Central
Coast
Watershed
Studies

CCoWS

Report No. WI-2007-03
15 October 2007

2007 Annual Report:
Hydrologic Conditions in Baseflow Reaches Pursuant to Conditions 14 and 15, Santa Lucia Preserve, Monterey County, California

Zachary Croyle
Douglas Smith (Ph.D.)

The Watershed Institute

Science and Environmental Policy
California State University
Monterey Bay
www.watershed.csumb.edu

100 Campus Center, Seaside, CA,
93955-8001
831 582 4694 / 4431.

Lead author contact details:
zachary_croyle@csumb.edu

Preface

This report presents the results of the 2007 baseflow condition surveys of the four major streams flowing through Santa Lucia Preserve– Las Garzas, Portrero, 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 presented here are an important part of the long term data set that will be used for future in depth watershed analyses.

Acknowledgments

We would like to acknowledge Chris Hauser of the Santa Lucia Conservancy and Scott Brown of Balance Hydrologics for providing logistic support and reference information.

Table of Contents

List of Figures

1 Introduction

The Santa Lucia Preserve (SLP) project was established in 1994 on the 20,000 acre former Rancho San Carlos property with the purpose of developing a residential community while preserving open space. SLP maintains 18,000 acres of undeveloped open space that is managed by the Santa Lucia Conservancy, while the community occupies the remaining 2,000 acres. As the lead CEQA agency, the Monterey County Planning and Building Inspection Department imposed conditions on the SLP project prior to approval of the final EIR in 1995. Conditions 14 and 15 require monitoring and evaluation of annual baseflow conditions on four major streams flowing through SLP lands:

- *Condition 14*
  "Measured daily base flows in Portrero 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."

To fulfill the requirements of Conditions 14 and 15, baseflow conditions were surveyed from September 21 through October 1, 2007 and compared to October 1990 conditions. This report presents the findings of the 2007 baseflow conditions mapping and specific conductance profiles of the four creeks flowing through SLP. Although the scope of this report is limited to the requirements of Conditions 14 and 15, the data collected to assess baseflow conditions are a vital part of a growing long term data set that will be essential for future, broader scale analyses of watershed function and change.

2 Methods

Condition 15 designates October 1990 baseflow conditions as the baseline for comparison to evaluate annual baseflow conditions. The primary purpose of the 1990 survey 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 surveys in previous years. In order to maintain consistency and continuity in data collection and presentation, methods used in previous annual baseflow reports have been continued here (Woyshner et al. 2004; 2005).

2.1 Baseflow Conditions Mapping

Each of the four creeks was surveyed by walking its length and making qualitative observations of baseflow conditions. Channel baseflow conditions along reaches were described in detail and the locations where conditions changed were recorded with a GPS unit. The results of this baseflow field survey are presented in maps generated using a GIS. The 1990 survey predates the use of GPS and as a result, the exact locations of changes in baseflow conditions along a stream were not mapped in great detail. Recent baseflow surveys conducted with GPS have more precisely documented the locations of changing conditions. However, in order to facilitate comparison with the 1990 data, the generalized map legend definitions used in previous reports have been retained. The following map legend definitions are used to describe sub-reach channel wetness (Woyshner et al. 2004; 2005):

- *"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 Portrero 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 here as an indicator of "dryness" in the watershed. This is based on the concept that as conditions become drier, baseflows are fed by increasingly "older" groundwater that has remained in the aquifer longer and therefore contains more dissolved solids; more dissolved solids results in higher specific conductance. Specific conductance on streams generally increases as streamflow decreases during the dry season, as Woyshner et al. (2003) demonstrated on Lower Las Garzas Creek. Because specific conductance may also change from year to year due to changing baseflow conditions, it is used as an additional, quantitative indicator in evaluating annual changes in stream "dryness."

[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.

3 Results

Results for the 2007 baseflow survey are briefly summarized here and compared with 1990 reference baseflow conditions.

3.1 Lower Las Garzas Creek

The baseflow survey on Lower Las Garzas Creek was conducted on October 01, 2007 and extended from the confluence of Las Garzas Creek with the Carmel River, upstream to the Santa Lucia Preserve property line. The 2007 survey on Lower Las Garzas Creek was discontinued and the upper reaches were not surveyed at this time. Due to concern about possible illegal marijuana cultivation activities in the vicinity, we were advised by law enforcement to avoid this area. However, more than half the creek was surveyed, including the "Protected Baseflow Reach." We feel that this data gives an accurate representation of prevalent 2007 baseflow conditions and allows us to successfully make comparisons with 1990 conditions for the purposes of this report.

The year 2007 was an extremely dry year for this region, receiving only 11.3 inches of rain and ranking the eighth driest in 85 years (Figure 1). However, October 2007 baseflow conditions were found to be still generally "wetter" than conditions observed in October 1990, although some specific conductance data indicate conditions in portions of the channel may be approaching those similar to1990. October 2007 conditions (Figure 2) included 1100 feet of continuously flowing channel (estimated discharge of 2 – 4 gallons/minute) from the SLP property line (end of 2007 survey) to the Pinyon Peak Tributary. This same reach was described as supporting only isolated pools in 1990 (Figure 3). In 2007 there was continuously flowing channel (estimated discharge of 2 – 4 gallons/minute) in the lower 1000 feet of the Pinyon Peak Reach. This section was also described as continuous in 1990. The Terraced Alluvial and Alluvial reaches supported several discontinuous segments of both isolated pools and surface flow in 2007; no surface flow was observed in these reaches in 1990.

The Lower Las Garzas specific conductance plot (Figure 4) shows 2007 values to be generally lower than 1990 values, particularly in the lower section of the "Protected Baseflow Reach." However, two specific conductance values from 2007 measured near the SLP property line are in the same range as those from 1990, perhaps indicating that this upper section of the creek may be approaching conditions similar to those in 1990. However, the 2007 baseflow mapping suggests overall conditions were generally "wetter" than in 1990.

3.2 Portrero Creek

The baseflow survey for Portrero Creek was conducted September 21 and 24, 2007 and extended from the SLP property line, upstream to 300 feet below Dead Rat Spring. Portrero Creek was flowing continuously (discharge was 0.035 ft^3/s at the gage site) from approximately 300 feet below the Lot 187 bridge to the downstream end of the "Protected Baseflow Reach" (Figure 5). Given that this section of channel (Figure 6) was described in 1990 (Woyshner et al.

2004) as having locally discontinuous flow, 2007 is seems clearly "wetter," since surface flow was continuous throughout this reach. Beyond this reach (not surveyed in 1990) there were 1300 feet of predominantly dry channel containing a few isolated low-volume pools, followed by 1500 feet of continuously flowing channel.

Only two specific conductance measurements were taken in 1990 and four in 1991. Conditions in 1991 were significantly wetter than 1990, although it was still a relatively dry year. The Portrero Creek specific conductance plot (Figure 7) shows 2007 values to be lower than both the 1990 and 1991 data (with the exception of the 2007 Slaughterhouse Spring value). Since 2007 values are significantly lower than 1991 values, and 1991 was wetter than 1990, this provides some additional indirect quantitative evidence that 2007 conditions were "wetter" than in 1990.

3.3 San Jose Creek

The San Jose Creek baseflow survey was conducted September 26 and 28, 2007 and extended from the SLP property line upstream to the Rancho San Carlos Road crossing above Stickleback Pond. Data indicate San Jose Creek was clearly "wetter" in 2007 than in 1990.

During the 2007 survey, San Jose Creek was continuously flowing from approximately 1400 feet upstream of the William's Canyon confluence downstream to the SLP property line (end of 2007 survey) (Figure 8). Streamflow declines significantly immediately upstream from William's Canyon, but faint, continuous flow persists. In contrast, San Jose Creek in October 1990 was predominantly dry in the reach downstream from Van Winkley's Canyon and was not continuously flowing (Figure 9). Discharge at the weir (200 feet downstream of Van Winkley's) was estimated in 1990 to be 0.0002 ft^3/s, while in 2007 it was estimated at 0.15 – 0.20 ft^3/s.

Upstream from William's Canyon (not surveyed in 1990), the 2007 survey observed 1200 feet of dry channel followed by 1900 feet of predominantly dry channel (containing some isolated pools), with a 400 foot flowing segment in between. San Jose Creek was predominantly wetted (and mostly flowing continuously) from Michael's Canyon confluence upstream for more than 5000 feet, after which it goes dry for the remainder of its length.

The 2007 specific conductance measurements (Figure 10) show values in 2007 to be significantly lower than those from 1990, lending additional support to our conclusion that baseflow conditions in 2007 are "wetter" than conditions in1990.

3.4 San Clemente Creek

San Clemente Creek was surveyed on September 29, 2007 from the SLP property line (Dormody Road) upstream to Robinson Canyon Road. Results indicate San Clemente Creek baseflow conditions were "wetter" in 2007 than in 1990.

