

MEMO

To: Georgina King
From: Chelsea Neill, Barry Hecht
Date: May 1, 2020
Cc: John Ricker, Sierra Ryan
Enclosure: Form, Tables, Figures

Subject: Draft water year 2019 accretion assessment on Bean Creek and adjoining parts of lower Zayante Creeks

Under the Sustainable Ground Water Management Act (SGMA) government and water agencies are required to develop and implement Groundwater Sustainability Plans (GSPs) to sustainably manage groundwater. One of the six sustainability indicators that must be evaluated within the GSP is the depletion of interconnected surface water that has significant and unreasonable adverse impacts on beneficial users of the surface water. As such, the connection between surface water and groundwater within the basin must be evaluated. One method of analyzing the surface water groundwater interaction in streams is through an accretion study, which tells us where and how water enters and leaves a stream during low flow conditions. Accretion studies are conducted by measuring changes in flow and specific conductance (“salinity”) at various points from downstream to upstream in a stream system on a single day. It also tells us where the aquifer is adding flow to the stream, and where the stream is replenishing the aquifer. Carefully conducted accretion studies are perhaps the best way of quantifying an understanding of aquifer dynamics and surface-groundwater exchange. It also serves as the quantitative baseline against which the recharge and other management efforts described in the GSP can be assessed in future 5-year assessments.

Balance has previously conducted accretion studies along the San Lorenzo River. This study extends the on-going accretion analysis along the San Lorenzo River and expands sites to the Zayante Creek portion of the Santa Margarita Basin, with an emphasis along Bean Creek. Both streams provide important habitat for fish and wildlife. This study was funded by the Santa Margarita Groundwater Agency and the County of Santa Cruz.

General Study Design

Three accretion sampling events were conducted during the flow recession of water year 2019: May 30-31, July 10, and September 24-25. The May sampling event included the greatest number of sites, with fewer sites sampled during the July and September events. The sampling in July and September was concurrent with accretion sampling along the San Lorenzo River. The results of that study are presented in a separate report for the County of Santa Cruz.

During the sampling events flow and specific conductance were measured at points along Zayante and Bean Creeks and their tributaries. Sampling locations along Zayante and Bean Creeks are shown in **Figure 1**. Flow measurements were typically taken upstream of a tributary and on the tributary. The two

measurements were then added together to calculate the amount of flow in the channel downstream of the tributary. Measurements were conducted on a single day to minimize variability associated with the strings of warm or foggy weather which are a hallmark of the San Lorenzo Valley summers.

Additionally, as part of the overall accretion study a gage was installed along Bean Creek at Mt Hermon Rd (former USGS gage 11160430) (**Figure 1**). This gage was operated by the USGS from 1989-2007, when it was discontinued. Balance operated a gage at this site during water year 2012 (Owens and Hecht, 2013). Balance re-installed the gage on May 13, 2019 and it was operational through the summer baseflow season.

Results

Conditions During WY2019

Water Year 2019 can be characterized as a wet year, with above-average precipitation rates (**Figure 2**). The San Lorenzo Valley Water District rain gage in Boulder Creek received 57.05 inches of rain (approximately 112% of the long-term average) and the CDEC rain gage in Santa Cruz (CRZ) received 36.46 inches of rain (approximately 127% of the long-term average) (see **Figure 1** for gage locations). The resulting runoff from the San Lorenzo River was approximately 60% above average, as measured at the USGS Big Trees stream gage (**Figure 2**).

The area received some late season precipitation in May, with approximately 4.16 inches falling between May 15 to 22, 2019. This late season rain increased baseflow and delayed the summer recession.

Accretion Sampling

In general, we found that flow increased along Bean and Zayante Creeks, with the exception of the one reach along Bean Creek, suggesting that there is inflow from groundwater within these watersheds. The study reach with relative downstream changes in flow can be seen in **Figure 3** for each of the three sampling events along Bean Creek. The changes in flow from the September event can also be seen in **Figure 4**. The observer's log from each of the sampling events can be seen in **Tables 1 to 3**. The findings of this study are consistent with previous observations within the basin, where the upper Bean Creek watershed and its tributaries are typically losing reaches that recharge the groundwater and streamflow in the lower watershed is enhanced by groundwater discharge from the Santa Margarita (Kennedy Jenks, 2015). We observed the greatest increases in flow downstream of the confluence of Ruins Creek with Bean Creek. This reach, in particular, is the primary gaining reach within the Santa Margarita Basin and is characterized by areas where the stream has cut into the Santa Margarita and springs in the streambed and along the sides of the stream are contributing groundwater discharge (Kennedy Jenks, 2015).

Through conversations with the County of Santa Cruz, it was noted that a section of Bean Creek was dry during the fall of 2019. This section of Bean Creek is difficult to access from the road and as a result is difficult to make quick observations of the flow conditions along this reach. On October 15, 2019 Chelsea Neill (Balance), Kristen Kittleson (County of Santa Cruz), Alex Johanson (Watershed Steward) and Maya Varva (Watershed Steward) walked this section of Bean Creek, from Lucinda St. upstream to Morgan's Run, to document the extent of the dry reach and to look for remaining pools. It has been noted that this reach typically goes dry in the summer and has done so since the 1960s, although the extents vary between years (Kennedy Jenks, 2015; John Ricker, pers. Comm., 2020). Within the dry reach, we found very few isolated pools. Because we did not walk the reach until the end of the season, we cannot be sure of the timing of when the reach went dry. It is possible that portions of the creek may have been dry

during the earlier sampling events. The results of this walk are compiled with the September sampling event (**Figures 3 and 4**).

To further evaluate the dry section of Bean Creek, we mapped the results of the September sampling event with a geologic map (**Figure 5**). The dry reach coincides with the axis of the Scotts Valley Syncline through the area, which runs approximately perpendicular to Bean Creek in this section. As noted in previous studies, this area could be an area of recharge, where water is infiltrating into the Santa Margarita as it dips below the ground surface in the syncline and reemerges further downstream. To further evaluate the potential source of the water, we examined the specific conductance values, which were 662 μs and 719 μs , upstream and downstream of the dry reach respectively, from the Creek walk on October 15, 2019. We noted a number of slumps and landslides and it is also possible that some water may be travelling sub-surface through the alluvial deposits along this reach. The interaction of surface water and groundwater at this location should be further evaluated.

The measured specific conductance values from each sampling event can be seen in **Figures 6-8**. In general, the specific conductance values tend to decrease from upstream to downstream, with the tributaries having lower specific conductance values than the main channel. This is a very unusual condition and has been commented upon many times since first being identified in the 1960s, Specific conductance is an indication of salt content, which is easily measured in the field. The upstream parts of the Zayante and Bean Creek basins are underlain by formations that are naturally saltier than parts of the basin south of the Zayante fault. The larger streams, which drain watersheds on both sides of the fault, carry the higher salt content from north of the fault, and then progressively are diluted by the fresher groundwater emanating from the Santa Margarita formation and other sandstones south of the Zayante fault. Hence, the salt content of the streams can provide information on where waters originate in the San Lorenzo Valley.

Bean Creek at Mt Hermon Rd

Balance reinstalled the gage on Bean Creek at Mt Hermon Rd. on May 13, 2019. The gage was instrumented with an In-situ Aquatroll sensor, which measures continuous depth, specific conductance and temperature, as well as a Solinst Levelogger, which continuously measures the stream's depth and water temperature. The flow record is shown in **Figure 9** and the specific conductance and temperature is shown in **Figure 10**. Daily flows are also shown in **Form 1**. Other observations made during our measurements are shown in the station observer log (**Table 4**).

Flows increased at the site in response to the approximately 4.16 inches falling between May 15 to 22, 2019 (**Figure 9**). This rain event increased the 2019 summer flows through the first week or two of June. Flows decreased through the rest of the summer, following a typical pattern. We observed a daily fluctuation in flow of approximately 1 cfs throughout the baseflow season at the Mount Hermon Road gage. This fluctuation is consistent with the flow pattern observed downstream at the Bean Creek at Mt Hermon Camp gage (approximately 1 mile downstream of the Mt Hermon Rd. gage). This fluctuation could be examined in future gaging to evaluate the potential cause, such as diurnal fluctuation from evapotranspiration or possibly influence from upstream diversions. There are no major diversions upstream of this gage.

On August 19, 2019 a large tree fell approximately 30 ft downstream of the gage, spanning the channel. The tree caused backwater conditions throughout the gaging pool and also caught small debris on its limbs moving downstream. We created numerous shifts in the record to attempt to correct for the continuously changing downstream conditions at the site as small wood and leaves continued to rack up

on the downstream tree. The fallen tree is large and we were unable to clear or move it due to safety concerns.

Water temperature at the site reached up to approximately 19°C during July and August (**Figure 10**). This is below the 20°C general temperature guideline for evaluating the lower threshold for temperature stress for steelhead life (D. Alley, 2017). Specific conductance readings (normalized to 25°C) were relatively consistent around 450 $\mu\text{S}/\text{cm}$ throughout the gaging period (**Figure 10**).

Tentative Conclusions

- This was the first year that accretion sampling has occurred along Bean and Zayante Creeks. One of the purposes of this study is to document conditions, such that future changes in flow may be distinguishable as conditions evolve in the Santa Margarita groundwater basin in response to water management, climate change, and other trends.
- The results of the accretion sampling are consistent with previously reported ideas about the surface water groundwater interaction along Bean Creek, where the upper Bean Creek watershed appears to be a losing reach and lower Bean Creek appears to gain discharge from groundwater.
- Identifying and documenting the dry reach along Bean Creek can help in understanding year-to-year and long-term hydrological trends in this watershed. It may also shape or control use of the channel by sensitive species. We were able to document the upstream and downstream limits of this reach during a wet year, setting a baseline against which conditions measured during a dry summer or a string of dry years may be compared.
- The comparison between the Mt Hermon Rd and the Mt Hermon Camp gage can be used to characterize the increase in flow between these two locations as they vary year-to-year, and to better understand the driving factors which influence flow in this highly-valued reach supporting sensitive species in light of the very complex geology along lower Bean Creek.

Recommendations

- Continue to conduct accretion sampling to understand groundwater discharge to streams during different types of water years. This effort should be coordinated with the accretion sampling efforts along the San Lorenzo River, to gain a better understanding of the flows throughout the basin.
- As part of the accretion sampling, we recommend walking the reach between Mt Hermon Camp and Lockhart Gulch along Bean Creek. We noted the greatest increase in flow along this reach. Documenting inflow from springs and small tributaries will provide further insight into the groundwater discharge in this area.
- Continue to walk the dry reach portion of Bean Creek to understand the extent and timing of the Creek going dry. Additionally, public outreach with landowners in the area could be beneficial to provide insight as to when this is occurring each year and to help guide the timing of the Creek walk or of necessary fish rescues.
- Continue to monitor flow at Bean Creek at Mt Hermon Rd. This gage, in conjunction with monitoring at Bean Creek at Mt Hermon Camp, is important for documenting and understanding the groundwater discharge in the lower portion of Bean Creek.

