# Monitoring Program 2019 Final Annual Report

## Sacramento Municipal Utility District

Hydro License Implementation • June 2020

Upper American River Project

FERC Project No. 2101

Powering forward. Together.

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# Acronyms and Abbreviations

| Acronym | Definition |
|---|---|
| BLM | U.S. Bureau of Land Management |
| BMI | Benthic macroinvertebrate |
| CDFW | California Department of Fish and Wildlife |
| cfs | Cubic Feet Per Second |
| CSCI | California Stream Condition Index |
| CVRWQCB | Central Valley Regional Water Quality Control Board |
| DBH | Diameter at breast height |
| DWR | California Department of Water Resources |
| ENF | El Dorado National Forest |
| EPT | Ephemeroptera, Trichoptera and Plecoptera |
| FERC | Federal Energy Regulatory Commission |
| FL | Fork Length |
| ft | feet |
| FYLF | Foothill yellow-legged frog |
| GIS | Geographic Information System |
| GNSS | global navigation satellite system |
| GPS | Global Positioning System |
| in. | inches |
| LWD | Large woody debris |
| mi | mile |
| mm | Millimeters |
| MMI | Multi-metric index |
| NAIP | National Agriculture Imagery Program |
| new license | The FERC License for the Upper American River Project 2101 issued July 2014 for which new flow regimes and other terms and conditions were implemented beginning in October 2014 |
| NOAA | National Oceanic and Atmospheric Administration |
| O/E | Observed-to-expected |
| old license | The original FERC License for Upper American River Project 2101 which concluded in July 2014 for which a different minimum flow regime and other terms and conditions were in place |
| OPUS | Online Positioning User Service |

| Acronym | Definition |
|---|---|
| Plan(s) | Trout Monitoring Plan, Aquatic Macroinvertebrate Monitoring Plan, Geomorphology Monitoring Plan, Riparian Vegetation Monitoring Plan, Bald Eagle Monitoring Plan, Hardhead Monitoring Plan, Amphibian and Aquatic Reptile Monitoring Plan, Sierra Nevada Yellow-legged Frog Monitoring, Bear Monitoring Plan, Large Woody Debris Monitoring Plan, and Water Temperature Monitoring Plan |
| PG&E | Pacific Gas and Electric Company |
| QC | Quality control |
| Report | Annual Monitoring Report |
| RTK | Real-time kinematic |
| RTS | robotic total station |
| RWB | Reach-wide benthos |
| SAFIT | Southwestern Association of Freshwater Invertebrate Taxonomists |
| SFAR | South Fork American River |
| Sierra IBI | Sierra Index of Biological Integrity |
| SL | Standard Length |
| SMUD | Sacramento Municipal Utility District |
| SNYLF | Sierra Nevada Yellow-legged Frog |
| SWAMP | Surface Water Ambient Monitoring Program |
| SWRCB | State Water Resources Control Board |
| TL | Total Length |
| UARP | Upper American River Project |
| USGS | U.S. Geological Survey |
| USFS | U.S. Department of Agriculture, Forest Service |
| USFWS | U.S. Fish and Wildlife Service |
| VESs | Visual Encounter Surveys |
| WPT | Western pond turtle |
| XS | Cross-section |
| YOY | young of-year |

# 1.0 INTRODUCTION AND BACKGROUND

This Annual Monitoring Report (Report) addresses monitoring requirements set forth in Sacramento Municipal Utility District's (SMUD) Trout Monitoring Plan, Aquatic Macroinvertebrate Monitoring Plan, Geomorphology Monitoring Plan, Riparian Vegetation Monitoring Plan, Bald Eagle Monitoring Plan, Hardhead Monitoring Plan, Amphibian and Aquatic Reptile Monitoring Plan, Sierra Nevada Yellow-legged Frog Monitoring, Bear Monitoring Plan, Large Woody Debris Monitoring Plan, and Water Temperature Monitoring Plan (Plans). Requirements of the Plans are found in State Water Resources Control Board (SWRCB) Conditions 8 and 10, and U.S. Department of Agriculture, Forest Service (USFS) 4(e) Condition 31 and 35, located in Appendices A and B, respectively, of the Federal Energy Regulatory Commission's (FERC) Order Issuing New License for the Upper American River Project (UARP; FERC Project No. 2101), dated July 23, 2014 (FERC 2014) and the USFS section 4(e) Conditions 14 and 15 for the Slab Creek Flow Facility Project License Amendment (USFS 2015). The Plans were developed in consultation with the SWRCB, USFS, California Department of Fish and Wildlife (CDFW), and U.S. Fish and Wildlife Service (USFWS). This Report presents the results of implementing the Plans in 2019.

SMUD owns and operates the UARP which is licensed by FERC. The UARP lies within El Dorado and Sacramento counties, primarily within lands of Eldorado National Forest (ENF). The UARP consists of three major storage reservoirs: Loon Lake, Union Valley, and Ice House (with a combined capacity of approximately 379,000 acre-feet), eight smaller regulating or diversion reservoirs, and eight powerhouses. The UARP also includes recreation facilities containing over 700 campsites, five boat ramps, hiking paths, and bicycle trails at the reservoirs.

All minimum streamflows required by the new FERC License were implemented in October 2014; therefore, Year 1 as it pertains to the Monitoring Program is 2015. Pre- and post-2014 minimum streamflow requirements (i.e., “old” license and “new” license) are provided in Appendix A1.

This Report summarizes results of Monitoring Year 5 (2019). Refer to Section 1.2 of this report for information about the frequency of resource-specific monitoring effort required by the License. Some monitoring activities have specific reporting requirements and deadlines in lieu of this Report.

For context in considering the monitoring results, the California Department of Water Resources (DWR) May Bulletin 120 forecast the 2019 water year type as Wet, and the UARP was operated under this scenario for the remainder of the water year. The final 2019 water year type remained classified as Wet based on DWR's Full Natural Flow record for the American River at Folsom in October 2019.

## 1.1 MONITORING SITES

Monitoring sites are depicted in Figure 1-1 through Figure 1-3 for all 2019 study locations.

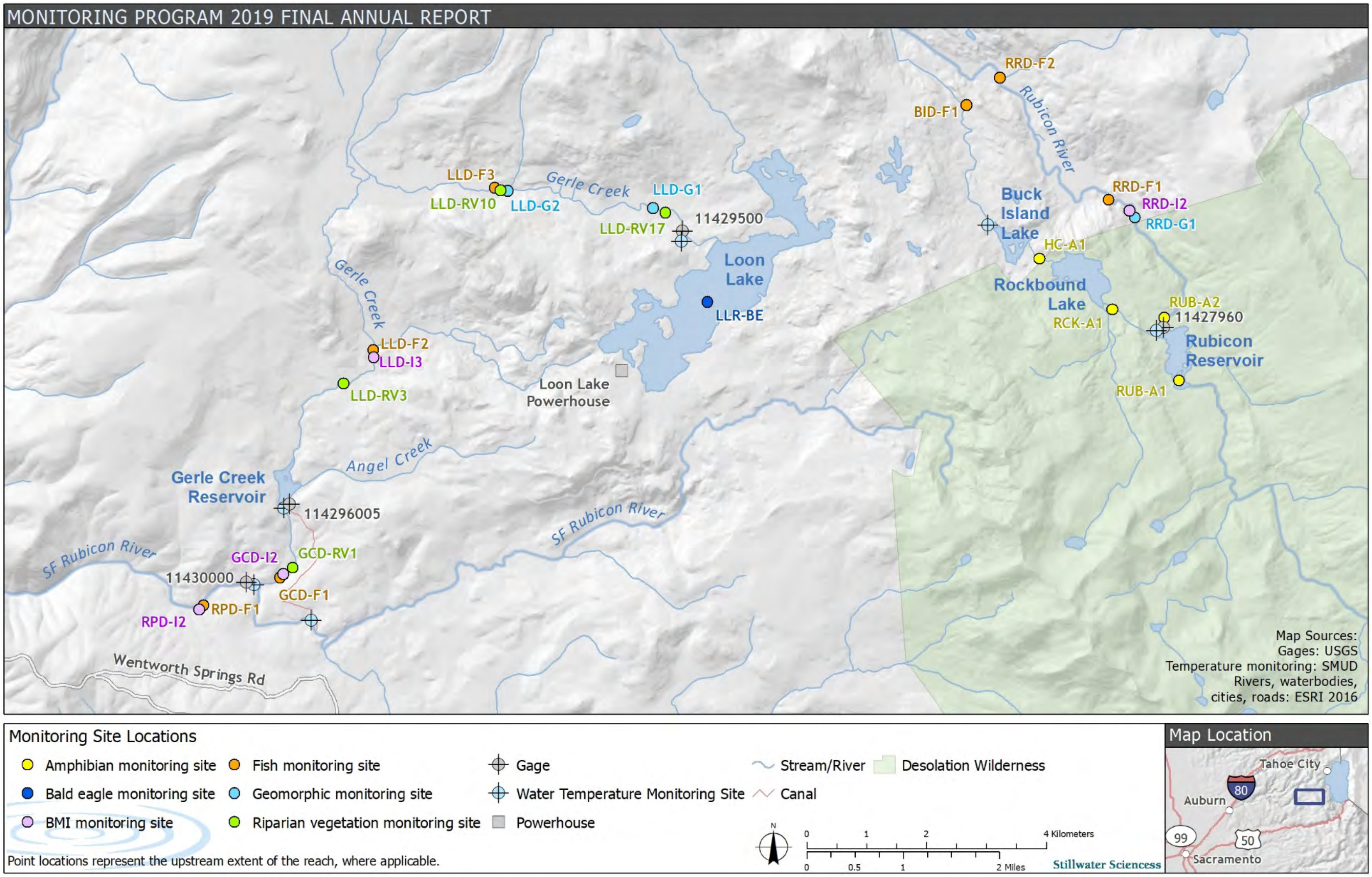


**Figure 1-1. Monitoring locations downstream of Rubicon Reservoir, Rockbound Lake, Loon Lake, and Gerle Creek Reservoir.**

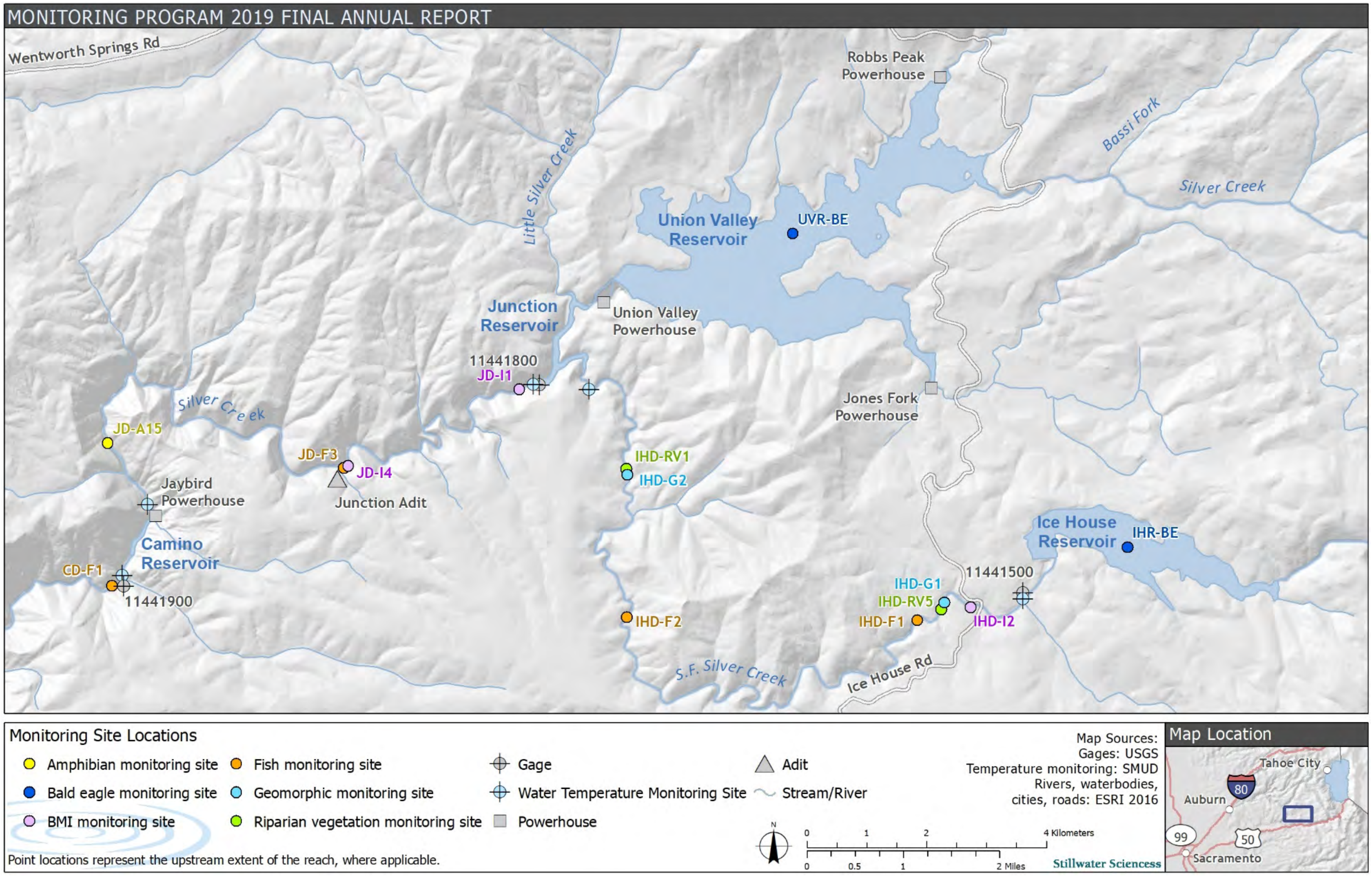


**Figure 1-2. Monitoring locations downstream of Ice House Reservoir, Union Valley Reservoir, Junction Reservoir, and Camino Reservoir.**

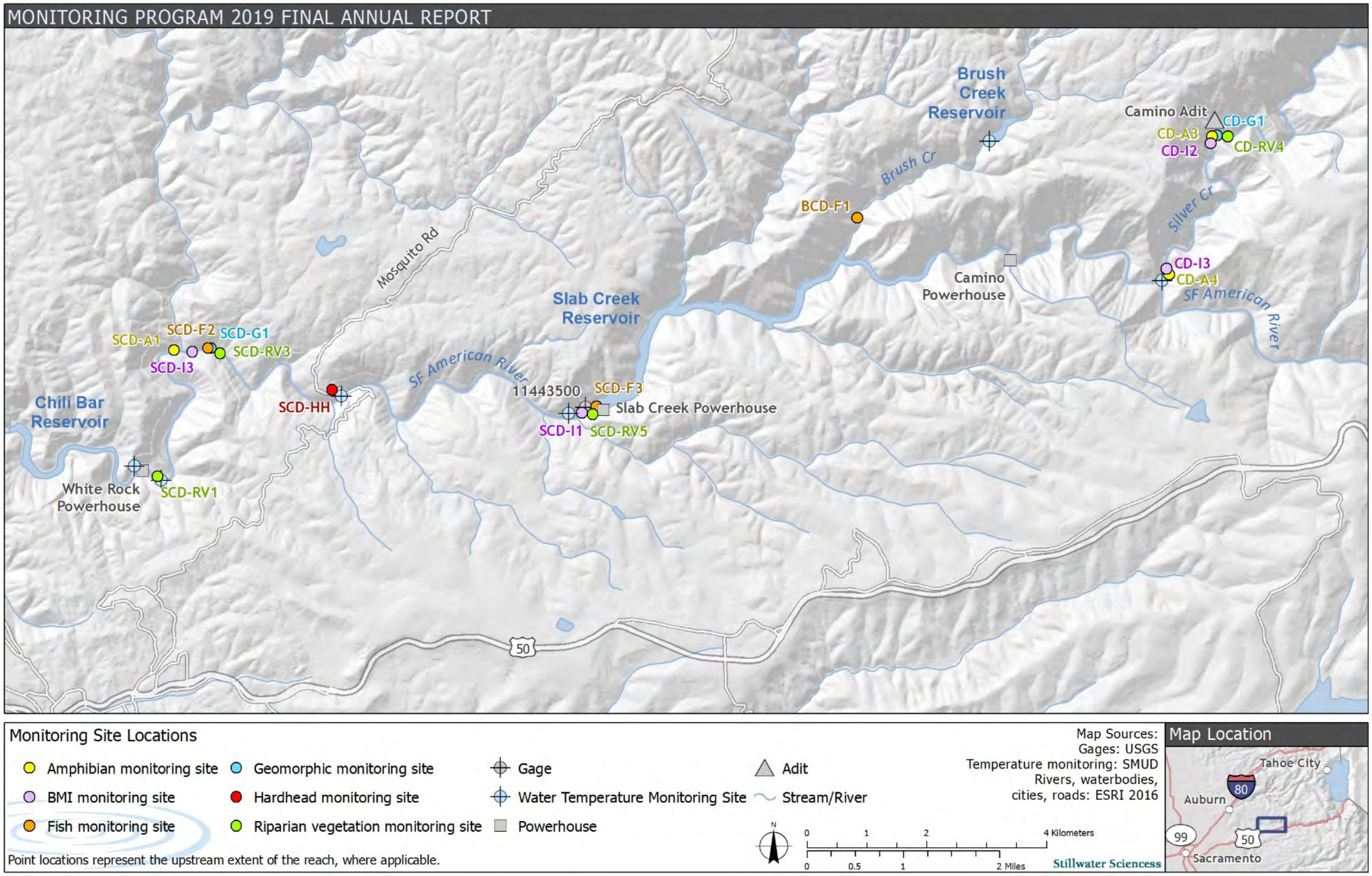


**Figure 1-3. Monitoring locations downstream of Camino Reservoir (continued), Brush Creek Reservoir, and Slab Creek Reservoir.**

## 1.2 MONITORING FREQUENCY

The Monitoring Program covers monitoring to be conducted during all years until a new license is issued. Table 1-1 describes the monitoring frequencies for the first five years of the License. As noted in Section 1.3, some monitoring activities have specific reporting requirements and deadlines in lieu of this Report.

**Table 1-1. Monitoring Program Frequency First Five Years.**

| | License Monitoring Year | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| **Monitoring Effort** | **(2015)** | **(2016)** | **(2017)** | **(2018)** | **(2019)** |
| Trout Population Monitoring | | | | | X |
| Hardhead Population Monitoring | | X | X | | X |
| Aquatic Macroinvertebrate | | | | | X |
| Amphibian and Aquatic Reptile Monitoring (including Foothill Yellow-legged Frog) | | X | X | X | X |
| Sierra Nevada Yellow-legged Frog (formerly Mountain Yellow-legged Frog) Monitoring | | | | | X |
| Riparian Vegetation Monitoring | | | | | X |
| Algae Species Identification and Monitoring | | X | | | |
| Geomorphology (Sensitive Site Investigation and Mitigation Plan Development) | X | X | | | |
| Geomorphology (Continuing Evaluation of Representative Channel Areas) | | | | | X |
| Water Temperature | | X | X | X | X |
| *In Situ* Water Quality | X | X | X | X | X |
| Bacteria Monitoring | X | X | X | X | X |
| Metals bioaccumulation | | X | | | |
| Water General Chemistry | | | X | | |
| Robbs Peak Powerhouse Entrainment | X | X | X | | |
| Bear Management Monitoring | | X | X | X | X |
| Bald Eagle Monitoring | | X | X | X | X |
| Large Woody Debris | X | X | X | X | X |

## 1.3 LITERATURE CITED

FERC (Federal Energy Regulatory Commission). 2014. Federal Energy Regulatory Commission Order 148 FERC 62,070 Issuing New License for the Sacramento Municipal Utility District Upper American River Hydroelectric Project No. 2101. Issued July 23.

# 2.0 TROUT

## 2.1 OBJECTIVES

The objective of the Trout Monitoring Plan is to evaluate changes in trout populations throughout the UARP area related to implementation of new minimum flow requirements under the 2014 FERC License (SMUD 2016).

## 2.2 METHODS

Site locations are shown in Figures 1-1 through 1-3, and methods are described in Section 4.0 of the Trout Monitoring Plan. The following methodological variations were implemented during the 2019 monitoring and analysis:

- Sites JD-F3 and SCD-F2 were surveyed via snorkeling rather than electrofishing due to access constraints (inability to safely transport gear to the site) and safety concerns caused by high flow conditions, respectively.
- The downstream extent of Site RRD-F2 and upstream extent of Site RPD-F1 were reduced by 45 feet and 20 feet, respectively, due to scour pools preventing effective block net placement.
- The upstream extent of Site LLD-F2 was extended 20 feet upstream. The original location of the upstream block net was immediately below a high gradient riffle, such that high flow through the riffle (under the new minimum flows) prevented block net deployment.
- A maximum-likelihood estimate was used to aid in the computation of trout density and biomass at sites RRD-F2 and IHD-F1, where low observation numbers and poor depletion patterns prevented reliable Zippin estimates. For these two sites, MicroFish 3.0 (Van Deventer and Platts 1989) was used to generate population estimates and capture probabilities, which were then used to estimate trout density and biomass.

## 2.3 RESULTS

Nine fish species were documented during the 2019 surveys, including six native and three non-native species, compared to 12 fish species previously documented during the 2002–2005 surveys (Table 2-1). The distribution of species observed among sites decreased from prior surveys to 2019; however, this may reflect a single year of sampling (in 2019) compared to multiple years of sampling in prior years (2002–2005; Table 2-1). The distribution of rainbow trout was similar to prior years, except for in the Buck Island Dam and Junction Dam reaches, where they were not observed in 2019. The distribution of brown trout was also similar to prior years, except for the Junction Dam and Camino Dam reaches, where they were not observed in 2019. The Slab Creek Dam Reach continued to have the greatest number (richness) of species, with five species observed in 2019 (Table 2-1). Fish survey data are provided in Appendix B1.

**Table 2-1. Fish Species Composition for the SMUD UARP Study Reaches, 2002–2019.[a]**

| Fish Species | | Stream Reach[b] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | RRD | BID | LLD | GCD | RPD | IHD | JD | CD | SCD |
| **Native** | | | | | | | | | | |
| California roach | *Hesperoleucus symmetricus* | ● □ | ● □ | | | | | | | ● |
| Hardhead | *Mylopharodon conocephalus* | | | | | | | | | ● |
| Hitch | *Lavina exilicauda* | ● | | | | | | | | |
| Rainbow trout | *Oncorhynchus mykiss* | ● □ | ● | ● □ | ● □ | ● □ | ● □ | ● | ● □ | ● □ |
| Riffle sculpin | *Cottus gulosus* | | | | | | | | | ● |
| Sacramento pikeminnow | *Ptychocheilus grandis* | | | | | | | | | ● □ |
| Sacramento sucker | *Catostomus occidentalis* | ● | □ | | | | ● □ | ● | ● | ● □ |
| Sculpin spp. | *Cottus spp.* | | | | | | | | | ● □ |
| Speckled dace | *Rhinichthys osculus* | ● □ | | | | | | | | ● |
| **Non-native** | | | | | | | | | | |
| Brook trout | *Salvelinus fontinalis* | ● | | | | | | | | |
| Brown trout | *Salmo trutta* | ● □ | | ● □ | ● □ | ● □ | ● □ | ● | ● | ● □ |
| Golden shiner | *Notemigonus crysoleucas* | | ● □ | | | | | | | |
| Sunfish spp. | *Lepomis spp.* | | | | | | | | | □ |

[a] ● 2002, 2003, 2004, and/or 2005 Surveys □ 2019 surveys
[b] BID = Buck Island Dam; IHD = Ice House Dam; RPD = Robbs Peak Dam
CD = Camino Dam; JD = Junction Dam; RRD = Rubicon Dam
GC = Gerle Creek Dam; LLD = Loon Lake Dam; SCD = Slab Creek Dam

Overall, rainbow and brown trout remained the dominant fish species throughout the UARP study area in 2019 (Figure 2-1); however, notable changes in species relative abundance occurred at several sites compared to prior survey years. For example, the relative abundance of trout increased in 2019 compared to prior survey years at sites IHD-F2 and SCD-F2, reflecting decreased abundance of sucker, sculpin, and minnow species. Also, the relative abundance of brown trout decreased in 2019 compared to prior survey years at several sites (GCD-F1, RPD-F1, IHD-F1, and LLD-F2), with Site LLD-F2 transitioning from brown trout to rainbow trout dominant (Figure 2-1).

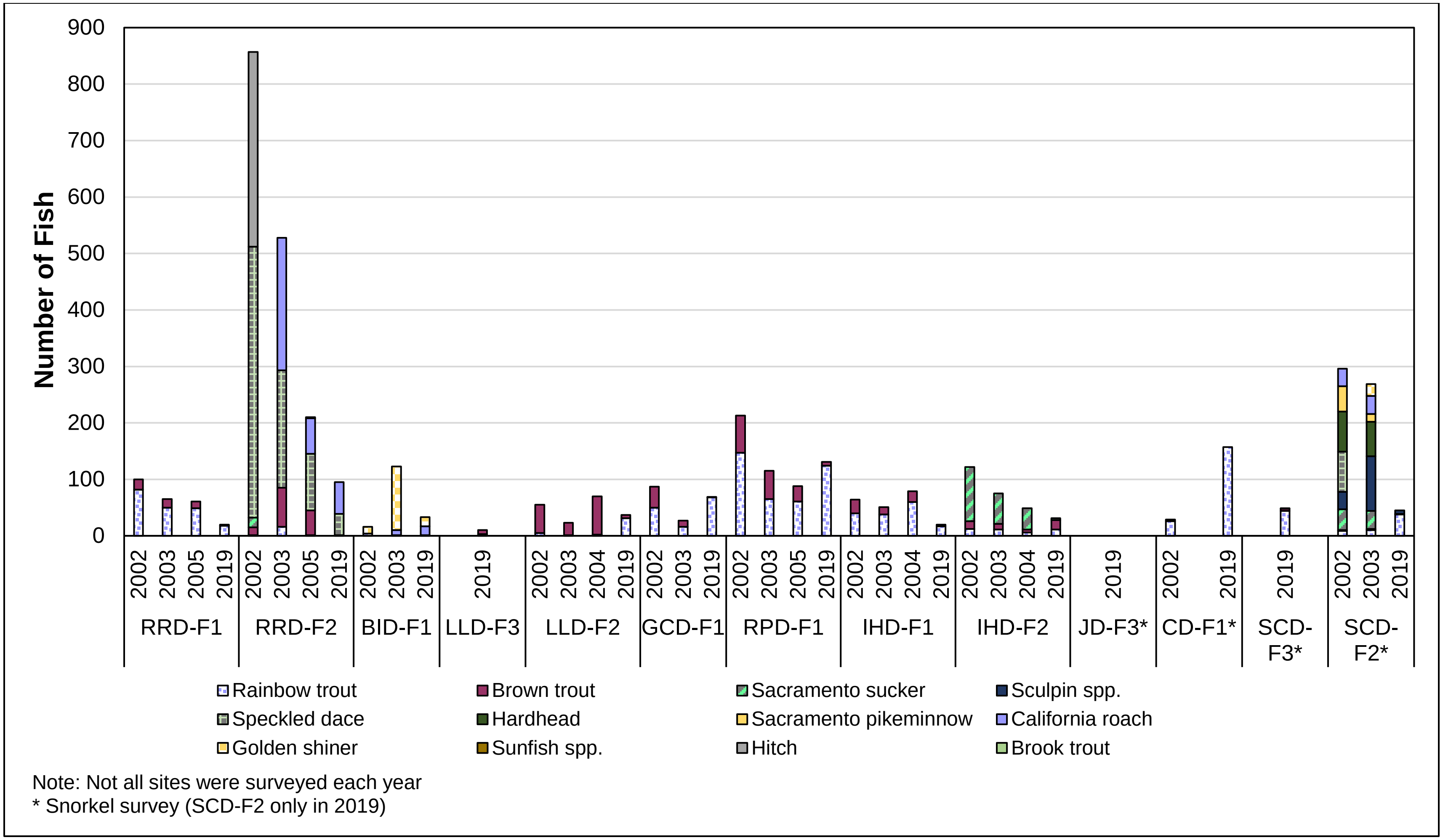


**Figure 2-1. Fish species relative abundance among UARP trout monitoring sites, 2002–2019.**

Trout biomass was estimated for sites that were sampled by electrofishing. Trout (rainbow and brown trout, combined) density was estimated for sites that were sampled by multiple-pass electrofishing and snorkel surveys. In general, trout densities were lower in 2019 than in 2002–2005 (Table 2-2); however, densities varied among sites. In 2019, trout densities at sites located at higher elevations (i.e., sites RRD-F1, RRD-F2, BID-F1, LLD-F3, and LLD-F2) were lower than in previous survey years, whereas trout densities at the middle and lower elevation sites (i.e., sites GCD-F1 and CD-F1, respectively) were either higher or within range of previous survey years (Figure 2-2). Similarly, average trout biomass was lower in 2019 than in previous survey years (Table 2-2) and included the lowest recorded levels at seven of the nine sites surveyed (Figure 2-3). Detailed trout biomass and density data are provided in Appendix B2.

**Table 2-2. Average Trout Density and Biomass, 2002–2019.[a,b]**

| | 2002 | 2003 | 2004 | 2005 | 2019 |
|---|---|---|---|---|---|
| **Density (trout/acre)** | 278.2 | 293.0 | 432.9 | 348.5 | 167.9 |
| **Biomass (lbs/acre)** | 20.4 | 13.4 | 30.2 | 13.7 | 9.4 |

lbs = pounds

[a] Averages for the monitoring years 2002–2005 exclude sites which were not surveyed in 2019.

[b] Average density was computed from sites that were surveyed by electrofishing and snorkel methods, while biomass only included sites that were electrofished.

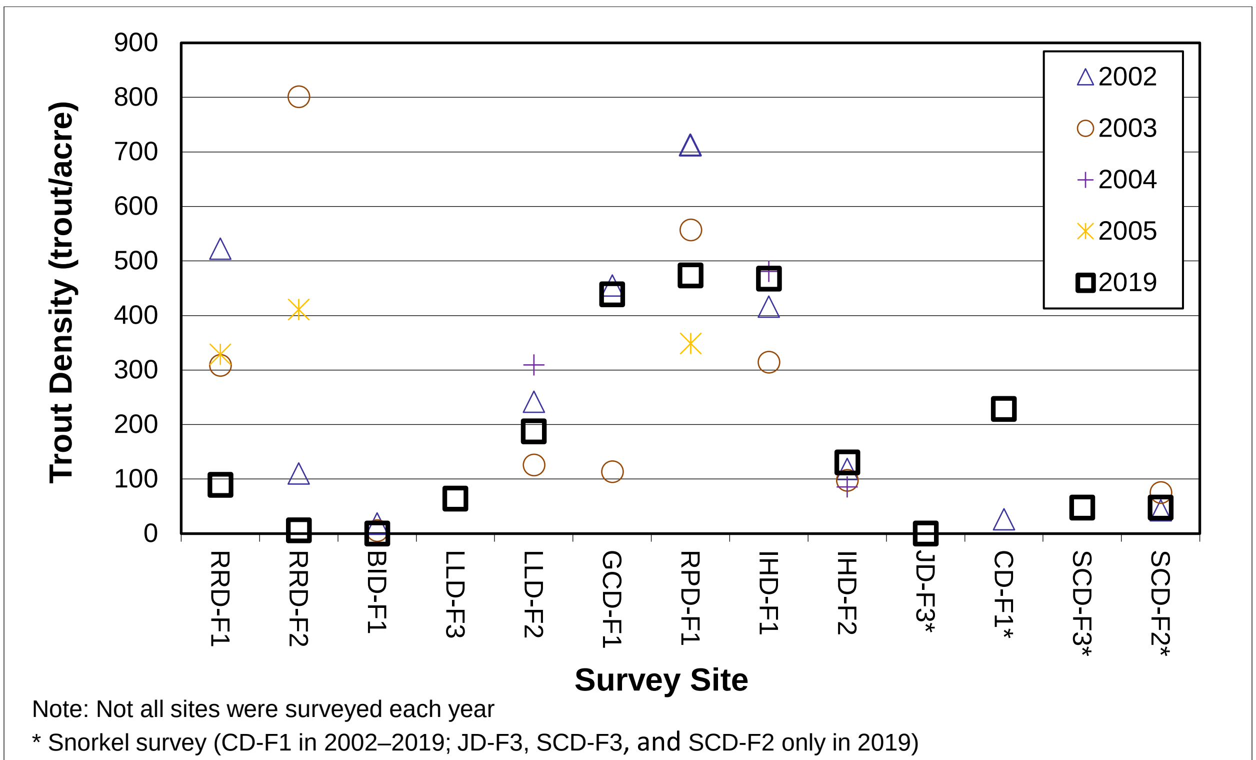


**Figure 2-2. Trout density in the UARP study area by site, arranged left to right by decreasing elevation, 2002–2019.**

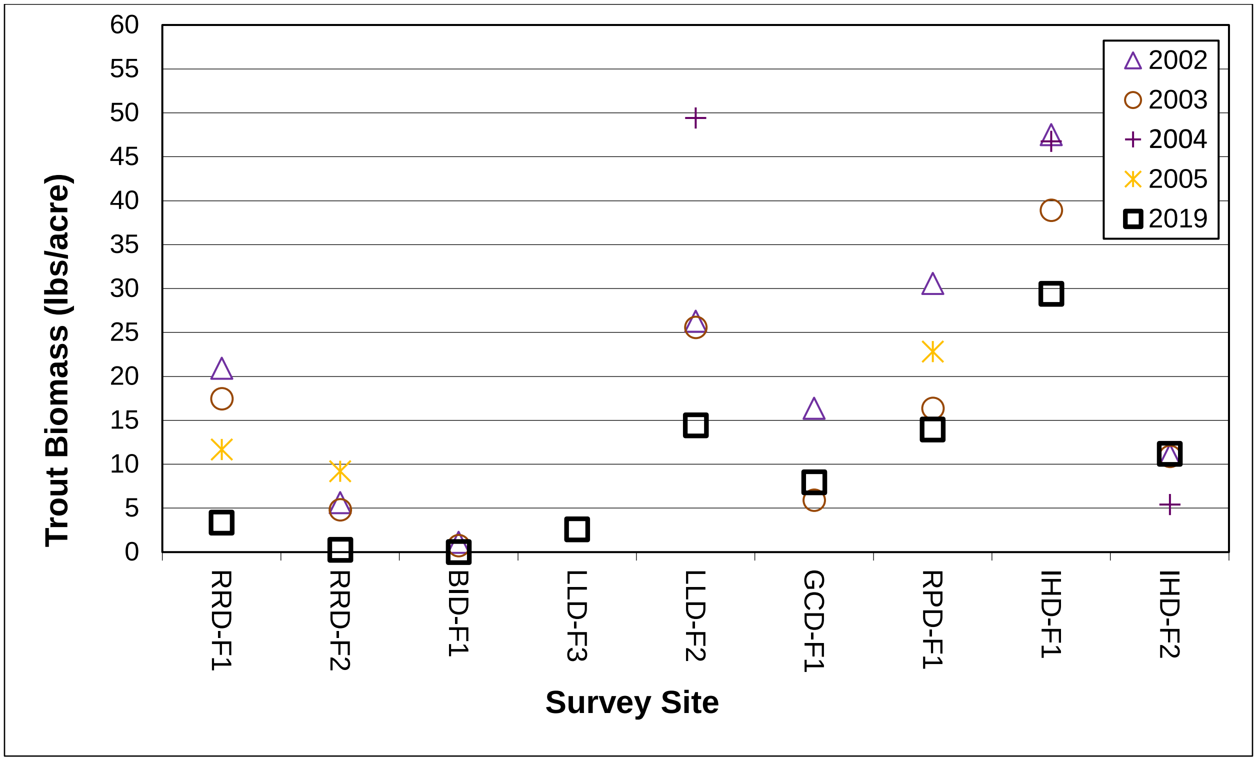


**Figure 2-3. Trout biomass in the UARP study area by site, arranged left to right by decreasing elevation, 2002–2019.**

Similar to trout density, the number of catchable trout per mile (trout that are greater than 152 millimeters (mm; 6 inches [in.]) decreased in higher elevation streams (Rubicon River, Little Rubicon River, Gerle Creek, and South Fork Rubicon River) and increased in lower elevation streams (South Fork Silver Creek, Silver Creek, and South Fork. American River) in 2019 compared to prior years (Figure 2-4).

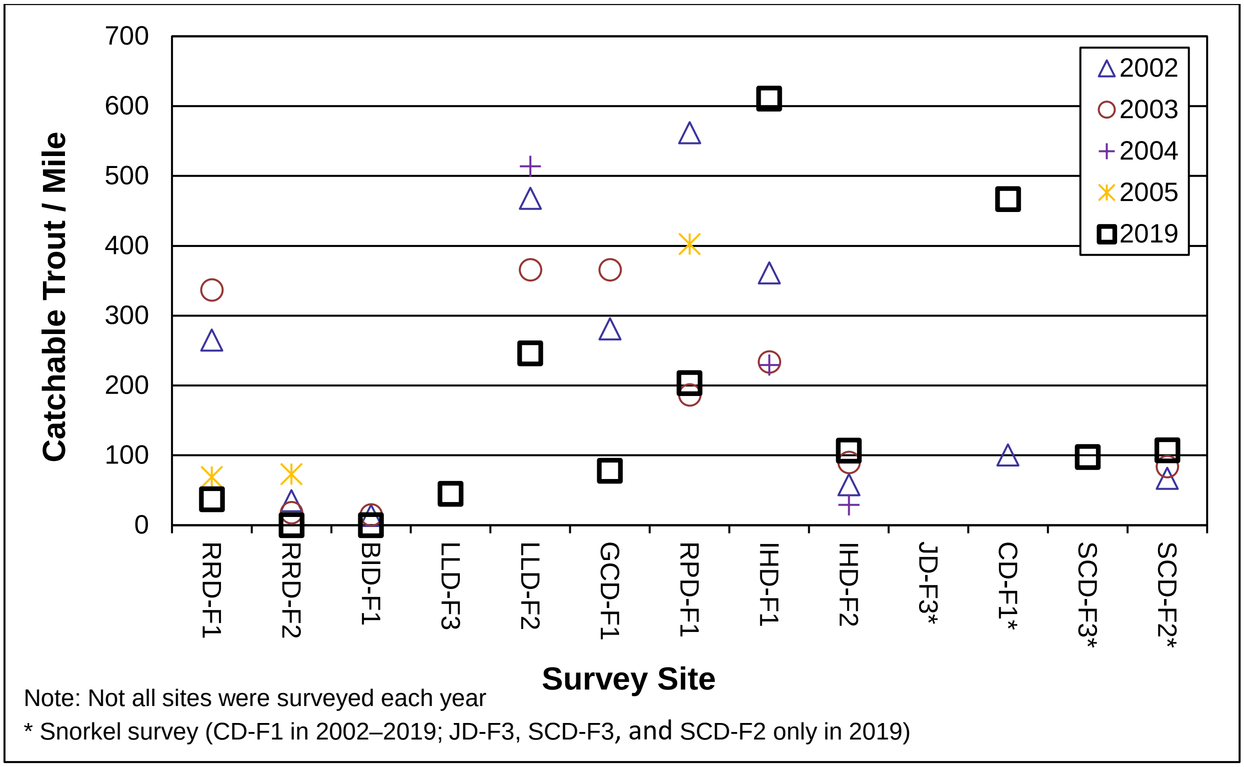


**Figure 2-4. Number of catchable trout (>152 mm) per mile in the UARP study area by site, arranged left to right by decreasing elevation, 2002–2019.**

Condition factors (K-values) indicate that rainbow trout were generally in good condition in 2019[1]; however, the average condition factor for all sites was lower than prior survey years (Figure 2-5, Table 2-3, and Appendix B3). The condition factors also indicate that brown trout were in good condition in 2019, and their average condition factor was comparable to previous survey years (Figure 2-6, Table 2-3, and Appendix B3).

[1] Condition factors in western Sierran streams typically range from 0.8 to 2.0, with a mean condition factor generally 1.2 or below (Beak 1991, EA 1986, Ebasco Environmental 1993, Wilcox 1994, Hanson Environmental 2005). Rabe (1967) reported the condition factor to be between 0.9 and 1.1 for rainbow trout in Alpine lakes. Arismendi et al. (2011) cites broader ranges (0.5 to 2.0); however, condition is dependent on the time of sampling, the species, the strain of trout, state of sexual maturity, and the way fish length is defined (e.g., fork length [FL], total length [TL], or standard length [SL]), which is not often documented with the results. Total length has been used as the standard of measurement throughout the 2002–2019 UARP trout monitoring surveys.

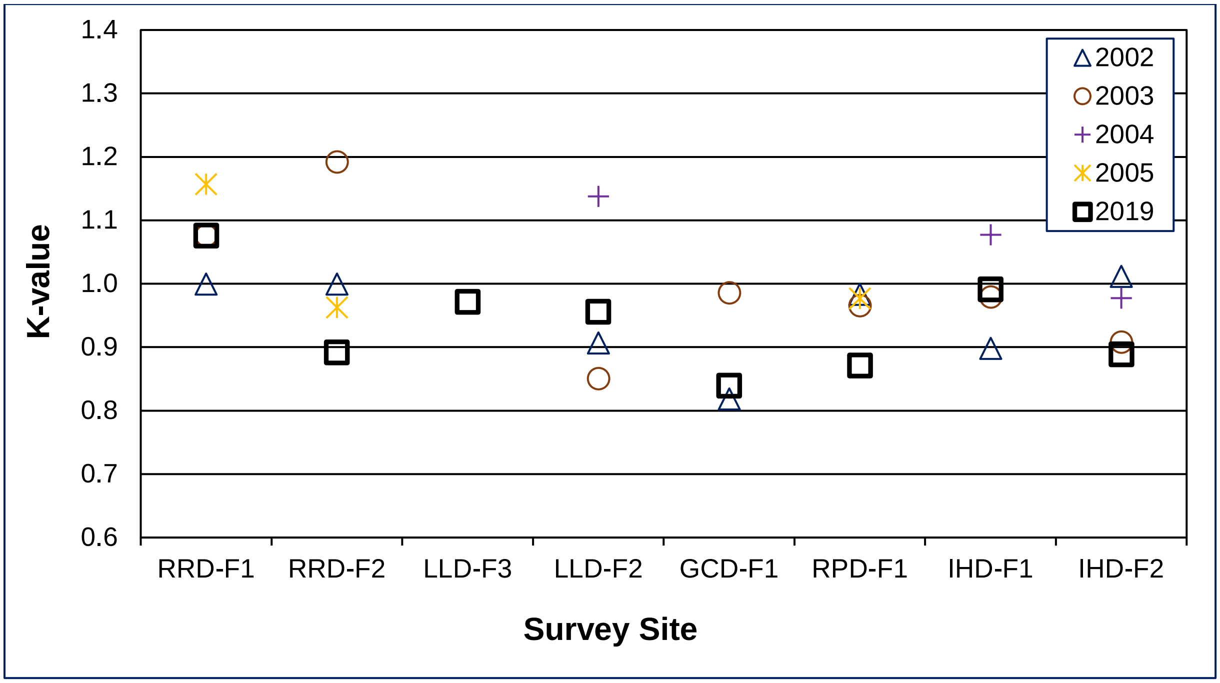


**Figure 2-5. Condition factors for rainbow trout captured by electrofishing in the UARP study area by site, arranged left to right by decreasing elevation, 2002–2019.**

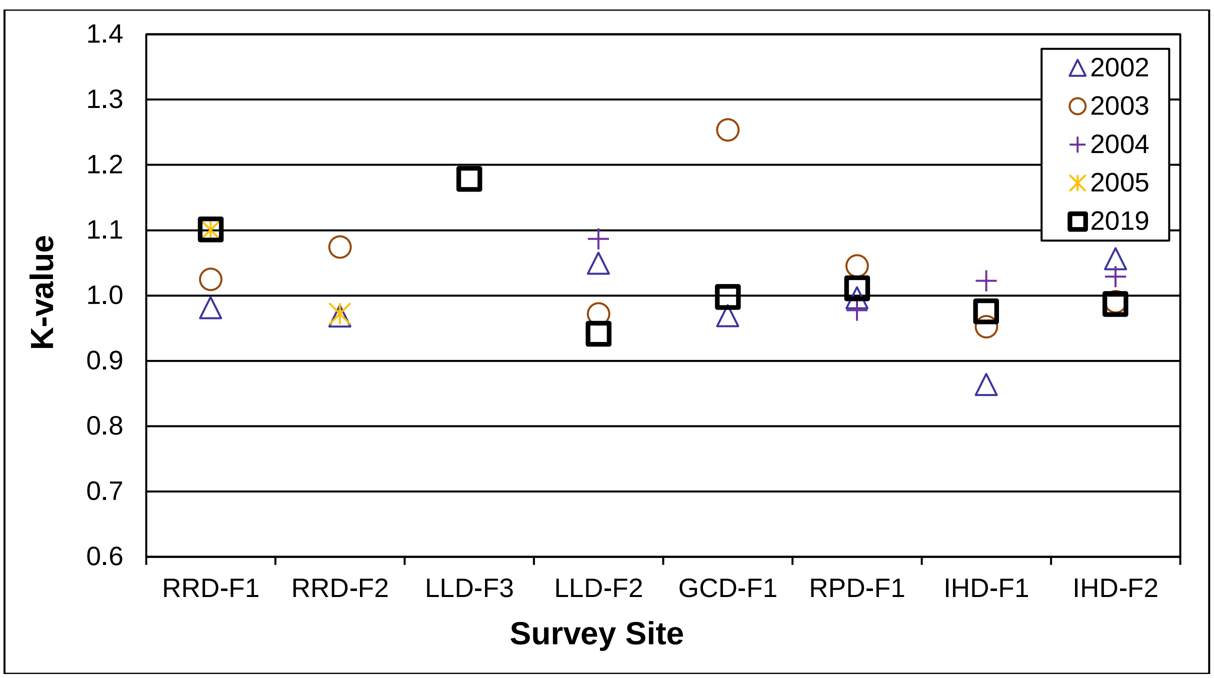


**Figure 2-6. Condition factors for brown trout captured by electrofishing in the UARP study area by site, arranged left to right by decreasing elevation, 2002–2019.**

**Table 2-3. Condition Factors for Rainbow and Brown Trout in the UARP Study Area by Site, 2002–2005 and 2019.[a]**

| Year | Survey Site | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | RRD-F1 | RRD-F2 | LLD-F3 | LLD-F2 | GCD-F1 | RPD-F1 | IHD-F1 | IHD-F2 | Average |
| **Rainbow trout** | | | | | | | | | |
| 2019 | 1.08 | 0.89 | 0.97 | 0.96 | 0.84 | 0.87 | 0.99 | 0.89 | **0.94** |
| 2005 | 1.16 | 0.96 | -- | -- | -- | 0.98 | -- | -- | **1.03** |
| 2004 | -- | -- | -- | 1.14 | -- | -- | 1.08 | 0.98 | **1.06** |
| 2003 | 1.08 | 1.19 | -- | 0.85 | 0.99 | 0.97 | 0.98 | 0.91 | **0.99** |
| 2002 | 1.00 | 1.00 | -- | 0.91 | 0.82 | 0.98 | 0.90 | 1.01 | **0.95** |
| **Average** | **1.08** | **1.01** | **0.97** | **0.96** | **0.88** | **0.95** | **0.99** | **0.95** | **0.98** |
| **Brown trout** | | | | | | | | | |
| 2019 | 1.10 | -- | 1.18 | 0.94 | 1.00 | 1.01 | 0.98 | 0.99 | **1.03** |
| 2005 | 1.10 | 0.97 | -- | -- | -- | -- | -- | -- | **1.04** |
| 2004 | -- | -- | -- | 1.09 | -- | 0.98 | 1.02 | 1.03 | **1.03** |
| 2003 | 1.02 | 1.07 | -- | 0.97 | 1.25 | 1.05 | 0.95 | 0.99 | **1.04** |
| 2002 | 0.98 | 0.97 | -- | 1.05 | 0.97 | 1.00 | 0.86 | 1.06 | **0.98** |
| **Average** | **1.05** | **1.00** | **1.18** | **1.01** | **1.07** | **1.01** | **0.95** | **1.02** | **1.02** |

-- = not sampled
[a] Condition factors calculated using TL as the metric for length measurement.

Length-at-age data used to determine approximate age classes of each trout species are provided in Table 2-4. Scale data from representative fish from all sites were combined for the analysis to supplement length-at-age data from the literature. Scale analysis data are provided in Appendix B4.

**Table 2-4. Trout Length-at-Age Summary.**

| Reference | Length-at-Age (mm TL) | | | | |
|---|---|---|---|---|---|
| | YOY | 1+ | 2+ | 3+ | 4+ |
| **Rainbow trout** | | | | | |
| Snider and Linden (1981), Moyle (2002) | <100 | 130–170 | 180–220 | 230–260 | --[b] |
| 2019 Scale Analysis | --[a] | 122–181 (n=27) | 187–212 (n=4) | --[b] | --[b] |
| **Brown trout** | | | | | |
| Moyle (2002) | <70 | 70–220 | 130–360 | 230–450 | -- |
| 2019 Scale Analysis | 72–90 (n=15) | 119–164 (n=6) | 147–222 (n=6) | 240–352 (n=4) | 325 (n=1) |

mm=millimeters; TL=Total Length; YOY=young-of-year
[a] Rainbow trout YOY scales were not collected due to potential harm to the fish and the scale's small/developing nature
[b] No fish in this size class collected

The following sections discuss results from individual reaches and sites. Site photos and habitat data are provided in Appendix B5 and Appendix B6, respectively.

### 2.3.1 Site RRD-F1

This sampling site is located approximately 1.6 miles downstream of Rubicon Dam, just upstream of Rubicon Springs. This site included bedrock and boulder-dominated riffle and run complexes with a small amount of pool habitat. The upper segment of this site had transitioned from almost entirely pool habitat in 2002 and 2003 to being run-dominant in 2019. This site was surveyed via electrofishing in 2002, 2003, 2005, and 2019; it was divided into upper and lower segments during sampling in all years for sampling efficiencies, although the data are presented for the entire site.

Both rainbow and brown trout were captured at this site in all survey years, with rainbow trout as the dominant species and little change in composition across years (Figure 2-1). Trout density and biomass in 2019 were much lower than all other years sampled (Figure 2-7).

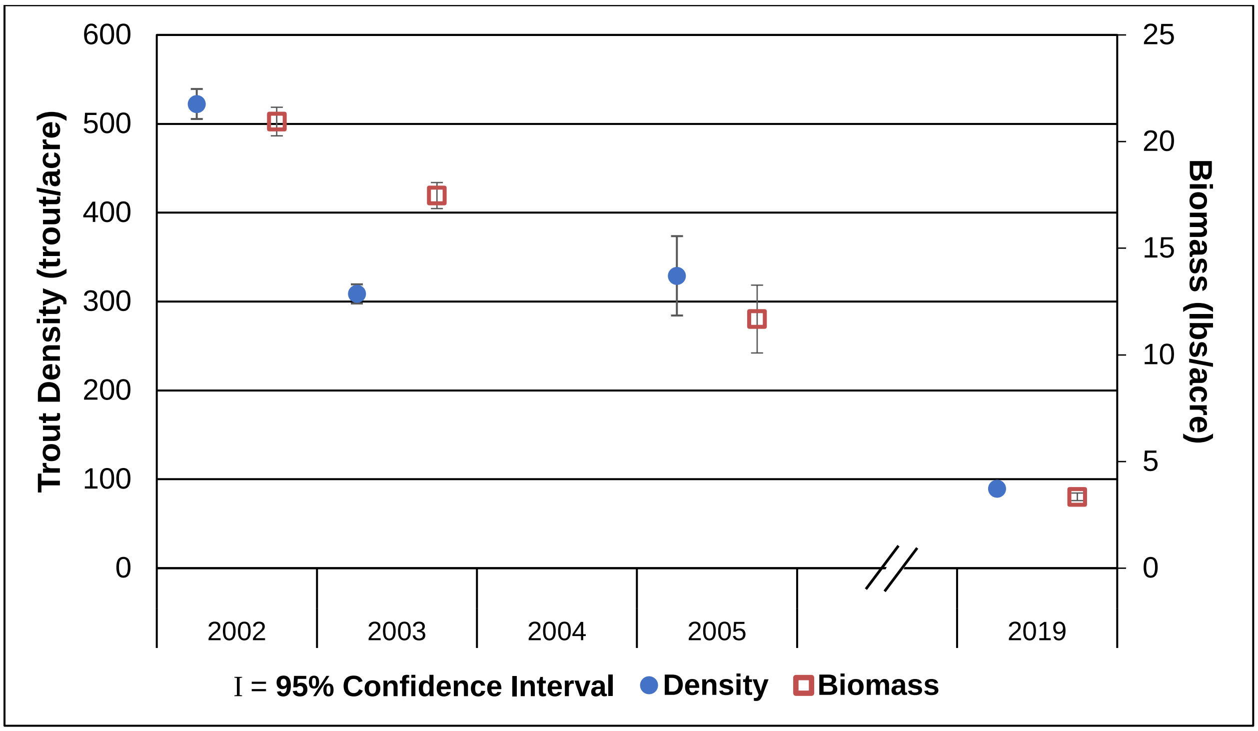


**Figure 2-7. Trout density and biomass at Site RRD-F1, Rubicon River, Rubicon Dam Reach, 2002–2019.**

Rainbow trout ranged in age from young-of-year (YOY) to age 2+ in 2019 (Figure 2-8). There was a flat distribution among age classes, which is not typical and indicates low recruitment in 2018 and 2019. Prior years, especially 2002, had a more typical length-frequency distribution, where highest numbers of YOY were followed by lower numbers of subsequent age classes.

Only two brown trout were observed at Site RRD-F1 in 2019. Both were YOY fish, indicating limited recruitment in late 2018 and early 2019. In previous monitoring years, small numbers of trout were observed in the 1+ and 2+ age classes which also indicated poor recruitment and low survival in those years (Figure 2-9).

The average condition factors for rainbow and brown trout (K=1.08 and 1.10, respectively) in 2019 suggests that trout were in good condition, which was generally consistent with previous monitoring years (Table 2-3, Figure 2-5, and Figure 2-6).

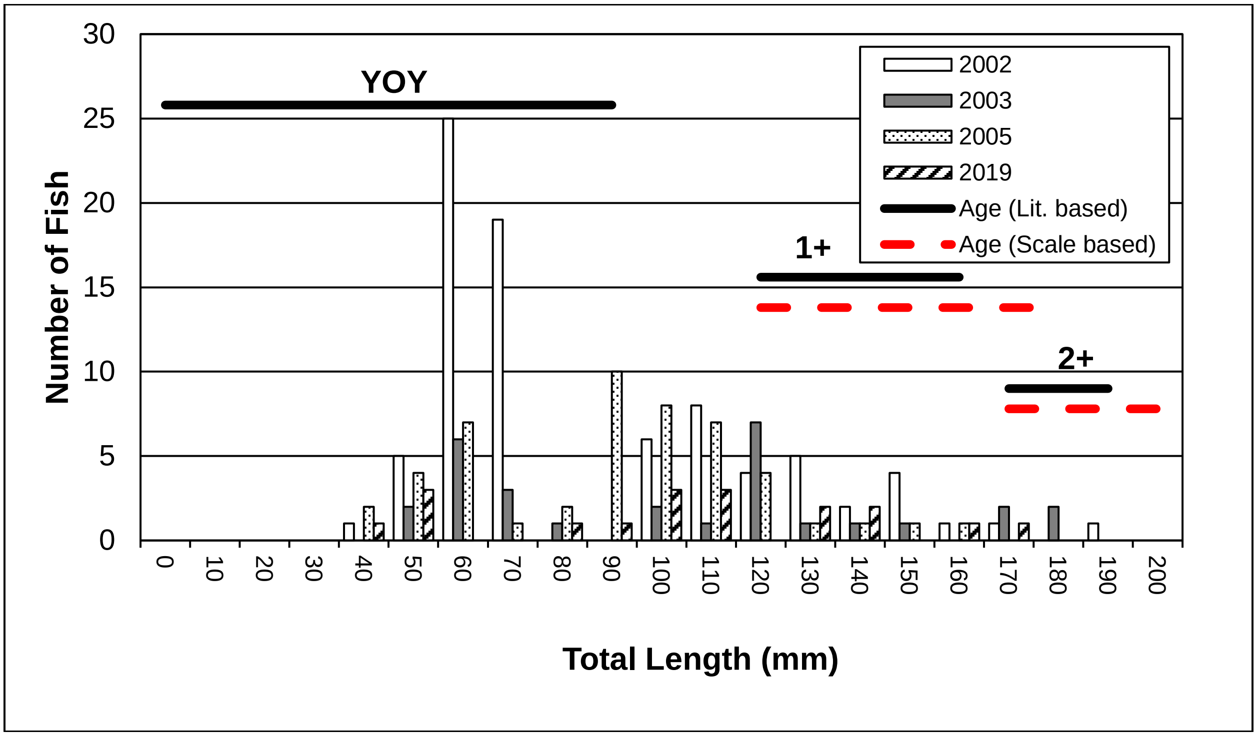


**Figure 2-8. Length-frequency and age-class distribution of rainbow trout at Site RRD-F1, Rubicon River, Rubicon Dam Reach, 2002–2019.**

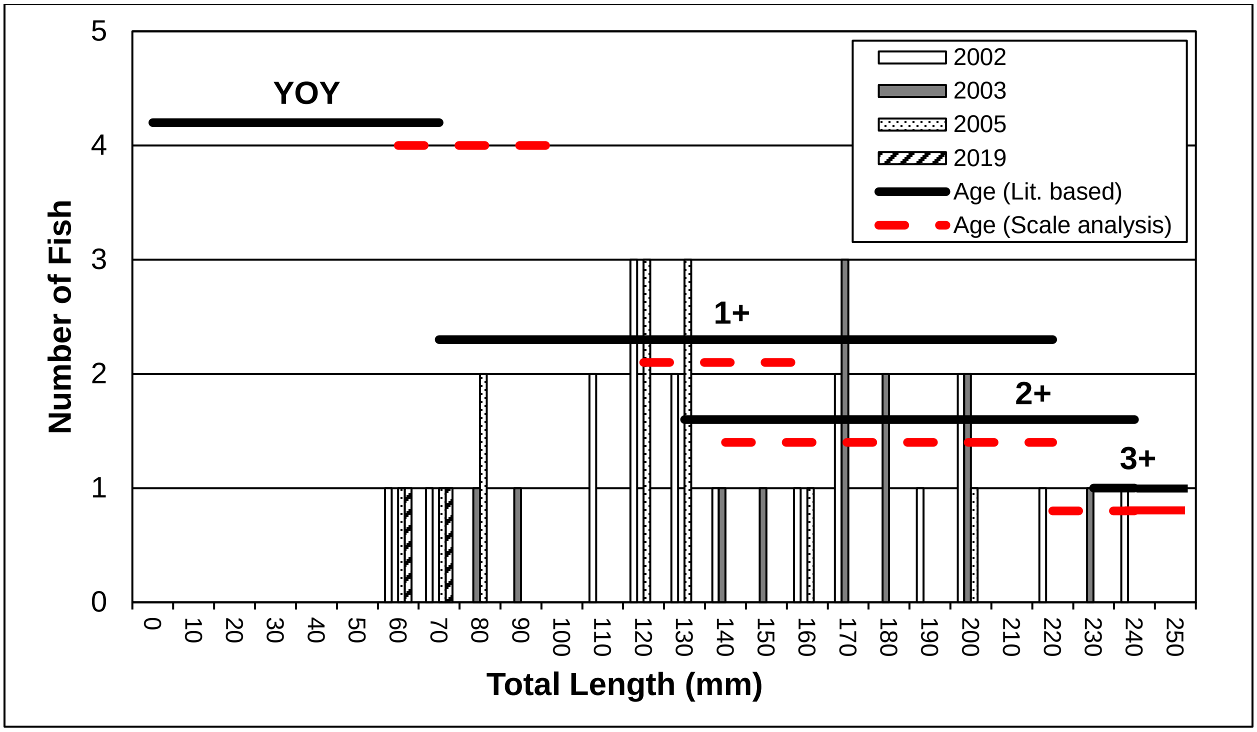


**Figure 2-9. Length-frequency and age-class distribution of brown trout at Site RRD-F1, Rubicon River, Rubicon Dam Reach, 2002–2019.**

2.3.2 <u>Site RRD-F2</u>

This sampling site is located at the downstream end of Rubicon Springs Valley, at the confluence of the Rubicon River and Miller Creek, 3.5 miles downstream of Rubicon Dam. The site included sand dominant pool and run habitat with limited riffle habitat. It was surveyed via electrofishing in 2002, 2003, 2005, and 2019 and was sampled as a single segment in 2019.

Fish species observed in 2019 included speckled dace, California roach, and rainbow trout, which is consistent with prior monitoring years; however, brown trout had also been previously observed (Figure 2-1). Trout density and biomass were lower in 2019 than all other monitoring years (Figure 2-10). The single rainbow trout observed was age 1+, indicating poor recruitment at this site in 2019. Previous monitoring years showed more typical length-frequency distributions for rainbow and brown trout, with higher numbers of YOY followed by lower numbers in subsequent age classes (Figures 2-11 and 2-12). The average condition factor for rainbow trout in 2019 (K=0.89) was also the lowest of all years sampled (Table 2-3, Figure 2-5).

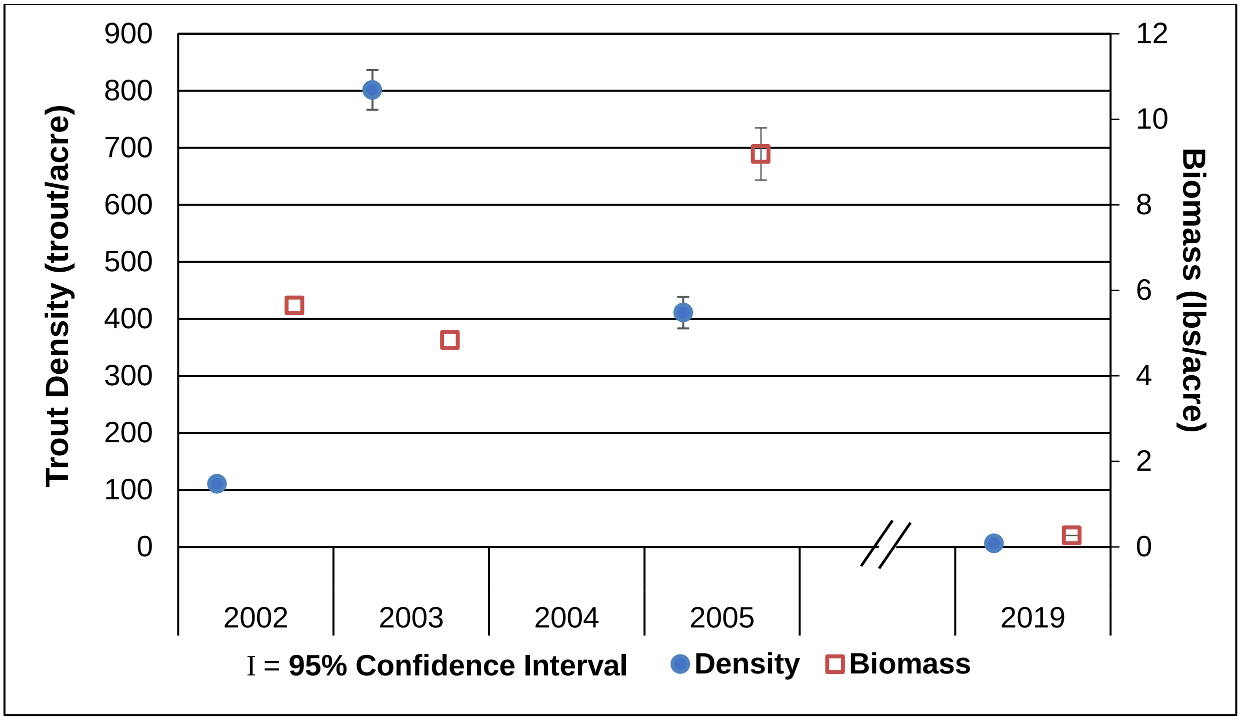


**Figure 2-10. Trout density and biomass at Site RRD-F2, Rubicon River, Rubicon Dam Reach, 2002–2019.**

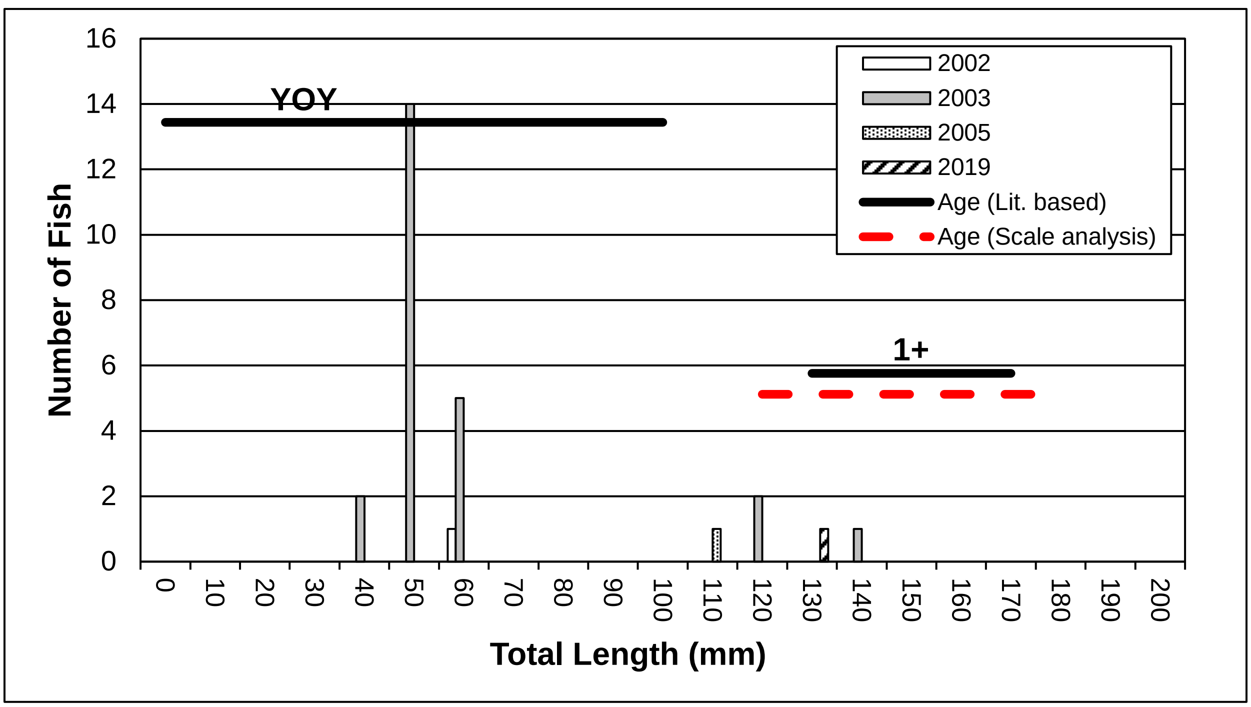


**Figure 2-11. Length-frequency and age-class distribution of rainbow trout at Site RRD-F2, Rubicon River, Rubicon Dam Reach, 2002–2019.**

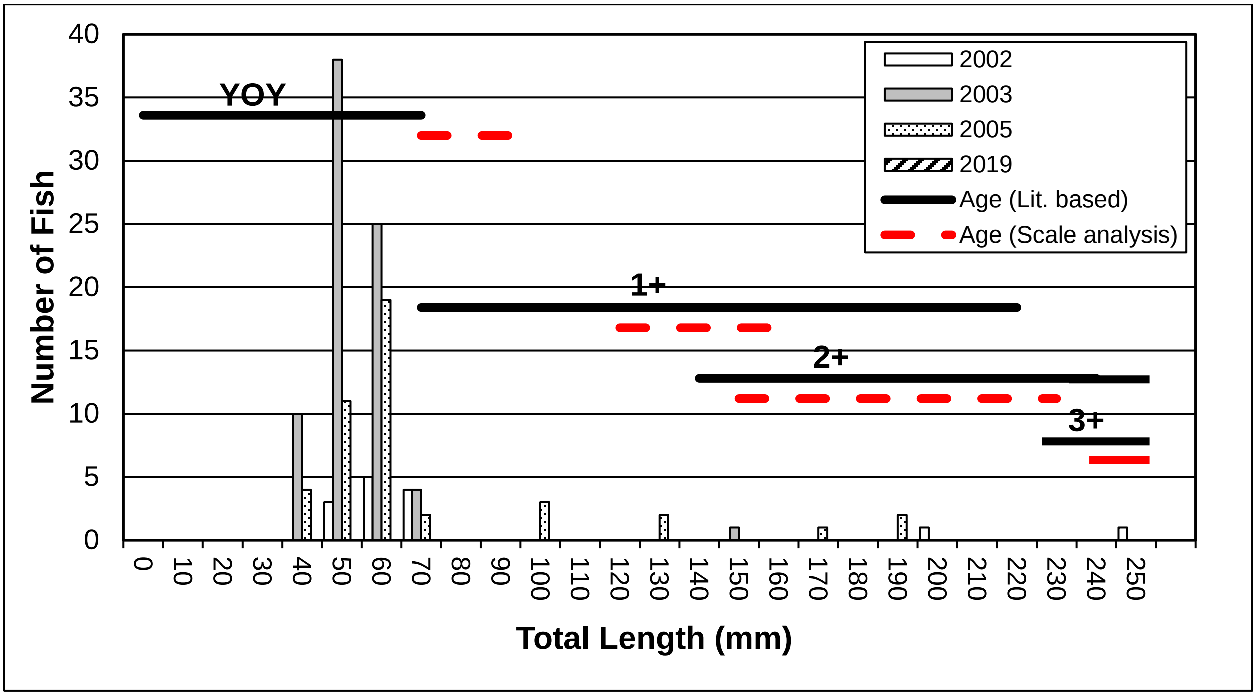


**Figure 2-12. Length-frequency and age-class distribution of brown trout at Site RRD-F2, Rubicon River, Rubicon Dam Reach, 2002– 2019.**

2.3.3 Site BID-F1

This sampling site is located 1.5 miles downstream of Buck Island Dam at a 90-degree bend in the channel and the base of a short bedrock slab, which resulted in a large boulder and bedrock dominant backwater scour pool in the upper segment. The narrower, higher-gradient lower segment contained riffle and run habitat. This site was surveyed via electrofishing in 2002, 2003, and 2019 and was divided into upper and lower segments during sampling.

California roach and golden shiner were observed in 2019, similar to 2002 and 2003; however, Sacramento sucker were also observed for the first time. Rainbow trout, which were present in small numbers in 2002 and 2003, were absent in 2019 (Figure 2-1). Trout density and biomass were the lowest in 2019 of all monitoring years (Figure 2-13). In prior years, rainbow trout ranged from YOY to age 2+ (Figure 2-14).

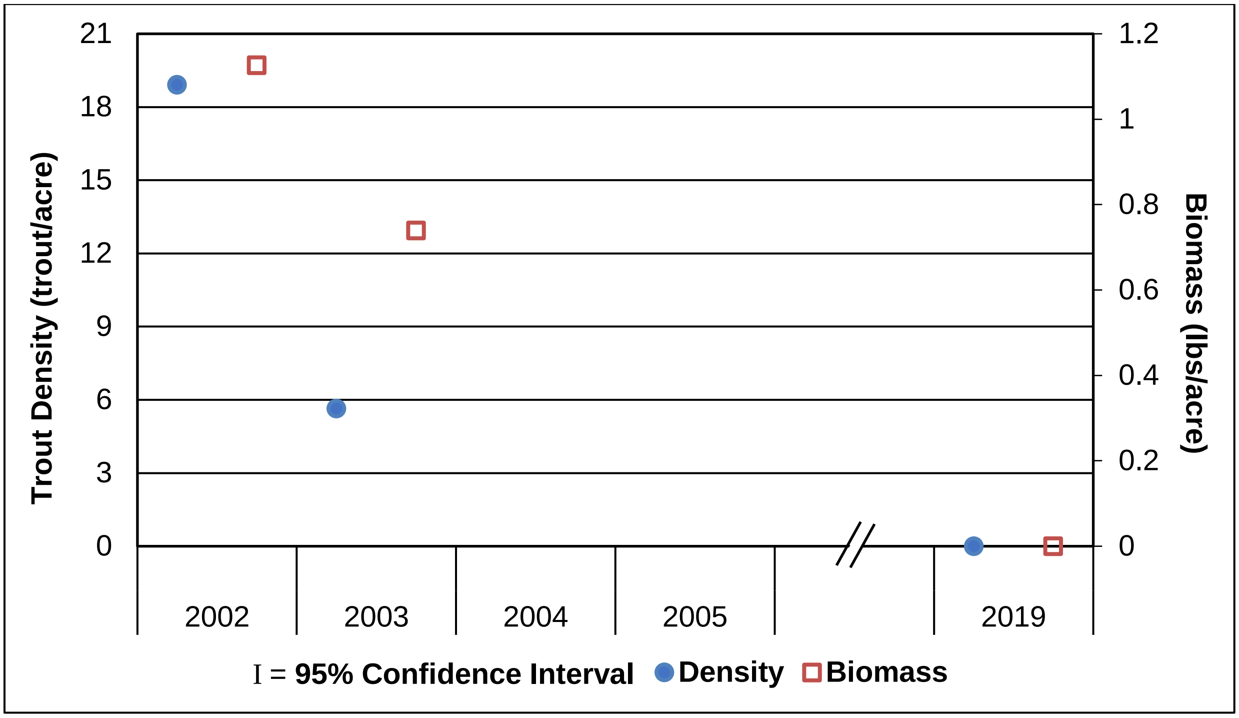


**Figure 2-13. Trout density and biomass at Site BID-F1, Little Rubicon River, Buck Island Dam Reach, 2002–2019.**

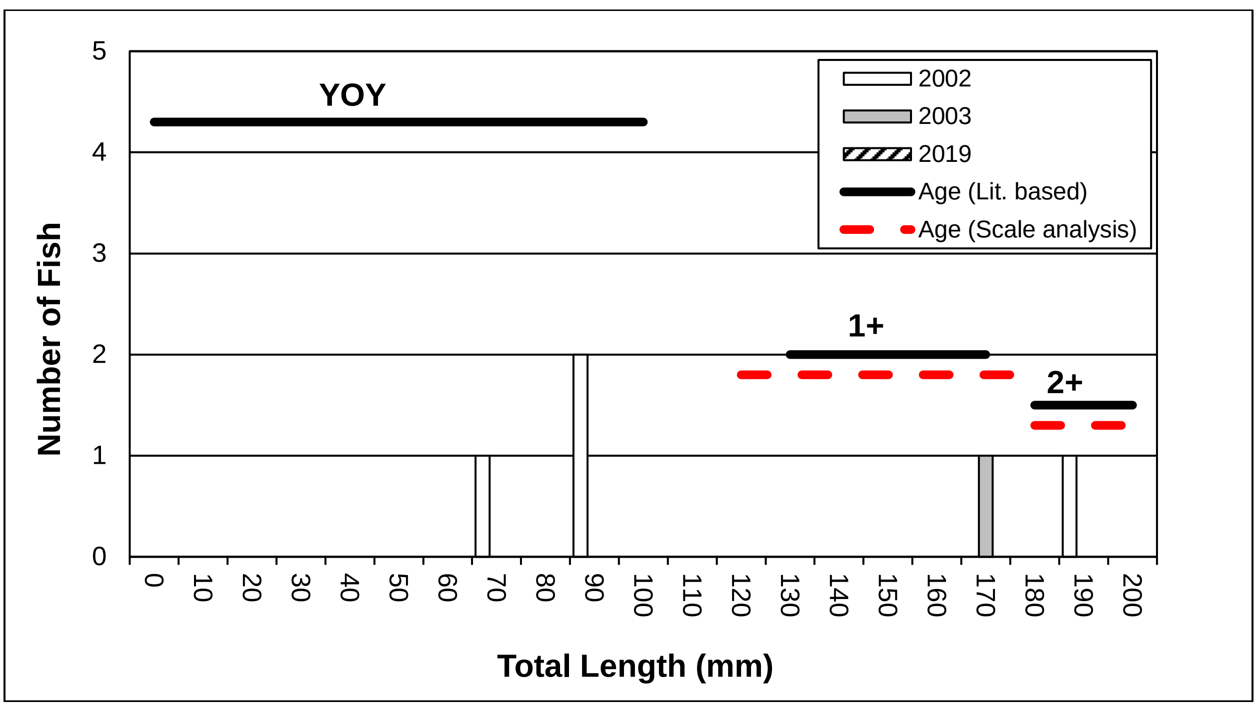


**Figure 2-14. Length-frequency and age-class distribution of rainbow trout at Site BID-F1, Little Rubicon River, Buck Island Dam Reach, 2002–2019.**

### 2.3.4 Site LLD-F3

Site LLD-F3 was sampled for the first time in 2019 as a replacement for LLD-F1. Site LLD-F1 is located on private land where access was restricted in 2019. Site LLD-F3 was determined to be a reasonable substitute for Site LLD-F1 because it is in close proximity to Site LLD-F1, contains multiple habitat types (run, pool, etc.), is of similar size and gradient to the area around Site LLD-F1, and is located on public land. This sampling site is located approximately 3 miles downstream of Loon Lake Dam and 0.5 miles downstream of Wentworth Springs. The site was composed primarily of run habitat with a small number of riffles and glides. It was surveyed via electrofishing and was divided into upper and lower segments during surveying.

Rainbow and brown trout were observed in 2019 (Figure 2-1). Trout density, biomass, and the number of catchable trout per mile were relatively low compared to other sites (Figures 2-2 through 2-4). Rainbow and brown trout ranged from YOY through age 2+, although the low abundance and flat age-class distributions indicate limited recruitment in 2018 and 2019 (Figures 2-15 and 2-16). Rainbow and brown trout were in good condition (K=0.97 and 1.18, respectively; Figures 2-5 and 2-6, Table 2-3).

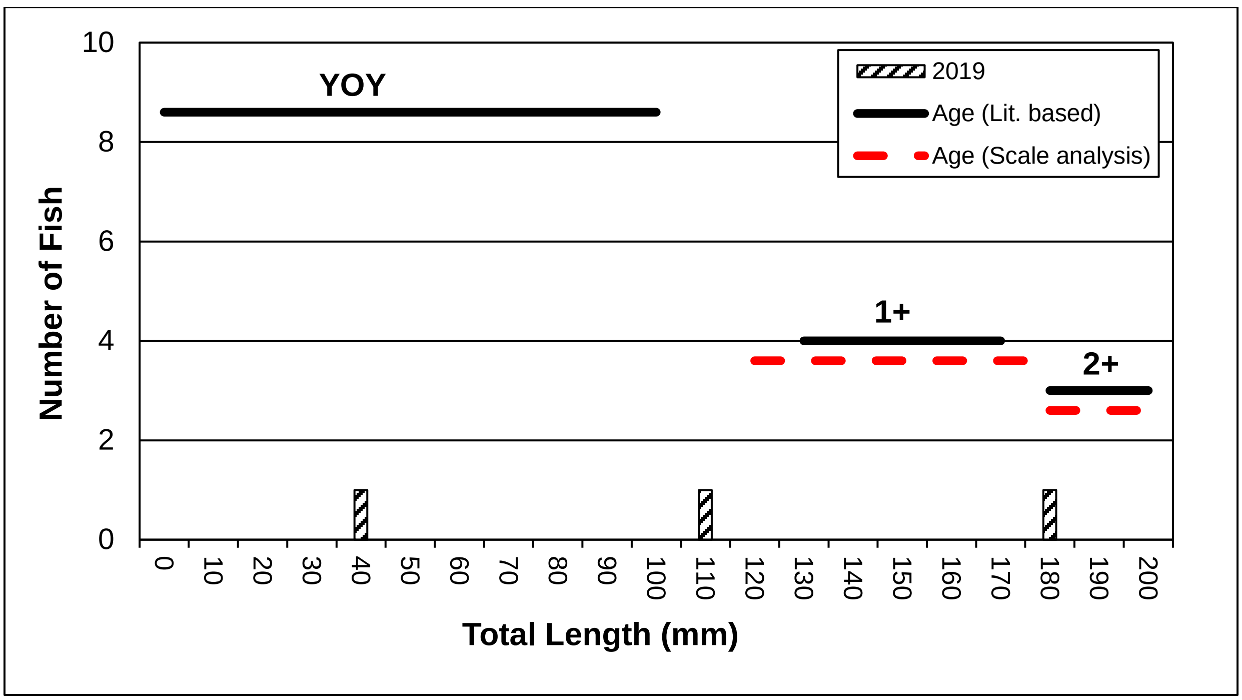


**Figure 2-15. Length-frequency and age-class distribution of rainbow trout at Site LLD-F3, Gerle Creek, Loon Lake Dam Reach, 2019.**

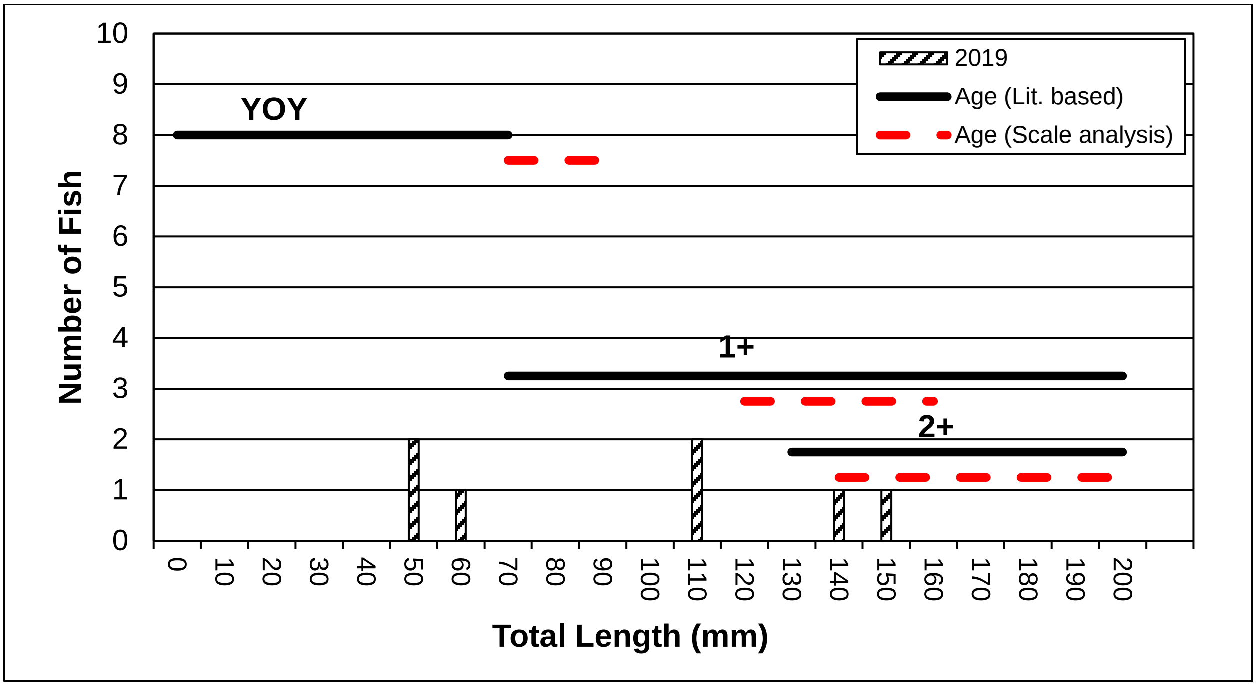


**Figure 2-16. Length-frequency and age-class distribution of brown trout at Site LLD-F3, Gerle Creek, Loon Lake Dam Reach, 2019.**

2.3.5 Site LLD-F2

Site LLD-F2 is located at the confluence of Gerle Creek with Rocky Basin Creek, approximately 4 miles downstream of Site LLD-F3 and 7 miles downstream of Loon Lake Dam. The site contained long runs with intermittent riffles, pools, and glide habitat. More riffle habitat was documented at the site relative to previous monitoring years. It was surveyed via electrofishing in 2002, 2003, 2004, and 2019 and was divided into upper and lower segments during sampling.

Rainbow and brown trout were observed at this site in all monitoring years. The site transitioned from brown trout dominant to rainbow trout dominant in 2019 (Figure 2-1). Trout density in 2019 was similar to other monitoring years, but biomass was slightly lower, which appears related to a decrease in the number of catchable trout per mile in 2019 (Figures 2-4 and 2-17).

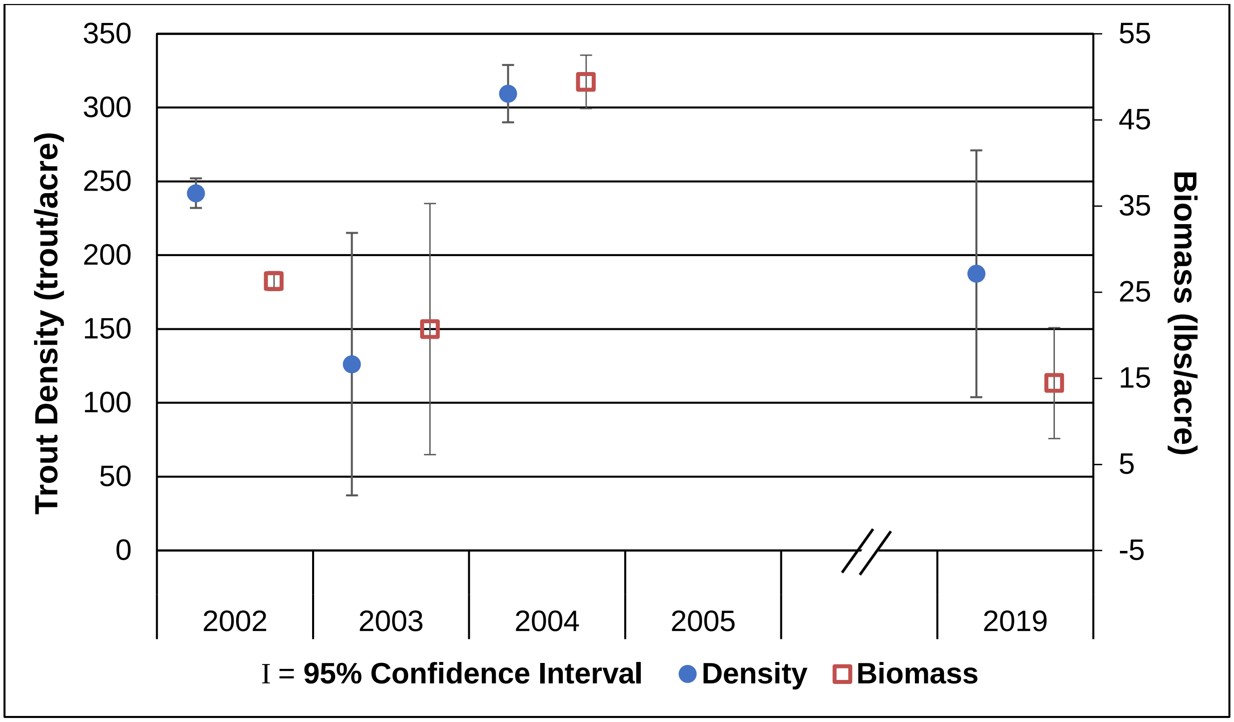


**Figure 2-17. Trout density and biomass at Site LLD-F2, Gerle Creek, Loon Lake Dam Reach, 2002–2019.**

Rainbow trout ranged from YOY through age 2+ in 2019; however, the age-class distribution was flat across all years and lacked older age classes, indicating both limited recruitment and survival success (Figure 2-18).

Brown trout belonged to the YOY through 3+ age classes in 2019; however, similar to rainbow trout, there was a flat distribution of age classes in 2019, indicating poor recruitment that year. The length-frequency distributions of previous monitoring years documented a more typical age-class distribution with higher recruitment and survival levels (Figure 2-19).

Rainbow and brown trout were in relatively good condition (K=0.96 and 0.94, respectively), which was consistent with previous monitoring years (Table 2-3, Figures 2-5 and 2-6).

