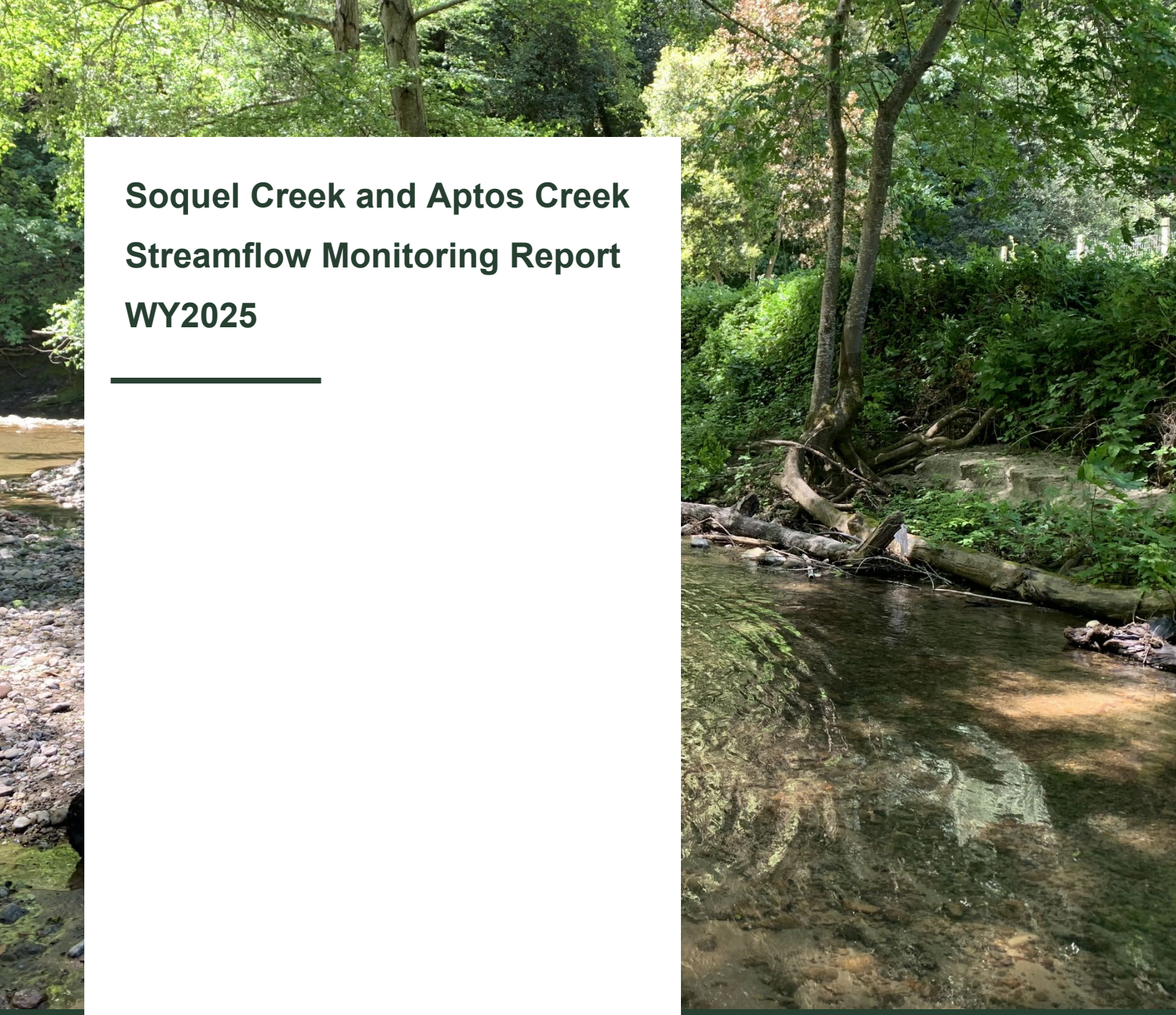

Soquel Creek and Aptos Creek Streamflow Monitoring Report WY2025

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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 WY2025, TU monitored stream conditions at 8 priority locations in the Basin. This report provides the results of the third 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 1995 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 30-year average annual rainfall here is 29.8 inches. Rainfall in WY2025 was 18.53 inches, below the long-term average, following two consecutive years of above average rainfall.

The three years of gaging summarized in this report, WY2023 – WY2025, represent a wide range of water year types in terms of the overall amount of precipitation received. In WY2023, the first year of this study, 51.09 inches of precipitation was recorded at the DeLaveaga gage, well above average, and the first wet year following three years of drought. In WY2024, 36.89 inches of rain was recorded, less than WY2023 but still above average. At 18.53 inches of precipitation, WY2025 was the driest year of the study, and the only-below average year of the study.

