CARPINTERIA GROUNDWATER BASIN
AB3030 GROUNDWATER MANAGEMENT PLAN

ANNUAL REPORT

WATER YEARS 2015 AND 2016

Prepared for:

CARPINTERIA VALLEY WATER DISTRICT

July 2017

July 25, 2017
Project No. 15-0094

Carpinteria Valley Water District
1301 Santa Ynez Avenue
Carpinteria, California 93013

Attention: Bob McDonald
General Manager

Subject: Carpinteria Groundwater Basin AB3030 Groundwater Management Plan Annual Report; Water Years 2015 and 2016.

Dear Mr. McDonald:

We are pleased to present to you the subject Annual Report for the Carpinteria Groundwater Basin Groundwater Management Plan. The report presents an overview of hydrogeologic conditions associated with the basin for the 2015 and 2016 water year periods, our conclusions regarding the basin conditions; and our recommendations for the continuance and enhancement of the plan and the data collection program.

Thank you for giving Pueblo the opportunity to assist you with this important project.

Sincerely,
Pueblo Water Resources, Inc.

Michael S. Burke
Principal Hydrogeologist, C.Hg. 678

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INTRODUCTION

Assembly Bill 3030 allowed certain defined local agencies to develop groundwater management plans (GWMP) for groundwater basins defined by the California Department of Water Resources (DWR) Bulletin 118. The Carpinteria Valley Water District developed a GWMP for the Carpinteria Groundwater Basin (CGB) and adopted the plan in 1999. Carpinteria's GWMP includes annual reporting on the hydrogeologic conditions of the CGB. This report presents the findings, conclusions and recommendations developed through the GWMP for Water Years (WY) 2015 and 2016 (Water Year is defined as October 1 of any given year through September 30 of the following year).

Prior to the GWMP reporting for WY 2015 and WY 2016 presented herein, previous annual reports were prepared for calendar year periods. The most recent calendar year report was prepared by Fugro Consultants for 2014 and presented to the District as a letter report dated July 31, 2015 (revised October 9, 2015). The District desired to revise the reporting period for the GWMP to be on a water year basis to be consistent with standard hydrogeologic practice, and to synchronize the reporting period of the GWMP with the reporting period for hydrologic budget updates prepared annually for the CGB by Pueblo Water Resources, Inc. (Pueblo).

The GWMP for the CGB includes collection, compilation, and analysis of precipitation data, water-level data, groundwater production data, and water-quality data. The data are compiled in tabular form and are presented graphically. The purpose of the GWMP is to provide a mechanism for the District to continually monitor groundwater conditions within the CGB and identify trends in groundwater production, water levels, and/or water quality. The District considers the GWMP to be an important tool for the management of the CGB.

FINDINGS

MONITORING WELL NETWORK AND MONITORING PROGRAM

The CGB GWMP includes the collection of data from 42 wells located throughout the basin. The well network includes the District's groundwater production wells, private wells, and monitoring wells. Water level data are collected on a bi-monthly basis (every other month) from 25 of the wells. Water quality data are collected on a bi-annual basis (fall and spring of each water year) from 25 wells. Water quality data are also collected from 6 surface water sampling locations within the basin. The locations of the CGB GWMP wells are shown on **Figure 1**, and basic information associated with each of the wells is provided in **Table 1**.

The GWMP also includes the collection, compilation, and assessment of precipitation data and groundwater production data. Groundwater production from District owned and operated wells is metered. Private pumping in the basin is not metered and has been estimated on an annual basis by the District since 1984 utilizing land use survey and water delivery information. Precipitation data is collected by the Santa Barbara County Flood Control District at the Carpinteria Fire Station (SBCFCD Gauging Station No. 208).

Water quality data are derived through the sampling at selected wells throughout the basin. In addition to groundwater samples, surface water samples are collected, when surface water conditions allow. The laboratory analytical program for the samples includes: total dissolved solids; basic inorganic chemical constituents, including chloride; and nitrates.

Water level data compiled through the GWMP are used to prepare hydrographs for each of the wells. In addition, the water level data are used to prepare contours of groundwater surface elevations for the fall and spring period of each water year. The hydrographs and contours allow for representation of basin wide water level conditions and facilitate the identification of trends and patterns with respect to CGB water level conditions.

Chemical hydrographs for selected constituents (TDS, chlorides, and nitrates) are also prepared as part of the GWMP. Again, the graphical representation of water quality data allow for easy identification of important trends in basin water quality.

Groundwater production data and precipitation data are also presented graphically in the annual report. These data are presented comparatively along with the water level and water quality data to help better visualize and understand the relationships between the various hydrogeologic components of the CGB.

While the GWMP was adopted in 1999, the District has been collecting hydrogeologic data from the CGB for many years prior. An update of basin conditions was prepared by Pueblo[1] in 2012 for the period WY 1985 through WY 2005. For the purpose of establishing a continuation on that work, graphics for this report date back at least to WY 1985.

Following Pueblo's 2012 update of CGB hydrologic conditions, subsequent updates were performed in 2014 and 2015 covering the periods of WY 2009 through 2014. Hydrologic updates for WY 2015 - 2016 have been prepared by Pueblo and are discussed as part of this GWMP report. The coordination of the GWMP and the annual updates of CGB hydrologic conditions achieve the District's goal of synchronizing these two important programs for the purpose of timely and effective basin management.

[1] *Carpinteria Groundwater Basin, Hydrogeologic Update and Groundwater Model Project Final Report*, prepared by Pueblo Water Resources, Inc. for Carpinteria Valley Water District, dated June 30, 2012.

Table 1. Well Information Summary*

Well No.	Water Level Monitor	Water Quality Monitor	Year Drilled	Drilled Depth (ft)	Casing Depth (ft)	Log D – Driller E - Elog
4N/25W-19E1		yes	1992	600	400	DE
4N/25W-19F4	yes		1930	250		
4N/25W-19J4		yes		150		
4N/25W-19J5	yes		1939	100		
4N/25W-19K5	yes	yes	1921			
4N/25W-19M1		yes		204		
4N/25W-19M3	yes					
4N/25W-19R1		yes		146		
4N/25W-20K4	yes		1988	1987	903	DE
4N/25W-21F1		yes	1991	460	450	DE
4N/25W-21L1		yes	1991	810	732	DE
4N/25W-21N1	yes		1936	405		
4N/25W-21N7		yes				
4N/25W-21Q1		yes	1991	820	740	DE
4N/25W-22R4		yes	1946	504	192	D
4N/25W-25F1		yes	1989	800	450	DE
4N/25W-25L3	yes			190		D
4N/25W-26B1		yes	1944	552	240	
4N/25W-26C6	yes		1949	417	89	D
4N/25W-26C8		yes	1947	360	144	D
4N/25W-27E1		yes	1930	300		
4N/25W-27F2	yes	yes	1975	1150	825	DE
4N/25W-27Q6	yes			580	100	D
4N/25W-28D2	yes		1990	2706	1214/924	DE
4N/25W-28D3	yes	yes	2010	1220	1210	DE
4N/25W-28F7	yes	yes	1976	1271	1240/980	DE
4N/25W-28G3		yes	1994	310	300	D
4N/25W-28H1		yes	1992	520	500	DE
4N/25W-28J1		yes	1919	175	175	D
4N/25W-28M1	yes			152		
4N/25W-29D1	yes			147		D
4N/25W-29D7	yes		1972	982	950	DE
4N/25W-29D8	yes	yes	2002	978	958	DE
4N/25W-29H2	yes		1912	98		
4N/25W-29L1	yes	yes		110		
4N/25W-30D1	yes	yes		210		
4N/25W-34B4		yes	1990	408	400	D

Well No.	Water Level Monitor	Water Quality Monitor	Year Drilled	Drilled Depth (ft)	Casing Depth (ft)	Log D – Driller E - Elog
4N/25W-35B5		yes	1990	285	280	D
4N/25W-35E1	yes		1939	385	260	
4N/26W-23A2	yes		1921	330		
4N/26W-24F1		yes	1922	262	227	D

* Data sources includes information collected from State Well Drillers reports, field inspection and SB County Environmental Health Well Construction permits.

PRECIPITATION DATA

The Santa Barbara County Flood Control District maintains precipitation data from the Carpinteria Fire Station. A period of recorded data from 1949 to present exists for that gauge. Annual rainfall during the 32-year WY 1985 - 2016 period of record is presented on **Figure 2**. As shown, the mean annual rainfall for this 32-year base period is 18.3 inches. Rainfall in WY 2015 and 2016 was only 8.48 and 10.1 inches, respectively. These annual rainfall totals represent approximately 46 and 55 percent of the base-period average, respectively.

The cumulative departure of annual rainfall from the long-term mean is also plotted on **Figure 2**. The cumulative departure from mean graph is used to identify climatic trends over the period of record. As shown, the cumulative departure curve exhibits a series of cyclic dry and wet periods in the basin over the period of record. The last five years of extended drought (WY 2012 through 2016) have been particularly dry, with annual rainfall totals generally less than half of the long term average.

Monthly precipitation records for the past three water years are presented in **Table 2**.

Table 2. Precipitation Data, Gauge No. 208, Carpinteria Fire Station WY 2014 through WY 2015

Month	WY 2014	WY 2015	WY 2016
October	0.01	0.00	0.16
November	0.02	0.00	0.48
December	0.62	0.78	0.10
January	0.03	3.62	0.30
February	0.00	1.69	4.60
March	2.54	0.47	1.14
April	1.68	0.45	3.02
May	0.48	0.24	0.26
June	0.09	0.16	0.02
July	0.04	0.75	0.03
August	0.00	0.32	0.00
September	0.05	0.00	0.00
WY Total	5.83	8.48	10.11

The complete record of precipitation data from SBFCD for the Carpinteria Fire Station Gauge is included in **Appendix A**.

GROUNDWATER PRODUCTION

Groundwater extractions from the CGB occur from both District and private production wells. District well production is metered, and monthly totals of production from the District wells were compiled for WY 2015 and 2016. Private pumping in the basin is not metered and has been estimated on an annual basis by the District since 1984 utilizing land use survey and water delivery information. As shown in **Table 3**, aggregate pumpage is estimated at approximately 6,131 afy during both WY 2015 and 2016. This amount of pumpage is approximately 60 percent greater than the 32-year long-term average of approximately 3,896 afy estimated for the WY 1985 – WY 2016 period. Groundwater production from the CGB between WY 1985 and WY 2016, by the District, from private pumpers, and in total, is presented graphically on **Figure 3**.

Table 3. Summary of Groundwater Pumpage WY 1985 through WY 2016 (in acre-feet)

Water Year	CVWD Pumpage	Private Pumpage	Total Pumpage
1985	1836	949	2785
1986	2032	1041	3073
1987	2363	932	3295
1988	2342	1065	3407
1989	2984	1520	4504
1990	3413	1990	5403
1991	3014	2261	5275
1992	1560	2165	3725
1993	1261	2422	3683
1994	1307	2818	4125
1995	1291	2389	3680
1996	1557	2510	4067
1997	1317	2437	3754
1998	575	2428	3003
1999	340	2990	3330
2000	1410	3105	4515
2001	185	3259	3444
2002	558	3103	3661
2003	402	2723	3125
2004	999	2803	3802
2005	1152	2060	3212
2006	1120	2083	3203
2007	1418	2507	3925
2008	661	2806	3467
2009	1628	2284	3912
2010	1053	2566	3619
2011	1236	2502	3738
2012	1015	2451	3466
2013	643	3033	3676
2014	1014	3541	4555
2015	2605	3526	6131
2016	2751	3380	6131
Average	**1470**	**2426**	**3896**
High	**3413**	**3541**	**6131**
Low	**185**	**932**	**2785**

WATER-LEVEL DATA

Water level data and the hydrographs prepared using the data are essential elements of the GWMP. Hydrographs help to identify water-level trends, assess aquifer response to various hydrogeologic conditions, and assess changes in groundwater storage between various periods in time.

Water-level data in the basin have historically been collected and maintained by the USGS and the District. The USGS database contains water-level records for 75 wells in the CGB, dating back to as early as 1919 (State Well No. 4N/25W-28J1); however, most records begin in either the 1940s or 1970s. The USGS database does not extend beyond 2001. After 2001 the District continued measuring water levels at various wells as part of the GWMP.

Currently, water level data are collected by District staff on a bi-monthly basis from approximately 25 wells located throughout the CGB. As part of the routine collection of water level data, District staff record observations made in the field regarding well activity to assist in determining whether the measurement made at a particular well represents a static or a recovering water level. Pumping water levels are not collected. Hydrographs are created with measurements that represent as close as possible static water level conditions, although it is likely that some of the measurements used are still experiencing some degree of recovery. It is also important to note that many of the wells throughout the basin are screened across multiple aquifer zones. Water bearing deposits within the CGB include interbedded layers of sand, gravel, silt and clay. The coarser grained units comprise the major aquifer zones within the basin, designated Aquifers A (youngest and shallowest), B, C, and D (oldest and deepest). These primary aquifer zones are distinct and generally on the order of 50 to 100 feet thick each, are separated by a series of fine-grained aquitards, and within the central portion of the basin occur under confined conditions. Water level data collected from wells screened across multiple aquifer zones represent composites of the water level conditions of the completed aquifers.

Pueblo has reviewed the water level data collected by the District staff for the WY 2015 and WY 2016 period, and has prepared hydrographs for 20 key wells. These hydrographs are presented on **Figures 4 and 5**. The records for many of the 20 wells were complete dating back to about 1982 so this date was used as the starting point for the hydrographs. Also presented on the hydrographs along with the water level data are graphical representations of precipitation and groundwater production over the period of record to allow for consideration of these two important hydrogeologic elements when evaluating the water level records.

The hydrographs generally display seasonal and small amplitude annual fluctuations superimposed upon some more enduring, prominent trends. When viewed as a whole, the set of hydrographs presented on **Figures 4 and 5** reveal some notable trends that occurred or are occurring within the CGB. Water levels were relatively high in the early- to mid-1980s, then declined relatively sharply in response to an extended 4-year drought that occurred between 1987 and 1990. Evidence of this drought is apparent in the precipitation data and the cumulative departure curve shown on **Figure 2**. Maximum water level declines in many of the wells occurred during the fall of 1991, after which, water levels trended upward in response to increased precipitation and subsequent recharge, and to some extent, a moderate decrease in basin pumpage. The peak of this trend of water level recovery occurred in the late 1990's – early 2000's. After that, the hydrographs show a general trend of steady though moderately declining water levels.

The results of the last five years of extended drought (WY 2012 through 2016) are apparent in the hydrographs and sharp declines in water levels have occurred during this period. Review of the hydrographs indicate that at some wells within the basin, the recent levels remain above the low levels attained in 1991, while at other wells, the magnitude of recent decline is equal to or has exceeded that of 1991. Over the past two years (WY2015 and WY2016) water levels throughout the basin, with a couple of exceptions, have been below sea level. In the center of the basin, water levels are generally between 30 feet and 40 feet below sea level.

Water level contours have been prepared for the spring and fall periods of WY 2015 and WY 2016. A contour map has also been prepared for the WY 2014 fall period to create a bridge from the reporting from calendar years to water years. The purpose of the water-level contours is to help to identify general patterns in the flow regime within the basin. The contours also are useful in identifying recharge and discharge patterns, and to help understand water level conditions along the margins of the basin, particularly at the coast. The water level contours are presented on **Figures 6 and 7**.

The water-level contours show that groundwater generally flows in a northeast to southwesterly direction in the eastern half of the basin, and north to south in the western half of the basin. The directions of groundwater flow generally reflect the movement of groundwater from the primary sources of recharge to the primary sources of extraction (groundwater pumping) in the confined area in the center of the basin.

Also apparent on the contour maps is the development of a water-level depression centered in the central portion the basin that has occurred as a result of the last five years of extended drought (WY 2012 through 2016) when limited recharge was available and groundwater extractions were higher than normal. The contour map for the WY 2016 fall period shows the groundwater surface of more than 40 feet below sea level. In the western portion of the basin, even though there are limited data west of well 30D1 and near the coast, the contour maps show water levels along the coast below sea level, although it is difficult to know the actual extent of this condition. Nevertheless, this water level condition may result in a reversal of the natural seaward groundwater gradient, creating the potential for seawater intrusion in this portion of the basin (i.e., in the general area from Sand Point to Serena). It is noted that although seawater intrusion has not historically been detected in existing wells in the basin, there are no existing monitoring wells along the coast that penetrate into the deep Aquifers A – C that can serve as reliable seawater intrusion "sentinel" wells.

HYDROLOGIC BUDGET

In 2012 Pueblo completed an update of hydrogeologic conditions of the CGB for the period WY1985 through WY2008 as part of a DWR Local Groundwater Assistance Fund grant. The project also included development of a calibrated groundwater model of the basin. Integral to the hydrogeologic update and model development project was an update of the hydrologic budget of the basin over the study period. The hydrologic budget update includes calculation of each of the various components of inflow and outflow in the basin for each water year, and the resulting cumulative changes in basin storage over the period.

Since completion of the 2012 project, Pueblo has provided the District hydrologic updates on an annual basis to allow the District to stay informed of basin conditions, in particular, the state of groundwater recharge and storage within the basin. The most recent hydrologic budget update for the CGB was recently completed by Pueblo for WY 2015 and WY 2016, the results of which were transmitted to the District in a technical memorandum dated March 31, 2017 (presented in Appendix B).

As described in the TM, the change in the amount of groundwater in storage depends on the annual water supply surplus or deficiency, as expressed in the water balance equation. The total inflow during WY 2015 and WY 2016 was estimated at 1,588 and 1,656 afy respectively, and the total amount of outflow was estimated at 6,231 afy in both WY 2015 and WY 2016. The result is a net annual storage depletion amount of approximately 4,643 and 4,575 afy, respectively, for WY 2015 and WY 2016. The storage depletion is a combined result of a limited amount of rainfall and subsequent recharge coupled with increased extractions over the two year period. The current storage conditions are similar to the conditions that existed at the end of the WY 1987 through WY 1990 drought. The hydrographs show that water levels within the basin recovered during the period following that drought, and the hydrologic budget shows an accompanying accumulation in basin storage.

WATER QUALITY DATA

Groundwater quality within the CGB is monitored through the analysis of samples collected from 25 wells located throughout the basin. Water samples are also collected from six surface water stations when surface water is present. The laboratory analytical program for the samples includes: total dissolved solids; basic inorganic chemical constituents, including chloride; and nitrates. Chemical hydrographs have been prepared for the 25 wells monitored and are presented on **Figures 8 and 9**.

In general, the chemistry of groundwater within the CGB is characterized as calcium-bicarbonate, with concentrations of total dissolved solids within the range of 600 milligrams per liter (mg/L) to 900 mg/L, and chlorides in the range of 40 mg/L to 80 mg/L. Nitrate concentrations are variable throughout the basin, generally lower in wells that are completed in relatively deep aquifer units, and higher in wells in agricultural areas of shallow completions.

There are some notable issues and trends with respect to the water quality within the CGB. In the eastern portion of the basin, TDS concentrations appear to be relatively stable, nitrate concentrations are on an increasing trend in several of the wells (28F7 – Lyons, 28H1, and 27E1), and chloride concentrations appear to be relatively stable with a couple of exceptions where slight increases have appeared to occur (27E1, 22R4, and 34B4). The increases in nitrate concentrations in the noted wells appear to be localized and not uncommon for wells located in predominantly agricultural areas.

In the western portion of the basin, well 19M1 showed a notable increase in both TDS and nitrate concentrations between the early 1990's and the year 2000. The TDS concentration at this well reached a peak of 2500 mg/L in 2006, but has steadily decreased to a current concentration of about 1500 mg/L. Similarly, the chloride concentration in this well peaked in excess of 400 mg/L in 2005, but declined since then to a recently reported concentration of 300 mg/L. Over this same period, the nitrate concentration in this well declined from a peak of approximately 430 mg/L to a recent concentration of about 160 mg/L. The condition of high nitrates at this well is believed to be a localized condition, and the owner of this well has cooperated with the District to investigate the source of the nitrates, but so far the investigation has been inconclusive.

