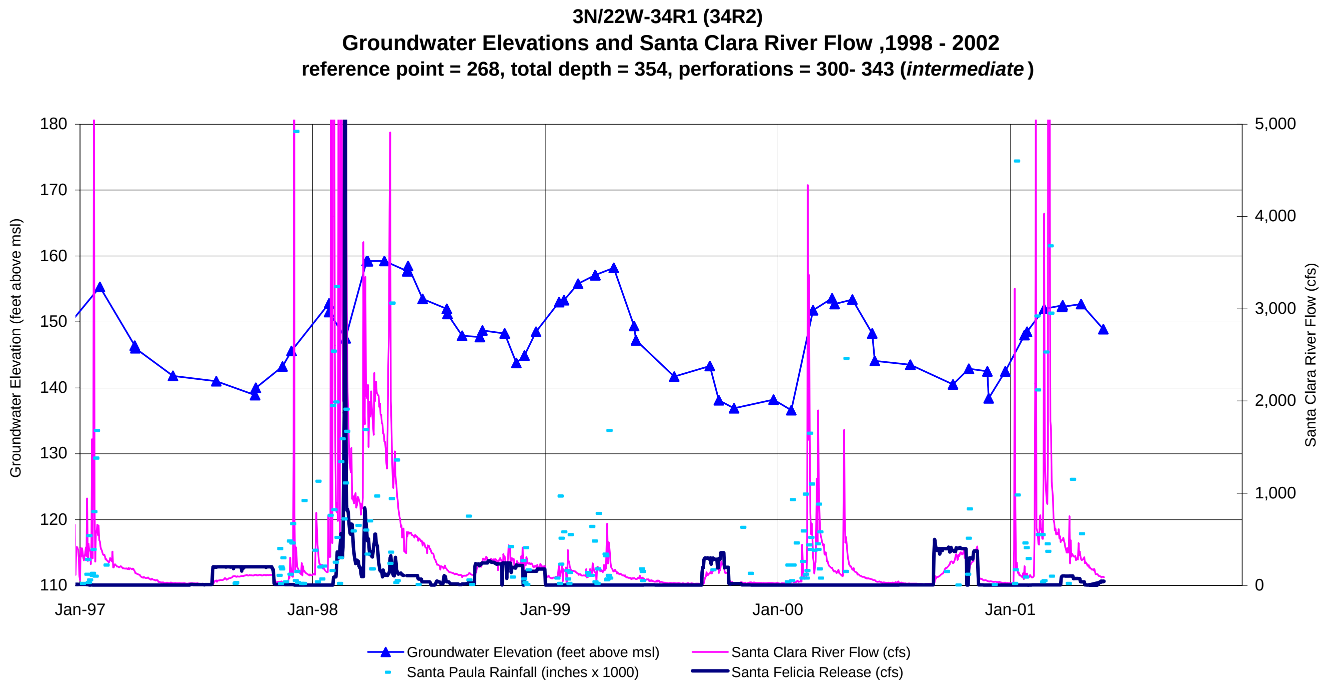

3N/22W-34R1 (34R2) Groundwater Elevations and Cumulative departues
reference point = 268, total depth = 354, perforations = 300- 343 (intermediate)
Base Period 1983 - 1995
Groundwater Elevation (feet above msl)
Cumulative Departure from the Average (percent)
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-77
Jan-79
Jan-81
Jan-83
Jan-85
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Groundwater Elevation (feet above msl)
Santa Paula Rainfall (cumulative departure from the average (percent), water years 1944-1998)
Santa Paula Creek Flow (cumulative departure from the average (percent), water years 1944-1998)

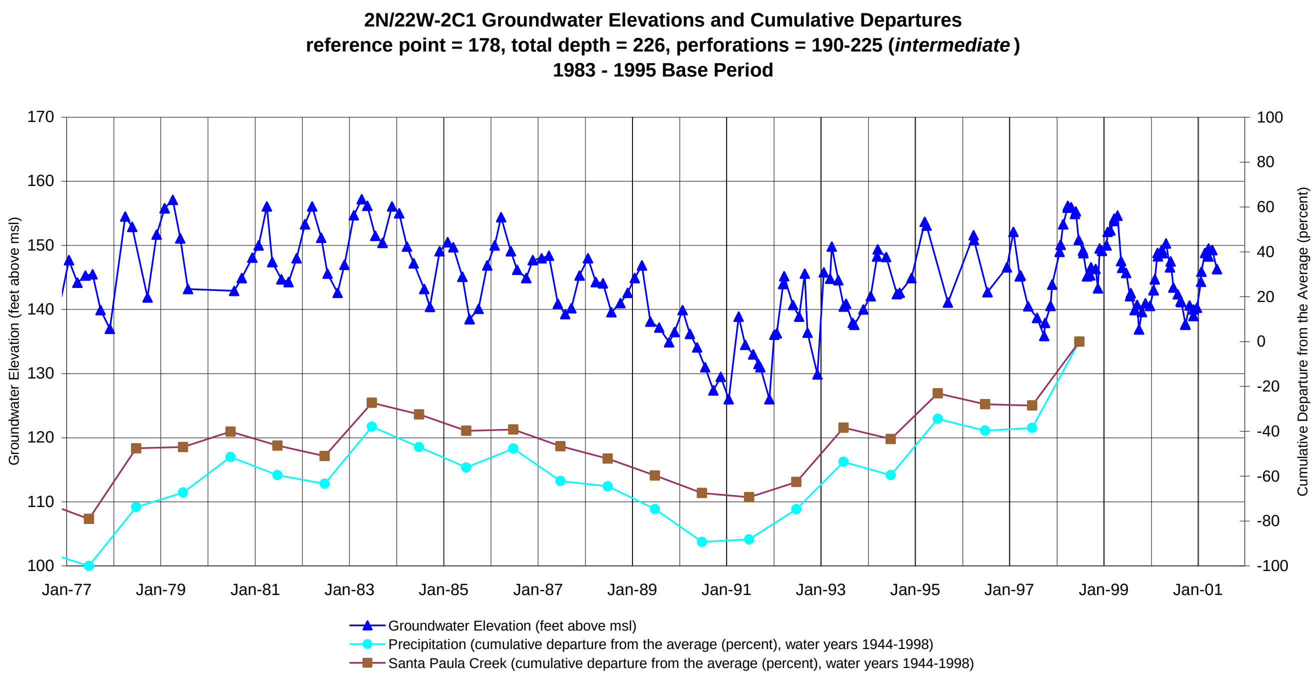

3N/22W-34R1 (34R2)
Groundwater Elevations and Santa Clara River Flow, 1983 - 1987
reference point = 268, total depth = 354, perforations = 300- 343 (*intermediate*)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
180
170
160
150
140
130
120
110
5000
4000
3000
2000
1000
0
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Groundwater Elevation (feet above msl)
Santa Paula Rainfall (inches x 1000)
Santa Clara River Flow (cfs)
Santa Felicia Release (cfs)

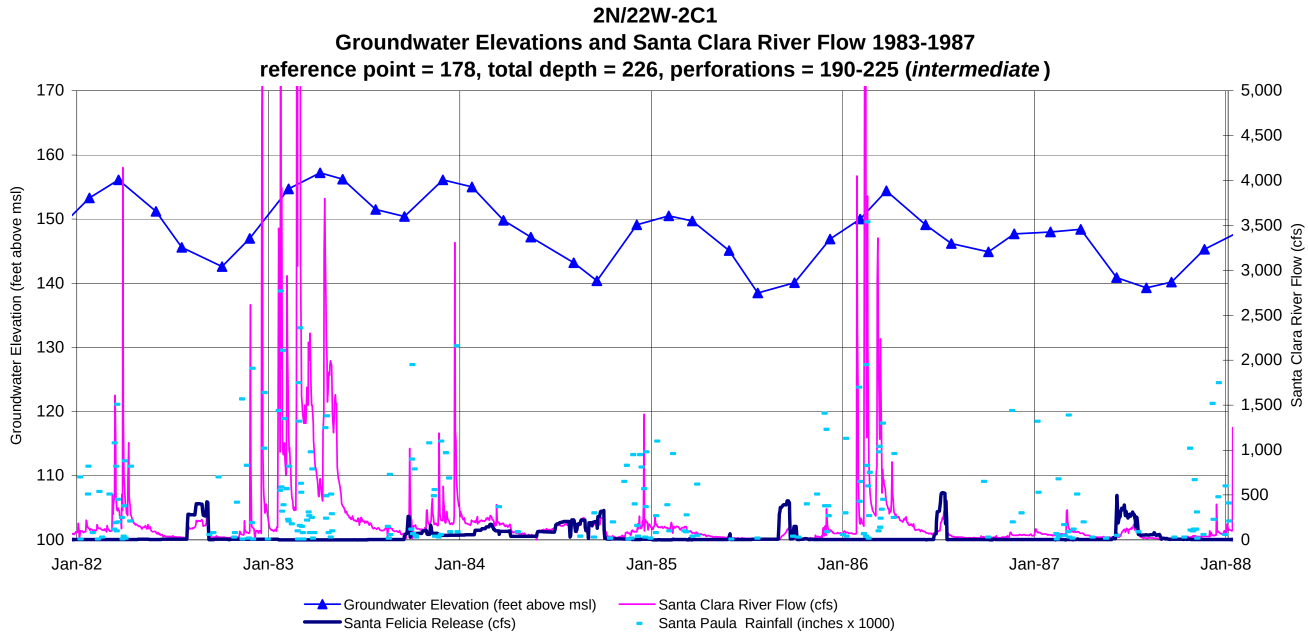

3N/22W-34R1 (34R2)
Groundwater Elevations and Santa Clara River Flow, 1990 - 1994
reference point = 268, total depth = 354, perforations = 300- 343 (*intermediate*)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
180
170
160
150
140
130
120
110
5,000
4,000
3,000
2,000
1,000
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Groundwater Elevation (feet above msl)
Santa Paual Rainfall (inches x 1000)
Santa Clara River Flow (cfs)
Santa Felicia Release (cfs)

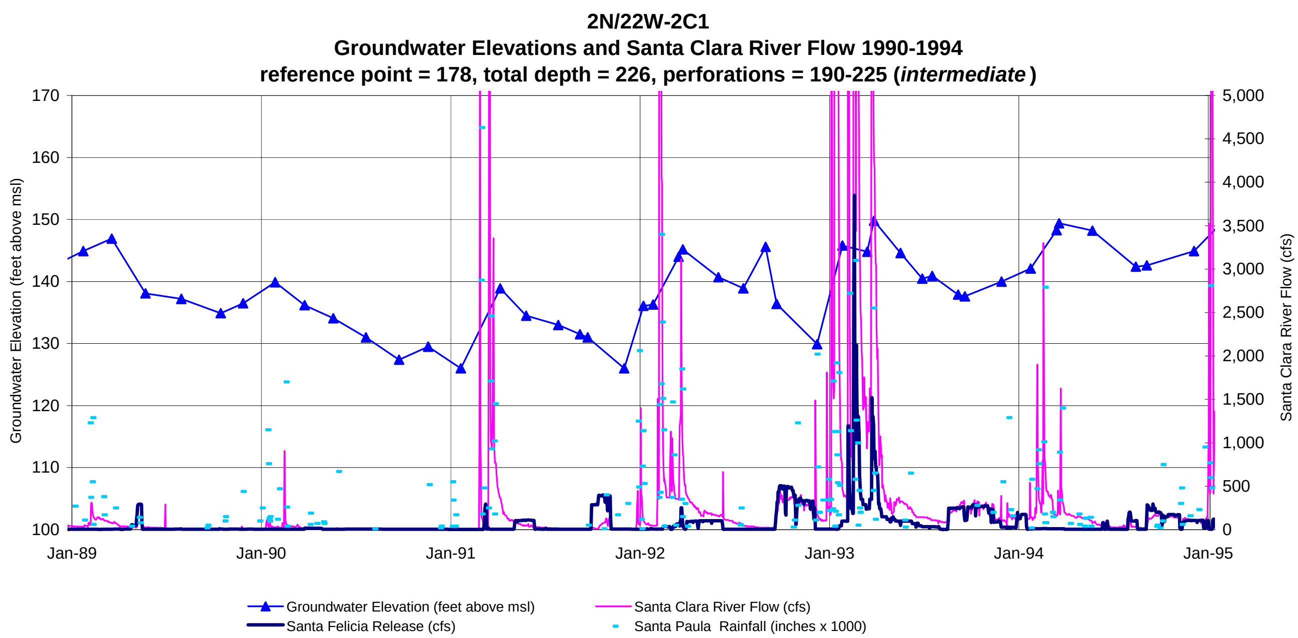

3N/22W-34R1 (34R2)
Groundwater Elevations and Santa Clara River Flow ,1993 - 1997
reference point = 268, total depth = 354, perforations = 300- 343 (intermediate)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
180
170
160
150
140
130
120
110
5,000
4,000
3,000
2,000
1,000
0
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Release (cfs)