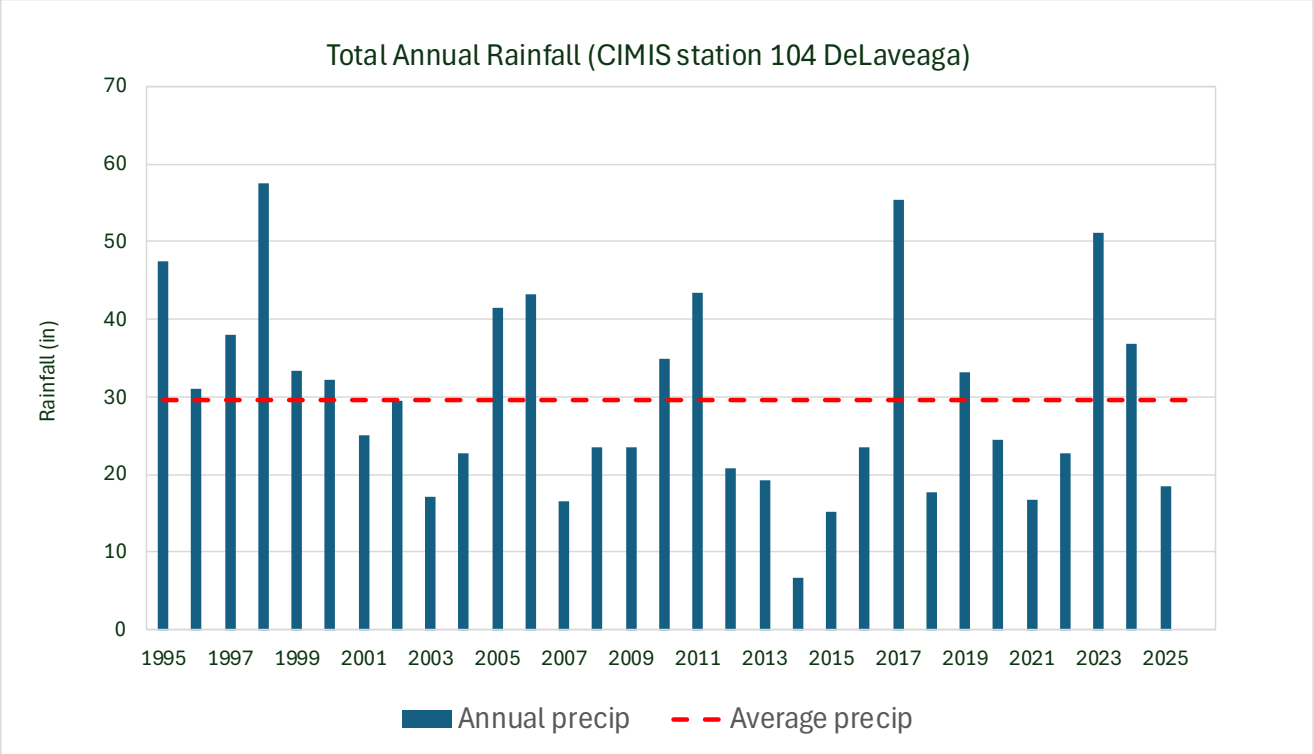

Figure 1. Annual precipitation (inches) for 30 years (WY1995 – WY2025), collected at CIMIS station 104 (DeLaveaga). The red dashed line represents the 30-year average annual rainfall (29.8 in) collected at the station.

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. Two of the 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. An additional Aptos Creek gage (Ap03) was installed in 2025, upstream of the original gages, within Nisene Marks State Park (Figure 2) While this site is not funded as part of this study or included in the long-term MGA stream monitoring, data is included for reference.

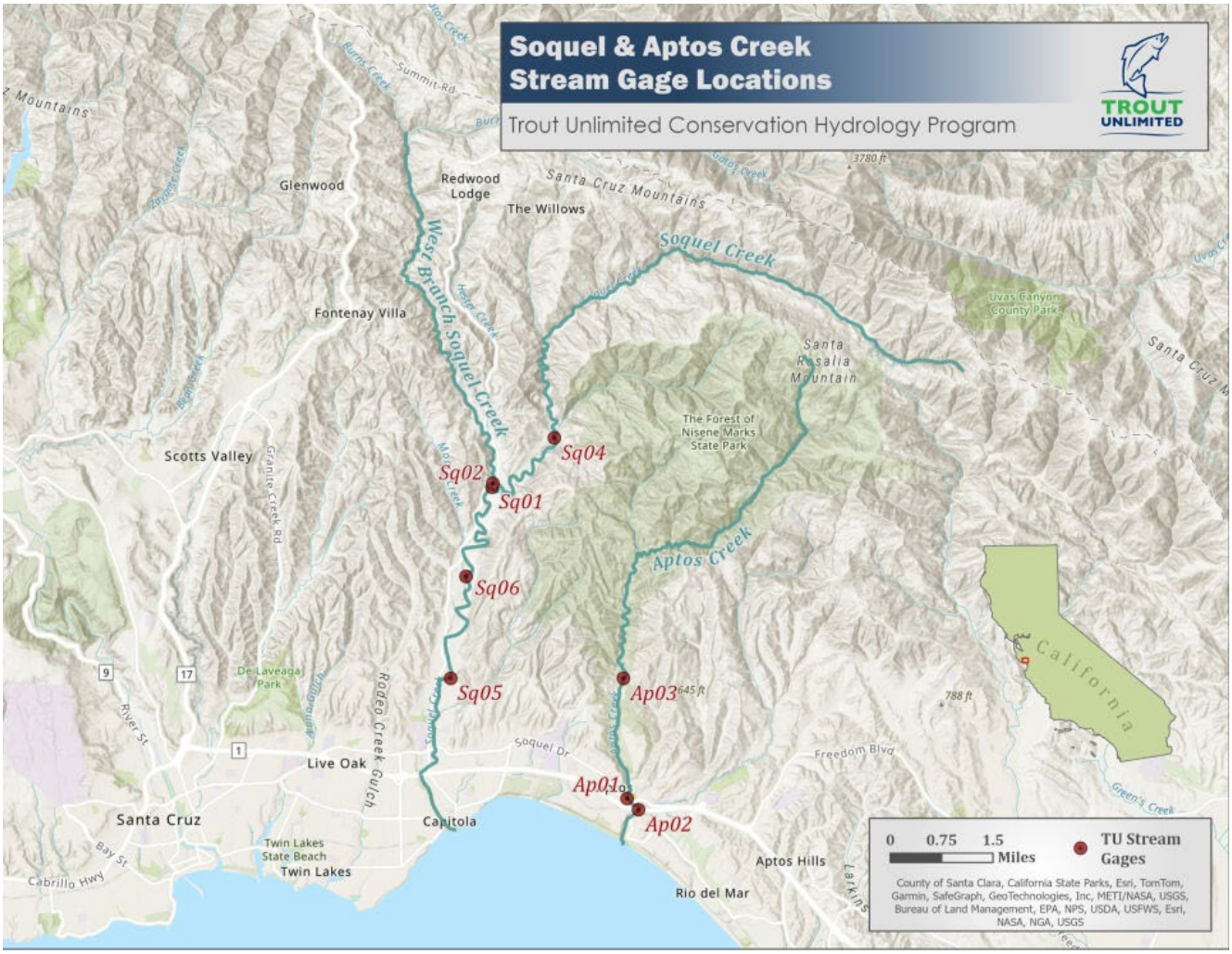

Figure 2. Location of Soquel Creek and Aptos Creek streamflow gages.

3. WY2025 Streamflow and Conductivity Conditions

Streamflow

TU began seasonal monitoring at the gage network in May of 2025. 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 2025. As seen in previous years of monitoring, in early May, streamflow was highest at the sites in the lower portion of the watershed (Sq06, Soquel at Mountain Elementary, and Sq05, Soquel at Cherryvale, both at ~13 cubic feet per second (ft^3/sec). Flows in the upper portions of the watershed were lower; flows at Sq01 (East Branch Soquel above West Branch) and Sq04 (Soquel Creek at the Quarry), had lower flows of approximately 6 ft^3/sec. Flows at the West Branch gage (Sq02) were the lowest of all sites, at about 4 ft^3/sec in early May. Flows at all sites receded quickly from May through July, reaching baseflow in early August through September. In October, flows began to rise again due to early fall rainfall events. 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 three Aptos Creek gages from early May through October 2025. Because of its smaller watershed size, flows are overall 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 3.4 and 2.5 ft^3/sec, respectively. These gages are low in the watershed, and similar to the gages in lower Soquel Creek, show high variability and daily fluctuations. On the date of installation of Ap01 and Ap02 (May 9, 2025), flows are similar at the upstream Ap03 site, at about 2.9 ft^3/sec. Unlike the downstream sites, Ap03 shows few daily variations. The relationship between gaining and losing between these three sites is not straightforward, and fluctuation between upstream to downstream losses and gains at various times through the season. However, these overall gains and losses are small, as flows at each site are generally similar to each other through the season. The lowest daily average flows observed at the sites hover just above 1 ft^3/sec in late September, before rising again due to fall storms.

