

# Water Year 2010 Biennial Review and Report Olympic Valley, California

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*Prepared for:  
Squaw Valley Public Service District*

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*Prepared by:*





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## ABBREVIATIONS

AB.....	Assembly Bill
ARR.....	Annual Review and Report
ASR.....	Aquifer Storage and Recovery
BRR.....	Biennial Review and Report
BMO .....	Basin Management Objective
cfs.....	Cubic Feet per Second
CHAMP .....	Chemical Application Management Plan
CRWQCB.....	California Regional Water Quality Control Board
CWC.....	California Water Code
DWR.....	California Department of Water Resources
EPA.....	United States Environmental Protection Agency
GMP .....	Groundwater Management Plan
GPM .....	Gallons per Minute
HSU .....	Hydrostratigraphic Unit
LLNL.....	Lawrence Livermore National Laboratory
MCL .....	Maximum Contaminant Limit
MG.....	Million Gallons
mg/L.....	milligrams/liter
ND .....	Non-Detect
NRCS.....	Natural Resources Conservation Service
RSC.....	Resort at Squaw Creek
SB .....	Senate Bill
SCADA .....	Supervisory Control and Data Acquisition
SVPSD .....	Squaw Valley Public Services District
SVWMC.....	Squaw Valley Mutual Water Company
TDS.....	Total Dissolved Solids
µg/L.....	micrograms/Liter
VOC.....	Volatile Organic Compound
WDR.....	Waste Discharge Requirements

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# SECTION 1

## INTRODUCTION

This report is the first biennial report to be prepared under the Olympic Valley Groundwater Management Plan (GMP). Previously, annual review and reports (ARR) were prepared for Water Years 2007 and 2008. Annual variations in groundwater conditions are small in Olympic Valley, and therefore the annual reports showed little year to year change. To avoid unnecessary production of repetitive reports, the Olympic Valley GMP implementation group opted to change from an annual to a biennial reporting schedule.

This biennial report summarizes the groundwater conditions in the basin during Water Years 2009 and 2010 (October 1, 2008 through September 30, 2010); and documents the status of groundwater management activities and recommended amendments to the GMP. The purposes of this report include:

- Providing a succinct description of current groundwater conditions in Olympic Valley.
- Providing all stakeholders data and analyses that can assist with groundwater management in Water Years 2011 and 2012.
- Detailing recent basin management activities.
- Recommending future groundwater management activities

This report is intended to provide information to all groundwater users and interested stakeholders in Olympic Valley. Stakeholders and groundwater users have identified that cooperative groundwater management is a priority for effectively managing the groundwater resources in Olympic Valley.

### 1.1 OLYMPIC VALLEY GROUNDWATER MANAGEMENT PLAN

The California Groundwater Management Act (California Water Code §10753 *et seq.*), enacted as Assembly Bill (AB) 3030 in 1992, encouraged local public agencies to adopt formal plans to manage groundwater resources within their jurisdictions. In September 2002, Senate Bill (SB) 1938 was signed into law amending sections of the Water Code related to groundwater management. SB1938 set forth specific requirements for GMPs including establishing Basin Management Objectives (BMOs), preparing a plan to involve other local agencies

in a cooperative planning effort, and adopting monitoring protocols that promote efficient and effective groundwater management.

In accordance with AB3030 and SB1938, the Squaw Valley Public Service District (SVPSD) developed a GMP in 2007 (HydroMetrics LLC, 2007). This plan was developed in coordination with input from a Stakeholders group that included representatives from other groundwater users, environmental advocates, regulatory agencies, and the general public. The SVPSD adopted the GMP on May 29, 2007. In accordance with the California Department of Water Resources (DWR) suggested components for a GMP (DWR, 2003) the Olympic Valley GMP included a requirement for regular reporting of groundwater activities and GMP implementation. This BRR is the vehicle for annually reporting on groundwater activities, and is an important component of the GMP implementation.

## **1.2 DESCRIPTION OF OLYMPIC VALLEY**

### **1.2.1 BASIN BOUNDARIES AND GMP MANAGEMENT AREA**

The GMP management area does not exactly coincide with the Olympic Valley Basin described in DWR Bulletin 118. The boundaries of the groundwater basin managed under the GMP are defined by geologic and hydrologic features that limit the movement of groundwater in the unconsolidated sediments filling Olympic Valley. These unconsolidated valley fill sediments are bounded by low permeability granitic and volcanic rocks on the north, west, and south. The hydrogeologic boundary shown on Figure 1 outlines the extent of the sediments filling the basin, extending to the Truckee River.

The GMP management area is a subarea of the unconsolidated sediments within the hydrogeologic boundary in Figure 1. The eastern end of the GMP management area is delimited by low permeability glacial moraine deposits. These moraine deposits are considerably less permeable than sediments in other parts of Olympic Valley and are interpreted to be a barrier to groundwater flow.



*Figure 1: GMP Management Area Boundary*



## 1.2.2 GEOLOGY OF GROUNDWATER BASIN SEDIMENTS

Groundwater extracted from Olympic Valley is derived primarily from unconsolidated sediments filling the Valley. These unconsolidated valley fill sediments are underlain by Cretaceous granitic rocks of the Sierra Nevada batholith and Pliocene volcanic rocks.

The unconsolidated sediments were deposited primarily by glacial, lacustrine, and fluvial processes. The most prominent glacial feature is the terminal moraine at the eastern end of the Valley. This moraine formed a dam in the Valley outlet. Various alluvial, glacial, and lacustrine sediments collected behind this dam, filling in the Valley to its present elevation. This moraine currently serves as a barrier to groundwater flow, and forms the eastern boundary of the area managed under the GMP, as discussed in Section 1.2.1.

Geological interpretation of the basin fill sediments is difficult because the alluvial and lacustrine deposits do not show any clear lateral continuity between wells. However, the sediments filling the Valley are generally coarser in the western part of the Valley and become finer towards the northeastern part of the Valley. This is consistent with the fact that Squaw Creek flows from west to east through the Valley. Coarser material is deposited by Squaw Creek proximal to the mountain front; finer material is carried farther downstream and deposited in the eastern portion of the Valley.

West Yost & Associates (2005) divided the basin sediments into three hydrostratigraphic units (HSU). HSU 1 is the shallowest unit. This unit consists of fine grained glacial lake and modern stream deposits. The modern Squaw Creek has cut channels in the lake deposits and deposited coarser grained stream sediments within the glacial sediments. HSU 2 underlies HSU 1 and consists of sands and gravels. West Yost & Associates interpreted these sediments as deposited by a stream between periods of glacial lake deposition. HSU 3, the deepest unit, consists primarily of fine grained sediments of very low permeability which may represent glacial lake or glacial till deposits.

### 1.2.3 WATER SUPPLY

All domestic, municipal, and irrigation water in Olympic Valley is derived from local groundwater sources. Groundwater is primarily extracted from glacial deposits and river alluvium filling Olympic Valley; a lesser amount is extracted from fractured bedrock along the sides of the Valley.

The bulk of the groundwater pumped from the Olympic Valley groundwater basin is pumped by three entities: SVPSD, Squaw Valley Mutual Water Company (SVMWC), and the Resort at Squaw Creek (RSC). Table 1 lists the quantities pumped from these three entities' Olympic Valley basin wells over the past two water years.

*Table 1: Major Pumping in Olympic Valley by Water Year*

Entity	Water Year 2009		Water Year 2010	
	Million Gallons	Acre-Feet	Million Gallons	Acre-Feet
SVPSD	105	322	113	347
RSC	data missing	data missing	55	169
SVMWC	28	86	23	71

A relatively minor amount of groundwater was pumped from the basin by PlumpJack Squaw Valley Inn and Squaw Valley Ski Corporation. Additional groundwater is pumped from outside the GMP management area from horizontal wells along the flanks of Olympic Valley, and from private wells such as the Poulsen Family well at the east end of the Valley. Because these wells lie outside the GMP management area, they are not discussed further in this report.



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## **SECTION 2**

### **DATA AVAILABILITY**

This section reviews the availability of various data relevant to groundwater management in Olympic Valley. This review includes a summary of the data available for Water Years 2009 and 2010, the data source, frequency, and the period of record.

#### **2.1 CLIMATE DATA**

Climate data are available from two stations within the Olympic Valley: the Old Fire Station precipitation gauge and the Squaw Valley SNOTEL snowpack measurement station.

##### **2.1.1 OLD FIRE STATION**

This station is operated by SVPSD and is located on the Valley floor within the GMP management area. Daily precipitation data are largely complete at this station from Water Year 1965 through the present. Daily precipitation data at the Old Fire Station is complete for the entire Water Year 2009 through 2010 period.

Two gauges currently operate at the old Fire Station: a Davis gauge which has operated since 2002, and the newer NovaLynx gauge which has operated since January 2009. The NovaLynx gauge was installed due to questionable accuracy of the Davis precipitation gauge in recent years. Prior to 2002, data were collected from the Old Fire Station by hand.

##### **2.1.2 SNOTEL SQUAW VALLEY**

The SNOTEL station is operated Squaw Valley Ski Corporation and is located west of the GMP management area at an elevation of 8,029 feet. Data from the SNOTEL station are shared with the Natural Resources Conservation Service (NRCS). Data are available for this station since January 1981. Available data include snow depth, precipitation, and temperature. Historical daily and monthly data are available on the internet.

## **2.2 PUMPING DATA**

Groundwater pumping data from within the GMP management area are available from SVPsD, SVMWC, and RSC. There are no data or estimates of pumping available from other pumpers within the groundwater management area. Total pumping other than SVPsD, SVMWC, and RSC is assumed to be relatively minor.

### **2.2.1 SVPsD PUMPING**

During Water Years 2009 and 2010, SVPsD pumped four wells within the GMP management area: wells SVPsD#1, SVPsD#2, SVPsD#3, and SVPsD#5. In addition, SVPsD also pumped groundwater from a horizontal well outside the GMP management area. The data from these wells are complete for Water Years 2009 and 2010.

### **2.2.2 SVMWC PUMPING**

During Water Years 2009 and 2010, SVMWC pumped two wells within the GMP management area: wells SVMWC#1 and SVMWC#2. In addition, SVMWC pumped water from their horizontal west well which is outside of the GMP management area. The pumping data from the two wells located in the GMP management area are complete for Water Years 2009 and 2010.

### **2.2.3 RSC PUMPING**

During Water Years 2009 and 2010, RSC pumped from three wells named 18-1, 18-2, and 18-3R into storage ponds. All water used by RSC for irrigation or snowmaking is pumped out of these ponds and passes through a single flow meter. Due to a change in Golf Course Superintendant, monthly data from September 2008 through April 2010 were lost and are therefore not available. Only monthly production data for a portion of Water Year 2010 are available and were provided by RSC.

## **2.3 HORIZONTAL WELL DATA**

At the request of the Basin Advisory Group, water produced from horizontal wells located along the edge of the Valley is reported in this BRR. SVPSD has two horizontal wells and SVMWC has one horizontal well. Each agency measures the monthly amount produced from their wells. Water from the horizontal wells is not derived from the groundwater basin, but may be viewed as intercepting potential recharge to the basin.

## **2.4 GROUNDWATER LEVEL DATA**

During Water Years 2009 and 2010, groundwater level measurements were available from three sources: SVPSD, SVMWC, and RSC's Chemical Application Management Plan (CHAMP) monitoring program (Figure 2).

### **2.4.1 SVPSD GROUNDWATER LEVEL DATA**

Groundwater levels are currently collected by SVPSD using level sensors with SCADA data loggers at wells SVPSD#1, SVPSD#2, and SVPSD#5. Groundwater level data from all of these wells are complete for Water Years 2009 and 2010. The SCADA for SVPSD#3 has not successfully been collecting data. Additional groundwater level data are collected from SVPSD monitoring wells SVPSD#5S, SVPSD#5D, SVPSD#4R, Poulsen shallow, Poulsen deep, PlumpJack shallow, and PlumpJack deep using Diver transducers that were installed in 2009 for the Creek/Aquifer Interaction Project. Due to some initial startup problems, some of the data for the monitoring wells were lost, however, these issues have been resolved and data are downloaded by SVPSD a minimum of twice a year per the Olympic Valley Monitoring Plan (HydroMetrics WRI, 2010).

### **2.4.2 SVMWC GROUNDWATER LEVEL DATA**

Up until the end of 2008, monthly static groundwater level measurements were collected by hand from wells SVMWC#1 and SVMWC#2. Since January 2009, only groundwater levels from SVMWC#1 have been collected. Groundwater level data for SVMWC#1 for Water Years 2009 and 2010 are complete.

### **2.4.3 RSC MEADOW AREA GROUNDWATER LEVEL DATA**

Groundwater levels are monitored by RSC at a number of wells in the Olympic Valley meadow. The monitoring is required by the California Regional Water Quality Control Board (CRWQCB) Order Number 6-93-26. This order incorporates provisions of RSC's Chemical Application Management Plan (CHAMP) including groundwater level monitoring.

Groundwater levels are measured during water quality sampling events specified in the revised Waste Discharge Requirements (WDR). The requirements were revised in May 2009, and state that all functioning meadow monitoring wells are to be monitored for static water level from May through October (CRWQCB, 2009). Previous to the 2009 WDR revision, shallow CHAMP wells were sampled every two years, and deep CHAMP wells were sampled every four years.

Since May 2009 groundwater level data have been collected during twelve sampling events: May through October 2009 and May through October 2010. These groundwater level data are complete. The monitoring wells from which levels were collected included well numbers 301 through 312, and 315 through 332.



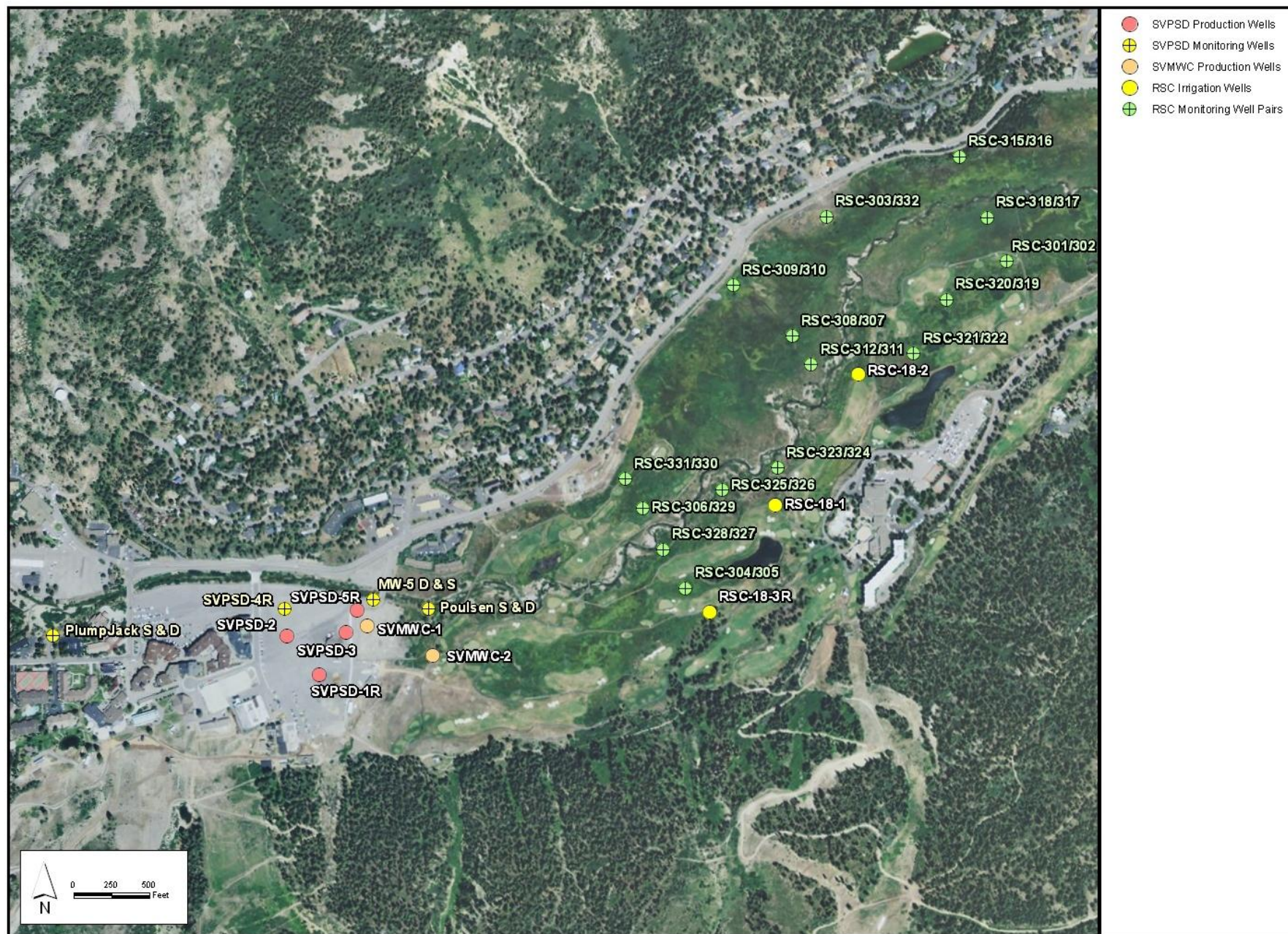


Figure 2: Well Locations for Groundwater Level Data

## **2.5 STREAM FLOW**

Three creek flow measurement gauges have operated in Olympic Valley since late fall 2002. The gauges are located on the Shirley Creek Fork of Squaw Creek, the South Tributary of Squaw Creek, and on Squaw Creek at the bridge east of the meadow. Reports summarizing each Water Year include a summary of visits, daily flow values, and the stage-discharge relation. Daily streamflow data are complete for Water Year 2009 and incomplete for Water Year 2010.

## **2.6 GROUNDWATER QUALITY**

Three sources of groundwater quality data are available: municipal supply data available from Title 22 drinking water requirements, data from regulated environmental compliance sites, and groundwater quality monitoring data from the CHAMP program at the golf course.

### **2.6.1 MUNICIPAL GROUNDWATER QUALITY**

Groundwater quality data from SVPSD and SVMWC municipal production wells are collected as required under the California Code of Regulations (CCR) Title 22 requirements.

#### *SVPSD*

During Water Years 2009 and 2010, groundwater quality data were collected at the SVPSD#1, SVPSD#2, SVPSD#3, and SVPSD#5 wells. These data are reviewed in Section 4.

#### *SVMWC*

During Water Years 2009 and 2010, groundwater quality data were collected by SVMWC at the SVMWC#1 and SVMWC#2 wells. These data are reviewed in Section 4.

### **2.6.2 ENVIRONMENTAL COMPLIANCE SITES**

There are no active CRWQCB cleanup sites within the GMP management area at this time. The most recent active site was at PlumpJack's Squaw Valley Inn, which was closed as of September 24, 2009. The last water quality data from this

site are from July 2008, which were included in the 2009 Annual Review and Report for Olympic Valley.

### **2.6.3 CHAMP PROGRAM**

The CHAMP program samples groundwater quality at 32 shallow and deep monitoring wells in the meadow. Currently, as per the revised WDR for the Resort at Squaw Creek, five monitoring wells are sampled monthly from May through October. The sampled wells are: SVPSD#5S, and RSC wells 305, 306, 322, and 301. Constituents currently analyzed include: dissolved nitrite (as nitrogen), dissolved nitrate (as nitrogen), dissolved kjeldahl nitrogen, dissolved total phosphorous, dissolved orthophosphate, pH, temperature, and electrical conductivity. The analyses of dissolved constituents, rather than total constituents, is a new requirement of the WDR. As such, there are no historical concentrations for these constituents to compare against.



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## SECTION 3

### GROUNDWATER SUPPLY ASSESSMENT

This section presents the status of the Olympic Valley Groundwater Basin during Water Years 2009 and 2010, including an analysis of stream flow, precipitation, pumping, and groundwater levels. Water Years' 2009 and 2010 hydrology are also compared to conditions of past years. In addition to reviewing the basin's groundwater conditions, the relation between stream flow, pumping, and groundwater levels in municipal production wells is examined in order to provide an understanding of the important variables controlling groundwater levels in the basin.

#### 3.1 PRECIPITATION

Snow-water equivalent precipitation measured at the NovaLynx Old Fire Station gauge equaled 56.52 inches during Water Year 2009 and 53.3 inches during Water Year 2010 (Figure 3). This precipitation is 109% and 102%, respectively, of the average annual Water Year precipitation of 52.0 inches measured between Water Year 1965 and Water Year 2008 using the Davis gauge.

Comparing data from the Davis gauge and the new NovaLynx gauge shows that there are discrepancies between their readings (Figure 3). Because of these differences, it is not feasible to combine the two gauges' data to calculate a long term annual average that includes Water Years 2009 and 2010. In order to get the long term average precipitation for this location, it will be necessary to correlate all nearby precipitation data through the use of double mass curves and other climatological techniques. These analyses are not part of the scope of this report.

Snow-water equivalent precipitation measured at the Squaw Valley SNOTEL station equaled 58.2 inches during Water Year 2009 and 58.6 inches during Water Year 2010. This precipitation is 89% and 90%, respectively of the average annual Water Year precipitation of 65.2 inches, and was an increase from Water Years 2007 and 2008.

Total annual precipitation by Water Year for the Old Fire Station gauges is presented in Figure 3. A horizontal line on Figure 3 shows the average precipitation for Water Year 1965 through Water Year 2008 for the Davis gauge. The NovaLynx Gauge WY 2009 column on Figure 3 includes October 2008



through December 2008 data from the Davis gauge, and January 2009 through September 2009 from the NovaLynx gauge. This is because the NovaLynx Gauge only started recording data in January 2009.

Total annual precipitation by Water Year for the Squaw Valley SNOTEL Station is presented in Figure 4. A horizontal line on Figure 4 shows the average SNOTEL precipitation for Water Year 1981 through Water Year 2010.