During the 2007 survey, San Clemente Creek was continuously flowing from the SLP property line (discharge estimated at 0.045 – 0.050 ft^3/s) upstream for 4000 feet (Figure 11). The channel becomes abruptly dry for 950 feet, followed by 200 feet of flowing channel that again becomes abruptly dry for an additional 200 feet. San Clemente Creek then flows continuously for 1400 feet before becoming dry and remaining so for 6000 feet. In September 1990, San Clemente Creek was surveyed from Robinson Canyon Road to the San Clemente Trail bridge (Figure 12). It was reported that no surface flow was present throughout this section, with the exception of a short reach, less than 100 meters in length. In 2007, this same section of channel included 500 feet of predominantly wetted channel (isolated pools, faint discontinuous surface flow) below the Golf Course Tributary as well as other predominantly wetted reaches of 1000 feet and 320 feet in length further upstream.

Because little data exist for October 1990 conditions on San Clemente Creek, fall 1991 streamflow and conductance spot measurements are also used as a basis for comparison of dry season baseflow conditions (Woyshner et al. 2004). The rationale for this has been that 1991 was considerably wetter than 1990, although still relatively dry; therefore if baseflow conditions for the current year are wetter than 1991, then they must also be wetter than 1990 (Woyshner et al. 2004). On August 23 and November 5, 1991 discharge at the gage site was estimated at 0.04 ft^3/s, while on September 29, 2007 discharge at this site was estimated at 0.045 – 0.050 ft^3/s. Since 2007 discharge was similar to the 1991 discharge, this indicates 2007 conditions were “wetter” than 1990 conditions. In addition, specific conductance values for 2007 (Figure 13) are less than those of 1990 and 1991. Although data for reference conditions are limited, taken together and compared with current conditions, the data strongly support the conclusion that 2007 baseflow conditions on San Clemente Creek were “wetter” than 1990 conditions.

4 Discussion

It may seem counter-intuitive that 2007 baseflow conditions were generally "wetter" than conditions in 1990, given that 2007 was a critically dry year and received even slightly less rainfall (11.3 inches) than in 1990 (13.1 inches). However, baseflow conditions in a given year are influenced not only by the amount of rainfall occurring that year, but also by rainfall totals from preceding years. Rainfall during wet years recharges aquifers which then contribute groundwater to baseflows throughout dry seasons during subsequent years. This "carry-over" effect is a well established concept in hydrology and has been studied in this region (Figure 14), including on streams flowing through SLP (James 2003; Leffler 2003; Smith et al. 2004). With this mechanism in mind, we can observe (Figure 1) that 1990 was preceded by three years of very dry conditions (rainfall of less than 13 inches per year), while 2007 was preceded by two years of above average rainfall (28 inches in 2006, 30 inches in 2005) and one year below average (18 inches in 2004). This explains why 2007 conditions were "wetter" than in 1990 even though 2007 received slightly less rainfall. However, if rainfall remains at critically dry levels in upcoming years, we can expect baseflow conditions to become as dry as those observed in 1990.

5 Conclusion

Baseflow conditions were surveyed on the Lower Las Garzas, Portrero, San Jose, and San Clemente Creeks, the four major streams flowing through the Santa Lucia Preserve. Data pertaining to the characteristics and distribution of baseflow conditions were collected and compared with 1990 reference conditions, in accordance County Condition 15. Results from the baseflow mapping and specific conductance plots indicate that 2007 baseflow conditions were "wetter" than conditions in 1990 for all four streams, although some specific conductance data on Lower Las Garzas indicate conditions in portions of the stream may be approaching those similar to 1990.

6 References

James G. 2004. Carmel River Basin: Surface water resources data report, water years 2000 – 2003. Monterey Peninsula Water Management District technical report. 249 pp.

Leffler P. 2003. Evaluation of groundwater pumping impacts on stream base flow at Santa Lucia Preserve. Technical memorandum prepared by Fugro West for the Santa Lucia Conservancy. 50pp.

Napolitano M, Hecht B. 1992. Baseline hydrologic assessment of streams and springs at Rancho San Carlos, Monterey County, California, 1990 – 1991. Consulting report prepared by Balance Hydrologics on behalf of The Habitat Restoration Group. 85 pp.

Smith DP, Newman WB, Watson FGR, Hameister J. 2004. Physical and hydrologic assessment of the Carmel River watershed, California. The Watershed Institute, California State University Monterey Bay. Publication No. WI – 2004 –05. 88 pp.

Woyshner M, Brown S, Hecht B. 2003. Dry season hydrologic and geomorphic conditions on lower Las Garzas Creek, Monterey County, California, 2002. Consulting report prepared by Balance Hydrologics for the Santa Lucia Conservancy. 123 pp.

Woyshner M, Brown S, Hecht B. 2004. 2004 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.

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

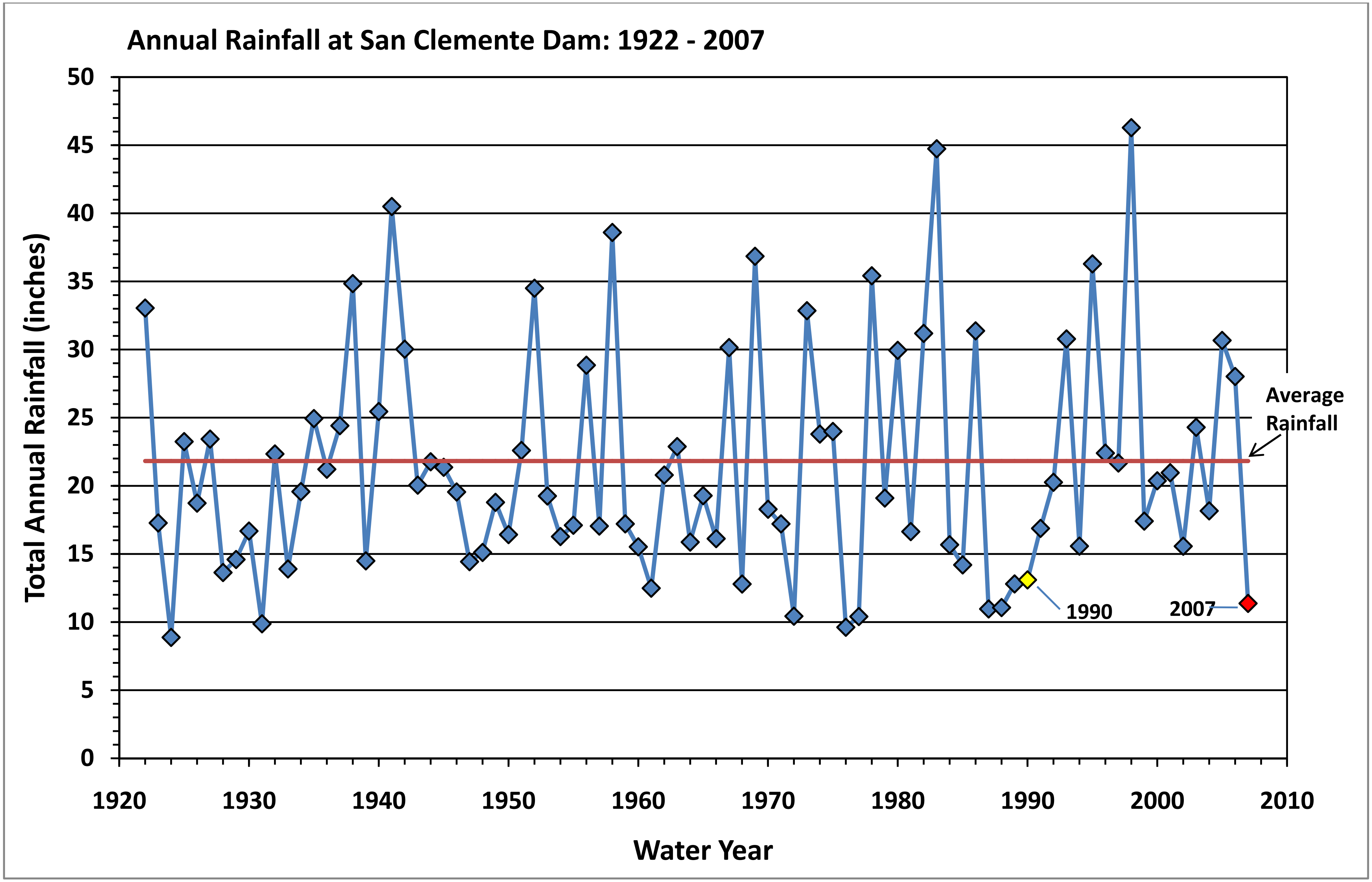

Figure 1. Total annual rainfall at San Clemente Dam for water years 1922 – 2007. Water years 1990 and 2007 had similar rainfall totals but 1990 was preceded by three extremely dry years whereas 2007 was preceded by two years of above average rainfall. Differences in rainfall for preceding years explain why 2007 had "wetter" baseflow conditions despite receiving even slightly less rain than in 1990.