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.

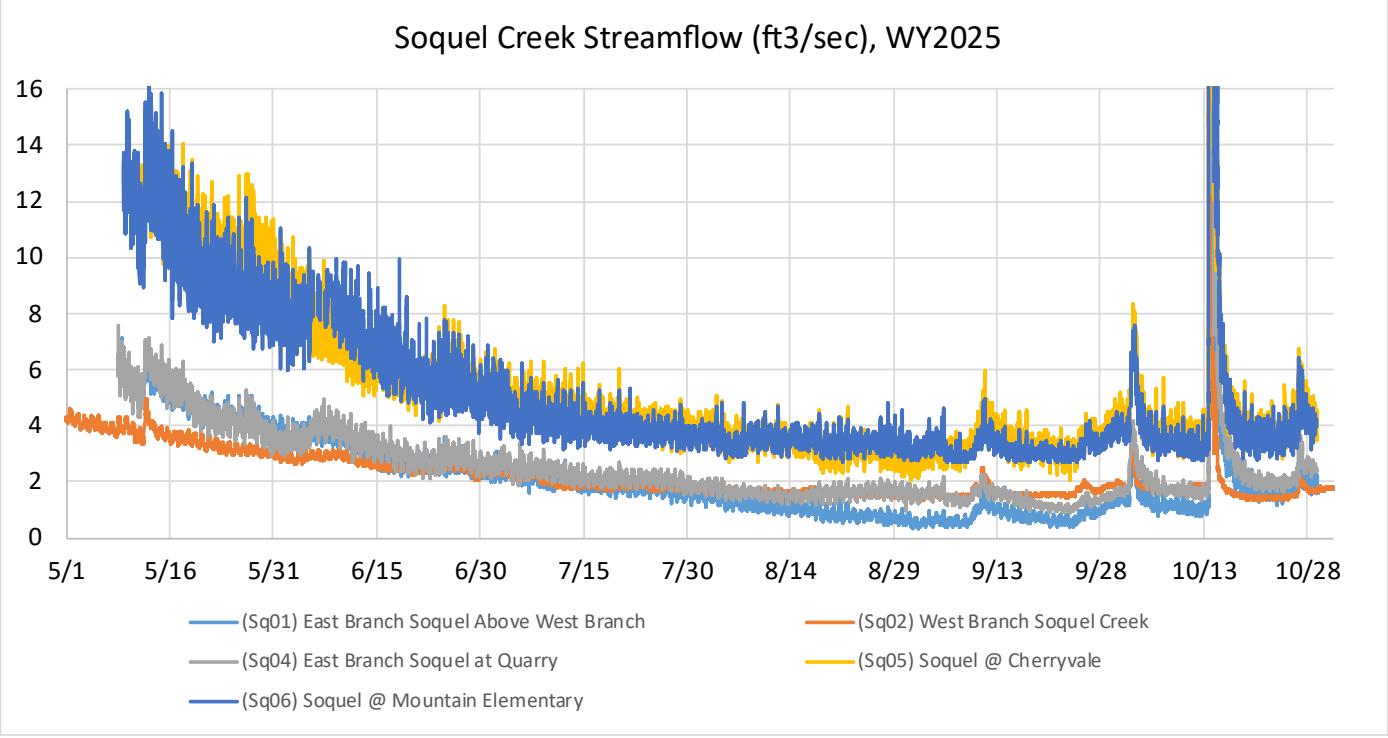

Figure 3. Streamflow conditions in Soquel Creek, at all gage sites in WY2025.

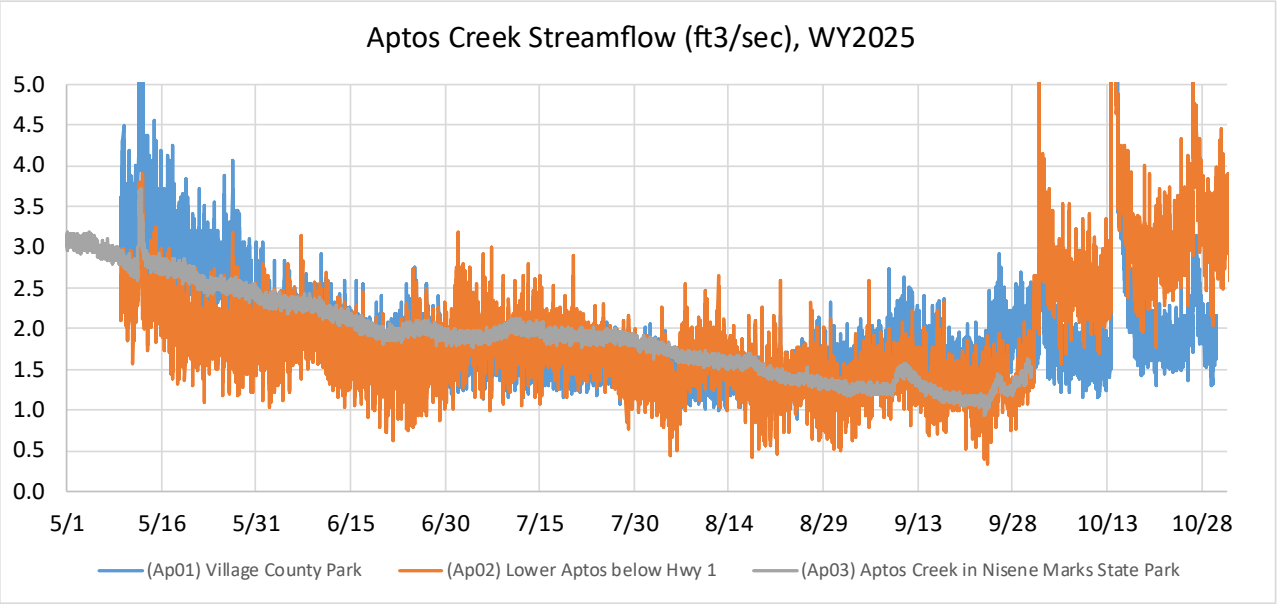

Figure 4. Streamflow conditions at Aptos Creek, WY2025.