3N/22W-34R1 (34R2)
Groundwater Elevations and Santa Clara River Flow ,1995 - 2000
reference point = 268, total depth = 354, perforations = 300- 343 (intermediate)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
180
170
160
150
140
130
120
110
5,000
4,000
3,000
2,000
1,000
0
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Release (cfs)

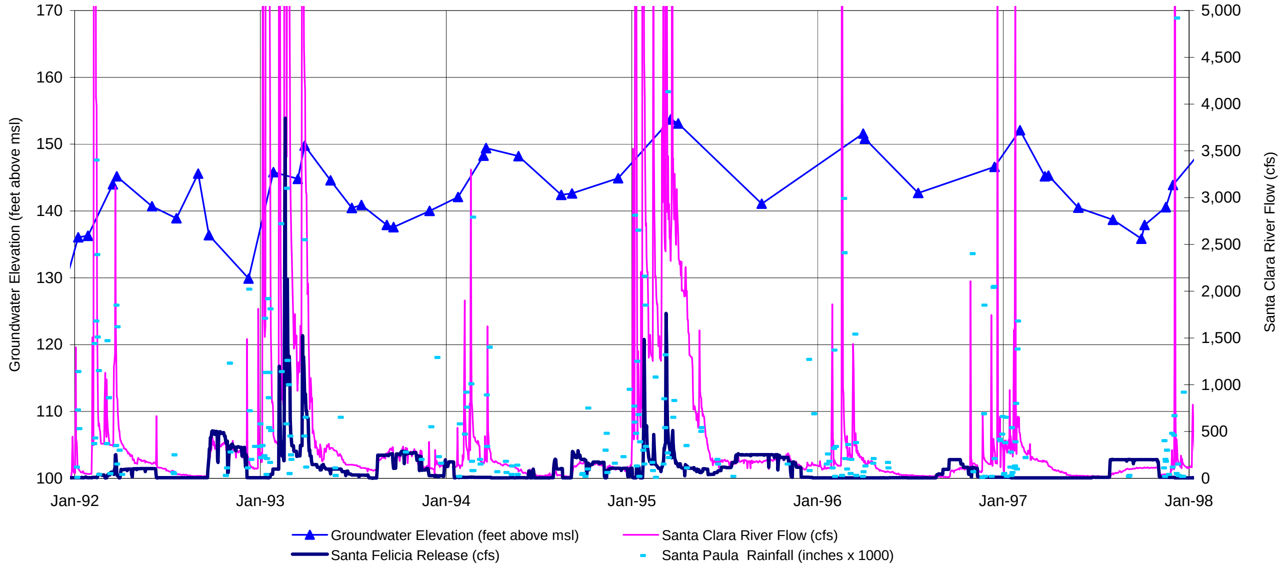

3N/22W-34R1 (34R2)
Groundwater Elevations and Santa Clara River Flow ,1998 - 2002
reference point = 268, total depth = 354, perforations = 300- 343 (intermediate)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Release (cfs)


2N/22W-2C1 Groundwater Elevations and Cumulative Departures
reference point = 178, total depth = 226, perforations = 190-225 (intermediate)
1983 - 1995 Base Period
Groundwater Elevation (feet above msl)
Cumulative Departure from the Average (percent)
Jan-77
Jan-79
Jan-81
Jan-83
Jan-85
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Groundwater Elevation (feet above msl)
Precipitation (cumulative departure from the average (percent), water years 1944-1998)
Santa Paula Creek (cumulative departure from the average (percent), water years 1944-1998)

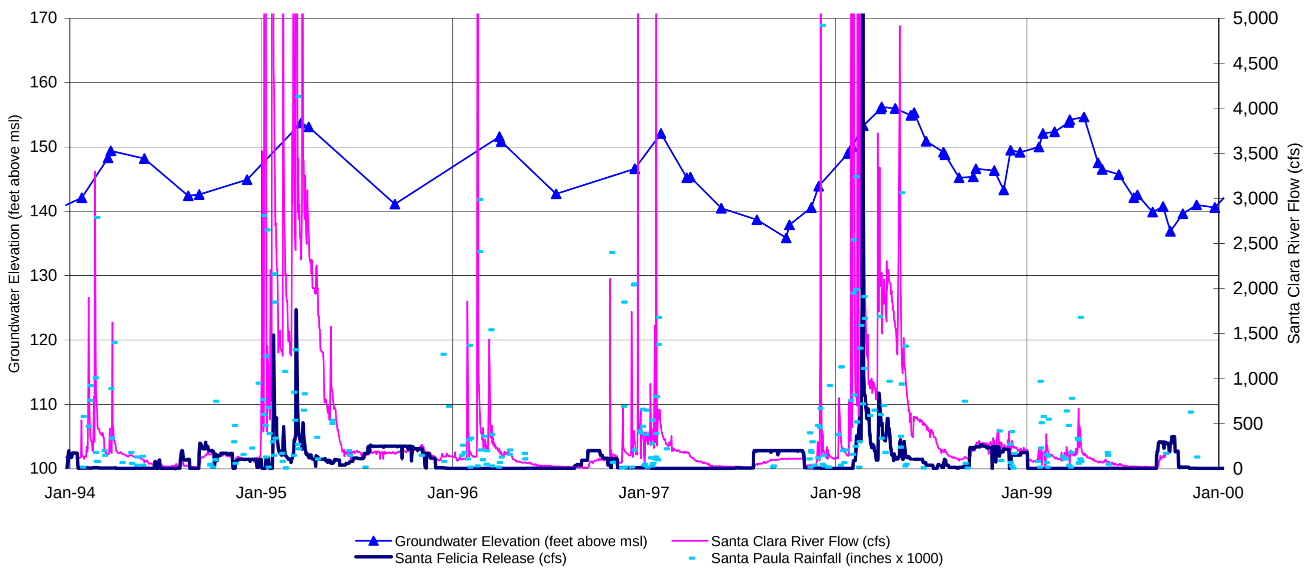

2N/22W-2C1
Groundwater Elevations and Santa Clara River Flow 1983-1987
reference point = 178, total depth = 226, perforations = 190-225 (intermediate)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
170
160
150
140
130
120
110
100
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Groundwater Elevation (feet above msl)
Santa Felicia Release (cfs)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)

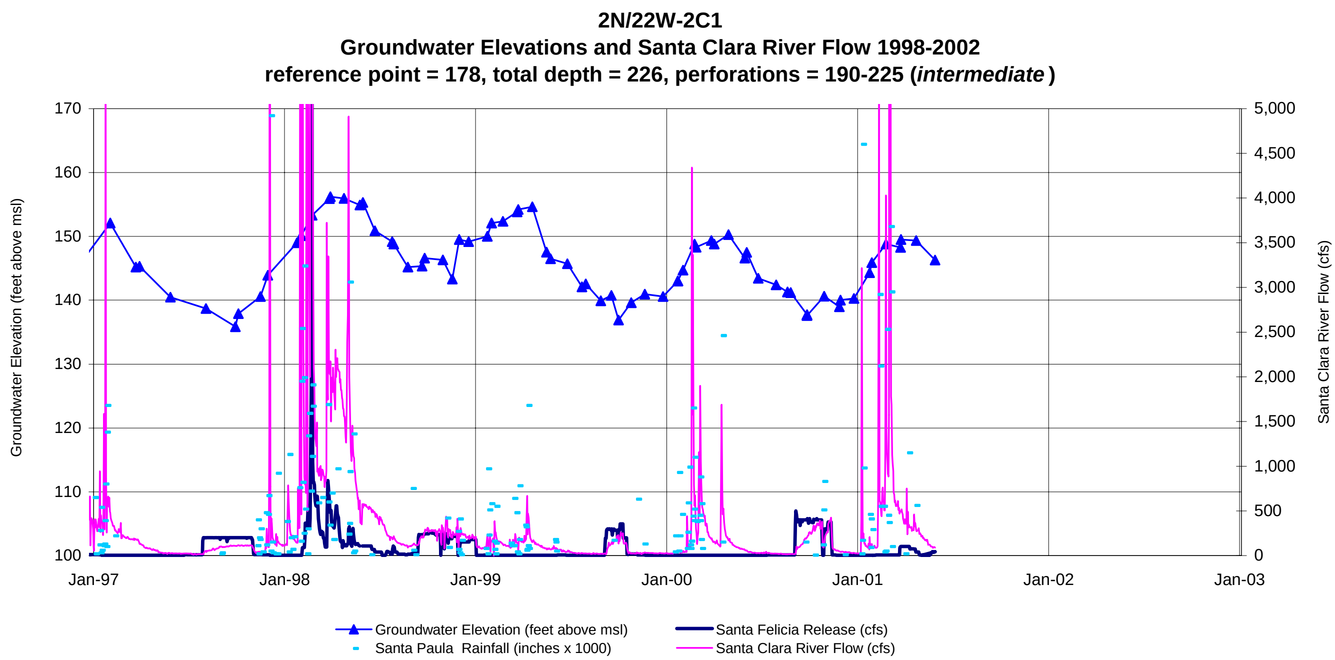

2N/22W-2C1
Groundwater Elevations and Santa Clara River Flow 1990-1994
reference point = 178, total depth = 226, perforations = 190-225 (intermediate)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
170
160
150
140
130
120
110
100
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Groundwater Elevation (feet above msl)
Santa Felicia Release (cfs)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)

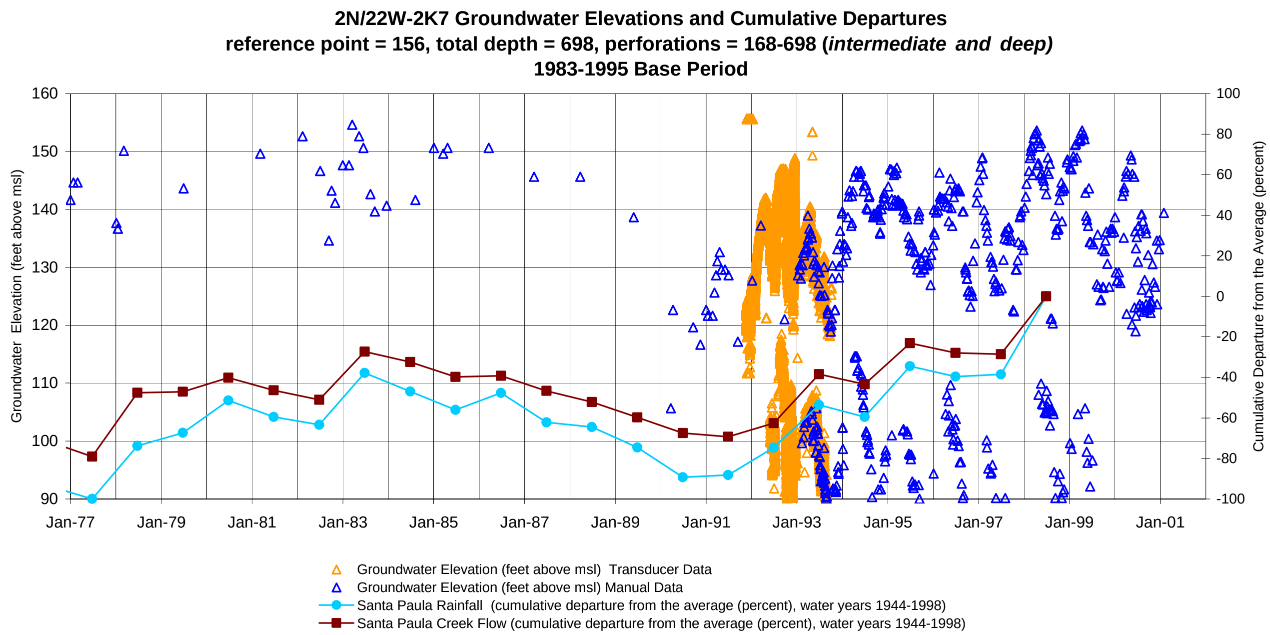
2N/22W-2C1
Groundwater Elevations and Santa Clara River Flow 1993-1997
reference point = 178, total depth = 226, perforations = 190-225 (*intermediate*)

