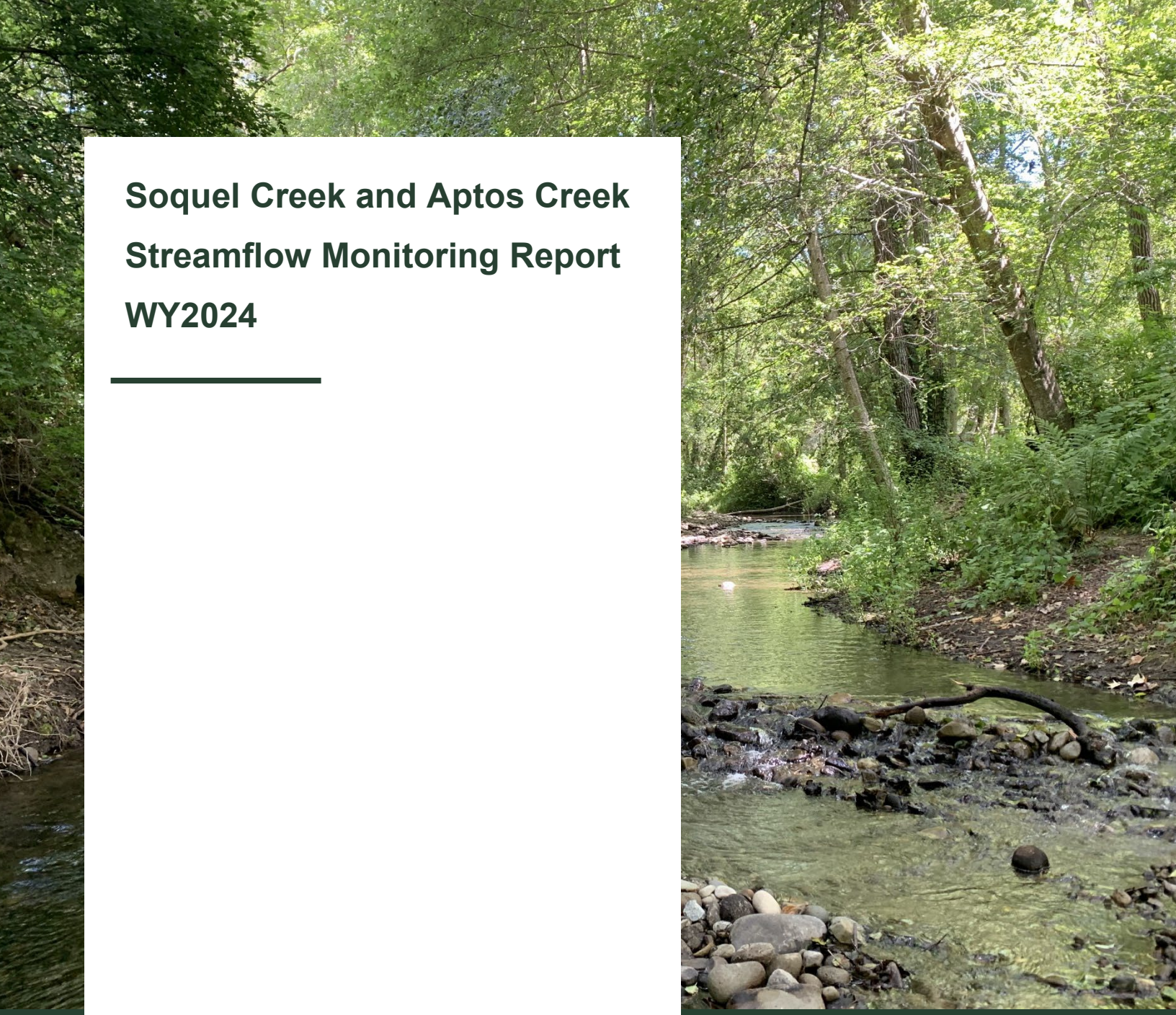

Soquel Creek and Aptos Creek Streamflow Monitoring Report WY2024

FEBRUARY 19, 2025

Prepared By: Trout Unlimited
Mia van Docto, Krysia Skorko, Troy Cameron and Anthony Modena