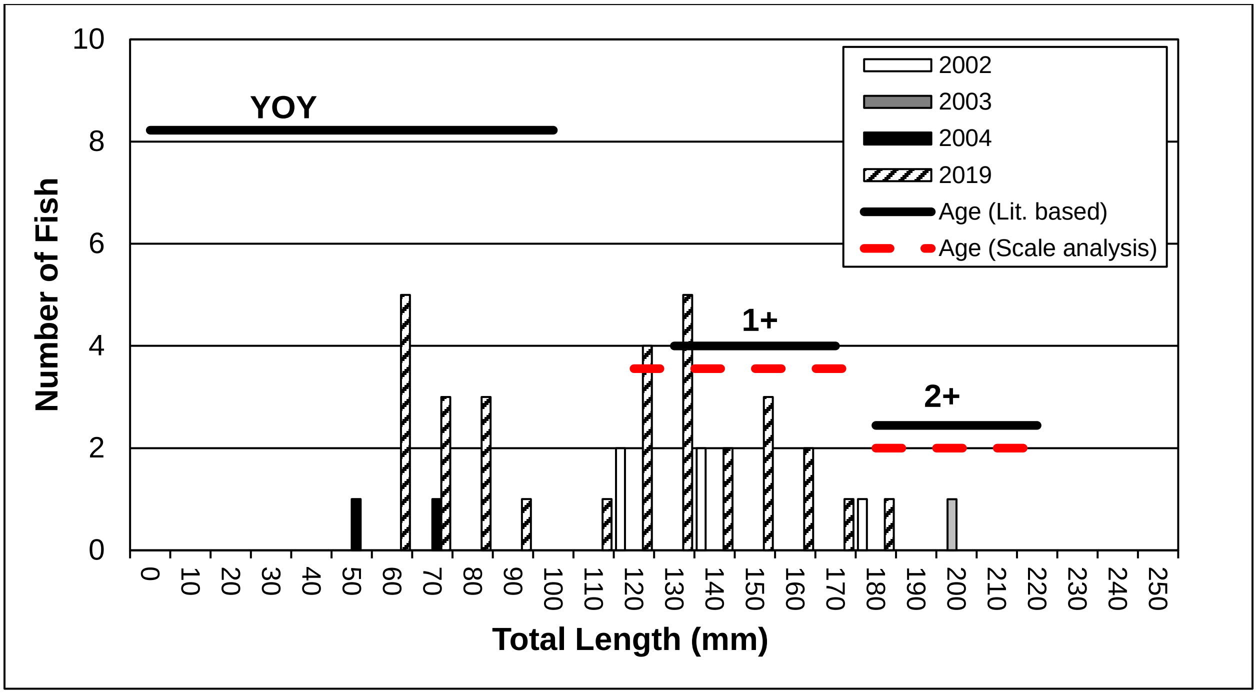


**Figure 2-18. Length-frequency and age-class distribution of rainbow trout at Site LLD-F2, Gerle Creek, Loon Lake Dam Reach, 2002–2019.**

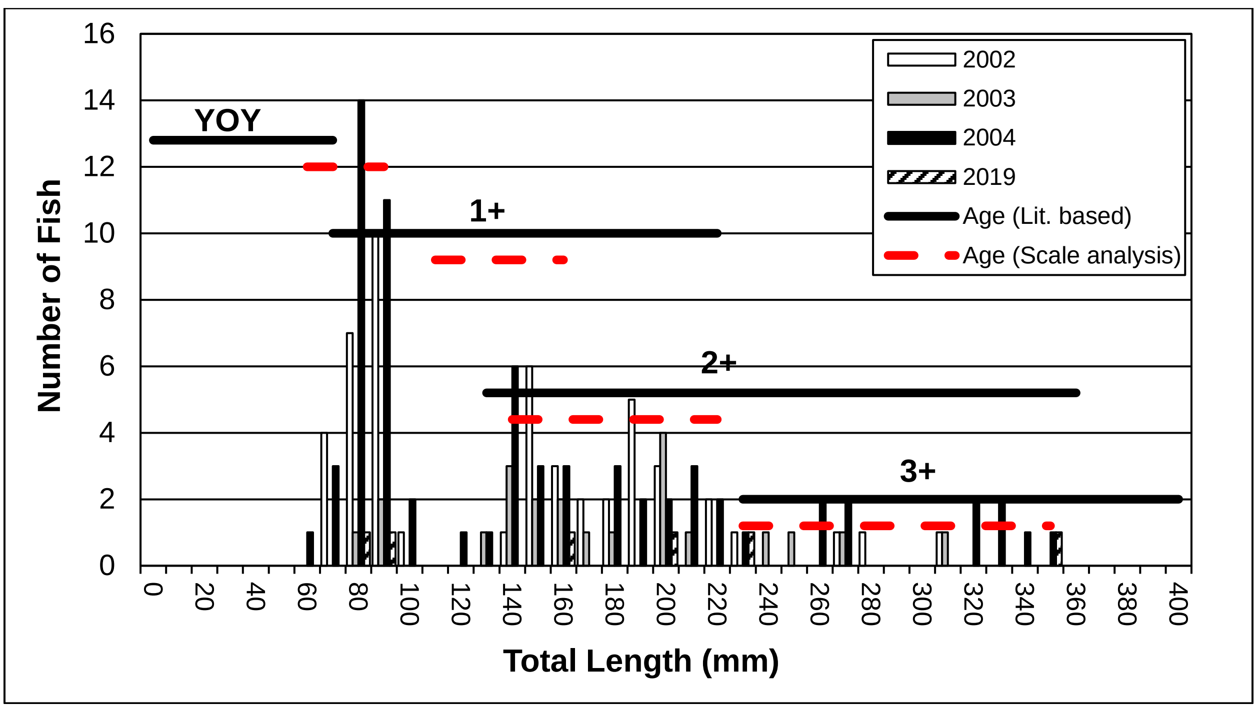


**Figure 2-19. Length-frequency and age-class distribution of brown trout at Site LLD-F2, Gerle Creek, Loon Lake Dam Reach, 2002–2019.**

## 2.3.6 Site GCD-F1

Site GCD-F1 is located approximately 1 mile downstream of Gerle Creek Dam and 0.25 miles upstream of the confluence with the South Fork Rubicon River. The site was characterized by run habitat and a large pool. It was surveyed via electrofishing in 2002, 2003, and 2019 and was divided into upper and lower segments during sampling.

Rainbow trout was the most abundant species observed across all three sampling years. Trout density and biomass in 2019 were within the range of levels observed in 2002 and 2003 (Figure 2-20). Although the number of catchable trout per mile was the lowest in 2019 of all years sampled (Figure 2-4).

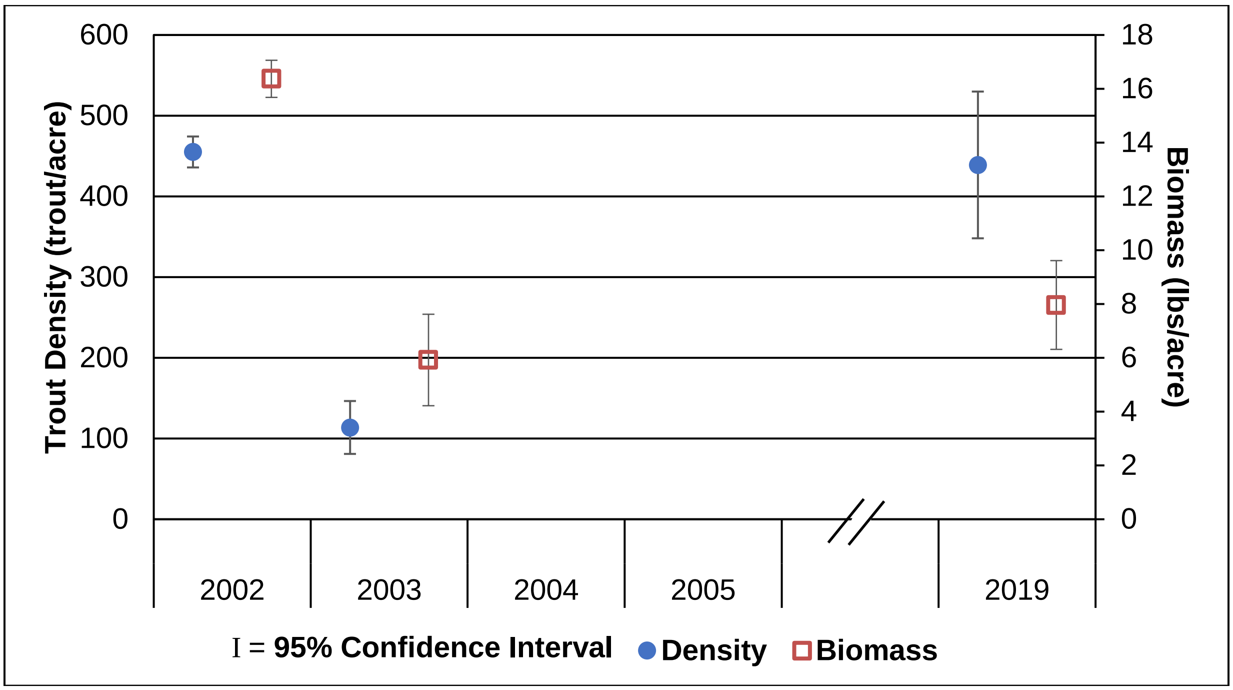


**Figure 2-20. Trout density and biomass at Site GCD-F1, Gerle Creek, Gerle Creek Dam Reach, 2002–2019.**

In 2019, rainbow trout ranged in age from YOY to age 2+ with a typical age-class distribution, where the highest number were YOY and fewer numbers were observed in each subsequent age class. A similar length-frequency distribution occurred in previous sampling years (Figure 2-21). Only one YOY brown trout was observed in 2019. In prior years, brown trout also demonstrated a more typical age-class distribution ranging up to age 3+ (Figure 2-22).

Rainbow trout condition was similar among years sampled, although the average condition was relatively low (K=0.84) at this site compared to the rest of the study area (Table 2-3, Figure 2-5). The single brown trout observed was in good condition (K=1.0) (Table 2-3, Figure 2-6).

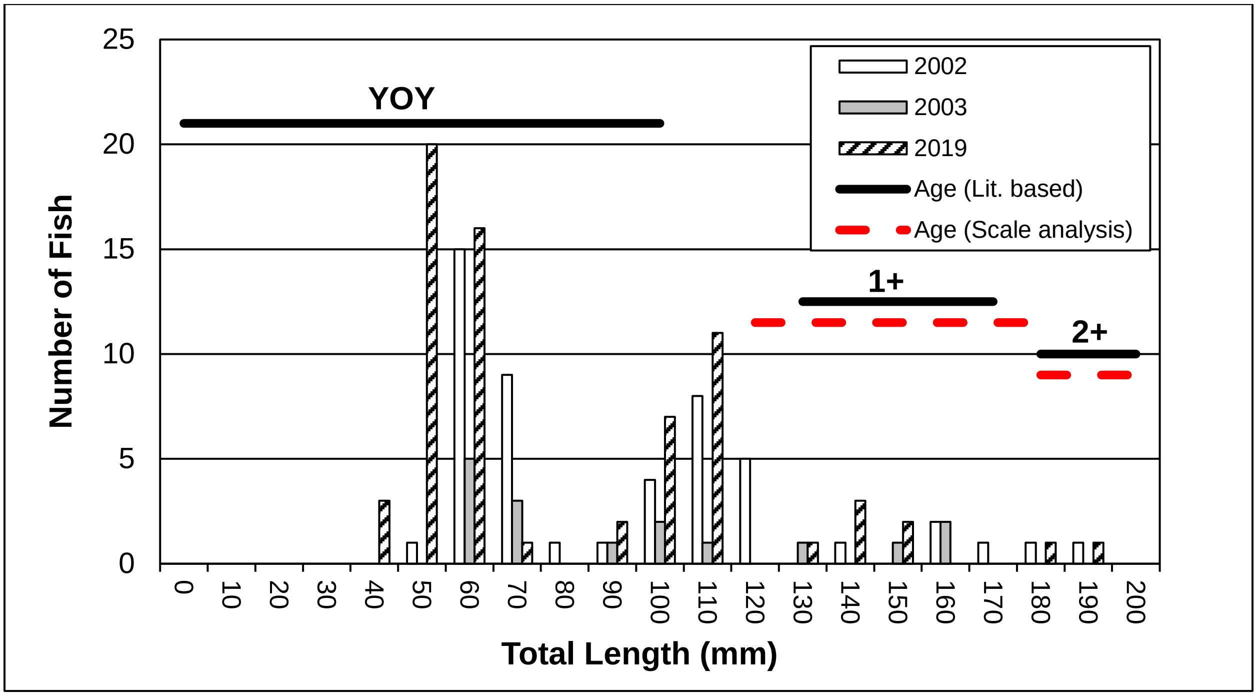


**Figure 2-21. Length-frequency and age-class distribution of rainbow trout at Site GCD-F1, Gerle Creek, Gerle Creek Dam Reach, 2002–2019.**

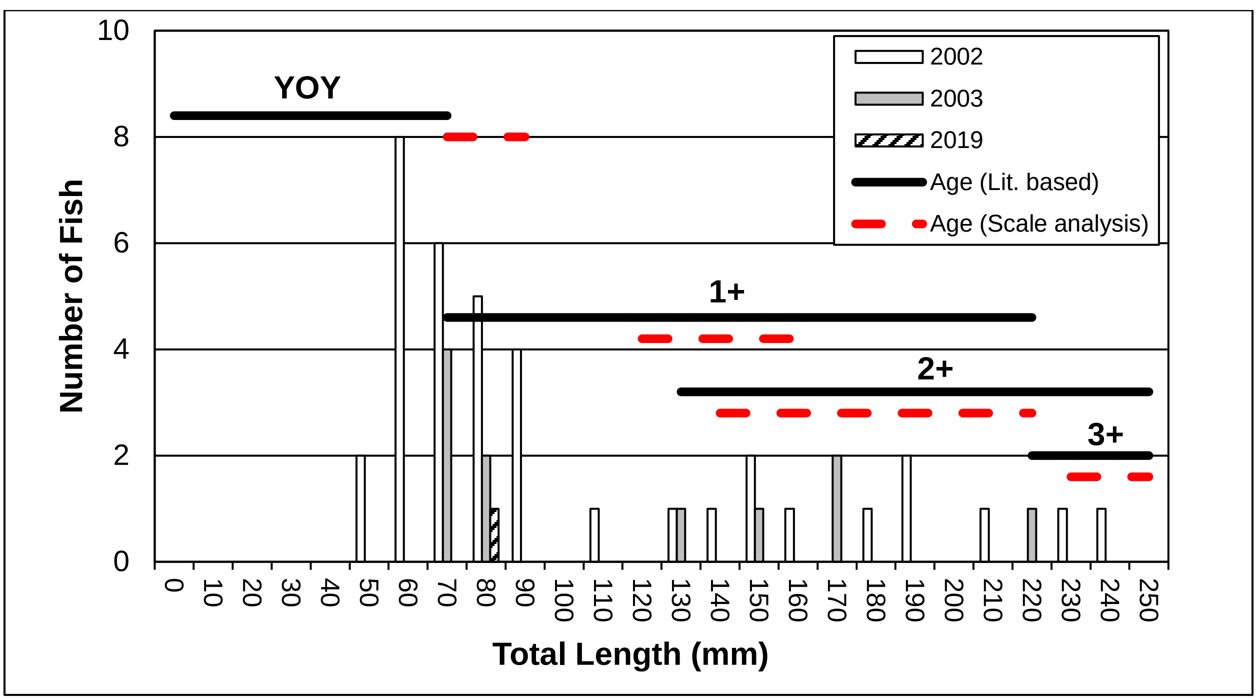


**Figure 2-22. Length-frequency and age-class distribution of brown trout at Site GCD-F1, Gerle Creek, Gerle Creek Dam Reach, 2002–2019.**

2.3.7 Site RPD-F1

Site RPD-F1 is located 3.5 miles downstream of Robbs Peak Dam and 0.75 miles below the confluence with Gerle Creek. It was surveyed via electrofishing in 2002, 2003, 2005, and 2019 and was divided into upper and lower segments during sampling. There was a large amount of riffle habitat at this site, with runs, pools, and glides interspersed throughout.

Rainbow trout and brown trout have been the only species observed at Site RPD-F1 in all years surveyed (Figure 2-1). Trout density in 2019 was similar to prior years; however, biomass was slightly lower in 2019 than prior years (Figure 2-23). Although trout density and biomass were at the lower range in 2019, compared to other survey years, density and biomass at Site RPD-F1 were still among the highest values recorded among sites in 2019 (Figures 2-2 and 2-3).

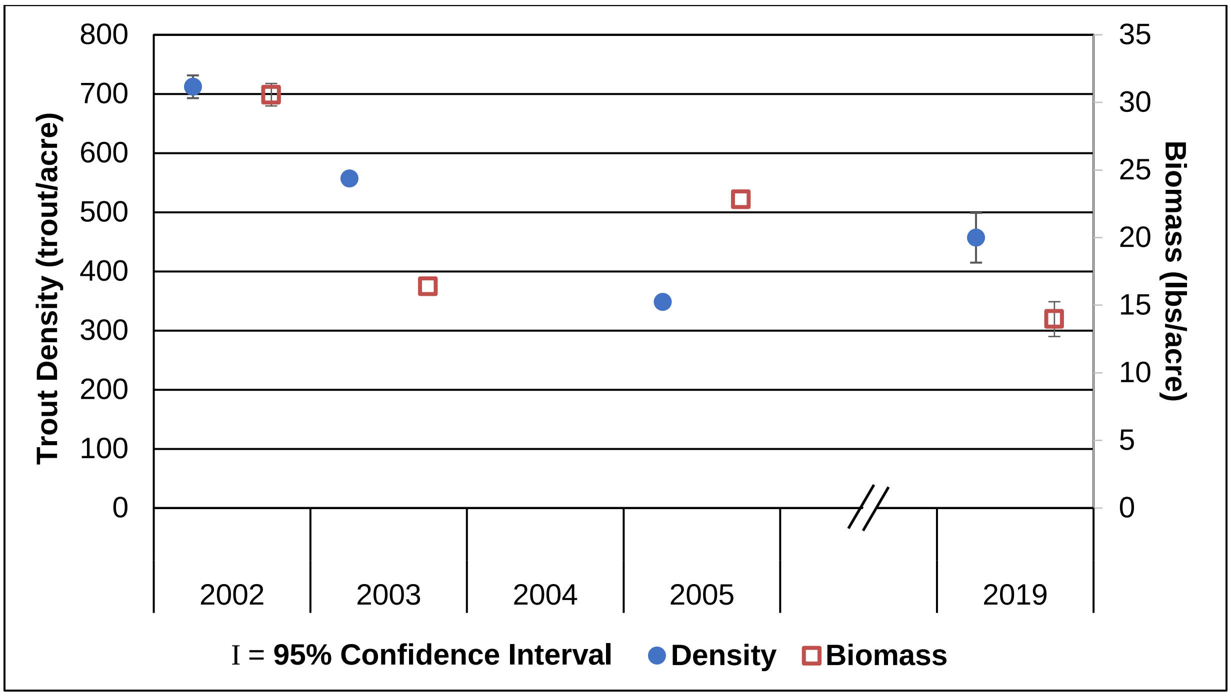


**Figure 2-23. Trout density and biomass at Site RPD-F1, S.F. Rubicon River, Robbs Peak Dam Reach, 2002–2019.**

Rainbow trout ranged from YOY through age 2+ in 2019 with a typical length-frequency distribution, suggesting strong recruitment, which is similar to prior years (Figure 2-24). Brown trout ranged from YOY through age 3+ in 2019, with a flat length-frequency distribution that suggests poor recruitment compared to prior years (Figure 2-25).

Rainbow trout condition (K=0.87) was lower than the previous sampling years, on average (Figure 2-5), whereas brown trout were of similar condition (K=1.01) to prior years (Table 2-3, Figure 2-6).

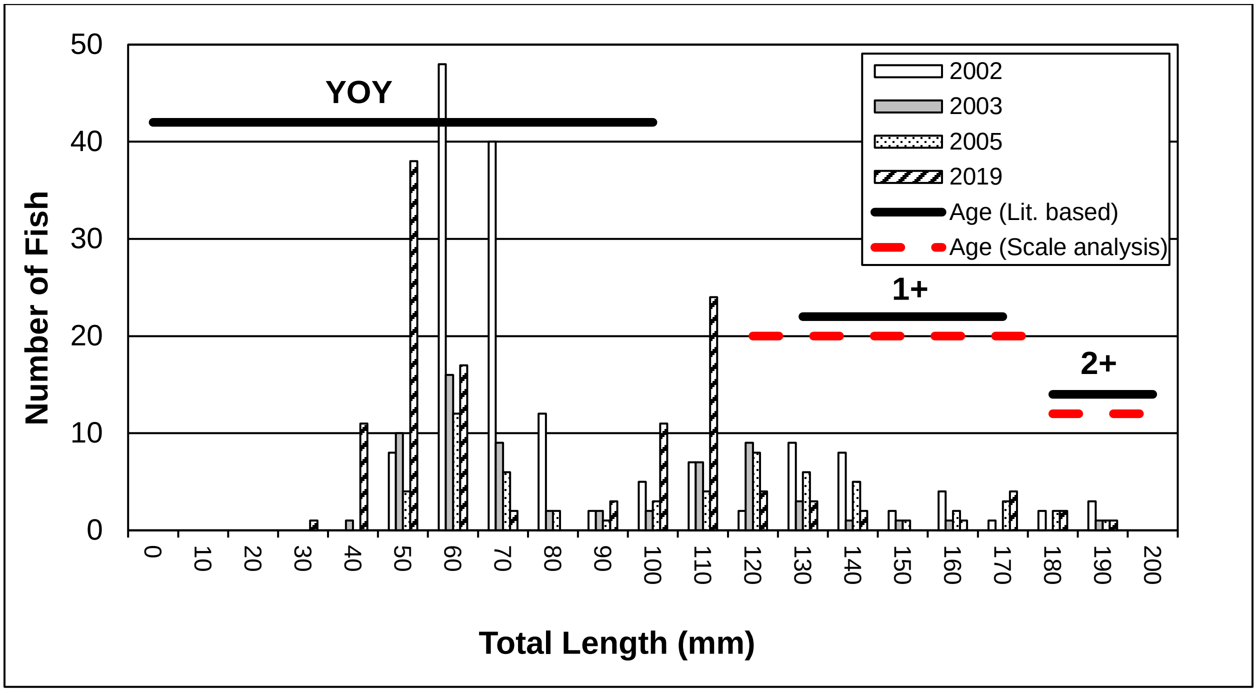


**Figure 2-24. Length-frequency and age-class distribution of rainbow trout at Site RPD-F1, S.F. Rubicon River, Robbs Peak Dam Reach, 2002–2019.**

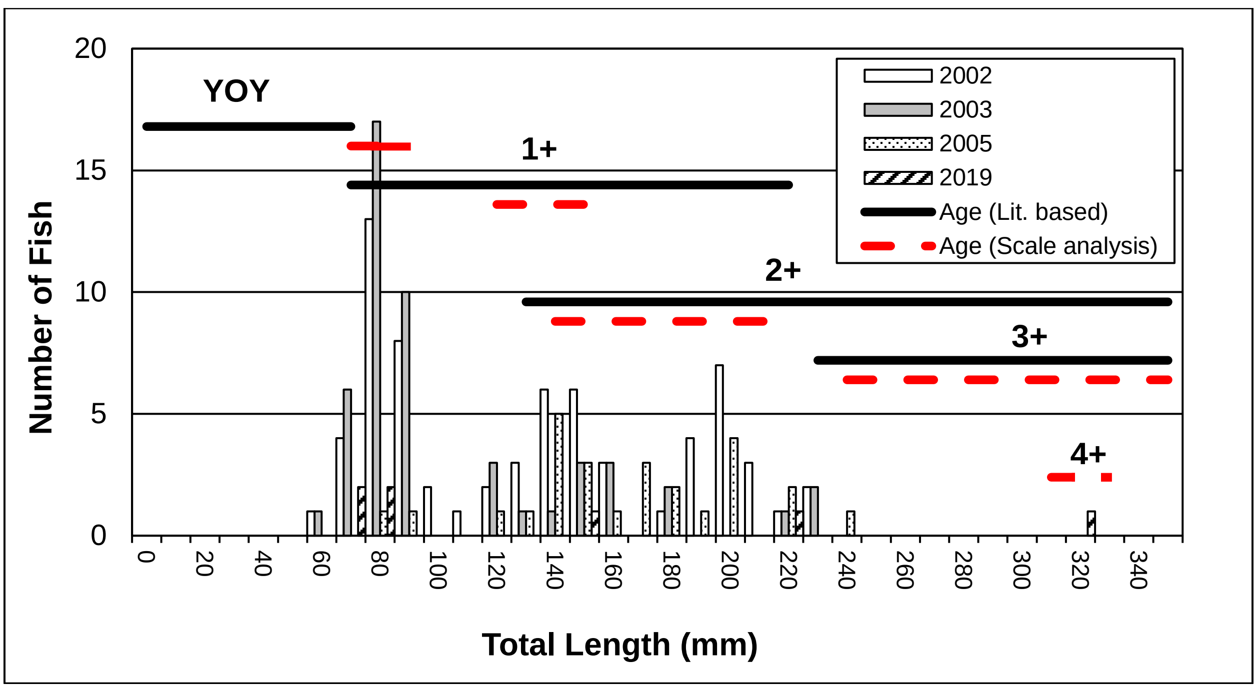


**Figure 2-25. Length-frequency and age-class distribution of brown trout at Site RPD-F1, S.F. Rubicon River, Robbs Peak Dam Reach, 2002–2019.**

2.3.8 Site IHD-F1

Site IHD-F1 is located approximately 0.25 miles downstream of Silver Creek Campground and 2.0 miles downstream of Ice House Dam. The site contained run and riffle habitat with smaller amounts of pool and glide habitat. The site was split into two segments during sampling and surveyed via electrofishing in 2002, 2003, 2004, and 2019.

Rainbow trout and brown trout have been the only species observed across all survey years, and rainbow trout was consistently the most abundant of the two. Trout density and biomass were relatively similar among survey years, and trout density at this site was the second highest of all sites surveyed in 2019 (Figures 2-2 and 2-26) (unfortunately, a poor depletion pattern in 2019 resulted in large confidence intervals at this site). Similarly, the number of catchable trout per mile in 2019 was also the highest of all sites for all years surveyed (Figure 2-4).

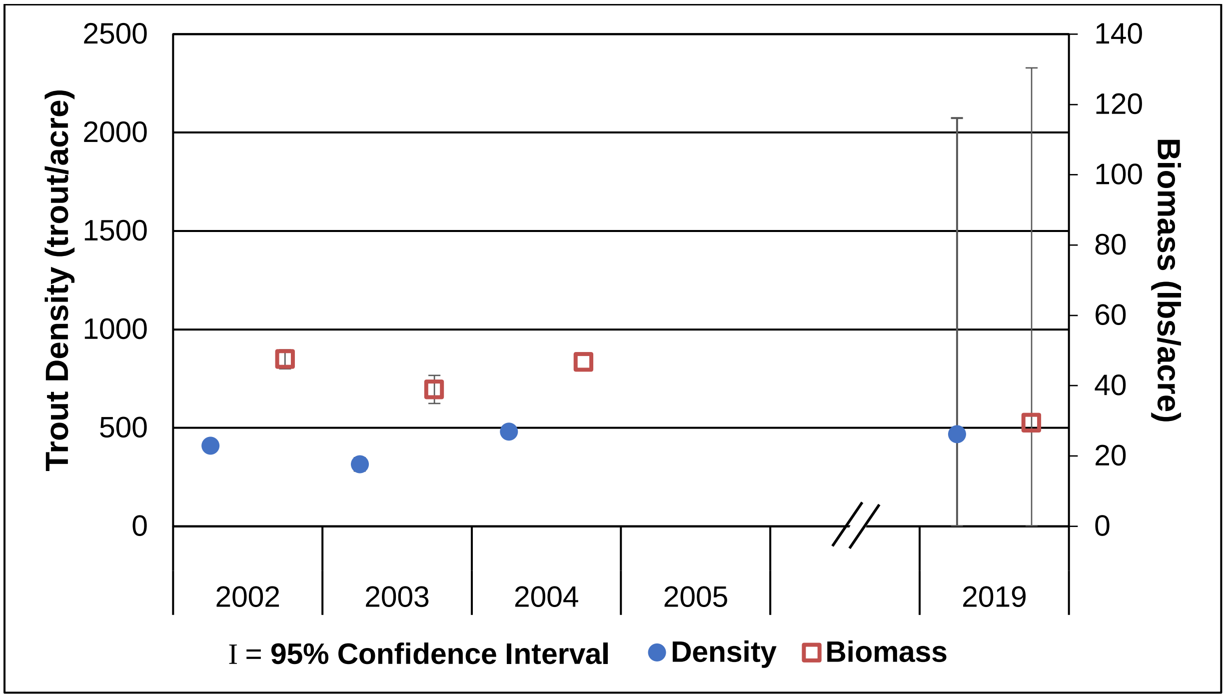


**Figure 2-26. Trout density and biomass at Site IHD-F1, S.F. Silver Creek, Ice House Dam Reach, 2002–2019.**

Rainbow trout ranged from YOY through age 2+ in 2019 with a somewhat typical length-frequency distribution, which is similar to prior years (Figure 2-27). Only three brown trout were observed in 2019, all belonging to the 1+ and 2+ age classes. The absence of a YOY age class in 2019, and the relatively flat age-class structure across all years, indicates limited brown trout recruitment (Figure 2-28).

The condition of rainbow and brown trout (K=0.99 and 0.98, respectively) suggests that trout were in good condition in 2019 (Table 2-3, Figures 2-5 and 2-6).

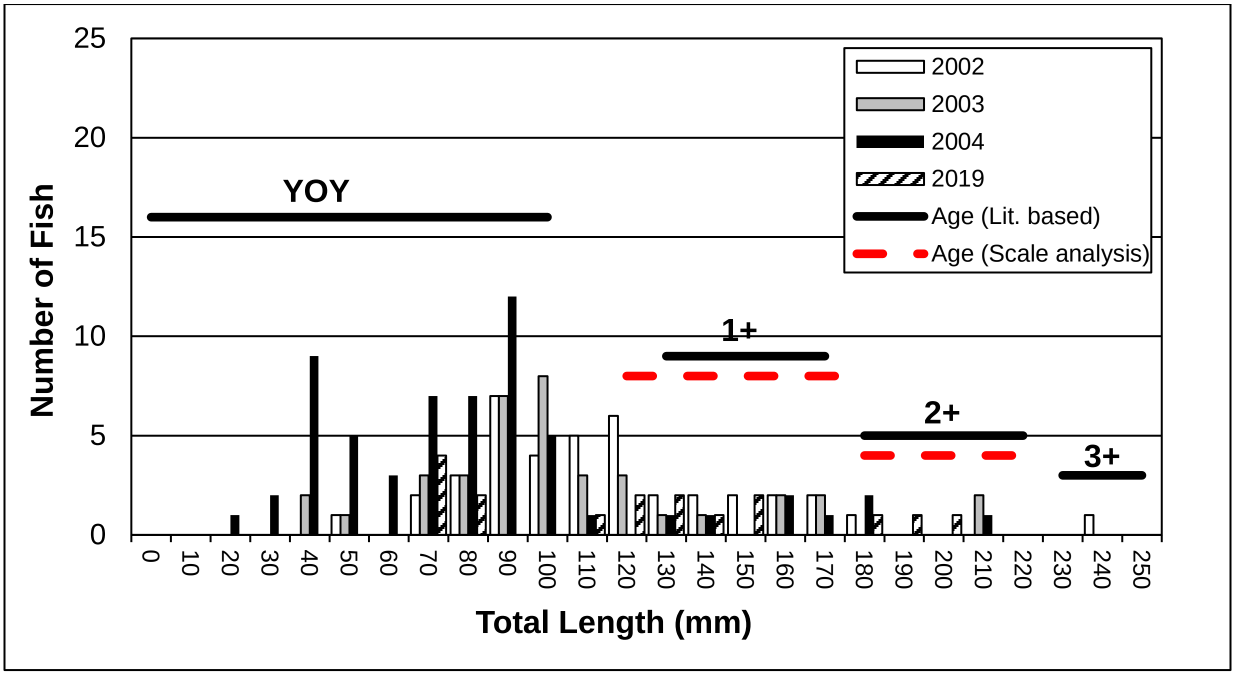


**Figure 2-27. Length-frequency and age-class distribution of rainbow trout at Site IHD-F1, S.F. Silver Creek, Ice House Dam Reach, 2002–2019.**

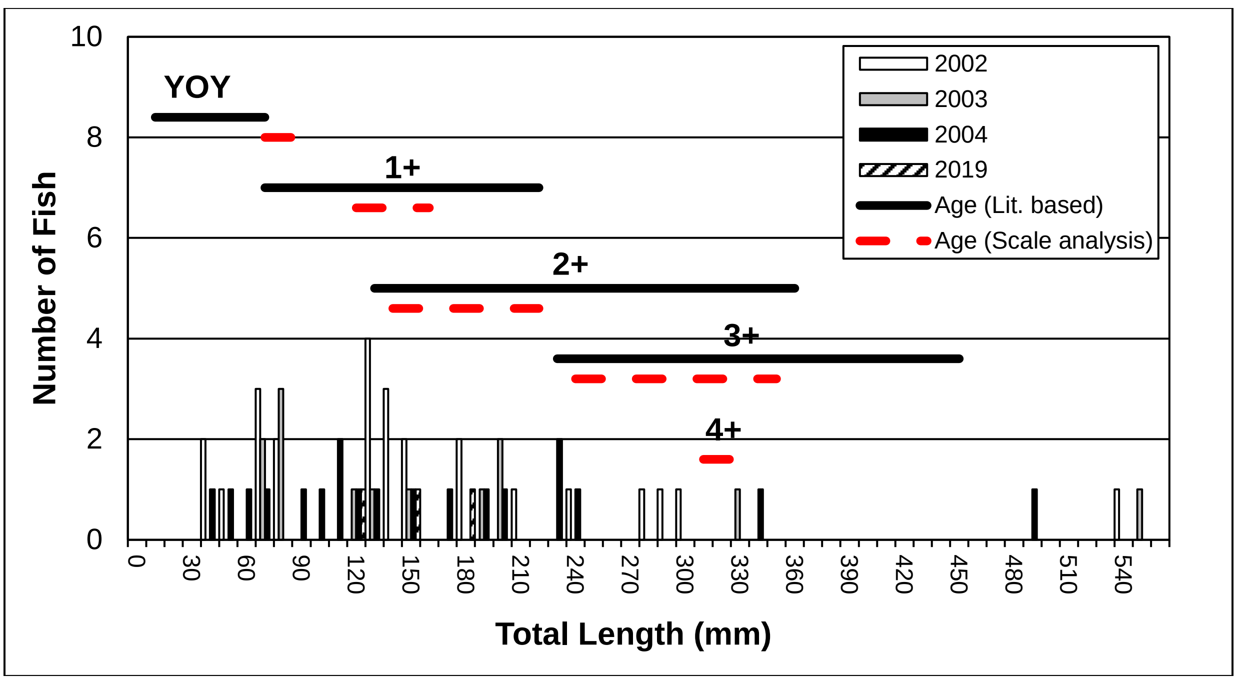


**Figure 2-28. Length-frequency and age-class distribution of brown trout at Site IHD-F1, S.F. Silver Creek, Ice House Dam Reach, 2002–2019.**

2.3.9 Site IHD-F2

Site IHD-F2 is located 7.5 miles downstream of Ice House Dam. There was a large amount of run habitat with several riffles and small pools interspersed. The site was split into two segments during electrofishing in 2002, 2003, 2004, and 2019.

Rainbow trout, brown trout, and Sacramento sucker were observed during all four survey years. Sacramento sucker were the most abundant species in 2002–2004; however, brown trout were most abundant in 2019 (Figure 2-1). Trout density, biomass, and the number of catchable trout were all similar, but slightly higher than previous survey years (Figures 2-2, 2-3, 2-4 and 2-29).

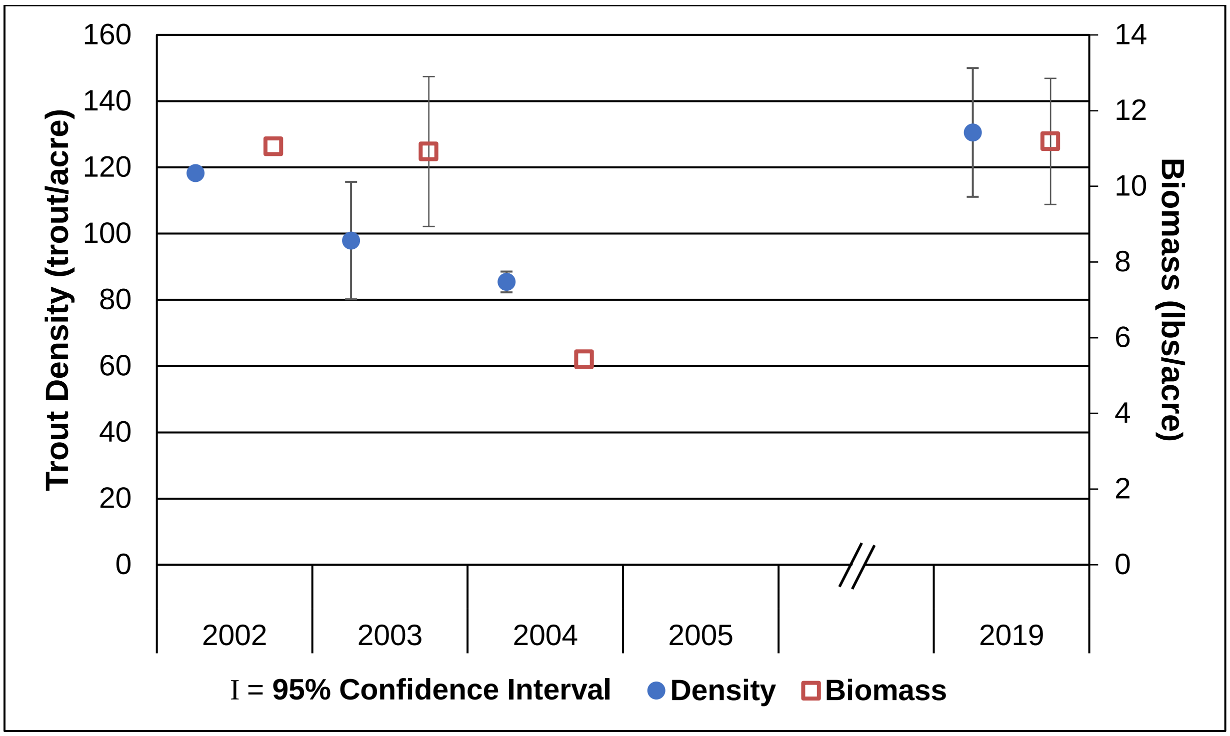


**Figure 2-29. Trout density and biomass at Site IHD-F2, S.F. Silver Creek, Ice House Dam Reach, 2002–2019.**

Rainbow trout ranged from YOY through age 2+ in 2019, but with an atypical distribution; the distribution of fish included higher numbers of age 1+ and 2+ than YOY, suggesting limited recruitment, but moderate survival, which is similar to prior survey years (Figure 2-30). Brown trout ranged from YOY through age 3+ with a slightly more typical distribution, although in low numbers, which is also similar to prior sampling (Figure 2-31).

Rainbow and brown trout were in generally good condition at this site in 2019 (Table 2-3, Figure 2-5 and 2-6). However, the condition of rainbow trout in 2019 (K=0.89) was the lowest of all sampling years, whereas brown trout had a higher than average condition factor (K=0.99) for this site.

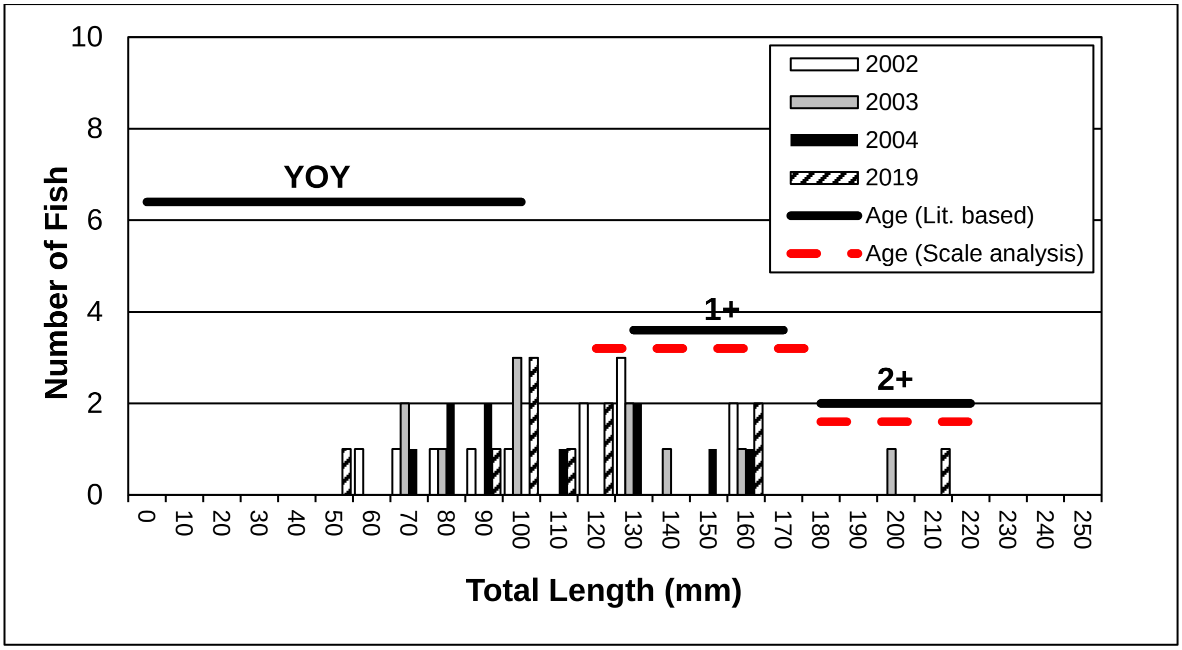


**Figure 2-30. Length-frequency and age-class distribution of rainbow trout at Site IHD-F2, S.F. Silver Creek, Ice House Dam Reach, 2002–2019.**

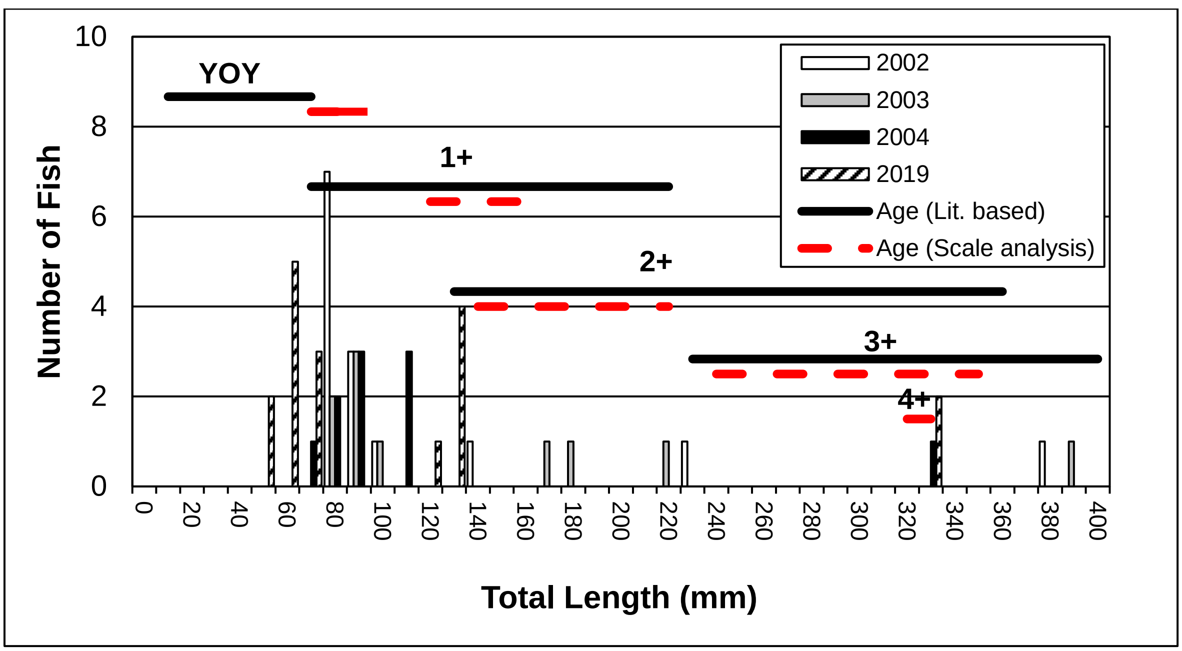


**Figure 2-31. Length-frequency and age-class distribution of brown trout at Site IHD-F2, S.F. Silver Creek, Ice House Dam Reach, 2002–2019.**

### 2.3.10 Site JD-F3

Site JD-F3 was sampled for the first time in 2019 as a replacement for JD-F1. Site JD-F1 is located on private land and access was restricted in 2019. Site JD-F3 was determined to be a reasonable substitute because it exhibits characteristics of other transitional sections in the reach and it is on public land where access is available. Site JD-F3 is located approximately 3.5 miles downstream of Junction Dam. The site was split up into four habitat units that were surveyed via snorkel methods. The habitat units consisted of a run, a high-gradient riffle, a long, deep pool, and a long riffle. 2019 was the first year of sampling at this location, since the site was selected to replace a prior sampling location where access was no longer available. No fish were observed during snorkel surveys in 2019; however, catchable rainbow trout were observed in the pool habitat unit during site reconnaissance the week prior. A river otter was observed foraging within the site during the snorkel survey, which likely influenced the results.

### 2.3.11 Site CD-F1

The Silver Creek, Camino Dam Reach was surveyed via snorkel methods at one site in 2019; it was also surveyed in 2002. Site CD-F1 is located approximately 0.50 miles downstream of Camino Dam and consisted of seven habitat units (all pool and riffle).

Rainbow trout were the only species observed at this site in 2019; in 2002 brown trout were also observed. Trout density and the number of catchable trout per mile increased in 2019 relative to 2002 (Figures 2-2 and 2-4). Rainbow trout age classes ranged from YOY through age 3+. Age 1+ fish had the greatest representation among all age classes in 2019 which could indicate poor recruitment; however, habitat at this site (larger pools and riffles) would favor older age classes, and YOY fish are more difficult to observe in larger rivers during snorkel surveys. Length-frequency was distributed more evenly in 2002 among the YOY through 3+ age classes, although the number of trout observed was low (Figure 2-32).

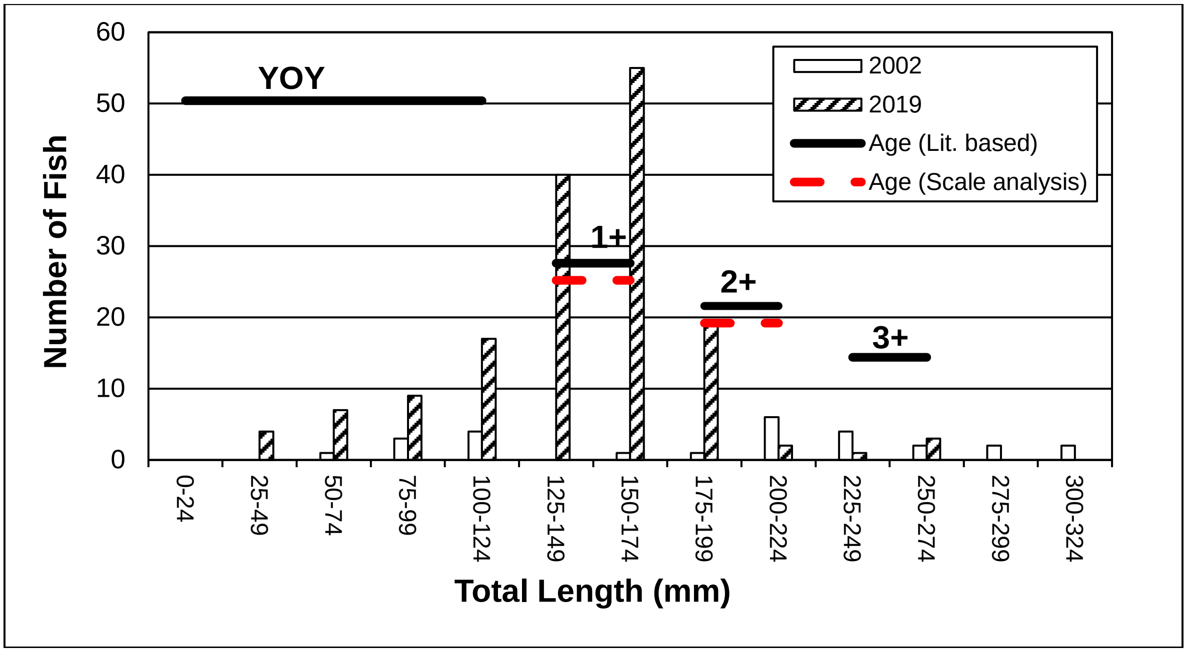


**Figure 2-32. Length-frequency and age-class distribution of rainbow trout at Site CD-F1, Silver Creek, Camino Dam Reach, 2002–2019.**

2.3.12 <u>Site SCD-F3</u>

The USFS 4(e) Condition No. 14 for the Slab Creek Flow Facility Project License Amendment (USFS 2015) specified that a new sampling site be established on the South Fork American River (SFAR) in the 0.25-mile reach between Slab Creek Dam and the proposed Slab Creek Flow Facility. Site SCD-F3 was located immediately downstream of the plunge pool below Slab Creek Dam and was surveyed for the first time in 2019 via snorkel methods. The site began at a section of pocket water just upstream of Iowa Canyon Creek, and included the large, deep pool under the pedestrian bridge, as well as the newly constructed high-gradient riffle and run habitat downstream of the plunge pool. In 2018, prior to channel construction activities, this stream segment was dewatered and fish were relocated downstream of the new Slab Creek Powerhouse Facility.

Rainbow trout, brown trout, and an unidentified sunfish were observed during the trout monitoring surveys, with rainbow trout being most abundant. Even with the recent construction activities, the estimated minimum trout density and the number of catchable trout per mile were comparable to Site SCD-F2 during all monitoring years (Figures 2-2 and 2-4). Fish previously relocated from this site in 2018 included rainbow trout, brown trout, Sacramento sucker, Sacramento pikeminnow, hardhead, and green sunfish (Stillwater Sciences 2018).

After completion of the snorkel survey, the margins of Site SCD-F3 were electrofished opportunistically to confirm species identification of juvenile fishes and to survey for species which may have been difficult to detect via snorkeling. Four rainbow trout were observed, all of which belonged to the YOY age class.

Rainbow trout age classes ranged from YOY through age 3+. Age 1+ had the greatest representation among age classes, followed by YOY (Figure 2-33); however, snorkel methods could bias against YOY fish, as they are more difficult to observe in larger rivers. The length-frequency distribution suggests higher recruitment of YOY in 2018 compared to 2019.

Brown trout age classes ranged from age 1+ through age 3+; a lack of YOY fish and limited numbers of older age classes suggests poor recruitment and/or survival between years (Figure 2-34).

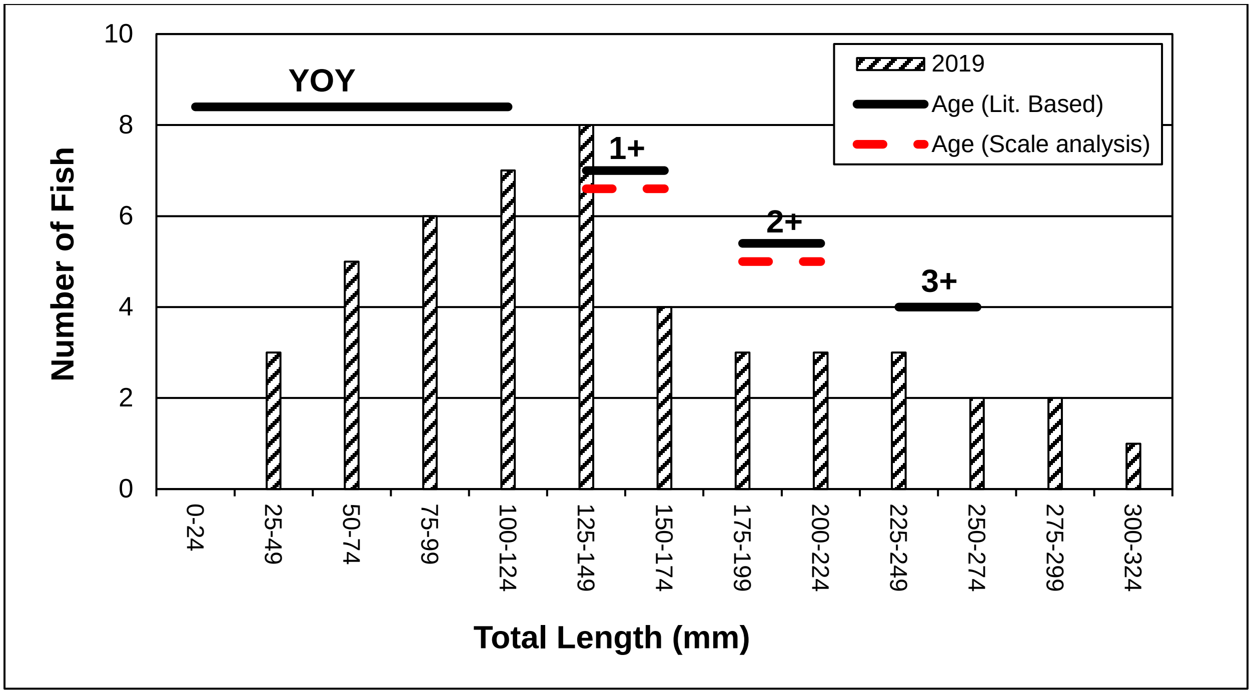


**Figure 2-33. Length-frequency and age-class distribution of rainbow trout at Site SCD-F3, South Fork American River, Slab Creek Dam Reach, 2019.**

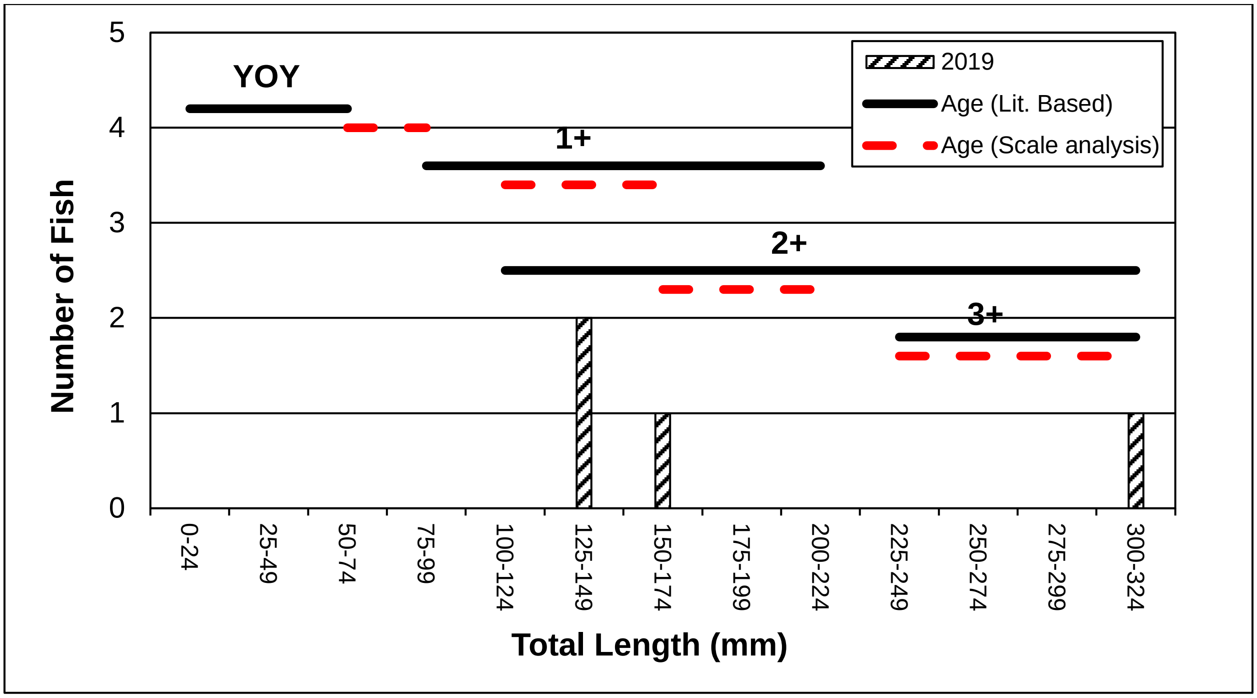


**Figure 2-34. Length-frequency and age-class distribution of brown trout at Site SCD-F3, South Fork American River, Slab Creek Dam Reach, 2019.**

2.3.13 Site SCD-F2

Site SCD-F2 was surveyed by electrofishing in 2002 and 2003. The site was surveyed via snorkel methods in 2019 because higher baseflows prevented effective electrofishing due to increased depths and water velocities. The site is located on the SFAR approximately 0.2 miles upstream of the confluence with Rock Creek. It was split into five units, including two runs, two pools, and one riffle.

Rainbow trout, sculpin, Sacramento sucker, and Sacramento pikeminnow were observed at this site in 2019, with rainbow trout being most abundant. In prior years, California roach, brown trout, hardhead, speckled dace, and smallmouth bass were also observed (Figure 2-1). The estimated minimum trout density and number of catchable trout per mile (based on snorkel observations) were similar to prior survey years (Figures 2-35 and 2-4). Brown trout were observed at this site during 2002 and 2003 in low numbers (n=1 and n=2, respectively), however they were not observed in 2019. After completion of the snorkel survey, the margins were electrofished opportunistically to confirm species identification and to survey for species which may have been difficult to detect via snorkeling. Two YOY Sacramento pikeminnow, three YOY Sacramento suckers, and 15 sculpin spp. were observed during the electrofishing.

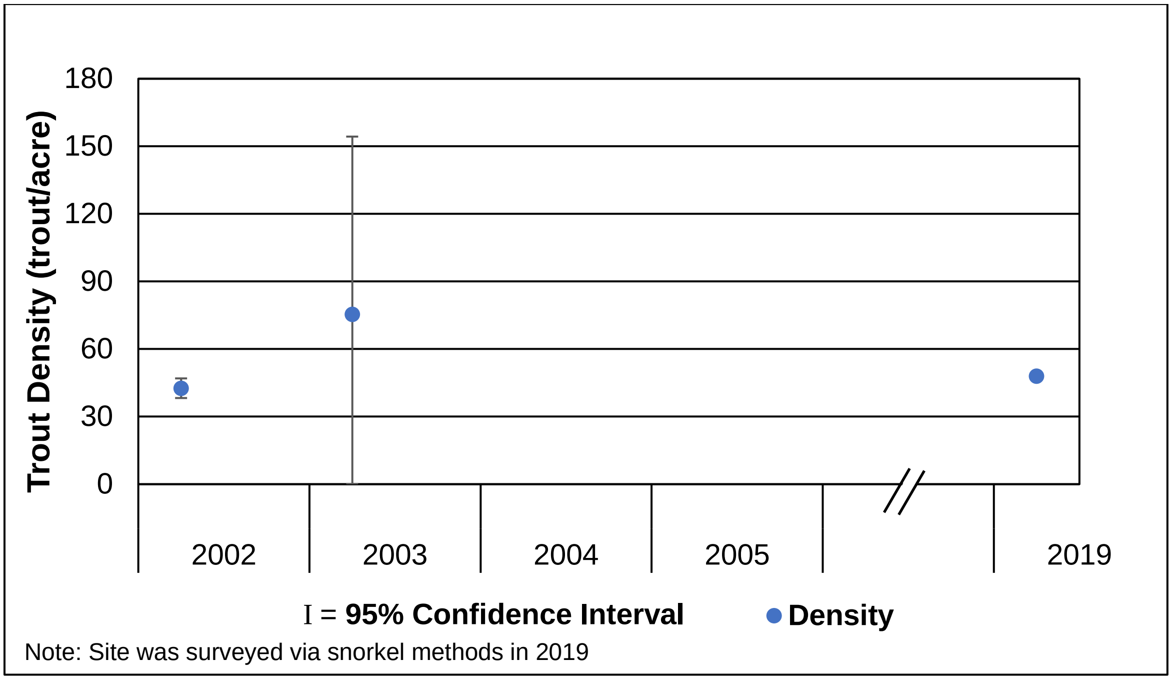


**Figure 2-35. Trout density at Site SCD-F2, South Fork American River, Slab Creek Dam Reach, 2002–2019.**

Rainbow trout age classes ranged from YOY through age 3+. The length-frequency distribution was atypical, with the highest number of fish belonging to the 1+ age class, although YOY fish can be difficult to observe in larger rivers during snorkel surveys; however, length-frequency distributions from the 2002 and 2003 electrofishing efforts showed a similar pattern (Figure 2-36).

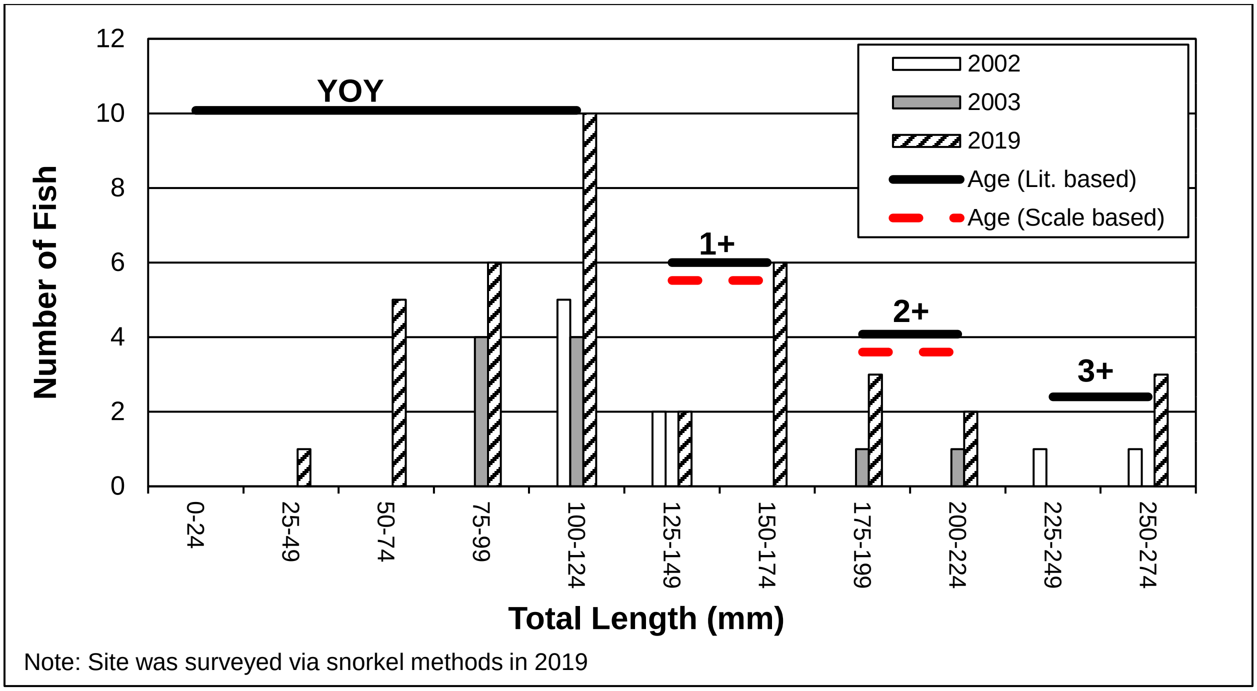


**Figure 2-36. Length-frequency and age-class distribution of rainbow trout at Site SCD-F2, South Fork American River, Slab Creek Dam Reach, 2002–2019.**

## 2.4 DISCUSSION

The number of fish species making up the community (i.e., richness) decreased throughout the UARP in 2019, although results varied on a site-by-site basis; species richness decreased from 12 species documented during the 2002–2005 surveys to 9 species during the 2019 surveys (Table 2-1). Decreases in species richness were particularly evident at sites RRD-F2 and SCD-F2, which transitioned from 4–7 species observed in 2002 to 2–3 species in 2019; the absence of some species at SCD-F2 (e.g., smallmouth bass) may improve conditions for native transitional zone species such as hardhead. However, 2019 results represent one year of monitoring, and future surveys may show an increase in richness. In addition, Site SCD-F2 was surveyed via electrofishing in 2002 and snorkeling in 2019, which may have affected the number of species observed. Subsequent monitoring years will determine if decreased species richness in 2019 was an anomaly or part of a greater trend throughout the UARP.

Trout populations varied across reaches in 2019 relative to previous surveys. Generally, trout density and biomass both decreased at upper elevation sites (sites RRD-F1, RRD-F2, BID-F1, LLD-F3, and LLD- F2), whereas trout density increased while biomass decreased at mid-elevation sites (sites GCD-F1, RPD-F1, IHD-F1, and IHD-F2), and both trout density and the number of catchable trout per mile increased or were within the range of previous years at the lower elevation sites (sites CD-F1, SCD-F3, and SCD-F2) (Figures 2-2, 2-3, and 2-4).

Trout recruitment in the upper reaches in 2019 may have been affected by peak storm runoff events. Unlike the 2002–2005 monitoring period, the 2019 monitoring year was preceded by high peak storm flows in both 2017 and 2019, particularly in the upper and middle reaches (Figure 4-2, *Geomorphology*). High storm flows have the potential to adversely affect trout density and biomass for 1–2 years following the event due to effects on recruitment. Cattanéo et al. (2002) reported strong negative correlations between YOY density and discharge rates, possibly due to displacement of YOY fish as a consequence of their inability to maintain stream position or to find shelter when water velocities increase during high discharges. High loss rates of alevins and fry during high discharge were also reported by Nicola et al. (2009). Multiple consecutive years of high discharge from peak storm events could depress trout biomass, as low recruitment would affect multiple year classes.

The 2019 monitoring year is the first year of sampling following implementation of new streamflow release schedules; there is not yet sufficient data to evaluate the influence of the modified minimum instream flow schedule on trout populations, and no conclusions are being drawn based on this first year of monitoring data. Future analyses will consider whether trends or patterns in trout populations within the UARP are developing, or whether the observed populations are within the range of variability observed under the prior flow regime.

### 2.4.1 Fisheries Objectives

The UARP and Chili Bar Hydroelectric Project Rational Report for the Relicensing Settlement Agreement (SMUD 2007) identifies ecological resource objectives and trout biomass goals (derived from Gerstung [1973] and SMUD 2004) for the UARP study reaches. These Fisheries Objectives aim to maintain, restore, or recover ecological conditions for all life stages of rainbow trout, other native fishes, and desired non-native fishes (namely brown trout) in their approximate range and habitat, accomplished by meeting components articulated in the “Fish Community Assessment Metrics” (SMUD 2004). Biomass for combined rainbow and brown trout is included as a metric because these species occupy the same ecological niche (SMUD 2004), and for consistency among reaches. Individual species are also evaluated based on relative abundance and other factors, such as recruitment success.

The Fisheries Objectives generally include goals of increasing trout populations and meeting biomass targets, but also include goals for maintaining fish communities in some reaches (Table 2-5). Generally, both trout populations and overall species richness declined in 2019 compared to prior sampling, and only two sites met the fisheries objectives. However, biomass goals derived from Gerstung (1973) were based on mean biomass estimates collected from 102 north Sierran streams assumed to be representative of California’s cold-water streams; these goals may not be attainable in some UARP reaches. As noted above, decreased trout abundance and species richness within some UARP monitoring reaches may be a result of high peak storm flows in 2017 and 2019; it should be noted that the license-mandated change in minimum flows is only one of many variables that can affect fish populations. This is the first year of the monitoring program, and future monitoring will help identify whether the lower numbers are anomalous or part of an overall trend within the UARP.

**Table 2-5. Fisheries Objectives as Specified in the Rationale Report for the Settlement Agreement (Adapted from SMUD 2007).**

| Stream Reach | Site Name | Stream Width (ft) | Populations: Objective (SMUD 2007) | Populations: Post License status | Trout Biomass or Catchable Trout: Goal [a,b] | Trout Biomass or Catchable Trout: Pre-License (2002–2005 Mean) status | Trout Biomass or Catchable Trout: Post License (2019) status |
|---|---|---|---|---|---|---|---|
| Rubicon River Below Rubicon Dam | RRD-F1 | 34 | Increase rainbow trout | Declined | Biomass ≥24 lbs/acre | 16.7 lbs/acre | 3.4 lbs/acre |
| Rubicon River Below Rubicon Dam | RRD-F2 | 28 | Increase rainbow trout | Declined | Biomass ≥24 lbs/acre | 6.9 lbs/acre | 0.3 lbs/acre |
| Little Rubicon River Below Buck Island Dam | BID-F1 | 27 | Reduce or eliminate golden shiners and increase rainbow trout | Golden shiner reduced from 2003 levels (nearly equal to 2002); rainbow trout decreased | Reduce or eliminate golden shiners; move toward 33 lbs/acre | 0.9 lbs/acre | 0 lbs/acre |
| Gerle Creek Below Loon Lake Dam | LLD-F3 | 25 | -- | -- | Biomass ≥33 lbs/acre | -- | 2.4 lbs/acre |
| | LLD-F2 | 34 | Increase rainbow trout and maintain brown trout | Rainbow trout and brown trout decreased | Biomass ≥24 lbs/acre | 33.1 lbs/acre | 14.4 lbs/acre |
| Gerle Creek Below Gerle Dam | GCD-F1 | 34 | Increase rainbow trout and maintain brown trout | Rainbow trout increased; brown trout decreased | Biomass ≥24 lbs/acre | 11.1 lbs/acre | 8.0 lbs/acre |
| SF Rubicon Downstream of Robbs Peak Dam | RPD-F1 | 42 | Increase rainbow trout and maintain brown trout | Rainbow trout increased from 2003 and 2005 levels, but slightly less than 2002; brown trout decreased | Biomass ≥24 lbs/acre | 23.2 lbs/acre | 15.3 lbs/acre |
| SF Silver Creek Below Ice House Dam | IHD-F1 | 26 | Increase rainbow trout | Rainbow decreased | Biomass ≥24 lbs/acre | 44.5 lbs/acre | 29.4 lbs/acre |
| SF Silver Creek Below Ice House Dam | IHD-F2 | 27 | Increase rainbow trout | Rainbow trout declined slightly | Biomass ≥24 lbs/acre | 9.13 lbs/acre | 11.2 lbs/acre |

| Stream Reach | Site Name | Stream Width (ft) | Populations | | Trout Biomass or Catchable Trout | | |
|---|---|---|---|---|---|---|---|
| | | | Objective (SMUD 2007) | Post License status | Goal [a,b] | Pre-License (2002–2005 Mean) status | Post License (2019) status |
| Silver Creek Below Junction Dam | JD-F3 | 40 | -- | -- | -- | -- | 0 trout/mi. |
| Silver Creek Below Camino Dam | CD-F1 | 32 | Increase rainbow trout | Rainbow trout increased | Catchable trout 278/mi. | 100.5 trout/mi. | 467 trout/mi. |
| SF American River below Slab Creek Dam | SCD-F3 | 40 | -- | -- | -- | -- | 98 trout/mi. |
| SF American River below Slab Creek Dam | SCD-F2 | 52 | Healthy age class distribution of transitional fishes, including hardhead | Fewer observations of transitional fishes, no hardhead observed[c] | Catchable trout 278/mi.[d] | 76 trout/mi. | 107 trout/mi. |

[a] Biomass in lbs/acre; goal based on Gerstung (1973)
[b] Number of catchable trout per mile; goal based on Gerstung (1973)
[c] Although hardhead were not observed at this site, they were observed upstream during the 2019 hardhead study (Section 7.0, *Hardhead*)
[d] Trout biomass was listed as the goal in the rationale document, however because SCD-F2 was snorkeled in 2019 and therefore biomass estimates were not possible, catchable trout per mile was used instead.

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# 3.0 BENTHIC MACROINVERTEBRATES

## 3.1 MONITORING PLAN OBJECTIVES

The primary goal of the Aquatic Macroinvertebrate Monitoring Plan (Macroinvertebrate Plan) is to monitor benthic macroinvertebrate (BMI) assemblages and utilize an aquatic ecosystem health index as an indicator of stream conditions during implementation of the modified flow regime associated with the new license (SMUD 2016).

## 3.2 METHODS

### 3.2.1 Benthic Macroinvertebrate Sampling and Physical Habitat Data Collection

Sampling was conducted using procedures based on the standard reach-wide benthos (RWB) method for documenting and describing BMI assemblages and physical habitat outlined by the Surface Water Ambient Monitoring Program (SWAMP; Ode et al. 2016). Sites were placed as close as possible to those stream sections sampled during the relicensing study (SMUD and PG&E 2005); however, in most cases site locations were adjusted slightly upstream or downstream to comply with contiguity of sampleable habitat recommendations described in the SWAMP protocol (Ode et al. 2016).

The SWAMP protocol was developed for wadeable streams and, as stated in the Macroinvertebrate Plan, collection procedures were modified as necessary to accommodate current stream conditions in the UARP. Modifications included crew members wearing dry suits instead of waders to increase accessibility, adjusting the standard length of the sample reach at some sites (typically based on average wetted width), and occasionally partitioning sample reaches within a site (e.g., adjusting transect placement to omit inaccessible or unsampleable habitat) for one or more of the following reasons: safe accessibility limitations (e.g., swift water), influence of tributary streams, and lack of contiguously sampleable aquatic habitat (e.g., large deep pools).

Sites were divided into 11 equidistant transects arranged perpendicular to the direction of flow and a single inter-transect was located between main transects. A total of 11 (1 per main transect) BMI subsamples were collected with a D-frame kicknet fitted with 0.02-inch diameter (0.5 mm) mesh to form a single RWB composite sample for each site (only physical habitat data were collected at inter-transects). Physical habitat and water quality parameters as described in the Macroinvertebrate Plan were also recorded. Additional detail on BMI and physical habitat data collection procedures is provided in the Macroinvertebrate Plan. Physical habitat data (e.g., substrate size) from points along transects that were not safely accessible (e.g., in a rapid) were not collected and recorded as inaccessible on the datasheet.

### 3.2.2 Laboratory Methods

As described in the Macroinvertebrate Plan, laboratory methods followed procedures outlined in the Standard Operating Procedures for Laboratory Processing and Identification of Benthic Macroinvertebrates in California (Woodard et al. 2012). At least 600 BMIs were subsampled from each composite sample and identified using standard aquatic BMI identification keys (e.g., Merritt et al. 2008, Stewart and Stark 2002, Thorp and Covich 2001, Wiggins 1996) and other appropriate references. All organisms from the subsample were identified to a minimum level 1 taxonomic effort as specified in the Southwestern Association of Freshwater Invertebrate Taxonomists (SAFIT; Richards and Rogers 2011) and an independent laboratory was contracted to conduct an external quality control (QC) of the BMI identification for 10 percent of the samples. Additional detail on standard laboratory procedures is provided in the Macroinvertebrate Plan.

### 3.2.3 Data Analysis

A suite of standard metrics describing richness, composition, and other characteristics that are often used to describe BMI assemblages (Karr and Chu 1999) was calculated for each sample; a detailed list of these metrics is provided in the Macroinvertebrate Plan. The Macroinvertebrate Plan describes using a subset of these metrics to calculate the Sierra Index of Biological Integrity (Sierra IBI) developed by Rehn (2009 and 2010). The more contemporary California Stream Condition Index (CSCI), also developed by Rehn et al. (2015), was calculated instead in order to maintain consistency with the current practices for BMI sample evaluation recommended by SWAMP (Rehn, pers comm, 2020). The CSCI is based on predictive modeling generated from a state-wide BMI database and is a more robust and computationally complex analytical tool than the Sierra IBI, requiring use of Geographic Information System (GIS) software and the statistical software R (R Core Team 2019) for its calculation (Rehn et al. 2015). The CSCI is used as a composite biological response variable to evaluate aquatic habitat quality at sites and identify overall trends related to stream condition as reflected by the BMI community.

The CSCI integrates two measures for evaluating sites: BMI taxonomic completeness, which is based on an observed-to-expected (O/E) ratio, and a multi-metric index (MMI). The O/E is a measure of taxonomic completeness between observed (O) taxa collected at a site and expected (E) taxa generated through predictive modeling from the input of site-specific environmental variables (e.g., climate, topography, and geology) that are known to influence BMI communities (Rehn et al. 2015). Based on these site-specific environmental variables, the MMI component of the CSCI generates anticipated values for six metrics[2] demonstrated to have a high signal to noise response (Rehn et al. 2015) and compares results with empirical values from the BMI sample collected from a given site. As observed taxa and metric values deviate from those predicted from reference sites using the site-specific environmental variables described above, scores for each

[2]Percent Clinger Taxa; Percent Coleoptera Taxa; Percent Ephemeroptera, Plecoptera, and Trichoptera (EPT) Taxa; Percent Intolerant Individuals; Shredder Taxa Richness and Taxonomic Richness.

measure (i.e., MMI and O/E) decrease. Conversely, as observed taxa and metric values approach similar distributions of expected taxa and metric values from reference sites, scores for each measure increase.

CSCI calculation integrates O/E taxonomic richness and MMI results into a single score typically ranging from 0.1 (great deviation from reference condition) to 1.4 (exceeding quality of reference condition). CSCI scores are further divided into three thresholds, based on the 30th, 10th, and 1st percentiles of CSCI scores at reference sites in the state-wide database. These three thresholds divide the CSCI scoring range into four categories of biological condition:

- ≥0.92 = likely intact condition;
- 0.91 to 0.80 = possibly altered condition;
- 0.79 to 0.63 = likely altered condition;
- ≤0.62 = very likely altered condition (Rehn et al. 2015).

CSCI scores were calculated for BMI samples collected in 2002 and 2003 for the relicensing study (SMUD and PG&E 2005) and in 2019. Historical scores were averaged where data for more than one sample were available for a given site (e.g., the site was sampled in 2002 and 2003). If a BMI sample was not collected from a current site during the relicensing study (i.e., sites JD-I4 and SCD-I3), data from the most proximal historical site was used as a comparative analogue. Additional information regarding data evaluation conducted as part of the BMI study, including standardization procedures for historical data and further description of individual metrics calculated is provided in the Macroinvertebrate Plan.

### 3.2.4 Variances and Problems Encountered

Variances from the Macroinvertebrate Plan referenced in previous sections of the methods included:

- Adjusting the length of the sample reach (typically based on average wetted width) due to safe accessibility limitations (e.g., swift water), influence of tributary streams, and/or lack of contiguously sampleable aquatic habitat (e.g., large deep pools) at the following sites: JD-I1, JD-I4, CD-I2, CD-I3, SCD-I1, and SCD-I3.
- Partitioning sample reaches (i.e., adjustments to transect placement) at sites CD-I2 and CD-I3 to avoid inaccessible or unsampleable habitat.
- Calculating the CSCI instead of the Sierra IBI for both the current (2019) and historical samples to maintain consistency with contemporary SWAMP analytical procedures, which have been updated since the Macroinvertebrate Plan was written.

These variances were made in consultation with authors of the current SWAMP collection and analytical procedures (Ode, pers comm, 2019 and Rehn, pers comm, 2020).

## 3.3 RESULTS

A total of 11 samples and one replicate were collected from 11 sites within the UARP (Figures 1-1 through 1-3 and Table 3-1). During an initial site assessment, one site described in the Macroinvertebrate Plan was not safely sampleable using the SWAMP methodology under the new minimum flow regime. This site, co-located with Site SCD-I1a, was identified as SCD-I1b in the Macroinvertebrate Plan and was replaced with an alternate (Site SCD-I3) farther downstream in the Slab Creek Dam Reach (Figure 1-1, Table 3-1). Accordingly, what was described as Site SCD-I1a in the Macroinvertebrate Plan is more simply referred to as Site SCD-I1 in this report.

**Table 3-1. Benthic Macroinvertebrate Sites Sampled in 2019 for the Upper American River Project.**

| Site Code | Sample Date | Stream (Reach) | Description | Coordinates (Northing/ Easting)[1] | Elevation (m) | Reach Length[2] (m) |
|---|---|---|---|---|---|---|
| RRD-I2 | 9/13/2019 | Rubicon River (Rubicon Dam) | Upstream of Rubicon Springs | 740001/ 4321159 | 1,865 | 150 |
| LLD-I3 | 9/12/2019 | Gerle Creek (Loon Lake Dam) | Upstream of Rocky Basin Creek Confluence | 727272/ 4318674 | 1,653 | 150 |
| GCD-I2 | 9/12/2019 | Gerle Creek (Gerle Creek Dam) | Upstream of South Fork Rubicon River | 725682/ 4314970 | 1,532 | 150 |
| RPD-I2 | 9/10/2019 | South Fork Rubicon River (Robbs Peak Dam) | Downstream of Gerle Creek Confluence | 724227/ 4314517 | 1,495 | 150 |
| IHD-I2 | 9/10/2019 | South Fork Silver Creek (Ice House Dam) | Downstream of Ice House Reservoir | 727760/ 4299814 | 1,596 | 150 |
| JD-I1 | 9/10/2019 | Silver Creek (Junction Dam) | Downstream of Junction Reservoir | 720200/ 4303286 | 1,303 | 150 |
| JD-I4[3] | 10/10/2019 | Silver Creek (Junction Dam) | Near Jaybird Adit access | 737319/ 4302088 | 1,211 | 150 |
| CD-I2 | 9/11/2019 | Silver Creek (Camino Dam) | Near Camino Adit access | 710090/ 4298471 | 730 | 90 |
| CD-I3 | 9/11/2019 | Silver Creek (Camino Dam) | Upstream of South Fork American River Confluence | 709334/ 4296211 | 628 | 100 |
| SCD-I1[4] | 9/11/2019 | South Fork American River (Slab Creek Dam) | Downstream of Slab Creek Dam, upstream of Iowa Canyon Creek | 699540/ 4293960 | 502 | 80 |
| SCD-I3[5] | 9/9/2019 | South Fork American River (Slab Creek Dam) | Upstream of Rock Creek Confluence | 692949/ 4295026 | 335 | 150 |

Notes: m=meter

[1] UTM, NAD83; located at Transect A as described in the SWAMP protocol and may differ slightly from historical site coordinates.

[2] See Section 3.2.1 for discussion on determining factors for reach length.

[3] As described in the Macroinvertebrate Plan, this site was not sampled during relicensing and was added to replace historical Site JD-I2 (SMUD and PG&E 2005), which is located on private property with unreliable access.

[4] Identified as Site SCD-I1a in the Macroinvertebrate Plan; Site SCD-I1b was relocated farther downstream (see table note #5 below), therefore this sample location is referred to more simply as Site SCD-I1 herein.

[5] Site not sampled during relicensing: replacement for Site SCD-I1b described in the Macroinvertebrate Plan which was determined to be unsafe to sample using SWAMP methodology during site assessment in 2019.

### 3.3.1 Water Quality

Water quality parameters recorded at sites during BMI collection are shown in Table 3-2. Additional information and discussion on water quality within UARP stream reaches can be found in the annual water quality report (SMUD 2020).

**Table 3-2. Water Quality Data by Site for Benthic Macroinvertebrate Samples Collected in 2019 for the Upper American River Project.**

| Site Code | Water Temperature (°C) | pH (s.u.) | Alkalinity (mg/L) | Dissolved Oxygen (% sat.) | Dissolved Oxygen (mg/L) | Specific Conductance (µS/cm) |
|---|---|---|---|---|---|---|
| RRD-I2 | 17.2 | 7.3 | 14 | 81 | 7.8 | 5.7 |
| LLD-I3 | 14.8 | 7.1 | 12 | 100 | 8.3 | 7.0 |
| GCD-I2 | 14.5 | 7.2 | 15 | 85 | 8.6 | 10.6 |
| RPD-I2 | 13.9 | 7.3 | 12 | 86 | 8.9 | 10.7 |
| IHD-I2 | 10.1 | 7.3 | 12 | 85 | 9.6 | 13.5 |
| JD-I1 | 9.8 | 7.3 | 12 | 101 | 9.9 | 10.0 |
| JD-I4 | 7.7 | 7.6 | 15 | 86 | 10.3 | 14.3 |
| CD-I2 | 13.9 | 7.4 | 12 | 106[2] | 10.0 | 14.0 |
| CD-I3 | 14.3 | 7.4 | 20 | 94 | 9.6 | 22.7 |
| SCD-I1 | 12.9 | 6.9[1] | 12 | 100 | 10.0 | 13.0 |
| SCD-I3 | 13.8 | 7.7 | 20 | 97 | 10.1 | 24.3 |

Notes: °C=degrees Celsius, s.u. = standard unit, mg/L = milligram per liter, % sat. = percent saturation, µS/cm=microsiemens per centimeter

[1] Water quality pH probe malfunctioned during BMI survey and no data was collected. Value reported was collected during SMUD water quality monitoring at nearby Site IS-19-SFAR on 7 October 2019.

[2] Value taken in afternoon and may be attributable to high oxygen production by algae throughout the day.

### 3.3.2 Physical Habitat Assessment

Physical habitat data are summarized by site in Tables 3-3 and 3-4. Photographs of the sites are presented in Appendix C1. Physical habitat among sampling sites was diverse, ranging from lower gradient pools to high gradient cascade/falls with associated substrate size classes ranging from cobble/sand to bedrock/boulder (Table 3-3). Boulder was the primary instream habitat complexity component and its abundance was scored from sparse to heavy (Table 3-4). Other commonly occurring habitat complexity components included filamentous algae and aquatic macrophytes/emergent vegetation. All other instream habitat complexity components including woody debris, undercut banks, overhang vegetation, live tree roots, and artificial structures were sparse or absent at most sites (Table 3-4). Average canopy cover was variable across sites, ranging from one to 42 percent (Table 3-3). At most sites the upper canopy was sparse and the middle canopy was sparse to moderate; ground cover was moderate at all sites.

Stream banks at most sites were categorized as stable, although bank vulnerability was noted at more than two transects at sites RRD-I2, GCD-I2, and IHD-2.

Due to the remoteness of most sites, evidence of in-channel human disturbance was minimal, although land use within the surrounding watershed by site becomes increasingly developed with decreasing elevation. Site SCD-I1 had the most evident human influence due a pedestrian bridge at the upstream end of the site, a river access trail on the north side of the river, and proximity to active construction for the new South Fork Powerhouse. Site SCD-I3 was near infrastructure associated with Rock Creek Powerhouse on the north side of the channel. At other sites, evidence of human disturbance was limited to minor amounts of trash.

**Table 3-3. Physical Habitat Data Collected by Site during Benthic Macroinvertebrate Sampling in 2019 for the Upper American River Project.**

| Site Code | Gradient (%)[1] | Discharge (cfs)[2] | Average Wetted Width (m)[3] | Average Canopy Cover (%) | Dominant Habitat (subdominant)[4] | Dominant Substrate (subdominant)[4] |
|---|---|---|---|---|---|---|
| **RRD-I2** | 1.1 | 7.5 | 10.9 | 42 | Riffle (Pool) | Cobble (Sand) |
| **LLD-I3** | 3.1 | 26.9 | 13.8 | 25 | Run (Pool) | Bedrock (Cobble) |
| **GCD-I2** | 2.2 | 7.7 | 9.9 | 44 | Riffle (Pool) | Bedrock, Cobble (Sand) |
| **RPD-I2** | 2.8 | 8.5 | 11.5 | 11 | Run (Cascade/Falls) | Bedrock (Sand) |
| **IHD-I2** | 1.8 | 21.2 | 9.4 | 29 | Run (Pool) | Bedrock (Sand) |
| **JD-I1** | 4.9 | 19.9 | 15.4 | 20 | Run (Glide, Rapid) | Small Boulder (Cobble) |
| **JD-I4** | 3.2 | 17 | 19.3 | 26 | Run (Pool) | Small Boulder (Large Boulder, Cobble, Bedrock) |
| **CD-I2** | 2.0 | 27.6 | 10.5 | 8 | Run (Pool) | Bedrock (Small Boulder) |
| **CD-I3** | 2.7 | 29.9 | 10.3 | 20 | Cascade/Falls (Run) | Cobble (Bedrock) |
| **SCD-I1** | 1.3 | 88.9 | 14.6 | 1 | Riffle (Rapid) | Small Boulder (Cobble) |
| **SCD-I3** | 1.8 | 88.7 | 29.6 | 3 | Run (Riffle, Pool) | Cobble (Large Boulder) |

Notes: %=percent, cfs=cubic feet per second, m=meter

1 Calculated using satellite imagery and the USGS National Elevation Dataset Digital Elevation Model
2 Estimated by discharge transect in field or recorded by nearest gage data
3 Averaged across 11 main transects
4 Multiple habitats and substrates listed were present in equal amounts.

**Table 3-4. Instream Habitat Complexity and Riparian Vegetation Cover Data Collected by Site during Benthic Macroinvertebrate Sampling in 2019 for the Upper American River Project.**

| Site | Instream Habitat Complexity Elements[1] | | | | | | | | | Riparian Cover[1] | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Filamentous Algae | Aquatic Macrophytes/ Emergent Vegetation | Boulders | Woody Debris (> 0.3 m) | Woody Debris (<0.3 m) | Undercut Banks | Overhang Vegetation | Live Tree Roots | Artificial Structures | Upper Canopy (>5m) | Lower Canopy (0.5–5 m) | Ground Cover (<0.5 m) |
| RRD-I2 | Sparse | Sparse | Sparse | Sparse | Sparse | Sparse | Sparse | Sparse | Absent | Moderate | Moderate | Moderate |
| LLD-I3 | Sparse | Sparse | Heavy | Sparse | Sparse | Sparse | Sparse | Sparse | Absent | Moderate | Moderate | Moderate |
| GCD-I2 | Sparse | Sparse | Sparse | Sparse | Sparse | Sparse | Moderate | Sparse | Absent | Sparse | Moderate | Moderate |
| RPD-I2 | Absent | Sparse | Sparse | Sparse | Sparse | Sparse | Sparse | Sparse | Absent | Sparse | Sparse | Moderate |
| IHD-I2 | Sparse | Sparse | Moderate | Sparse | Sparse | Sparse | Sparse | Sparse | Absent | Sparse | Moderate | Moderate |
| JD-I1 | Moderate | Sparse | Heavy | Sparse | Sparse | Sparse | Sparse | Sparse | Absent | Sparse | Moderate | Moderate |
| JD-I4 | Sparse | Moderate | Heavy | Sparse | Sparse | Absent | Sparse | Sparse | Absent | Moderate | Sparse | Moderate |
| CD-I2 | Sparse | Sparse | Moderate | Sparse | Sparse | Sparse | Sparse | Sparse | Absent | Sparse | Sparse | Moderate |
| CD-I3 | Sparse | Sparse | Heavy | Sparse | Sparse | Absent | Sparse | Sparse | Absent | Sparse | Sparse | Moderate |
| SCD-I1 | Sparse | Sparse | Heavy | Absent | Sparse | Sparse | Sparse | Sparse | Sparse | Sparse | Moderate | Moderate |
| SCD-I3 | Sparse | Sparse | Moderate | Sparse | Sparse | Sparse | Sparse | Sparse | Absent | Sparse | Moderate | Moderate |

Notes: m=meter

[1]Presence averaged across 11 main transects: Absent = 0%, Sparse = <10%, Moderate (Mod) = 10–40%, Heavy = 41–75%, Very Heavy (V. Heavy) = >75%

### 3.3.3 Benthic Macroinvertebrate Assemblage Evaluation

A total of 7,448 BMIs representing 112 distinct taxa (identifiable to genus or species) were processed from the 11 composite samples and one replicate collected from the UARP BMI study sites in 2019. All composite samples contained more than the minimum 600 organism subsample size, and the average subsample size was 621 organisms (range: 603 to 647). Inter-laboratory Quality Control (QC) indicated a few minor sorting errors and one minor taxonomic discrepancy that is undergoing further review (Appendix C2). QC parameters for all samples were within the standardly accepted threshold for error rate. A complete taxonomic list with associated functional feeding group and tolerance value designations is presented in Appendix C3. Commonly reported metrics (e.g., the Shannon Weaver Diversity Index) including those that comprise the MMI component of the CSCI (Percent Clinger Taxa; Percent Coleoptera Taxa; Percent Ephemoptera, Plecoptera, and Trichoptera [EPT] Taxa; Percent Intolerant Individuals; Shredder Taxa Richness and Taxonomic Richness) are presented in Appendix C4.

Results of the application of the CSCI to the BMI samples collected in 2019 are presented in Figure 3-1. CSCI scores ranged from 0.71 to 1.26 with scores for samples collected from over half (six) of the sites exceeding the threshold for the highest categorical interpretation of the score, described as “likely intact” (Rehn et al. 2015). Scores for other sites ranked within the next two lower categorical tiers of “possibly altered” condition (0.80 to 0.91) or “likely altered” condition (0.63 to 0.79). None of the samples collected scored within the lowest tier, described as “very likely altered” condition (≤0.62) (Rehn et al. 2015). Application of the CSCI to historical BMI data from the relicensing study (SMUD and PG&E 2005) yielded very similar results with scores ranging from 0.63 to 1.17 (Figure 3-2). Historical samples from six sites scored above the threshold for the highest category, “likely intact” condition and scores for samples collected from other sites placed either within the “possibly altered” or “likely altered” conditions categories. None of the historical samples scored within the lowest condition category, “very likely altered” (Figure 3-2).

