MONITORING REPORT ◦ JUNE 2019

San Luis Obispo County
Low Flow Monitoring Report (2015-2018)

PREPARED FOR

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Photo description: Crystal Johns (NOAA Veteran's Program) in Arroyo Grande Creek.

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1. BACKGROUND

California's central coast communities are building their collective understanding about how to establish a functional water portfolio that meets a wide range of needs. Without careful management, the water demands of urban, agricultural and rural communities can result in impaired habitat for ecological resources. To coordinate efforts to conserve and enhance in-stream flows for ecological benefits on the central coast, a consortium of local non-profit and government agencies involved in land and water conservation began to convene in early 2015. This consortium of organizations is now known as the Central Coast Water Conservancy (CCWC). In-stream flows provide a wide range of ecological benefits. For example, periodic winter floods alter channel morphology to create and maintain aquatic habitat, while spring and summer low flows sustain aquatic habitat through the dry season. This study focuses on low flows because without adequate flows to sustain aquatic habitat through the dry season, all other environmental instream flows become obsolete.

The first critical step in effectively conserving and enhancing in-stream low flows is to understand the existing conditions, ideally under a range of water-year types (e.g. dry, average, and wet). Further complicating management of in-stream low flows is the reality that sections of some central coast streams are often dry for periods of the year even under unimpaired conditions. Because CCWC recognizes *Onchorynchus mykiss* (steelhead trout) as a focal species for stream management, reaches that would be expected to go dry under unimpaired conditions are not currently a priority. Thus, for this study, only sites with a high potential for *O.mykiss* rearing based on intrinsic watershed characteristics (including historical perennial flows) were selected (NOAA, 2006; Stillwater Sciences, 2014).

In 2015 under the umbrella of CCWC, one of the partner organizations, Central Coast Salmon Enhancement, now doing business as Creek Lands Conservation (hereafter abbreviated as CLC), began to monitor low flows in San Luis Obispo County streams. The following year, CLC received a Proposition 1 grant from the California Wildlife Conservation Board (WCB) Streamflow Enhancement Program to expand and continue this program for three years (2016-2018). The specific objectives of this effort are to collect sufficient data to: 1) compare existing in-stream flow conditions to minimum spring and summer in-stream environmental water demand (EWD); and, 2) create a scientific basis for the prioritization of regional in-stream flow enhancement projects aimed at measurably improving spring and summer low flows. The EWD values utilized in this memo are approximate, minimum environmental water demands as estimated by Stillwater Sciences (2014) for the two most flow-sensitive periods for *O. mykiss*: spring and summer. These estimates of EWD are minimum values needed to maintain basic aquatic systems and should not be interpreted as "enough" water to support long-term, sustainable O. mykiss populations or the complex ecosystems in which they live. This approach invites innovative water stewardship involving appropriate land user water management that focuses on water conservation, stormwater management, and groundwater recharge.

2. EXISTING SUPPLEMENTAL FLOWS

Existing supplemental flow releases affect several creeks in San Luis Obispo County during the dry season. These include reaches affected by wastewater treatment plant flow releases, dam flow releases, and flow releases from oil extraction operations. Water quality (e.g., water temperature) is variable at these locations and was not considered in this study. The monitoring sites that are typically influenced by these discharges are identified in Table 1. A brief description of significant supplemental flow release points known to CLC are summarized below. This is not intended to be a complete list of existing supplemental flow releases in SLO County and these descriptions are CLC's best current understanding of existing flow releases. Information associated with these flow releases will be updated in future reports as appropriate.

Arroyo Grande Creek

Lopez Reservoir is located on upper Arroyo Grande Creek and has minimum flow release requirements that vary from less than 3 cubic feet per second (cfs) to 20 cfs based on time of year and amount of water in the reservoir (Stetson Engineers, 2004). Release requirements are currently being evaluated as part of a San Luis Obispo County led Habitat Conservation Plan. Releases from the reservoir likely contribute substantial flows during the spring and summer at the middle and lower Arroyo Grande monitoring sites. The most downstream reaches include 3 miles of a County maintained Flood Control Channel that does not have a monitoring site for the purposes of this study and is commonly dry during spring and summer months.

Pismo Creek

Privately owned and operated Righetti Reservoir is located on upper Pismo Creek and has minimum flow release requirements as follows: from June 1 to Nov 30th flow should be 'unimpeded' and from Dec 1 to May 30 flow release should be equivalent to 1.5 cfs or to the natural unimpeded flow, whichever is less. Flow releases do not typically flow past the Righetti property line and thus do not enhance our monitoring sites that are further downstream on Pismo Creek. An oil operation in Price Canyon releases treated water into Pismo Creek that is derived from water produced from pumping oil from the ground. The operation is permitted to release up to 0.84 MGD (1.3 cfs). This operation likely contributes to flows at monitoring sites downstream of the discharge point. To our knowledge, no minimum in-stream flow requirement from this point of discharge exists and the term of release is tied to the longevity of the operation.

San Luis Obispo Creek

The San Luis Obispo Water Resource and Recovery Facility (WRRF) releases water into lower San Luis Obispo Creek. The WRRF is currently being upgraded and will have an average recycled water availability equivalent to 6.5 cfs (Hix et al, 2013). In addition to being partially released in-stream, this water will be utilized for non-potable uses in the City of SLO and potentially other applications within and outside the watershed. The current minimum in-stream flow release requirement from the facility is 2.5 cfs (City of SLO, 2018). This discharge likely contributes substantial flows to all downstream monitoring sites in this study.

Wild Cherry Canyon

Wild Cherry Canyon Creek drains into San Luis Obispo Bay approximately 2,500 feet west of San Luis Obispo Creek. Flow in Wild Cherry Canyon may be supported by natural springs or seepage from upstream water treatment ponds. Water treatment ponds are operated by the San Miguelito Mutual Water Company and may contribute some flow by incidental percolation from the ponds, through groundwater-conducting layers, and into the creek. The ponds were not designed to discharge into the Creek (pers comm Dylan Wade, 2019).

Chorro Creek

The California Department of Corrections and Rehabilitation Wastewater Treatment Plant (WWTP) discharges up to 1.2 MGD (1.9 cfs) of treated wastewater from the California Men's Colony Wastewater Treatment Plant, the California Army National Guard (Camp San Luis Obispo), Cuesta College, and several County facilities. The minimum in-stream flow release requirement is 0.75 cfs (Warner et al, 1984; SLO WMP, 2012). This discharge likely contributes to flows at all downstream monitoring sites in this study.