Conductivity

Manual field measurements of temperature, actual conductivity and specific conductivity at 25 degrees C were made in May through November of 2025, 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 spring and fall 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. 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 (µs/cm)	Specific Conductivity at 25 deg C (µs/cm)
(Ap01) Village County Park	6/4/2025 11:35	14.8	736	914
	7/1/2025 10:53	15	765	946
	8/6/2025 11:42	16.2	794	954
	9/4/2025 10:49	16.5	820	979
	10/1/2025 9:27	17.8	771	894
	11/6/2025 10:54	13.7	737	940
(Ap02) Lower Aptos below Hwy 1	5/9/2025 11:13	13.9	697	885
	6/4/2025 12:37	15.5	736	899
	7/1/2025 11:53	15.1	765	943
	8/6/2025 12:46	16.9	795	941
	9/4/2025 11:41	16.7	818	972
	10/1/2025 10:11	18.4	759	868
	11/6/2025 11:43	13.8	739	940
(Sq01) E Branch Soquel Abv W Branch	5/8/2025 15:54	17.8	729	845
	6/4/2025 14:14	18.1	813	936
	7/1/2025 14:54	19.2	904	1017
	8/6/2025 15:58	19.8	999	1109
	9/5/2025 11:54	18	1066	1231
	11/6/2025 15:08	15	936	1157
(Sq02) West Branch Soquel Creek	5/8/2025 14:03	15.7	699	850
	6/4/2025 15:15	17.4	725	848
	7/1/2025 13:59	18.5	742	847
	8/6/2025 15:04	19.7	750	834
	9/5/2025 11:15	16.9	760	899
(Sq04) East Branch Soquel at Quarry	5/8/2025 13:11	13.7	734	936
	6/5/2025 9:41	15.2	835	1027
	7/2/2025 10:25	16.1	952	1147
	8/7/2025 12:13	17	1069	1262
	9/5/2025 9:54	16.8	1174	1392
	10/2/2025 13:22	18.4	1100	1259
	11/7/2025 12:10	13.3	972	1252
(Sq05) Soquel at Cherryvale	5/9/2025 8:14	14.8	707	878
	6/5/2025 12:40	16.4	750	897
	7/2/2025 9:19	16.7	779	926
	8/7/2025 10:30	17.6	795	926
	11/7/2025 10:54	13.5	814	1043
(Sq06) Soquel at Mountain Elementary	5/9/2025 8:45	13.9	699	887
	6/5/2025 10:46	15.6	747	910
	7/2/2025 11:24	16.8	772	915
	8/7/2025 13:29	19.1	787	887
	9/5/2025 13:06	19	778	879
	11/7/2025 13:19	14.1	811	1024

Table 1. Temperature, actual conductivity and specific conductivity measurements, Soquel and Aptos Creeks, WY2025.

4. Comparison of Hydrologic Conditions, WY2023 – WY2025

Figures 5-9, below, show daily average summer streamflow at the Soquel Creek sites from WY2023 – WY2025. Note that site Sq02 was not monitored in WY2023. Plots are presented in order of highest site in the watershed to the lowest (Sq04, Sq02, Sq01, Sq06, and Sq05). As discussed in Section 2 of this report, WY2023 was the wettest year of the study with well above-average rainfall, WY2024 was drier than WY2023 but still above average, and WY2025 was the driest year of the study, with well below-average rainfall. This is reflected in the streamflow recorded at the monitoring sites. In general, streamflows were highest in WY2023, slightly

lower in WY2024, and lowest in WY2025. The differences between years is highest at the beginning of the monitoring season (May-June) and by September into November, the difference is smaller as baseflow is reached and early autumn storms start to raise flow again. These patterns were also observed at the Aptos Creek sites (Figures 10-11).

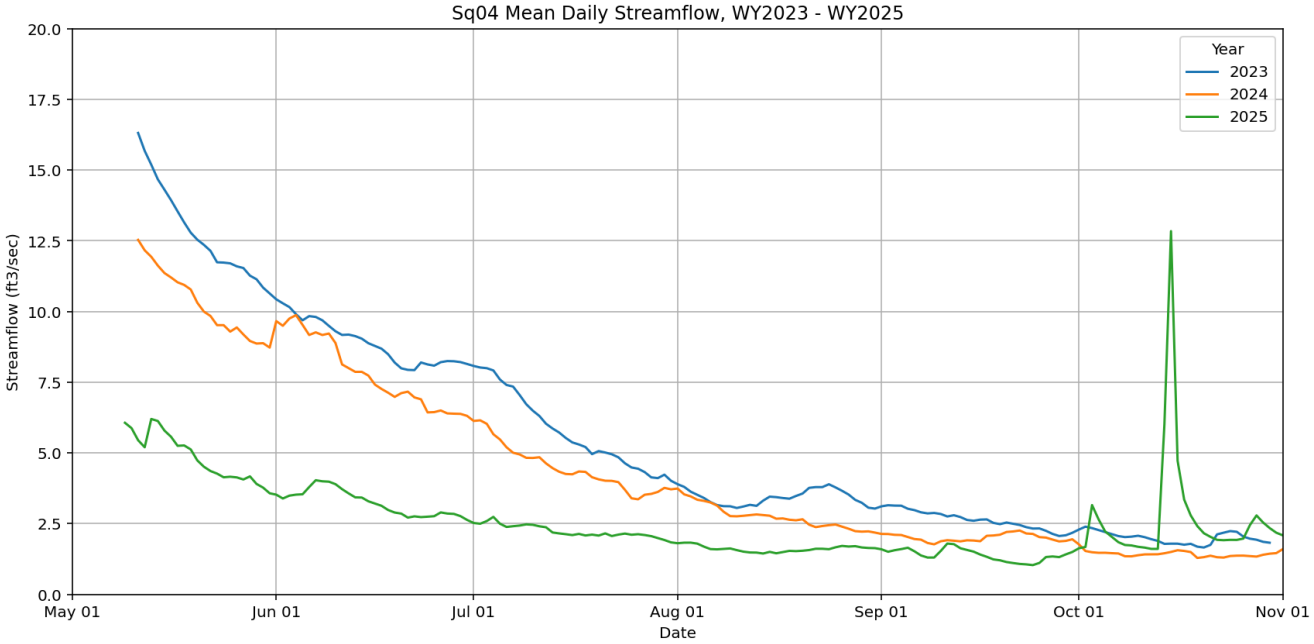

Figure 5. Sq04 summer streamflow, WY2023 – WY2025.