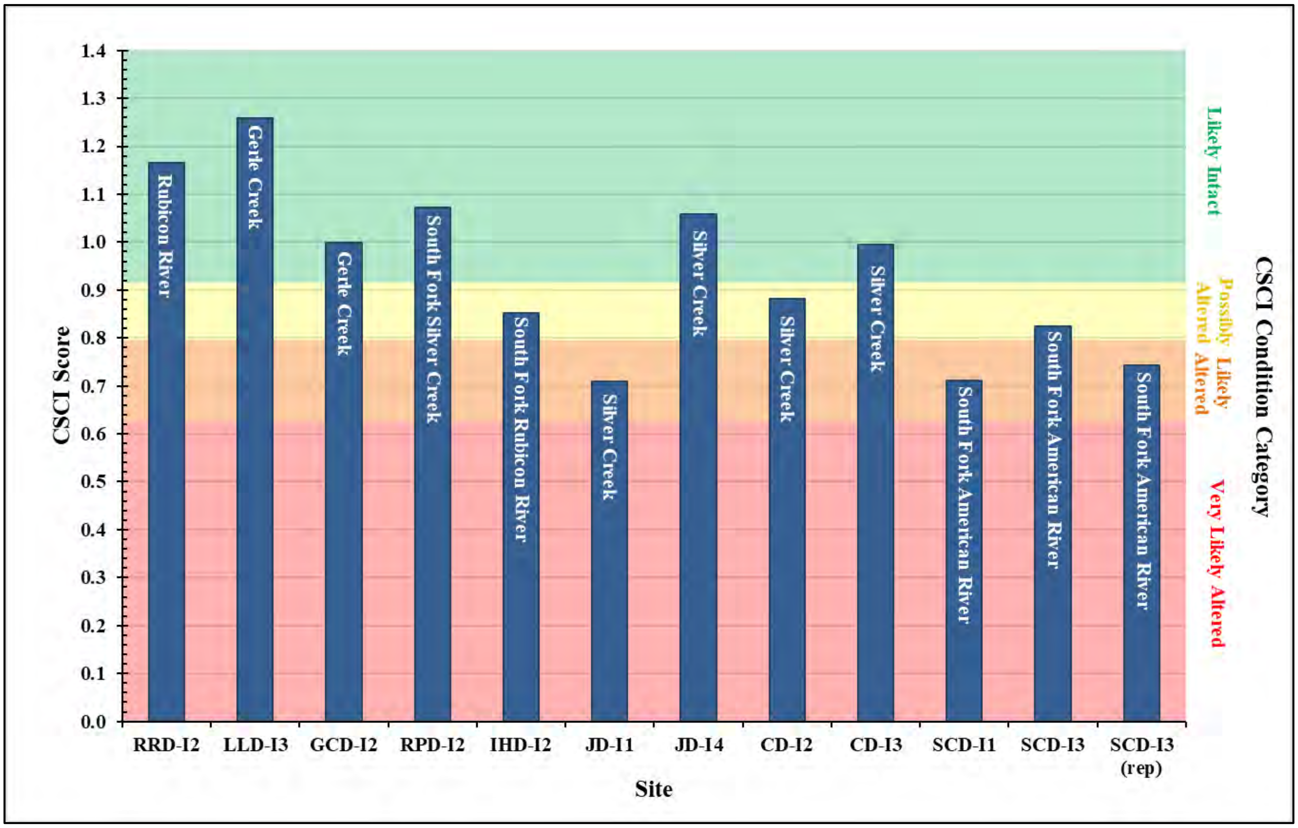


**Figure 3-1. California Stream Condition Index scores and condition categories for Benthic Macroinvertebrate samples collected for the Upper American River Project in 2019.**

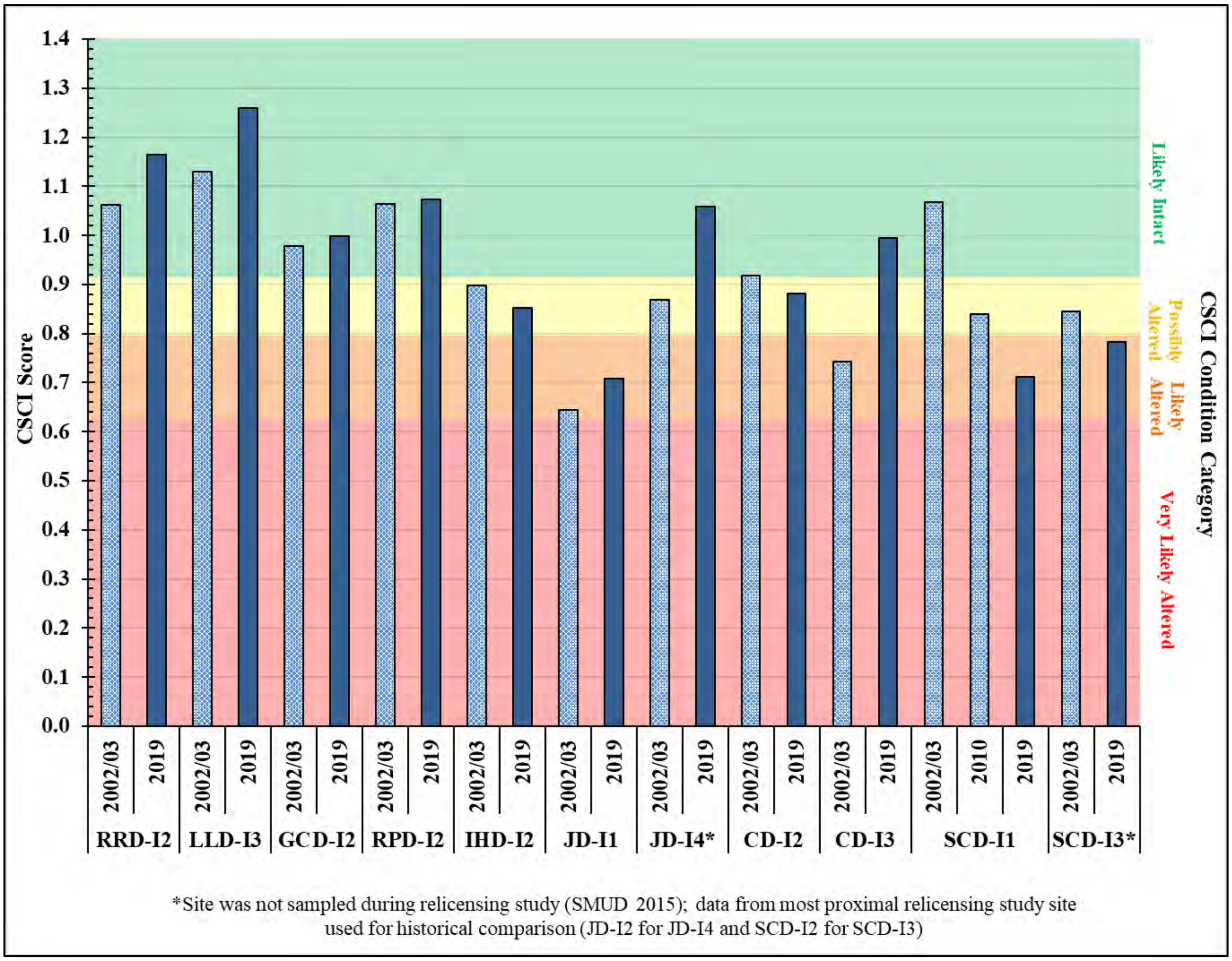


**Figure 3-2. California Stream Condition Index scores and condition categories for Benthic Macroinvertebrate samples collected for the Upper American River Project in 2002/2003, 2010, and 2019 (average where data for more than one sample [multiple years or replicates within a year] was available for a site).**

## 3.4 DISCUSSION

BMI assemblages collected from the UARP in 2019 were generally of good quality as indicated by CSCI scores for over half of the samples ranking within the highest condition category (“likely intact”) of the index. CSCI scores for samples collected from sites in higher elevation reaches were typically higher than those collected from sites in lower elevation reaches, which could be attributable to increased human influence (e.g., development) affecting regulated UARP stream reaches and associated unregulated tributaries at lower elevation (Table 3-1 and Figure 3-1). Some of the other variation in CSCI scores for samples collected from the UARP in 2019 demonstrate a trend consistent with findings from a study on the effects of hydropower projects on BMI assemblages in which relatively low biological index values were documented immediately downstream of large reservoirs but increased with distance downstream from the dam (Rehn et al. 2007). CSCI scores for samples collected in 2019 from the sites immediately below Junction Reservoir (Site JD-I1), Ice House Reservoir (Site IHD-I2), and Slab Creek Reservoir (Site SCD-I1) scored within the “possibly altered” or “likely altered” condition categories (Figure 3-1). An attenuating effect was evident with distance downstream in the Junction Dam Reach where the CSCI score for the sample collected downstream from Site JD-I4 was higher, placing within the “likely intact” condition category (Figure 3-1). There is not a current monitoring site farther downstream in the Ice House Dam Reach, however attenuation with distance downstream was documented in this reach during the relicensing study in which the composite metric score used for analysis was lowest at the site closest to Ice House Dam (Site IHD-I1) and gradually increased with distance downstream at Sites IHD-I2 through IHD-I4 (SMUD and PG&E 2005).

In 2019 attenuation was not as apparent, however, in the Slab Creek Dam Reach. The lower score (in the “likely altered” condition category) for the sample collected from Site SCD-I1 immediately below Slab Creek Dam is likely related to proximity to the dam and activities associated with the construction of the new South Fork Powerhouse. CSCI scores for the sample and replicate collected downstream from Site SCD-I3 were higher, yet still placed within the same condition category indicating possible impairment (Figure 3-1). There are a number of factors in the reach that could be contributing to this, including increased human influence (e.g., development) affecting regulated reaches of the UARP and associated unregulated tributaries at lower elevation (see Section 3.3.2) and flow fluctuation related to prolonged high-volume spill events in recent high water years (i.e., 2017 and 2019) and periodic recreational releases (Allen 2004, Kennedy et al. 2016, Olden and Naiman 2010, and Steel et al. 2018). Primary ways that flow fluctuation can influence BMI assemblages include (1) stranding on the margins, (2) thermal effects, and/or (3) velocity-related effects (e.g., increased drift or scour). Ramping the flow change minimizes but does not necessarily eliminate stranding effects and, while temperature differences between base flow and higher flow events in Slab Creek Dam Reach are not as great as those seen farther downstream in the Reach Downstream of Chili Bar due to differences in thermal conditions and hydro operations in the respective upstream reservoirs, thermal variation may still have an effect. The factors potentially contributing to the lower CSCI score for the sample collected from Site SCD-I3 are not mutually exclusive and, therefore, difficult to partition. However, CSCI scores for BMI samples in future water years during which spill events and/or recreational releases may or may not occur in Slab Creek Dam Reach will provide additional comparative information and may yield further insight regarding potential sources of impairment affecting the BMI community at Site SCD-I3.

Application of the CSCI to historical data for the current monitoring sites collected in 2002 and 2003 during the relicensing study (SMUD and PG&E 2005) and in 2010 from Site SCD-I1 for the license amendment request for the South Fork Powerhouse (ECORP 2011) demonstrated similar trends (Figure 3-2) with higher scores for samples collected from sites in higher elevation reaches compared to scores for samples collected from sites in lower elevation reaches in the hydrologic system (Figure 3-2).

Scores for historical samples collected at the same sites (or analogue sites as described in Section 3.2.3 and notes in Figure 3-2) ranked within the same condition category as scores for samples collected in 2019 for all but four sample locations (sites CD-I2, CD-I3, JD-I4, and SCD-I1). Of the four sample locations that had scores that placed in different condition categories, two sites (sites CD-13 and JD-14) had higher CSCI scores in 2019 compared to historical data, and two sites (site CD-I2 and SCD-I1) had a lower CSCI score in 2019 compared to historical data.

CSCI scores for samples collected at Site CD-I2 placed within different condition categories between datasets yet were numerically similar (historical = 0.92 and 2019 = 0.88) (Figure 3.2). The notably higher CSCI score for the sample collected downstream from Site CD-I3 in 2019 (0.99) compared to historical data (0.74) may be attributable to changes in physical habitat at the site, particularly large woody debris accumulation that has increased habitat complexity since the relicensing study. The difference in CSCI scores for samples collected from sites in the lower Junction Dam Reach (1.06 for Site JD-I4 sampled in 2019 and 0.87 for Site JD-I2 used as its historical analogue) is likely attributable to attenuation with increasing distance downstream of Junction Reservoir. Site JD-I2 was historically located approximately one mile downstream of the reservoir, whereas Site JD-I4 is located another mile farther downstream. The lower CSCI score for the sample collected from Site SCD-I1 in 2019 (0.71 in the “likely altered” condition category) in comparison to historical data (1.1 for 2002/03) is likely partially attributable to temporary dewatering of the reach in 2018 and ongoing construction activity (including channel bed disturbance) associated with the new South Fork Powerhouse. The quality of aquatic habitat at this site may increase over time following completion of construction; however, the score for the sample collected from this site in 2010 prior to construction of the powerhouse although higher (0.84) also fell within a condition category indicating possible impairment (Figure 3-2), suggesting that proximity to Slab Creek Dam may also be a factor.

Overall CSCI scores for historical samples versus those for samples collected in 2019 reflect a similar range (0.63–1.17 and 0.71–1.26, respectively) and average scores (0.93 and 0.94, respectively) for samples collected from each period exceed the threshold for the “likely intact” condition category. This suggests that overall stream condition and quality of aquatic habitat in the UARP stream reaches as reflected by the BMI community has not changed significantly with implementation of the new minimum flow regime under the current license. Additional BMI samples collected in future years will further facilitate identification of changes at monitoring sites or new system-wide trends in stream condition over time. In accordance with the frequency described in the Macroinvertebrate Plan, BMI samples will be collected again from the UARP in the following years: 2020, 2024, 2025, 2029, 2030, and thereafter for two consecutive years every 10 years for the term of the license.

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# 4.0 GEOMORPHOLOGY

## 4.1 MONITORING PLAN OBJECTIVES

The primary objectives of this report as described in the Geomorphology Monitoring Plan (SMUD 2017) are to assess geomorphic changes associated with the change in minimum flow regime under the new license. Geomorphology monitoring site locations are shown in Figures 1-1 to 1-3.

## 4.2 METHODS

Methods used for this study are described in the Geomorphology Monitoring Plan. Additional methodological detail is provided below to further clarify implementation of the study and improve repeatability among years.

### 4.2.1 Hydrologic Data

Hydrologic data for the stream reaches of interest (see Table 4-1) were downloaded from the U.S. Geological Survey (USGS) for the period of record for each gage through Water Year 2018. Data for Water Year 2019 were provided by SMUD. For the Rubicon River below Rubicon Dam Reach, the discharge measured at the USGS gage was added to spill data over the dam provided by SMUD. The Rubicon Dam spill data extended from 01 January 2002 to 30 September 2019. The USGS gages used in this analysis are listed in Table 4-1. Annual peak flow data and monthly average flow for each gage are provided in Appendix D1.

**Table 4-1. Hydrologic Data Used to Assess Changes in the Geomorphic Study Sites.**

| Stream Reach | Study Site(s) | USGS gage number | Period of record | Drainage Area at gage ($mi^2$) |
|---|---|---|---|---|
| Rubicon River below Rubicon Dam[1] | RRD-G1 | 11427960 | 10/1/2002–9/30/2019 | 26.8 |
| Gerle Creek below Loon Lake Dam | LLD-G1<br>LLD-G2 | 11429500 | 10/1/1962–9/30/2019 | 8.01 |
| South Fork Silver Creek below Ice House Dam | IHD-G1<br>IHD-G2 | 11441500 | 10/1/1924–9/30/2019 | 27.5 |
| Silver Creek below Camino Dam | CD-G1 | 11441900 | 10/1/1960–9/30/2019 | 171 |
| South Fork American River below Slab Creek Dam | SC-G1 | 11443500 | 10/1/1922–9/30/2019 | 493 |

$mi^2$ = square miles; USGS = U.S. Geological Survey
[1]Rubicon River discharge was calculated by adding daily average spill data provided by SMUD to daily average flow for USGS gage 11427960.

With the exception of the Rubicon River, instantaneous peak flow data through Water Year 2018 were downloaded from the USGS website for the gages listed in Table 4-1. Because instantaneous peak flow data were not available from the USGS for 2019, peak flows for 2019 were calculated using the Water Year 2019 maximum daily average flow.

Instantaneous data were not available for the Rubicon River below Rubicon Dam for its entire period of record. For the Rubicon River, the maximum daily average flow for each water year was used as the annual peak flow for the entire period from 2002–2019. This likely underestimates the instantaneous peak discharge but provides a reasonable estimate of the relative magnitude of peak flows through time.

#### 4.2.2 Field Surveys

This study included seven study sites, all of which were originally surveyed in 2003 (SMUD 2005). Benchmarks and endpins (i.e., fixed elevation points at each end of the cross-section) at each study site were surveyed with a real-time kinematic (RTK) global navigation satellite system (GNSS) to ensure the coordinates and elevations were accurately recorded. GNSS positions were post-processed using the National Oceanic and Atmospheric Administration’s (NOAA’s) Online Positioning User Service (OPUS) to derive control point position accuracies with < 0.1 feet of horizontal and vertical error. The sites and their upstream and downstream extents are listed in Table 4-2. The locations of all survey points are shown in the overview maps in Appendix D2.

**Table 4-2. 2019 Upper American River Project Geomorphology Study Sites.**

| Stream | Stream Reach | Site ID | Survey Date | Drainage Area ($mi^2$) | Length (ft) | Upstream Extent[1] | | Downstream Extent[1] | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Northing (ft) | Easting (ft) | Northing (ft) | Easting (ft) |
| Rubicon | Below Rubicon Dam | RRD-G1 | 9/10/2019 | 33 | 500 | 2132902 | 7065109 | 2133230 | 7065089 |
| Gerle Creek | Below Loon Lake Dam Upper Reach | LLD-G1 | 7/18/2019 | 7 | 400 | 2133700 | 7038682 | 2133918 | 7038267 |
| | Below Loon Lake Dam Middle Reach | LLD-G2 | 8/7/2019 | 11 | 700 | 2134728 | 7030737 | 2134809 | 7029814 |
| South Fork Silver Creek | Below Ice House Reservoir Upper Reach | IHD-G1 | 8/9/2019 | 33 | 1,200 | 2063499 | 7022990 | 2062667 | 7022344 |
| | Below Ice House Reservoir Lower Reach | IHD-G2 | 8/9/2019 | 43 | 1,300 | 2071134 | 7005768 | 2072218 | 7005535 |
| Silver Creek | Below Camino Dam | CD-G1 | 8/6/2019 | 175 | 700 | 2060492 | 6966631 | 2059877 | 6966196 |
| South Fork American River | Below Slab Creek Dam | SC-G1 | 11/7/2019 | 516 | 650 | 2049397 | 6910900 | 2049326 | 6910890 |

[1] The Upstream and Downstream Extent are from the 2019 Surveys in California State Plane Coordinate System Zone 2 (NAD-1983).
$mi^2$ = square miles
ft = feet

#### 4.2.2.1 Site Description

At each site, representative photographs of the channel were taken from various locations within the study reach (see Appendix D3). Photographs were taken from positions to provide views of (1) cross-sections from both channel banks, (2) upstream and downstream views from each cross-section, (3) endpins at each cross-section, and (4) any observed sources of erosion or sedimentation. Locations of photographs were recorded with GPS enabled cameras, and reference points such as boulders or healthy, mature trees were identified within each photograph. Notes describing channel conditions were made during each site visit to summarize the morphology of the site and any controls on erosion and sedimentation.

#### 4.2.2.2 Longitudinal Profile

A longitudinal profile of the channel thalweg was surveyed through the length of each study reach using either a robotic total station (RTS) or RTK GNSS depending on site condition. Northing and easting data were converted to distance by calculating the sum of squares differences between consecutive survey points. The survey interval was typically about five feet. At Site SCD-G1, dangerous depth and velocity conditions precluded a complete longitudinal profile survey. The longitudinal profile elevations were tied to the local datum used for the cross-section survey. The longitudinal profile survey followed procedures established by the USFS (Harrelson et al.1994), including surveying a sufficient number of points (6 feet spacing on average) with which to capture the topography of pool, riffles, and other habitat features, as well as other significant breaks in channel gradient. Longitudinal profiles are provided in Appendix D4.

Longitudinal profile data were used to determine reach-average slope and to compare with the results of previous surveys. Since 2003, survey equipment has changed considerably; the RTS and GNSS used for the 2019 study were much more accurate and facilitated more direct comparisons with future surveys. Modern surveying equipment also allowed a much higher density of survey points to be collected in a similar time frame, hence the 2019 survey points were much denser than the 2003 surveys. Because the 2003 surveys used an auto level and tape the distance calculations likely underestimated distances relative to the 2019 surveys. To compare the 2003 and 2019 longitudinal profile points, the 2003 survey stationing was corrected to match the 2019 stationing for the three cross-sections. Given the uncertainty of some of the cross-section locations described below, this likely leads to some differences between the two surveys, but in the absence of this correction the difference between known points were much greater. Differences between the 2003 and 2019 longitudinal profiles may therefore reflect differences in survey methodology and may not reflect topographic change. The reach-average slope measurements should be relatively insensitive to these differences and are therefore also described below.

#### 4.2.2.3 Cross-Sections

Three cross-sections were surveyed at each representative site using either an RTS or RTK GNSS. At each cross-section, existing endpins were reoccupied where possible. Where endpin location was not clear, new endpins were established as close to the previous location as possible. The proximity of the relocated endpins to the original location is not known, but based on comparison with 2003 photographs, the relocated endpins were within 10 feet of the original location, with the exception of Site LLD-G1 where the floodplain had changed to a degree that made recreating the endpin location very difficult. The positions of both endpins for each cross-section were recorded using either an RTK or RTS to enable reoccupation during future monitoring efforts. At some sites, additional temporary benchmarks were established and their positions recorded. Cross-section figures are provided in Appendix D5.

The cross-section survey was conducted in sufficient detail (3 feet spacing on average) to capture any change in grade and to characterize channel geometry, following standard survey procedures established by the USFS (Harrelson et al. 1994). This included capturing the bankfull elevation on both banks, the edge of water during the surveys, and the thalweg elevation. The survey approach ensured that all topographic breaks across the channel cross-section and all cross-section elevations within a given representative site were measured and tied into a State Plane Coordinate System. Where both endpins of a cross-section were recovered, the 2019 surveys were compared with the original surveys from 2003. Identifying bankfull elevations is somewhat subjective for rivers without clear floodplains, such as the majority of the study sites in this report. Other evidence such as kinks in the bank topography and changes in vegetation can reflect local changes (i.e., wood deposition) and/or recent high flows. Bankfull characteristics can therefore adjust due to differences in the definition of bankfull elevations rather than a change in cross-section topography. Channel cross-section locations and endpin coordinates are provided in Appendix D2.

Cross sections in Site LLD-G2 were also surveyed in 2015 prior to a pulse flow test in Gerle Creek and in 2016 following the test (SMUD 2016). These survey data were included in our cross-section comparison for the site.

#### 4.2.2.4 Bed Particle Size Distributions

Along each cross-section, a pebble count (Wolman 1954) was performed to characterize the bed particle size distribution. The count entailed measuring the intermediate axis (b-axis) of 100 particles to classify the bed particle size distribution. All silt- and sand-sized particles were classified as < 2mm and were included in the grain size distribution.

Bed particle size distribution data were used to calculate commonly used bed particle size metrics: the particle size for which 16% of the distribution is finer (D16), the particle size for which 50% of the distribution is finer (D50, or the median size), and the particle size for which 84% of the distribution is finer (D84). Where possible, these data were compared with historical data to assess any recent trends in bed coarsening or fining (see Appendix D6).

#### 4.2.2.5 Sediment Facies Mapping

Aerial imagery was collected at each representative site using an unmanned aerial vehicle to efficiently generate base maps for facies mapping during future monitoring efforts. Aerial imagery was captured from an elevation sufficient to show morphological features and extended several hundred feet upstream and downstream of the representative site boundaries. The imagery was orthorectified and tied into the local coordinate system. Orthorectified aerial images were used to characterize sediment facies size classes into textural patches throughout each representative study site. Sediment facies size classes were delineated by order of abundance of specific grain sizes following procedures established by Buffington et al. (1999). Facies maps are provided in Appendix D7.

#### 4.2.2.6 Large Woody Debris

All large woody debris (LWD) longer than one-half bankfull width at least partially within bankfull stage were documented. We categorized LWD as either single pieces, pieces with rootwads, or aggregates (see Appendix D8). An aggregate was defined as four or more pieces in contact that each met the minimum length criterion. A root wad was defined as a root mass with a diameter equal to or longer than the trunk length.

#### 4.2.2.7 V* (Fine Sediment Storage)

V* describes the volume of fine sediment stored in pools and is specifically designed for wadable pools (Lisle and Hilton 1992, Hilton and Lisle 1993). The Geomorphology Monitoring Plan included specific criteria for situations where V* should be measured (see Attachment 6 of the plan). These criteria were generally not met. In particular, pools often did not have clearly defined boundaries and fine sediment tended to deposit as a veneer over the entire bed rather than accumulate in pools. The lone exception was the upstream pool at Site IHD-G2 (see Appendix D9). The pool at Site IHG-G2 had a defined form and had extensive fine sediment (sand and silt) on the bed that was appropriate for a V* measurement. Because the pool was too deep to wade, the methods outlined in Hilton and Lisle (1993) and Attachment 6 of SMUD (2017) were adapted to estimate V* during a field survey on 9 September 2019. From a float tube, a graduated 8-foot-long steel rod was used to measure the water depth and thickness of fine sediment along three profiles of the pool (centerline, left edge, right edge). For each profile, the longitudinal area of the pool, fine sediment, and residual pool volume were calculated. The residual pool depth (the pool depth minus the depth at the pool outlet) was 0.4 feet for all three profiles as measured at the pool outlet. Locations where the pool plus fines thickness was greater than 8 feet (the length of the survey rod) were noted, but those locations were not included in the V* measurement because the depth of fines couldn't accurately be measured. V* was calculated as the average of the three profiles.

SMUD (2017) states that if V* is less than 0.1 or conditions are not suitable to survey fine sediment accumulation for 2 consecutive surveys (including the 2003 surveys) future V* measurements will not be made at the site.

4.2.2.8 Additional Channel Condition Assessments

Rosgen Level III, Rosgen Bank Erosion and Riparian Vegetation, and Pfankuch Bank Stability Assessments (Rosgen 1994, Pfankuch 1975) were also conducted as part of the study. Amended Pfankuch ratings were used to characterize channel stability as a function of stream classification (Rosgen 1984). These data are provided in Appendix D10, Appendix D11, and Appendix D12, respectively.

4.2.3 Data Analysis

Where possible, results from the cross-section and longitudinal profile surveys were compared with surveys from 2003 to assess geomorphic change. Because the longitudinal profiles do not start and stop at endpins, there is likely some uncertainty in aligning the 2003 and 2019 surveys. Nevertheless, changes in slope and locations of aggradation and incision were noted to assess cross-section adjustments. Geomorphic change in cross-sections was quantified using the change in bed elevation and bankfull characteristics. Differences in the location of endpins can cause apparent cross-section changes between surveys primarily due to differences in the location sampled and the distance from the endpin. Cross-sections where one or both the endpins were not recovered were therefore not directly compared. Based on the photographs of the endpins in 2003, the endpins replaced in 2019 were estimated to be within 10 feet of the original endpin, although this estimate could not be tested. While these differences can affect the shape of the cross-section, they are less likely to affect the pebble counts, because the pebble counts are less sensitive to the distance from the endpin. Hence pebble counts at cross-sections where one or more of the 2003 endpins was missing were still compared. In all reaches, but particularly reaches confined by bedrock and boulders, the bankfull elevation was difficult to identify and differences in bankfull depth and width resulted more from differences in bankfull elevation estimates in the field than significant morphologic changes, as discussed in Section 4.3.2. The pebble count statistics and bankfull characteristics from the 2003 data were recalculated from the original surveys to be consistent with the 2019 analysis and to facilitate comparison with future survey data. This results in some differences between the 2003 data reported here and that reported in SMUD and PG&E (2005). Changes in longitudinal profiles were quantified by comparing reach-average slope between monitoring years.

## 4.3 RESULTS

### 4.3.1 Hydrology

To understand potential causes for geomorphic change between the 2003 and 2019 surveys, the hydrology under the old license from water years 2003–2014 was compared to hydrology under the new license from water years 2015–2019. In 2015, SMUD instituted new minimum instream and recreational flows as part of the new FERC License. These new flows are designed to better mimic the natural hydrograph in the spring. The new flows also include pulse flows in Below Normal, Above Normal, and Wet water year types for the Rubicon River below Rubicon Dam, South Fork Silver Creek below Ice House Dam, and Gerle Creek below Loon Lake Dam. Although operations under the new license do not affect peak flows, peak flows were analyzed because they can have a strong effect on channel morphology. Figures 4-1, 4-3, 4-4, 4-5, and 4-6 overlay the daily average flow for water years 2003–2014 (in grey) and water years 2015–2109 (in red) for the five flow gages used in the geomorphic assessment. Monthly average flows from 2003–2019 are included in Appendix D1.

#### 4.3.1.1 Rubicon River Below Rubicon Dam

Flow downstream of Rubicon Dam consists of flow releases through the outlet works of the dam (measured by SMUD at the USGS gage) and spill over the dam (measured by SMUD). The daily average flows from 2015–2019 for the Rubicon River below Rubicon Dam have generally increased relative to 2003–2014 (Figure 4-1). The monthly average discharge in March to June ranged from 6–27 cubic feet per second (cfs) under the old license and 10–87 cfs under the new license (Figure 4-1, Appendix D1, Table D1-1). Since 2015, flows from July to February were higher, on average, than flows from 2003–2014; however, the range of flows was similar (Figure 4-1).

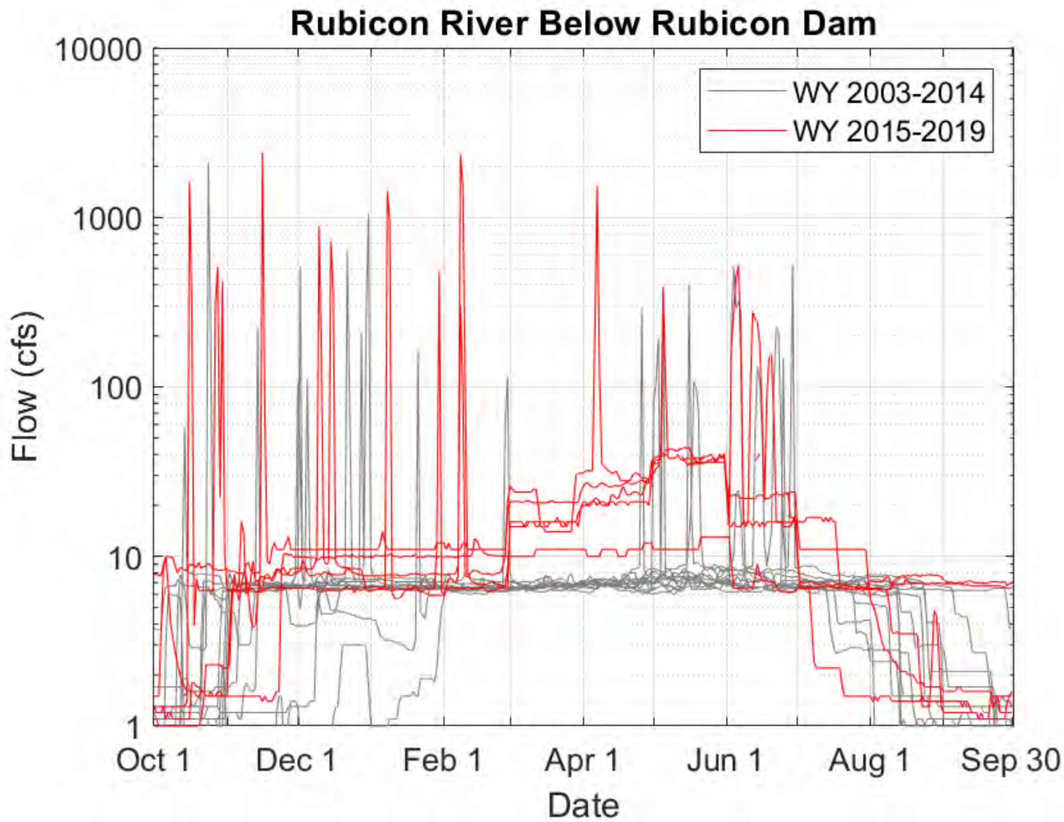


**Figure 4-1. Daily average flow for 2003–2019 water years for the Rubicon River Below Rubicon Dam. Grey lines show data prior to the new license flow regime (2003–2014) and red lines show data after the new license flow regime (2015–2019).**

Peak flows are associated with spill over the Rubicon Dam. Water spilled over the dam on 121 days during the period of record, 59 of these days occurred from 2003–2014 and 62 occurred from 2015–2019 (Figure 4-1). There were no spill events in 2003–2004, 2008, and 2014. Throughout the period of record spills occurred from October through June with the majority of spills (63%) in May and June. Peak flows ranged up to 2397 cfs (Figure 4-2). Peaks greater than 1000 cfs occurred in 2006, 2011, 2017, and 2018. Of the 121 spill events during the period of record (Figure 4-2), 85 (70%) occurred during these four years.

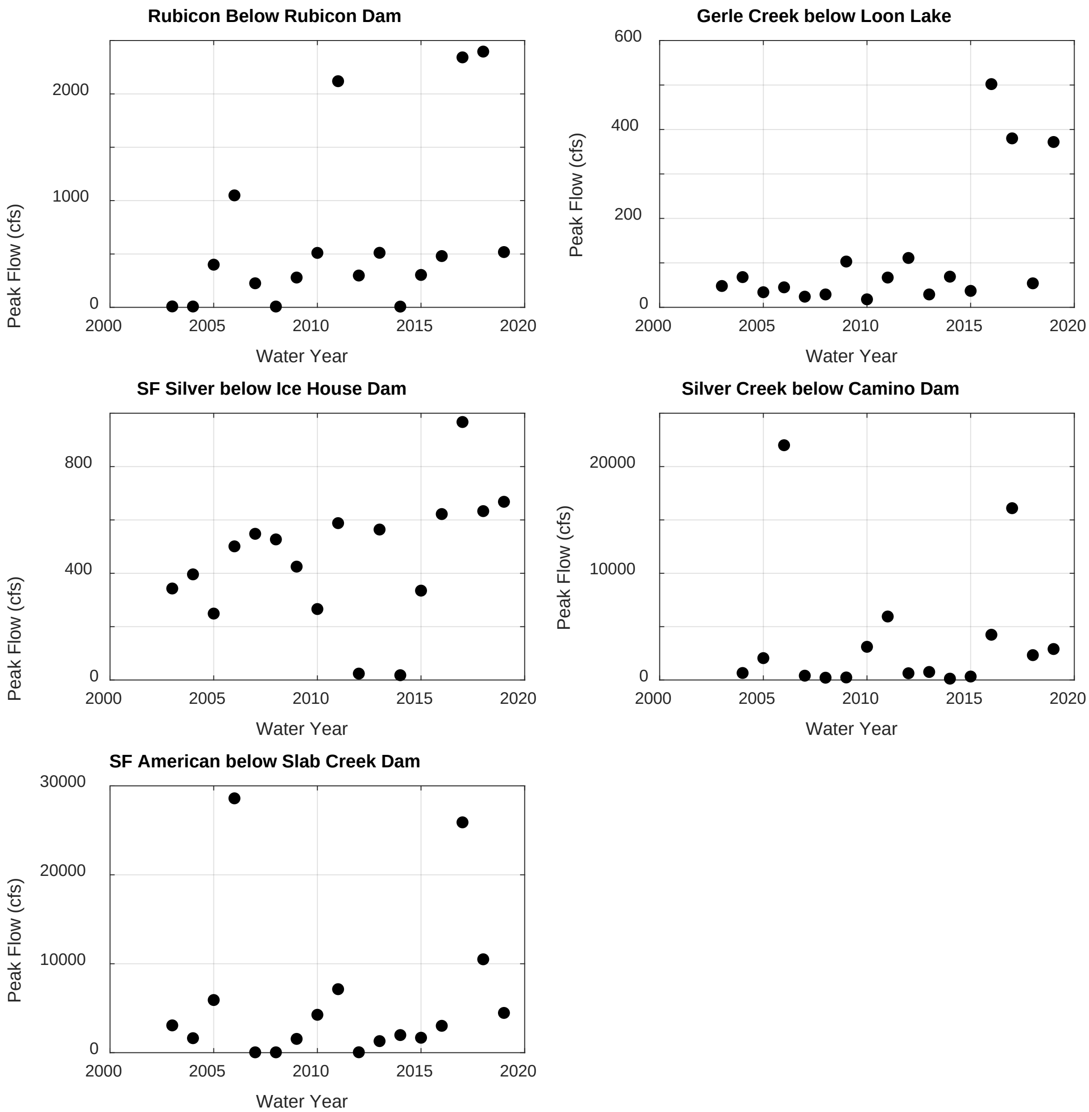


**Figure 4-2. Annual peak flows for gages in the study reaches from 2003–2019. All 2019 peaks and the entire Rubicon record were estimated from the daily average flows; otherwise peak flows were downloaded from the USGS (SF Silver = South Fork Silver Creek; SF American = South Fork American River).**

### 4.3.1.2 Gerle Creek below Loon Lake Dam

Other than during 2015 (the only Critically Dry water year since implementation of new license flows), the January–September daily average flows at Gerle Creek below Loon Lake Reservoir from 2016–2019 were 2–5 times the flows from 2003–2014 (Figure 4-3).

Under the new license flow regime, the hydrograph has transitioned from one with nearly constant flows and periodic peaks typically less than 30 cfs, to a broad snowmelt-style hydrograph with February through July flows ranging from 26–69 cfs depending on the water year type (Figure 4-3).

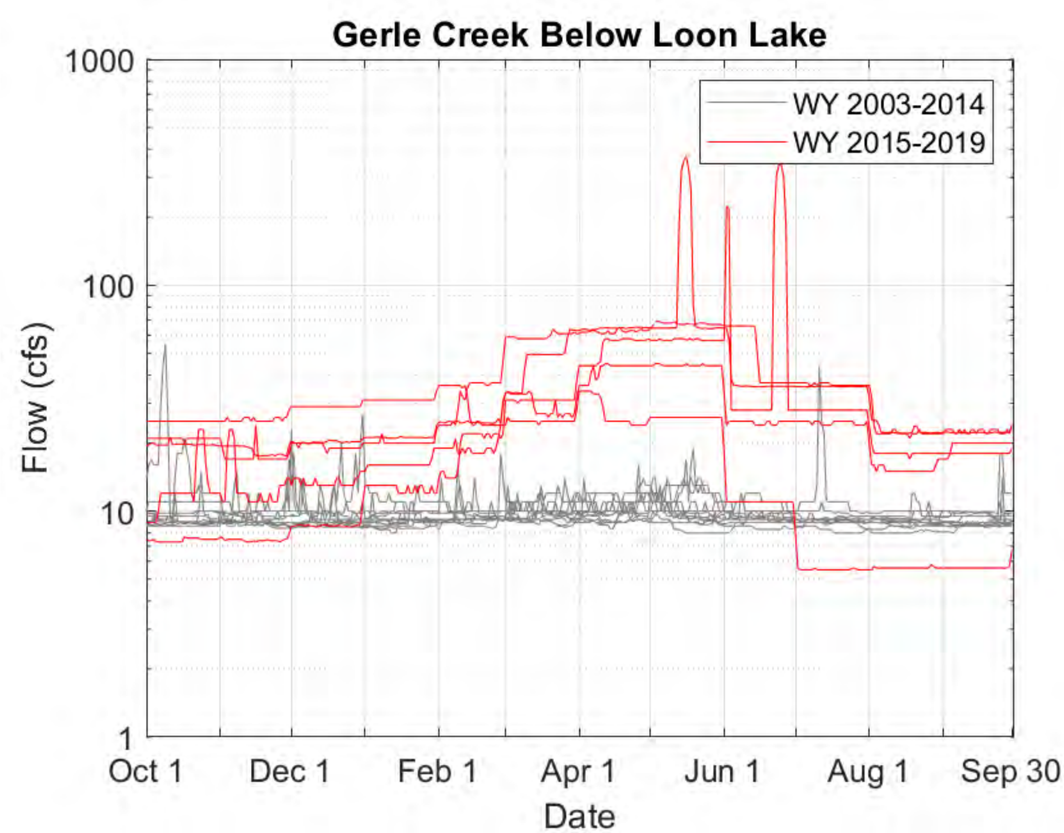


**Figure 4-3. Daily average flow for 2003–2019 water years for Gerle Creek Below Loon Lake Dam. Grey lines show data prior to the new license flow regime (2003–2014) and red lines show data after the new license flow regime (2015–2019).**

The new license calls for managed pulse releases in Gerle Creek below Loon Lake Dam. During June 2016 a two-day managed pulse flow with a peak daily average discharge of 224 cfs and a 5-day managed pulse flow with a peak daily average discharge of 340 cfs were released by SMUD as part of the Gerle Creek Sensitive Site Investigation (SMUD 2016) (Figure 4 2). A five-day managed pulse flow with a peak daily average discharge of 371.8 cfs was released in May 2019 (Figure 4 2 and Figure 4 3). There were no pulse flows in 2017 and 2018. These pulses generally elevate flow over the course of one week and are the highest flows measured at the gage since 1996 (Appendix D1).

The annual peak flows averaged about 54 cfs from 2003–2014 and 268 cfs from 2015–2019 (Figure 4-2, Appendix D1).

### 4.3.1.3 South Fork Silver Creek below Ice House Dam

Prior to the new license flow regime, daily average flows were <15 cfs for most of the year and included large peak flows up to 500 cfs in the fall. The new license flow regime includes a broad snowmelt hydrograph that extends from May through July, with monthly average flows that were approximately 10 times higher than 2003–2014 (Figure 4-4, Appendix D1). In addition, winter base flows in South Fork Silver Creek below Ice House Dam have increased from 3–7 cfs to 7.5–19.0 cfs (Figure 4-4). Recreation flows between 200 and 600 cfs have also been implemented in addition to the higher snowmelt baseflow (Figure 4-4).

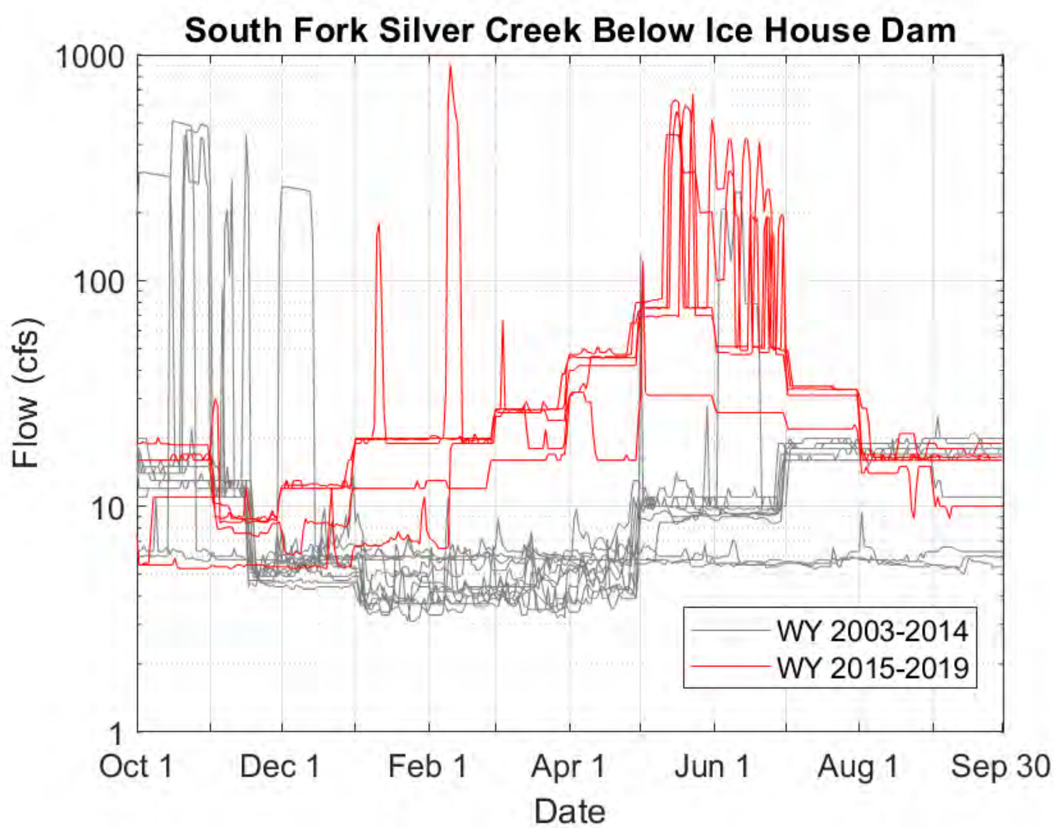


**Figure 4-4. Daily average flow for 2003–2019 water years for South Fork Silver Creek Below Ice House Dam. Grey lines show data prior to the new license flow regime (2003–2014) and red lines show data after the new license flow regime (2015–2019).**

The timing of instantaneous peak flows in South Fork Silver Creek has shifted from predominantly the fall to the spring (Figure 4-4) since recreation flows were implemented under the new license, and high flows (>500 cfs) have occurred regularly over the past 20 years (Figure 4-2).

4.3.1.4 Silver Creek below Camino Dam

The daily average flows in spring for Silver Creek below Camino Dam have increased from 12–23 cfs in 2003–2014 to 32–73 cfs in 2015–2019 (Figure 4-5). Fall and summer flows in 2015–2019 were within the range of summer flows from 2003–2014 (Figure 4-5). Flows in 2017 (a Wet water year) were consistently very high and ranged from 200 to 16,100 cfs and included a 3-month period where flows were continuously greater than 600 cfs (almost nine times greater than the highest minimum flow of 68 cfs).

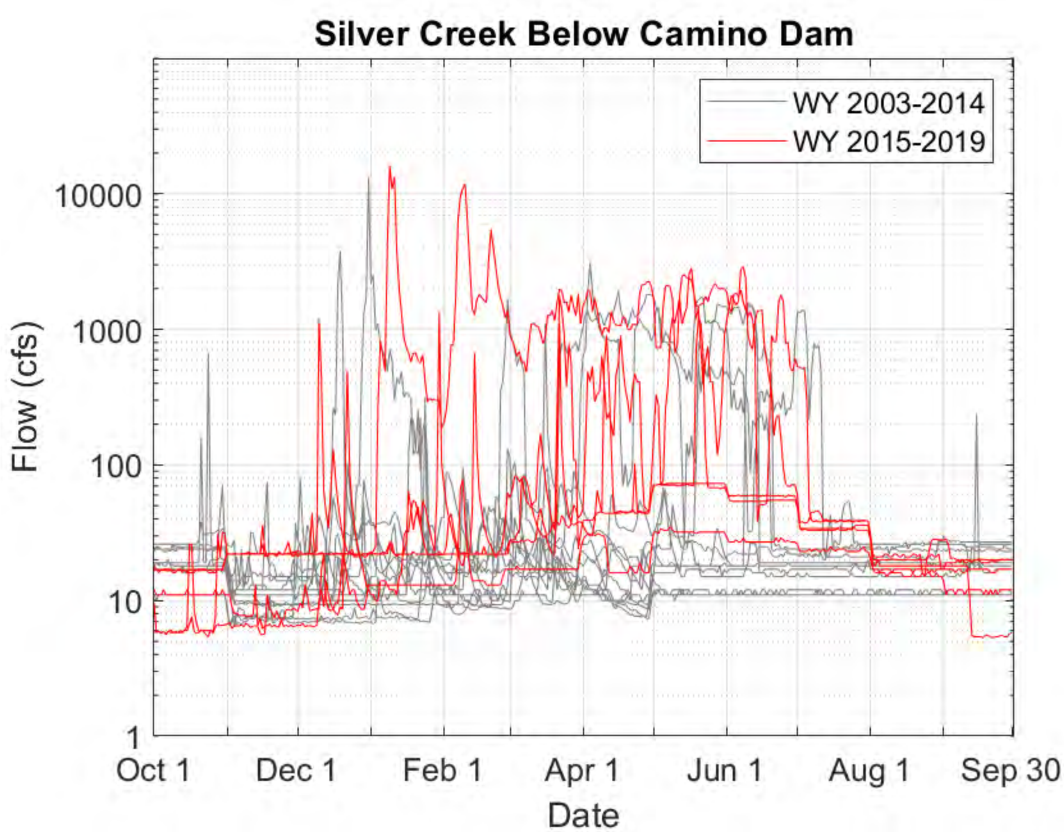


**Figure 4-5. Daily average flow for 2003–2019 water years for Silver Creek Below Camino Dam. Grey lines show data prior to the new license flow regime (2003–2014) and red lines show data after the new license flow regime (2015–2019).**

High instantaneous peak flows (>15,000 cfs) at Silver Creek below Camino Dam occurred in 2006 and 2017 (Figure 4-2).

4.3.1.5 South Fork American River below Slab Creek Dam

With the exception of spill periods, flows in the SFAR below Slab Creek Dam were typically 38–40 cfs year-round from 2003–2014 Figure 4-6). Under the new license flow regime, baseflows have increased to 60–220 cfs during all but the critically dry 2015. Discharge is highly variable at this site with frequent spills during the winter. During 2017, daily average discharge was generally above 2,000 cfs from March to mid-June.

There have been two high peak flows (>25,000 cfs) in this reach since 2003, occurring in 2006 and 2017 (Figure 4-6).

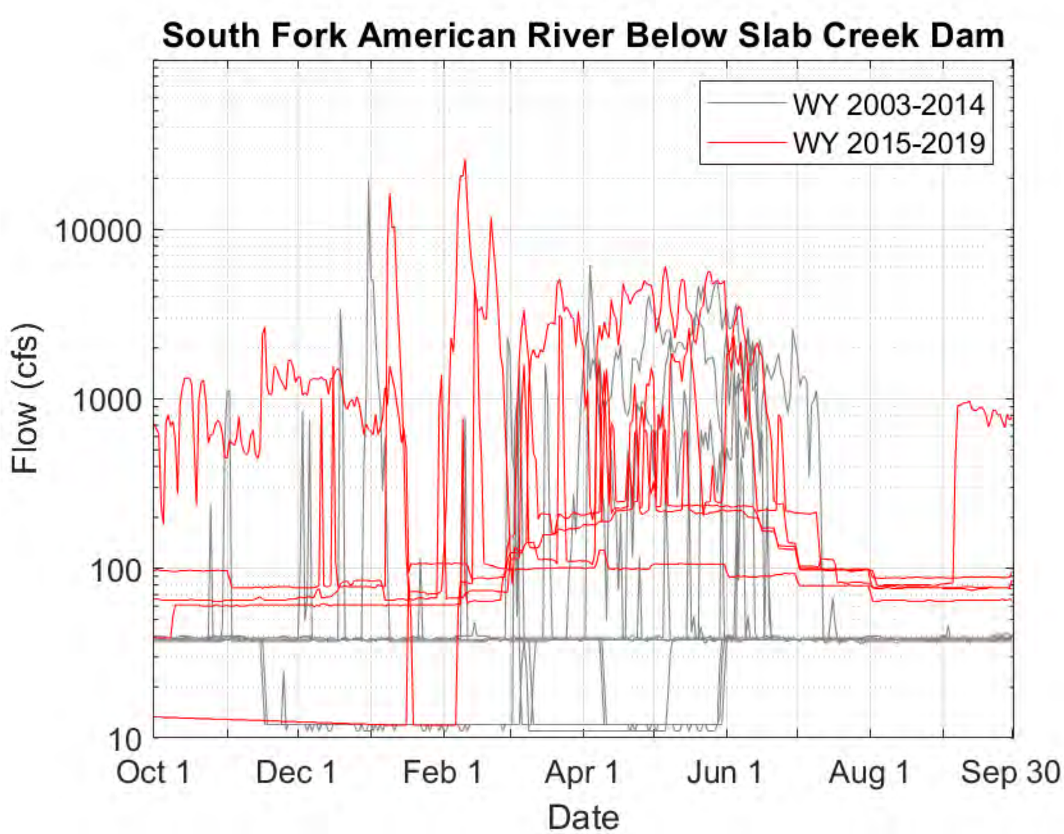


**Figure 4-6. Daily average flow for 2003–2019 water years for South Fork American River Below Slab Creek Dam. Grey lines show data prior to the new license flow regime (2003–2014) and red lines show data after the new license flow regime (2015–2019).**

4.3.2 Geomorphic Field Data

4.3.2.1 Site RRD-G1 (Rubicon River below Rubicon Dam)

Site Description

The site is located approximately 1.5 miles downstream of Rubicon Reservoir Dam and has a drainage area of about 33 square miles. Site RRD-G1 is immediately downstream of the Desolation Wilderness Boundary where roads are not a source of sediment supply. The site lies within a formerly glaciated valley with large areas of exposed granitic bedrock making up the moderately steep valley slopes (30–40%). There was little evidence of mass wasting near the study site. A well-established evergreen forest surrounded the channel, and the banks were well vegetated with thick grasses and deciduous understory. Survey measurements indicate that the channel in this reach was a Rosgen F4 (Rosgen 1994), with a moderately entrenched channel, a high width-to-depth ratio (30-63), an average local bed slope of 0.008 (0.8%), a sinuosity of 1.35, and a gravel dominated substrate. The study site was in a relatively straight, pool-riffle reach with irregular meanders and well-vegetated, lateral and mid-channel gravel bars. Boulder and bedrock outcrops occurred on the channel margins (Figure 4-7). Recently eroded (raw) banks were small and infrequent and reflected local erosion around boulders, and there was no evidence of recent deposition or bar development. Woody debris was generally absent from the flood prone areas. Key LWD pieces that span the channel were not observed along this reach, and no evidence of beaver activity was noted. Representative photos of this site are included in Appendix D3.

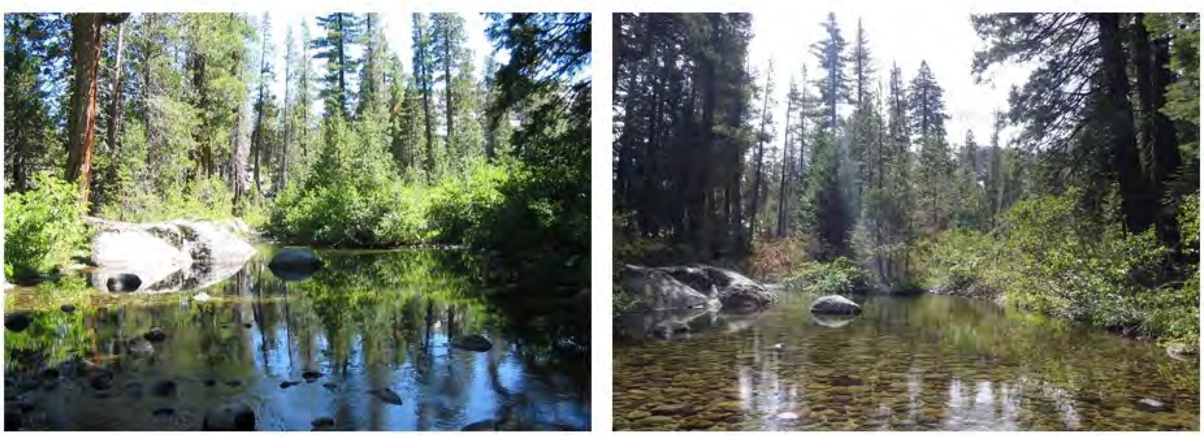

**Figure 4-7. Site RRD-G1 looking upstream from XS-2 in 2003 (left) and 2019 (right).**

Longitudinal Profile

The longitudinal profiles from 2003 and 2019 are shown in Appendix D4, Figure D4-1. The 2019 profile was 450 feet long and extended 125 feet upstream of the upstream cross-section (XS-1) and 50 feet downstream of the downstream cross-section (XS-3). The mean local slope, calculated as a best-fit line to the long profile, was 0.007 (0.7%) during 2003 surveys and 0.008 (0.8%) during the 2019 surveys. This difference reflects the greater upstream extent of the 2019 surveys (as shown in Appendix D4, Figure D4-1) rather than topographic changes. The 2019 and 2003 longitudinal profiles were generally similar. There was 0.5 to 2 feet of local incision, but it was not systematic.

Cross-Sections

The Rubicon River cross-sections for 2003 and 2019 are shown in Appendix D5 Figures D5-1 to D5-3, and characteristics are summarized in Table 4-3. At this site, the three cross-sections surveyed in 2003 were re-occupied in 2019, although the elevation difference for endpins at XS-1 did not match the elevation difference in 2003 surveys or additional surveys at the site completed in 2005. The re-occupied cross-sections show up to 0.4 feet of incision relative to 2003 (Appendix D5 Figures D5-2 and D5-3), but in general the cross-section geometry is very similar. The differences in bankfull data reported in XS-3 reflect differences in the definition of bankfull indicators in the field rather than a change in geometry. The upstream cross-section shows the multiple channel section of the reach with a vegetated island on the left bank, while the other two cross-sections are single-threaded.

**Table 4-3. Cross-Section Data for Site RRD-G1 from 2003 and 2019.**

| Cross-Section (XS) | Bankfull width (ft) | | Mean bankfull depth (ft) | | W/D ratio | |
|---|---|---|---|---|---|---|
| | 2003 | 2019 | 2003 | 2019 | 2003 | 2019 |
| XS-1 (Upstream) | 73 | 69 | 1.9 | 1.1 | 38 | 61 |
| XS-2 (Intermediate) | 60 | 47 | 1.4 | 1.6 | 43 | 30 |
| XS-3 (Downstream) | 75 | 41 | 1.1 | 1.4 | 68 | 30 |

ft = feet
W/D = bankfull width divided by bankfull depth
The 2003 bankfull parameters were recalculated using the original survey data.

Bed Particle Size Distributions

The bed at all three cross-sections was primarily made up of gravel with <5% boulders at the intermediate and downstream cross-sections and no boulders at the upstream cross-section (Appendix D6 Figures D6-1 to D6-3, Table 4-4). Sand content from the 2019 pebble counts was 6, 12, and 18% of the measured particles at the upstream, intermediate, and downstream cross-sections, respectively. Relative to the 2003 surveys, the amount of fine gravel (<20 mm) increased while coarse gravel and cobble decreased at all three cross-sections; the extent of sand in the pebble count was similar (Appendix D6 Figures D6-1 to D6-3, Table 4-4).

**Table 4-4. Pebble Count Data for Site RRD-G1 from 2003 and 2019.**

| Cross-Section (XS) | Particle Size | | | | | |
|---|---|---|---|---|---|---|
| | D16 (mm) | | D50 (mm) | | D84 (mm) | |
| | 2003 | 2019 | 2003 | 2019 | 2003 | 2019 |
| XS-1 (Upstream) | 6 | 8 | 30 | 39 | 60 | 134 |
| XS-2 (Intermediate) | 2 | 4 | 33 | 50 | 92 | 121 |
| XS-3 (Downstream) | 4 | 2 | 31 | 44 | 66 | 136 |

mm = millimeters
D16=particle size at which 16% of the bed is finer
D50=particle size at which 50% of the bed is finer
D50=particle size at which 84% of the bed is finer

## Sediment Facies Mapping

The majority of the bed area (54%) had cobble-dominant substrate with gravel-dominant substrate comprising 30% of the bed area (Appendix D7 Figure D7-1, Table 4-5). There were no boulder-dominant facies at this site. Approximately half of the facies had sand as a dominant or sub-dominant component.

**Table 4-5. Dominant Sediment Facies at Site RRD-G1.**

| Dominant Facies | Area ($ft^2$) | % Area |
|---|---|---|
| Sand | 3,195 | 12 |
| Gravel | 8,514 | 30 |
| Cobble | 14,855 | 54 |
| Boulder | - | - |
| Bedrock | 1,159 | 4 |

$ft^2$= square feet

## Large Woody Debris

No large wood was observed at this site (see Appendix D8).

## V* (Fine Sediment Storage)

V* was not measured because discrete fine sediment deposits were not observed in the pools in the site. Sand was generally mixed with gravel and occurred as a thin veneer over gravel where it was present in the reach. Because conditions did not meet the V* monitoring requirement for two consecutive surveys, V* will not be measured at this site for the remainder of the license.

Additional Channel Condition Assessments

The Rosgen Level III, Rosgen Bank Erosion and Riparian Vegetation, and Pfankuch Bank Stability assessments are provided in Appendix D10, Appendix D11, and Appendix D12, respectively. The overall Pfankuch stability rating was 76 (good). Morphological characteristics of the site are summarized in Table 4-6.

**Table 4-6. Morphological characteristics for the 2003 and 2019 surveys.**

| | 2003 Reach Characteristics | | | 2019 Reach Characteristics | | | | |
|---|---|---|---|---|---|---|---|---|
| **Study Site** | **Bed slope** | **Level II** | **Morphology** | **Reach-average Slope** | **Level II** | **Morphology** | **Type** | **Pfankuch Stability Score** |
| RRD-G1 | 0.007 | F4 | Pool-riffle | 0.008 | F4 | Pool-riffle | Response | 76 |
| LLD-G1 | 0.007 | E5 | Pool-riffle | 0.008 | E5 | Pool-riffle | Response | 101 |
| LLD-G2 | 0.013 | C3 | Plane-bed | 0.010 | C3 | Plane-bed | Response | 56 |
| IHD-G1 | 0.002 | C4 | Pool-riffle | 0.002 | C4 | Pool-riffle | Response | 105 |
| IHD-G2 | 0.006 | C3 | Plane-bed | 0.008 | C3 | Plane-bed | Transport | 52 |
| CD-G1 | 0.016 | B3c | Bedrock/ Step-pool | 0.012 | B3c | Bedrock/ Step-pool | Transport | 61 |
| SCD-G1 | 0.028 | B3 | Cascade/ Step-pool | - | B3 | Cascade/ Step-pool | Transport | 62 |

4.3.2.2 Site LLD-G1 (Gerle Creek Below Loon Lake Dam, Upper Reach)

Site Description

This site is located approximately 0.75 miles downstream of Loon Lake Dam and has a drainage area of about 6.6 square miles. At this site, the creek flows through a glaciated valley. The right bank for most of the reach is the southern limit of an 88-foot wide by 1,400-foot-long meadow. The downstream end of the reach is constricted by bedrock which acts as the hydraulic control for the reach (Appendix D2). During the 2003 surveys, the meadow was forested with lodgepole pines. Subsequently, several beaver dams in the channel raised the water surface elevation and flooded the lodgepole pine forest (SMUD 2016). The die-off was apparent on Google Earth images starting in about 2010, and resulted in an incredibly high wood loading that dominates the flow and morphology of the channel (Figure 4-8 and Figure 4-9). The channel is characterized by vegetated point and lateral bars, regular meanders, and subtle pool-riffle morphology. The study site is a Rosgen E5 channel. There is very little entrenchment and the width-to-depth ratio ranged from 7-20. The bed slope is 0.008 (0.8%) over the whole reach and 0.0023 for the upstream portion of the profile. The bed material is primarily fine to coarse sand with patchy surficial silt deposits. Extensive fine sediment deposits were observed within the bankfull channel and on the floodplains. Representative photos of this site are included in Appendix D3.

**Figure 4-8. Site LLD-G1 looking downstream from XS-2 in 2003 (left) and 2019 (right).**


**Figure 4-9. Aerial photographs of the area surrounding Site LLD-G1 showing the forest die-off adjacent to the channel.**

Longitudinal Profile

The 2019 longitudinal profile is shown in Appendix D4, Figure D4-2. The 2019 profile was 690 feet long and extended 190 feet upstream of XS-1 and 275 feet downstream of XS-3. The slope steepened significantly downstream of XS-3, where the channel banks transitioned to bedrock and the valley was more confined. The slope from the upstream end of the reach to just downstream of XS-3 was 0.0023 (0.23%). The mean local slope for the entire reach was 0.007 (0.7%) during 2003 surveys and 0.008 (0.8%) during the 2019 surveys. Because longitudinal profiles were generally similar in 2003 and 2019, the difference in slope between years likely reflects a the much higher survey density in 2019 and different survey extents (approximately 690 feet in 2019 versus approximately 430 feet in 2003) rather than a change in the slope of the reach. Minor topographic adjustments are visible in Appendix D4, Figure D4-2, but for the most part the channel bed appears stable.

Cross-Sections

Site LLD-G1 cross-sections for 2019 are shown in Appendix D5, Figures D5-4 to D5-6, and characteristics are summarized in Table 4-7. The three cross-sections that had been surveyed in 2003 were not re-occupied in 2019. Cross-section endpins were not located due to frequent downed trees in the bankfull and flood prone areas. In lieu of locating original endpins, the approximate 2003 cross-section locations were relocated by using the 2003 site photos. Given the widespread changes due to the die-off of the forest and frequent downed trees, the new cross-sections were only roughly near the original cross-section location. The morphology of all three cross-sections was very similar in 2003 and 2019.

**Table 4-7. Cross-Section Data for Site LLD-G1 from 2003 and 2019.**

| Cross-Section (XS) | Bankfull width (ft) | | Mean bankfull depth (ft) | | W/D ratio | |
|---|---|---|---|---|---|---|
| | 2003 | 2019 | 2003 | 2019 | 2003 | 2019 |
| XS-1 (Upstream) | 21.5 | 25 | 2.6 | 3.4 | 8.5 | 7.3 |
| XS-2 (Intermediate) | 34.1 | 34.1 | 3.8 | 4.7 | 8.9 | 7.3 |
| XS-3 (Downstream) | 23.2 | 28 | 2.7 | 3.7 | 8.5 | 7.6 |

ft = feet; W/D = bankfull width divided by bankfull depth
The 2003 bankfull parameters were recalculated using the original survey data.

Bed Particle Size Distributions

Pebble counts were not performed at this site because the bed was entirely comprised of sand in both 2003 and 2019 and pebble counts are only intended for gravel beds.

Sediment Facies Mapping

Sediment facies was not mapped because the channel bed was entirely comprised of sand and silt and the bed was not sufficiently visible to differentiate sand and silt due to low visibility (high depth and turbidity).

Large Woody Debris

Wood loading was extensive in the reach. Rather than count the individual pieces, wood was counted and measured on the aerial photograph taken for the facies map. There were 564 logs that exceeded 6 feet in length in the 690-foot long reach (Appendix D8). The logs had a mean length of 14.6 feet and a standard deviation of 8.7 feet. The logs were randomly oriented, and many logs crossed the channel. Many logs were within the active channel, and log movement appeared to be minimal.

V* (Fine Sediment Storage)

V* was not measured because the bed was comprised of sand and no gravel was observed in the reach or noted below the sandy bed. V* is only a useful measure in a gravel bed channel with defined pools where fine sediment can be distinguished from coarser sediment by probing with a rod, which is not possible with the sand and silt that made up the bed of this site. V* is not intended to assess deposition in sand-bed reaches. Because conditions did not meet the V* monitoring requirement for two consecutive surveys, V* will not be measured at this site for the remainder of the license.

Additional Channel Condition Assessments

The Rosgen Level III, Rosgen Bank Erosion and Riparian Vegetation, and Pfankuch Bank Stability assessments are provided in Appendix D10, Appendix D11, and Appendix D12, respectively. The overall Pfankuch stability rating was 101 (poor). Morphological characteristics of the site are summarized in Table 4-6.

#### 4.3.2.3 Site LLD-G2 (Gerle Creek Below Loon Lake Dam, Middle Reach)

Site Description

The site is located in a broad glaciated valley approximately 2 miles downstream of Loon Lake Dam and has a drainage area of about 11 square miles. The Wentworth Springs Road is 300–500 feet north of the stream for the entire length of the reach. Survey measurements indicated that this reach was a Rosgen C3 channel. The width-to-depth ratio ranged from 22 to 46 and the entrenchment ratio ranged from 9 to 25. The average local bed slope was 0.01 (1%) and the sinuosity was 1.1. For most of the reach length, the channel has a pool-riffle sequence with boulder steps at the upstream end of the reach. Pools had a residual depth less than 3.5 feet. Sand deposits were not observed in the pools. The channel had alternate bars visible in cross-sections 1 and 3, and one mid-channel bar at the downstream end of the reach. The banks were made up of cobbles with an overlying fine sediment layer and were densely vegetated with riparian trees and conifers. Vegetation encroached on the channel throughout the reach (Figure 4-10). The floodplain was made up of sand and silt deposits at its downstream end and was not visible at its upstream end where the floodplain was densely vegetated. LWD had a moderate density, with the majority of logs deposited as individuals rather than in jams. Beaver activity was not noted during the 2019 survey but was observed close to the site in 2019 (E. Koenigs, SMUD, pers. comm., July 2019).

**Figure 4-10. Site LLD-G2 looking upstream from XS-2 in 2003 (left) and 2019 (right).**

<u>Longitudinal Profile</u>

The longitudinal profiles from monitoring years 2003 and 2019 are shown in Appendix D4 Figure D4-3. The 2019 longitudinal profile was 1,000 feet long and extended 100 feet upstream of XS-1 and 400 feet downstream of XS-3. The reach-average slope was 0.012 (1.2%) in 2003 and 0.011 (1.1%) in 2019. Comparison of the longitudinal profile between monitoring years shows very minor changes in thalweg elevation. Relative to the 2003 surveys, the channel bed incised in some locations and aggraded in others. The most notable location where incision was observed was approximately 40 feet downstream of XS-3, where the channel incised by one approximately one foot over a distance of 40 feet, but thalweg elevation changes were generally less than 0.2 feet.

<u>Cross-Sections</u>

Endpin recovery was complicated at Site LLD-G2 due to a mixture of endpins from the 2003 survey and endpins from the Gerle Creek Sensitive Site Investigation (SMUD 2016). The 2016 SMUD endpins that were recovered in 2019 for the intermediate cross-section (XS-2) and XS-3 were within 1 foot of the 2003 endpins, and the different endpins likely do not affect cross section geometry appreciably. The 2015 SMUD left bank endpin was not found in 2019 and thus the difference between the endpins is not known. The 2019 surveys used a mixture of 2016 and 2003 endpins detailed in Table 4-8. Site LLD-G2 cross-sections for 2003 and 2019 are shown in Appendix D5 Figures D5-7 to D5-9, and characteristics are summarized in Table 4-9. The compilation of cross-section photos for this site is provided in Appendix D3. In general, the cross-sections showed similar geometry between monitoring years (Table 4-9). The large difference in bankfull width between the 2003 and subsequent surveys reflects changes in the definition of bankfull width rather than large cross section changes. Comparison of the cross sections at Site LLD-G2 shows thalweg incision of approximately 0.5 feet following the 2016 pulse flows and approximately 0.2 feet of additional incision in the thalweg in 2019. XS-2 morphology was relatively stable since 2003 and during the pulse flow. Comparison of XS-3 (the downstream cross-section) shows that the channel had aggraded somewhat between 2003 and 2015. Following the 2016 pulse flow, the 2016 channel was very similar at XS-3 to 2003. The channel subsequently deepened by approximately 0.5 feet but maintained a similar width following the 2019 flows the main channel in XS-3 transitioned from a mid-channel bar to a single channel with a pool approximately 0.4 feet deeper than 2016 (Appendix D5 Figure D5-9). The two upstream cross-sections were generally similar in 2003 and 2019.

**Table 4-8. Cross-Section Endpins Used in the 2019 survey for Site LLD-G2**

| Cross Section (XS) | Left Bank Endpin | Right Bank Endpin |
|---|---|---|
| XS-1 (Upstream) | 2003 Endpin | SMUD 2016 Endpin |
| XS-2 (Intermediate) | 2003 Endpin | SMUD 2016 Endpin |
| XS-3 (Downstream) | SMUD 2016 Endpin | 2003 Endpin |

**Table 4-9. Cross-Section Data for Site LLD-G2 from 2003, 2106 and 2019.**

| Cross-Section (XS) | Bankfull width (ft) | | | Mean bankfull depth (ft) | | | W/D ratio | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2003 | 2016 | 2019 | 2003 | 2016 | 2019 | 2003 | 2016 | 2019 |
| XS-1 (Upstream) | 54 | 27 | 46 | 2.1 | 1.1 | 1.0 | 26 | 27 | 46 |
| XS-2 (Intermediate) | 38 | 23 | 30 | 1.5 | 1.6 | 1.3 | 25 | 14 | 23 |
| XS-3 (Downstream) | 51 | 35 | 38 | 1.1 | 1.0 | 1.1 | 46 | 32 | 35 |

ft = feet; W/D = bankfull width divided by bankfull depth
The 2003 bankfull parameters were recalculated using the original survey data.

## Bed Particle Size Distributions

The bed at all three cross-sections was primarily made up of cobbles with <10% boulders at the upper and middle cross-sections and no boulders at the lower cross-section (Appendix D6 Figures D6-4 to D6-6). Relative to the 2003 surveys, the bed coarsened at the upstream and intermediate cross-sections but fined slightly at the downstream cross-section (Table 4-10, Appendix D6 Figures D6-4 to D6-6).

**Table 4-10. Pebble Count Data for Site LLD-G2 from 2003 and 2019.**

| Cross-Section (XS) | D16 (mm) | | | D50 (mm) | | | D84 (mm) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2003 | 2015 | 2019 | 2003 | 2015 | 2019 | 2003 | 2015 | 2019 |
| XS-1 (Upstream) | 14 | 57 | 39 | 69 | 113 | 95 | 137 | 231 | 190 |
| XS-2 (Intermediate) | 14 | 57 | 42 | 66 | 117 | 90 | 152 | 261 | 184 |
| XS-3 (Downstream) | 40 | 41 | 32 | 90 | 77 | 82 | 170 | 150 | 136 |

mm = millimeters
D16=particle size at which 16% of the bed is finer
D50=particle size at which 50% of the bed is finer
D84=particle size at which 84% of the bed is finer

## Sediment Facies Mapping

The majority of the channel bed was cobble-dominated, and the floodplains were sand-dominated (Appendix D7 Figures D7-2 to D7-3). Cobble-dominant facies comprised 54% of the bed area and gravel-dominant facies comprised 21% of the bed area (Table 4-11). Sand-dominant facies were primarily observed on the floodplains and cobble-dominant facies made up the majority of the wetted channel. Sediment facies gradually fined from the upstream end to the downstream end of the site.

**Table 4-11. Dominant Sediment Facies at Site LLD-G2.**

| Dominant Facies | Area ($ft^2$) | % Area |
|---|---|---|
| Sand | 2,381 | 12 |
| Gravel | 4,210 | 21 |
| Cobble | 10,527 | 52 |
| Boulder | 2,927 | 15 |
| Bedrock | - | - |

$ft^2$= square feet

Large Woody Debris

Site LLD-G2 had 108 logs that met the minimum length criteria of 12.5 feet (1/2 average bankfull width). Of these logs, 70 were individual pieces and 38 were in 4 aggregates of 4–17 logs (Appendix D8). There were no logs with rootwads in the site. Wood appeared to be relatively stable and was locally sourced based on the degree of weathering. LWD did not appear to be significantly affecting channel morphology.

V* (Fine Sediment Storage)

V* was not measured because fine sediment was not observed in the pools in the site. Because conditions did not meet the V* monitoring requirement for two consecutive surveys, V* will not be measured at this site for the remainder of the license.

Additional Channel Condition Assessments

The Rosgen Level III, Rosgen Bank Erosion and Riparian Vegetation, and Pfankuch Bank Stability assessments are provided in Appendix D10, Appendix D11, and Appendix D12, respectively. The overall Pfankuch stability rating was 56 (good). Morphological characteristics of the site are summarized in Table 4-6.

#### 4.3.2.4 Site IHD-G1 (South Fork Silver Creek below Ice House Dam, Upper Reach)

Site Description

The Ice House upper site is located approximately 1.5 miles downstream of Ice House Dam and has a drainage area of about 33 square miles. At this site, the valley is densely vegetated and valley slope is less than 30%, and there is no evidence of major mass wasting events. Silver Creek Group Campground is on the south bank of the river, and rock weirs built by campers can alter low flow hydraulics. The banks were densely vegetated (Figure 4-11) with frequent terrace surfaces above the estimated bankfull elevation. Survey measurements indicated that the channel in this reach was a Rosgen C4 channel. It was slightly entrenched, with a width-to-depth ratio sufficient to support alternate bars (8-28). The average local bed slope was 0.002 (0.2%) and the sinuosity was 1.16. Bed material is primarily unconsolidated gravels and sands, which form frequent bars along the channel margins. Comparison of photographs from 2003 and 2019 shows that vegetation has encroached on the channel (Figure 4-11). Medium to small sized woody debris is present in moderate amounts. Several key LWD pieces that span the channel are located in the lower part of the site. They are stable in the channel, form backwater pools, act as instream cover, and effectively reduce flow velocity. This reach exhibits pool-riffle morphology, with a vegetated mid-channel bar in the middle of the reach. Representative photos of this site are included in Appendix D3. Beaver activity was not observed at this site in 2019.

**Figure 4-11. Site IHD-G1 looking upstream from XS-2 in 2003 (left) and 2019 (right).**

Longitudinal Profile

The longitudinal profile for monitoring year 2019 is shown in Appendix D4 Figure D4-4. The 2019 profile totaled 1,200 feet and extended 360 feet upstream of XS-1 and 275 feet downstream of XS-3. The mean slope was 0.002 (0.2%) in 2003 and 2019. Overall, the longitudinal profile was relatively similar from 2003 and 2019. The largest change was approximately 2 feet of thalweg aggradation near the downstream distance of 1100 feet. The surveys also show about 2 feet of incision in the pool at the upstream end of the reach (where the V* measurement was taken). Given that the bed was primarily gravel and cobble at this site in 2003 and has up to 3 feet of sand on the bed now, the total gravel incision was approximately 5 feet. There is also no evidence of deposition of the missing material downstream. This is a relatively large amount of incision without a record of extraordinarily large flows that may have caused it. It is also possible that the "incision" is an artificial artifact of a somewhat different alignment of the profile and the higher density of survey points in 2019.

Cross-Sections

Site IHD-G1 cross-sections for 2019 are shown in Appendix D5 Figures D5-10 to D5-12, and characteristics are summarized in Table 4-12. The compilation of cross-section photos for this site is provided in Appendix D3. At this site, only XS-1 was re-occupied in 2019. In lieu of locating original endpins at XS-2 and XS-3, the approximate 2003 cross-section locations were relocated by using the 2003 site photos. The geometry of XS-1, which is immediately downstream of the pool where V* was measured, shows very little change between 2003 and 2019, and the differences in bankfull characteristics in Table 4-12 are primarily due to differences in bankfull estimation in the field and the inclusion of a side channel within the bankfull channel in 2003. XS-2 (where neither end pin was recovered in 2019) and XS-3 (where only one end pin was recovered in 2019) both had significantly different morphology than the 2003 surveys. Although the orientation of the original surveys is not known, differences in the cross-section location or orientation across the channel in 2019 and 2003 would cause this apparent change rather than morphological adjustments.

**Table 4-12. Cross-Section Data for Site IHD-G1 from 2003 and 2019.**

| Cross-Section (XS) | Bankfull width (ft) | | Mean bankfull depth (ft) | | W/D ratio | |
|---|---|---|---|---|---|---|
| | 2003 | 2019 | 2003 | 2019 | 2003 | 2019 |
| XS-1 (Upstream) | 53 | 45 | 2.7 | 1.6 | 20 | 28 |
| XS-2 (Intermediate) | 59 | 26 | 1.8 | 3.4 | 33 | 8 |
| XS-3 (Downstream) | 49 | 26 | 2.8 | 1.6 | 18 | 17 |

ft = feet
W/D = bankfull width divided by bankfull depth
The 2003 bankfull parameters were recalculated using the original survey data.

<u>Bed Particle Size Distributions</u>

The bed at all three cross-sections was primarily made up of gravel with <15% cobbles and no boulders (Appendix D6 Figures D6-7 to D6-9, Table 4-13). Sand content totaled <15% in all three pebble counts, although pebble counts typically underrepresent the portion of sand on the bed (Bunte and Abt 2001). Relative to the 2003 surveys, the bed coarsened at all three cross-sections (Appendix D6 Figures D6-7 to D6-9, Table 4-13), but as noted above the location of XS-2 and XS-3 may have differed in 2003 and 2019.

**Table 4-13. Pebble Count Data for Site IHD-G1 from 2003 and 2019.**

| Cross-Section (XS) | D16 (mm) | | D50 (mm) | | D84 (mm) | |
|---|---|---|---|---|---|---|
| | 2003 | 2019 | 2003 | 2019 | 2003 | 2019 |
| XS-1 (Upstream) | 2 | 14 | 16 | 35 | 30 | 59 |
| XS-2 (Intermediate) | 2 | 5 | 10 | 11 | 18 | 18 |
| XS-3 (Downstream) | 2 | 3 | 10 | 15 | 24 | 34 |

mm = millimeters
D16=particle size at which 16% of the bed is finer
D50=particle size at which 50% of the bed is finer
D84=particle size at which 84% of the bed is finer

Sediment Facies Mapping

The facies maps for this site are located in Appendix D7 Figures D7-4 through D7-6 The majority of the channel bed was gravel-dominated with substantial amounts of sand observed intermixed with gravel-dominant facies and on the floodplains. Boulders were commonly observed along the banks but often poorly visible due to being buried in sand. Gravel-dominant facies comprised 50% of the channel bed and sand-dominant facies comprised 43% of the channel bed (Table 4-14).

**Table 4-14. Dominant Sediment Facies at Site IHD-G1.**

| Dominant Facies | Area ($ft^2$) | % Area |
|---|---|---|
| Sand | 20,461 | 43 |
| Gravel | 23,905 | 50 |
| Cobble | 112 | <1 |
| Boulder | 3,580 | 7 |
| Bedrock | - | - |

$ft^2$= square feet

Large Woody Debris

Site IHD-G1 had 58 logs: 39 individual pieces without rootwads, 5 individual pieces with rootwads, and 14 additional logs in two jams (Appendix D8). Thirteen logs were observed during the 2003 surveys, none with rootwads.

V* (Fine Sediment Storage)

As stated above, only one pool met the conditions to survey V* at IHD-G1. Due to pool depth that exceeded wadable conditions, the V* survey methods outlined in SMUD (2017) could not be applied. The methods were therefore adapted to measure V* under the conditions at the site. Other pools in the study reach did not have clear hydraulic controls or were associated with mid-channel bars and did not meet the pool-width criteria outlined in SMUD (2017). The average V* of the pool in Site IHD-G1 was 0.32 (Table 4-15, Appendix D9). The profile on river left had the thickest deposits of fine sediments and included extensive silt deposits as well as sand. All three profiles had V*>0.25. If we assume the fine sediment had an average width of 25 feet based on the facies mapping, the total volume of fine sediment in the pool was 4,200 cubic feet. Fine sediment was not observed at this site during the 2003 surveys.

**Table 4-15. V* Survey Results for Site IHD-G1.**

| Profile | Fine sediment area ($ft^2$) | Residual pool area ($ft^2$) | Profile V* |
|---|---|---|---|
| Centerline | 158.0 | 593.9 | 0.27 |
| River Right | 141.1 | 554.1 | 0.25 |
| River Left | 207.6 | 480.5 | 0.43 |
| **Average** | **168.9** | **542.8** | **0.32** |

ft$^2$ = square feet

Additional Channel Condition Assessments

The Rosgen Level III, Rosgen Bank Erosion and Riparian Vegetation, and Pfankuch Bank Stability assessments are provided in Appendix D10, Appendix D11, and Appendix D12, respectively. The overall Pfankuch stability rating was 105 (fair). Morphological characteristics of the site are summarized in Table 4-6.

#### 4.3.2.5 Site IHD-G2 (Ice House Lower)

Site Description

For most of this reach, South Fork Silver Creek is confined by hillslopes and bedrock outcrops. A small, ephemeral unnamed tributary joins South Fork Silver Creek between XS-2 and XS-3. Grain size distributions and sediment facies maps indicate that coarse cobble and small boulder are the dominant size classes in the channel. Recent sand deposits are present on floodplain and terraces, with moderate deposition of new gravel and coarse sand on old and new bars. The stream was slightly entrenched with a width-to-depth ratio sufficient to support alternate bars (23-34). The channel slope was 0.008 (0.8%) with a sinuosity of 1.1. Survey measurements indicated that the channel in this reach was a Rosgen C3 channel, but with a much lower sinuosity than expected for a C3 channel due to hillslope and bedrock control of the channel form. This reach primarily exhibits pool-riffle morphology. LWD does not provide significant scour or habitat within the bankfull channel. The area around the site burned during the Cleveland Fire in 1992. Comparison of photographs shows that vegetation regrowth on the hillslopes and adjacent to the channel has been significant since 2003 (Figure 4-12). There is little to no evidence of mass wasting along the site. Stands of willow and alder line the channel banks. No beaver activity was observed at this site.


**Figure 4-12. Site IHD-G2 looking upstream from XS-1 in 2003 (left) and 2019 (right) showing the regrowth of vegetation since the 1992 Cleveland Fire.**

Longitudinal Profile

The longitudinal profile for monitoring years 2003 and 2019 is shown in Appendix D4 Figure D4-5. The 2019 profile totaled 1,200 feet and extended 240 feet upstream of XS-1 and 315 feet downstream of XS-3. The mean local slope was 0.009 (0.9%) during 2003 surveys and 0.008 (0.8%) during 2019 surveys. The difference in slope is likely due to the 2019 longitudinal profile extending farther downstream than the 2003 longitudinal profile. Comparison of the longitudinal profile between monitoring years shows minor changes in thalweg elevation. Relative to the 2003 surveys, aggradation ranging from 0.3 to 1.7 feet was observed throughout most of the reach. Notable aggradation was observed between XS-1 and XS-2, where the channel aggradation ranged from 0.2 to 0.9 feet. Other notable aggradation was observed approximately 100 feet downstream of XS-2, where the channel aggraded by up to 1.7 feet over a distance of 80 feet.

Cross-Sections

The cross-sections for 2003 and 2019 are shown in Appendix D5 Figures D5-13 to D5-15, and characteristics are summarized in Table 4-16. The compilation of cross-section photos for this site is provided in Appendix D3. At this site, all three 2003 cross-sections were reoccupied in 2019. Comparisons of the 2003 and 2019 cross-sections show very little aggradation or degradation and little change in cross-section geometry (Table 4-16). The large differences in the bankfull characteristics of XS-1 reflected differences in the identified bankfull depth rather than differences in topography because the bankfull depth was overestimated in 2003.

**Table 4-16. Cross-Section Data for the IHD-G2 Site from 2003 and 2019.**

| | Bankfull width (ft) | | Mean bankfull depth (ft) | | W/D ratio | |
|---|---|---|---|---|---|---|
| **Cross-Section (XS)** | **2003** | **2019** | **2003** | **2019** | **2003** | **2019** |
| XS-1 (Upstream)[a] | 124 | 53 | 2.8 | 2.3 | 44 | 23 |
| XS-2 (Intermediate) | 62 | 56 | 2.6 | 1.7 | 24 | 34 |
| XS-3 (Downstream) | 57 | 47 | 2.6 | 1.8 | 22 | 26 |

[a]2003 characteristics for XS-1 (Upstream) overestimated the bankfull depth.
ft = feet
W/D = bankfull width divided by bankfull depth
The 2003 bankfull parameters were recalculated using the original survey data.

Bed Particle Size Distributions

Pebble counts were only conducted at XS-1 and XS-2 during 2019 monitoring (Appendix D6 Figures D6-10 to D6-12 and Table 4-17). The pebble count at XS-3 was not measured in 2019 because the bed was predominantly bedrock. The bed material at XS-1 and XS-2 was cobble-dominant with <5% sand and <15% boulder. The grain size distribution finer than the 75th percentile coarsened at XS-1 and XS-2 in 2019 relative to 2003. The coarsest 25 percent of the particles had similar grain sizes in 2003 and 2019, suggesting that these coarser particles are immobile (Appendix D6 Figures D6-10 to D6-12).

**Table 4-17. Pebble Count Data for Site IHD-G2 from 2003 and 2019.**

| Cross-Section (XS) | D16 (mm) | | D50 (mm) | | D84 (mm) | |
|---|---|---|---|---|---|---|
| | 2003 | 2019 | 2003 | 2019 | 2003 | 2019 |
| XS-1 (Upstream) | 25 | 32 | 45 | 85 | 150 | 148 |
| XS-2 (Intermediate) | 20 | 51 | 80 | 106 | 300 | 210 |
| XS-3 (Downstream) | 2 | - | 45 | - | 125 | - |

mm = millimeters
D16=particle size at which 16% of the bed is finer
D50=particle size at which 50% of the bed is finer
D84=particle size at which 84% of the bed is finer

## Sediment Facies Mapping

The channel bed at this site was predominantly bedrock with boulder and cobble-dominant facies occurring as a thin surficial layer covering the bedrock (Appendix D7, Figures D7-7 through D7-9). Bedrock comprised 49% of the channel bed, and cobble-dominant facies comprised 34% of the channel bed (Table 4-18). Sand was rarely observed within the bankfull area and primarily located on the floodplains.

**Table 4-18. Dominant Sediment Facies at Site IHD-G2.**

| Dominant Facies | Area ($ft^2$) | % Area |
|---|---|---|
| Sand | - | - |
| Gravel | 129 | <1 |
| Cobble | 21,198 | 34 |
| Boulder | 10,170 | 17 |
| Bedrock | 30,672 | 49 |

$ft^2$= square feet

## Large Woody Debris

Two logs meeting the length criteria were observed at Site IHD-G2 in 2019. None of the logs had rootwads or were in jams. Sixty-eight logs were observed during the 2003 surveys, but only nine of them met the length criteria (> ½ bankfull width or 28 feet) (Appendix D8).

## V* (Fine Sediment Storage)

V* was not measured because there were no pools in the reach and there was little fine sediment accumulation in the active channel. Because conditions did not meet the V* monitoring requirement for two consecutive surveys, V* will not be measured at this site for the remainder of the license.

Additional Channel Condition Assessments

The Rosgen Level III, Rosgen Bank Erosion and Riparian Vegetation, and Pfankuch Bank Stability assessments are provided in Appendix D10, Appendix D11, and Appendix D12, respectively. The overall Pfankuch stability rating was 52 (good). Morphological characteristics of the site are summarized in Table 4-6.

#### 4.3.2.6 Site CD-G1 (Silver Creek Below Camino Dam Study Reach)

Site Description

A landslide from the tailings pile on the right (north) valley occurred in the upstream end of the site between 2014 and 2016. The landslide entered the channel and likely was a source of coarse and fine sediment to the river reach. The bedrock valley slopes are moderately steep (40–60%) and confine the stream in a relatively narrow channel with low sinuosity (1.21). The two to three smaller landslides/debris flows that enter the reach on the right (north) bank are visible in aerial imagery. The riparian zone is relatively narrow, with low plant diversity and density. Channel character and hydraulics are primarily controlled by large flow obstructions created by frequent bedrock outcrops and large boulders (Figure 4-13). Survey measurements indicate that the channel in this reach is a Rosgen B3c channel, with moderate entrenchment, a moderate to high width-to-depth ratio (18-25). The average bed slope is 0.012 (1.2%), and the bed has a cobble dominated substrate. Bedrock and step-pool morphology dominates with occasional cascades. This reach has a stable substrate with little to no LWD present within the active channel. Pockets of gravel and cobble are deposited in the low velocity zones on the downstream sides of large flow obstructions and along the channel margins. No beaver activity was observed at this site.

**Figure 4-13. Site CD-G1 looking downstream from XS-2 in 2003 (left) and 2019 (right).**

Longitudinal Profile

The 2019 profile was 915 feet long and extended 200 feet upstream of XS-1 and 190 feet downstream of XS-3. The mean local slope was 0.016 (1.6%) during 2003 surveys and 0.012 (1.2%) during 2019 surveys, but this difference was due to differences in the beginning and ending location of the surveys and to the density of survey points, which was higher in 2019 (Appendix D4 Figure D4-6). Overall, there was little systematic change in the thalweg profile from 2003 to 2019 (Appendix D4 Figure D4-6).