Two wells in the western portion of the basin, 19E1 and 19K5, have exhibited increasing TDS and chloride concentrations in recent past. While there are insufficient data to definitively establish the existence of the increasing trends at 19E1, the TDS concentration appears to have increased from about 1200 mg/L to 1400 mg/L, with a corresponding increase in chlorides from 320 mg/L to possible concentrations of 500 mg/L. Over this same period, the nitrate concentration in the well increased steadily from about 10 mg/L to 50 mg/L.

For Well 19K5, again, the amount of data are insufficient to clearly confirm a firm trend, but TDS concentrations in this well appear to have increased possibly from 1250 mg/L to 1500 mg/L. The trend in chlorides at this well is more clearly established, having increased from about 140 mg/L to 240 mg/L between 2005 and the present.

Another notable water quality issue is associated with well 30D1, where chloride concentrations increased from approximately 25 mg/L to about 70 mg/L between 2009 and 2012. This well is considered to be unsuitable for monitoring and unreliable with respect to water quality conditions within the CGB because the well head has been severely compromised, for the most part open to the atmosphere, and water within the salt marsh has been observed to be high enough to inundate this monitoring well on some occasions.

Surface water quality data are plotted and presented on **Figure 10**. A trend of slightly increasing TDS concentrations for the surface water quality is apparent over the period of record. Nitrate and chloride concentrations at surface water sampling stations appear to be relatively stable since monitoring began.

Laboratory reports for samples analyzed during the current reporting period (WY 2015 and WY 2016) are included in **Appendix C**, along with complete summaries of compiled water quality data collected since the inception of the GWMP.

CONCLUSIONS AND RECOMMENDATIONS

This annual report presents the findings of Carpinteria Valley Water District's AB 3030 Groundwater Management Plan for the WY 2015 and WY 2016 reporting periods. The conclusions and recommendations developed through assessment of the data collected through the GWMP are as follows:

CONCLUSIONS

- Total rainfall during WY 2015 and 2016 was approximately 8.48 and 10.1 inches, respectively, which are approximately 50 percent less than the long-term average of 18.3 inches.

- The limited amounts of rainfall and stream runoff during the period resulted in no percolation recharge to the CGB. Total recharge during WY 2015 and 2016 is estimated to be approximately 1,588 and 1,656 afy, respectively, which are approximately 60 percent less than the long-term average of approximately 3,790 afy.

- Aggregate Pumpage from the CGB is estimated to have been 6,131 afy for WY 2015 and 6,131 afy for WY 2016. This amount of annual pumpage of 6,131 afy is approximately 57 percent greater than the 32-year long-term average of approximately 3,896 afy estimated for the WY 1985 – WY 2016 period. The average of 3,896 afy is within the recommended long-term operational yield of the basin.

- Water levels in the basin have declined over the past two years in response to the recent extended drought and higher than normal groundwater extractions. At some wells, the magnitude of water level decline is about the same as or greater than the decline that occurred in 1991.

- Contour maps show that throughout WY 2015 and WY 2016, water levels within the central portion of the basin have been consistently below sea level, most recently on the order of 30 to 40 feet toward the center of the depression.

- Although there are no suitable monitoring wells for monitoring water levels within distinct aquifer units at locations adjacent to the coast, there is a possibility that water levels along the coast may have been consistently below sea level during the past two years, a condition that if continued could ultimately result in sea water intrusion within the basin.

- Water quality has generally remained stable throughout the basin, although some wells, particularly in the western portion of the basin, have experienced slight increases in TDS and chlorides. While the cause of TDS and chloride increases has not been determined, this trend is not believed to be related to seawater intrusion.

- Although conditions potentially exist that could lead to seawater intrusion, seawater intrusion into the basin has not occurred to date.

RECOMMENDATIONS

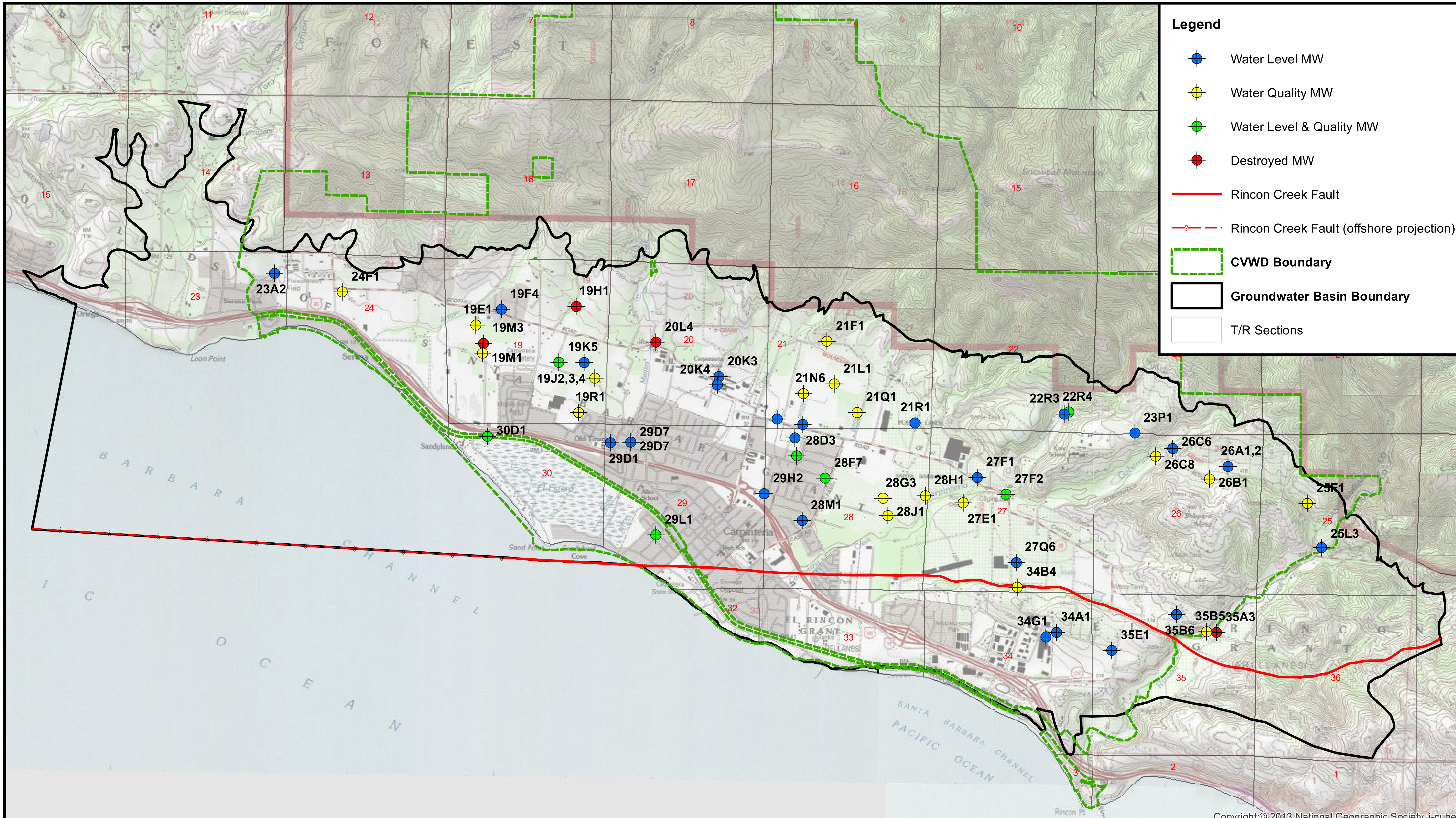
- Continue data collection and analysis as prescribed by the GWMP.
- Closely monitor water quality conditions at wells 19E1 and 19K5 and consider investigating the cause of the increasing TDS and chlorides at these wells if these trends continue.
- Proceed with the installation of a sea water intrusion “sentinel well” along the coast, as planned by the District, as soon as possible. The sentinel well should include a clustered array of separate wells completed in distinct aquifer zones.
- Include the sentinel wells in the GWMP for the prescribed collection of water level and water quality data once the wells are installed.
- Compliment the sentry well project with a geophysical investigation to further evaluate whether or not seawater intrusion can be detected along the coast. An electrical resistivity tomography (ERT) survey along the beach in the western portion of the CGB where basin aquifers may outcrop offshore could provide useful in determining groundwater quality conditions at this important location.
- Destroy well 30D1, as this well does not provide data that is representative of CGB conditions.
- As a longer term goal, additional monitoring wells, completed in discrete aquifer zones at key locations within the basin, should be installed. These wells would provide valuable information regarding water level and water quality conditions throughout the basin.
- Submit an Application and Notice of Intent for coverage under SWRCB General Waste Discharge Requirements for Aquifer Storage and Recovery Projects and consider conducting and ASR Pilot Project with the intent of implementing a long-term ASR project.

CLOSURE

This annual report has been prepared for the exclusive use of the Carpinteria Valley Water District, for specific application to the AB 3030 Groundwater Management Plan for the Carpinteria Groundwater Basin, in Santa Barbara County, California. The findings, conclusions, and recommendations presented herein were prepared in accordance with generally accepted hydrogeologic practices. No other warranty, expressed or implied, is made.

FIGURES

July 2017
Project No. 15-0094



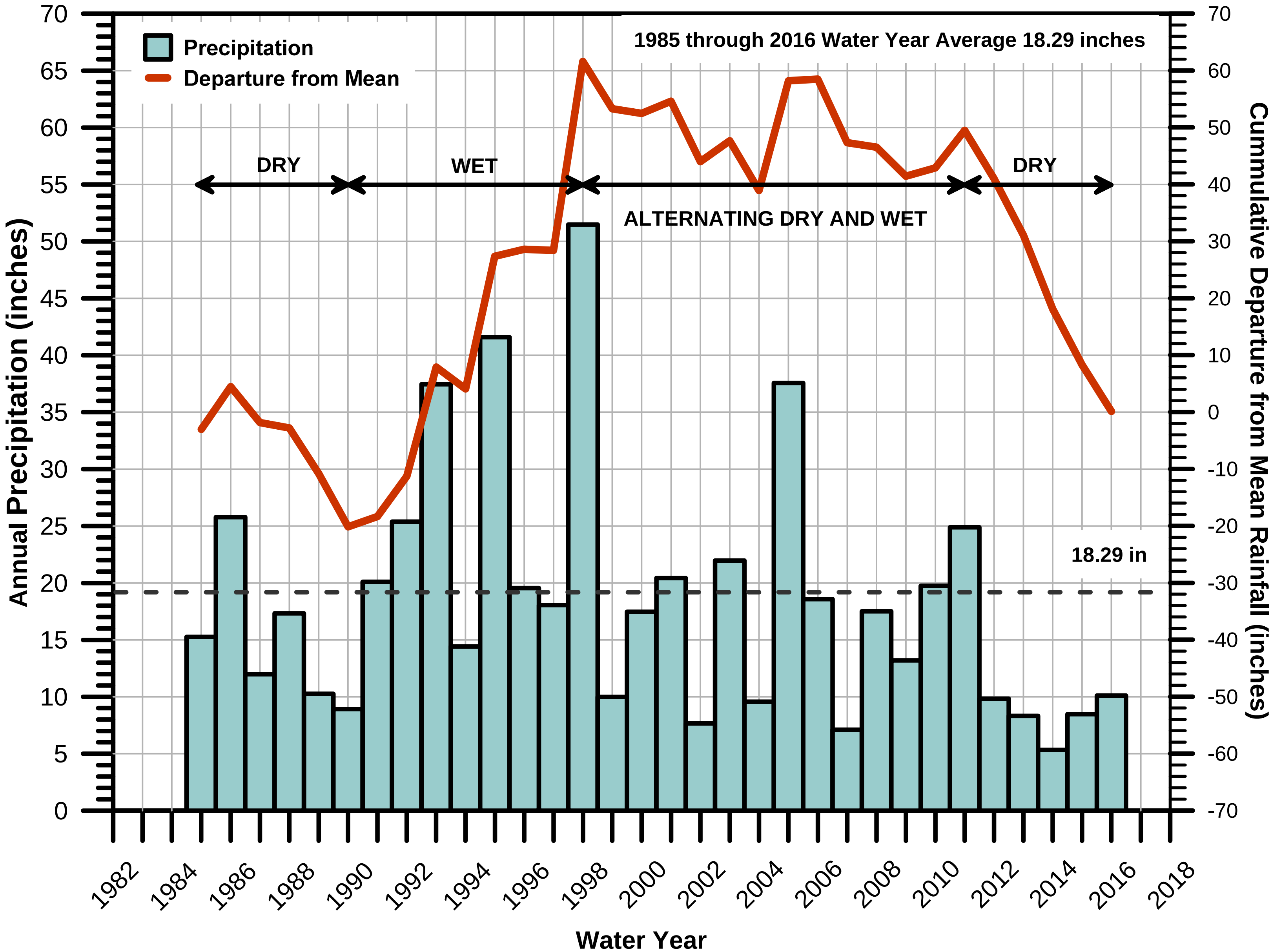
PUEBLO water resources

N W E S

1 inch = 3,000 feet

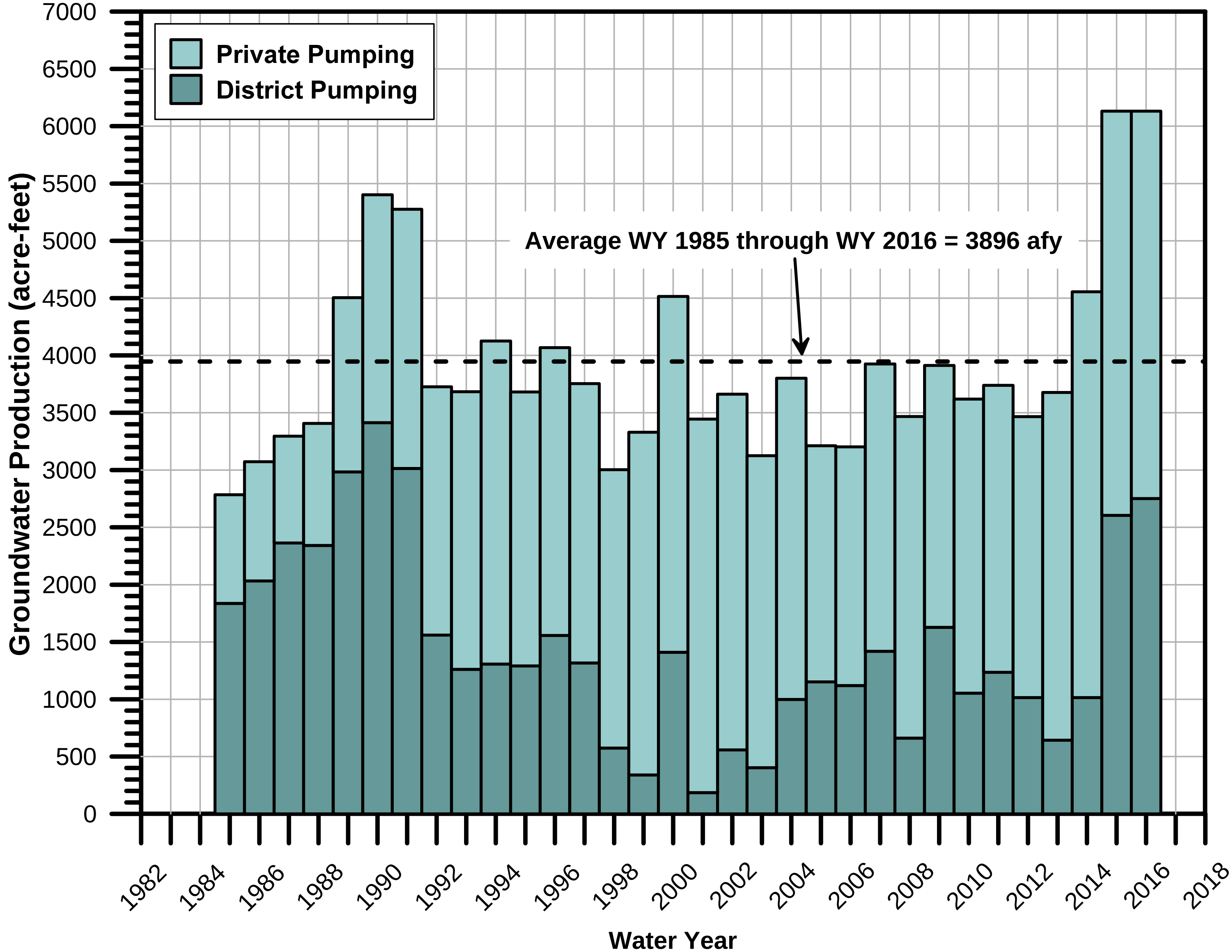
0 3,000 6,000 Feet

FIGURE 1. WELL LOCATION MAP
AB3030 Groundwater Management Program
Carpinteria Valley Water District



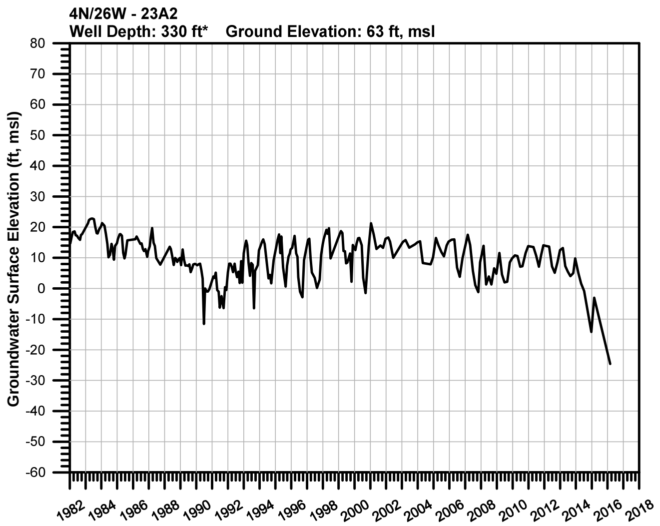
PUEBLO water resources

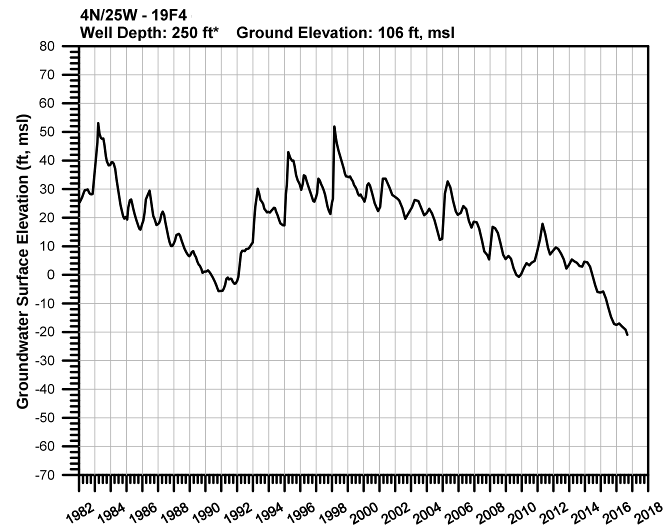
Figure 2. Carpinteria Groundwater Basin Precipitation
AB 3030 Groundwater Management Program
Carpinteria Valley Water District