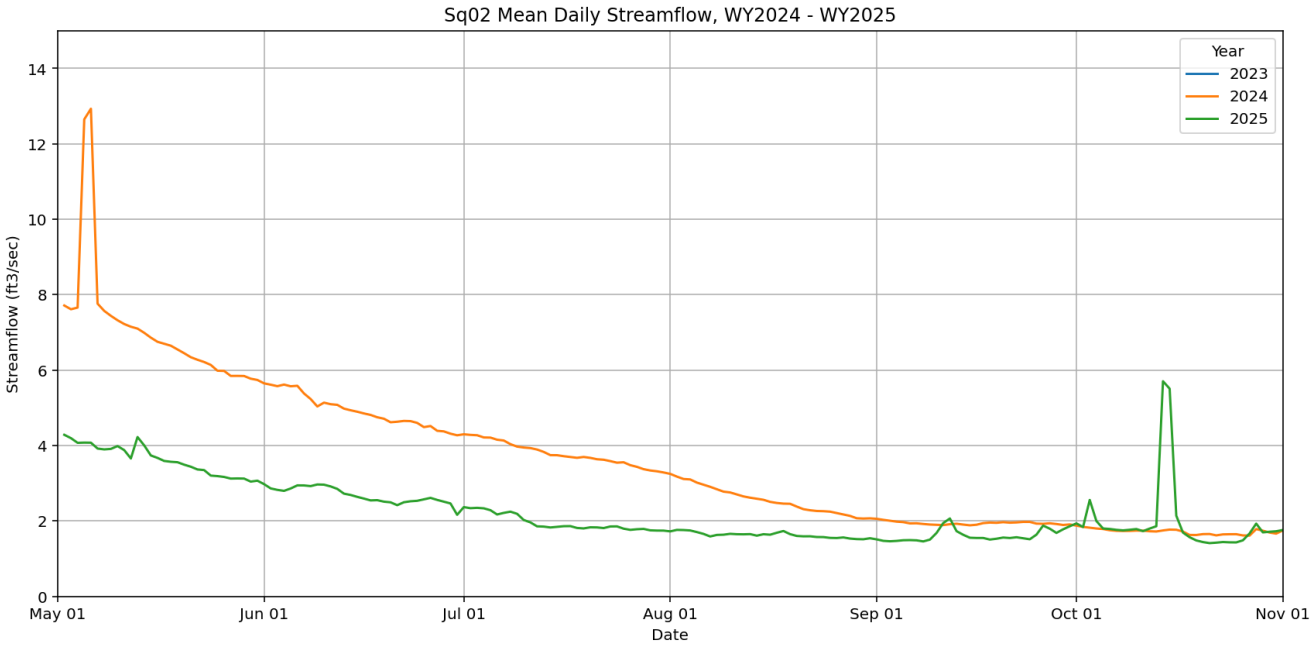

Figure 6. Sq02 summer streamflow, WY2024 – WY2025.

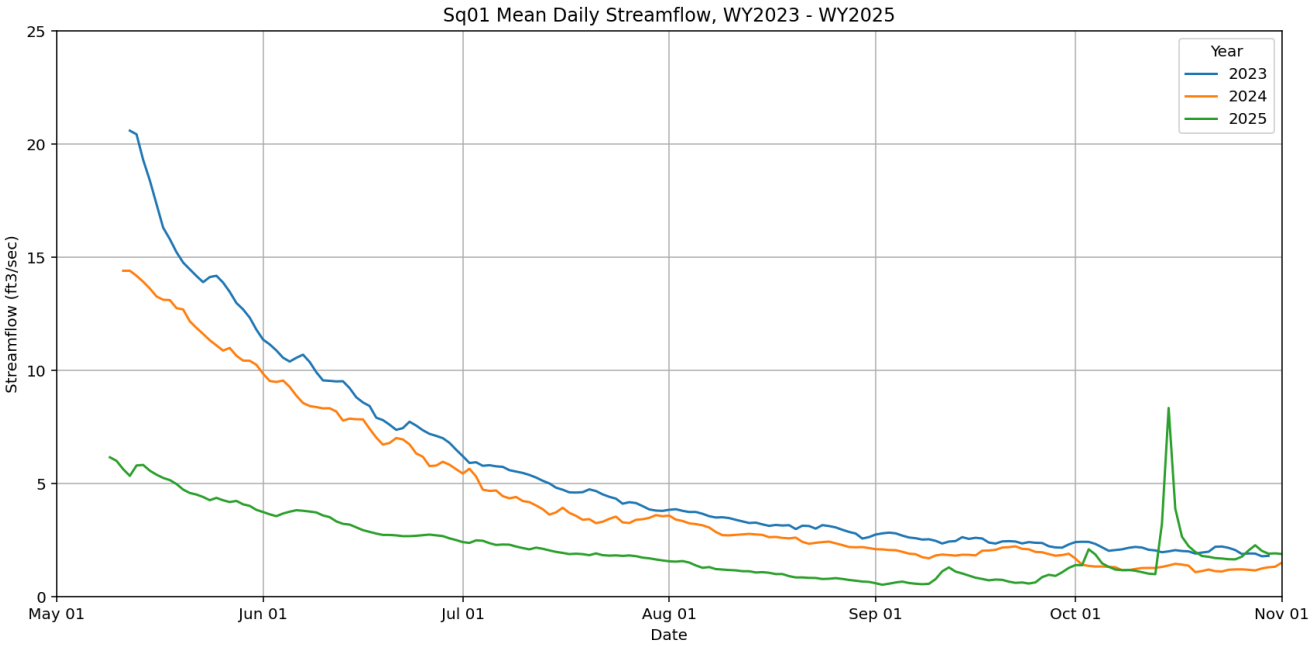

Figure 7. Sq01 summer streamflow, WY2023 – WY2025.

