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2009 Annual Report:
Hydrologic Conditions in Baseflow Reaches Pursuant to Conditions 14 and 15, Santa Lucia Preserve, Monterey County, California

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Preface

This report presents the results of the 2009 baseflow condition surveys of the four major streams flowing through Santa Lucia Preserve– Lower Las Garzas, Potrero, San Jose, and San Clemente Creeks. This report has been prepared for the Santa Lucia Conservancy and is primarily intended for the staff of Monterey County and California Department of Fish and Game, in accordance with the baseflow monitoring and reporting requirements outlined in County Conditions 14 and 15. The scope of this report is limited to the presentation and evaluation of existing baseflow conditions as required by Conditions 14 and 15, and is not intended as a comprehensive analysis. However, data collected will serve an integral part establishing a long term dataset necessary for future analyses.

Acknowledgments

We would like to acknowledge Chris Hauser and Jim Sulentich of the Santa Lucia Conservancy and Scott Brown of Balance Hydrologics for providing logistic support and reference information. We thank Sean Castorani and Kyle Stoner for field assistance and support.

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1 Introduction

The Santa Lucia Preserve (SLP) is a residential community established in 1994 on the 20,000 acre Rancho San Carlos property. The Santa Lucia Conservancy manages 18,000 acres of open space while the remaining 2,000 is occupied by the community. The Monterey County Planning and Building Inspection Department, the lead CEQA agency imposed stipulations on the Preserve before approving the final Environmental Impact Report. Through Conditions 14 and 15, annual baseflow monitoring is required on four major streams flowing through the property.

- *Condition 14*

  "Measured daily base flows in Potrero Canyon, San Clemente and Las Garzas Creeks shall be recorded at approved locations near the boundaries of Rancho San Carlos. An annual survey of pools and base flow conditions in the gaged creeks and in San Jose Creek shall be conducted in September of each year. At least every year, a base flow monitoring report for evaluating base flow conditions shall be prepared and filed with Environmental Health, Water Resource Agency, the Department of Fish and Game, and the Monterey County Planning and Building Inspection Department."

- *Condition 15*

  "If the Base Flow Monitoring Report demonstrates that the base flow in any of the four creeks has dropped below the October 1990 level as a direct result of the project, flow shall be augmented by discharging water into the creek near the upstream end of the affected Base Flow Reach. The rate of augmentation shall be of an amount sufficient to sustain pools and base flow approximately equal to conditions in October 1990; the maximum required combined augmentation for all four creeks is 30 gpm at the points where the augmented water reaches the protected base flow reaches. The proposed augmentation methods, the actual rate(s) of augmentation and the location(s) of augmentation shall be reviewed with the Water Resources Agency prior to implementation of this condition."

Baseflow conditions were surveyed from September 4 through September 25, 2009 and compared to October 1990 conditions pursuant to the requirements of Conditions 14 and 15. Garzas Creek was also surveyed on August 12, 2009. This report is a compilation of the findings of the 2009 baseflow conditions mapping and specific conductance profiles of the four creeks flowing through the Santa Lucia Preserve. Although the scope of this report is limited to the requirements of Conditions 14 and 15, the data collected will serve an integral part establishing a long term dataset necessary for future analyses.

2 Methods

The baseline comparison for baseflow conditions is an October 1990 study as indicated in Condition 15. The purpose of the study was to develop a "baseline characterization of the physical influences of stream aquatic and associated riparian habitat conditions at Rancho San Carlos" (Napolitano and Hecht 1992). Balance Hydrologics has conducted the annual baseflow survey in years prior to 2007. In 2007 the study was conducted by Zachary Croyle of CSUMB and in 2008 by Sean Castorani of CSUMB. Methods used in previous surveys have been used here to maintain continuity throughout the study (Woyshner et al. 2004;2005, Croyle 2007).

2.1 Baseflow Conditions Mapping

Surveys of the four major creeks in the Santa Lucia Preserve were conducted by walking the length of the creek and recording qualitative observations. Baseflow conditions were described in detail and the locations of changing conditions were recorded with a GPS unit. The results were mapped in GIS. The 1990 surveys predate the use of GPS and therefore exact locations of changing stream conditions are not known. For comparison purposes, definitions from previous surveys which describe stream conditions have been retained. Furthermore, the maps presented in this report have been formatted similar to previous surveys to maintain a consistent presentation of the baseflow data. The following definitions are used to describe sub-reach channel conditions (Woyshner et al. 2004;2005, Croyle 2007).

- *"Predominantly wetted channel:* Flowing segments and/or strings of isolated pools, without reference to exact location of segments. Most pools contain at least some water, however riffles may be dry. In the 1990 and 1991 memos and field notes, these segments were referred to as "continuously wetted channel[1]," but we have changed the phrase to avoid confusion with "continuously flowing" and to provide a more general definition that can be applied to all creeks. Some short sections of dry channel may be included, but the reach/sub-reach was defined as having predominantly wetted conditions."
- *"Predominantly dry channel:* Stream reaches or sub-reaches with isolated pools and completely dry channel (short, predominantly-wetted channel segments separated by long dry channel segments). Some very short sections with flowing water may be included, but reach-wide conditions are predominantly dry or contain only low-volume pools. Many to most pools in these reaches are dry. The current mapping of the

[1] "'Wetted channel,' as used in the 1990 and 1991 reconnaissance reports, described channels with sufficient moisture to sustain riparian vegetation reliably during droughts. Generally, these were channels in which mature riparian vegetation could expect to obtain water from pools, underflow, or springs. In some cases, most notably Potrero creek, a 'wetted' channel had no expression of surface water, but we had reason to believe (often supported by digging in pools) that moist or saturated sands were within a few feet of the bed (Woyshner et al. 2005)."

1990/1991 accounts and field notes is based on reach descriptions without reference to exact locations of surface water and dry segments."

- *"Dry:* Stream reaches or sub-reaches having no surface water"

2.2 Specific Conductance Profiles

In addition to qualitative descriptions and mapping of baseflow conditions, specific conductance[2], dissolved oxygen, temperature, and pH were measured at select pools during each survey. Specific conductance is used as a proxy for "dryness" in the watershed. As the watershed begins to dry, groundwater with increasing amounts of dissolved solids feeds stream baseflow. This results in higher specific conductance. As streams begin to dry, specific conductance generally increases as demonstrated on Lower Garzas Creek by Wolshner (2003). Specific conductance is used additionally as a quantitative indicator when evaluating stream "dryness" due to changes in baseflow conditions between years.

3 Results

Results for the 2009 baseflow survey are briefly summarized and compared with 1990 reference baseflow conditions. The water year 2009 was drier than average, receiving 18.08 inches of rain at the San Clemente Dam (Figure 1). The average rainfall for the area is 21.1 inches per year. This water year is the third consecutive year of below average rainfall.

3.1 Lower Las Garzas Creek

Two baseflow surveys of Lower Las Garzas Creek were conducted. The first survey was on August 12, 2009 (Figure 2a) and the second of September 25, 2009 (Figure 2b). The surveys began at the confluence of the Las Garzas Creek with the Carmel River and extended upstream to Moore's Lake at Robinson Canyon Road.

In August 2009, Garzas showed conditions that were comparable to October of 1990, but in September of 2009, Garzas was demonstrably drier. In particular, there were no reaches or subreaches with "flowing water" connecting adjacent pools in September. Rather, the entire survey saw only isolated pools. This September 2009 condition is therefore defensibly drier than conditions depicted in the 1990 map of Garzas Creek (Figure 3).

The specific conductivity data for 1990 is extremely variable, so it is very difficult to "characterize" the data for 1990 with a meaningful average. The specific conductance in August

[2] Specific conductance measures the ability of water to conduct electrical current and is a relative measure of the amount of dissolved solids in water.

and September 2009 is far less variable, but it follows the same general trend as 1990 (Figure 4). The underlying trend is from higher values to lower values with distance upstream, with a regional maximum occurring somewhere around 8000 ft to 10000 ft upstream of the Carmel River confluence. There is a slight shift toward higher conductivity (drier) conditions between August and September (Fig. 4).

The rain event of October, 13, 2009 produced a runoff event through the study reach, and there was stream flow observed through the protected baseflow reach in late October. The early rain brought the creek back to conditions that are wetter than 1990.

3.2 Potrero Creek

The Potrero Creek baseflow survey was conducted on September 11, 2009 and extended from the SLP gatehouse to approximately 1,300 feet before dead rat spring (Figure 5). The channel flows continuously from 300 feet above the "Protected Baseflow Reach" to approximately 200 feet below the Lot 187 Bridge. Wolshner et al. (2004) describes the "Pretoected Baseflow Reach" section as surveyed in 1990 as having locally discontinuous flow (Figure 6), while the flow was continuous for the same stretch in 2009. Given this description, Potrero Creek seems "wetter" than 1990 conditions.

Only two specific conductance measurements were taken during the 1990 survey and only four during the 1991 survey. Conditions in 1991 were wetter than 1990, but still well below average. Potrero Creek specific conductance measurements taken in 2009 are slightly lower than those of 1991 (Figure 7). Potrero Creek conductivity measurements have been relatively high compared to other creeks on the Santa Lucia Preserve, but the conductivity measurements in 2009 were lower than measurements from 1990 and 1991.