Nacimiento

The Nacimiento Reservoir is located on the upper Nacimiento River. The river downstream of the reservoir has minimum flow release requirements of 60 cfs for the entire year until a rearing habitat flow is identified and concurred with by NMFS (MCWRA, 2005). We are uncertain if such a flow has been identified to date. The minimum release of 60 cfs does not occur when the reservoir elevation is below 687.8 feet mean sea level (MSL), the reservoir's minimum pool or during dam maintenance. Releases from the reservoir likely contribute substantial flows to the monitoring site on the Nacimiento River for this study.

3. METHODS

Flow was measured following the California Department of Fish and Wildlife's (CDFW) Standard Operating Procedures (SOP) for Discharge Measurements (CDFW-IFP-002) and the United States Geological Survey (USGS) protocol for measuring and computing stream discharge (USGS, 1982; USGS, 2010; CDFW, 2013) using hand-held flow meters. Three hand-held flow models were utilized: 1) the Marsh McBirney Flow Meter; 2) the SonTek Flow Tracker version 1; and, 3) the HACH FH950 Flow Meter. All field crews were trained by certified professional hydrologists and followed standard quality assurance/quality control (QA/QC) procedures (Appendix A). The QA/QC procedure included spot check measurements by senior hydrologists, duplicate measurements by different field crews a sub-set of sites, and duplicate measurements by the same field crew on a sub-set of sites.

Low flow measurements were collected during base flow conditions. Base flows are those in-stream flows that come exclusively from the subsurface including deep groundwater and shallow subsurface flow. During base flow conditions, precipitation-driven surface runoff has ceased entering the stream system. Although our measurements occur during natural base flow conditions only, the measurements did include water released into the stream from supplemental human sources (e.g. dams, wastewater discharge). As such we utilize the term "low flow" rather than "base flow."

Monitoring sites were identified in the SLO County In-stream Flow Study (Stillwater Sciences, 2014) and can be viewed online: https://creeklands.org/monitoring-ecologically-critical-creek-flows-in-san-luis-obispo-county/. In 2015 a subset of sites was visited. In 2016 all accessible sites were visited. In addition to the sites identified by Stillwater Sciences, all accessible creek mouths were visited. Sand bars at each stream were described as either "open" or "closed," and were examined to determine if they were dry, had standing water, or flowing water. Open/closed conditions were defined as the presence/absence of a defined channel. If mouths were open and flowing, a flow measurement was collected for sites where a measurement immediately upstream had not been collected. EWD was not estimated for creek mouths. Flowing and standing water were visually determined from observable surface water movement.

At some sites flows were so low that they were difficult to measure reliably. Through trial and error, it was determined that, on average, flows became difficult to measure at less than around 0.20 cfs. However, at any given site, the minimum flow that could be measured was a function of the site geometry which affected the flow depth and velocity for a given flow rate. For example, the minimum flow that could be measured in a wide shallow channel was greater than the minimum flow that could be measured in a narrower, deeper channel. To measure and report very low flow rates consistently, the following procedure was followed. First, if very low flows were observed in an accessible site, a flow measurement was attempted. If a measurement could not be obtained but the water was flowing, the value "<0.20 cfs" was reported. If a measurement could be obtained, and was less than 0.20 cfs, the flow was reported as <0.20 cfs and the measured flow value was also reported in parentheses. Our confidence in the accuracy of measurements less than 0.20 cfs was moderate. Because cross-sectional geometry varied between sites and over time, the minimum value that was measured varied as a function of location and time. In some locations, values as low as 0.04 cfs were measured and are reported. A current on-going National Fish and

Wildlife (NFWF) funded study quantifying the error associated with methods commonly utilized to measure low flows (including those utilized in this study) will provide additional insight into the reliability of the lower end values reported in this report (CLC, in progress). If water was not flowing, sites were identified as either dry (complete absence of water), isolated pools (pools with water with no visible surface water connecting the pools), or standing (channel is filled with water but no flow can be detected either visually or utilizing the velocity meter).

4. RESULTS

4.1 WATER YEAR TYPES

To assist interpreting results, five water year types (very wet, wet, average, dry, very dry) were developed based on precipitation recorded at Cal Poly. The Cal Poly precipitation gage is located at an elevation of 330 feet and provides the longest period of record in the region (148 years). To determine the precipitation thresholds that define the water year types, a precipitation frequency analysis was conducted (Figure 1). The water year type definitions were created using commonly utilized exceedance probabilities, ensuring the average precipitation totals were bracketed and the extreme (very wet and very dry) categories have less than a 10% probability of occurring (Table 1). The probabilities reported in Table 1 are equivalent to the probability that in any given year the total annual precipitation will equal or exceed a certain total amount. For example, there in a 91% chance that in any given year the total annual rainfall will equal or exceed 11.7 inches and there is a 67% chance it will equal or exceed 17.0 inches. Utilizing the above water year type definitions and thresholds, Table 2 summarizes the total water year precipitation for water years 2015–2018. Precipitation water years start in July and end in June; whereas water years for surface flows start in October and end in September. For the purposes of this study both precipitation and surface water years are designated by the calendar year in which they end.

