Depletion of Critical Streams

The Critical Streams Table, included in the Resource Protection Policy, was developed to estimate the allowable depletion of dry season streamflow without causing significant adverse impacts on stream-related public trust resources. It considers the value of existing resources and the extent of current flow depletion due to surface diversions and groundwater extraction. The table is based on best available information and professional judgment but can be refined as more information becomes available or information is developed for stream locations not listed in the table.

Resource Value and Allowable Depletion

The amount of additional allowable depletion is based on the amount of depletion that is already occurring and the resource value of the stream and the fish resources in that stream. Mapped information from the Coho Salmon Recovery Plan (2012), the South Central California Steelhead Recovery Plan (2013), and the Coastal Multispecies Plan for Central Coast Steelhead (2016) were consulted to identify the resource value of specific streams, with some adjustments made based on more current information regarding occurrence of coho or lack thereof.

Allowable Additional Cumulative Flow Depletion

	Amount of Current Depletion			
	>20%	10-20%	5-10%	<=5%
Resource Value				
Coho Core-1	1%	1%	5%	10%
Coho Recovery-2	1%	5%	5%	10%
Steelhead high intrinsic=3	1%	5%	5%	10%
Steelhead/Other Fish-4	1%	5%	10%	15%

The current resource value, streamflow conditions, estimated amount of current depletion, and the allowable additional depletion for specific streams are shown in the following table. The amount of unimpaired flow was generally derived from the Natural Flows Database, except in cases where those estimates were clearly inaccurate based on local knowledge and historical streamflow measurements. In that case, a locally derive estimate of unimpaired flow was used which took into account both measured dry season flows and knowledge of the amount of depletion currently occurring as a result of surface diversions and groundwater extractions. Local estimates of unimpaired flow are based on adding the estimated depletion to the amount of observed dry season flow. Sources of data and methodology applied to estimates for specific streams are indicated in the table and are described in more detail following the table.

Additional streams or specific reaches that need to be addressed will be added using a similar methodology. Estimates will also be updated as new information becomes available.

Flow Estimates and Allowable Depletion for Specific Streams:

Stream	Resource Value	All years 10th Percentile Dry Season Unimpaired Flow - NFD	Local Estimates of Dry Seaon Unimpaired Flow	All Years 10th Percentile Dry Seas. Observed Flow	Data Sources Observed Flow, Local Estimates	Current Estimated Depletion	Data Sources Estimated Depletion	Allowed Additional Depletion *	Allowed Depletion cfs*
Lower Soquel @USGS	2	2.44		0.84	A	65%	B,G,H,G	1%	0.008
E. Branch Soquel @ W. Branch	1	1.23	0.25	0.1	B,D,E,G	60%	B,D,E,G	1%	0.001
W. Branch Soquel @ E. Branch	2	0.63	0.95	0.81	B,D,E,F	15%	B,D,E,F	5%	0.041
Moore's Gulch	4	0.05	0.2	0.15	E,F	17%	E,I	5%	0.008
Other Soquel Tribs	4					10-20%	E	5%	
Aptos ab Valencia	2	0.46	0.7	0.66	D,E,G	<=5%	D,E	10%	0.046
Valencia	4	0.11		0.02	D,E,G	82%	D,E	1%	0.001
Upper Corraltios	4	0.63		0.3	D, E	50%	D,E	1%	0.006
Browns Valley Cr.	4	0.22		0.2	D, E	>20%	D,E	1%	0.002
SLR @ Big Trees (Felton, mainstem)	2	15.2		12	A,C,G,H	30%	C,D,E,G,H	1%	0.120
Branciforte	2	0.34	0.66	0.5	C,D,E,F	25%	C,D,E	1%	0.003
Bean	1	0.5	2.8	2.3	C,D,F,G	21%	C,F,G,H	1%	0.023
Zayente ab Bean	1	1.19	1.65	1.53	A,D,E,G,H	5-10%	C,D,E,G	5%	0.077
Bear	2	1.12	0.66	0.63	C,D,E,F	<=5%	C,D,E	10%	0.063
Kings	2	0.58	0.25	0.2	A,C,E,F	<=5%	C,E	10%	0.058
Boulder Creek	3	0.89	1.4	1.1	A,C,D,E,F	25%	C,D,E	1%	0.011
SLR Other Tribs	4				C,E	5-10%	C,E	10%	
Laguna	1	0.5	1.1	0.9	A,E,G	>10%	E,F,G	1%	0.009
Majors	2	0.22	0.9	0.71	A,E,G	>10%	E,F,G	5%	0.036
San Vicente	1	0.85			A	>10%	E	1%	0.009
Scott	1	1.99			A	>10%	E	1%	0.020
Other County Streams	4				E	5-10%	E	10%	