3.3 San Jose Creek

The San Jose Creek baseflow survey was conducted on September 18, 2009. The survey began at the SLP property line and extended upstream to Stickleback Pond (Figure 8). Continuous flow was documented from the property line until approximately 3,500 feet above the William's Canyon confluence, although volume was significantly reduced along the reach. The 1990 survey was discontinued above Van Winkley's Canyon and found predominantly dry conditions for the majority of the survey (Figure 9). San Jose Creek was clearly "wetter" in 2009 than in 1990.

The specific conductance profile for San Jose Creek display data for 2009 that are lower than data collected in 1990 (Figure 10).

3.4 San Clemente Creek

The baseflow survey for San Clemente Creek was conducted on September 4, 2009. The survey began at the SLP property line (Dormody Road) and continued upstream to Robinson Canyon Road. Continuously flowing water was recorded from the property line until it abruptly ends approximately 6,700 feet later, approximately 1,300 feet beyond the "Protected Baseflow Reach" (Figure 11).

During the 1990 survey, San Clemente Creek was surveyed from the San Clemente Trail Bridge to Robinson Canyon Road (Figure 12). No data for the conditions through the "Protected Baseflow Reach" exist. Only one short section was described as predominantly wetted, while the remainder of the creek was described as predominantly dry. Discharge at the gage site was estimated to be approximately 0.03 ft^3/s on September 30, 2009 while August 23 and November 5, 1991 estimates are 0.04 ft^3/s. Specific conductance data from 2009 are all similar to the data from 1990 and 1991 (Figure 13). Although little reference data exists for 1990 conditions, judging by conductance values and discharge estimates, San Clemente Creek is "wetter" than 1990 conditions.

4 Discussion

The 2009 water year rainfall (18.08 inches) was significantly higher than 1990 (13.1 inches). Conditions of the streams resemble that of 2008 as well as 2007 (Castorani 2008, Croyle 2007). As noted in Croyle (2007) baseflow conditions in a given year are influenced by rainfall totals of previous years. This effect is known as "carry-over" and has been studied in this region (Figure 14) on streams that flow through the SLP (James 2003; Leffler 2003; Smith et al. 2004). The reference conditions in 1990 were after four years of drought. After three years of below average rainfall, we would still expect the baseflow to be "wetter" than 1990.

5 Conclusion

Given the differences in water years 1990 and 2009 and the antecedent water years leading 1990 and 2009, we would anticipate wetter baseflow conditions in 2009 than were present in 1990. Baseflow conditions were surveyed on the four major streams which flow through the Santa Lucia Preserve - Lower Las Garzas, Potrero, San Clemente, and San Jose. The baseflow characteristics of these streams were collected and compared with conditions in 1990 reference conditions as stipulated in County Condition 15. Results from baseflow mapping and specific conductance plots suggest 2009 conditions are "wetter" than those of 1990 for Potrero, San Clemente and San Jose Creeks. The September 2009 condition of Las Garzas Creek is drier than conditions depicted in the 1990 map. Streamflow augmentation is unnecessary because an early rainfall event around October 13, 2009 ameliorated the dry conditions.

6 References

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Woyshner M, Brown S, Hecht B. 2005. 2005 Annual report: hydrologic conditions in baseflow reaches pursuant to conditions 14 and 15, Santa Lucia Preserve, Monterey County, California. Consulting report prepared by Balance Hydrologics for the Santa Lucia Conservancy. 29 pp.

7 Figures

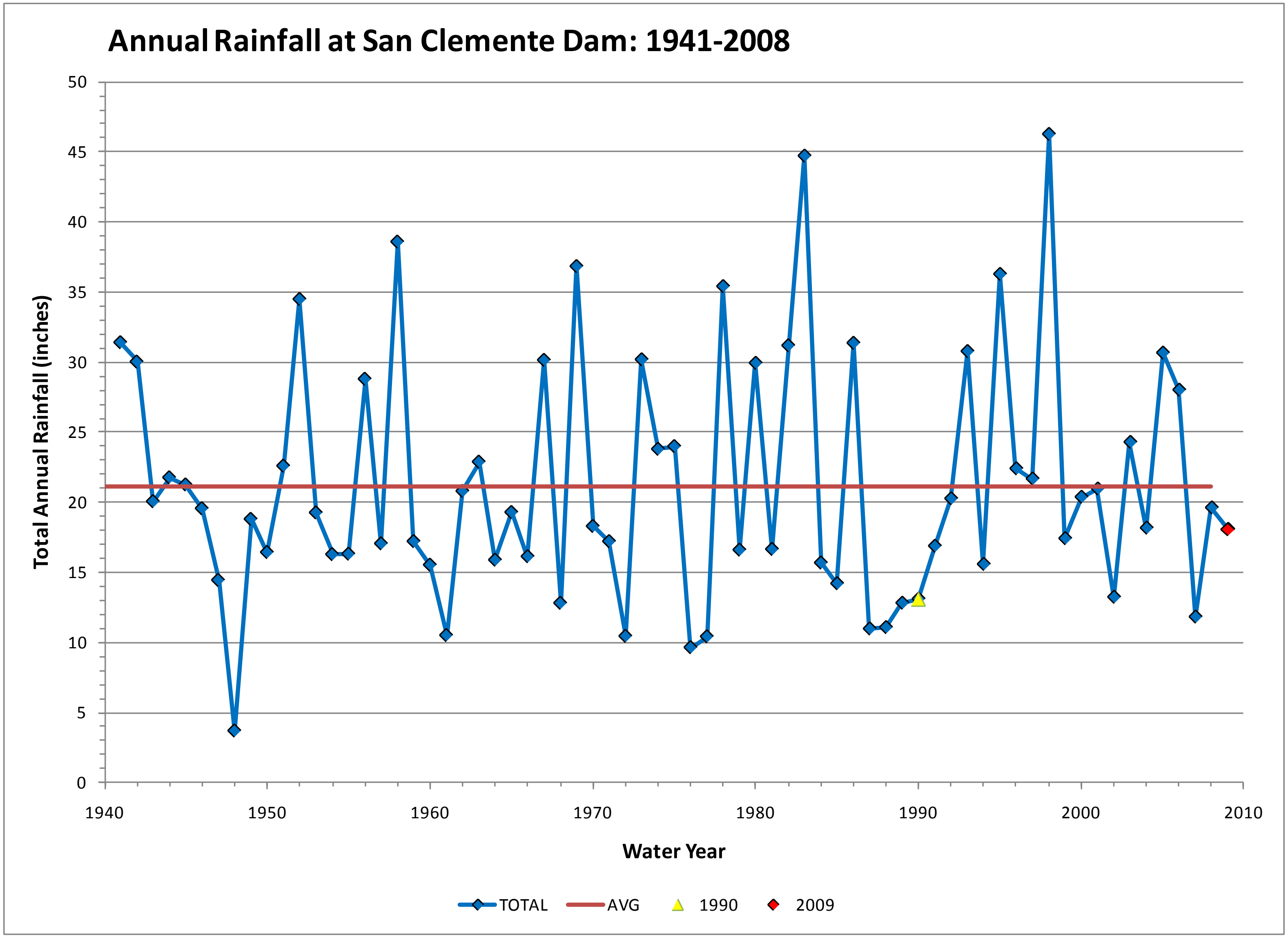

Figure 1. Total rainfall at San Clemente Dam for water years 1922 -2008. Water years 2007 and 2008 had more rainfall than the years preceding 1990 andhelp explain why baseflow conditions in 2009 were “wetter” than 1990.