1. Introduction

In 2022, Trout Unlimited (TU) was awarded a 3-year contract from the Santa Cruz Mid-County Groundwater Agency (MGA) to perform dry season (May through October) streamflow and year-round groundwater monitoring in the Santa Cruz Mid-County Groundwater Basin (Basin). The monitoring will inform evaluations of sustainable groundwater management as part of the MGA's 2019 Groundwater Sustainability Plan (GSP). The MGA GSP seeks to avoid undesirable results for five sustainability indicators: groundwater level declines, groundwater storage reductions, interconnected surface water depletion, seawater intrusion, and water quality degradation. The TU monitoring effort will primarily help assess interconnected surface water depletion while contributing to a larger data collection effort by MGA in assessing long-term groundwater levels. In WY2024, TU monitored stream conditions at 7 priority locations in the Basin. This report provides the results of the second year of streamflow monitoring. Funding for this project has been provided in part from the Budget Act of 2021 and through an agreement with the California Department of Water Resources.

2. Study Area

Watershed Characteristics

The Soquel Creek and Aptos Creek watersheds are coastal drainages dominated by mixed conifer forests, comprised mainly of coastal redwood, tan oak, madrone and Douglas fir (RCDSCC 2019). Most of the study area is within unincorporated Santa Cruz County. Soquel Creek drains approximately 42 sq. miles, and Aptos Creek drains approximately 25 sq. miles. Land use in Soquel Creek includes rural residential development, parks and recreation, mining, and timber harvesting. Roughly 25% of the headwaters of the Soquel Creek Watershed are State-protected lands (RCDSCC 2019). Logging has been conducted in the middle and upper watershed since the mid-nineteenth century (RCDSCC 2003). Land use in the Aptos Creek Watershed includes more than 50% forested and state park lands; other land uses include urban and rural residential. There is both historical and modern-day logging on these lands (SCC Environmental Health Dept). Both creeks provide important coho salmon and steelhead trout habitat (RCDSCC 2019).

Rainfall

The Soquel Creek and Aptos Creek watersheds have a Mediterranean climate like most of coastal California, with warm dry summers and cool wet winters. The Parameter-elevation Regression on Independent Slopes Model (PRISM), a precipitation model developed at Oregon State University, indicates that average precipitation throughout the watershed is extremely variable, with the lower portion receiving an average

30 to 40 inches of rainfall annually, and rainfall averages of up to 60 inches in the higher elevation portions of the watersheds. Figure 1 shows 30 years of rainfall data collected beginning in 1994 from the California Irrigation Management Information System (CIMIS) station in Santa Cruz, CA (CIMIS station 104 DeLaveaga, hereafter, DeLaveaga station). The DeLaveaga station is located in the northern portion of the city of Santa Cruz near DeLaveaga Park, at an approximate elevation of 300 feet. The data show that the long-term average annual rainfall here is 29.9 inches. Rainfall in WY2024 was 36.89 inches, above the long-term average, and second above-average year in a row, following three consecutive years of below average rainfall.