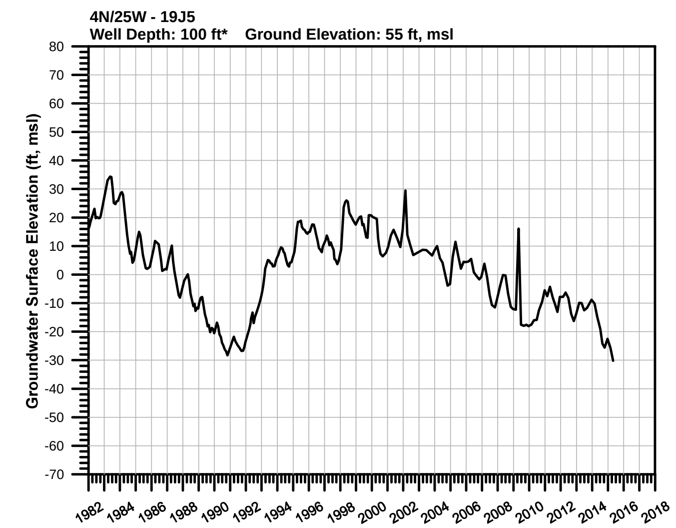


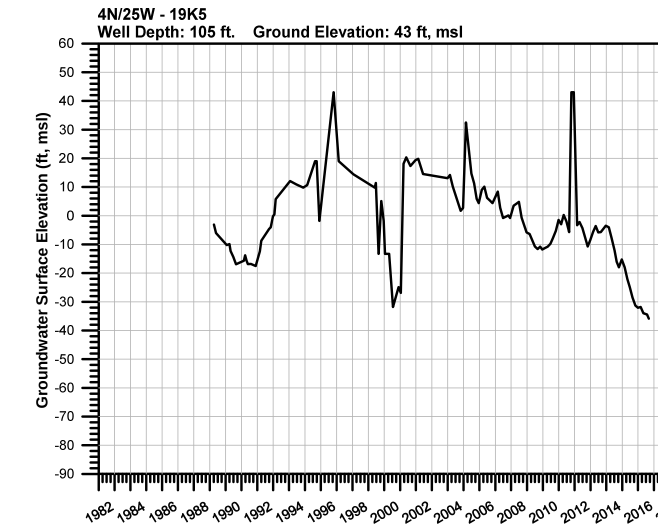
PUEBLO water resources

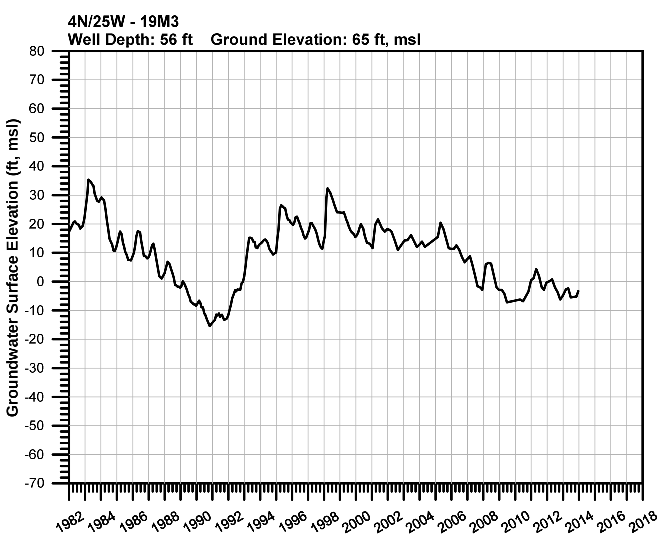
Figure 3. Carpinteria Groundwater Basin Pumpage
AB 3030 Groundwater Management Program
Carpinteria Valley Water District

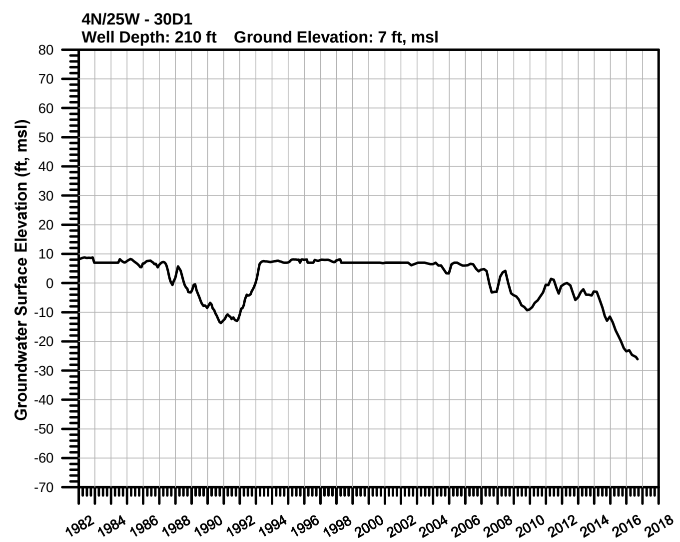


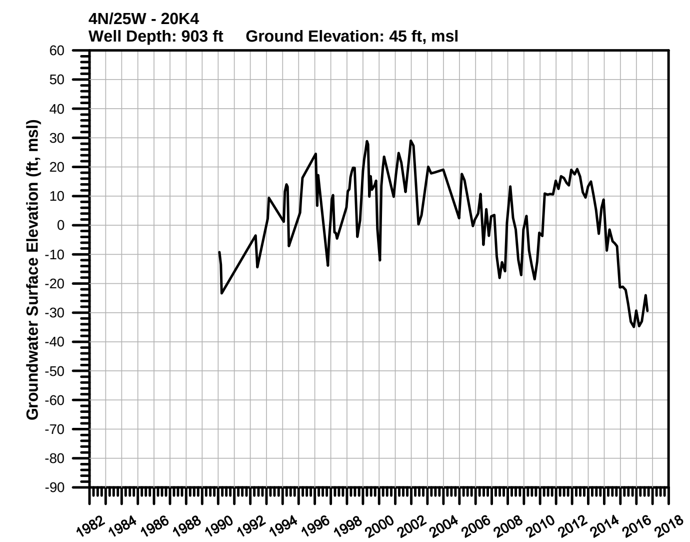


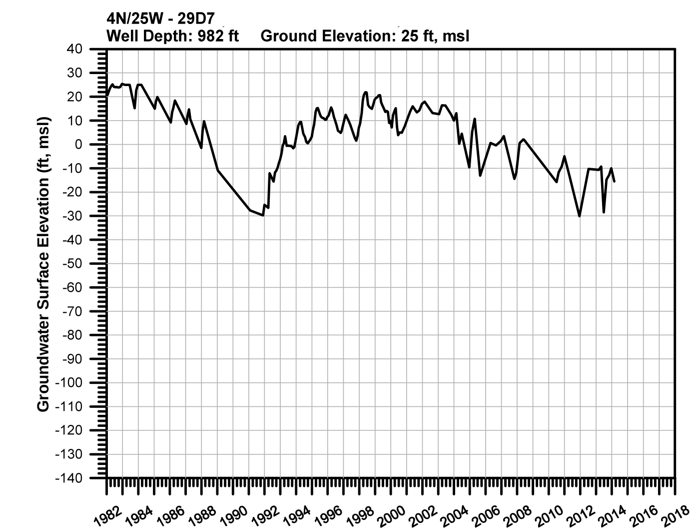


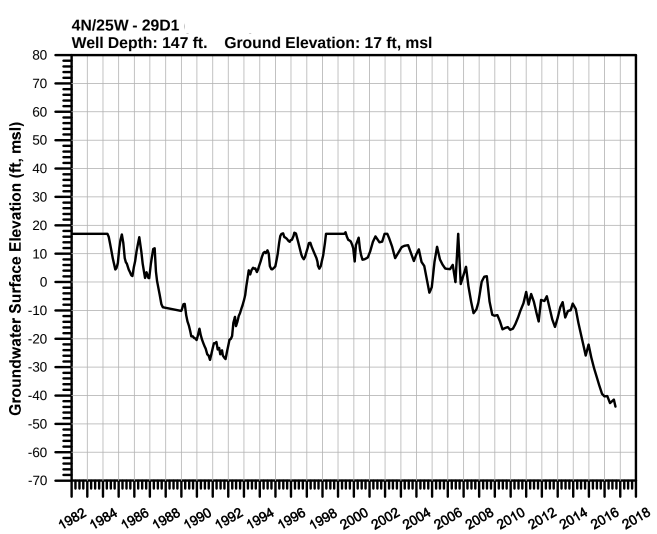


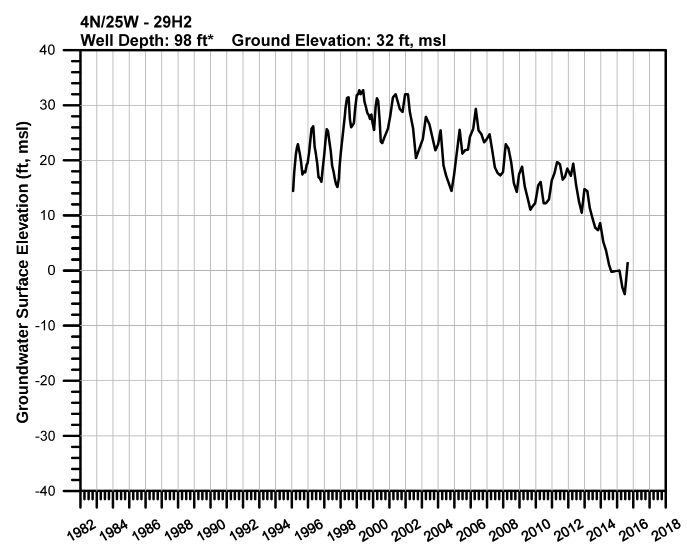


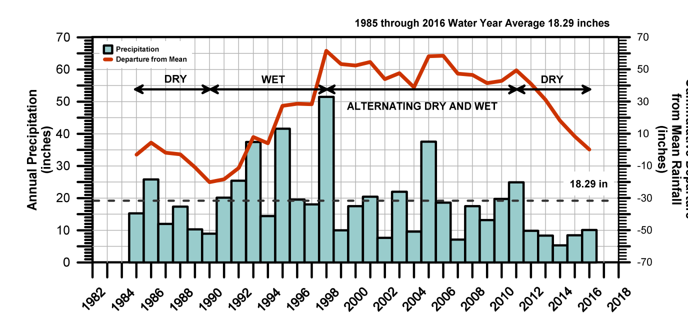


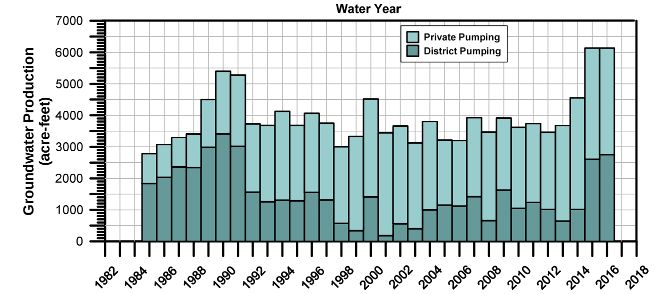












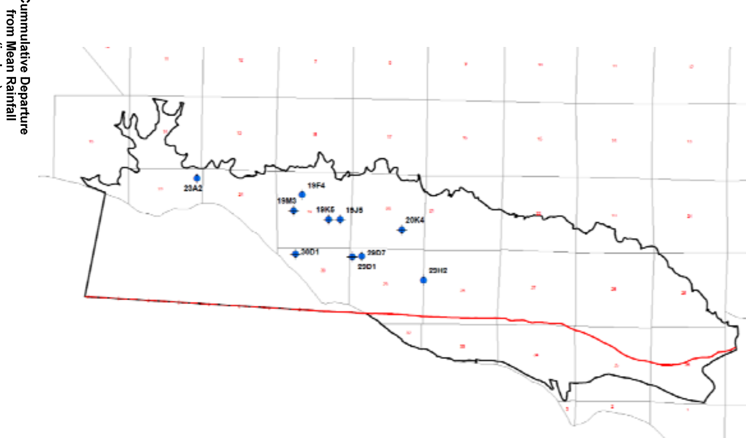
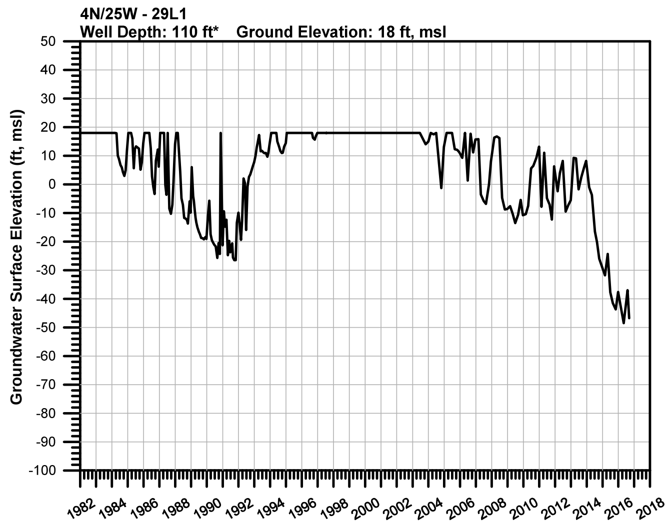
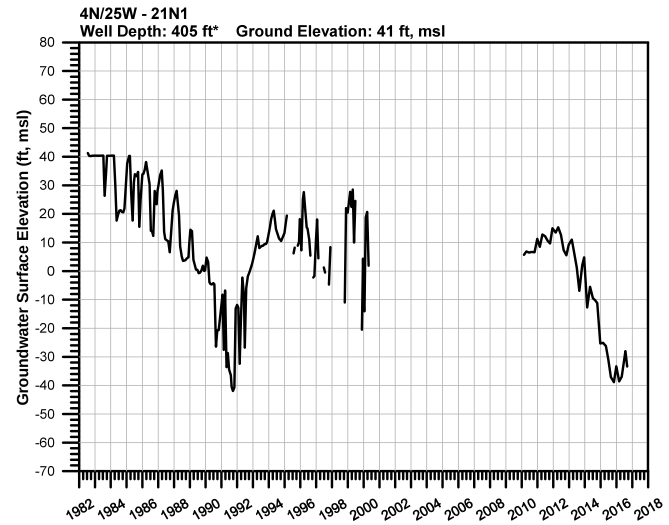
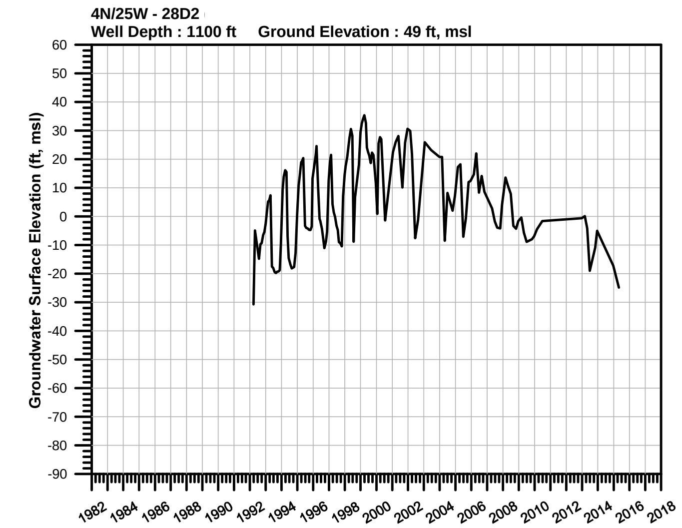
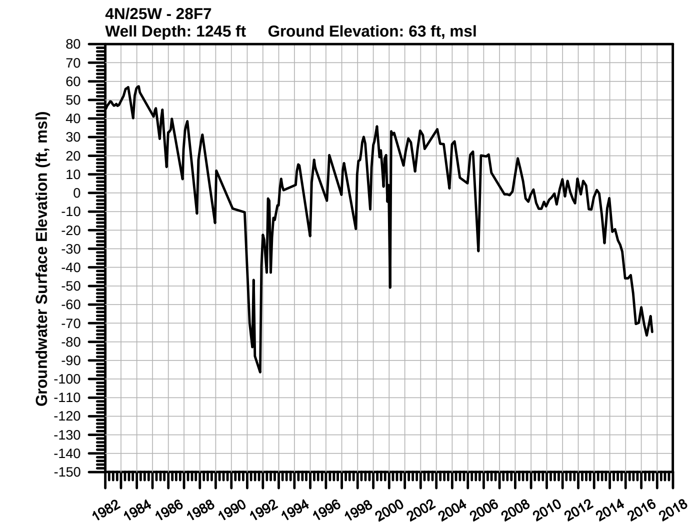


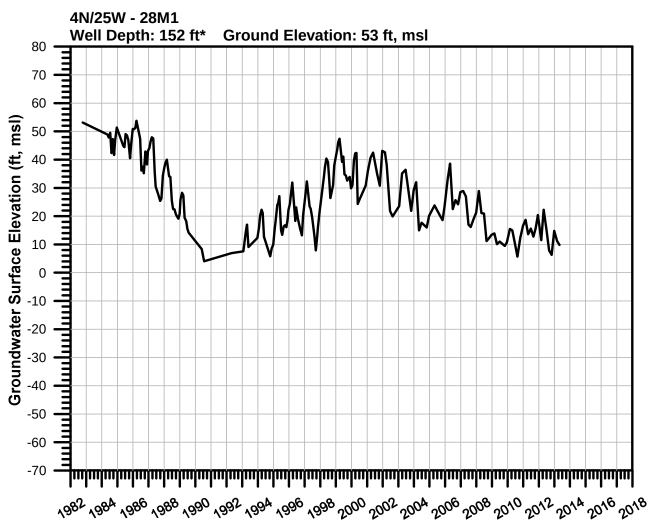
Figure 4. Water Level Hydrographs - West
AB 3030 Groundwater Management Program
Carpinteria Valley Water District