Cross-Sections

Site CD-G1 cross-sections for 2003 and 2019 are shown in Appendix D5 Figures D5-16 to D5-18, and characteristics are summarized in Table 4-19. The compilation of cross-section photos for this site is provided in Appendix D3. At this site, both endpins were recovered for XS-2 and XS-3 in 2019, while only one endpin was recovered for XS-3. Comparisons of the 2003 and 2019 cross-sections show very little change in cross-section morphology (Appendix D5 Figures D5-16 to D5-18). Differences between 2003 and 2019 at XS-3 for distance greater than about 70 feet likely reflect alignment differences and differences between the survey methodology rather than topographic change. Similarly, the differences in Table 4-19 reflect changes in the identification of bankfull depth and width rather than erosion or deposition. This is not surprising given that identification of bankfull characteristics in a canyon channel confined by boulders and bedrock is highly subjective.

**Table 4-19. Cross-Section Data for Site CD-G1 from 2003 and 2019.**

| | Bankfull width (ft) | | Mean bankfull depth (ft) | | W/D ratio | |
|---|---|---|---|---|---|---|
| **Cross-Section (XS)** | **2003** | **2019** | **2003** | **2019** | **2003** | **2019** |
| XS-1 (Upstream) | 73 | 57 | 2.7 | 3.1 | 27.0 | 18.5 |
| XS-2 (Intermediate) | 89 | 74 | 3.8 | 3.0 | 23.4 | 24.5 |
| XS-3 (Downstream) | 77 | 61 | 3.2 | 2.7 | 24.1 | 23.2 |

ft = feet
W/D = bankfull width divided by bankfull depth
The 2003 bankfull parameters were recalculated using the original survey data.

Bed Particle Size Distributions

The bed at XS-1 is primarily comprised of coarse gravels and small cobbles. The bed at the intermediate and downstream cross-sections is primarily made up of cobbles with <20% boulders. (Appendix D6 Figures D6-13 to D6-15, Table 4-20). Bedrock substrate was frequently observed at all three cross-sections. No sand was measured during the pebble counts. Relative to the 2003 surveys, the bed fined slightly at the upper and middle cross-sections but coarsened at the lower cross-section (Appendix D6 Figures D6-13 to D6-15, Table 4-20). In general, the particle size distributions between 2003 and 2019 are similar, with XS-1 and XS-2 finer in 2019 than 2003 and XS-3 coarser in 2019 than 2003.

**Table 4-20. Pebble Count Data for Site CD-G1 from 2003 and 2019.**

| Cross-Section (XS) | D16 (mm) | | D50 (mm) | | D84 (mm) | |
|---|---|---|---|---|---|---|
| | 2003 | 2019 | 2003 | 2019 | 2003 | 2019 |
| XS-1 (Upstream) | 45 | 30 | 71 | 64 | 156 | 157 |
| XS-2 (Intermediate) | 46 | 41 | 82 | 80 | 143 | 135 |
| XS-3 (Downstream) | 38 | 42 | 74 | 103 | 189 | 280 |

mm = millimeters
D16=particle size at which 16% of the bed is finer
D50=particle size at which 50% of the bed is finer
D50=particle size at which 84% of the bed is finer

Sediment Facies Mapping

Site CD-G1 is dominated by boulders and bedrock (Appendix D7 Figures D7-10 and D7-11). Cobble and gravel facies are present in low velocity zones and were commonly observed on channel margins and downstream of flow obstructions. During the 2019 surveys, the wetted area of the channel was predominantly comprised of bedrock and boulder-dominant facies (Table 4-21). The channel banks and flood prone area were dominated by bedrock (sand and gravel comprised <1% of the mapped area).

**Table 4-21. Dominant sediment facies at Site CD-G1.**

| Dominant Facies | Area ($ft^2$) | % Area |
|---|---|---|
| Sand | 36 | <1 |
| Gravel | 1,001 | <1 |
| Cobble | 3,626 | 3 |
| Boulder | 33,054 | 30 |
| Bedrock | 75,025 | 67 |

$ft^2$= square feet

Large Woody Debris

Two logs were observed in Site CD-G1 in 2019, and only one log (categorized as 3–10 feet long) was observed in 2003 (Appendix D8). Two additional logs were located just downstream of the study reach in 2019.

V* (Fine Sediment Storage)

V* was not measured because fine sediment was not observed in the pools in the site. Because conditions did not meet the V* monitoring requirement for two consecutive surveys, V* will not be measured at this site for the remainder of the license.

Additional Channel Condition Assessments

The Rosgen Level III, Rosgen Bank Erosion and Riparian Vegetation, and Pfankuch Bank Stability assessments are provided in Appendix D10, Appendix D11, and

Appendix D12, respectively. The overall Pfankuch stability rating was 61 (fair). Morphological characteristics of the site are summarized in Table 4-6.

4.3.2.7 Site SCD-G1 (South Fork American River below Slab Creek Dam Study Reach)

Site Description

It was not possible to conduct a complete survey at Site SCD-G1 due to the higher minimum flows in this reach. The new license minimum flows were double the flows during the 2003 survey, precluding a safe survey of the channel. The study reach morphology is comprised of high gradient boulder steps and pools. The site is in the Slab Creek recreation boating run which is ranked Class IV/V (SMUD 2004), and even at lower flows (approximately 90 cfs) was not safely wadable. Channel banks are predominantly comprised of bedrock and very large boulders (Figure 4-14). Very little fine sediment was observed in the study reach. Fine sediment was only observed in the wake of larger particles. Particles are strongly imbricated. There is a cobble boulder point bar on river left at the upstream end of the study reach. The bed slope in 2003 was about 0.015 (1.5 %).

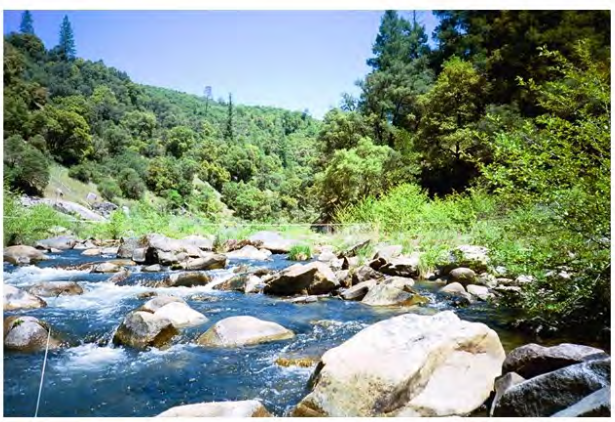

**Figure 4-14. Site SCD-G1 looking upstream near XS-2 in 2003 (left) and 2019 (right).**

Longitudinal Profile

Under the new flow regime, the thalweg is not wadable in this reach, and frequent boulders makes surveying the channel bottom by boat dangerous. The long profile was therefore not surveyed in this reach. In the 2003 survey, the reach had a slope of 0.024 (2.4%), which is by far the steepest of the study reaches and helps to explain why the reach was so difficult to survey.

Cross-Sections

Although the deepest portion of the bed could not be surveyed, the majority of XS-1 and XS-2 were reoccupied in 2019, and the entirety of XS-3 was resurveyed. The cross-sections were generally similar between 2003 and 2019, and differences in bed elevation are at least partially due to differences in cross-section alignment in 2003 and 2019 arising from the difficulty of wading the site (Appendix D5 Figures D5-19 to D5-21, Table 4-22). Bankfull depth and width-depth ratio were not calculated for XS-1 and XS-2 because depth could not be calculated over the entire length. The differences in bankfull characteristics between 2003 and 2019 were due to differences in the definition of bankfull, rather than topographic changes, and if the 2019 definition of bankfull was used for the 2003 surveys, the bankfull width would be similar. Bankfull characteristics are generally difficult to estimate in confined sites such as SCD-G1.

**Table 4-22. Cross-Section Data for Site SCD-G1 from 2003 and 2019.**

| | Bankfull width (ft) | | Mean bankfull depth (ft) | | W/D ratio | |
|---|---|---|---|---|---|---|
| **Cross-Section (XS)** | **2003** | **2019** | **2003** | **2019** | **2003** | **2019** |
| XS-1 (Upstream) | 32.8 | 122 | 5.6 | n/a | 5.8 | n/a |
| XS-2 (Intermediate) | 62.8 | 163 | 3.4 | n/a | 18.4 | n/a |
| XS-3 (Downstream) | 61.3 | 122 | 3.0 | 6.6 | 20.2 | 18.7 |

ft = feet;
W/D = bankfull width divided by bankfull depth
The 2003 bankfull parameters were recalculated using the original survey data.

Bed Particle Size Distributions

Pebble counts were not conducted in this boulder and bedrock reach because the bed could not safely be measured.

Sediment Facies Mapping

The sediment facies were dominated by boulder and bedrock, with boulder-dominant substrate totaling 97% of the mapped channel area and bedrock-dominant comprising the additional 3% (Table 4-23). The remaining <1% of the mapped area was cobble-dominate substrate (Appendix D7, Figures D7-12 and D7-13).

**Table 4-23. Dominant Sediment Facies at Site SCD-G1.**

| Dominant Facies | Area ($ft^2$) | % Area |
|---|---|---|
| Sand | - | - |
| Gravel | - | - |
| Cobble | 397 | <1 |
| Boulder | 89,791 | 97 |
| Bedrock | 2,624 | 3 |

$ft^2$= square feet

Large Woody Debris

No wood was observed in this reach.

V* (Fine Sediment Storage)

V* was not measured because fine sediment was not observed in the pools in the site. Because conditions did not meet the V* monitoring requirement for two consecutive surveys, V* will not be measured at this site for the remainder of the license.

Additional Channel Condition Assessments

The Rosgen Level III, Rosgen Bank Erosion and Riparian Vegetation, and Pfankuch Bank Stability assessments are provided in Appendix D10, Appendix D11, and Appendix D12, respectively. The overall Pfankuch stability rating was 62 (fair). Morphological characteristics of the site are summarized in Table 4-6.

## 4.4 DISCUSSION

### 4.4.1 Changes between 2003 and 2019

#### 4.4.1.1 Site RRD-G1 (Rubicon River below Rubicon Dam)

Downstream of Rubicon Dam, March through June daily average flows have increased by at least 50% under the new license. Approximately 44% of the days with spill over the dam occurred in 2017 and 2019 just prior to the most recent surveys. Comparison of the 2003 and 2019 surveys shows little change in the overall cross-section. Overall, the bed at all three cross-sections coarsened, but the fraction of the bed covered by fine gravel (<20 mm) and sand increased. The degree to which this change reflects a long-term trend or is due to the occurrence of two of the highest daily average peak flows since 2002, in 2017 and 2018 is not clear.

#### 4.4.1.2 Site LLD-G1 (Gerle Creek Below Loon Lake Dam, Upper Reach)

The most significant change at Site LLD-G1 since the 2003 surveys was the increase in the wood load due to tree mortality induced by beaver dam flooding (SMUD 2016). During the 2003 surveys, Site LLD-G1 contained 63 logs with part of their length in the active channel; this was the among highest wood loading observed for the sites surveyed in 2003. By 2019, the number of LWD pieces has increased to 563, a nearly nine-fold increase. The increase in LWD likely affects the channel in several ways. First, it represents a dramatic increase in the channel roughness with a corresponding decrease in flow velocity and increase in flow depth. The water surface was 0 to 0.5 feet below the top of the bank during the 2019 survey during a flow of 35.9 cfs. Although the flows were considerably lower during the 2003 survey (11 cfs), the flow was also close to overtopping the bank. The water surface slope using the three cross-sections was -0.001 (i.e., the water surface increased downstream). The water surface elevation profile is strongly influenced by local backwater conditions behind logs.

Site LLD-G1 is anomalous in that it has a sand rather than gravel bed. The sand bed was also present in 2003, and its origin is not clear. While the bed slope (0.007) is sufficiently steep to move gravel, the combination of extensive wood and downstream bedrock control imparted a negligible water surface slope at the time of the surveys. Recent overbank deposits suggest that sand is transported to the reach, but the degree to which sand moves through the reach is unknown.

#### 4.4.1.3 Site LLD-G2 (Gerle Creek Below Loon Lake Dam, Middle Reach)

Site LLD-G2 has multiple channels at high flows. During the 2019 surveys, water was present and flowing in the side channels. Similar to Site LLD-G1, Site LLD-G2 had increased LWD loading since the original surveys, albeit of a lower magnitude. The grain size distribution of the bed coarsened in two of the three cross-sections and fined slightly in XS-3 at the downstream end of the reach. Comparison of the cross-sections at Site LLD-G2 show that in one of the three cross-sections, the 2016 and 2019 pulse flows caused some incision of the thalweg and that additional thalweg deepening occurred in 2019 associated with a transition from a mid-channel bar to a single channel at the lowermost cross-section. Subsequent 5-year monitoring will help to assess the impacts of these pulse flows more fully.

#### 4.4.1.4 Site IHD-G1 (South Fork Silver Creek below Ice House Dam, Upper Reach)

The increase in both spring snowmelt flows and short-term peak flow on South Fork Silver Creek below Ice House Dam (up to 967 cfs in 2017) are well below the peak flows in 1996 and 1997 of 7,530 and 4,440 cfs, respectively. The channel narrowed slightly at XS-1 between 2003 and 2019, likely due to the LWD jam immediately downstream of the cross-section, but otherwise the cross-section morphology was largely similar. The trends in sediment at the site between 2003 and 2019 are somewhat contradictory. There was less sand in the pebble counts in 2019 than 2003 and the bed coarsened considerably during that period at XS-1 and to a lesser degree at XS-2 and XS-3. Pebble counts often under-represent sand which is not accurately measured using that method (Bunte and Abt 2003), but the sand content is generally 10–20 percent greater in the pebble counts in 2003 than 2019. This change is likely greater than the uncertainty in the method. Sand was a common subdominant facies in 2003 and 2019. The main change is the deposition of sand in the upstream pool where

V* was measured. This sand was not observed in 2003 and may reflect sand transported since the initiation of the new license flow regime. Because sand is trapped in the pool, it may be reducing sand supply to the lower end of the site, hence the decreased sand content of the pebble counts.

The large sand deposit in the upstream pool could originate due to increased sand supply to the reach or a decreased ability to transport the sand. Given that the flows have increased substantially, it is likely that more sand is being delivered to the reach due to higher flows and the sand is being trapped in the pool.

#### 4.4.1.5 Site IHD-G2 (South Fork Silver Creek below Ice House Dam, Lower Reach)

The hillslopes and riparian zone at this study site have seen significant regrowth of vegetation since 2003. The cross-section surveys showed little change, but the pebble counts showed that the channel bed coarsened from 2003 to 2019, with extensive bedrock and cobbles for the majority of the reach. LWD continues to play little role in channel morphology in the reach. The channel is relatively wide (> 50 feet) and is generally confined by relatively steep hillslopes on one bank and a terrace on the other with little variation in bed elevation (and extensive bedrock at the downstream end of the reach). This morphology is likely to promote log movement and unlikely to trap fluvially transported wood delivered from upstream (Braudrick and Grant, 2001). The fine sediment accumulation observed upstream at Site IHD-G1 was not observed in this reach. The higher peak flows and snowmelt pulses have likely increased the magnitude and duration of sediment transport, causing the bed to coarsen. Some continued grain size adjustment at this site is possible, but the bedrock and coarse materials that make up the majority of the reach make cross-section adjustments unlikely.

#### 4.4.1.6 Site CD-G1 (Silver Creek Below Camino Dam Study Reach)

Changes to the flow regime in the reach downstream of Camino Dam under the new flow regime caused increased baseflows but have not altered peak flows. These hydrologic changes are unlikely to affect sediment transport which typically occurs during high flows. The landslide that occurred between 2014 and 2016 likely increased sediment supply to the reach but caused few morphological changes or changes to the bed between 2003 and 2019, with the exception of a slight coarsening at the downstream cross-section (XS-3). The degree of future sediment supply from the landslide due to erosion of the landslide toe is unknown. Given the steep and confined channel morphology and the lack of alteration to peak flows, geomorphological adjustments to the site are unlikely in the absence of large increased in sediment supply. Given the widespread bedrock, the morphology of the site is unlikely to adjust in response to the new flow regime.

#### 4.4.1.7 Site SCD-G1 (South Fork American River Below Slab Creek Dam Study Reach)

Due to unsafe higher minimum flows, Site SCD-G1 could not be completely resurveyed in 2019. The reach is a very steep and confined rapid with frequent boulders, and geomorphic change is highly unlikely to occur in response to the new minimum flow regime and the lack of changes to high flows. Given the safety issues associated with the reach and the low likelihood of channel adjustment due to the very coarse and steep nature of the bed, it is recommended that this reach be dropped from the monitoring program since there are little useful data to be gained.

## 4.5 LITERATURE CITED

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# 5.0 RIPARIAN

## 5.1 MONITORING PLAN OBJECTIVES

The primary goals of this report are summarized in the Riparian Vegetation Monitoring Plan (Riparian Study Plan; SMUD 2016). Riparian vegetation monitoring site locations are shown in Figures 1-1 to 1-3 and representative photos of each site are included in Appendix E1.

## 5.2 METHODS

All plant species observed in the field were identified following the taxonomy of the *Jepson eFlora* (Jepson Flora Project 2019).

### 5.2.1 Vegetation Mapping

A preliminary map of vegetation communities was prepared for the 10 riparian vegetation monitoring sites in GIS using National Agriculture Imagery Program (NAIP) aerial imagery and ESRI World Imagery (1-ft resolution collected in July 2016, and 1.5-ft resolution collected in August 2018, respectively). The preliminary maps were verified during field surveys and subsequently revised in GIS. Vegetation types were categorized in accordance with the online *Manual of California Vegetation* (CNPS 2019a); a crosswalk with CalVeg types (USFS 2019) used in the 2004 riparian vegetation study (SMUD and PG&E 2004) was also conducted. The extent of mapping captured the three permanent transects at each site (including the transition to adjacent upland habitat) and a small area of vegetation just beyond the upstream- and downstream-most transects.

### 5.2.2 Transect and Greenline Surveys

Field methods were consistent with the Riparian Study Plan, except for the variances specified in Section 5.2.4. At each study site, data were collected at three transects which were selected to reoccupy the 2004 riparian vegetation study transects (SMUD and PG&E 2004). Each transect was perpendicular to the river and extended through the riparian corridor to the boundary with upland vegetation. Line-point intercept and point-centered quarter data were collected along these transects:

- Line-point intercept survey data were collected to assess riparian vegetation composition, canopy complexity, and the extent of riparian vegetation.

- Point-centered quarter data were collected to quantify riparian tree and shrub composition, successional stage, overall health, and density.

- Greenline location and composition were collected along the channel margin within each site to assess stability class.

5.2.3 Data Analysis

Data analysis methods conformed to the Riparian Study Plan, except for variances specified in Section 5.2.4. In addition, comparisons between 2004 and 2019 data required analysis of comparable datasets from both years. To compare changes in the ratio of dominant upland species to dominant wetland species, species from both years were categorized as wetland species when defined as hydrophytic (i.e., listed as facultative, facultative wetland, or obligate wetland plants [Lichvar 2016]). Dominant species from 2019 line-point intercept data were defined as all species that, either individually or together, accounted for over 50% of the total vegetative cover, plus any additional species that had at least 20% cover. Dominant species from the 2004 line-point intercept were taken from those listed as dominant in the 2004 riparian vegetation study (SMUD and PG&E 2004). To compare greenline stability classes between years, the 2004 data was assigned a stability class (Winward 2000) using the same methods used for the 2019 data.

5.2.4 Variances and Problems Encountered

Variances from the Riparian Study Plan and problems encountered during 2019 are itemized below:

- Vegetation mapping methodologies were consistent with the Riparian Study Plan, except where the specified minimum mapping unit of 0.25 acres was insufficient to capture fine scale changes in riparian vegetation along the channel margin, in which case smaller map units were used.
- Variances in transect data collection were made as necessary to improve data quality and ensure consistency would be achievable in future monitoring years. At sites where the 2004 riparian vegetation study had less than three transect locations (i.e., Sites GCD-RV1 and CD-RV4), additional transects were established in coordination with SMUD and Resource Agencies including CDFW, Bureau of Land Management (BLM), USFW, and SWRCB. At Sites LLD-RV10 and LLD-RV17, riparian vegetation communities extended well beyond the riparian corridor associated more closely with the stream channel. Therefore, transects at these sites were established to reoccupy the more limited extent of the 2004 riparian vegetation study and did not extend all the way to the boundary with upland vegetation. At Site SCD-RV1, Transect 2 was extended from the 2004 riparian vegetation study extent (right bank only) to cross the channel and capture both right and left banks.
- Variances from the point-centered quarter field methodologies specified in the Riparian Study Plan included the following:
    - o Given that riparian vegetation corridors were often narrow, the riparian vegetation corridor was divided equally to accommodate seven point-

centered quarters, rather than spacing point-centered quarters according to woody stem density.
  - A quarter was recorded as vacant if no tree or shrub was present within 10 meters of the transect.
  - When upland species were observed within the riparian corridor, data were recorded on the upland species; however, at transect endpoints when quarters contained no riparian trees or shrubs before transitioning to the adjacent upland community located outside the transect extent, no data were taken on the adjacent upland community.
  - Stem number and diameter at breast height (DBH) of each stem were recorded for both shrubs and trees.
  - The point-center quarter methodology followed the final version of the *National Riparian Core Protocol* (USFS 2017) rather than the draft version (USFS 2014) that was referenced in the Riparian Study Plan.
- Variances from the point-centered quarter analytical methodologies specified in the Riparian Study Plan included the following:
  - In addition to the analysis of tree and shrub species, DBH, age, and vigor per USFS 2017, analysis of riparian tree and shrub density, cover, and frequency was performed using the methods outlined by Mitchell (2015) to utilize all data collected.
  - At transect endpoints with no riparian trees or shrubs, the adjacent upland community is included in the analysis of species composition (i.e., recorded as "upland") but not within the analysis of vegetative cover.
- Variances from the greenline field methodologies specified in the Riparian Study Plan included the following:
  - It was not always feasible to walk the greenline due to dense woody vegetation, swift flows, and/or deep water; therefore, the method of measuring one's pace and counting paces to determine greenline composition was modified. The greenline was sampled in segments by viewing from in the channel, on the bank, or a point that allowed sufficient viewing of the greenline. The percent composition of the greenline in each segment was recorded and segment endpoints were recorded on field maps. These annotations were then digitized in GIS and their lengths were calculated. Percent composition within the segment was translated into feet of each greenline element within each segment, then summed for the site and translated to percent composition of each greenline element for the site. This method was more feasible, accurate, and safer to apply in swift or deep water and in dense vegetation where it was not feasible to walk the greenline. Regardless, the minimum of 363 feet of greenline sampling was completed at all sites.
  - Where a segment had portions with no greenline (e.g., a lineal grouping of perennial vegetation was not present on the first or second terrace [or no terraces present] and not present within 20 feet of the edge of the stream,

per Cowley et al. 2006), the greenline survey extent line was still indicated on the fieldmap and that distance was recorded as having no greenline.

- No significant problems were encountered such that data collection was not feasible. At a few transect endpoints, it was not possible to install rebar stake (e.g., transect endpoint located on bedrock); however, the locations were recorded with a sub-meter accuracy GPS unit and photographed to allow for accurate future relocation.

## 5.3 RESULTS

### 5.3.1 Vegetation Mapping

A total of 19 vegetation alliances were documented within the study area; dominant riparian vegetation types included lodgepole pine forest, mountain alder thickets, and torrent sedge patches. Appendix E2, Figures E2-1 through E2-10 show the mapped riparian vegetation alliances and Table 5-1 quantifies acreages of the vegetation alliances at each of the 10 monitoring sites.

**Table 5-1. Vegetation Alliances Documented at Riparian Vegetation Monitoring Sites within the UARP in 2019.**

| Site | Community Type | Manual of California Vegetation Type | CalVeg Type | Acres | Sensitive Natural Community[1]? |
|---|---|---|---|---|---|
| LLD-RV17 | Riparian | Lodgepole pine forest | Lodgepole pine | 0.85 | No |
| | | Mountain alder thicket | Mountain alder | 1.55 | Yes (S3) |
| | | Torrent sedge patches | Wet grasses and forbs | 4.11 | Yes (S3) |
| | Upland/other | Huckleberry oak chaparral | Huckleberry oak | 0.33 | No |
| | | Open water | | 0.92 | n/a |
| | | White fir forest | White fir | 2.25 | No |
| | **LLD-RV17 Total** | | | **10.01** | |
| LLD-RV10 | Riparian | Lodgepole pine forest | Lodgepole pine | 7.39 | No |
| | | Mountain alder thicket | Mountain alder | 0.57 | Yes (S3) |
| | | Red osier thickets | Dogwood | 0.29 | Yes (S3?) |
| | Upland/other | Open water | | 0.46 | n/a |
| | | White fir forest | White fir | 0.40 | No |
| | **LLD-RV10 Total** | | | **9.12** | |
| LLD-RV3 | Riparian | Lodgepole pine forest | Lodgepole pine | 0.19 | No |
| | | Mountain alder thicket | Mountain alder | 0.89 | Yes (S3) |
| | Upland/other | Incense cedar forest | Incense-cedar | 2.21 | Yes (S3.2) |
| | | Jeffrey pine forest | Jeffrey pine | 0.21 | No |
| | | Open water | | 0.63 | n/a |
| | **LLD-RV3 Total** | | | **4.14** | |
| GCD-RV1 | Riparian | Lodgepole pine forest | Lodgepole pine | 0.12 | No |
| | | Mountain alder thicket | Mountain alder | 0.12 | Yes (S3) |
| | Upland/other | Douglas fir forest | Pacific Douglas-fir | 1.16 | No |
| | | Incense cedar forest | Incense-cedar | 1.34 | Yes (S3.2) |
| | | Open water | | 1.11 | n/a |
| | | White fir forest | White fir | 1.27 | No |
| | **GCD-RV1 Total** | | | **5.11** | |
| IHD-RV5 | Riparian | Lodgepole pine forest | Lodgepole pine | 2.03 | No |
| | | Mountain alder thicket | Mountain alder | 1.16 | Yes (S3) |
| | Upland/other | Open water | | 0.54 | n/a |
| | | White fir forest | White fir | 2.03 | No |
| | **IHD-RV5 Total** | | | **5.76** | |

| Site | Community Type | Manual of California Vegetation Type | CalVeg Type | Acres | Sensitive Natural Community[1]? |
|---|---|---|---|---|---|
| IHD-RV1 | Riparian | Arroyo willow thickets | Willow | 0.14 | No |
| | | Mountain alder thicket | Mountain alder | 0.22 | Yes (S3) |
| | | Red osier thickets | Dogwood | 0.09 | Yes (S3?) |
| | Upland/other | Green leaf manzanita chaparral | Greenleaf manzanita | 1.75 | No |
| | | Mountain whitethorn chaparral | Mountain whitethorn | 0.48 | No |
| | | Open water | | 0.83 | n/a |
| | | Ponderosa pine forest | Ponderosa pine | 1.94 | No |
| | **IHD-RV1 Total** | | | **5.45** | |
| CD-RV4 | Riparian | Himalayan blackberry - rattlebox - edible fig riparian scrub | Non-native/ornamental shrub | 0.03 | No |
| | | White alder groves | White alder | 0.24 | No |
| | Upland/other | Bedrock/boulder | | 1.00 | No |
| | | Canyon live oak forest | Canyon live oak | 0.53 | No |
| | | Gravel bar | | 0.07 | n/a |
| | | Open water | | 0.73 | n/a |
| | **CD-RV4 Total** | | | **2.60** | |
| SCD-RV5 | Riparian | Arroyo willow thickets | Willow | 0.24 | No |
| | | Himalayan blackberry - rattlebox - edible fig riparian scrub | Non-native/ornamental shrub | 0.20 | No |
| | Upland/other | Bedrock/boulder | | 0.83 | No |
| | | Canyon live oak forest | Canyon live oak | 0.53 | No |
| | | Open water | | 0.65 | n/a |
| | | Poison oak scrub | not treated | 0.06 | No |
| | **SCD-RV5 Total** | | | **2.51** | |
| SCD-RV3 | Riparian | Arroyo willow thickets | Willow | 0.56 | No |
| | | Sandbar willow thickets | Willow | 0.15 | No |
| | | White alder groves | White alder | 0.02 | No |
| | Upland/other | Bedrock/boulder | | 0.33 | n/a |
| | | Canyon live oak forest | Canyon live oak | 1.31 | No |
| | | Open water | | 0.79 | n/a |
| | **SCD-RV3 Total** | | | **3.16** | |

| Site | Community Type | Manual of California Vegetation Type | CalVeg Type | Acres | Sensitive Natural Community[1]? |
|---|---|---|---|---|---|
| SCD-RV1 | Riparian | Arroyo willow thickets | Willow | 0.96 | No |
| | | Red willow thickets | Willow | 0.40 | Yes (S3) |
| | | Torrent sedge patches | Wet grasses and forbs | 0.24 | Yes (S3) |
| | | White alder groves | White alder | 0.75 | No |
| | Upland/other | Bedrock/boulder | | 0.31 | n/a |
| | | Canyon live oak forest | Canyon live oak | 3.78 | No |
| | | Gravel bar | | 1.43 | n/a |
| | | Open water | | 2.28 | n/a |
| | **SCD-RV1 Total** | | | **10.14** | |

1 Sensitive natural communities were defined as those natural community types with a state ranking of S1 (critically imperiled), S2 (imperiled), or S3 (vulnerable) as listed in the most recent *California Sensitive Natural Communities List*. A ranking of S3.2 indicates vulnerable and threatened, while a ranking of S3? indicates vulnerable but with an inexact numeric rank due to insufficient samples over the full expected range of the type (CDFW 2018); n/a is not applicable.

### 5.3.2 Transect and Greenline Surveys

Results of the riparian vegetation composition and greenline surveys are presented below. Average transect lengths within a site ranged from just 96-ft (Site CD-RV4) to 281-ft (Site IHD-RV1) (Figure 5-1). In addition to the results detailed below, one special-status plant species was documented: Sierra bayberry (*Myrica hartwegii*), which has a California Rare Plant Rank of 4.3 (i.e., watch list, not very threatened in California [CNPS 2019b]) but is not listed on the ENF sensitive plant list (USFS 2016), was observed at Sites IHD-RV1 and IHD-RV5. Approximately 150 individuals were found at the low flow water's edge or slightly higher in silty sand among boulders in moderate shade; plant associates included white alder (*Alnus rhombifolia*), Oregon ash (*Fraxinus latifolia*), torrent sedge (*Carex nudata*), and Himalayan blackberry (*Rubus armeniacus*).

#### 5.3.2.1 Line-point Intercept

A total of 138 plant species were recorded during line-point intercept surveys, 20 of which were non-native plant species. Species diversity documented at each site ranged from eight species at Site SCD-RV5 to 38 species at Site IHD-RV5 (Figure 5-2). Of the total species documented, 59 species are considered to be hydrophytic: 27 species (20%) are facultative, 22 species (16%) are facultative wetland, and 10 species (7%) are obligate wetland species (Lichvar 2016). The most commonly observed species across all sites were mountain alder (*Alnus incana* subsp. *tenuifolia*) and torrent sedge. Nativity, wetland indicator status, and percent cover of each species (relative canopy cover) are presented in Appendix E3, Table E3-1; percent cover of vegetated canopy (absolute vegetative cover) is presented by site in Appendix E3, Table E3-2.


**Figure 5-1. Average riparian vegetation study transect length (in feet) by site within the UARP in 2019.**

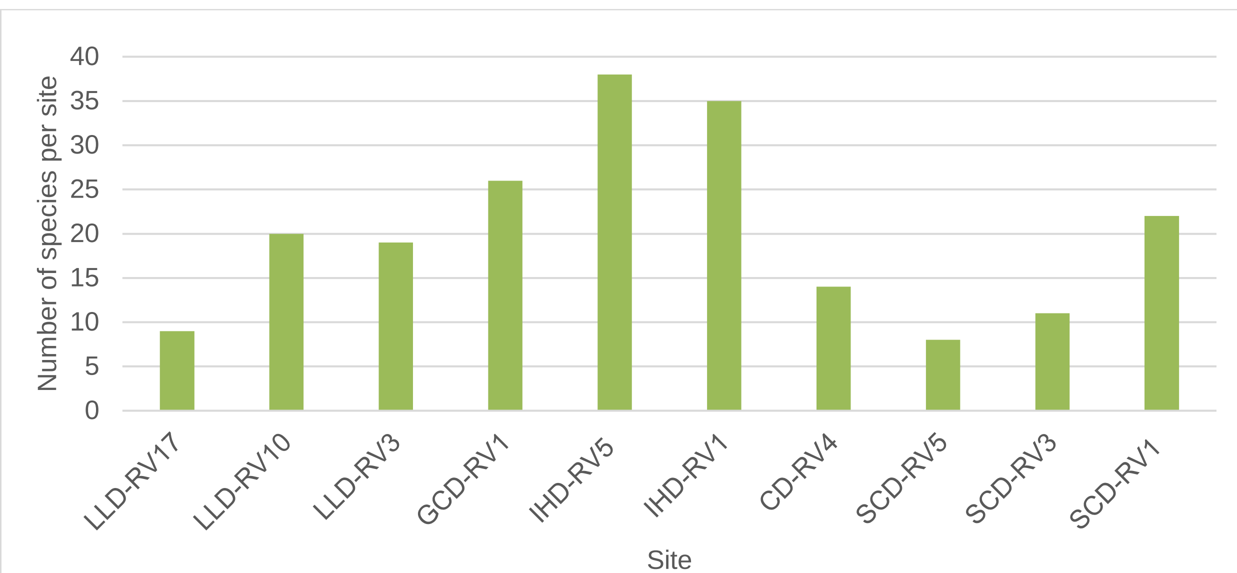


**Figure 5-2. Plant species diversity documented by site within the UARP in 2019.**

Of the ten sites surveyed, Site SCD-RV5 had the lowest absolute cover of vegetation documented across all canopy classes; vegetation canopy cover was minimal in the understory (i.e., 24% cover of vegetation under one meter tall) and the mid-story (i.e., 10% cover of vegetation one to five meters tall), and the overstory canopy was absent (i.e., no vegetation over five meters tall). Site IHD-RV5 had the highest vegetative cover in both the understory (i.e., 87% cover) and mid-story canopy (i.e., 63% cover, tied with Site LLD-RV10), with relatively high cover in the overstory canopy (i.e., 29% cover). Figure 5-3 shows the percent cover by canopy height class, as observed along line-point intercept transects.

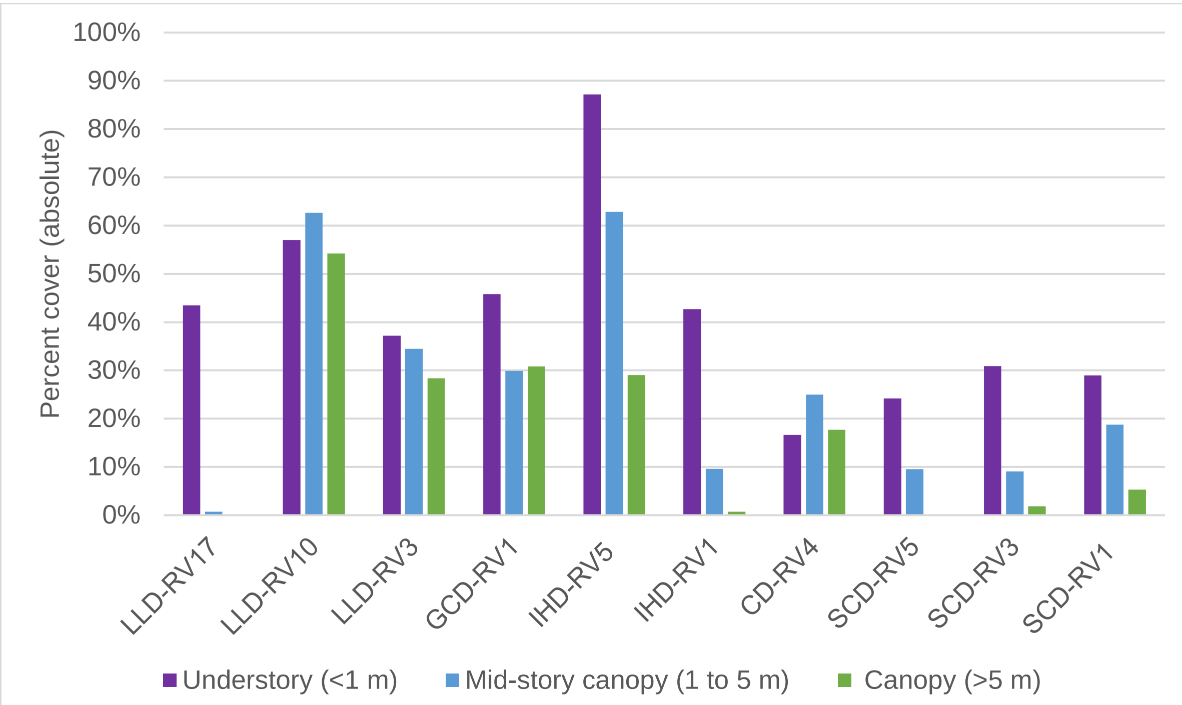


**Figure 5-3. Vegetative cover (absolute) in each canopy class documented during line-point intercept surveys within the UARP in 2019.**

Natural recruitment of woody vegetation was observed at all sites, except Site SCD-RV5. Seedlings and saplings of white fir (*Abies concolor*), mountain alder, and narrowleaf willow (*Salix exigua)* were the most commonly observed recruits. Recruitment of upland species (e.g. Douglas-fir [*Pseudotsuga menziesii*], incense cedar [*Calocedrus decurrens*], and white fir) was observed at Sites IHD-RV1, IHD-RV5, and GCD-RV1.

Non-native plant species were documented at all sites except Sites CD-RV4 and GCD-RV4. Himalayan blackberry was the most commonly observed non-native species. Although it was only detected via line-point intercept surveys at Sites SCD-RV1, SCD-RV3, and SCD-RV5, additional incidental observations of this species were made throughout the UARP. Site SCD-RV5 had the highest relative cover of Himalayan blackberry (i.e., 55%). Site SCD-RV1 had the most non-native species: Scotch broom

(*Cytisus scoparius)*, white sweetclover (*Melilotus albus*), and Himalayan blackberry. Both Sites IHD-RV1 and IHD-RV5 had the lowest cover (i.e., 1%) of non-native species, sheep sorrel (*Rumex acetosella)* was documented at Site IHD-RV1 and Klamath weed (*Hypericum perforatum* subsp. *perforatum)* was documented at Site IHD-RV5.

5.3.2.2 Point-centered Quarter

Point-centered quarter results of tree and shrub composition, successional stage, and overall vegetative health are presented by site in Appendix E4, Table E4-1; Figure 5-4 depicts vegetation composition and relative cover of each plant species by site. Overall, the composition of riparian tree and shrub species shifted from predominantly mountain alder in the upper reaches of the UARP to predominantly willows (*Salix exigua*, *S. laevigata*, and *S. lasiolepis*) in the lower reaches (Figure 5-4). American dogwood (*Cornus sericea*), Jepson's willow (*Salix jepsonii*), and conifers including lodgepole pine (*Pinus contorta*), ponderosa pine (*Pinus ponderosa*), and white fir were also often observed at sites in the upper reaches below Loon Lake, Gerle Creek, and Ice House Dams. Where conifers were present (i.e., at Sites LLD-RV17, LLD-RV10, IHD-RV5, and IHD-RV1) they often provided the majority of the cover. Similarly, in the lower reaches, white alder was observed at most sites, and although less frequent than other species, it often provided a large proportion of the cover (e.g., absolute cover of 13.11ft$^2$/ac for 99% relative cover at Site CD-RV4). Upland plant species (e.g., ponderosa pine, greenleaf manzanita [*Arctostaphylos patula*]) and upland habitats were observed within the riparian corridor at six sites (i.e., Sites LLD-RV3, GCD-RV1, IHD-RV1, CD-RV4, SCD-RV5, and SCD-RV1).

Disparities between plant species composition and cover can be attributed, at least in part, to the difference in DBH between shrubs and trees. While shrubs like mountain alder and willows occurred frequently and often had multiple stems, each stem's DBH rarely exceeded 1 inch. Trees, however, while typically only having one stem, had average DBH values reaching 13.0 in. (e.g., Jeffrey pine [*Pinus jeffreyi*] at IHD-RV5).

The average density (i.e., number of individuals per acre) of trees and shrubs ranged from ten individuals per acre at Site SCD-RV5 to 1,226 individuals per acre at Site LLD-RV10. In general, the sites in the reaches below Slab Creek and Camino dams had much lower tree and shrub density than sites higher in the watershed.

Sites lower in the watershed, particularly the sites below Slab Creek Dam, averaged higher vigor than the higher elevation reaches, except for Site LLD-RV17 which also averaged very high vigor across all species (e.g., <10% of canopy had reduced vigor). None of the species observed at any site displayed significant amounts of leaf death, branch dieback, or other indicators of poor health. The average proportion of canopy with signs of reduced vigor rarely exceeded 20% across all sites and species.

Finally, no overall pattern of average age class was documented either by site or by species. In general, shrub species averaged a mature age class (i.e., >4 years old) while trees averaged a young age class (i.e., 4–10 years old); however, individuals in all age classes were observed at all sites.

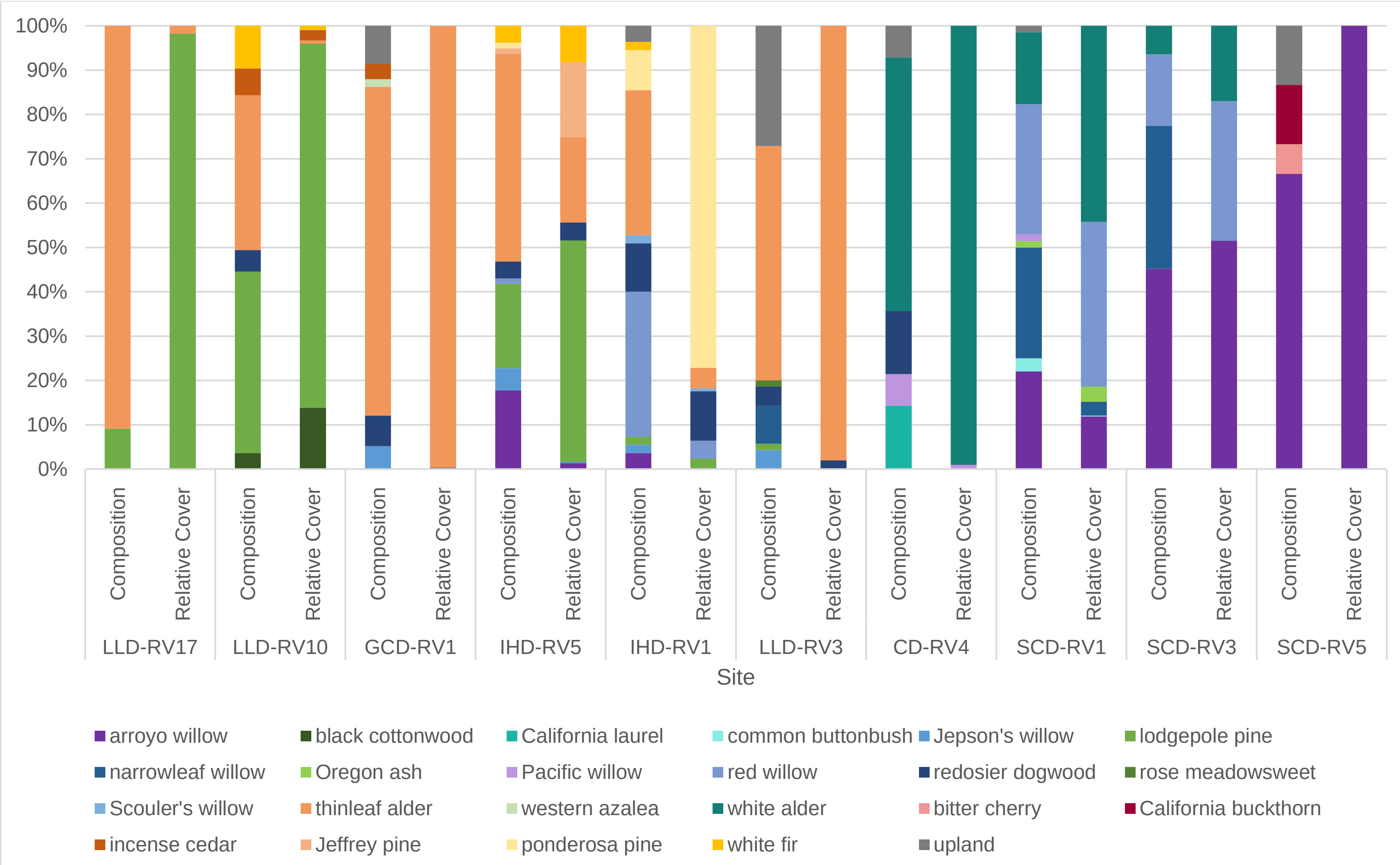


**Figure 5-4. Percent composition and relative cover of species detected using the point-center quarter method, within the UARP in 2019.**

5.3.2.3 Greenline

Greenline results are presented in Appendix E2, Figures E2-1 through E2-10; Table 5-2; and Appendix E5, Table E5-1. In addition to numerous perennial vegetation types, the greenline also included wood, boulders, and bedrock at some sites. Overall site stability ranged from 6.5 at Site SCD-RV1 to 9.7 at Site SCD-RV5 (Table 5-2); a crosswalk of vegetation alliances, their closest related Winward (2000) cover type, and the successional status and stability class is provided in Appendix E5, Table E5-2.

**Table 5-2. Average Bank Stability Class Based on Greenline Composition at Each Site within the UARP in 2019 (Per Winward 2000).**

| Site | Stability Class[1] |
|---|---|
| LLD-RV17 | 8.9 |
| LLD-RV10 | 7.3 |
| LLD-RV3 | 7.6 |
| GCD-RV1 | 9.4 |
| IHD-RV5 | 7.7 |
| IHD-RV1 | 7.6 |
| CD-RV4 | 8.1 |
| SCD-RV5 | 9.7 |
| SCD-RV3 | 8.0 |
| SCD-RV1 | 6.5 |

[1] Stability classes range from 1 to 10, with 1–2 indicating very low stability and 9-10 indicating excellent stability.

## 5.4 DISCUSSION

### 5.4.1 Vegetation Mapping

There was high variability in vegetation composition and complexity across sites in 2019. Comparisons to 2004 riparian vegetation study (SMUD and PG&E 2004) results are largely qualitative, as quantitative comparisons of this parameter are confounded by nuanced differences in mapped acreages, site boundaries, data availability and precision, and vegetation classification systems between 2004 and 2019. However, field observations indicated some sites have changed significantly since the 2004 riparian vegetation study.

Site LLD-RV17 experienced a dramatic change in both vegetation composition and channel alignment, likely due to beaver dam flooding that caused tree and shrub mortality and initiated geomorphic change (E. Koenigs, SMUD, pers. comm., July 2019). In addition, Site LLD-RV17 Transect 1 appeared perpendicular to the channel in 2004, but was positioned oblique to the channel – at a 25-degree angle – in 2019.

Sites CD-RV4, SCD-RV1, SCD-RV3, and SCD-RV5 appeared to have been affected by high flows. Evidence of significant scour and damage to riparian vegetation on gravel bars was observed at these sites; however, many of the damaged willow branches remained in place and had evidence of resprout at the base of branches. Large white alders appeared to have also been affected but had less evidence of resprout occurring.

### 5.4.2 Transect and Greenline Surveys

A comparison of 2004 and 2019 data showed no established trend in the percentage of wetland and upland species observed (Figure 5-5). Sites with a high percentage of dominant upland species detected during transect surveys in 2004 generally retained a high incidence of dominant upland species in 2019 (i.e., Sites GCD-RV1, IHD-RV5, and IHD-RV1). The biggest change between years was observed at Site IHD-RV1, where dominant upland species increased by 38% (i.e., upland plant species increased from 40% to 78% of the total dominant plant species). This change is likely attributed to the colonization of the large floodplain by upland plants, which was mapped as unconsolidated shore in 2004 (i.e., ponderosa pine, greenleaf manzanita, and mountain whitethorn [*Ceanothus cordulatus*] colonized the unconsolidated shore).

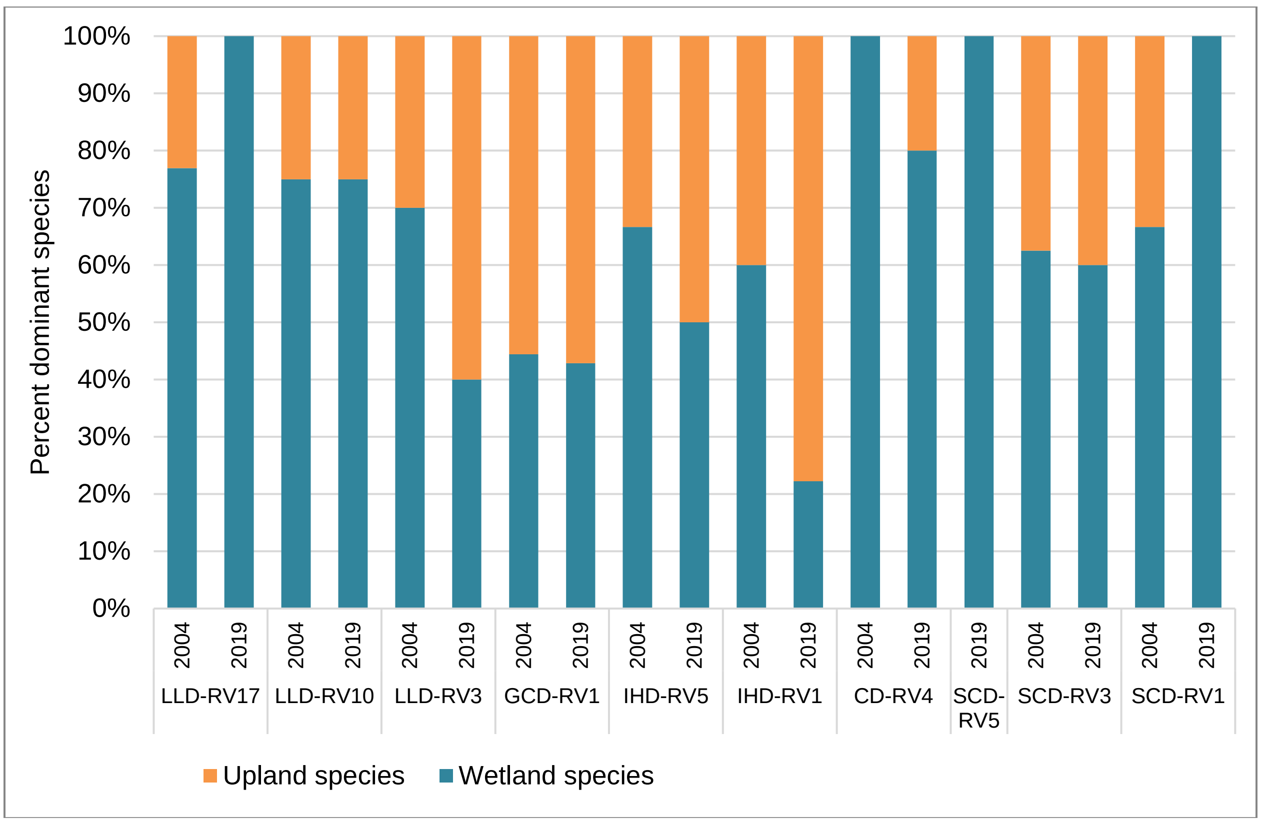


**Figure 5-5. Comparison of the percent of dominant wetland and upland species observed at sites within the UARP in 2004 and 2019 (Site SCD-RV5 was not monitored in 2004).**

Recruitment of woody riparian species was observed at all sites except Site SCD-RV5. At this site, substrate composed of bedrock and boulder, and high flows from dam releases immediately upstream likely inhibit the establishment and survival of recruited riparian species. In addition, this site was temporarily dewatered in 2018 to facilitate construction of the South Fork Powerhouse and during this timeframe substrate at the site was engineered to create the low-flow channel associated with the South Fork Powerhouse Project Habitat Improvement Plan (SMUD 2018); as such, recruitment may be documented in the future.

Conifer encroachment into the riparian zone was observed at the same three sites that showed the highest percent of dominant upland species in both 2004 and 2019 (Sites GCD-RV1, IHD-RV5, and IHD-RV1). Although narrow riparian corridors and presence of upland species was documented in 2004, results from 2019 surveys show an increase in encroachment of conifers and upland species into the riparian zone (Figure 5-5). At one transect within Site IHD-RV5 (i.e., Transect 3), a lodgepole pine was documented within the active channel. Additional conifer encroachment (i.e., ponderosa pine) was observed on both banks at Site GCD-RV1, with more severe encroachment documented on the right bank: ponderosa pine, white fir, incense cedar, and lodgepole pine were all documented along the right bank channel margin. Finally, Site LLD-RV3 had both conifer encroachment as well as encroachment of another upland species, greenleaf manzanita, along the channel banks. The observed changes in species dominance and composition may be a function of a variety of factors (e.g., changes in transect extent since 2004, variances between years in methods used to determine dominance, or other data collection methods) rather than real changes in the riparian vegetation community or a narrowing of the riparian corridor since 2004. Consistency in the use of the 2019 methods and precise site boundaries will facilitate more detailed comparisons in the future and help determine if changes may be attributed to infrequent scour events higher in the watershed, changes to flow, or other mechanisms (e.g., fire frequency, fire recovery, climate change).

A comparison of percent vegetated greenline in 2004 and 2019 generally shows a decrease in vegetation stabilizing banks at most sites (Figure 5-6). This trend is most pronounced at sites lower in the watershed that are largely composed of bedrock and boulder, which also showed evidence of scour from high flow events (i.e., Sites CD-RV4, SCD-RV3 and SCD-RV1). Site LLD-RV17, the beaver affected reach, maintained a high percent of vegetated greenline, but with changes to vegetation composition; in 2004, approximately half of the greenline was composed of mature shrubs and trees while in 2019, the greenline was entirely herbaceous, composed of sedges (*Carex* spp.) and rushes (*Juncus* spp.).

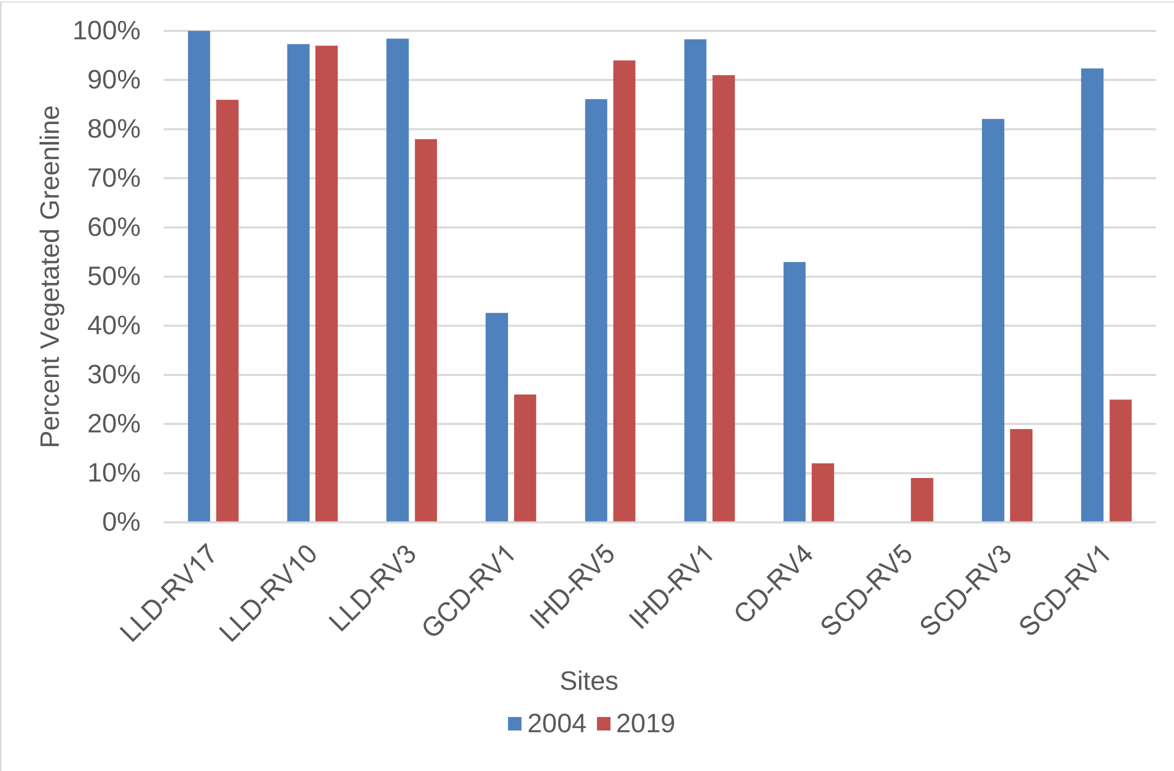


**Figure 5-6. Comparison of percent vegetated greenline at sites within the UARP in 2004 and 2019 (Site SCD-RV5 was not monitored in 2004).**

Despite a reduction in the percent vegetated greenline observed at many sites, the average greenline stability class did not change significantly between 2004 and 2019 (Figure 5-7). Nearly all sites' average stability class was within one unit of that measured in 2004. Relative comparison of a site's bank stability indicates areas that may be more or less susceptible to damage from higher flow events. A low bank stability score could indicate that vegetation has not yet become established. The site with the highest stability class was Site SCD-RV5, largely due to the portion of the greenline composed of bedrock and boulder (i.e., 91% combined). The greenline at Sites CD-RV4, SCD-RV3 and GCD-RV1 also was predominately composed of bedrock or boulder (i.e., 70% or greater). Site CD-RV4 had the greatest change between years, with an average stability class increase of 1.2. This increase in stability documented at Site CD-RV4 is likely due to scour from high flows removing vegetation and exposing bedrock, which has the maximum stability ranking of 10. Of the sites where banks were stabilized by riparian vegetation (i.e., Sites IHD-RV1, IHD-RV5, LLD-RV10 and LLD-RV17), over 85% of the greenline was vegetated. At Site LLD-RV17, a site with one of the higher overall stability classes, the greenline was vegetated by herbaceous plants: torrent sedge, southern beaked sedge (*Carex utriculata*), and iris-leaved rush (*Juncus xiphioides*). Because bank materials are generally made up of boulders and bedrock, little change in stability due to either a change in bank materials or vegetation is expected over time.

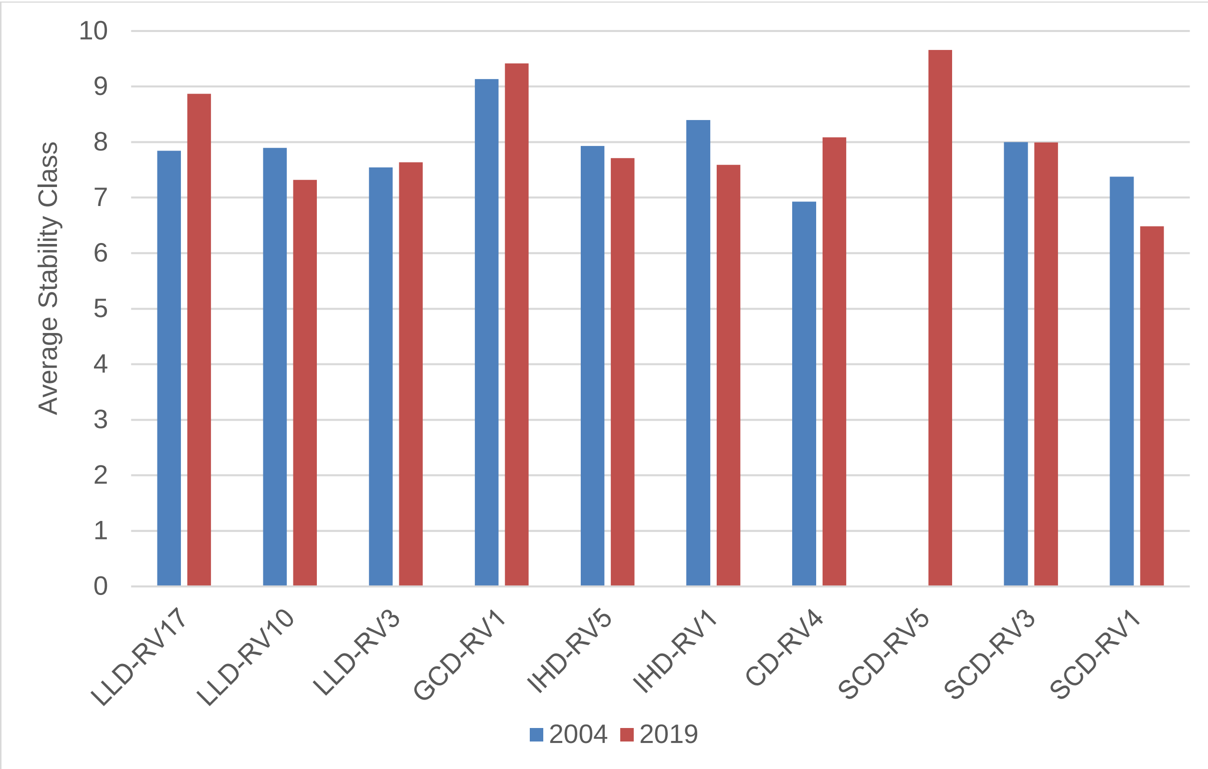


**Figure 5-7. Comparison of average stability class of greenline at sites within the UARP in 2004 and 2019 (Site SCD-RV5 was not monitored in 2004).**

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# 6.0 BALD EAGLE

## 6.1 MONITORING PLAN OBJECTIVES

The primary objectives of the bald eagle monitoring program are to monitor bald eagle nesting activity in the study area (see Section 1.0) and ensure that bald eagle nest sites are not adversely affected by activities related to the UARP. The results of the monitoring are intended to inform future bald eagle management in the UARP area (SMUD 2015).

## 6.2 METHODS

Bald eagle surveys were conducted during the 2019 breeding season at Union Valley Reservoir, Loon Lake Reservoir, and Ice House Reservoir. Surveys for new nests and at known nest sites were conducted in accordance with protocols described in the *Protocol for Evaluating Bald Eagle Habitat and Populations in California* (Jackman and Jenkins 2004) and *Bald Eagle Breeding Survey Instructions* (CDFG 2010). Where possible (i.e., weather-related conditions permitting), surveys were conducted at each reservoir during the following time periods: late February through March (early breeding season), late April through May (mid-breeding season), and early June to early July (late breeding season). If weather conditions precluded surveying during the early breeding season, an additional survey was performed during the mid- or late breeding season so that three surveys in total were performed at each reservoir.

Surveys typically began at dawn and concluded in the late afternoon. Nest sites documented during the previous year of surveys were revisited (SMUD 2018) and other areas with suitable habitat surrounding each reservoir, including historical nest sites documented during relicensing surveys (SMUD 2004), were evaluated for signs of bald eagle nesting activity. Observations were made using binoculars and/or a spotting scope from a boat and land-based vantage points accessed by vehicle and/or foot (Figure 6-1). Detailed notes on the location, age class, activity, movement, and behavior of bald eagles were taken and incidental observations of other avian species and recreational activities on the day of the survey were recorded (Appendices F1 and F2). Bald eagle perches and nests located during the surveys were mapped using a handheld Global Positioning System (GPS) unit. Using the California Bald Eagle Nesting Territory Form (CDFG 2010), a detailed summary of all bald eagle observations at each reservoir was submitted to CDFW at the end of the breeding season (Appendix F2).

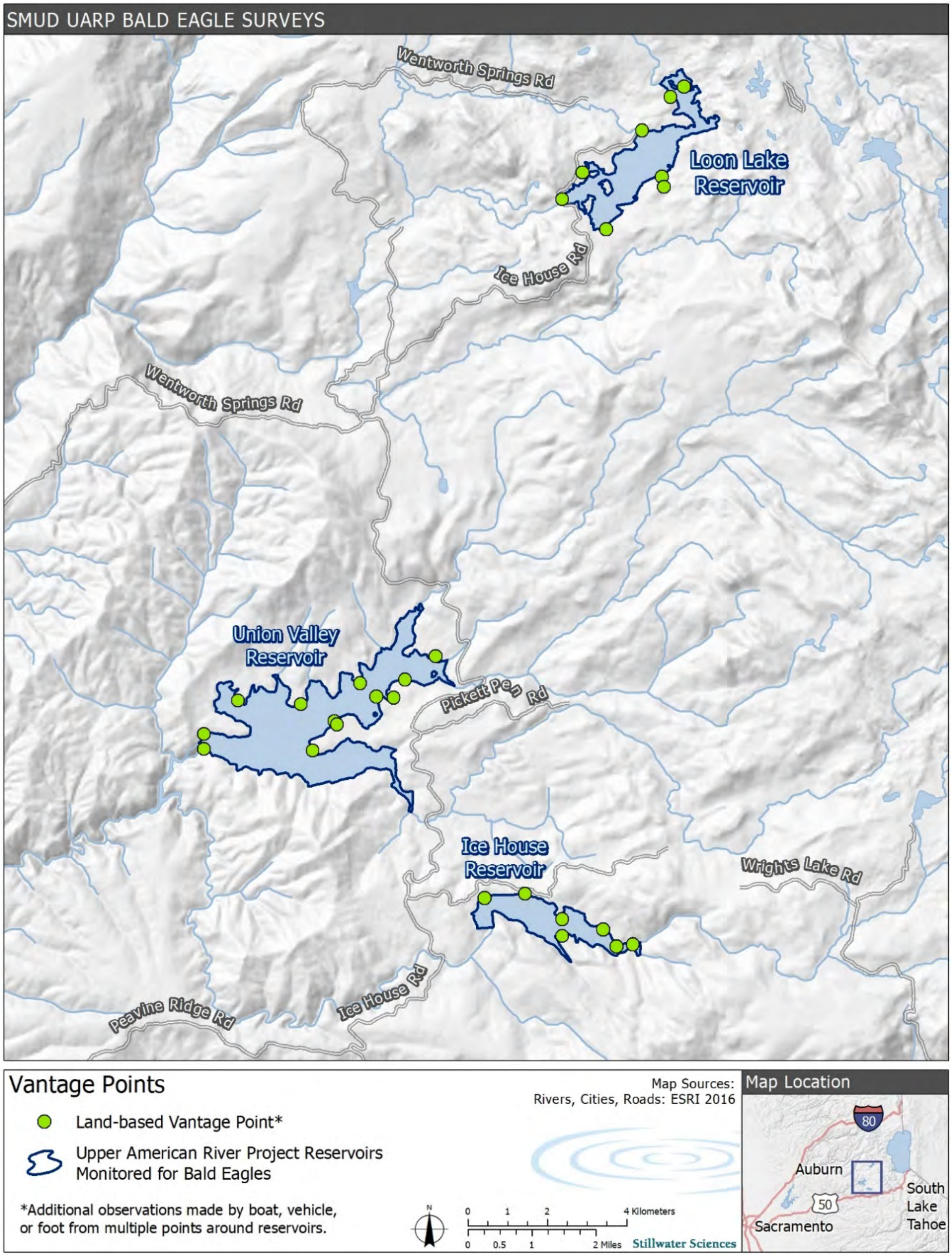


**Figure 6-1. Land-based vantage points used for monitoring in the Upper American River Project bald eagle study area.**

## 6.3 RESULTS

### 6.3.1 Union Valley Reservoir

Surveys for bald eagles during the 2019 breeding season were conducted at Union Valley Reservoir on 24 March, 13 May, and 10 June; additional reproductive status checks, beyond the required protocol, were performed on 14 May, 11 June, and 12 June. Table 6-1 summarizes bald eagle observations made during the surveys and status checks.

**Table 6-1. Bald Eagle Observations During the 2019 Breeding Season Surveys at Union Valley Reservoir.**

| Date (Time) | Number of Eagles | Age Class | Notes |
|---|---|---|---|
| 03/24/19 (10:15) | 1 | Adult | Adult observed in foraging perch on southeast side of Union Valley Dam. |
| 03/24/19 (11:45) | 1 | Adult | Adult departing foraging perch on southeast side of Union Valley Dam, flying west toward Fashoda Sunset Peninsula. |
| 03/24/19 (13:30) | 1 | Adult | Adult (female) observed in nest, actively lining nest with fresh greenery. |
| 03/24/19 (15:00) | 1 | Adult | Adult (male) heard vocalizing, then seen in previously documented roost south of nest tree. |
| 05/06/19 | 1 | Adult | Observation by SMUD staff of an adult perched in nest tree above the nest approximately one week prior to mid-breeding season survey. |
| 05/13/19 (11:25) | 1 | Adult | Adult flying in from north and landing in previously documented foraging perch along shore, approximately 500 ft from nest tree. |
| 05/13/19 (11:30) | 1 | Adult | Adult departing foraging perch, flying over nest, and continuing southwest towards Jones Fork. |

Results of the survey conducted in the early breeding season of 2019 at Union Valley Reservoir indicated occupancy and initiation of reproductive activity. The nest located in Sunset Campground (Figure 6-2) that was utilized successfully in 2016 and 2017 and partially rebuilt in 2018 during a failed reproductive attempt had deteriorated substantially, but rebuilding activity was documented and an adult bald eagle was observed in incubation position in the nest during the early breeding season survey (Table 6-1). Subsequent surveys, however, indicated that the reproductive attempt was not successful. The nest structure was intact during the mid-breeding season survey, but bald eagle presence in the area was limited to an adult male observed in a nearby perch (Figure 6-3, Table 6-1) and there was no activity observed in the nest. Despite extended observation during the late breeding season survey and additional follow-up reproductive status checks described above, no additional bald eagle activity or evidence of nesting was observed at Sunset Campground or elsewhere on Union Valley Reservoir in 2019. Surveyors visited the historical nest site (2015) and the USFS nest platform on Granlees Point (Figure 6-4) during each of the 2019 breeding season surveys and, although there was continued evidence of bald eagle roosting in the vicinity, there was no indication of nesting at either of these locations (Figure 6-2). Additional detail regarding surveys and reproductive status checks conducted in 2019 at Union Valley Reservoir is provided in Appendix F2.

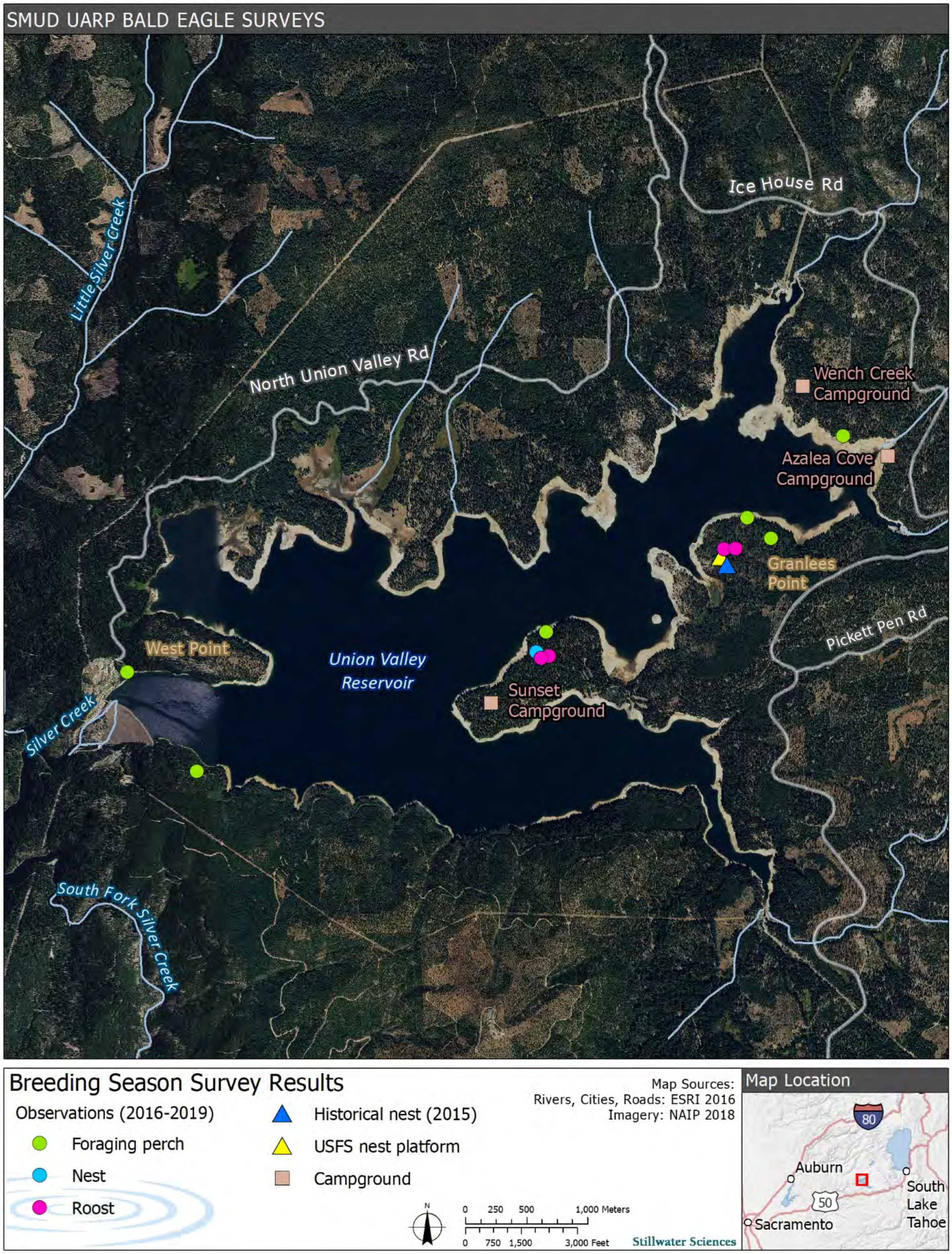


**Figure 6-2. Bald eagle activity sites at Union Valley Reservoir.**

**Figure 6-3. Adult bald eagle in foraging perch in Sunset Campground during the mid-breeding season survey in 2019.**

**Figure 6-4. Unoccupied bald eagle nesting platform on Granlees Point at Union Valley Reservoir (May 2019).**

### 6.3.2 Loon Lake Reservoir

Surveys for bald eagles during the 2019 breeding season were conducted at Loon Lake Reservoir on the following dates: 14 May, 12 June, and 09 July. Although bald eagles were observed during the early and late breeding season surveys, no evidence of a reproductive attempt was observed at Loon Lake Reservoir in 2019. The nest located on the south side of the reservoir (Figure 6-5) that was utilized successfully in 2018 was deteriorated and no evidence of rebuilding activity was observed. Table 6-2 summarizes bald eagle observations made during surveys at Loon Lake Reservoir in 2019; additional detail regarding surveys is provided in Appendix F2.

**Table 6-2. Bald Eagle Observations During the 2019 Breeding Season Surveys at Loon Lake Reservoir.**

| Date (Time) | Number of Eagles | Age | Notes |
|---|---|---|---|
| 05/14/19 (09:10) | 1 | Adult | Adult flying east to west toward dam. |
| 05/14/19 (10:15) | 1 | Adult | Adult perched in snag on northwest side of reservoir. |
| 07/09/19 (11:30) | 1 | Adult | Adult flying west to east in southern section of Pleasant Lake. |
| 07/09/19 (11:50) | 1 | Adult | Adult flying south to north toward northern section of Pleasant Lake. |

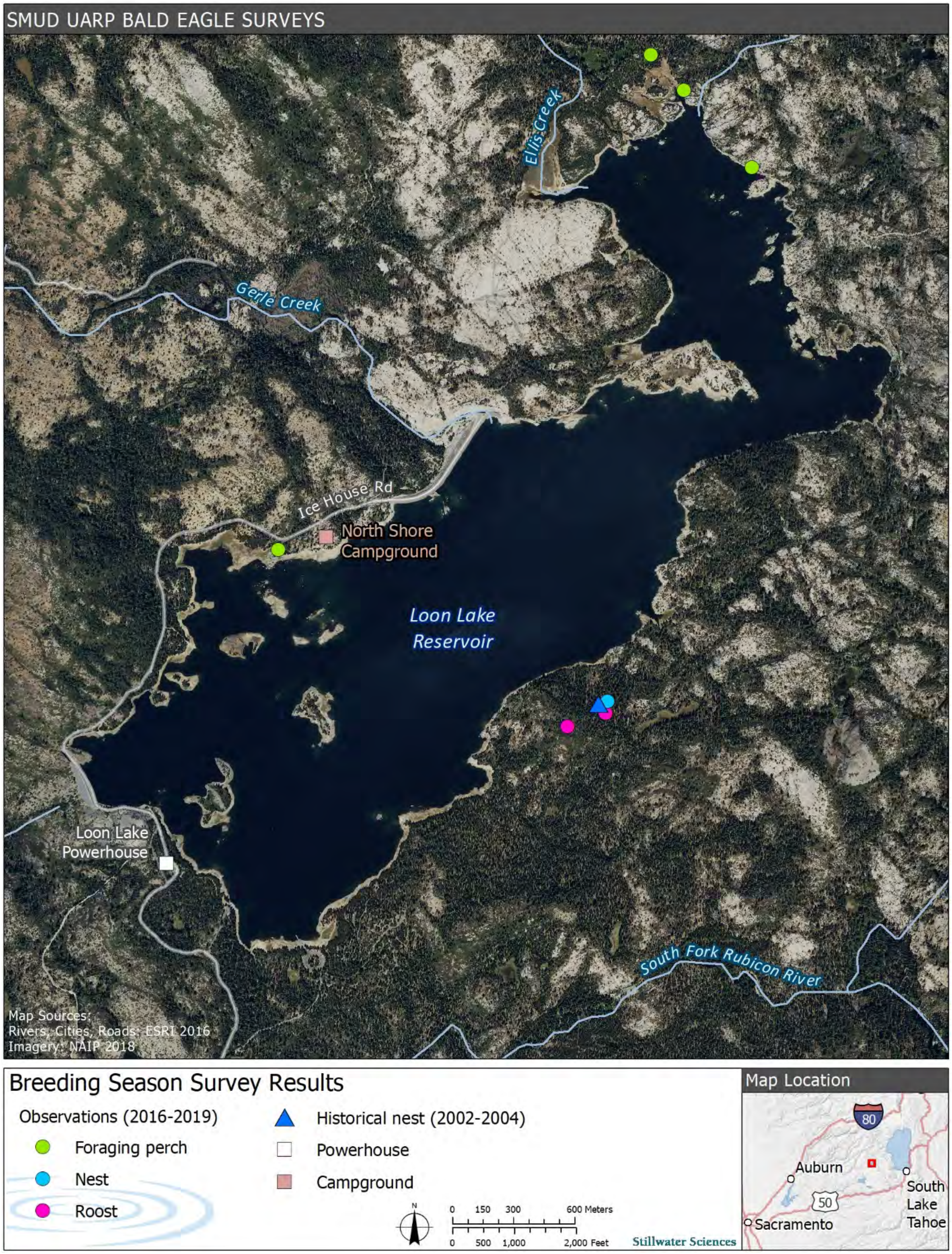


**Figure 6-5. Bald eagle activity sites at Loon Lake Reservoir.**

6.3.3 Ice House Reservoir

Surveys for bald eagles during the 2019 breeding season were conducted at Ice House Reservoir on the following dates: 25 March, 14 May, and 11 June; additional reproductive status checks, beyond the required protocol, were performed on 13 May, 12 June, and 09 July. Bald eagles were observed numerous times on the southeast side of the reservoir (Figures 6-6 through 6-8); however, despite extended observation and a thorough canvass of the area, no evidence of a reproductive attempt was observed at Ice House Reservoir in 2019. Table 6-3 summarizes bald eagle observations made during the surveys; additional detail regarding surveys is provided in Appendix F2.

**Figure 6-6. Adult bald eagle on foraging perch along Ice House Reservoir (May 2019).**

**Figure 6-7. Adult bald eagle on foraging perch along Ice House Reservoir (July 2019).**


**Figure 6-8. Bald eagle activity sites at Ice House Reservoir.**

**Table 6-3. Bald Eagle Observations During the 2019 Breeding Season Surveys at Ice House Reservoir.**

| Date (Time) | Number of Eagles | Age Class | Notes |
|---|---|---|---|
| 05/13/19 17:30 | 1 | Adult | Adult flying west from southeast end of reservoir, eventually perching in fir on southwest shore. |
| 05/13/19 18:15 | 1 | Adult | Adult departing perch in fir on southwest shore, flying northeast over reservoir. |
| 05/14/19 16:30 | 1 | Adult | Adult (male) perched in snag located on southeast perimeter of reservoir. |
| 05/14/19 17:30 | 1 | Adult | Adult (male) departing snag after altercation with osprey nesting nearby, relocating to alternate perch approximately 300 feet west. |
| 05/14/19 18:00 | 1 | Adult | Adult (female) observed in large snag on south side of reservoir. |
| 05/14/19 18:25 | 1 | Adult | Adult (female) departing snag on south side, relocating to dominant sugar pine also on south side. |
| 05/14/19 20:15 | 2 | Adults | Adults (male and female) observed in separate respective roosts, approximately 0.75 mi apart at survey conclusion just after sunset. |
| 06/11/19 19:10 | 2 | Adults | Pair perched in previously documented dominant sugar pine on south side of reservoir. |
| 06/11/19 19:45 | 1 | Adult | Adult (male) departing sugar pine, relocating in small fir approximately 150 ft east. |
| 06/11/19 20:05 | 1 | Adult | Adult (female) departing sugar pine, flying west. |
| 06/12/19 07:00 | 1 | Adult | Adult (female) perched in snag approximately 100 feet east of previously documented dominant sugar pine. |
| 06/12/19 07:10 | 1 | Adult | Adult (female) departing snag and relocating to nearby dominant sugar pine. |
| 06/12/19 18:15 | 1 | Adult | Adult (female) perched in previously documented dominant sugar pine. |
| 06/12/19 19:00 | 1 | Adult | Adult (female) departing dominant sugar pine, relocating to alternate sugar pine approximately 0.5 mi west. |
| 07/09/19 18:15 | 1 | Adult | Adult (female) perched in previously documented dominant sugar pine on south side of reservoir. |
| 07/09/19 19:00 | 1 | Adult | Adult (male) perched in snag on southeast end of reservoir. |

## 6.4 DISCUSSION

### 6.4.1 Union Valley Reservoir

Bald eagles continue to use the habitat surrounding Union Valley Reservoir, although the reproductive attempt in 2019 was unsuccessful. Reservoir levels were unlikely to have affected bald eagle nesting success at Union Valley Reservoir in 2019 as they remained relatively consistent during the breeding season, gradually increasing from approximately 4,850 feet above mean sea level in March to approximately 4,870 feet by the end of May (DWR 2019 [UNV]). Weather, however, may have been an influencing factor. Snowpack (as measured by water content) at Robbs Peak Powerhouse peaked at close to 20 in. in late February, remained largely static through March, and dissipated by the end of April (DWR 2019 [RBP]). The 2019 water year was wetter than average and cumulative precipitation in the region was approximately 125% of normal (NOAA 2019). Cumulative precipitation during the breeding season at Moratinni Flat (the closest gage to Union Valley Reservoir with available data) was approximately 40 in. (DWR 2019 [MFT]). The most significant rainfall (approximately 30 in.) occurred by mid-April and a series of events in May brought another 10 in. of precipitation. Minimum air temperatures regularly dropped below freezing through mid-April and the portion of the lake to the north and east of Granlees Point was partially frozen during the early breeding season (DWR 2019 [RBP]). Wind speeds at Big Hill, approximately one mile south of Union Valley Reservoir, were highest early in the breeding season, surpassing 30 mph during five events in February and March and reaching a maximum of 40 mph on 6 March (DWR 2019 [BHS]). Peak wind speeds steadily decreased throughout the breeding season, with occasional recordings between 25 and 30 mph in April and May and only one recording exceeding 20 mph in June and July.

Recreational activity observed on or around the reservoir during breeding season surveys was low and consisted of occasional fishing and boating (see Appendix F2 for additional details). Maintenance or construction activities involving noise-generating equipment performed at Union Valley Reservoir during the breeding season in 2019 included improvements to North Union Valley Road along the northern perimeter of the reservoir approximately two to three miles from Fashoda Sunset Peninsula (Figure 6-2). Due to snow levels, construction associated with this improvement did not begin until mid-June and was completed by the end of October. No observations of bald eagles exhibiting agitation or appearing disturbed as a result of recreational or maintenance activity at Union Valley Reservoir were made during the surveys.

### 6.4.2 Loon Lake Reservoir

There is a limited season of suitable bald eagle reproductive habitat around Loon Lake Reservoir due to its high elevation (approximately 6,500 feet). The duration of this season varies with weather conditions from year to year. Although bald eagles were infrequently observed during surveys, there was no evidence of a reproductive attempt at Loon Lake Reservoir in 2019. The reservoir remained largely frozen over through most of May and, as stated previously, the 2019 water year was wetter than average (NOAA 2019), which may have been an influencing factor. Cumulative rainfall at Loon Lake Reservoir during the breeding season was approximately 28 in., with the majority (19 in.) of it occurring before the middle of April and an additional 11 in. falling during precipitation events in late May (DWR 2019 [LON]). Minimum air temperatures regularly dropped below freezing through the month of May (DWR 2019 [LON]) and snowpack (as measured by water content) at the nearby Van Vleck Gage peaked at approximately 67 in. in early April and did not melt completely until mid-June (DWR 2019 [VVL]). Reservoir levels during the breeding season remained relatively consistent, ranging from approximately 6375 to 6410 feet above mean sea level (DWR 2019 [LON]).

There was no recreational activity observed on or around the reservoir during the early breeding season survey and surveyors noted a moderate increase in activity during the mid- and late breeding season surveys (see Appendix F2 for additional details). Maintenance and construction activities involving noise-generating equipment performed by SMUD during the 2019 breeding season included improvements to facilities at Northshore Campground (Figure 6-5) that began in June and were completed by mid-November. No observations of bald eagles exhibiting agitation or appearing disturbed as a result of recreational or maintenance activity at Loon Lake Reservoir were made during the surveys.

### 6.4.3 Ice House Reservoir

Bald eagles were observed more frequently at Ice House Reservoir during the 2019 breeding season surveys than they were in the previous surveys conducted in 2016, during which no adults were observed and two juveniles were seen only during the mid-breeding season survey (SMUD 2016). Despite increased bald eagle activity, no evidence of a reproductive attempt was observed at Ice House Reservoir during the 2019 breeding season. As stated previously, the 2019 water year was wetter than average (NOAA 2019), which may have been an influencing factor on reproductive activity. Ice House Reservoir was entirely frozen over during the early breeding season survey in late March but had thawed completely by the mid-breeding season survey in mid-May. Snowpack (as measured by water content) at Ice House Reservoir peaked at 21 inches in late February, remained largely static through March, and dissipated by the end of April (DWR 2019 [IHS]). Cumulative precipitation during the breeding season at Moratinni Flat (the closest gage to Ice House Reservoir with available data) was approximately 40 in. (DWR 2019 [MFT]). The most significant accumulation (approximately 30 in.) occurred by mid-April and a series of events in May brought another 10 in. of precipitation. Minimum air temperatures regularly dropped below freezing through mid-April (DWR 2019 [RBP]). Wind speeds at Big Hill, approximately 2.5 miles northeast of Ice House Reservoir, were highest early in the breeding season, surpassing 30 mph during five events in February and March and reaching a maximum of 40 mph on 6 March (DWR 2019 [BHS]). Peak wind speeds steadily decreased throughout the breeding season, with occasional recordings between 25 and 30 mph in April and May and only one recording exceeding 20 mph in June and July. Reservoir levels during the breeding season remained relatively consistent, ranging from approximately 5405 to 5449 feet above mean sea level (DWR 2019 [ICS]).

There was little to no recreational activity observed on or around the reservoir during the mid- and early breeding season surveys; however, surveyors noted heavy recreational activity during the late breeding season survey (see Appendix F2 for additional details). Maintenance and construction activities involving noise-generating equipment performed by SMUD during the 2019 breeding season included improvements to Lakeshore Road (Figure 6-6) that began in May and were completed by mid-November. No observations of bald eagles exhibiting agitation or appearing disturbed as a result of recreational or maintenance activity at Ice House Reservoir were made during the surveys.

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# 7.0 HARDHEAD

## 7.1 MONITORING PLAN OBJECTIVES

The objective of the Hardhead Monitoring Plan (Plan) is to evaluate any long-term changes in longitudinal distribution and relative abundance of hardhead (*Mylopharodon conocephalus*) in response to higher flows following implementation of the 2014 license conditions in the SFAR downstream of Slab Creek Dam (SMUD 2016).

## 7.2 METHODS

### 7.2.1 Field Surveys

The hardhead monitoring location is presented in Figure 1-3. Detailed survey locations are depicted in Figure 7-1. Site locations and field methods were described in Sections 3.1 and 4.1 of the Plan (SMUD 2016).

### 7.2.2 Data Analysis

Analytical methods were described in detail in the Section 4.2 of the Plan (SMUD 2016).

## 7.3 RESULTS

Surveys were conducted on 12 and 13 August 2019. Conditions during the surveys included calm weather, clear skies, and water visibility that ranged from approximately 13 to 33 ft. Discharge from Slab Creek Dam during the snorkel survey effort was 88 cfs.

### 7.3.1 Habitat Characteristics

Survey sites ranged from approximately 157–433 ft in length and included at least two habitat units (e.g., run, pool, or pocket water). Most habitat units were dominated by boulder, cobble, and/or bedrock substrates (Table 7-1). Fish cover, primarily in the form of large boulders, was present in all units; other forms of cover included overhanging and instream vegetation and bubble curtains. Water quality conditions during the sampling effort included dissolved oxygen levels near or greater than saturation (average 102%), cool water temperatures (ranging from 13.7 °C [56.7 °F] to 18.0 °C [64.4 °F]), and low conductivity (ranging from 19.8 to 20.3 μS/cm) (Table 7-2).