Notes:

* Allowed depletion for Tiers 1-3. Additional Analysis would be required for Tier 4.

Data Sources (See Notes for more information)

A-California Natural Flows Database

B-RCDSCC-TU surface diversion info

C- San lorenzo River Watershed Plan

D-JSSH September Flow Summary-cbec

E - Judgement and observations

F-Flow Measurements

G-Gage data, current

H-Numerical Basin Model

I - Calculated Water Budget

Streamflow Data Sources:

- NFD (2024): The California Natural Flows Database was established to model estimated unimpaired flow characteristics on individual stream reaches throughout the state. It uses the record from nearby unaltered reference gages to estimate flows on ungaged streams and to calculate statistics for the gaged streams. While many statistics are available, the analysis for Santa Cruz County has primarily made use of the 10th percentile dry season baseflow for all years as that can also be readily compared to the statistic for observed flows. In many cases the NFD overestimates or

underestimates flows for many streams, likely due to the fact that it may not take into account underlying geology which can have a significant effect on dry season baseflow. *California Environmental Flows Working Group (CEFWG). California Natural Flows Database: Functional flow metrics v1.2.1, May 2021*. https://rivers.codefornature.org/ *(1/14/24)*

- RCDSCC/TU (2019): The Resource Conservation District of Santa Cruz County contracted with Trout Unlimited to conduct the Soquel Creek Streamflow Assessment Study, which included dry season gaging at 4 locations for 2017-2022 and assessment of basin water use and likely impacts of surface diversions. *Resource Conservation District of Santa Cruz County. December 2019. Soquel Creek Streamflow Assessment Study, with Trout Unlimited*.

- SLRWMP (1979): The San Lorenzo River Watershed Management Plan Hydrology Technical Section includes estimates of monthly flow frequency statistics for major tributaries based on USGS monthly flow measurements in 1973-76 as related to gaged stations, including flow statistics for the 10th percentile flow for each month at each location. The September 80% exceedance flow at Big Trees is comparable to the observed 10th percentile observed dry season flow for all years in the NFD. The September 80% exceedance flow is utilized as the observed flow for the ungauged tributaries unless more recent information is available. The document also includes estimates of the impact of stream diversions based on observed diversions, water rights records and actual diversion records. This provides an upper estimate of the impact of diversions since the actual number of stream diversions has been significantly reduced since that time. *County of Santa Cruz, San Lorenzo River Watershed Management Plan Hydrology Technical Section, 1979*.

- JSSH September Flow Summary, 2024: The County and partner agencies have conducted the Juvenile Steelhead and Stream Habitat (JSSH) Monitoring program in 1981, 1988, 1997 and annually from 2002- present. It includes monitoring of juvenile steelhead populations and various parameters in stream reaches throughout much of the county. This program has included flow measurements, but in order to more consistently characterize flow in relation to observed populations, it was determined that flow should be characterized for June and September of each year. A local consultant, cbec Inc., was commissioned to utilize historical flow measurements to develop a linear relationship to one of two gaged streams, either San Lorenzo at Big Tress or Soquel at Soquel, separately for each of those months. These relationships are typically based on 8-20 instantaneous flow measurements at the specific location during each period of high baseflow (June) and low baseflow (September). For many

ungaged streams, flow estimates were based on the JSSH September flow estimates for the years that the reference stations had mean September flows comparable to the 10th percentile dry season observed flow for those stations in the NFD. It is believed that in many cases the JSSH estimates are more accurate than the estimates in the NFD.