- Increasing the number of stream gages in the area would provide more information on the flow recessions in the basin. These stream gages would be particularly useful for establishing the baseline for instream flows, prior to project implementation as part of the GSP. We recommend the addition of temporary gages further upstream on Bean Creek, near Morgan’s Run, to aid in understanding the reach that goes dry, as well as a gage on Zayante Creek at Graham Hill Rd. A gage at Graham Hill Rd, would capture all of the flow coming from the Bean and Zayante Creek watersheds prior to flowing into the San Lorenzo River and into the Felton groundwater basin. A gage at this location could additionally be beneficial for understanding backwater conditions and flooding that occur along Zayante Creek in the Felton Acres neighborhood during periods of high flow.
- At this time, there are few monitoring wells located near Bean Creek. Installing and monitoring shallow wells in proximity to the streams will provide valuable insight into the surface water groundwater interactions within the basin.

Acknowledgments

We are grateful for the cooperation and sharing of data between the Santa Margarita Groundwater Agency, County of Santa Cruz Environmental Health, and the San Lorenzo Valley Water District and look forward to future efforts. We would like to thank Kristen Kittleson and the Watershed Stewards, Alex Johanson and Maya Varva, for providing insight and participating in the Bean Creek dry reach walk.

Limitations

Hydrologic calculations of low flows in coastal California are very complex, often requiring consideration of many years of data collection. Our work conforms with the standard of care for such work in coastal northern California; no other warranties are stated or implied.

References

- Alley, D., 2017, Fishery implications of water-temperature data collected in the San Lorenzo River system in 2014-2017: Consulting report prepared for the San Lorenzo Valley Water District, April 2018. 101 p.
- Kennedy/Jenks Consultants, 2015, Santa Margarita Basin Groundwater Modeling Technical Study: consultant report prepared for Scotts Valley Water District, 233 p. plus appendices.
- Owens, J., and Hecht, B., 2013, Draft annual hydrologic record for Bean Creek at Mount Hermon Road, Scotts Valley, Santa Cruz County, California: data report for water year 2012: Balance Hydrologics consulting report prepared for Scotts Valley Water District, Santa Cruz County, 7 p. plus appendices.
- Parke, J., and Hecht, B., 2018, San Lorenzo River Longitudinal Accretion and Hydrochemistry: Balance Hydrologics consulting report prepared for County of Santa Cruz, Health Services- Environmental Health, 17p. plus appendices.
- Parke, J. and Hecht B., in prep, San Lorenzo River Longitudinal Accretion and Hydrochemistry: Balance Hydrologics consulting report prepared for County of Santa Cruz, Health Services- Environmental Health.
- Ricker, J., 2020, personal communication, conversation on April 16, 2020.

FORMS

Water Year: 2019 (seasonal), includes Oct. 2019
Stream: Bean Creek
Station: at Mount Hermon Road
County: Santa Cruz County, CA

Form 1. Annual Hydrologic Record

Station Location / Watershed Descriptors

Latitude: 37° 03' 19", Longitude: 122° 02' 25" Scotts Valley, CA. Drainage area above gage is 8.81 sq. miles. Elevation 320 ft above MSL (from topo map). Gage is installed on right bank, about 50 feet upstream from Mount Hermon Road culvert. This is a reoccupied USGS gaging station (ID# 11160430). Land use is a mix of urban and open space (mosaic of grasslands, scrub, and woodlands).

Mean annual flow (MAF)

MAF for the USGS period of record (WYs 1989 to 2007) is 11.8 cubic feet per second (cfs)
 Mean Daily Flow for WY2012 = 5.41 cfs

Peak Flows

| Date | Time (24-hr) | Gage Ht. (feet) | Discharge (cfs) | Date | Time (24-hr) | Gage Ht. (feet) | Discharge (cfs) |
|---|--------------|-----------------|-----------------|------|--------------|-----------------|-----------------|
| High water marks not observed | | | | | | | |
| The peak for the USGS period of record (Jan. 1989 to Sept. 2007) was 1,870 cfs on Dec. 16, 2002 | | | | | | | |

Map



Period of Record

USGS operated this station Jan. 1989 to September 2007. Occasional earlier measurements made by Santa Cruz Co.; Previous gaging sponsored by Scotts Valley Water District and/or Santa Cruz County. Since May 2019 by the Santa Margarita Groundwater Agency

WY 2019 (Seasonal) Daily Mean Flow (cubic feet per second)

| DAY | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEPT | OCT |
|----------|-----|-----|-----|-----|-----|-----|-----|-------|-------|-------|-------|-------|-------|
| 1 | - | - | - | - | - | - | - | - | 5.09 | 3.43 | 2.67 | 2.46 | 2.83 |
| 2 | - | - | - | - | - | - | - | - | 5.03 | 3.39 | 2.60 | 2.53 | 2.85 |
| 3 | - | - | - | - | - | - | - | - | 4.85 | 3.43 | 2.59 | 2.63 | 2.84 |
| 4 | - | - | - | - | - | - | - | - | 4.65 | 3.38 | 2.57 | 2.57 | 2.85 |
| 5 | - | - | - | - | - | - | - | - | 4.55 | 3.41 | 2.61 | 2.55 | 2.75 |
| 6 | - | - | - | - | - | - | - | - | 4.44 | 3.32 | 2.64 | 2.48 | 2.56 |
| 7 | - | - | - | - | - | - | - | - | 4.39 | 3.32 | 2.59 | 2.58 | 2.40 |
| 8 | - | - | - | - | - | - | - | - | 4.25 | 3.24 | 2.53 | 2.61 | 2.32 |
| 9 | - | - | - | - | - | - | - | - | 4.05 | 3.23 | 2.51 | 2.66 | 2.29 |
| 10 | - | - | - | - | - | - | - | - | 3.95 | 3.14 | 2.47 | 2.63 | 2.32 |
| 11 | - | - | - | - | - | - | - | - | 3.89 | 3.09 | 2.48 | 2.54 | 2.41 |
| 12 | - | - | - | - | - | - | - | - | 3.97 | 3.09 | 2.50 | 2.25 | 2.41 |
| 13 | - | - | - | - | - | - | - | 4.82 | 4.04 | 3.05 | 2.48 | 2.08 | 2.45 |
| 14 | - | - | - | - | - | - | - | 5.05 | 4.01 | 3.00 | 2.45 | 2.06 | 2.60 |
| 15 | - | - | - | - | - | - | - | 8.99 | 4.03 | 2.91 | 2.45 | 2.16 | 2.58 |
| 16 | - | - | - | - | - | - | - | 13.30 | 4.08 | 2.92 | 2.54 | 2.46 | 2.54 |
| 17 | - | - | - | - | - | - | - | 6.68 | 4.04 | 2.99 | 2.65 | 2.53 | 2.67 |
| 18 | - | - | - | - | - | - | - | 12.08 | 3.89 | 2.99 | 2.68 | 2.62 | 2.61 |
| 19 | - | - | - | - | - | - | - | 22.83 | 3.94 | 3.08 | 2.58 | 2.59 | 2.57 |
| 20 | - | - | - | - | - | - | - | 10.42 | 4.00 | 2.98 | 2.55 | 2.54 | 2.46 |
| 21 | - | - | - | - | - | - | - | 8.98 | 3.93 | 2.92 | 2.55 | 2.43 | 2.46 |
| 22 | - | - | - | - | - | - | - | 7.74 | 3.85 | 2.85 | 2.60 | 2.42 | 2.65 |
| 23 | - | - | - | - | - | - | - | 7.17 | 3.78 | 2.78 | 2.77 | 2.49 | 2.57 |
| 24 | - | - | - | - | - | - | - | 6.62 | 3.77 | 2.72 | 2.67 | 2.39 | 2.54 |
| 25 | - | - | - | - | - | - | - | 6.34 | 3.68 | 2.69 | 2.60 | 2.01 | 2.42 |
| 26 | - | - | - | - | - | - | - | 6.32 | 3.63 | 2.71 | 2.56 | 2.23 | 2.62 |
| 27 | - | - | - | - | - | - | - | 5.91 | 3.56 | 2.64 | 2.59 | 2.14 | 2.45 |
| 28 | - | - | - | - | - | - | - | 5.57 | 3.55 | 2.70 | 2.60 | 2.24 | 2.60 |
| 29 | - | - | - | - | - | - | - | 5.40 | 3.54 | 2.69 | 2.49 | 2.52 | 2.61 |
| 30 | - | - | - | - | - | - | - | 5.20 | 3.52 | 2.69 | 2.53 | 2.62 | 2.55 |
| 31 | - | - | - | - | - | - | - | 5.09 | - | 2.75 | 2.52 | - | 2.74 |
| MEAN | - | - | - | - | - | - | - | 8.13 | 4.06 | 3.02 | 2.57 | 2.43 | 2.56 |
| MAX. DAY | - | - | - | - | - | - | - | 22.83 | 5.09 | 3.43 | 2.77 | 2.66 | 2.85 |
| MIN. DAY | - | - | - | - | - | - | - | 4.82 | 3.52 | 2.64 | 2.45 | 2.01 | 2.29 |
| cfs days | - | - | - | - | - | - | - | 154.5 | 121.9 | 93.5 | 79.6 | 73.0 | 79.5 |
| ac-ft | - | - | - | - | - | - | - | 306.5 | 241.9 | 185.5 | 157.9 | 144.8 | 157.7 |

Monitor's Comments

1. We collected a continuous water-level record for the full water year
2. No regulation; small diversions upstream for domestic use; possible discharges from industrial sources
3. Multiple stage shifts were applied to the rating equation. Stage shifts adjust for local scour and fill in addition to water-level changes due to algal growth or dams caused by accumulation of fallen leaves and branches
4. Daily values with more than 2 to 3 significant figures result from electronic calculations, no additional precision is implied.