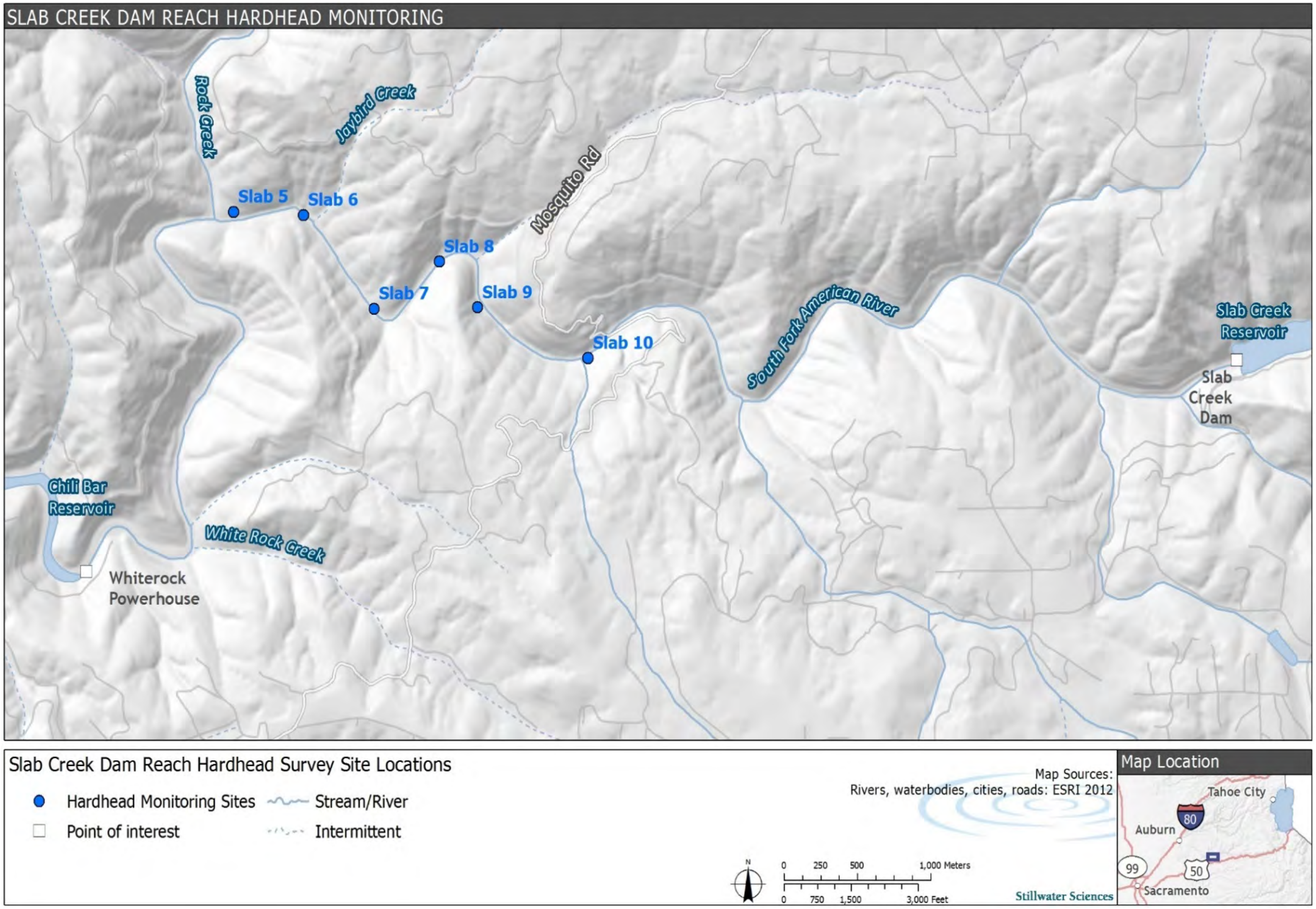


**Figure 7-1. Hardhead survey site locations in the Slab Creek Dam Reach of the South Fork American River.**

**Table 7-1. Physical Characteristics at Survey Sites During Hardhead Monitoring in the Slab Creek Dam Reach, August 2019.**

| Survey Site | Habitat Type | Substrate | | Cover | | | Average Width (ft) | Unit Length (ft) |
|---|---|---|---|---|---|---|---|---|
| | | Dominant | Sub-dominant | Dominant | Sub-dominant | Total % | | |
| Slab 5 | Run | Boulder | Cobble | Boulder | Instream/ Overhanging vegetation | 20 | 87 | 230 |
| | Pool | Boulder | Bedrock/ Cobble | Boulder/ bubble | Overhanging vegetation | 25 | 68 | 72 |
| Slab 6 | Pool | Boulder | Cobble | Boulder | Overhanging vegetation | 45 | 72 | 335 |
| | Run | Boulder | Cobble | | None | 20 | 50 | 98 |
| Slab 7 | Pool 1 | Boulder | Bedrock/ Cobble | | Instream vegetation | 15 | 66 | 89 |
| | Pool 2 | Boulder | Bedrock | Boulder/ Instream vegetation | Bubble | 25 | 59 | 69 |
| Slab 8 | Run 1 | Cobble | Boulder | Boulder | None | 15 | 55 | 128 |
| | Run 2 | Bedrock | Boulder | Boulder | None | 15 | 53 | 53 |
| | Pool | Bedrock | Boulder | Boulder | Overhanging vegetation/ Bubble | 25 | 72 | 217 |
| Slab 9 | Pool | Bedrock | Boulder | | None | 15 | 41 | 115 |
| | Run | Boulder | Bedrock | | None | 40 | 44 | 98 |
| Slab 10 | Pocket Water | Cobble | Boulder | | Instream vegetation | 25 | 57 | 56 |
| | Run | Boulder | Bedrock | | Bubble | 25 | 52 | 161 |

**Table 7-2. Water Quality Conditions at Survey Sites During Monitoring for Hardhead in the Slab Creek Dam Reach, August 2019.**

| Survey Site | Habitat Unit | Conductivity (µS/cm) | Temp (°C/°F) | Dissolved Oxygen | |
|---|---|---|---|---|---|
| | | | | % | mg/L |
| Slab 5 | Run | 20.3 | 17.5/63.5 | 109.3 | 10.40 |
| | Pool | | | | |
| Slab 6 | Pool | 20.2 | 18/64.4 | 106.3 | 9.70 |
| | Run | | | | |
| Slab 7 | Pool 1 | 20 | 17.1/62.9 | 89.3 | 8.33 |
| | Pool 2 | | | | |
| Slab 8 | Run 1 | 19.9 | 15.4/59.7 | 95.6 | 9.18 |
| | Run 2 | | | | |
| | Pool | | | | |
| Slab 9 | Run | 20 | 14.1/57.4 | 102.9 | 10.28 |
| | Pool | | | | |
| Slab 10 | Pocket Water | 19.8 | 13.7/56.7 | 106.2 | 10.60 |
| | Pocket Water | | | | |

### 7.3.2 Snorkel Surveys

Five fish species were observed in the Slab Creek Dam Reach during the 2019 monitoring effort: hardhead, Sacramento pikeminnow (*Ptychocheilus grandis*), rainbow trout (*Oncorhynchus mykiss*), Sacramento sucker (*Catostomus occidentalis*), and sculpin (*Cottus spp.*) (Figure 7-2).

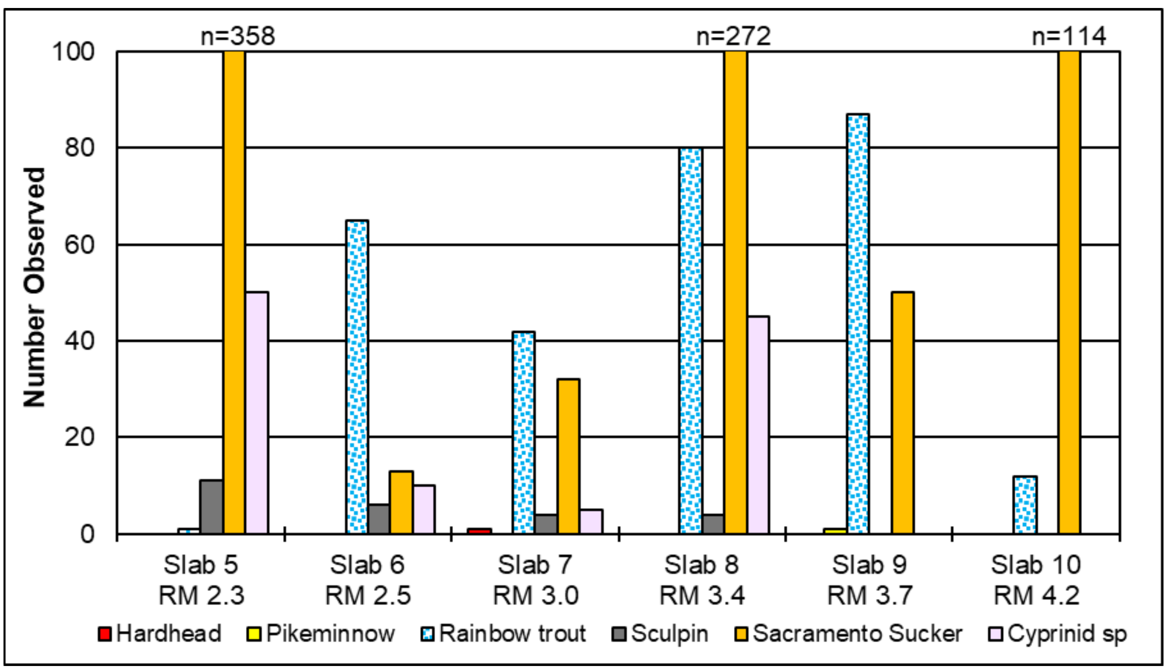


**Figure 7-2. Fish species observed during snorkel surveys in the Slab Creek Dam Reach, August 2019.**

7.3.2.1 Cyprinids

Cyprinids were observed at every survey site except for Site Slab 10 (Figure 7-2). Ninety-eight percent of the observed cyprinids were larval fish that could not be positively identified to species but were determined to be either Sacramento pikeminnow or hardhead (Figure 7-3). These larval observations occurred in the lower four survey sites (sites Slab 5 through Slab 8). One hardhead was observed at Site Slab 7 and one Sacramento pikeminnow was observed at Site Slab 9; they were estimated to be in the 200–224 mm TL and 75–99 mm TL size classes, respectively (Figure 7-3).

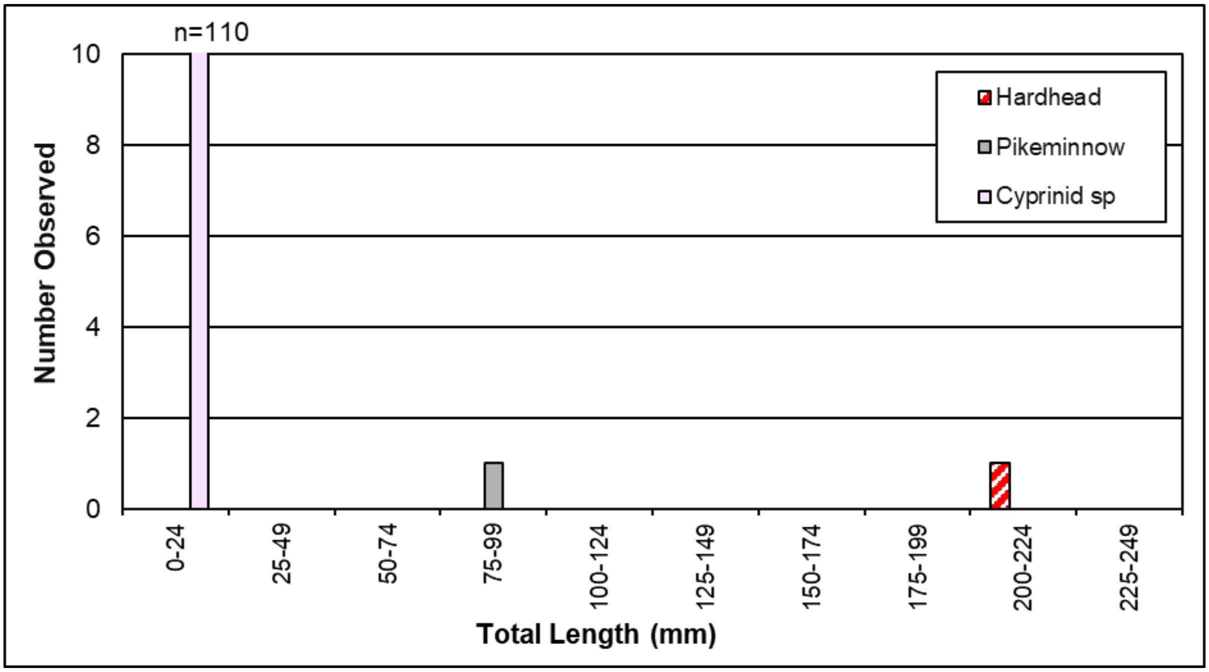


**Figure 7-3. Length-frequency distribution for cyprinids observed during snorkel surveys in the Slab Creek Dam Reach in August 2019.**

7.3.2.2 Salmonids

Rainbow trout were observed throughout the study reach and were the second most abundant species observed (Figure 7-2). Multiple size-classes were observed, ranging from 25–49 to 325–349 mm TL (Figure 7-4). Rainbow trout were observed in greatest concentrations at sites Slab 6 through Slab 9 (Figure 7-2).

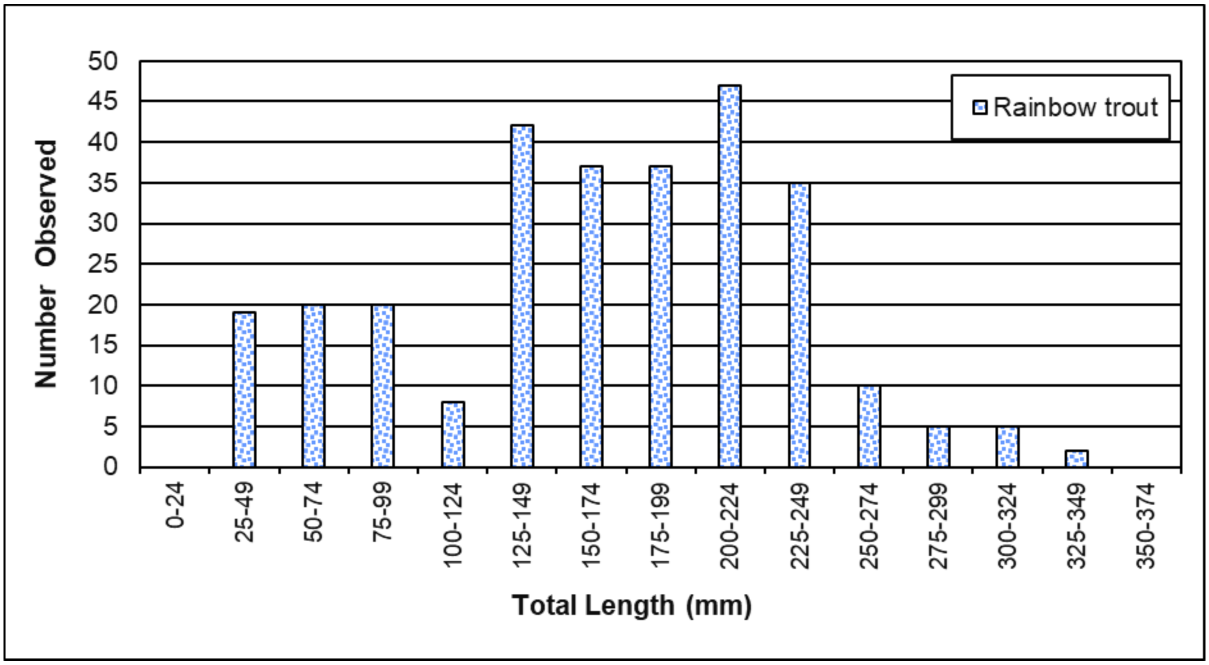


**Figure 7-4. Length-frequency distribution for salmonids observed during snorkel surveys in the Slab Creek Dam Reach in August 2019.**

### 7.3.2.3 Additional Species

Additional species observed included Sacramento sucker and sculpin[3] (Figure 7-2). Sacramento sucker were the most abundant species observed during the survey and were observed at every survey site. The majority of Sacramento sucker were larval fish measuring 0–24 mm TL (Figure 7-5). Sculpin were distributed from sites Slab 5 through Slab 8 (Figure 7-2) and ranged from 0–24 mm TL to 75–99 mm TL (Figure 7-5).

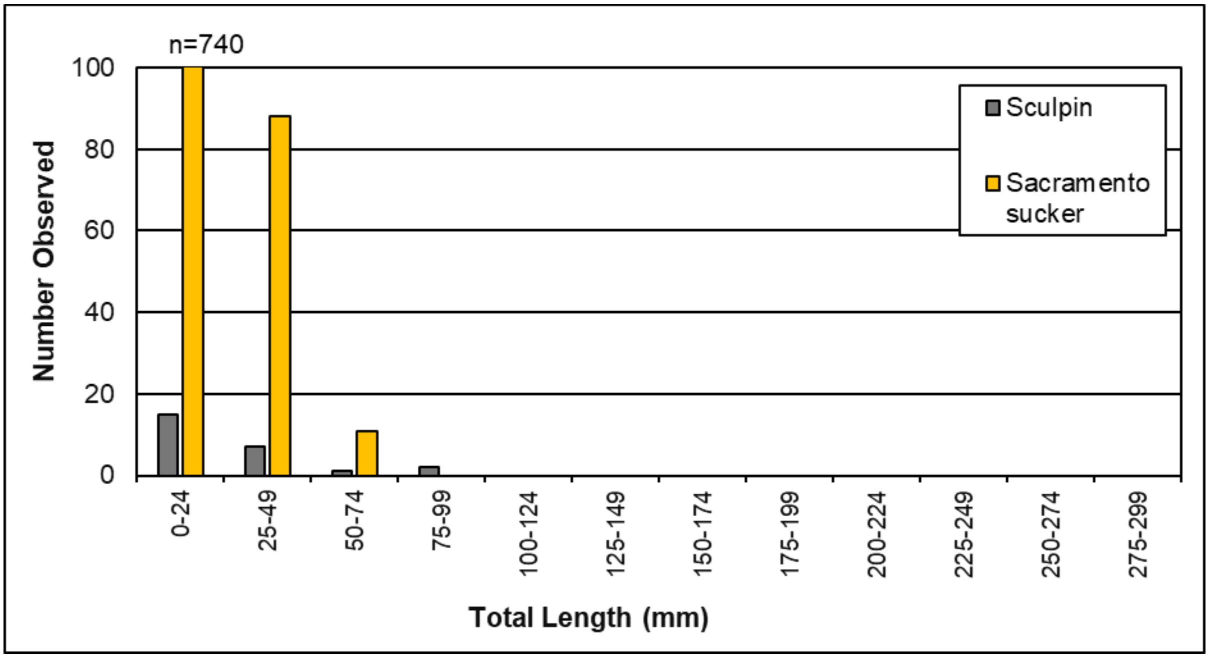


**Figure 7-5. Length-frequency distribution for Sacramento sucker and sculpin spp. observed during snorkel surveys in the Slab Creek Dam Reach in August 2019.**

[3] Riffle sculpin and prickly sculpin have historically been documented in Slab Creek Dam Reach during electrofishing surveys (SMUD 2006), however these species cannot typically be differentiated during snorkel surveys.

7.3.3 Historical Comparison

The 2019 hardhead surveys showed decreased species diversity and shifting distributions compared to the 2004, 2007, 2016, and 2017 surveys. Whereas in previous survey years species observations included California roach (2004), brown trout (2007, 2016, 2017), speckled dace (2007, 2016, 2017), and smallmouth bass (2007), none of these species were encountered during the 2019 survey (Figure 7-6). Sacramento pikeminnow, which occurred at sites Slab 5 through Slab 10 in 2016 and at every site except for Site Slab 9 in 2017, was limited to Site Slab 9 in 2019. Rainbow trout, Sacramento sucker, and sculpin distribution remained similar to prior survey years (Figure 7-6). Rainbow trout continued to represent a large percentage of species observations in 2019, accounting for 60% or greater of observations at 4 of 5 sites (sites Slab 6 through Slab 10) (Figure 7-6).

The total number and average density (hardhead/1,000 ft) of hardhead across sites was the lowest in 2019 of all five survey years (Figure 7-7). The average density of hardhead was highest in 2004, with a variable but downward trend to the low observed in 2019. Total numbers of hardhead followed a similar trend.

Hardhead observations occurred only at Site Slab 7 in 2019, representing one of the most restricted distributions of all survey years. A similarly restricted distribution was observed during the Fall 2007 survey, when hardhead were only observed at Site Slab 5. In all five survey years, observations of hardhead occurred in the lower 3.4 RM of the study reach at sites Slab 5 through Slab 8, with the exception of two hardhead observations at Site Slab 9 in 2004 (Figure 7-8). The greatest longitudinal extent of hardhead observations occurred in the fall of 2004, when they were documented at sites Slab 5 through Slab 7 and at Site Slab 9. A slightly more constricted distribution was observed during the 2016 and 2017 survey efforts, when hardhead were observed at all survey sites except sites Slab 9 and Slab 10 (Figure 7-8).

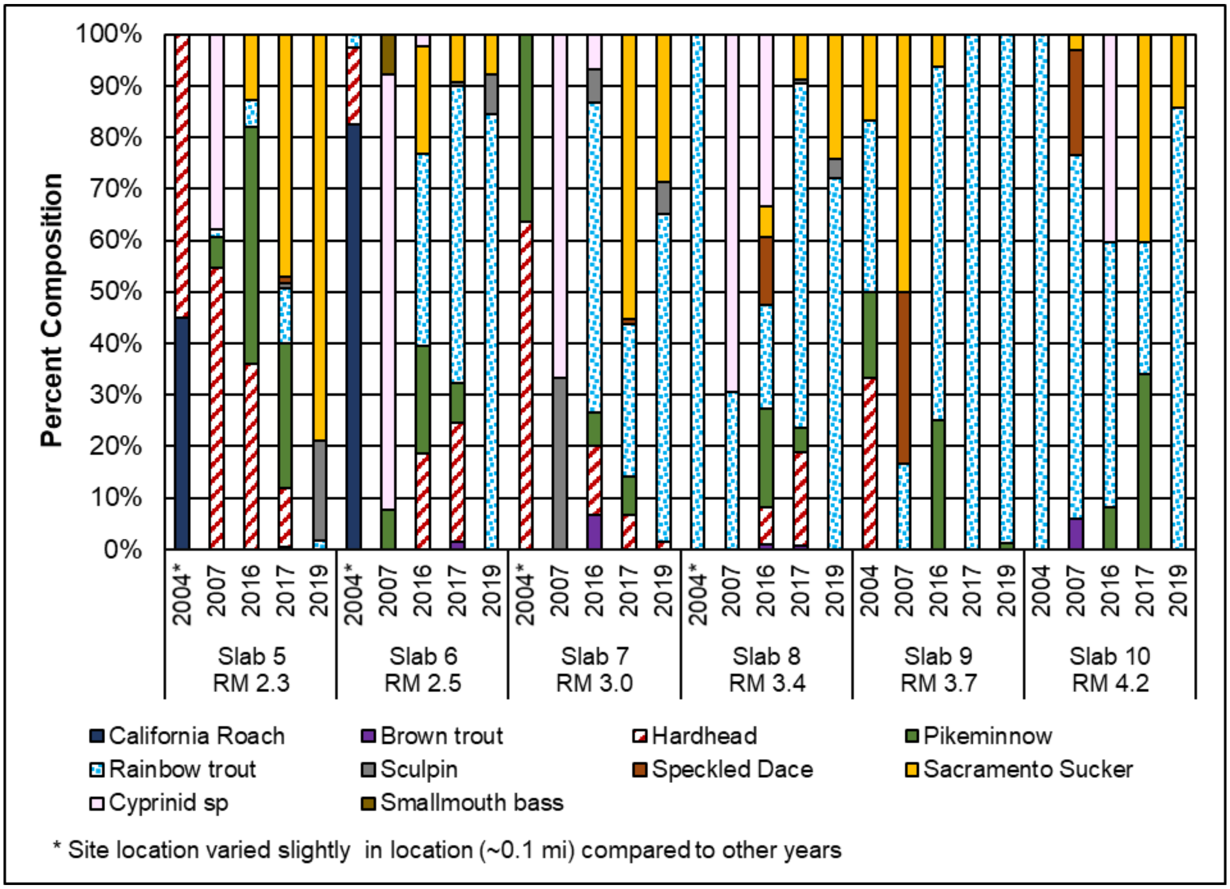


**Figure 7-6. Species composition and distribution observed during snorkel surveys conducted in fall 2004 and summer 2007, 2016, 2017, and 2019 (larval fish [<25 mm] have been excluded).**

The weighted "center" of the hardhead population[4] within the study reach has not significantly shifted over time (Figure 7-9) and the lower sites continue to support more hardhead (Figure 7-8), even as overall densities have generally decreased (Figure 7-7). This suggests some proportionality in the hardhead population response from year to year (i.e., the densities may be decreasing over time, but the remaining hardhead are not clearly shifting their distribution within the study reach since the population "center" has only moved +/- 0.3 mile).

[4] Calculated by weighting the density of hardhead by river mile.

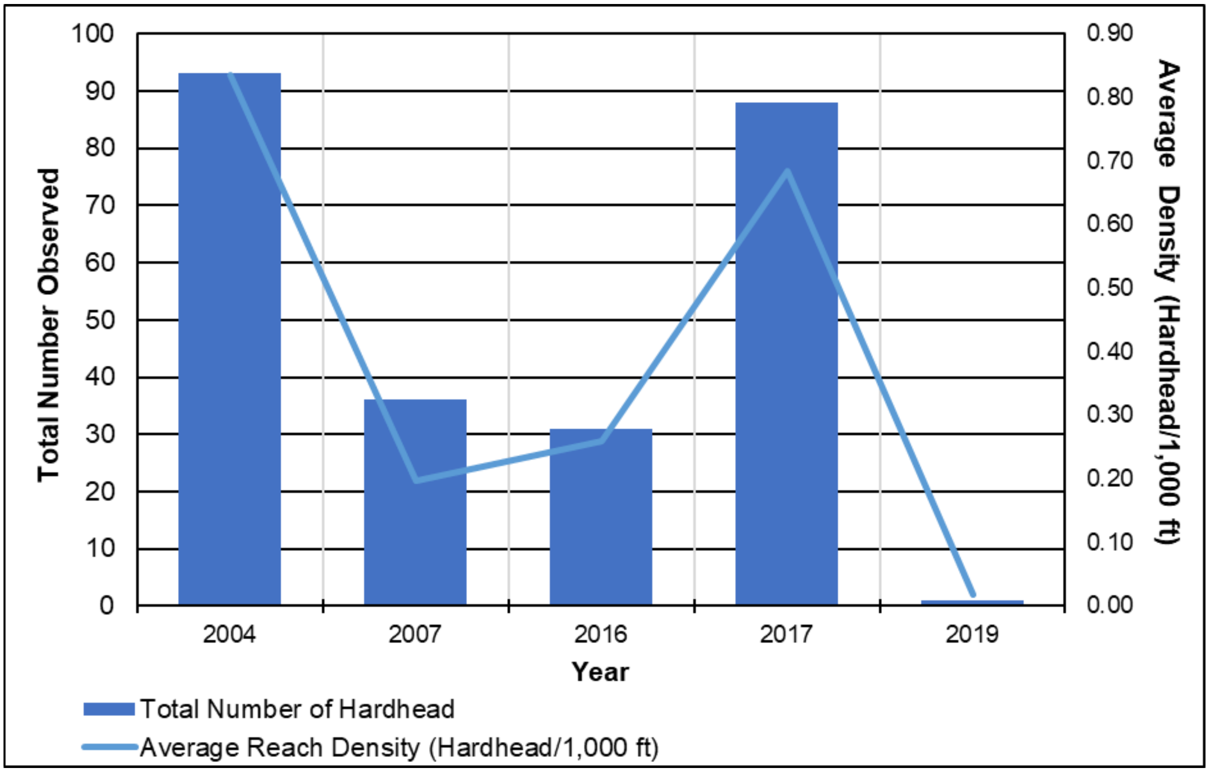


**Figure 7-7. Total number observed and average density of hardhead across sites within the Slab Creek Dam Reach, 2004–2019.**

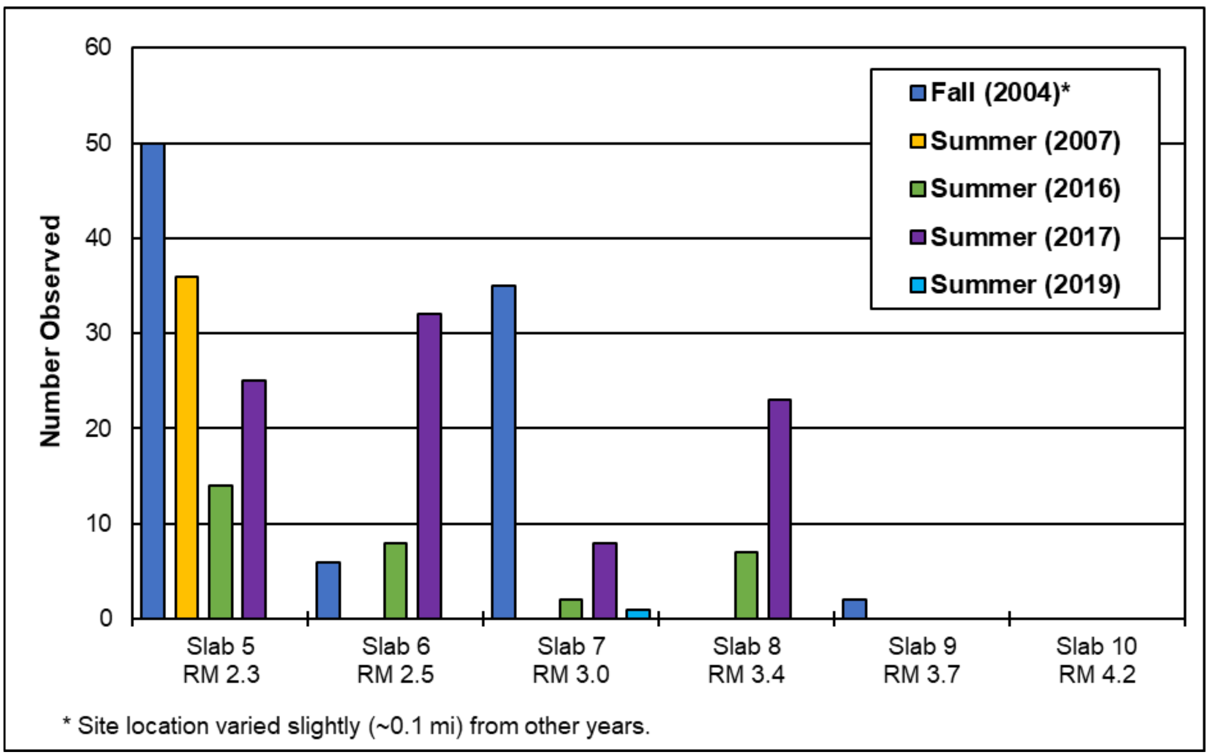


**Figure 7-8. Longitudinal distribution of hardhead within the Slab Creek Dam Reach, 2004–2019 (larval fish [<25 mm] have been excluded).**

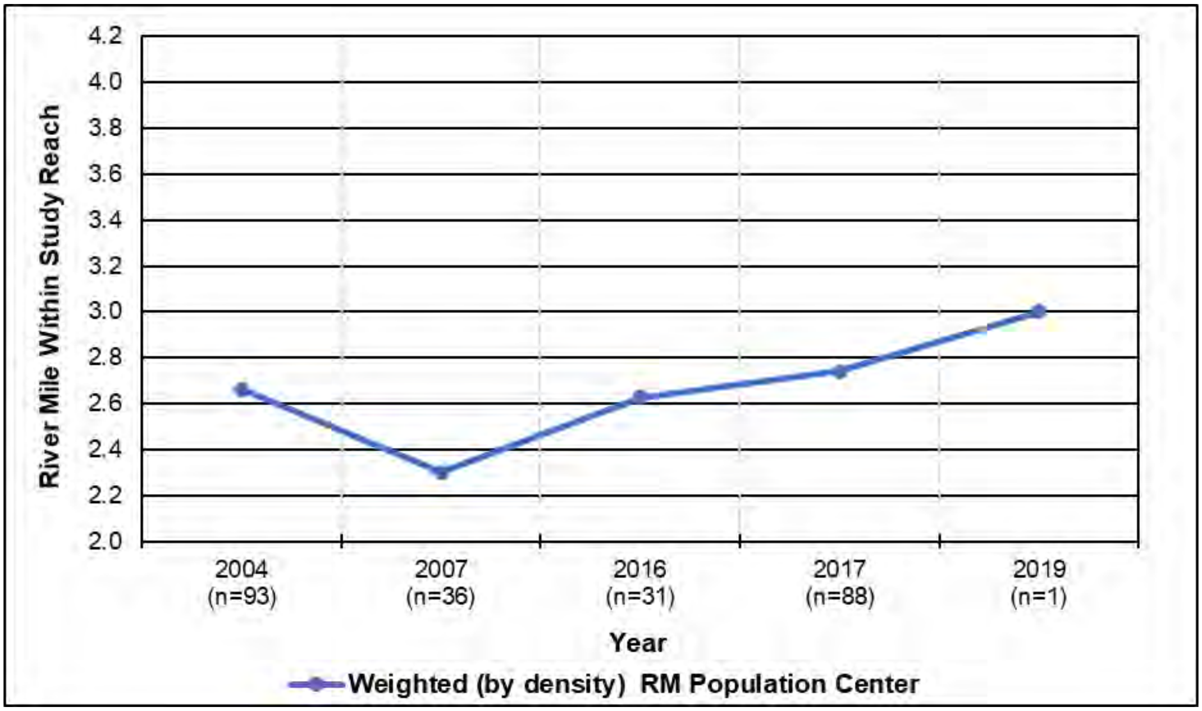


**Figure 7-9. Longitudinal distribution of the hardhead population center within the Slab Creek Dam Reach, 2004–2019 (larval fish [<25 mm] have been excluded).**

Hardhead density in 2019 was the lowest recorded at every site of every monitoring year, except for Site Slab 7 in 2007 in which no hardhead were observed (Figure 7-10). Reach-wide densities under the new flow regime have gone down (Figure 7-11), but results are mixed by site. High density sites have shown steep declines (e.g., sites Slab 5 and Slab 7), whereas some lower density sites have seen slight increases (e.g., sites Slab 6 and Slab 8). Because the locations of these sites are mixed relative to each other (i.e., not trending upstream or downstream), there is not a clear and consistent shift in the population center, as described above and illustrated in Figure 7-9.

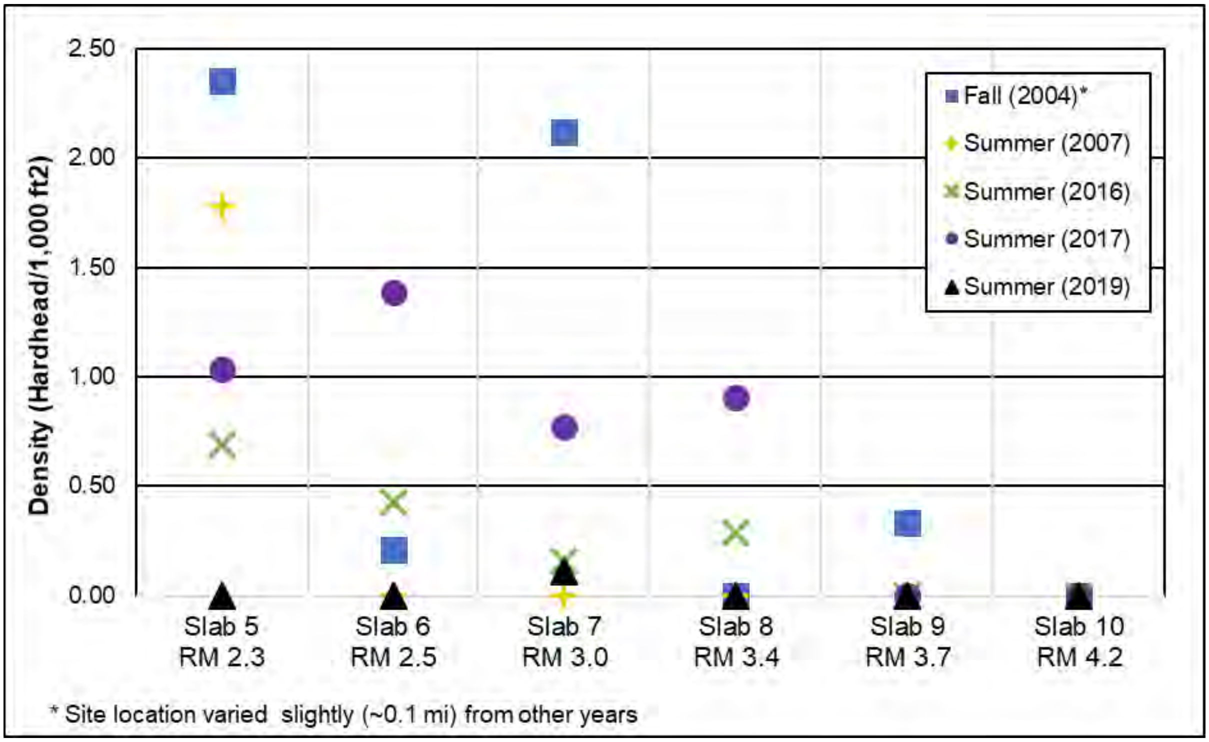


**Figure 7-10. Hardhead density by site within the Slab Creek Dam Reach, 2004–2019 (larval fish [<25 mm] have been excluded).**

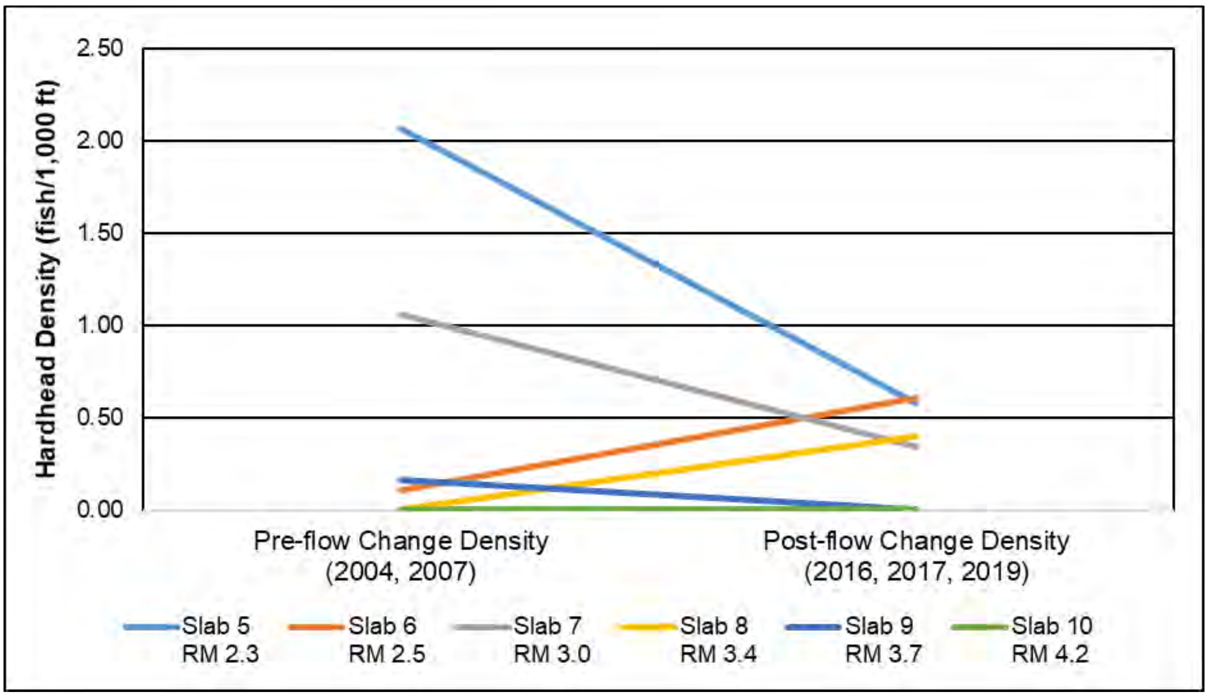


**Figure 7-11. Hardhead density before and after minimum flows changes in the Slab Creek Dam Reach, 2004–2019 (larval fish [<25 mm] have been excluded).**

## 7.4 DISCUSSION

A new minimum flow regime was implemented in the Slab Creek Dam Reach following issuance of the new FERC license in July 2014. As a result, the thermal regime changed (Figures 7-12, 7-13, and 7-14), mean summer water temperatures decreased, and it was originally hypothesized by members of the Relicensing Aquatic Technical Work Group that there may be a change in hardhead distribution as a result (which was the primary reason for implementing the monitoring plan). Hardhead continue to be present in the Slab Creek Dam Reach since implementation of the new minimum flow regime. There appears to be a net decline in hardhead numbers and densities following implementation of the new minimum flow regime (although summer flows are also affected by extended runoff periods depending on the water year type), but there is high variability in the hardhead data and additional years of survey results will be needed to assess whether there is a clear downward trend in the population or whether the observed populations are within the range of variability observed under the prior flow regime.

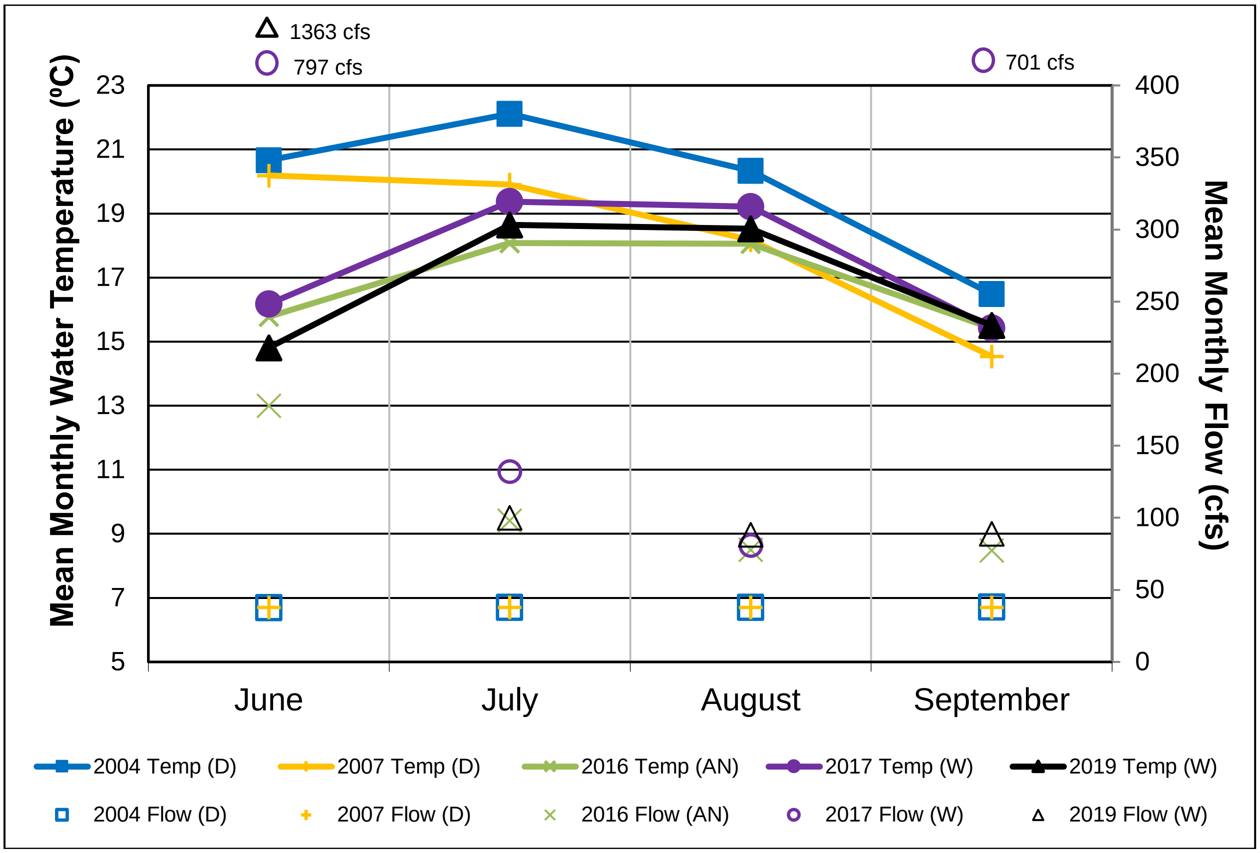


**Figure 7-12. Mean monthly water temperatures and water year type ("D" = Dry, "AN" = Above Normal, "W" = Wet) in the South Fork American River above White Rock Powerhouse (SMUD Gage SFAR15, RM 0.0) and mean monthly flow below Slab Creek Dam, before (2004–2007) and after (2016–2019) the new minimum flow regime. (Note: the June 2017 water temperature is an estimate based on monthly temperature differentials from a similar water year [2018])**

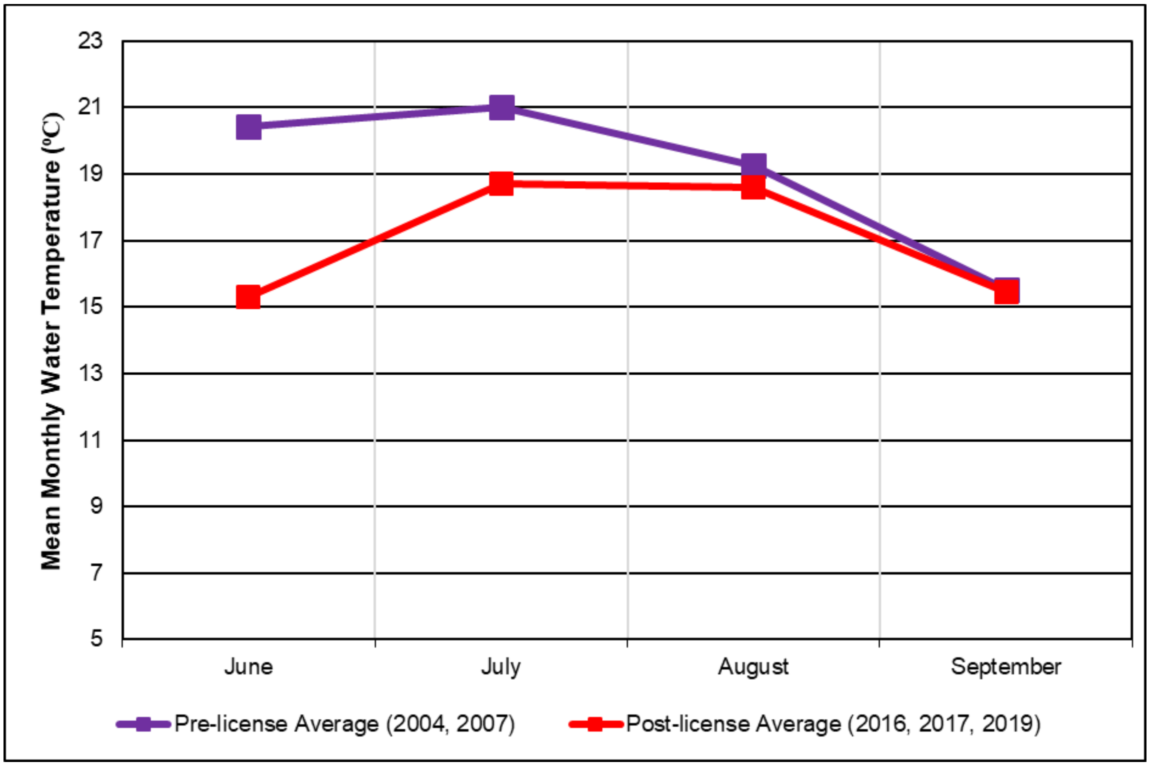


**Figure 7-13. Mean monthly water temperatures in the South Fork American River above White Rock Powerhouse (SMUD Gage SFAR15, RM 0.0) before and after the new minimum flow regime.**

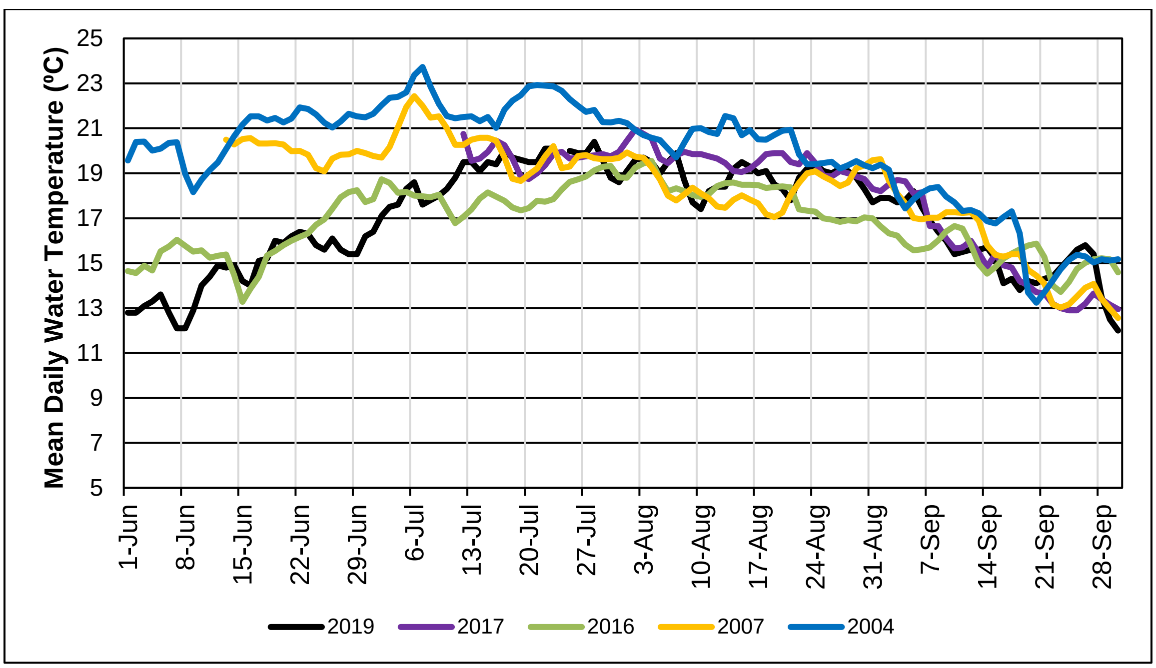


**Figure 7-14. Mean daily water temperatures in the South Fork American River above White Rock Powerhouse (SMUD Gage SFAR15, RM 0.0) for each of the**

**hardhead survey years. (Note: Location of 2007 data recording was 0.75 mi. upstream from SMUD Gage SFAR15)**

## 7.5 LITERATURE CITED

SMUD (Sacramento Municipal Utility District). 2006. Stream Fisheries Summary Report. February 2006.

SMUD. 2016. Hardhead monitoring plan. Hydro License Implementation for the Upper American River Project (FERC Project No. 2101). July.

Stillwater Sciences. 2018. South Fork Powerhouse Fish Rescue and Relocation Project. Prepared by Stillwater Sciences, Davis, California for Sacramento Municipal Utility District, Sacramento, California.

# 8.0 AMPHIBIAN AND AQUATIC REPTILE

## 8.1 MONITORING PLAN OBJECTIVES

The main objectives of the Amphibian and Aquatic Reptile Monitoring Plan (SMUD 2016) are to monitor for and document the presence and distribution of sensitive amphibians and aquatic reptiles, focused primarily on foothill yellow-legged frog (*Rana boylii*) (FYLF) and western pond turtle (*Actinemys marmorata*) (WPT), over the term of the License (SMUD 2016). Monitoring is being conducted to help determine if populations of these species in Project-affected streams are increasing or decreasing for any life stage as a result of Project streamflow changes or fluctuations; additional details of the objectives are presented in the monitoring plan. The monitoring plan also includes stream water temperature monitoring at specified sites with known breeding or suitable breeding habitat for FYLF. Temperature monitoring is intended to provide information about the relationship between water temperature and the initiation of FYLF breeding.

## 8.2 FIELD METHODS

### 8.2.1 Monitoring Sites

In accordance with the monitoring plan, four monitoring sites within three Project reaches[5] were surveyed during License Year 5 (2019), as listed in Table 8-1 and illustrated in Figures 1-1 to 1-3. These sites include locations with either documented FYLF presence (sites Camino Dam CD-A3 and CD-A4) or potential habitat, as described in the monitoring plan. FYLF and WPT observations during relicensing studies (2003–2004) and new license implementation studies Years 1–3 (2016–2018) are provided in Table 8-1.

5 "Project reach" is a term used in this report to describe a segment of stream downstream of a dam (e.g., "Camino Dam Reach" is Silver Creek downstream of Camino Dam)

**Table 8-1. Amphibian and Aquatic Reptile Monitoring Sites, 2019.**

| Project Reach | Site Code | Site Description | UTM Coordinates[a] | | Site Length[b,c] | Elevation[b,d] | FYLF[e] Observed | | | WPT[e] Observed | | | Water Temperature Monitoring |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Downstream End | Upstream End | | | 2003/ 2004[f] | 2016/ 2017[f] | 2018[f] | 2003/ 2004[f] | 2016/ 2017[f] | 2018[f] | |
| Junction Dam Reach | JD-A15 | Silver Creek below Junction Reservoir Dam | 4302306N/ 713564E | 4302466N/ 713444E | 653 ft/ 0.12 mi | 3,045 ft | No | No | -[g] | No | No | -[g] | No |
| Camino Dam Reach | CD-A3 | Silver Creek below Camino Reservoir Dam (near Camino Adit) | 4298484 N/ 710087 E | 4298651 N/ 710236 E | 735 ft/ 0.14 mi | 2,336 ft | Yes | Yes | Yes | No | No | No | Yes |
| | CD-A4 | Silver Creek below Camino Reservoir Dam (at confluence with SF American River) | 4296233 N/ 709331 E | 4296310 N/ 709424 E | 404 ft/ 0.08 mi | 2,067 ft | Yes | No | Yes | No | No | No | Yes |
| Slab Creek Dam Reach | SCD-A1 | SF American River below Slab Creek Reservoir Dam | 4292873 N/ 692573 E | 4295022 N/ 692931 E | 10,404 ft/ 2.0 mi | 1,007 ft | No | No | No | Yes | Yes | No | Yes |

[a] Projection: NAD83 UTM Zone 10 North, N = Northing, E = Easting
[b] Site lengths and elevations are calculated in geographic information systems (GIS) (projection: NAD83 UTM Zone 10 North)
[c] Site lengths are reported in feet (ft) and miles (mi)
[d] Elev. = Elevation, which is for the most downstream survey location at the site
[e] FYLF = Foothill yellow-legged frog; WPT = Western pond turtle
[f] Relicensing studies (2003–2004) and new license implementation studies Years 1–3 (2016–2018).
[g] Project reach not surveyed during 2018 as per the monitoring plan.

### 8.2.2 Foothill Yellow-legged Frog

#### 8.2.2.1 Visual Encounter Surveys

Visual Encounter Surveys (VESs) were performed in all safely accessible and permissible areas within each site, following protocols outlined in the Visual Encounter Survey Protocol for *Rana boylii* in Lotic Environments (Peek et al. 2017), as well as protocols similar to those outlined in Heyer et al. (1994), Lind (1997), and Pacific Gas and Electric Company (PG&E) (2002a, 2002b). In addition to FYLF, all other amphibian and reptile species observed during the surveys were recorded, as well as any potential predators (e.g., fish, crayfish, and bullfrogs). The specific survey methodology for each species and site follows methods described in the monitoring plan (SMUD 2016) and expanded on in the 2017 and 2018 Annual Monitoring Reports (SMUD 2018 and 2019).

Four focused VESs were conducted at each site in 2019 as follows:

- two egg mass surveys during the late breeding and early tadpole development period (July–early August),
- one tadpole survey during the tadpole development period (August), and
- one survey for newly metamorphosed (YOY) FYLF in fall (September–October).

Survey dates for each site are listed in Table 8-2. VESs were conducted once crews were able to safely navigate study reaches downstream of dam infrastructure without risk of uncontrolled spill events. An unusually high snowpack in late spring/early summer[6] resulted in high spring run-off and prolonged spills at Project dams, including Camino Dam upstream of the Silver Creek sites. While the typical egg-laying period for FYLF is often referenced as mid-April to late June, initial egg mass surveys were postponed until mid-July due to high flows and the expected onset of late breeding in Silver Creek (e.g., late July or early August, in part based on results of previous surveys including tadpole observations in Silver Creek during September 2018) (SMUD 2019).

[6] Data from California Department of Water Resources (DWR 2019) indicated northern Sierra snowpack was 130% of average on May 1, 2019.

**Table 8-2. Amphibian and Aquatic Reptile Monitoring Survey Dates, 2019.**

| Site Code | Site Description | Survey Date (2019) | | | |
|---|---|---|---|---|---|
| | | VES 1 | VES 2[a] | VES 3 | VES 4 |
| JD-A15 | Silver Creek below Junction Reservoir Dam | 7/15 | 7/29 | 8/26 | 9/30 |
| CD-A3 | Silver Creek below Camino Reservoir Dam (near Camino Adit) | 7/18 | 8/1 | 8/27 | 10/1 |
| CD-A4 | Silver Creek below Camino Reservoir Dam (near confluence with SF American River) | 7/16 | 7/30 | 8/27 | 10/1 |
| SCD-A1 | SF American River below Slab Creek Reservoir Dam | 7/17 | 7/31 | 8/28 | 10/2 |

[a] Focused western pond turtle surveys were conducted at all sites during VES 2.

#### 8.2.2.2 Water Temperature Monitoring

The monitoring plan (SMUD 2016) requires temperature monitoring as an indicator of FYLF breeding initiation at the two sites below Camino Reservoir Dam (historical breeding sites CD-A3 and CD-A4) and below Slab Creek Reservoir Dam (suitable breeding Site SCD-A1) during years 2 through 6 of the new License.

Two Onset Hobo© Pro v2 water temperature loggers ("temperature loggers") were deployed at each temperature monitoring site between October 2018 and July 2019, labeled as follows: CD-A3-1 and CD-A3-2 (at site CD-A3), CD-A4-1 and CD-A4-2 (at site CD-A4), and SCD-A1-5 and SCD-A1-6 (at site SCD-A1). These temperature loggers remained deployed over winter to ensure water temperature data were collected during the onset of the 2019 breeding season (April–June), anticipating site conditions in spring could preclude safe access for temperature logger installation. A total of six edgewater temperature loggers were then deployed at each site between July and October 2019, in addition to one thalweg temperature logger deployed at Site CD-A3. Temperature monitoring locations SCD-A1-5 and CD-A4-6 experienced equipment failure; because no temperature data were collected at these locations, they are not included in subsequent report figures or analyses. The approximate temperature monitoring locations are depicted in Figure 8-1 through Figure 8-3. Temperature logger location photos are provided in Appendix H1. Temperature logger deployment materials and methods follow those described in the monitoring plan (SMUD 2016) and expanded on in the 2017 and 2018 monitoring reports (SMUD 2018 and 2019).


**Figure 8-1. Temperature logger locations at amphibian monitoring site CD-A3, 2019.**

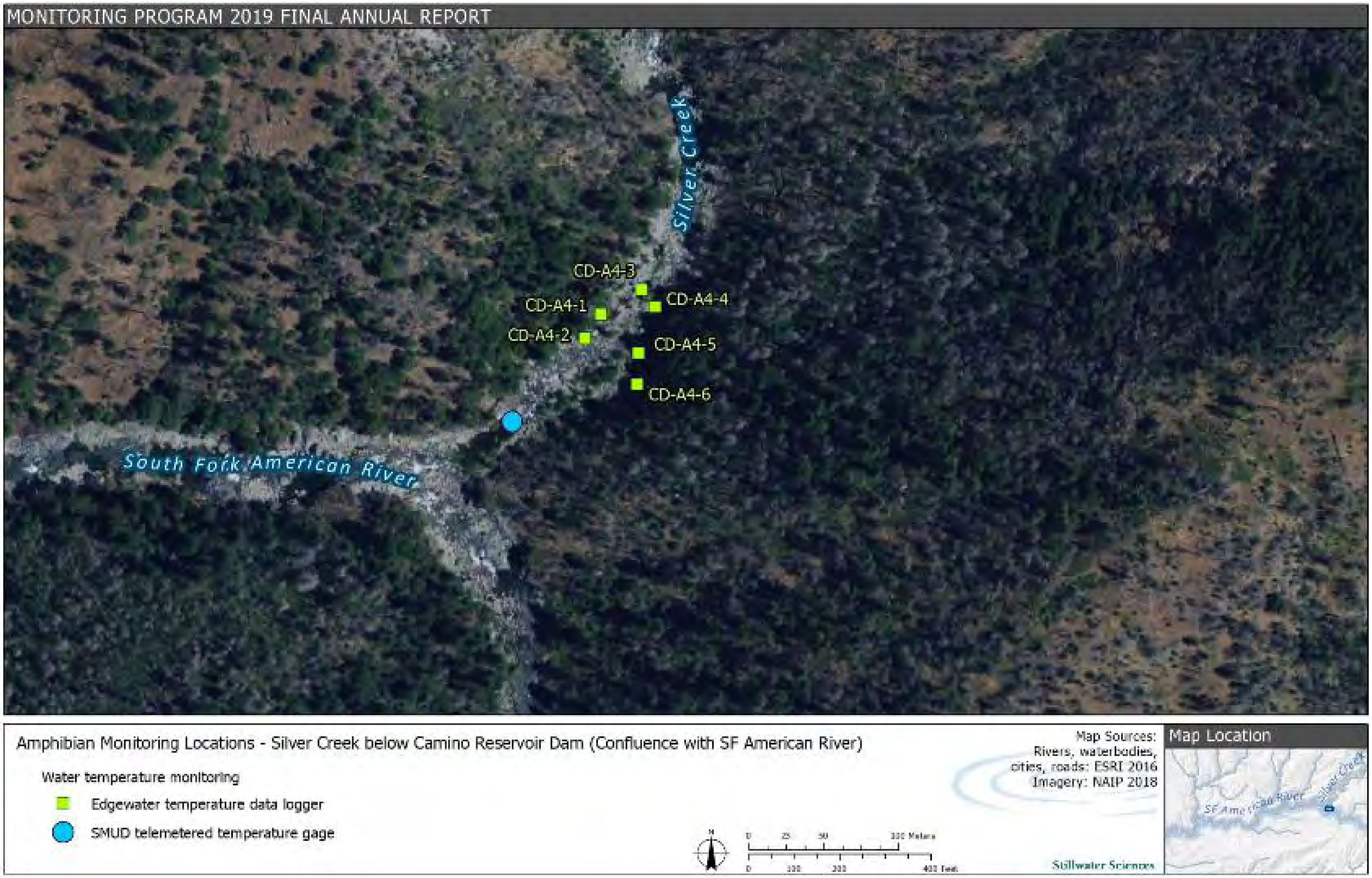


**Figure 8-2. Temperature logger locations at amphibian monitoring site CD-A4, 2019.**

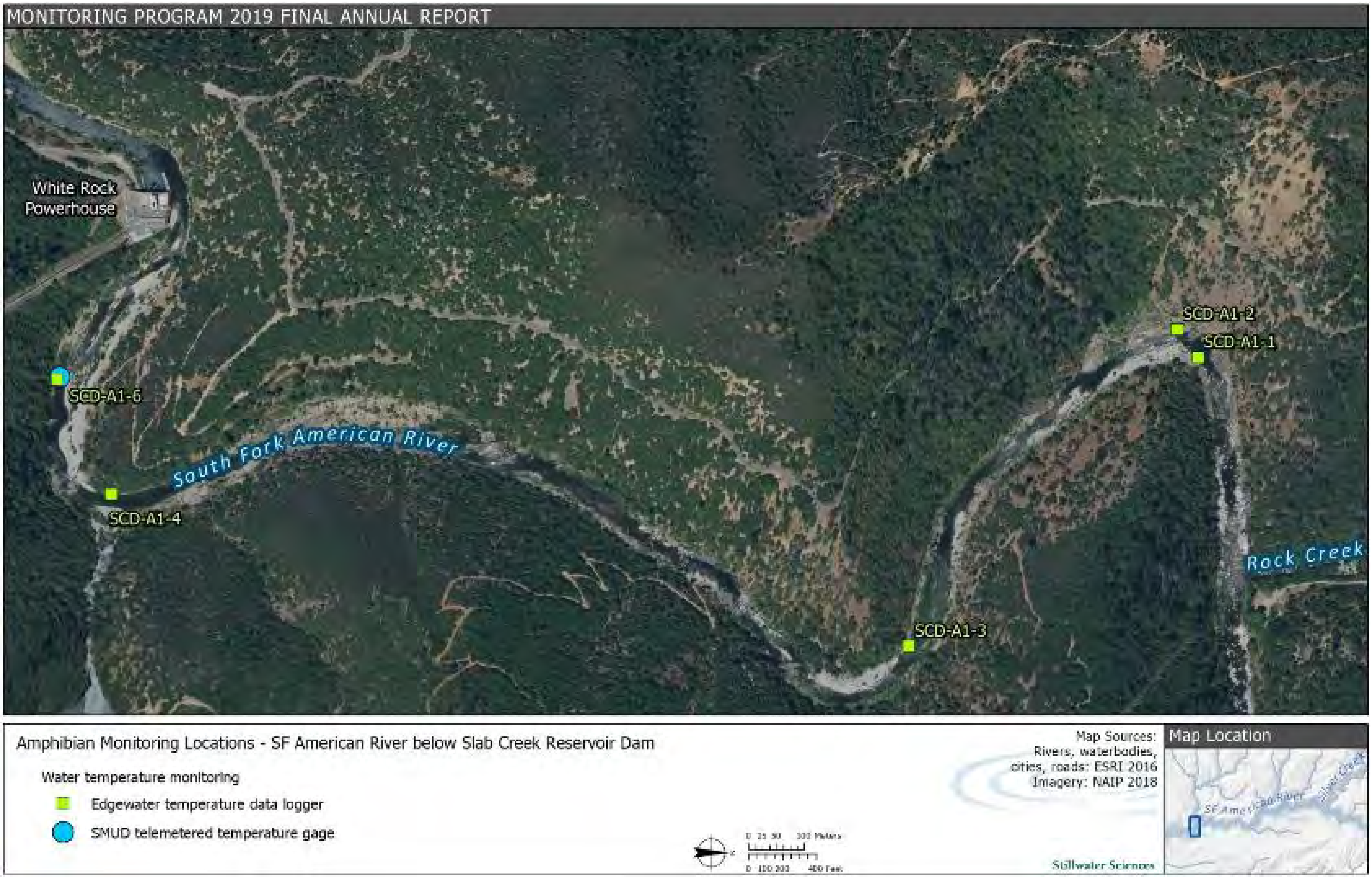


**Figure 8-3. Temperature logger locations at amphibian monitoring site SCD-A1, 2019.**

8.2.2.3 Adaptive Management Monitoring

As part of adaptive management, the monitoring plan outlines requirements for SMUD to monitor FYLF following spill events at Camino and Slab Creek reservoirs, and during flow fluctuations from Camino Dam (SMUD 2016). Monitoring for effects to FYLF include looking for evidence of damage, displacement, or scouring of egg mass or larvae, as well as evidence of egg mass or larval stranding/desiccation.

There was a prolonged spill event at Camino Reservoir and Slab Creek Reservoir during June 2019, occurring after temperatures exceeded a daily mean of 12°C for a 7-day running average at the associated water temperature monitoring site. The earliest that adaptive management surveys could be feasibly and safely performed (i.e., after surveyors were able to navigate study reaches downstream of dam infrastructure without risk of additional uncontrolled spill events) coincided with VES 1.

Flow fluctuations in Silver Creek below Camino Reservoir Dam did not meet criteria described in SMUD's Block of Water Plan (2016) to trigger FYLF adaptive management monitoring during 2019.

8.2.3 Western Pond Turtle

Focused WPT surveys were conducted concurrently with the mid-summer (late August) FYLF survey (Table 8-2), where one additional dedicated surveyor independently looked for WPT (for the survey on the SFAR, there were two surveyors due to the larger river channel width). In addition, during all other VESs, any incidental WPT sightings were noted. The survey methodology follows methods described in the monitoring plan (SMUD 2016) and 2017/2018 monitoring reports (SMUD 2018 and 2019).

## 8.3 RESULTS

Table 8-3 provides survey start and end times, along with water and air temperatures recorded during VESs at each site. Representative habitat photos are included in Appendix H1.

**Table 8-3. Foothill Yellow-legged Frog and Western Pond Turtle Survey Conditions, 2019.**

| Site Code | Survey Date (2019) | VES # | Time | | Temperature Ranges | |
|---|---|---|---|---|---|---|
| | | | Start Time (hours) | End Time (hours) | Water (°C) | Air (°C) |
| JD-A15 | 7/15 | 1 | 1415 | 1535 | 17.5 | 30–31 |
| | 7/29 | 2 | 1555 | 1720 | 18–18.5 | 24–32 |
| | 8/26 | 3 | 1430 | 1510 | 18.5–19 | 34–38 |
| | 9/30 | 4 | 1405 | 1440 | 9 | 12 |
| CD-A3 | 7/18 | 1 | 1110 | 1225 | 14.5 | 28.5–33.5 |
| | 8/1 | 2 | 1050 | 1230 | 13–14 | 30.5–31.5 |
| | 8/27 | 3 | 1355 | 1450 | 17 | 29–30 |

| Site Code | Survey Date (2019) | VES # | Time | | Temperature Ranges | |
|---|---|---|---|---|---|---|
| | | | Start Time (hours) | End Time (hours) | Water (°C) | Air (°C) |
| | 10/1 | 4 | 1501 | 1730 | 10–10.5 | 13.5–14 |
| CD-A4 | 7/16 | 1 | 1215 | 1345 | 18 | 29–31 |
| | 7/30 | 2 | 1015 | 1145 | 16–17.5 | 28–30 |
| | 8/27 | 3 | 915 | 1010 | 17–18 | 19–22 |
| | 10/1 | 4 | 945 | 1119 | 9.5–10 | 8–15.5 |
| SCD-A1 | 7/17 | 1 | 1010 | 1700 | 17–21 | 25.5–31 |
| | 7/31 | 2 | 940 | 1610 | 14.5–19 | 22–32.5 |
| | 8/28 | 3 | 1010 | 1550 | 15–19 | 20–24 |
| | 10/2 | 4 | 1040 | 1750 | 10–13 | 12–12.5 |

VES # = visual encounter survey number
°C = degrees Celsius

### 8.3.1 Foothill Yellow-legged Frog

#### 8.3.1.1 Visual Encounter Surveys

Foothill Yellow-legged Frog Observations

FYLFs were found at or near CD-A3, and not documented at any of the other survey sites in 2019 (CD-A4 in Silver Creek near the SFAR confluence, JD-A15 in the Junction Dam Reach, or SCD-A1 in the Slab Creek Dam Reach) (Table 8-1). FYLFs have only ever been documented at sites CD-A3 and CD-A4 during relicensing studies (2003–2004) and new license implementation studies Years 1–3 (2016–2018) (Table 8-1).

FYLFs were found in three general locations around CD-A3 (Table 8-4, Figure 8-4). One of these locations, Site CD-A3, was a formal VES site; the other two were informal survey locations, a tributary adjacent to the foot trail to Silver Creek and a seep next to the gravel access road approximately 0.5 miles southwest of Camino Adit. At Site CD-A3, one FYLF tadpole and one adult[7] were documented during VES 3 on 1 October 2019, one adult was documented incidentally during the geomorphic monitoring effort on 6 August 2019, and two adults were documented during the benthic macroinvertebrate monitoring effort on 11 September 2019. Two adults were observed on two separate occasions (18 July and 1 August 2019) in the tributary informally searched for FYLF while surveyors hiked to the main channel site, CD-A3. At the seep near the access road to Camino Adit, two adult FYLF were found on 18 July 2019. No egg masses were found during 2019 monitoring. FYLF observation details are summarized in Table 8-4 and Figure 8-4.

[7] An individual was classified as adult if it possessed secondary sexual characteristics (such as enlarged nuptial pads in males) or was equal to or greater than 37 millimeters (mm; 2 inches) snout-to-vent length (Storer 1925, Zweifel 1955).

**Table 8-4. Foothill Yellow-legged Frog Observation Locations and Data, 2019.**

| Location Description | UTM Coordinates[a] | | Date (2019) | Foothill Yellow-legged Frog Observations | | |
|---|---|---|---|---|---|---|
| | Northing | Easting | | Life stage/ Sex | SVL or TL mm (in)[c] | Habitat |
| Site CD-A3 along Silver Creek | 4298636 | 710202 | 8/6[b] | Adult/ -[e] | -[e] | Main channel side pool |
| | 4298537 | 710116 | 9/11[b] | Adult/Male | 45 (1.8) | Main channel side pool |
| | 4298546 | 710122 | 9/11[b] | Adult/Female[d] | 44 (1.7) | Main channel side pool |
| | 4298632 | 710195 | 10/1 | Tadpole (Gosner stage 41) | 57 (2.2) | Backwater pool |
| | 4298527 | 710111 | 10/1 | Adult/Female[d] | 45 (1.8) | Isolated side pool |
| Tributary to Silver Creek, downstream of access road and adjacent to foot trail to Silver Creek, near Site CD-A3 | 4298734 | 710270 | 7/18 | Adult/ -[e] | -[e] | Tributary |
| | 4298734 | 710270 | 8/1 | Adult/ -[e] | -[e] | Tributary |
| Seep next to access road to Camino Adit, near Site CD-A3 | 4298286 | 709810 | 7/18 | Adult/Female | 49 (1.9) | In seep |
| | | | | Adult/Female | 51 (2.0) | In seep |

[a] Projection: NAD83 UTM Zone 10 North
[b] Incidental sighting during Geomorphic and Benthic Macroinvertebrates monitoring efforts.
[c] SVL=snout-to-vent length (if adult); TL=total length (if tadpole); mm=millimeters; in=inches
[d] Same individuals, confirmed with chin markings
[e] No data. Frog observed but not captured.


**Figure 8-4. Foothill Yellow-legged Frog observation locations at or near site CD-A3, 2019.**

One FYLF tadpole was captured at Site CD-A3 on 1 October 2019. The tadpole was in a connected side pool with no observable flow on the right riverbank (Table 8-4, Figure 8-5). This was the same location where three tadpoles were observed on 4 September 2018 (SMUD 2019). The dominant substrate was bedrock and the bottom of the pool was covered with algae. The pool was largely separated from the main channel by surrounding bedrock, though it was hydrologically connected to the main channel by a small connection at its downstream end. Total water depth at the tadpole location was 0.1 m (0.3 ft).

One adult female FYLF was captured twice[8] at Site CD-A3 (Table 8-4, Figure 8-6). On 11 September 2019 this FYLF was found basking on a piece of wood under sedges in a pool adjacent to the main channel. During a formal survey on 1 October 2019, the FYLF was found approximately 20 m (64 ft) downstream in an isolated granite pool approximately 2 m (6.6 ft) from the main channel (Table 8-4, Figure 8-6). Total water depth of the pool was 0.2 m (0.7 ft).

One adult male FYLF was incidentally captured at Site CD-A3 on 11 September 2019. The FYLF was found submerged in a main channel side pool (Table 8-4, Figure 8-7). An additional adult FYLF was observed but not captured on 6 August 2019 in Silver Creek (Site CD-A3) (Table 8-4, Figure 8-8).

Other areas with previous incidental FYLF sightings that were informally and opportunistically searched for FYLF during site visits in 2019 included a foot trail adjacent to Silver Creek, a seep next to the access road approximately 0.5 miles southwest of Camino Adit, and Camino Adit (Figure 8-4). These locations were visited several times throughout the monitoring season as FYLFs were observed using these habitats during monitoring in 2016 (SMUD 2017). Two adult female FYLFs were captured during an informal survey at the seep on 28 July 2019 (Table 8-4, Figure 8-9). The seep was checked during subsequent surveys and no FYLF were found. Two adult FYLFs were observed but not captured in a small tributary to Silver Creek, located near the top of Site CD-A3 on 18 July and 1 August 2019 (Table 8-4, Figure 8-10). No FYLFs were found at the Camino Adit.

[8] Chin photographs were used for identification of individual frogs. Chin patterns are hypothesized to be unique to each frog and persist throughout the life of the frog (Marlow et al. 2016).

**Figure 8-5. Foothill Yellow-legged Frog tadpole (left) found in side-channel pool habitat (right) during the VES at site CD-A3 on 1 October 2019.**

<u>Habitat Conditions</u>

Habitat conditions along the Silver Creek sites (CD-A3 and CD-A4) and the SFAR site (SCD-A1) were similar to conditions observed during 2017 and 2018 monitoring (SMUD 2018, 2019). Decreased cover along the channel and banks caused by high stream flows during the wet 2017 water year persisted in 2019. Suitable FYLF habitat was found at all sites (Figure 8-11 through Figure 8-14). The increased sun exposure resulting from this loss of cover to the channel led to continued presence of benthic algae at Site CD-A3 during 2019 (Figure 8-15). Additional habitat photos are provided in Appendix H1.

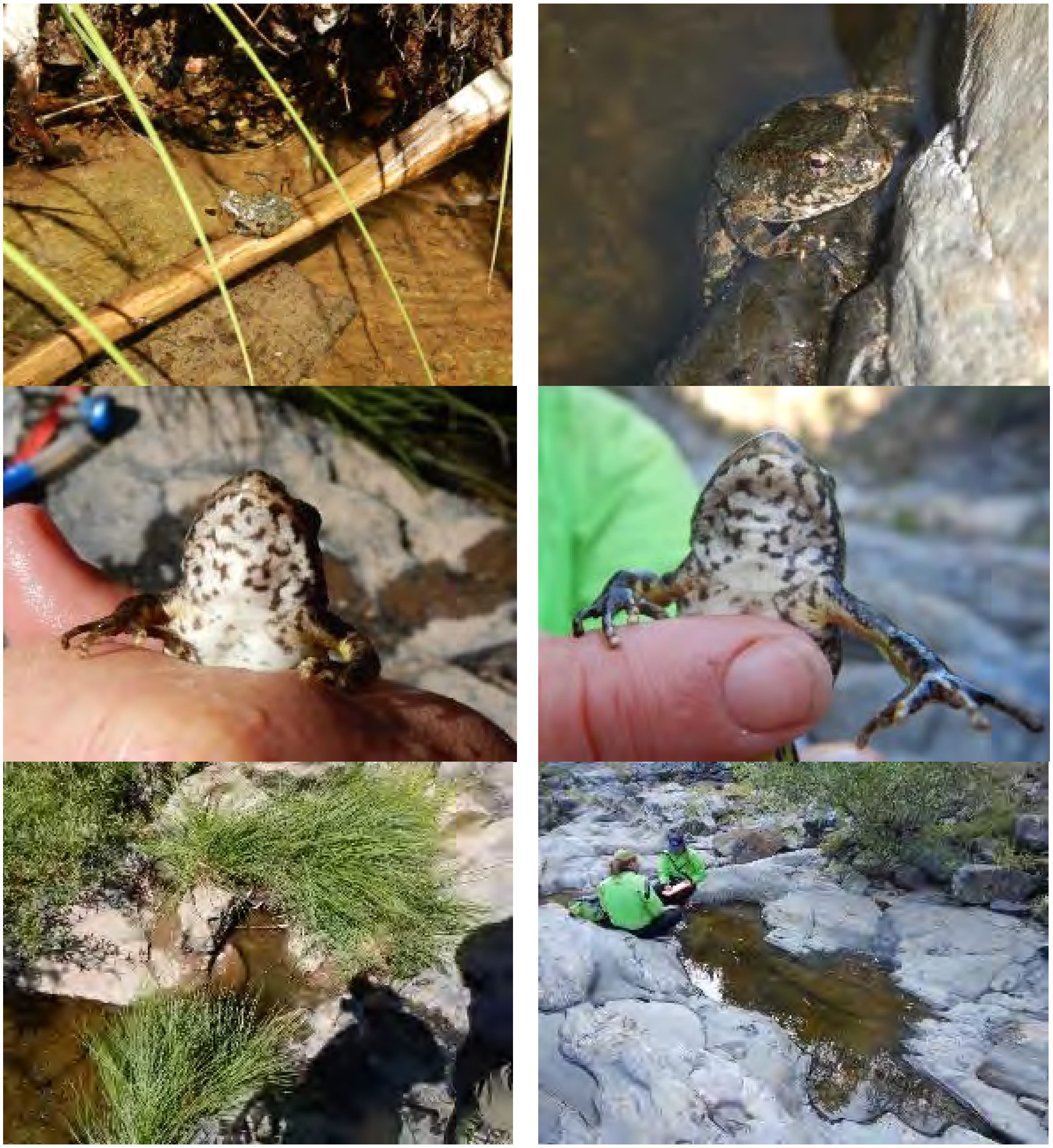

**Figure 8-6. Adult female Foothill Yellow-legged and habitat found on 11 September 2019 (left column) and on 1 October 2019 (right column).**

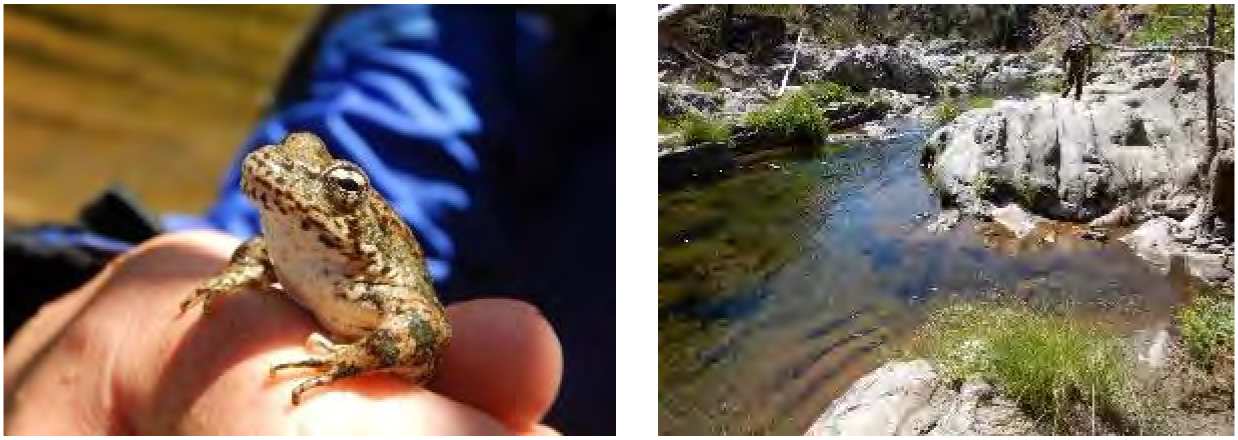

**Figure 8-7. Adult male Foothill Yellow-legged Frog found incidentally at site CD-A3 on 11 September 2019.**

**Figure 8-8. Adult Foothill Yellow-legged Frog incidentally observed at site CD-A3 on 6 August 2019.**

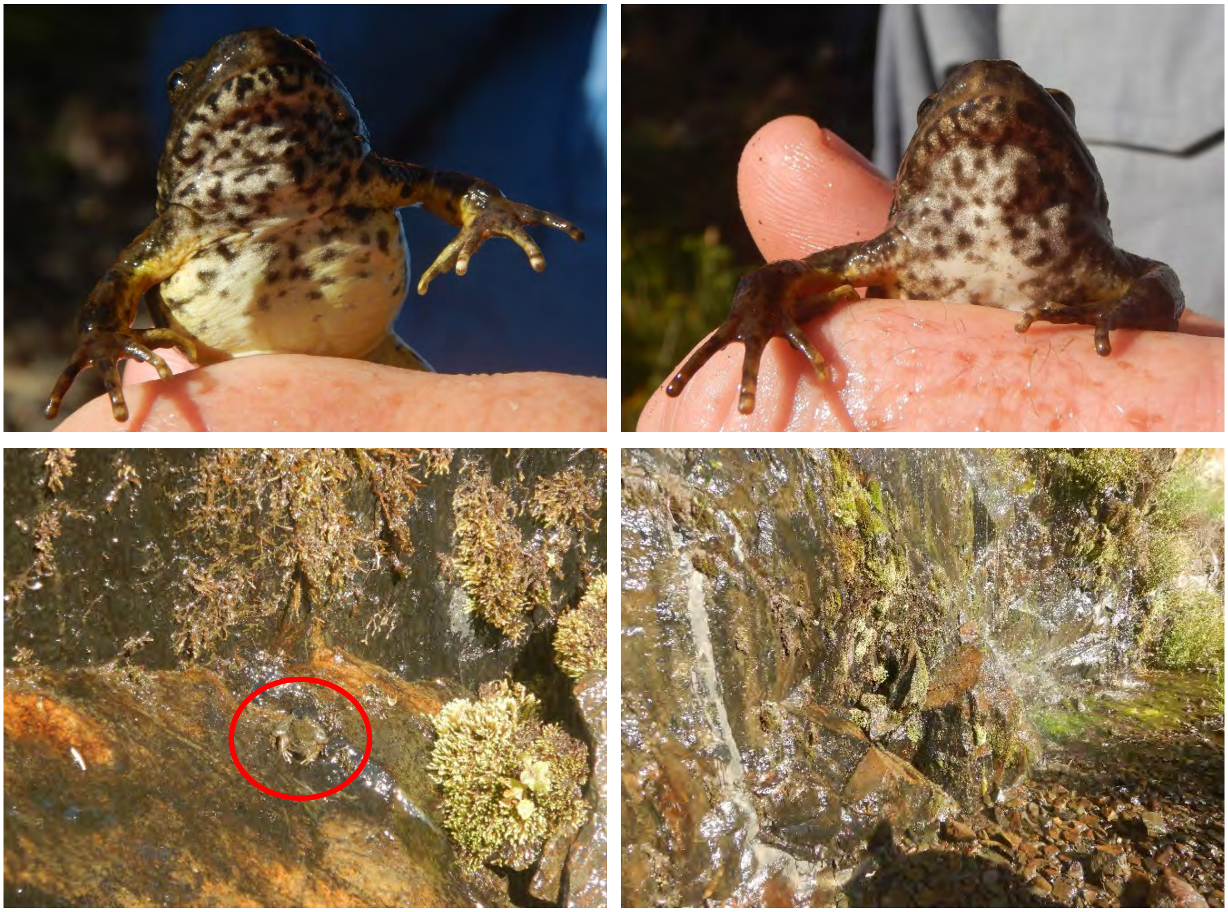

**Figure 8-9. Two adult female Foothill Yellow-legged Frogs found at the seep on 18 July 2019.**

**Figure 8-10. Adult Foothill Yellow-legged Frogs observed at the tributary near the trail to CD-A3 on 18 July 2019 (left) and 1 August 2019 (right).**

**Figure 8-11. Representative photo of suitable Foothill Yellow-legged Frog habitat along Silver Creek, JD-A15, 30 September 2019.**

**Figure 8-12.Representative photo of suitable Foothill Yellow-legged Frog habitat along Silver Creek, CD-A3, 1 August 2019.**

**Figure 8-13.Representative photo of suitable Foothill Yellow-legged Frog habitat along CD-A4, 27 August 2019.**

**Figure 8-14. Representative photo of suitable Foothill Yellow-legged Frog habitat along on SCD-A1, 28 August 2019.**

**Figure 8-15. Benthic green algae in Silver Creek, Site CD-A3, 1 August 2019.**

#### 8.3.1.2 Water Temperature Monitoring

Table 8-5 provides edgewater temperature data recorded at amphibian site water monitoring locations, summarized by month. The mean monthly edgewater temperatures for all three sites ranged from 7.7°C to 19.5°C during the primary FYLF breeding and rearing months of April through September. Maximum daily averages for this time period ranged from 11.4°C to 20.7°C. Mean monthly temperatures for Silver Creek were approximately 0.2°C to 2.5°C warmer at CD-A4 (near the confluence with SFAR) than at Site CD-A3 (near the Camino Adit Site).

Figure 8-16 through Figure 8-18 provide plots of mean daily edgewater temperatures for all three sites, with the dates of FYLF observations incorporated.

Although a robust statistical analysis of the temperature data, including data relationships between edgewater and thalweg temperatures, will be conducted after five years of data collection (License Year 6), the following preliminary observations from this year’s data can be made:

- In relatively confined, steep-gradient channels lacking broad, shallow, exposed, low-velocity microhabitats, different edgewater areas tend to have similar temperatures and edgewater temperatures are similar to thalweg temperatures (Figure 8-16 [Site CD-A3] and Figure 8-17 [Site CD-A4]).

During wet years with high spring flows, mean daily edgewater temperatures drop below 12° C until early July in Silver Creek (Site CD-A3 [Figure 8-16] and Site CD-A4 [Figure 8-17]) and late May in the SFAR (Site SCD-A1 [Figure 8-18]).

**Table 8-5. Edgewater Temperature Data Summarized by Month, 2019.**

| Temperature Monitoring Site | Month | Mean Monthly Temperature (°C) | Maximum Daily Average Temperature (°C) |
|---|---|---|---|
| Silver Creek Near Camino Adit (CD-A3) | April | 7.7 | 11.4 |
| | May | 8.8 | 11.7 |
| | June | 11.9 | 14.7 |
| | July | 15.1 | 16.5 |
| | August | 17.0 | 18.2 |
| | September | 14.2 | 17.0 |
| Silver Creek at Confluence with South Fork American River (CD-A4) | April | 8.1 | 12.1 |
| | May | 9.1 | 11.9 |
| | June | 12.4 | 14.9 |
| | July | 17.1 | 18.9 |
| | August | 19.5 | 20.7 |
| | September | 16.1 | 19.4 |
| South Fork American River Upstream of White Rock Powerhouse (SCD-A1) | April | 10.6 | 12.5 |
| | May | 11.2 | 13.5 |
| | June | 14.8 | 16.3 |
| | July | 18.5 | 19.6 |
| | August | 18.1 | 19.0 |
| | September | 15.2 | 17.3 |

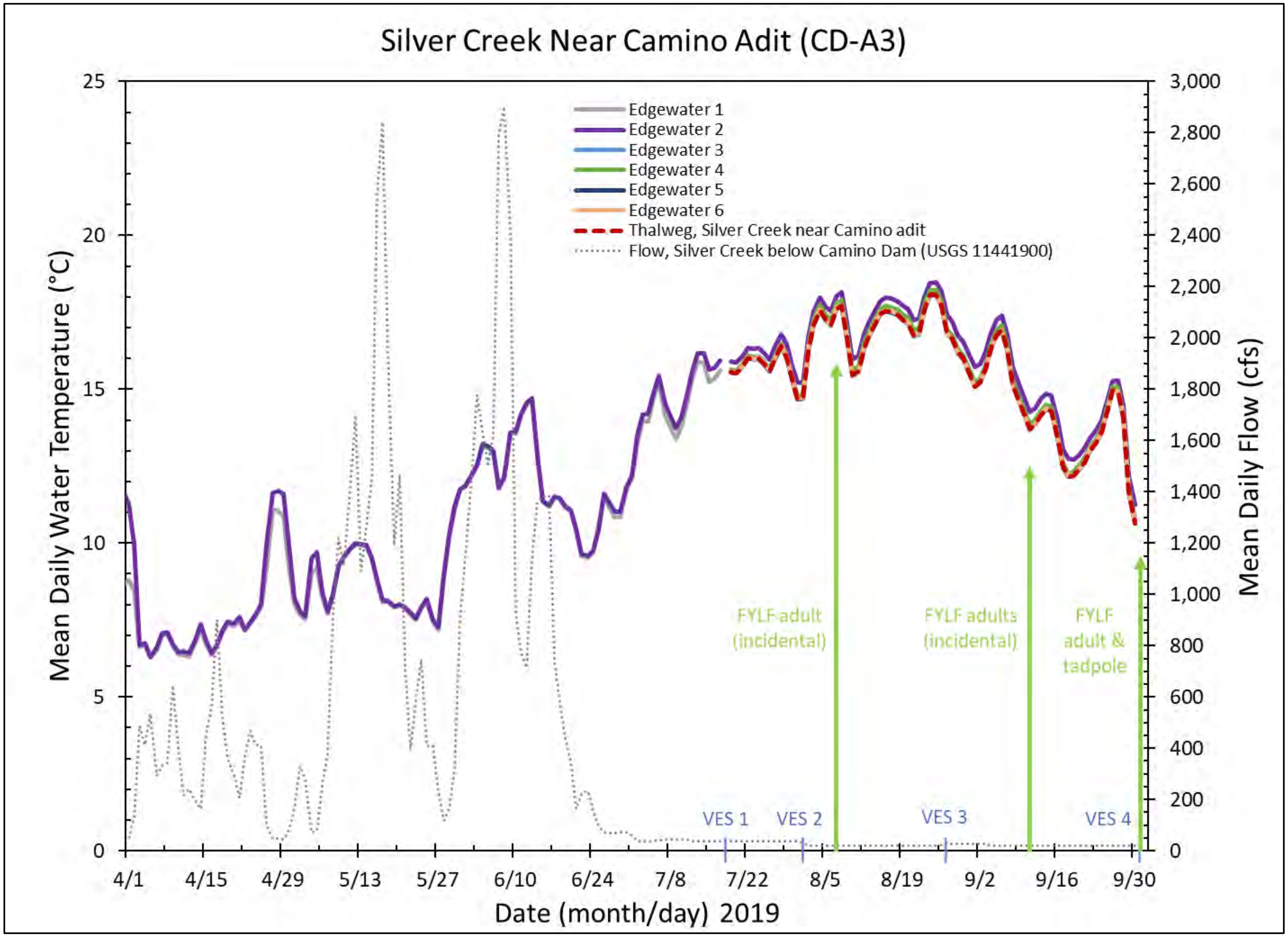


**Figure 8-16. Edgewater and Thalweg temperature data for Silver Creek near Camino Adit (CD-A3) and flow data for Silver Creek below Camino Dam, with foothill yellow-legged frog (FYLF) observations**.