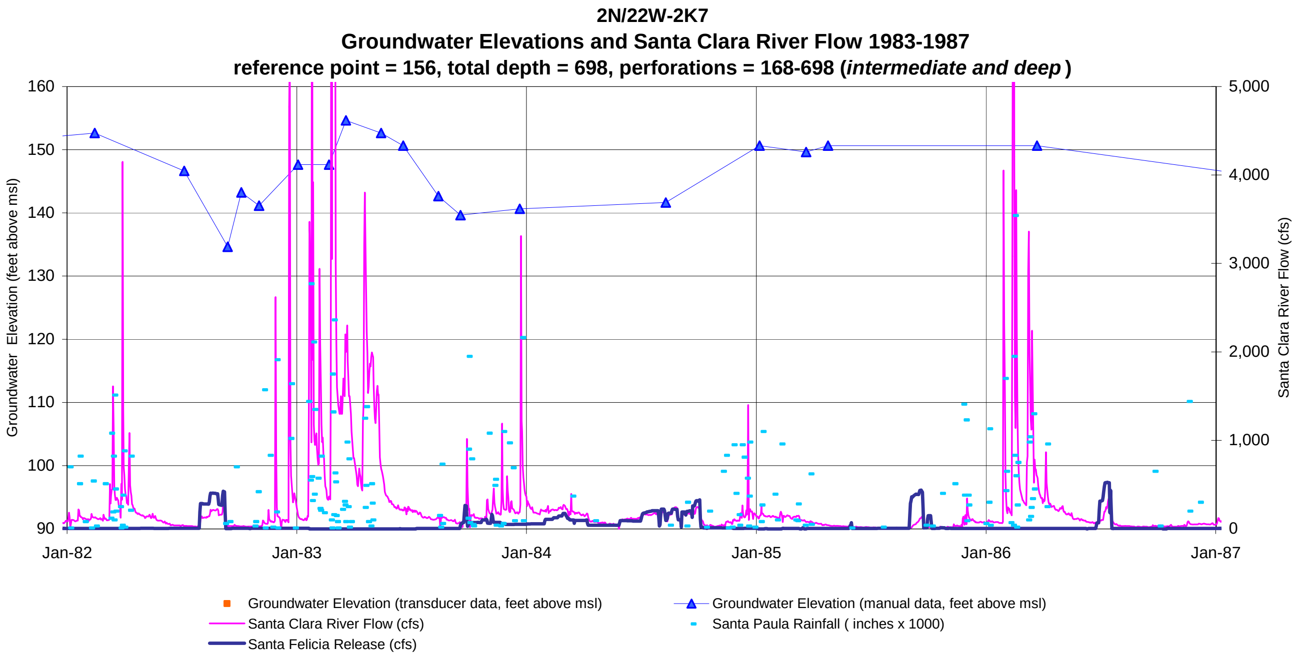


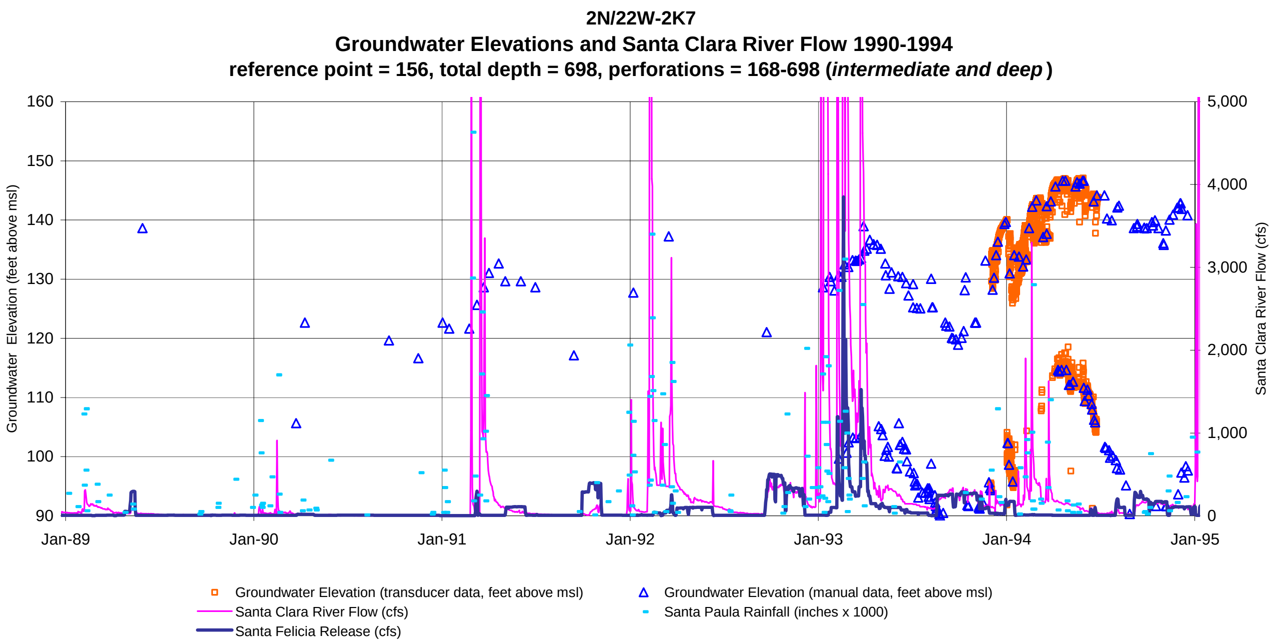
2N/22W-2C1
Groundwater Elevations and Santa Clara River Flow 1995-1999
reference point = 178, total depth = 226, perforations = 190-225 (*intermediate*)

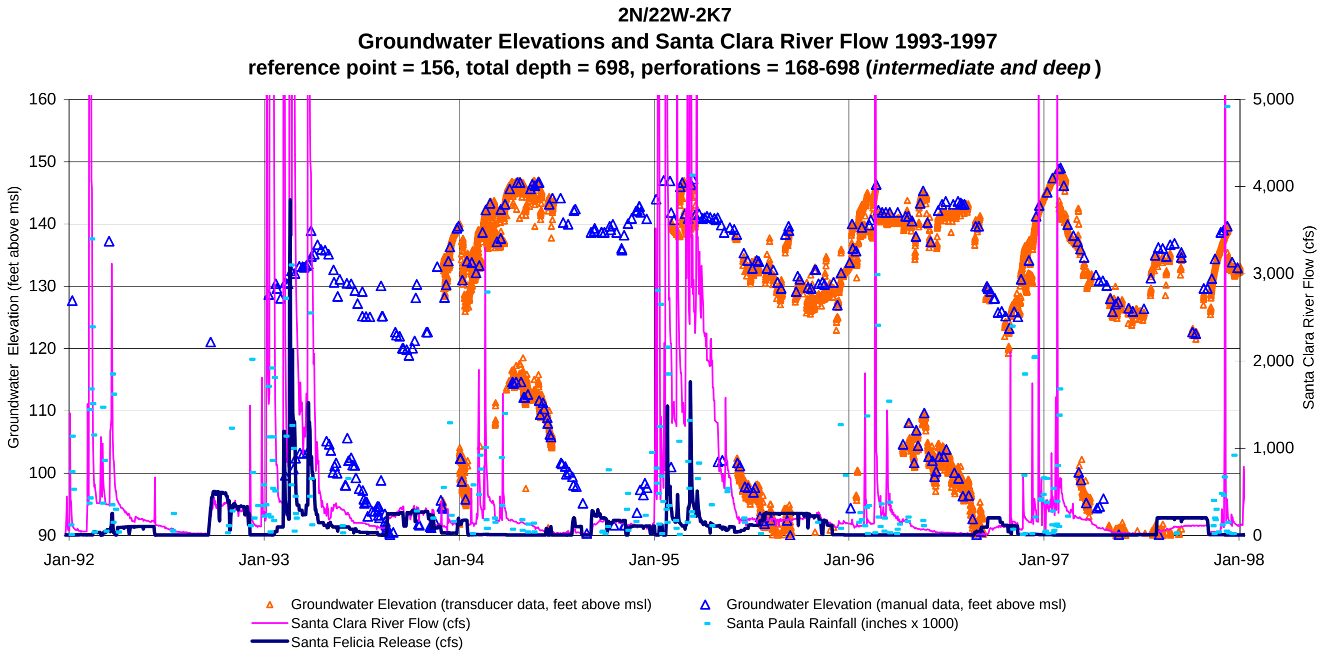


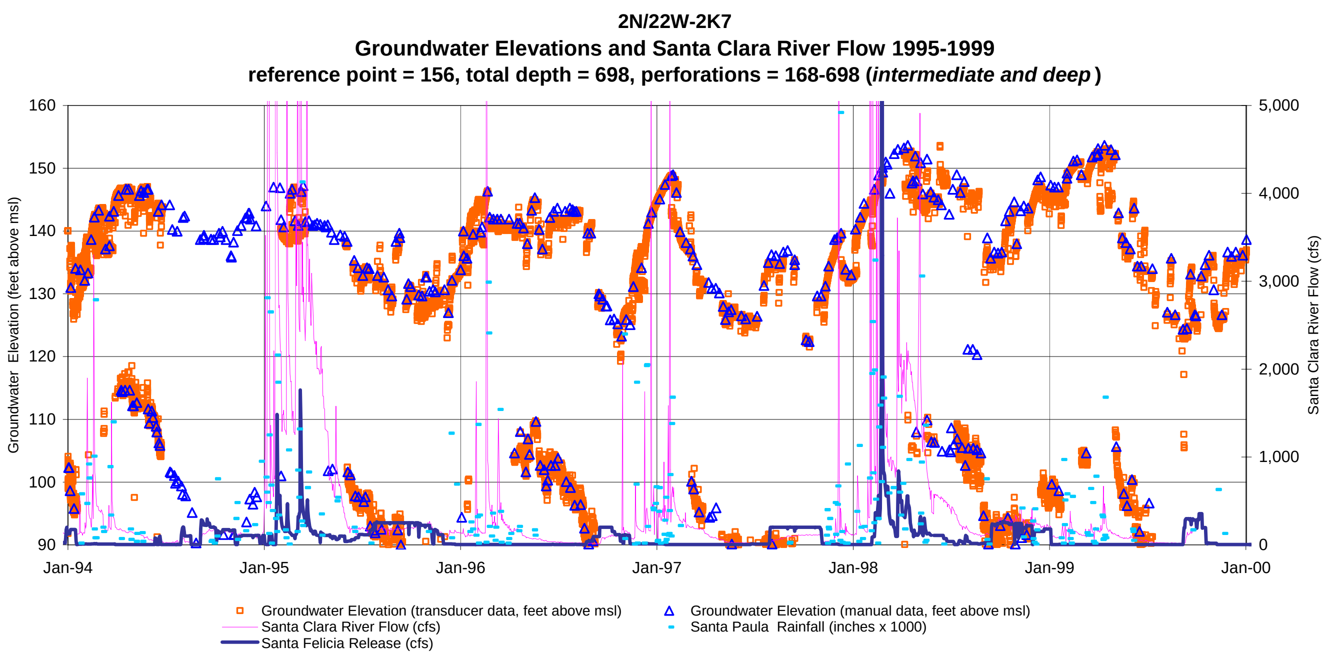

2N/22W-2C1
Groundwater Elevations and Santa Clara River Flow 1998-2002
reference point = 178, total depth = 226, perforations = 190-225 (intermediate)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
170
160
150
140
130
120
110
100
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Groundwater Elevation (feet above msl)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Release (cfs)
Santa Clara River Flow (cfs)