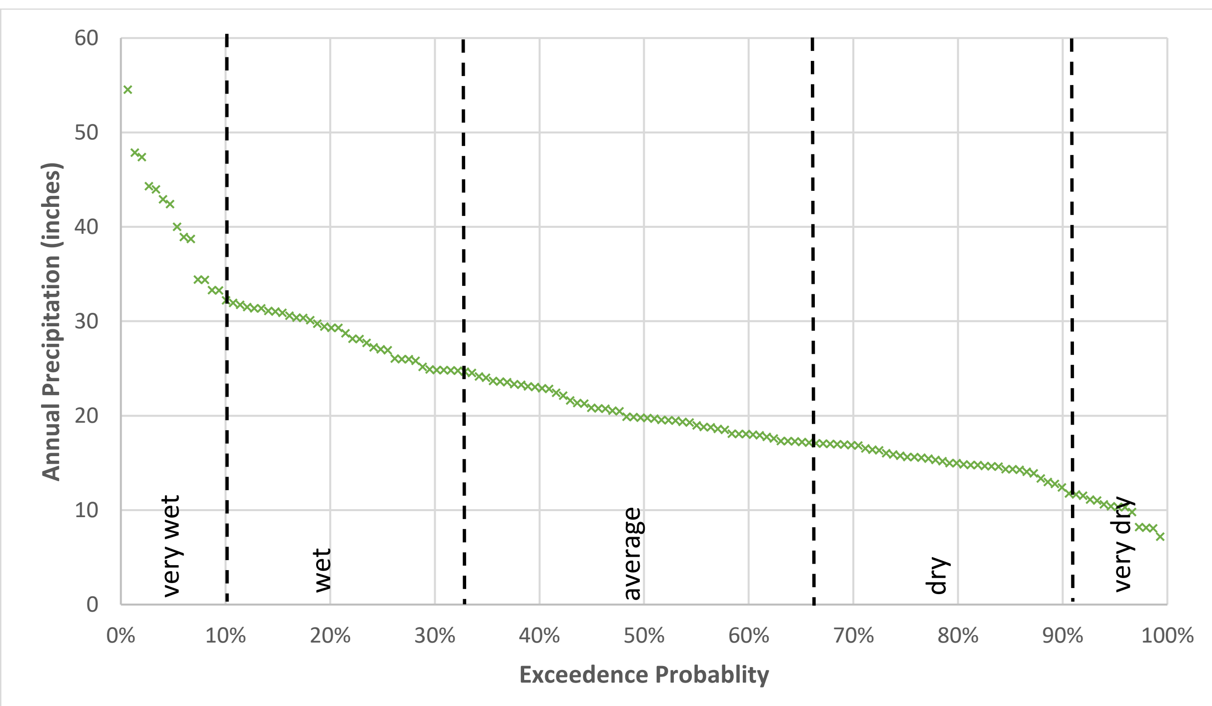

***Figure 1**. Precipitation frequency analysis conducted on Cal Poly total annual precipitation data (1871-2018*

***Table 1**. Water year types and thresholds based on exceedance probability analysis of Cal Poly gage data.*

Year Type	**Precipitation (in/yr)**		**Annual Exceedance Probability (%)**	**n**
	Lower (in/yr)	**Upper (in/yr)**		
Very Dry	0.0	11.7	≥ 91	13
Dry	11.7	17.0	≥ 67	36
Average	17.0	24.6	≥ 33	50
Wet	24.6	32.2	≥ 10	35
Very Wet	32.2			14
Long-Term Average WY Precipitation = 22.0 in/yr				
Water Year Record = 1871 - 2018				

***Table 2**. Water year types for 2012–2018 based on Cal Poly total annual precipitation data.*

Water Year[1]	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Total Annual Precipitation (in)	14.6	14.3	10.6	11.5	19.5	38.9	14.3
Water Year Type	Dry	Dry	Very Dry	Very Dry	Average	Very Wet	Dry

[1] For the purposes of this study precipitation water years begin in July and end in June and are designated by the calendar year in which they end (*e.g.*, water year 2012 covers the period of July 1, 2011 through June 30, 2012)

At the beginning of this study (2015-2016), San Luis Obispo County was classified as being in an exceptional drought, the most severe drought classification possible as given by the National Drought Mitigation Center (NDMC, 2016). By most measures, the 2012-2016 drought was the most severe of the past century (Griffin and Anchukaitis, 2014). This drought classification given by the NDMC is based on multiple variables including precipitation, temperature, soil moisture, and streamflow.

4.2 COUNTY WIDE MONITORING RESULTS AND COMPARISON TO EWD

A summary of results are provided in table 4 at the end of this report and on-line by clicking on each site at: https://creeklands.org/monitoring-ecologically-critical-creek-flows-in-san-luis-obispo-county/. Not surprisingly the number of monitoring sites meeting environmental water demand (EWD) was lower in drier years than in wetter years (Figure 2, Table 3). However, there appeared to be a correlation in stream flow conditions and precipitation events from the prior year. For example, in 2016 which was locally an average year for precipitation, EWD was met in approximately 20% of sites in spring and 17% of sites in summer which was similar to conditions during the previous year (2015) where EWD was met at approximately 17% of sites in spring and 15% of sites in summer even though 2015 was classified as a very dry year based on low precipitation. The low percentage of locations meeting the EWD in 2016 is likely due to the extended drought that preceded 2016. Conversely, in 2018 which was a dry year, EWD was achieved at a much higher rate than in 2016 even though precipitation was lower in 2018 than in 2016. The high percentage of sites meeting EWD in 2018 (approximately 58% of sites in spring and 38% in summer) is likely due to the very wet conditions during the preceding year (2017), with the EWD met at approximately 80% of the sites in spring and 47% of the sites in summer. These results exemplify that low flows are driven by subsurface groundwater conditions which in turn are impacted by multi-year, not single year, precipitation conditions. Flow monitoring results for all sites are included in Table 4 at the end of this report.

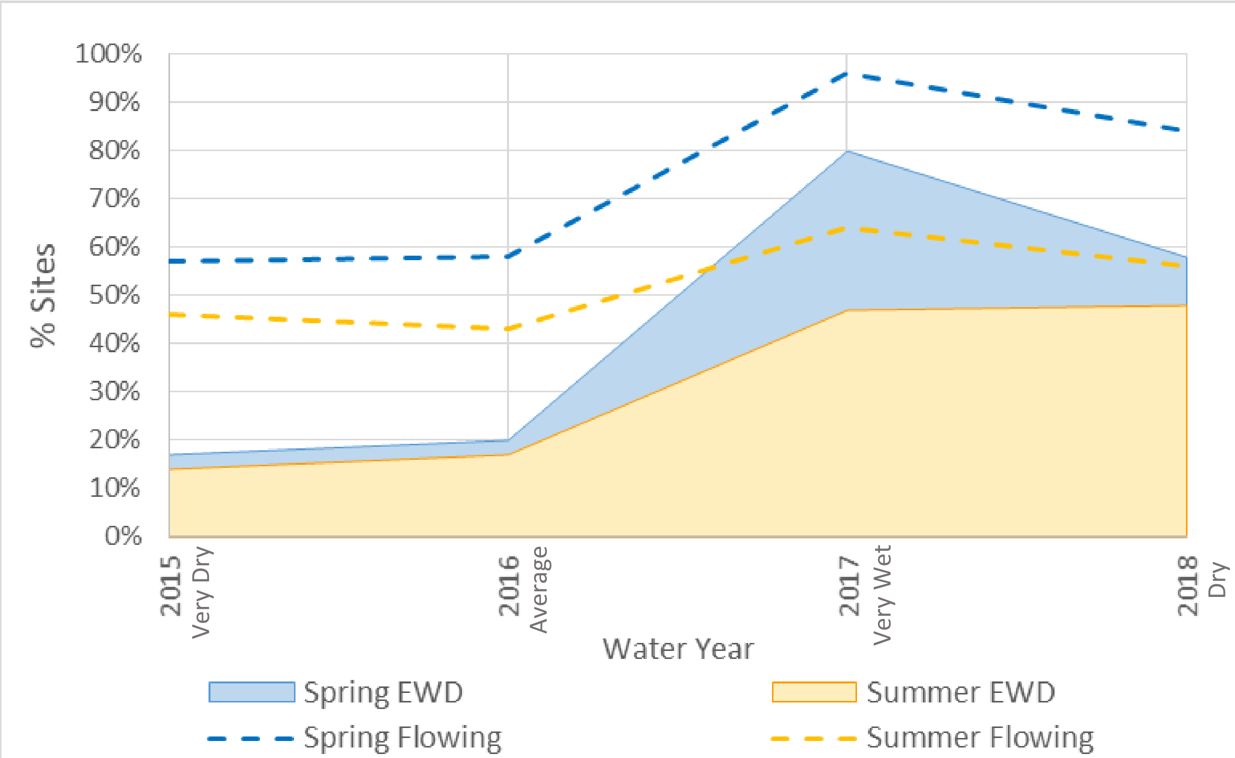

Figure 2. *Percentage of study sites meeting environmental water demand (solid) and percentage of sites with flowing water (dashed line) in spring (blue) and summer (orange).*