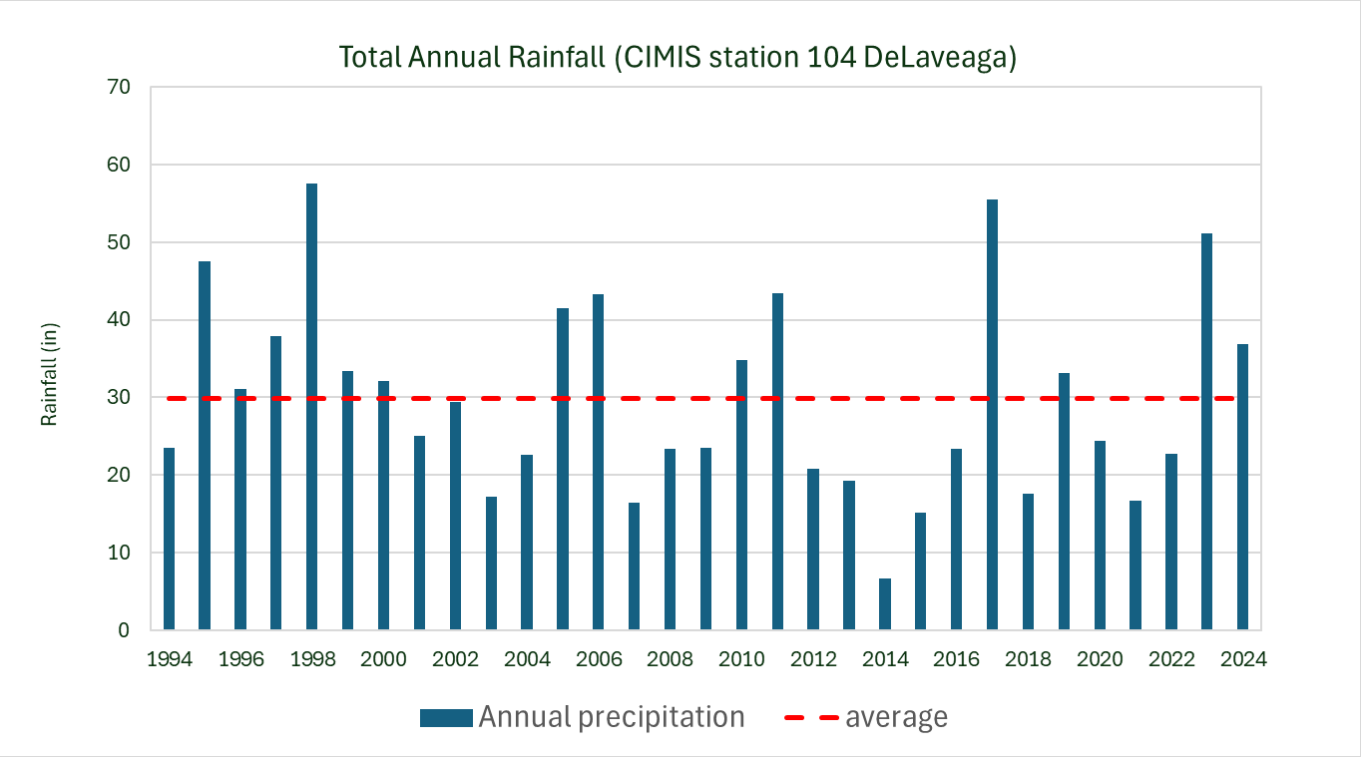

Figure 1. Annual precipitation (inches) for 30 years (WY1994 – WY2024), collected at CIMIS station 104 (DeLaveaga). The red dashed line represents the long-term average annual rainfall (29.9 in) collected at the station.

Monitoring Sites

Figure 2 shows the locations of the gages on Soquel Creek and Aptos Creek. Soquel Creek has five gages in both the upper and lower reaches of the watershed. Soquel Creek at the Quarry (Sq04) is the most upstream gage, just downstream of the confluence with Hinckley Creek. Next downstream is East Branch Soquel above West Branch (Sq01), located on the East Branch of Soquel Creek just upstream of the confluence with the West Branch. In 2024, an additional gage at this location on the West Branch (Sq02) was reactivated and monitored. The next downstream gage is the Soquel at Mountain Elementary gage (Sq06). Furthest downstream is the Soquel at Cherryvale gage (Sq05), which is upstream of the confluence with Bates Creek. The two gages on Aptos Creek are in the lower portion of the watershed; Aptos at County Park (Ap01) is upstream of Highway 1 and Aptos below Highway 1 (Ap02) is downstream.