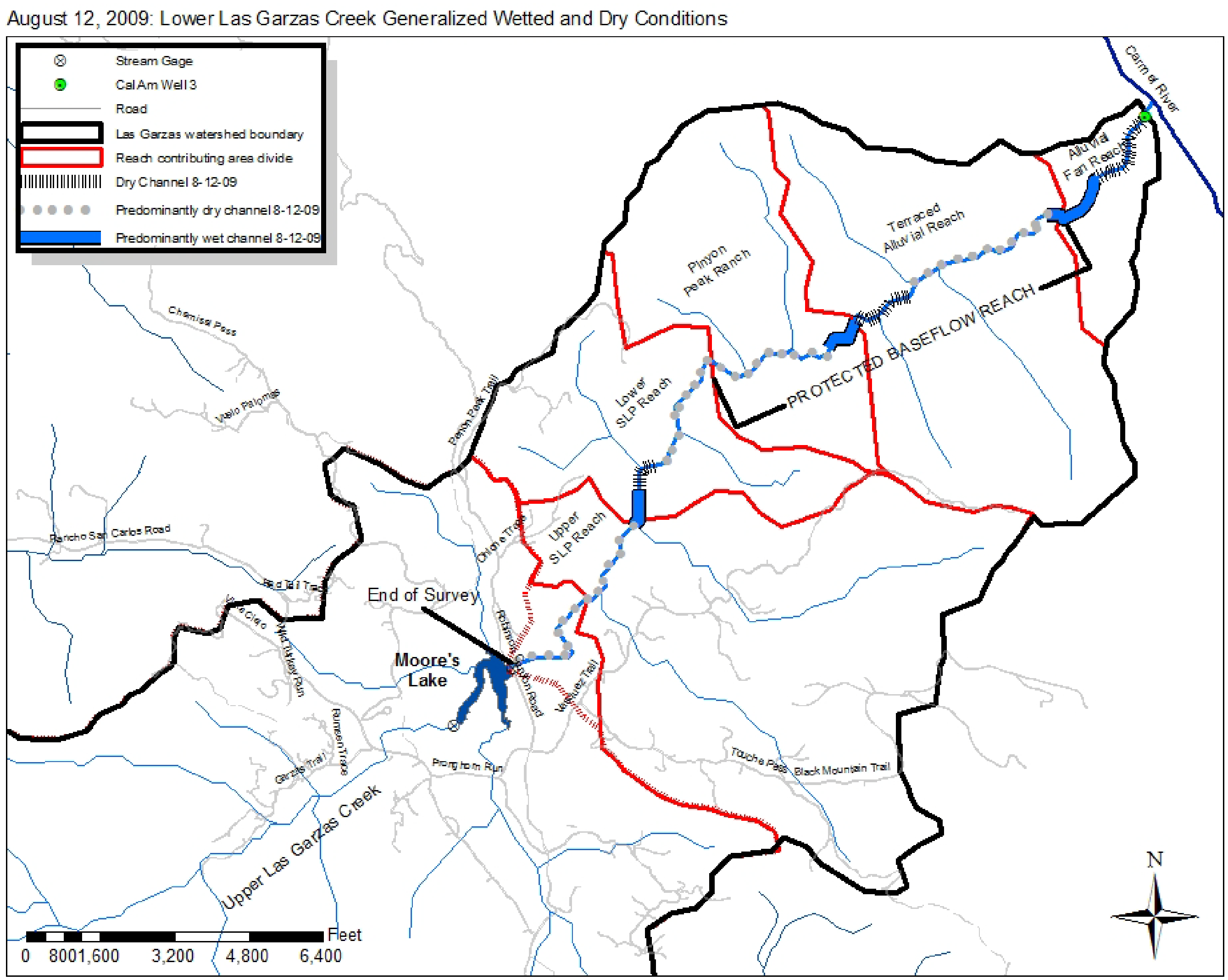

Figure 2a. Map showing generalized flow conditions for lower Las Garzas Creek on August 12, 2009.

September 25, 2009: Lower Las Garzas Creek Generalized Wetted and Dry Conditions

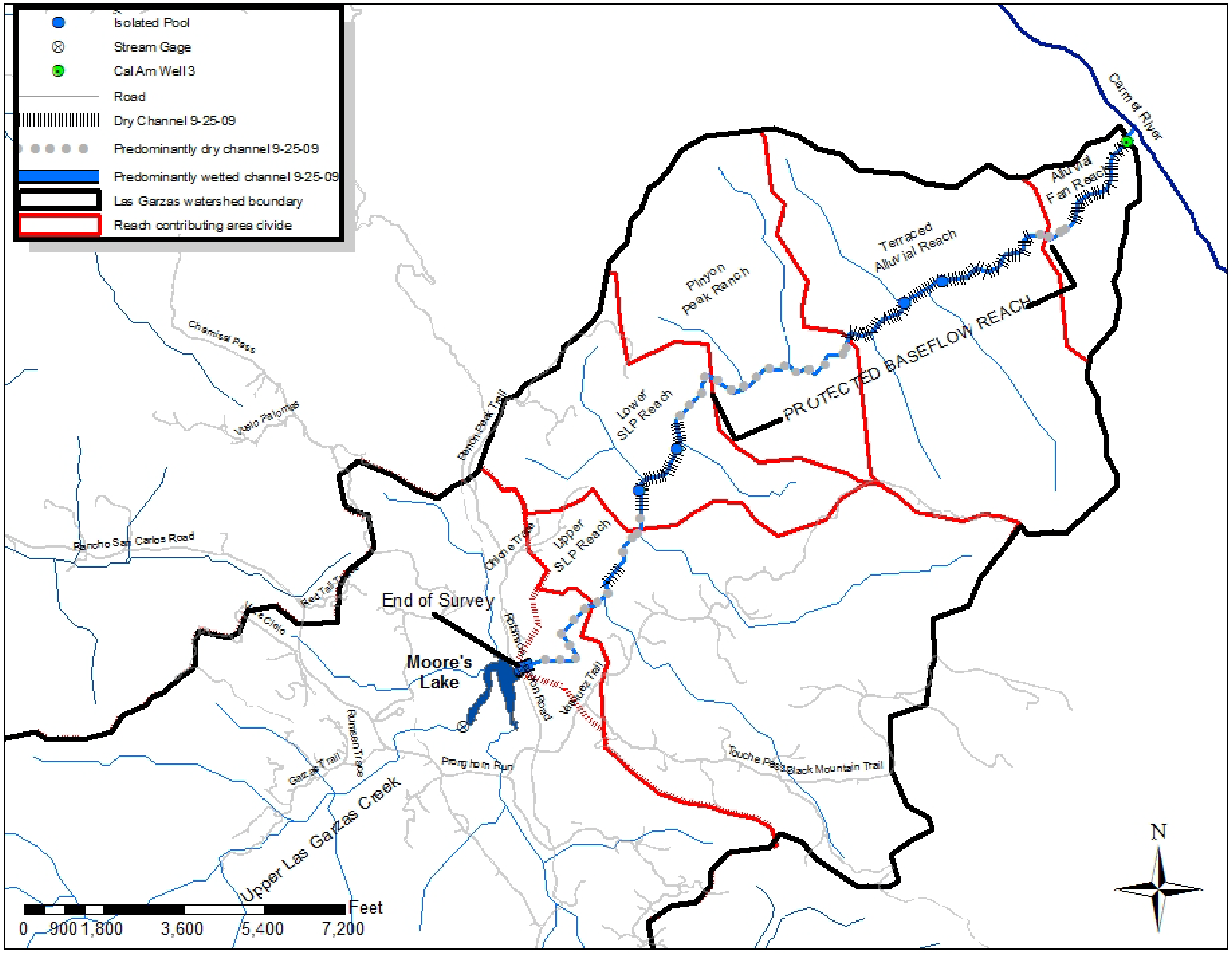

Figure 2b. Map showing generalized flow conditions for lower Las Garzas Creek on September 25, 2009.

October 30, 1990: Lower Las Garzas Creek Generalized Wetted and Dry Conditions

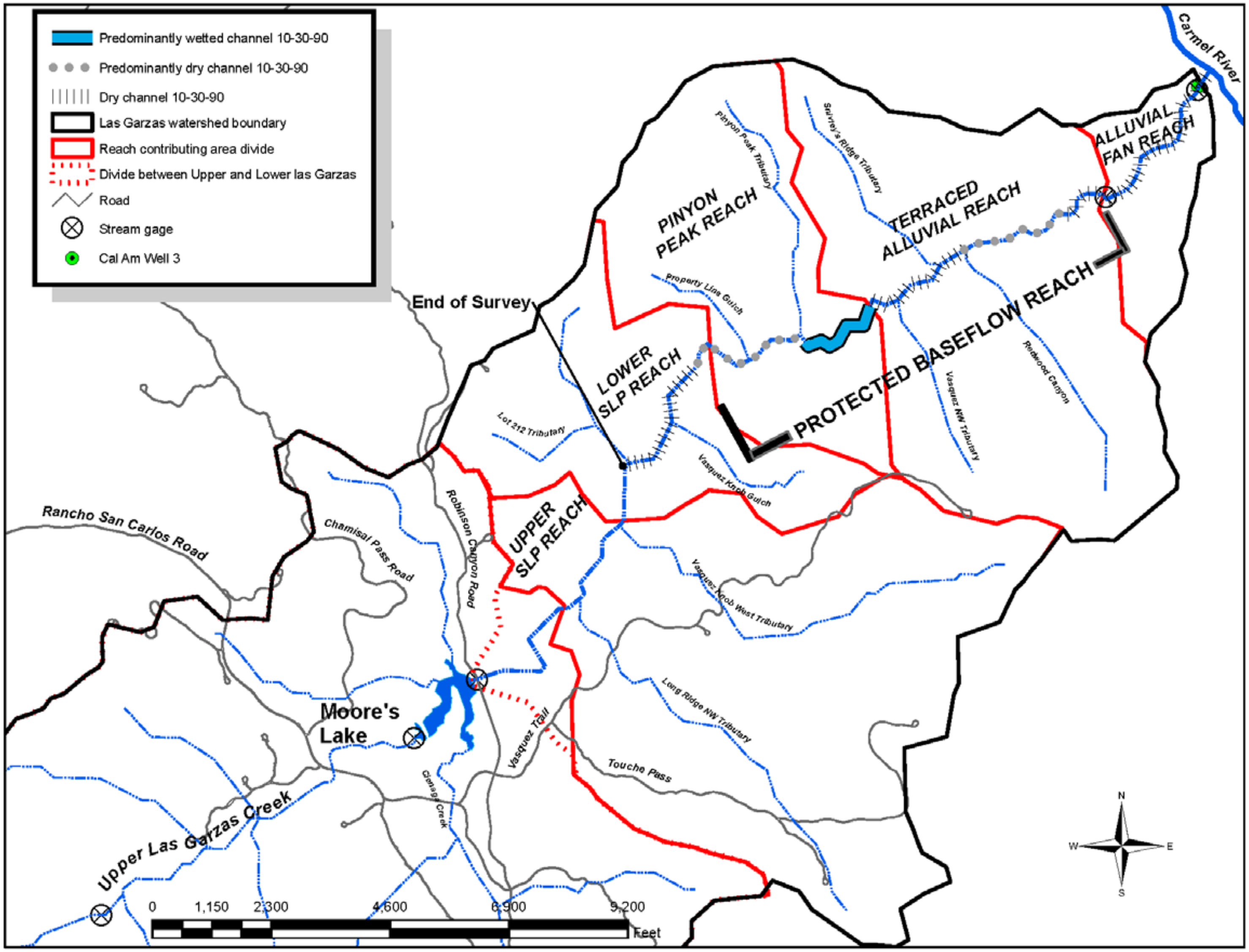

Figure 3. Generalized flow conditions on Lower Las Garzas Creek on October 30, 1990. In 1990, the upper part of Pinyon Pk. Reach consisted of isolated pools while the lower part of that reach had some continuous flow. Surface flow was not observed in the lower reaches.