Sites that maintained or nearly maintained EWD in both spring and summer for all water year types included Upper Arroyo Grande Creek, Upper Chorro Creek, Lower SLO Creek, and, the Lower Nacimiento River.

Except for Upper Arroyo Grande Creek, these sites all have existing operations which supplement instream flows upstream. During the drought a significant number of sites that met EWD were on creeks with existing supplemental flows. For example, in 2015 (a very dry year) the majority of sites that met EWD were in locations with supplemental flows (80% of the sites in spring and 60% the sites in summer) (Figure 3). In contrast, in 2017 (a very wet year), the majority of sites that met EWD were in locations without supplemental flows (80% of the sites in the spring and 65% of the sites in the summer). In other words, during years with low precipitation stream reaches that have enhanced flow from human sources (dams, oil operations, wastewater treatment facilities) provide critical spring and summer flow refugia for *O. mykiss*.

Sites that consistently went dry during the summer include Tar Spring Creek, Los Berros Creek, East and West Corral de Piedra, Lower Los Osos, Lower Old Creek, Lower Cayucos, Van Gordon Creek, and all Salinas River tributaries except for Santa Rita and Nacimiento River. This is especially relevant to *O. mykiss* management because the portion of stream that go dry, unless they have deep groundwater fed isolated pools that persist through the summer months, cannot support over summering juvenile *O. mykiss*. However, these monitoring locations are not indicative of the entire stream system and would require additional monitoring sites to determine the extent of dry conditions. For example, in a current on-going study, dry season flow measurements were made upstream of the monitoring sites reported here-in

Table 3. *Summarized statistics of low flow monitoring results for 2015 (very dry), 2016 (average), 2017 (very wet) and 2018 (dry). Data updated from previous annual monitoring reports.*

2015-2018 Low Flow Results Statistics	2015 (very dry)		2016 (average)		2017 (very wet)		2018 (dry)	
	Spring	Summer	Spring	Summer	Spring	Summer	Spring	Summer
Site Conditions								
Number of sites measured	30	37	50	54	55	55	55	55
Number of sites flowing	17	17	29	23	53	35	46	31
Percentage of sites flowing	57%	46%	58%	43%	96%	64%	84%	56%
Environmental Water Demand (EWD)								
Number of sites meeting EWD	5	5	10	9	44	26	32	21
Number of sites not meeting EWD	25	32	40	45	11	29	23	34
Percentage of sites meeting EWD	17%	14%	20%	17%	80%	47%	58%	38%
Supplemental Flows								
Number of sites with supplemental flows	15	15	15	15	15	15	15	15
Number of sites meeting EWD that have supplemental flows	4	3	5	6	9	9	8	9
Percentage of sites meeting EWD that have supplemental flows	80%	60%	50%	67%	20%	35%	25%	43%
Creek Mouths								
Number of stream mouths observed	8	17	18	19	20	19	19	19
Number of streams with open mouths	4	6	4	4	18	7	14	4
Percentage of streams with mouths open	50%	35%	22%	21%	90%	37%	74%	21%
Number of open mouths with enhanced flows	2	3	2	3	6	3	5	2
Percentage of open mouths with enhanced flows	50%	50%	50%	75%	33%	43%	36%	50%

in some Salinas River tributaries. These measurements demonstrated perennial flow conditions in some Salinas River tributaries, especially higher in the watershed than the monitoring sites included in this study (CLC, in progress).

Five creeks (Pismo, San Luis Obispo, Islay, Los Osos and Chorro creeks) typically maintained flow in their lower reaches allowing hydrologic connectivity to their estuaries and the ocean, either continuously or on an intermittent basis during the spring and/or summer. While this connectivity may be partially (or completely) due to human influence on Pismo and San Luis Obispo Creeks, other creeks like Islay Creek, which is located in Montana de Oro State Park, are less influenced by human activities.