Seasonal Totals, Summer 2019:

| | | |
|--------------------------|-------|------------|
| Seasonal mean daily flow | 3.50 | (cfs) |
| Seasonal max. daily flow | 23 | (cfs) |
| Seasonal min. daily flow | 2.01 | (cfs) |
| Seasonal total | 602 | (cfs-days) |
| Seasonal total | 1,194 | (ac-ft) |

Balance Hydrologics, Inc. 800 Bancroft Way, Suite 101, Berkeley, CA 94710 (510) 704-1000; www.balancehydro.com
 Balance Hydrologics, Inc. 224 Walnut Avenue, Suite E, Santa Cruz, CA 95060 Phone: (831) 457-9900

TABLES

**Table 1. Station observer log; May 30-31, 2019
Santa Margarita Basin, Water Year 2019**

Data preliminary, subject to revision

| Stream, Site description | Site Information | | | | | Streamflow | | | | Water Quality Observations | | | High-Water Marks | Remarks | |
|--|-------------------------|--------------------|-------------|-------------------------------|-------------------------|-----------------------------|------------------------------|----------------------------|---------------------------------|----------------------------|---|--|--|---|--|
| | Date/Time (mm/dd/yr) | River Mile mile | Observer(s) | Stage (staff plate) (feet) | Hydrograph (R/F/S/B) | Measured discharge (cfs) | Estimated Discharge (cfs) | Instrument Used (AA/PY) | Estimated Accuracy (e/g/f/p) | Water Temperature oC | Specific Conductance at field temp. (µmhos/cm) | Specific Conductance at 25°C µmhos@25oC | Estimated stage at staff plate (feet) | | |
| LOMPICO CREEK | | | | | | | | | | | | | | | |
| Lompico Creek at LCWD diversion below Mill Cr. | 5/30/19 16:18 | - | jp | 3.92 | B | 0.74 | - | PY | g | 14.3 | 241 | 303 | 6.6 | Some crossing flow lines affecting velocity. | |
| Lompico Creek 50 feet upstream of Zayante Creek | 5/30/19 15:34 | - | jp | - | B | 1.58 | - | PY | g | 15.8 | 293 | 355 | 1' ft above water level | Water has tan tint with no odor. | |
| ZAYANTE CREEK | | | | | | | | | | | | | | | |
| Zayante Creek at Zayante Store upstream of Lompico Creek | 5/30/19 17:07 | - | jp | 6.06 | B | 6.58 | - | PY | g | 15.2 | 484 | 595 | 7.6 | Some crossing flow lines affecting velocity. | |
| Spring tributary into Zayante Creek at Woodwardia weir | 5/30/17 15:00 | - | jp | | | - | 0.07 | - | - | 17.6 | 99 | 115 | - | Downstream seep flowing at ~1-2 gpm; Tsm tributary | |
| Zayante Creek at Woodwardia weir beneath Mt. Hermon Bypass | 5/30/19 13:58 | - | jp | 0.84 | B | 10.64 | - | PY | g | 15.1 | 383 | 470 | 1.8 | Specific conductance was taken in the middle of the channel; Next to the gage the specific conductivity is 333 µmhos/cm @ 15.6 °C and 404 µmhos/cm at 25 °C; the downstream seep is flowing at approximately 1-2 gpm | |
| Zayante at Mount Hermon Camp upstream of Bean Creek | 5/30/19 10:30 | - | jp | 2.28 | B | 11.94 | - | PY | g | 14 | 317 | 401 | 3.5 | Water level is high due to recent rains | |
| Zayante Creek at Graham Hill Road | 5/31/19 7:49 | - | jp, cn | | B | 17.61 | 11.70 | AA | g/f | 14 | 366 | 464 | 7-8' above water level | Water is clear, flow is not completely laminar; high-water mark is debris built up on tree, additional HWM about 3.4 ft above water level; bed is cobble with some sand creating some non-laminar flow verticals | |
| BEAN CREEK | | | | | | | | | | | | | | | |
| Bean Creek upstream of Glenwood Cutoff | 5/31/19 15:01 | 7.57 | cn, jp | - | B | 0.68 | 0.68 | PY | - | 14.2 | 585 | 738 | 2-2.5' above water level | Water clear; some seeps along the left bank flowing less than 1 gpm and is to low too measure; No infiltration to Santa Margarita basin thought to occur upstream; high-water marks is debris on bank | |
| Bean Creek at Redwood Camp | 5/31/19 13:32 | 5.04 | jp, cn | - | B | 2.08 | - | PY | g/f | 14.3 | 454 | 568 | 1.5' above water level | There may be flow loss between this site and Morgan's Run | |
| Bean Creek upstream of McKenzie Creek at Morgan's Run | 5/31/19 12:17 | 4.19 | jp | - | B | 2.01 | - | PY | g | 15 | 448 | 555 | 2' above water level | There is a landslide 250 ft - 300ft upstream of cross section upstream of Bean Creek Rd; Landslide is mostly shear sand face and this reach is mostly 1-5 cm gravel with sand; Chuck from Monterey Bay Salmon and Trout is onsite looking for fish for potential rescue, he says creek dries up from Gopher Gulch to ~0.5 miles downstream and starts drying downstream to upstream; good, smooth cross section; lots of 1-3cm fish | |
| Mackenzie Creek upstream of Morgan's Run near mouth | 5/31/19 12:16 | 4.16 | cn, jp | - | B | 0.16 | 0.11 | PY | g | 15.2 | 278 | 342 | 1.2' above water level | Water clear, the substrate of the creek is gravel and cobble; specific conductivity on Bean Creek just upstream of McKenzie Creek confluence is 488 µmhos/cm @ 15.1 °C and 600 µmhos/cm at 25 °C | |

**Table 1. Station observer log; May 30-31, 2019
Santa Margarita Basin, Water Year 2019**

Data preliminary, subject to revision

| Stream, Site description | Site Information | | | | | Streamflow | | | | Water Quality Observations | | | High-Water Marks | Remarks |
|--|-------------------------|--------------------|-------------|-------------------------------|-------------------------|-----------------------------|------------------------------|----------------------------|---------------------------------|----------------------------|---|--|--|--|
| | Date/Time (mm/dd/yr) | River Mile mile | Observer(s) | Stage (staff plate) (feet) | Hydrograph (R/F/S/B) | Measured discharge (cfs) | Estimated Discharge (cfs) | Instrument Used (AA/PY) | Estimated Accuracy (e/g/f/p) | Water Temperature oC | Specific Conductance at field temp. (µmhos/cm) | Specific Conductance at 25°C umhos@25oC | Estimated stage at staff plate (feet) | |
| Bean Creek at Green Valley Rd | 5/31/19 10:40 | 2.32 | jp | - | B | 2.00 | - | PY | e/g | 14.2 | 416 | 524 | 2.7' above water level | Excellent cross section with smooth verticals |
| Ruins Creek upstream of confluence with Bean Creek | 5/31/19 10:46 | 2.25 | cn, jp | - | - | 0.36 | 0.24 | PY | g/f | 14.4 | 389 | 487 | 1.-2 ft above current water level | Water is clear; substrate cobbles and gravel with sand deposition; specific conductivity on Bean Creek downstream of Ruins Creek confluence is 438.6 µmhos/cm @ 14.3 °C and 552 µmhos/cm at 25 °C |
| Bean Creek upstream of Lockhart Gulch | 5/31/19 9:33 | 2.14 | jp | - | B | 3.15 | - | PY | g | 13.9 | 411 | 521 | 2' above water level | Fairly smooth verticals; some fanning out of flow lines on right bank |
| Lockhart Gulch upstream of confluence | 5/31/19 9:17 | 2.13 | cn, jp | - | B | 0.57 | 0.48 | PY | f | 13.6 | 313 | 400 | 3.0-3.5' above water level | Water is clear; lots of cobbles and turbulent flow, not ideal spot for measurement; seep ~75ft downstream confluence is not flowing; multiples points of diversion on Bean Creek; sand is soft; specific conductance on Bean Creek downstream of Lockhart Gulch confluence is 408.3 µmhos/cm @ 13.9 °C and 518 µmhos/cm at 25 °C |
| Bean Creek at Mount Hermon Rd (former USGS site) | 5/30/19 9:13 | 1.48 | jp | 0.98 | B | 5.25 | - | PY | e/g | 14.3 | 331 | 417 | 1.7 | Water level is ~0.2 ft below old USGS short staff plate. |
| Bean Creek at Mount Hermon Camp near mouth | 5/30/19 12:14 | 0.16 | jp | 1.35 | B | 6.11 | - | PY | e/g | 15.4 | 364 | 445 | 1.9 | No debris in the downstream riffle |
| Ferndell Creek just upstream of Bean Cr/Zayante confluence | 5/30/19 11:45 | 0.01 | jp | - | B | 0.36 | - | PY | - | 14.9 | 157 | 194 | 0.1-0.15' above water level | Water is clear; no odor |

Notes:

Observer Key: cn = Chelsea Neill; jp = Jason Parke

Stage: Water level observed at outside staff plate.

Hydrograph: Describes stream stage as rising (R), at peak (P), falling (F), steady (S), baseflow (B), diversion (D), not spilling (NS) or uncertain (U).

Instrument: If measured, typically made using a standard (AA) or Pygmy (PY) bucket-wheel ("Price-type") current meter or 5 gallon bucket (bkt), plastic bag (bag), If estimated, from rating curve (R) or visual (V).

Estimated measurement accuracy: Excellent (E) = +/- 2%; Good (G) = +/- 5%; Fair (F) = +/- 9%; Poor (P) estimated percent accuracy given

High-water mark (HWM): Measured or estimated at location of the staff plate

Specific conductance: Measured in micromhos/cm in field; then adjusted to 25degC by equation $(1.8813774452 - [0.050433063928 * \text{field temp}] + [0.00058561144042 * \text{field temp}^2]) * \text{Field specific conductance}$

**Table 2. Station observer log; July 10, 2019
Santa Margarita Basin, Water Year 2019**

Data preliminary, subject to revision

| Stream, Site description | Site Information | | | | Streamflow | | | | Water Quality Observations | | | High-Water Marks | Remarks |
|--|-------------------------|--------------------|------------------------------------|-------------------------|-----------------------------|------------------------------|----------------------------|---------------------------------|----------------------------|---|---|--|--|
| | Date/Time (mm/dd/yr) | River Mile mile | Observer(s) Stage (staff plate) | Hydrograph (R/F/S/B) | Measured discharge (cfs) | Estimated Discharge (cfs) | Instrument Used (AA/PY) | Estimated Accuracy (e/g/f/p) | Water Temperature oC | Specific Conductance at field temp. (umhos/cm) | Specific Conductance at 25C umhos@25oC | Estimated stage at staff plate (feet) | |
| LOMPICO CREEK | | | | | | | | | | | | | |
| Lompico Creek at LCWD diversion below Mill Cr. | 7/3/19 9:00 | - | cn 3.82 | B | 0.34 | 0.35 | PY | g | 12.8 | 276.4 | 360 | - | Flow measurement is fair due to location between rocks and non-parallel flow lines |
| Lompico Creek 50 feet upstream of Zayante Creek | 7/10/19 10:30 | - | cn - | B | 0.62 | 0.79 | PY | g/f | 14.7 | 302 | 376 | - | Water clear; flow measurement taken just upstream of converging flows |
| ZAYANTE CREEK | | | | | | | | | | | | | |
| Zayante Creek at Zayante Store upstream of Lompico Creek | 7/10/19 11:37 | - | cn 5.90 | B | 2.78 | 4.80 | PY | g | 15.7 | 533 | 647 | 3-3.5' above water level | Water clear; flow not laminar due to gravel and cobble substrate |
| Zayante Creek at Graham Hill Road | 7/10/19 8:57 | - | cn - | B | 9.29 | 12.00 | AA | e/g | 15.7 | 379 | 461 | 3-3.5' above water level | Water clear; flow lower than last visit; laminar flow; boulder and cobble substrate with sand through cross section |
| BEAN CREEK | | | | | | | | | | | | | |
| Bean Creek upstream of Glenwood Cutoff | 7/10/19 17:53 | 7.57 | cn - | B | 0.23 | 0.23 | PY | g/f | 16.3 | 498 | 599 | - | Water clear; saw fish approximately 6 inches in length |
| Bean Creek at Green Valley Rd | 7/10/19 16:32 | 2.32 | cn - | B | 0.47 | 0.70 | PY | g | 18 | 489 | 564 | - | Water clear; measured just upstream of Green Valley Rd; laminar flow |
| Bean Creek upstream of Lockhart Gulch | 7/10/19 15:33 | 2.14 | cn - | B | 1.18 | 0.75 | PY | g/f | 16.2 | 458 | 545 | - | Water clear; could not find good section downstream of Lockhart Gulch to measure due to fallen trees and debris in channel; measured upstream of confluence at Lockhart Gulch Rd |
| Lockhart Gulch upstream of confluence | 7/10/19 16:05 | 2.13 | cn - | B | - | 0.20 | - | - | 16.4 | 345 | 411 | - | Water clear, estimated flow upstream of confluence with Bean Creek |
| Bean Creek at Mount Hermon Rd (former USGS site) | 7/10/19 14:26 | 1.48 | cn 0.83 | B | 2.87 | 3.00 | PY | g | 18.3 | 334 | 383 | - | Water clear; measured flow downstream of gage at culvert |