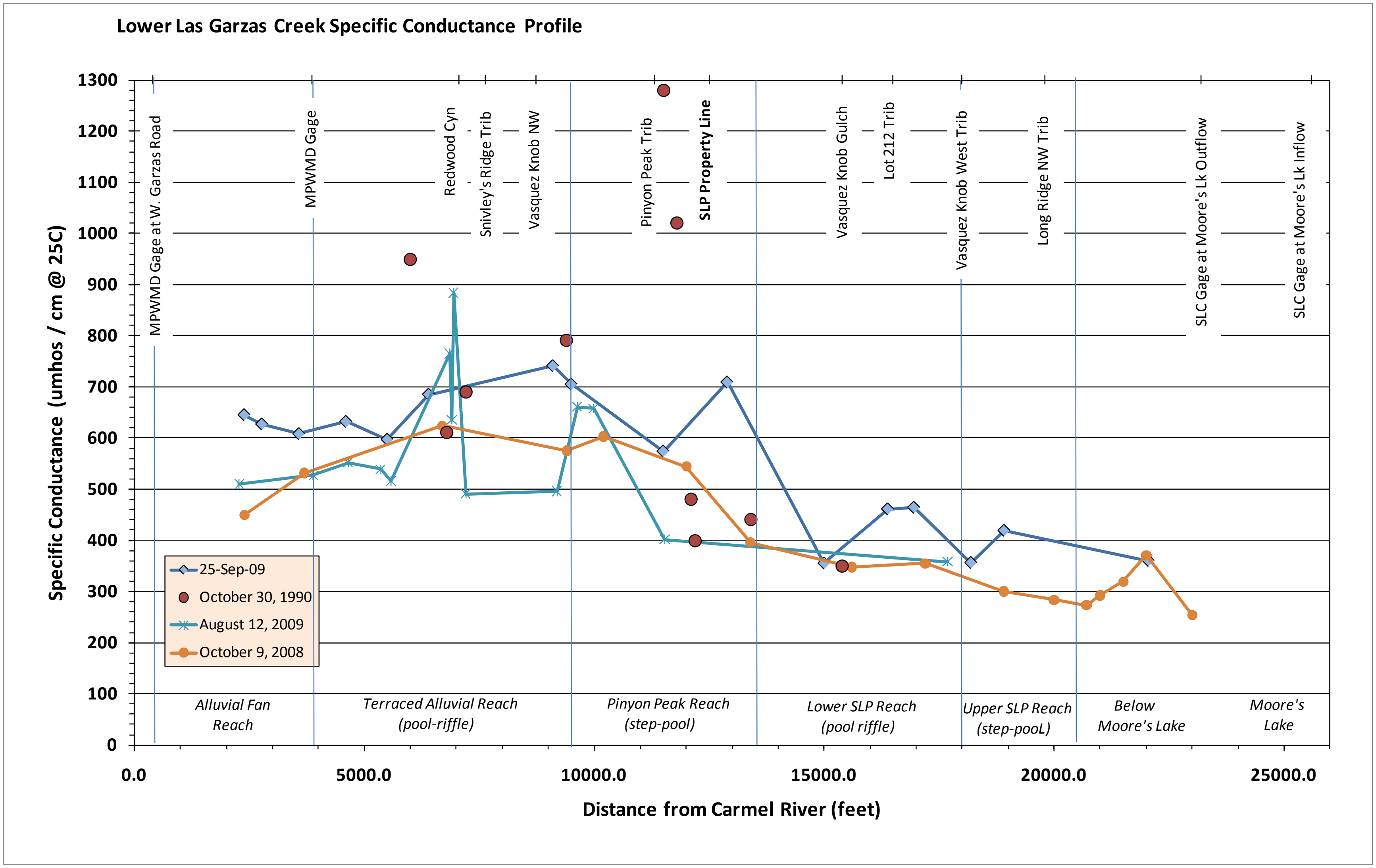

Figure 4. Lower Las Garzas Creek specific conductance measurements for 1990, 2008, August 12, 2009 and September 25, 2009. The specific conductivity data for 1990 is extremely variable, so it is very difficult to "characterize" the data for 1990 with a meaningful average. The specific conductance on September 2009 is far less variable, but it follows the same general trend as 1990. The underlying trend is from higher values to lower values with distance upstream, with a regional maximum occurring somewhere around 8000 ft to 10000 ft upstream of the Carmel River confluence. There is a shift toward higher conductivity (drier) conditions between August and September in 2009.

September 11, 2009: Potrero Creek Generalized Wetted and Dry Conditions

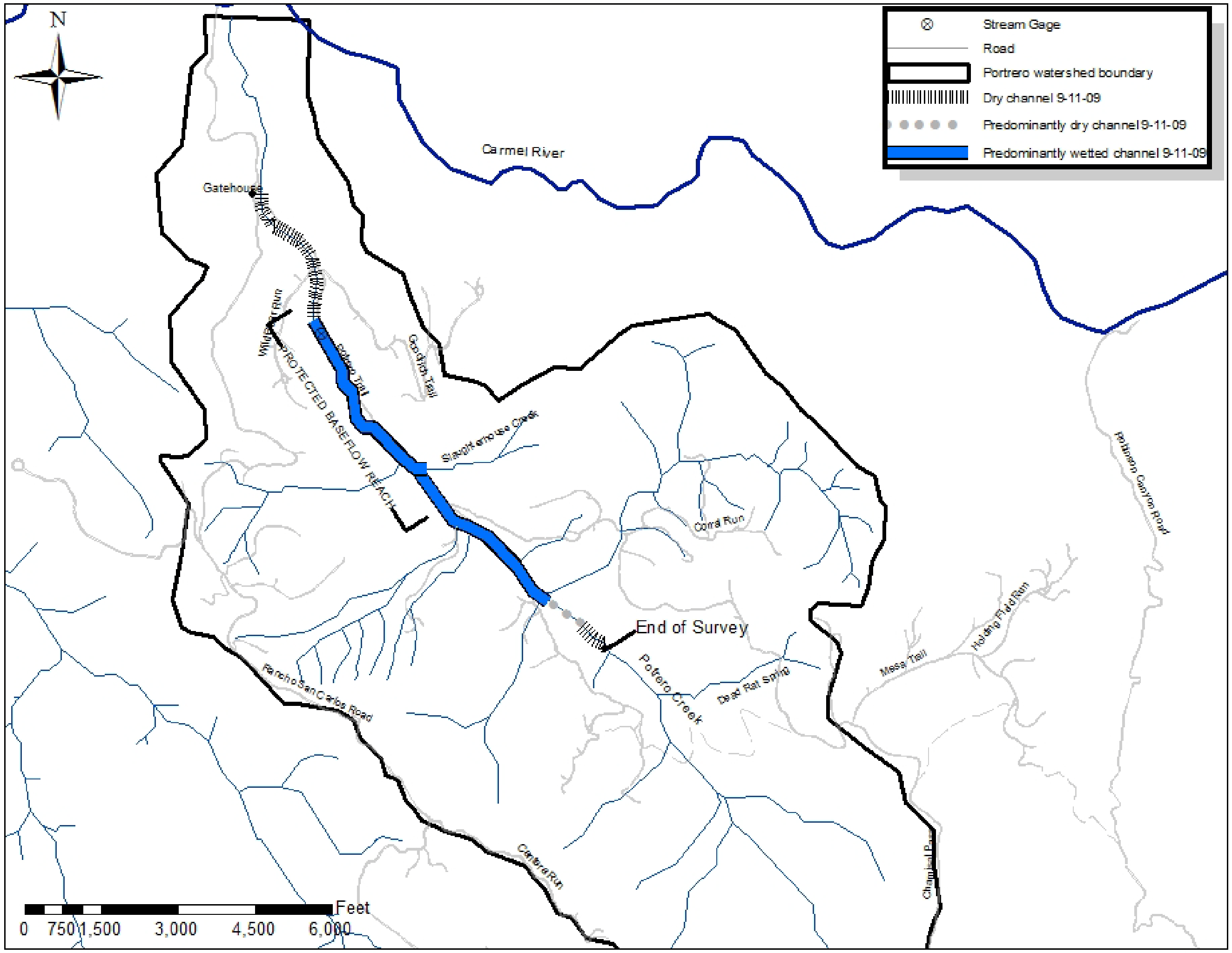

Figure 5. Map showing generalized flow conditions for lower Potrero Creek on September 11, 2009