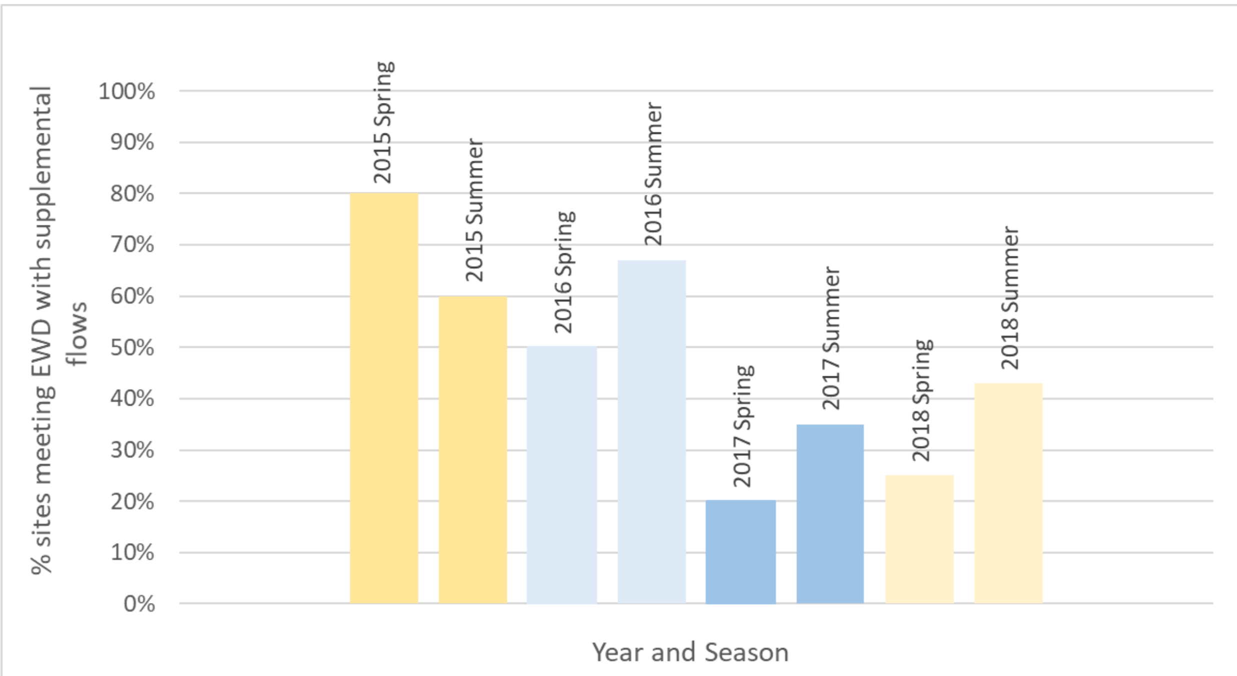

Figure 3. *Percentage of study sites meeting environmental water demand (EWD) that are downstream of significant existing supplemental flow release locations (e.g. dam releases or wastewater treatment plant discharge)*

4. MANAGEMENT IMPLICATIONS

In additional to comparing flow data to EWD, the second objective of this study was to create a scientific basis for the prioritization of regional in-stream flow enhancement projects aimed at measurably improving spring and summer low flows. Flow enhancement projects include a mix of strategies varying from water conservation to groundwater recharge. These projects typically provide incremental improvements of flow and are more likely to be effective on stream reaches that are close to meeting EWD but are not consistently dry across all water year types under current land and water management practices. High priority flow enhancement stream systems are those streams that maintained EWD in some seasons in some years or maintained enough flowing water that they could significantly benefit from flow enhancement. Streams with a high potential to ecologically benefit from flow enhancement based on existing hydrologic conditions are listed below south to north.

- Arroyo Grande Creek,
- Pismo Creek,
- Stenner Creek,

- SLO Creek,
- Wild Cherry Canyon Creek,
- Diablo Creek,
- Coon Creek,
- Islay Creek,
- Chorro Creek,
- San Luisito Creek,
- Morro Creek,
- Toro Creek,
- Villa Creek,
- Santa Rosa Creek,
- San Simeon Creek,
- Upper Salinas River, and,
- Santa Rita Creek.

For streams that under this study consistently meet EWD (e.g. Arroyo Grande, San Luis Obispo, Chorro), the reach monitored may not be the target of the enhancement work itself but adjacent reaches which do not meet EWD would be. Other factors such as geology, connectivity between perennial reaches, quality of rearing habitat, and existing human water management practices in the watershed should be considered to further prioritize creek systems and reaches within those creeks.

Creeks or creek reaches which are not listed are not necessarily poor candidates. Among other challenges, private property and access limited the ability to effectively monitor some streams. For example, sites for north county coastal streams such as Pico, Little Pico, Oak Knoll, Arroyo de la Cruz, and San Carpoforo were all out of necessity in the lower watershed near tidal influence. These sites may be more representative of *O. mykiss* migratory channel conditions rather than *O. mykiss* rearing conditions. For all watersheds the results are simply a snapshot and not a complete representative of temporal and spatial changes in flows.

We recommend that the following monitoring and management steps be conducted.

1) Continue spring and summer monitoring at all accessible sites.

2) Expand monitoring in reaches that contain critical *O. mykiss* rearing habitat but do not have flow monitoring sites established including (but not limited to):
    - Upper Pismo: Measure flow data upstream and immediately downstream of Righetti Reservoir. If this data is already being collected and reported to the state, obtain and synthesize the data;
    - Upper San Simeon: Measure flow on one or two sites on Steiner Creek;
    - North Coast: Establish monitoring sites further upstream on all north coast watersheds including Pico, Little Pico, Oak Knoll, Arroyo de la Cruz, and San Carpoforo, as well as, Toro, Old, Cayucos, and Villa Creeks.
    - Upper reaches of select Salinas tributaries including but not limited to Jack, Santa Rita, Santa Margarita, and Trout Creek.

3) Conduct dry season flow enhancement opportunity studies on all key watersheds. While some watersheds have various related water studies underway which are contributing to an understanding of watershed-wide flow enhancement opportunities and constraints (e.g. Arroyo Grande and Chorro), other watersheds (e.g. Santa Rosa, Stenner) could benefit from characterization of a watershed wide analysis of flow enhancement opportunities.

5. SUMMARY OF RESULTS

This study encompassed flow conditions in a wide range of water years types including very wet and very dry. This variability of hydrologic conditions allowed us to examine in-stream flow trends across a range of conditions. In summary the results show that:

1) Spring flows are in moderately good condition in SLO County, especially in wetter years or in years following wet years.
2) Summer flows are in poor condition in SLO County in all water year types. Even in a very wet year (2017) only 47% of sites met summer EWD, whereas in a very dry year (2015), only 14% of site met summer EWD.
3) Existing supplemental flows (e.g. dam releases or wastewater discharge) played a significant role during the drought (2015 and 2016) in providing sufficient flows for *O. mykiss* and may provide critical refuge habitat in a warming climate. For example, in 2015 80% and 60% of sites that met EWD in spring and summer, respectively, were enhanced by flow releases. Under existing land and water management practices on the central coast these enhanced flows likely play a critical role in sustaining *O. mykiss* populations through droughts.
4) Only two sites (Upper Arroyo Grande Creek (Lopez Creek) and the Nacimiento River) met EWD in spring and summer in all water year types. Upper Arroyo Grande Creek (Lopez Creek) is the only non-enhanced site to consistently meet EWD. This site, combined with consistent visual observations of upper reaches by this author at locations without monitoring sites, suggests that on the central coast upstream habitats may play a critical role in sustaining *O. mykiss* populations through long-term droughts. Additional establishment of sites in upper watersheds is recommended, even though such locations are challenging to identify due to private property restrictions.
5) Hydrologic conditions as monitored under this study suggest that high potential watersheds for future flow protection and enhancement may include (south to north): Arroyo Grande Creek, Pismo Creek, Stenner Creek, San Luis Obispo Creek, Wild Cherry Canyon Creek, Coon Creek, Islay Creek, Chorro Creek, San Luisito Creek, Morro Creek, Toro Creek, Villa Creek, Santa Rosa Creek, San Simeon Creek, Upper Salinas River, and Santa Rita Creek.