- Flow Measurements and Gage Data: Since 1975, Santa Cruz County staff have made over 3000 individual flow measurements during the dry season (June-October) at 170 locations in the county. Most of these are at regular water quality sampling stations, with 6-60 dry season measurements at each location. This data is used to check and adjust values estimated by the Natural Flows Database, also utilizing local knowledge of the conditions in the watershed and best professional judgement. In addition to ongoing periodic discharge measurements, there are numerous continuous stream gages measuring low flows that are maintained by the USGS and local agencies, including 3 on North Coast streams, 8 in the San Lorenzo Watershed, 7 on mid-county streams, and 5 in the Pajaro watershed in Santa Cruz County. The City of Santa Cruz maintains gages on the north coast streams and Newell Creek, and conducts periodic flow measurements on Branciforte and Pogonip Creeks.

- Numeric Groundwater Models: Groundwater models have been developed and utilized for each of the three groundwater basins subject to management under SGMA. These models simulate both groundwater conditions and interactions with surface water and have been used to estimate impacts on streamflow of basin-wide groundwater extraction. The geology of the areas of the County outside of the SGMA basins are not suitable for developing numeric models.

Notes on Specific Streams

Soquel Creek:

Soquel Creek and all its tributaries have been determined by the State Water Resources Control Board to be fully appropriated in the dry season. The State Board completed an adjudication of surface water rights in 1977, which did not recognize any new riparian rights beyond those specified in the adjudication. Stream surveys by County staff in 2013 indicated that only about 25% of the permitted diversions from lower Soquel Creek were active. A number of studies have been conducted over the years to assess the impact of groundwater pumping on streamflow but have not conclusively established a measurable impact. There are many factors affecting flow, including upstream watershed contribution, surface diversions, riparian evapotranspiration and streambed aggradation. Soquel Creek had 0 flow at the USGS gage in 1977, 1988, 1992 and 1994, but has not experienced 0 flow since. Numeric groundwater modelling for the Mid-County basin GSP suggested that the potential surface water depletion in Soquel Creek from groundwater pumping could be as much as 1.4 cfs, or 57% of the estimated NFD 10 percentile unimpaired dry season flow

(2.44 cfs). This depletion is primarily a result of cumulative impacts of municipal pumping, with the groundwater level observed to be drawn down below the stream level at times in the lower reaches of Soquel Creek and measured losses in flow from upstream to downstream during dry periods. Modelling indicated that eliminating all the inland non-municipal pumping would only increase flow by 0.1 cfs. Eliminating all non-municipal pumping in Soquel Valley and Bates Creek valley would increase Soquel flow by 0.15 cfs. Rural non-municipal pumping is thus only reducing 10 percentile dry season flow by 6%. Surface diversions are estimated to account for another reduction of 0.2 cfs, or 8%.

East Branch of Soquel Creek

The NFD estimate of unimpaired flow seems to be a significant overestimate as compared to observed flow on the East Branch and the estimated flow on the West Branch. The East Branch is subject to some direct surface diversions upstream as well as groundwater extraction in the lower reach from a quarry and de minimis uses. The dry season flow is reduced in the lower reach and has been observed to go dry in some years. cbec Inc. (a local hydrology firm) estimated the flow to be 0 at the lower reach of the east branch during the 10th percentile dry years at the USGS gage on Soquel Creek (2014 and 2021). The East Branch has been gaged upstream near the quarry and at the confluence with the West Branch since 2017. It did not go dry, but the low flow in 2021 was 0.1 cfs. The upper gage location has an estimated 10 percentile dry season flow of 0.35 cfs, while the lower station estimated flow is 0.1 cfs. There may be a geologic reason for the decline in flow at the lower gage. The East Branch has been designated as a core area for coho recovery and juvenile coho were found there several years ago.

West Branch Soquel Creek

The West Branch flows through a deep bedrock gorge in much of its lower reach, with limited nearby groundwater pumping. The upper watershed has low density rural wells and surface diversions. Although the observed flow is greater than the estimated unimpaired flow, it is estimated that actual depletion is likely approximately 15%, similar to the maximum depletion calculated for Moore's Gulch.