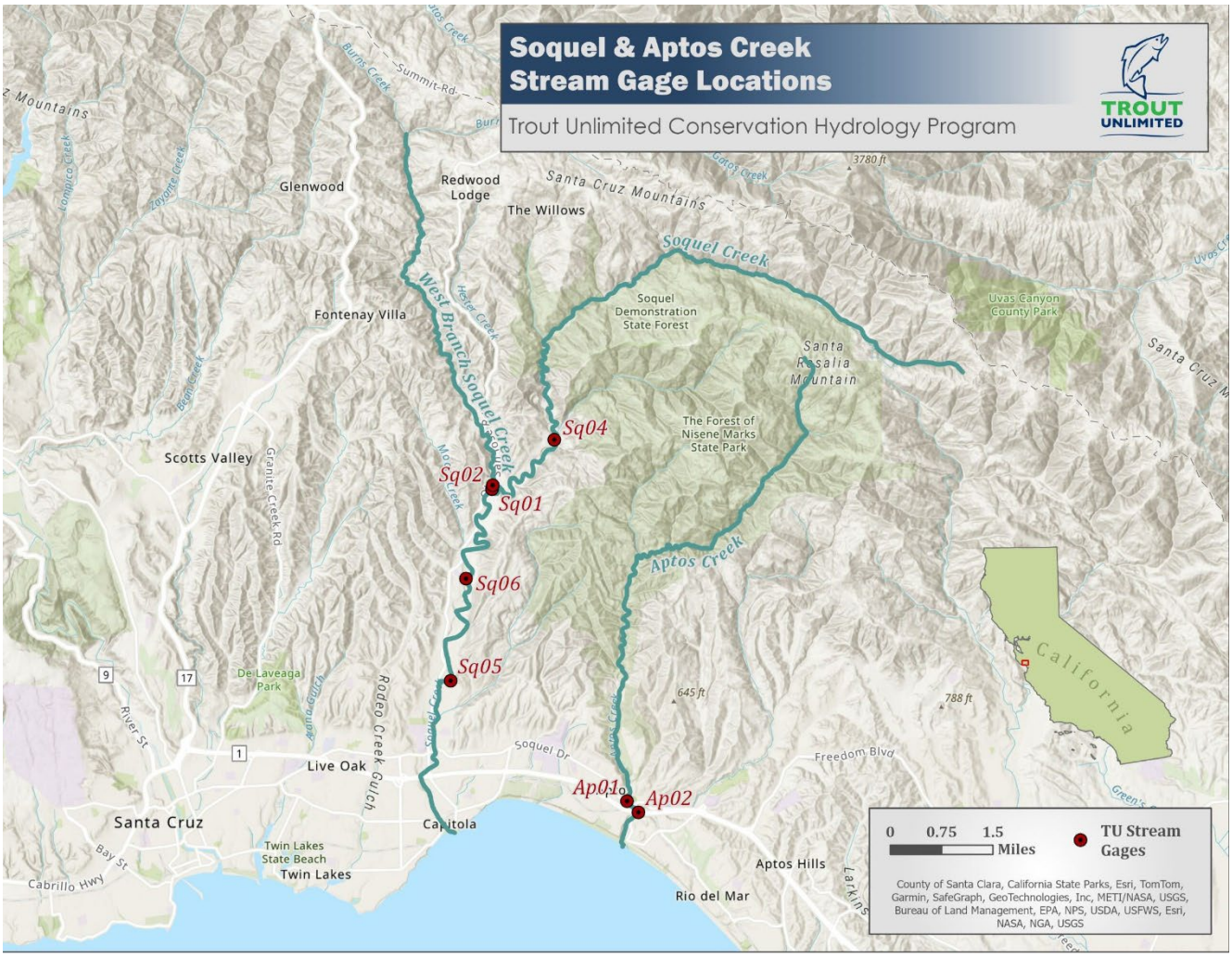

Figure 2. Location of Soquel Creek and Aptos Creek streamflow gages.

3. Streamflow and Conductivity Conditions

Streamflow

TU began seasonal monitoring at the gage network in May of 2024. Each streamflow gage was operated following United States Geological Survey (USGS) standard procedures, as described in Rantz (1982). Streamflow measurements were collected approximately monthly using a Flow Tracker 2, following USGS protocols for measuring streamflow velocity (Turnipseed and Sauer 2010). Staff plate readings were used to detect pressure transducer drift and other factors that may cause phase shifts (i.e., changes in the relationship between stage and streamflow) over the course of the project and to tie data in to surveyed benchmarks. Using measured streamflow values, rating curves were developed to correlate streamflow with stage at each site. Manual measurements of temperature and conductivity were collected using a handheld YSI probe.

Figure 3 shows 15-minute streamflow at the five Soquel Creek gages from May through October 2024. In early May, streamflow was highest at the sites in the lower portion of the watershed (Sq06, Soquel at Mountain Elementary, at ~22 ft^3/sec, and Sq05, Soquel at Cherryvale, at ~18 ft^3/sec). Flows in the upper portions of the watershed were lower; flows at Sq01 (East Branch Soquel above West Branch) were approximately 15 ft^3/sec and the highest gage in the watershed (Sq04, Soquel Creek at the Quarry), had lower flows of approximately 12 ft^3/sec. Flows at the West Branch gage (Sq02) were the lowest of all sites, at about 6.5 ft^3/sec in mid-May. Flows at all sites receded quickly from May through July, reaching baseflow in mid-August, September and October. The lower portion of the watershed consistently gained flow from the upper portion, and baseflows

remained higher at the lower gages (Sq05, Sq06) than at the upper watershed gages. The lower watershed gages show a higher level of variability and daily fluctuations.