**Table 2. Station observer log; July 10, 2019
Santa Margarita Basin, Water Year 2019**

Data preliminary, subject to revision

| Stream, Site description | Site Information | | | | | Streamflow | | | | Water Quality Observations | | | High-Water Marks | Remarks |
|--|-------------------------|--------------------|----------------------------|--|---------------------------------------|---|---|---|---|--|--|--|--|--|
| | Date/Time (mm/dd/yr) | River Mile mile | Observer(s) Observer(s) | Stage (staff plate) Stage (staff plate) (feet) | Hydrograph Hydrograph (R/F/S/B) | Measured discharge Measured discharge (cfs) | Estimated Discharge Estimated Discharge (cfs) | Instrument Used Instrument Used (AA/PY) | Estimated Accuracy Estimated Accuracy (e/g/f/p) | Water Temperature Water Temperature oC | Specific Conductance at field temp. Specific Conductance at field temp. (umhos/cm) | Specific Conductance at 25C Specific Conductance at 25C umhos@25oC | Estimated stage at staff plate Estimated stage at staff plate (feet) | |
| Bean Creek at Mount Hermon Camp near mouth | 7/10/19 13:45 | 0.16 | cn | 1.26 | B | 3.77 | 3.00 | AA | e/g | 16.4 | 315 | 377 | - | Water clear; measured flow approximately 10 ft downstream of gage; lots of small fish in gage pool |

Notes:

Observer Key: cn = Chelsea Neill; jp = Jason Parke

Stage: Water level observed at outside staff plate.

Hydrograph: Describes stream stage as rising (R), at peak (P), falling (F), steady (S), baseflow (B), diversion (D), not spilling (NS) or uncertain (U).

Instrument: If measured, typically made using a standard (AA) or Pygmy (PY) bucket-wheel ("Price-type") current meter or 5 gallon bucket (bkt), plastic bag (bag), If estimated, from rating curve (R) or visual (V).

Estimated measurement accuracy: Excellent (E) = +/- 2%; Good (G) = +/- 5%; Fair (F) = +/- 9%; Poor (P) estimated percent accuracy given

High-water mark (HWM): Measured or estimated at location of the staff plate

Specific conductance: Measured in micromhos/cm in field; then adjusted to 25degC by equation $(1.8813774452 - [0.050433063928 * \text{field temp}] + [0.00058561144042 * \text{field temp}^2]) * \text{Field specific conductance}$

**Table 3. Station observer log; September 25, 2019
Santa Margarita Basin, Water Year 2019**

Data preliminary, subject to revision

| Site Information | | | | | | Streamflow | | | | Water Quality Observations | | | High-Water Marks | Remarks |
|--|---------------|------------|-------------|---------------------|------------|--------------------|---------------------|-----------------|--------------------|----------------------------|-------------------------------------|-----------------------------|--------------------------------|--|
| Stream, Site description | Date/Time | River Mile | Observer(s) | Stage (staff plate) | Hydrograph | Measured discharge | Estimated Discharge | Instrument Used | Estimated Accuracy | Water Temperature | Specific Conductance at field temp. | Specific Conductance at 25C | Estimated stage at staff plate | |
| | (mm/dd/yr) | mile | (feet) | (R/F/S/B) | (cfs) | (cfs) | (AA/PY) | (e/g/f/p) | oC | (µmhos/cm) | umhos@25oC | (feet) | | |
| LOMPICO CREEK | | | | | | | | | | | | | | |
| Lompico Creek at LCWD diversion below Mill Cr. | 9/24/19 17:06 | - | jp | 3.76 | B | 0.14 | - | PY | f | 17.2 | 337 | 399 | - | Water does not have visible tannin color. Cleared debris downstream of gage after measurement - stage dropped from 3.76 to 3.68. |
| Lompico Creek 50 feet upstream of Zayante Creek | 9/25/19 10:17 | - | cn | - | B | 0.41 | 0.60 | PY | g/f | 15.1 | 471 | 588 | - | Water clear; not all flow lines parallel |
| ZAYANTE CREEK | | | | | | | | | | | | | | |
| Zayante Creek at Zayante Store upstream of Lompico Creek | 9/24/19 15:41 | - | jp | 5.73 | B | 0.99 | - | PY | g | 16.9 | 577 | 684 | - | No debris jams downstream of gage. |
| Spring tributary into Zayante Creek at Woodwardia weir | 9/24/19 15:33 | - | jp | - | - | - | 0.003 | - | - | 17.9 | 131 | 152 | - | |
| Zayante Creek at Woodwardia weir beneath Mt. Hermon Bypass | 9/24/19 14:50 | - | jp | 0.63 | B | 2.80 | - | PY | g | 16.7 | 355 | 422 | - | Downstream of weir seems a bit backwatered however there is a good cross section |
| Zayante Creek at Graham Hill Road | 9/25/19 7:55 | - | cn | - | B | 6.48 | 7.20 | PY | g | 15.3 | 329 | 403 | - | Water clear; flow is laminar through cross section and downstream of riffle |
| BEAN CREEK | | | | | | | | | | | | | | |
| Bean Creek upstream of Glenwood Cutoff | 9/25/19 17:25 | 7.57 | cn | - | B | 0.02 | 0.04 | PY | p | 16.3 | 683 | 820 | - | Flow is very low; no evidence of flow in pools; water is stagnant with leaves on surface; flow measurement through small area of concentrated flow |
| Bean Creek upstream of McKenzie Creek at Morgan's Run | 9/25/19 16:20 | 4.19 | cn | - | B | 0.07 | 0.10 | PY | f | 18.5 | 561 | 641 | - | Measurement is fair due to low flow through cobbles; no flow from station 4.8 - 6.4; saw flow in Bean Creek at Lucinda, did not see dry section |
| Mackenzie Creek upstream of Morgan's Run near mouth | 9/25/19 16:05 | 4.16 | cn | - | B | - | 0.003 | - | - | 19 | 309 | 349 | - | Flow too low to measure; lots of debris in channel (leaves) upstream of bridge at 16:05 |
| Bean Creek at Green Valley Rd | 9/25/19 14:07 | 2.32 | cn | - | B | 0.10 | 0.15 | PY | f | 17.1 | 500 | 589 | - | No good places to take measurement; flow is dispersed through cobbles; cross section was in area of concentrated flow (not dispersed) but velocities were slow |
| Ruins Creek upstream of confluence with Bean Creek | 9/25/19 14:53 | 2.25 | cn | - | B | 0.22 | 0.20 | PY | f | 16.4 | 386 | 461 | - | Flow is not laminar in cross section due to cobble substrate; appears to be comparable or slightly more flow in Ruins Creek than in Bean Creek upstream of Ruins Creek; saw small fish in Bean upstream of Ruins |

**Table 3. Station observer log; September 25, 2019
Santa Margarita Basin, Water Year 2019**

Data preliminary, subject to revision

| Stream, Site description | Site Information | | | | | Streamflow | | | | Water Quality Observations | | | High-Water Marks | Remarks |
|--|--------------------------------|---------------------------|-------------|--------------------------------------|--------------------------------|------------------------------------|-------------------------------------|-----------------------------------|--|--------------------------------|--|--|---|--|
| | Date/Time <i>(mm/dd/yr)</i> | River Mile <i>mile</i> | Observer(s) | Stage (staff plate) <i>(feet)</i> | Hydrograph <i>(R/F/S/B)</i> | Measured discharge <i>(cfs)</i> | Estimated Discharge <i>(cfs)</i> | Instrument Used <i>(AA/PY)</i> | Estimated Accuracy <i>(e/g/f/p)</i> | Water Temperature <i>oC</i> | Specific Conductance at field temp. <i>(umhos/cm)</i> | Specific Conductance at 25C <i>umhos@25oC</i> | Estimated stage at staff plate <i>(feet)</i> | |
| Bean Creek upstream of Lockhart Gulch | 9/25/19 12:53 | 2.14 | cn | - | B | 0.50 | 0.36 | PY | g/f | 16.8 | 549 | 664 | - | Water cress growing in channel just upstream of confluence; saw a few fish, 2-3" in length; flow was pretty laminar, some willow roots along right bank in channel upstream of cross section |
| Lockhart Gulch upstream of confluence | 9/25/19 13:27 | 2.13 | cn | - | B | 0.22 | 0.30 | PY | f | 16.1 | 398 | 478 | - | Some water cress growing in channel at confluence; flow is slightly turbulent through cobbles in cross section |
| Bean Creek at Mount Hermon Rd (former USGS site) | 9/24/19 13:45 | 1.48 | jp | 1.10 | B | 2.28 | - | PY | e/g | 16.8 | 375 | 446 | - | Trees have fallen in to the gaged reach making access to the gage difficult and creating backwater in the gaged pool. Tree may cause problems at high flow with catching debris |
| Bean Creek at Mount Hermon Camp near mouth | 9/24/19 11:37 | 0.16 | jp | 1.28 | B | 3.14 | - | PY | e/g | 15.2 | 345 | 424 | - | Minor debris downstream of gage, however not likely affecting the station. Very laminar and smooth sandy bed. |
| Ferndell Creek just upstream of Bean Cr/Zayante confluence | 9/24/19 12:41 | 0.01 | jp | - | B | 0.28 | - | PY | g | 15.8 | 173 | 210 | - | Some crossing flow lines and turbulence. No odor or color. |

Notes:

Observer Key: cn = Chelsea Neill; jp = Jason Parke

Stage: Water level observed at outside staff plate.

Hydrograph: Describes stream stage as rising (R), at peak (P), falling (F), steady (S), baseflow (B), diversion (D), not spilling (NS) or uncertain (U).

Instrument: If measured, typically made using a standard (AA) or Pygmy (PY) bucket-wheel ("Price-type") current meter or 5 gallon bucket (bkt), plastic bag (bag). If estimated, from rating curve (R) or visual (V).