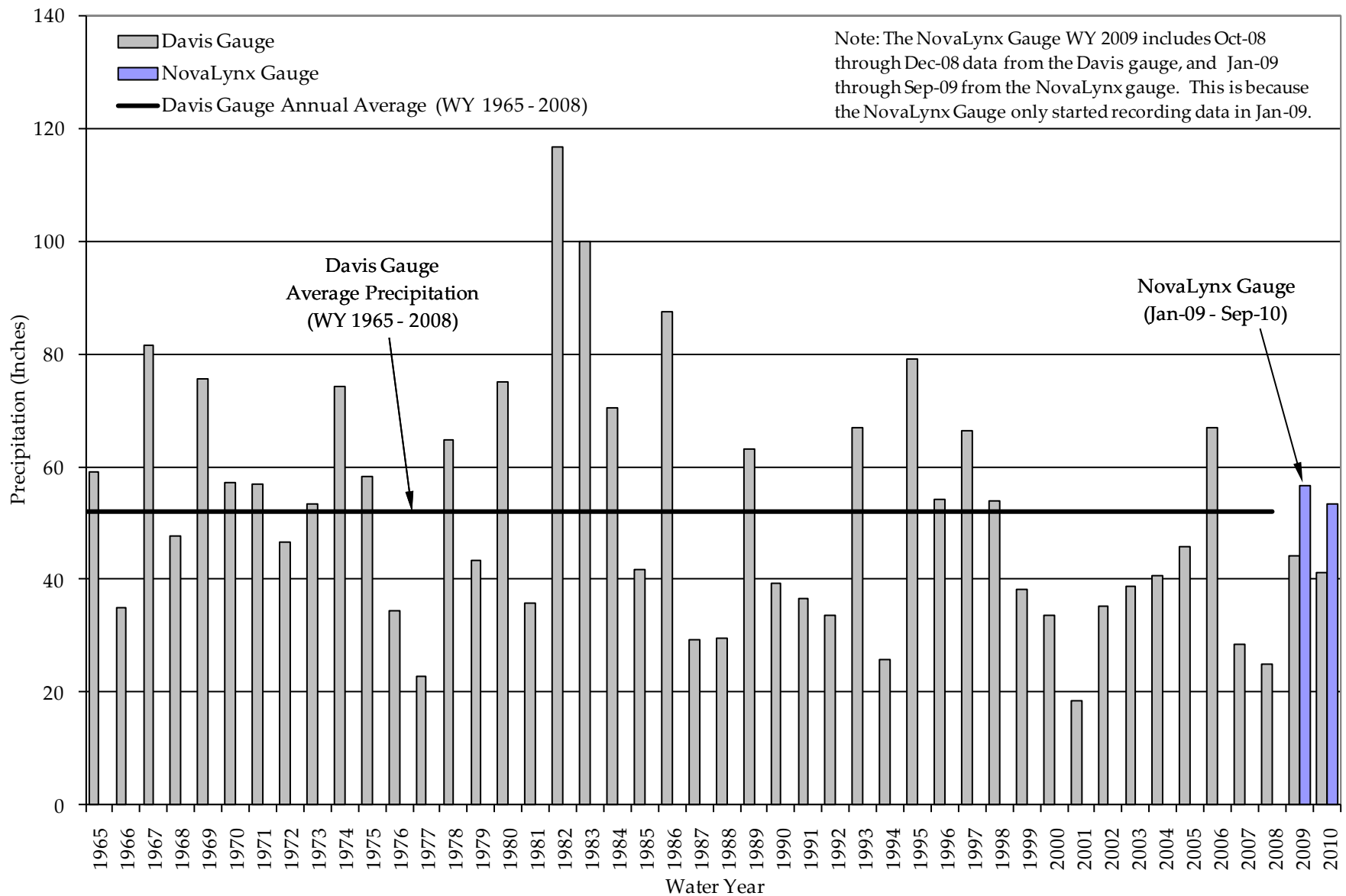


Figure 3: Olympic Valley Precipitation by Water Year: Old Fire Station

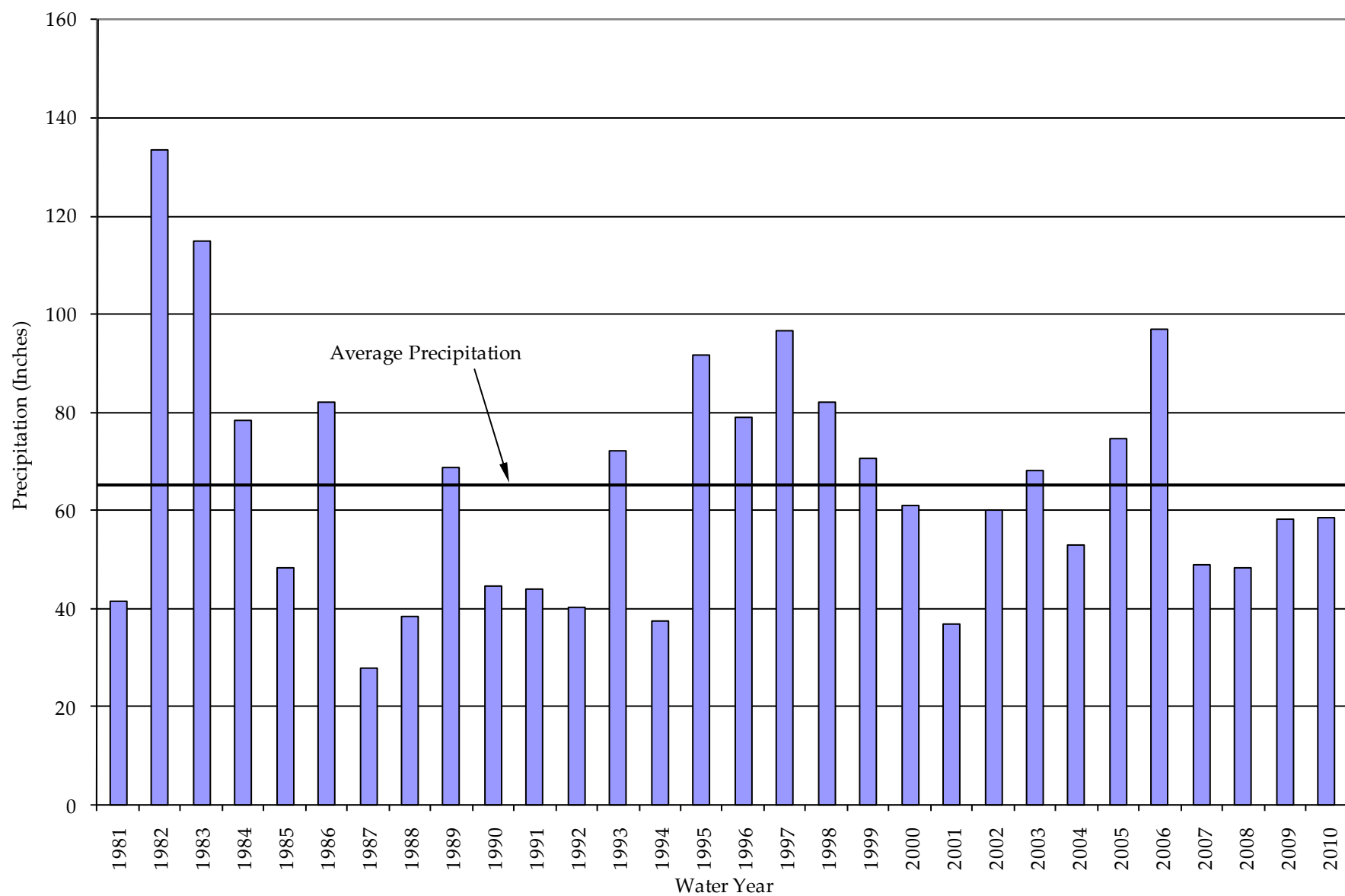


Figure 4: Olympic Valley Precipitation by Water Year: Squaw Valley SNOTEL Station

### 3.2 STREAMFLOW

Flow in Squaw Creek is measured at three gauges, shown in Figure 5. The two main forks of Squaw Creek are gauged at the eastern end of the Valley, just outside the GMP management area. The northern gauge, QV1, measures flow in Shirley Canyon Creek and the southern gauge, QV2, measures flow in the South Fork of Squaw Creek. Gauge QV3 measures flow downstream of the terminal moraine, east of the GMP management area boundary.

Total annual volumes of flow in Squaw Creek at the three gauges for Water Years 2003 through 2010 are provided in Table 2. This table shows that for Water Year 2009, the total flow of Squaw Creek entering Olympic Valley (sum of QV1 + QV2) increased closer to normal volumes. Due to various problems: issues with the power supply at the South Tributary gauge (QV1), bubblers at the Shirley Creek gauge (QV2), and changing streambed conditions at the Squaw Creek gauge (QV3), there are a number of data gaps and data quality issues in the streamflow data for Water Year 2010. Sound Watershed Consulting plans to apply regression relationships to fill the data gaps, but will not be completed before the due date of this report.

*Table 2: Total Water Year Discharge at Squaw Creek Gauges*

Water Year	QV1 Shirley Creek (acre-feet)	QV2 South Tributary (acre-feet)	Sum QV1 + QV2 (acre-feet)	QV3 Squaw Creek (acre-feet)
2003	10,100	5,890	15,990	19,000
2004	6,820	4,020	10,840	15,300
2005	14,750	8,420	23,170	24,300
2006	17,340	7,840	25,180	33,940
2007	5,750	4,380	10,130	11,380
2008	5,443	3,587	9,030	12,540
2009	8,527	5,640	14,167	18,239
2010	missing data	missing data	missing data	18,169

Water Year 2003 and 2004 data from West Yost & Associates 2005

Water Year 2005 through 2008 data provided by Watermark Engineering

Water Year 2009 through 2010 data provided by Sound Watershed Consulting



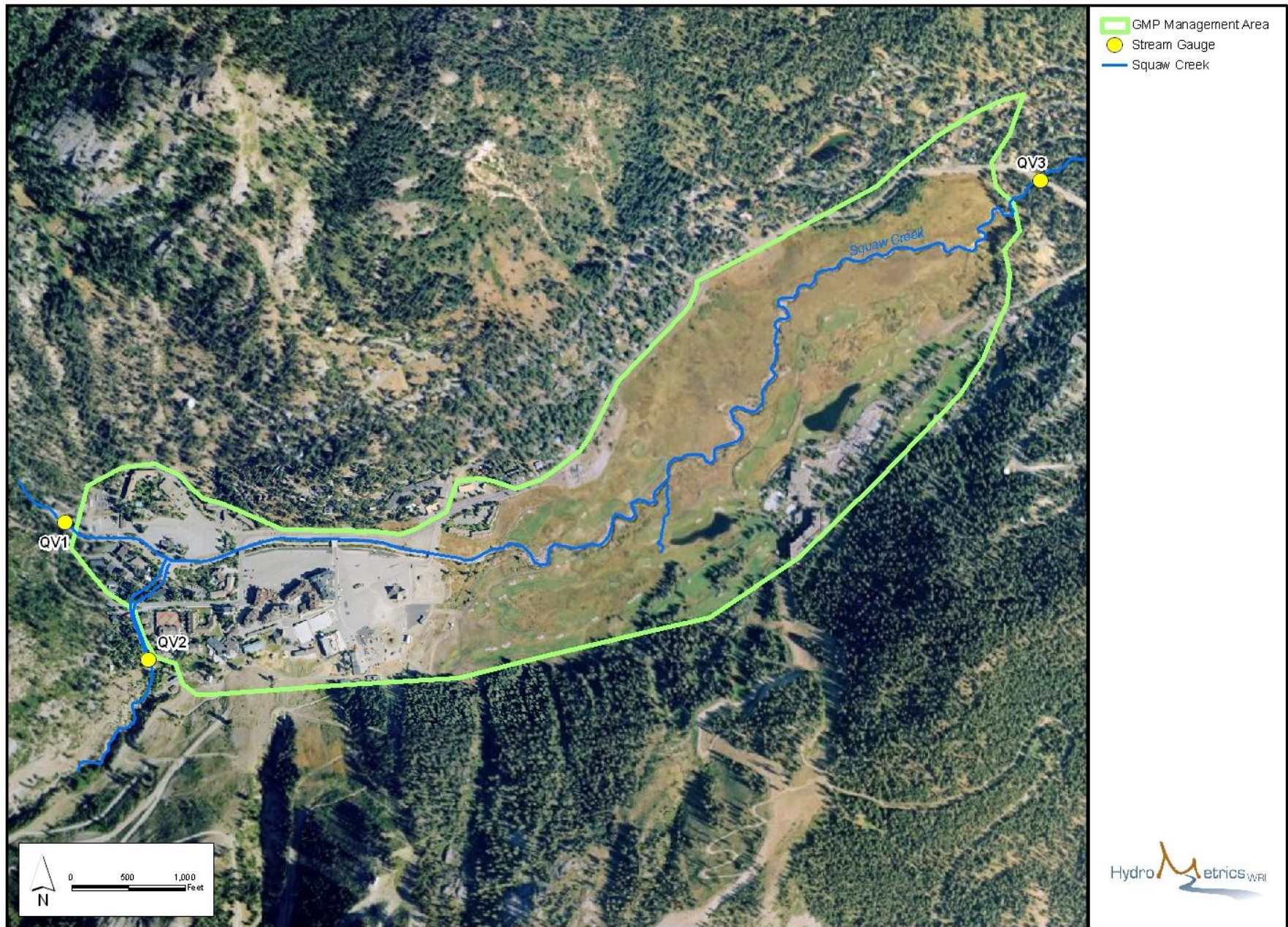


Figure 5: Stream Gauge Locations



Table 2 shows that there is a net gain to Squaw Creek within the GMP management area every year, indicating that more water flows out of the GMP management area through Squaw Creek than flows into the area through the two main forks of Squaw Creek. During Water Year 2009, the GMP management area was a net source of 1,326 MG (4,072 acre-feet) of water to Squaw Creek. Due to missing data, the net gain volume could not be calculated for Water Year 2010.

Mean daily streamflow in Squaw Creek at each of the three gauges during Water Years 2009 and 2010 is presented in Figure 6 and Figure 7, respectively. Intermittent flows in Squaw Creek begin in October, with sharp spikes during storms and low flows in between storms. Beginning around March, the hydrograph character changes at the three gauges; the daily discharge increases and is continuously higher. This more continuous flow starting in March is due to the contribution of snowmelt to streamflow.

Mean daily streamflow at gauge QV3 for Water Years 2007, 2007, 2008 and 2010 are presented in Figure 8. The daily discharge in Squaw Creek was much higher in Water Years 2009 and 2010 than in the preceding two water years. This higher discharge reflects the higher precipitation during these two water years. Peak daily discharge was 87 and 179 cubic feet per second (cfs) in Water Years 2007 and 2008, respectively. Peak mean daily discharge in Water Years 2009 and 2010 was 335 and 281 cfs, respectively.

The upper two graphs in Figure 8 show flow at gauge QV3 during Water Years 2007 and 2008 approaching zero in mid July. The bottom graph shows flow during Water Years 2009 and 2010 approaching zero in early to mid August. The flow at gauge QV3 during Water Years 2009 and 2010 is more similar to pre-Water Year 2007 flows. This shift in timing of the start of zero streamflow reflects the higher precipitation during the two most recent water years allowing for more normal snowmelt patterns.

The average annual volume of water flowing through Squaw Creek is far greater than the volume of groundwater pumped from the basin. Average annual discharge volume at QV3 during the last eight water years was 19,110 acre-feet (6,225 MG). Water Years 2009 and 2010 QV3 discharge volume was 18,240 acre-feet (5,940 MG) and 18,170 acre-feet (5,920 MG), respectively; approximately 25 times the average annual volume of 718 acre-feet (234 MG) pumped from the GMP management area.

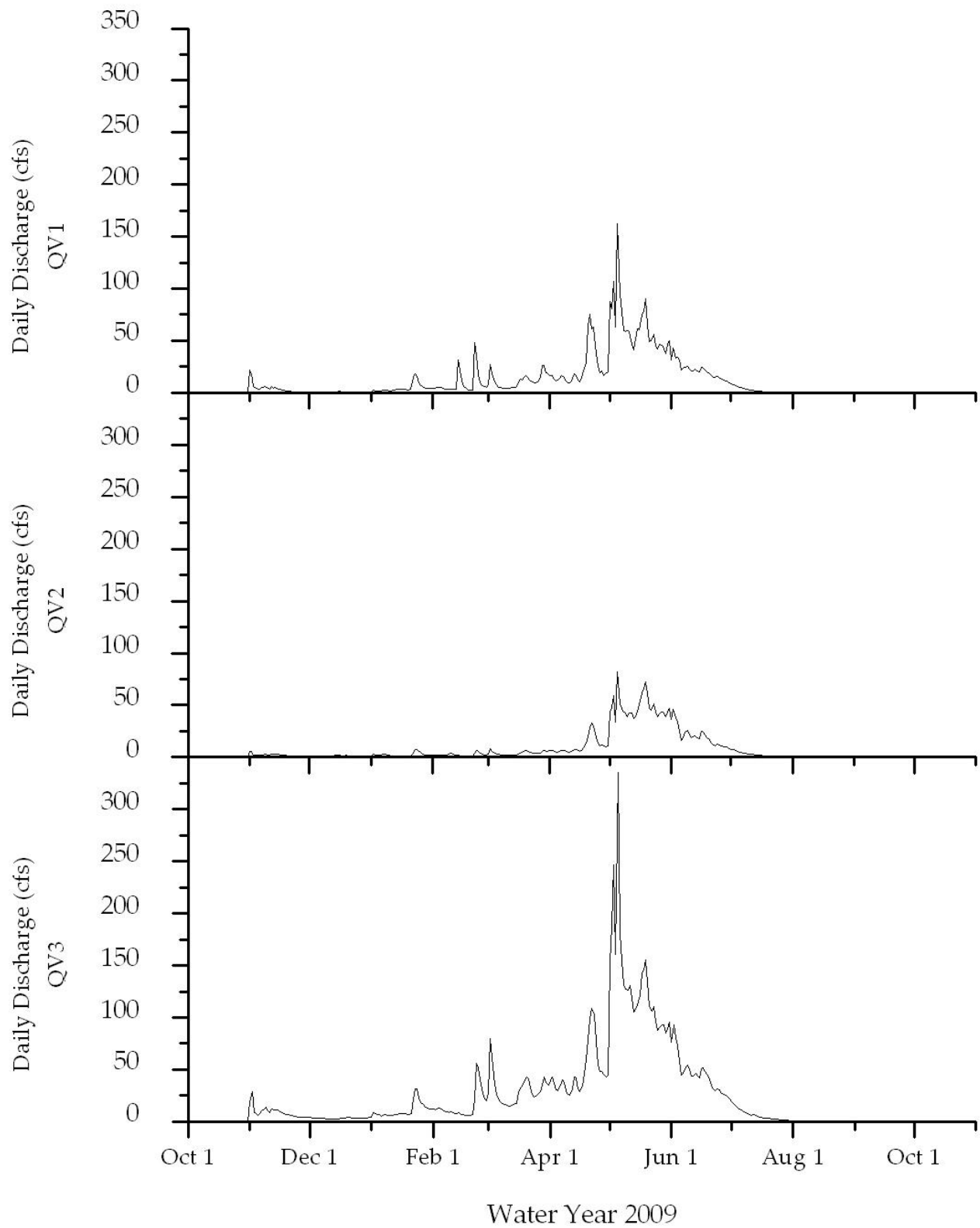


Figure 6: Water Year 2009 Mean Daily Streamflow

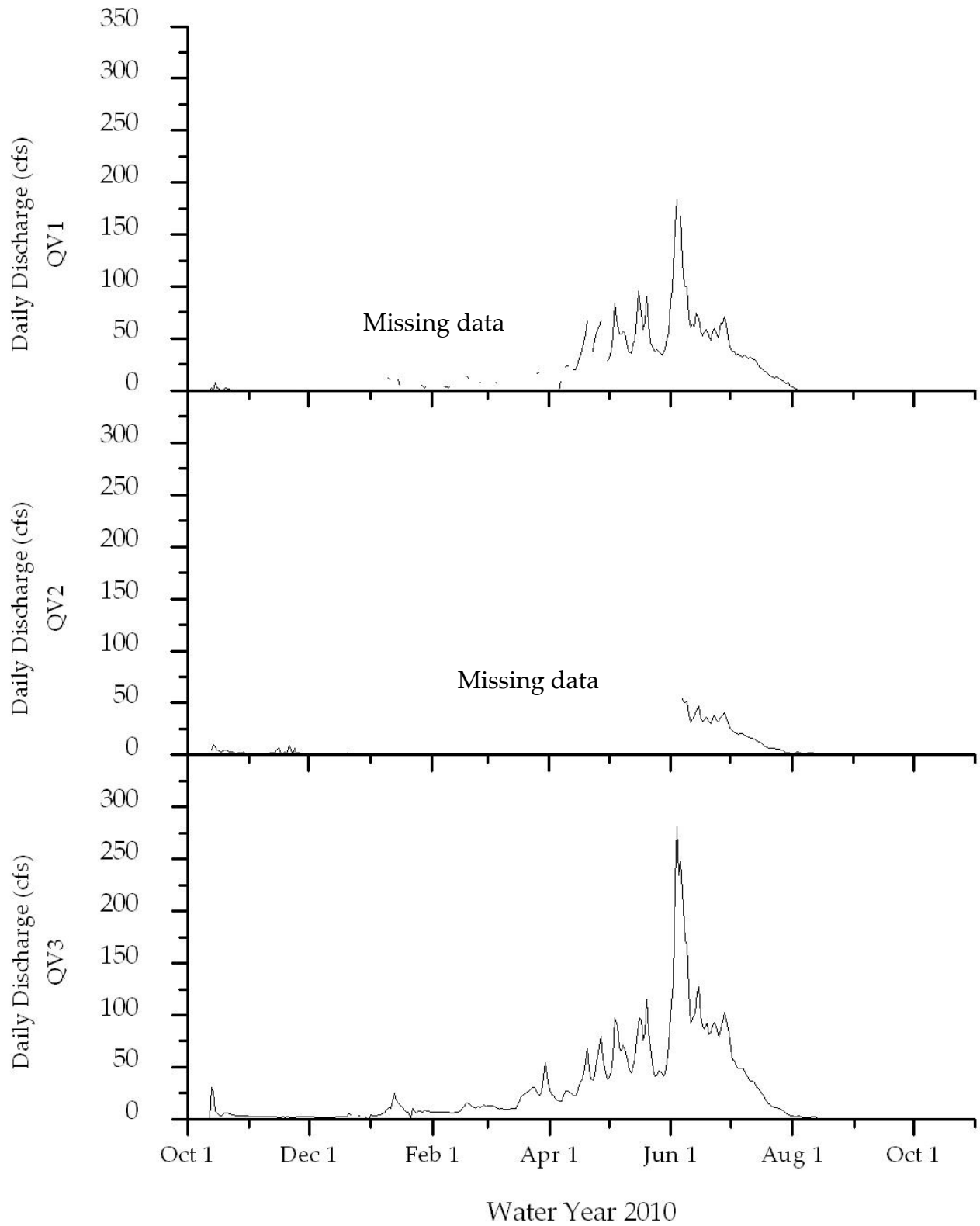


Figure 7: Water Year 2010 Mean Daily Streamflow

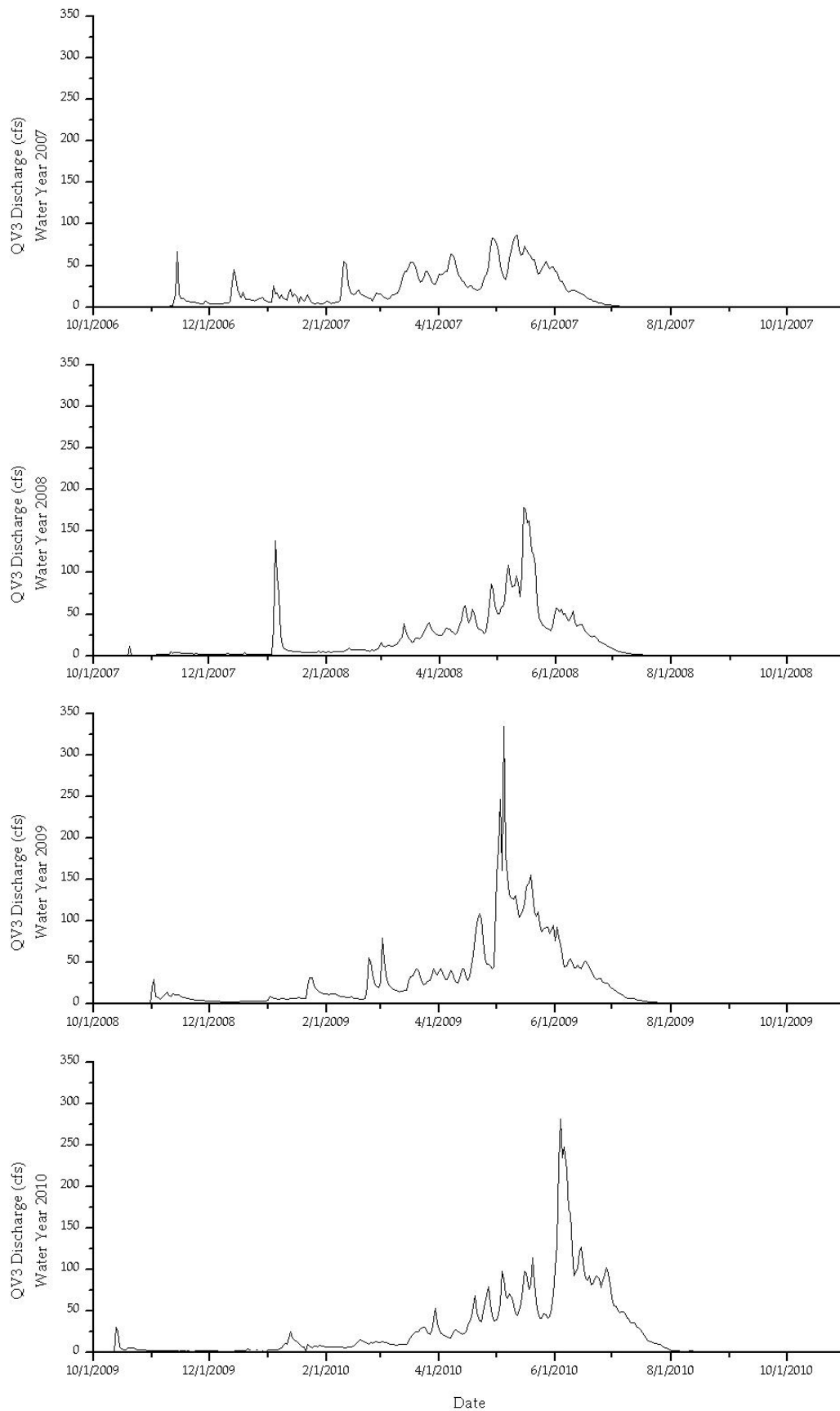


Figure 8: Mean Daily Streamflow at QV3 during 2007, 2008, 2009, and 2010

### 3.3 GROUNDWATER PUMPING

Groundwater is extracted from the GMP management area by SVPsD, SVMWC, RSC, PlumpJack Squaw Valley Inn, and Squaw Valley Ski Corporation. These entities pump from a total of fourteen wells. Four wells are currently pumped by SVPsD, two wells are pumped by SVMWC, three wells are pumped by the Resort at Squaw Creek, one well is pumped by PlumpJack Squaw Valley Inn, and four wells are pumped by Squaw Valley Ski Corporation. The quantities of groundwater pumped by the PlumpJack Squaw Valley Inn and Squaw Valley Ski Corporation are assumed minor compared to the pumping by the other three entities. There are no other known groundwater extractors in the GMP management area.