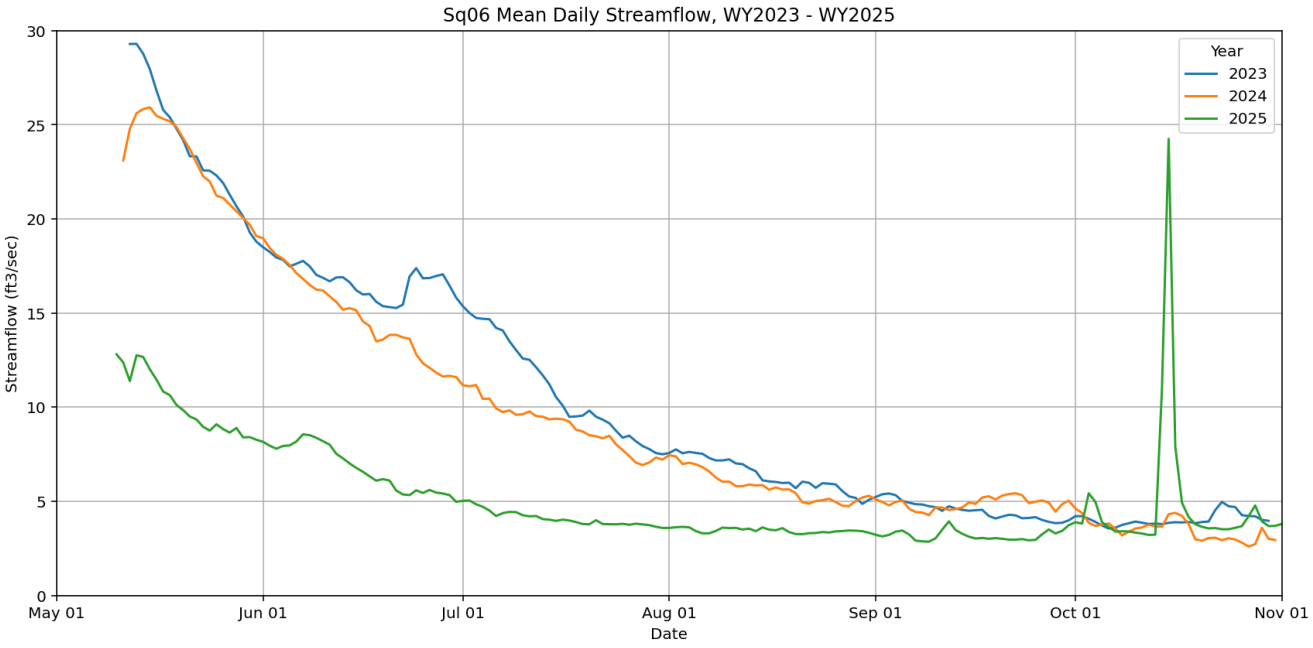

Figure 8. Sq06 summer streamflow, WY2023 – WY2025.

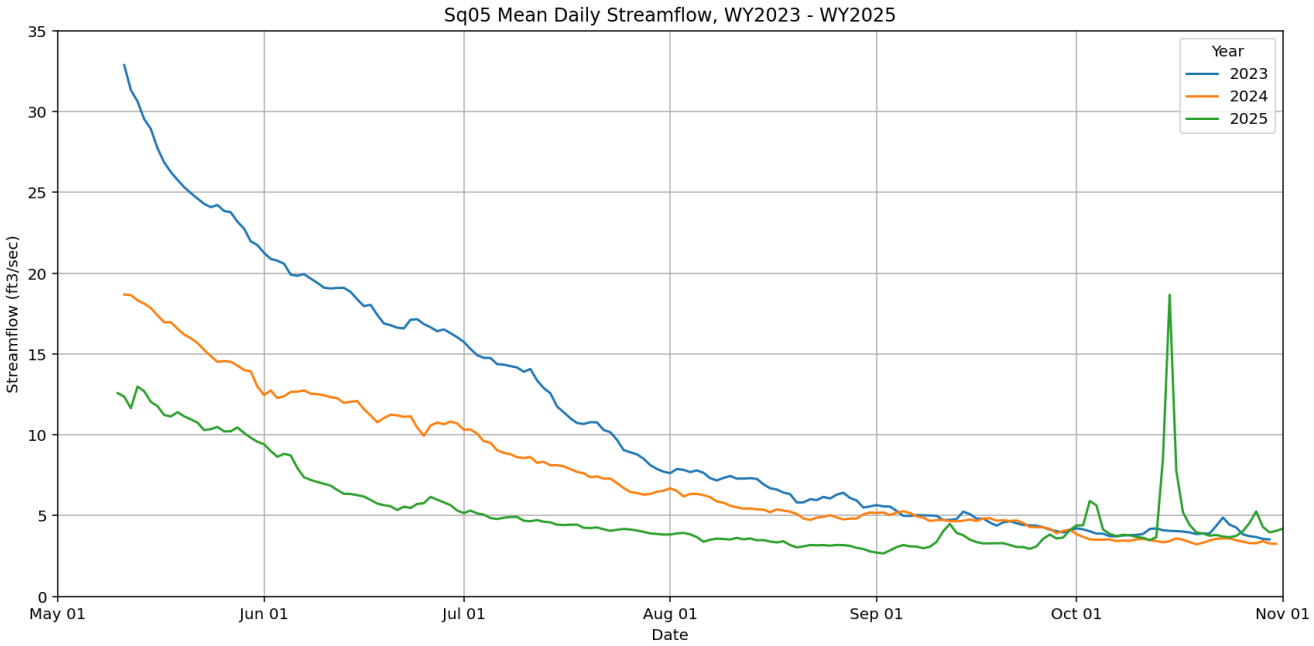

Figure 9. Sq05 summer streamflow, WY2023 – WY2025.