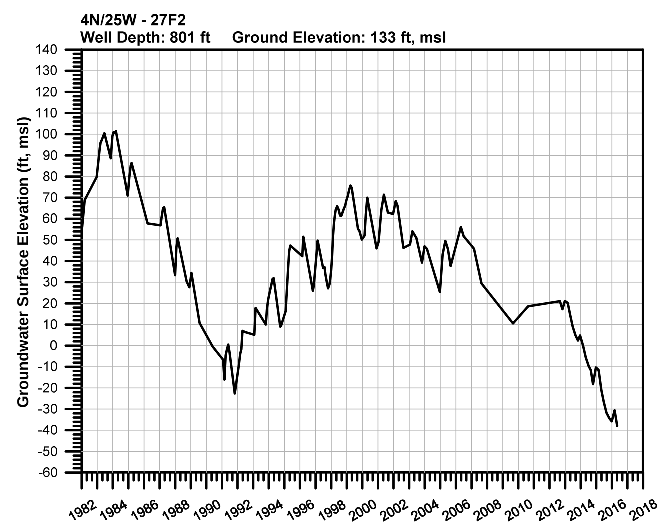


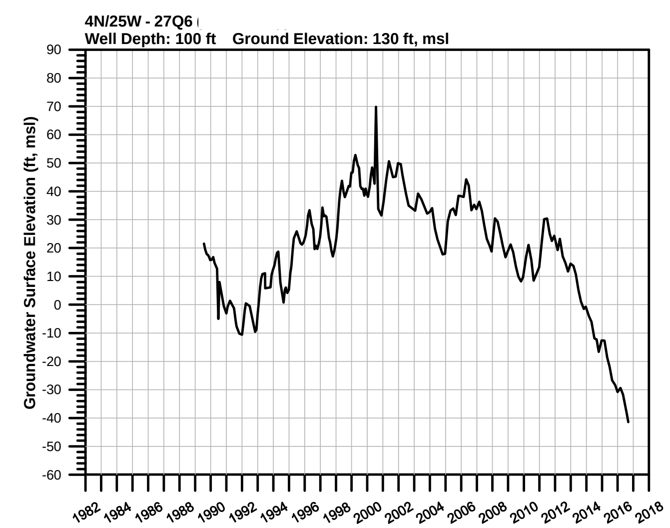


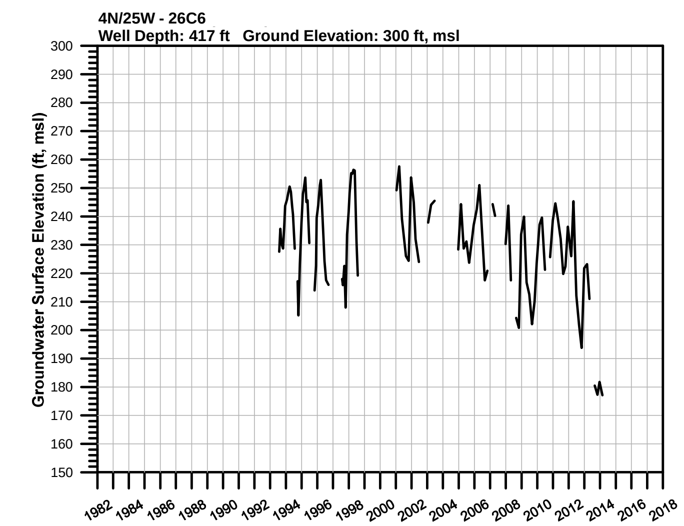


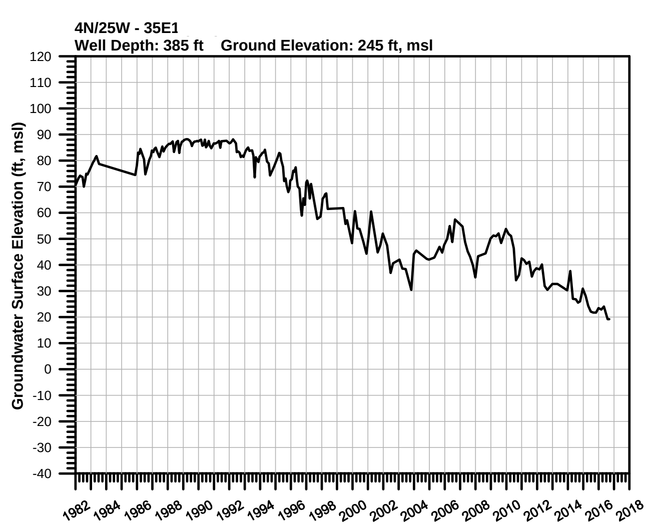


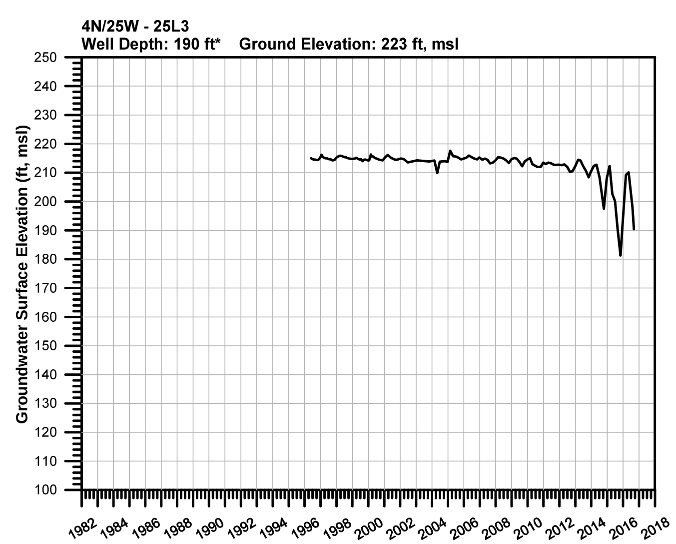


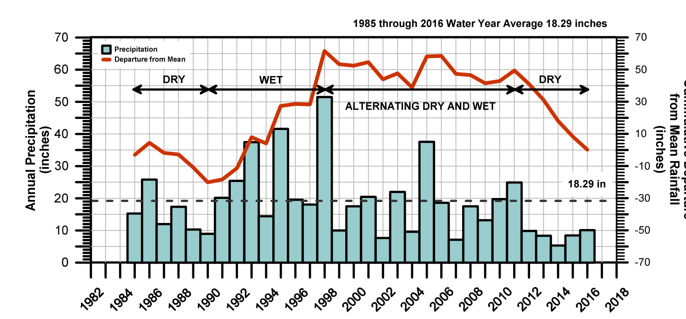


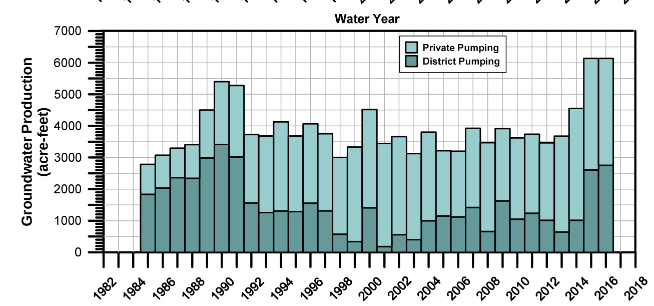












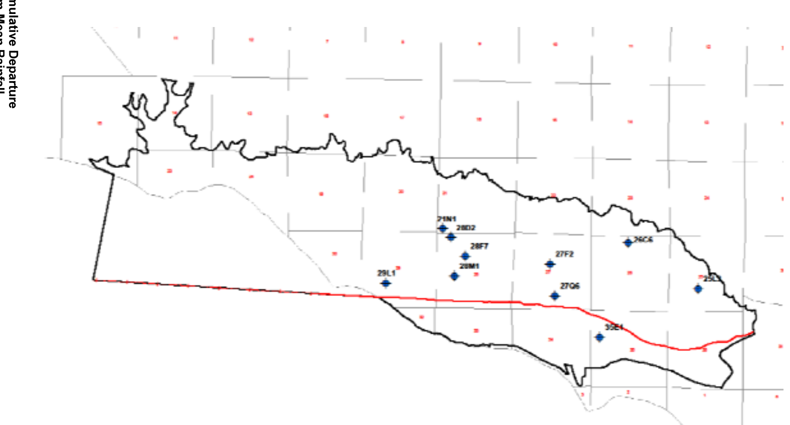
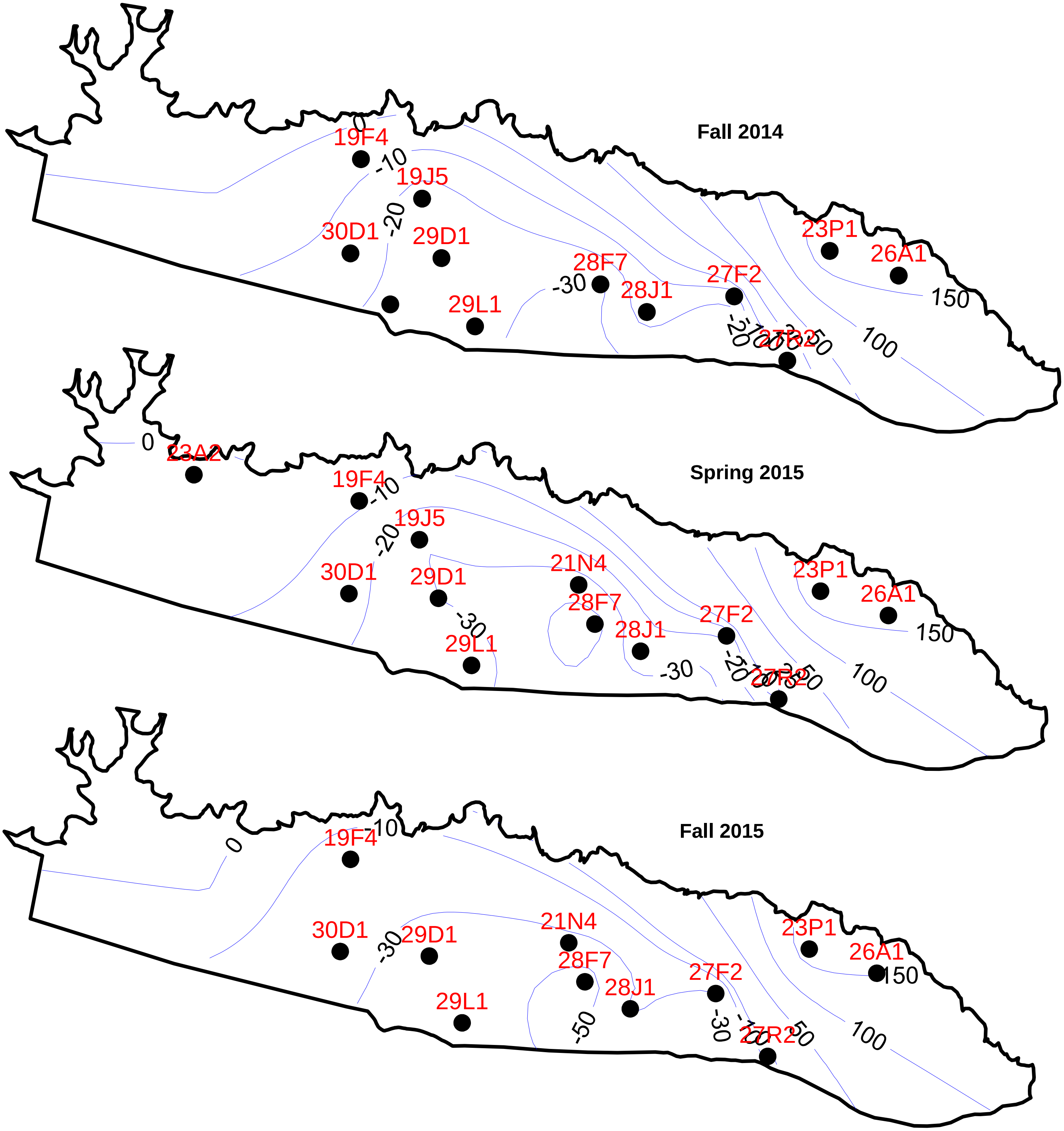
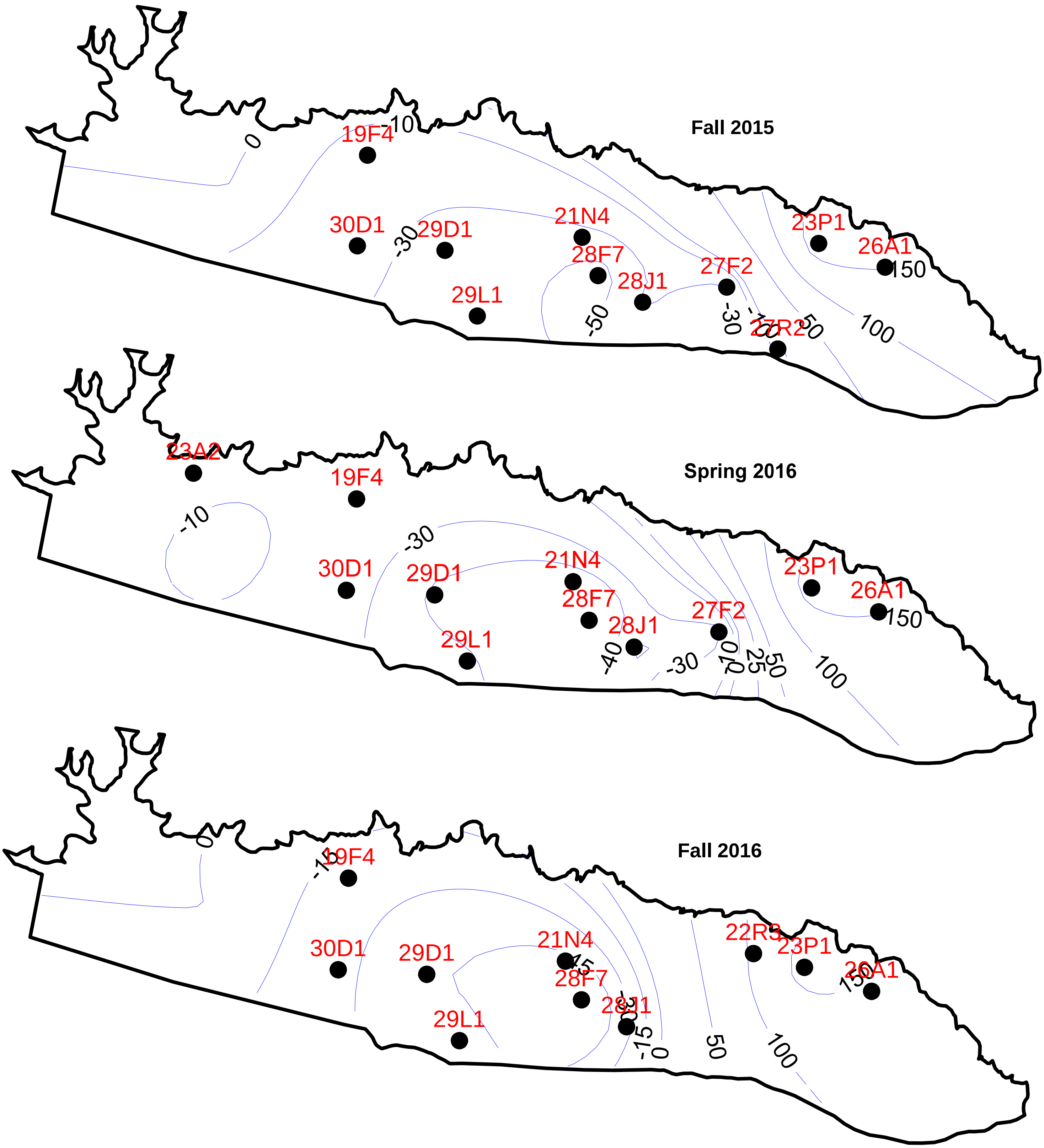


Figure 5. Water Level Hydrographs - East
AB 3030 Groundwater Management Program
Carpinteria Valley Water District



PUEBLO
water resources

Figure 6. Groundwater Contours, Fall 2014 - Fall 2015
AB 3030 Groundwater Management Program
Carpinteria Valley Water District



PUEBLO water resources

Figure 7. Groundwater Contours, Fall 2015 - Fall 2016
AB 3030 Groundwater Management Program
Carpinteria Valley Water District

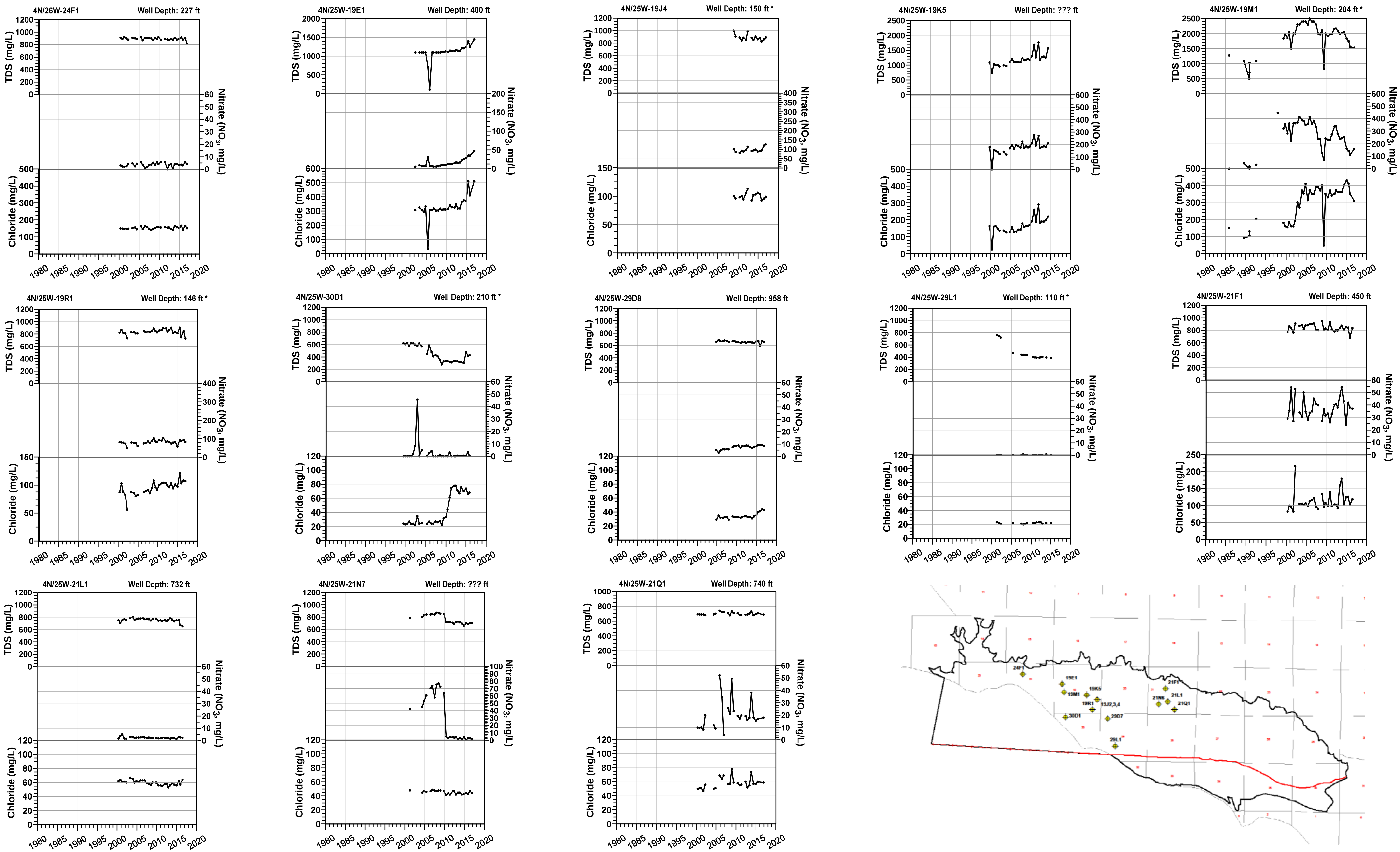
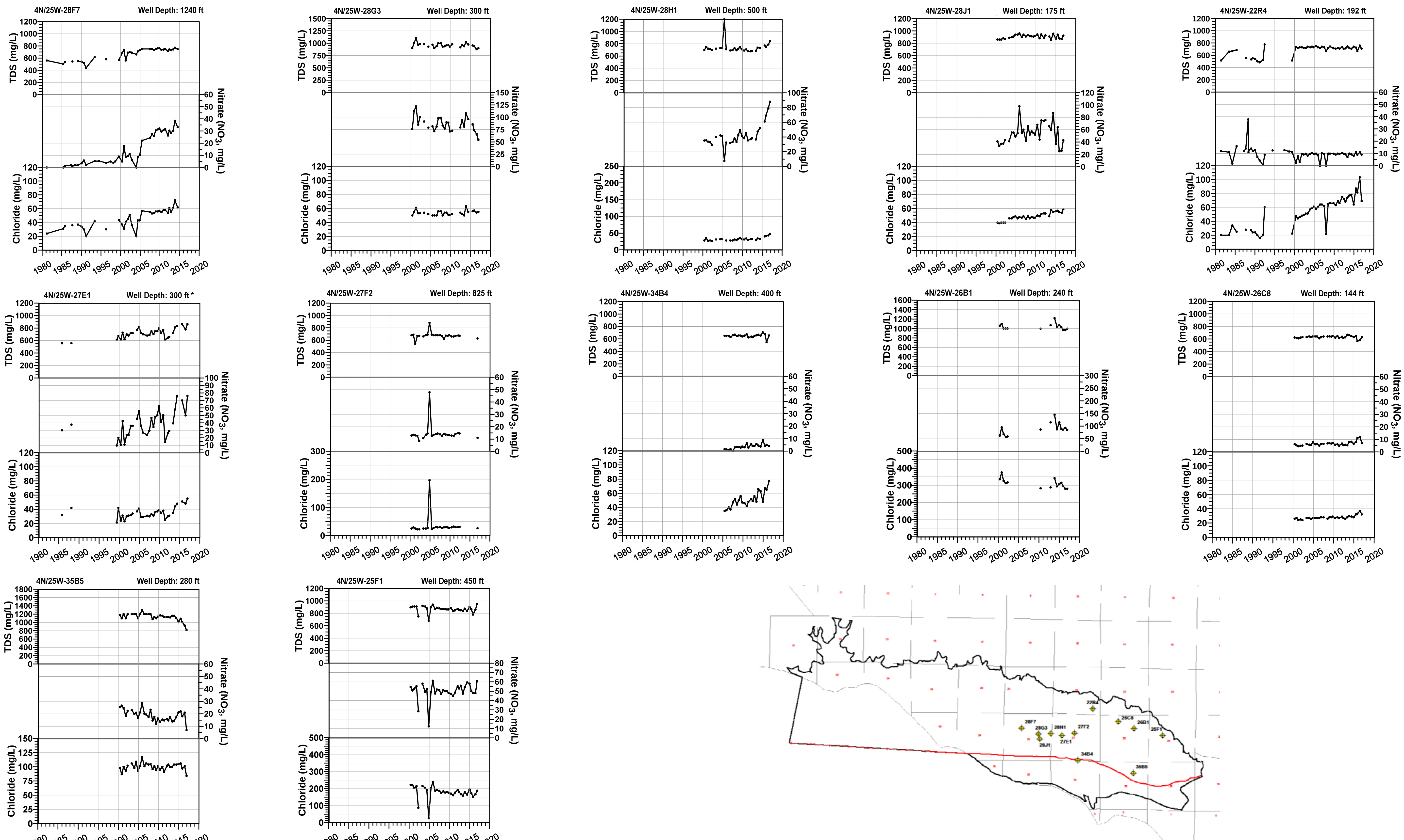