October 06, 1990: Portrero Creek Generalized Wetted and Dry Conditions

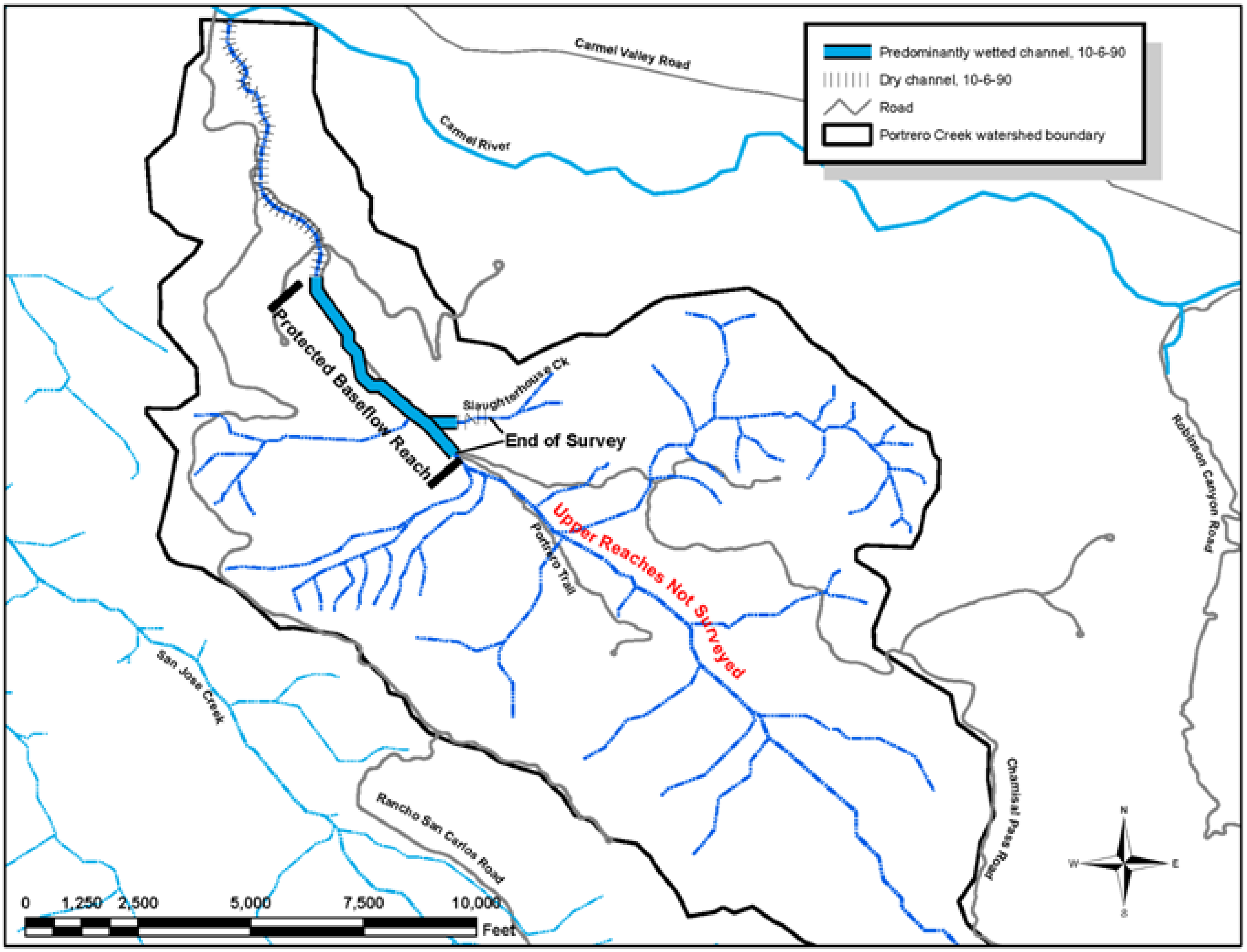

Figure 6. Generalized flow conditions on Portrero Creek on October 30, 1990.

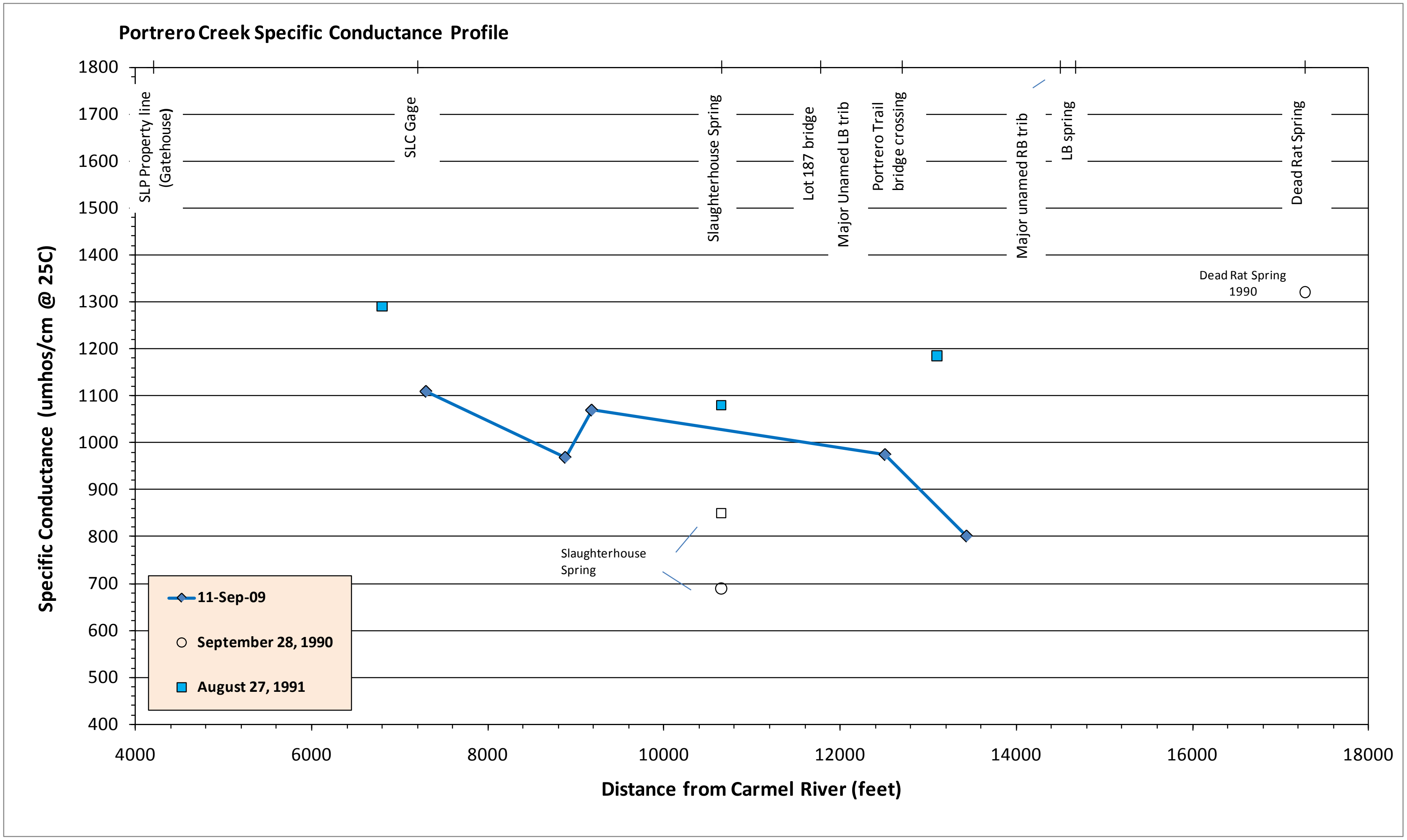

Figure 7. Potrero Creek specific conductance measurements for 1990, 1991, and 2009. Specific conductivity measurements in 2009 were generally lower than in 1991. There was not enough flow for a measurement of the Slaughterhouse Spring in 2009.