Figure 9 shows the locations of the known active production wells in the GMP management area. The vertical bars at each well represent the relative volume of pumping at each well during Water Years 2009 and 2010. The Resort at Squaw Creek does not monitor pumping at each individual well. The distribution of water pumped by RSC's wells was based on estimates provided by AMEC for pumping from May through October, between 2002 and 2006. The average pumping percentage for each RSC well was applied to the Water Years 2009 and 2010 pumping to develop the distribution shown on Figure 9.

#### 3.3.1 PUMPING TRENDS

Historical pumping by Water Year is shown in Figure 10. Total pumping in this figure includes only pumping from SVPsD, SVMWC, and RSC. All other pumping is considered minor. Pumping data are incomplete for Water Years 2005, 2006, and 2009; incomplete data records are shown in red on the Figure 10. Pumping presented in this report includes only pumping from the GMP management area, and does not include pumping from SVPsD and SVMWC horizontal wells.

Between Water Years 1993 and 2010 (excluding 2005 and 2006 for all pumpers, and excluding 2009 for RSC), SVPsD, SVMWC, and RSC pumped an average of 234 MG (718 acre-feet) per year. The average pumping for each entity is approximately:

- SVPsD - 128 MG (387 acre-feet)
- SVMWC - 31 MG (95 acre-feet)
- RSC - 75 MG (230 acre-feet).



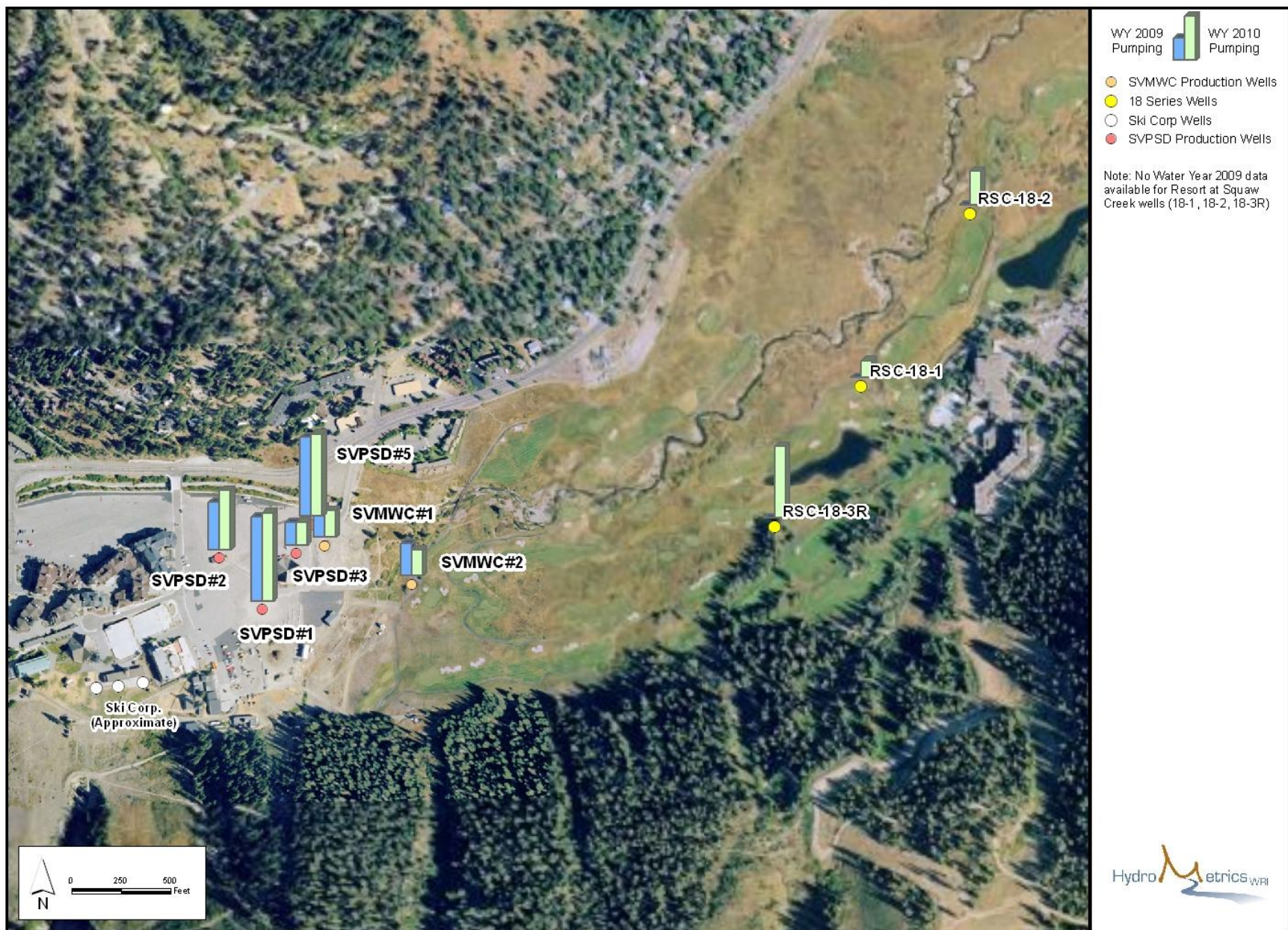


Figure 9: Production Well Locations and WY 2009 and 2010 Pumping Quantities

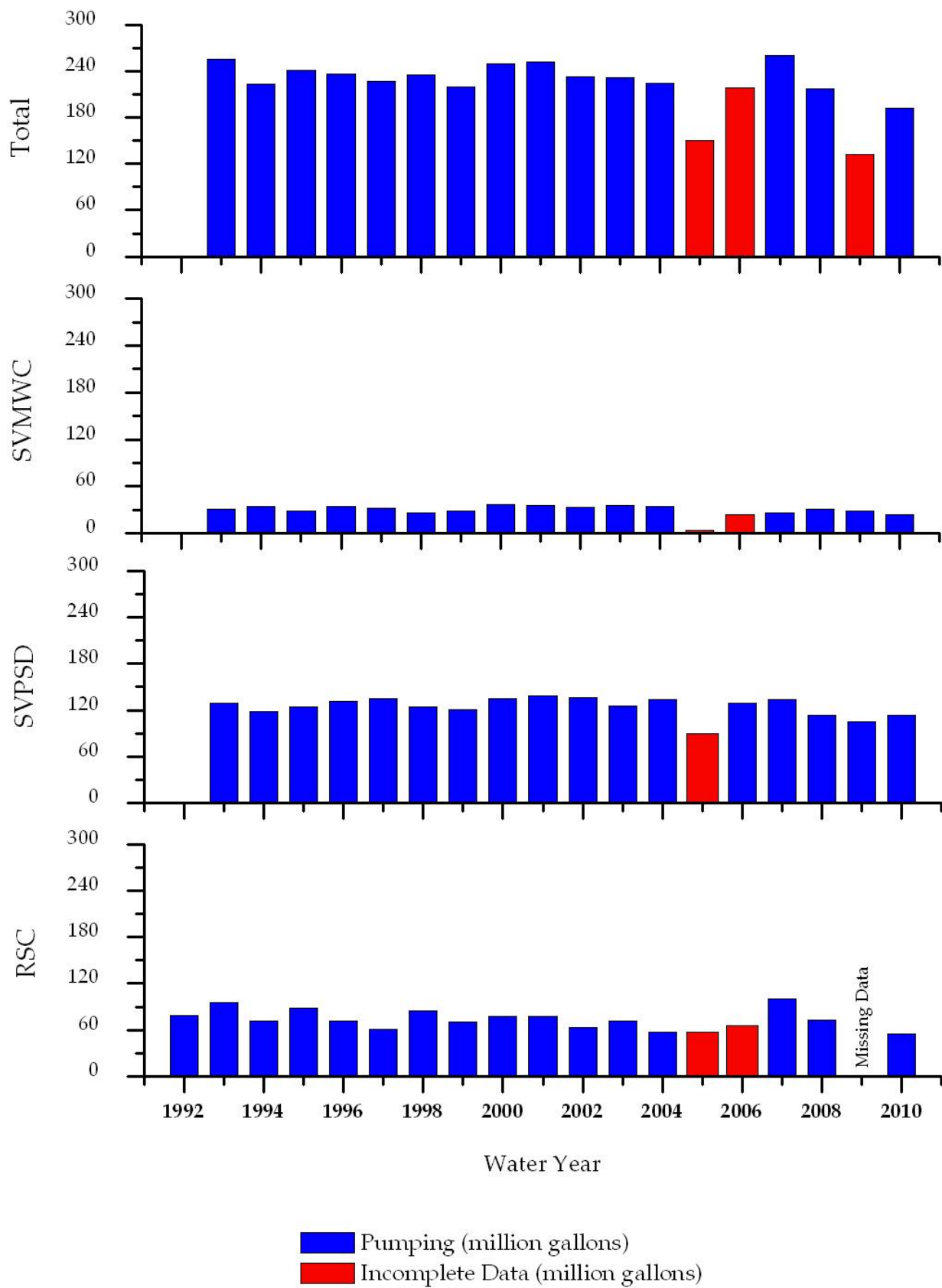
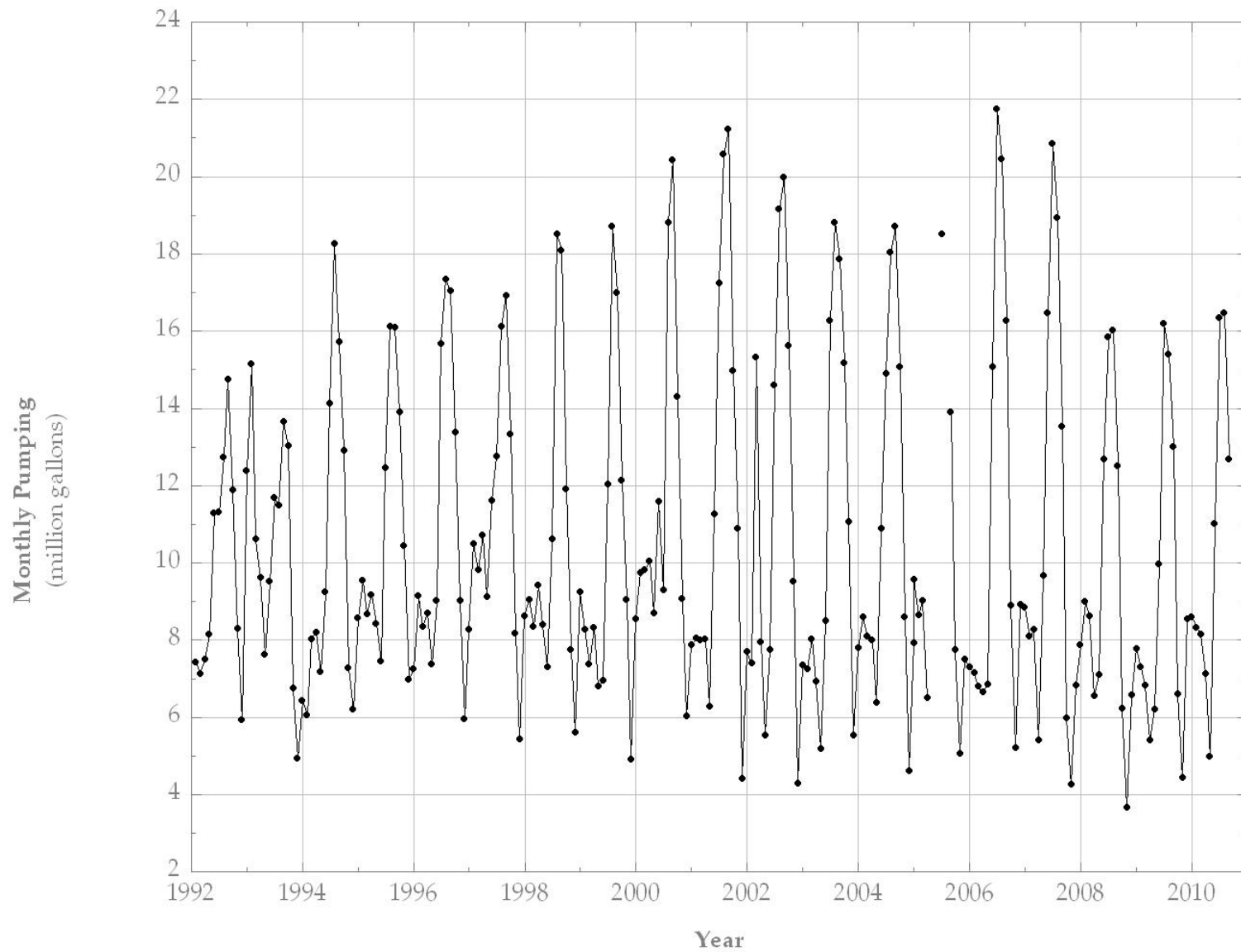


Figure 10: Annual Pumping by Water Year

The total pumping recorded for Water Year 2009 was 132 MG (405 acre-feet), excluding RSC pumping for which data were not available; and for Water Year 2010 it was 192 MG (589 acre-feet). Water Year 2010 pumping was 18% lower than the long term average pumping. No clear long-term trends are seen in the annual pumping for SVMWC, SVPSD, or RSC.

Historical monthly SVPSD pumping is presented in Figure 11. The monthly pumping peaks on this graph occur in the summer due to increased irrigation demand. The annual peaks in monthly pumping for Water Years 2009 and 2010, remained at a similar level to 2008 (approximately 16 MG), which marked a break from the previous trend of increasing annual peak monthly pumping.

Figure 12 presents a plot of total precipitation and total pumping by water year. The plot shows that there is no strong correlation between total annual pumping and precipitation, implying that the total amount of precipitation does not have a significant effect on water demand. A drought will not cause water supply problems through an increase in demand. This is partially due to lower winter demands during droughts, when ski seasons are shortened.



*Figure 11: Historical Monthly SVPsD Pumping*



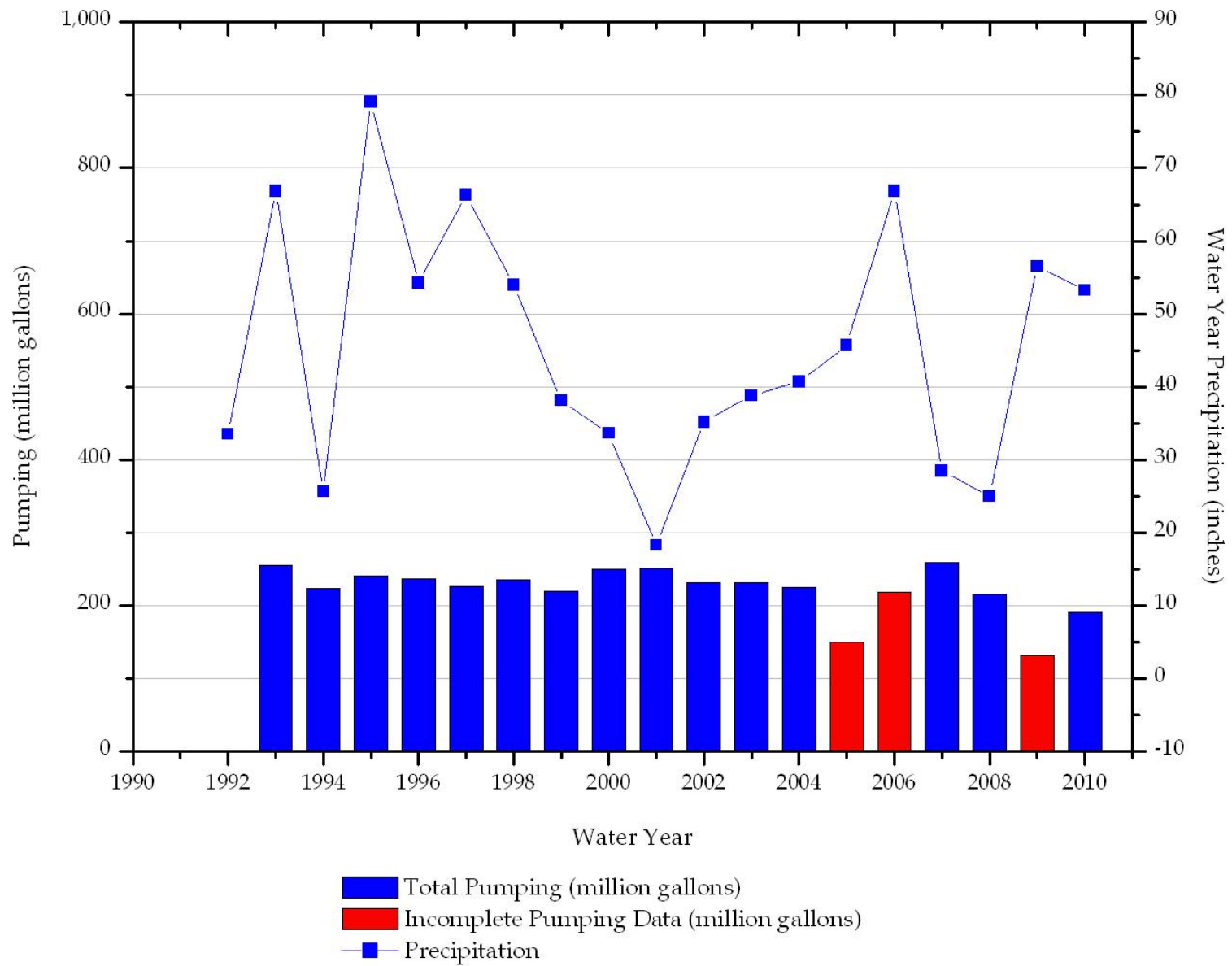


Figure 12: Historical Water Year Precipitation and Water Year Pumping



### **3.3.2 WATER YEAR 2009 MONTHLY PUMPING DISTRIBUTION**

Monthly pumping volumes for Water Year 2009 are presented in Figure 13. Total pumping shown in the top graph is the sum of the RSC, SVPSD, and SVMWC pumping shown in the three lower graphs. Note that no data were available for RSC wells due to a change in golf superintendant and the misplacing of data during the transition. The monthly total pumping volume usually has two peaks during each water year: a smaller December peak primarily due to pumping by RSC for snowmaking, and a second larger peak in July in response to increased irrigation demand by SVPSD and SVMWC customers, as well as peak irrigation pumping by RSC. Figure 13 does not reflect the smaller December peak due to the lack of RSC data, although it probably did occur. The lowest monthly demand occurs in April after snow making is over and irrigation demand is just beginning.

### **3.3.3 WATER YEAR 2010 MONTHLY PUMPING DISTRIBUTION**

Monthly pumping volumes for Water Year 2010 are presented in Figure 14. Total pumping shown in the top graph is the sum of the RSC, SVPSD, and SVMWC pumping shown in the three lower graphs. The monthly total pumping volume had two peaks during Water Year 2010. The greatest pumping volume occurred in July. This peak in pumping is due to increased irrigation demand by SVPSD and SVMWC customers as well as peak irrigation pumping by RSC. The smaller December peak in total pumping is primarily due to pumping by RSC for snowmaking. The lowest monthly demand occurs in April after snow making is over and irrigation demand is just beginning.

### **3.3.4 PUMPING PATTERNS**

Figure 9 shows the relative distribution of pumping throughout Olympic Valley. Only SVPSD, SVMWC and RSC pumping is shown on Figure 9. The height of each bar on this figure is proportional to the total pumping at each well. Since only total pumping volumes are known for the RSC wells, the volumes pumped separately from each of these wells were estimated based on an analysis by AMEC for the RSC Phase II expansion.

Pumping patterns have not changed significantly in recent years. This is due to two factors:

1. There are a limited number of entities that pump groundwater from the Olympic Valley basin.
2. There have been no new production additional wells in the basin and the pumping distribution remains relatively constant among the existing wells.