Estimated measurement accuracy: Excellent (E) = +/- 2%; Good (G) = +/- 5%; Fair (F) = +/- 9%; Poor (P) estimated percent accuracy given

High-water mark (HWM): Measured or estimated at location of the staff plate

Specific conductance: Measured in micromhos/cm in field; then adjusted to 25degC by equation $(1.8813774452 - [0.050433063928 * \text{field temp}] + [0.00058561144042 * \text{field temp}^2]) * \text{Field specific conductance}$

**Table 4. Station observer log: Bean Creek, Scotts Valley, water year 2019
Bean Creek at Mount Hermon Road (USGS gaging station)**

| Site Conditions | | | | Streamflow | | | | Water Quality Observations | | | | High-Water Marks | | Remarks | |
|-------------------------|-------------|---|--|-------------------------|--------------------------------|---------------------------------|----------------------------|------------------------------------|------------------------------|---|--|--|---|------------------|--|
| Date/Time (mm/dd/yr) | Observer(s) | Stage: on USGS staff plate (feet) | Stage: on Balance staff plate (feet) | Hydrograph (r/f/s/b) | Measured Discharge (cfs) | Estimated Discharge (cfs) | Instrument Used (AA/PY) | Estimated Accuracy (e/g/f/p) | Water Temperature (°C) | Specific Conductance at field temp. (ms) | Specific Conductance at 25°C (ms) | Additional sampling (Qbed, etc.) | Estimated stage at staff plate (feet) | | Inferred dates (m/d/yr) |
| 5/13/2019 14:30 | JP | 3.58 short, 1.0 slanted | 0.95 | B | 4.8 | - | PY | g/e | 16.5 | 382 | 455 | - | 7.9 USGS crest gage, 10.7 slanted | WY17 (likely) | Reinstalled gage in the same previously gaged side pool, about 2 ft upstream of previous (2014) gage. Good cross section with smooth bed and smooth velocity verticals. |
| 5/30/2019 9:13 | JP | 3.80 | 0.98 | B | 5.3 | - | PY | g/e | 14.3 | 331 | 417 | - | 1.68 or 1.18 | recent | Water is approximately 0.2 ft below bottom of USGS short staff plate (approximatley 3.8) |
| 6/14/2019 12:02 | JP | - | 0.90 | B | 4.1 | - | PY | g | - | - | - | - | - | - | USGS short staff plate is disconnected from water, added in-situ probe and replaced siltling well. |
| 6/19/2019 11:36 | CN | - | 0.89 | B | - | - | - | - | 15.5 | 375 | 457 | Nutr | - | - | nutrient sampling |
| 7/10/2019 14:15 | CN | - | 0.83 | B | 2.9 | 3 | PY | g | 18.3 | 334 | 383 | - | - | - | Water clear, measured flow in culvert |
| 9/24/2019 13:45 | JP | - | 1.10 | B | 2.3 | - | PY | g | 16.8 | 375 | 446 | - | - | - | Trees have fallen in to the gaged reach just downstream of the gage, making access to the gage difficult and creating backwater at the gage. Tree may cause problems at high flow with catching debris. |
| 11/1/2019 15:55 | JP | - | 1.40 | B | 2.3 | - | PY | g | 13.2 | 337 | 435 | - | - | - | Gage is still heavily backwatered by the downed trees down in the pool/run. Walked upstream about 1000 feet and found a trib flowing about 0.2-0.3 cfs with Tsm conductivity at 219 uS at 25C |
| 2/4/2020 12:29 | CN | - | 1.09 | B | - | 2.1 | visual | p | 10.1 | 290 | 405 | - | 2.7 | recent | Some debris downstream of gage has been cleared by higher flows, water is still likely backwatered in gage pool, some sediment in the gage pool appears to be relatively fresh (mostly sand with some gravel), high-water mark is debris on downed trees downstream of gage. |

Notes:

Observer Key: jp = Jason Parke; cn= Chelsea Neill

Stage: Water level observed at outside staff plate

Hydrograph: Describes stream stage as rising (R), falling (F), steady (S), baseflow (B), or uncertain (U).

Instrument: If measured, typically made using a standard (AA); pygmy (PY) bucket-wheel ("Price-type") current meter; or portable flume (flume). If estimated, from rating curve (R), visual (V), or float test (F).

Estimated measurement accuracy: Excellent (E) = +/- 2%; Good (G) = +/- 5%; Fair (F) = +/- 9%; Poor (P) estimated percent accuracy given

High-water mark (HWM): Measured or estimated at location of the staff plate

Specific conductance: Measured in microSiemens (micromhos/cm) in field; and adjusted to 25°C using the internal meter conversion

Additional Sampling: Qbed = bedload; Qss = suspended sediment; DO = dissolved oxygen; Nutr = nutrients

FIGURES

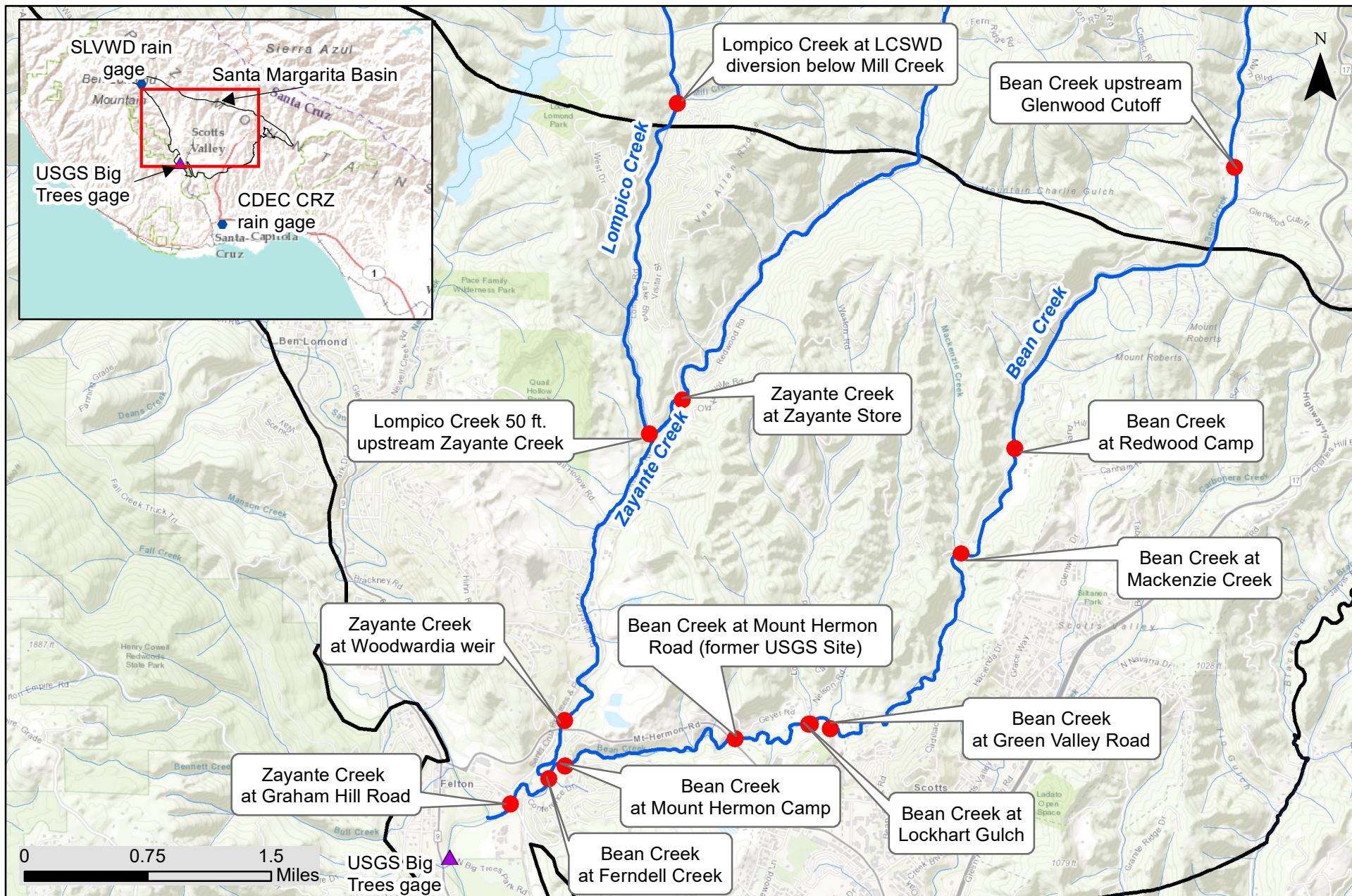


Figure 1 . Zayante and Bean Creeks accretion study reach, Santa Cruz County, California. Emphasis of this study is on Bean Creek and the complex system feeding it.

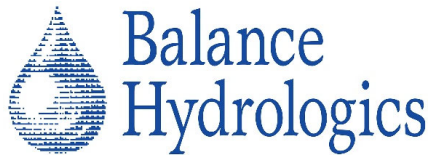
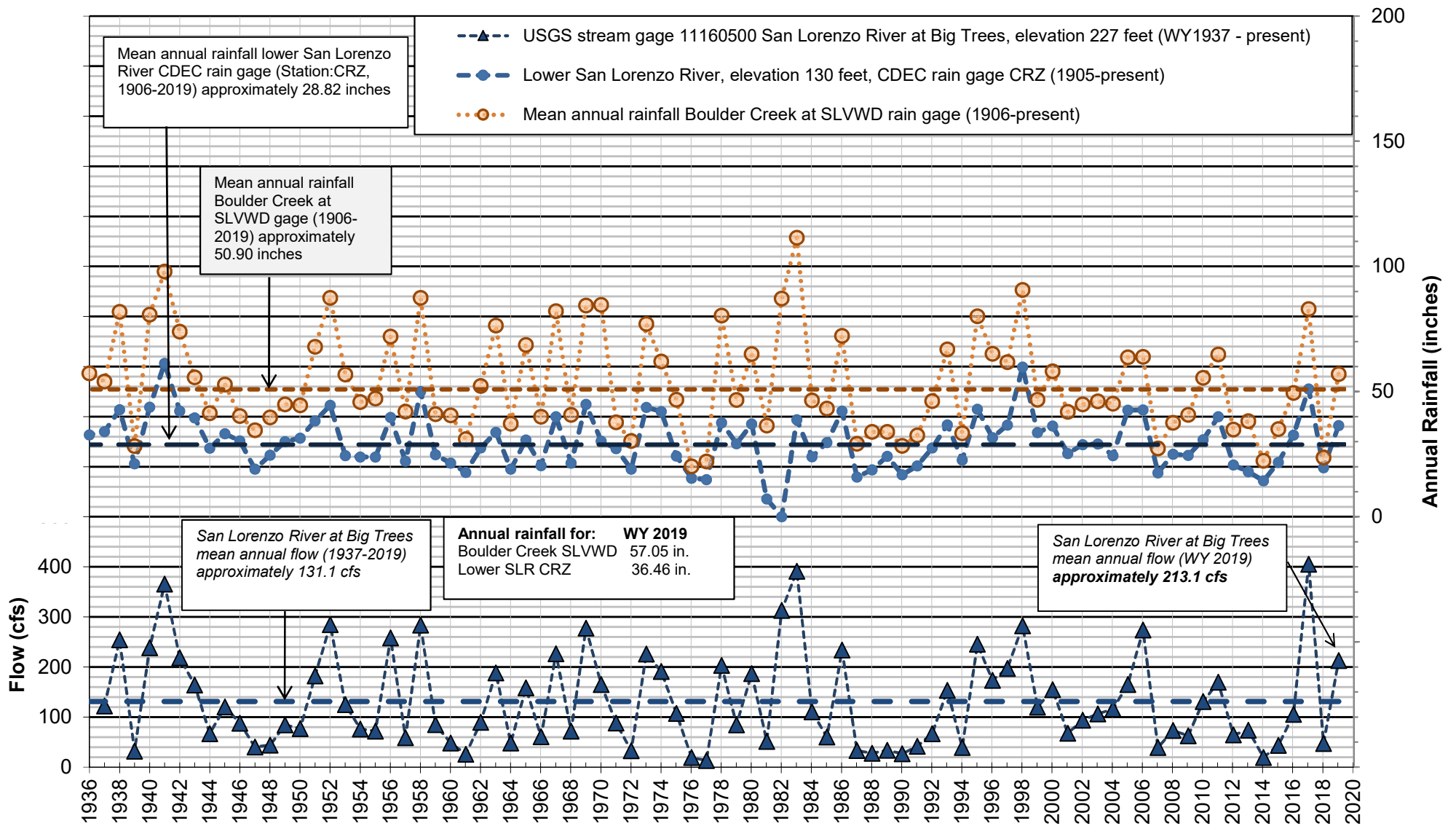