September 18, 2009: San Jose Creek Generalized Wetted and Dry Conditions

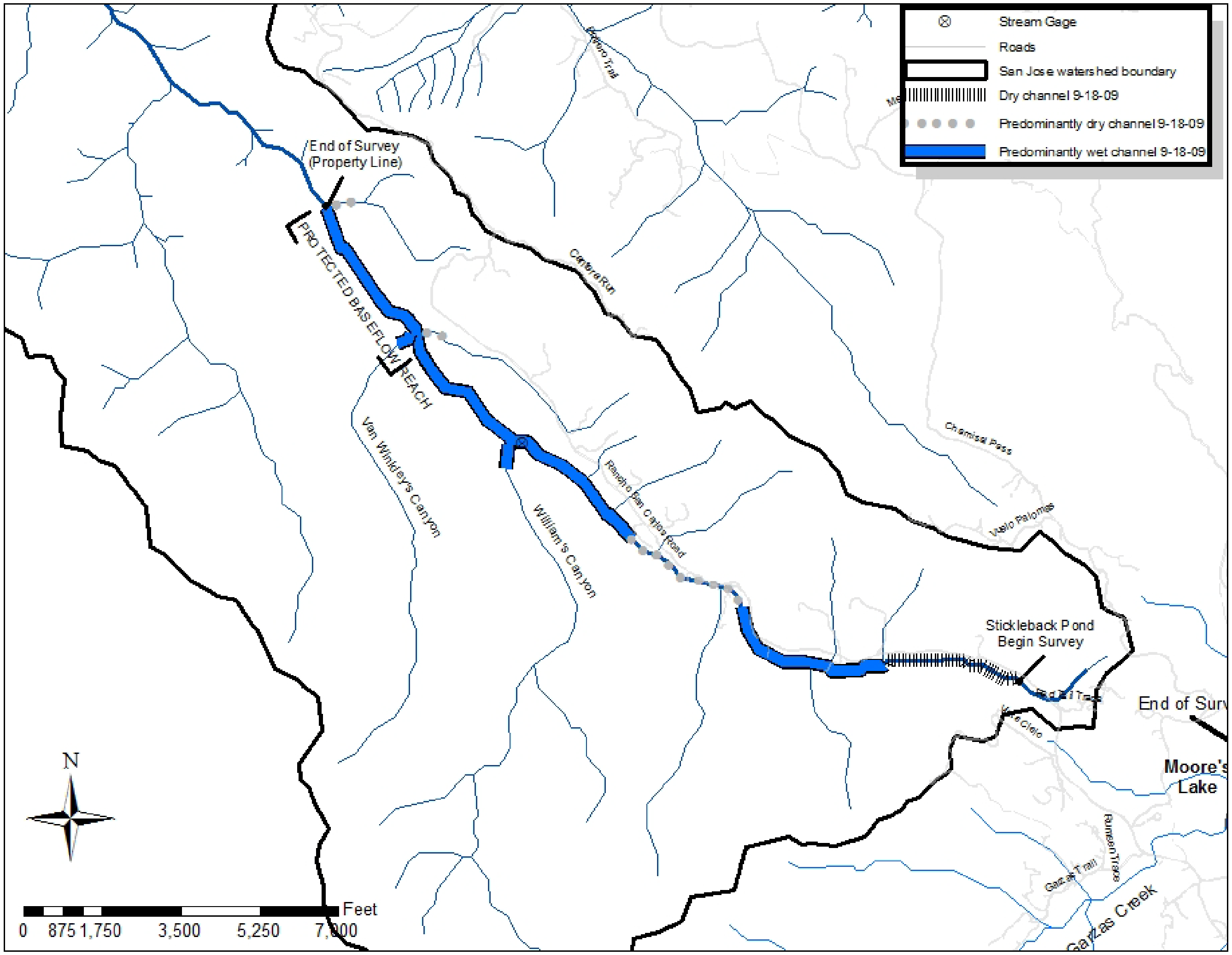

Figure 8. Map showing generalized flow conditions for San Jose Creek on September 18, 2009.

September 1990: San Jose Creek Generalized Wetted and Dry Conditions

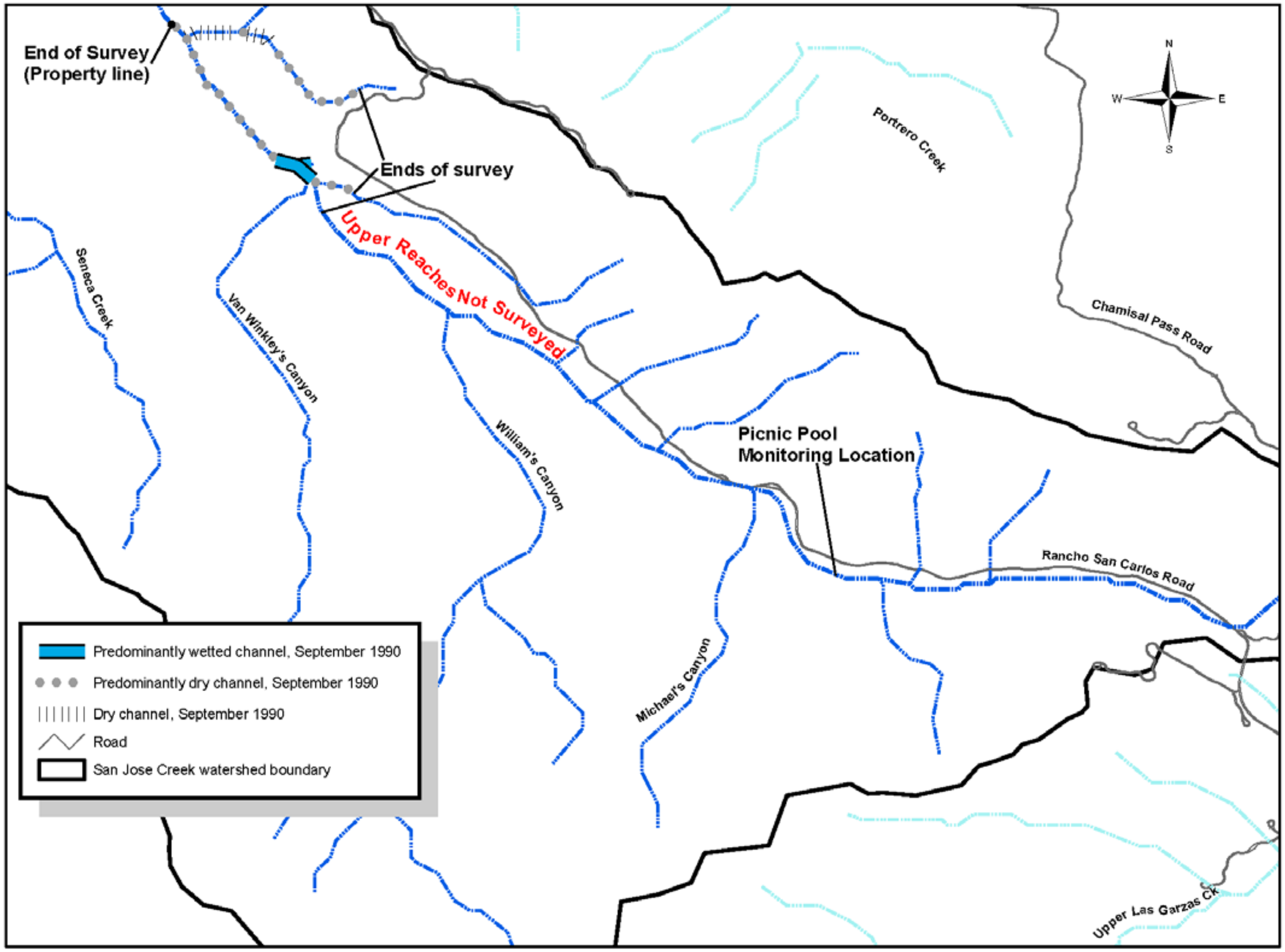

Figure 9. Generalized flow conditions on San Jose Creek in September1990.