October 01, 2007: Lower Las Garzas Creek Generalized Wetted and Dry conditions

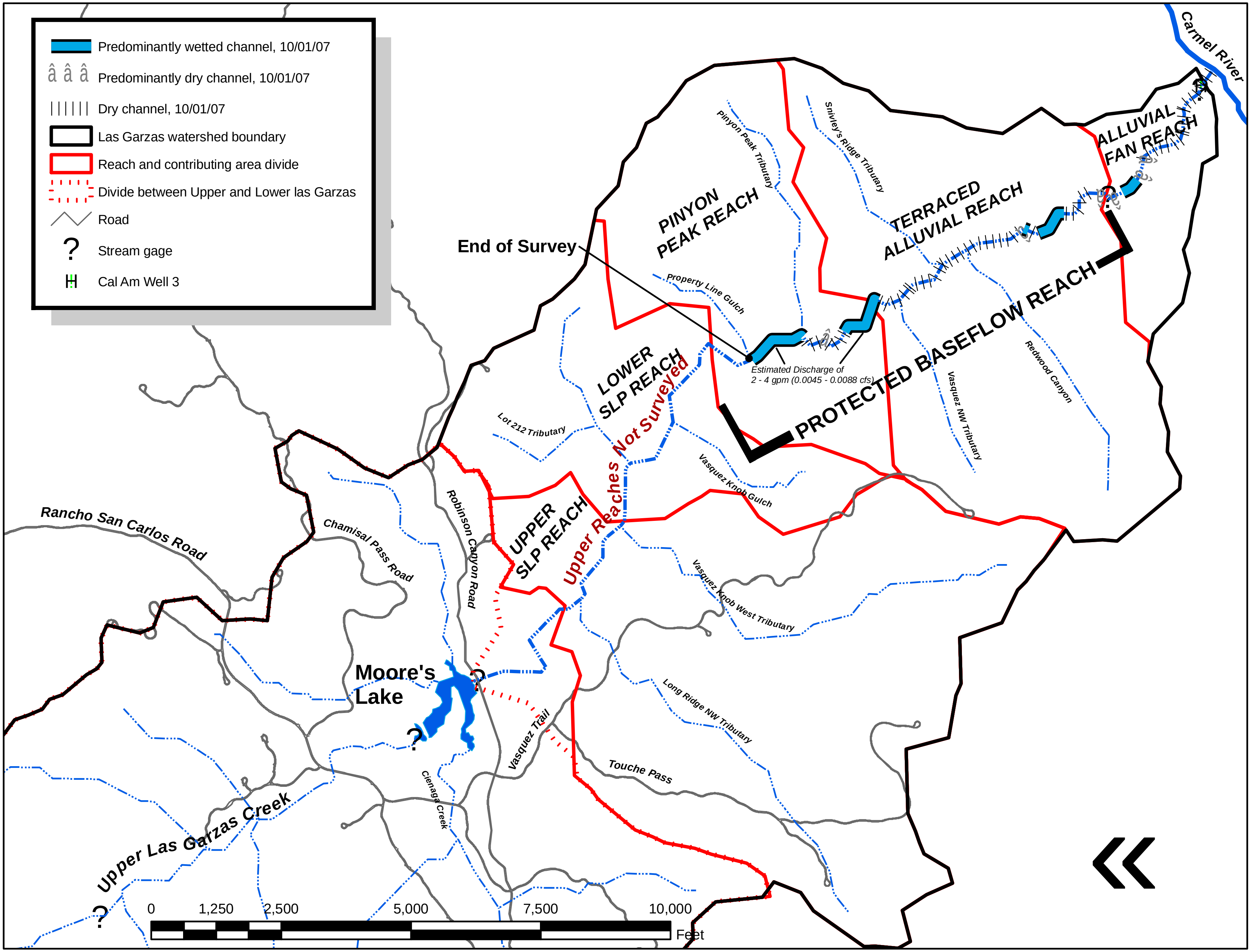

Figure 2. Map showing generalized flow conditions for lower Las Garzas Creek on October 01, 2007.

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

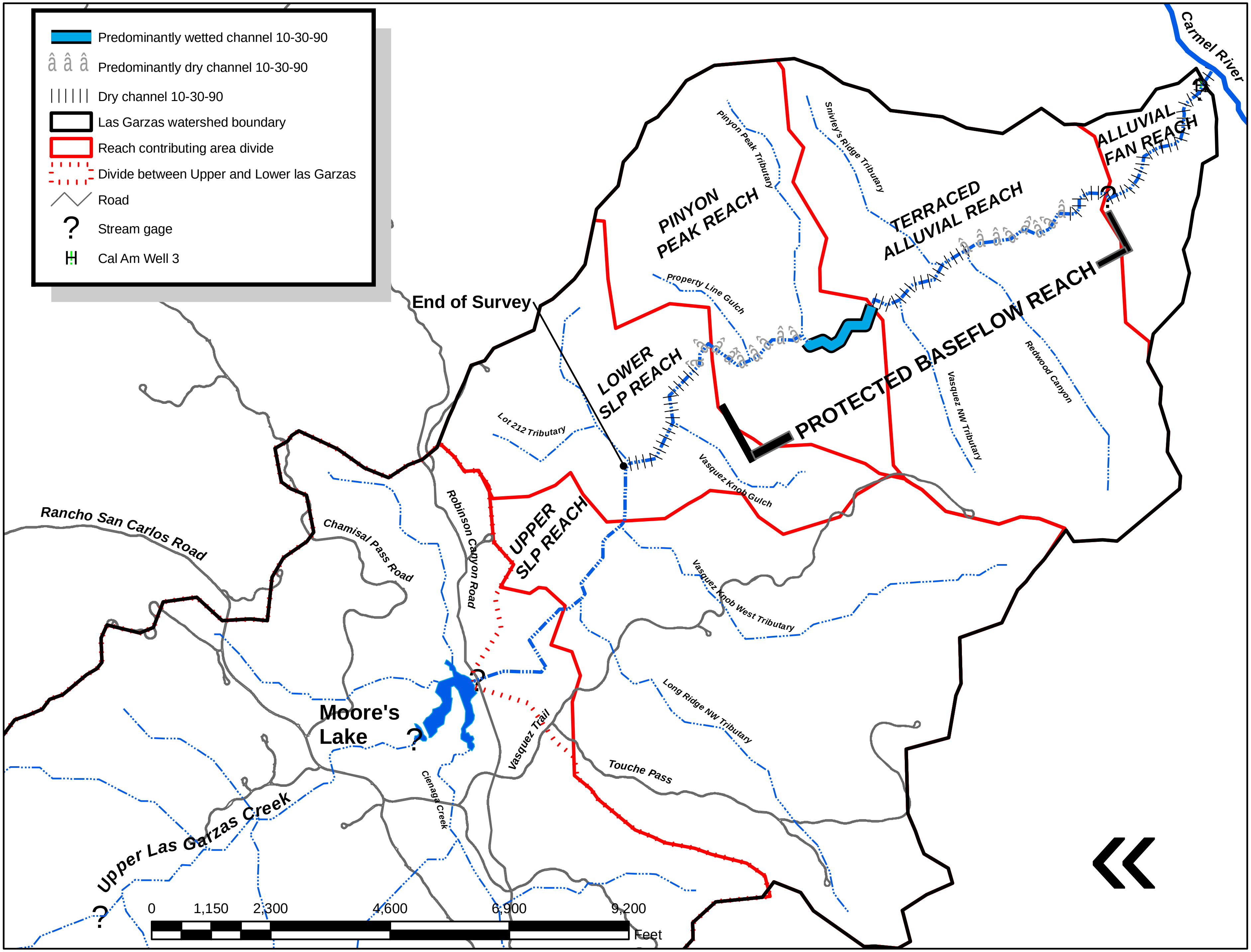

Figure 3. Generalized flow conditions on Lower Las Garzas Creek on October 30, 1990. In 1990, the upper part of Pinyon Pk. Reach consisted of isolated pools while the lower part of that reach had some continuous flow. Surface flow was not observed in the lower reaches.