Figure 4 shows 15-minute streamflow at the two Aptos Creek gages from May through October 2024. Because of its smaller watershed size, flows are lower than in Soquel Creek. Flow at the upstream site (Ap01) starts out slightly higher than at the downstream site (Ap02) in May, at approximately 5.5 and 4.5 ft^3/sec, respectively. This relationship reverses in early June through August, but by the time the sites recede to baseflow in early September, flows are still slightly higher at the upstream site. These gages are low in the watershed, and similar to the gages in lower Soquel Creek, show high variability and daily fluctuations.

Analysis of data from Sq05, Sq06, Ap01 and Ap02 at a daily time step show that the sensors picked up fluctuations in stage that do not match typical diurnal patterns. This variability could be caused by sensor sensitivity limitations and the locations of the gages. Due to the nature of the reach conditions TU had to work with, these gages are in pools with higher near-bed velocity gradients than the upper watershed gage pools (Sq01 and Sq04). The reaches' more turbulent nature causes water levels to vary more frequently, resulting in slightly noisier data.

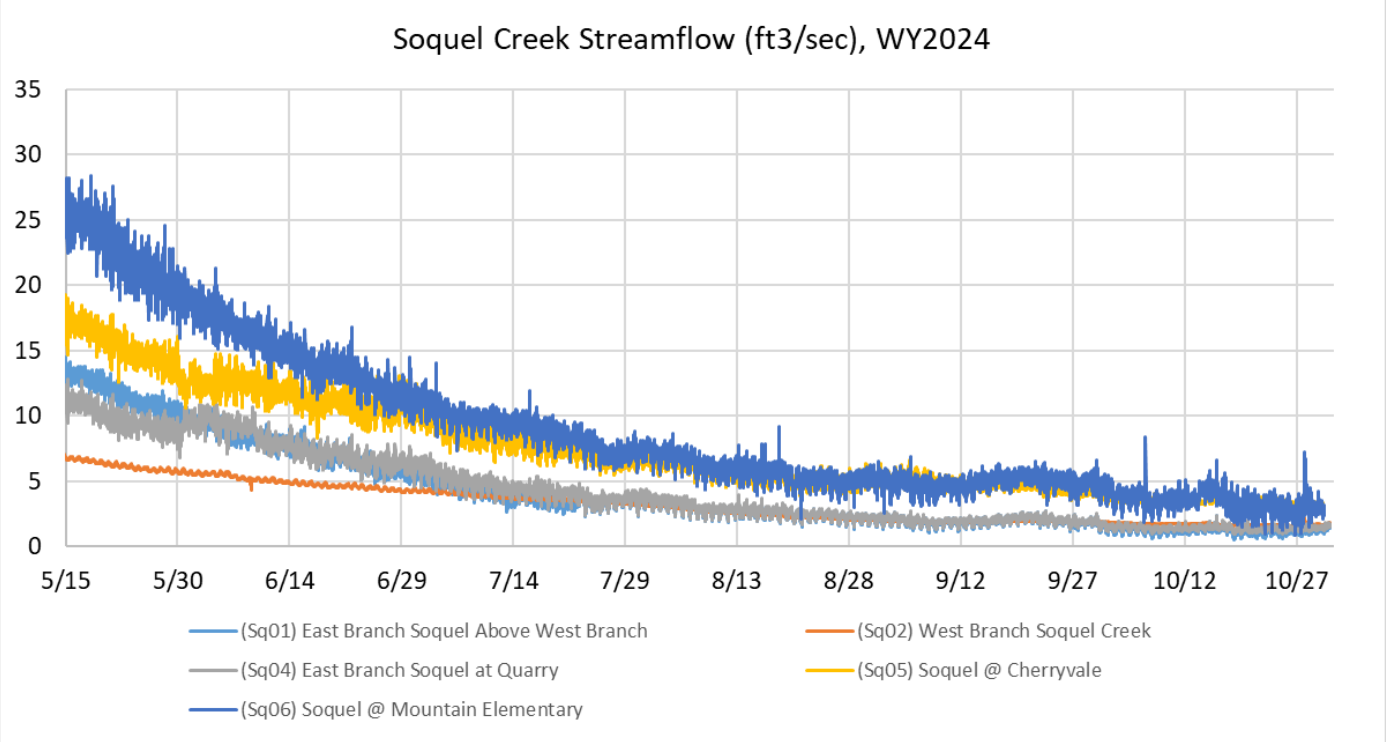

Figure 3. Streamflow conditions in Soquel Creek, at all gage sites in WY2024.