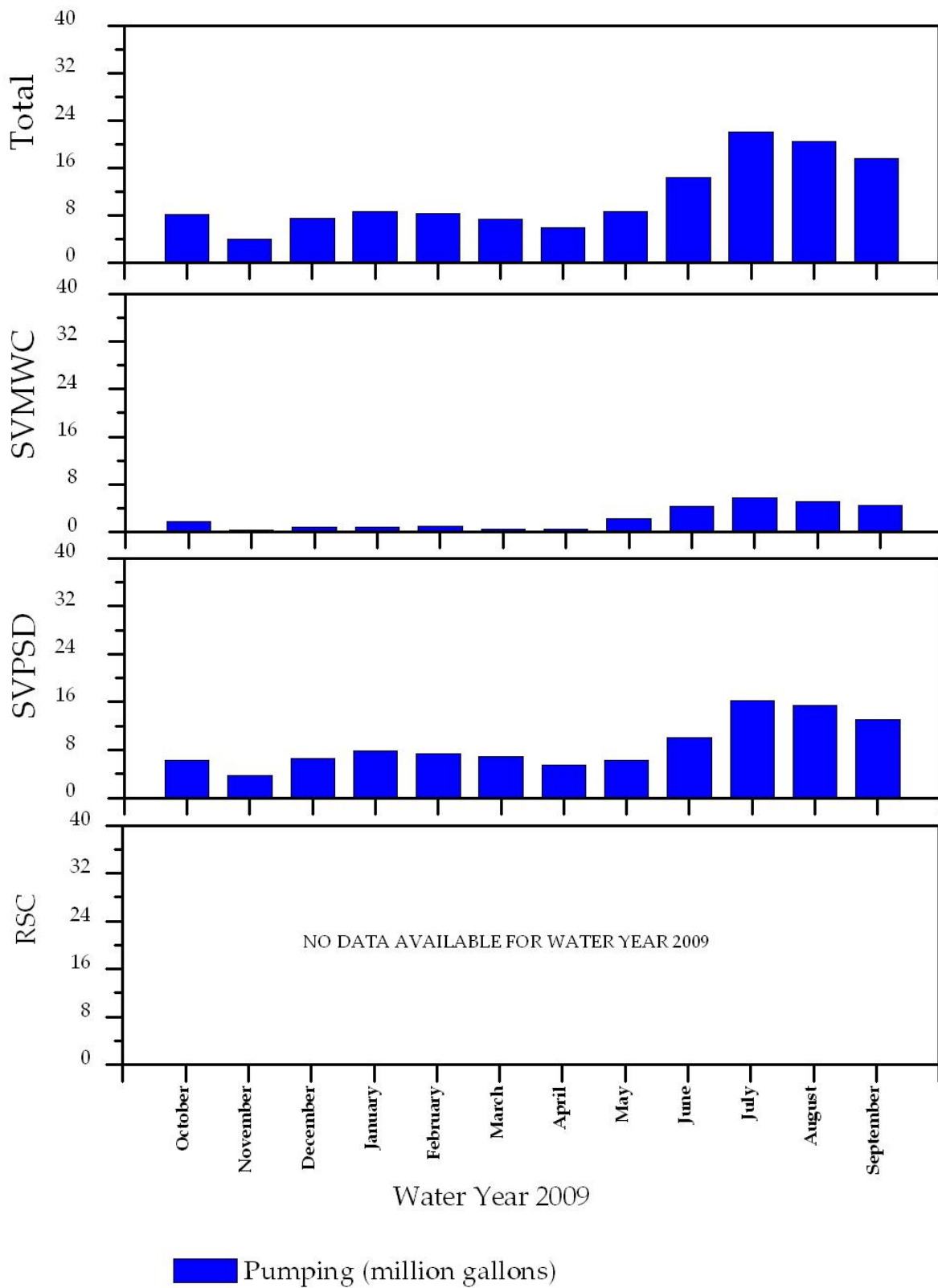
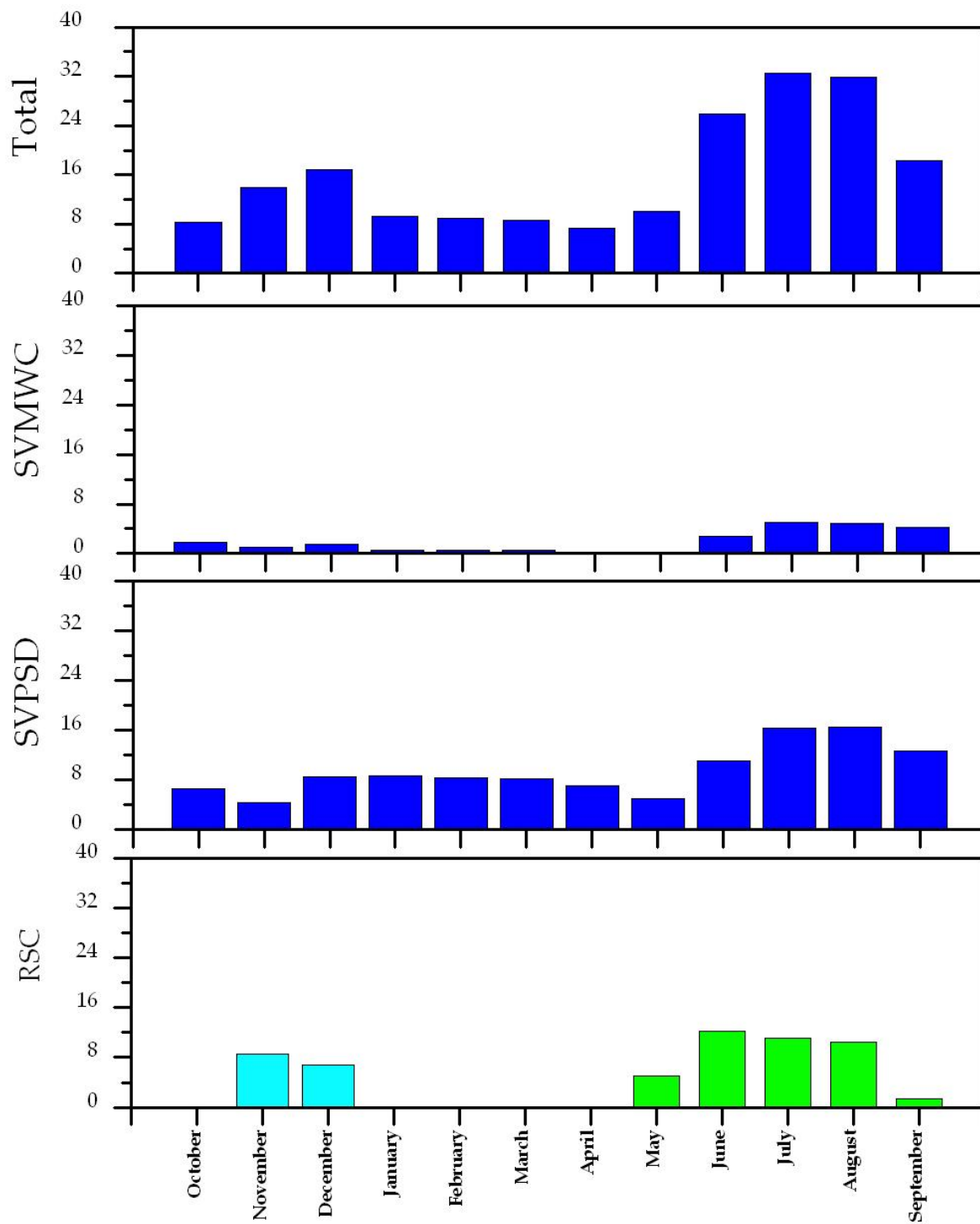


Figure 13: 2009 Water Year Monthly Pumping Distribution



Water Year 2010

- Pumping (million gallons)
- Snow Making Pumping (million gallons)
- Irrigation Pumping (million gallons)

Figure 14: 2010 Water Year Monthly Pumping Distribution

### 3.4 HORIZONTAL WELL PRODUCTION

SVPSD produced 6.9 and 7.5 MG (21 and 23 acre-feet) from their two horizontal wells, for Water Year 2009 and 2010 respectively. SVMWC produced 13 MG (40 acre-feet) for both Water Year 2009 and Water Year 2010. Annual production for each agency and the total from SVPSD and SVMWC horizontal wells is shown on Figure 15.

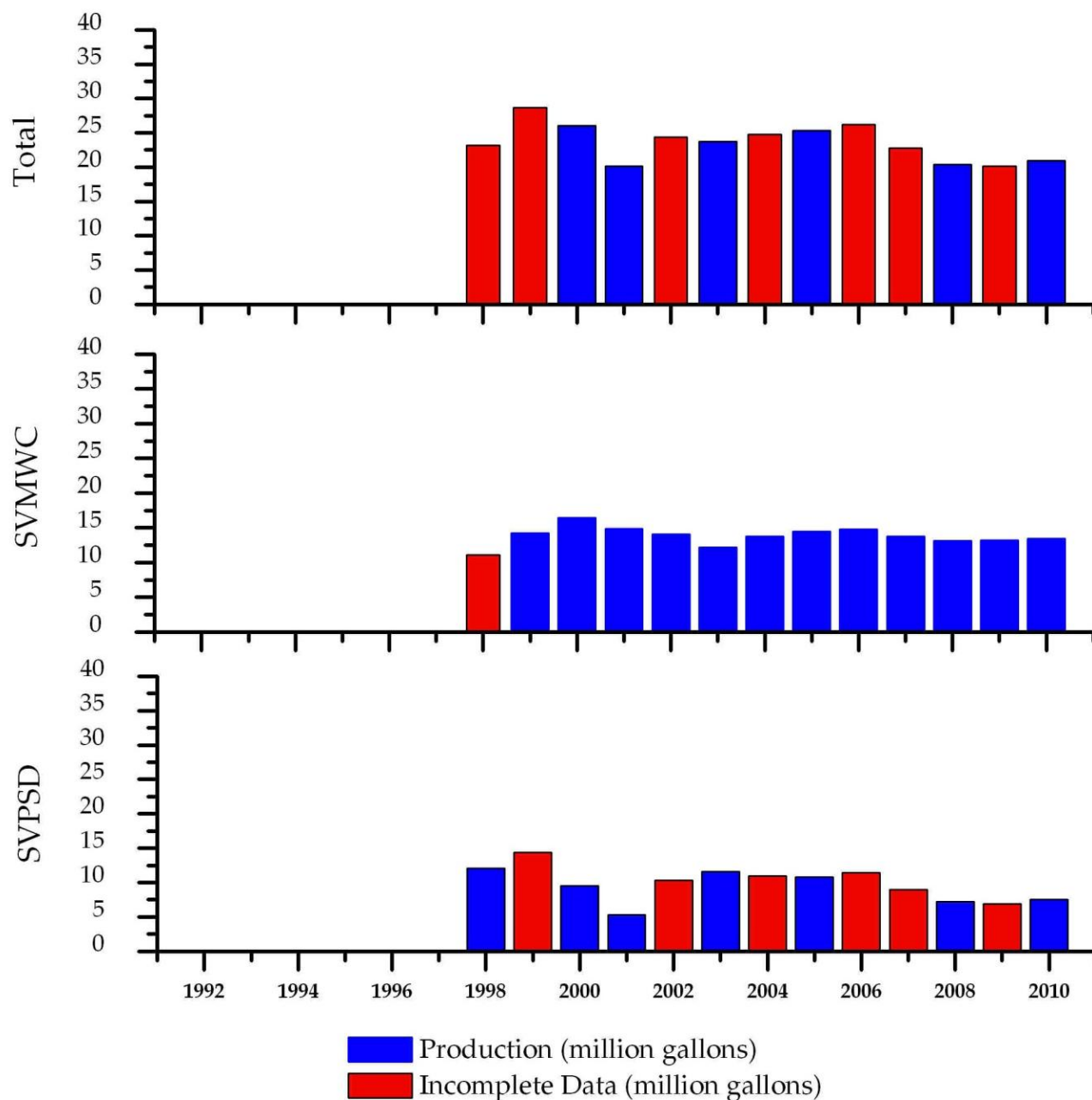


Figure 15: Annual Horizontal Well Production by Water Year



## 3.5 GROUNDWATER LEVELS

### 3.5.1 HYDROGRAPHS

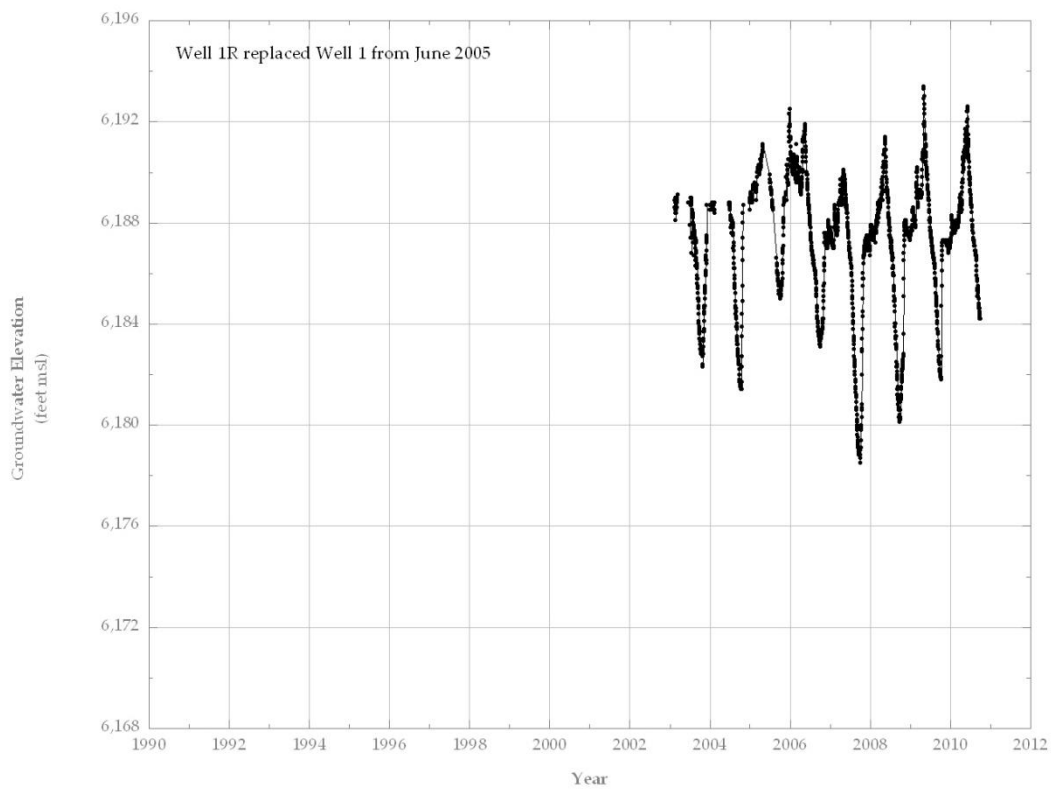
Hydrographs in this report are grouped by location. Most of the pumping is concentrated in the west end of the basin, and consequently groundwater levels are more strongly influenced by pumping in this area. In the meadow area, there is relatively little or no pumping; hydrographs from meadow wells show little fluctuation from pumping.

#### *WEST END OF GROUNDWATER BASIN*

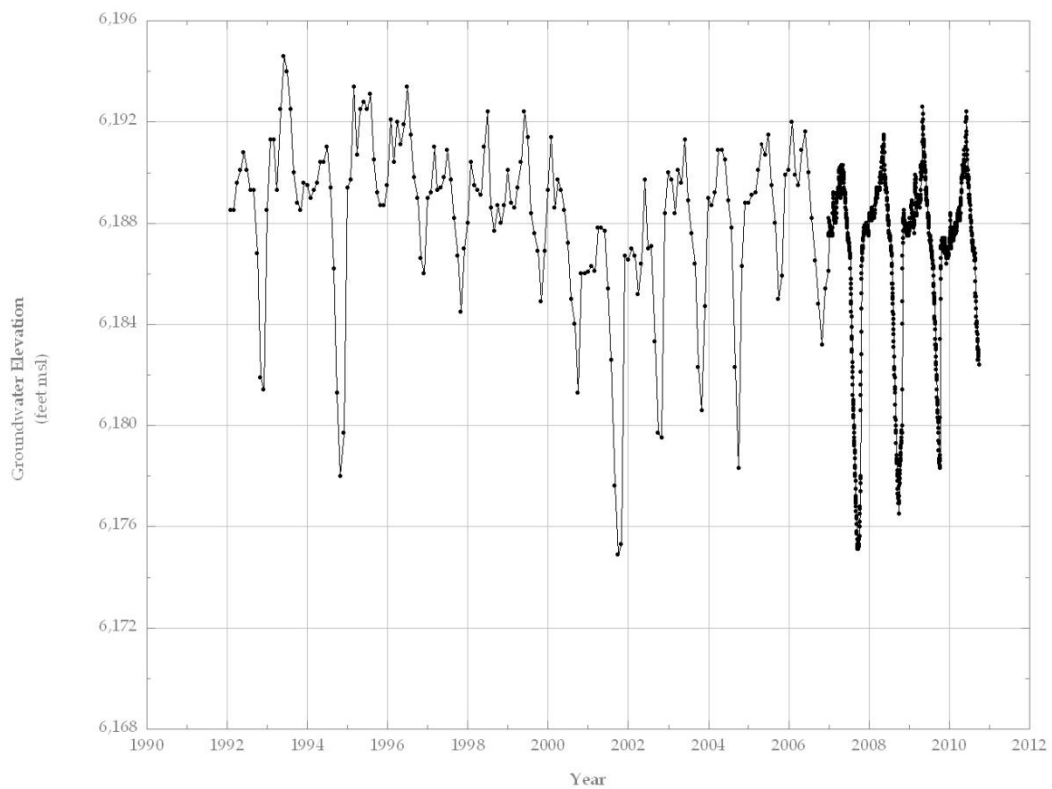
Hydrographs of historical groundwater levels from ten wells in the western portion of the groundwater basin are shown in Figure 16 through Figure 22. Hydrographs from the SVPD#4R, SVPD#5S, SVPD#5D, Poulsen shallow, Poulsen deep, PlumpJack shallow, and PlumpJack deep wells (Figure 19 through Figure 22) were not included in previous annual reports. All seven of these wells were equipped with groundwater level transducers in 2009 as part of the Creek/Aquifer interaction project. The transducers log groundwater levels every hour, collecting the abundant data that produce informative hydrographs.

Hydrographs for wells SVPD#1, SVPD#2, and SVPD#5 show that the lowest annual groundwater levels, measured during autumn, have been rising since 2007. More water is remaining in the basin at the end of summer. This could possibly be attributed to the approximately 4 MG reduction in peak pumping during 2008 through 2010 compared to 2007. The hydrographs also show that the highest annual groundwater levels, measured in spring, rose through 2009, then dipped slightly in 2010. This follows the pattern of increasing precipitation through 2009.

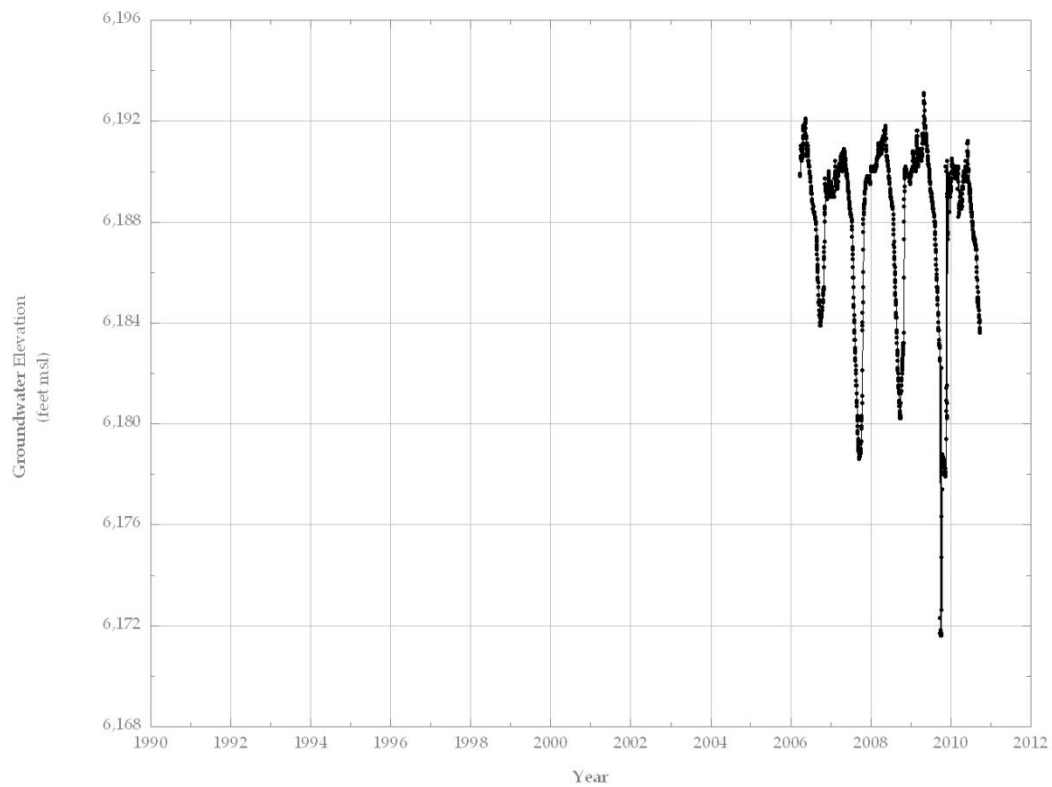
Hydrographs for paired deep and shallow wells are shown on Figure 20 through Figure 22. All three hydrographs show generally upward gradients. The SVPD #5 well pair (Figure 20) shows a weak upward gradient in winter and spring when the aquifers are discharging to the creek; and no vertical gradient in the fall. The PlumpJack monitoring wells show a surprisingly significant upward gradient. This suggests that the shallow aquifer is not well connected to the deeper aquifer in the westernmost portion of the basin.