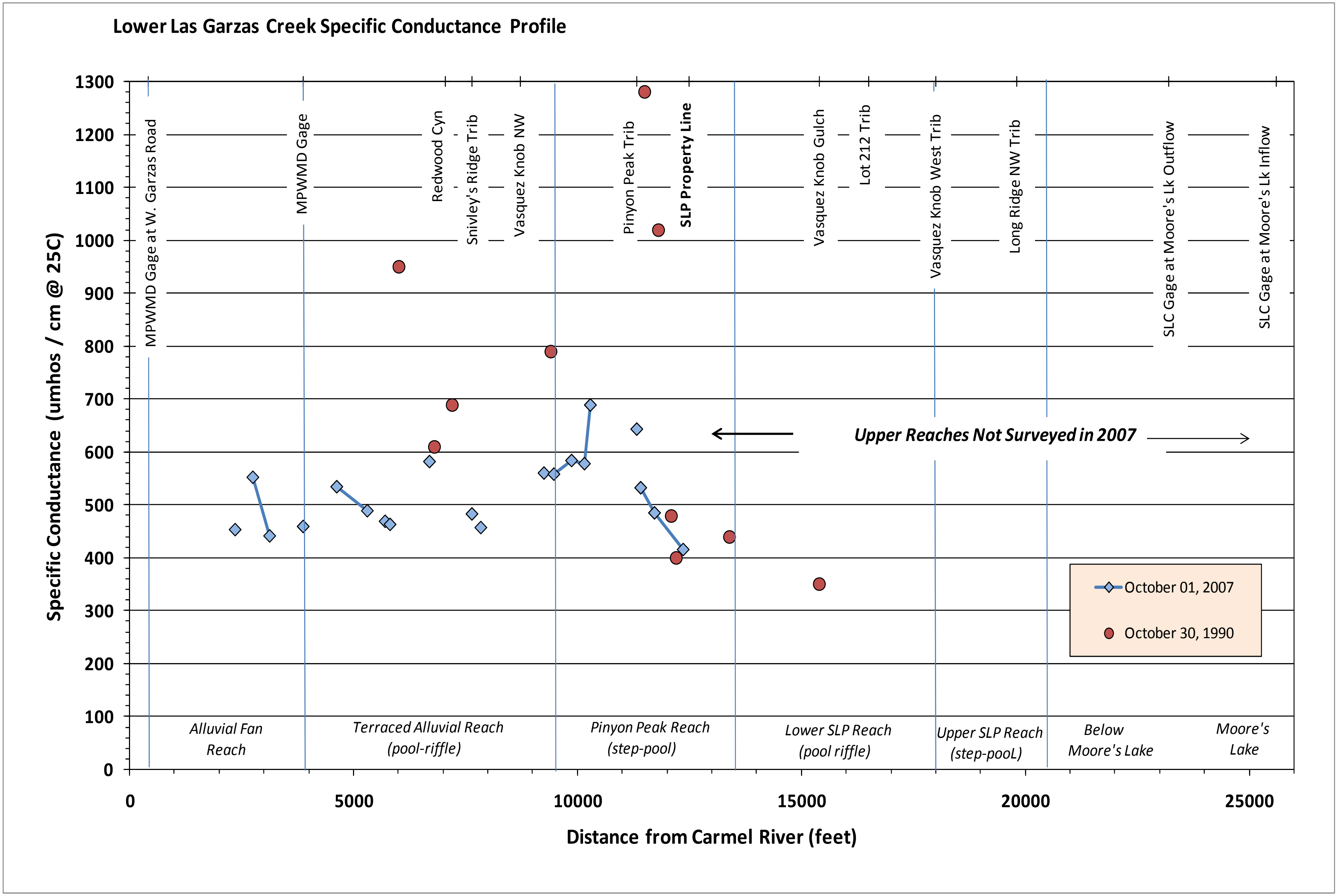

Figure 4. Lower Las Garzas Creek specific conductance measurements for 1990, 2007. For 2007 data, line breaks indicate discontinuous flow between two points.

September 21 & 24, 2007: Portrero Creek Generalized Wetted and Dry Conditions

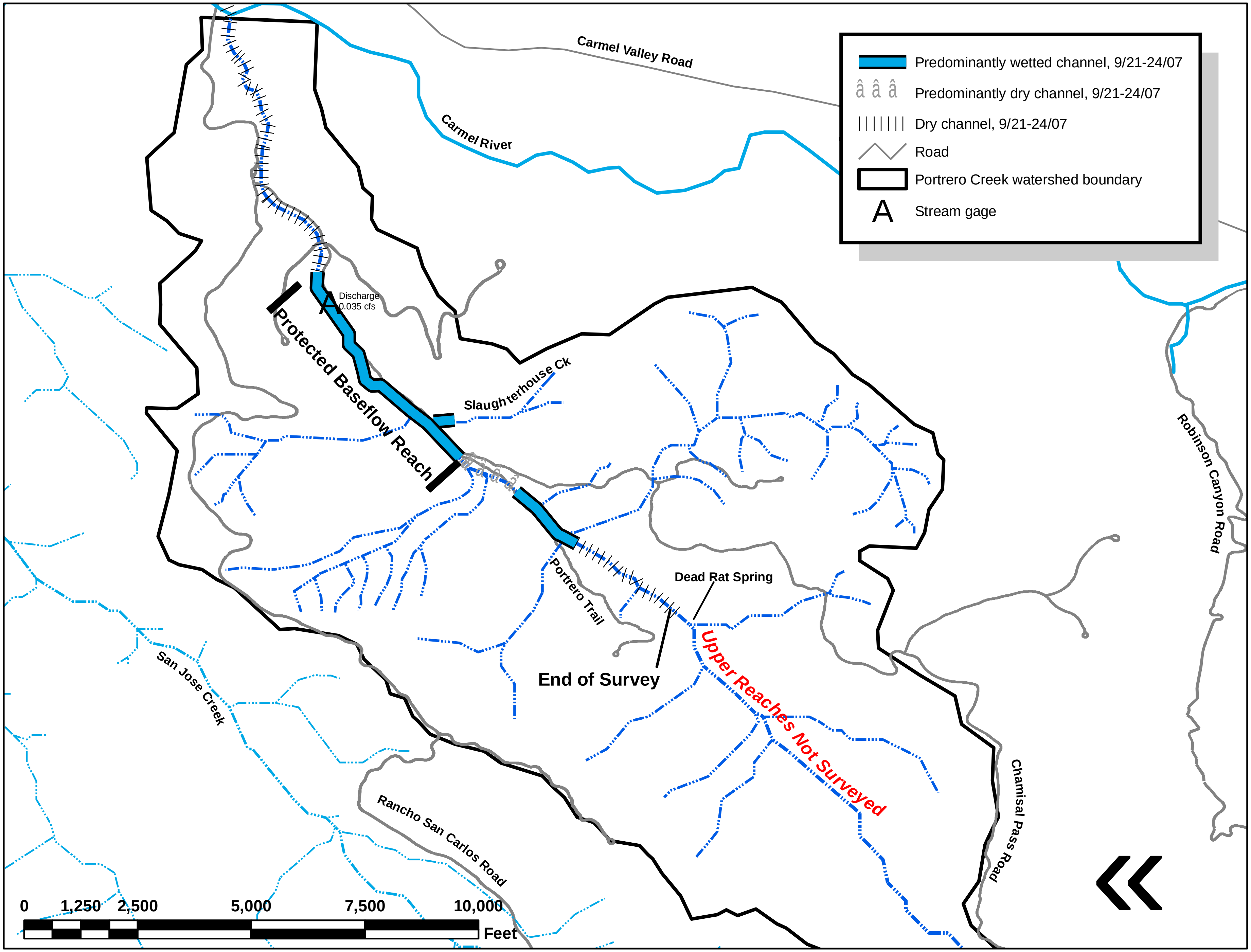

Figure 5. Generalized flow conditions on Portrero Creek, September 21 & 24, 2007. Channel was flowing continuously throughout the entire "protected baseflow reach."