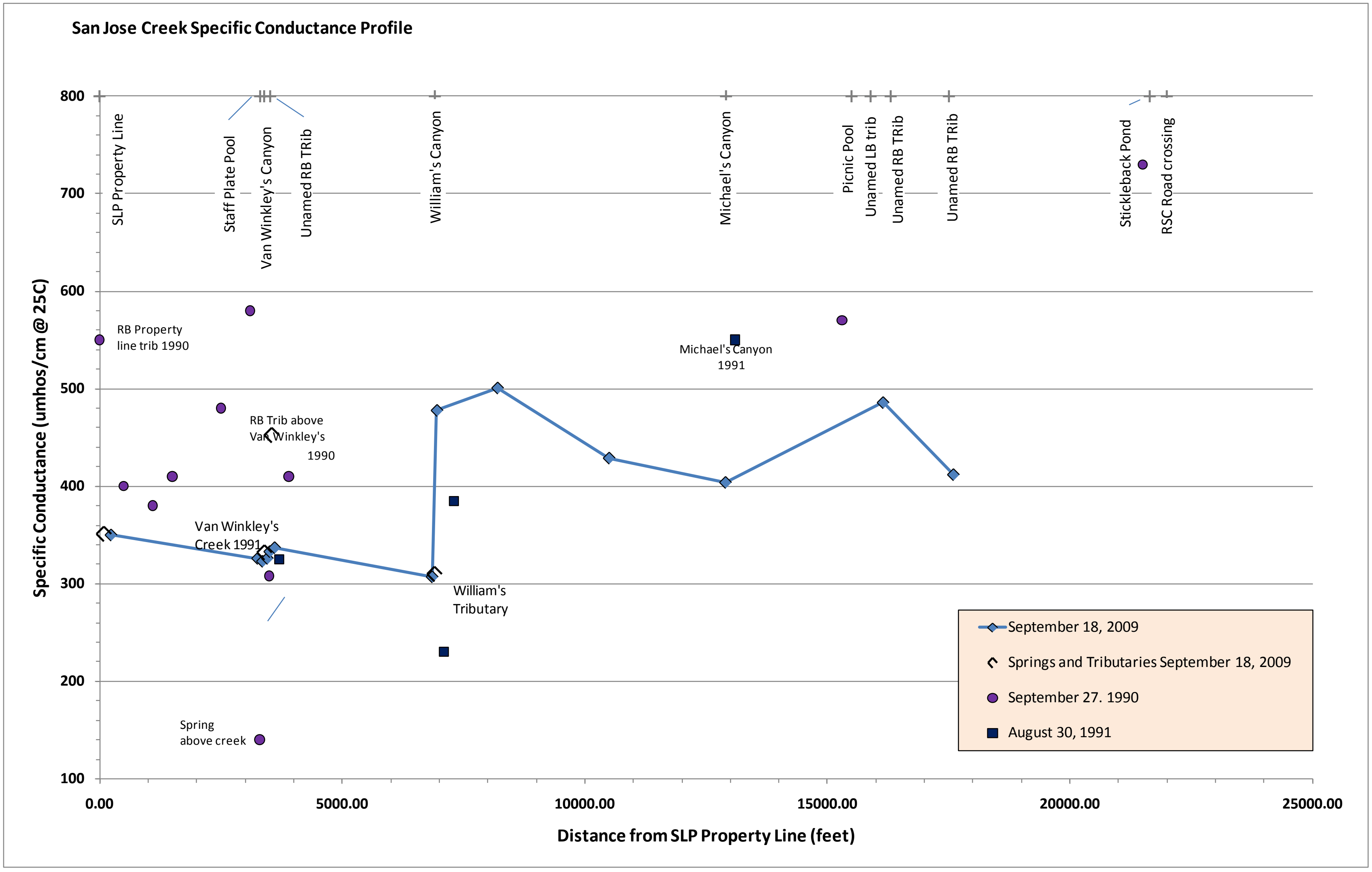

Figure 10. San Jose creek specific conductance measurements for 1990, 1991, and 2009. Specific conductivity measurements from 2009 were generally lower than 1990 measurements. There is an increase in specific conductivity upstream of William's Canyon tributary.

September 4, 2009: San Clemente Creek Generalized Wetted and Dry Conditions

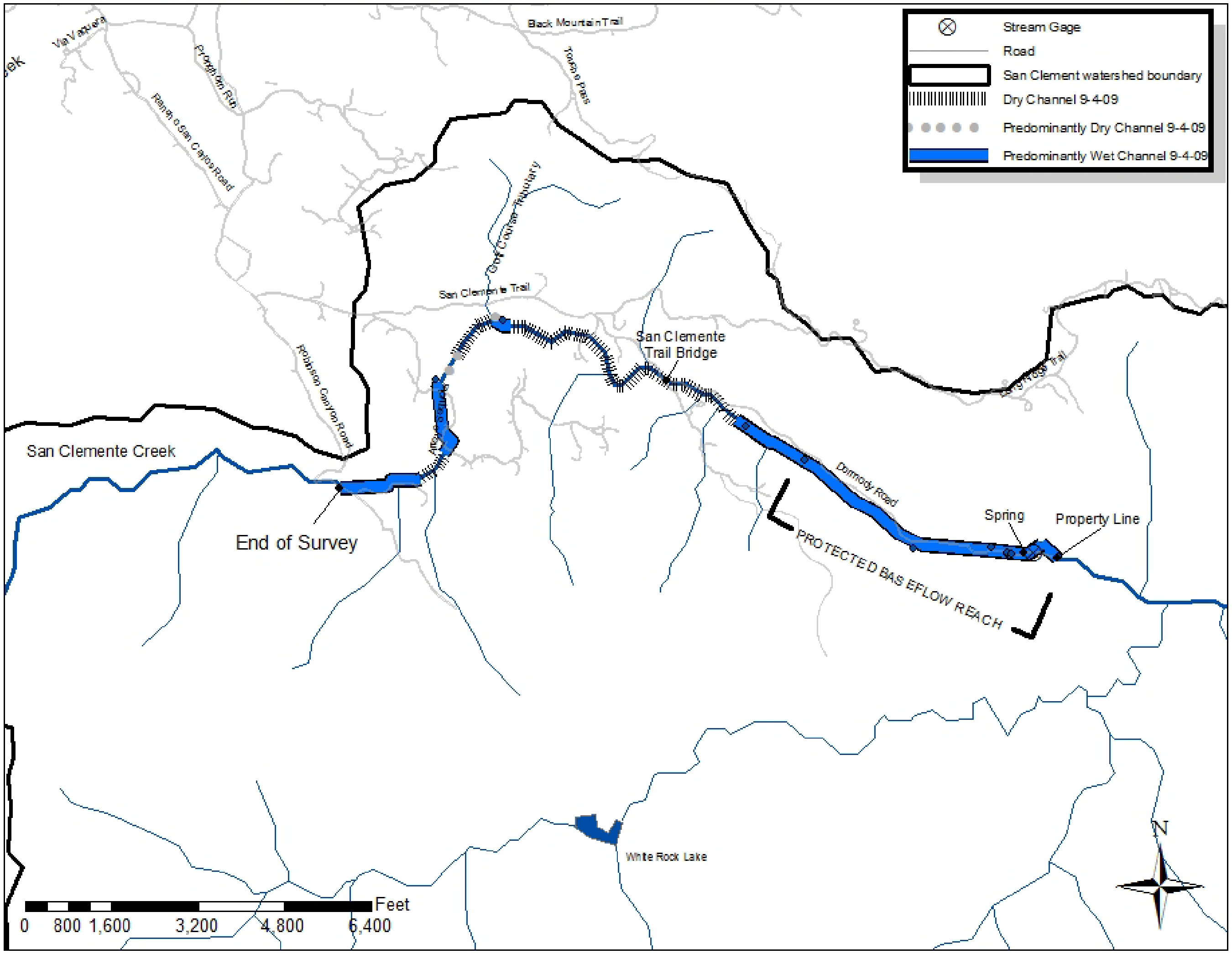

Figure 11. Map showing generalized flow conditions for San Clemente Creek on September 4, 2009.

September 28, 1990: San Clemente Creek Generalized Wetted and Dry Conditions

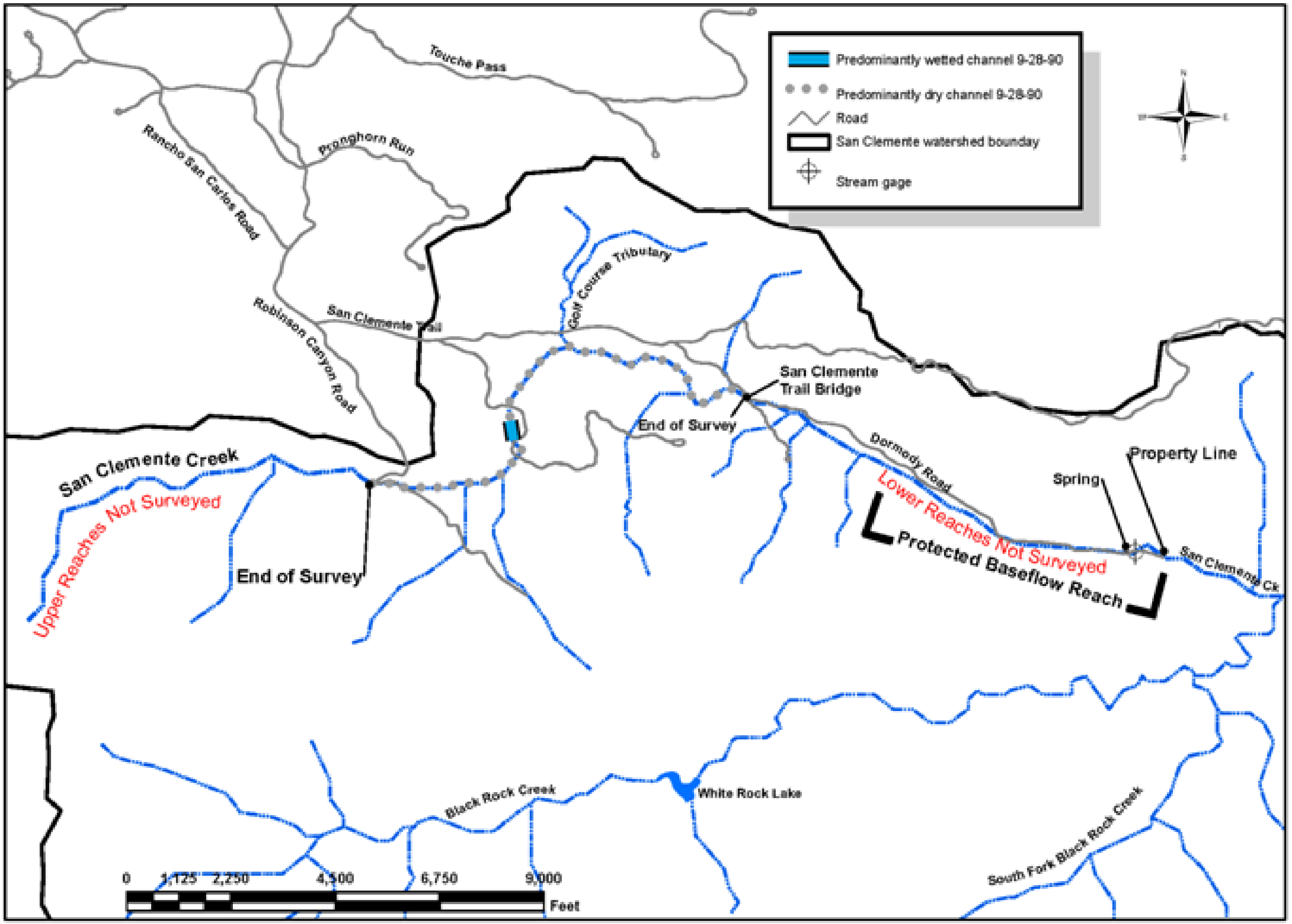

Figure 12. Generalized flow conditions on San Clemente Creek on September 28, 1990.