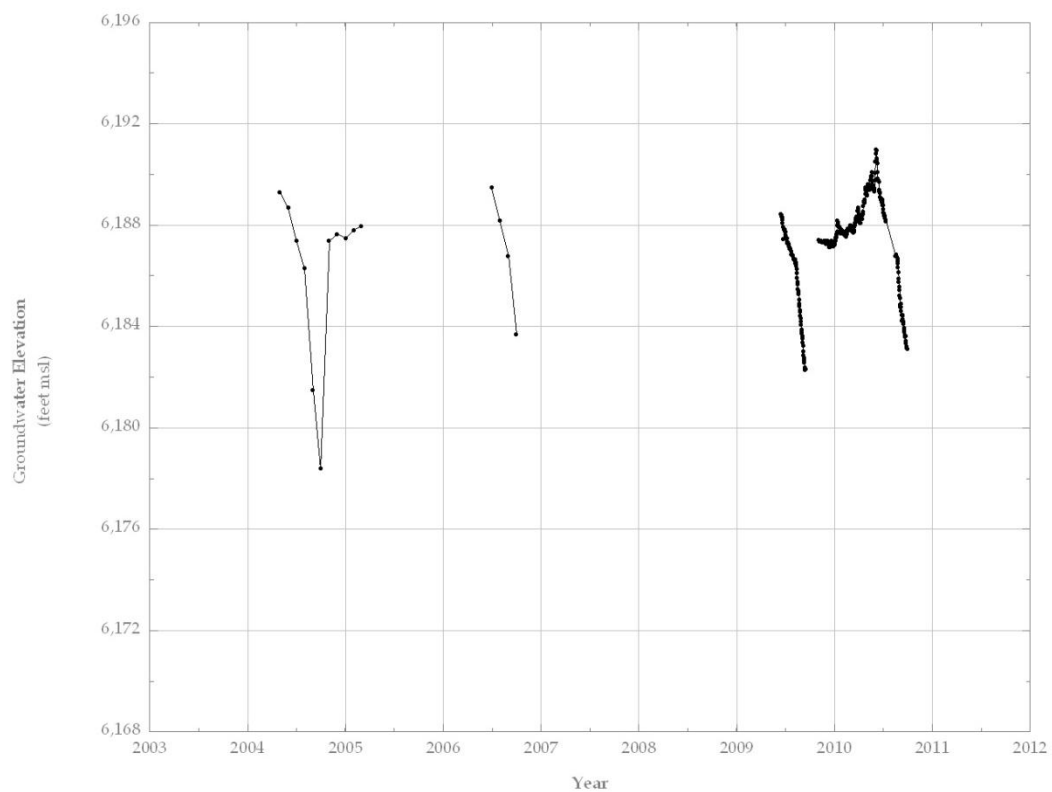
*Figure 16: SVPsD #1 Groundwater Elevation Hydrograph*



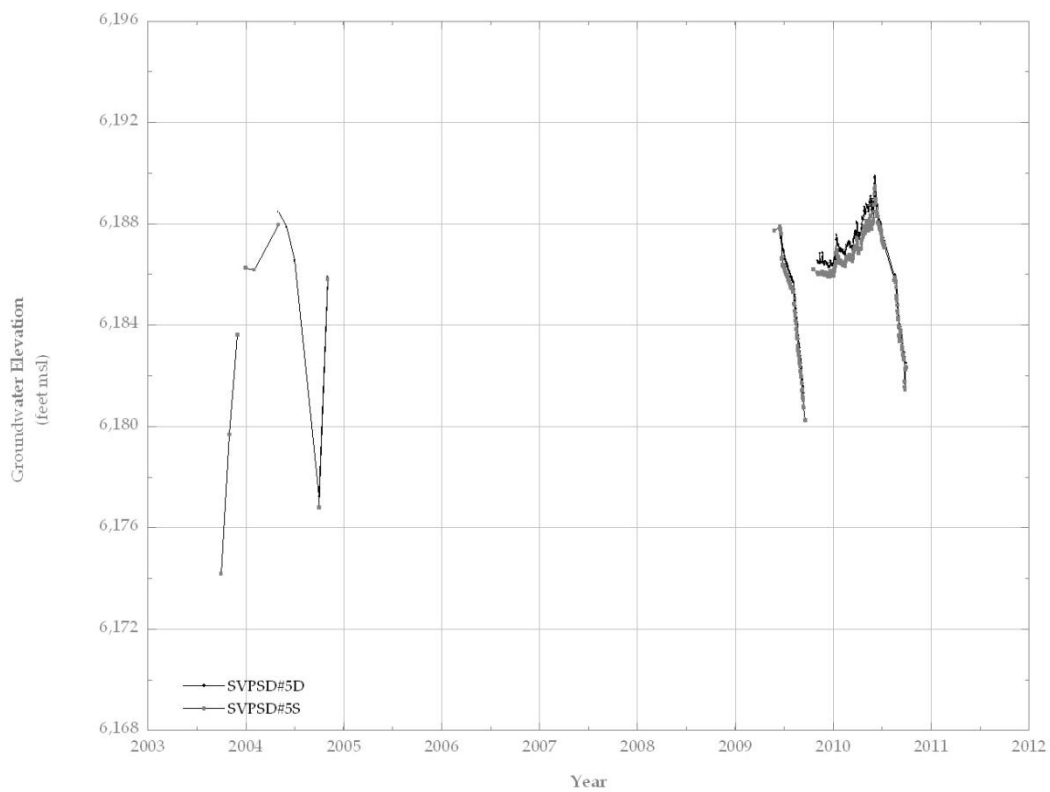
*Figure 17: SVPsD #2 Groundwater Elevation Hydrograph*



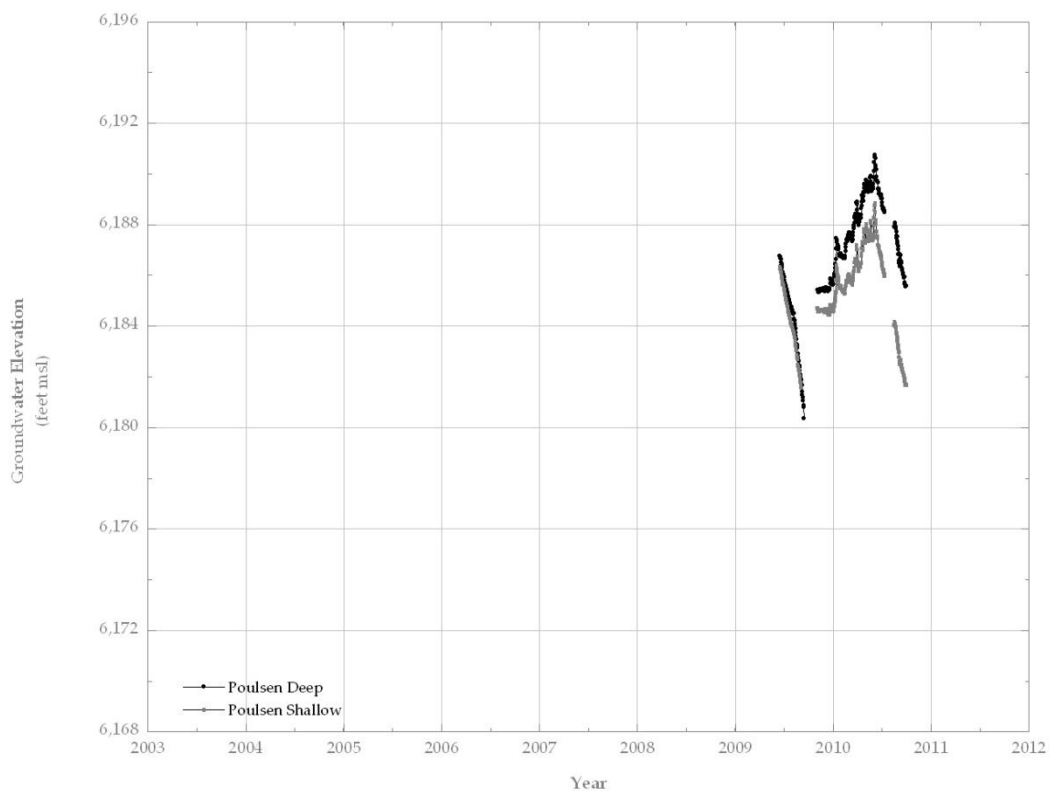
*Figure 18: SVP5D #5 Groundwater Elevation Hydrograph*



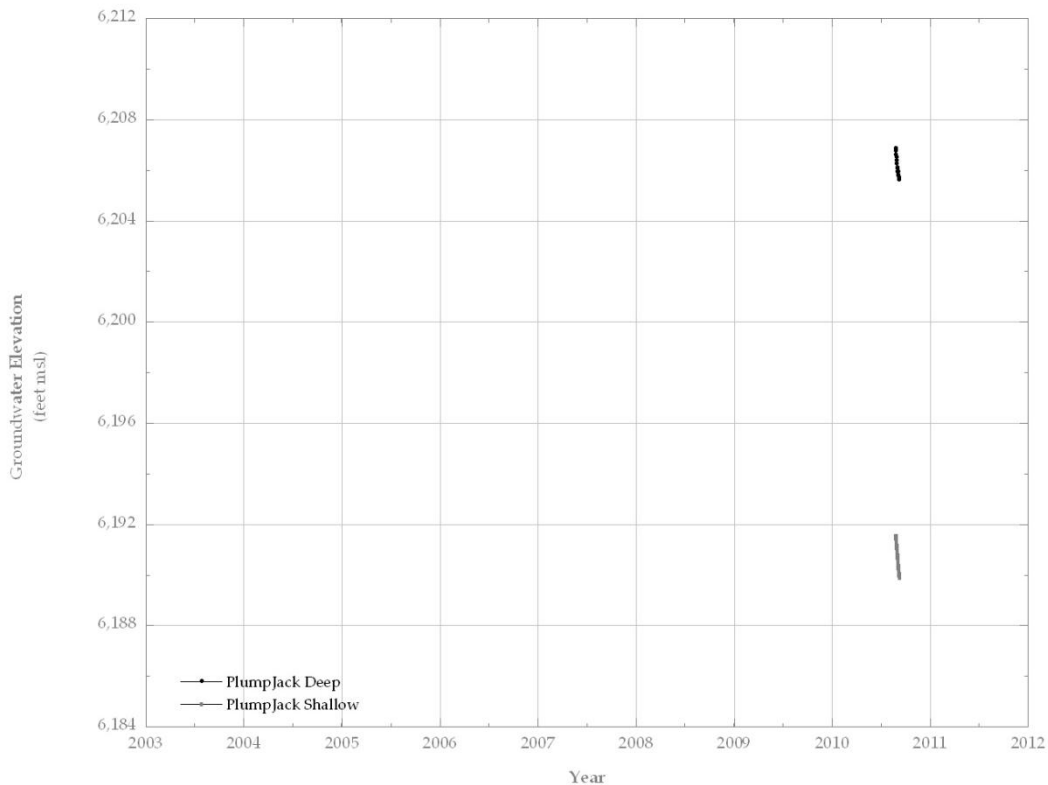
*Figure 19: SVP5D #4R Groundwater Elevation Hydrograph*



*Figure 20: SVPsD #5 Shallow and Deep Groundwater Elevation Hydrograph*



*Figure 21: SVPsD Poulsen Shallow and Deep Groundwater Elevation Hydrograph*



*Figure 22: SVPsD PlumpJack Shallow and Deep Groundwater Elevation Hydrograph*

Hydrographs of historical groundwater levels in wells SVMWC#1 and SVMWC#2 are shown in Figure 23 and Figure 24. The hydrograph of well SVMWC#1 shows that highest annual groundwater levels, measured in spring, have declined since 2008. This is different than the trend observed in the SVPsD production wells. Similar to the SVPsD production wells, the hydrograph of well SVMWC#1 shows that the lowest annual groundwater levels, measured in fall, have been increasing slightly. Figure 24 shows the hydrograph for well SVMWC#2, which had no groundwater level data recorded in 2009 and 2010; therefore no trends over the reporting period are described.

Figure 25 and Figure 26 compare daily groundwater levels in well SVPsD#2, streamflow in Squaw Creek, and SVPsD total pumping for Water Years 2009 and 2010. The well SVPsD#2 hydrograph in the third panel of Figure 25 and Figure 26 shows that the aquifer filled up rapidly in response to streamflow and rainfall recharge. During the first period of high flow in Squaw Creek, the groundwater level in well SVPsD#2 reached the maximum or full level, as shown with the left most vertical line on Figure 25 and Figure 26. Later, slightly higher groundwater levels occur as snowmelt creates more sustained flows in the Creek.

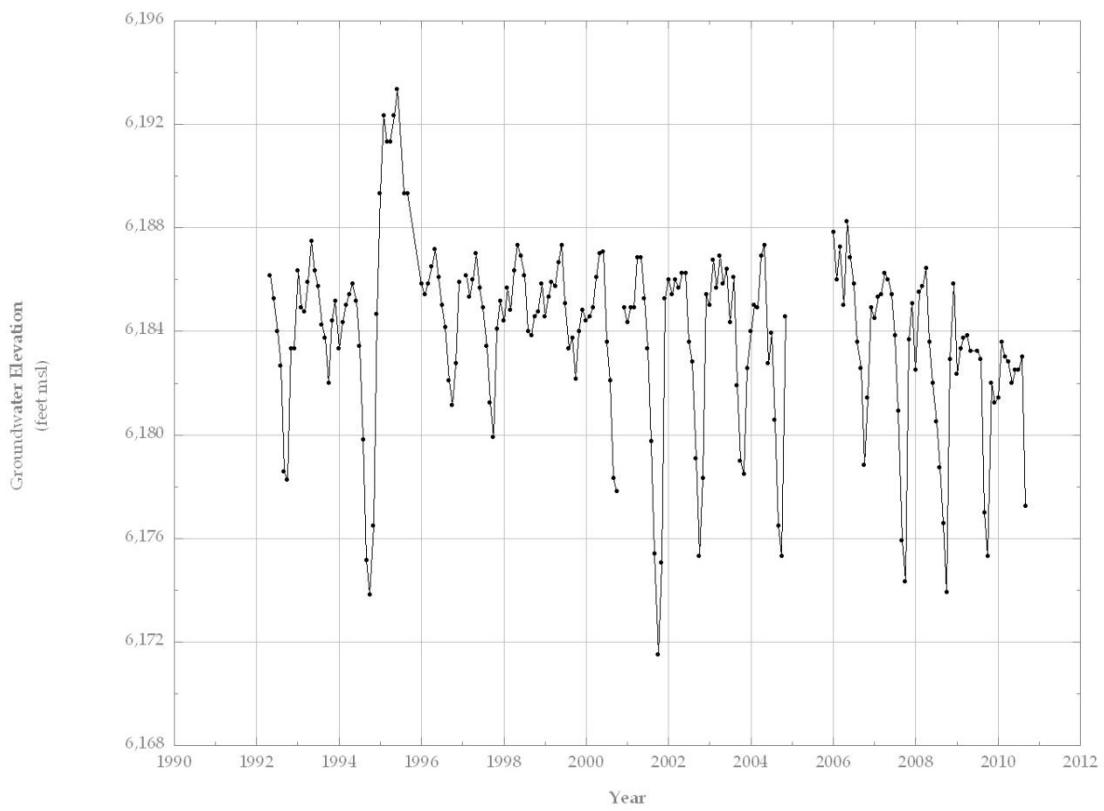


Groundwater levels first begin to slowly decline in May 2009 and June 2010. This first drop in groundwater levels is due to three potential mechanisms:

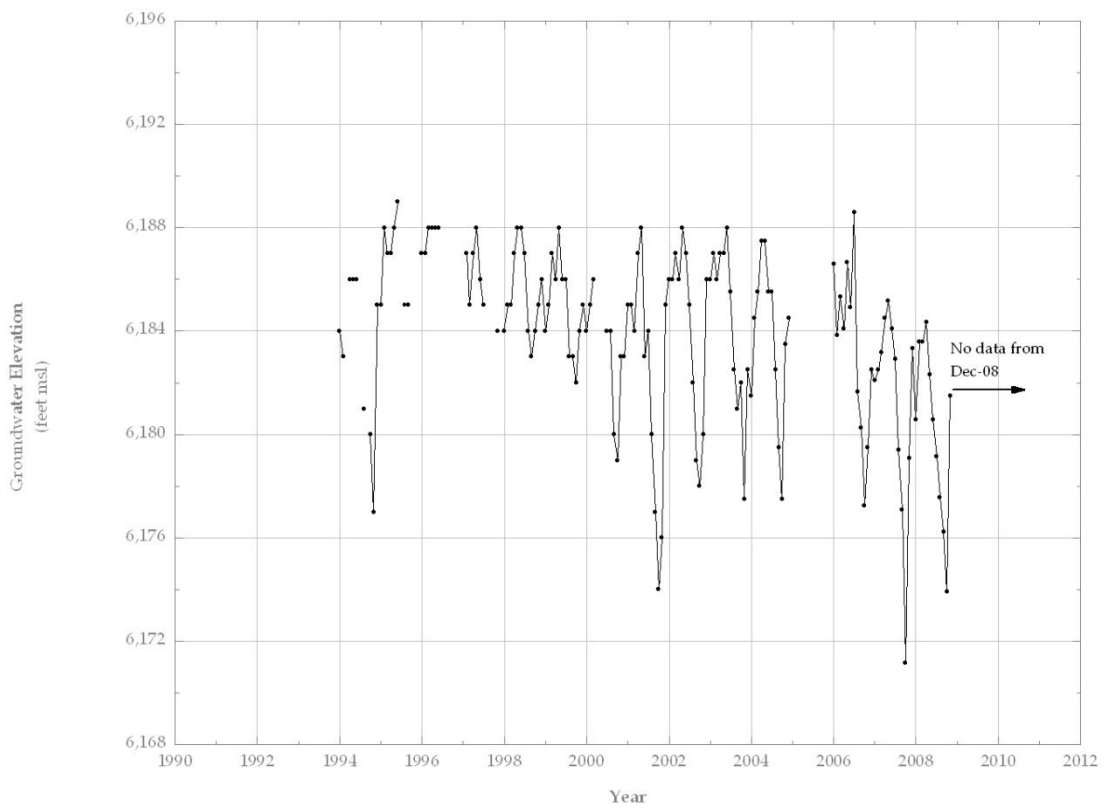
1. Groundwater levels drop in response to reduced recharge as streamflow in Squaw Creek drops;
2. Groundwater levels drop in response to increased pumping that occurs during this period; and
3. Groundwater drains into the trapezoidal channel as streamflow and water levels drop in the Creek.

The initial groundwater level decline likely does not represent a regional lowering of the aquifer; rather it represents a localized deepening of the cone of depression around well SVPsD#2. During this period there is flow in the stream available to recharge the aquifer and keep the basin full.

A second, steeper drop in groundwater levels occurs when flows in Squaw Creek cease, and the Creek no longer recharges the aquifer. Without a source of recharge, groundwater levels drop more rapidly even though pumping is decreasing. This section of the hydrograph represents a regional lowering of groundwater levels in the western portion of the basin.



*Figure 23: SVMWC #1 Groundwater Elevation Hydrograph*



*Figure 24: SVMWC #2 Groundwater Elevation Hydrograph*

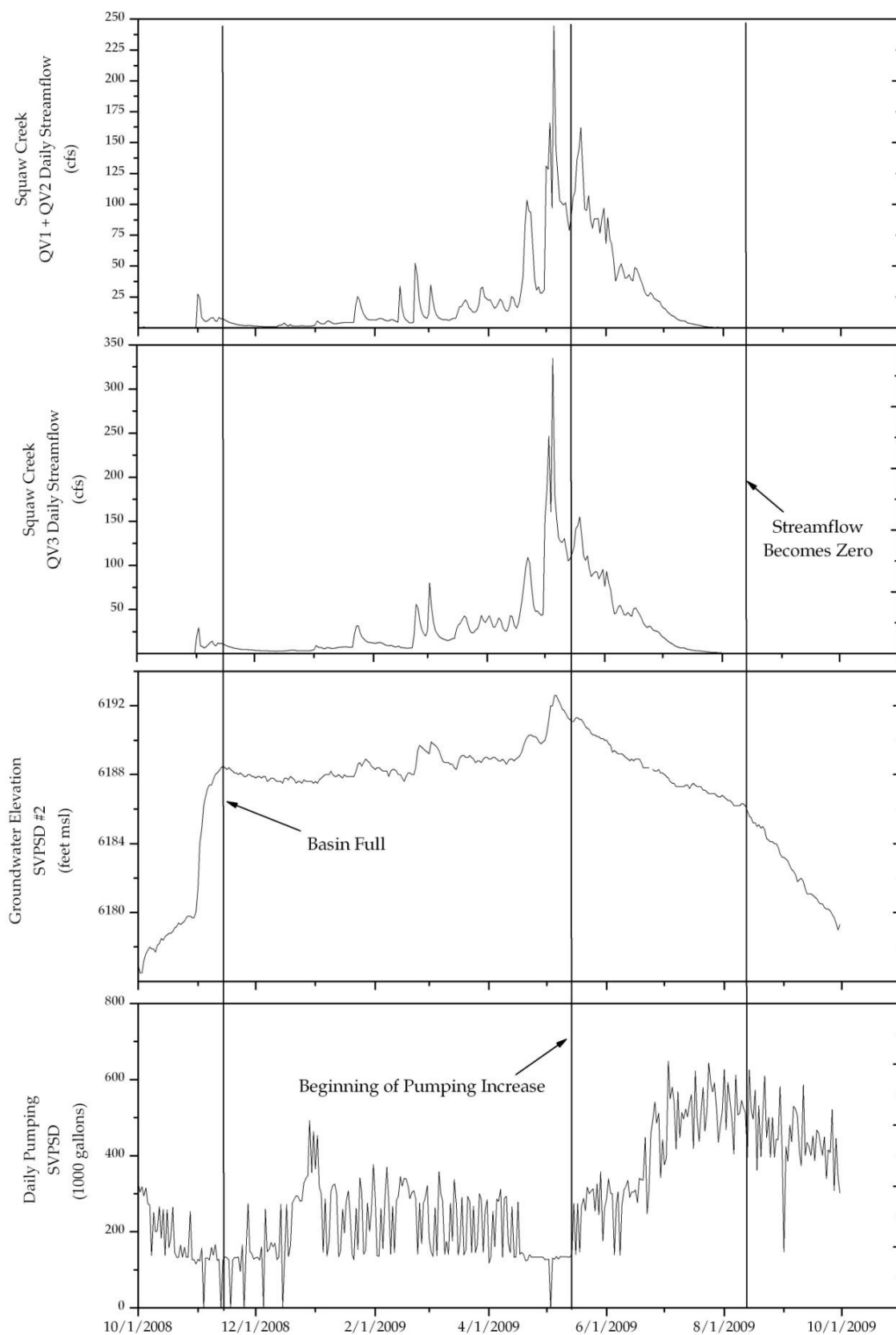


Figure 25: Water Year 2009 Groundwater Elevations, Streamflow, and Pumping

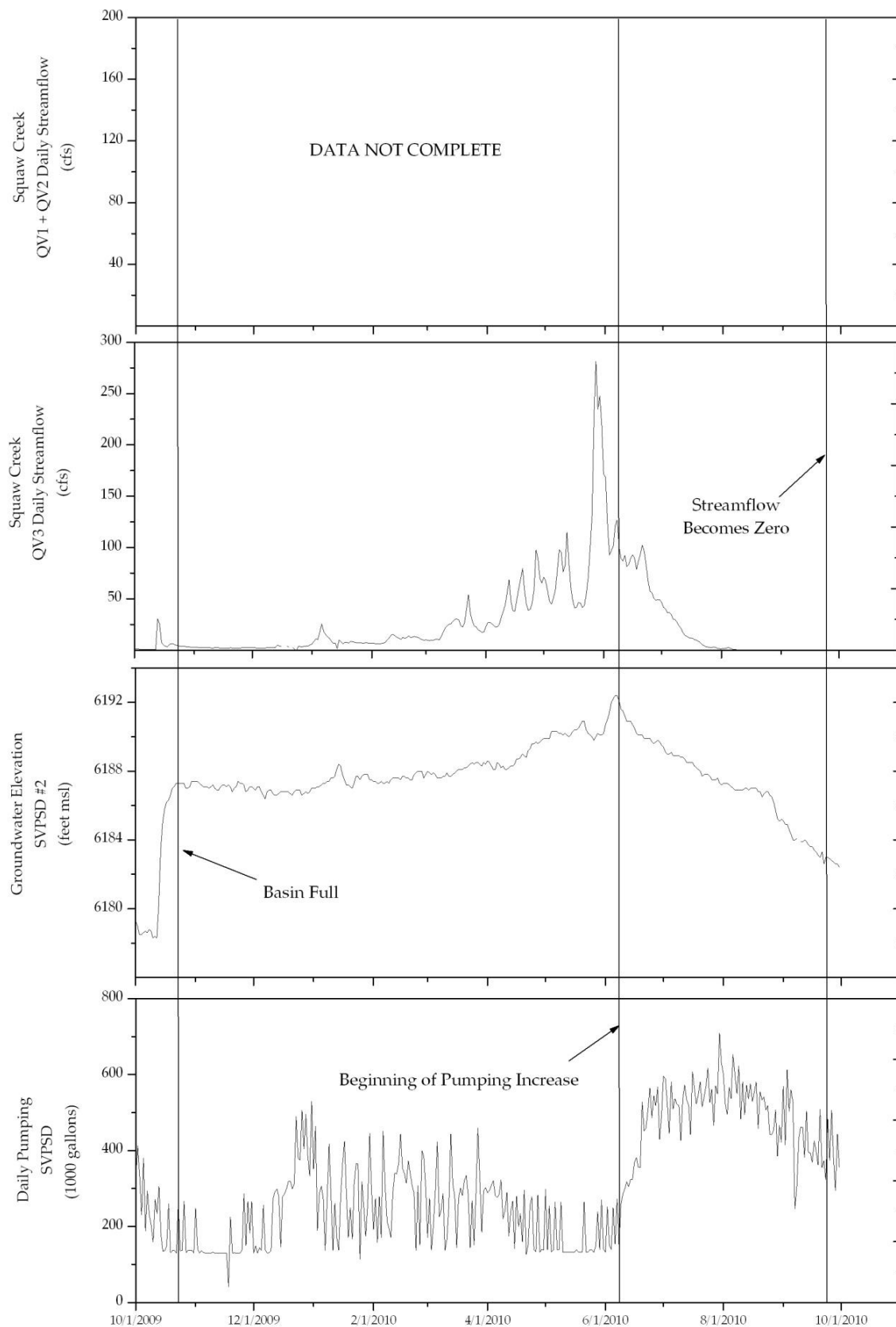


Figure 26: Water Year 2010 Groundwater Elevations, Streamflow, and Pumping

Figure 27 compares hydrographs for wells SVMWC#1 and SVPD#2 with Water Year precipitation measured at the Squaw Valley SNOTEL station. The lowest annual groundwater levels, measured in the fall, appear to correlate with annual precipitation. The likely relation between precipitation and annual low groundwater levels is as follows:

1. The groundwater basin fills up with the first significant flow in Squaw Creek and stays relatively full until streamflow ceases, as seen in Figure 25. The basin generally fills up every year, even in low precipitation years.
2. Groundwater levels decline regionally only after streamflow in Squaw Creek ceases.
3. The date at which streamflow ceases is related to the amount of snow pack in the previous winter. The lowest precipitation years have a small snow pack which finishes melting earlier, causing streamflow to cease earlier in those years.
4. The volume of groundwater pumped after streamflow ceases and before the first significant flows in the fall or winter, determines how far groundwater levels will decline in the basin.