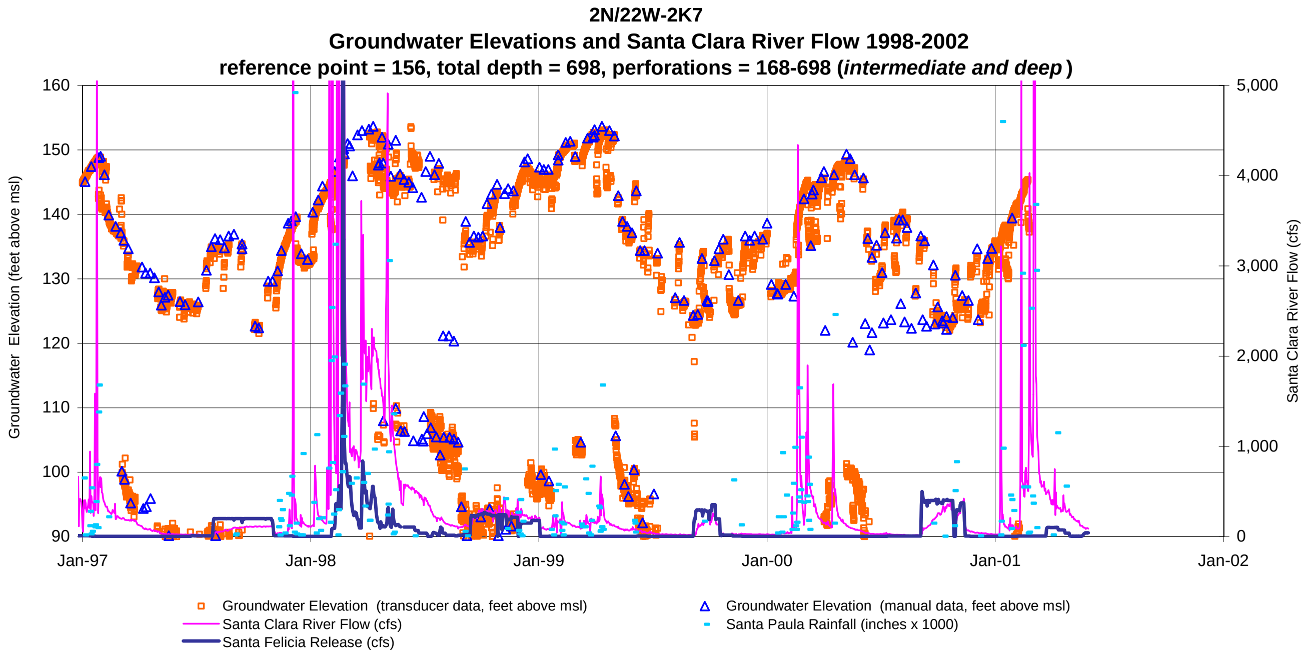

2N/22W-2K7 Groundwater Elevations and Cumulative Departures
reference point = 156, total depth = 698, perforations = 168-698 (intermediate and deep)
1983-1995 Base Period
Groundwater Elevation (feet above msl)
Cumulative Departure from the Average (percent)
160
150
140
130
120
110
100
90
100
80
60
40
20
0
-20
-40
-60
-80
-100
Jan-77
Jan-79
Jan-81
Jan-83
Jan-85
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Groundwater Elevation (feet above msl) Transducer Data
Groundwater Elevation (feet above msl) Manual Data
Santa Paula Rainfall (cumulative departure from the average (percent), water years 1944-1998)
Santa Paula Creek Flow (cumulative departure from the average (percent), water years 1944-1998)

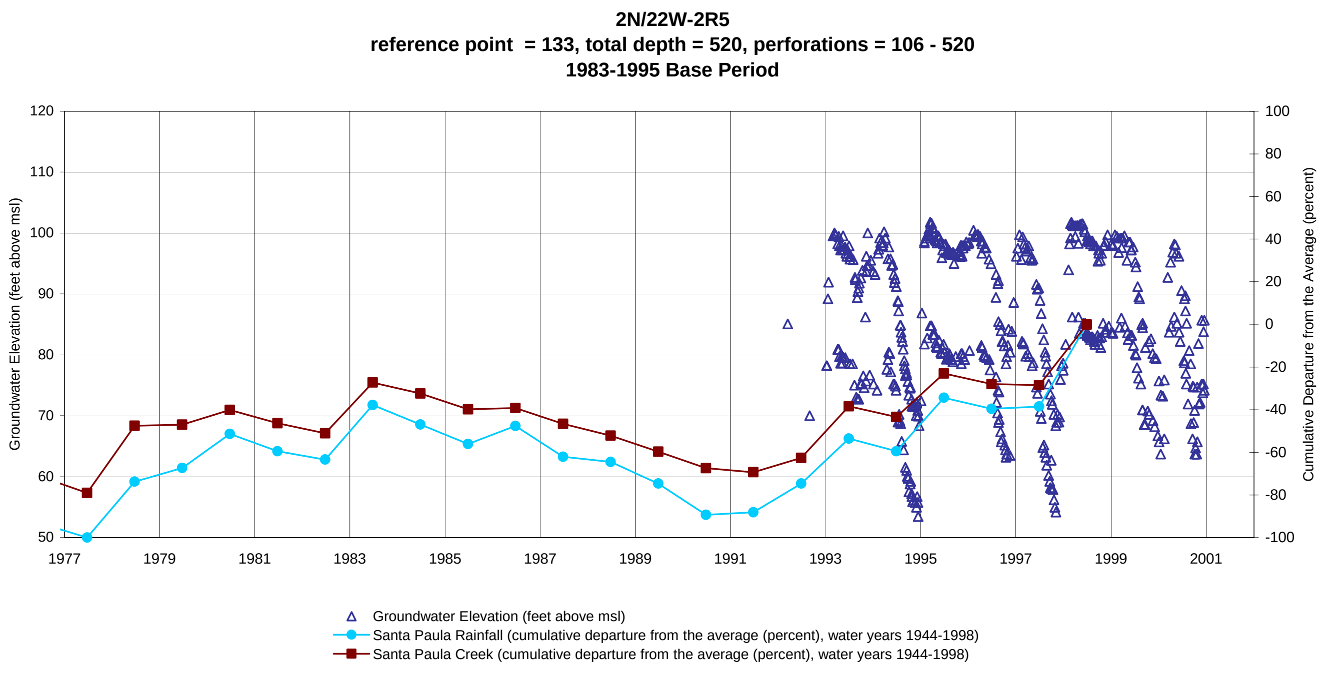

2N/22W-2K7
Groundwater Elevations and Santa Clara River Flow 1983-1987
reference point = 156, total depth = 698, perforations = 168-698 (intermediate and deep)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
160
150
140
130
120
110
100
90
5,000
4,000
3,000
2,000
1,000
0
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Groundwater Elevation (transducer data, feet above msl)
Groundwater Elevation (manual data, feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Release (cfs)

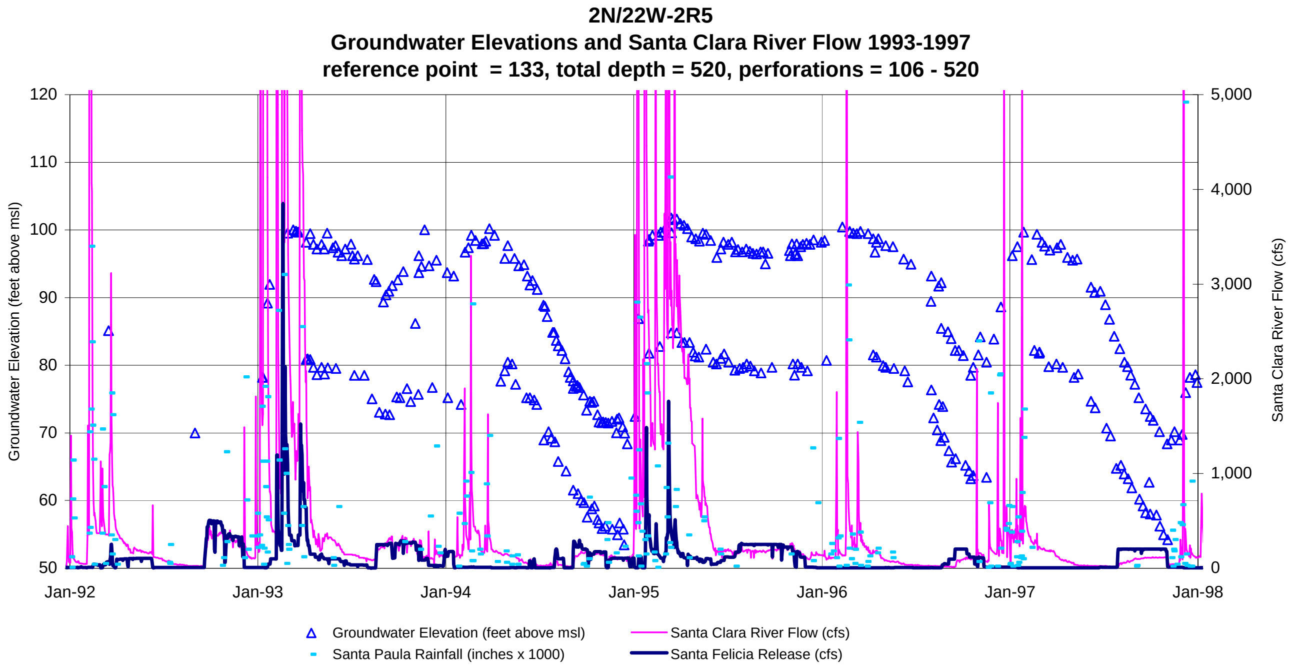

2N/22W-2K7
Groundwater Elevations and Santa Clara River Flow 1990-1994
reference point = 156, total depth = 698, perforations = 168-698 (intermediate and deep)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
160
150
140
130
120
110
100
90
5,000
4,000
3,000
2,000
1,000
0
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Groundwater Elevation (transducer data, feet above msl)
Groundwater Elevation (manual data, feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Release (cfs)

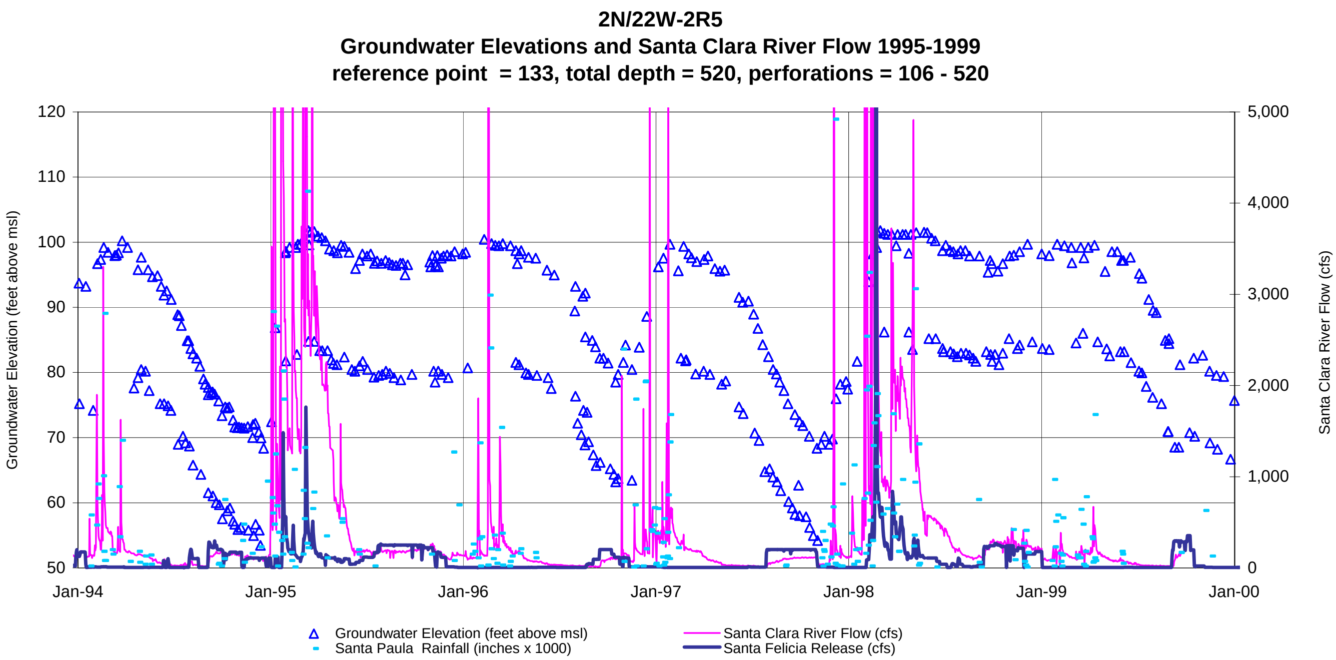

2N/22W-2K7
Groundwater Elevations and Santa Clara River Flow 1993-1997
reference point = 156, total depth = 698, perforations = 168-698 (intermediate and deep)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
160
150
140
130
120
110
100
90
5,000
4,000
3,000
2,000
1,000
0
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Groundwater Elevation (transducer data, feet above msl)
Groundwater Elevation (manual data, feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Release (cfs)