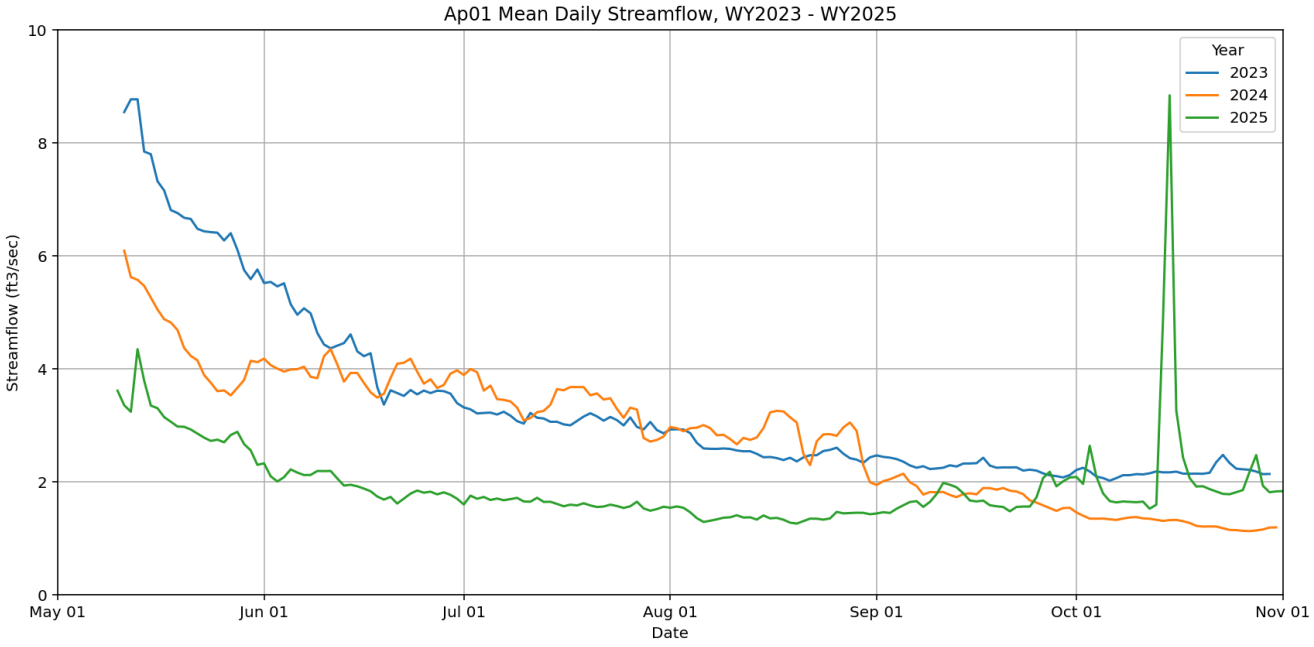

Figure 10. Ap01 summer streamflow, WY2023 – WY2025.

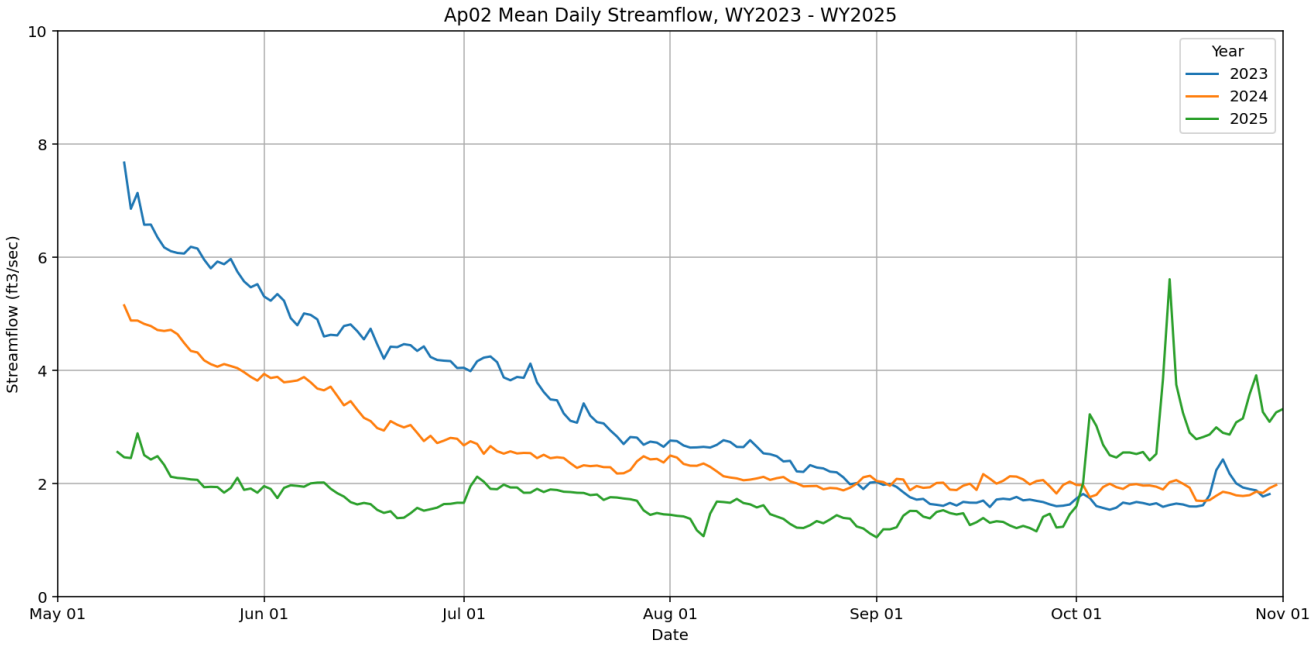

Figure 11. Ap02 summer streamflow, WY2023 – WY2025.

Figure 12 shows manual measurements of specific conductivity at 25 degrees C for Soquel Creek sites for WYs 2023 – 2025. Measurements were limited in WY2023, and tool place in August and September. Measurements in WY2024 were conducted in July through October, and WY2025 measurements took place from May through November. All measurements were within the normal range for freshwater streams. Conductivity generally increased through the dry season as streamflow decreased. While the overall variation in conductivity between years was not notable, the highest conductivities were measured in late October WY2024, at the more upstream sites (Sq04 and Sq04). In general, these sites had higher conductivity than the downstream sites.

Figure 13 shows manual measurements of specific conductivity at 25 degrees C for Aptos Creek sites for WYs 2023 – 2025, for the same range of dates as taken at the Soquel sites. Here too, all measurements were within the normal range for freshwater streams. Conductivity generally increased through the dry season as streamflow decreased. While overall conductivity varied only slightly between water years, the highest conductivity was recorded in late October of WY2024. The Aptos Creek sites are close to each other geographically, and showed little variation between sites.