Figure 8. Water Quality Hydrographs - West
AB 3030 Groundwater Management Program
Carpinteria Valley Water District



PUEBLO water resources

Figure 9. Water Quality Hydrographs - East
AB 3030 Groundwater Management Program
Carpinteria Valley Water District

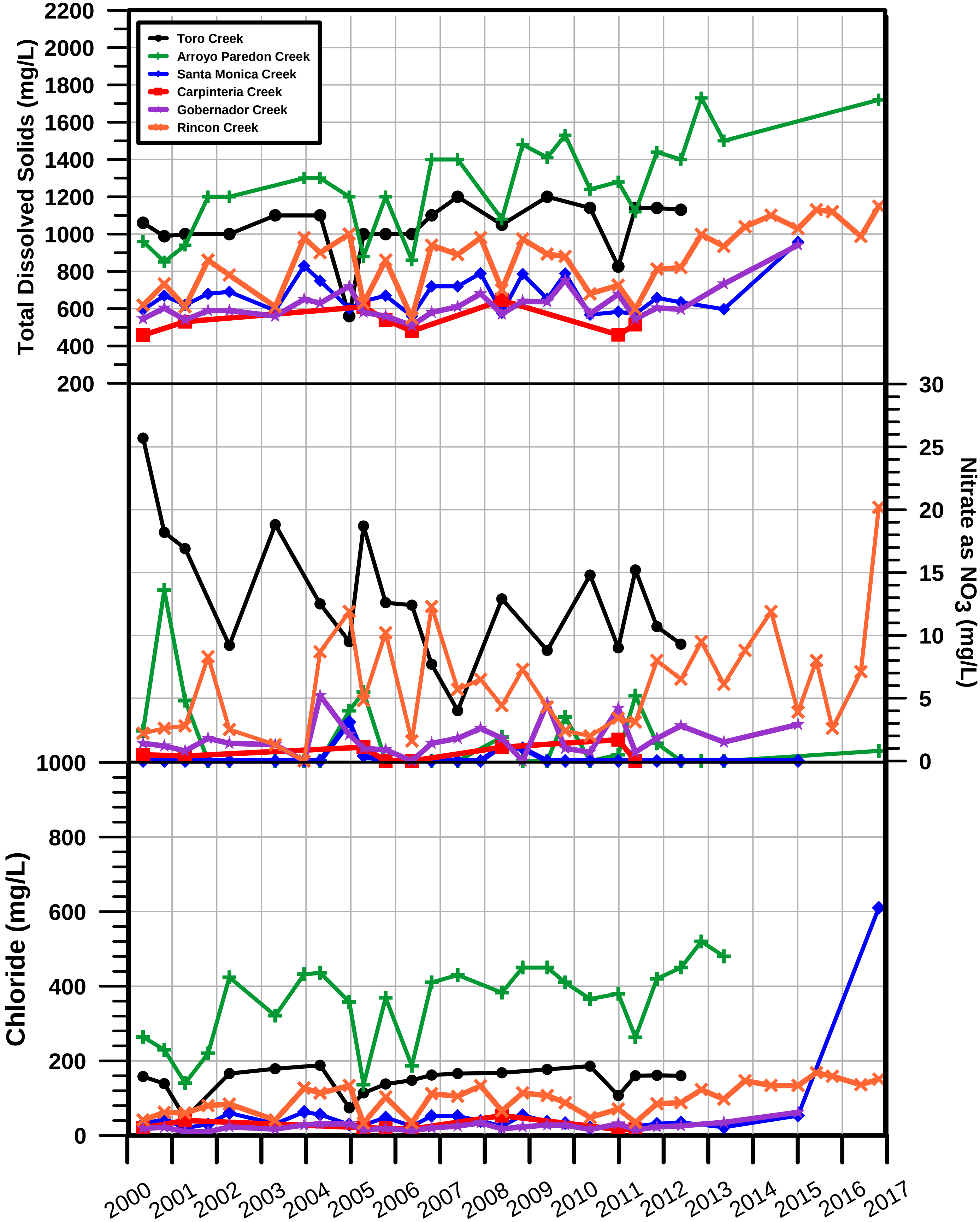


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Figure 10. Surface Water Quality Hydrographs
AB 3030 Groundwater Management Program
Carpinteria Valley Water District

APPENDIX A
HYDROLOGIC DATA

Santa Barbara County - Flood Control District

130 East Victoria Street, Santa Barbara, CA 93101
805.568.3440 - www.countyofsb.org/pwd

Official Monthly and Yearly Rainfall Record

(Monthly Depth Durations and Average Recurrence Intervals)

Station: 208 **Station Type: Alert, Data Logger w/TB** **Latitude: 342353** **Longitude: 1193106**

Station Name: Carpinteria Fire Station **Elevation (ft): 32** **Rainfall (in.)**

WY	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	WY
1948-49	0.00	0.00	0.00	2.63	1.43	1.12	1.89	0.18	1.29	0.09	0.00	0.00	8.63
1949-50	0.00	0.00	2.42	3.12	2.24	2.73	1.18	0.38	0.00	0.13	0.09	0.00	12.29
1950-51	0.63	0.61	1.30	0.29	1.89	1.27	0.56	1.46	0.00	0.00	0.00	0.09	8.10
1951-52	0.00	0.80	1.82	4.87	10.75	0.04	6.40	2.02	0.00	0.00	0.00	0.00	26.70
1952-53	0.00	0.00	3.56	4.63	1.51	0.00	1.13	1.53	0.00	0.00	0.00	0.00	12.36
1953-54	0.00	0.00	2.32	0.13	5.57	2.39	3.88	0.34	0.00	0.00	0.00	0.00	14.63
1954-55	0.00	0.00	1.56	1.56	4.41	2.00	0.31	2.71	0.54	0.00	0.00	0.00	13.09
1955-56	0.00	0.00	1.47	5.27	6.94	0.73	0.00	2.52	1.00	0.00	0.00	0.00	17.93
1956-57	0.00	0.07	0.00	0.27	4.10	3.08	0.44	1.57	0.92	0.00	0.00	0.00	10.45
1957-58	0.00	1.52	0.71	4.45	2.75	7.80	5.79	5.05	0.28	0.00	0.00	0.00	28.35
1958-59	1.06	0.00	0.00	0.07	1.96	4.15	0.00	1.18	0.00	0.00	0.00	0.00	8.42
1959-60	0.00	0.00	0.00	0.81	3.21	3.32	1.12	1.94	0.00	0.00	0.00	0.00	10.40
1960-61	0.00	0.05	6.35	0.00	1.16	0.04	0.62	0.00	0.00	0.00	0.00	0.00	8.22
1961-62	0.18	0.00	2.61	1.00	2.33	16.99	1.27	0.00	0.00	0.00	0.00	0.00	24.38
1962-63	0.00	0.49	0.00	0.00	0.89	5.93	3.68	2.57	0.27	1.02	0.00	0.00	14.85
1963-64	1.87	1.02	3.29	0.00	1.51	0.00	1.78	2.29	0.09	0.00	0.00	0.00	11.85
1964-65	0.00	0.78	2.14	4.57	1.02	0.59	2.18	7.44	0.14	0.06	0.00	0.00	18.92
1965-66	0.19	0.00	9.81	3.72	1.76	1.02	0.10	0.00	0.21	0.00	0.00	0.00	16.81
1966-67	0.00	0.00	3.30	6.69	6.00	0.43	2.74	4.27	0.00	0.00	0.00	0.00	23.43
1967-68	0.36	0.00	4.80	1.07	1.79	1.51	3.92	0.93	0.00	0.00	0.00	0.13	14.51
1968-69	0.00	1.21	0.67	2.02	16.30	9.45	0.49	1.81	0.16	0.08	0.00	0.00	32.19
1969-70	0.00	0.00	2.27	0.22	3.02	2.29	5.79	0.00	0.00	0.00	0.00	0.00	13.59
1970-71	0.00	0.05	4.72	5.09	1.17	2.10	0.86	0.56	2.09	0.00	0.00	0.00	16.64
1971-72	0.00	0.13	0.55	6.95	0.63	0.00	0.00	0.16	0.00	0.10	0.00	0.00	8.52
1972-73	0.00	0.22	4.65	0.88	6.17	10.47	3.04	0.05	0.20	0.04	0.00	0.12	25.84
1973-74	0.00	0.57	2.79	1.19	8.70	0.14	4.22	0.25	0.00	0.00	0.00	0.00	17.86
1974-75	0.00	0.89	0.13	7.72	0.00	4.11	4.18	1.15	0.00	0.00	0.00	0.00	18.18
1975-76	0.15	0.18	0.09	0.28	0.00	6.59	2.31	0.90	0.03	0.23	0.00	0.00	10.76
1976-77	5.65	0.00	0.46	0.73	3.87	0.23	1.70	0.00	3.92	0.11	0.00	0.61	17.28
1977-78	0.00	0.00	0.27	6.58	8.83	9.63	11.39	2.44	0.00	0.09	0.00	0.08	39.31
1978-79	1.39	0.09	1.80	2.15	3.23	5.06	7.61	0.00	0.08	0.00	0.00	0.16	21.57
1979-80	0.71	0.65	0.65	1.23	6.78	11.71	3.68	0.76	0.19	0.00	0.04	0.00	26.40
1980-81	0.03	0.00	0.00	1.08	2.84	1.99	5.69	0.81	0.00	0.00	0.00	0.00	12.44
1981-82	0.50	0.00	1.85	0.89	3.10	0.55	5.54	2.70	0.15	0.11	0.00	0.00	15.39
1982-83	1.32	0.58	5.54	3.11	8.89	6.28	7.52	3.73	0.31	0.18	0.00	1.65	39.11
1983-84	0.97	3.93	3.51	3.29	0.04	0.00	0.35	0.24	0.25	0.00	0.00	0.58	13.16
1984-85	0.55	0.45	2.54	5.05	1.49	1.86	1.50	0.12	0.00	0.00	0.00	0.00	13.56
1985-86	0.07	0.65	4.47	0.88	2.07	7.66	5.52	1.60	0.00	0.00	0.00	0.00	22.92
1986-87	1.43	0.00	1.25	0.36	2.08	2.25	3.16	0.13	0.00	0.00	0.00	0.00	10.66
1987-88	0.00	1.36	1.71	3.50	2.58	2.42	0.54	3.35	0.00	0.00	0.00	0.00	15.46
1988-89	0.09	0.00	1.05	2.93	0.44	3.19	0.54	0.71	0.22	0.00	0.00	0.00	9.17
1989-90	0.07	0.96	0.42	0.00	2.79	2.71	0.15	0.09	0.78	0.00	0.00	0.00	7.97
1990-91	0.06	0.00	0.29	0.05	1.60	2.27	13.30	0.04	0.00	0.27	0.02	0.04	17.94
1991-92	0.00	0.55	0.19	5.02	2.76	9.33	3.99	0.00	0.31	0.09	0.42	0.00	22.66
1992-93	0.00	1.74	0.00	5.50	12.35	7.39	5.42	0.00	0.09	0.77	0.07	0.00	33.33
1993-94	0.00	0.09	1.38	1.47	0.98	5.79	2.07	0.65	0.37	0.00	0.00	0.00	12.80
1994-95	0.42	0.40	1.59	1.14	19.08	1.72	10.87	0.35	0.88	0.61	0.00	0.00	37.06
1995-96	0.00	0.00	0.21	3.11	2.03	8.48	2.05	1.14	0.37	0.00	0.00	0.00	17.39
1996-97	0.00	2.70	0.00	6.25	6.97	0.09	0.00	0.00	0.00	0.09	0.00	0.00	16.10
1997-98	0.00	0.08	2.86	7.69	4.42	20.97	3.71	2.13	3.83	0.14	0.00	0.00	45.83
1998-99	0.12	0.00	0.75	0.95	2.26	0.86	3.16	1.87	0.00	0.02	0.00	0.00	9.99
1999-00	0.02	0.00	0.72	0.00	1.43	8.66	2.74	3.90	0.00	0.00	0.00	0.00	17.47
2000-01	0.00	2.18	0.00	0.08	6.30	5.24	4.73	1.67	0.18	0.02	0.03	0.00	20.43
2001-02	0.04	0.49	3.75	1.78	0.59	0.31	0.37	0.11	0.14	0.01	0.05	0.02	7.66
2002-03	0.20	0.01	5.88	4.59	0.09	2.91	4.46	1.90	1.72	0.19	0.02	0.00	21.97
2003-04	0.04	0.09	1.31	1.89	0.42	5.18	0.57	0.01	0.02	0.01	0.03	0.00	9.57
2004-05	0.00	4.46	0.10	8.62	11.20	7.41	3.96	0.74	1.01	0.02	0.00	0.04	37.56
2005-06	0.20	1.08	0.82	0.72	2.82	2.88	3.26	5.88	0.90	0.00	0.00	0.02	18.58
2006-07	0.01	0.09	0.26	0.72	3.24	1.86	0.18	0.70	0.00	0.02	0.01	0.02	7.11
2007-08	0.28	0.28	0.02	3.06	12.00	1.75	0.00	0.08	0.04	0.00	0.00	0.00	17.51

Santa Barbara County - Flood Control District

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Official Monthly and Yearly Rainfall Record

(Monthly Depth Durations and Average Recurrence Intervals)

Station: 208 **Station Type: Alert, Data Logger w/TB** **Latitude: 342353 Longitude: 1193106**

Station Name: Carpinteria Fire Station **Elevation (ft): 32** **Rainfall (in.)**

WY	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	WY
2008-09	0.03	0.06	2.71	2.55	0.63	6.18	0.78	0.15	0.03	0.07	0.00	0.00	13.19
2009-10	0.06	3.61	0.01	2.86	6.14	3.86	0.56	2.45	0.15	0.03	0.02	0.00	19.75
2010-11	0.01	2.45	1.00	9.66	0.59	4.06	6.20	0.05	0.48	0.36	0.00	0.03	24.89
2011-12	0.09	1.06	1.35	0.32	1.59	0.06	2.32	2.93	0.06	0.02	0.02	0.01	9.83
2012-13	0.06	0.04	2.27	3.05	1.32	0.18	0.75	0.26	0.29	0.09	0.02	0.00	8.33
2013-14	0.01	0.02	0.62	0.30	0.00	2.54	1.68	0.48	0.09	0.04	0.00	0.05	5.83
2014-15	0.00	0.00	0.78	3.62	1.69	0.47	0.45	0.24	0.16	0.75	0.32	0.00	8.48
2015-16	0.16	0.48	0.10	0.30	4.60	1.14	3.02	0.26	0.02	0.03	0.00	0.00	10.11
Total	19.03	39.22	117.82	176.58	255.34	257.42	195.37	87.93	24.26	5.89	1.16	3.65	1183.67
N	68	68	68	68	68	68	68	68	68	68	68	68	68
Mean	**0.28**	**0.58**	**1.73**	**2.60**	**3.75**	**3.79**	**2.87**	**1.29**	**0.36**	**0.09**	**0.02**	**0.05**	**17.41**
Max	5.65	4.46	9.81	9.66	19.08	20.97	13.30	7.44	3.92	1.02	0.42	1.65	45.83
StdDev	0.77	0.96	1.89	2.44	3.88	4.04	2.82	1.53	0.74	0.19	0.06	0.22	8.88
CV	2.74	1.66	1.09	0.94	1.03	1.07	0.98	1.18	2.07	2.22	3.76	4.11	0.51
Reg CV	2.68	1.28	1.03	0.84	0.90	0.99	0.87	1.11	1.83	2.91	3.81	4.10	0.44
Reg Skew	3.80	1.80	1.40	1.00	1.60	1.10	1.10	1.70	2.60	3.60	4.40	4.80	1.10
FIC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Average Recurrence Intervals (in Years)

2	0.00	0.37	1.32	2.25	2.91	3.11	2.42	0.91	0.12	0.00	0.00	0.00	16.03
5	0.47	1.05	3.00	4.25	6.05	6.60	4.75	2.24	0.67	0.16	0.03	0.07	23.15
10	1.06	1.55	4.12	5.52	8.25	8.81	6.22	3.19	1.15	0.36	0.08	0.24	27.67
25	1.97	2.19	5.53	7.05	11.05	11.51	8.02	4.42	1.84	0.66	0.16	0.53	33.18
50	2.72	2.68	6.55	8.14	13.15	13.49	9.35	5.33	2.37	0.90	0.23	0.78	37.24
100	3.51	3.16	7.57	9.18	15.21	15.37	10.60	6.23	2.92	1.16	0.31	1.05	41.07
200	4.34	3.64	8.57	10.21	17.24	17.20	11.82	7.13	3.48	1.42	0.39	1.34	44.83
500	5.99	4.45	10.14	11.69	20.58	19.90	13.62	8.63	4.44	1.95	0.55	1.95	50.34
1000	6.31	4.74	10.83	12.48	21.90	21.29	14.55	9.20	4.79	2.06	0.58	2.04	53.17
10000	9.26	6.31	13.99	15.60	28.49	26.98	18.35	12.12	6.71	3.00	0.87	3.10	64.82

PUEBLO water resources

APPENDIX B
HYDROLOGIC BUDGET UPDATE TECHNICAL MEMORANDUM

TECHNICAL MEMORANDUM
Pueblo Water Resources, Inc.
4478 Market St., Suite 705
Ventura, CA 93003
Tel: 805.644.0470
Fax: 805.644.0480

To:	Carpinteria Valley Water District	Date:	March 31, 2017
Attention:	Bob McDonald, P.E. General Manager	Project No:	15-0094
Copy to:	Mike Burke, P.G, C.Hg.		
From:	Robert Marks, P.G., C.Hg		
Subject:	Carpinteria Groundwater Basin Hydrologic Budget Update, Water Years 2015 – 2016		

Introduction

Presented in this Technical Memorandum (TM) is documentation of our findings developed from an update of the hydrologic budget for the Carpinteria Groundwater Basin (CGB) for Water Years 2015 - 2016. A hydrologic budget for a groundwater basin is an inventory of the various sources of recharge and outflow in the basin, and is expressed by the following equation:

Change in Storage = Inflow - Outflow

where Inflow equals:

- Subsurface Inflow
- Streambed Percolation
- Percolation of Precipitation, and
- Percolation of Irrigation Return Water (pumped and imported);

and Outflow equals:

- Subsurface Outflow
- Gross Groundwater Pumpage, and
- Extraction by Phreatophytes.