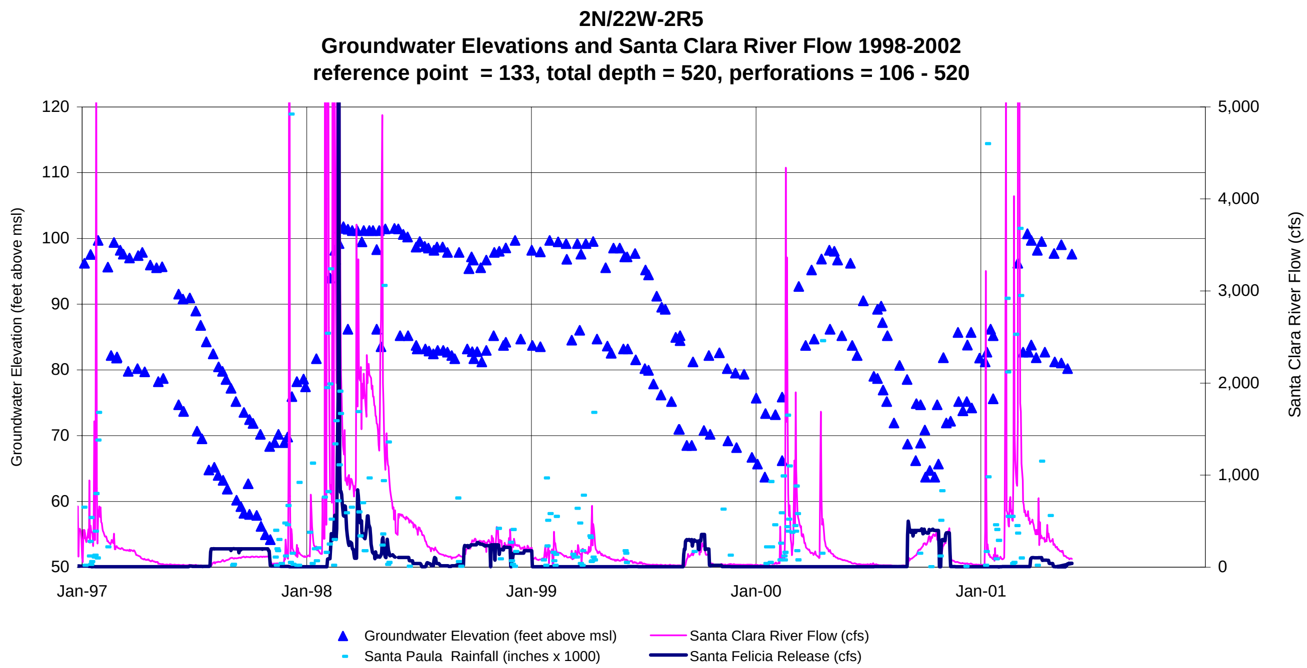

2N/22W-2K7
Groundwater Elevations and Santa Clara River Flow 1995-1999
reference point = 156, total depth = 698, perforations = 168-698 (intermediate and deep)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
160
150
140
130
120
110
100
90
5,000
4,000
3,000
2,000
1,000
0
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Groundwater Elevation (transducer data, feet above msl)
Groundwater Elevation (manual data, feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Release (cfs)

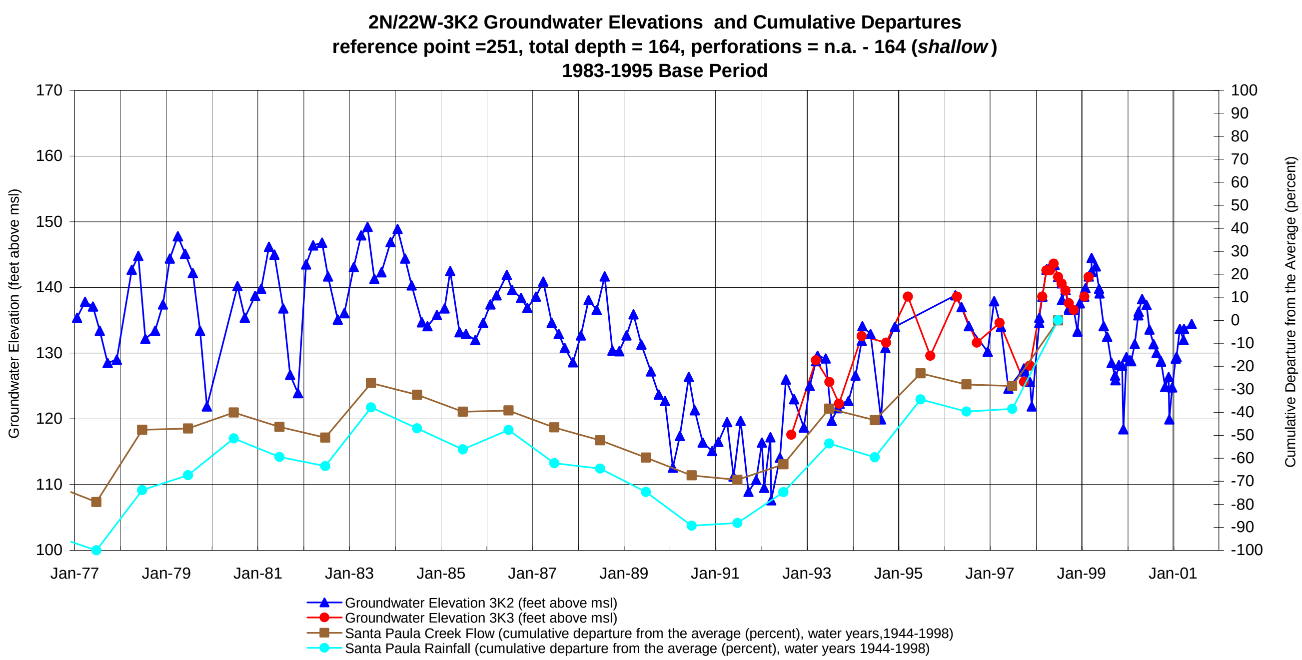

2N/22W-2K7
Groundwater Elevations and Santa Clara River Flow 1998-2002
reference point = 156, total depth = 698, perforations = 168-698 (intermediate and deep)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
160
150
140
130
120
110
100
90
5,000
4,000
3,000
2,000
1,000
0
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Groundwater Elevation (transducer data, feet above msl)
Groundwater Elevation (manual data, feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Release (cfs)

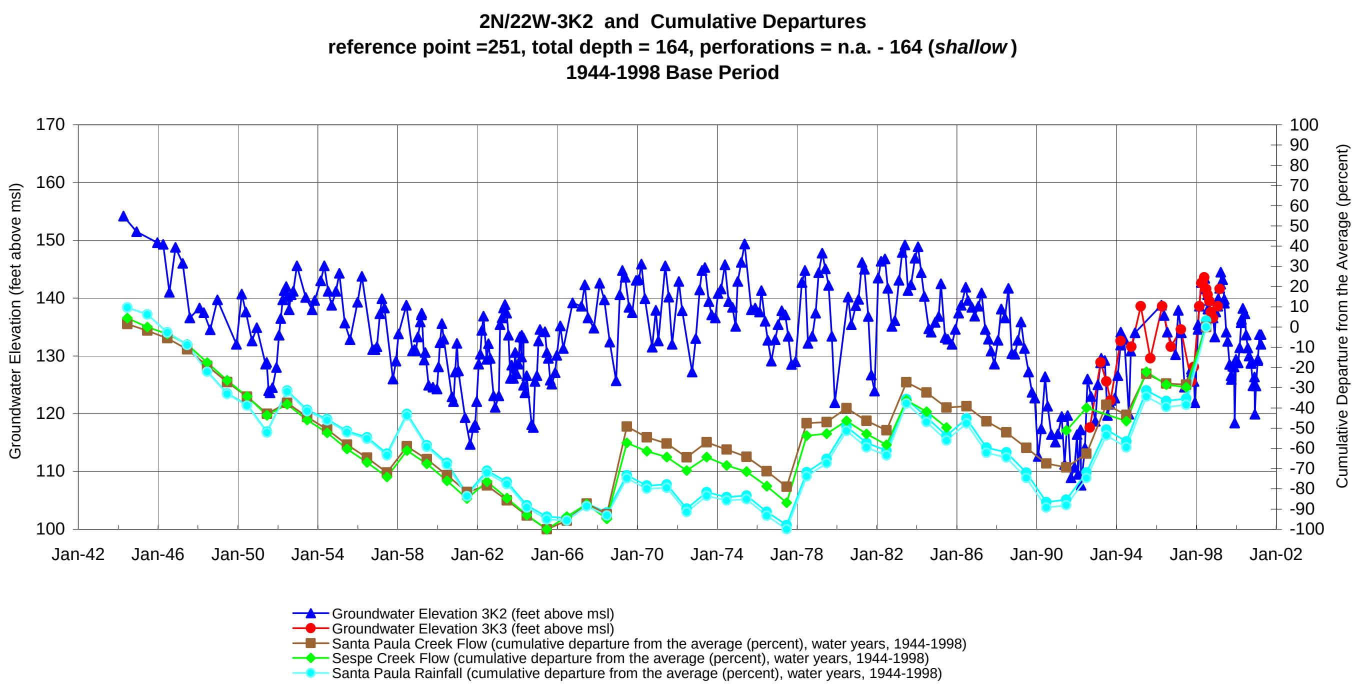

2N/22W-2R5
reference point = 133, total depth = 520, perforations = 106 - 520
1983-1995 Base Period
Groundwater Elevation (feet above msl)
Cumulative Departure from the Average (percent)
120
110
100
90
80
70
60
50
100
80
60
40
20
0
-20
-40
-60
-80
-100
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
Groundwater Elevation (feet above msl)
Santa Paula Rainfall (cumulative departure from the average (percent), water years 1944-1998)
Santa Paula Creek (cumulative departure from the average (percent), water years 1944-1998)