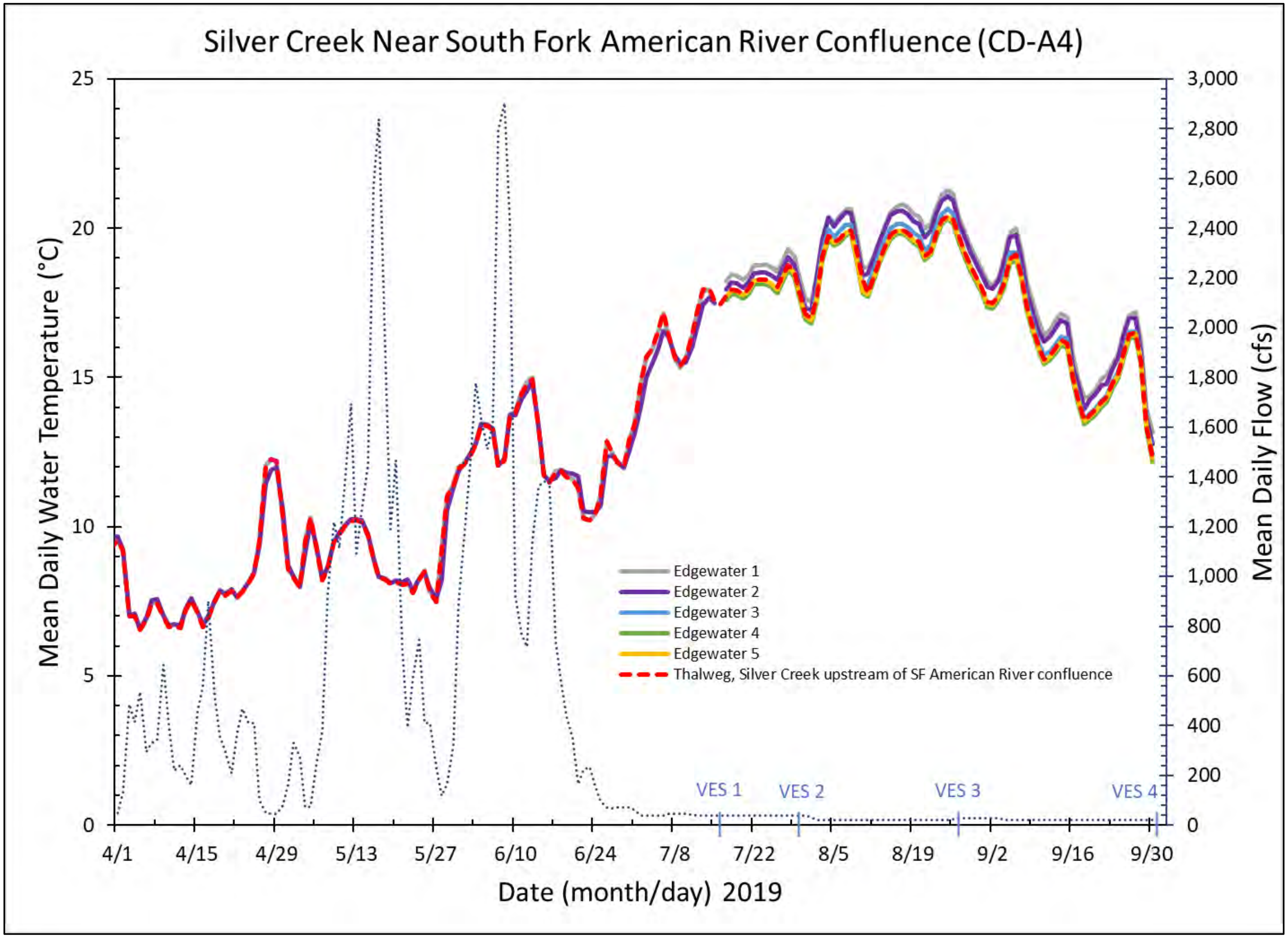


**Figure 8-17. Edgewater temperature data for Silver Creek upstream of South Fork American River Confluence (CD-A4) and flow data for Silver Creek below Camino Dam.**

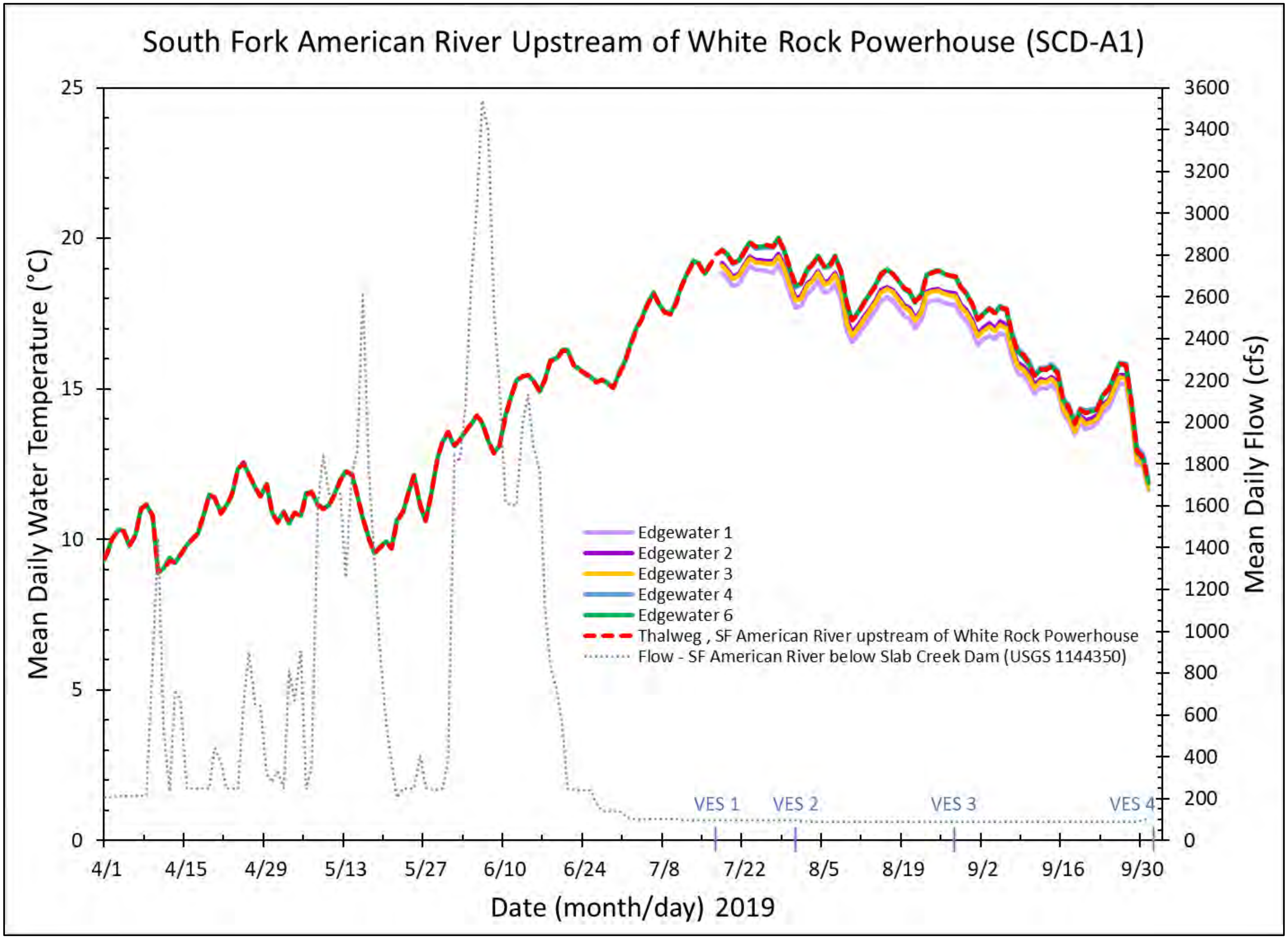


**Figure 8-18. Edgewater and Thalweg Temperature Data for South Fork American River Upstream of White Rock Powerhouse (SCD-A1) and Flow Data for SF American River below Slab Creek Dam.**

8.3.1.3 Adaptive Management Monitoring

Adaptive management monitoring following the prolonged June spill events at Camino and Slab Creek reservoirs coincided with VES 1 (see Section 8.2.2.3), the results of which are provided in Section 8.3.1.1.

8.3.2 Western Pond Turtle

Conditions for WPT surveys are provided in Table 8-3. Weather conditions were good to ideal during all WPT surveys, with warm temperatures, sunny/clear skies, and no wind to a light breeze.

A total of five WPT were observed on the SFAR (Site SCD-A1). Of these, three were hand-captured. WPT observation details are presented in Table 8-6, and locations mapped on Figure 8-19.

One adult[9] female WPT was hand-captured on 31 July 2019 (Table 8-6, Figure 8-20). It was located underwater in a willow- and alder-shaded pool measuring 1 m (3.3 ft) deep on river right.

Two WPT were hand-captured on 2 October 2019. One adult male was found underwater in a pool with little riparian cover (Figure 8-21). The second adult male was found 1 km (0.6 mi) downstream from the first adult male, underwater among woody debris, with approximately 100% riparian cover overhead (Figure 8-22).

Two adult WPT were observed but not captured. One adult WPT was observed basking on a boulder in a backwater pool on 17 July 2019. One adult WPT was observed approximately 1.5 m (5 ft) underwater in a pool with boulder and cobble substrate on 28 August 2019.

[9] A carapace length of 120 mm combined with the identification of secondary sexual characteristics were used to categorize an individual as an adult versus juvenile, since western pond turtles in this region generally reach maturity at this size (Holland 1994, Germano and Bury 2001, Bury et al. 2012).

**Table 8-6. Western Pond Turtle Observation Locations and Data at Site SCD-A1, 2019.**

| Location Description | UTM Coordinates[a] | | Date (2019) | Life stage/ Sex | Carapace | | No. of Scute Rings | Habitat |
|---|---|---|---|---|---|---|---|---|
| | Northing | Easting | | | Length mm (in)[b] | Width mm (in)[b] | | |
| SFAR – Slab Creek Dam Reach (SCD-A1) | 692803 | 4292901 | 7/17 | Adult/-[c] | -[c] | -[c] | -[c] | Basking on boulder in backwater pool |
| | 4293754 | 692710 | 7/31 | Adult/ Female | 152 (6.0) | 124 (4.9) | 9 | Under water in shaded pool |
| | 4294766 | 692546 | 8/28 | Adult/-[c] | -[c] | -[c] | -[c] | Under water in pool with boulder and cobble |
| | 4294475 | 692858 | 10/2 | Adult/ Male | 127.5 (5.0) | 97 (3.8) | 1–2 | Under water in unshaded pool |
| | 4293754 | 692710 | 10/2 | Adult/ Male | 142.5 (5.6) | 120 (4.7) | 7 | Under water in woody debris |

[a] Projection: NAD83 UTM Zone 10 North
[b] mm=millimeters, in=inches
[c] No data. Turtle observed but not captured.

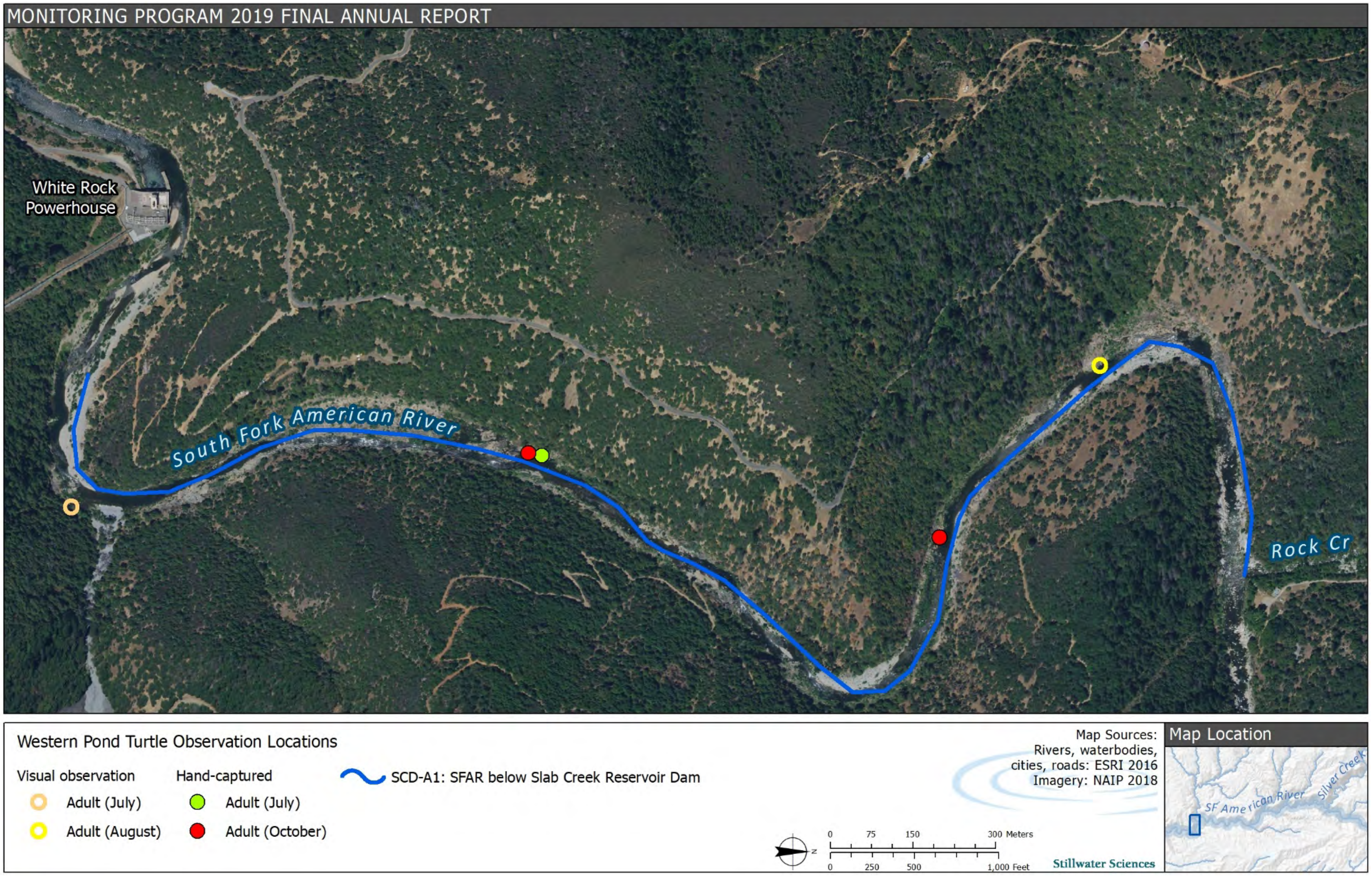


**Figure 8-19. Western Pond Turtle observation locations at site SCD-A1, 2019.**

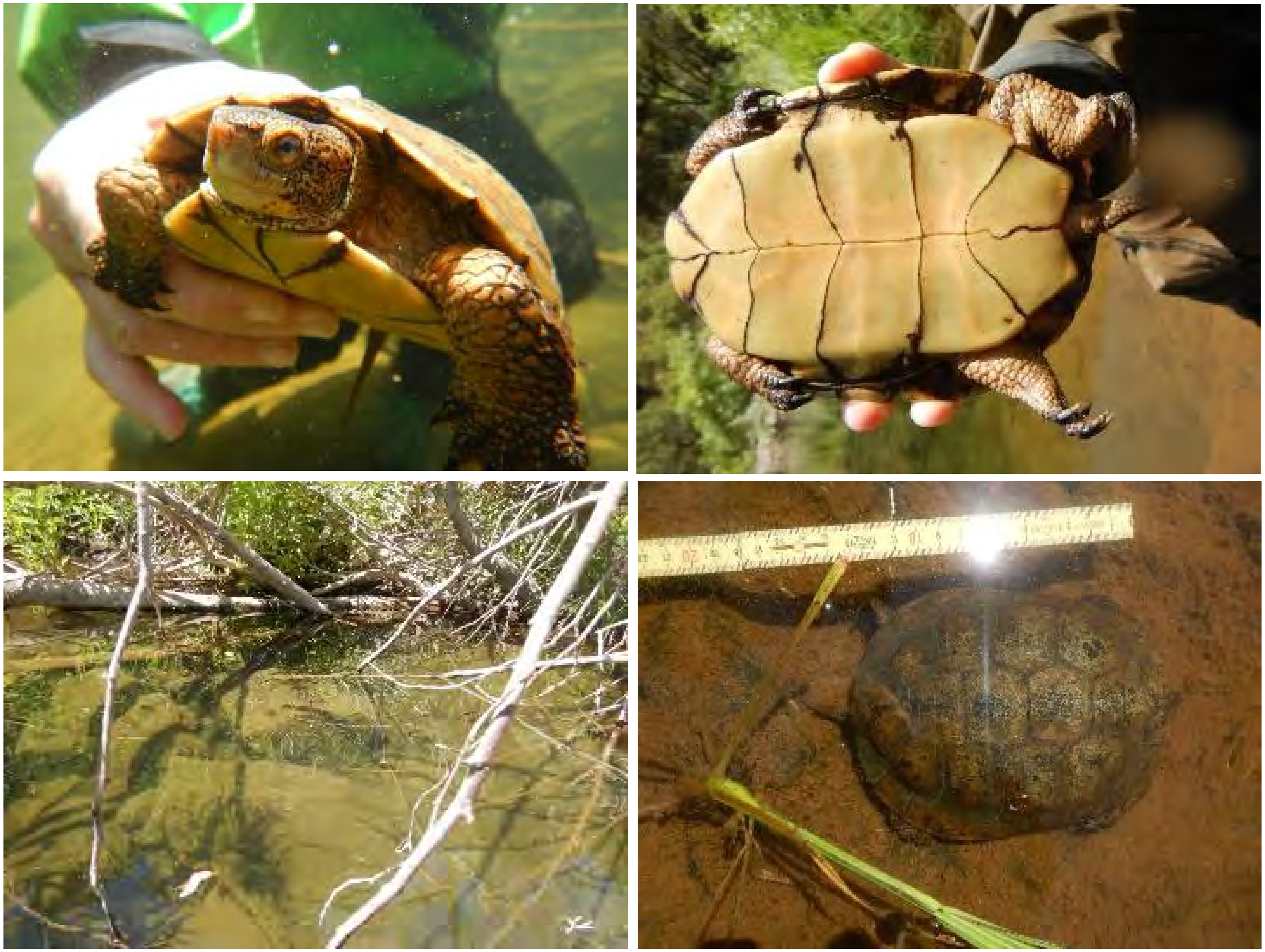

**Figure 8-20. Adult female Western Pond Turtle and habitat on the South Fork American River (SCD-A1) on 31 July 2019.**

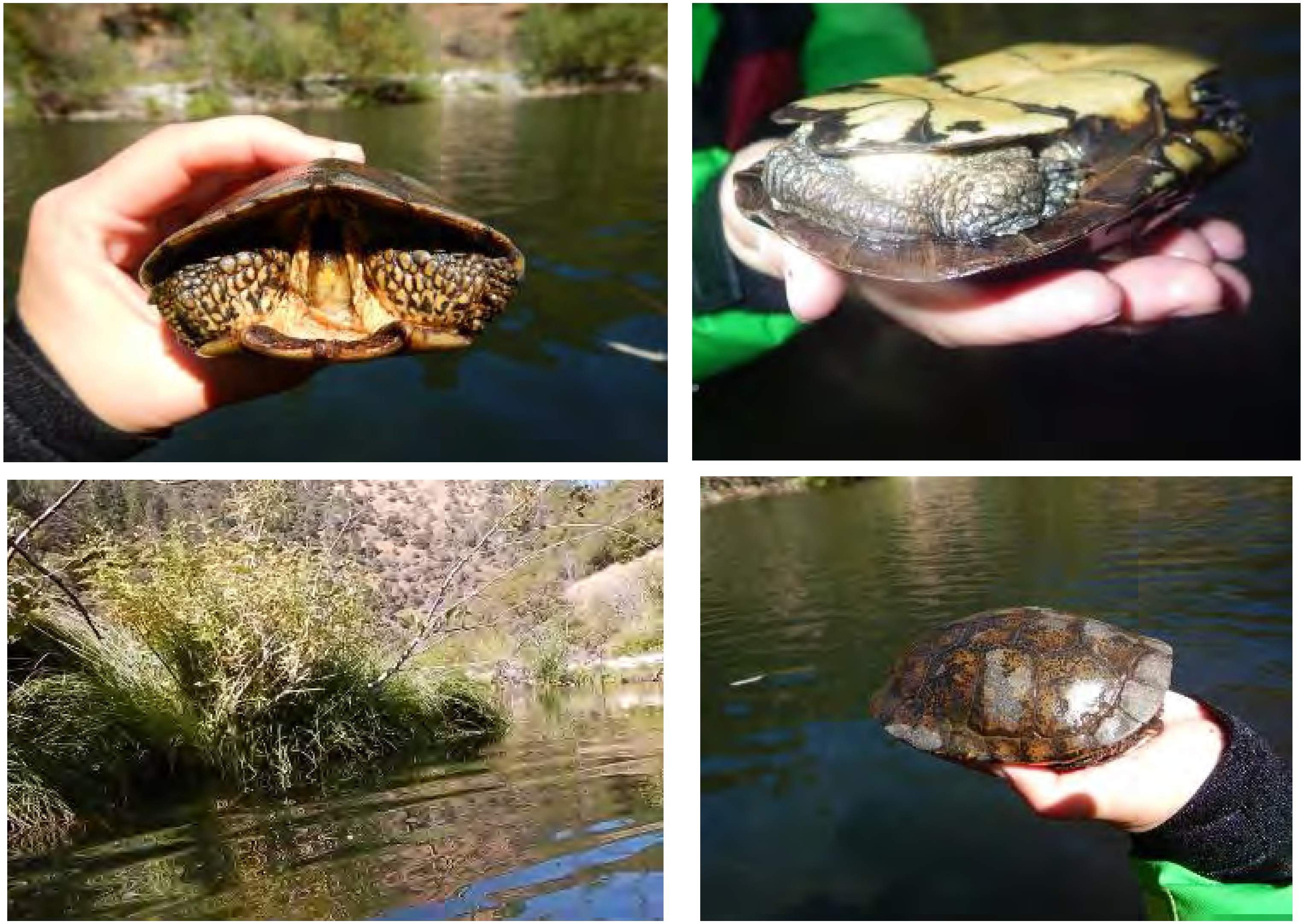

**Figure 8-21. Adult male Western Pond Turtle and habitat on the South Fork American River (SCD-A1) on 2 October 2019.**

**Figure 8-22. Adult male Western Pond Turtle and habitat on the South Fork American River (SCD- A1) on 2 October 2019.**

### 8.3.3 Other Amphibian and Aquatic Reptile Species

Seven non-special-status amphibian and reptile species were observed throughout the study area during VESs, summarized in Table 8-7 by species, life stage, and location(s) where documented. American bullfrogs (*Lithobates catesbeianus*) were not observed in the SFAR (Site SCD-A1) or any other VES sites in 2019.

**Table 8-7. Additional Herpetofauna Species Observed, by Life Stage, 2019.**

| Species Common Name (*Scientific name*) | Life Stage | | | | Location(s) Where Species Documented |
|---|---|---|---|---|---|
| | Egg Mass | Larvae | Young-of-Year | Juv/ Adult | |
| **Amphibians** | | | | | |
| Sierra newt (*Taricha sierrae*) | X | | | X[a] | JD-A15, CD-A3 |
| Sierran treefrog (*Pseudacris sierra*) | | X | | | SCD-A1, CD-A3 (Adit) |
| Western toad (*Anaxyrus boreas*) | | X | | | SCD-A1 |
| **Reptiles** | | | | | |
| Sierra garter snake (*Thamnophis couchii*) | | | | X | CD-A3 |
| Unidentified garter snake | | | | X | CD-A3 |
| Western rattle snake (*Crotalus oreganus*) | | | | X | JD-A15 |
| Alligator Lizard (*Elgaria coerulea*) | | | | X[a] | CD-A3 |

Juv = Juvenile
X = Observed
[a] Observed incidentally on the access trail, outside of the VES area

### 8.3.4 Other Incidental Sightings

One western pearlshell freshwater mussel (*Margaritifera falcata*) (Figure 8-23) was incidentally observed at Site JD-A15 on 15 July 2019.


**Figure 8-23. Western pearlshell mussel found at JD-A15, 15 July 2019.**

## 8.4 DISCUSSION

The tadpole observation at Site CD-A3 provides evidence that FYLF were breeding in Silver Creek in 2019. The tadpole was observed at the same backwater/edgewater pool as three tadpoles and one YOY found in September 2018 (SMUD 2019), which indicates that conditions at that location are favorable for FYLF breeding. This pool includes large boulders with interstitial spaces for egg mass attachment, algae for tadpole cover and food, very low water velocities, appropriate water depths (0.1–0.6 m [0.3–2 ft]), and relatively warmer water temperatures than the mainstem and other edgewater locations. Edgewater temperatures collected in this pool (edgewater monitoring site CD-A3-2) were 0.3 to 0.6°C warmer than the thalweg, and 0.2 to 0.5°C warmer than the average edgewater temperature at Site CD-A3 between July and September 2019 (Figure 8-16).

The presence of a tadpole on 1 October 2019 suggests that the onset of breeding may be occurring in Silver Creek during mid-summer, estimated to be late July or mid-August. This is supported by riverine conditions and the distribution of adult frogs during 2019 surveys. For example, favorable conditions for FYLF breeding in Silver Creek started in approximately mid-July, such as mean daily water temperatures increasing to between 12°C and 15°C, and mean daily flows stabilizing to near 39 cfs (Figure 8-16). The presence of adult frogs at one or more locations outside of Silver Creek (i.e., the seep and tributary) on 18 July and 1 August 2019, and the lack of sightings during subsequent surveys, indicate that adult frogs may have migrated from tributaries and seeps down to Silver Creek for breeding between mid-July and mid-August (Table 8-4, Figure 8-4).

There appears to be a slight trend towards recently improved breeding success of the Silver Creek FYLF population. This is based on the presence of tadpoles, YOY, and juveniles in Silver Creek in 2018 and the presence of tadpoles in Silver Creek in 2019, as compared with the lack of breeding evidence (including detections of juveniles) in Silver Creek during 2016 and 2017 surveys. However, while breeding has been documented for two consecutive years (2018 and 2019) in Silver Creek since 2003–2004 relicensing surveys, and suitable breeding habitat is present, the total number of individual FYLF tadpoles and YOY observed during monitoring has been very small (four and one, respectively). Future monitoring will continue to provide coarse data on population trends.

The presence of frogs at areas outside of Silver Creek (i.e., the tributary to Silver Creek and seep next to the Camino Adit access road) indicate that FYLFs are likely using these habitats for basking, foraging, and overwintering. One or more individual FYLF have been observed in the tributary during at least one survey in all monitoring years: 2016, 2017, 2018, and 2019. Incidental FYLF observations at the roadside seep were less frequent; two to three FYLF were found at the seep during June 2016 and July 2019. As expected, based on habitat conditions, there was no evidence of breeding (i.e., egg masses or tadpoles) at these locations.

The increase in number of WPTs observed during 2019 compared to monitoring years 2016, 2017, and 2018 (which yielded 0–1 WPT per year [SMUD 2017, 2018, 2019]) suggests there may be a trend towards an increased population of WPTs in the SFAR (Site SCD-A1). WPT observations were distributed throughout Site SCD-A1 during 2019, indicating that the population is utilizing suitable pool habitat throughout the reach (Figure 8-19). Of the WPT captured, the number of scute rings[10] (2, 7, 9) suggest that the population of WPT varies in age class. Future monitoring will continue to provide coarse data on population trends.

## 8.5 LITERATURE CITED

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[10] Evidence suggests that scute rings can be used to determine approximate age of turtle, by the assumption that one ring is deposited per year up to a certain age (Ashton et al. 2012).

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# 9.0 SIERRA NEVADA YELLOW-LEGGED FROG

## 9.1 MONITORING PLAN OBJECTIVES

The objective of the Sierra Nevada Yellow-legged Frog Monitoring Plan (SMUD 2017) is to help determine future presence/distribution of Sierra Nevada yellow-legged frog[11] (*Rana sierrae*) (SNYLF) in UARP reservoirs and, if found, coarsely evaluate long-term population trends (i.e., evaluate populations trends as increasing, decreasing, or stable). An additional objective is to use habitat data to evaluate long-term changes in habitat suitability in project-affected areas.

## 9.2 METHODS

### 9.2.1 Monitoring Sites

In accordance with the monitoring plan, SNYLF monitoring was conducted at the following four sites, as detailed in Table 9-1 and illustrated in Figure 1-1:

- Rubicon Reservoir Inlet Area (Site RUB-A1), including the Rubicon River up to the FERC Boundary.
- Rubicon Reservoir Outlet Area (Site RUB-A2), including ponded waters in the vicinity and Rubicon River downstream of the dam for approximately 300 meters (984 feet).
- Rockbound Lake Inlet Area (Site RCK-A1), including off-channel ponds and (upper) Highland Creek for approximately 325 meters (1,066 feet) upstream of the confluence with Rockbound Lake.
- Lower Highland Creek[12] between Rockbound Lake and Buck Island Reservoir (Site HC-A1), including any ponded waters adjacent to the creek.

Major aquatic features (i.e., streams, ponds, seeps, and reservoir inlets) at each site were identified and surveyed, as listed in Table 9-1 and illustrated in Figures 9-1 through 9-4. All ponded water outside of the major aquatic features was surveyed. Since no SNYLF had been previously detected within the Project-affected stream reaches and reservoirs (SMUD and PG&E 2005), the SNYLF monitoring sites include locations with potential habitat as described in the monitoring plan. All surveyed aquatic features were located within USFWS designated critical habitat for SNYLF (USFWS 2016).

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[11] Formerly known as mountain yellow-legged frog (*Rana muscosa*), but now recognized as a separate species (Vredenburg et al. 2007).
[12] Highland Creek between Rockbound Lake and Buck Island Reservoir, Site HC-A1, is referred to as lower Highland Creek to differentiate it from Highland Creek upstream of Rockbound Lake.

**Table 9-1. Sierra Nevada Yellow-legged Frog Monitoring Sites and Aquatic Features, 2019.**

| Site Code | Site Description | Elevation[a,b] | Aquatic Feature | Aquatic Feature | | |
|---|---|---|---|---|---|---|
| | | | | UTM[c] | Length[a,d] | Area[a,d] |
| RUB-A1 | Rubicon Reservoir Inlet Area | 6,529 ft | Rubicon River | 4318230 N/ 740976 E | 409 ft | - |
| | | | Rubicon Reservoir Inlet | 4318307 N/ 740776 E | - | 4.1 ac |
| | | | Pond (perennial) | 740873 N/ 4318423 E | - | 0.7 ac |
| RUB-A2 | Rubicon Reservoir Outlet Area | 6,523 ft | Rubicon River | 4319406 N/ 740459 E | 1,900 ft[e] | - |
| | | | Rubicon Dam Seep | 4319324 N/ 740652 E | 618 ft | - |
| | | | Pond (ephemeral) | 4319450 N/ 740303 E | - | 0.6 ac |
| RCK-A1 | Rockbound Lake Inlet Area | 6,539 ft | Rockbound Lake Inlet | 4319569 N/ 739651 E | - | 5.1 ac |
| | | | Upper Highland Creek | 4319346 N/ 739589 E | 1,390 ft[e] | - |
| HC-A1 | Highland Creek | 6,435 ft | Lower Highland Creek | 4320346 N/ 738378 E | 1,691 ft | - |

[a] Site elevations, lengths, and areas are calculated in geographic information system (GIS) (projection: 10-m DEM from USGS).
[b] Elevations are for the most downstream survey location at the site, reported in feet (ft).
[c] Projection: NAD83 UTM Zone 10 North, N = Northing, E = Easting. Coordinates listed are for the approximate center of the aquatic feature.
[d] Site lengths are reported in feet (ft) for streams. Site areas are reported in acres (ac) for inlet areas and ponds.
[e] Lengths are based on the linear extent of the stream reach surveyed, which are greater than the approximated distances in the monitoring plan.

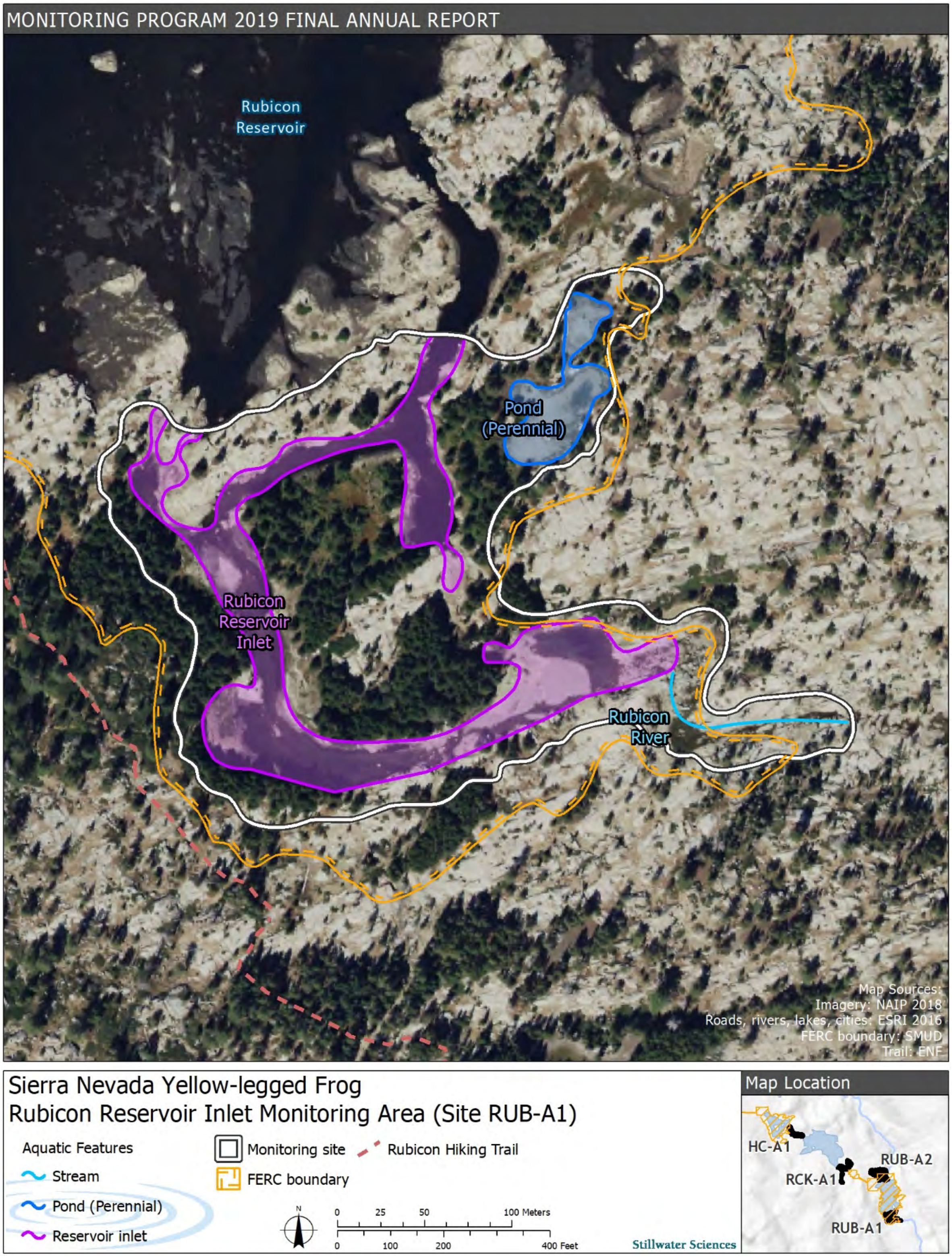


**Figure 9-1. Aquatic features at the Rubicon Reservoir Inlet Monitoring Area (Site RUB-A1), 2019.**

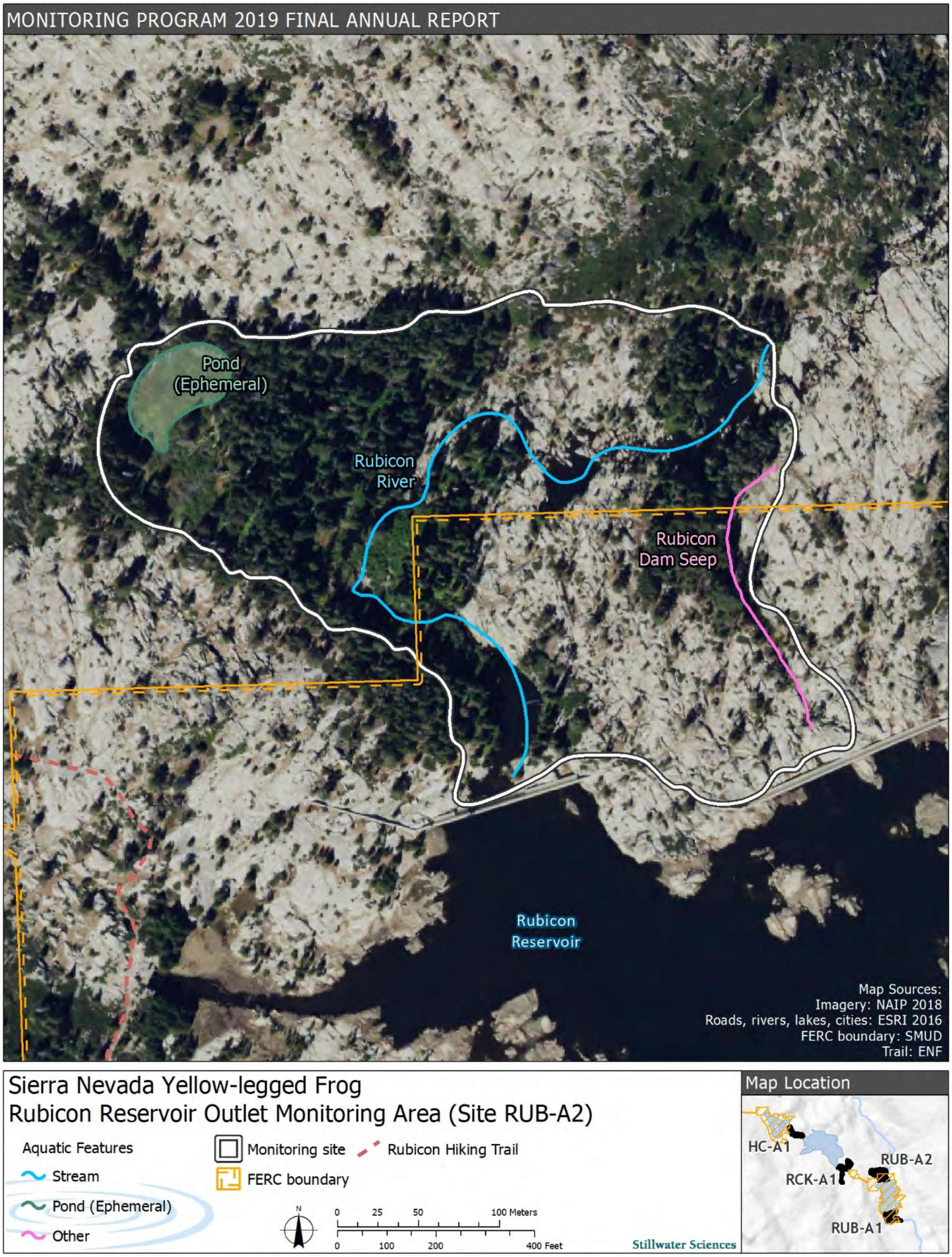


**Figure 9-2. Aquatic features at the Rubicon Reservoir Outlet Monitoring Area (Site RUB-A2), 2019.**

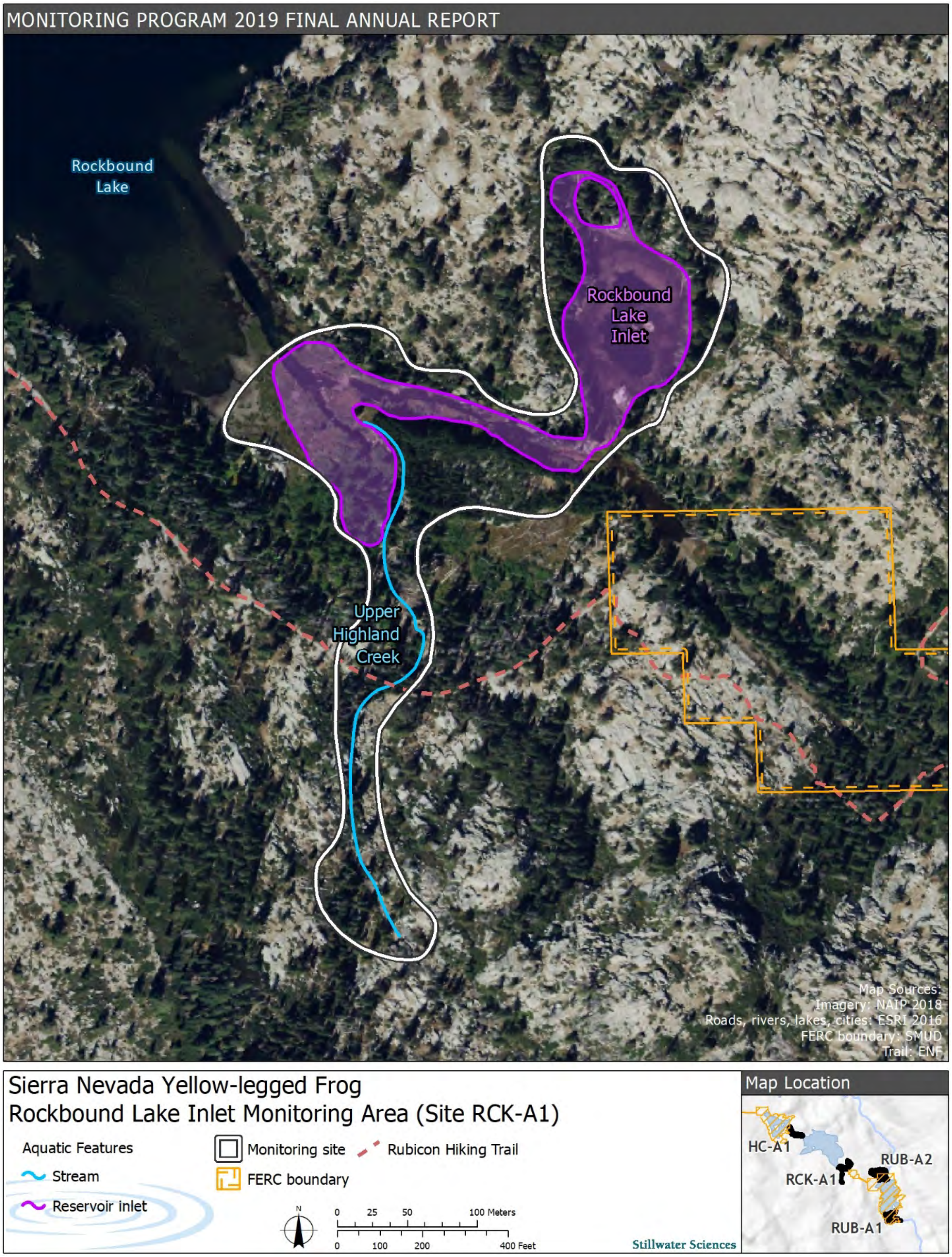


**Figure 9-3. Aquatic features at the Rockbound Lake Inlet Monitoring Area (Site RCK-A1), 2019.**


**Figure 9-4. Aquatic features at the lower Highland Creek Monitoring Area (Site HC-A1), 2019.**

CDFW conducted one herpetofaunal survey around the perimeter of Rubicon Reservoir, Rockbound Lake, Buck Island Lake and adjacent ponds during 2019; no SNYLF were found (I. Chellman, CDFW, pers. comm., February 20, 2020).

### 9.2.2 Visual Encounter Surveys

Diurnal Visual Encounter Surveys (VESs) were performed in all safely accessible areas within each site, generally following protocols outlined in CDFW (2017). Surveys focused on adults, subadults, and tadpoles. In addition to SNYLF, all other amphibian and reptile species observed during the surveys were recorded, as well as any potential predators (e.g., fish). The specific survey methodology follows methods described in the monitoring plan (SMUD 2017).

Three focused VESs were conducted at least one month apart at each site in 2019 as follows: one survey after snowmelt and after frogs presumably emerged for breeding (July), one mid-season survey (August), and one late-season survey (September). Survey dates for each site are listed in Table 9-2.

VESs were conducted once crews were able to safely access study sites. An unusually high snowpack resulted in high run-off in late spring/early summer[13] in the UARP and affected site accessibility. Some segments of creeks and reservoir inlets (i.e., Rubicon River above Rubicon Reservoir, upper Highland Creek above Rockbound Lake, Rockbound Lake Inlet near Rockbound Lake, and lower Highland Creek between Buck Island Reservoir and Rockbound Lake) were unsafe to cross or access due to high flows during the July survey; portions of these sites were not surveyed and/or survey methods were modified (e.g., the left bank of lower Highland Creek at Site HC-A1 was surveyed from the right bank using binoculars due to high flows preventing a safe stream crossing). During August and September surveys, all aquatic features were safely accessible.

**Table 9-2. Sierra Nevada Yellow-Legged Frog Monitoring Survey Dates, 2019.**

| Site Code | Site Description | Survey Date (2019) | | |
|---|---|---|---|---|
| | | VES 1 | VES 2 | VES 3 |
| RUB-A1 | Rubicon Reservoir Inlet Area | 7/10 | 8/14 | 9/24 |
| RUB-A2 | Rubicon Reservoir Outlet Area | 7/9 | 8/13 | 9/25 |
| RCK-A1 | Rockbound Lake Inlet Area | 7/11 | 8/15 | 9/25 |
| HC-A1 | Highland Creek | 7/11 | 8/15 | 9/26 |

### 9.2.3 Habitat Conditions

Habitat conditions were recorded in the field during VESs, including the presence of suitable habitat elements for SNYLF. Pertinent habitat characteristics recorded included

[13] Data from California Department of Water Resources (DWR 2019) indicated northern Sierra snowpack was 130% of average on May 1, 2019.

habitat types (e.g., pools, creeks, seeps, side channel or backwater areas, cascades, etc.), aquatic cover types (e.g., logs, undercut banks, boulders, rootwads, or vegetation that can provide refuge for frogs), aquatic and terrestrial vegetation descriptions (percent cover and types of margin vegetation, emergent and submerged vegetation, terrestrial vegetation, and riparian canopy), aquatic substrate type (e.g., silt/sand, cobble, boulder, bedrock), and other aquatic feature characteristics (e.g., bank slope, flow regime [perennial or ephemeral], sun exposure, and potential SNYLF basking areas).

Photo points were established to document representative suitable SNYLF habitat at each site. Global Positioning System (GPS) coordinates were collected using an Oregon 600 GPS unit. Photographs were collected at the same location at least twice during 2019.

## 9.3 RESULTS

### 9.3.1 Sierra Nevada Yellow-legged Frog Observations

No SNYLFs were found at any of the survey sites in 2019. Table 9-3 provides survey start and end times, along with water and air temperatures recorded during VESs at each site.

### 9.3.2 Habitat Conditions

Suitable physical habitat for SNYLF was observed at each of the monitoring sites. Fish were documented in all perennial aquatic features except one pond at Site RUB-A1 and a seep at Site RUB-A2. Table 9-4 provides a summary of habitat characteristics and fish presence for perennial aquatic features located within each monitoring site. Representative photographs are included in Appendix I1.

## Table 9-3. Sierra Nevada Yellow-Legged Frog Survey Conditions.

| Site Code | Site Description | Date (2019) | VES# | Time (hours) | | Aquatic Feature | Temperature (Celsius) | |
|---|---|---|---|---|---|---|---|---|
| | | | | Start | End | | Water | Air |
| RUB-A1 | Rubicon Reservoir Inlet Area | 7/10 | 1 | 1055 | 1500 | Rubicon River | 8 | 20–35 |
| | | | | | | Rubicon Reservoir Inlet | 8–12 | |
| | | | | | | Pond | 27 | |
| | | 8/14 | 2 | 1100 | 1600 | Rubicon River | 16–16.5 | 24–28 |
| | | | | | | Rubicon Reservoir Inlet | 18.5 | |
| | | | | | | Pond | 24 | |
| | | 9/24 | 3 | 1210 | 1447 | Rubicon River | 18 | 19–23 |
| | | | | | | Rubicon Reservoir Inlet | 16–17 | |
| | | | | | | Pond | 20 | |
| RUB-A2 | Rubicon Reservoir Outlet Area | 7/9 | 1 | 1000 | 1435 | Rubicon River | 10–10.5 | 25–26.5 |
| | | | | | | Dam Seep | 21–22.5 | |
| | | | | | | Pond | 22 | |
| | | 8/13 | 2 | 1150 | 1450 | Rubicon River | 16.5–17 | 24.5–28 |
| | | | | | | Dam Seep | 19 | |
| | | | | | | Pond | 20 | |
| | | 9/25 | 3 | 1010 | 1145 | Rubicon River | 15–16 | 22–24 |
| | | | | | | Dam Seep | 14 | |
| | | | | | | Pond | not surveyed (dry) | |
| RCK-A1 | Rockbound Lake Inlet Area | 7/11 | 1 | 1000 | 1405 | Rockbound Lake Inlet | 9.5–10 | 17–27.5 |
| | | | | | | Upper Highland Creek | 9.5–12 | |
| | | 8/15 | 2 | 1015 | 1455 | Rockbound Lake Inlet | 18–21 | 23–32 |
| | | | | | | Upper Highland Creek | 16.5–17 | |
| | | 9/25 | 3 | 1315 | 1545 | Rockbound Lake Inlet | 17–17.5 | 21–26.5 |
| | | | | | | Upper Highland Creek | 13–15 | |
| HC-A1 | Highland Creek | 7/11 | 1 | 1555 | 1640 | Lower Highland Creek | 11 | 21.5–28 |
| | | 8/15 | 2 | 1530 | 1650 | Lower Highland Creek | 20–21 | 27–28 |
| | | 9/26 | 3 | 1030 | 1135 | Lower Highland Creek | 15.5–16.5 | 22–23 |

**Table 9-4. Sierra Nevada Yellow-legged Frog Habitat Characteristics by Monitoring Site and Perennial Aquatic Feature, 2019.**

| Site Code | Aquatic Feature | Habitat Type | Aquatic Cover | Dominant Aquatic Substrate | Stream Bank Vegetative Cover | Emergent/ Submerged Vegetative Cover | Terrestrial Cover | Dominant Terrestrial Substrate | Riparian Canopy | Fish Present |
|---|---|---|---|---|---|---|---|---|---|---|
| RUB-A1 | Rubicon River | stream (pool [50%], run [30%], plunge/pool [10%], cascade [10%] | 15% (boulder, log) | bedrock (80%) | <5% (shrubs) | absent/absent | 25% (log, boulder) | bedrock (90%) | <5% (conifer) | Yes |
| | Rubicon Reservoir Inlet | reservoir channels, backwater pools, ephemeral creeks | 15% (rootwad, log, boulder, undercut bank) | sand (70%) | 10% (grass) | <5% (grass, herbaceous)/ <5% (vegetation) | 40% (vegetation, rootwad, log, boulder, burrows) | bedrock (50%) / Sand (50%) | 25% (conifer, willow, alder) | Yes |
| | Pond | natural perennial pond | <5-20% (rootwad, log, boulder) | silt/mud (95%) | 95% (grass, shrubs) | 10% (grass)/ 5% (small macrophytes) | 70% (vegetation, log, boulder) | bedrock (70%) | <10% (conifer) | No |
| RUB-A2 | Rubicon River | stream (pool [50%], run [30%], riffle [20%]) | 50% (log, rootwad, vegetation, boulder, burrows) | boulder (35%) / bedrock (35%) | 50% (forbs, grass, shrub, pines, oak, alder) | <5% (grass)/ <5% (algae) | 75% (log, rootwad, vegetation, boulder, burrows) | boulder (30%) / Bedrock (30%) / Sand (30%) | 50% (alder, conifer, oak, shrub) | Yes |
| | Rubicon Dam Seep | seep | 30% (boulder, log) | boulder (50%) | 20% (shrub, grass, pine) | <5% (grass)/ <5% (algae) | 50 % (log, vegetation, boulder) | bedrock (60%) | 25% (pine) | No |

| Site Code | Aquatic Feature | Habitat Type | Aquatic Cover | Dominant Aquatic Substrate | Stream Bank Vegetative Cover | Emergent/ Submerged Vegetative Cover | Terrestrial Cover | Dominant Terrestrial Substrate | Riparian Canopy | Fish Present |
|---|---|---|---|---|---|---|---|---|---|---|
| RCK-A1 | Rockbound Lake Inlet | reservoir, stream, pool, meadow | 60% (vegetation, undercut bank, log, boulder, rootwad) | silt/mud (60%) | 95% (grass, sedge, alder, pines) | 10% (herbaceous, grass, sedge, floating)/ <5% (algae) | 90% (logs, boulder, vegetation, rootwad, burrows) | sand (80%) | 40% (conifer) | Yes |
| | Lower Highland Creek | stream (riffle [25%], run [5%], pool [40%], plunge/pool [30%]) | 35–50% (log, boulder, undercut bank) | D/S: sand (45%) / silt & mud (45%); U/S: Boulder (75%) | D/S: 60% (alder, pine, grass, sedge, forbes); U/S: 10% (shrub, alder) | <5% (grass)/ <5% (algae) | D/S: 90% (vegetation, rootwad, log); U/S 80% (boulder, log, vegetation) | U/S: Sand (90%); D/S Boulder (55%) | 50% (conifer) | Yes |

| Site Code | Aquatic Feature | Habitat Type | Aquatic Cover | Dominant Aquatic Substrate | Stream Bank Vegetative Cover | Emergent/ Submerged Vegetative Cover | Terrestrial Cover | Dominant Terrestrial Substrate | Riparian Canopy | Fish Present |
|---|---|---|---|---|---|---|---|---|---|---|
| HC-A1 | Upper Highland Creek | stream (pool [50%], plunge/pool [20%], riffle [15%], cascade [15%]) | 50% (boulder, log, undercut bank, vegetation, rootwad) | boulder (50%) | 5% (grass, shrub, pine) | <5% (herbaceous, grass)/ <5% (algae) | 60% (boulder, log, vegetation, rootwad) | bedrock (45%), boulder (35%) | 35% (conifer) | Yes |

D/S=downstream; U/S=upstream; %=percent

9.3.2.1 Rubicon Reservoir Inlet Area (Site RUB-A1)

Three perennial aquatic features were identified and surveyed at Site RUB-A1: Rubicon River, Rubicon Reservoir Inlet, and one pond (Figure 9-1). Ephemeral creeks and ponded water were present at Site RUB-A1 during July, but mostly dry by the August survey.

Rubicon River

The Rubicon River is the most upstream aquatic feature at Site RUB-A1 (Figure 9-5). Its downstream start point is a cascade at the confluence with Rubicon Reservoir Inlet; it then extends approximately 409 feet upstream. Flows in the Rubicon River decreased between July (200–400 cfs) and September (3 cfs). The reach consists of a bedrock-lined channel of moderate gradient, and the estimated average wetted width is 15 feet. Habitat included pools, runs, high-gradient riffle, and cascades. Pools provided side-channel habitat with slow or still water, and boulders provided aquatic cover. Fish were present in the river. Low-gradient (<15°) granite and boulder stream banks with sparse vegetation had high sun exposure, providing potential basking areas. There was minimal riparian shading and the upland habitat was mixed conifer.

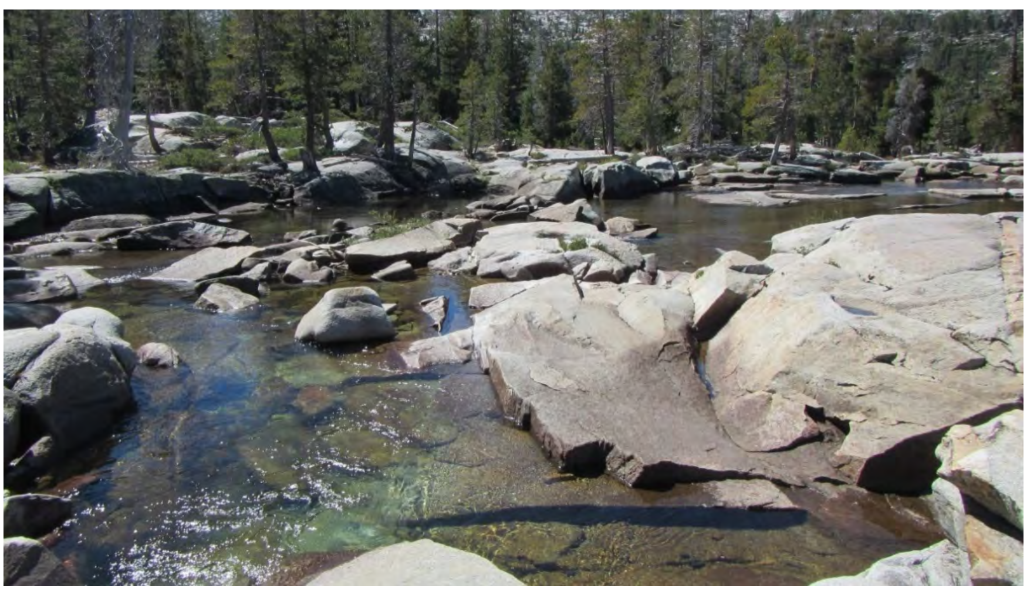

**Figure 9-5. Representative photo of habitat at Site RUB-A1 along the Rubicon River, 24 September 2019.**

Rubicon Reservoir Inlet

Rubicon Reservoir Inlet is a 4.1-acre wetted area that connects the Rubicon River and Rubicon Reservoir (Figure 9-6). Habitat included slow-moving deep channels (estimated water depth was 0–15 feet and average wetted width was 130 feet), backwater pools, and ephemeral creeks. Rubicon Reservoir Inlet water surface elevation was highest during the August survey. Aquatic cover was predominately boulders, but in some backwater and side-channel areas it was provided by logs, rootwads, undercut banks, and underwater vegetation. Fish were observed in Rubicon Reservoir Inlet. Banks were gently to steeply sloped (with bank gradients ranging between 0° to 40°) and were characterized by bedrock and boulders with sparse vegetation or sandy banks with vegetation; these areas included sections of both high and low sun exposure with potential basking sites. Upland habitat was dominated by conifers.

**Figure 9-6. Representative photos at Site RUB-A1 of two locations along Rubicon Reservoir Inlet, 14 August 2019 (top) 24 September 2019 (bottom).**

Pond (perennial)

The 0.7-acre natural perennial pond located at Site RUB-A1 included two ponded areas connected by a narrow channel (Figure 9-7). The pond remained wet during all surveys and the maximum depth was estimated at 6 feet. Fish were not observed in the pond. During the July and August surveys emergent vegetation (i.e., grasses) provided aquatic cover; during the September survey these areas were no longer submerged but emergent vegetation provided cover at the pond margins. Aquatic cover was also provided by rootwads, logs, and boulders. Stream margins included both steeply sloped (>40°) bedrock/boulder banks and lower-gradient (<15°) sandy banks with vegetation, including areas of high and low sun exposure, providing potential basking sites. Upland habitat was dominated by conifers.

**Figure 9-7. Representative photo of habitat at Site RUB-A1 of the pond (perennial), 10 July 2019.**

9.3.2.2 Rubicon Outlet Area (Site RUB-A2)

Two perennial aquatic features were identified and surveyed at Site RUB-A2: Rubicon River and Rubicon Dam Seep; one ephemeral pond was surveyed during July (Figure 9-2) but dried before subsequent surveys. Additional ponded water and side channel pools were present throughout the Site RUB-A2 in July, but these areas were dry by the August survey.

Rubicon River

The Rubicon River at Site RUB-A2, is a 1,900-foot-long reach downstream of Rubicon Dam (Figure 9-8). Flows were regulated at Rubicon Dam and were similar during all surveys. Habitat included pools, riffle, and runs. The habitat changed at approximately 580 feet upstream. The downstream habitat was characterized by an open, wide, granite and boulder-lined channel, with sparse-to-moderate margin vegetation, high sun exposure, and potential basking sites. The upstream habitat, closer to the dam, was characterized by deep pools, large woody debris jams, and areas of sand accumulation and dense vegetation along the stream margin. The wetted width was variable and ranged from 16 to 40 feet. Aquatic cover throughout the reach included logs, boulders, rootwads, underwater vegetation, and undercut banks. Fish were present in the river. There was moderate riparian shading and the upland habitat was mixed conifer.

**Figure 9-8. Representative photos at Site RUB-A2 of downstream (top) and upstream (bottom) habitat along the Rubicon River, 25 September 2019.**

Rubicon Dam Seep

Rubicon Dam Seep at Site RUB-A2 is a 618-foot-long reach downstream of the east side of Rubicon Dam (Figure 9-9). The water appears to seep from Rubicon Reservoir, creating continuous ponded water with low to no apparent flow observed during all surveys. The habitat included granite-lined pools and the average wetted width was 6.5 feet. Aquatic cover included boulders, logs, and undercut banks. Fish were not observed. Banks were generally steep (>40°) with granite boulders.

**Figure 9-9. Representative photo of habitat at Site RUB-A2 along Rubicon Dam Seep, 9 July 2019.**

Pond (ephemeral)

One naturally occurring pond was surveyed during July and was mostly dry by August (Figure 9-10). During July, the pond was 0.6 acres and the maximum depth was estimated at 4 feet. Aquatic cover was 90% and was dominated by submerged and emergent grasses. The banks were low gradient (<15°) and sandy. Vegetation along the pond margins included shrubs and pine.

**Figure 9-10. Ephemeral pond at Site RUB-A1 on 9 July 2019 (top) and 13 August 2019 (bottom).**

9.3.2.3 Rockbound Lake Inlet Area (Site RCK-A1)

Two perennial aquatic features were identified and surveyed at Site RCK-A1: Rockbound Lake Inlet and upper Highland Creek (Figure 9-3). Additional ponded water and side channel pools were present throughout Site RUB-A2 in July, but these areas were dry by the August survey.

Rockbound Lake Inlet

Rockbound Lake Inlet water supply is from the diversion tunnel that connects Rubicon Reservoir to Rockbound Lake. The 5.1-acre survey area included 658 feet of low-gradient stream channel, one 2.9-acre backwater pool, and one 1.4-acre wetland at the Rockbound Lake margin (Figure 9-11 through Figure 9-13). The wetland was not surveyed during July as it was submerged due to high water levels in Rockbound Lake. Aquatic cover included logs, boulders, underwater vegetation, rootwad, and undercut banks. Fish were observed in Rockbound Lake Inlet. Banks were predominately low gradient (<15°) and covered with vegetation (i.e., grasses and sedges), sun exposure was moderate to high, and potential basking areas were present. Upland habitat was mixed conifer.

**Figure 9-11. Representative photo at Site RCK-A1 of habitat along the stream margin located at Rockbound Lake Inlet, 15 August 2019.**

**Figure 9-12. Representative photo at Site RCK-A1of habitat along the side-channel pond area located at Rockbound Lake Inlet, 15 August 2019.**

**Figure 9-13. Representative photo at Site RCK-A1 of habitat along the wetland located at Rockbound Lake Inlet, 15 August 2019.**

Upper Highland Creek

Upper Highland Creek is an 1,390-foot-long reach that starts at Rockbound Lake Inlet, is intersected by the Rubicon Hiking Trail further upstream, and ends at a steep cascade at the upstream end of the reach (Figure 9-14). Flows were highest during July surveys. Habitat included pools, riffle, runs, and cascades. A shift in habitat occurred at the Rubicon Hiking Trail stream crossing. The subreach below the trail consisted of low-gradient channel with low-gradient (<15°) banks, deep pools, large woody debris jams, areas of sand accumulation and dense vegetation along the margin. The upstream subreach was a high-gradient confined channel, characterized by boulder and granite substrate, sparse vegetation, high sun exposure, and potential basking areas. Fish were observed in the reach downstream of the trail. Aquatic cover throughout the reach included logs, boulders, rootwads, underwater vegetation, and undercut banks. The upland habitat was mixed conifer.

**Figure 9-14. Representative photos of habitat at Site RCK-A1 along upper Highland Creek upstream (top) and downstream (bottom) of the Rubicon Hiking Trail, 15 August 2019.**

### 9.3.2.4 Highland Creek (Site HC-A1)

Lower Highland Creek was the only identified perennial aquatic site at Site HC-A1 (Figure 9-4). Ephemeral seeps and ponded water were present at Site HC-A1 during July, but these off-channel areas were mostly dry by the August survey.

The 1,691-foot-long reach of lower Highland Creek connects Rockbound Lake with Buck Island Reservoir (Figure 9-15). Flows in the creek decreased between July and September. Habitat included cascades, plunge pools, large pools, riffles, and runs. The cascades were predominately bedrock aquatic substrate, lacked aquatic cover, and had high sun exposure. The other habitat units (i.e., pools, riffles, and runs) were predominately boulder and cobble aquatic substrate, provided aquatic cover (i.e., logs, boulders, undercut banks, underwater vegetation, and rootwads), and had moderate sun exposure. Fish were observed in the stream. Potential basking habitat was present throughout the reach. Upland habitat was mixed conifer.

**Figure 9-15. Representative photo at Site HC-A1 along lower Highland Creek, 15 August 2019.**

9.3.3 Other Amphibian and Aquatic Reptile Species

Five non-special status amphibian and reptile species were observed throughout the monitoring sites during VESs; species, life stage, and location(s) where documented and summarized in Table 9-5. Figure 9-16 through Figure 9-18 show photographs of documented Sierran treefrogs and western toads.

**Table 9-5. Additional Herpetofauna Species Observed, by Life Stage, 2019.**

| Species Common Name (*Scientific name*) | Life Stage | | | | Location(s) Where Species Documented |
|---|---|---|---|---|---|
| | Egg Mass | Larvae | Young-of-Year | Juv/ Adult | |
| **Amphibians** | | | | | |
| Sierran treefrog (*Pseudacris sierra*) | X[a] | X | X | X | RUB-A1 (Rubicon Reservoir Inlet, Pond), RUB-A2 (Rubicon Dam Seep, Pond), RCK-A1 (Rockbound Lake Inlet, upper Highland Creek), HC-A1 (lower Highland Creek) |
| Western toad (*Anaxyrus boreas*) | | | | X | RCK-A1 (Rockbound Lake Inlet), RUB-A2 (small ephemeral pool near dam) |
| **Reptiles** | | | | | |
| Sierra garter snake (*Thamnophis couchii*) | | | | X | RUB-A1 (Rubicon River, Pond), RUB-A2 (Rubicon Dam Seep) |
| Valley garter snake *(Thamnophis sirtalis fitchi)* | | | | X | RUB-A1 (Pond) |
| Mountain garter snake (*Thamnophis elegans elegans*) | | | | X | RUB-A1 (Pond), RUB-A2 (Pond), HC-A1 (lower Highland Creek) |

Juv = juvenile
X = observed
[a]Spent egg masses at RUB-A2 ephemeral pond on 7/9/2019

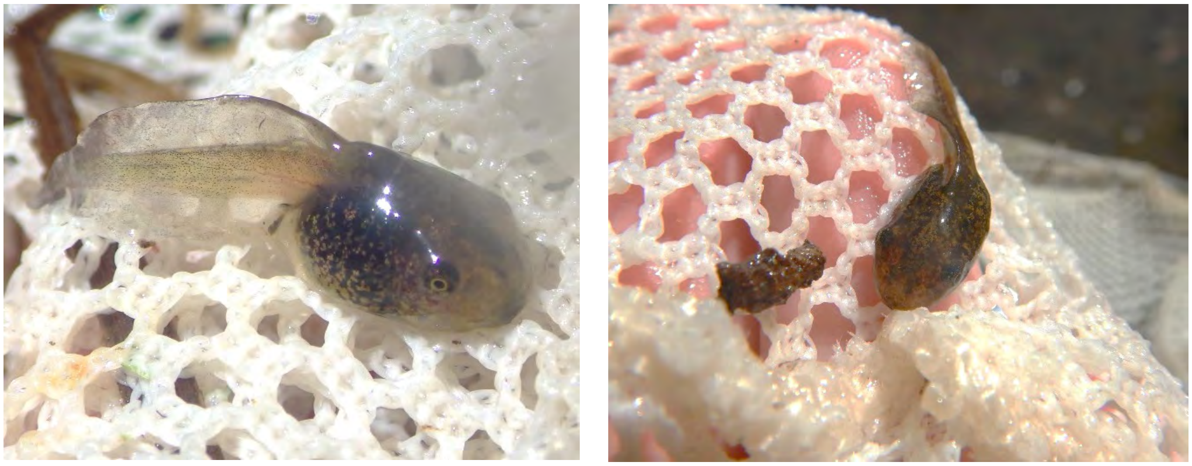

**Figure 9-16. Sierran tree frog tadpoles found at Site RUB-A2 on 9 July 2019 and Site RUB-A1 on 14 August 2019.**

**Figure 9-17. Sierran treefrogs found at Site RUB-A1 on 14 August (top left), Site RCK-A1 on 15 August (top right), Site RUB-A1 on 24 September 2019 (bottom left), and Site HC-A1 on 26 September 2019 (bottom right).**

**Figure 9-18. Western toads found at Site RUB-A2 on 9 July 2019 (left) and Site RCK-A1 on 15 August 2019 (right).**

## 9.4 DISCUSSION

The lack of SNYLF detections during 2019 VESs are consistent with past survey results; no SNYLFs have been historically detected within the Project-affected stream reaches and reservoirs (SMUD and PG&E 2005; Stillwater Sciences 2017, 2018). During relicensing studies in 2004, VESs for SNYLF were conducted throughout the UARP, including the following locations: Rubicon Reservoir, Rubicon Springs, Rockbound Dam, three ponds near Rockbound Dam, Highland Creek, Little Rubicon River, Buck Island Reservoir, Loon Lake, four ponds near Loon Lake, unnamed tributaries to Loon Lake, Ellis Creek, Gerle Creek, South Fork Rubicon River, South Fork Silver Creek, Jones Fork Silver Creek, and Yellow Jacket Creek (SMUD and PG&E 2005); no SNYLF were found during these surveys at these locations. In 2017 and 2018, focused VESs for SNYLF were conducted prior to vegetation and invasive weed management (SMUD 2017) as well as other operations, maintenance, and construction activities at various UARP locations around Loon Lake, Gerle Creek Reservoir, Union Valley Reservoir, Ice House Reservoir, Rubicon Reservoir, Buck Island Reservoir, and the Rubicon Hiking Trail; no SNYLFs were found during these surveys (Stillwater Sciences 2017, 2018). Furthermore, CDFW conducted one survey at Rubicon Reservoir, Rockbound Lake, and Buck Island Reservoir and adjacent ponds during 2019; no SNYLF were found (I. Chellman, CDFW, personal communication, February 20, 2020).

Although SNYLFs have not been detected in the UARP, SNYLFs have been observed at other lakes located in Desolation Wilderness including Highland Lake, Lake Zitella, McConnell Lake, and Leland Lakes (CDFW 2015a, CDFW 2015b, CDFW 2017, CDFW 2019, CDFW 2020). These lakes are located between 1.4 and 3.5 miles south of the Rubicon Reservoir Inlet Area. The number of SNYLF observed by CDFW and ENF biologists has increased during one or more surveys since 2014 at the two lakes closest to the UARP: (1) Highland Lake, including its outlet stream and associated ponds (upstream of, and hydrologically connected to Rockbound Lake via Highland Creek, 2.2 miles to the southwest of the Rubicon Reservoir Inlet Area), and (2) Lake Zitella (1.4 miles south of Rubicon Reservoir Inlet Area) (CDFW 2019). The removal of introduced predatory fish (i.e., rainbow trout [*Oncorhynchus mykiss*]) by CDFW between 2012–2015 (CDFW 2019) substantially improved the SNYLF population at Highland Lake and drainage to over one thousand adults, hundreds of subadults, and over one thousand tadpoles during 2018 VESs (CDFW 2019). The proximity of this robust and hydrologically connected SNYLF population suggests that SNYLF could immigrate to the UARP, though the presence of fish in the area of the UARP likely reduces the potential of SNYLF to become established in the UARP area.

Suitable physical habitat was documented at all monitoring sites, including perennial streams, wetlands, and ponds. Suitable habitat elements were also present, including basking areas for thermoregulation, slow-moving permanent water for breeding (e.g., side pools in stream systems and ponds), aquatic cover for refuge from predators (e.g., boulders, logs, aquatic vegetation, undercut bank, rootwads), and terrestrial cover for refuge (Table 9-4, Appendix I1). However, fish were documented within all perennial habitat units except the pond at Site RUB-A1 and Rubicon Dam Seep at Site RUB-A2. Fish observed included salmonids and were likely rainbow trout and brown trout (*Salmo trutta*), which were documented in 2019 below Rubicon Dam (see Section 2.0 Trout). Non-native trout are predators of SNYLF and are one of the factors that have led to the decline of SNYLF populations in the Sierra Nevada mountains (Knapp and Matthews 2000, Wilkins et al. 2019*).* Other factors adversely impacting SNYLF populations include the spread of chytrid fungus (*Batrachochytrium dendrobatidis)*, pesticide use, and climate change (e.g., increased drought severity) (Davidson and Knapp 2007, Wilkens et al. 2019). Although suitable physical habitat is present in the UARP, it may be unlikely for SNYLF from relatively nearby populations (e.g., Highland Lakes, Lake Zitella) to expand into the UARP due to the considerable presence of predatory fish. Future monitoring will continue to provide information on potential presence of SNYLF in project-affected areas and on interannual and long-term changes in habitat suitability (e.g., habitat elements, prevalence of predatory fish, potential effects of climate change/increased drought).

## 9.5 LITERATURE CITED

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CDFW. 2015b. Native amphibian restoration and monitoring in Desolation Wilderness; Action: Highland Lake fish removal and *Rana sierrae* monitoring. Memorandum from Kevin Thomas, Senior Environmental Scientist (Supervisor), North Central Region to Sarah Mussulman, Environmental Scientist—High Mountain Lakes, North Central Region. October 26.

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# 10.0 BEAR MANAGEMENT MONITORING

## 10.1 MONITORING PLAN OBJECTIVES

The primary objectives and rationale for the bear management monitoring program, as described in the Plan are:

*Monitor effectiveness of measures related to bear management using a method acceptable to FS, FWS, and CDFG.*

This monitoring will help determine if bear management measures used to keep bear populations away from recreation sites within the UARP are effective. As described in Settlement Agreement Article 1-6.10;

*If, over a 5-year period, monitoring indicates that the number of bear/human interaction incidents does not decline or decrease in severity, the licensee shall work with FS, FWS, and CDFG to identify and implement additional measures necessary to reduce such problems.*

Additionally, the results of this monitoring may be useful to SMUD and the USFS when planning and prioritizing locations to install bear-proof food lockers.

## 10.2 STUDY AREA AND SAMPLING LOCATIONS

As was done since monitoring began in 2016, monitoring was carried out at developed, UARP-related recreation facilities within the Project area (Figure 10-1 and Table 10-1). These included both day-use and overnight facilities; hosted and unhosted**.**

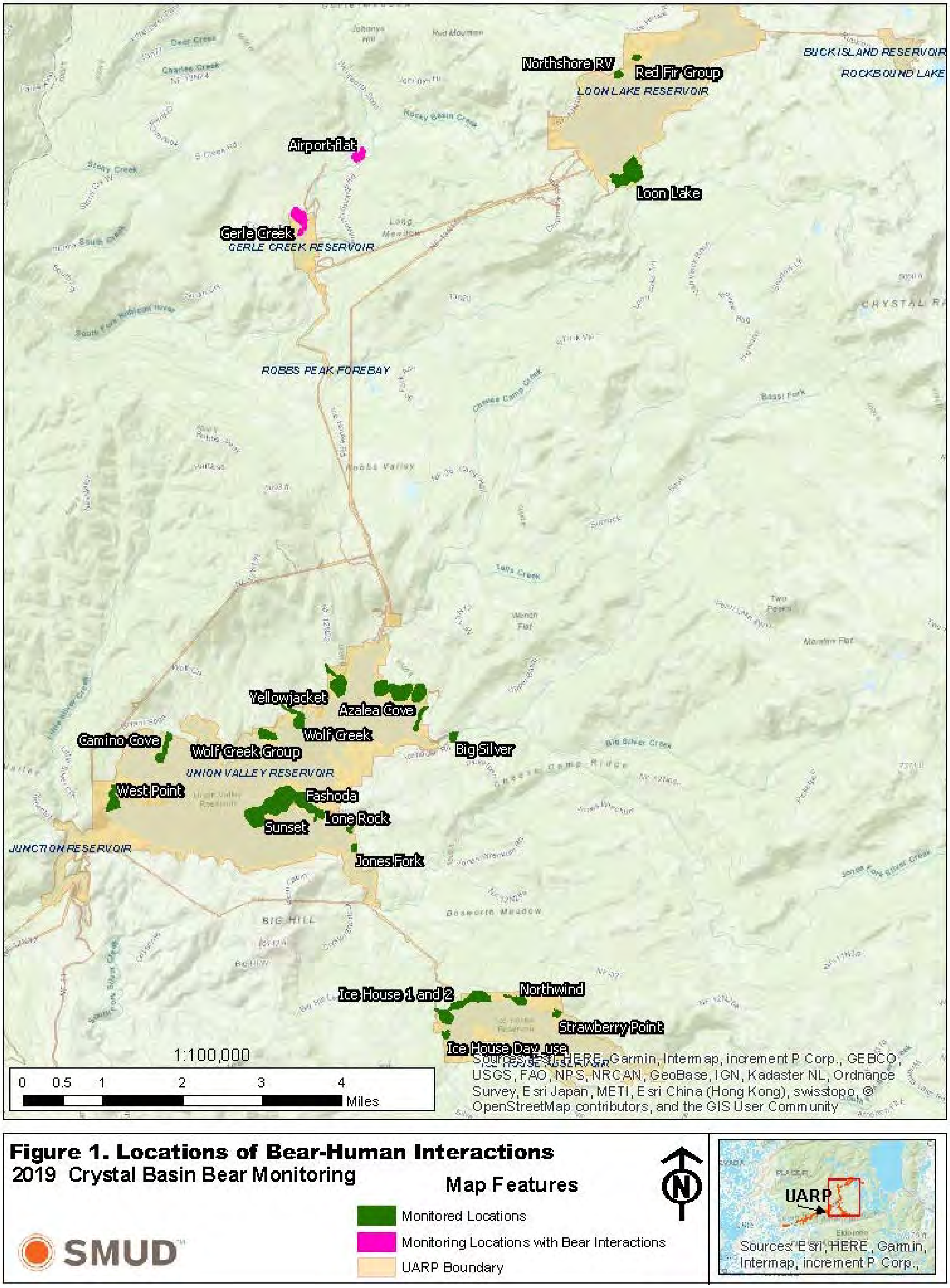


**Figure 10-1. Bear-human interaction monitoring locations**

**Table 10-1. Sites associated with the UARP bear-human interaction 2019 monitoring program.**

| Facility | Existing Lockers/ Trash | Hosted Site | Monitored | Comment |
|---|---|---|---|---|
| Northshore RV CG | Y | N | N | Site closed in 2019; Campground rebuilt, and lockers installed |
| Loon Lake Family CG; Boat Launch RV CG; Equestrian CG; Group CG; and Equestrian Group CG | Y | Y | Y | Host administering multiple LL facilities was responsible for collecting forms |
| Red Fir CG | Y | N | Y | Monitoring form box installed |
| Pleasant Boat In CG | Y | N | N | Monitoring Box not deployed here |
| Airport Flat CG | Y | N | Y | Monitoring form box installed |
| Gerle Creek CG | Y | Y | Y | Host supplied with forms |
| Sunset Family CG | Y | Y | Y | Host supplied with forms |
| Fashoda CG | Y | Y | Y | Host supplied with forms |
| West Point CG | N | N | Y | Monitoring form box installed |
| Yellowjacket CG | N | Y | Y | Host supplied with forms |
| Wench Family and Group CG | Y | Y | Y | Host supplied with forms |
| Wolf Creek Family and Group CG | Y | Y | N | Site closed for 2019 season |
| Azalea Cove CG | Y | N | Y | Monitoring form box installed |
| Big Silver Group CG | Y | N | Y | Monitoring form box installed |
| Camino Cove CG | Y | N | N | Site closed for 2019 season |
| Jones Fork CG | Y | N | Y | Monitoring form box installed |
| Lone Rock CG | Y | N | Y | Monitoring form box installed |
| Ice House Family CG | N | Y | Y | Host supplied with forms |
| Northwind CG | Y | N | Y | Monitoring form box installed |

| Facility | Existing Lockers/ Trash | Hosted Site | Monitored | Comment |
|---|---|---|---|---|
| Strawberry Point CG | Y | N | Y | Monitoring form box installed |
| **Day-use Areas** | | | | |
| Angel Creek | Y | N | Y | Monitoring form box installed |
| Gerle Creek | N | Y | Y | Host supplied with forms |
| Ice House | N | Y | Y | Host supplied with forms |
| Fashoda | N | Y | Y | Host supplied with forms |
| Jones Fork Bike Trailhead | N | N | Y | Monitoring form box installed at CG |
| Big Silver Bike Trailhead | N | N | Y | Monitoring form box installed at CG |
| Wench Creek Bike Trailhead | Y | Y | Y | Host supplied with forms |
| Loon Lake – Desolation Wilderness | N | N | Y | Monitoring form box installed at TH |

## 10.3 METHODS

Prior to the start of the 2019 recreation season (Memorial Day weekend), SMUD and the USFS coordinated the redeployment of the boxes and forms at unhosted sites. Signs alerting recreationists of the bear monitoring program were installed by USFS staff at each location. On May 22, 2019 the USFS hosted a recreation season kickoff meeting with its new recreation concessionaire Royal Elks. At this meeting, SMUD staff discussed the bear monitoring program and asked for the help of concessionaire staff at hosted campgrounds to distribute forms and collect information from campers. In addition, CDFW participated with a bear awareness presentation and urged USFS and concessionaire staff to continue to educate recreationists on bear safety and enforce food storage rules.

USFS staff collected the forms mid-season and provided them to SMUD. Following the conclusion of the recreation season in early October 2019, SMUD contacted the USFS to ask for assistance in collecting any remaining completed forms from camp hosts and unhosted sites. No additional forms were received by SMUD.

## 10.4 RESULTS AND DISCUSSION

SMUD received 15 completed forms from the USFS for the 2019 recreation season (Appendix J1), the results of which are summarized in the table located in Appendix J2. The reports came from Gerle Creek (12), Airport Flat (2), and Millionaire Camp

(1). Only two reports were from dispersed camping areas; Millionaire Camp and one near the developed campground at Airport Flat

Since monitoring started in 2016 the number of reported incidents has fluctuated from a high of 43 in 2017 to 15 in 2019. Reported incidents have come from across the Crystal Basin but the Gerle Creek/Airport Flat area continues to be the hot spot for bear activity by far. The bears seem to be habituated to humans and are not easily deterred. Aside from the visitor reports, the campground hosts consistently report that the bears are knocking over dumpsters. As of 2019 most locations have bear resistant trash and food storage containers (Table 10-1).

The low number of reported incidents in 2019 may be a result of declining incidents, or missing forms due to staffing changes at the ENF along with a new campground concessionaire managing the sites. Getting completed forms is a continuing challenge. SMUD will work with the USFS during the 2020 season to refine the form collection protocol to ensure forms are collected on a regular basis.

In 2019, 9 of the 15 reports, or 60%, indicated that bears found food that was not properly stored in a bear-proof food locker, which is similar to past seasons. As indicated in previous reports, these numbers seem to indicate that more education and enforcement is needed so that visitors understand that ***all food, trash or scented products*** need to be stored in a bear-proof food locker. This message needs to be heavily reinforced by the USFS and its concessionaire hosts.

Based on observations and the monitoring results to-date, SMUD makes the following recommendations:

1. SMUD, CDFW and the USFS should continue to present information on the monitoring program to the concessionaire's campground hosts during an annual meeting and emphasize the importance of proper food storage.
2. SMUD and the USFS should improve the form collection protocol to be employed by USFS staff and camp concessionaire.
3. SMUD and USFS should meet briefly once toward the middle of the recreation season to discuss the need for more forms, cooperation of concessionaire staff, how often boxes are being checked, and whether signage is adequate, among other things.
4. Because there appears to be one or more problem bears in the Gerle Creek/Airport Flat area, CDFW may want to coordinate with the USFS on a strategy to address the problem. Campground hosts should have a nightly routine to check-in with each camper reminding them to store all food securely.

SMUD will continue to provide the results of the monitoring to the USFS and CDFW and any management decisions or actions will be at the discretion of those agencies with jurisdiction over the resource. SMUD may assist in any management decisions, as appropriate.

10.4.1 Upcoming Survey Plans

In accordance with the Plan, monitoring will occur annually during the recreation season (approximately Memorial Day through the end of September). For 2020, SMUD will ensure that each site to be monitored, including hosted sites, has adequate signage to educate the public about bears and to inform visitors of the monitoring program. SMUD will attend the annual kick-off meeting with the recreation concessionaire and the USFS to present the details of the monitoring program and enlist the support and assistance of the camp hosts and USFS recreation staff. For the monitoring to be effective it will be imperative to make sure the visiting public knows about the monitoring program and their need to fill out forms following any incidents. It is equally important that all sites have forms available throughout the year and that all forms are collected and returned to SMUD at the close of the season.

As stated in Article 1-6.10 of the Settlement Agreement (above), the parties are to determine if bear interactions are declining or decreasing in severity over the first 5 years of monitoring. The conclusion of monitoring in 2020 will mark the end of the first 5-year period so the 2020 report will attempt to determine whether the bear interactions are declining or not. Based on current data, its likely that no real overall conclusions will be evident with the exception that it appears that the Gerle Creek area is experiencing regular bear activity year after year despite having bear-proof food and trash receptacles.

## 10.5 LITERATURE CITED

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SMUD (Sacramento Municipal Utility District). 2015. Bear-Human Interaction Monitoring Plan. Hydro License Implementation for the Upper American River Project (FERC Project No. 2101).

## 11.0 LARGE WOODY DEBRIS

No Large Woody Debris (LWD) meeting the size requirement to pass was encountered in 2019 at Robbs Forebay, Junction, or Camino reservoirs. It is not known if any LWD meeting the size requirement to pass was present at Slab Creek Reservoir. Regardless, on February 14, prior to a spill event, the log booms were configured to the spill mode and all LWD was allowed to pass over the dam (Figure 11-1). The reservoir was left in this state until March 28, 2019 when the log booms were reconfigured to span the reservoir. There was no public access to the reservoir during this time.

**Figure 11-1. Log boom reconfiguration at Slab Creek Dam allowing large woody debris to move downstream.**

## 12.0 WATER TEMPERATURE

The Water Temperature Monitoring Plan was developed in consultation with the SWRCB, USFS, CDFW, and USFWS. FERC approved the monitoring plan on September 30, 2015.

## 12.1 MONITORING PLAN OBJECTIVES

The primary objectives and rationale for the water temperature monitoring program, as described in the Plan are as follows:

> *Annual water temperature monitoring at specified stream sites will provide information needed to determine whether cold freshwater resource objectives are being met and will provide an evaluation of breeding conditions for sensitive amphibian species. Stream temperature monitoring results will also be used to determine whether water temperature profiles within the reservoirs are needed to better understand cold water availability. An adaptive approach to water temperature monitoring will allow the removal of specific monitoring sites if results indicate water temperatures are adequate at those specific locations (Condition 8.I.).*

This monitoring will help determine if water temperatures in UARP waters meet the Basin Plan beneficial use of Cold Freshwater Habitat (CVRWQCB 1998) and other identified habitats/species needs. If such a study is inconclusive, reservoir temperature profile monitoring may be required to assist in the decision-making process. Currently, the Plan requires water temperature monitoring in stream reaches throughout the duration of the license term or until *"the Licensee can demonstrate to the satisfaction of the Deputy Director that operation of the UARP reasonably protects the "cold freshwater" beneficial use at any site for which the Licensee seeks modification to the* temperature monitoring requirement."

These data are also utilized to direct the following requirements of the new license:

- Adaptive management decisions regarding initiation of FYLF breeding
- Cancellation of recreational boating releases due to FYLF breeding
- Temperature monitoring related to the 'block of water' releases on Silver Creek
- Response of aquatic resources to spill events and pulse flows after thresholds have been reached.
- Requirement of the Basin Plan that "At no time or place shall the temperature of COLD or WARM intrastate waters be increased more than 5° F above the natural receiving water temperature.

## 12.2 METHODS

### 12.2.1 Study Area and Sampling Locations

Continuous water temperature monitoring of stream reaches occurred in 2019 at 19 sites throughout the UARP area utilizing fixed stations or dataloggers. In general, these sites measured water temperatures in diverted stream reaches downstream of UARP reservoirs. Table 12-1 describes the locations and characteristics of each site. Final site development at a local scale was determined using proximity to release point, presence of isothermal water column, logistics, and channel morphology. Figures 1-1 through 1-3 depict the monitoring site locations relative to the UARP and primary streams and rivers.