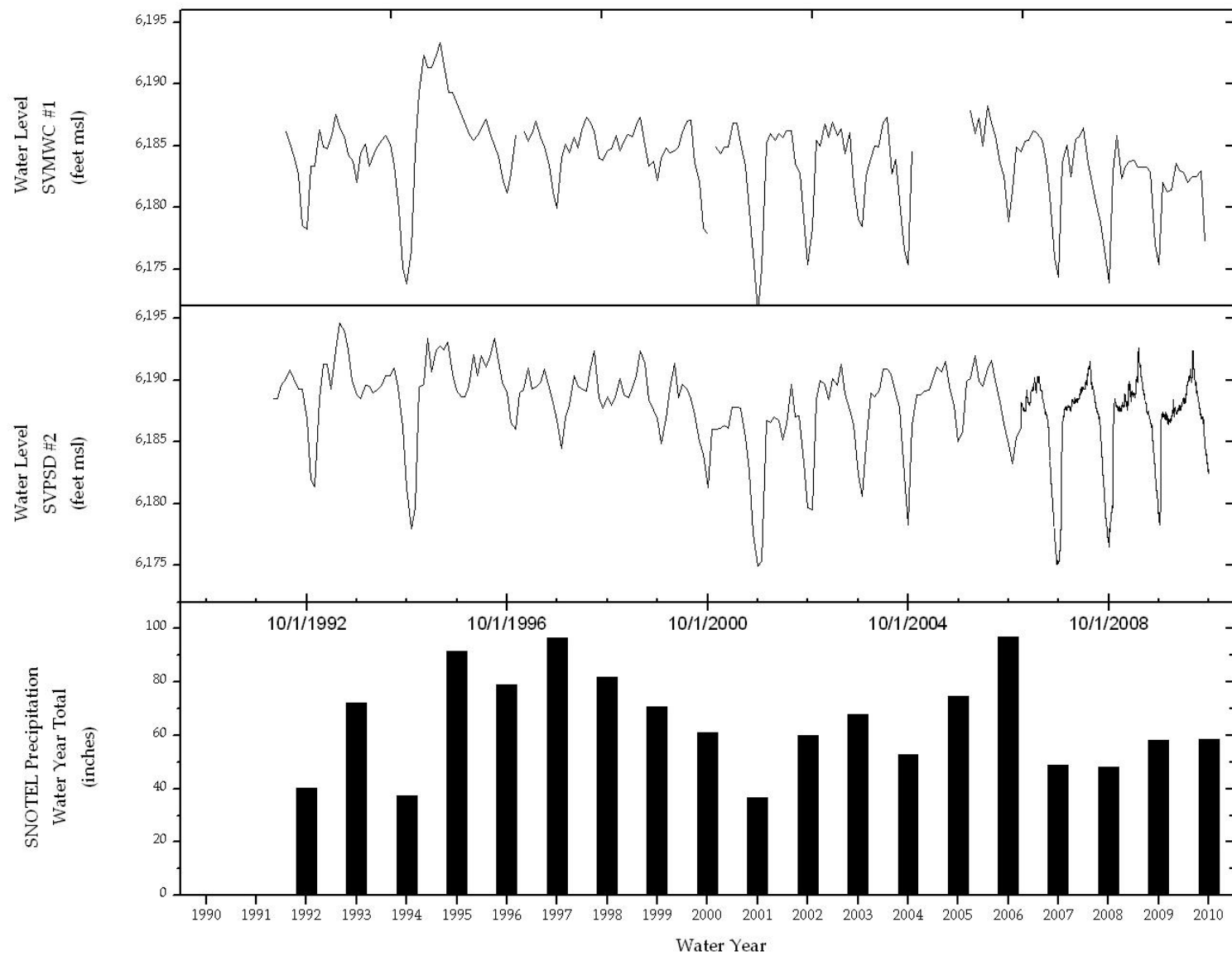


Figure 27: Monthly Precipitation and Groundwater Elevations

## MEADOW AREA

Groundwater level data from the meadow were collected by RSC as part of the CHAMP program monitoring. The CHAMP program measures groundwater levels in 32 monitoring wells, shown on Figure 2. Hydrographs from representative wells were selected based on location and completeness of data. Additionally, hydrographs for monitoring wells that have pressure transducers installed as part of the Creek/Aquifer interaction project are also included. The hydrographs are shown in Figure 28 through Figure 34, and are ordered from west to east. Well pairs are included on the same page. The blue data points represent the data logger recorded groundwater levels which were installed in August/September 2010.

The hydrographs show that there is no apparent long term groundwater level trends in any of the wells. Generally fluctuations of between three and six feet are seen in the meadow hydrographs. The exception is RSC-324, located 250 feet away from the RSC's irrigation well 18-1, which has seasonal fluctuations of up to twelve feet (Figure 30).

Under the original CHAMP monitoring schedule, data were not collected frequently enough to see complete seasonal groundwater level fluctuations in the wells. In 2009, the groundwater level monitoring schedule was changed to require monthly groundwater level measurements from May through October. Since the new sampling schedule took effect, simultaneous measurement at shallow and deep groundwater levels are available for certain well pairs. Using these data, vertical gradients have been calculated, and summarized in Table 3.

*Table 3: Vertical Hydraulic Gradients in Meadow Wells*

RSC Well Pair	Vertical Hydraulic Gradient
307/308	Downward
311/312	
323/324	
309/310	Upward
315/316	
301/302	

Note: The well pair 304/305 is not included in this table as RSC-304 was not measured.

Two well pairs with upward hydraulic gradients are along the northern edge of the valley, with the other upwards gradient well pair, RSC-301/302, located closer to the middle of the valley. We expect well pairs on the edge of the valley to have an upward gradient due to fracture flow of groundwater being more prominent around the edges of a basin. The deep monitoring well RSC-302 located more centrally in the valley may be influenced by a fracture below the aquifer.

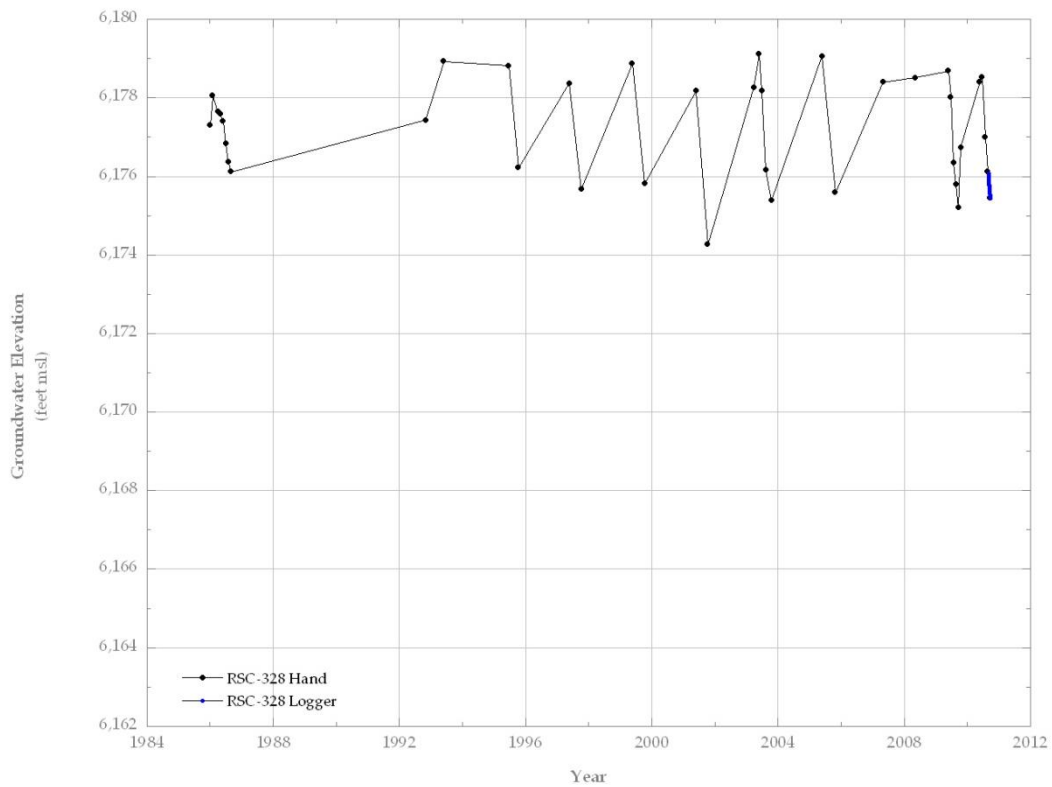


Figure 28: Meadow Groundwater Elevation Hydrograph -- Well 328 (shallow)

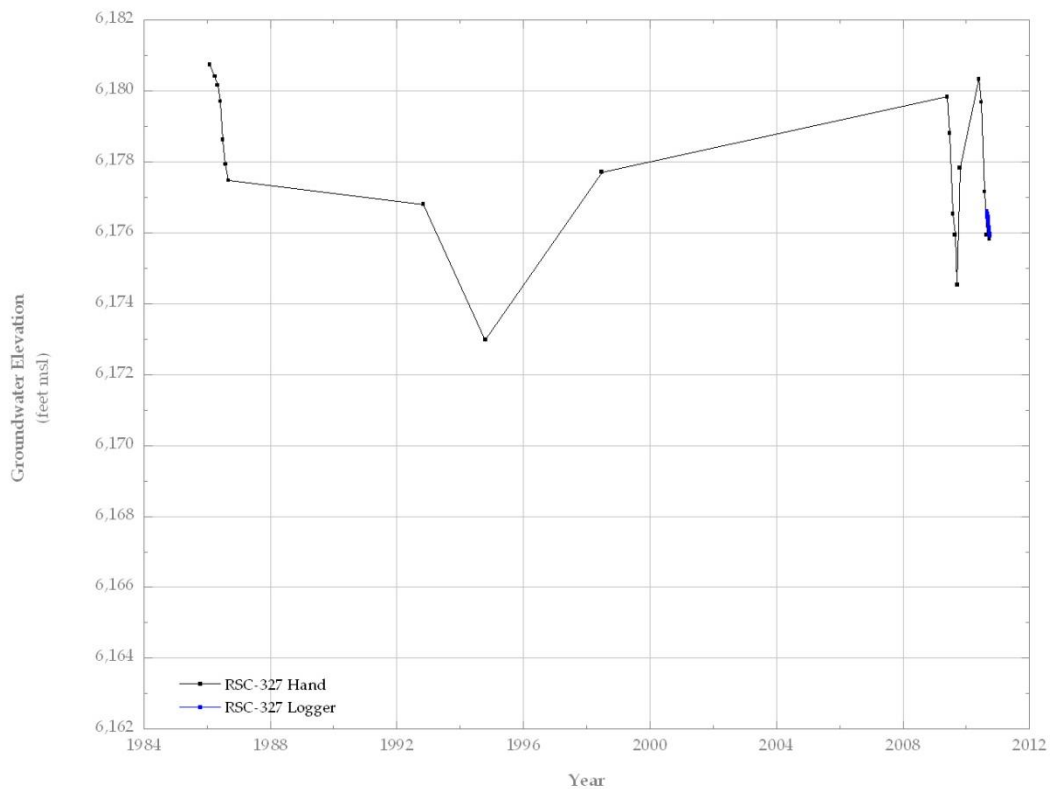


Figure 29: Meadow Groundwater Elevation Hydrograph -- Well 327 (deep)

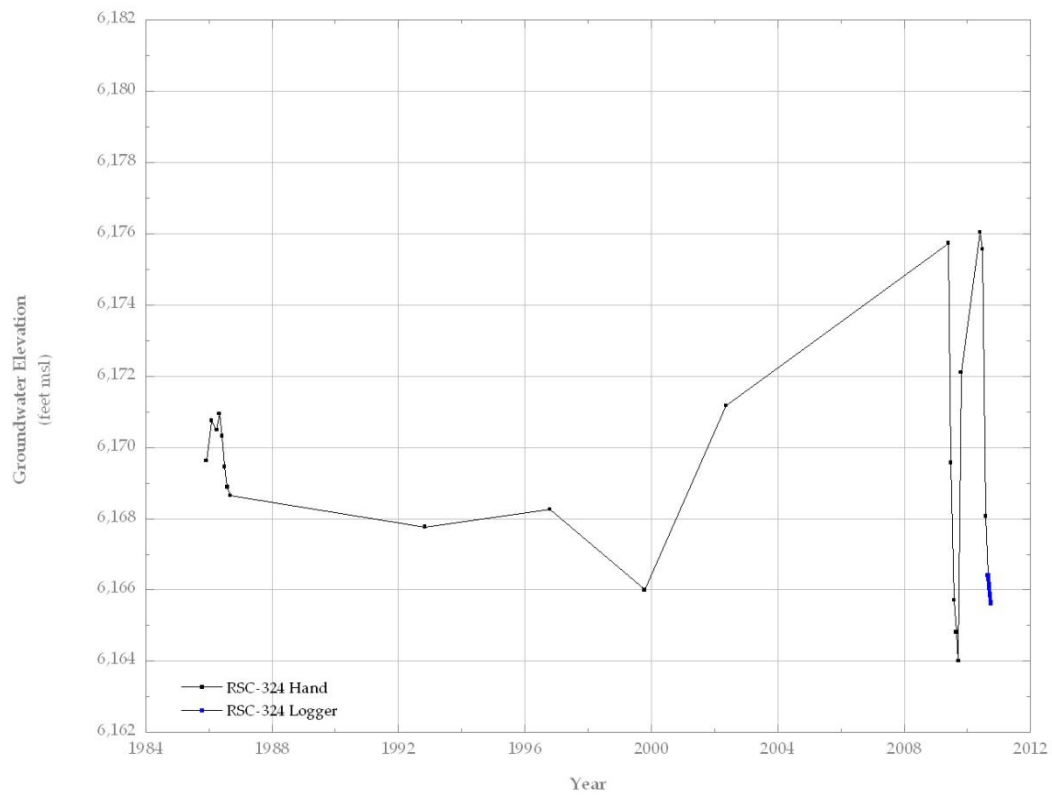


Figure 30: Meadow Groundwater Elevation Hydrograph -- Well 324 (shallow)



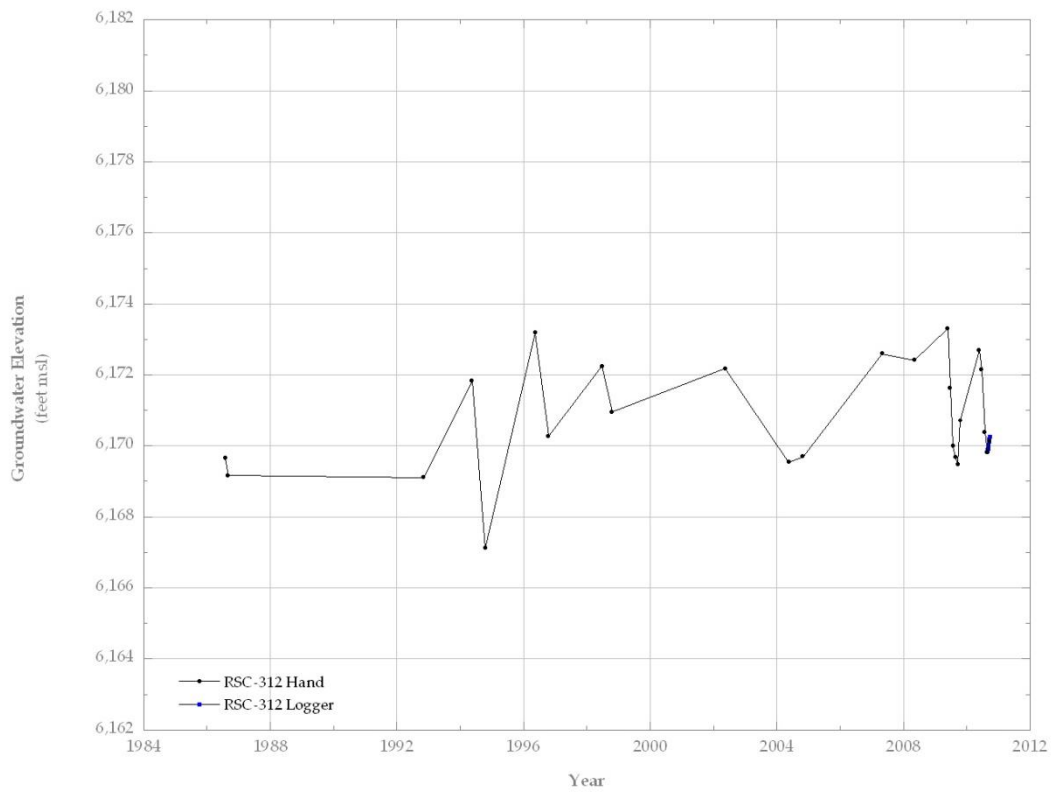


Figure 31: Meadow Groundwater Elevation Hydrograph -- Well 312 (shallow)

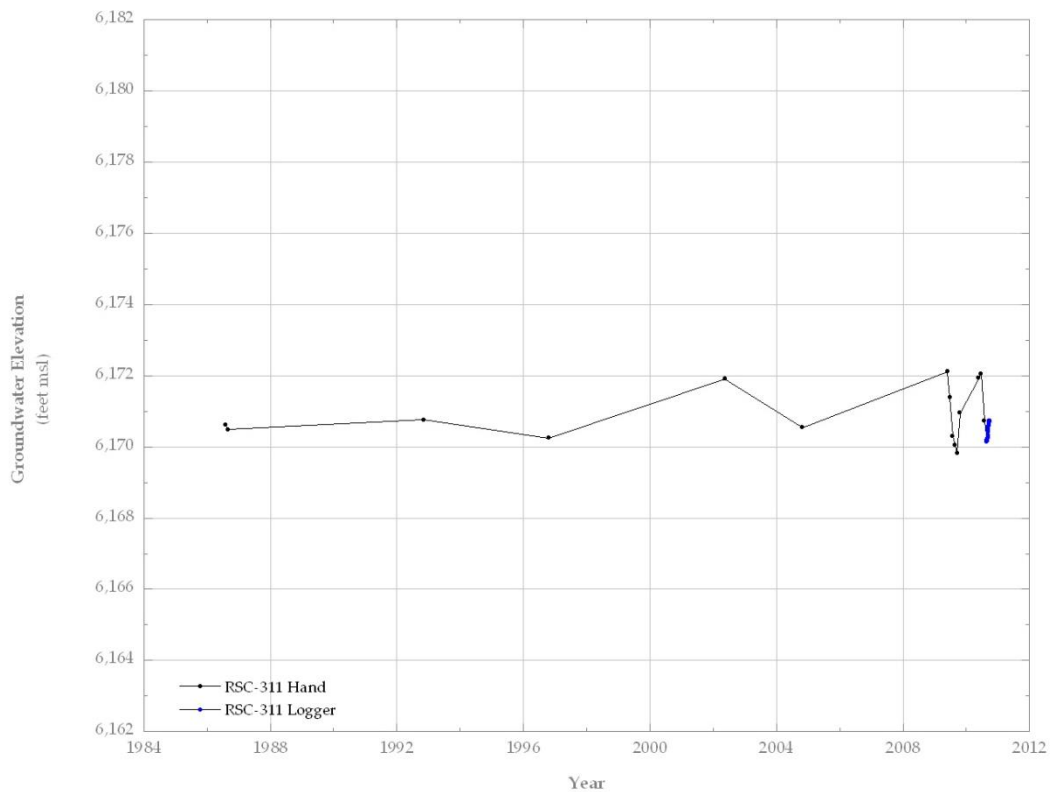


Figure 32: Meadow Groundwater Elevation Hydrograph -- Well 311 (deep)

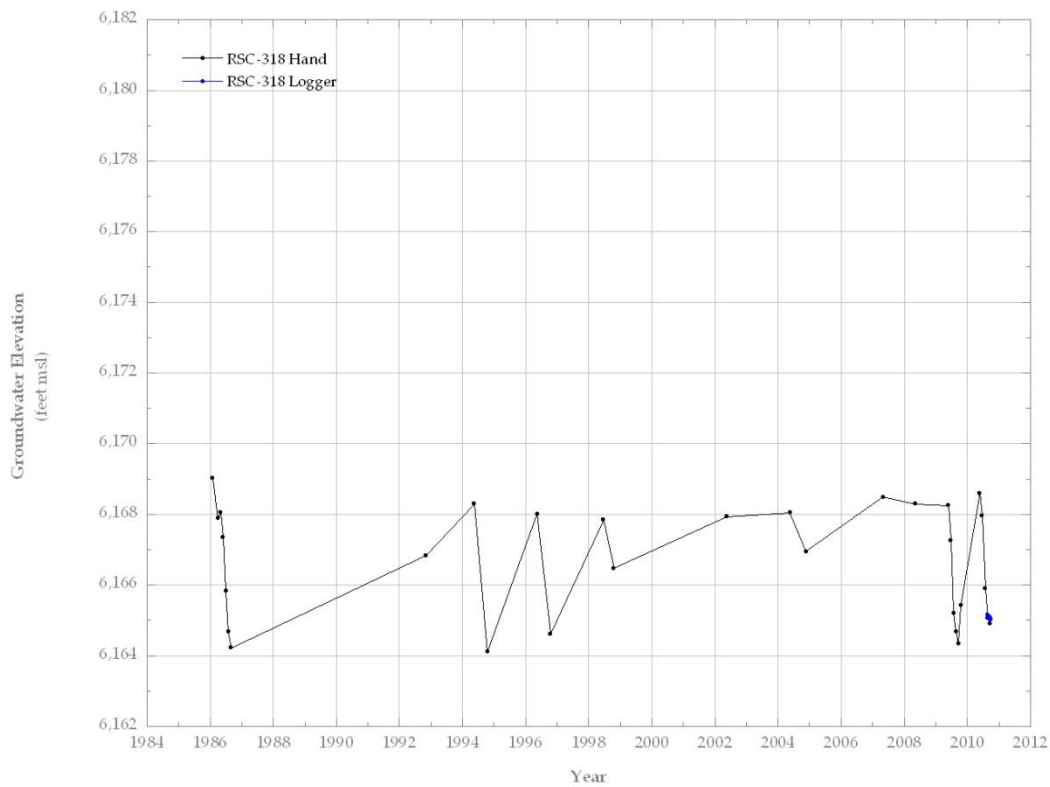


Figure 33: Meadow Groundwater Elevation Hydrograph -- Well 318 (shallow)