Contributing Partners

The San Luis Obispo County low flow monitoring conducted in the spring and summer of 2015 and 2016 was a collaborative effort. Field crews from Creek Lands Conservation (CLC), California Conservation Corps (CCC), NOAA Veterans Program, City of San Luis Obispo, and California Polytechnic State University, San Luis Obispo (Cal Poly) conducted monitoring. The Coastal San Luis Resource Conservation District (CSLO-RCD), the CCC, CLC, and Cal Poly provided flow equipment. Cal Poly students enrolled in a 1-unit course developed specifically to support monitoring efforts and provide practical experience for students. Supervision and QA/QC of CLC, CCC, and NOAA Vets crew was provided by Aleksandra Wydzga, P.H. (Cal Poly, CLC). Supervision and QA/QC of Cal Poly students was provided by Chris Surfleet, Ph.D., P.H. (Cal Poly). Stillwater Sciences both conducted the in-stream flow study that lay this foundation for this monitoring effort, as well as, created and hosts the web-site for this study.

CCWC Participants

Central Coast Regional Water Quality Control Board; California Conservation Corps (CCC); City of San Luis Obispo; California Polytechnic State University at San Luis Obispo (Cal Poly); Coastal San Luis Resource Conservation District (CSLO-RCD); Upper Salinas Las-Tablas RCD (S-LT RCD); California Department of Fish and Wildlife (CDFW); California State Parks; Creek Lands Conservation (CLC); County of San Luis Obispo Water Resources Division; Morro Bay National Estuary Program (MBNEP); The Watershed Progressive; Hicks Law; Stillwater Sciences; Green Space the Cambria Land Trust; Trout

Unlimited; Monterey Bay National Marine Sanctuary; and the National Oceanic and Atmospheric Administration National Marine Fisheries Service. Participation is open to all interested Central Coast parties.

Table 4. 2015-2018 spring and summer low flow results.

Site No.	Site Description	Spring					Summer				
		2015 (cfs)	2016 (cfs)	2017 (cfs)	2018 (cfs)	EWD (cfs)	2015 (cfs)	2016 (cfs)	2017 (cfs)	2018 (cfs)	EWD (cfs)
Arroyo Grande Creek											
1	Upper Arroyo Grande Creek	1.52[i]	1.59[i]	9.44/10.00[i]	6.26	**1.33**	1.05[i]	0.54/0.48[i]	2.66/2.96[i]	1.67/1.03[i(p)]	**0.45**
2	Middle Arroyo Grande Creek[ii]	0.73	1.69	7.15	5.65	**4.14**	0.99	3.87	4.28	4.39	**1.17**
3	Tar Spring Creek	dry	dry	<0.20 (0.15)	<0.20	**0.50**	dry	dry	standing	isolated pools	**0.24**
4	Los Berros Creek	dry	dry	dry	dry	**1.05**	dry	dry	dry	dry	**0.38**
5	Lower Arroyo Grande Creek[ii]	0.84	1.15	8.33	1.79	**5.30**	0.25	0.57	5.07	1.82	**1.46**
	Arroyo Grande Creek Mouth	*closed/ standing*	*closed/ standing*	*open/ flowing*	*open/ flowing*		*closed/ standing*	*closed/ standing*	*closed/ standing*	*closed/ standing*	
Pismo Creek											
6	West Corral De Piedra	dry	dry	0.88	dry	**0.63**	dry	dry	dry	dry	**0.27**
7	East Corral De Piedra	dry	dry	0.81	dry	**0.55**	dry	dry	dry	dry	**0.25**
8	Lower Pismo Creek[ii]	<0.2	0.41	8.41	2.48	**2.17**	<0.2	0.26	1.22	0.70	**0.67**
	Pismo Mouth[ii]	*closed/ standing*	*closed/ standing*	*open/ flowing (6.57)*	*open/ flowing*		*open/ flowing (0.24)*	*open/ flowing (0.41)*	*open/ flowing (2.01)*	*closed/ standing*	
San Luis Obispo Creek											
9	Upper SLO Creek	0.33/0.30[iii]	1.01/0.99[iii]	6.07	2.96	**0.89**	<0.20 (0.04)	0.38	1.40	0.84	**0.34**
10	Stenner Creek	0.40/0.38[iii]	0.73	5.50	2.57	**0.85**	0.34	0.27	2.07	0.79	**0.33**
11	East Fork SLO Creek	standing	standing	2.36	1.04	**0.81**	dry	isolated pools	<0.20	standing	**0.32**
12	Lower SLO Creek[ii]	5.35/5.12[iii]	6.38/5.68[iii]	35.49	19.45	**3.63**	0.94	4.02/4.51[iv]	6.24	5.61	**1.04**
13	See Canyon Creek	dry	<0.20	2.97	2.22	**0.72**	dry	dry	0.64	0.21	**0.30**
14	Hardford Canyon	dry	dry	0.66	0.38	**0.46**	dry	dry	<0.20	dry	**0.23**
15	SLO Creek near Avila[ii]	6.70/5.49[iii]	4.73	40.05	34.26	**4.25**	0.43	4.34	7.31	6.64	**1.21**
	SLO Creek Mouth[ii]	*open/ flowing*	*open/ flowing (5.57)*	*open/ flowing*	*open/ flowing*		*open/ flowing*	*open/ flowing (5.24)*	*open/ flowing*	*open/ flowing*	
Wild Cherry Canyon Creek											
16	Wild Cherry Canyon[ii]	no access	no access	0.32	<0.20 (0.19)	**0.39**	no access	<0.20 (0.06)	<0.20 (0.13)	<0.20 (0.10)	**0.21**