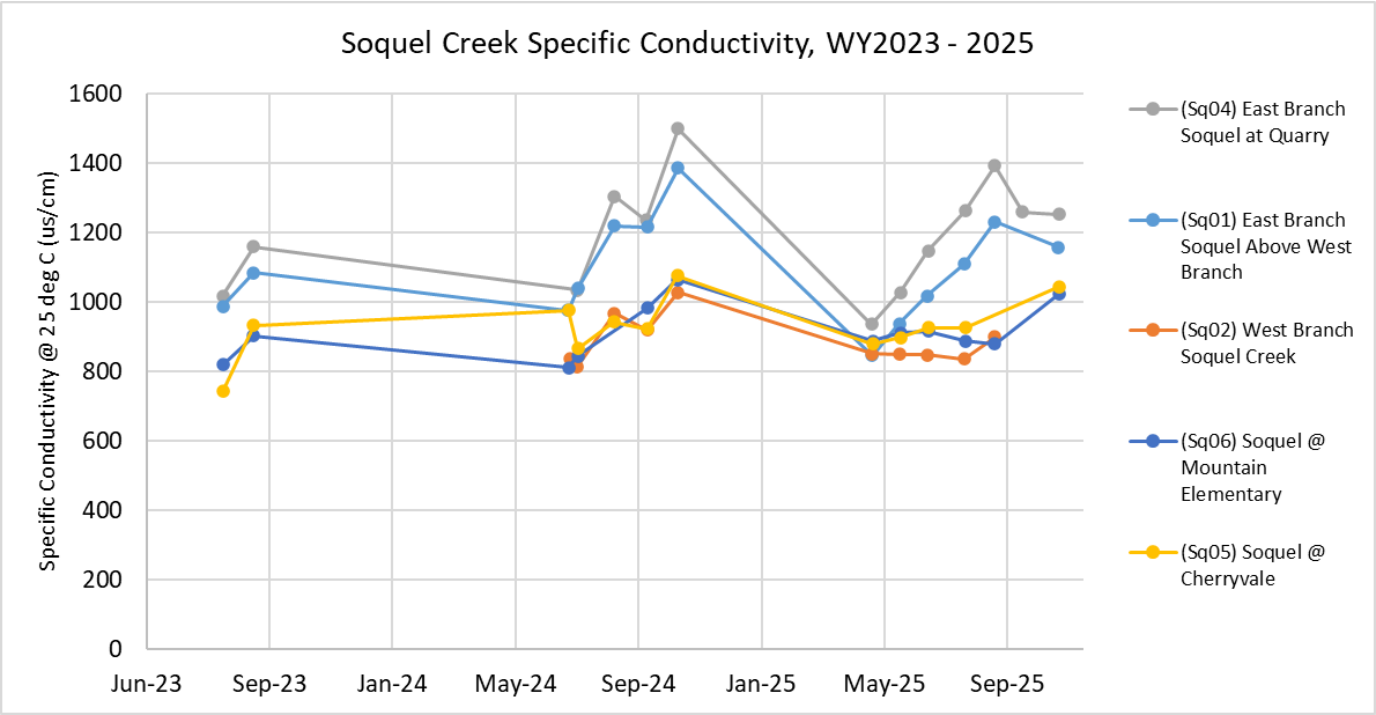

Figure 12. Soquel Creek specific conductivity measurements, WY2023 – WY2025.

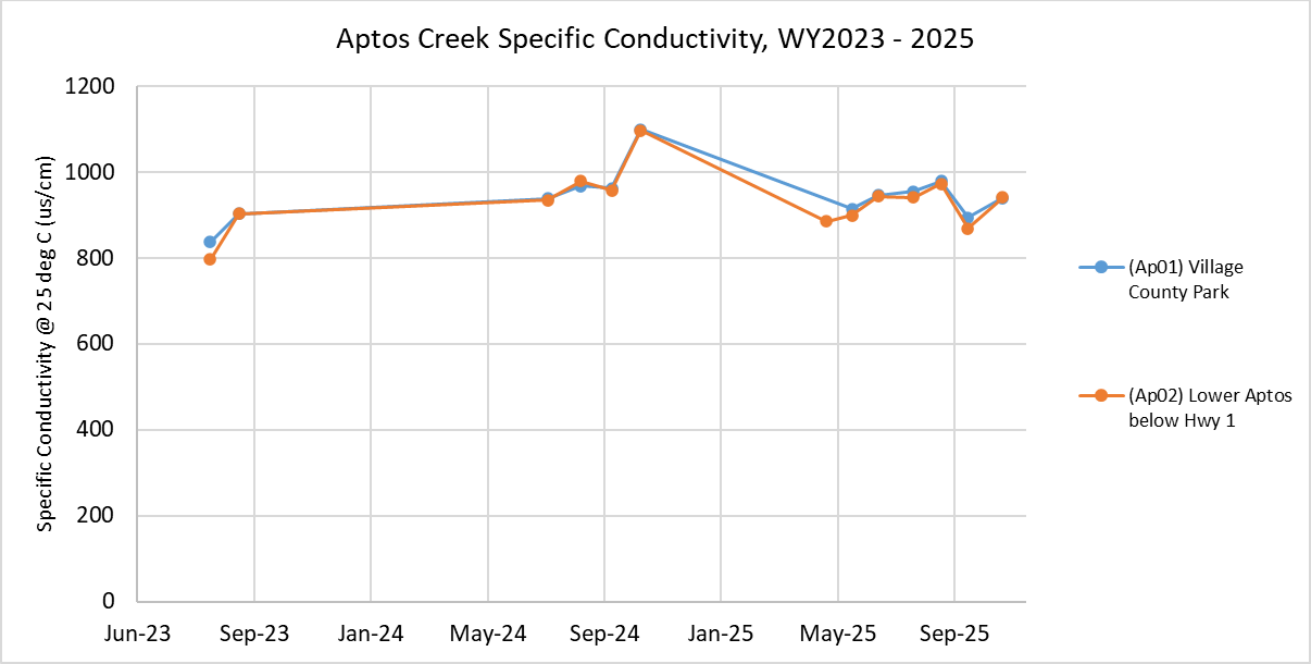

Figure 13. Aptos Creek specific conductivity measurements, WY2023 – WY2025.

5. Conclusions

This report represents the third full year of streamflow and conductivity data collection at the Soquel and Aptos creeks MGA long-term monitoring sites. The gage data presented in this report represent a drier than average year. Rainfall in WY2025 was 18.53 inches, lower than average of 29.8 inches, and the first dry year of the study, following two above-average water years in 2023 and 2024. 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, flows were similar upstream and downstream. 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.

Streamflow and conductivity were also compared between the three years of monitoring (WY2023 – WY2025). In general, the amount of recorded streamflow reflected the amount of precipitation received. Flows were highest in WY2023, slightly lower in WY2024, and lowest in WY2025. The differences between each year is highest at the beginning of the monitoring season (May-June), but when baseflow is reached in late autumn, the difference in flow between water years is minimal. All sites remained connected in all water years.

All conductivity measurements taken between WY2023 and WY2025 were within the normal range for freshwater streams. Conductivity generally increased through the dry season as streamflow decreased. While the overall variation in conductivity between years was not notable, the highest conductivities were measured in late October WY2024. In Soquel Creek, conductivity was generally highest at the upstream sites (Sq04 and Sq04), while downstream Soquel sites and Aptos Creek sites were similar to each other.

Streamflow and conductivity will continue to be monitored in WY2026; additional years of gaging data will provide further insights into streamflow dynamics.

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