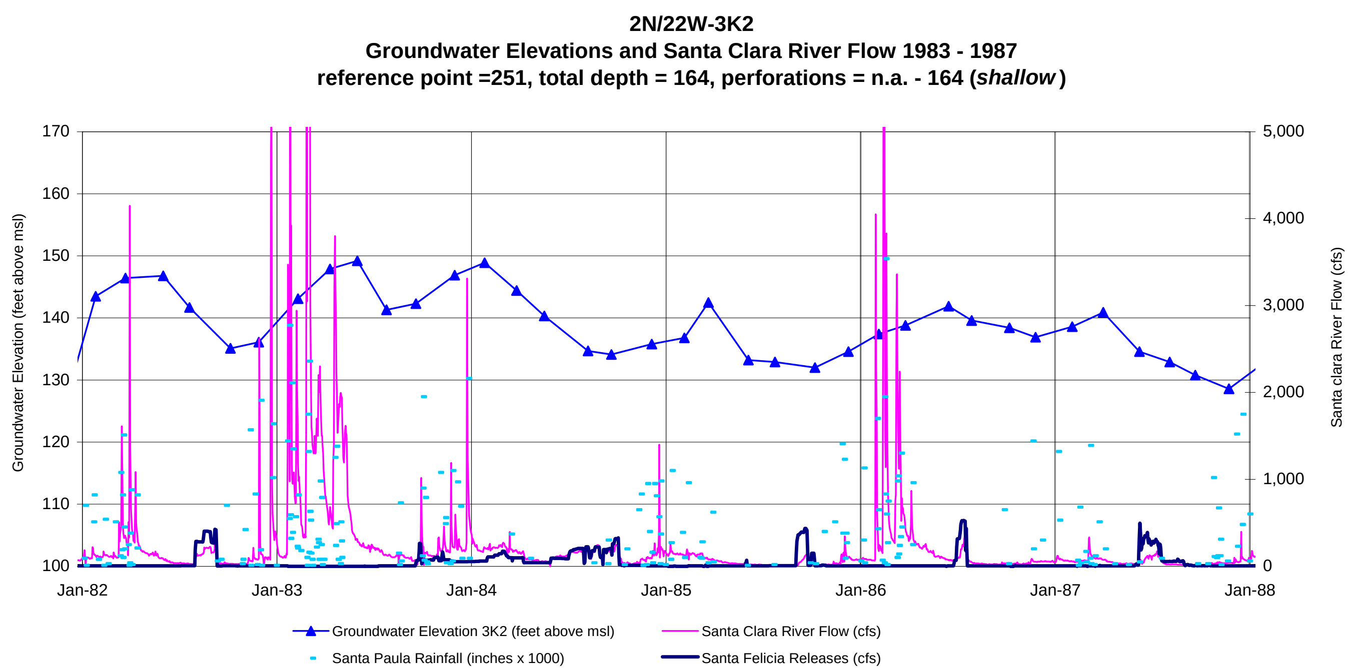

2N/22W-2R5
Groundwater Elevations and Santa Clara River Flow 1993-1997
reference point = 133, total depth = 520, perforations = 106 - 520
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
120
110
100
90
80
70
60
50
5,000
4,000
3,000
2,000
1,000
0
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Groundwater Elevation (feet above msl)
Santa Paula Rainfall (inches x 1000)
Santa Clara River Flow (cfs)
Santa Felicia Release (cfs)

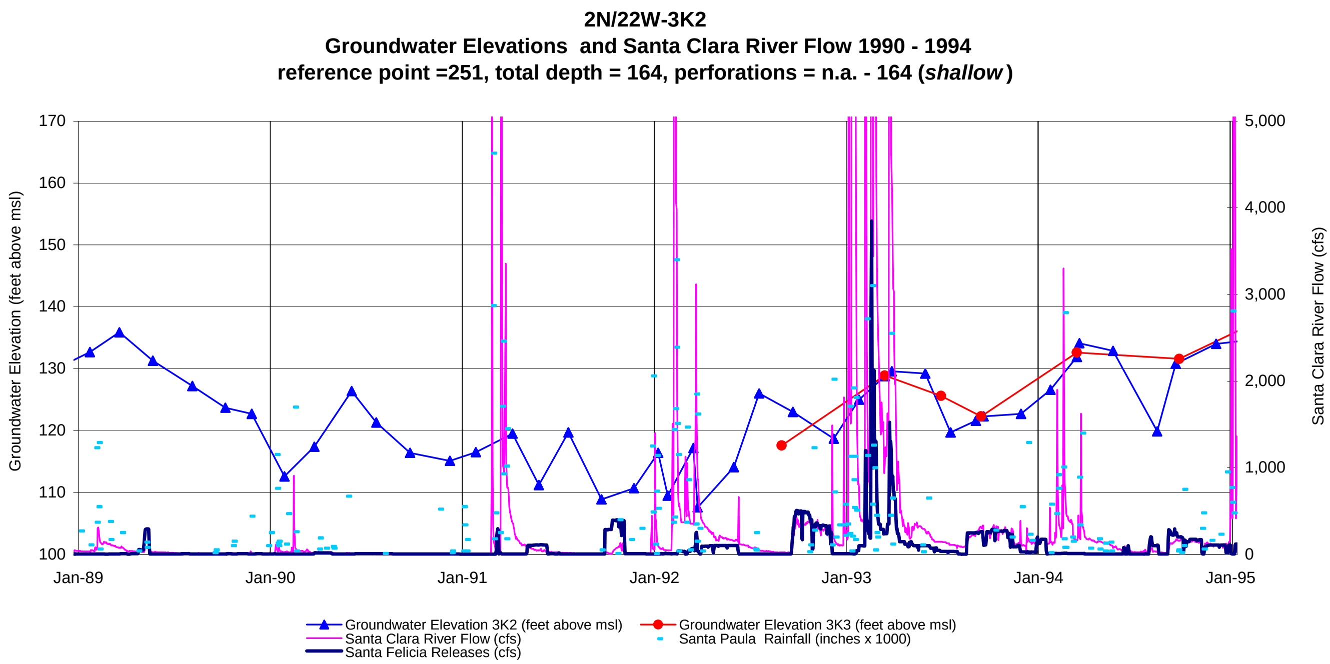

2N/22W-2R5
Groundwater Elevations and Santa Clara River Flow 1995-1999
reference point = 133, total depth = 520, perforations = 106 - 520
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
120
110
100
90
80
70
60
50
5,000
4,000
3,000
2,000
1,000
0
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Groundwater Elevation (feet above msl)
Santa Paula Rainfall (inches x 1000)
Santa Clara River Flow (cfs)
Santa Felicia Release (cfs)

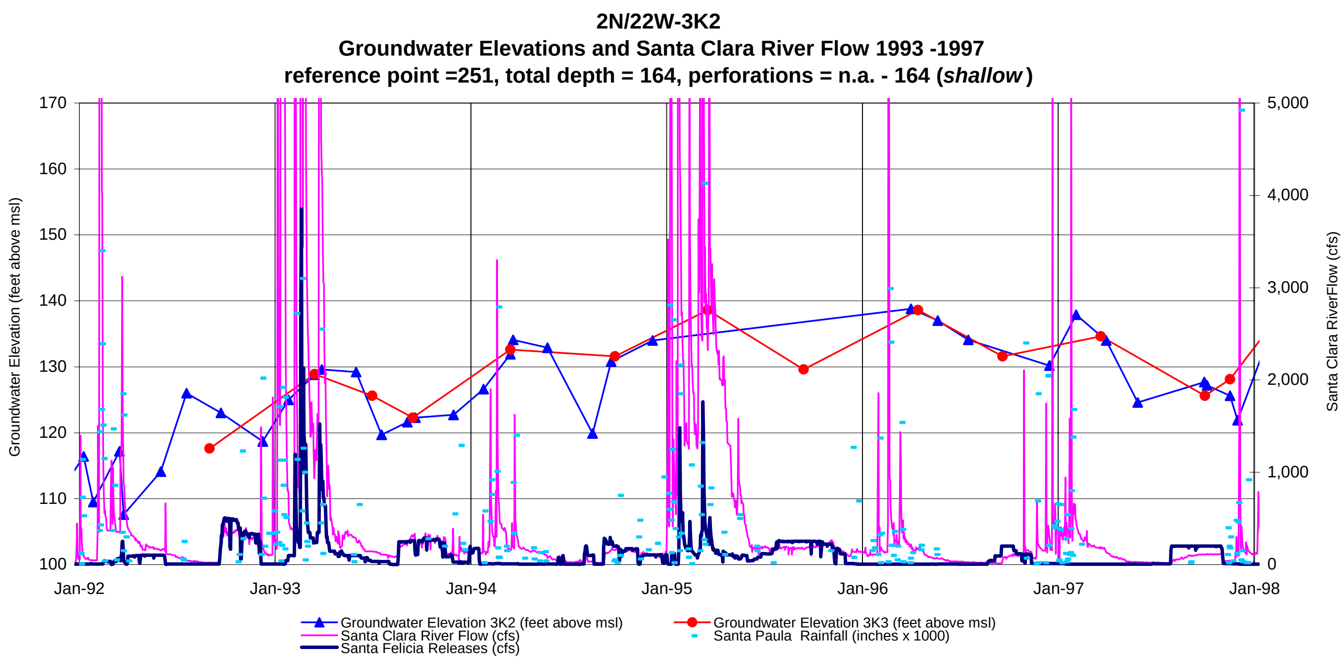

2N/22W-2R5
Groundwater Elevations and Santa Clara River Flow 1998-2002
reference point = 133, total depth = 520, perforations = 106 - 520
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
120
110
100
90
80
70
60
50
5,000
4,000
3,000
2,000
1,000
0
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Groundwater Elevation (feet above msl)
Santa Paula Rainfall (inches x 1000)
Santa Clara River Flow (cfs)
Santa Felicia Release (cfs)

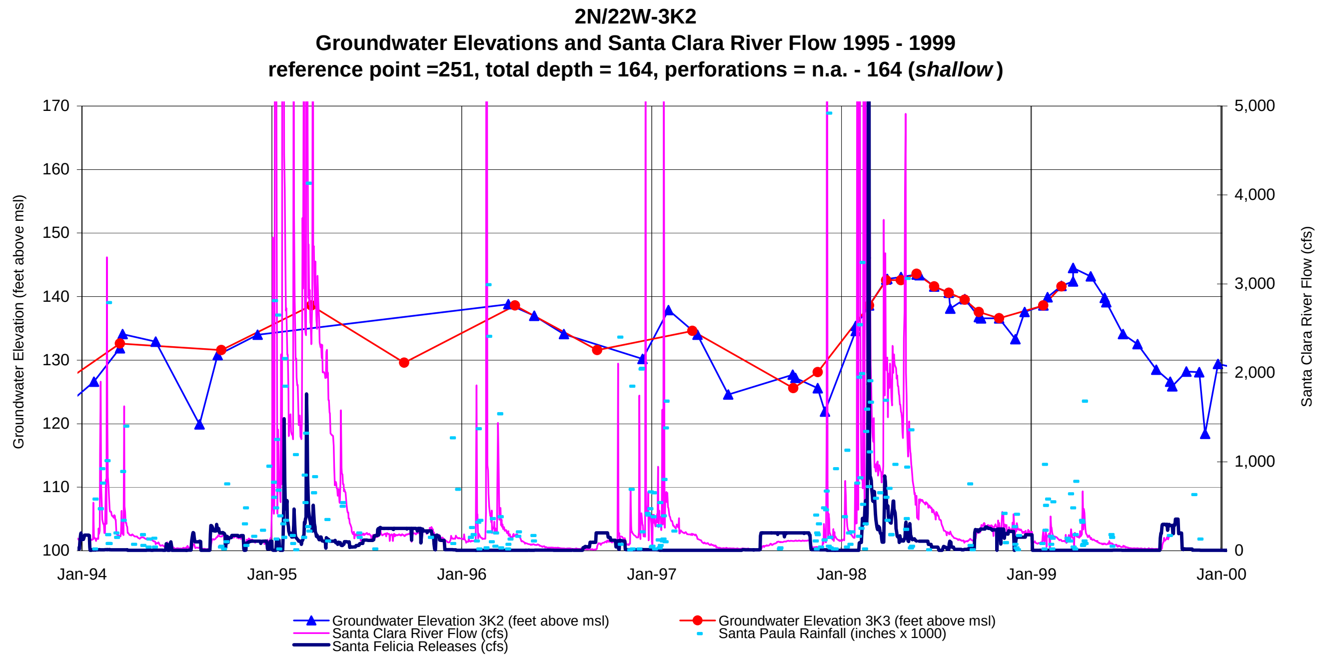

2N/22W-3K2 Groundwater Elevations and Cumulative Departures
reference point =251, total depth = 164, perforations = n.a. - 164 (shallow)
1983-1995 Base Period
Groundwater Elevation (feet above msl)
Cumulative Departure from the Average (percent)
170
160
150
140
130
120
110
100
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-77
Jan-79
Jan-81
Jan-83
Jan-85
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Groundwater Elevation 3K2 (feet above msl)
Groundwater Elevation 3K3 (feet above msl)
Santa Paula Creek Flow (cumulative departure from the average (percent), water years,1944-1998)
Santa Paula Rainfall (cumulative departure from the average (percent), water years 1944-1998)