Site No.	Site Description	Spring					Summer				
		2015 (cfs)	**2016 (cfs)**	**2017 (cfs)**	**2018 (cfs)**	**EWD (cfs)**	**2015 (cfs)**	**2016 (cfs)**	**2017 (cfs)**	**2018 (cfs)**	**EWD (cfs)**
	Wild Cherry Cyn Mouth[ii,v]	*nd*	*nd*	*open/ flowing*	*open/ flowing*		*nd*	*open/ flowing*	*open/ flowing*	*open/ flowing*	
Diablo Creek											
17	Lower Diablo Creek	no access	no access	0.80	0.44	**0.56**	no access	no access	0.40	0.28	**0.26**
	Diablo Creek Mouth[vi]	*nd*	*nd*	*open/ flowing*	*no access*		*nd*	*no access*	*no access*	*no access*	
Coon Creek											
18	Lower Coon Creek	0.27[iii]	dry	0.94	0.78	**0.71**	dry	<0.20 (0.14)	0.24/0.13[vii]	<0.20	**0.30**
	Coon Creek Mouth	*nd*	*closed/ standing*	*open/ flowing*	*closed/ standing*		*nd*	*closed/ standing*	*closed/ standing*	*closed/ standing*	
Islay Creek											
19	Islay Creek	0.50[iii]	0.61/1.05[iii]	3.30	2.69	**0.77**	<0.20	0.47	1.61	1.20	**0.31**
	Islay Mouth	*open/ flowing*	*open/ flowing*	*open/ flowing*	*open/ flowing*		*open/ flowing*	*closed/ flowing*	*open/ flowing*	*closed/ standing*	
Los Osos Creek											
20	Lower Los Osos Creek	dry	dry	0.84	isolated pools	**0.66**	dry	dry	dry	dry	**0.28**
	Los Osos Mouth	*open/ flowing*	*open/ flowing*	*open/ flowing*	*open/ flowing*		*open/ flowing*	*open/ flowing*	*open/ flowing*	*open/ flowing*	
Chorro Creek											
21	Upper Chorro Creek[ii]	1.30[iii]/1.14[vii]	2.14/2.31[vii]	8.84/7.78[vii]	4.11	**1.18**	0.81/0.87[vii]	1.07/0.83[vii]	3.85/4.14[vii]	2.21	**0.42**
22	Middle Chorro Creek[ii]	0.40[iii] /0.65[vii]	2.69/3.02[vii]	8.85	4.39	**1.38**	0.80/0.50[vii]	0.74/0.95[vii]	3.35	1.78	**0.47**
23	San Luisito Creek	0.28[iii] /0.17[vii]	0.28/0.12[vii]	4.08/5.1[viii]	1.49	**0.68**	<0.20/0.27[vii]	dry	1.31/1.82[vii]	0.63	**0.29**
24	Lower Chorro Creek[ii]	0.35[iii] /0.32[vii]	2.11/2.67[vii]	15.76	7.48	**2.30**	dry	0.35	4.87/5.09[vii]	2.16	**0.70**
25	San Bernardo Creek	dry	dry	>1.00[viii]	0.60	**0.72**	dry	dry	>1.00[viii]	dry	**0.30**
	Chorro Mouth	*open/ flowing (0.34[vii])*	*open/ flowing (<0.2(0.09)[vii]*	*open/ flowing (16.35/18.33[vii])*	*open/ flowing (8.91)*		*open/ flowing*	*open/ flowing (<0.2 (0.13)/0.05[vii])*	*open/ flowing (5.60/5.77[vii])*	*open/ flowing (2.65)*	
Morro Creek											
26	Upper Morro Creek	<0.20[iii]	<0.20 (0.03)	2.48	1.37	**0.66**	<0.20 (0.07)	<0.20	0.25	0.24	**0.28**
27	Lower Morro Creek	no access	no access	6.85	1.75	**1.19**	no access	dry	0.81	<0.20	**0.42**
28	Lower Little Morro Creek	dry	dry	<0.20 (0.19)	dry	**0.57**	dry	dry	0.44	dry	**0.26**

Site No.	Site Description	Spring					Summer				
		2015 (cfs)	2016 (cfs)	2017 (cfs)	2018 (cfs)	**EWD (cfs)**	2015 (cfs)	2016 (cfs)	2017 (cfs)	2018 (cfs)	**EWD (cfs)**
	Morro Mouth	*nd*	*closed/ standing*	*open/ flowing*	*open/ flowing*		*closed/ standing*	*closed/ dry*	*open/ flowing*	*closed/ standing*	
Toro Creek											
29	Lower Toro Creek #1 (at 2nd bridge)	nd	<0.20	5.61	1.80	**1.01**	dry	<0.20	1.30	0.70	**0.37**
30	Lower Toro Creek #2 (at 1st bridge)	nd	<0.20/0.10[iii]	6.20	1.80	**1.05**	<0.2	<0.20	1.45	0.74	**0.38**
	Toro Mouth	*nd*	*closed/ standing*	*open/ flowing*	*open/ flowing*		*open/ flowing*	*closed/ standing*	*open/ flowing*	*open/ flowing*	
Old Creek											
31	Upper Old Creek	no access	no access	no access	no access	**0.83**	no access	no access	no access	no access	**0.33**
32	Lower Old Creek	nd	standing	<0.20 (0.15)	<0.20 (0.11)	**1.31**	standing	isolated pools	standing	standing	**0.45**
	Old Creek Mouth	*nd*	*closed/ standing*	*open/ flowing*	*open/ flowing*		*closed/ standing*	*closed/ standing*	*closed/ standing*	*closed/ standing*	
Cayucos Creek											
33	Lower Cayucos Creek	nd	dry	0.99	0.79	**0.82**	dry	dry	dry	dry	**0.32**
	Cayucos Mouth	*nd*	*closed/ standing*	*open/ flowing*	*open/ flowing*		*closed/ standing*	*closed/ standing*	*closed/ standing*	*closed/ standing*	
Villa Creek											
34	Lower Villa Creek	nd	dry	2.70	2.23	**1.03**	dry	dry	<0.20	0.28	**0.38**
	Villa Mouth	*nd*	*closed/ standing*	*open/ flowing*	*closed/ standing*		*closed/ standing*	*closed/ standing*	*closed/ standing*	*closed/ standing*	
Santa Rosa Creek											
35	Upper Santa Rosa Creek	nd	1.28	8.83	3.69	**0.93**	<0.20 (0.06)	0.33	1.24	0.90	**0.35**
36	Perry Creek	nd	nd	1.50	1.02	**1.43**	dry	isolated pools	<0.2	isolated pools	**0.48**
37	Lower Santa Rosa Creek	nd	1.37/1.09[ix]	11.96	6.46	**2.50**	dry	<0.2 (0.11)	1.11	1.98	**0.75**
	Santa Rosa Mouth	*closed/ standing*	*closed/ standing*	*closed/ standing*	*closed/ standing*		*closed/ standing*	*closed/ standing*	*closed/ standing*	*closed/ standing*	
San Simeon Creek											
38	Upper San Simeon Creek #2	dry	0.79	5.95	2.87	**0.93**	nd	<0.20 (0.08)	0.96	0.46	**0.35**