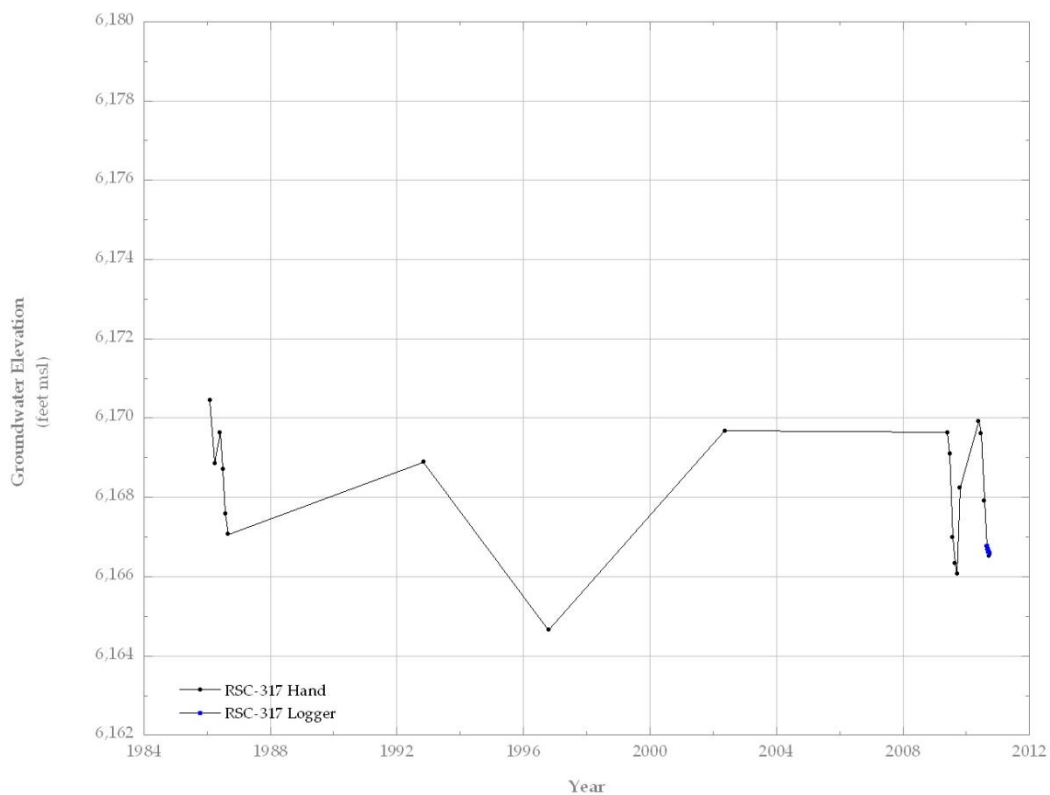


Figure 34: Meadow Groundwater Elevation Hydrograph -- Well 317 (deep)

## SECTION 4

### GROUNDWATER QUALITY SUMMARY

#### 4.1 MUNICIPAL WATER SUPPLY GROUNDWATER QUALITY

SVPSD and SVMWC routinely test their untreated groundwater to determine the water quality of the basin. Groundwater quality parameters analyzed by SVPSD and SVMWC include general minerals, general physical parameters, and organic/inorganic compounds. Analyses for these are conducted in accordance with the requirements of the CCR Title 22. The frequency of water quality testing of public water supply wells is conducted in accordance with the California Department of Public Health (DPH) schedule provided in Table 4. Individual purveyors also test for certain constituents more regularly than the DPH requirements. For example, perchlorate in SVPSD#2 is tested up to four times per year.

*Table 4: Public Water Supply Well Water Quality Schedule*

	SVPSD-1	SVPSD-2	SVPSD-3	SVPSD-5R	SVMWC-1	SVMWC-2
Nitrate (as NO <sub>3</sub> )	1 year	1 year	1 year	1 year	1 year	1 year
Nitrite (as N)	3 years	3 years	3 years	3 years	3 years	3 years
Inorganics	3 years	9 years	9 years	9 years	9 years	9 years
Asbestos	Waived	Waived	9 years	Waived	Waived	Waived
Perchlorate	3 years	3 years	3 years	3 years	3 years	3 years
Gross Alpha	9 years	9 years	9 years	9 years	9 years	9 years
Radium 228	3 months	3 months	3 months	3 months	3 months	3 months
Regulated SOC	Waived	Waived	Waived	Waived	Waived	Waived
Regulated VOC	6 years	6 years	6 years	6 years	6 years	6 years
GM&P	3 - 9 years*	9 years	9 years	9 years	9 years	9 years
Manganese	3 months	9 years	9 years	9 years	9 years	9 years

Notes: VOC = volatile organic compound, SOC = synthetic organic compound, GM&P = General Mineral and General Physical, \* = schedule for different constituents ranges from 3 to 9 years

Source:

[www.cdph.ca.gov/certlic/drinkingwater/Documents/Monitoringschedule/LassenDistrict02.pdf](http://www.cdph.ca.gov/certlic/drinkingwater/Documents/Monitoringschedule/LassenDistrict02.pdf)

#### 4.1.1 SQUAW VALLEY PUBLIC SERVICE DISTRICT

General mineral and general physical, inorganics, and manganese samples were collected and analyzed for well SVPD#2, well SVPD#3, and well SVPD#5R in Water Year 2009. Selected sampling results from SVPD wells obtained during Water Years 2009 and 2010 are summarized in Table 5 and Table 6, respectively. None of the constituents tabled or others not included in the table exceeded primary or secondary maximum contaminant levels (MCL). Additional samples were collected for certain constituents over the two water years as discussed below.

Perchlorate concentrations in well SVPD#2 were analyzed during Water Years 2009 and 2010. Four sampling events took place in Water Year 2009, and three in Water Year 2010. Perchlorate was detected only once, at a concentration of 4.9 µg/L in June 2009. This is below the MCL of 6 µg/L. The single detection of perchlorate in Water Year 2009 is similar to a perchlorate detection observed in Water Year 2008. In June 2008 perchlorate was detected in well SVPD#2 at 4.8 µg/L. Subsequent samples were non-detects in that Water Year. These two detects of perchlorate in June of 2008 and 2009 followed by non-detects are not likely laboratory error; as was surmised in the Water Year 2008 Annual Report. Other possibilities for the introduction of perchlorate into the environment such as the use of explosives for avalanche control should be examined.

Manganese in Olympic Valley public supply wells is closely monitored because it is found at elevated concentrations in some wells in the basin, even though concentrations have remained below drinking water MCLs in the municipal production wells. During Water Year 2009, wells SVPD#2, SVPD#3, and SVPD#1R were tested once for manganese. All samples were below the secondary MCL of 50 µg/L. No manganese was tested for in Water Year 2010.

Table 5: SVPSD Water Year 2009 Sampling Results

Constituent	Primary/ Secondary MCL	SVPSD#1R	SVPSD#2	SVPSD#3	SVPSD#5R
		Concentration (units same as MCL)			
Barium	1,000 µg/L	-	36.3	43.9	3.4
Cadmium	5 µg/L	-	ND	ND	ND
Chloride	250 mg/L	-	-	9.6	7.9
Iron	0.3 mg/L	-	-	ND	0.027
Nitrate + Nitrite (As N)	10 mg/L	-	0.57	0.53	0.38
Sulfate	50 µg/L	-	15.7	12.7	14.3
TDS	250 mg/L	-	121	79	82

Table 6: SVPSD Water Year 2010 Sampling Results

Constituent	Primary/ Secondary MCL	SVPSD#1R	SVPSD#2	SVPSD#3	SVPSD#5R
		Concentration (units same as MCL)			
Nitrate + Nitrite (As N)	10 mg/L	0.27	0.51	0.59	0.57

#### 4.1.2 SQUAW VALLEY MUTUAL WATER COMPANY

Perchlorate, copper, lead, nitrate, radiochemistry, and VOCs were collected and analyzed for well SVMWC#1 and well SVMWC#2 in Water Years 2009 and 2010. Perchlorate was not detected in SVMWC#2 when it was sampled in April 2009.

Selected sampling results from SVMWC wells obtained during Water Years 2009 and 2010 are summarized in Table 7 and Table 8 respectively. None of the constituents tabled or others not included in the table exceeded primary or secondary MCLs.



*Table 7: SVMWC Water Year 2009 Sampling Results*

Constituent	Primary/ Secondary MCL	SVMWC#1	SVMWC#2
		Concentration (units same as MCL)	
Gross Alpha MDA95	15 pCi/L	1.38	1.29
Gross Beta MDA95	4 mrem/yr	1.73	1.64
Mercury	0.002 mg/L	ND	ND
Nitrate + Nitrite (As N)	10 mg/L	0.4	0.26
Radium 228	2 pCi/L	0.252	0.236
TDS	250 mg/L	100	120
Turbidity	5 NTU	2.3	2

*Table 8: SVMWC Water Year 2010 Sampling Results*

Constituent	Primary/ Secondary MCL	SVMWC#1	SVMWC#2
		Concentration (units same as MCL)	
Gross Alpha MDA95	15 pCi/L	2.48	2.32
Gross Beta MDA95	4 mrem/yr	1.83	1.80
Nitrate + Nitrite (As N)	10 mg/L	0.6	ND
Radium 228	2 pCi/L	0.523	0.523

## 4.2 RESORT AT SQUAW CREEK CHAMP PROGRAM

The CHAMP groundwater quality monitoring program includes 32 monitoring wells in the Meadow (Figure 2). Previously, samples were taken twice annually: in May and October. This schedule has been changed with the revised 2009 WDR to sampling five wells monthly from May through October, starting in May 2009. The WDR was revised to be consistent with the monitoring and reporting required for all golf courses in the Lake Tahoe basin.

The wells included in the revised WDR are, from west to east: wells SVP5D#5S, RSC-305, RSC-306, RSC-322, and RSC-301. The constituents currently tested for include: dissolved nitrite as nitrogen, dissolved nitrate as nitrogen, dissolved kjeldahl nitrogen, dissolved total phosphorous, dissolved orthophosphate, pH, temperature, and specific conductivity. Dissolved constituents (filtered) instead of total constituents are now required by CDPH. Filtering the water samples attempts to isolate organic forms of fertilizer now commonly used on golf courses. Because the sampling and analysis techniques are different than in previous years, a direct comparison of previous results with the 2009 and 2010 results is not possible.

Previous ARR's reported that all constituents tested were below the MCLs, with the exception of iron. No MCLs or other regulatory limits exist for the current analyses, and therefore the only undesirable result is a steady upward trend in any concentrations. Figure 35 through Figure 40 chart the results of the monthly sampling events from May through October for both 2009 and 2010. Charts are not included for pH and temperature.

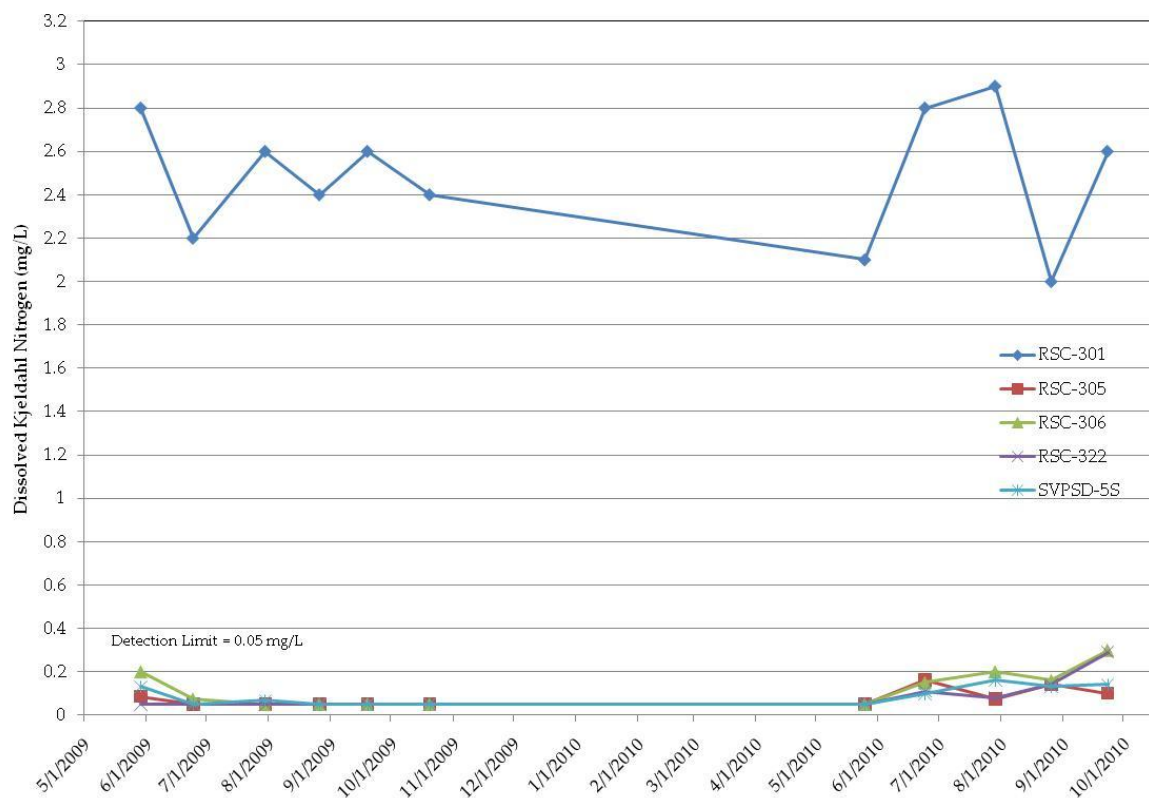


Figure 35: Water Years 2009 and 2010 Dissolved Kjeldahl Nitrogen for CHAMP Wells

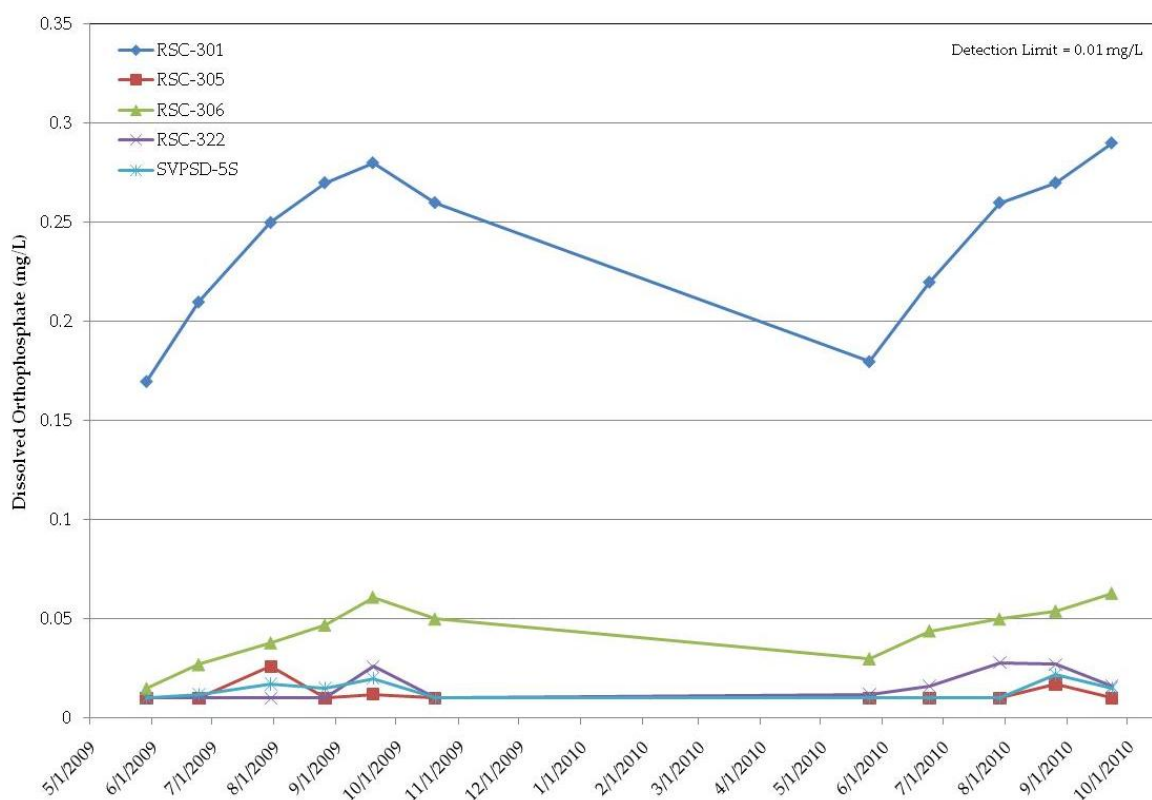


Figure 36: Water Years 2009 and 2010 Dissolved Orthophosphate for CHAMP Wells

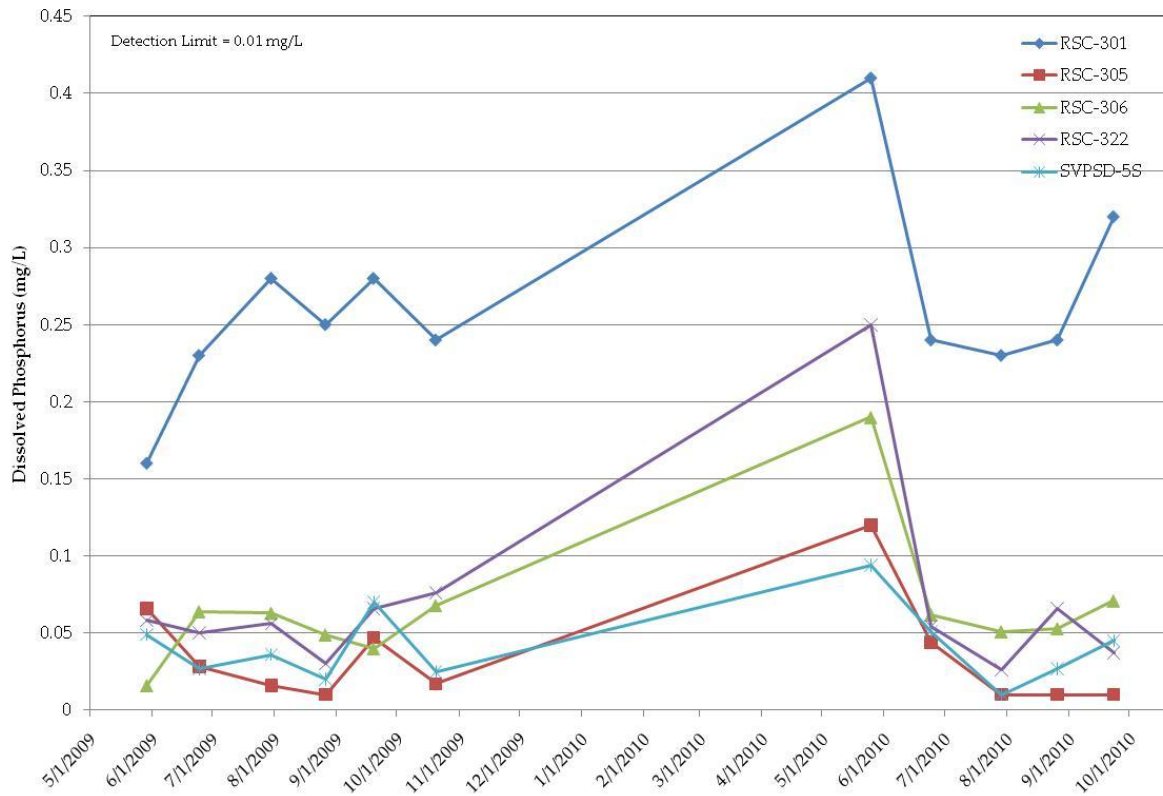


Figure 37: Water Years 2009 and 2010 Dissolved Phosphorus for CHAMP Wells

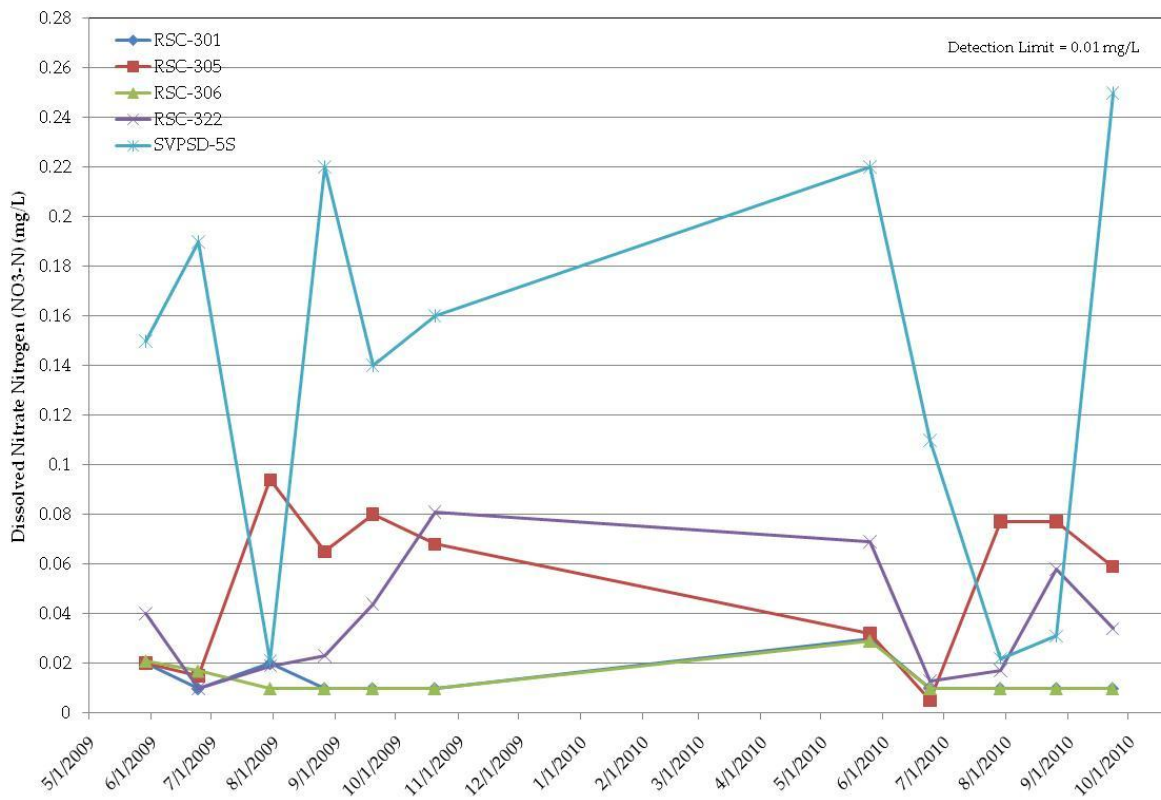


Figure 38: Water Years 2009 and 2010 Dissolved Nitrate as Nitrogen (NO<sub>3</sub>-N) for CHAMP Wells