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

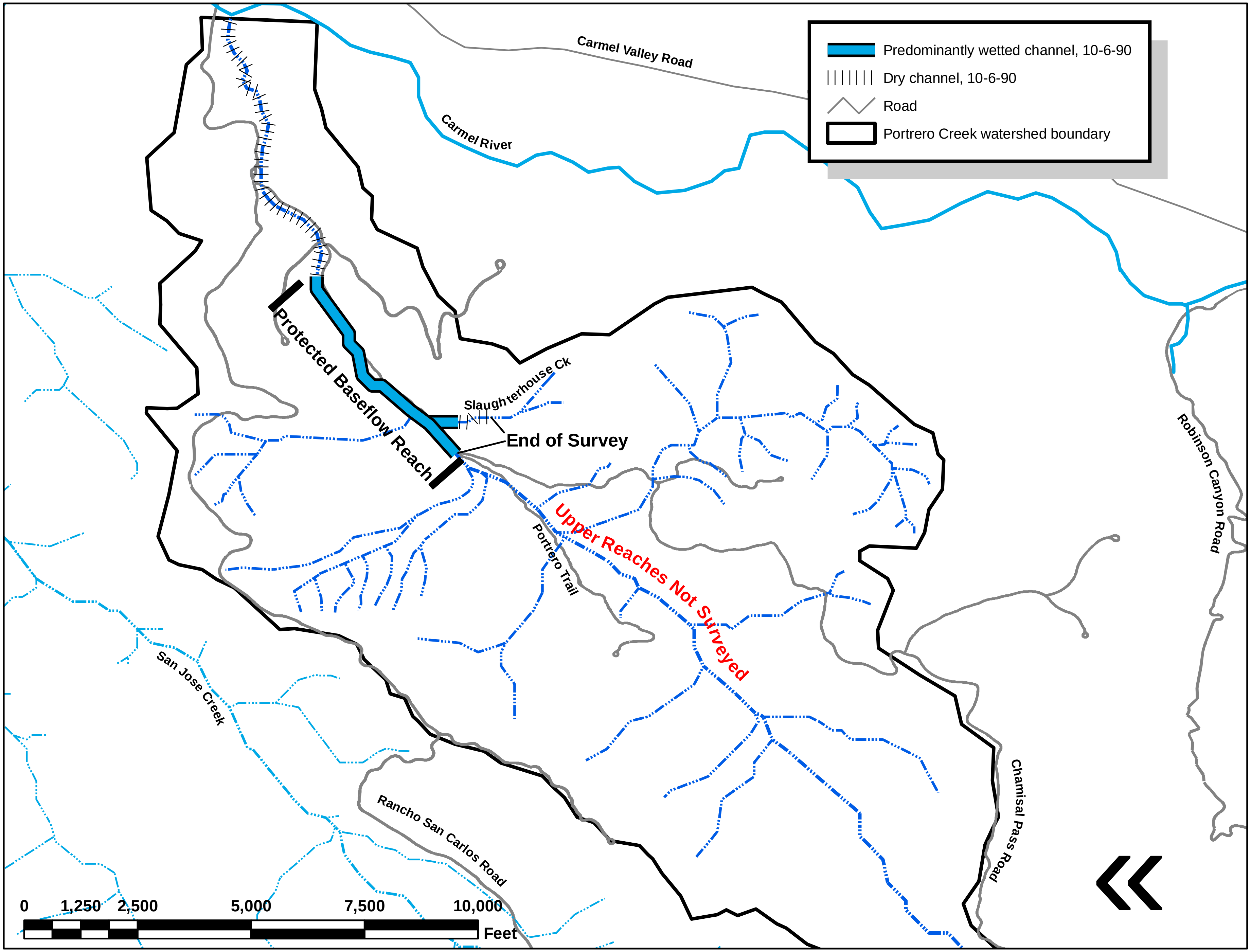

Figure 6. Generalized flow conditions on Portrero Creek on October 30, 1990.

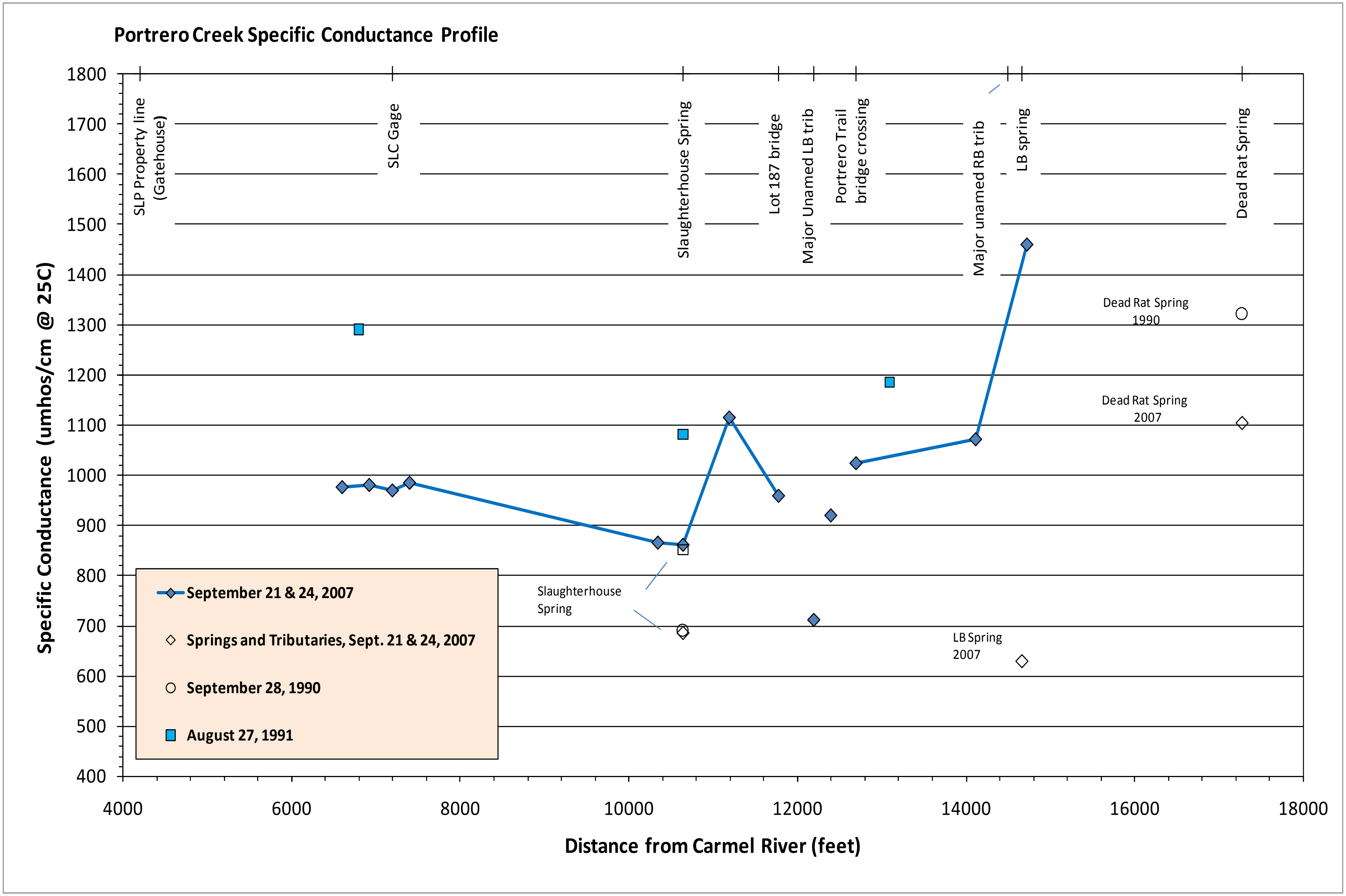

Figure 7. Portrero Creek specific conductance measurements for 1990, 1991, and 2007. For 2007 data, line breaks indicate discontinuous flow between two points. Hollow points represent springs and tributaries