Site No.	Site Description	Spring					Summer				
		2015 (cfs)	2016 (cfs)	2017 (cfs)	2018 (cfs)	EWD (cfs)	2015 (cfs)	2016 (cfs)	2017 (cfs)	2018 (cfs)	EWD (cfs)
39	Upper San Simeon Creek #1	no access	no access	no access	no access	**0.79**	no access	no access	no access	no access	**0.32**
40	Middle San Simeon Creek	0.25	0.69	10.63	4.13	**1.51**	nd	dry	<0.20 (0.18)	<0.20 (0.17)	**0.50**
41	Lower San Simeon Creek	standing	dry	8.56	3.12	**1.60**	nd	dry	standing	isolated pools	**0.52**
42	Van Gorden Creek	dry	dry	0.24	dry	**0.45**	nd	dry	dry	dry	**0.23**
	San Simeon Mouth	*closed/ standing*	*closed/ standing*	*open/ flowing (3.37)*	*closed/ standing*		*closed/ standing*	*closed/ standing*	*closed/ standing*	*closed/ standing*	
Pico Creek											
43	Pico Creek	no access	standing	6.80	2.29	**0.96**	no access	dry	isolated pools	isolated pools	**0.36**
	Pico Mouth	*nd*	*closed/ standing*	*open/ flowing*	*open/ flowing*		*closed/ standing*	*closed/ standing*	*closed/ standing*	*closed/ standing*	
Little Pico Creek											
44	Lower Little Pico Creek	no access	<0.20 (0.10)/0.10[iii]	1.22	0.53	**0.61**	no access	<0.20	isolated pools	<0.20	**0.27**
	Lower Little Pico Mouth	*nd*	*closed/ standing*	*open/ flowing*	*open/ flowing*		*closed/ standing*	*closed/ standing*	*closed/ standing*	*closed/ standing*	
Oak Knoll Creek											
45	Lower Oak Knoll Creek	no access	standing	0.78	standing	**0.63**	standing	standing	standing	standing	**0.27**
	Oak Knoll Mouth	*nd*	*closed/ standing*	*open/ flowing*	*open/ flowing*		*closed/ standing*	*closed/ standing*	*closed/ standing*	*closed/ standing*	
	Arroyo de la Cruz										
46	Lower Arroyo de la Cruz	nd	1.76	>EWD[x]	11.99	**2.39**	<0.20	0.23	1.51	2.71	**0.72**
	Arroyo de la Cruz Mouth	*nd*	*nd*	*closed/ standing*	*closed/ standing*		*nd*	*closed/ standing*	*closed/ standing*	*closed/ standing*	
San Carpoforo											
47	Lower San Carpoforo Creek	nd	1.08	24.66	10.29	**2.05**	dry	dry	standing	isolated pools	**0.64**
	San Capoforo Mouth	nd	closed/ standing	open/ flowing	open/ flowing		closed/ standing	closed/ standing	closed/ standing	closed/ standing	
Salinas Watershed											
48	Upper Salinas River	nd	flowing/ no access	1.77	1.74	**3.75**	nd	dry	0.33	0.50	**1.10**

Site No.	Site Description	Spring					Summer				
		2015 (cfs)	2016 (cfs)	2017 (cfs)	2018 (cfs)	EWD (cfs)	2015 (cfs)	2016 (cfs)	2017 (cfs)	2018 (cfs)	EWD (cfs)
49	Pilitas Creek	nd	dry	<0.20 (0.10)	<0.20	**0.65**	nd	dry	dry	dry	**0.30**
50	Upper Santa Margarita Creek	nd	flowing/ no access	2.31	1.01	**0.80**	nd	dry	dry	dry	**0.28**
51	Moreno Creek	nd	dry	isolated pools	isolated pools	**0.53**	nd	dry	dry	dry	**0.20**
52	Middle Branch Huerhuero Creek	no access	no access	<0.20 (0.09)	dry	**1.35**	nd	dry	dry	dry	**0.46**
53	Lower Atascadero Creek	nd	0.32	1.51	1.02	**0.99**	nd	dry	dry	dry	**0.37**
54	Upper Graves Creek	nd	isolated pools	0.39	<0.20 (0.15)	**0.64**	nd	dry	dry	isolated pools	**0.28**
55	Santa Rita Creek	nd	dry	~20-30[viii]	~5.00 [viii]	**1.22**	nd	dry	~1.00 [viii]	~0.50 [viii]	**0.43**
56	Jack Creek	nd	<0.20	3.83	1.49	**1.81**	nd	dry	isolated pools	isolated pools	**0.58**
57	Lower Nacimiento River[ii]	30[xii]	60[xii]	440[xii]	345[xii]	**18.39**	60[xii]	61.23/60.00[xii]	450[xii]	428[xii]	**4.78**

[i] USGS Gauge data (p = provisional, e = estimated) [https://waterdata.usgs.gov/ca/nwis/dv?referred_module=sw&site_no=11141280]
nd No data available
[ii] Sites downstream of known, significant dry season flow releases
[iii] Duplicate measurement from Cal Poly SLO crews
[iv] Duplicate measurement from CLC crews
[v] Stream flows into culvert under parking lot before entering ocean. Possible fish passage barrier.
[vi] Stream flows through a series of long, steeply gradient culverts before entering ocean. Total fish passage barrier.
[vii] Duplicate measurement from MBNEP crews
[viii] Visual observation based on extensive knowledge of field site
[xi] Duplicate measurement from the Central Coast Regional Water Quality Control Board (CCRWQCB)
[x] Field conditions precluded measurement of high flows
[xi] Site precludes accurate measurements due to site conditions (boulders)
[xii] Flow releases values from Nacimiento Dam by the Monterey County Water Resources Agency (MCWRA) [http://www.co.monterey.ca.us/home/showdocument?id=24234]

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Appendix A: Central Coast Water Conservancy's Quality Assurance/ Quality Control (QA/QC) Plan

1) All field crews are trained by a certified Professional Hydrologist, certified Professional Hydrologic Technician, or a licensed Professional Engineer. Hydrologists and hydrologic technicians are certified by the American Institute of Hydrology (http://aih.engr.siu.edu/) and engineers are licensed by the state of California (http://www.bpelsg.ca.gov/)

2) All measurements shall be collected in accordance with CDFW Standard Operating Procedures for Discharge Measurements in Wadable Streams (CDFW-IFP-002) (CDFW, 2013).

3) All measurements and calculations shall be made in accordance with USGS Water-Supply Paper 2175: "Measurement and Calculation of Stream Flow" (USGS, 1982). The CDFW and USGS protocols are complimentary to one another.

4) On smaller streams, a stadia rod shall be used to set up the transect, rather than a measuring tape. The stadia rod, because it does not sag, reduces the potential for tape errors. It the stadia rod is a preferred tool over a measuring tape and will be utilized when possible.

5) For 10% of sites, a second velocity reading at three segments in the transect shall be collected. The two velocity values for the segment should be within 25% of each other.

6) For 10% of sites, a separate crew shall collect a duplicate flow measurement.

7) All flow meters shall be calibrated and serviced by the manufacturer annually. The calibration and service paperwork shall be kept on file.

8) Electro-magnetic meters shall be zero calibrated before each field use.

9) A certified or licensed professional as previously described shall conduct spot checks of field methods annually.

10) All discharge calculations shall be reviewed by certified or licensed professional as previously described.