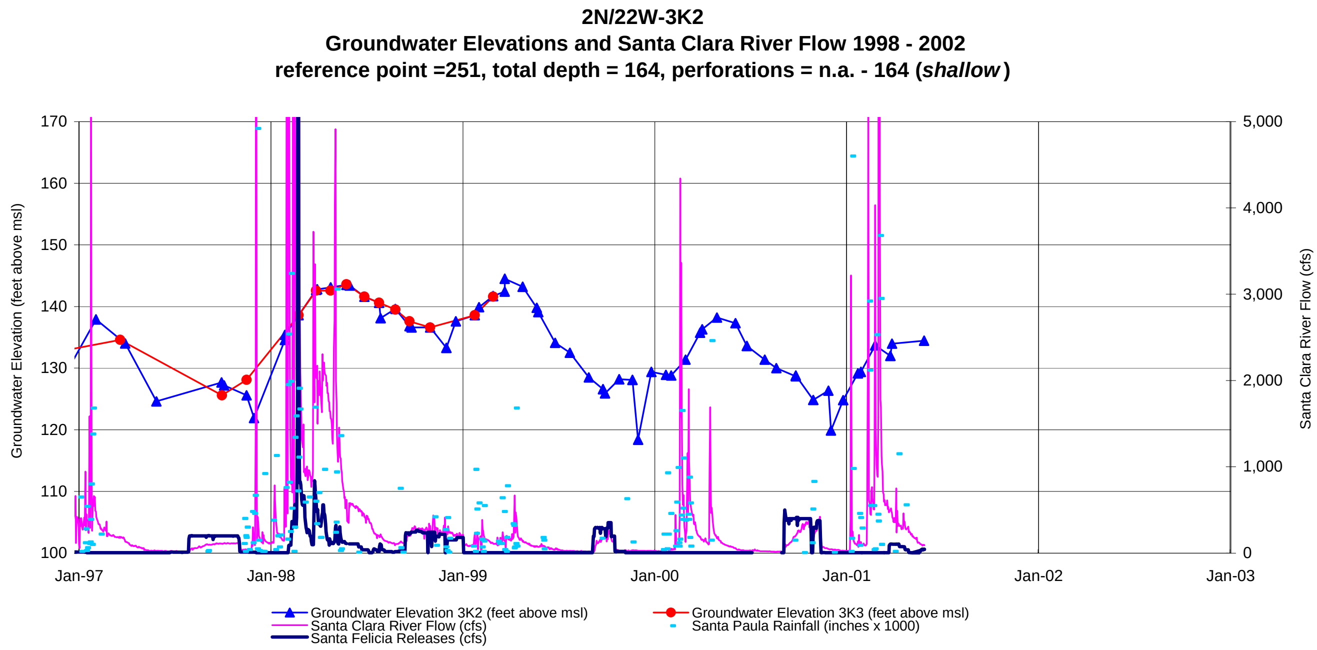

2N/22W-3K2 and Cumulative Departures
reference point =251, total depth = 164, perforations = n.a. - 164 (shallow)
1944-1998 Base Period
Groundwater Elevation (feet above msl)
Cumulative Departure from the Average (percent)
Jan-42
Jan-46
Jan-50
Jan-54
Jan-58
Jan-62
Jan-66
Jan-70
Jan-74
Jan-78
Jan-82
Jan-86
Jan-90
Jan-94
Jan-98
Jan-02
Groundwater Elevation 3K2 (feet above msl)
Groundwater Elevation 3K3 (feet above msl)
Santa Paula Creek Flow (cumulative departure from the average (percent), water years, 1944-1998)
Sespe Creek Flow (cumulative departure from the average (percent), water years, 1944-1998)
Santa Paula Rainfall (cumulative departure from the average (percent), water years, 1944-1998)

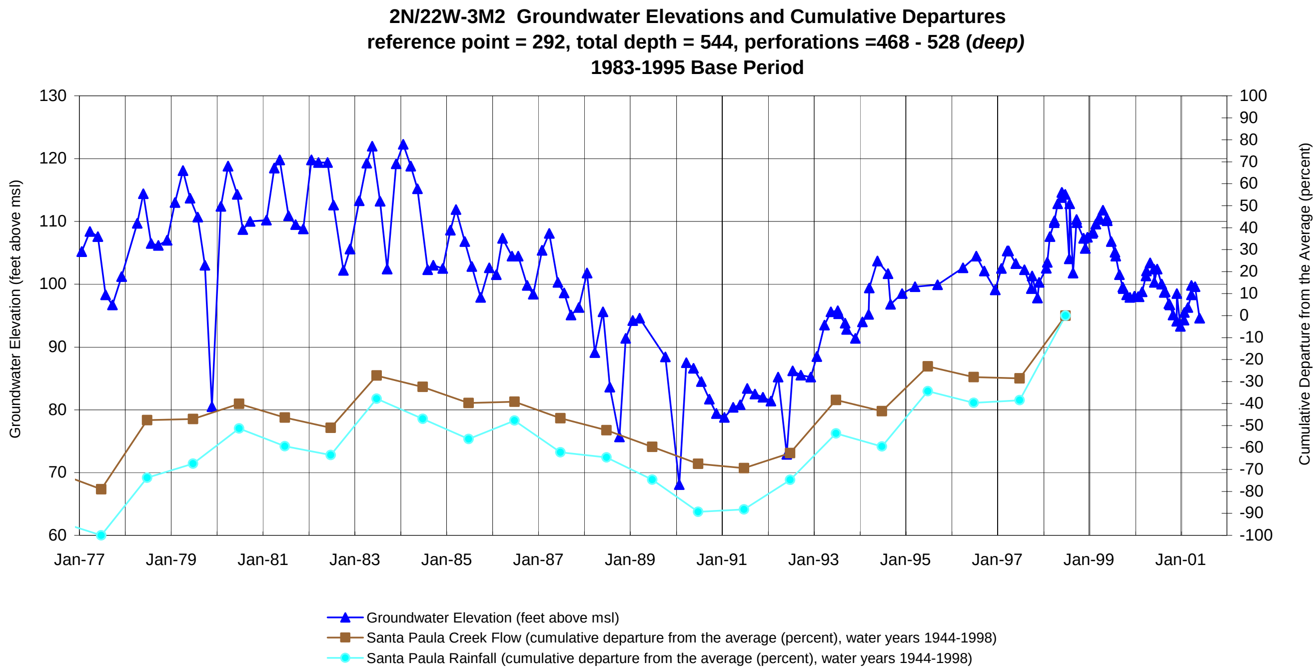

2N/22W-3K2
Groundwater Elevations and Santa Clara River Flow 1983 - 1987
reference point =251, total depth = 164, perforations = n.a. - 164 (shallow)
Groundwater Elevation (feet above msl)
Santa clara River Flow (cfs)
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Groundwater Elevation 3K2 (feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Releases (cfs)

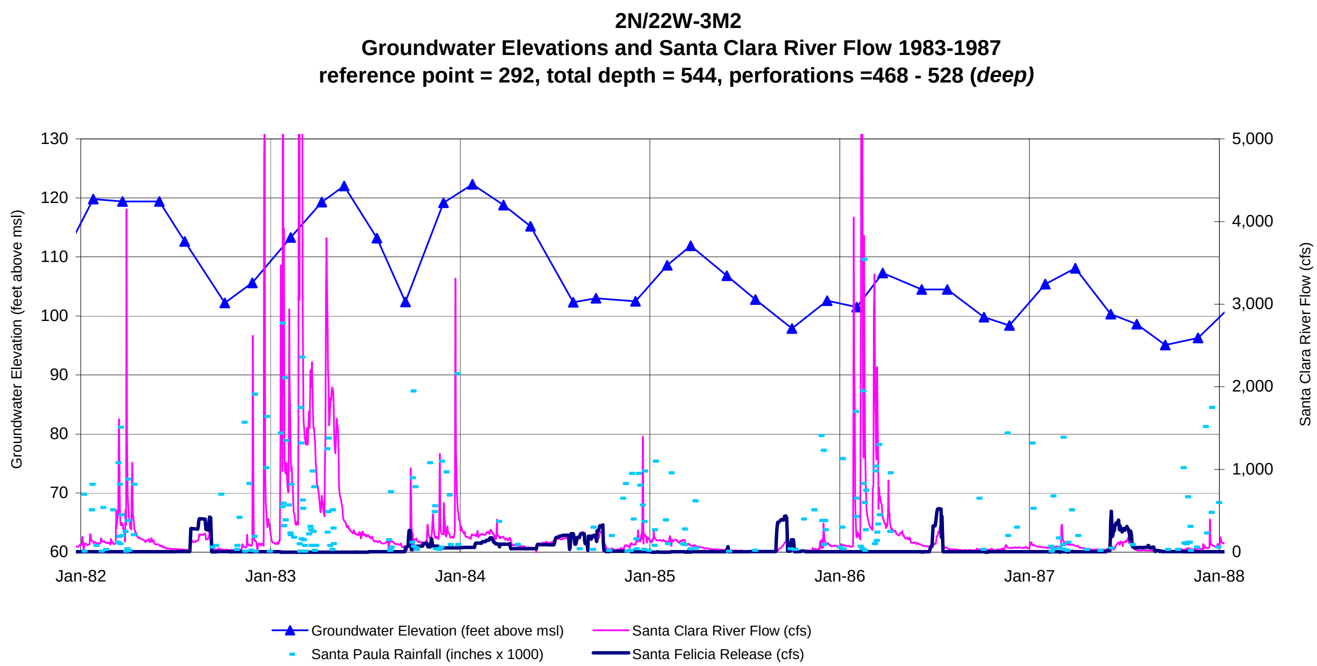

2N/22W-3K2
Groundwater Elevations and Santa Clara River Flow 1990 - 1994
reference point =251, total depth = 164, perforations = n.a. - 164 (shallow)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Jan-89
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Groundwater Elevation 3K2 (feet above msl)
Groundwater Elevation 3K3 (feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Releases (cfs)


2N/22W-3K2
Groundwater Elevations and Santa Clara River Flow 1993 -1997
reference point =251, total depth = 164, perforations = n.a. - 164 (shallow)
Groundwater Elevation (feet above msl)
Santa Clara RiverFlow (cfs)
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Groundwater Elevation 3K2 (feet above msl)
Groundwater Elevation 3K3 (feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Releases (cfs)

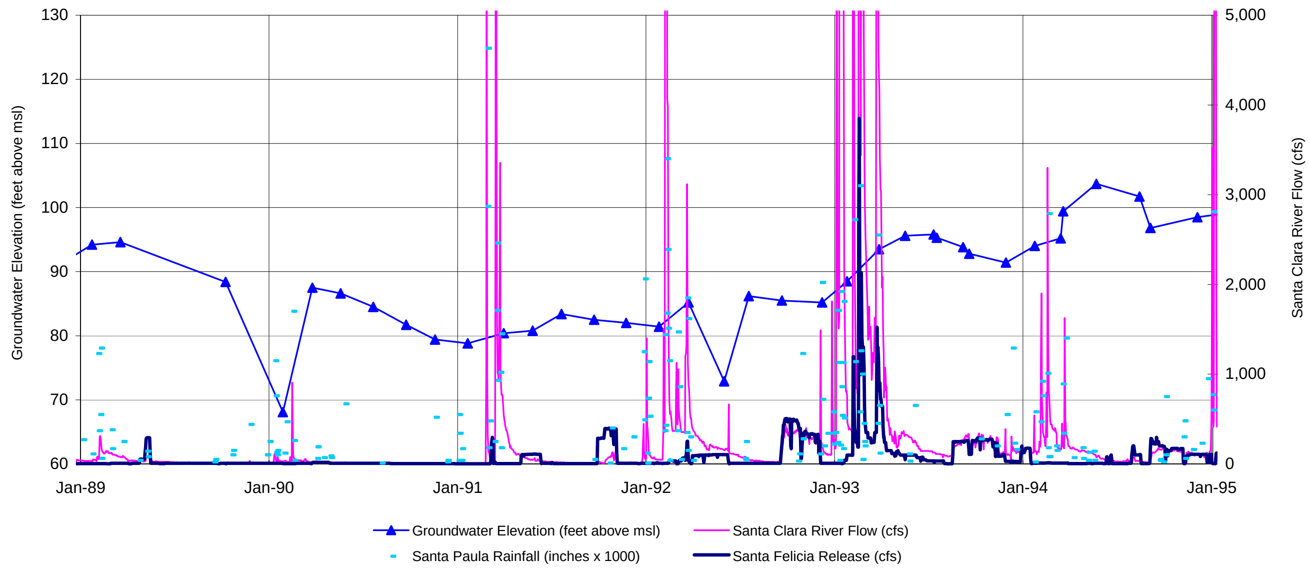

2N/22W-3K2
Groundwater Elevations and Santa Clara River Flow 1995 - 1999
reference point =251, total depth = 164, perforations = n.a. - 164 (shallow)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
170
160
150
140
130
120
110
100
5,000
4,000
3,000
2,000
1,000
0
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Groundwater Elevation 3K2 (feet above msl)
Groundwater Elevation 3K3 (feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Releases (cfs)