Moore's Gulch

An example of a typical rural basin with significant de minimis groundwater use. It is a 1.5 square mile basin that drains to Soquel Creek, with a measured late dry season flow of 0.15-0.3 cfs, for dry and wet years, respectively, based on periodic County flow measurements. (The Natural Flows database estimates a natural dry season flow range of 0.05 cfs (10th percentile) to 0.45 cfs (90th percentile).) The basin is mostly underlain by the Purisima AA unit, with groundwater depth increasing from 10 ft near the stream to 40 ft on the mid-slopes to 100 ft near the ridgetops. The basin includes 105 rural dwelling units, with landscaping, vegetable gardens, and some livestock. It also has a small public water system serving an institutional facility that extracts 2 af/yr. Well density in Moore's Gulch watershed is 70 units/sq.mi., compared to a maximum density of 52/sq.mi. in parts of Santa Margarita and 144/sq.mi. in parts of Mid-County. Well density would not be expected to change significantly in the future, as the area is at least 90% built out. Applying the water

use factors and return flow estimates used in the MGA GSP, total consumptive indoor water use would be 0.225 af/month and total outdoor water use would be 1.75 af/month during the 6-month summer period. That would amount to 2 af/month in the driest month of September, or 0.03 cfs., 9-14% of the measured dry season streamflow. Applying the Sonoma County method of estimating streamflow depletion, groundwater use divided by recharge equals 8%, which is comparable to a July-September streamflow depletion rate of 14%. This water budget estimate does not take into account any mitigating factors such as distance from the stream, pumping from deeper layers, or the effect of riparian transpiration on unimpacted groundwater discharge.

Other Soquel Tributaries

Other Soquel Creek tributaries are judged to have similar conditions to Moore's Gulch with approximately 15% depletion attributed to de minimis pumping.

Aptos and Valencia Creeks

Most of the Aptos Creek watershed upstream of Valencia Creek is in State Parks, with limited influence from surface or groundwater extraction. The observed flows based on the JSSH data and the gaging history is greater than the NFD unimpaired flow. A gage has been reestablished on Aptos Creek. Valencia Creek is impacted by surface diversions and groundwater extractions and is hydraulically disconnected from underlying groundwater for much of its distance. Consequently, additional groundwater pumping will not increase depletion in these areas where it is hydraulically disconnected. Valencia does go dry in the lower reach in drier years.

Corralitos and Browns Valley Creeks

Corralitos Creek is designated as fully appropriated during the dry season upstream of Rider Creek. Both upper Corralitos and Browns Valley Creeks have nearby wells, individual surface diversions and municipal diversions for the City of Watsonville. Downstream of the confluence, Corralitos Creek is hydraulically disconnected from groundwater and goes dry most summers. The GSP concludes there is no potential for further depletion of interconnected surface water, but it does include a measurable objective to increase the extent and frequency of connectedness "where reasonably achievable."

San Lorenzo River

The San Lorenzo River and its tributaries are designated as fully appropriated during the dry season. Practically all streams in the San Lorenzo Watershed and the Santa Margarita Basin are considered to be interconnected to groundwater. Groundwater modelling suggests that if there was no groundwater pumping, an additional 1000 af/yr (1.4 cfs) would be released to surface water most of it eventually reaching the mainstem of the River at the Big Trees gage in Felton. This represents a depletion of about 10%. Upstream surface diversions on west side tributaries, primarily for municipal use, account for 20% depletion of about 3-4 cfs. The River receives contributions from karst areas in Fall Creek and other west side watersheds that help to maintain dry season flows and lower water

temperatures. Flows in the San Lorenzo River from Felton downstream are managed by established flow targets in the City of Santa Cruz Habitat Conservation Plan (HCP).