The hydrologic budget for the CGB was updated by Pueblo Water Resources, Inc. (PWR) in 2012 for the period of Water Years (WY) 1985 through 2008 as part of the development of a numerical groundwater flow model of the CGB[1]. PWR performed a

[1] *Carpinteria Groundwater Basin, Hydrogeologic Update and Groundwater Model Project Final Report*, prepared by Pueblo Water Resources, Inc. for Carpinteria Valley Water District, dated June 30, 2012.

subsequent updates in 2014 and 2015 covering the periods of WY 2009 through 2014 as part of the District's 2013 and 2014 Annual Reports pursuant to its AB3030 Groundwater Management Plan. The subject update for WY 2015 - 2016 represents a continuation of the District's ongoing effort to maintain an updated hydrologic budget for the CGB.

FINDINGS

The hydrologic budget inventory for the CGB for WY 2015 - 2016 was updated utilizing the same methods that were developed for the 2012 hydrogeologic update and groundwater model project. Detailed descriptions of the methodologies used for each component of the hydrologic budget are presented in PWR's 2012 report and will not be repeated here. A summary of the updated hydrologic budget for the WY 1985 – 2016 period (32 years) is presented in **Table 1**. The values shown in **Table 1** are also presented graphically on **Figure 1**. Summary descriptions for each component of the hydrologic budget are presented below.

Rainfall

Rainfall is the primary source of inflow/recharge to the basin, whether it falls directly on the basin and percolates vertically downward through the surface soils and into basin sediments, or falls on adjacent watershed areas and flows into the basin via streambed percolation or subsurface inflow. The Santa Barbara County Flood Control District maintains precipitation data from the Carpinteria Fire Station with a period of record from 1949 to the present. Annual rainfall during the 32-year WY 1985 - 2016 period of record is presented on **Figure 2**. As shown, the mean annual rainfall for this 32-year base period is 18.3 inches. Rainfall in WY 2015 and 2016 was only 8.48 and 10.1 inches, respectively. These annual rainfall totals represent approximately 46 and 55 percent of the base-period average, respectively.

The cumulative departure of annual rainfall from the long-term mean is also plotted on **Figure 2**. The cumulative departure from mean graph is used to identify climatic trends over the period of record. As shown, the cumulative departure curve exhibits a series of cyclic dry and wet periods in the basin over the period of record. The last five years of extended drought (WY 2012 through 2015) have been particularly dry, with annual rainfall totals generally less than half of the long term average.

Subsurface Inflow

Subsurface inflow is flow from consolidated rocks in the hill and mountain areas adjacent to the CGB. A direct relationship between subsurface inflow and precipitation has been developed by previous investigators, and seasonal subsurface inflow for the WY 1985 – 2016 base period was estimated using this same relationship. As shown in **Table 1**, for WY 2015 and 2016, 482 and 574 afy, respectively, of subsurface inflow was estimated, compared to the 32-year average of 838 afy for the WY 1985 – 2016 period.

Table 1. Hydrologic Budget Summary, WY 1985 – WY 2016

Water Year	Rainfall (in)	INFLOW (acre-feet per year)							OUTFLOW (acre-feet per year)					Change in Storage	
		Subsurface Inflow	Streambed Percolation	Percolation of Precipitation		Percolation of Irrigation Water		Total Inflow	Subsurface Outflow	Groundwater Pumpage		Extraction by Phreatophytes	Total Outflow		
				Recharge Area	Confined Area	Delivered	Pumped			CVWD	Private			Year	Cummulative
1985	15.26	867	57	391	49	58	190	**1,612**	16	1,836	949	100	**2,901**	-1,289	**-1,289**
1986	25.78	1,100	866	4,198	522	80	208	**6,973**	0	2,032	1,041	100	**3,173**	3,801	**2,511**
1987	11.99	681	91	30	4	90	186	**1,082**	0	2,363	932	100	**3,395**	-2,314	**198**
1988	17.34	985	112	731	91	103	213	**2,235**	0	2,342	1,065	100	**3,507**	-1,271	**-1,074**
1989	10.27	584	26	0	0	116	304	**1,029**	0	2,984	1,520	100	**4,604**	-3,574	**-4,648**
1990	8.93	507	4	0	0	246	398	**1,155**	0	3,413	1,990	100	**5,503**	-4,347	**-8,995**
1991	20.11	1,100	758	1,634	203	166	452	**4,313**	0	3,014	2,261	100	**5,375**	-1,062	**-10,057**
1992	25.39	1,100	1,026	4,174	519	140	433	**7,392**	0	1,560	2,165	100	**3,825**	3,567	**-6,490**
1993	37.45	1,100	1,434	5,499	683	177	484	**9,378**	0	1,261	2,422	100	**3,783**	5,596	**-894**
1994	14.43	820	352	278	35	184	564	**2,232**	0	1,307	2,818	100	**4,225**	-1,993	**-2,887**
1995	41.59	1,100	1,746	5,487	660	162	478	**9,632**	231	1,291	2,389	100	**4,011**	5,621	**2,733**
1996	19.55	1,100	894	1,401	168	162	502	**4,227**	239	1,557	2,510	100	**4,406**	-178	**2,555**
1997	18.07	1,027	958	862	104	192	487	**3,630**	58	1,317	2,437	100	**3,912**	-282	**2,273**
1998	51.48	1,100	1,744	5,467	657	149	486	**9,602**	418	575	2,428	100	**3,521**	6,081	**8,354**
1999	9.99	568	434	0	0	292	598	**1,891**	376	340	2,990	100	**3,806**	-1,914	**6,439**
2000	17.47	993	789	740	88	256	621	**3,486**	86	1,410	3,105	100	**4,702**	-1,216	**5,223**
2001	20.43	1,100	1,096	1,692	205	205	652	**4,950**	202	185	3,259	100	**3,746**	1,204	**6,428**
2002	7.66	435	7	0	0	257	621	**1,319**	196	558	3,103	100	**3,957**	-2,638	**3,790**
2003	21.97	1,100	521	2,293	276	245	545	**4,981**	62	402	2,723	100	**3,287**	1,694	**5,484**
2004	9.57	544	2	0	0	277	561	**1,384**	4	999	2,803	100	**3,906**	-2,522	**2,962**
2005	37.56	1,100	1,657	5,366	646	289	412	**9,471**	0	1,152	2,060	100	**3,312**	6,159	**9,121**
2006	18.58	1,056	927	930	112	316	417	**3,756**	0	1,120	2,083	100	**3,302**	454	**9,575**
2007	7.11	404	9	0	0	410	501	**1,324**	0	1,418	2,507	100	**4,025**	-2,701	**6,874**
2008	17.51	995	1,041	683	82	317	561	**3,680**	0	661	2,806	100	**3,567**	113	**6,987**
2009	13.19	749	13	108	13	396	457	**1,736**	0	1,628	2,284	100	**4,012**	-2,276	**4,711**
2010	19.75	1,100	671	1,407	169	335	513	**4,196**	0	1,053	2,566	100	**3,719**	476	**5,187**
2011	24.89	1,100	1,053	3,515	423	324	500	**6,915**	0	1,236	2,502	100	**3,838**	3,077	**8,265**
2012	9.83	559	7	0	0	397	490	**1,452**	0	1,015	2,451	100	**3,566**	-2,114	**6,151**
2013	8.33	473	0	0	0	436	607	**1,516**	0	643	3,033	100	**3,776**	-2,260	**3,891**
2014	5.33	303	11	0	0	463	708	**1,485**	0	1,014	3,541	100	**4,655**	-3,171	**721**
2015	8.48	482	0	0	0	401	705	**1,588**	0	2,605	3,526	100	**6,231**	-4,643	**-3,923**
2016	10.11	574	0	0	0	405	676	**1,656**	0	2,751	3,380	100	**6,231**	-4,575	**-8,498**
Avg.	18.29	838	572	1,465	178	251	485	**3,790**	59	1,470	2,426	100	**4,056**	-127	
High	51.48	1,100	1,746	5,499	683	463	708	**9,632**	418	3,413	3,541	100	**6,231**	6,159	
Low	5.33	303	0	0	0	58	186	**1,029**	0	185	932	100	**2,901**	-4,643	
% of Total		22	15	39	5	7	13	**100**	1	36	60	2	**100**		

Streambed Percolation

There are five principal streams in the CGB; Carpinteria, Gobernador, Santa Monica, Arroyo Parida, and Rincon Creeks. Streambed percolation is assumed to occur only where the stream reaches cross the Recharge Area. Once streamflow reaches the Confined Area, the amount of deep percolation to the main groundwater system is assumed to be insignificant. Previous studies developed runoff vs. streambed percolation relationships for each individual stream. As shown in **Table 1** above, **zero streambed percolation** for both WY 2015 and 2016 was estimated.

Percolation of Precipitation

Percolation of precipitation is the most important source of recharge to the basin, accounting for approximately 45 percent of the total inflow. Precipitation recharges the basin principally through deep percolation to the zone of saturation in the Recharge Area. In addition, one of the important findings from calibrating the numerical groundwater flow model of the CGB in 2012 was that approximately 25 percent of precipitation percolation in the Confined Area does reach the deep aquifers.

The total volume of deep percolation for each year of the base period is shown in **Table 1**. As shown, significant deep percolation only occurs in the wetter years. In years when the average annual rainfall is less than approximately 12 inches, no deep percolation is estimated to occur. It is notable that **no deep percolation of precipitation** is estimated to have occurred in the CGB during the 5-year drought period of WY 2012 - 2016.

Percolation of Irrigation Water

Percolation of irrigation return water in the CGB is dependent on a variety of factors, including climatic conditions, crop type, and irrigation practices. Studies by the U.S. Soil Conversation Service for Santa Barbara County indicate irrigation efficiencies range from 65 to 70 percent. For purposes of estimating deep percolation of irrigation return water in the CGB, a conservative estimate is that 20 percent of applied water (both pumped and delivered, which includes imported water) percolates into the basin. As shown in **Table 1,** the annual recharge to the basin during WY 2015 and 2016 from percolation of irrigation water is estimated to be approximately 1,106 and 1,081 afy, respectively, which is approximately 50 percent greater than the 32-year average of 736 afy. The greater than average amount of irrigation return water reflects the increased amount of applied water required to support crops during WY 2015 and 2016 due to the relative lack of precipitation.

Subsurface Outflow

The quantity of subsurface outflow from the CGB is estimated using Darcy's Law, in which the rate of discharge through a given cross section of saturated material is proportional to the hydraulic gradient. The hydraulic gradient is driven by water-levels in the basin, and outflow occurs only when there is a seaward gradient (i.e., when water levels are generally above sea level). The results of the subsurface outflow calculations are shown in **Table 1**. As shown, zero subsurface outflow was estimated during WY 2015 and 2016 because the seaward gradient between the coast and inland portions of the basin was reversed (i.e., water levels were lower inland than at the coast). It is noted that the existing reversal of the naturally occurring seaward gradient creates conditions for the potential for seawater intrusion into the basin to occur (i.e., rather than subsurface outflow from the basin to offshore areas, subsurface inflow into the basin from offshore areas is likely occurring).

Groundwater Pumpage

Groundwater extractions from the CGB occur from both District and private production wells. District well production is metered, and monthly totals of production from the District wells were compiled for WY 2015 and 2016. Private pumping in the basin is not metered and has been estimated on an annual basis by the District since 1984 utilizing land use survey and water delivery information. As shown in **Table 1**, aggregate pumpage is estimated at approximately 6,131 afy during both WY 2015 and 2016. This amount of pumpage is approximately 60 percent greater than the 32-year long-term average of approximately 3,896 afy estimated for the WY 1985 – WY 2016 period.

Extraction by Phreatophytes

Phreatophytes are water loving plants (roots extend into the water table) that live in the vicinity of stream channels and in areas of high groundwater. Groundwater consumed by phreatophytes is dependent on many factors, including plant species, vegetative density, climate, soil types and conditions, and depth to groundwater. Direct measurements of consumptive use by phreatophytes in the CGB do not currently exist. By applying the results of study in San Diego County (Blaney and Criddle, 1963), extractions by phreatophytes have been roughly estimated to be approximately 100 afy. As shown in **Table 1**, phreatophytes consumption is estimated to be a relatively insignificant portion (2 percent) of the overall outflow from the basin.

Changes in Storage

The change in the amount of groundwater in storage depends on the annual water supply surplus or deficiency, as expressed in the water balance equation. As shown in **Table 1**, the total inflow during WY 2015 and 2016 was estimated at 1,588 and 1,656 afy respectively. The total amount of outflow was estimated at 6,231 afy in both WY 2015 and 2016, resulting in net annual storage depletion amount of approximately 4,643 and 4,575 afy, respectively.

Figure 3 presents a comparison of the cumulative departure/change curves for both rainfall and basin storage for the WY 1985 – 2016 base period. As shown, the cumulative change in storage curve understandably trends similarly to the cumulative departure of annual rainfall curve. For example, the plots show the period of the WY 1987 through 1990 drought and the corresponding depletion of storage, followed by the cumulatively wet period of WY 1991 through WY 1998 and the corresponding accumulation of basin storage. The relative lack of rainfall during the recent 5-year drought period of WY 2012 - 2016 corresponds to lower amounts of rainfall and recharge in the basin and a resulting cumulative depletion of storage.

As shown in **Table 1** and on **Figures 1 and 3**, as of WY 2016 the amount of cumulative storage depletion in the CGB is estimated at approximately 8,500 af relative to basin conditions at the start of WY 1985. The current storage conditions are similar to, but not quite as depleted as, those at the end of the WY 1987 through 1990 drought period, when it was depleted by as much as 11,500 af relative to the conditions at the start of WY 1985.

CONCLUSIONS AND RECOMMENDATIONS

Based on the findings developed from the subject update to the CGB hydrologic budget for WY 2015 - 2016, we offer the following conclusions and recommendations:

- Total rainfall during WY 2015 and 2016 was approximately 8.48 and 10.1 inches, respectively, which are approximately 50 percent less than the long-term average of 18.3 inches.

- The limited amounts of rainfall and stream runoff during the period resulted in no percolation recharge to the CGB. Total recharge during WY 2015 and 2016 is estimated to be approximately 1,588 and 1,656 afy, respectively, which are approximately 60 percent less than the long-term average of approximately 3,790 afy.

- Extractions from the basin during WY 2015 and 2016 are estimated at approximately 6,231 afy, which is approximately 50 percent greater than the long-term average of approximately 4,056 afy.

- Due to the relatively limited amounts of natural recharge, combined with increased levels of extractions, approximately 4,600 afy of storage depletion is estimated to have occurred in both WY 2015 and 2016. During the 5-year drought period from WY 2012 - 2016, total cumulative storage depletion of approximately 16,800 af is estimated to have occurred in the basin, corresponding to an average storage loss rate of approximately 3,360 afy. This compares to the estimated 4-year cumulative storage depletion during the WY 1987 – 1990 drought of approximately 11,500 af (approximately 2,900 afy on average).

- There was no subsurface outflow estimated during the period (indeed, no subsurface outflow from the basin has been estimated to have occurred during the last 12 years) due to depressed water levels in the basin. Water levels are currently as much as 40 feet below sea level in the western portion of basin, an area where the Rincon Creek Fault barrier is located offshore. These conditions present a potential risk for seawater intrusion to occur in the CGB.

- Given the current basin conditions, the seawater intrusion “sentinel well” planned by CVWD should be installed as soon as possible.

CLOSURE

This Technical Memorandum has been prepared exclusively for Carpinteria Valley Water District for the specific application to the Carpinteria Groundwater Basin Hydrologic Budget Update Project. The findings, conclusions, and recommendations presented herein were prepared in accordance with generally accepted hydrogeologic practices. No other warranty, express or implied, is made.

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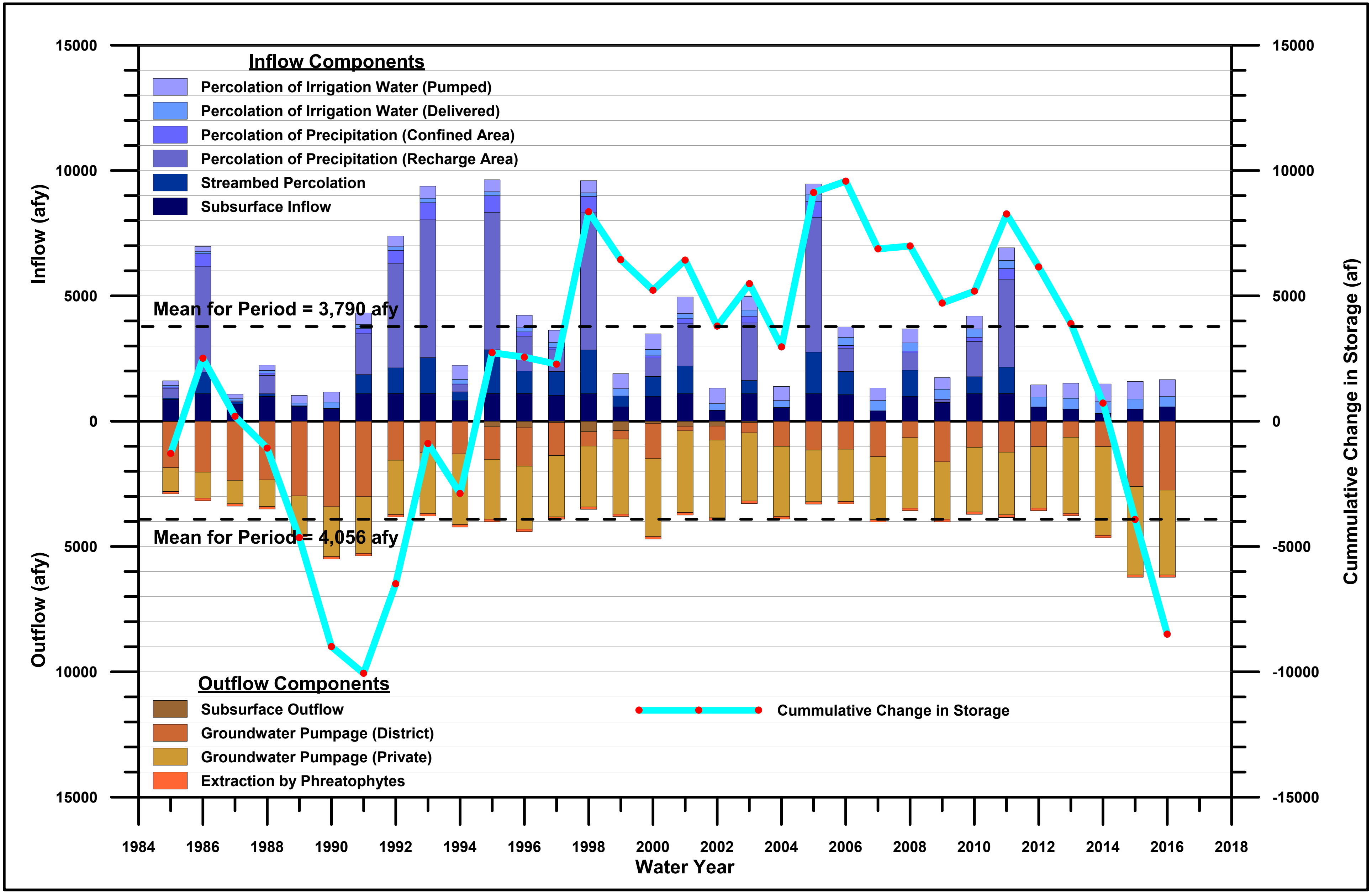
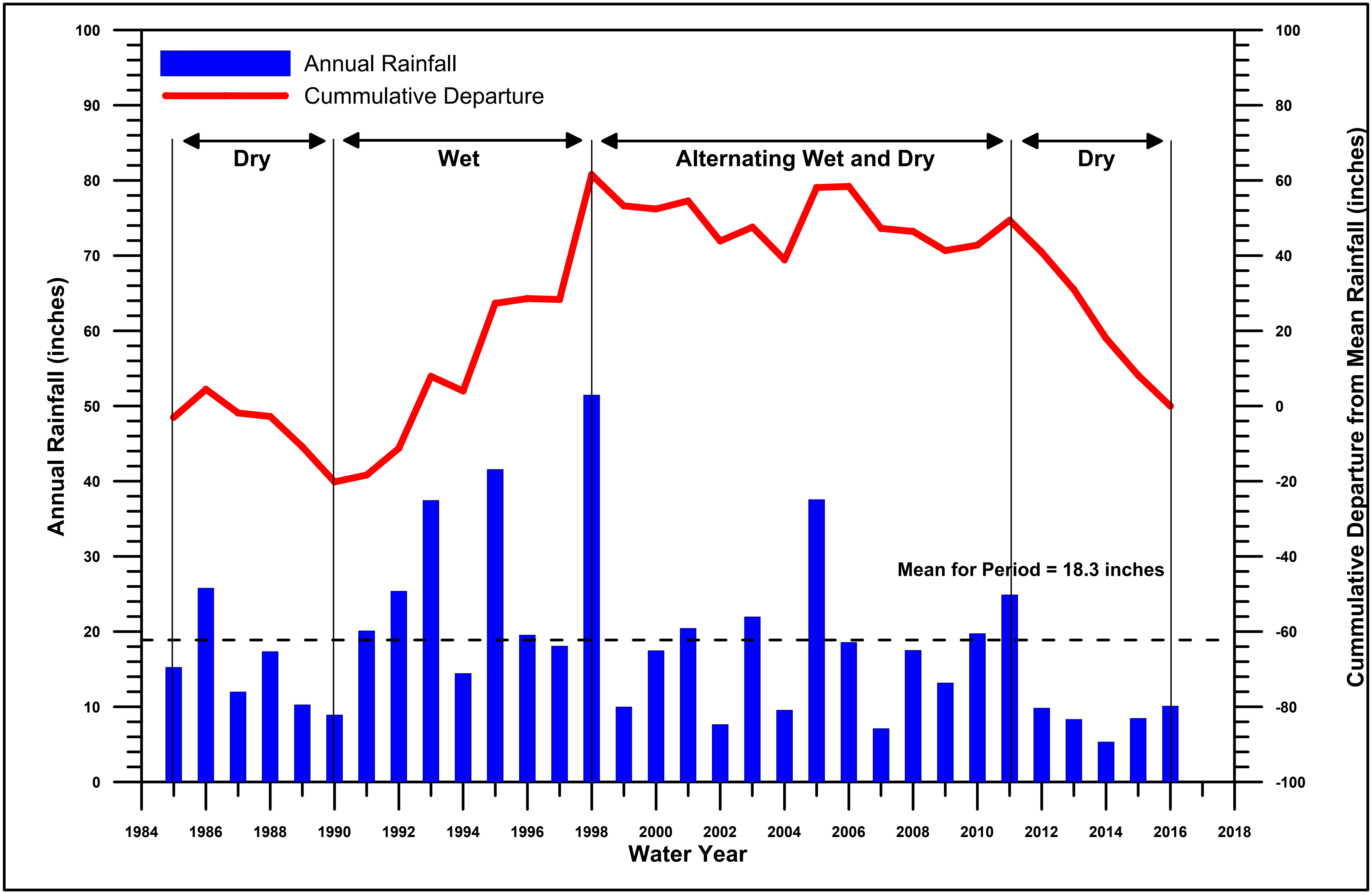
March 2017
Project No. 15-0094