**Table 12-1. UARP Water Temperature Monitoring Site Locations**

| Site Name | Site Description | UTM (NAD 83) | | Sensor Type | Data Transfer | Threshold Trigger | Complete Data |
|---|---|---|---|---|---|---|---|
| | | Easting | Northing | | | | |
| RR5 | Rubicon River immediately below Rubicon Reservoir Dam | 740501 | 4319200 | CS450L | Telemetry | None | Yes |
| LRR3 | Little Rubicon River immediately below Buck Island Reservoir Dam | 737558 | 4320907 | CS450L | Telemetry | None | Yes |
| RR1 | Rubicon River below confluence of Little Rubicon River at the Project boundary | 736593 | 4323887 | Onset datalogger | Manual | None | Yes |
| GC7 | Gerle Creek immediately below Loon Lake Reservoir Dam | 732455 | 4320776 | CS450L | Telemetry | None | Yes |
| GC8 | Gerle Creek immediately below Gerle Creek Reservoir Dam | 725745 | 4316219 | CS107 or CS450L | Telemetry | None | Yes |
| SFRR5 | South Fork Rubicon River immediately below Robbs Peak Reservoir Dam | 726202 | 4314316 | CS450L | Fiber Optic Network | None | Yes |
| SFRR6 | SF Rubicon River below confluence of Gerle Creek at the Project boundary | 725256 | 4314907 | CS450L | Telemetry | None | Yes |
| SFRR7 | SF Rubicon River immediately upstream of the confluence with the Rubicon River | 719438 | 4316236 | Onset datalogger | Manual | None | No |
| SFSC7 | South Fork Silver Creek immediately | 728745 | 4299871 | CS450L | Telemetry | None | Yes |

| Site Name | Site Description | UTM (NAD 83) Easting | UTM (NAD 83) Northing | Sensor Type | Data Transfer | Threshold Trigger | Complete Data |
|---|---|---|---|---|---|---|---|
| | below Ice House Reservoir Dam[1] | | | | | | |
| SFSC8 | South Fork Silver Creek immediately upstream of Junction Reservoir | 721498 | 4303358 | CS450L | Telemetry | 7DMAVG | Yes |
| SC5 | Silver Creek immediately below Junction Reservoir Dam | 720466 | 4303467 | CS 450L | Fiber Optic Network | None | Yes |
| SC6 | Silver Creek immediately above Camino Reservoir Dam | 714119 | 4301407 | CS450L | Telemetry | DAVG | Yes |
| SC7 | Silver Creek immediately below Camino Reservoir Dam[1] | 713631 | 4300155 | CS450L | Fiber Optic Network | None | Yes |
| SC8 | Silver Creek immediately upstream of South Fork American River | 709310 | 4296208 | CS450L | Telemetry | DAVG | Yes |
| BC4 | Brush Creek immediately below Brush Creek Reservoir Dam | 706407 | 4298536 | CS451 | Fiber Optic Network | None | Yes |
| SFAR13 | South Fork American River immediately below Slab Creek Reservoir Dam | 699644 | 4294054 | CS450L | Fiber Optic Network | None | Yes |
| SFAR7 | South Fork American River at Mosquito Rd Bridge | 695572 | 4294304 | Onset Datalogger | Manual | None | No |
| SFAR15 | South Fork American River approximately ½ mile upstream of White Rock Powerhouse | 692576 | 4292875 | CS450L | Telemetry | 7DMAVG | Yes |
| SFAR16 | South Fork American River to record White Rock Powerhouse discharge temps | 692212 | 4293046 | CS450L | Fiber Optic Network | None | Yes |

### 12.2.2 Temperature Data at Fixed-Stations

Sixteen of the nineteen water temperature sites were located at fixed stations. Monitoring compliance at these sites were accomplished using gaging stations located at weirs, stilling wells, or powerhouse tailraces. Each fixed station site utilized a Campbell Scientific datalogger and a redundant pair of temperature sensors. Sensor cables were contained inside conduit, and the sensors were placed as close as possible to the stream thalweg where water is well mixed. A solar shield helped prevent exposure to direct sunlight. Depending on the site, power was supplied either by photovoltaic panels and DC batteries or through an existing power supply. Data transfer occurred through radio telemetry or fiber optic network. At the fixed stations, temperature readings were collected at 15-minute intervals and telemetered to SMUD databases, where the data was summarized to hourly means and calculated to daily statistics.

### 12.2.3 Temperature Data at Datalogger Stations

Simple, non-permanent, calibrated temperature dataloggers (ONSET HOBO Water Temperature Pro V2) were deployed prior to March 15, 2018 at the remaining three sites (‘Manual’ sites in Table 12-1). The sensors were inserted into perforated metal framed housings that allowed for adequate water movement throughout.

Each housing was secured to large boulders or bedrock using hardened 3/8" chain and placed to assure that the sensor remained submerged and was not exposed to direct sunlight. Two dataloggers were installed at each site to protect against data loss in the event of equipment failure or drift. Dataloggers were deployed in habitat strata where the water was well-mixed, typically at the head of a pool just below a riffle input. Table 12-2 describes the equipment specifications for all sensors selected for water temperature monitoring. Hourly data from HOBO loggers were manually downloaded using Onset Computer Corporation software. All water temperature data is stored in a Microsoft SQL database designed for this purpose.

**Table 12-2. Specifications for monitoring equipment**

| Sampling Equipment | Accuracy | Range | Calibration |
|---|---|---|---|
| Campbell Scientific 107L | <±0.2°C from 0°to 50° | -35° to +50°C | Annual |
| Campbell Scientific 450L | ±0.2°C from 0°to 50° C | 0° to 60°C | Biennial |
| Onset Computer Corp. HOBO® | ±0.2°C from 0° to 50°C | -40° to 50°C | Annual |
| Campbell Scientific CR 1000 Datalogger | ±3 min. per year | Not Applicable | Annual |

## 12.3 QA/QC

Raw data is reviewed on a routine basis. Temperature trends inspected include physical range limits, practical range limits, and rates of temperature change. Data obtained from the fixed stations were checked for validity using procedures that run every 24 hours following data download. A report is generated and sent to pertinent SMUD staff via email for any suspected erroneous data. The same procedures are run manually following download from the data loggers. Erroneous temperature values were adjusted manually; however, the original raw data was maintained in the database.

This review, along with graphical analysis and routine equipment inspection, ensured that sensors were functioning and recording properly throughout the monitoring period. For fixed stations, this allowed for a timely response if the need arose. Any equipment malfunction that required a field visit was addressed during normal business hours, under safe conditions. Repairs were made in as timely a manner as possible.

## 12.4 DECISION-MAKING THRESHOLDS

SMUD will use real-time water temperature information to make efforts to protect endangered species and Cold Freshwater Habitat. Eventually the 12°C 7DMAVG temperature trigger thresholds below may be adjusted on a site-specific basis if data from the FYLF monitoring supports such a change. In particular, SMUD will:

- Use water temperature thresholds to protect FYLF breeding activities by canceling recreational boating flows in the following reaches when the 7DMAVG exceeds 12°C:
- South Fork Silver Creek below Ice House Dam (If FYLF are found in this reach)
- SFAR below Slab Creek Reservoir
- Monitor for effects to aquatic resources following spills that occur at Camino and Slab Creek reservoirs when the 7DMAVG exceeds 12°C.
- Monitor other temperature thresholds to protect the Cold Freshwater Habitat requirements on Silver Creek, as described in the 401(SWRCB 2013). This involves informing the release of an additional "block of water" during wet water year types when the daily average temperature (DAVG) exceeds 20°C.
- Compare water temperature trends over time with other annual climatic conditions collected by SMUD. This will assist in determining whether the UARP is protecting the Basin Plan beneficial use of Cold Freshwater Habitat (CVRWQCB 1998).

## 12.5 ADAPTIVE MANAGEMENT

The water temperature sensors located at Mosquito Bridge were lost for the 2019 monitoring season (Table 12-1). The water temperature sensors located at South Fork Rubicon River (SFRR7) were not able to be recovered due to high flows. Three thresholds that are connected to various UARP adaptive management conditions were crossed during the monitoring period (Table 12-3). The exact dates are listed below.

Various thresholds triggered adaptive management actions. At Silver Creek Upstream of SFAR Confluence (SC8) the average daily water temperature crossed the 20°C threshold on August 24th. The next business day on August 26th SMUD increased the minimum streamflow from Camino Dam from 18 cfs to a target daily average flow of 28 cfs, and followed the process outlined in the Block of Water Plan. These releases resulted in the intended effect - the average daily water temperature at SC8 was reduced from approximately 20.5° C, to approximately 17.5° C, over the seven-day release period of ~28 cfs (see below). On September 3rd, the release was reduced back to the required minimum of 18 cfs. SMUD released approximately 150 acre-feet of additional water under the Block of Water release.

For water temperature monitoring at SFAR at Slab Creek Dam (SFAR13) and Silver Creek at Camino Gaging Station (SC7), the 7DMAVG exceeded the 12°C threshold in early June while spilling was occurring. Once spills subsided and conditions were safe, annual visual encounter surveys were performed. These surveys occurred below both Camino Dam and Slab Creek Dam.

**Table 12-3. Crossed Thresholds**

| Site Name | Site Description | Date Crossed Threshold | Duration of crossed Threshold |
|---|---|---|---|
| SFSC8 | South Fork Silver Creek immediately upstream of Junction Reservoir | June 22, 2019 | 77 days |
| SC8 | Silver Creek immediately upstream of South Fork American River | August 24, 2019 | 3 days |
| SFAR15 | South Fork American River approximately ½ mile upstream of White Rock | May 31, 2019 | 133 days |

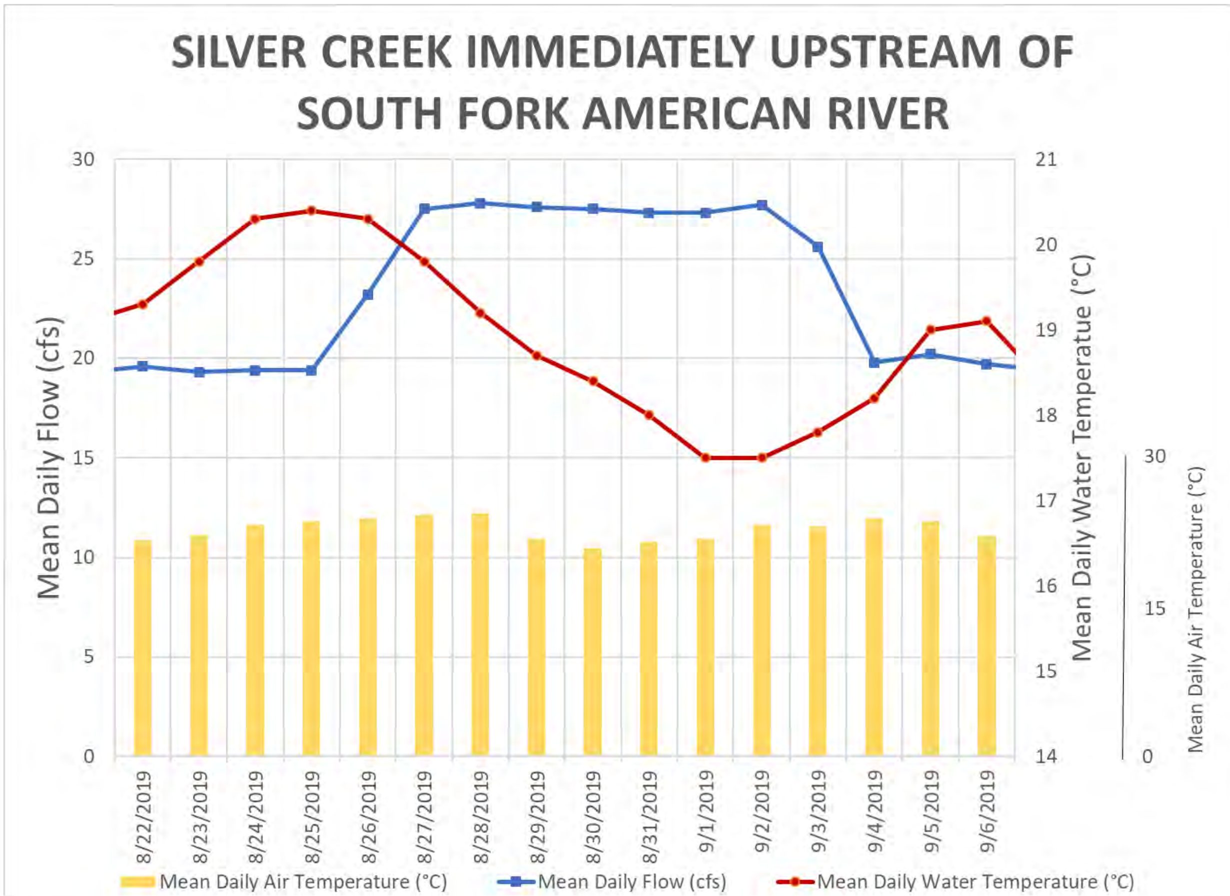


**Figure 12-1. Silver Creek Upstream of South Fork American River Confluence (SC8) block of water**

## 12.6 RESULTS

Data was analyzed at varying frequencies depending on the format of data retrieval (real-time opposed to manually retrieved/downloaded). All data was summarized to include values for daily mean, minimum and maximum temperatures. Further analysis included calculating the highest seven-day moving average temperature (7DMAVG). In a typical year, sites associated with trigger thresholds (Table 12-1), daily minimum, maximum, average and seven day moving average values were determined to notify SMUD staff if these thresholds were being exceeded. These processes are automated in the SMUD License Implementation database, which include a notification process when threshold triggers have been reached.

Water temperature data is presented graphically in Appendix K1. It is impractical to place hourly and daily data for all sites into this report, although this data will be made available upon request.

## 12.7 LITERATURE CITED

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# APPENDIX A1

## Pre- and Post-License Minimum Streamflow Requirements for the Upper American River Project (FERC P-2101)

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**Table A1-1. Summary of minimum streamflow requirements prior to the 2014 UARP FERC license.**

| USGS Gaging Station | TYPE 1 - Years when less than 1 million acre-ft annual inflow is forecasted for Folsom Reservoir | FERC Article 29 Ref. | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11427960 | Rubicon River Below Rubicon Dam | (a) | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | See Note 1 |
| 11428400 | Little Rubicon River Below Buck Island Dam | (b) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | See Note 2 |
| 11429500 | Gerle Creek below Loon Lake Dam | (c) | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | |
| 11430000 | South Fork Rubicon River below Robbs Peak Dam | (d) (g) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | See Notes 3,8 |
| 11430000 | Gerle Creek below Gerle Creek Dam | (d) (g) | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | See Notes 3,8 |
| 11441500 | South Fork Silver Creek below Ice House Dam | (e) (g) | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | See Note 4 |
| 11441800 | Silver Creek below Junction Dam | (f) (g) | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | See Note 3 |
| 11441900 | Silver Creek below Camino Dam | (g) | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | See Note 3 |
| 11442700 | Brush Creek below Brush Creek Dam | (I) | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 2 | 2 | 2 | 2 | See Notes 5, 6 |
| 1143500 | South Fork American River below Slab Creek Dam | (h) | 36 | 36/10 | 10 | 10 | 10 | 10 | 10 | 10 | 36 | 36 | 36 | 36 | See Notes 6, 7 |
| **USGS Gaging Station** | **TYPE 2 - Years when 1.0-1.499 million acre-ft annual inflow is forecasted for Folsom Reservoir** | **FERC Article 29 Ref.** | **OCT** | **NOV** | **DEC** | **JAN** | **FEB** | **MAR** | **APR** | **MAY** | **JUN** | **JUL** | **AUG** | **SEP** | **Comments** |
| 11427960 | Rubicon River Below Rubicon Dam | (a) | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | See Note 1 |
| 11428400 | Little Rubicon River Below Buck Island Dam | (b) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | See Note 2 |
| 11429500 | Gerle Creek below Loon Lake Dam | (c) | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | |
| 11430000 | South Fork Rubicon River below Robbs Peak Dam | (d) (g) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | See Notes 3,8 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11430000 | Gerle Creek below Gerle Creek Dam | (d) (g) | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | See Notes 3,8 |
| 11441500 | South Fork Silver Creek below Ice House Dam | (e) (g) | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | See Note 4 |
| 11441800 | Silver Creek below Junction Dam | (f) (g) | 10 | 6 | 6 | 6 | 6 | 6 | 6 | 10 | 10 | 10 | 10 | 10 | See Note 3 |
| 11441900 | Silver Creek below Camino Dam | (g) | 10 | 6 | 6 | 6 | 6 | 6 | 6 | 10 | 10 | 10 | 10 | 10 | See Note 3 |
| 11442700 | Brush Creek below Brush Creek Dam | (i) | 2 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 2 | 2 | 2 | 2 | See Notes 5, 6 |
| 11443500 | South Fork American River below Slab Creek Dam | (h) | 36 | 36/10 | 10 | 10 | 10 | 10 | 10 | 10 | 36 | 36 | 36 | 36 | See Notes 6,7 |

**Notes:**

1. 6 cfs or the natural flow, whichever is less, plus storage provided by stream flow maintenance dams of the CDFG in Lakes Clyde, Schmidell, Lois, and Middle Velma.
2. 1 cfs at all times in addition to the storage releases from stream flow maintenance dams of the CDFG in Rockbound and Highland Lakes as determined by that dept.
3. Requirements are based on the 4/1 CDWR Bulletin 120 forecasted "Water Year Unimpaired Runoff" for the Folsom Reservoir (which is deemed to be the same as American River at Fair Oaks).
4. Requirements are based on the CDWR Bulletin 120 forecasted "Water Year Unimpaired Runoff" to Folsom Reservoir, beginning with the 4/1 bulletin and applying in turn the 5/1 bulletin as it is issued.
   The 5/1 bulletin shall apply until 4/1 bulletin of the succeeding year is issued.
5. Requirements are as specified or natural flow, whichever is less.
6. Based on the CDWR Bulletin 120 forecasted "Water Year Unimpaired Runoff" to Folsom Reservoir, beginning with the 3/1 bulletin and applying in turn the 4/1 & 5/1 bulletins as they are issued.
   The 5/1 bulletin shall apply until 3/1 bulletin of the succeeding year is issued.
7. From November 1 - November 15, releases are 10 cfs. From November 16- November 30, releases are 4 cfs.
8. Combined releases should be either 10 cfs or 5 cfs (distributed as noted in this chart), measured on the South Fork Rubicon River below the mouth of Gerle Creek.

**Table A1-2. Summary of minimum streamflow requirements included in the current 2014 UARP FERC license.**

| USGS Gaging Station | Above Normal years when 2.6 to 3.5 MAF water year unimpaired inflow was forecast for Folsom Lake | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11427690 | Rubicon Dam | 6* | 6* | 15 | 20 | 35 | 15 | 6* | 6* | 6* | 6* | 6* | 6* | |
| 11428400 | Buck Island Dam | 1* | 1* | 3 | 5 | 8 | 3 | 1* | 1* | 1* | 1* | 1* | 1* | |
| 11429500 | Loon Lake Dam | 23 | 27 | 37 | 49 | 49 | 27 | 27 | 17 | 17 | 20 | 20 | 22 | |
| | Gerle Creek Dam | 6 | 6 | 9 | 9 | 15 | 15 | 15 | 12 | 10 | 10 | 6 | 6 | (4) |
| | Robbs Peak Dam | 7 | 8 | 9 | 10 | 13 | 13 | 13 | 11 | 6 | 3 | 3 | 4 | (4) |
| 11441500 | Ice House Dam | 18 | 18 | 24 | 41 | 68 | 46 | 30 | 15 | 15 | 15 | 8 | 11 | |
| 11441800 | Junction Dam | 20 | 20 | 25 | 42 | 68 | 59 | 35 | 18 | 18 | 15 | 20 | 20 | |
| 11441900 | Camino Dam | 20 | 20 | 25 | 42 | 68 | 59 | 35 | 18 | 18 | 15 | 20 | 20 | |
| 11442700 | Brush Creek Dam | 9* | 9* | 9* | 9* | 9* | 9* | 5* | 4* | 3* | 4* | 9* | 9* | |
| 11443500 | Slab Creek Dam | 80 | 80 | 110-130-150-180 | 188-197-213-222 | 229-236-247-263 | 228-193-158-123 | 90 | 70 | 70 | 80 | 80 | 80 | (2) |
| **USGS Gaging Station** | **Wet years when more than 3.5 MAF water year unimpaired inflow was forecast for Folsom Lake** | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Notes** |
| 11427690 | Rubicon Dam | 6* | 6* | 15 | 20 | 35 | 15 | 6* | 6* | 6* | 6* | 6* | 6* | |
| 11428400 | Buck Island Dam | 1* | 1* | 3 | 5 | 8 | 3 | 1* | 1* | 1* | 1* | 1* | 1* | |
| 11429500 | Loon Lake Dam | 28 | 32 | 44 | 58 | 58 | 32 | 32 | 20 | 20 | 23 | 23 | 26 | |
| | Gerle Creek Dam | 6 | 6 | 9 | 9 | 15 | 15 | 15 | 12 | 10 | 10 | 6 | 6 | (4) |
| | Robbs Peak Dam | 7 | 8 | 9 | 10 | 13 | 13 | 13 | 11 | 6 | 3 | 3 | 4 | (4) |
| 11441500 | Ice House Dam | 18 | 18 | 24 | 41 | 68 | 46 | 30 | 15 | 15 | 15 | 8 | 11 | |
| 11441800 | Junction Dam | 20 | 20 | 25 | 42 | 68 | 59 | 35 | 18 | 18 | 15 | 20 | 20 | |
| 11441900 | Camino Dam | 20 | 20 | 25 | 42 | 68 | 59 | 35 | 18 | 18 | 15 | 20 | 20 | |
| 11442700 | Brush Creek Dam | 10* | 10* | 10* | 10* | 10* | 9* | 5* | 4* | 3* | 4* | 9* | 10* | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 11443500 | Slab Creek Dam | 90 | 90 | 110-130-150-180 | 188-197-213-222 | 229-236-247-263 | 228-193-158-123 | 90 | 70 | 70 | 90 | 90 | 90 | (2) |

* Or natural inflow if less, but in all cases not less than 1 cfs

Notes
1. The water year total volume of unimpaired inflow to Folsom Lake is used to determine the water year. The California DWR makes forecasts of this volume, in units of thousands of acre-feet (TAF). One million acre feet (MAF) equal 1,000 TAF. DWR publishes Bulletin 120 or posts the forecast on its web site several days after February 1, March 1, April 1, and May 1 each year. The value forecasted in May applies until mid October. DWR also computes the actual water year unimpaired inflow and post this value on its web site in mid October. The value posted in October applies until the subsequent February 1 forecast is published.
2. Flows listed for Slab Creek Dam apply during the first five years of the license.
3. MAF denotes million acre-feet. Bulletin 120 gives forecasts in TAF, thousand acre-feet. 1,000 TAF = 1 MAF
4. New USGS gages to be installed in 2008 or 2009

# APPENDIX B1

## 2019 Fish Survey Data

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**Table B1-1. 2019 SMUD UARP Fish Survey Data.**

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| Rubicon | Rubicon Dam | RRD-F1 | Lower | E-fish | 1 | Rainbow trout | 177 | 57.2 | 1 | Scale sample #1 |
| Rubicon | Rubicon Dam | RRD-F1 | Lower | E-fish | 1 | Rainbow trout | 102 | 10.6 | 1 | Scale sample #2 |
| Rubicon | Rubicon Dam | RRD-F1 | Lower | E-fish | 1 | Rainbow trout | 94 | 10.3 | 1 | Scale sample #3 |
| Rubicon | Rubicon Dam | RRD-F1 | Lower | E-fish | 1 | Rainbow trout | 115 | 13.9 | 1 | Scale sample #4 |
| Rubicon | Rubicon Dam | RRD-F1 | Lower | E-fish | 1 | Rainbow trout | 144 | 35.9 | 1 | Scale sample #5 |
| Rubicon | Rubicon Dam | RRD-F1 | Lower | E-fish | 1 | Rainbow trout | 53 | 1.4 | 1 | Scale sample #6 |
| Rubicon | Rubicon Dam | RRD-F1 | Lower | E-fish | 1 | Rainbow trout | 55 | 1.4 | 1 | Scale sample #7 |
| Rubicon | Rubicon Dam | RRD-F1 | Lower | E-fish | 1 | Rainbow trout | 48 | 1.4 | 1 | Scale sample #8 |
| Rubicon | Rubicon Dam | RRD-F1 | Lower | E-fish | 1 | Rainbow trout | 113 | 15.3 | 1 | Scale sample #9 |
| Rubicon | Rubicon Dam | RRD-F1 | Lower | E-fish | 1 | Rainbow trout | 161 | 47.6 | 1 | Scale sample #10 |
| Rubicon | Rubicon Dam | RRD-F1 | Lower | E-fish | 1 | Rainbow trout | 132 | 34.1 | 1 | Scale sample #11 |
| Rubicon | Rubicon Dam | RRD-F1 | Lower | E-fish | 1 | Rainbow trout | 111 | 10.9 | 1 | Scale sample #12 |
| Rubicon | Rubicon Dam | RRD-F1 | Lower | E-fish | 1 | Rainbow trout | 60 | 1.3 | 1 | Scale sample #13 |
| Rubicon | Rubicon Dam | RRD-F1 | Lower | E-fish | 1 | Rainbow trout | 108 | 13.7 | 1 | Scale sample #14 |
| Rubicon | Rubicon Dam | RRD-F1 | Lower | E-fish | 1 | Brown trout | 67 | 3.4 | 1 | Scale sample #15 |
| Rubicon | Rubicon Dam | RRD-F1 | Lower | E-fish | 2 | Brown trout | 72 | 4.0 | 1 | Scale sample #16 |
| Rubicon | Rubicon Dam | RRD-F1 | Lower | E-fish | 2 | Rainbow trout | 84 | 9.0 | 1 | Scale sample #17 |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| Rubicon | Rubicon Dam | RRD-F1 | Lower | E-fish | 3 | Rainbow trout | 106 | 15.7 | 1 | Scale sample #18 |
| Rubicon | Rubicon Dam | RRD-F2 | Upper | E-fish | 1 | Rainbow trout | 135 | 25.1 | 1 | Scale sample #1 |
| Rubicon | Rubicon Dam | RRD-F2 | Upper | E-fish | 2 | Rainbow trout | 145 | 27.6 | 1 | Scale sample #2 |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 1 | Golden shiner | 66 | 2.2 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 1 | Golden shiner | 60 | 1.5 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 1 | Golden shiner | 57 | 1.6 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 1 | Golden shiner | 75 | 4.0 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 1 | Golden shiner | 57 | 1.7 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 1 | Golden shiner | 70 | 3.4 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 1 | Golden shiner | 53 | 1.3 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 1 | California roach | 90 | 7.7 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 1 | California roach | 71 | 3.0 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 1 | Golden shiner | 49 | 0.9 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 1 | California roach | 91 | 8.2 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 1 | Golden shiner | 63 | 2.4 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 1 | California roach | 92 | 6.8 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 1 | California roach | 99 | 9.3 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 1 | California roach | 82 | 5.4 | 1 | |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 1 | Golden shiner | 49 | 1.0 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 1 | Sacramento sucker | 280 | 144.5 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 2 | Golden shiner | 57 | 1.2 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 2 | Golden shiner | 71 | 3.1 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 2 | Golden shiner | 69 | 2.6 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 2 | Golden shiner | 51 | 1.2 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 2 | California roach | 31 | 0.1 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 2 | California roach | 76 | 4.2 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 2 | Golden shiner | 50 | 1.0 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 2 | California roach | 81 | 5.6 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 2 | California roach | 83 | 5.9 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 3 | Golden shiner | 78 | 4.8 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Upper | E-fish | 1 | California roach | 67 | 2.7 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Upper | E-fish | 1 | California roach | 89 | 6.8 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Upper | E-fish | 1 | California roach | 57 | 1.8 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Upper | E-fish | 1 | California roach | 80 | 4.4 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Upper | E-fish | 2 | California roach | 70 | 3.0 | 1 | |
| Little Rubicon | Buck Island Dam | BID-F1 | Upper | E-fish | 2 | California roach | 52 | 1.2 | 1 | |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| Gerle Creek | Loon Lake Dam | LLD-F3 | Lower | E-fish | 1 | Rainbow trout | 120 | 14.6 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F3 | Lower | E-fish | 1 | Brown trout | 59 | 5.0 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F3 | Lower | E-fish | 1 | Rainbow trout | 48 | 1.3 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F3 | Lower | E-fish | 1 | Brown trout | 120 | 15.5 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F3 | Lower | E-fish | 1 | Brown trout | 160 | 39.7 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F3 | Lower | E-fish | 2 | Rainbow trout | 181 | 53.0 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F3 | Lower | E-fish | 2 | Brown trout | 147 | 31.5 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F3 | Upper | E-fish | 1 | Brown trout | 60 | 2.2 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F3 | Upper | E-fish | 1 | Brown trout | 61 | 2.0 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F3 | Upper | E-fish | 3 | Brown trout | 119 | 17.8 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Lower | E-fish | 1 | Rainbow trout | 73 | 4.3 | 1 | Scale Sample #1 |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Lower | E-fish | 1 | Rainbow trout | 150 | 29.0 | 1 | Scale Sample #2 |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Lower | E-fish | 1 | Rainbow trout | 149 | 29.9 | 1 | Scale Sample #3 |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Lower | E-fish | 1 | Rainbow trout | 127 | 14.8 | 1 | Scale Sample #4 |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Lower | E-fish | 1 | Rainbow trout | 84 | 5.6 | 1 | Scale Sample #5 |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Lower | E-fish | 1 | Rainbow trout | 79 | 4.5 | 1 | Scale Sample #6 |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Lower | E-fish | 1 | Rainbow trout | 62 | 2.4 | 1 | Scale Sample #7 |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Lower | E-fish | 1 | Rainbow trout | 65 | 1.8 | 1 | Scale Sample #8 |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| Gerle Creek | Loon Lake Dam | LLD-F2 | Lower | E-fish | 2 | Rainbow trout | 157 | 31.4 | 1 | Scale Sample #9 |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Lower | E-fish | 2 | Rainbow trout | 139 | 23.5 | 1 | Scale Sample #10 |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Lower | E-fish | 2 | Rainbow trout | 133 | 18.6 | 1 | Scale Sample #11 |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Lower | E-fish | 2 | Rainbow trout | 125 | 50.8 | 1 | Scale Sample #12 |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Lower | E-fish | 2 | Rainbow trout | 67 | 2.3 | 1 | Scale Sample #13 |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Lower | E-fish | 3 | Rainbow trout | 122 | 16.4 | 1 | Scale Sample #14 |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Lower | E-fish | 3 | Rainbow trout | 91 | 6.8 | 1 | Scale Sample #15 |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Lower | E-fish | 3 | Rainbow trout | 85 | 5.9 | 1 | Scale Sample #16 |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-fish | 1 | Rainbow trout | 65 | 2.7 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-fish | 1 | Rainbow trout | 160 | 34.1 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-fish | 1 | Brown trout | 210 | 93.7 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-fish | 1 | Rainbow trout | 137 | 24.2 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-fish | 1 | Rainbow trout | 169 | 39.7 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-fish | 1 | Rainbow trout | 130 | 18.3 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-fish | 1 | Rainbow trout | 79 | 4.7 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-fish | 1 | Brown trout | 164 | 36.3 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-fish | 1 | Brown trout | 352 | 450.0 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-fish | 2 | Rainbow trout | 85 | 4.9 | 1 | |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-fish | 2 | Rainbow trout | 133 | 19.3 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-fish | 2 | Rainbow trout | 62 | 2.3 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-fish | 2 | Rainbow trout | 133 | 18.3 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-fish | 2 | Rainbow trout | 174 | 3.2 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-fish | 2 | Rainbow trout | 116 | 12.1 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-fish | 2 | Brown trout | 92 | 7.1 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-fish | 2 | Rainbow trout | 167 | 43.4 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-fish | 2 | Rainbow trout | 155 | 33.7 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-fish | 3 | Brown trout | 82 | 4.8 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-fish | 3 | Brown trout | 240 | 137.9 | 1 | |
| Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-fish | 3 | Rainbow trout | 181 | 54.8 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 1 | Rainbow trout | 147 | 28.4 | 1 | Scale Sample #1 |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 1 | Rainbow trout | 119 | 11.3 | 1 | Scale Sample #2 |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 1 | Rainbow trout | 141 | 24.4 | 1 | Scale Sample #3 |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 1 | Rainbow trout | 103 | 8.8 | 1 | Scale Sample #4 |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 1 | Rainbow trout | 116 | 12.8 | 1 | Scale Sample #5 |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 1 | Rainbow trout | 59 | 1.7 | 1 | Scale Sample #6 |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 1 | Rainbow trout | 110 | 11.0 | 1 | Scale Sample #7 |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 1 | Rainbow trout | 59 | 1.2 | 1 | Scale Sample #8 |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 1 | Rainbow trout | 67 | 2.4 | 1 | Scale Sample #9 |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 1 | Rainbow trout | 56 | 1.4 | 1 | Scale Sample #10 |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 1 | Rainbow trout | 55 | 1.5 | 1 | Scale Sample #11 |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 1 | Rainbow trout | 51 | 1.1 | 1 | Scale Sample #12 |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 1 | Rainbow trout | 59 | 1.5 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 1 | Rainbow trout | 118 | 14.9 | 1 | Scale Sample #13 |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 1 | Rainbow trout | 137 | 20.3 | 1 | Scale Sample #14 |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 1 | Rainbow trout | 61 | 1.8 | 1 | Scale Sample #15 |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 1 | Rainbow trout | 109 | 10.7 | 1 | Scale Sample #16 |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 1 | Rainbow trout | 105 | 10.3 | 1 | Scale Sample #17 |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 1 | Rainbow trout | 53 | 1.2 | 1 | Scale Sample #18 |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 1 | Rainbow trout | 67 | 2.4 | 1 | Scale Sample #19 |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 1 | Rainbow trout | 98 | 7.7 | 1 | Scale Sample #20 |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 1 | Rainbow trout | 60 | 2.0 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 1 | Rainbow trout | 63 | 2.1 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 1 | Rainbow trout | 62 | 3.0 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 2 | Rainbow trout | 107 | 11.5 | 1 | |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 2 | Rainbow trout | 66 | 2.4 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 2 | Rainbow trout | 50 | 1.1 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 2 | Rainbow trout | 117 | 12.9 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 2 | Rainbow trout | 66 | 2.0 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 2 | Rainbow trout | 46 | 0.8 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 2 | Rainbow trout | 60 | 1.8 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 2 | Rainbow trout | 51 | 1.2 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 2 | Rainbow trout | 65 | 2.1 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 2 | Rainbow trout | 151 | 27.2 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 2 | Rainbow trout | 114 | 12.2 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 2 | Rainbow trout | 183 | 45.4 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 2 | Rainbow trout | 105 | 10.6 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 2 | Rainbow trout | 52 | 1.3 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 2 | Rainbow trout | 62 | 2.0 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 3 | Rainbow trout | 68 | 2.5 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 3 | Rainbow trout | 56 | 2.0 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 3 | Rainbow trout | 155 | 29.5 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 3 | Rainbow trout | 193 | 63.7 | 1 | |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 3 | Rainbow trout | 66 | 2.3 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 3 | Rainbow trout | 62 | 2.0 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 3 | Rainbow trout | 56 | 1.5 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 3 | Rainbow trout | 54 | 1.8 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 3 | Rainbow trout | 115 | 12.6 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 3 | Rainbow trout | 60 | 1.8 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 4 | Rainbow trout | 115 | 11.5 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 4 | Rainbow trout | 57 | 1.7 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 4 | Rainbow trout | 55 | 1.6 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 4 | Rainbow trout | 120 | 12.7 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 4 | Rainbow trout | 143 | 25.4 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Upper | E-fish | 1 | Rainbow trout | 117 | 14.4 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Upper | E-fish | 1 | Rainbow trout | 118 | 12.9 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Upper | E-fish | 1 | Rainbow trout | 71 | 2.8 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Upper | E-fish | 1 | Rainbow trout | 60 | 1.8 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Upper | E-fish | 1 | Rainbow trout | 61 | 2.1 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Upper | E-fish | 2 | Rainbow trout | 97 | 7.9 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Upper | E-fish | 2 | Rainbow trout | 65 | 2.1 | 1 | |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Upper | E-fish | 2 | Rainbow trout | 55 | 1.3 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Upper | E-fish | 2 | Rainbow trout | 101 | 8.8 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Upper | E-fish | 2 | Brown trout | 82 | 5.5 | 1 | Scale Sample #1 |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Upper | E-fish | 3 | Rainbow trout | 63 | 1.7 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Upper | E-fish | 3 | Rainbow trout | 51 | 1.0 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Upper | E-fish | 3 | Rainbow trout | 113 | 12.1 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Upper | E-fish | 4 | Rainbow trout | 46 | 0.7 | 1 | |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | Upper | E-fish | 4 | Rainbow trout | 62 | 2.2 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 91 | 6.6 | 1 | Scale Sample #1 |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 61 | 1.7 | 1 | Scale Sample #2 |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 57 | 1.5 | 1 | Scale Sample #3 |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 58 | 1.5 | 1 | Scale Sample #4 |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 61 | 1.8 | 1 | Scale Sample #5 |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 51 | 1.2 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 50 | 101.0 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 114 | 14.0 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 109 | 10.5 | 1 | Scale Sample #6 |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 59 | 1.8 | 1 | Scale Sample #7 |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 55 | 1.2 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 54 | 1.4 | 1 | Scale Sample #8 |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 44 | 0.7 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 58 | 1.7 | 1 | Scale Sample #9 |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 114 | 12.9 | 1 | Scale Sample #10 |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 118 | 15.6 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 62 | 2.1 | 1 | Scale Sample #11 |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 122 | 15.6 | 1 | Scale Sample #12 |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 118 | 13.7 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 66 | 2.1 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Brown trout | 79 | 5.0 | 1 | Scale Sample #13 |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 48 | 1.0 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 113 | 12.4 | 1 | Scale Sample #14 |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 52 | 1.2 | 1 | Scale Sample #15 |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 48 | 0.9 | 1 | Scale Sample #16 |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 51 | 1.1 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 116 | 13.8 | 1 | Scale Sample #17 |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 58 | 1.8 | 1 | Scale Sample #18 |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 120 | 14.7 | 1 | Scale Sample #19 |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 170 | 48.8 | 1 | Scale Sample #20 |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 58 | 2.2 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Brown trout | 325 | 398.0 | 1 | Scale Sample #21 |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 66 | 2.5 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 68 | 2.4 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 53 | 0.2 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 75 | 3.2 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 67 | 2.7 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 67 | 2.2 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 108 | 10.4 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 52 | 1.2 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 128 | 17.8 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 113 | 13.1 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 62 | 2.0 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 67 | 2.5 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 1 | Rainbow trout | 54 | 1.4 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 2 | Rainbow trout | 54 | 1.3 | 1 | |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 2 | Rainbow trout | 53 | 1.3 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 2 | Rainbow trout | 107 | 11.5 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 2 | Rainbow trout | 64 | 2.4 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 2 | Rainbow trout | 47 | 0.9 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 2 | Rainbow trout | 50 | 1.3 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 2 | Rainbow trout | 61 | 1.9 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 2 | Rainbow trout | 104 | 10.8 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 2 | Rainbow trout | 175 | 48.8 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 2 | Rainbow trout | 59 | 1.5 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 2 | Rainbow trout | 63 | 2.3 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 2 | Rainbow trout | 55 | 1.5 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 2 | Rainbow trout | 43 | 0.6 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 2 | Rainbow trout | 66 | 2.3 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 2 | Rainbow trout | 45 | 0.5 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 2 | Rainbow trout | 60 | 2.2 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 2 | Rainbow trout | 125 | 17.6 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 2 | Rainbow trout | 145 | 31.5 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 2 | Rainbow trout | 179 | 52.1 | 1 | |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 2 | Rainbow trout | 120 | 16.2 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 2 | Brown trout | 222 | 124.9 | 1 | Scale Sample #22 |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 3 | Rainbow trout | 118 | 13.6 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 3 | Rainbow trout | 99 | 8.6 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 3 | Rainbow trout | 57 | 1.6 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 3 | Rainbow trout | 117 | 14.5 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 3 | Rainbow trout | 101 | 9.0 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 3 | Rainbow trout | 55 | 1.5 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 3 | Rainbow trout | 58 | 1.6 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 3 | Rainbow trout | 105 | 10.8 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 3 | Rainbow trout | 54 | 1.3 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 39 | 0.5 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 62 | 1.6 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 55 | 1.7 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 58 | 1.4 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 175 | 61.2 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 54 | 1.4 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 56 | 1.5 | 1 | |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 105 | 9.2 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 187 | 55.6 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 57 | 1.5 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 120 | 16.2 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 111 | 10.4 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 178 | 52.0 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 60 | 2.2 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 113 | 11.1 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 102 | 8.3 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 45 | 0.7 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 54 | 1.7 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 120 | 15.8 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 117 | 15.1 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 55 | 1.2 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 58 | 1.8 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 49 | 1.1 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 61 | 2.0 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 147 | 27.8 | 1 | |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 115 | 13.8 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 92 | 7.2 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 49 | 1.1 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 135 | 23.3 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 118 | 14.5 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 107 | 9.8 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Rainbow trout | 118 | 16.1 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Brown trout | 80 | 4.8 | 1 | Scale Sample #23 |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 1 | Brown trout | 160 | 42.6 | 1 | Scale Sample #24 |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 2 | Rainbow trout | 57 | 1.9 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 2 | Rainbow trout | 55 | 1.2 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 2 | Rainbow trout | 64 | 2.7 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 2 | Rainbow trout | 130 | 19.9 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 2 | Rainbow trout | 57 | 1.6 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 2 | Rainbow trout | 60 | 1.6 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 2 | Rainbow trout | 55 | 1.5 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 2 | Rainbow trout | 108 | 10.5 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 2 | Rainbow trout | 139 | 22.2 | 1 | |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 2 | Rainbow trout | 113 | 11.7 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 2 | Rainbow trout | 115 | 14.3 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 2 | Rainbow trout | 112 | 13.2 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 2 | Brown trout | 90 | 6.8 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 2 | Rainbow trout | 190 | 61.0 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 3 | Rainbow trout | 59 | 1.7 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 3 | Rainbow trout | 111 | 11.5 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 3 | Rainbow trout | 115 | 13.4 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 3 | Rainbow trout | 139 | 24.2 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 3 | Rainbow trout | 71 | 3.4 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 3 | Brown trout | 90 | 6.2 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 3 | Rainbow trout | 108 | 11.0 | 1 | |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 3 | Rainbow trout | 199 | 78.7 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F1 | Lower | E-fish | 1 | Rainbow trout | 80 | 5.3 | 1 | Scale Sample #1 |
| S.F. Silver Creek | Ice House Dam | IHD-F1 | Lower | E-fish | 1 | Rainbow trout | 136 | 24.2 | 1 | Scale Sample #2 |
| S.F. Silver Creek | Ice House Dam | IHD-F1 | Lower | E-fish | 1 | Brown trout | 185 | 63.9 | 1 | Scale Sample #3 |
| S.F. Silver Creek | Ice House Dam | IHD-F1 | Lower | E-fish | 1 | Rainbow trout | 121 | 22.0 | 1 | Scale Sample #4 |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| S.F. Silver Creek | Ice House Dam | IHD-F1 | Lower | E-fish | 1 | Rainbow trout | 74 | 4.0 | 1 | Scale Sample #5 |
| S.F. Silver Creek | Ice House Dam | IHD-F1 | Lower | E-fish | 2 | Rainbow trout | 115 | 15.7 | 1 | Scale Sample #6 |
| S.F. Silver Creek | Ice House Dam | IHD-F1 | Lower | E-fish | 2 | Brown trout | 151 | 33.9 | 1 | Scale Sample #7 |
| S.F. Silver Creek | Ice House Dam | IHD-F1 | Lower | E-fish | 3 | Rainbow trout | 160 | 40.4 | 1 | Scale Sample #8 |
| S.F. Silver Creek | Ice House Dam | IHD-F1 | Lower | E-fish | 3 | Rainbow trout | 89 | 6.7 | 1 | Scale Sample #9 |
| S.F. Silver Creek | Ice House Dam | IHD-F1 | Lower | E-fish | 3 | Rainbow trout | 81 | 4.6 | 1 | Scale Sample #10 |
| S.F. Silver Creek | Ice House Dam | IHD-F1 | Lower | E-fish | 4 | Rainbow trout | 187 | 67.3 | 1 | Scale Sample #11 |
| S.F. Silver Creek | Ice House Dam | IHD-F1 | Lower | E-fish | 4 | Rainbow trout | 154 | 36.1 | 1 | Scale Sample #12 |
| S.F. Silver Creek | Ice House Dam | IHD-F1 | Upper | E-fish | 1 | Rainbow trout | 134 | 23.2 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F1 | Upper | E-fish | 2 | Rainbow trout | 79 | 4.6 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F1 | Upper | E-fish | 3 | Rainbow trout | 203 | 76.1 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F1 | Upper | E-fish | 3 | Rainbow trout | 191 | 71.1 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F1 | Upper | E-fish | 3 | Rainbow trout | 145 | 29.5 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F1 | Upper | E-fish | 4 | Rainbow trout | 72 | 3.9 | 1 | |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| S.F. Silver Creek | Ice House Dam | IHD-F1 | Upper | E-fish | 4 | Rainbow trout | 128 | 19.6 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F1 | Upper | E-fish | 4 | Brown trout | 127 | 19.1 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Lower | E-fish | 1 | Brown trout | 64 | 2.1 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Lower | E-fish | 1 | Brown trout | 64 | 2.2 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Lower | E-fish | 1 | Rainbow trout | 212 | 82.5 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Lower | E-fish | 1 | Brown trout | 131 | 25.0 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Lower | E-fish | 1 | Brown trout | 338 | 355.0 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Lower | E-fish | 1 | Rainbow trout | 130 | 18.5 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Lower | E-fish | 1 | Rainbow trout | 100 | 7.9 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Lower | E-fish | 1 | Brown trout | 131 | 21.3 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Lower | E-fish | 1 | Rainbow trout | 102 | 11.2 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Lower | E-fish | 1 | Brown trout | 59 | 2.1 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Lower | E-fish | 1 | Brown trout | 140 | 26.1 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Lower | E-fish | 3 | Brown trout | 130 | 18.8 | 1 | |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Lower | E-fish | 3 | Rainbow trout | 51 | 1.2 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Lower | E-fish | 4 | Sacramento sucker | 240 | 160.0 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Upper | E-fish | 1 | Rainbow trout | 169 | 48.8 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Upper | E-fish | 1 | Brown trout | 68 | 3.8 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Upper | E-fish | 1 | Brown trout | 67 | 4.2 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Upper | E-fish | 1 | Rainbow trout | 168 | 36.5 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Upper | E-fish | 2 | Brown trout | 336 | 320.0 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Upper | E-fish | 2 | Rainbow trout | 109 | 11.8 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Upper | E-fish | 2 | Rainbow trout | 129 | 18.9 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Upper | E-fish | 2 | Brown trout | 79 | 4.6 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Upper | E-fish | 2 | Brown trout | 79 | 4.5 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Upper | E-fish | 2 | Brown trout | 66 | 2.4 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Upper | E-fish | 2 | Sacramento sucker | 28 | 0.1 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Upper | E-fish | 3 | Brown trout | 137 | 28.2 | 1 | |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Upper | E-fish | 3 | Sacramento sucker | 204 | 100.0 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Upper | E-fish | 3 | Rainbow trout | 118 | 14.2 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Upper | E-fish | 3 | Brown trout | 75 | 4.1 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Upper | E-fish | 3 | Brown trout | 58 | 2.2 | 1 | |
| S.F. Silver Creek | Ice House Dam | IHD-F2 | Upper | E-fish | 4 | Rainbow trout | 108 | 11.1 | 1 | |
| Silver Creek | Camino Dam | CD-F1 | 1 Pool | Snorkel | - | Rainbow trout | 150-175 | - | 35 | |
| Silver Creek | Camino Dam | CD-F1 | 1 Pool | Snorkel | - | Rainbow trout | 175-200 | - | 10 | |
| Silver Creek | Camino Dam | CD-F1 | 1 Pool | Snorkel | - | Rainbow trout | 125-150 | - | 5 | |
| Silver Creek | Camino Dam | CD-F1 | 1 Pool | Snorkel | - | Rainbow trout | 125-150 | - | 12 | |
| Silver Creek | Camino Dam | CD-F1 | 1 Pool | Snorkel | - | Rainbow trout | 200-225 | - | 1 | |
| Silver Creek | Camino Dam | CD-F1 | 1 Pool | Snorkel | - | Rainbow trout | 125-150 | - | 1 | |
| Silver Creek | Camino Dam | CD-F1 | 1 Pool | Snorkel | - | Rainbow trout | 25-50 | - | 1 | |
| Silver Creek | Camino Dam | CD-F1 | 1 Pool | Snorkel | - | RAINBOW TROUT | 50-75 | - | 1 | |
| Silver Creek | Camino Dam | CD-F1 | 2 Riffle | Snorkel | - | Rainbow trout | 100-125 | - | 3 | |
| Silver Creek | Camino Dam | CD-F1 | 2 Riffle | Snorkel | - | Rainbow trout | 125-150 | - | 8 | |
| Silver Creek | Camino Dam | CD-F1 | 2 Riffle | Snorkel | - | Rainbow trout | 150-175 | - | 12 | |
| Silver Creek | Camino Dam | CD-F1 | 2 Riffle | Snorkel | - | Rainbow trout | 175-200 | - | 2 | |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| Silver Creek | Camino Dam | CD-F1 | 2 Riffle | Snorkel | - | Rainbow trout | 75-100 | - | 1 | |
| Silver Creek | Camino Dam | CD-F1 | 2 Riffle | Snorkel | - | Rainbow trout | 50-75 | - | 2 | |
| Silver Creek | Camino Dam | CD-F1 | 2 Riffle | Snorkel | - | Rainbow trout | 100-125 | - | 2 | |
| Silver Creek | Camino Dam | CD-F1 | 2 Riffle | Snorkel | - | Rainbow trout | 175-200 | - | 1 | |
| Silver Creek | Camino Dam | CD-F1 | 3 Pool | Snorkel | - | Rainbow trout | 75-100 | - | 3 | |
| Silver Creek | Camino Dam | CD-F1 | 3 Pool | Snorkel | - | Rainbow trout | 100-125 | - | 3 | |
| Silver Creek | Camino Dam | CD-F1 | 3 Pool | Snorkel | - | Rainbow trout | 125-150 | - | 5 | |
| Silver Creek | Camino Dam | CD-F1 | 3 Pool | Snorkel | - | Rainbow trout | 150-175 | - | 1 | |
| Silver Creek | Camino Dam | CD-F1 | 3 Pool | Snorkel | - | Rainbow trout | 175-200 | - | 3 | |
| Silver Creek | Camino Dam | CD-F1 | 3 Pool | Snorkel | - | Rainbow trout | 225-250 | - | 1 | |
| Silver Creek | Camino Dam | CD-F1 | 4 Riffle | Snorkel | - | Rainbow trout | 75-100 | - | 1 | |
| Silver Creek | Camino Dam | CD-F1 | 4 Riffle | Snorkel | - | Rainbow trout | 100-125 | - | 1 | |
| Silver Creek | Camino Dam | CD-F1 | 5 Pool | Snorkel | - | Rainbow trout | 25-50 | - | 1 | |
| Silver Creek | Camino Dam | CD-F1 | 5 Pool | Snorkel | - | Rainbow trout | 50-75 | - | 1 | |
| Silver Creek | Camino Dam | CD-F1 | 5 Pool | Snorkel | - | Rainbow trout | 75-100 | - | 1 | |
| Silver Creek | Camino Dam | CD-F1 | 5 Pool | Snorkel | - | Rainbow trout | 125-150 | - | 5 | |
| Silver Creek | Camino Dam | CD-F1 | 5 Pool | Snorkel | - | Rainbow trout | 150-175 | - | 7 | |
| Silver Creek | Camino Dam | CD-F1 | 5 Pool | Snorkel | - | Rainbow trout | 175-200 | - | 3 | |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| Silver Creek | Camino Dam | CD-F1 | 5 Pool | Snorkel | - | Rainbow trout | 200-225 | - | 1 | |
| Silver Creek | Camino Dam | CD-F1 | 7 Pool | Snorkel | - | Rainbow trout | 25-50 | - | 2 | |
| Silver Creek | Camino Dam | CD-F1 | 7 Pool | Snorkel | - | Rainbow trout | 50-75 | - | 3 | |
| Silver Creek | Camino Dam | CD-F1 | 7 Pool | Snorkel | - | Rainbow trout | 75-100 | - | 3 | |
| Silver Creek | Camino Dam | CD-F1 | 7 Pool | Snorkel | - | Rainbow trout | 100-125 | - | 8 | |
| Silver Creek | Camino Dam | CD-F1 | 7 Pool | Snorkel | - | Rainbow trout | 125-150 | - | 4 | |
| Silver Creek | Camino Dam | CD-F1 | 7 Pool | Snorkel | - | Rainbow trout | 250-275 | - | 3 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 1 POW | Snorkel | - | Unidentified sunfish | 50-75 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 1 POW | Snorkel | - | Rainbow trout | 50-75 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 1 POW | Snorkel | - | Rainbow trout | 100-125 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 1 POW | Snorkel | - | Rainbow trout | 125-150 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 1 POW | Snorkel | - | Rainbow trout | 25-50 | - | 2 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 1 POW | Snorkel | - | Rainbow trout | 100-125 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 1 POW | Snorkel | - | Rainbow trout | 125-150 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 1 POW | Snorkel | - | Rainbow trout | 50-75 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 1 POW | Snorkel | - | Rainbow trout | 75-100 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 1 POW | Snorkel | - | Rainbow trout | 100-125 | - | 2 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 1 POW | Snorkel | - | Rainbow trout | 150-175 | - | 2 | |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| S.F. American | Slab Creek Dam | SCD-F3 | 1 POW | Snorkel | - | Rainbow trout | 200-225 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 1 POW | Snorkel | - | Rainbow trout T | 300-325 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 1 POW | Snorkel | - | Brown trout | 300-325 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 1 POW | Snorkel | - | Rainbow trout | 225-250 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 1 POW | Snorkel | - | Rainbow trout | 75-100 | - | 2 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 1 POW | Snorkel | - | Rainbow trout | 150-175 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 2 Pool | Snorkel | - | Brown trout | 125-150 | - | 2 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 2 Pool | Snorkel | - | Rainbow trout | 250-275 | - | 2 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 2 Pool | Snorkel | - | Rainbow trout | 100-125 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 2 Pool | Snorkel | - | Rainbow trout | 125-150 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 2 Pool | Snorkel | - | Rainbow trout | 175-200 | - | 3 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 2 Pool | Snorkel | - | Rainbow trout | 200-225 | - | 2 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 2 Pool | Snorkel | - | Rainbow trout | 275-300 | - | 2 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 2 Pool | Snorkel | - | Rainbow trout | 225-250 | - | 2 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 2 Pool | Snorkel | - | Rainbow trout | 25-50 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 2 Pool | Snorkel | - | Rainbow trout | 150-175 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 2 Pool | Snorkel | - | Rainbow trout | 125-150 | - | 2 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 3 Riffle | Snorkel | - | Rainbow trout | 75-100 | - | 1 | |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| S.F. American | Slab Creek Dam | SCD-F3 | 4 Run | Snorkel | - | Brown trout | 150-175 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 4 Run | Snorkel | - | Rainbow trout | 50-75 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 4 Run | Snorkel | - | Rainbow trout | 50-75 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 4 Run | Snorkel | - | Rainbow trout | 100-125 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 4 Run | Snorkel | - | Rainbow trout | 125-150 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 4 Run | Snorkel | - | Rainbow trout | 100-125 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | 4 Run | Snorkel | - | Rainbow trout | 125-150 | - | 2 | |
| S.F. American | Slab Creek Dam | SCD-F3 | - | E-fish | 1 | Rainbow trout | 77 | 3.5 | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | - | E-fish | 1 | Rainbow trout | 85 | 5.0 | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | - | E-fish | 1 | Rainbow trout | 75 | 3.5 | 1 | |
| S.F. American | Slab Creek Dam | SCD-F3 | - | E-fish | 1 | Rainbow trout | 70 | 2.7 | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 2 Run | Snorkel | - | Rainbow trout | 100-125 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 2 Run | Snorkel | - | Rainbow trout | 100-125 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 3 Run | Snorkel | - | Rainbow trout | 100-125 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 3 Run | Snorkel | - | Rainbow trout | 100-125 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 3 Run | Snorkel | - | Rainbow trout | 100-125 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 4 Riffle | Snorkel | - | Rainbow trout | 100-125 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 4 Riffle | Snorkel | - | Rainbow trout | 100-125 | - | 1 | |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| S.F. American | Slab Creek Dam | SCD-F2 | 4 Riffle | Snorkel | - | Rainbow trout | 100-125 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 5 Pool | Snorkel | - | Rainbow trout | 100-125 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 5 Pool | Snorkel | - | Rainbow trout | 100-125 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 4 Riffle | Snorkel | - | Rainbow trout | 125-150 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 5 Pool | Snorkel | - | Rainbow trout | 125-150 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 2 Run | Snorkel | - | Rainbow trout | 150-175 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 2 Run | Snorkel | - | Rainbow trout | 150-175 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 3 Run | Snorkel | - | Rainbow trout | 150-175 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 3 Run | Snorkel | - | Rainbow trout | 150-175 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 3 Run | Snorkel | - | Rainbow trout | 150-175 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 5 Pool | Snorkel | - | Rainbow trout | 150-175 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 2 Run | Snorkel | - | Rainbow trout | 175-200 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 3 Run | Snorkel | - | Rainbow trout | 175-200 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 5 Pool | Snorkel | - | Rainbow trout | 175-200 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 2 Run | Snorkel | - | Rainbow trout | 200-225 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 5 Pool | Snorkel | - | Rainbow trout | 200-225 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 2 Run | Snorkel | - | Rainbow trout | 250-275 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 2 Run | Snorkel | - | Rainbow trout | 250-275 | - | 1 | |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| S.F. American | Slab Creek Dam | SCD-F2 | 2 Run | Snorkel | - | Rainbow trout | 250-275 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 2 Run | Snorkel | - | Rainbow trout | 25-50 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 3 Run | Snorkel | - | Rainbow trout | 50-75 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 3 Run | Snorkel | - | Rainbow trout | 50-75 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 3 Run | Snorkel | - | Rainbow trout | 50-75 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 4 Riffle | Snorkel | - | Rainbow trout | 50-75 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 5 Pool | Snorkel | - | Rainbow trout | 50-75 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 2 Run | Snorkel | - | Rainbow trout | 75-100 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 2 Run | Snorkel | - | Rainbow trout | 75-100 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 3 Run | Snorkel | - | Rainbow trout | 75-100 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 3 Run | Snorkel | - | Rainbow trout | 75-100 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 3 Run | Snorkel | - | Rainbow trout | 75-100 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 4 Riffle | Snorkel | - | Rainbow trout | 75-100 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 3 Run | Snorkel | - | Sculpin spp. | 25-50 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 3 Run | Snorkel | - | Sculpin spp. | 25-50 | - | 2 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 3 Run | Snorkel | - | Sculpin spp. | 25-50 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 4 Riffle | Snorkel | - | Sculpin spp. | 25-50 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | 1 Pool | Snorkel | - | Sculpin spp. | 50-75 | - | 1 | |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| S.F. American | Slab Creek Dam | SCD-F2 | 3 Run | Snorkel | - | Sacramento sucker | 275-300 | - | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | - | E-fish | 1 | Sacramento pikeminnow | 60 | 1.5 | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | - | E-fish | 1 | Sacramento sucker | 44 | 0.7 | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | - | E-fish | 1 | Sacramento sucker | 39 | 0.6 | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | - | E-fish | 1 | Sacramento pikeminnow | 34 | 0.2 | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | - | E-fish | 1 | Sacramento sucker | 81 | 6.0 | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | - | E-fish | 1 | Sculpin spp. | 85 | 7.1 | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | - | E-fish | 1 | Sculpin spp. | 70 | 3.7 | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | - | E-fish | 1 | Sculpin spp. | 39 | 0.7 | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | - | E-fish | 1 | Sculpin spp. | 70 | 3.8 | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | - | E-fish | 1 | Sculpin spp. | 87 | 7.9 | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | - | E-fish | 1 | Sculpin spp. | 82 | 5.8 | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | - | E-fish | 1 | Sculpin spp. | 35 | 0.4 | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | - | E-fish | 1 | Sculpin spp. | 66 | 3.4 | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | - | E-fish | 1 | Sculpin spp. | 71 | 4.4 | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | - | E-fish | 1 | Sculpin spp. | 64 | 3.0 | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | - | E-fish | 1 | Sculpin spp. | 62 | 2.5 | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | - | E-fish | 1 | Sculpin spp. | 36 | 0.7 | 1 | |

| Stream | Reach | Site | Segment | Method | Pass | Species | Length (mm) | Weight (g) | Count | Notes |
|---|---|---|---|---|---|---|---|---|---|---|
| S.F. American | Slab Creek Dam | SCD-F2 | - | E-fish | 1 | Sculpin spp. | 72 | 4.3 | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | - | E-fish | 1 | Sculpin spp. | 41 | 0.7 | 1 | |
| S.F. American | Slab Creek Dam | SCD-F2 | - | E-fish | 1 | Sculpin spp. | 44 | 0.8 | 1 | |

g = grams
mm = millimeters
spp. = species

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# APPENDIX B2

## Fish Population Data

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Table B2-1. Fish Population Data, 2002–2019, for Site RRD-F1, Rubicon River, Rubicon Dam Reach.

| Stream and Reach | Site | Section | Year | Site Length (ft) | Avg. Width (ft) | Avg. Area ($ft^2$) | Species | Total Number Captured | Removal Pattern | Number of Fish / Mile | Catchable Trout / Mile (>152 mm) | Estimated Density, Zippin Method: No. of Fish / Acre | Estimated Density, Zippin Method: 95 Percent Confidence Interval (No. of fish/acre) | | Total Biomass (g) | Estimated Biomass: g/acre | Estimated Biomass: lbs/acre | Estimated Biomass: 95 Percent Confidence Interval (lbs/acre) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rubicon River, Rubicon Dam | RRD-F1 | Combined | 2019 | 287 | 34 | 9,758 | Trout (brown & rainbow) | 20 | 16-3-1 | 372 | 37 | 89 | 85 | 94 | 339.8 | 1,519.5 | 3.4 | 3.2 | 3.5 |
| | | Upper | | 161 | 39 | 6,241 | Trout (brown & rainbow) | 2 | 1-1-0 | 72 | 0 | 15 | 5 | 25 | 52.7 | 399.2 | 0.9 | 0.3 | 1.5 |
| | | Lower | | 126 | 30 | 3,762 | Trout (brown & rainbow) | 18 | 15-2-1 | 758 | 84 | 210 | 200 | 220 | 287.1 | 3,347.5 | 7.4 | 7.0 | 7.7 |
| | | Combined | 2005 | 314 | 28 | 8,792 | Trout (brown & rainbow) | 61 | 37-16-8 | 1,098 | 69 | 329 | 284 | 374 | 983.3 | 5,307.0 | 11.7 | 10.1 | 13.2 |
| | | Upper | | 175 | 29 | 5,075 | Trout (brown & rainbow) | 36 | 22-10-4 | 1,183 | 91 | 337 | 284 | 389 | 644.7 | 6,029.0 | 13.3 | 11.2 | 15.4 |
| | | Lower | | 149 | 26 | 3,874 | Trout (brown & rainbow) | 25 | 15-6-4 | 1,003 | 35 | 317 | 237 | 398 | 338.6 | 4,291.1 | 9.5 | 7.1 | 11.9 |
| | | Combined | 2003 | 302 | 28 | 8,469 | Trout (brown & rainbow) | 65 | 50-12-3 | 1,155 | 337 | 339 | 327 | 351 | 1,670.6 | 8,709.0 | 19.2 | 18.5 | 19.9 |
| | | Upper | | 158 | 31 | 4,862 | Trout (brown & rainbow) | 41 | 33-7-1 | 1,385 | 469 | 370 | 359 | 381 | 1,225.9 | 11,054.0 | 24.4 | 23.7 | 25.1 |
| | | Lower | | 144 | 25 | 3,646 | Trout (brown & rainbow) | 24 | 17-5-2 | 911 | 183 | 297 | 267 | 327 | 444.7 | 5,497.5 | 12.1 | 10.9 | 13.4 |
| | | Combined | 2002 | 299 | 28 | 8,372 | Trout (brown & rainbow) | 100 | 75-20-5 | 1,798 | 265 | 522 | 505 | 539 | 1,819.9 | 9,480.0 | 20.9 | 20.3 | 21.6 |
| | | Upper | | 149 | 28 | 4,109 | Trout (brown & rainbow) | 56 | 42-11-3 | 2,022 | 496 | 605 | 578 | 631 | 1,458.2 | 15,730.6 | 34.7 | 33.2 | 36.2 |
| | | Lower | | 150 | 29 | 4,403 | Trout (brown & rainbow) | 44 | 33-9-2 | 1,576 | 35 | 443 | 422 | 464 | 361.7 | 3,637.8 | 8.0 | 7.6 | 8.4 |

ft = feet
g = grams
lbs = pounds
mm = millimeters

**Table B2-2. Fish Population Data, 2002–2019, for Site RRD-F2, Rubicon River, Rubicon Dam Reach.**

| Stream and Reach | Site | Section | Year | Site Length (ft) | Avg. Width (ft) | Avg. Area ($ft^2$) | Species | Total Number Captured | Removal Pattern | Number of Fish / Mile | Catchable Trout / Mile (>152 mm) | Estimated Density, Zippin Method | | | Total Biomass (g) | Estimated Biomass | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | No. of Fish / Acre | 95 Percent Confidence Interval (No. of fish/acre) | | | g/acre | lbs/acre | 95 Percent Confidence Interval (lbs/acre) | |
| Rubicon River, Rubicon Dam | RRD-F2 | Combined | 2019 | 250 | 28 | 6,908 | Trout (brown & rainbow) | 1 | 0-0-1 | 21 | 0 | 6 | [a] | [a] | 19.6 | 122.5 | 0.3 | [a] | [a] |
| | | | | | | | California roach | 56 | 17-5-34 | - | - | - | - | - | - | - | - | - | - |
| | | | | | | | Speckled dace | 38 | 10-3-25 | - | - | - | - | - | - | - | - | - | - |
| | | Combined | 2005 | 289 | 18 | 5,202 | Trout (brown & rainbow) | 47 | 34-9-4 | 886 | 73 | 411 | 383 | 438 | 477.3 | 4,173.1 | 9.2 | 8.6 | 9.8 |
| | | Upper | | 166 | 24 | 3,984 | Trout (brown & rainbow) | 33 | 23-6-4 | 1,104 | 127 | 385 | 342 | 428 | 422.4 | 4,930.6 | 10.9 | 9.7 | 12.1 |
| | | | | | | | Brook trout | 1 | 1-0-0 | - | - | - | - | - | - | - | - | - | - |
| | | | | | | | California roach | 61 | 45-11-5 | - | - | - | - | - | - | - | - | - | - |
| | | | | | | | Speckled dace | 56 | 27-14-15 | - | - | - | - | - | - | - | - | - | - |
| | | Lower | | 123 | 12 | 1,548 | Trout (brown & rainbow) | 14 | 11-3-0 | 606 | 0 | 418 | 397 | 438 | 54.9 | 1,637.5 | 3.6 | 3.4 | 3.8 |
| | | | | | | | Brook trout | 1 | 1-0-0 | - | - | - | - | - | - | - | - | - | - |
| | | | | | | | California roach | 2 | 2-0-0 | - | - | - | - | - | - | - | - | - | - |
| | | | | | | | Speckled dace | 48 | 34-12-2 | - | - | - | - | - | - | - | - | - | - |
| | | Combined | 2003 | 293 | 20 | 5,716 | Trout (brown & rainbow) | 102 | 73-22-4 | 1,896 | 18 | 802 | 767 | 837 | 339.7 | 2,676.2 | 5.9 | 5.6 | 6.1 |
| | | Upper | | 164 | 24 | 3,944 | Trout (brown & rainbow) | 37 | 21-12-4 | 1,334 | 32 | 456 | 370 | 543 | 149.5 | 1,841.6 | 4.1 | 3.3 | 4.8 |
| | | | | | | | California roach | 199 | 96-67-36 | - | - | - | - | - | - | - | - | - | - |
| | | | | | | | Speckled dace | 163 | 89-47-27 | - | - | - | - | - | - | - | - | - | - |
| | | Lower | | 129 | 15 | 1,922 | Trout (brown & rainbow) | 48 | 35-10-3 | 2,013 | 0 | 1,115 | 1,052 | 1,178 | 125.7 | 2,916.6 | 6.4 | 6.1 | 6.8 |
| | | | | | | | California roach | 36 | 101-20-9 | - | - | - | - | - | - | - | - | - | - |
| | | | | | | | Speckled dace | 45 | 1-0-0 | - | - | - | - | - | - | - | - | - | - |

| Stream and Reach | Site | Section | Year | Site Length (ft) | Avg. Width (ft) | Avg. Area ($ft^2$) | Species | Total Number Captured | Removal Pattern | Number of Fish / Mile | Catchable Trout / Mile (>152 mm) | Estimated Density, Zippin Method: No. of Fish / Acre | Estimated Density, Zippin Method: 95 Percent Confidence Interval (No. of fish/acre) | | Total Biomass (g) | Estimated Biomass: g/acre | Estimated Biomass: lbs/acre | Estimated Biomass: 95 Percent Confidence Interval (lbs/acre) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rubicon River, Rubicon Dam | RRD-F2 | Combined | 2002 | 300 | 19 | 5,799 | Trout (brown & rainbow) | 15 | 15-0-0 | 264 | 35 | 112 | [a] | [a] | 347.9 | 2,540.1 | 5.6 | [a] | [a] |
| | | Upper | | 172 | 22 | 3,772 | Brown trout | 8 | 8-0-0 | 246 | 61 | 92 | [a] | [a] | 326.9 | 3,773.9 | 8.3 | [a] | [a] |
| | | | | | | | California roach | 291 | 188-56-47 | - | - | - | - | - | - | - | - | - | - |
| | | | | | | | Speckled dace | 350 | 209-99-42 | - | - | - | - | - | - | - | - | - | - |
| | | | | | | | Sacram-ento sucker | 16 | 11-0-5 | - | - | - | - | - | - | - | - | - | - |
| | | Lower | | 128 | 17 | 2,143 | Trout (brown & rainbow) | 7 | 7-0-0 | 289 | 0 | 142 | [a] | [a] | 21.0 | 426.4 | 0.9 | [a] | [a] |
| | | | | | | | Hitch | 53 | 36-13-4 | - | - | - | - | - | - | - | - | - | - |
| | | | | | | | Sacram-ento sucker | 1 | 1-0-0 | - | - | - | - | - | - | - | - | - | - |
| | | | | | | | Speckled dace | 130 | 101-20-9 | - | - | - | - | - | - | - | - | - | - |

ft = feet
g = grams
lbs = pounds
mm = millimeters
[a] Confidence interval could not be calculated due to low capture number on one or more passes.

**Table B2-3. Fish Population Data, 2002–2019, for Site BID-F1, Little Rubicon River, Buck Island Dam Reach.**

| Stream and Reach | Site | Section | Year | Site Length (ft) | Avg. Width (ft) | Avg. Area ($ft^2$) | Species | Total Number Captured | Removal Pattern | Number of Fish / Mile | Catchable Trout / Mile (>152 mm) | Estimated Density, Zippin Method: No. of Fish / Acre | Estimated Density, Zippin Method: 95 Percent Confidence Interval (No. of fish/acre) | | Total Biomass (g) | Estimated Biomass: g/acre | Estimated Biomass: lbs/acre | Estimated Biomass: 95 Percent Confidence Interval (lbs/acre) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Little Rubicon, Buck Island Dam | BID-F1 | Combined | 2019 | 349 | 27 | 9,465 | Trout (rainbow and brown) | 0 | 0-0-0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | Upper | | 123 | 43 | 5,234 | California roach | 6 | 4-2-0 | - | - | - | - | - | - | - | - | - | - |
| | | Lower | | 226 | 12 | 2,640 | California roach | 10 | 6-4-0 | - | - | - | - | - | - | - | - | - | - |
| | | | | | | | Golden shiner | 16 | 10-5-1 | - | - | - | - | - | - | - | - | - | - |
| | | | | | | | Sacramento sucker | 1 | 1-0-0 | - | - | - | - | - | - | - | - | - | - |
| | | Combined | 2003 | 352 | 26 | 9,046 | Rainbow trout | 1 | [c] | [c] | 15 [b] | 6 [b] | [c] | [c] | 59.4 | 331.1 [b] | 0.7 [b] | [c] | [c] |
| | | Upper | | 123 | 38 | 4,705 | Trout (rainbow and brown) | 0 | 0-0-0-0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | California roach | 5 | 2-2-0-1 | - | - | - | -- | -- | - | - | - | - | - |
| | | | | | | | Golden shiner | 71 | 39-11-13-8 | - | - | - | -- | -- | - | - | - | - | - |
| | | Lower | | 229 | 13 | 3,023 | Rainbow trout | 1 | 1-0-0 | 23 | 23 | 14 | [a] | [a] | 59.4 | 857.3 | 1.9 | [a] | [a] |
| | | | | | | | California roach | 4 | 2-2-0 | - | - | - | -- | -- | - | - | - | - | - |
| | | | | | | | Golden shiner | 42 | 30-7-5 | - | - | - | -- | -- | - | - | - | - | - |
| | | Combined | 2002 | 383 | 27 | 10,341 | Rainbow trout | 4 | [c] | [c] | [c] | 19 [b] | [c] | [c] | 108.3 | 499.0 [b] | 1.1 [b] | [c] | [c] |
| | | Upper | | 152 | 41 | 6,232 | Trout (rainbow and brown) | 0 | 0-0-0-0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | | | | | | | Golden shiner | 5 | 1-1-1-2 | - | - | - | - | - | - | - | - | - | - |
| | | Lower | | 231 | 13 | 3,087 | Rainbow trout | 4 | 3-1-0 | 92 | 23 | 57 | 50 | 64 | 108.3 | 1542.2 | 3.4 | 3.0 | 3.8 |
| | | Lower | | | | | Golden shiner | 7 | 4-2-1 | - | - | - | -- | | - | - | - | - | - |

ft = feet
g = grams
lbs = pounds
mm = millimeters
[a] Confidence interval could not be calculated due to low capture number on one or more passes.
[b] Calculated using weighted average.
[c] Not calculated due to an unequal number of passes.

**Table B2-4. Fish Population Data, 2019, for Site LLD-F3, Gerle Creek, Loon Lake Dam Reach.**

| Stream and Reach | Site | Section | Year | Site Length (ft) | Avg. Width (ft) | Avg. Area ($ft^2$) | Species | Total Number Captured | Removal Pattern | Number of Fish / Mile | Catchable Trout / Mile (>152 mm) | Estimated Density, Zippin Method | | | Total Biomass (g) | Estimated Biomass | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | No. of Fish / Acre | 95 Percent Confidence Interval (No. of fish/acre) | | | g/acre | lbs/acre | 95 Percent Confidence Interval (lbs/acre) | |
| Gerle Creek, Loon Lake Dam | LLD-F3 | Combined | 2019 | 296 | 25 | 7,504 | Trout (brown & rainbow) | 10 | 7-2-1 | 186 | 45 | 61 | 50 | 71 | 182.6 | 1,088.6 | 2.4 | 2.0 | 2.9 |
| | | Upper | | 111 | 25 | 2,830 | Brown trout | 3 | 2-0-1 | 180 | 0 | 58 | 0 | 133 | 22.0 | 426.4 | 0.9 | 0.0 | 2.2 |
| | | Lower | | 185 | 25 | 4,667 | Trout (brown & rainbow) | 7 | 5-2-0 | 203 | 60 | 66 | 59 | 74 | 160.6 | 1,519.5 | 3.4 | 3.0 | 3.7 |

ft = feet
g = grams
lbs = pounds
mm = millimeters

Table B2-5. Fish Population Data, 2002–2019, for Site LLD-F2, Gerle Creek, Loon Lake Dam Reach.

| Stream and Reach | Site | Section | Year | Site Length (ft) | Avg. Width (ft) | Avg. Area ($ft^2$) | Species | Total Number Captured | Removal Pattern | Number of Fish / Mile | Catchable Trout / Mile (>152 mm) | Estimated Density, Zippin Method: No. of Fish / Acre | Estimated Density, Zippin Method: 95 Percent Confidence Interval (No. of fish/acre) | | Total Biomass (g) | Estimated Biomass: g/acre | Estimated Biomass: lbs/acre | Estimated Biomass: 95 Percent Confidence Interval (lbs/acre) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gerle Creek, Loon Lake Dam | LLD-F2 | Combined | 2019 | 311 | 37 | 11,464 | Trout (brown & rainbow) | 37 | 17-14-6 | 837 | 246 | 187 | 104 | 271 | 1,233.4 | 6,545.3 | 14.4 | 8.0 | 20.9 |
| | | Upper | | 212 | 43 | 9,042 | Trout (brown & rainbow) | 21 | 9-9-3 | 711 | 255 | 138 | 51 | 225 | 1,045.5 | 6,844.7 | 15.1 | 5.5 | 24.6 |
| | | Lower | | 99 | 31 | 3,078 | Trout (rainbow) | 16 | 8-5-3 | 1,109 | 67 | 295 | 112 | 478 | 248.0 | 4,563.1 | 10.1 | 3.8 | 16.3 |
| | | Combined | 2004 | 297 | 35 | 10,235 | Trout (brown & rainbow) | 70 | 48-17-5 | 1,295 | 514 | 309 | 290 | 329 | 5,075.0 | 22,416.5 | 49.4 | 46.3 | 52.5 |
| | | Upper | | 197 | 40 | 7,913 | Trout (brown & rainbow) | 45 | 30-11-4 | 1,268 | 429 | 260 | 236 | 288 | 2,397.3 | 13,869.7 | 30.6 | 27.7 | 33.4 |
| | | Lower | | 100 | 29 | 2,873 | Trout (brown) | 25 | 18-6-1 | 1,356 | 637 | 388 | 359 | 416 | 2,677.7 | 41,500.0 | 91.4 | 84.8 | 98.1 |
| | | Combined | 2003 | 285 | 32 | 11,329 | Trout (brown & rainbow) | 23 | 11-7-1 | 608 | 366 | 156 | 46 | 266 | 1,713.0 | 11,611.9 | 25.6 | 7.6 | 43.6 |
| | | Upper | | 188 | 40 | 7,473 | Trout (brown & rainbow) | 15 | 7-5-3 | 593 | 334 | 123 | 20 | 226 | 1,070.9 | 8,786.1 | 19.4 | 3.1 | 35.6 |
| | | Lower | | 97 | 25 | 2,383 | Trout (brown & rainbow) | 8 | 4-2-2 | 636 | 444 | 214 | 0 | 487 | 642.1 | 17,141.3 | 37.8 | 0.0 | 86.1 |
| | | Combined | 2002 | 293 | 34 | 10,062 | Trout (brown & rainbow) | 55 | 42-10-3 | 1,007 | 468 | 242 | 232 | 252 | 2,712.5 | 11,929.5 | 26.3 | 25.2 | 27.4 |
| | | Upper | | 191 | 42 | 7,917 | Trout (brown & rainbow) | 34 | 25-7-2 | 961 | 900 | 191 | 179 | 204 | 1,457.4 | 8,196.4 | 18.1 | 16.9 | 19.2 |
| | | Lower | | 102 | 27 | 2,770 | Trout (brown & rainbow) | 21 | 17-3-1 | 1,095 | 620 | 330 | 317 | 349 | 1,255.1 | 19,903.6 | 43.9 | 41.8 | 46.0 |

**Table B2-6. Fish Population Data, 2002–2019, for Site GCD-F1, Gerle Creek, Gerle Creek Dam Reach.**

| Stream and Reach | Site | Section | Year | Site Length (ft) | Avg. Width (ft) | Avg. Area ($ft^2$) | Species | Total Number Captured | Removal Pattern | Number of Fish / Mile | Catchable Trout / Mile (>152 mm) | Estimated Density, Zippin Method: No. of Fish / Acre | Estimated Density, Zippin Method: 95 Percent Confidence Interval (No. of fish/acre) | | Total Biomass (g) | Estimated Biomass: g/acre | Estimated Biomass: lbs/acre | Estimated Biomass: 95 Percent Confidence Interval (lbs/acre) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gerle Creek, Gerle Creek Dam | GCD-F1 | Combined | 2019 | 241 | 34 | 8,217 | Trout (brown & rainbow) | 69 | 29-20-13-7 | 1,815 | 78 | 439 | 348 | 530 | 568.3 | 3,628.7 | 8.0 | 6.3 | 9.6 |
| | | Upper | | 102 | 32 | 3,242 | Trout (brown & rainbow) | 15 | 5-5-3-2 | 1,096 | 0 | 284 | 46 | 522 | 77.3 | 1,460.6 | 3.2 | 0.5 | 5.9 |
| | | Lower | | 139 | 36 | 5,058 | Trout (brown & rainbow) | 54 | 24-15-10-5 | 2,528 | 128 | 574 | 417 | 730 | 491.0 | 5,211.8 | 11.5 | 8.4 | 14.6 |
| | | Combined | 2003 | 322 | 37 | 12,036 | Trout (brown & rainbow) | 27 | 15-8-4 | 515 | 366 | 114 | 81 | 146 | 637.7 | 2,676.2 | 5.9 | 4.2 | 7.6 |
| | | Upper | | 190 | 36 | 6,872 | Trout (brown & rainbow) | 11 | 6-4-1 | 342 | 98 | 78 | 50 | 106 | 216.2 | 1,533.1 | 3.4 | 2.2 | 4.6 |
| | | Lower | | 132 | 39 | 5,093 | Trout (brown & rainbow) | 16 | 9-4-3 | 769 | [d] | 164 | 92 | 237 | 421.5 | 4,327.3 | 9.5 | 5.3 | 13.8 |
| | | Combined | 2002 | 244 | 35 | 8,534 | Trout (brown & rainbow) | 87 | 62-21-4 | 1,928 | 281 | 455 | 436 | 474 | 1421.1 | 7,438.9 | 16.4 | 15.7 | 17.1 |
| | | Upper | | 108 | 34 | 3,628 | Trout (brown & rainbow) | 26 | 18-7-1 | 1,312 | 295 | 321 | 294 | 347 | 664.2 | 8,187.3 | 18.1 | 16.6 | 19.6 |
| | | Lower | | 137 | 36 | 4,941 | Trout (brown & rainbow) | 61 | 44-14-3 | 2,412 | 270 | 551 | 524 | 577 | 756.9 | 6,826.6 | 15.1 | 14.3 | 15.8 |

ft = feet
g = grams
lbs = pounds
mm = millimeters
[d] Could not be calculated due to poor depletion pattern of juvenile/adults.

**Table B2-7. Fish Population Data, 2002–2019, for Site RPD-F1, S.F. Rubicon River, Robbs Peak Dam Reach.**

| Stream and Reach | Site | Section | Year | Site Length (ft) | Avg. Width (ft) | Avg. Area ($ft^2$) | Species | Total Number Captured | Removal Pattern | Number of Fish / Mile | Catchable Trout / Mile (>152 mm) | Estimated Density, Zippin Method: No. of Fish / Acre | Estimated Density, Zippin Method: 95 Percent Confidence Interval (No. of fish/acre) | | Total Biomass (g) | Estimated Biomass: g/acre | Estimated Biomass: lbs/acre | Estimated Biomass: 95 Percent Confidence Interval (lbs/acre) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S. F. Rubicon, Robbs Peak Dam | RPD-F1 | Combined | 2019 | 321 | 42 | 13,340 | Trout (brown & rainbow) | 131 | 79-35-17 | 2,382 | 203 | 473 | 429 | 518 | 1,923.4 | 6,940.0 | 15.3 | 13.9 | 16.7 |
| | | Upper | | 161 | 41 | 6,513 | Trout (brown & rainbow) | 56 | 34-14-8 | 2,047 | 228 | 417 | 354 | 479 | 756.4 | 5,624.5 | 12.4 | 10.5 | 14.3 |
| | | Lower | | 161 | 43 | 6,826 | Trout (brown & rainbow) | 75 | 45-21-9 | 2,717 | 196 | 527 | 464 | 591 | 1,167.0 | 8,196.4 | 18.1 | 15.9 | 20.2 |
| | | Combined | 2005 | 341 | 35 | 11,935 | Trout (brown & rainbow) | 88 | [c] | [c] | 403 | 348 [b] | [c] | [c] | 2,605.5 | 10,296.6 | 22.7 | [c] | [c] |
| | | Upper | | 173 | 40 | 6,903 | Trout (brown & rainbow) | 51 | 30-8-12-1 | 1,638 | 519 | 339 | 309 | 369 | 1,580.4 | 10,496.3 | 23.1 | 21.1 | 25.2 |
| | | Lower | | 168 | 30 | 5,074 | Trout (brown & rainbow) | 37 | 21-11-5 | 1,325 | 283 | 362 | 283 | 440 | 1,025.1 | 10,011.0 | 22.1 | 17.3 | 26.8 |
| | | Combined | 2003 | 340 | 38 | 13,037 | Trout (brown & rainbow) | 115 | [c] | [c] | 187 | 557 [b] | [c] | [c] | 1,725.2 | 7,438.9 [b] | 16.4 [b] | [c] | [c] |
| | | Upper | | 169 | 45 | 7,526 | Trout (brown & rainbow) | 45 | 29-13-3 | 1,478 | 281 | 274 | 248 | 300 | 1,096.1 | 6,663.3 | 14.7 | 13.3 | 16.1 |
| | | Lower | | 171 | 32 | 5,504 | Trout (brown & rainbow) | 70 | 18-26-18-8 | 3,697 | 93 | 945 | 357 | 1533 | 629.1 | 8,482.2 | 18.7 | 7.1 | 30.3 |
| | | Combined | 2002 | 338 | 41 | 13,802 | Trout (brown & rainbow) | 220 | 162-42-16 | 3,523 | 546 | 712 | 693 | 731 | 4,287.7 | 13,879.9 | 30.6 | 29.8 | 31.4 |
| | | Upper | | 173 | 47 | 8,158 | Trout (brown & rainbow) | 120 | 88-25-7 | 3,743 | 640 | 655 | 633 | 678 | 2,604.9 | 14,215.6 | 31.3 | 30.3 | 32.4 |
| | | Lower | | 165 | 35 | 5,693 | Trout (brown & rainbow) | 100 | 74-17-9 | 3,292 | 480 | 787 | 753 | 821 | 1,682.8 | 13,231.3 | 29.2 | 27.9 | 30.4 |

ft = feet
g = grams
lbs = pounds
mm = millimeters
[b] Calculated using weighted average
[c] Not calculated due to an unequal number of passes.
.

**Table B2-8. Fish Population Data, 2002–2019, for Site IHD-F1, S.F. Silver Creek, Ice House Dam Reach.**

| Stream and Reach | Site | Section | Year | Site Length (ft) | Avg. Width (ft) | Avg. Area ($ft^2$) | Species | Total Number Captured | Removal Pattern | Number of Fish / Mile | Catchable Trout / Mile (>152 mm) | Estimated Density, Zippin Method | | | Total Biomass (g) | Estimated Biomass | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | No. of Fish / Acre | 95 Percent Confidence Interval (No. of fish/acre) | | | g/acre | lbs/acre | 95 Percent Confidence Interval (lbs/acre) | |
| S.F. Silver, Ice House Dam | IHD-F1 | Combined | 2019 | 267 | 26 | 6,796 | Trout (brown & rainbow) | 20 | 6-3-6-5 | 1,426 | 611 | 468 | 0 | 2,074 | 571.2 | 13,335.6 | 29.4 | 0.0 | 130.5 |
| | | Upper | | 133 | 21 | 2,772 | Trout (brown & rainbow) | 8 | 1-1-3-3 | 79,817 | 19,954 | 31,482 | 0 | 19,495,432 | 247.1 | 971,504.0 | 2,141.8 | 0.0 | 1,326,355.0 |
| | | Lower | | 134 | 29 | 3,937 | Trout (brown & rainbow) | 12 | 5-2-3-2 | 711 | 283 | 200 | 0 | 420 | 324.1 | 5,388.7 | 11.9 | 0.0 | 25.0 |
| | | Combined | 2004 | 276 | 30 | 8,133 | Trout (brown & rainbow) | 79 | [c] | [c] | 229 [b] | 481 [b] | [c] | [c] | 3,309.0 | 21,228.1 [b] | 46.8 [b] | [c] | [c] |
| | | Upper | | 142 | 31 | 4,440 | Trout (brown & rainbow) | 38 | 27-10-1 | 1,443 | 264 | 381 | 359 | 403 | 719.7 | 7,212.1 | 15.9 | 15.0 | 16.8 |
| | | Lower | | 134 | 28 | 3,742 | Trout (brown & rainbow) | 41 | 15-14-8-4 | 2,037 | 320 | 600 | 402 | 797 | 2,589.3 | 37,829.6 | 83.4 | 55.9 | 110.9 |
| | | Combined | 2003 | 271 | 28 | 7,507 | Trout (brown & rainbow) | 51 | 32-15-4 | 1,056 | 246 | 315 | 282 | 347 | 2,865.7 | 17,644.7 | 38.9 | 34.9 | 42.9 |
| | | Upper | | 137 | 25 | 3,462 | Trout (brown & rainbow) | 21 | 11-9-1 | 894 | 206 | 292 | 225 | 359 | 524.6 | 7,302.8 | 16.1 | 12.4 | 19.8 |
| | | Lower | | 134 | 30 | 4,037 | Trout (brown & rainbow) | 30 | 21-6-3 | 1,233 | 287 | 338 | 303 | 372 | 2,341.1 | 26,308.4 | 58.0 | 52.1 | 64.0 |
| | | Combined | 2002 | 263 | 27 | 7,012 | Trout (brown & rainbow) | 65 | 47-13-5 | 1344 | 361 | 416 | 393 | 439 | 3,382.4 | 21,636.4 | 47.7 | 45.1 | 50.3 |
| | | Upper | | 135 | 23 | 3,060 | Trout (brown & rainbow) | 33 | 19-10-4 | 1,446 | 352 | 526 | 418 | 634 | 2,341.2 | 37,285.3 | 82.2 | 65.4 | 99.0 |
| | | Lower | | 128 | 31 | 3,923 | Trout (brown & rainbow) | 32 | 28-3-1 | 1,324 | 371 | 356 | 349 | 363 | 1,041.2 | 11,566.6 | 25.5 | 25.0 | 26.0 |

ft = feet
g = grams
lbs = pounds
mm = millimeters
[b] Calculated using weighted average.
[c] Not calculated due to an unequal number of passes.