September 26 and 28, 2007: San Jose Creek Generalized Wetted and Dry Conditions

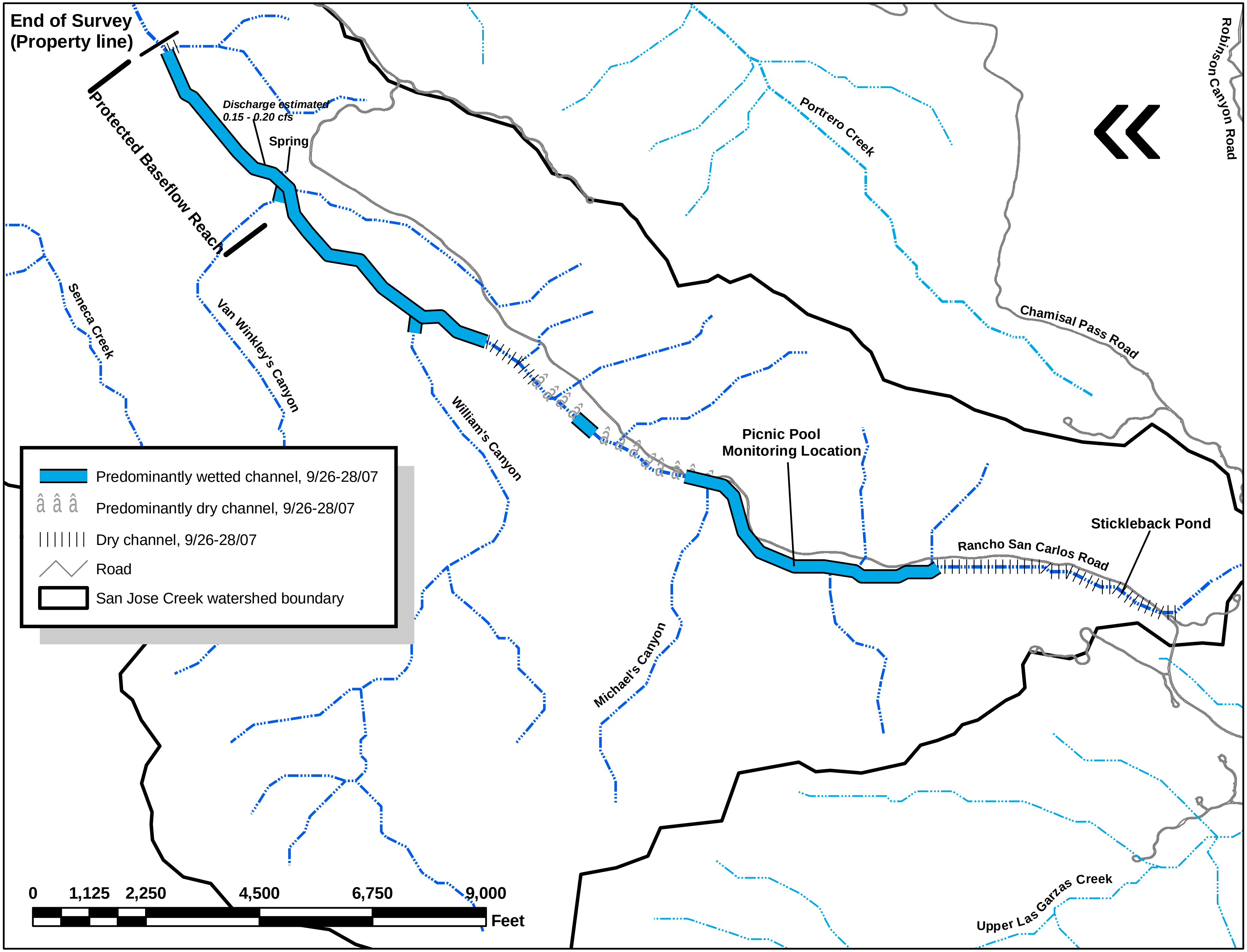

Figure 8. Generalized flow conditions on San Jose Creek on September 26 and 28, 2007. It was flowing continuously from above William's Canyon to the SLP Property line.

September 1990: San Jose Creek Generalized Wetted and Dry Conditions

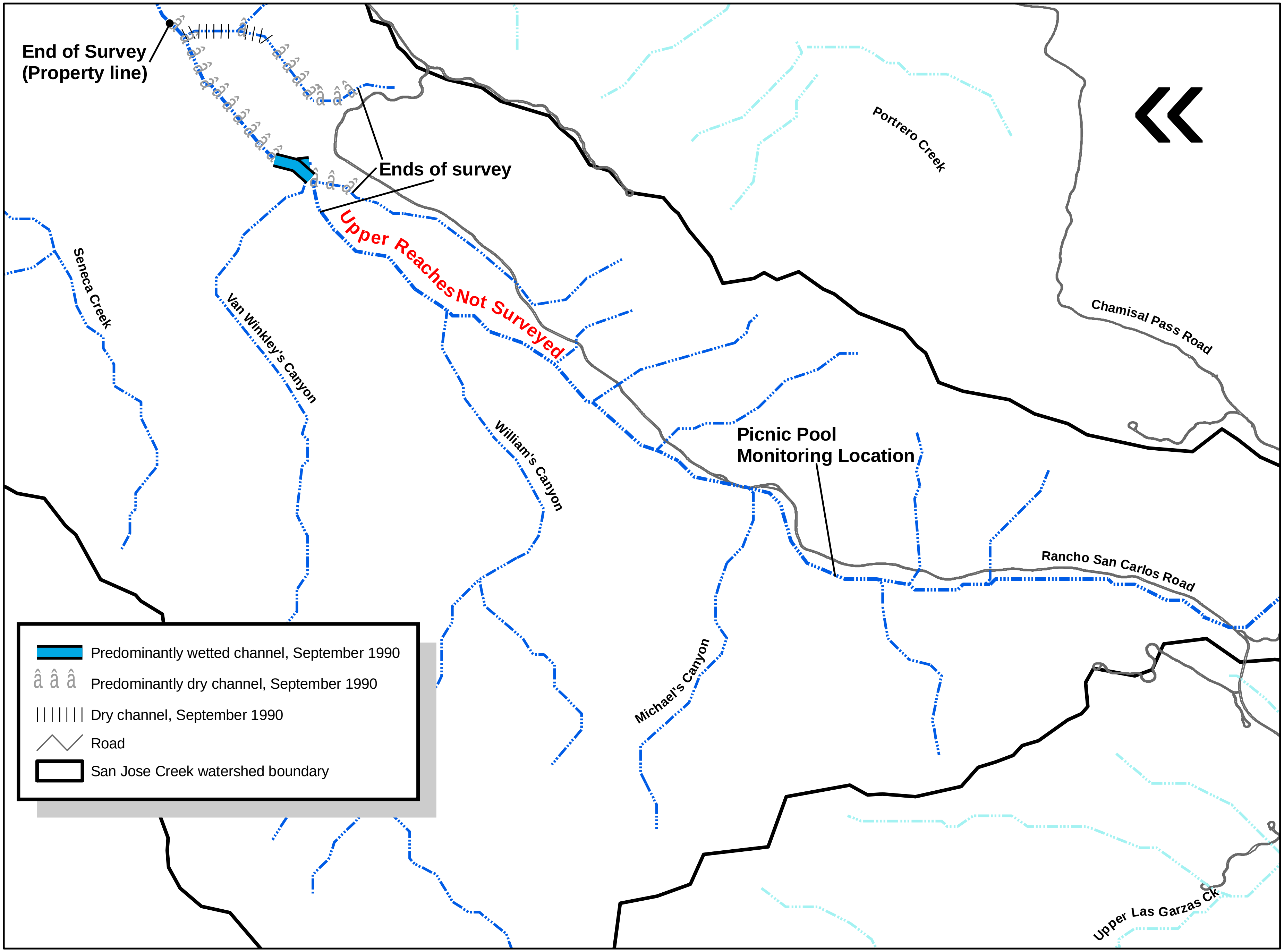

Figure 9. Generalized flow conditions on San Jose Creek in September1990.

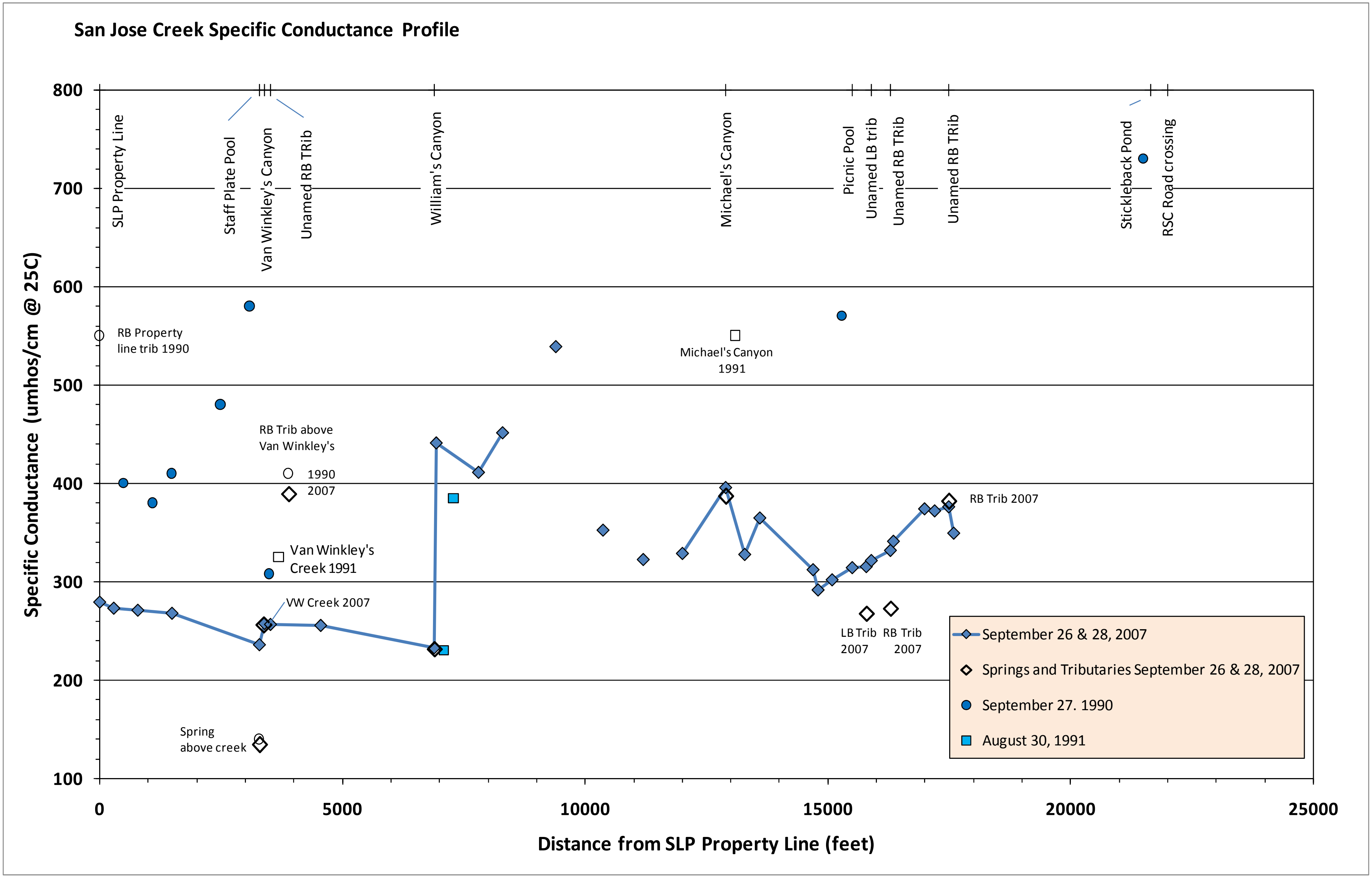

Figure 10. San Jose Creek specific conductance measurements for 1990, 1991, 2007. For 2007 data, line breaks indicate discontinuous flow between two points. Hollow points represent springs and tributaries