PUEBLO water resources

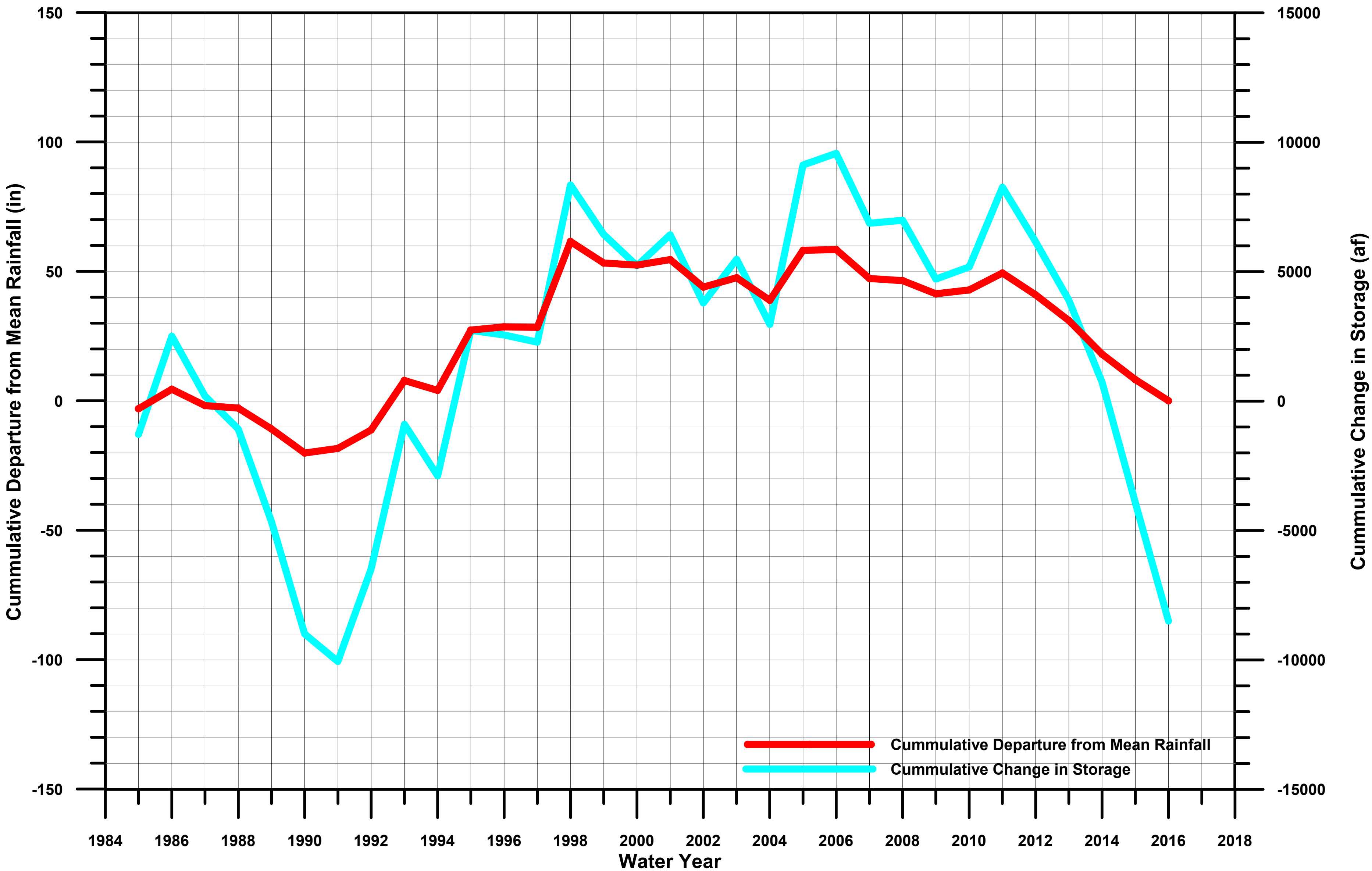
FIGURE 1. HYDROLOGIC BUDGET SUMMARY FOR WY 1985 - 2016 PERIOD
WY 2015-2016 GWMP Annual Report
Carpinteria Valley Water District



PUEBLO water resources

FIGURE 2. CUMULATIVE DEPARTURE OF ANNUAL RAINFALL - CARPINTERIA FIRE STATION (WY 1985 - 2016)
WY 2015-2016 GWMP Annual Report
Carpinteria Valley Water District

March 2017
Project No. 15-0094



PUEBLO water resources

FIGURE 3. CUMMULATIVE DEPARTURE/CHANGE CURVE COMPARISON FOR WY 1985 - 2016 PERIOD
WY 2015-2016 GWMP Annual Report
Carpinteria Valley Water District

APPENDIX C
WATER QUALITY DATA

Summary of Water Quality Data, Spring & Fall 2015
Carpinteria Valley Water District
Groundwater Basin Data Collection Program

																	PH		E.C.						
Well No.	Sample Date	Calcium	Magnesium	Potassium	Sodium	Carbonate	Bicarbonate	Sulfate	Chloride	Nitrate	Fluoride	Boron	Copper	Iron	Manganese	Zinc	Field	Lab	Field	Lab	SAR	TDS	Alkalinity	Hardness	Ammonia-N
4N/25W-19E1	5/21/2015	148	43	1	213	<10	320	126	510	35.3	1.3	2.2	<0.01	0.04	0.04	0.04	7.5	7.5	1976	2090	4	1400	270	546	--
	10/13/2015	151	42	1	211	<10	270	127	410	35.2	1.3	2	<0.01	0.04	0.02	<0.02	6.81	6.6	2060	2110	3.9	1250	220	550	--
4N/25W-19J4	6/2/2015	136	39	1	50	<10	300	164	104	89.8	0.4	0.1	<0.01	<0.03	<0.01	0.03	7.4	7.2	1172	1230	1	884	250	500	--
	10/14/2015	134	37	1	48	<10	270	147	92	93.2	0.3	0.1	<0.01	<0.03	<0.01	<0.02	7.2	6.7	1176	1190	0.9	825	220	487	--
4N/25W-19K5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4N/25W-19K9	6/17/2015	168	51	1	79	<10	250	230	158	133	0.4	0.4	<0.01	<0.03	0.02	<0.02	7.5	7.3	1265	1480	1.4	1070	200	629	--
	10/13/2015	178	53	1	83	<10	260	218	140	137	0.3	0.4	<0.01	<0.03	0.02	<0.02	7.17	6.7	1599	1650	1.4	1070	210	662	--
4N/25W-19M1	6/18/2015	241	66	1	167	<10	430	290	410	141	0.8	1.1	<0.01	8.3	0.12	<0.02	7.2	6.9	2470	2470	2.5	1750	360	873	--
	11/13/2015	233	66	1	157	<10	390	250	350	112	0.7	1	0.02	30	0.57	0.03	7.25	6.8	2300	2420	2.3	1560	320	853	--
4N/25W-19R1	6/2/2015	145	39	1	48	<10	300	156	121	94.9	0.5	<0.1	<0.01	<0.03	0.1	<0.02	7.5	7.3	1231	1270	0.9	905	250	522	--
	10/12/2015	136	36	<1	48	<10	200	137	103	86.8	0.4	<0.1	<0.01	<0.03	0.06	<0.02	7.85	7.1	1137	1160	0.9	747	170	487	--
4N/25W-20C1	5/19/2015	96	29	2	78	<10	340	109	87	<1	0.4	0.2	<0.01	<0.03	0.37	<0.02	7.5	7.1	690	1000	1.8	741	280	359	--
	10/20/2015	87	27	2	73	<10	290	105	83	<0.4	0.4	0.2	<0.01	<0.03	0.33	<0.02	7.36	6.6	979	993	1.8	667	240	328	--
4N/25W-20J2	5/20/2015	130	39	2	86	<10	380	141	57	120	0.3	0.2	0.05	0.06	1.4	0.03	7.3	7.2	1215	1230	1.7	955	310	485	--
	10/13/2015	119	36	2	83	<10	260	140	57	117	0.3	0.1	0.02	0.05	0.24	<0.02	7.3	7	1198	1170	1.7	814	220	445	--
4N/25W-20K4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4N/25W-20K4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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4N/25W-20L2	6/25/2015	67	19	1	91	<10	370	79	57	4	0.4	0.2	<0.01	0.1	0.27	<0.02	7.6	7.2	903	883	2.5	684	300	245	--
	11/13/2015	72	19	1	83	<10	360	95	44	7.2	0.4	0.2	<0.01	0.3	0.05	<0.02	7.9	7.4	918	918	2.2	682	290	258	--
4N/25W-20L3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	10/13/2015	113	39	1	91	<10	300	117	124	87	0.4	0.1	<0.01	0.03	<0.01	0.07	7.63	7.1	1263	1280	1.9	872	250	442	--
4N/25W-20M1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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4N/25W-20Q3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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4N/25W-20R4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	10/13/2015	118	36	2	80	<10	350	129	52	117	0.3	0.2	<0.01	<0.03	0.03	<0.02	7.56	7.4	1195	1210	1.7	878	290	443	--
4N/25W-21F1	5/20/2015	93	41	2	82	<10	430	27	126	42.3	0.4	0.2	<0.01	<0.03	<0.01	0.04	7.4	7.4	1069	1080	1.8	844	350	401	--
	10/14/2015	88	39	1	80	<10	300	29	102	38.1	0.5	0.2	<0.01	<0.03	<0.01	0.04	7.38	7.1	1105	1110	1.8	678	250	380	--
4N/25W-21L1	5/28/2015	90	30	2	75	<10	380	116	62	2.8	0.3	0.2	<0.01	<0.03	0.03	<0.02	7.37	7.4	965	979	1.7	758	310	348	--
	10/13/2015	87	30	2	73	<10	320	104	57	2.6	0.3	0.2	<0.01	<0.03	0.04	0.03	7.28	7.1	965	965	1.7	675	260	341	--
4N/25W-21N7	5/19/2015	86	27	2	76	<10	360	105	44	<0.5	0.3	0.2	0.01	<0.03	0.23	0.05	7.4	7.2	875	895	1.8	700	290	326	--
	10/13/2015	79	26	1	71	<10	360	108	43	2.9	0.3	0.2	<0.01	<0.03	0.19	0.03	7.3	7	895	892	1.8	690	300	304	--
4N/25W-21N4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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4N/25W-21Q1	5/20/2015	86	28	1	74	<10	350	90	60	16.7	0.4	0.1	<0.01	<0.03	0.44	0.02	7.3	7.2	879	906	1.8	706	280	330	--
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4N/25W-22R4	5/28/2015	106	29	1	50	<10	290	151	87	11.3	0.2	<0.1	<0.01	<0.03	<0.01	<0.02	7.3	7.2	980	1000	1.1	726	240	384	--
	10/12/2015	106	30	1	53	<10	250	138	81	9.2	0.2	0.1	<0.01	0.03	<0.01	<0.02	7.17	6.9	980	983	1.2	668	200	388	--
4N/25W-25F1	5/20/2015	124	42	2	69	<10	290	114	173	50.3	0.4	<0.1	<0.01	0.31	0.02	<0.02	7.4	7.2	1199	1220	1.4	865	240	482	--
	10/12/2015	120	40	1	66	<10	240	114	151	48.1	0.3	<0.1	<0.01	0.14	<0.01	<0.02	7.15	7	1214	1240	1.3	780	200	464	--
4N/25W-26B1	6/3/2015	181	42	2	55	<10	240	107	315	87.7	0.3	<0.1	<0.01	<0.03	<0.01	<0.02	7.2	7.1	1567	1630	1	1030	200	624	--
	10/26/2015	176	42	2	53	<10	210	106	298	85.7	0.2	<0.1	<0.01	<0.03	<0.01	<0.02	7.51	6.9	1570	1590	0.9	973	180	612	--
4N/25W-26C8	6/2/2015	95	28	1	35	<10	280	171	32	8	0.3	<0.1	<0.01	<0.03	<0.01	<0.02	7.53	7.4	830	839	0.8	650	230	352	--
	10/12/2015	99	30	1	38	<10	200	153	33	11.4	0.2	<0.1	<0.01	<0.03	<0.01	<0.02	7.43	7.1	862	866	0.9	566	160	370	--
4N/25W-26P2	5/19/2015	121	37	2	86	<10	280	78	195	26.6	0.3	0.1	<0.01	<0.03	<0.01	<0.02	7.9	7.6	1221	1250	1.8	826	230	454	--
	10/21/2015	114	35	2	79	<10	290	86	196	32.5	0.3	0.2	<0.01	<0.03	<0.01	<0.02	7.38	6.7	1269	1280	1.7	835	230	428	--
4N/25W-27D1	6/25/2015	90	30	1	50	<10	310	133	73	19.2	0.4	<0.1	<0.01	<0.03	<0.01	<0.02	7.6	7.2	933	953	1.2	707	250	348	--
	11/13/2015	97	32	1	53	<10	310	123	52	13.2	0.4	0.1	<0.01	0.11	<0.01	<0.02	7.64	7.3	909	944	1.2	682	260	374	--
4N/25W-27E1	7/6/2015	137	39	1	47	<10	360	159	51	70.1	0.3	0.1	<0.01	<0.03	<0.01	<0.02	7.5	7.2	1111	1120	0.9	864	290	502	--
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4N/25W-27F2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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4N/25W-27R2	6/29/2015	140	43	2	108	<10	340	106	262	13.7	0.4	0.2	<0.01	0.08	0.26	0.03	7.8	7.3	1430	1520	2	1020	280	526	--
	10/26/2015	124	37	2	100	<10	340	101	222	11.3	0.5	0.2	<0.01	<0.03	0.24	<0.02	7.57	7	1406	1440	2	938	280	462	--
4N/25W-28A1	5/19/2015	94	29	1	60	<10	330	106	50	<0.5	0.3	0.1	<0.01	<0.03	0.03	<0.02	7.5	7.4	889	895	1.4	670	270	354	--
	10/13/2015	88	28	1	57	<10	290	103	47	19.6	0.3	0.1	<0.01	<0.03	0.03	<0.02	7.5	7.1	894	847	1.4	634	240	335	--
4N/25W-28D2	5/20/2015	99	28	2	56	<10	340	140	37	9.2	0.3	0.1	<0.01	0.06	0.12	<0.02	7.5	7.4	855	879	1.3	712	270	362	--
	10/13/2015	93	27	1	54	<10	280	123	34	10.1	0.3	0.1	<0.01	0.04	0.1	<0.02	7.6	7	874	831	1.3	622	230	343	--
4N/25W-28D2	5/20/2015	101	28	2	58	<10	340	121	37	6.9	0.3	0.1	0.05	<0.03	<0.01	<0.02	7.4	7.4	881	883	1.3	694	280	367	--
	10/13/2015	92	27	1	56	<10	280	124	36	10.1	0.3	0.1	0.04	<0.03	<0.01	<0.02	7.38	7	888	883	1.3	626	230	341	--
4N/25W-28F7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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4N/25W-28G3	6/1/2015	147	41	1	54	<10	390	179	56	86	0.3	<0.1	<0.01	<0.03	0.03	<0.02	7.33	7.1	592	1270	1	954	320	535	--
	10/21/2015	143	39	1	52	<10	390	185	57	73.9	0.3	0.1	<0.01	<0.03	<0.01	<0.02	7.55	6.9	1215	1220	1	941	320	517	--
4N/25W-28H1	7/6/2015	120	34	1	49	<10	340	126	40	61.1	0.3	0.1	<0.01	<0.03	<0.01	<0.02	7.8	7.2	913	1010	1	771	280	439	--
	10/19/2015	117	33	1	47	<10	310	129	41	69.2	0.3	0.1	<0.01	0.05	<0.01	<0.02	7.6	6.9	1033	1040	1	747	260	428	--
4N/25W-28J1	5/28/2015	145	40	1	48	<10	400	187	57	62.4	0.3	<0.1	<0.01	<0.03	<0.01	<0.02	7.4	7.3	1103	1200	0.9	941	330	526	--
	10/14/2015	142	39	1	45	<10	390	180	55	25	0.3	<0.1	<0.01	0.04	<0.01	<0.02	7.17	6.8	1155	1150	0.9	878	320	515	--
4N/25W-29D7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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4N/25W-29D8	5/19/2015	91	24	2	62	<10	330	112	37	<0.5	0.3	0.1	0.01	<0.03	0.11	<0.02	7.4	7.3	845	849	1.5	658	270	326	--
	10/13/2015	84	23	1	59	<10	260	114	39	9.8	0.3	0.1	<0.01	<0.03	0.1	<0.02	7.36	7.1	850	848	1.5	589	220	304	--
4N/25W-29D8	5/19/2015	89	24	2	64	<10	330	113	40	9.2	0.3	0.1	<0.01	<0.03	<0.01	<0.02	7.4	7.2	840	860	1.6	672	270	321	--
	10/13/2015	85	23	1	60	<10	260	114	41	9.5	0.3	0.1	<0.01	<0.03	<0.01	<0.02	7.4	7	849	855	1.5	593	220	307	--
4N/25W-29K2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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4N/25W-29L1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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4N/25W-30D1	5/21/2015	21	14	2	83	<10	220	13	66	3.3	0.7	0.2	<0.01	4.4	0.3	0.44	8.6	7.8	625	635	3.4	423	180	110	--
	10/19/2015	20	15	2	81	<10	240	3	68	0.4	0.7	0.2	<0.01	8.6	0.41	0.5	8.3	7.4	640	637	3.3	430	200	112	--
4N/25W-34A1	6/3/2015	161	49	2	109	<10	380	360	142	<0.4	0.5	0.2	<0.01	0.8	0.2	<0.02	7.18	7.1	1525	1600	1.9	1200	310	603	--
	10/19/2015	155	46	3	106	<10	340	310	125	<0.4	0.4	0.2	<0.01	2.6	0.25	<0.02	7.2	6.8	1495	1510	1.9	1090	280	576	--
4N/25W-34G1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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4N/25W-34B4	5/20/2015	97	29	2	59	<10	320	98	67	3.8	0.4	0.1	<0.01	<0.03	0.02	<0.02	7.5	7.5	883	884	1.4	676	260	361	--
	10/12/2015	88	27	1	55	<10	210	97	65	4.9	0.3	0.1	<0.01	0.05	0.03	<0.02	7.7	7.1	872	850	1.3	548	170	331	--
4N/25W-35B5	5/20/2015	162	52	2	90	<10	380	280	106	21.6	0.3	0.3	<0.01	<0.03	<0.01	0.02	7.7	7.7	1407	1420	1.6	1090	310	618	--
	10/16/2015	139	46	2	83	<10	380	240	97	18.2	0.3	0.2	<0.01	0.05	<0.01	<0.02	7.8	7.2	1350	1340	1.6	1010	310	536	--
4N/25W-35E4	5/20/2015	164	52	3	144	<10	220	510	181	<2.5	0.4	0.2	<0.01	0.46	0.08	<0.02	7.07	7.1	1617	1660	2.5	1270	180	623	--
	10/16/2015	146	50	2	138	<10	130	440	145	1.8	0.3	0.2	<0.01	0.61	0.07	<0.02	7.25	6.9	1625	1690	2.5	1050	110	570	--
4N/26W-13R1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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4N/26W-23A2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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4N/26W-24F1	6/2/2015	81	35	1	136	<10	450	42	166	3.6	1.1	0.3	<0.01	0.3	0.09	<0.02	7.4	7.4	1220	1250	3.2	916	370	346	--
	10/13/2015	76	35	1	133	<10	450	39	143	3.1	1.0	0.3	<0.01	0.23	0.09	<0.02	7.28	6.9	1225	1200	3.2	881	370	334	--
Toro Creek	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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Arroyo Paredon Creek	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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Santa Monica Creek	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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Carpinteria Creek	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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Gobernador Creek	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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Rincon Creek	6/3/2015	102	59	2	135	<10	460	196	168	8	0.8	0.6	<0.01	<0.03	<0.01	<0.02	8.5	8.1	1440	1490	2.6	1130	380	497	<0.2
	10/12/2015	109	57	3	141	<10	460	188	159	2.6	0.7	0.7	<0.01	<0.03	<0.01	<0.02	8.15	7.8	1480	1520	2.7	1120	380	506	<0.2