Figure 2. Comparison of historic annual rainfall in San Lorenzo Basin to annual streamflow at USGS Gage 11160500, San Lorenzo River at Big Trees, Santa Cruz County, CA

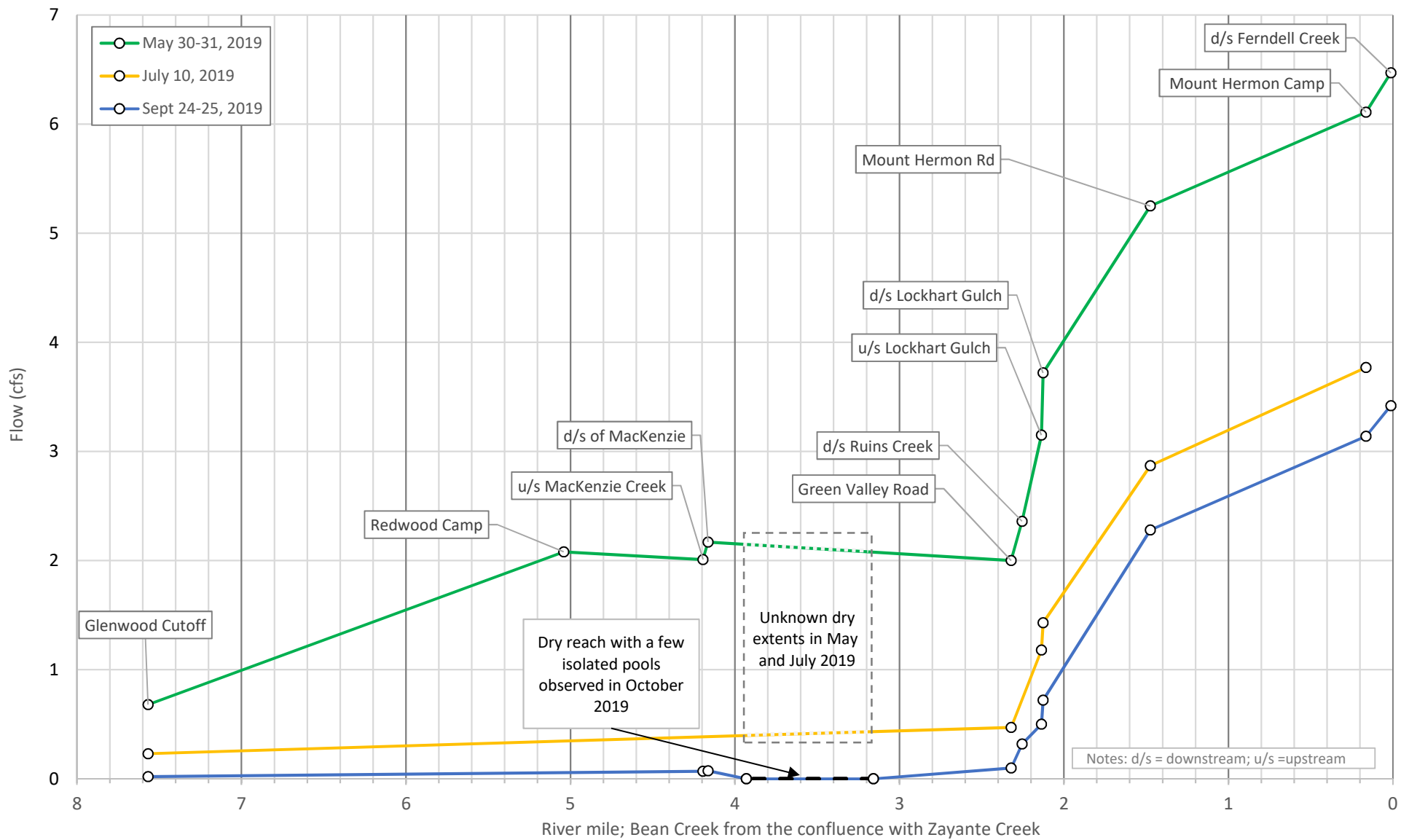


Figure 3. Bean Creek downstream changes in flow as measured during 2019, Santa Cruz County, CA Note location of dry reach.

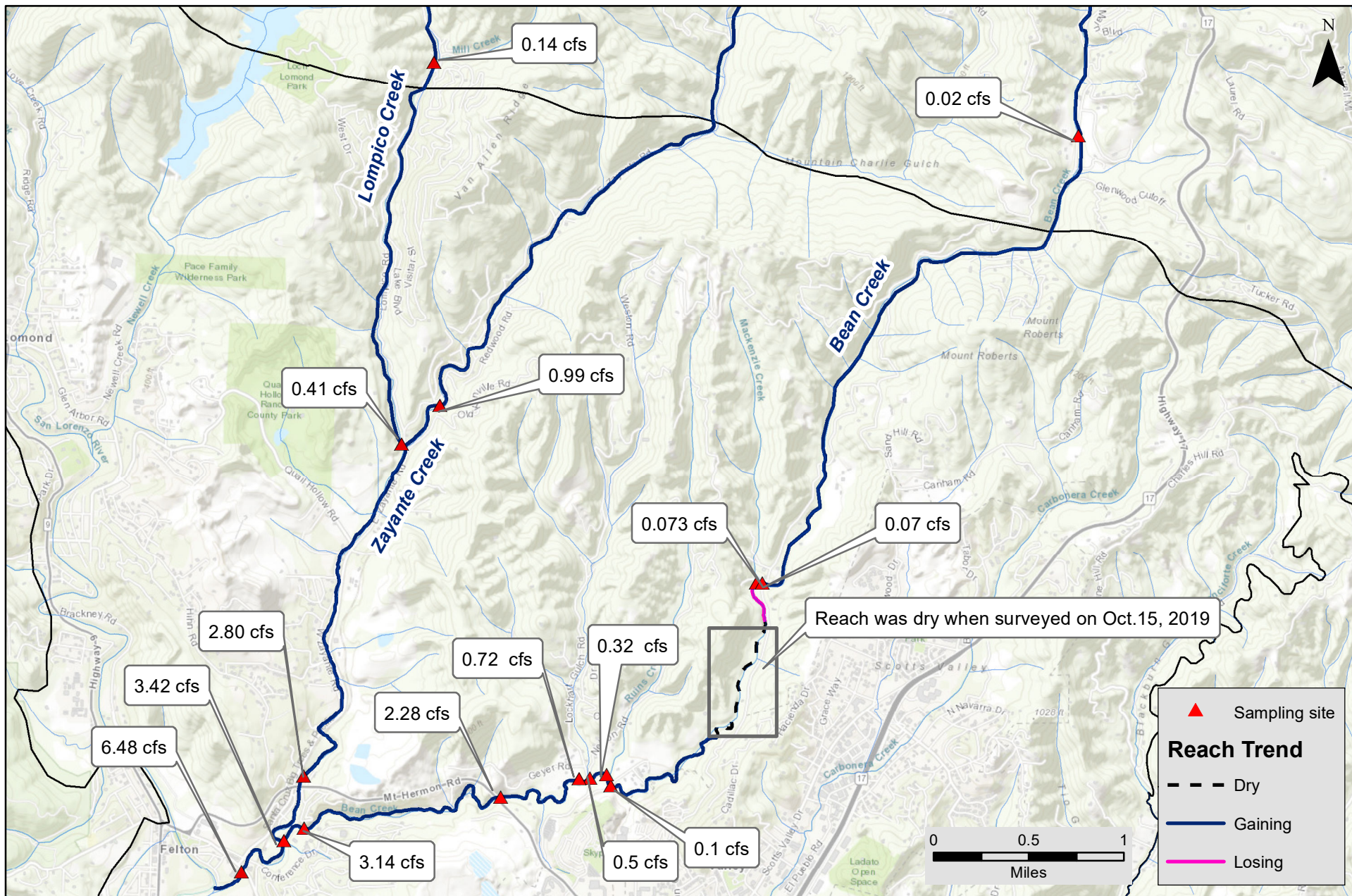


Figure 4. Results of Zayante and Bean Creek Accretion Measurements, September 2019, Santa Cruz County, California