2N/22W-3K2
Groundwater Elevations and Santa Clara River Flow 1998 - 2002
reference point =251, total depth = 164, perforations = n.a. - 164 (shallow)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
170
160
150
140
130
120
110
100
5,000
4,000
3,000
2,000
1,000
0
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Jan-03
Groundwater Elevation 3K2 (feet above msl)
Groundwater Elevation 3K3 (feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Releases (cfs)

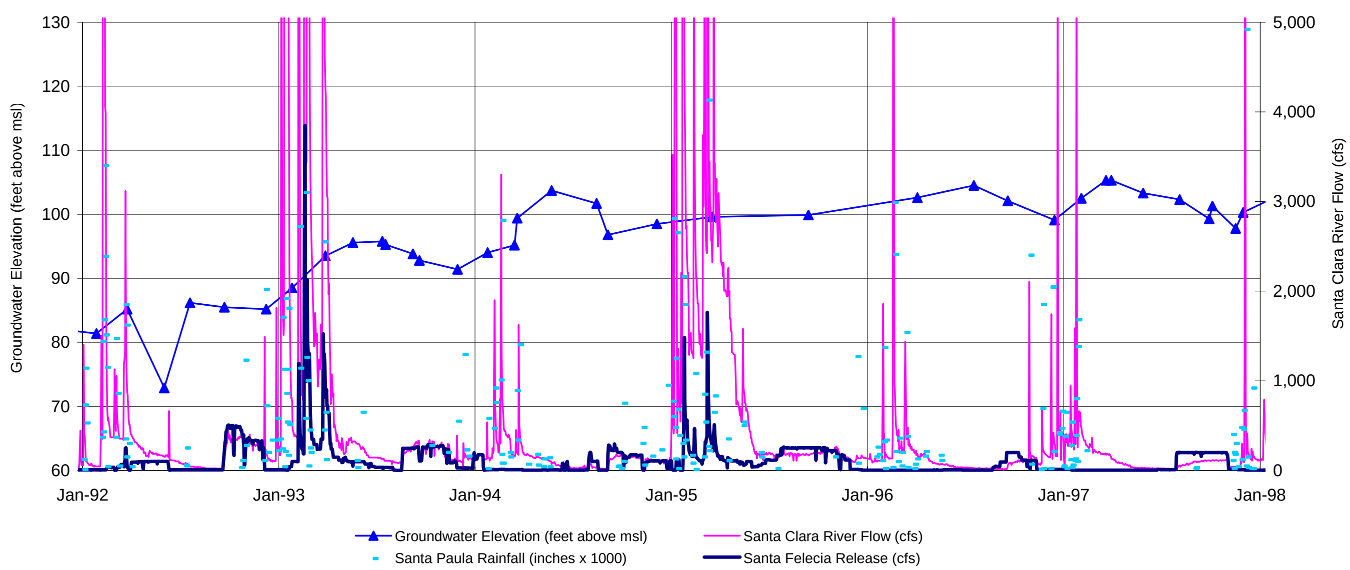

2N/22W-3M2 Groundwater Elevations and Cumulative Departures
reference point = 292, total depth = 544, perforations =468 - 528 (deep)
1983-1995 Base Period
Groundwater Elevation (feet above msl)
Cumulative Departure from the Average (percent)
130
120
110
100
90
80
70
60
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
Jan-77
Jan-79
Jan-81
Jan-83
Jan-85
Jan-87
Jan-89
Jan-91
Jan-93
Jan-95
Jan-97
Jan-99
Jan-01
Groundwater Elevation (feet above msl)
Santa Paula Creek Flow (cumulative departure from the average (percent), water years 1944-1998)
Santa Paula Rainfall (cumulative departure from the average (percent), water years 1944-1998)

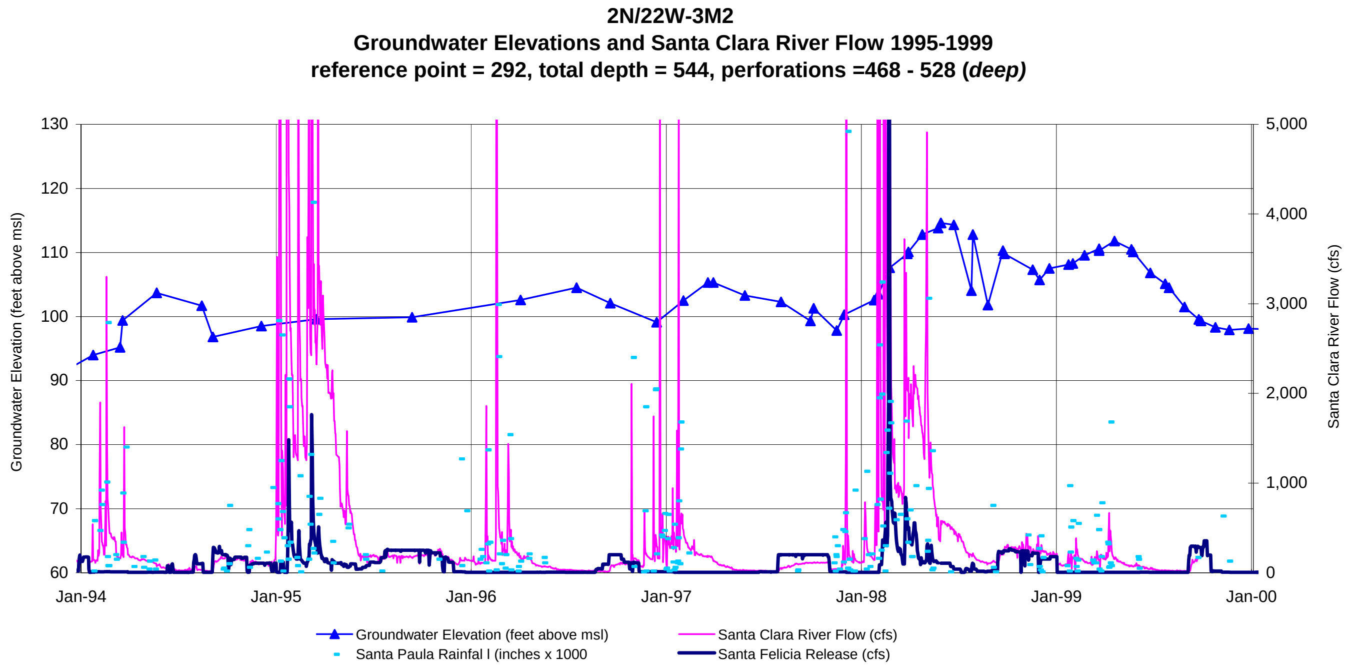

2N/22W-3M2
Groundwater Elevations and Santa Clara River Flow 1983-1987
reference point = 292, total depth = 544, perforations =468 - 528 (deep)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
130
120
110
100
90
80
70
60
5,000
4,000
3,000
2,000
1,000
0
Jan-82
Jan-83
Jan-84
Jan-85
Jan-86
Jan-87
Jan-88
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
Santa Paula Rainfall (inches x 1000)
Santa Felicia Release (cfs)

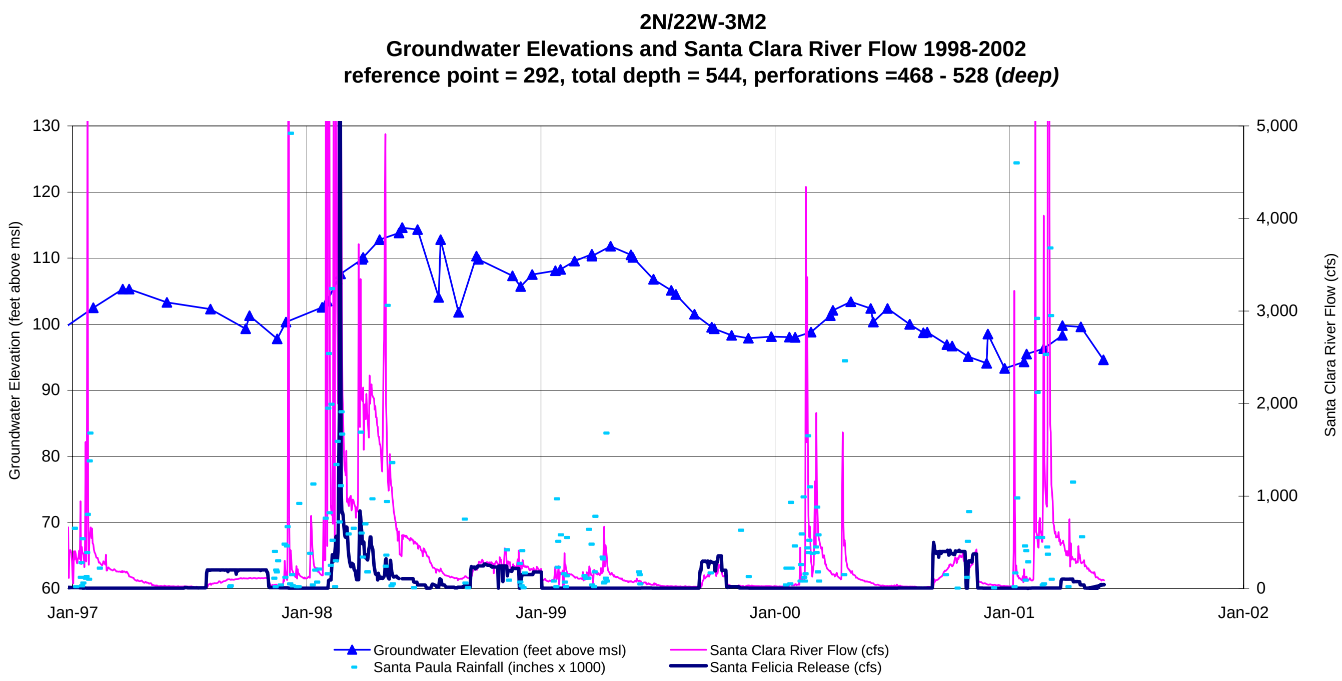
2N/22W-3M2
Groundwater Elevations and Santa Clara River Flow 1990-1994
reference point = 292, total depth = 544, perforations =468 - 528 (*deep)*



2N/22W-3M2
Groundwater Elevations and Santa Clara River Flow 1993-1997
reference point = 292, total depth = 544, perforations =468 - 528 (*deep)*




2N/22W-3M2
Groundwater Elevations and Santa Clara River Flow 1995-1999
reference point = 292, total depth = 544, perforations =468 - 528 (deep)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
130
120
110
100
90
80
70
60
5,000
4,000
3,000
2,000
1,000
0
Jan-94
Jan-95
Jan-96
Jan-97
Jan-98
Jan-99
Jan-00
Groundwater Elevation (feet above msl)
Santa Paula Rainfal l (inches x 1000
Santa Clara River Flow (cfs)
Santa Felicia Release (cfs)


2N/22W-3M2
Groundwater Elevations and Santa Clara River Flow 1998-2002
reference point = 292, total depth = 544, perforations =468 - 528 (deep)
Groundwater Elevation (feet above msl)
Santa Clara River Flow (cfs)
130
120
110
100
90
80
70
60
5,000
4,000
3,000
2,000
1,000
0
Jan-97
Jan-98
Jan-99
Jan-00
Jan-01
Jan-02
Groundwater Elevation (feet above msl)
Santa Paula Rainfall (inches x 1000)
Santa Clara River Flow (cfs)
Santa Felicia Release (cfs)