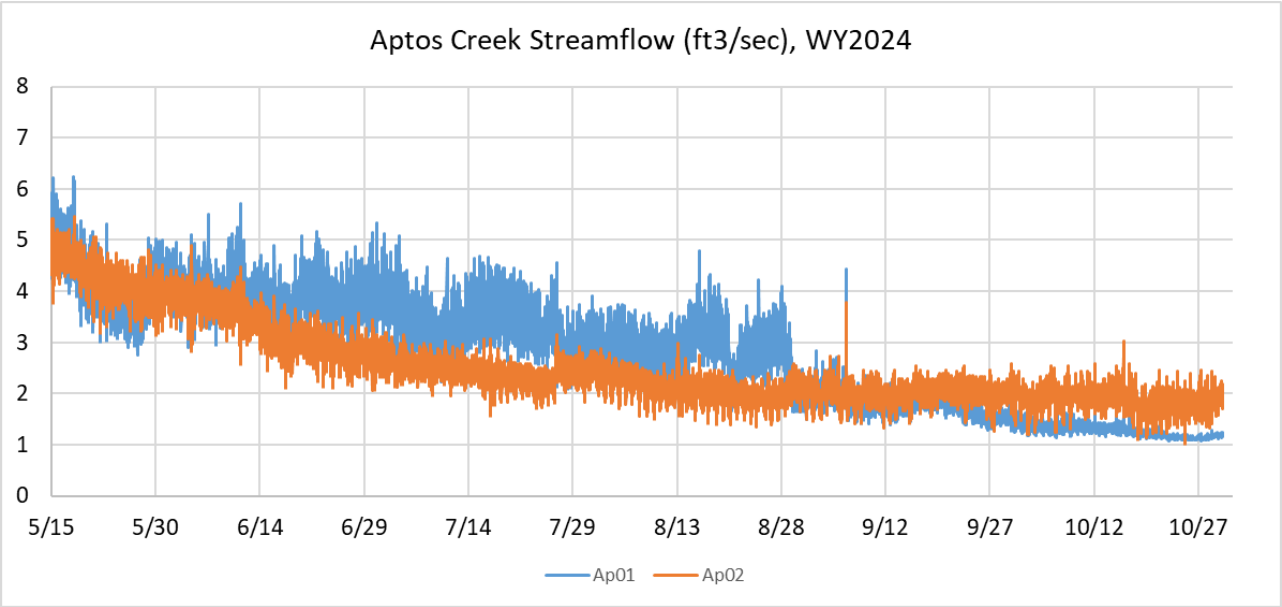

Figure 4. Streamflow conditions at Aptos Creek, WY2024.

Conductivity

Manual field measurements of temperature, actual conductivity and specific conductivity at 25 degrees C were made in July through September of 2024, the results are shown in Table 1. Conductivity is a measure of the ability of water to pass an electrical current. Each body of water has a baseline conductivity that is considered to be its normal range, often dictated by local geology. It can be affected by rain, spring water inputs, minerals, tides and mixing zones and evaporation. The normal range for freshwater streams is between 100 and 2,000 µs/cm (SWRCB 2002). According to the EPA, because dissolved salts and other inorganic chemicals conduct electrical current, conductivity increases as salinity increases.