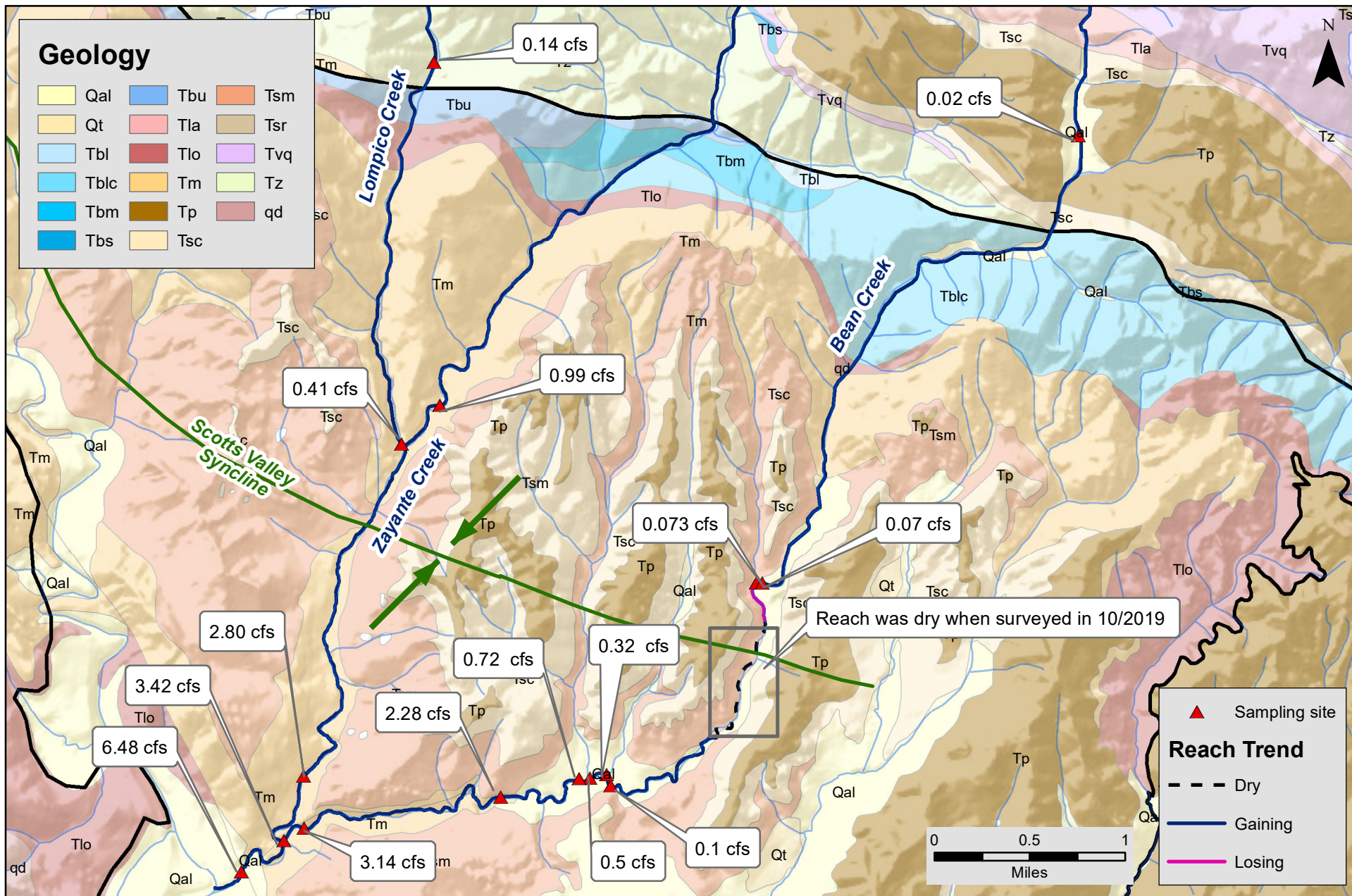


Figure 5. Results of Zayante and Bean Creek Accretion Measurements, September 2019, Santa Cruz County, California

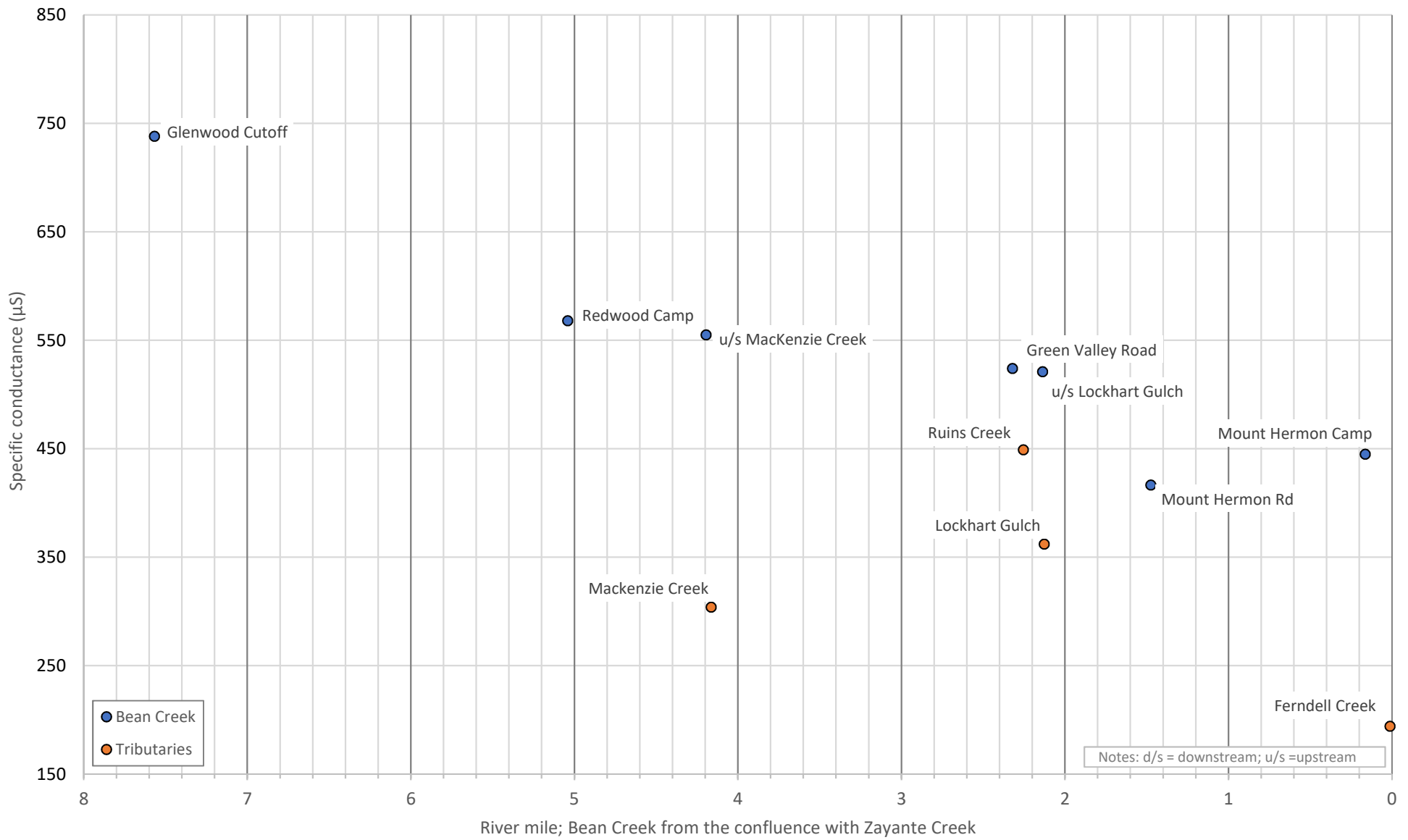


Figure 6. Bean Creek specific conductance from samples taken on May 30-31, 2019, Santa Cruz County, CA

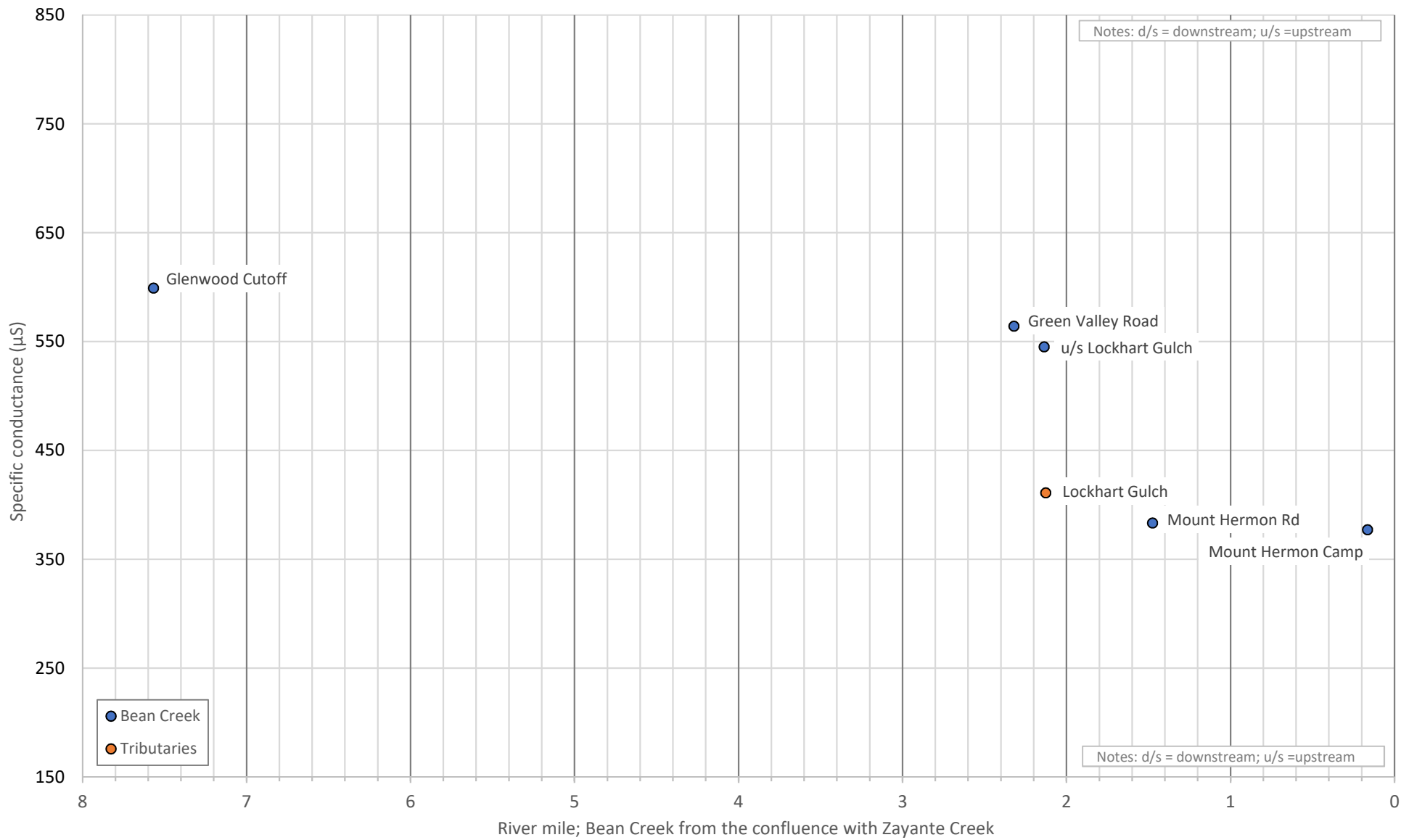


Figure 7. Bean Creek specific conductance from samples taken July 10, 2019, Santa Cruz County, CA