Concentrations in milligrams per liter, except Electrical Conductance (micromhos/cm) and pH.
Non detected concentrations shown as < PQL (Practical Quantitation Limit)
Not Available = --

Summary of Water Quality Data, Spring & Fall 2016
Carpinteria Valley Water District
Groundwater Basin Data Collection Program

																	PH		E.C.						
Well No.	Sample Date	Calcium	Magnesium	Potassium	Sodium	Carbonate	Bicarbonate	Sulfate	Chloride	Nitrate	Fluoride	Boron	Copper	Iron	Manganese	Zinc	Field	Lab	Field	Lab	SAR	TDS	Alkalinity	Hardness	Ammonia-N
4N/25W-19E1																									
	10/25/2016	173	49	1	193	<10	330	141	510	47.3	1.2	2	<0.01	<0.03	0.01	0.03	7.61	7	2200	2350	3.3	1450	270	633	--
4N/25W-19J4	6/9/2016	138	38	1	49	<10	280	140	96	120	0.3	0.1	<0.01	0.34	<0.01	0.08	7.36	7.2	1215	1260	1	862	230	501	--
	10/26/2016	137	38	<1	45	<10	300	146	99	126	0.2	<0.1	<0.01	0.53	0.01	0.16	7.67	6.3	1156	1230	0.9	891	240	498	--
4N/25W-19K5	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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4N/25W-19K9	6/6/2016	174	52	1	81	<10	340	216	136	134	0.3	0.5	0.02	<0.03	0.02	<0.02	7.53	7.2	1577	1700	1.4	1130	280	648	--
	10/27/2016	161	49	1	79	<10	380	218	138	121	0.4	0.4	0.05	0.07	0.02	<0.02	7.37	6.8	1547	1600	1.4	1150	310	603	--
4N/25W-19M1																									
	11/7/2016	219	61	2	151	<10	390	244	310	156	0.9	1.1	0.03	8.4	0.24	0.05	7.44	7.1	2140	2250	2.3	1530	320	797	--
4N/25W-19R1	6/2/2016	144	40	1	55	<10	300	137	108	93.6	0.4	0.2	<0.01	<0.03	0.06	<0.02	7.71	7.1	1195	1260	1	879	250	524	--
	11/8/2016	134	37	1	48	<10	300	139	107	83	0.4	<0.1	<0.01	0.15	0.56	<0.02	7.56	4.8	1180	1190	0.9	849	240	487	--
4N/25W-20C1	5/25/2016	86	27	2	73	<10	330	113	97	<0.4	0.4	0.2	<0.01	<0.03	0.34	<0.02	7.56	7.4	985	1020	1.8	728	270	326	--
	11/2/2016	83	27	1	74	<10	270	109	84	<0.4	0.4	0.2	<0.01	<0.03	0.33	<0.02	7.64	7.1	946	990	1.8	667	220	318	--
4N/25W-20J2	5/24/2016	115	36	2	82	<10	390	145	67	109	0.4	0.2	0.03	0.07	0.36	<0.02	7.59	7.4	1160	1230	1.7	946	320	435	--
	10/28/2016	98	31	1	73	<10	400	101	57	61.2	0.4	0.2	<0.01	0.07	0.1	<0.02	7.62	7	1084	1100	1.6	823	330	372	--
4N/25W-20K4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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4N/25W-20K4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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4N/25W-20L2	6/2/2016	79	22	1	95	<10	380	75	58	3.2	0.3	0.2	<0.01	0.05	0.14	<0.02	7.74	7.3	937	954	2.4	714	310	288	--
	11/16/2016	74	20	1	95	<10	370	88.8	60	4.2	0.4	0.2	<0.01	0.08	0.32	<0.02	8.11	7.1	575	925	2.5	713	300	267	--
4N/25W-20L3	5/24/2016	100	37	2	77	<10	270	187	85	46.2	0.4	0.2	<0.01	0.04	<0.01	0.19	7.71	7.1	1088	1120	1.7	805	220	402	--
	10/28/2016	119	42	1	90	<10	340	134	133	126	0.4	0.1	<0.01	<0.03	<0.01	0.27	7.89	7.1	1354	1400	1.8	985	280	470	--
4N/25W-20M1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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4N/25W-20Q3	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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4N/25W-20R4	5/10/2016	110	34	2	78	<10	390	131	59	95.6	0.3	0.2	<0.01	<0.03	0.04	<0.02	7.81	6.9	1171	1240	1.7	900	320	414	--
	10/28/2016	100	31	1	75	<10	310	112	60	64.8	0.3	0.2	<0.01	<0.03	0.05	<0.02	7.91	7	1062	1100	1.7	754	260	377	--
4N/25W-21F1	6/8/2016	95	42	2	89	<10	430	23	119	36.6	0.5	0.2	<0.01	<0.03	<0.01	0.04	7.81	7.2	1171	1240	1.9	837	350	410	--
4N/25W-21L1	5/9/2016	85	30	1	73	<10	280	118	64	2.2	0.4	0.2	<0.01	0.05	0.09	<0.02	7.55	7.2	963	1020	1.7	654	230	336	--
4N/25W-21N7	5/9/2016	80	26	1	69	<10	360	120	47	2.5	0.3	0.1	<0.01	<0.03	0.16	<0.02	7.77	7.2	891	951	1.7	706	290	307	--
	10/25/2016	81	27	1	66	<10	360	119	44	1.8	0.3	0.1	<0.01	<0.03	0.17	<0.02	7.68	7	884	919	1.6	700	290	313	--
4N/25W-21N4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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4N/25W-21Q1																									
	10/28/2016	75	26	<1	70	<10	350	89.7	59	17.5	0.4	0.1	<0.01	<0.03	0.39	<0.02	7.56	7.2	900	906	1.8	688	290	294	--
4N/25W-22R4	5/25/2016	104	30	2	52	<10	290	166	103	11.4	0.3	0.1	<0.01	0.04	<0.01	<0.02	7.75	7.2	999	1030	1.2	759	240	383	--
	11/7/2016	103	30	2	53	<10	300	142	69	9.1	0.2	0.1	<0.01	0.08	<0.01	<0.02	7.78	6.9	955	979	1.2	708	250	380	--
4N/25W-25F1	5/25/2016	116	40	2	69	<10	260	155	167	48.4	0.4	0.1	<0.01	0.03	<0.01	<0.02	8.04	7.4	1249	1290	1.4	858	210	454	--
	10/26/2016	134	47	2	75	<10	300	142	188	61.1	0.4	<0.1	<0.01	0.21	<0.01	<0.02	7.84	7	1330	1390	1.4	950	250	528	--
4N/25W-26B1	5/25/2016	174	42	2	53	<10	220	103	280	93	0.2	<0.1	<0.01	<0.03	<0.01	<0.02	7.85	7.2	1541	1640	0.9	967	180	607	--
	11/14/2016	181	44	2	55	<10	250	99.7	280	85.4	0.2	<0.1	<0.01	0.05	<0.01	<0.02	7.77	6.7	1188	1610	1	997	200	633	--
4N/25W-26C8	6/2/2015	100	30	1	39	<10	200	160	37	11.9	0.4	<0.1	<0.01	0.03	<0.01	<0.02	7.77	7.5	875	940	0.9	579	170	373	--
	11/14/2016	96	29	1	36	<10	270	159	32	7.1	0.3	<0.1	<0.01	<0.03	<0.01	<0.02	8.14	7.3	819	817	0.8	630	220	359	--
4N/25W-26P2	5/25/2016	112	35	2	80	<10	180	92	196	33.6	0.3	0.1	<0.01	<0.03	<0.01	<0.02	7.61	7.5	1277	1340	1.7	731	140	423	--
	11/11/2016	113	36	2	80	<10	310	102	167	30	0.3	0.2	<0.01	0.08	<0.01	<0.02	8.03	5	808	1250	1.7	840	260	430	--
4N/25W-27D1	6/2/2016	107	36	1	58	<10	310	128	75	20.7	0.3	0.1	<0.01	<0.03	<0.01	<0.02	7.85	7.2	969	1000	1.2	736	250	415	--
	11/16/2016	101	34	1	54	<10	310	132	78	18.1	0.3	<0.1	<0.01	<0.03	<0.01	<0.02	7.86	7.1	955	992	1.2	728	250	392	--
4N/25W-27E1	5/13/2016	112	32	1	41	<10	330	164	48	50.1	0.4	<0.1	<0.01	<0.03	<0.01	<0.02	7.87	7	986	1050	0.9	778	270	411	--
	11/7/2016	124	36	3	44	<10	350	175	55	75.7	0.3	<0.1	0.03	0.19	<0.01	0.23	7.99	6.9	1115	1130	0.9	863	280	458	--
4N/25W-27F2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	10/26/2016	100	28	1	33	<10	290	139	26	10.9	0.2	<0.1	<0.01	0.18	<0.01	<0.02	8.1	7.1	809	819	0.8	628	240	365	--
4N/25W-27R2	5/24/2016	122	38	2	104	<10	340	102	237	11.7	0.5	0.1	<0.01	0.05	0.26	<0.02	7.6	7.4	1390	1460	2.1	957	280	461	--
	11/7/2016	102	27	1	36	<10	310	142	32	12.3	0.2	<0.1	<0.01	0.06	0.01	<0.02	7.71	7.1	850	864	0.8	662	260	366	--
4N/25W-28A1	5/24/2016	89	28	1	57	<10	330	111	46	22.8	0.4	0.1	<0.01	<0.03	0.02	<0.02	7.82	7.7	885	898	1.4	685	270	337	--
	11/7/2016	86	28	1	62	<10	310	79	85	42.7	0.4	<0.1	0.01	0.06	0.32	<0.02	7.62	6.8	920	954	1.5	694	250	330	--
4N/25W-28D2	5/11/2016	93	26	1	53	<10	290	131	37	13.2	0.3	0.1	<0.01	0.04	0.09	<0.02	7.71	7.1	887	962	1.3	644	240	339	--
	10/26/2016	94	27	1	50	<10	340	127	37	15.9	0.3	<0.1	<0.01	0.04	0.09	<0.02	7.79	6.8	854	906	1.2	692	280	346	--
4N/25W-28D2	5/11/2016	93	27	1	55	<10	340	128	39	13.5	0.3	<0.1	0.05	<0.03	0.01	<0.02	7.49	7	902	945	1.3	697	280	343	--
	10/26/2016	96	29	1	54	<10	340	127	39	16	0.3	<0.1	<0.01	<0.03	<0.01	<0.02	7.91	7	897	920	1.2	702	280	359	--
4N/25W-28F7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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4N/25W-28G3	6/1/2016	146	43	1	60	<10	330	178	54	66.3	0.3	0.1	<0.01	<0.03	<0.01	<0.02	7.82	7.1	1158	1200	1.1	879	270	541	--
	11/15/2016	133	38	1	52	<10	390	175	55	54.7	0.3	<0.1	<0.01	<0.03	<0.01	<0.02	7.88	7	834	1150	1	899	320	488	--
4N/25W-28H1	6/8/2016	121	35	1	49	<10	330	130	43	78.8	0.3	0.1	<0.01	0.03	<0.01	0.04	7.66	7.3	1005	1120	1	788	270	446	--
	11/7/2016	123	36	1	49	<10	360	134	48	87.5	0.3	<0.1	0.09	0.04	<0.01	0.05	7.56	6.9	1052	1100	1	839	290	455	--
4N/25W-28J1	5/24/2016	140	40	1	47	<10	380	179	54	25.7	0.4	<0.1	<0.01	0.05	<0.01	<0.02	7.61	7.4	1145	1200	0.9	867	310	514	--
	10/25/2016	143	41	1	47	<10	410	179	59	43.4	0.3	<0.1	<0.01	<0.03	<0.01	<0.02	7.63	6.9	1147	1180	0.9	924	340	525	--
4N/25W-29D7	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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4N/25W-29D8	5/16/2016	85	23	1	58	<10	330	122	44	9.1	0.4	0.1	<0.01	<0.03	0.11	<0.02	7.63	7.1	853	896	1.4	672	270	307	--
	10/24/2016	85	24	1	54	<10	330	111	43	8.3	0.2	0.1	<0.01	<0.03	0.1	<0.02	7.66	7.5	830	857	1.3	656	270	311	--
4N/25W-29D8	5/16/2016	85	23	1	60	<10	320	109	42	9.1	0.3	0.1	<0.01	<0.03	<0.01	0.05	7.65	7.2	863	899	1.5	649	260	307	--
	10/24/2016	86	24	1	56	<10	330	114	46	10.5	0.3	0.1	<0.01	<0.03	<0.01	<0.02	7.55	7.3	847	868	1.4	668	270	313	--
4N/25W-29K2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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4N/25W-29L1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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4N/25W-30D1																									
4N/25W-34A1	5/25/2016	154	49	3	106	<10	340	370	150	<0.4	0.5	0.3	<0.01	1.9	0.27	<0.02	7.61	7.3	1555	1620	1.9	1170	280	586	--
	11/2/2016	155	48	2	105	<10	390	329	135	<0.4	<0.1	0.2	<0.01	1.1	0.2	<0.02	7.48	6.9	1535	1600	1.9	1160	320	562	--
4N/25W-34G1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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4N/25W-34B4	5/24/2016	89	27	2	57	<10	290	109	77	4.4	0.4	0.2	<0.01	0.05	0.03	<0.02	7.91	7.2	895	939	1.4	656	240	333	--
4N/25W-35B5	5/24/2016	138	47	2	88	<10	270	260	101	21.1	0.3	0.3	<0.01	0.03	<0.01	0.25	8.15	7.6	1352	1430	1.7	927	230	538	--
	11/7/2016	102	34	2	78	<10	370	139	84	6.9	0.3	0.2	<0.01	0.06	<0.01	0.15	8.21	7.3	1090	1100	1.7	816	300	394	--
4N/25W-35E4	5/24/2016	146	50	3	149	<10	190	550	177	1.7	0.4	0.2	<0.01	0.48	0.08	<0.02	7.59	7.3	1663	1740	2.7	1270	150	570	--
	11/7/2016	148	51	3	152	<10	190	526	172	2.9	0.4	0.2	<0.01	1.3	0.08	<0.02	7.76	6.9	1661	1760	2.7	1250	150	579	--
4N/26W-13R1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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4N/26W-23A2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	10/28/2016	53	34	1	157	<10	370	140	116	7.8	0.9	0.4	<0.01	0.05	0.02	0.18	7.64	7	1231	1230	4.1	880	300	272	--
4N/26W-24F1	5/24/2016	78	36	1	135	<10	440	39	166	5.5	1.1	0.3	0.01	0.6	0.1	0.02	7.51	7	1238	1300	3.2	902	360	343	--
	10/25/2016	79	36	1	124	<10	370	45	151	4.3	1.1	0.3	<0.01	0.18	0.09	<0.02	8.17	6.9	1515	1240	2.9	812	300	345	--
Toro Creek	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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Arroyo Paredon Creek	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	10/25/2016	93	24	3	420	<10	540	30	610	0.8	3.3	6	<0.01	0.03	0.03	<0.02	8.45	7.7	255	274	10	1720	440	331	ND
Santa Monica Creek	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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Carpinteria Creek	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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Gobernador Creek	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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Rincon Creek	6/1/2016	110	57	2	143	<10	350	181	136	7.1	0.6	0.8	<0.01	0.05	<0.01	<0.02	8.67	7.7	1391	1450	2.8	987	280	509	<0.2
	10/25/2016	111	63	2	132	<10	480	186	151	20.2	0.5	0.6	<0.01	<0.03	<0.01	<0.02	8.17	7.6	1515	1560	2.5	1150	400	536	ND

Concentrations in milligrams per liter, except Electrical Conductance (micromhos/cm) and pH.
Non detected concentrations shown as < PQL (Practical Quantitation Limit)
Not Available = --