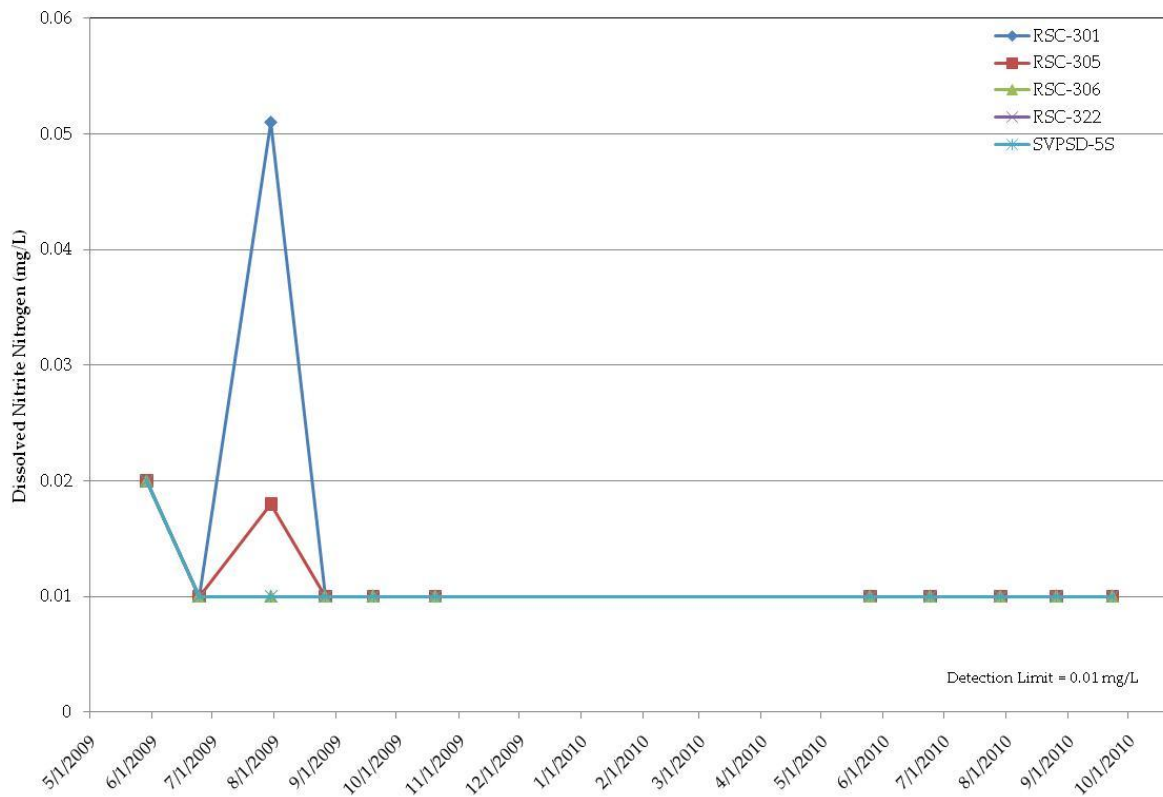


Figure 39: Water Years 2009 and 2010 Dissolved Nitrite as Nitrogen for CHAMP Wells

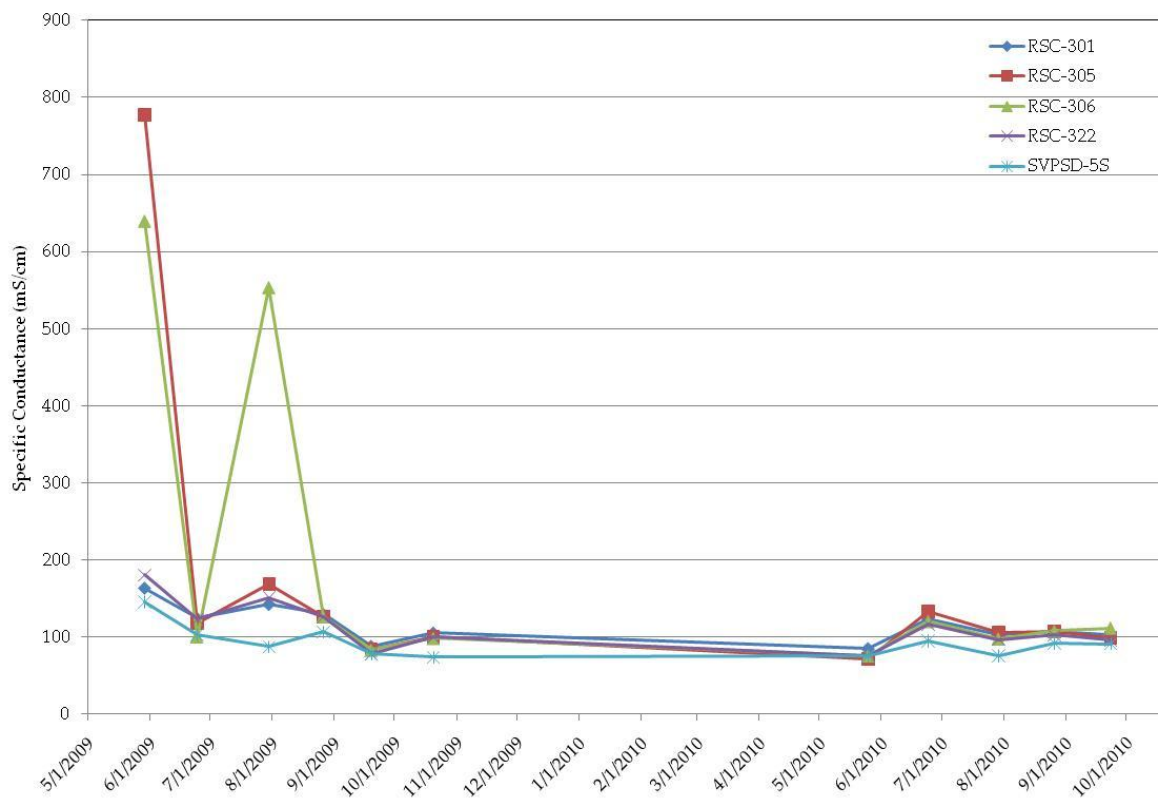


Figure 40: Water Years 2009 and 2010 Specific Conductance for CHAMP Wells

The two year trend for dissolved constituents monitored by the current CHAMP wells show that for dissolved kjeldahl nitrogen (Figure 35), orthophosphate (Figure 36)Figure 36, and phosphorus (Figure 37), the downgradient well RSC-301 has a higher concentration than upgradient wells. Seasonal fluctuations are evident in these constituents: concentrations increase over the golf course operational period and then decrease at the end of the season when fertilizer application stops. This suggests some seasonal groundwater quality impacts from golf course fertilizers. Kleinfelder & Associates (2010) noted in their annual reporting for the RSC that concentrations do not increase along the groundwater flow path from upgradient monitoring well SVPD#5S to the mid-course monitoring well RSC-322.

Kjeldahl nitrogen in the downgradient RSC-301 is an order of magnitude higher than the other monitoring wells (Figure 35). The possibility of a localized source of kjeldahl nitrogen near RSC-301 should be examined.

Dissolved nitrate as nitrogen has a different distribution compared to the other dissolved constituents. The upgradient well SVPD#5S has the highest concentration of the CHAMP wells currently sampled. The seasonal fluctuation in this well is also different from the other constituents: concentrations decrease in August/September before increasing again to higher than pre-August concentrations ( Figure 38).

Dissolved nitrite as nitrogen for the five wells is mostly below the reporting limit of 0.01 mg/L, however there were some temporarily elevated concentrations in the downgradient RSC-301 in May through August 2009 (Figure 39).

Specific conductance is a property that is measured in the field at the time the sample is collected by Kleinfelder. In general, this constituent for all wells is approximately 100 mS/cm (Figure 40). The beginning portion of the 2009 summer season had some elevated levels. It is possible that these levels were due to sample or equipment error.

## **4.3 REGULATED CONTAMINATION SITES**

No existing regulated contamination sites exist within the GMP area, and no new cases were opened during Water Years 2009 and 2010.



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## **SECTION 5**

### **GROUNDWATER MANAGEMENT ACCOMPLISHMENTS AND BMO STATUS**

Significant progress was made on a number of groundwater management activities during Water Years 2009 and 2010. This continues the history of active implementation of the projects and programs suggested in the GMP. Progress made on each of the projects during Water Year 2009 and Water Year 2010, and the status of the various BMOs are detailed below.

#### **5.1 COORDINATE GROUNDWATER DATA COLLECTION ACTIVITIES**

At an October 19, 2010 meeting, a coordinated groundwater monitoring plan was presented to the Olympic Valley Advisory Group. This plan outlined the methodology and timing for collecting coordinated groundwater elevation data. The plan suggested that data loggers be installed in a number of wells throughout the Valley. The data loggers would be maintained by SVPSD after they are installed.

The first data loggers were deployed in the fall of 2010. Eight data loggers were installed in wells in the meadow, and six new data loggers were installed in wells in the western portion of Squaw Valley. The data loggers are currently collecting data hourly.

These actions implement a high priority recommendation from the Water Year 2007 ARR. This agreement additionally implements section two of Element 1: Groundwater Monitoring from the GWMP. As mentioned in the GWMP, this element addresses multiple BMOs including:

- BMO 1-1 – Maintain groundwater supplies sufficient to provide water for current and future domestic, municipal, commercial, private, and fire protection uses during summer and autumn of the second consecutive year of low rainfall.
- BMO 1-2 – Minimize drawdown and maximize basin storage.

## 5.2 COORDINATE DATA SHARING

At an October 19, 2010 meeting, the coordinated groundwater database and monitoring plan was presented to the Olympic Valley Advisory Group.. This single database contains data necessary for groundwater management, including monthly water level data and all water quality data from all groundwater producers in Olympic Valley. This action implements a high priority recommendation from the Water Year 2007 ARR. This agreement additionally implements section two of Element 8: Enhance Groundwater Basin Management Tools from the GWMP. As mentioned in the GWMP, this element addresses multiple BMOs including:

- BMO 1-1 – Maintain groundwater supplies sufficient to provide water for current and future domestic, municipal, commercial, private, and fire protection uses during summer and autumn of the second consecutive year of low rainfall.
- BMO 1-2 – Minimize drawdown and maximize basin storage.

## 5.3 INITIATE CREEK/AQUIFER INTERACTION STUDY

Phase I of the Squaw Valley Creek/Aquifer interaction study was conducted during 2009 and 2010. This action implements a high priority recommendation from the Water Year 2007 ARR. It additionally addresses and implements the following:

- BMO 3-2 - Promote viable and healthy riparian and aquatic habitats by avoiding or minimizing future impacts from pumping on streamflow.

## 5.4 STREAM MONITORING

The Friends of Squaw Creek assumed responsibility for maintaining the stream gages on Squaw Creek. In addition to maintaining the gages, FOSC is responsible for downloading and analyzing the streamflow data from all three gages. The continued stream monitoring supports the following BMO:

- BMO 3-2 – Promote viable and healthy riparian and aquatic habitats.

## 5.5 INSTALL GROUNDWATER DATA LOGGERS

Fourteen new groundwater level data loggers were installed in 2010. The fourteen wells equipped with new data loggers, and the equipment installed in each well are shown in Table 9.

*Table 9: Monitoring Equipment Installed in Monitoring Wells*

Well	Current Equipment
RSC-312	10m Mini-Diver and DDC
RSC-318	10m Mini-Diver and DDC
RSC-328	10m Mini-Diver and DDC
RSC-324	10m Mini-Diver and DDC
RSC-311	10m Mini-Diver and DDC
RSC-317	10m Mini-Diver and DDC
RSC-327	10m Mini-Diver and DDC
Poulsen Shallow	10m Mini-Diver and DDC
Poulsen Deep	20m Mini-Diver and DDC
PlumpJack Shallow	20m Mini-Diver and DDC
PlumpJack Deep	20m Mini-Diver and DDC
SVPSD#5S	20m Mini-Diver and DDC
SVPSD#5D	20m Mini-Diver and DDC
SVPSD#4R	20m Mini-Diver and DDC

DDC = Diver Data Cable

10m = 10 meter range

20m = 20 meter range

Thirteen of the fourteen wells equipped with new data loggers were chosen for their proximity to Squaw Creek. Groundwater level data from these wells will help manage pumping impacts on Squaw Creek. Installing these data loggers addresses multiple BMOs including:

BMO 1-2 – Minimize drawdown and maximize basin storage.

BMO 3-2 – Promote viable and healthy riparian and aquatic habitats by avoiding or minimizing future impacts from pumping on streamflow.

BMO 3-3 – Minimize future impacts from pumping on identified wetlands.

## 5.6 REPLACE WELL SVPSD#2

A new well was drilled and installed immediately adjacent to existing well SVPSD#2 in 2009. The new well is designed to replace the existing well SVPSD#2. The new well SVPSD#2R is designed with a deeper screen to allow additional drawdown, and to extract water preferentially from deeper sediments. This installation addresses the following BMO

BMO 1-1 – Maintain groundwater supplies sufficient to provide water for current and future uses.

BMO 1-2 – Minimize drawdown and maximize use of basin storage.

## 5.7 STATUS OF BMOs

This section reviews status of BMOs during Water Year 2008. Each BMO in the GMP is listed, along with any accomplishments that address the BMO.

*BMO 1-1: MAINTAIN GROUNDWATER SUPPLIES SUFFICIENT TO PROVIDE WATER FOR CURRENT AND FUTURE DOMESTIC, MUNICIPAL, COMMERCIAL, PRIVATE, AND FIRE PROTECTION USES DURING SUMMER AND AUTUMN OF THE SECOND CONSECUTIVE YEAR OF LOW RAINFALL.*

- Groundwater levels were regularly measured at SVPSD and SVWMC municipal supply wells.
- Groundwater levels were measured regularly as part of the RSC CHAMP monitoring program.
- SVPSD continued monthly audits of its system to identify system losses.
- Four new monitoring wells were installed and equipped with data loggers to provide additional data.
- Data loggers were installed in a total of 14 wells to provide hourly water level data.

*BMO 1-2: MINIMIZE DRAWDOWN AND MAXIMIZE USE OF BASIN STORAGE*

- Phase I of the Squaw Valley Creek/Aquifer study was completed. This study will lead to plans to maximize basin storage in the western part of the basin.

*BMO 1-3: ENCOURAGE WATER CONSERVATION, AND MANAGE OR REDUCE WATER DEMAND*

- SVPSD continued posting customer water usage numbers on the internet. This information allows customers to identify potential leaks and manage their water consumption.
- SVPSD continued monthly audits of its system to identify system losses
- SVPSD sent leak notification letters each month to every customer with a suspected leak

*BMO 1-4: ESTIMATE AND ACKNOWLEDGE LIKELY FUTURE WATER DEMANDS IN MANAGEMENT DECISIONS*

- No relevant activities occurred during Water Years 2009 and 2010.

*BMO 2-1: COMPLY WITH EXISTING WATER QUALITY STANDARDS*

- Drinking water from SVPSD wells was tested according to Title 22 requirements. June 2008 and June 2009 testing detected perchlorate in SVPSD#2 but did not exceed the MCL. All other months the well was tested resulted in non-detect results for perchlorate.
- Both SVMWC wells were tested for perchlorate during Water Year 2009. No perchlorate was detected in either well.
- The RSC CHAMP program sampled surface and groundwater quality in the meadow area.

*BMO 2-2: MINIMIZE THE RISK OF GROUNDWATER CONTAMINATION*

- Neither the County nor the State of California has proposed any new ordinances for well construction and abandonment. The GMP stakeholders continue to support any changes that strengthen groundwater quality protection.
- The CHAMP groundwater monitoring plan was revised in 2009 to include monthly monitoring of dissolved constituents from May through October at five selected wells

*BMO 2-3: IMPROVE GROUNDWATER QUALITY WHERE FEASIBLE*

- No relevant activities occurred during Water Years 2009 and 2010.



*BMO 2-4: IDENTIFY AND PROTECT THE RECHARGE WATER QUALITY AND RECHARGE CAPACITY OF GROUNDWATER RECHARGE ZONES*

- SVPSD conducted phase 1 of the Creek/Aquifer interaction study that will provide information on the recharge characteristics of the trapezoidal channel.

*BMO 3-1: PROTECT THE STRUCTURE AND HYDRAULIC CHARACTERISTICS OF THE GROUNDWATER BASIN BY AVOIDING WITHDRAWALS THAT CAUSE SUBSIDENCE*

- No relevant activities occurred during Water Years 2009 and 2010.

*BMO 3-2: PROMOTE VIABLE AND HEALTHY RIPARIAN AND AQUATIC HABITATS BY AVOIDING OR MINIMIZING FUTURE IMPACTS FROM PUMPING ON STREAMFLOW*

- The SVPSD initiated phase 1 of the Creek/Aquifer investigation.
- Friends of Squaw Creek assumed responsibility for the monitoring program that measures flows at three sites on Squaw Creek.
- New data loggers were installed in wells adjacent to Squaw Creek.
- Groundwater levels were regularly measured in wells adjacent to Squaw Creek.

*BMO 3-3: MINIMIZE FUTURE IMPACTS FROM PUMPING ON IDENTIFIED WETLANDS*

- The SVMWC monitored groundwater levels in two production wells adjacent to the Olympic Valley meadow
- The RSC collected groundwater level data from the Olympic Valley meadow as part of their CHAMP groundwater level monitoring program.
- Data loggers were installed in nine meadow wells adjacent to Squaw Creek.

*BMO 3-4: SUPPORT ONGOING STREAM RESTORATION EFFORTS AS THEY RELATE TO GROUNDWATER MANAGEMENT*

- Phase I of the Squaw Valley Creek/Aquifer study was completed. This study will lead to plans that minimize pumping impacts on Squaw Creek.

## **SECTION 6**

### **CONCLUSIONS AND RECOMMENDATIONS**

#### **6.1 CONCLUSIONS**

##### **6.1.1 GROUNDWATER PUMPING**

Groundwater pumping in Olympic Valley was similar to previous years during Water Years 2009 and 2010. Pumping does not vary much from year to year. No clear trends in annual pumping are seen in the data. Total Pumping for the entire basin for Water Year 2009 was 132 MG (405 acre-feet), excluding RSC pumping for which data were not available. Pumping in Water Year 2010 decreased to 192 MG (589 acre-feet), which was 18% below the historical average pumping of 234 MG (718 acre-feet). The percent change cannot be determined for Water Year 2009 due to missing data from RSC.

##### **6.1.2 GROUNDWATER LEVELS**

Important trends and groundwater levels observed during Water Years 2009 and 2010 include the following.

- The SVPSPD production wells showed a general upward trend in the lowest groundwater levels measured in the fall. This is possibly due to decreased summer pumping over the past three water years, relatively wetter winters and longer periods of streamflow in Squaw Creek.
- No groundwater level trends are observed in data collected from monitoring wells in the Meadow. Pressure transducers install in five of the Meadow wells will start to show seasonal fluctuations previously not measured.

##### **6.1.3 GROUNDWATER QUALITY**

Important trends in groundwater quality observed during Water Years 2009 and 2010 include the following.

- Two detects of perchlorate in June of 2008 and 2009 at well SVPSPD#2 have been followed up by non-detects. The occurrence is not likely laboratory error as surmised in the Water Year 2008 Annual Report. Perchlorate in groundwater could be derived from a number of sources including

natural sources, explosives, flares, torches used in the torchlight parade, or fireworks

- The schedule and constituents sampled at the CHAMPS wells have been changed due to a revision of the WDR. Five selected wells are sampled monthly, starting in May 2009, from May through October.
- Because the sampling and analysis techniques for the CHAMPS wells are different than in previous years, a direct comparison of previous results with the 2009 and 2010 results is not possible.
- The downgradient CHAMPS well, RSC-301, has a higher concentration of dissolved kjeldahl nitrogen, orthophosphate, and phosphorus than upgradient wells. .
- Kjeldahl nitrogen in the downgradient RSC-301 is an order of magnitude higher than the other monitoring wells (Figure 35). The possibility of a localized source of kjeldahl nitrogen near RSC-301 should be examined as a potential source.
- The one remaining active CRWQCB site in the Olympic Valley GMP management area, the PlumpJack site, was closed as of September 24, 2009.
- No new hazardous waste sites were identified during Water Years 2009 and 2010.

#### 6.1.4 GROUNDWATER MANAGEMENT

A number of significant groundwater management activities were completed during Water Years 2009 and 2010. These include:

- SVPSD completed phase 1 of the Olympic Valley Creek/Aquifer study. This study was funded through the California Department of Water Resource's Local Groundwater Assistance program. The study will help quantify how much aquifer storage is lost to Squaw Creek, and how pumping influence flows in Squaw Creek. As part of this study, the following activities occurred.
  - Four new monitoring wells were installed.
  - Data Loggers were installed in 14 wells. Most wells that were equipped with new data loggers are adjacent to Squaw Creek, allowing for ongoing creek/aquifer interaction data

- Two aquifer tests were conducted.
- Friends of Squaw Creek assumed responsibility for maintaining the stream gages on Squaw Creek and continued the ongoing creek monitoring program
- The coordinated groundwater database was completed and populated with existing groundwater level and groundwater quality data.
- A coordinated groundwater monitoring plan was developed to ensure that all entities are collecting groundwater level data with similar levels of accuracy and frequency.

## **6.2 RECOMMENDED AMENDMENTS TO THE GMP**

We recommend that the Advisory Group review the recent Local Groundwater Assistance Grant application. Any points deducted from the application for inadequate GMP should be addressed if possible.

## **6.3 RECOMMENDED ACTIONS FOR WATER YEAR 2011**

Based on the analyses and conclusions presented above, the following recommendations are made for future groundwater management activities. Our recommendations are grouped by priority.

### **6.3.1 HIGH PRIORITY RECOMMENDATIONS**

High priority recommendations are those that should be initiated within the next six to twelve months. The high priority recommendations include:

- Implement the coordinated monitoring program detailed in the monitoring plan. Included in this recommendation are buying and installing data loggers for production and monitoring wells. This recommendation will have the advantage of producing a single, consistent data set that can be used for basin analysis.
- Continue to populate the unified database of groundwater level data with data as they become available. This database can then be used for managing the aquifers in Squaw Valley.
- Coordinate with, and support, Friends of Squaw Creek's efforts at stream restoration (GMP Element 2.2).

- Compare Old Fire Station precipitation data from the Davis gauge, the new NovaLynx gauge, and other nearby gauges. Adjust historical data if necessary to produce a consistent record of precipitation.
- Meter pumping from all wells in the Valley.

### **6.3.2 MEDIUM PRIORITY RECOMMENDATIONS**

Medium priority recommendations are those that should be completed within the next year to two years. These recommendations are important for long-term groundwater management.

- Initiate phase 2 of the Creek/Aquifer study. Phase 2 will analyze data from phase 1 and present recommendations for groundwater management.
- Evaluate the flow data that is collected as part of the TMDL monitoring.

### **6.3.3 LOW PRIORITY RECOMMENDATIONS**

Low priority recommendations are those that could be initiated within the next two years, but could be deferred. These include.

- Encourage residential water use audits and other conservation efforts. (GMP Element 7.2)
- Develop a plan and approach for investigating the impact of the horizontal wells on groundwater in the GMP management area (GMP Element 5.5)
- Establish a baseline for subsidence as part of surveying for the monitoring program.

## SECTION 7

### REFERENCES

- California Regional Water Quality Control Board (CRWQCB), Lahontan Region, 2009. *Monitoring and reporting program no. R6T-2009-(proposed) updated waste discharge requirements for the Resort at Squaw Creek, Placer County.*
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- HydroMetrics WRI, 2010. *Olympic Valley monitoring plan and database.* September.
- Kleinfelder & Associates, 2010. *Summary of 2010 surface water and groundwater monitoring, The Resort at Squaw Creek, Olympic Valley, California.* December 15, 2010.
- West Yost & Associates, 2005. *Groundwater management support activities, groundwater characterization report*, May 12, 2005.