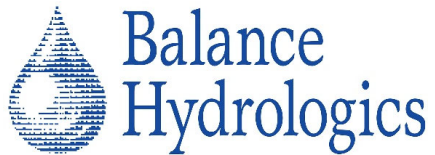
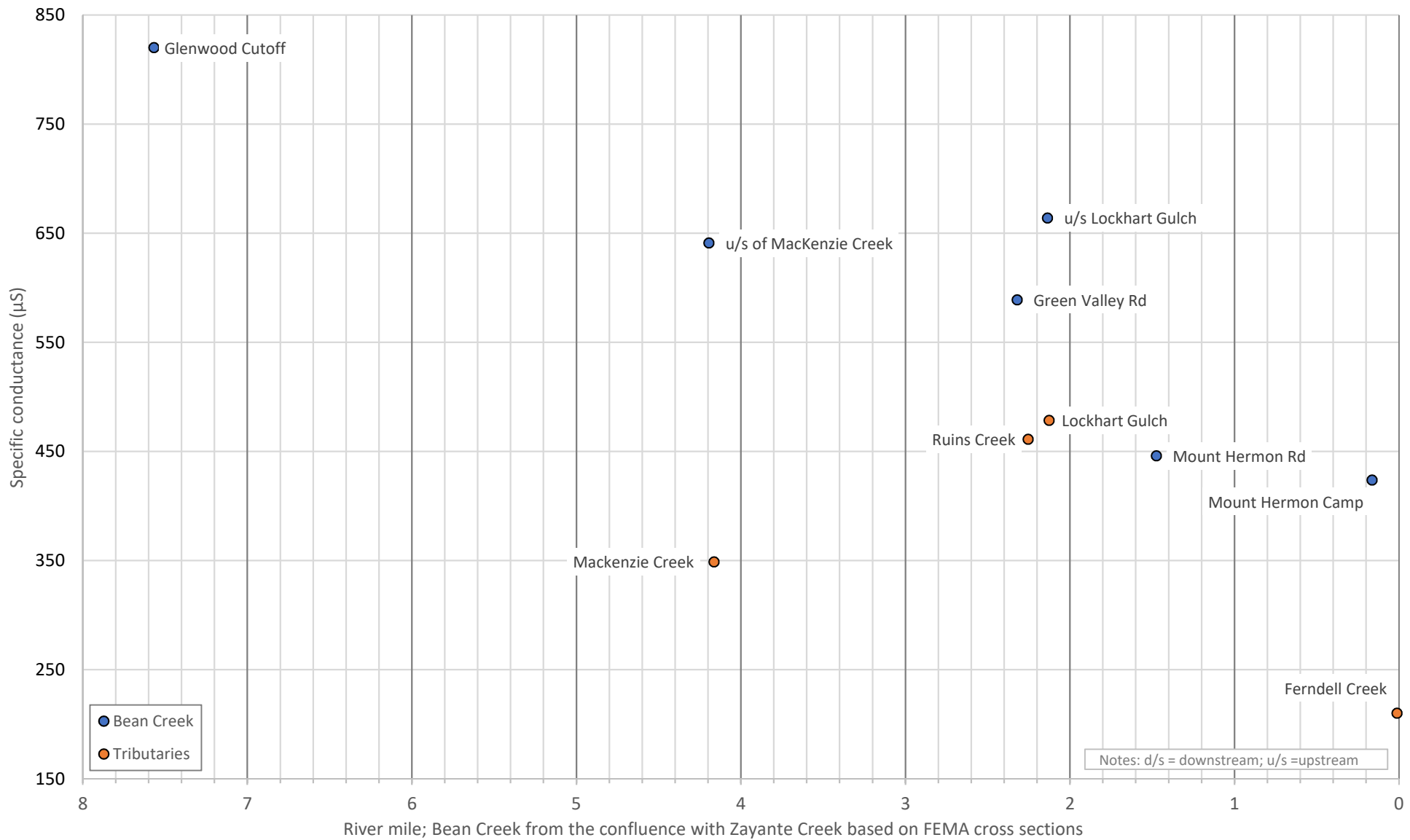


Figure 8. Bean Creek specific conductance from samples taken September 24-25, 2019, Santa Cruz County, CA

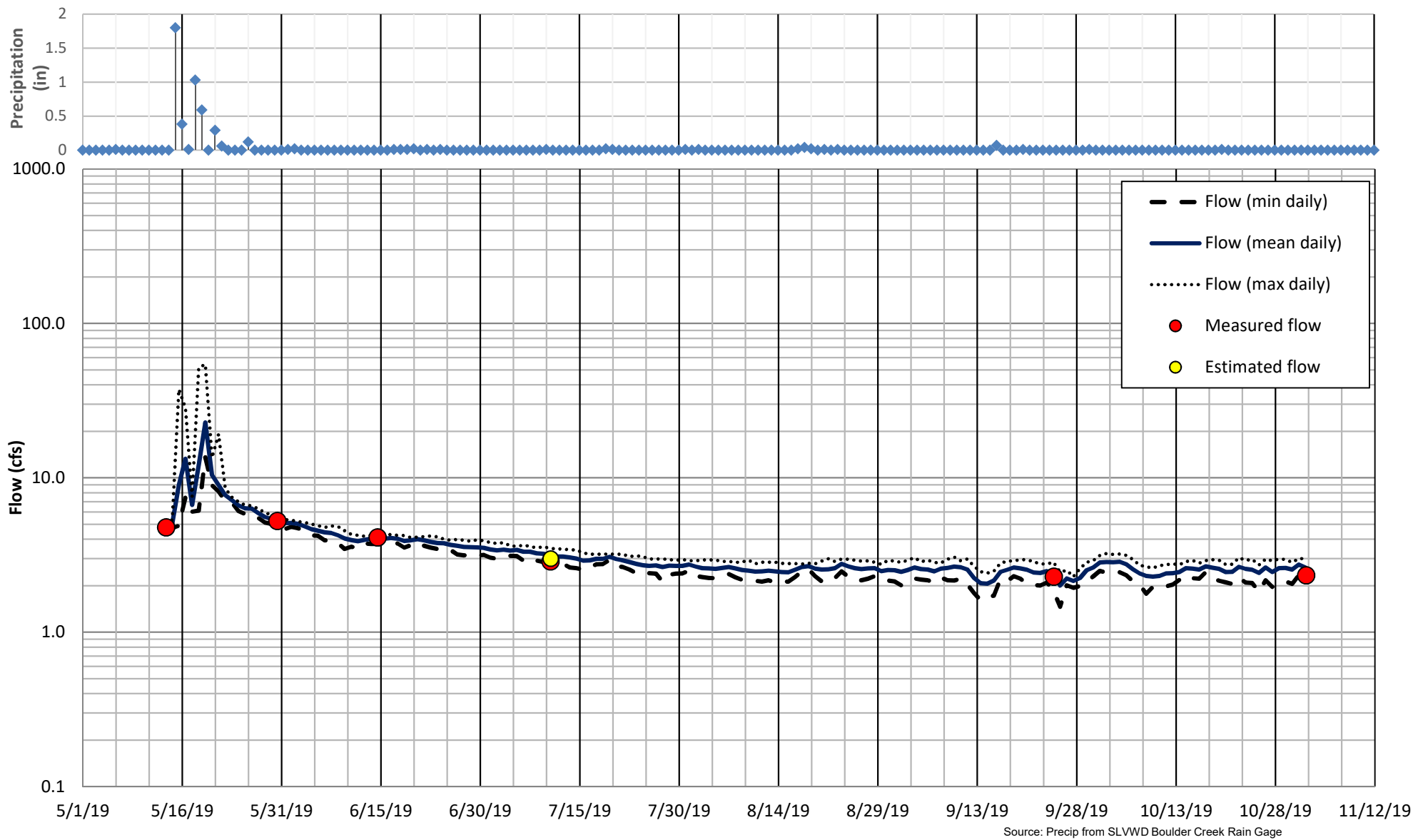


Figure 9. Bean Creek at Mount Hermon Road water year 2019 seasonal baseflow, Santa Cruz County, Ca

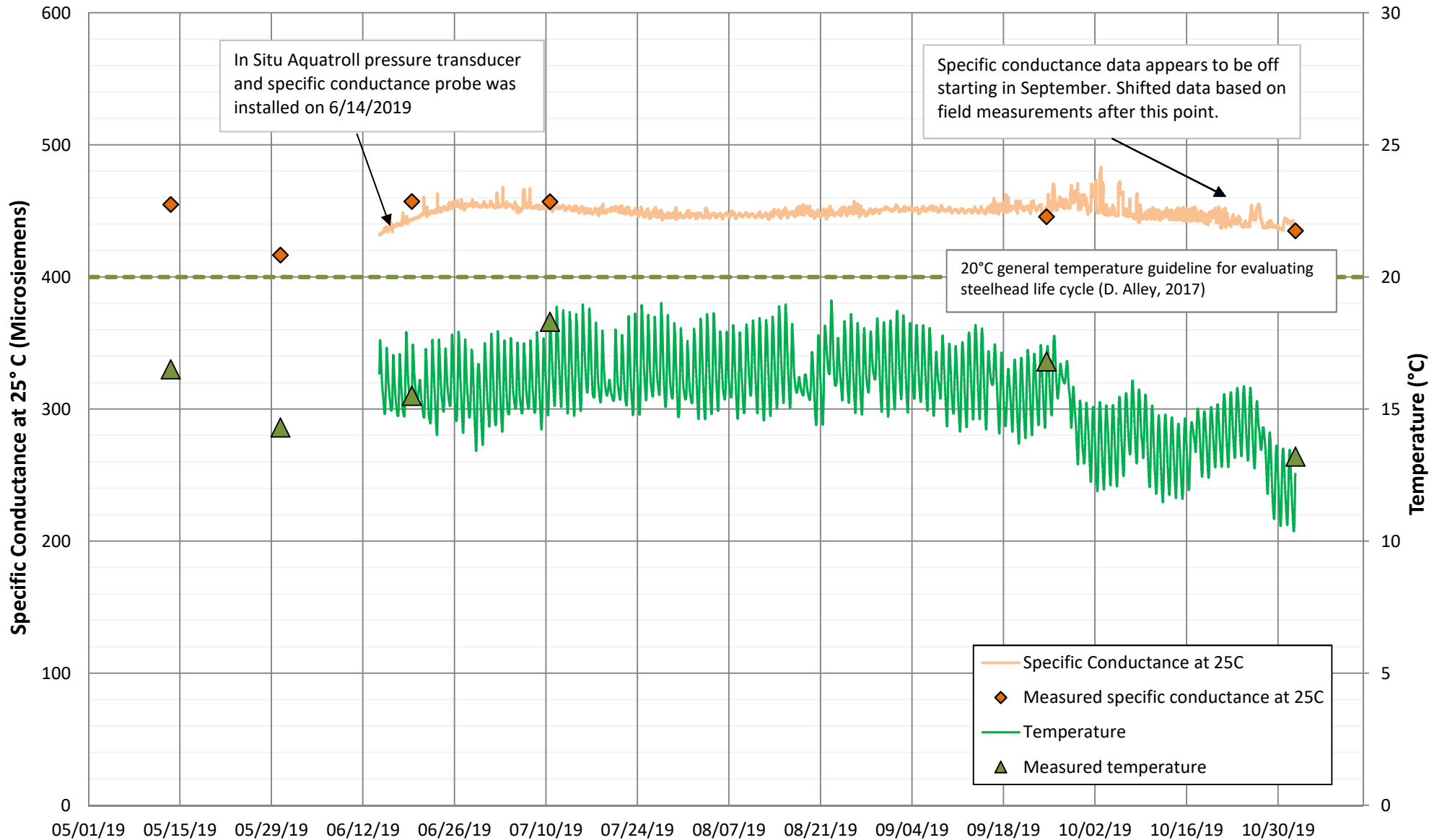


Figure 10. Specific conductance and temperature at Bean Creek at Mt. Hermon Rd. seasonal low flow water year 2019