Bean Creek

Lower Bean Creek receives considerable groundwater discharge from the Santa Margarita groundwater basin, whereas the middle reach of Bean loses water and goes dry many years. This is a geologic condition that has been documented by old Fish and Game Surveys to have occurred at least back as far as the 1940's. The NFD greatly underestimates the dry season 10 percentile unimpaired flow in Bean Creek as 0.5 cfs, whereas the observed flow is 2.3 cfs. Numerical groundwater modelling for the Santa Margarita GSP provides an estimate of the extent to which Bean Creek flow is influenced by groundwater pumping. The model indicates that if there was no groundwater pumping, flow in Bean Creek would increase by 0.5 cfs, which is about 18% of the modelled unimpaired dry season flow. The majority of the pumping impact is from municipal pumping (only 8% of the pumping in the Santa Margarita Basin is attributable to de minimis wells). More shallow monitoring wells are being installed to better characterize groundwater/surface water interactions. An additional 0.1cfs is attributed to surface diversions. Bean Creek is a designated Coho restoration core area and coho were last found in Bean Creek in 2005.

Zayante Creek

Lower Zayante Creek receives significant groundwater contribution from the Santa Margarita Basin and its observed 10 percentile dry season flow (1.53 cfs) is greater than the NFD estimated unimpaired flow of 1.19 cfs. Most of the properties in the watershed are served by municipal water and the one large upstream surface diversion has been discontinued. Current depletion is estimated at 5-10%. Zayante is also designated as a core coho recovery stream.

Branciforte Creek

The Branciforte Creek watershed is split between the Santa Margarita groundwater Basin and the Santa Cruz Mid-County Groundwater Basin. While some homes have municipal supply, the majority rely on individual wells and some stream diversions, amounting to an estimated 0.16 cfs of depletion. Overall depletion is estimated to be 25%. Branciforte is a designated coho recovery stream.

Bear Creek and Kings Creek

Bear Creek and Kings Creek have low density rural de minimis use and are located within geologic formations that produce relatively low baseflows, unlike Bean, Zayante, or Boulder Creeks. Areas of denser development in the lower watersheds are served by municipal sources and a limited number of private diversions have been observed. A historical municipal stream diversion on Bear Creek has been long discontinued. The NFD greatly overestimates unimpaired flow for Bear Creek and likely for Kings Creek. Kings Creek has gone dry in very dry years.

Boulder Creek

Most of Boulder Creek is served by municipal sources, with some significant surface municipal diversions and one municipal well. There is limited de minimis groundwater use in the upper watershed, which also has poor water-bearing capacity. Upper Boulder Creek has gone dry in very dry years, but the lower reaches have good flow from the southwest tributaries.

Other San Lorenzo Tributaries

Other tributaries have likely experienced depletion ranging from 10% to less than 5%. Denser areas are served by municipal sources and a low number of private diversions have been observed. If a Tier 3 or 4 well is proposed on one of the other tributaries a more in-depth analysis of current flow depletion will be performed.

Laguna, Majors and Liddell Creeks

These creeks are sources of water supply for the City of Santa Cruz and are managed under established flow targets in the City of Santa Cruz HCP. The City has maintained stream gages in the anadromous reaches of these creeks and will continue to monitor flow. They are subject to influences from agricultural, residential and industrial wells and stream diversions upstream and downstream of the City intakes. Laguna Creek supports an increasing population of coho salmon.

San Vicente Creek

San Vicente Creek supports two municipal diversions for town of Davenport, along with at least one large agricultural well in the lower watershed and some rural groundwater use in the upper watershed of Mill Creek. The majority of the San Vicente watershed is timberland and parkland. San Vicente supports a sustained coho population.

Scott Creek

Scott Creek watershed has wells for low density rural use, agricultural use and some surface diversions, including the Monterey Bay Salmon and Trout Project fish hatchery. The watershed supports a sustained coho population. Much of the land in this watershed is affiliated with Cal Poly State University, which is managed for working lands and conservation, and may not be subject to the County's ordinance.

Waddell Creek

The Waddell Creek watershed supports a sustained steelhead and coho population. Although most of the watershed is in state Park, there are some private wells and surface diversions in the East Branch watershed.

Other County Streams

Other county streams are judged to support steelhead, but not coho, and likely have a current level of depletion of 5-10%. More site-specific analysis would be done if a Tier 3 or 4 well is proposed near one of the other county streams.