Comparison of the specific conductivity measurements in Table 1 shows that at each site, conductivity generally increased between July and October as streamflow decreased, and all measurements remained within the normal range for freshwater streams. Specific conductivity at the Aptos sites were similar to each other between sites. The highest conductivities in the Soquel watershed were observed in the upper reaches of the watershed, at the Soquel Creek at the Quarry (Sq04) site and EB Soquel above West Branch site (Sq01), with lower conductivities observed at the further downstream sites (Sq05, Sq06) and at the West Branch site (Sq02)

Site	Date/time	Water Temp (deg C)	Actual Conductivity at Field Temp	Specific Conductivity at 25 deg C (µs/cm)
(Ap01) Village County Park	7/26/2024 11:03	16.1	778	937
	8/29/2024 12:03	16.8	816	968
	9/30/2024 11:15	14.7	773	962
	10/30/2024 11:07	10.8	801	1099
(Ap02) Lower Aptos below Hwy 1	7/26/2024 11:59	16.3	779	934
	8/29/2024 13:09	16.8	825	978
	9/30/2024 12:36	15	774	957
	10/30/2024 12:16	11.1	805	1096
(Sq01) E Branch Soquel Abv W Branch	7/16/2024 9:28	17.1	828	975
	7/25/2024 12:27	19.7	933	1038
	8/30/2024 10:03	16.5	1021	1219
	10/1/2024 10:15	15.4	993	1216
	10/31/2024 11:58	12.1	1044	1385
(Sq02) West Branch Soquel Creek	7/18/2024 11:25	16.2	695	835
	7/25/2024 11:14	18.1	706	813
	8/30/2024 10:52	15.8	797	967
	10/1/2024 10:45	15.1	745	919
	10/31/2024 11:21	11.2	756	1027
(Sq04) East Branch Soquel at Quarry	7/16/2024 10:48	16.5	851	1016
	7/25/2024 9:52	17.5	885	1033
	8/30/2024 8:58	15.81	1074	1303
	9/30/2024 14:15	16.7	1039	1235
	10/31/2024 10:21	11.8	1121	1499
(Sq05) Soquel at Cherryvale	7/16/2024 14:22	17.1	828	975
	7/25/2024 14:16	22.4	822	865
	8/29/2024 14:14	19.8	848	942
	10/1/2024 12:45	17.8	795	922
	10/30/2024 13:32	12.3	814	1075
(Sq06) Soquel at Mountain Elementary	7/16/2024 13:32	20	733	810
	7/25/2024 15:34	23	811	843
	10/1/2024 9:15	15	795	983
	10/30/2024 14:42	12.6	812	1064

Table 1. Temperature, actual conductivity and specific conductivity measurements, Soquel and Aptos Creeks, WY2024.

4. Conclusions

The gage data presented in this report represent a wetter than average year. Rainfall in WY2024 was 36.89 inches, higher than average of 29.9 inches, and the second wet year in a row following WY2023. All of the gage sites monitored remained flowing throughout the dry season, and specific conductivity remained relatively low. Out of the five gages on Soquel Creek, summer baseflows were highest in the lower portions of the watershed and lowest in the upper portions of the watershed. In Aptos Creek, the downstream gage generally had lower flows than the upstream gage. Flow in the lower portion of both watersheds show higher than expected daily fluctuation in streamflow that could not be explained by diurnal variability. Potential causes of the variability include sensor sensitivity limitations and the gages being in higher near-bed velocity gradient pools. This report represents the second full year of data collection at these gages. Streamflow will continue to be monitored and comparison of multiple years of gaging will provide further insights into streamflow dynamics.

References

Rantz, S.E. and others. 1982. Measurement and Computation of Streamflow: Volume 1. Measurement of Stage and Discharge. Geological Survey Water-Supply Paper 2175. Washington, D.C.: GPO.

Resource Conservation District of Santa Cruz County (RCDSCC). 2003. Soquel Creek Watershed Assessment and Enhancement Plan.

Resource Conservation District of Santa Cruz County (RCDSCC). 2019. Soquel Creek Streamflow Assessment Study.

Santa Cruz County Environmental Health Dept. https://scceh.com/NewHome/Programs/WaterResources/FisheriesWatershedManagement/SantaCruzCountyWatersheds.aspx

State Water Resources Control Board (SWRCB), Division of Water Quality. The Clean Water Team Guidance Compendium for Watershed Monitoring and Assessment. FS-3.1.3.0(EC)V2e. July 2002.

Turnipseed, D.P., and Sauer, V.B., 2010, Discharge measurements at gaging stations: U.S. Geological Survey Techniques and Methods Book 3, Chap. A8, 87 p. (Available at http://pubs.usgs.gov/tm/tm3-a8/)

United States Environmental Protection Agency Website. https://www.epa.gov/national-aquatic-resource-surveys/indicators-conductivity.