September 29, 2007: San Clemente Creek Generalized Wetted and Dry Conditions

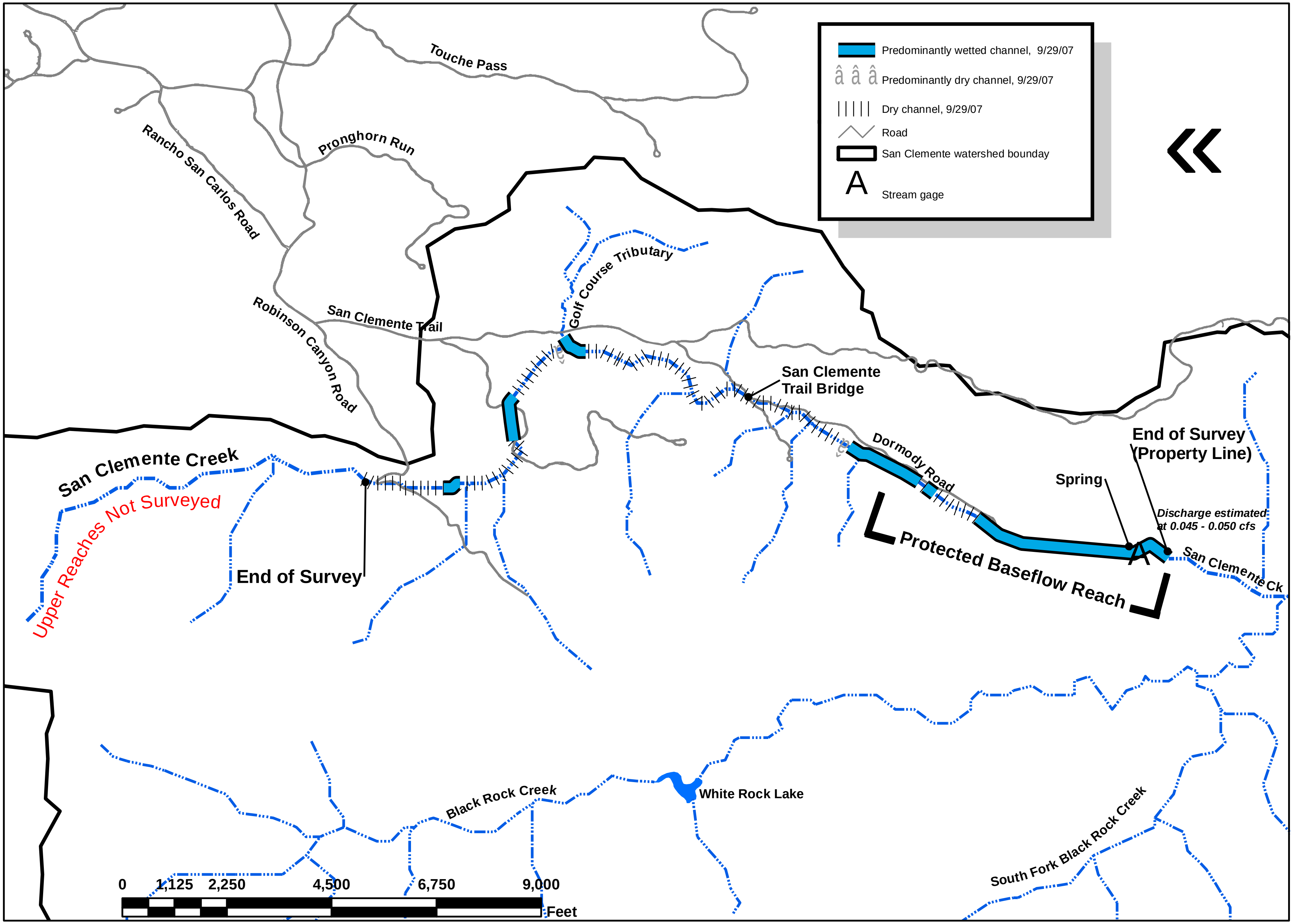

Figure 11. Generalized flow conditions on San Clemente Creek on September 29, 2007

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

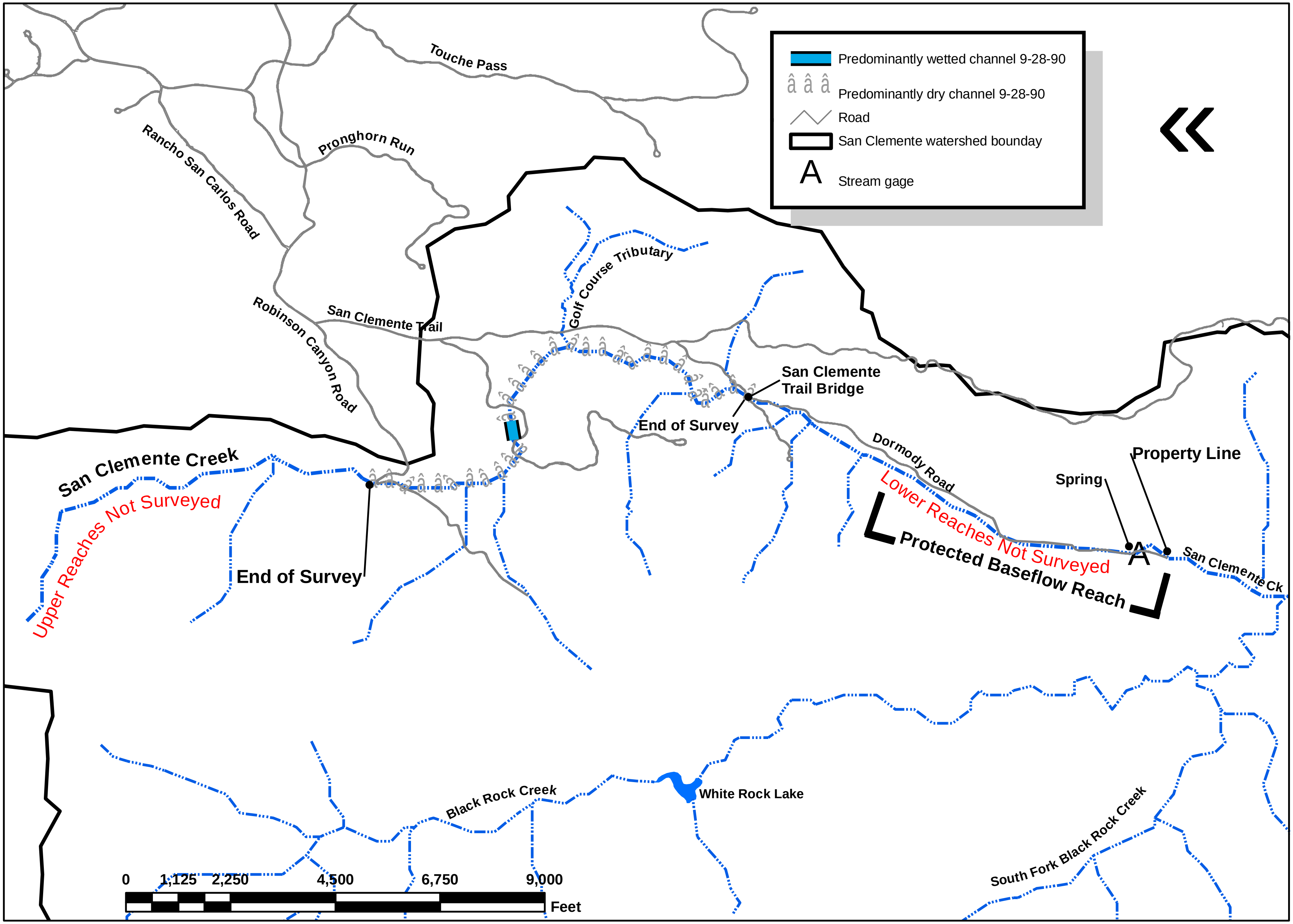

Figure 12. Generalized flow conditions on San Clemente Creek on September 28, 1990.