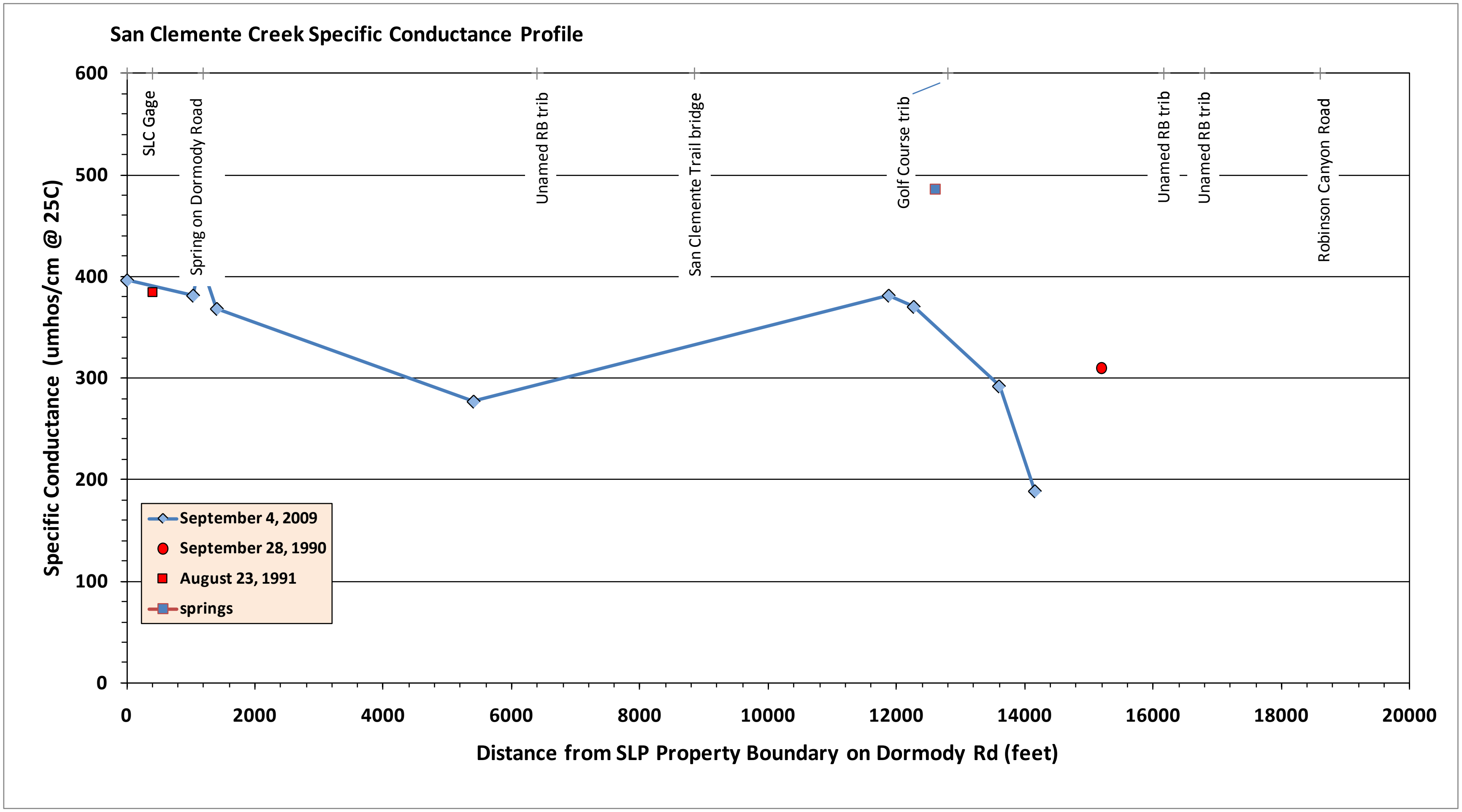

Figure 13. San Clemente creek specific conductance measurements for 1990, 1991, and 2009. There are few measurements from 1990 and 1991, but the specific conductivity measurements from 2009 look similar or lower than the 1990 and 1991 measurements.

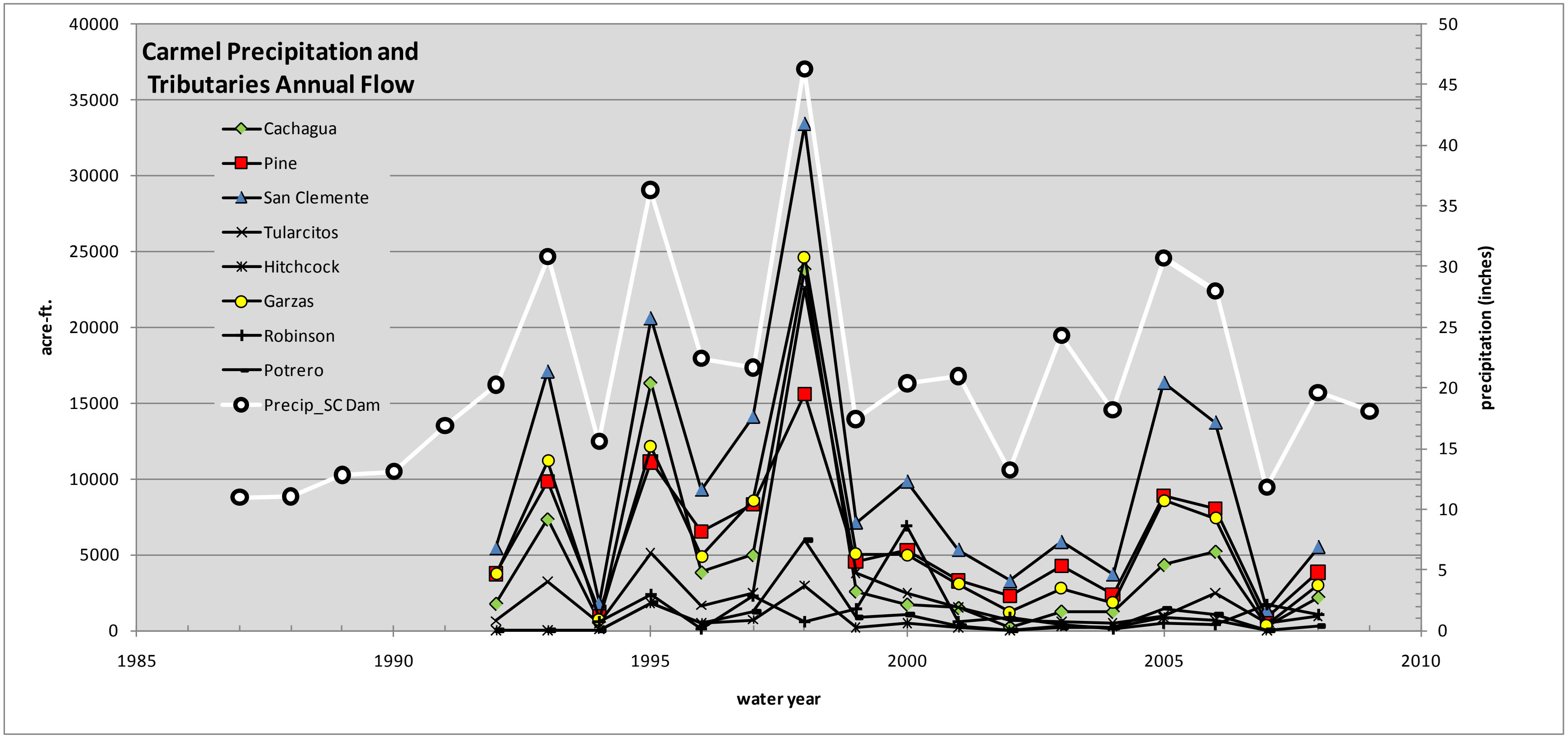

Figure 14. Annual water yield of Carmel River tributaries, with annual rainfall. The effect of rainfall on streamflow in subsequent years can be observed: There was a drought previous to the 1990 baseflow survey (tributary annual flow data not available until1992). Rainfall from 2008 and 2009 was below average, but more than the rainfall in 1987-1990 (figure from Smith et al. 2004).