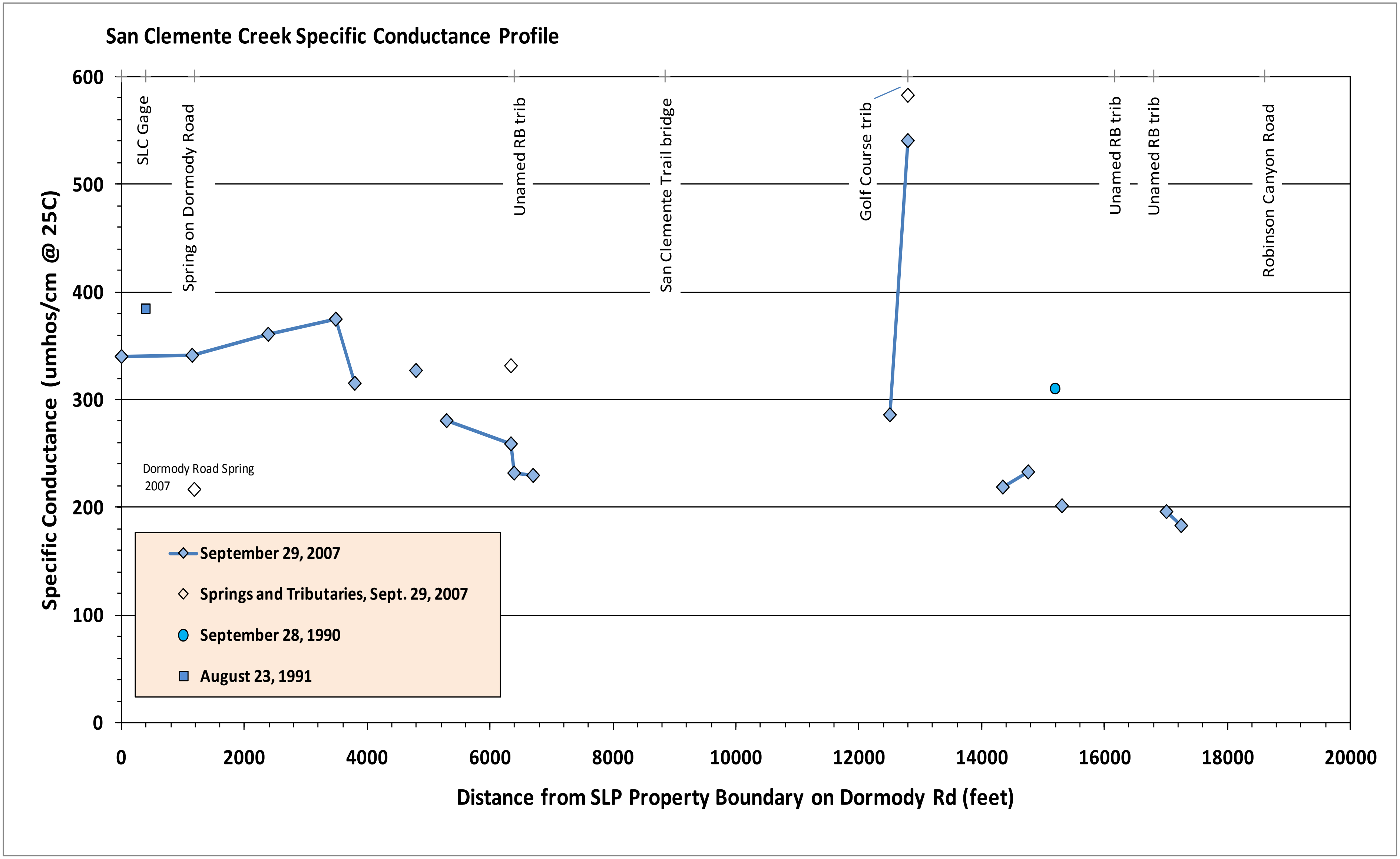

Figure 13. San Clemente Creek specific conductance measurements for 1990, 1991, 2007. For 2007 data, line breaks indicate discontinuous flow between two points. Hollow points represent springs and tributaries

Carmel River Basin Tributary Water Yield and Annual Rainfall

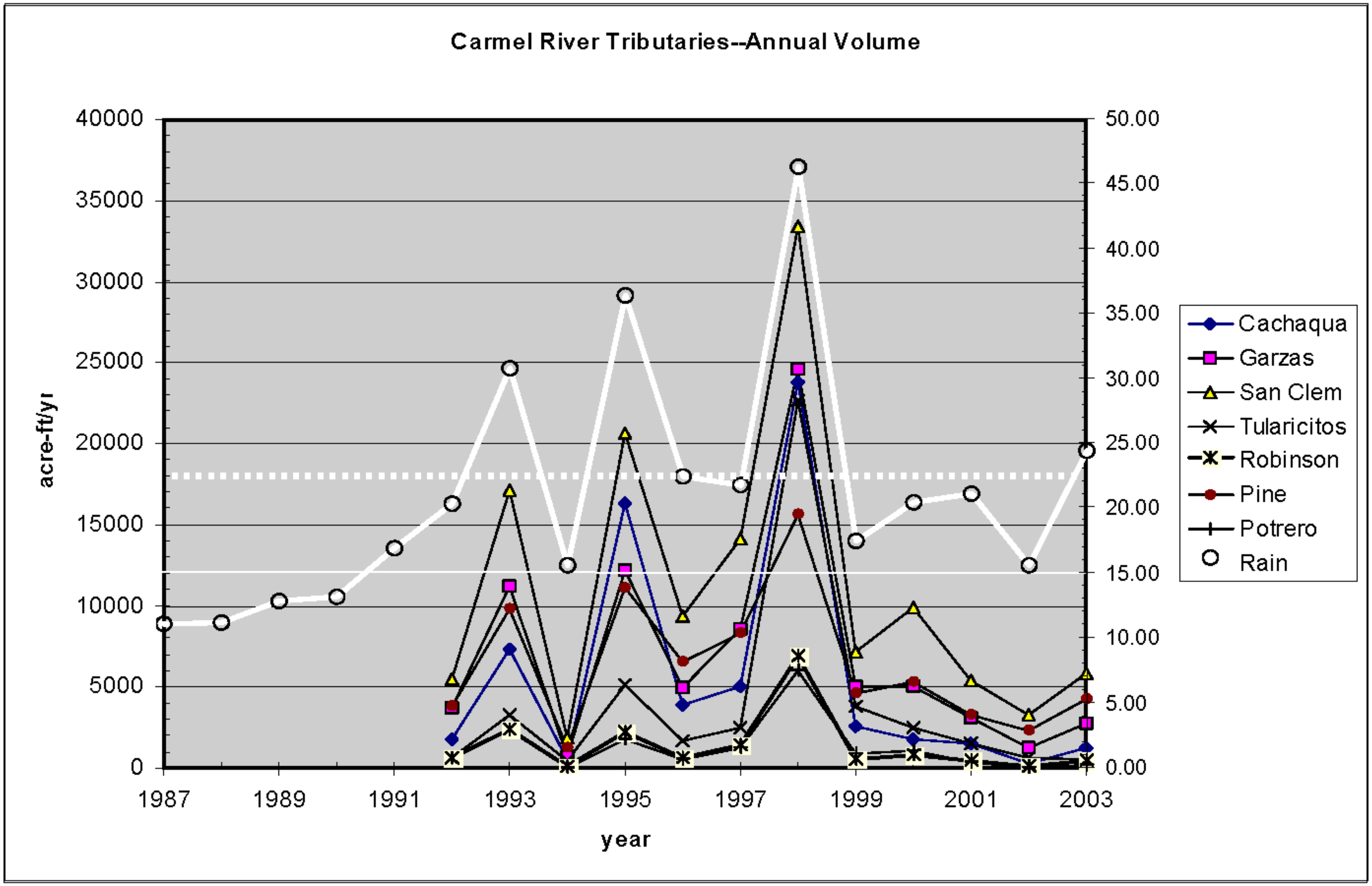

Figure 14. Annual water yield of Carmel River tributaries, with annual rainfall. The effect of wet years on streamflow in subsequent years can be observed: total rainfall in 2000 is nearly identical to rainfall in 2001, yet streamflow in 2000 is significantly higher than in 2001, due to the influence of a wet year in 1998 (figure from Smith et al. 2004).