Table B2-9. Fish Population Data, 2002–2019, for Site IHD-F2, S.F. Silver Creek, Ice House Dam Reach.

| Stream and Reach | Site | Section | Year | Site Length (ft) | Avg. Width (ft) | Avg. Area ($ft^2$) | Species | Total Number Captured | Removal Pattern | Number of Fish / Mile | Catchable Trout / Mile (>152 mm) | Estimated Density, Zippin Method: No. of Fish / Acre | Estimated Density, Zippin Method: 95 Percent Confidence Interval (No. of fish/acre) | | Total Biomass (g) | Estimated Biomass: g/acre | Estimated Biomass: lbs/acre | Estimated Biomass: 95 Percent Confidence Interval (lbs/acre) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S.F. Silver, Ice House Dam | IHD-F2 | Combined | 2019 | 365 | 27 | 10,021 | Trout (brown & rainbow) | 28 | 15-6-6-1 | 435 | 73 | 131 | 111 | 150 | 1,089.2 | 5,071.2 | 11.2 | 9.5 | 12.9 |
| | | Upper | | 226 | 29 | 6,583 | Trout (brown & rainbow) | 15 | 4-6-4-1 | 501 | 126 | 142 | 21 | 262 | 515.3 | 4,867.0 | 10.7 | 1.6 | 19.9 |
| | | | | | | | Sacramento sucker | 2 | 0-1-1-0 | - | - | - | - | - | - | - | - | - | - |
| | | Lower | | 139 | 26 | 3,580 | Trout (brown & rainbow) | 13 | 11-0-2-0 | 497 | 76 | 159 | 153 | 164 | 573.9 | 7,003.5 | 15.4 | 14.9 | 16.0 |
| | | | | | | | Sacramento sucker | 1 | 0-0-0-1 | - | - | - | - | - | - | - | - | - | - |
| | | Combined | 2004 | 361 | 28 | 10,258 | Trout (brown & rainbow) | 20 | 16-4-0 | 294 | 29 | 85 | 82 | 89 | 577.4 | 2,449.4 | 5.4 | 5.2 | 5.6 |
| | | Upper | | 212 | 30 | 6,398 | Trout (brown & rainbow) | 9 | 8-1-0 | 225 | 0 | 61 | 60 | 63 | 106.7 | 726.4 | 1.6 | 1.6 | 1.6 |
| | | | | | | | Sacramento sucker | 17 | 12-3-2 | - | - | - | - | - | - | - | - | - | - |
| | | Lower | | 149 | 27 | 3,975 | Trout (brown & rainbow) | 11 | 8-3-0 | 394 | 71 | 122 | 112 | 132 | 470.7 | 5,230.0 | 11.5 | 10.6 | 12.5 |
| | | | | | | | Sacramento sucker | 38 | 23-10-5 | - | - | - | - | - | - | - | - | - | - |
| | | Combined | 2003 | 352 | 29 | 10,046 | Trout (brown & rainbow) | 21 | 15-2-4 | 339 | 93 | 98 | 80 | 116 | 1,063.2 | 4,944.2 | 10.9 | 8.9 | 12.9 |
| | | Upper | | 211 | 28 | 5,997 | Trout (brown & rainbow) | 14 | 12-0-2 | 356 | 100 | 103 | 95 | 112 | 859.0 | 6,332.1 | 14.0 | 12.9 | 15.1 |
| | | | | | | | Sacramento sucker | 48 | 25-15-8 | - | - | - | - | - | - | - | - | - | - |
| | | Lower | | 141 | 29 | 4,043 | Trout (brown & rainbow) | 7 | 3-2-2 | 548 | 75 | 158 | 0 | 639 | 204.2 | 4,594.9 | 10.1 | 0.0 | 41.1 |
| | | | | | | | Sacramento sucker | 6 | 5-1-0 | - | - | - | - | - | - | - | - | - | - |
| | | Combined | 2002 | 365 | 30 | 10,950 | Trout (brown & rainbow) | 26 | [c] | [c] | 58 | 118 [b] | [c] | [c] | 1,169.1 | 5,034.9 | 11.1 [b] | [c] | [c] |

| Stream and Reach | Site | Section | Year | Site Length (ft) | Avg. Width (ft) | Avg. Area ($ft^2$) | Species | Total Number Captured | Removal Pattern | Number of Fish / Mile | Catchable Trout / Mile (>152 mm) | Estimated Density, Zippin Method | | | Total Biomass (g) | Estimated Biomass | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | No. of Fish / Acre | 95 Percent Confidence Interval (No. of fish/acre) | | | g/acre | lbs/acre | 95 Percent Confidence Interval (lbs/acre) | |
| S.F. Silver, Ice House Dam | IHD-F2 | Upper | 2002 | 214 | 32 | 6,923 | Trout (brown & rainbow) | 17 | 12-3-2 | 439 | 74 | 112 | 96 | 128 | 990.6 | 6,522.7 | 14.4 | 12.3 | 16.5 |
| | | | | | | | Sacramento sucker | 78 | 65-9-4 | - | - | - | - | - | - | - | - | - | - |
| | | Lower | | 151 | 28 | 4,228 | Trout (brown & rainbow) | 9 | 4-2-1-2 | 436 | 35 | 128 | 0 | 257 | 178.5 | 2,544.7 | 5.6 | 0.0 | 11.2 |
| | | | | | | | Sacramento sucker | 18 | 5-9-3-1 | - | - | - | - | - | - | - | - | - | - |

ft = feet
g = grams
lbs = pounds
mm = millimeters
[b] Calculated using weighted average.
[c] Not calculated due to an unequal number of passes.

**Table B2-10. Fish Population Data, 2019, for Site JD-F3, Silver Creek, Junction Dam Reach.**

| | | | | | | | | | | | | Minimum Density | | | | Estimated Biomass | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream and Reach | Site | Section | Year | Site Length (ft) | Avg. Width (ft) | Avg. Area ($ft^2$) | Species | Total Number Observed | Removal Pattern | Number of Fish / Mile | Catchable Trout / Mile (>152 mm) | No. of Fish / Acre | 95 Percent Confidence Interval (No. of fish/acre) | | Total Biomass (g) | g/acre | lbs/acre | 95 Percent Confidence Interval (lbs/acre) | |
| Silver Creek, Junction Dam | JD-F3 | -- | 2019 [e] | 921 | 40 | 38,728 | No fish | 0 | -- | 0 | 0 | 0 | -- | -- | -- | -- | -- | -- | -- |

ft = feet
g = grams
lbs = pounds
mm = millimeters
[e] Snorkel survey.

**Table B2-11. Fish Population Data, 2002–2019, for Site CD-F1, Silver Creek, Camino Dam Reach.**

| | | | | | | | | | | | | Minimum Density | | | | Estimated Biomass | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stream Reach | Site | Section | Year | Site Length (ft) | Avg. Width (ft) | Avg. Area ($ft^2$) | Species | Total Number Observed | Removal Pattern | Number of Fish / Mile | Catchable Trout / Mile (>152 mm) | No. of Fish / Acre | 95 Percent Confidence Interval (No. of fish/acre) | | Total Biomass (g) | g/acre | lbs/acre | 95 Percent Confidence Interval (lbs/acre) | |
| Silver Creek, Camino Dam | CD-F1 | -- | 2019 [e] | 905 | 32 | 29,931 | Trout (rainbow) | 157 | -- | 917 | 467 | 228 | -- | -- | -- | -- | -- | -- | -- |
| | | -- | 2002 [e] | 999 | 49 | 48,765 | Trout (brown & rainbow) | 29 | -- | 153 | 105 | 26 | -- | -- | -- | -- | -- | -- | -- |
| | | | | | | | Rainbow trout | 26 | -- | 137 | 79 | 24 | -- | -- | -- | -- | -- | -- | -- |
| | | | | | | | Brown trout | 3 | -- | 16 | 0 | 3 | -- | -- | -- | -- | -- | -- | -- |

ft = feet
g = grams
lbs = pounds
mm = millimeters
[e] Snorkel survey.

**Table B2-12. Fish Population Data, 2002–2019, for Site SCD-F3, S.F. American River, Slab Creek Dam Reach.**

| Stream and Reach | Site | Section | Year | Site Length (ft) | Avg. Width (ft) | Avg. Area ($ft^2$) | Species | Total Number Observed | Removal Pattern | Number of Fish / Mile | Catchable Trout / Mile (>152 mm) | Minimum Density | | | Total Biomass (g) | Estimated Biomass | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | No. of Fish / Acre | 95 Percent Confidence Interval (No. of fish / acre) | | | g/acre | lbs/acre | 95 Percent Confidence Interval (lbs/acre) | |
| S.F. American, Slab Creek Dam | SCD-F3 | -- | 2019 [e] | 1,083 | 40 | 43,212 | Trout (brown & rainbow) | 48 | -- | 235 | 98 | 48 | -- | -- | -- | -- | -- | -- | -- |
| | | | | | | | Rainbow trout | 44 | -- | 215 | 88 | 44 | -- | -- | -- | -- | -- | -- | -- |
| | | | | | | | Brown trout | 4 | -- | 20 | 10 | 4 | -- | -- | -- | -- | -- | -- | -- |
| | | | | | | | Unidentif-ied Sunfish | 1 | -- | 5 | -- | -- | -- | -- | -- | -- | -- | -- | -- |

ft = feet
g = grams
lbs = pounds
mm = millimeters
[e] Snorkel survey.

**Table B2-13. Fish Population Data, 2002–2019, for Site SCD-F2, S.F. American River, Slab Creek Dam Reach.**

| Stream and Reach | Site | Section | Year | Site Length (ft) | Avg. Width (ft) | Avg. Area (ft$^2$) | Species | Total Number Captured/ Observed | Removal Pattern | Number of Fish / Mile | Catchable Trout / Mile (>152 mm) | Estimated Density, Zippin Method: No. of Fish / Acre | Estimated Density, Zippin Method: 95 Percent Confidence Interval (No. of fish/acre) | | Total Biomass (g) | Estimated Biomass: g/acre | Estimated Biomass: lbs/acre | Estimated Biomass: 95 Percent Confidence Interval (lbs/acre) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| S.F. American, Slab Creek Dam | SCD-F2 | -- | 2019 [e] | 689 | 52 | 34,473 | Trout (rainbow) | 38 | -- | 291 | 107 | 48 | -- | -- | -- | -- | -- | -- | -- |
| | | | | | | | Sculpin sp. | 6 | -- | 46 | -- | 8 | -- | -- | -- | -- | -- | -- | -- |
| | | | | | | | Sacramento sucker | 1 | -- | 8 | -- | 1 | -- | -- | -- | -- | -- | -- | -- |
| | | Combined | 2003 | 252 | 40 | 10,080 | Trout (brown & rainbow) | 12 | 7-1-4 | 369 | 195 | 76 | 0 | 154 | 321.4 | 4422.5 | 4.5 | 0.0 | 9.1 |
| | | Upper | | 134 | 35 | 4,690 | Trout (brown & rainbow) | 12 | 7-1-4 | 694 | 366 | 165 | 0 | 338 | 321.4 | 4422.5 | 9.8 | 0.0 | 19.9 |
| | | | | | | | California roach | 2 | 0-2-0 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | | | | | | | Sacramento sucker | 24 | 13-8-3 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | | | | | | | Speckled dace | 45 | 34-8-3 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | | | | | | | Hardhead | 2 | 0-1-1 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | | | | | | | Sacramento pikeminnow | 6 | 5-1-0 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | | Lower | | 118 | 46 | 5,411 | Trout (brown & rainbow) | 0 | 0-0-0 | 0 | 0 | 0 | 0 | 0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | California roach | 19 | 6-7-6 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | | | | | | | Sacramento sucker | 8 | 5-2-1 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | | | | | | | Speckled dace | 16 | 12-1-3 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | | | | | | | Hardhead | 12 | 0-11-1 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | | | | | | | Sacramento pikeminnow | 26 | 23-2-1 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | | Combined | 2002 | 236 | 44 | 10,384 | Trout (brown & rainbow) | 10 | 7-3-0 | 228 | 67 | 43 | 38 | 47 | 521.4 | 2,222.6 | 4.9 | 4.4 | 5.4 |
| | | Upper | | 113 | 39 | 4,341 | Trout (brown & rainbow) | 9 | 6-3-0 | 432 | 141 | 93 | 80 | 105 | 503.9 | 5,171.0 | 11.4 | 9.9 | 12.9 |
| | | | | | | | California roach | 10 | 9-0-1 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | | | | | | | Sacramento sucker | 22 | 15-5-2 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |

| Stream and Reach | Site | Section | Year | Site Length (ft) | Avg. Width (ft) | Avg. Area ($ft^2$) | Species | Total Number Captured/ Observed | Removal Pattern | Number of Fish / Mile | Catchable Trout / Mile (>152 mm) | Estimated Density, Zippin Method | | | Total Biomass (g) | Estimated Biomass | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | No. of Fish / Acre | 95 Percent Confidence Interval (No. of fish/acre) | | | g/acre | lbs/acre | 95 Percent Confidence Interval (lbs/acre) | |
| S.F. American, Slab Creek Dam | SCD-F2 | Upper | 2002 | 113 | 39 | 4,341 | Speckled dace | 53 | 28-13-12 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | | | | | | | Hardhead | 3 | 1-2-0 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | | | | | | | Sacramento pikeminnow | 4 | 3-1-0 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | | Lower | | 123 | 46 | 5,668 | Trout (rainbow) | 1 | 1-0-0 | 43 | 0 | 8 | [c] | [c] | 17.5 | 136.1 | 0.3 | [c] | [c] |
| | | | | | | | California roach | 21 | 16-3-2 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | | | | | | | Sacramento sucker | 16 | 11-4-1 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | | | | | | | Speckled dace | 18 | 9-2-7 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | | | | | | | Hardhead | 68 | 51-11-6 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | | | | | | | Sacramento pikeminnow | 41 | 23-13-5 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |

ft = feet
g = grams
lbs = pounds
mm = millimeters
[c] Couldn't not be calculated due to unequal number of passes.
[e] Conducted by snorkel survey.

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# APPENDIX B3

## Trout Condition Table

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**Table B3-1. Fulton's Condition Factors (K-values), 2002–2019.**

| Stream | Reach | Site | Year | Rainbow Trout | | | Brown Trout | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sample size | Average K | Standard Error | Sample size | Average K | Standard Error |
| Rubicon | Rubicon Reservoir Dam | RRD-F1 | 2002 | 82 | 1.00 | 0.02 | 18 | 0.98 | 0.03 |
| Rubicon | Rubicon Reservoir Dam | RRD-F1 | 2003 | 50 | 1.08 | 0.02 | 15 | 1.03 | 0.02 |
| Rubicon | Rubicon Reservoir Dam | RRD-F1 | 2005 | 49 | 1.16 | 0.02 | 12 | 1.10 | 0.05 |
| Rubicon | Rubicon Reservoir Dam | RRD-F1 | 2019 | 18 | 1.08 | 0.06 | 2 | 1.10 | 0.03 |
| Rubicon | Rubicon Reservoir Dam | RRD-F2 | 2002 | 1 | 1.00 | 0.00 | 14 | 0.97 | 0.03 |
| Rubicon | Rubicon Reservoir Dam | RRD-F2 | 2003 | 16 | 1.19 | 0.05 | 69 | 1.07 | 0.02 |
| Rubicon | Rubicon Reservoir Dam | RRD-F2 | 2005 | 1 | 0.96 | -- | 44 | 0.97 | 0.02 |
| Rubicon | Rubicon Reservoir Dam | RRD-F2 | 2019 | 1 | 0.89 | -- | 0 | -- | -- |
| Little Rubicon | Buck Island Dam | BID-F1 | 2002 | 4 | 1.02 | 0.03 | 0 | -- | -- |
| Little Rubicon | Buck Island Dam | BID-F1 | 2003 | 1 | 1.17 | -- | 0 | -- | -- |
| Little Rubicon | Buck Island Dam | BID-F1 | 2019 | 0 | -- | -- | 0 | -- | -- |
| Gerle Creek | Loon Lake Dam | LLD-F2 | 2002 | 5 | 0.91 | 0.13 | 50 | 1.05 | 0.01 |
| Gerle Creek | Loon Lake Dam | LLD-F2 | 2003 | 1 | 0.85 | -- | 22 | 0.97 | 0.02 |
| Gerle Creek | Loon Lake Dam | LLD-F2 | 2004 | 2 | 1.14 | 0.03 | 68 | 1.09 | 0.03 |
| Gerle Creek | Loon Lake Dam | LLD-F2 | 2019 | 31 | 0.96 | 0.06 | 6 | 0.94 | 0.03 |
| Gerle Creek | Loon Lake Dam | LLD-F3 | 2019 | 3 | 0.97 | 0.10 | 7 | 1.18 | 0.21 |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | 2002 | 50 | 0.82 | 0.05 | 37 | 0.97 | 0.04 |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | 2003 | 16 | 0.99 | 0.03 | 11 | 1.25 | 0.22 |
| Gerle Creek | Gerle Creek Dam | GCD-F1 | 2019 | 68 | 0.84 | 0.01 | 1 | 1.0 | -- |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | 2002 | 153 | 0.98 | 0.05 | 67 | 1.0 | 0.01 |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | 2003 | 65 | 0.97 | 0.01 | 50 | 1.05 | 0.03 |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | 2005 | 60 | 0.98 | 0.02 | 26 | 0.98 | 0.01 |
| S.F. Rubicon | Robbs Peak Dam | RPD-F1 | 2019 | 124 | 0.87 | 0.01 | 7 | 1.01 | 0.04 |

| Stream | Reach | Site | Year | Rainbow Trout | | | Brown Trout | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | Sample size | Average K | Standard Error | Sample size | Average K | Standard Error |
| S.F. Silver | Ice House Dam | IHD-F1 | 2002 | 40 | 0.90 | 0.03 | 25 | 0.86 | 0.05 |
| S.F. Silver | Ice House Dam | IHD-F1 | 2003 | 38 | 0.97 | 0.01 | 13 | 0.95 | 0.04 |
| S.F. Silver | Ice House Dam | IHD-F1 | 2004 | 60 | 1.07 | 0.03 | 19 | 1.02 | 0.04 |
| S.F. Silver | Ice House Dam | IHD-F1 | 2019 | 17 | 1.00 | 0.02 | 3 | 0.98 | 0.02 |
| S.F. Silver | Ice House Dam | IHD-F2 | 2002 | 12 | 1.01 | 0.03 | 14 | 1.06 | 0.02 |
| S.F. Silver | Ice House Dam | IHD-F2 | 2003 | 11 | 0.91 | 0.03 | 10 | 1.00 | 0.03 |
| S.F. Silver | Ice House Dam | IHD-F2 | 2004 | 10 | 0.98 | 0.04 | 10 | 1.03 | 0.05 |
| S.F. Silver | Ice House Dam | IHD-F2 | 2019 | 11 | 0.89 | 0.03 | 17 | 0.99 | 0.04 |

# APPENDIX B4

## 2019 Scale Analysis Data

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**Table B4-1. Scale Analysis Data, 2019.**

| Species | Sample ID | Length (TL mm) | Weight (g) | Age | 1st Scale Annuli Count | 2nd Scale Annuli Count | 3rd Scale Annuli Count |
|---|---|---|---|---|---|---|---|
| **LLD-F2** | | | | | | | |
| Rainbow trout | 14 | 122 | 16.4 | 1+ | 1+ (scale 1) | 1+ (scale 7) | 1+ (scale 8) |
| Rainbow trout | 12 | 125 | 50.8 | 1+ | 1+ (scale 4) | 1+ (scale 5) | 1+ (scale 9) |
| Rainbow trout | 4 | 127 | 14.8 | 1+ | 1+ (scale 1) | 1+ (scale 3) | 1+ (scale 7) |
| Rainbow trout | 11 | 133 | 18.6 | 1+ | 1+ (scale 2) | 1+ (scale 3) | 1+ (scale 5) |
| Rainbow trout | 10 | 139 | 23.5 | 1+ | 1+ (scale 4) | 1+ (scale 5) | 1+ (scale 6) |
| Rainbow trout | 3 | 149 | 29.9 | 1+ | 1+ (scale 4) | 1+ (scale 5) | 1+ (scale 6) |
| Rainbow trout | 2 | 150 | 29.0 | 1+ | 1+ (scale 4) | 1+ (scale 1) | 1+ (scale 5) |
| Rainbow trout | 9 | 157 | 31.4 | 1+ | 1+ (scale 1) | 1+ (scale 3) | 1+ (scale 4) |
| Brown trout | 4 | 92 | 7.1 | 0+ | 0+ (scale 1) | 0+ (scale 6) | 0+ (scale 12) |
| Brown trout | 5 | 82 | 4.8 | 0+ | 0+ (scale 4) | 0+ (scale 3) | 0+ (scale 9) |
| Brown trout | 1 | 210 | 93.7 | 2+ | 2+ (scale 5) | 2+ (scale 6) | 2+ (scale 2) |
| Brown trout | 6 | 240 | 137.9 | 3+ | 3+ (scale 3) | 3+ (scale 4) | (scale 9) |
| Brown trout | 2 | 164 | 36.3 | 1+ | 1+ (scale 1) | 1+ (scale 3) | 1+ (scale 7) |
| Brown trout | 3 | 352 | 450.0 | 3+ | 3+ (scale 1) | 3+ (scale 3) | 3+ (scale 5) |
| **LLD-F3** | | | | | | | |
| Rainbow trout | 6 | 130 | 18.5 | 1+ | 1 (scale 1) | 1 (scale 5) | 1 (scale 8) |
| Rainbow trout | 6 | 181 | 53.0 | 1+ | 1+ (scale 5) | 1+ (scale 4) | 1+ (scale 9) |
| Rainbow trout | 3 | 212 | 82.5 | 2+ | 2+ (scale 1) | 2+ (scale 5) | 2+ (scale 4) |
| Brown trout | 3 | 119 | 17.8 | 1+ | 1+ (scale 1) | 1+ (scale 3) | 1+ (scale 4) |
| Brown trout | 4 | 120 | 15.5 | 1+ | 1+ (scale 1) | 1+ (scale 2) | 1+ (scale 3) |
| Brown trout | 12 | 130 | 18.8 | 1+ | 1+ (scale 1) | 1+ (scale 3) | 1+ (scale 9) |
| Brown trout | 8 | 131 | 21.3 | 1+ | 1+ (scale 1) | 1+ (scale 2) | 1+ (scale 4) |
| Brown trout | 4 | 131 | 25.0 | 1+ | 1+ (scale 1) | 1+ (scale 2) | 1+ (scale 9) |

| Species | Sample ID | Length (TL mm) | Weight (g) | Age | 1st Scale Annuli Count | 2nd Scale Annuli Count | 3rd Scale Annuli Count |
|---|---|---|---|---|---|---|---|
| Brown trout | 11 | 140 | 26.1 | 1+ | 1+ (scale 4) | 1+ (scale 3) | 1+ (scale 7) |
| Brown trout | 7 | 147 | 31.5 | 1+ | 1+ (scale 1) | 1+ (scale 2) | 1+ (scale 4) |
| Brown trout | 5 | 160 | 39.7 | 1+ | 1+ (scale 1) | 1+ (scale 7) | 1+ (scale 8) |
| Brown trout | 5 | 338 | 355.0 | 3+ | 3+ (scale 4) | 3+ (scale 1) | 3+ (scale 7) |
| **RRD F-1** | | | | | | | |
| Rainbow trout | 11 | 132 | 34.1 | 1+ | 1+ (scale 1) | 1+ (scale 2) | 1+ (scale 9) |
| Rainbow trout | 1 | 135 | 25.1 | 1+ | 1+ (scale 2) | 1+ (scale 3) | 1+ (scale 4) |
| Rainbow trout | 5 | 144 | 35.9 | 2+ | 2+ (scale 1) | 2+ (scale 3) | 2+ (scale 7) |
| Rainbow trout | 2 | 145 | 27.6 | 2+ | 2+ (scale 1) | 2+ (scale 4) | 2+ (scale 8) |
| Rainbow trout | 10 | 161 | 47.6 | 2+ | 2+ (scale 4) | 2+ (scale 7) | 2+ (scale 8) |
| Rainbow trout | 1 | 177 | 57.2 | 2+ | 2+ (scale 5) | 2+ (scale 7) | 2+ (scale 8) |
| Brown trout | 16 | 72 | 4.0 | 0+ | 0 (scale 1) | 0 (scale 5) | 0 (scale 6) |
| **RRD F-2** | | | | | | | |
| Rainbow trout | 1 | 130 | 19.6 | 1+ | 1+ (scale 5) | 1+ (scale 6) | 1+ (scale 9) |
| **GCD-F1** | | | | | | | |
| Rainbow trout | 14 | 137 | 20.3 | 1+ | 1+ (scale 1) | 1+ (scale 3) | 1+ (scale 4) |
| Rainbow trout | 3 | 141 | 24.4 | 1+ | 1+ (scale 2) | 1+ (scale 4) | 1+ (scale 8) |
| Rainbow trout | 1 | 147 | 28.4 | 1+ | 1+ (scale 1) | 1+ (scale 4) | 1+ (scale 5) |
| Brown trout | 1 | 82 | 5.4 | 0+ | 0+ (scale 1) | 0+ (scale 3) | 0+ (scale 4) |
| **RPD F-1** | | | | | | | |
| Rainbow trout | 20 | 170 | 48.8 | 2+ | 2+ (scale 1) | 2+ (scale 2) | -- |
| Brown trout | 13 | 79 | 5.0 | 0+ | 0+ (scale 1) | 0+ (scale 2) | 0+ (scale 3) |
| Brown trout | 23 | 80 | 4.8 | 0+ | 0+ (scale 1) | 0+ (scale 2) | 0+ (scale 3) |
| Brown trout | 26 | 90 | 6.2 | 0+ | 0+ (scale 1) | 0+ (scale 3) | 0+ (scale 4) |
| Brown trout | 25 | 90 | 6.8 | 0+ | 0+ (scale 1) | 0+ (scale 4) | 0+ (scale 7) |
| Brown trout | 24 | 160 | 42.6 | 1+ | 1+ (scale 1) | 1+ (scale 2) | 1+ (scale 4) |

| Species | Sample ID | Length (TL mm) | Weight (g) | Age | 1st Scale Annuli Count | 2nd Scale Annuli Count | 3rd Scale Annuli Count |
|---|---|---|---|---|---|---|---|
| Brown trout | 22 | 222 | 124.9 | 2+ | 2+ (scale 1) | 2+ (scale 3) | 2+ (scale 4) |
| Brown trout | 21 | 325 | 398.0 | 4+ | 4+ (scale 3) | 4+ (scale 5) | 4+ (scale 6) |
| **IHD F-1** | | | | | | | |
| Rainbow trout | 1 | 134 | 23.2 | 1+ | 1+ (scale 1) | 1+ (scale 2) | 1+ (scale 3) |
| Rainbow trout | 2 | 136 | 24.2 | 1+ | 1+ (scale 1) | 1+ (scale 2) | 1+ (scale 4) |
| Rainbow trout | 5 | 145 | 29.5 | 1+ | 1+ (scale 1) | 1+ (scale 3) | 1+ (scale 4) |
| Rainbow trout | 12 | 154 | 36.1 | 1+ | 1+ (scale 1) | 1+ (scale 6) | 1+ (scale 6) |
| Rainbow trout | 11 | 187 | 67.3 | 2+ | 1+ (scale 1) | 2+ (scale 2) | 2+ (scale 5) |
| Rainbow trout | 4 | 191 | 71.1 | 2+ | 2+ (scale 2) | 2+ (scale 3) | 2+ (scale 4) |
| Rainbow trout | 3 | 203 | 76.1 | 2+ | 2+ (scale 1) | 2+ (scale 3) | 2+ (scale 6) |
| Brown trout | 8 | 127 | 19.1 | 1+ | 1+ (scale 1) | 1+ (scale 3) | 1+ (scale 4) |
| Brown trout | 7 | 151 | 33.9 | 2+ | 2+ (scale 3) | 2+ (scale 6) | 2+ (scale 9) |
| Brown trout | 3 | 185 | 63.9 | 2+ | 2+ (scale 1) | 2+ (scale 3) | 2+ (scale 7) |
| **IHD F-2** | | | | | | | |
| Rainbow trout | 4 | 168 | 36.5 | 2+ | 2+ (scale 2) | 2+ (scale 3) | 2+ (scale 5) |
| Rainbow trout | 1 | 169 | 48.8 | 2+ | 2+ (scale 1) | 2+ (scale 2) | 2+ (scale 3) |
| Brown trout | 13 | 75 | 4.1 | 0+ | -- | -- | -- |
| Brown trout | 9 | 79 | 4.6 | 0+ | -- | -- | -- |
| Brown trout | 8 | 79 | 4.6 | 0+ | -- | -- | -- |
| Brown trout | 11 | 139 | 28.2 | 1+ | 1+ (scale 2) | 1+ (scale 3) | 1+ (scale 4) |
| Brown trout | 5 | 336 | 320.0 | 3+ | 3+ (scale 3) | 3+ (scale 4) | 3+ (scale 5) |

g = grams
mm = millimeters
TL = total length

**Table B4-2. Summary Scale Analysis Data, 2019.**

| Site | Rainbow Trout Age-Class Size Ranges (FL) | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0+ | | | 1+ | | | 2+ | | | 3+ | | | 4+ | | |
| Site | n | min | max | n | min | max | n | min | max | n | min | max | n | min | max |
| LLD F-2 | -- | -- | -- | 8 | 122 | 157 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| LLD F-3 | -- | -- | -- | 2 | 130 | 181 | 1 | 212 | 212 | -- | -- | -- | -- | -- | -- |
| RRD F-1 | -- | -- | -- | 6 | 132 | 177 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| RRD F-2 | -- | -- | -- | 1 | 130 | 130 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| GCD F-1 | -- | -- | -- | 3 | 137 | 147 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| RPD F-1 | -- | -- | -- | 1 | 170 | 170 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| IHD F-1 | -- | -- | -- | 4 | 134 | 154 | 3 | 187 | 203 | -- | -- | -- | -- | -- | -- |
| IHD F-2 | -- | -- | -- | 2 | 168 | 169 | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | Brown Trout Age-Class Size Ranges (FL) | | | | | | | | | | | | | | |
| | 0+ | | | 1+ | | | 2+ | | | 3+ | | | 4+ | | |
| Site | n | min | max | n | min | max | n | min | max | n | min | max | n | min | max |
| LLD F-2 | 2 | 82 | 92 | 1 | 164 | 164 | 1 | 210 | 210 | 2 | 240 | 352 | -- | -- | -- |
| LLD F-3 | -- | -- | -- | 3 | 119 | 130 | 2 | 147 | 160 | 1 | 338 | 338 | -- | -- | -- |
| RRD F-1 | 1 | 72 | 72 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| RRD F-2 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| GCD F-1 | 1 | 82 | 82 | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| RPD F-1 | 8 | 79 | 90 | 1 | 160 | 160 | 1 | 222 | 222 | -- | -- | -- | 1 | 325 | 325 |
| IHD F-1 | -- | -- | -- | -- | -- | -- | 2 | 151 | 185 | -- | -- | -- | -- | -- | -- |
| IHD F-2 | 3 | 75 | 79 | 1 | 139 | 139 | -- | -- | -- | 1 | 336 | 336 | -- | -- | -- |

TL = total length
-- = no data

# APPENDIX B5

## Site Photos

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**Figure B5-1. Site RRD-F1, Rubicon River, Rubicon Dam Reach. From top: upper net looking upstream, middle net looking river-right, bottom net looking downstream.**

**Figure B5-2. Site RRD-F2, Rubicon River, Rubicon Dam Reach. From top: upper net looking upstream, lower net looking downstream.**

**Figure B5-3. Site BID-F1, Little Rubicon River, Buck Island Dam Reach. From top: natural barrier at upstream end of upper segment, middle net looking downstream, lower net looking upstream.**

**Figure B5-4. Site LLD-F3, Gerle Creek, Loon Lake Dam Reach. From top: upper net looking upstream, middle net looking downstream, lower net looking upstream.**

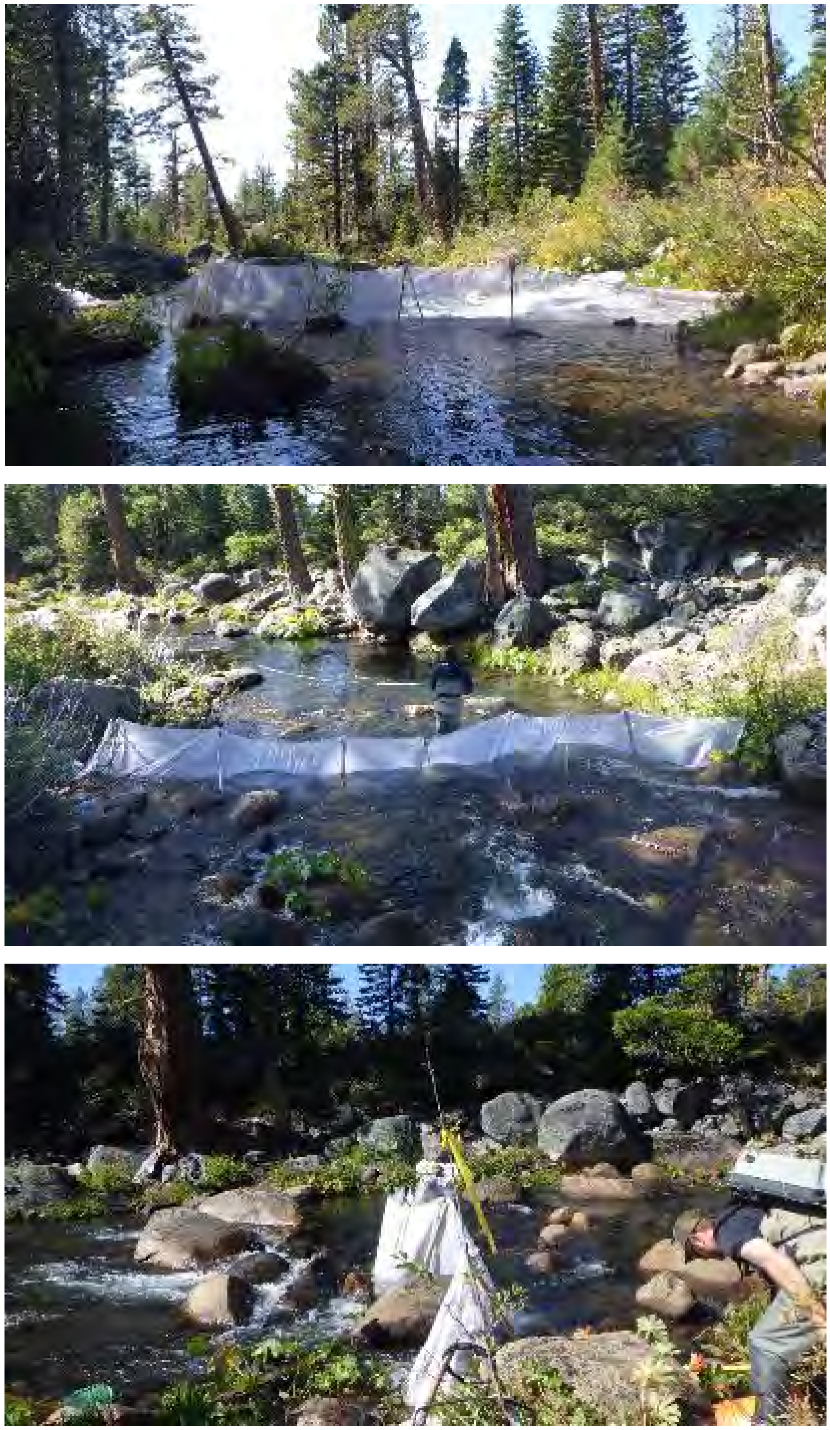

**Figure B5-5. Site LLD-F2, Gerle Creek, Loon Lake Dam Reach. From top: upper net looking downstream, middle net looking downstream, lower net looking river-right.**

**Figure B5-6. Site GCD-F1, Gerle Creek, Gerle Creek Dam Reach. From top: upper net looking upstream, middle net looking upstream, lower net looking upstream.**

**Figure B5-7. Site RPD-F1, S.F. Rubicon River, Robbs Peak Dam Reach. From top: upper net looking upstream, middle net looking downstream, lower net looking upstream.**

**Figure B5-8. Site IHD-F1, S.F. Silver Creek, Ice House Dam Reach. From top: upper net looking upstream, middle net looking downstream, lower net looking upstream.**

**Figure B5-9. Site IHD-F2, S.F. Silver Creek, Ice House Dam Reach. From top: upper net looking downstream, middle net looking upstream, lower net looking upstream.**

**Figure B5-10. Site JD-F3, Silver Creek, Junction Dam Reach. Clockwise from top: Unit #1 - run, Unit #2 - high gradient riffle, Unit #3 - pool, Unit #4 - riffle.**

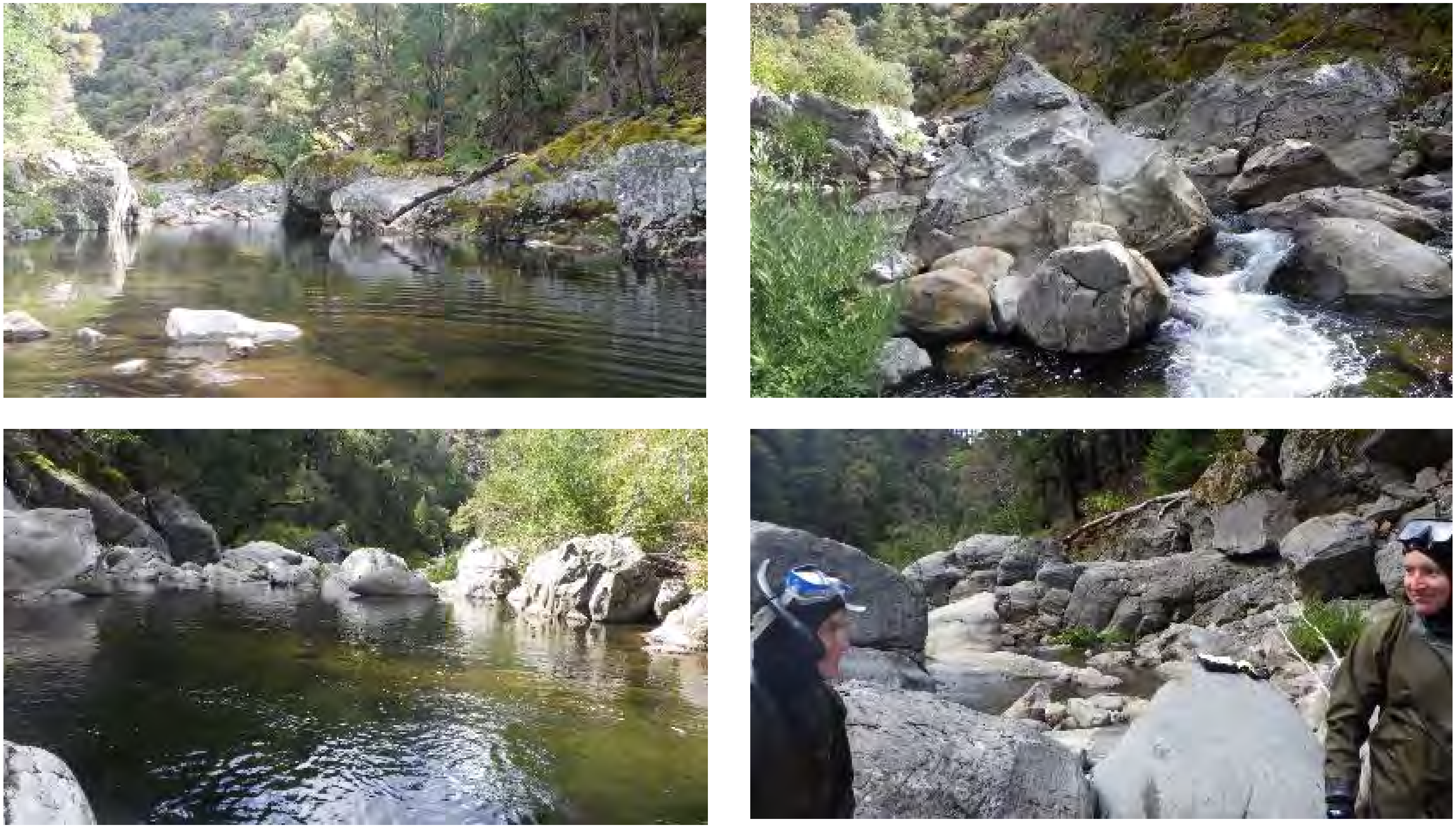

**Figure B5-11. Site CD-F1, Silver Creek, Camino Dam Reach. Clockwise from top: Unit #1 - pool, Unit #2 - riffle, Unit #3 - pool, Unit #4 - riffle.**

**Figure B5-12. Site CD-F1, Silver Creek, Camino Dam Reach. From top: Unit #5 - pool, Unit #6 - riffle, Unit #7 - pool.**

**Figure B5-13. Site SCD-F3, S.F. American River, Slab Creek Dam Reach. Clockwise from top: Unit #1 - pocket water, Unit #2 - pool, Unit #3 - riffle, Unit #4 - pool.**

**Figure B5-14. Site SCD-F2, S.F. American River, Slab Creek Dam Reach. From top: Unit #1: pool, Unit #2 - run, Unit #3 - run.**

**Figure B5-15. Site SCD-F2, S.F. American River, Slab Creek Dam Reach. From top: Unit #4 - riffle, Unit #5 - pool.**

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# APPENDIX B6

## Site Conditions

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**Table B6-1. Survey Site Conditions at UARP Trout Survey Locations, 2002–2019.**

| Date | Stream | Reach | Site Name | Habitat Section | Method | Site length (ft) | Avg. Width (ft) | Max Depth (ft) | Water Temp. (ºC) | Electric Cond. (ms) | Approx. Flow (cfs) | Percent Habitat Type | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | Pool | Riffle | Run | Glide |
| | | | | | | 2019 | | | | | | | | | |
| 09/11/19 | Rubicon | Rubicon River Dam | RRD-F1 | Lower | E-fish | 126.3 | 29.8 | 2.5 | 15.3 | 13.0 | 7 | 15 | 30 | 50 | 5 |
| 09/11/19 | Rubicon | Rubicon River Dam | RRD-F1 | Upper | E-fish | 160.5 | 38.9 | 5.5 | 15.3 | 13.0 | 7 | 15 | 5 | 80 | 0 |
| 09/12/19 | Rubicon .0 | Rubicon River Dam | RRD-F2 | Combined | E-fish | 250.0 | 27.6 | 3.5 | 15.4 | 15.6 | 7 | 55 | 15 | 30 | 0 |
| 09/10/19 | Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 226.0 | 11.7 | 2.5 | 18.7 | 9.4 | 1 | 30 | 25 | 45 | 0 |
| 09/10/19 | Little Rubicon | Buck Island Dam | BID-F1 | Upper | E-fish | 123.0 | 42.6 | 4.5 | 18.7 | 9.4 | 1 | 95 | 0 | 5 | 0 |
| 09/03/19 | Gerle Creek | Loon Lake Dam | LLD-F3 | Lower | E-fish | 184.7 | 25.3 | 2.5 | 15.4 | 8.4 | 22 | 0 | 25 | 65 | 10 |
| 09/03/19 | Gerle Creek | Loon Lake Dam | LLD-F3 | Upper | E-fish | 111.2 | 22.4 | 3.5 | 15.4 | 8.4 | 22 | 0 | 15 | 85 | 0 |
| 10/01/19 | Gerle Creek | Loon Lake Dam | LLD-F2 | Lower | E-fish | 99.1 | 31.1 | 4.0 | 8.9 | 10.1 | 25 | 0 | 0 | 90 | 10 |
| 10/01/19 | Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-fish | 212.0 | 42.7 | 1.5 | 8.9 | 10.1 | 25 | 10 | 15 | 75 | 0 |
| 10/02/19 | Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 139.1 | 36.4 | 2.0 | 9.1 | 11.5 | 11 | 25 | 10 | 65 | 0 |
| 10/02/19 | Gerle Creek | Gerle Creek Dam | GCD-F1 | Upper | E-fish | 101.8 | 31.9 | 6.0 | 9.1 | 11.5 | 11 | 40 | 0 | 60 | 0 |
| 10/03/19 | S.F. Rubicon | Robb's Peak Dam | RPD-F1 | Lower | E-fish | 160.6 | 42.5 | 4.0 | 6.9 | 3.4 | 14 | 5 | 50 | 40 | 5 |
| 10/03/19 | S.F. Rubicon | Robb's Peak Dam | RPD-F1 | Upper | E-fish | 160.7 | 40.5 | 3.0 | 6.9 | 3.4 | 14 | 25 | 50 | 5 | 20 |
| 09/05/19 | S.F. Silver Creek | Ice House Dam | IHD-F1 | Lower | E-fish | 134.0 | 29.4 | 3.5 | 11.0 | 13.7 | 16 | 15 | 40 | 40 | 5 |
| 09/05/19 | S.F. Silver Creek | Ice House Dam | IHD-F1 | Upper | E-fish | 132.5 | 20.9 | 8.0 | 11.0 | 13.7 | 16 | 20 | 15 | 65 | 10 |
| 09/04/19 | S.F. Silver Creek | Ice House Dam | IHD-F2 | Lower | E-fish | 138.7 | 25.8 | 3.5 | 16.9 | 14.7 | 16 | 5 | 15 | 85 | 0 |
| 09/04/19 | S.F. Silver Creek | Ice House Dam | IHD-F2 | Upper | E-fish | 226.0 | 29.1 | 3.5 | 16.9 | 14.7 | 16 | 10 | 25 | 65 | 0 |
| 10/4/19 | Silver Creek | Junction Dam | JD-F3 | 1 | Snorkel | 177.0 | 29.8 | 4.0 | 6.9 | 13.9 | 17 | 0 | 10 | 90 | 0 |
| 10/4/19 | Silver Creek | Junction Dam | JD-F3 | 2 | Snorkel | 171.0 | 32.9 | 3.5 | 6.9 | 13.9 | 17 | 0 | 100 | 0 | 0 |
| 10/4/19 | Silver Creek | Junction Dam | JD-F3 | 3 | Snorkel | 262.5 | 43.6 | 15 | 6.9 | 13.9 | 17 | 100 | 0 | 0 | 0 |
| 10/4/19 | Silver Creek | Junction Dam | JD-F3 | 4 | Snorkel | 310.0 | 52.8 | 4.0 | 6.9 | 13.9 | 17 | 0 | 100 | 0 | 0 |
| 9/30/19 | Silver Creek | Camino Dam | CD-F1 | 1 | Snorkel | 221.0 | 50.9 | 10.0 | 9.8 | 14.5 | 20 | 100 | 0 | 0 | 0 |
| 9/30/19 | Silver Creek | Camino Dam | CD-F1 | 2 | Snorkel | 170.0 | 23.3 | 6.0 | 9.8 | 14.5 | 20 | 50 | 50 | 0 | 0 |
| 9/30/19 | Silver Creek | Camino Dam | CD-F1 | 3 | Snorkel | 63.0 | 29.5 | 5.0 | 9.8 | 14.5 | 20 | 100 | 0 | 0 | 0 |
| 9/30/19 | Silver Creek | Camino Dam | CD-F1 | 4 | Snorkel | 92.0 | 37.4 | 6.0 | 9.8 | 14.5 | 20 | 50 | 50 | 0 | 0 |
| 9/30/19 | Silver Creek | Camino Dam | CD-F1 | 5 | Snorkel | 110.5 | 28.9 | 6.0 | 9.8 | 14.5 | 20 | 100 | 0 | 0 | 0 |
| 9/30/19 | Silver Creek | Camino Dam | CD-F1 | 6 | Snorkel | 148.0 | 19.2 | 3.0 | 9.8 | 14.5 | 20 | 0 | 100 | 0 | 0 |
| 9/30/19 | Silver Creek | Camino Dam | CD-F1 | 7 | Snorkel | 100.0 | 34.0 | 3.0 | 9.8 | 14.5 | 20 | 85 | 15 | 0 | 0 |
| 10/8/19 | S.F. American | Slab Creek | SCD-F3 | 1 | Snorkel | 269.0 | 47.0 | 2.5 | 11.1 | 20.2 | 90 | 0 | 50 | 50 | 0 |
| 10/8/19 | S.F. American | Slab Creek | SCD-F3 | 2 | Snorkel | 367.5 | 34.4 | 20+ | 11.1 | 20.2 | 90 | 100 | 0 | 0 | 0 |
| 10/8/19 | S.F. American | Slab Creek | SCD-F3 | 3 | Snorkel | 173.9 | 34.4 | 2.5 | 11.1 | 20.2 | 90 | 0 | 100 | 0 | 0 |
| 10/8/19 | S.F. American | Slab Creek | SCD-F3 | 4 | Snorkel | 272.3 | 43.7 | 4.0 | 11.1 | 20.2 | 90 | 0 | 0 | 100 | 0 |
| 10/8/19 | S.F. American | Slab Creek | SCD-F2 | 1 | Snorkel | 91.9 | 58.5 | 4.0 | 13.1 | 24.0 | 100 | 100 | 0 | 0 | 0 |
| 10/8/19 | S.F. American | Slab Creek | SCD-F2 | 2 | Snorkel | 137.8 | 51.4 | 3.0 | 13.1 | 24.0 | 100 | 0 | 0 | 100 | 0 |
| 10/8/19 | S.F. American | Slab Creek | SCD-F2 | 3 | Snorkel | 226.4 | 48.1 | 3.5 | 13.1 | 24.0 | 100 | 0 | 15 | 85 | 0 |
| 10/8/19 | S.F. American | Slab Creek | SCD-F2 | 4 | Snorkel | 144.4 | 37.2 | 3.0 | 13.1 | 24.0 | 100 | 0 | 100 | 0 | 0 |
| 10/8/19 | S.F. American | Slab Creek | SCD-F2 | 5 | Snorkel | 88.6 | 65.0 | 10.0 | 13.1 | 24.0 | 100 | 100 | 0 | 0 | 0 |

| Date | Stream | Reach | Site Name | Habitat Section | Method | Site length (ft) | Avg. Width (ft) | Max Depth (ft) | Water Temp. (ºC) | Electric Cond. (ms) | Approx. Flow (cfs) | Percent Habitat Type | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | Pool | Riffle | Run | Glide |
| **2005** | | | | | | | | | | | | | | | |
| 10/11/05 | Rubicon | Rubicon River Dam | RRD-F1 | Lower | E-fish | 149.0 | 26.1 | 2.5 | 9.9 | 21.4 | 2 | - | 15 | 85 | - |
| 10/11/05 | Rubicon | Rubicon River Dam | RRD-F1 | Upper | E-fish | 175.0 | 28.9 | 5.0 | 9.9 | 21.4 | 2 | 30 | - | 10 | 60 |
| 10/13/05 | Rubicon | Rubicon River Dam | RRD-F2 | Lower | E-fish | 122.8 | 11.9 | 1.0 | 10.8 | 22.3 | 1 | - | 30 | 70 | - |
| 10/13/05 | Rubicon | Rubicon River Dam | RRD-F2 | Upper | E-fish | 166.0 | 23.8 | 3.0 | 10.8 | 22.3 | 1 | 30 | - | 10 | 60 |
| 10/10/05 | S.F Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 168.0 | 30.2 | 2.5 | 9.6 | 10.6 | 9 | 5 | 55 | 40 | - |
| 10/10/05 | S.F Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 173.0 | 39.9 | 4.0 | 9.6 | 10.6 | 9 | 45 | 45 | 10 | - |
| **2004** | | | | | | | | | | | | | | | |
| 10/5/04 | Gerle Creek | Loon Lake Dam | LLD-F1 | Lower | E-Fish | 212.0 | 23.8 | 4.0 | 13.0 | 4.7 | 9 | 5 | 30 | 40 | 25 |
| 10/5/04 | Gerle Creek | Loon Lake Dam | LLD-F1 | Upper | E-Fish | 115.0 | 28.3 | 4.0 | 14.0 | 4.7 | 9 | 100 | 0 | 0 | 0 |
| 10/6/04 | Gerle Creek | Loon Lake Dam | LLD-F2 | Lower | E-Fish | 99.5 | 28.9 | 4.0 | 10.8 | 4.7 | 10 | 0 | 0 | 0 | 100 |
| 10/6/04 | Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-Fish | 197.0 | 40.2 | 3.0 | 12.9 | 9.0 | 10 | 5 | 30 | 65 | 0 |
| 10/9/04 | Silver Creek | Ice House Dam | IHD-F1 | Lower | E-Fish | 133.5 | 28.0 | 4.0 | 7.7 | 8.7 | 8 | 10 | 10 | 80 | 0 |
| 10/9/04 | Silver Creek | Ice House Dam | IHD-F1 | Upper | E-Fish | 142.0 | 31.3 | 5.0 | 9.0 | 8.9 | 8 | 20 | 5 | 75 | 0 |
| 10/10/04 | Silver Creek | Ice House Dam | IHD-F2 | Lower | E-Fish | 149.3 | 26.6 | 2.5 | 10.1 | 9.8 | 11 | 10 | 5 | 85 | 0 |
| 10/10/04 | Silver Creek | Ice House Dam | IHD-F2 | Upper | E-Fish | 211.5 | 30.2 | 2.5 | 12.5 | 10.2 | 11 | 0 | 50 | 50 | 0 |
| **2003** | | | | | | | | | | | | | | | |
| 10/22/03 | Rubicon | Rubicon River Dam | RRD-F1 | Lower | E-Fish | 144.0 | 25.3 | 1.5 | 9.5 | 11.2 | 1 | 0 | 15 | 85 | 0 |
| 10/22/03 | Rubicon | Rubicon River Dam | RRD-F1 | Upper | E-Fish | 157.5 | 30.9 | 5.5 | 11.7 | 13.2 | 1 | 100 | 0 | 0 | 0 |
| 10/23/03 | Rubicon | Rubicon River Dam | RRD-F2 | Lower | E-Fish | 129.0 | 14.9 | 1.0 | 7.6 | 16.6 | 1 | 0 | 30 | 70 | 0 |
| 10/23/03 | Rubicon | Rubicon River Dam | RRD-F2 | Upper | E-Fish | 163.5 | 24.1 | 2.0 | 10.8 | 18.1 | 1 | 30 | 0 | 10 | 60 |
| 10/21/03 | Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-Fish | 229.0 | 13.2 | 2.0 | 9.8 | 6.5 | 1 | 0 | 30 | 70 | 0 |
| 10/21/03 | Little Rubicon | Buck Island Dam | BID-F1 | Upper | E-Fish | 123.0 | 38.3 | 5.0 | 14.6 | 7.4 | 1 | 100 | 0 | 0 | 0 |
| 09/25/03 | Gerle Creek | Loon Lake Dam | LLD-F1 | Lower | E-Fish | 212.6 | 23.9 | 4.0 | 15.6 | 7.4 | 8 | 5 | 30 | 40 | 25 |
| 09/25/03 | Gerle Creek | Loon Lake Dam | LLD-F1 | Upper | E-Fish | 112.5 | 28.2 | 4.0 | 16.7 | 7.6 | 8 | 100 | 0 | 0 | 0 |
| 09/26/03 | Gerle Creek | Loon Lake Dam | LLD-F2 | Lower | E-Fish | 97.0 | 24.6 | 4.0 | 12.9 | 8.7 | 8 | 0 | 0 | 100 | 0 |
| 09/26/03 | Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-Fish | 188.0 | 39.8 | 3.0 | 15.3 | 9.1 | 8 | 0 | 60 | 40 | 0 |
| 09/24/03 | Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-Fish | 132.0 | 38.6 | 3.8 | 15.3 | 5.7 | 10 | 20 | 40 | 40 | 0 |
| 09/24/03 | Gerle Creek | Gerle Creek Dam | GCD-F1 | Upper | E-Fish | 190.0 | 36.2 | 5.0 | 17.5 | 9.0 | 10 | - | - | - | - |
| 09/23/03 | S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-Fish | 170.5 | 32.3 | 2.5 | 14.6 | 10.1 | 10 | 5 | 55 | 40 | 0 |
| 09/23/03 | S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-Fish | 169.0 | 44.5 | 4.5 | 14.0 | - | 10 | 70 | 10 | 20 | 0 |
| 09/27/03 | S.F. Silver Creek | Ice House Dam | IHR-F1 | Lower | E-Fish | 134.0 | 30.1 | 4.0 | 6.3 | 8.2 | 13 | 10 | 10 | 80 | 0 |
| 09/27/03 | S.F. Silver Creek | Ice House Dam | IHR-F1 | Upper | E-Fish | 137.0 | 25.3 | 5.0 | 10.8 | 9.2 | 13 | 20 | 0 | 80 | 0 |
| 10/09/03 | S.F. Silver Creek | Ice House Dam | IHR-F2 | Lower | E-Fish | 141.0 | 28.7 | 2.5 | 10.6 | 9.8 | 11 | 10 | 5 | 85 | 0 |
| 10/09/03 | S.F. Silver Creek | Ice House Dam | IHR-F2 | Upper | E-Fish | 211.0 | 28.4 | 2.5 | 12.9 | 10.5 | 14 | 0 | 50 | 50 | 0 |
| 10/10/03 | S.F. American | Slab Creek Dam | SCD-F2 | Lower | E-Fish | 117.5 | 46.1 | - | 12.7 | 20.6 | 35 | 60 | 0 | 40 | 0 |
| 10/10/03 | S.F. American | Slab Creek Dam | SCD-F2 | Upper | E-Fish | 133.5 | 34.6 | - | 14.9 | 21.7 | 35 | 0 | 90 | 10 | 0 |

| Date | Stream | Reach | Site Name | Habitat Section | Method | Site length (ft) | Avg. Width (ft) | Max Depth (ft) | Water Temp. (ºC) | Electric Cond. (ms) | Approx. Flow (cfs) | Percent Habitat Type Pool | Riffle | Run | Glide |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | **2002** | | | | | | | | |
| 10/16/02 | Rubicon | Rubicon River Dam | RRD-F1 | Lower | E-Fish | 150.0 | 29.4 | 1.5 | 9.0 | 20.0 | 5 | 0 | 15 | 85 | 0 |
| 10/16/02 | Rubicon | Rubicon River Dam | RRD-F1 | Upper | E-Fish | 149.0 | 27.6 | 5.5 | 10.0 | 10.0 | 5 | 95 | 0 | 5 | 0 |
| 10/17/02 | Rubicon | Rubicon River Dam | RRD-F2 | Lower | E-Fish | 128.0 | 16.7 | 1.5 | 10.0 | 20.0 | 3 | 0 | 50 | 50 | 0 |
| 10/17/02 | Rubicon | Rubicon River Dam | RRD-F2 | Upper | E-Fish | 172.0 | 21.9 | 2.0 | 10.0 | 20.0 | 3 | 30 | 0 | 10 | 60 |
| 10/15/02 | Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-Fish | 231.5 | 13.3 | 2.0 | 10.0 | 10.0 | 5 | 0 | 30 | 70 | 0 |
| 10/15/02 | Little Rubicon | Buck Island Dam | BID-F1 | Upper | E-Fish | 152.0 | 41.0 | 5.0 | 10.0 | 10.0 | 5 | 100 | 0 | 0 | 0 |
| 10/10/02 | Gerle Creek | Loon Lake Dam | LLD-F2 | Lower | E-Fish | 102.2 | 27.1 | 4.0 | 12.0 | 9.2 | 15 | 20 | 0 | 80 | 0 |
| 10/10/02 | Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-Fish | 191.0 | 41.5 | 3.5 | 12.0 | 9.2 | 15 | 10 | 20 | 70 | 0 |
| 10/08/02 | Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-Fish | 136.8 | 36.2 | 3.0 | 13.0 | 10.2 | 15 | 20 | 30 | 50 | 0 |
| 10/08/02 | Gerle Creek | Gerle Creek Dam | GCD-F1 | Upper | E-Fish | 107.5 | 33.8 | 5.0 | 13.0 | 10.2 | 15 | 100 | 0 | 0 | 0 |
| 10/14/02 | S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-Fish | 165.0 | 34.5 | 2.5 | 10.0 | 10.0 | 10 | 0 | 50 | 50 | 0 |
| 10/14/02 | S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-Fish | 173.2 | 47.1 | 4.5 | 10.0 | 10.0 | 10 | 70 | 10 | 20 | 0 |
| 10/07/02 | S.F. Silver Creek | Ice House Dam | IHD-F1 | Lower | E-Fish | 128.0 | 30.6 | 3.5 | 6.0 | 9.4 | 15 | 50 | 0 | 50 | 0 |
| 10/07/02 | S.F. Silver Creek | Ice House Dam | IHD-F1 | Upper | E-Fish | 135.0 | 22.7 | 5.5 | 10.0 | 10.1 | 15 | 0 | 0 | 100 | 0 |
| 10/11/02 | S.F. Silver Creek | Ice House Dam | IHD-F2 | Lower | E-Fish | 151.0 | 28.0 | 2.5 | 6.0 | 10.2 | 25 | 0 | 50 | 50 | 0 |
| 10/11/02 | S.F. Silver Creek | Ice House Dam | IHD-F2 | Upper | E-Fish | 214.0 | 32.4 | 2.5 | 9.0 | 10.4 | 25 | 0 | 100 | 0 | 0 |
| 10/22/02 | Silver Creek | Camino Dam | CD -F1 | 1 | Snorkel | 283.0 | 62.5 | 20.0 | 9.0 | - | - | 100 | - | - | - |
| 10/22/02 | Silver Creek | Camino Dam | CD -F1 | 2 | Snorkel | 130.0 | 49.5 | 2.0 | 9.0 | - | - | - | 100 | - | - |
| 10/22/02 | Silver Creek | Camino Dam | CD -F1 | 3 | Snorkel | 74.0 | 49.2 | 7.0 | 9.0 | - | - | 100 | - | - | - |
| 10/22/02 | Silver Creek | Camino Dam | CD -F1 | 4 | Snorkel | 78.0 | 45.5 | 3.0 | 9.0 | - | - | - | 100 | - | - |
| 10/22/02 | Silver Creek | Camino Dam | CD -F1 | 5 | Snorkel | 124.0 | 25.2 | 5.0 | 10.0 | - | - | 100 | - | - | - |
| 10/22/02 | Silver Creek | Camino Dam | CD -F1 | 6 | Snorkel | 168.0 | 38.8 | 3.0 | 10.0 | - | - | - | 100 | - | - |
| 10/22/02 | Silver Creek | Camino Dam | CD -F1 | 7 | Snorkel | 142.0 | 55.0 | 8.0 | 10.0 | - | - | 100 | - | - | - |
| 10/30/02 | S.F. American | Slab Creek Dam | SCD-F2 | Lower | E-Fish | 123.0 | 46.0 | 5.0 | 10.0 | 30.0 | 25 | 70 | 0 | 30 | 0 |
| 10/29/02 | S.F. American | Slab Creek Dam | SCD-F2 | Upper | E-Fish | 112.8 | 38.5 | 3.0 | 10.0 | 30.0 | 25 | 0 | 100 | 0 | 0 |

ºC = degrees Celsius
cfs = cubic feet per second
ft = feet
ms = microsiemens
-- = no data

**Table B6-2. Substrate, Cover, and Visibility Conditions at UARP Trout Survey Locations, 2002–2019.**

| Date | Stream | Reach | Site Name | Habitat Section | Method | Percent Cover | | | | | | | Percent Substrate | | | | | | Vis (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Under-cut Bank | In-stream Veg | Over-hanging Veg | LWD | Bubble | Large Boulder | No Cover | Bed | Bldr | Cob | Grvl | Snd | Silt | |
| **2019** | | | | | | | | | | | | | | | | | | | |
| 09/11/19 | Rubicon | Rubicon River Dam | RRD-F1 | Lower | E-fish | 5 | 5 | 10 | 0 | 0 | 20 | 60 | 35 | 40 | 10 | 10 | 5 | 0 | 5.5 |
| 09/11/19 | Rubicon | Rubicon River Dam | RRD-F1 | Upper | E-fish | 5 | 10 | 5 | 0 | 0 | 25 | 55 | 40 | 40 | 10 | 8 | 3 | 0 | 5.5 |
| 09/12/19 | Rubicon | Rubicon River Dam | RRD-F2 | Combined | E-fish | 5 | 5 | 15 | 5 | 0 | 0 | 70 | 0 | 0 | 5 | 50 | 30 | 15 | 3.5 |
| 09/10/19 | Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-fish | 0 | 0 | 0 | 0 | 0 | 40 | 60 | 25 | 60 | 10 | 5 | 0 | 0 | 4.5 |
| 09/10/19 | Little Rubicon | Buck Island Dam | BID-F1 | Upper | E-fish | 5 | 0 | 10 | 0 | 0 | 15 | 75 | 5 | 50 | 20 | 5 | 20 | 0 | 4.5 |
| 09/03/19 | Gerle Creek | Loon Lake Dam | LLD-F3 | Lower | E-fish | 0 | 10 | 20 | 0 | 0 | 0 | 70 | 0 | 20 | 60 | 20 | 0 | 0 | 3.5 |
| 09/03/19 | Gerle Creek | Loon Lake Dam | LLD-F3 | Upper | E-fish | 5 | 0 | 15 | 0 | 0 | 0 | 80 | 0 | 15 | 55 | 30 | 0 | 0 | 3.5 |
| 10/01/19 | Gerle Creek | Loon Lake Dam | LLD-F2 | Lower | E-fish | 5 | 5 | 0 | 0 | 0 | 10 | 80 | 0 | 80 | 20 | 0 | 0 | 0 | 4.0 |
| 10/01/19 | Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-fish | 0 | 15 | 0 | 0 | 5 | 5 | 75 | 0 | 70 | 25 | 5 | 0 | 0 | 4.0 |
| 10/02/19 | Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-fish | 0 | 55 | 10 | 0 | 5 | 10 | 20 | 0 | 60 | 35 | 5 | 0 | 0 | 6.0 |
| 10/02/19 | Gerle Creek | Gerle Creek Dam | GCD-F1 | Upper | E-fish | 10 | 5 | 20 | 0 | 0 | 10 | 55 | 70 | 10 | 20 | 0 | 0 | 0 | 6.0 |
| 10/03/19 | S.F. Rubicon | Robb's Peak Dam | RPD-F1 | Lower | E-fish | 5 | 5 | 10 | 0 | 10 | 10 | 60 | 90 | 10 | 0 | 0 | 0 | 0 | 4.0 |
| 10/03/19 | S.F. Rubicon | Robb's Peak Dam | RPD-F1 | Upper | E-fish | 0 | 0 | 15 | 0 | 5 | 20 | 60 | 70 | 15 | 5 | 5 | 5 | 0 | 4.0 |
| 09/05/19 | S.F. Silver Creek | Ice House Dam | IHD-F1 | Lower | E-fish | 5 | 5 | 20 | 0 | 0 | 30 | 40 | 60 | 15 | 10 | 10 | 5 | 0 | 8.0 |
| 09/05/19 | S.F. Silver Creek | Ice House Dam | IHD-F1 | Upper | E-fish | 0 | 0 | 15 | 0 | 0 | 30 | 55 | 50 | 20 | 5 | 5 | 15 | 0 | 8.0 |
| 09/04/19 | S.F. Silver Creek | Ice House Dam | IHD-F2 | Lower | E-fish | 5 | 0 | 10 | 0 | 0 | 10 | 75 | 50 | 25 | 20 | 5 | 0 | 0 | 3.5 |
| 09/04/19 | S.F. Silver Creek | Ice House Dam | IHD-F2 | Upper | E-fish | 5 | 5 | 5 | 0 | 0 | 10 | 75 | 40 | 30 | 20 | 5 | 5 | 0 | 3.5 |
| 10/4/19 | Silver Creek | Junction Dam | JD-F3 | 1 | Snorkel | 0 | 0 | 0 | 0 | 0 | 30 | 70 | 35 | 40 | 20 | 5 | 0 | 0 | 37.2 |
| 10/4/19 | Silver Creek | Junction Dam | JD-F3 | 2 | Snorkel | 0 | 0 | 0 | 0 | 20 | 30 | 50 | 20 | 50 | 20 | 10 | 0 | 0 | 37.2 |

| Date | Stream | Reach | Site Name | Habitat Section | Method | Percent Cover | | | | | | | Percent Substrate | | | | | | Vis (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Under-cut Bank | In-stream Veg | Over-hanging Veg | LWD | Bubble | Large Boulder | No Cover | Bed | Bldr | Cob | Grvl | Snd | Silt | |
| 10/4/19 | Silver Creek | Junction Dam | JD-F3 | 3 | Snorkel | 0 | 0 | 0 | 0 | 0 | 35 | 65 | 25 | 25 | 25 | 25 | 0 | 0 | 37.2 |
| 10/4/19 | Silver Creek | Junction Dam | JD-F3 | 4 | Snorkel | 0 | 0 | 0 | 0 | 0 | 20 | 80 | 0 | 60 | 30 | 10 | 0 | 0 | 37.2 |
| 9/30/19 | Silver Creek | Camino Dam | CD-F1 | 1 | Snorkel | 0 | 1 | 0 | 0 | 0 | 10 | 89 | 5 | 45 | 40 | 10 | 0 | 0 | 16.0 |
| 9/30/19 | Silver Creek | Camino Dam | CD-F1 | 2 | Snorkel | 0 | 0 | 0 | 0 | 20 | 15 | 65 | 10 | 40 | 25 | 25 | 0 | 0 | 16.0 |
| 9/30/19 | Silver Creek | Camino Dam | CD-F1 | 3 | Snorkel | 5 | 0 | 15 | 0 | 5 | 15 | 60 | 65 | 35 | 0 | 0 | 0 | 0 | 16.0 |
| 9/30/19 | Silver Creek | Camino Dam | CD-F1 | 4 | Snorkel | 0 | 5 | 0 | 0 | 15 | 25 | 55 | 50 | 30 | 20 | 0 | 0 | 0 | 16.0 |
| 9/30/19 | Silver Creek | Camino Dam | CD-F1 | 5 | Snorkel | 0 | 0 | 5 | 0 | 5 | 15 | 75 | 40 | 35 | 25 | 0 | 0 | 0 | 16.0 |
| 9/30/19 | Silver Creek | Camino Dam | CD-F1 | 6 | Snorkel | 0 | 0 | 0 | 0 | 60 | 20 | 20 | 40 | 40 | 20 | 0 | 0 | 0 | 16.0 |
| 9/30/19 | Silver Creek | Camino Dam | CD-F1 | 7 | Snorkel | 0 | 0 | 0 | 0 | 15 | 20 | 65 | 35 | 40 | 25 | 0 | 0 | 0 | 16.0 |
| 10/8/19 | S.F. American | Slab Creek | SCD-F3 | 1 | Snorkel | 0 | 0 | 10 | 0 | 15 | 10 | 65 | 0 | 60 | 25 | 25 | 0 | 0 | 12.1 |
| 10/8/19 | S.F. American | Slab Creek | SCD-F3 | 2 | Snorkel | 0 | 0 | 10 | 0 | 0 | 0 | 90 | 40 | 40 | 20 | 0 | 0 | 0 | 12.1 |
| 10/8/19 | S.F. American | Slab Creek | SCD-F3 | 3 | Snorkel | 0 | 0 | 0 | 0 | 70 | 10 | 20 | 0 | 70 | 30 | 0 | 0 | 0 | 12.1 |
| 10/8/19 | S.F. American | Slab Creek | SCD-F3 | 4 | Snorkel | 0 | 0 | 0 | 0 | 0 | 20 | 80 | 0 | 70 | 30 | 0 | 0 | 0 | 12.1 |
| 10/8/19 | S.F. American | Slab Creek | SCD-F2 | 1 | Snorkel | 0 | 0 | 5 | 0 | 0 | 10 | 85 | 0 | 30 | 30 | 20 | 20 | 0 | 13.5 |
| 10/8/19 | S.F. American | Slab Creek | SCD-F2 | 2 | Snorkel | 0 | 5 | 0 | 0 | 0 | 20 | 75 | 20 | 55 | 20 | 5 | 0 | 0 | 13.5 |
| 10/8/19 | S.F. American | Slab Creek | SCD-F2 | 3 | Snorkel | 5 | 0 | 10 | 0 | 10 | 10 | 65 | 20 | 35 | 30 | 10 | 5 | 0 | 13.5 |
| 10/8/19 | S.F. American | Slab Creek | SCD-F2 | 4 | Snorkel | 0 | 0 | 10 | 0 | 45 | 10 | 35 | 0 | 80 | 20 | 0 | 0 | 0 | 13.5 |
| 10/8/19 | S.F. American | Slab Creek | SCD-F2 | 5 | Snorkel | 0 | 0 | 0 | 0 | 0 | 30 | 70 | 20 | 40 | 40 | 0 | 0 | 0 | 13.5 |

| Date | Stream | Reach | Site Name | Habitat Section | Method | Percent Cover | | | | | | | Percent Substrate | | | | | | Vis (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Under-cut Bank | In-stream Veg | Over-hanging Veg | LWD | Bubble | Large Boulder | No Cover | Bed | Bldr | Cob | Grvl | Snd | Silt | |
| **2005** | | | | | | | | | | | | | | | | | | | |
| 10/11/05 | Rubicon | Rubicon River Dam | RRD-F1 | Lower | E-fish | 10 | 0 | 10 | 0 | 0 | 40 | 40 | 40 | 30 | 15 | 5 | 5 | 0 | Max |
| 10/11/05 | Rubicon | Rubicon River Dam | RRD-F1 | Upper | E-fish | 0 | 0 | 0 | 0 | 0 | 70 | 30 | 20 | 50 | 15 | 10 | 5 | 0 | Max |
| 10/13/05 | Rubicon | Rubicon River Dam | RRD-F2 | Lower | E-fish | 10 | 0 | 5 | 0 | 0 | 0 | 85 | 0 | 0 | 0 | 80 | 20 | 0 | Max |
| 10/13/05 | Rubicon | Rubicon River Dam | RRD-F2 | Upper | E-fish | 10 | 0 | 15 | 0 | 0 | 0 | 75 | 1 | 0 | 5 | 74 | 20 | 0 | Max |
| 10/10/05 | S.F Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-fish | 0 | 5 | 0 | 0 | 0 | 5 | 90 | 95 | 5 | 0 | 0 | 0 | 0 | Max |
| 10/10/05 | S.F Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-fish | 10 | 5 | 5 | 0 | 0 | 50 | 30 | 40 | 25 | 10 | 5 | 10 | 10 | Max |
| **2004** | | | | | | | | | | | | | | | | | | | |
| 10/5/04 | Gerle Creek | Loon Lake Dam | LLD-F1 | Lower | E-Fish | 0 | 0 | 20 | 0 | 0 | 5 | 65 | 40 | 40 | 15 | 5 | 0 | 0 | max |
| 10/5/04 | Gerle Creek | Loon Lake Dam | LLD-F1 | Upper | E-Fish | 10 | 0 | 20 | 0 | 0 | 5 | 65 | 15 | 15 | 55 | 10 | 0 | 5 | max |
| 10/6/04 | Gerle Creek | Loon Lake Dam | LLD-F2 | Lower | E-Fish | 0 | 0 | 0 | 0 | 0 | 40 | 50 | 5 | 75 | 50 | 0 | 0 | 0 | max |
| 10/6/04 | Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-Fish | 0 | 5 | 0 | 0 | 0 | 40 | 55 | 0 | 45 | 45 | 10 | 2 | 2 | max |
| 10/9/04 | Silver Creek | Ice House Dam | IHD-F1 | Lower | E-Fish | 0 | 0 | 5 | 0 | 0 | 20 | 75 | 60 | 30 | 0 | 0 | 5 | 5 | max |
| 10/9/04 | Silver Creek | Ice House Dam | IHD-F1 | Upper | E-Fish | 0 | 0 | 10 | 0 | 0 | 30 | 60 | 70 | 15 | 5 | 10 | 0 | 0 | max |
| 10/10/04 | Silver Creek | Ice House Dam | IHD-F2 | Lower | E-Fish | 0 | 2 | 7 | 0 | 0 | 5 | 86 | 60 | 10 | 20 | 75 | 25 | 0 | max |
| 10/10/04 | Silver Creek | Ice House Dam | IHD-F2 | Upper | E-Fish | 0 | 1 | 3 | 0 | 0 | 5 | 91 | 30 | 25 | 40 | 2 | 2 | 0 | max |
| **2003** | | | | | | | | | | | | | | | | | | | |
| 10/22/03 | Rubicon | Rubicon River Dam | RRD-F1 | Lower | E-Fish | 0 | 0 | 3 | 0 | 0 | 20 | 77 | 40 | 30 | 20 | 5 | 5 | 0 | 2 |
| 10/22/03 | Rubicon | Rubicon River Dam | RRD-F1 | Upper | E-Fish | 0 | 0 | 0 | 0 | 0 | 30 | 70 | 50 | 35 | 5 | 5 | 5 | 0 | 4 |
| 10/23/03 | Rubicon | Rubicon River Dam | RRD-F2 | Lower | E-Fish | 5 | 0 | 5 | 0 | 0 | 0 | 90 | 0 | 0 | 0 | 90 | 10 | 0 | 1 |
| 10/23/03 | Rubicon | Rubicon River Dam | RRD-F2 | Upper | E-Fish | 5 | 0 | 20 | 0 | 0 | 0 | 75 | 1 | 0 | 1 | 78 | 15 | 5 | 4 |

| Date | Stream | Reach | Site Name | Habitat Section | Method | Percent Cover | | | | | | | Percent Substrate | | | | | | Vis (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Under-cut Bank | In-stream Veg | Over-hanging Veg | LWD | Bubble | Large Boulder | No Cover | Bed | Bldr | Cob | Grvl | Snd | Silt | |
| 10/21/03 | Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-Fish | 0 | 1 | 1 | 0 | 0 | 27 | 71 | 47 | 46 | 0 | 2 | 5 | 0 | 2 |
| 10/21/03 | Little Rubicon | Buck Island Dam | BID-F1 | Upper | E-Fish | 0 | 2 | 3 | 0 | 0 | 30 | 65 | 56 | 30 | 0 | 2 | 5 | 0 | 5 |
| 09/25/03 | Gerle Creek | Loon Lake Dam | LLD-F1 | Lower | E-Fish | 0 | 0 | 20 | 0 | 0 | 15 | 65 | 40 | 40 | 15 | 5 | 0 | 0 | 4 |
| 09/25/03 | Gerle Creek | Loon Lake Dam | LLD-F1 | Upper | E-Fish | 10 | 0 | 20 | 0 | 0 | 5 | 65 | 15 | 15 | 55 | 10 | 0 | 5 | 4 |
| 09/26/03 | Gerle Creek | Loon Lake Dam | LLD-F2 | Lower | E-Fish | 0 | 0 | 10 | 0 | 0 | 40 | 50 | 5 | 75 | 20 | 0 | 0 | 0 | 4 |
| 09/26/03 | Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-Fish | 0 | 5 | 0 | 0 | 0 | 40 | 55 | 0 | 40 | 50 | 10 | 0 | 0 | 3 |
| 09/24/03 | Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-Fish | 0 | 0 | 40 | 0 | 0 | 20 | 30 | 50 | 20 | 15 | 10 | 0 | 5 | 4 |
| 09/24/03 | Gerle Creek | Gerle Creek Dam | GCD-F1 | Upper | E-Fish | 0 | 0 | 5 | 0 | 0 | 15 | 80 | 90 | 8 | 1 | 1 | 0 | 0 | 5 |
| 09/23/03 | S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-Fish | 0 | 5 | 5 | 0 | 0 | 0 | 90 | 90 | 10 | 0 | 0 | 0 | 0 | 3 |
| 09/23/03 | S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-Fish | 0 | 3 | 3 | 0 | 0 | 15 | 79 | 90 | 5 | 3 | 0 | 2 | 0 | 5 |
| 09/27/03 | S.F. Silver Creek | Ice House Dam | IHR-F1 | Lower | E-Fish | 0 | 0 | 5 | 0 | 0 | 20 | 75 | 60 | 30 | 0 | 0 | 5 | 5 | 4 |
| 09/27/03 | S.F. Silver Creek | Ice House Dam | IHR-F1 | Upper | E-Fish | 0 | 0 | 10 | 0 | 0 | 50 | 40 | 70 | 15 | 5 | 10 | 0 | 0 | 5 |
| 10/09/03 | S.F. Silver Creek | Ice House Dam | IHR-F2 | Lower | E-Fish | 0 | 2 | 7 | 0 | 0 | 5 | 86 | 60 | 10 | 20 | 7.5 | 2.5 | 0 | 3 |
| 10/09/03 | S.F. Silver Creek | Ice House Dam | IHR-F2 | Upper | E-Fish | 0 | 1 | 3 | 0 | 0 | 5 | 91 | 30 | 25 | 40 | 2 | 2 | 1 | 3 |
| 10/10/03 | S.F. American | Slab Creek Dam | SCD-F2 | Lower | E-Fish | 0 | 3 | 5 | 0 | 0 | 30 | 62 | 5 | 45 | 50 | 0 | 0 | 0 | max |
| 10/10/03 | S.F. American | Slab Creek Dam | SCD-F2 | Upper | E-Fish | 0 | 3 | 0 | 0 | 0 | 20 | 77 | 10 | 65 | 20 | 5 | 0 | 0 | max |

| Date | Stream | Reach | Site Name | Habitat Section | Method | Percent Cover | | | | | | | Percent Substrate | | | | | | Vis (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Under-cut Bank | In-stream Veg | Over-hanging Veg | LWD | Bubble | Large Boulder | No Cover | Bed | Bldr | Cob | Grvl | Snd | Silt | |
| **2002** | | | | | | | | | | | | | | | | | | | |
| 10/16/02 | Rubicon | Rubicon River Dam | RRD-F1 | Lower | E-Fish | 0 | 0 | 0 | 0 | 0 | 90 | 10 | 70 | 20 | 0 | 5 | 5 | 0 | max |
| 10/16/02 | Rubicon | Rubicon River Dam | RRD-F1 | Upper | E-Fish | 0 | 0 | 0 | 0 | 0 | 60 | 40 | 50 | 40 | 5 | 5 | 0 | 0 | max |
| 10/17/02 | Rubicon | Rubicon River Dam | RRD-F2 | Lower | E-Fish | 20 | 5 | 20 | 0 | 0 | 0 | 55 | 0 | 0 | 10 | 60 | 30 | 0 | max |
| 10/17/02 | Rubicon | Rubicon River Dam | RRD-F2 | Upper | E-Fish | 10 | 5 | 20 | 0 | 0 | 65 | 0 | 0 | 0 | 5 | 40 | 40 | 15 | max |
| 10/15/02 | Little Rubicon | Buck Island Dam | BID-F1 | Lower | E-Fish | 0 | 1 | 1 | 0 | 0 | 27 | 71 | 47 | 46 | 0 | 2 | 5 | 0 | max |
| 10/15/02 | Little Rubicon | Buck Island Dam | BID-F1 | Upper | E-Fish | 0 | 2 | 3 | 0 | 0 | 85 | 10 | 56 | 30 | 0 | 2 | 10 | 2 | max |
| 10/10/02 | Gerle Creek | Loon Lake Dam | LLD-F2 | Lower | E-Fish | 0 | 10 | 15 | 0 | 0 | 65 | 10 | 60 | 30 | 5 | 3 | 3 | 0 | max |
| 10/10/02 | Gerle Creek | Loon Lake Dam | LLD-F2 | Upper | E-Fish | 2 | 0 | 10 | 0 | 0 | 83 | 5 | 20 | 60 | 10 | 8 | 2 | 0 | max |
| 10/08/02 | Gerle Creek | Gerle Creek Dam | GCD-F1 | Lower | E-Fish | 2 | 0 | 0 | 0 | 0 | 93 | 5 | 0 | 80 | 15 | 4 | 1 | 0 | max |
| 10/08/02 | Gerle Creek | Gerle Creek Dam | GCD-F1 | Upper | E-Fish | 0 | 0 | 2.5 | 0 | 0 | 94 | 2.5 | 0 | 80 | 15 | 4 | 1 | 0 | max |
| 10/14/02 | S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Lower | E-Fish | 3 | 1 | 7 | 0 | 0 | 84 | 5 | 55 | 15 | 5 | 10 | 5 | 10 | max |
| 10/14/02 | S.F. Rubicon | Robbs Peak Dam | RPD-F1 | Upper | E-Fish | 0 | 0 | 2.5 | 0 | 0 | 95 | 2.5 | 95 | 5 | 0 | 0 | 0 | 0 | max |
| 10/07/02 | S.F. Silver Creek | Ice House Dam | IHD-F1 | Lower | E-Fish | 0 | 2 | 3 | 0 | 0 | 90 | 5 | 99 | 0 | 0 | 1 | 1 | 0 | max |
| 10/07/02 | S.F. Silver Creek | Ice House Dam | IHD-F1 | Upper | E-Fish | 1 | 1 | 3 | 0 | 0 | 90 | 5 | 95 | 2 | 1 | 1 | 1 | 0 | max |
| 10/11/02 | S.F. Silver Creek | Ice House Dam | IHD-F2 | Lower | E-Fish | 0 | 2 | 2 | 0 | 0 | 94 | 2 | 85 | 10 | 0 | 0 | 5 | 0 | max |
| 10/11/02 | S.F. Silver Creek | Ice House Dam | IHD-F2 | Upper | E-Fish | 0 | 0 | 2 | 0 | 0 | 88 | 10 | 40 | 40 | 0 | 15 | 5 | 0 | max |
| 10/22/02 | Silver Creek | Camino Dam | CD -F1 | 1 | Snorkel | 5 | 1 | 1 | 0 | 0 | 88 | 5 | 60 | 10 | 10 | 10 | 5 | 5 | max |
| 10/22/02 | Silver Creek | Camino Dam | CD -F1 | 2 | Snorkel | 0 | 1 | 2 | 0 | 0 | 97 | 0 | 60 | 20 | 11 | 2 | 2 | 5 | max |
| 10/22/02 | Silver Creek | Camino Dam | CD -F1 | 3 | Snorkel | 5 | 0 | 0 | 0 | 0 | 10 | 85 | 60 | 25 | 5 | 5 | 5 | 0 | 11 |

| Date | Stream | Reach | Site Name | Habitat Section | Method | Percent Cover | | | | | | | Percent Substrate | | | | | | Vis (ft) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Under-cut Bank | In-stream Veg | Over-hanging Veg | LWD | Bubble | Large Boulder | No Cover | Bed | Bldr | Cob | Grvl | Snd | Silt | |
| 10/22/02 | Silver Creek | Camino Dam | CD -F1 | 4 | Snorkel | 0 | 0 | 0 | 0 | 15 | 75 | 10 | 0 | 75 | 10 | 10 | 5 | 0 | 12 |
| 10/22/02 | Silver Creek | Camino Dam | CD -F1 | 5 | Snorkel | 5 | 0 | 0 | 0 | 5 | 15 | 75 | 30 | 60 | 5 | 3 | 3 | 0 | 12 |
| 10/22/02 | Silver Creek | Camino Dam | CD -F1 | 6 | Snorkel | 5 | 0 | 0 | 0 | 10 | 50 | 35 | 50 | 35 | 10 | 5 | 0 | 0 | 12 |
| 10/22/02 | Silver Creek | Camino Dam | CD -F1 | 7 | Snorkel | 0 | 0 | 0 | 0 | 0 | 40 | 60 | 15 | 70 | 5 | 5 | 5 | 0 | 12 |
| 10/30/02 | S.F. American | Slab Creek Dam | SCD-F2 | Lower | E-Fish | 0 | 0 | 0 | 0 | 20 | 60 | 20 | 35 | 55 | 5 | 5 | 0 | 0 | 12 |
| 10/29/02 | S.F. American | Slab Creek Dam | SCD-F2 | Upper | E-Fish | 0 | 0 | 0 | 0 | 0 | 10 | 90 | 45 | 45 | 5 | 0 | 0 | 5 | 12 |

Bed = Bedrock
Bldr = Boulder
Cob = Cobble
Grvl = Gravel
LWD = Large woody debris
Snd = Sand
Vis = Visibility
Veg = Vegetation

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# APPENDIX C1

## Benthic Macroinvertebrate Site Photos

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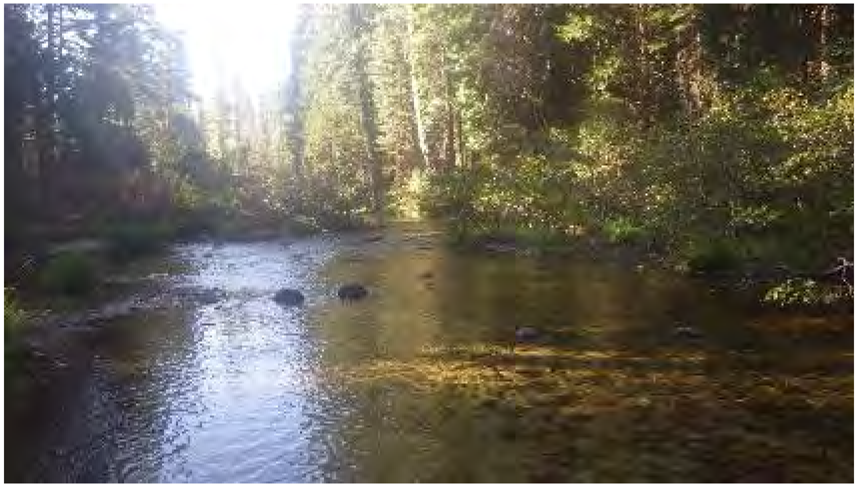


Facing upstream from Transect A

Facing downstream from Transect F

Facing upstream from Transect F

Facing downstream from Transect K

**Figure C1-1. Photographs of the Rubicon River at Sample Site RRD-I2.**

Facing upstream from Transect A

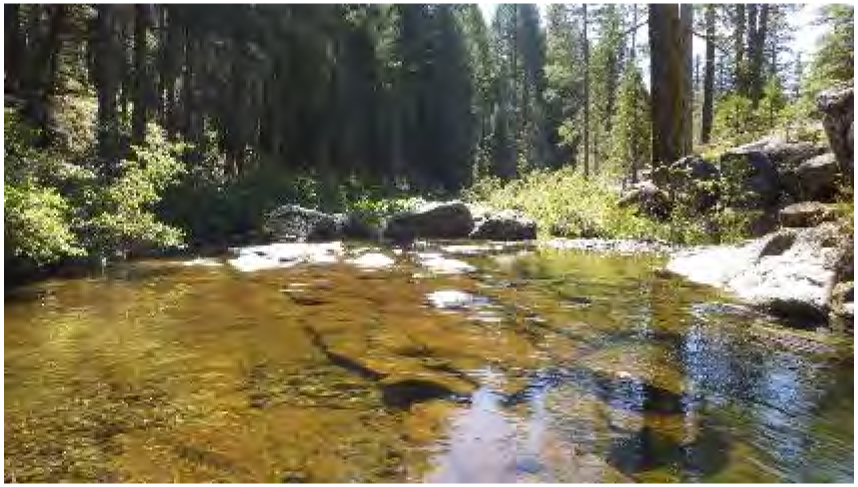
Facing downstream from Transect F

Facing upstream from Transect F

Facing downstream from Transect K

**Figure C1-2. Photographs of Gerle Creek at Sample Site LLD-I3.**

Facing upstream from Transect A



Facing downstream from Transect F

Facing upstream from Transect F

Facing downstream from Transect K

**Figure C1-3. Photographs of Gerle Creek at Sample Site GCD-I2.**

Facing upstream from Transect A

Facing downstream from Transect F

Facing upstream from Transect F

Facing downstream from Transect K

**Figure C1-4. Photographs of the South Fork Rubicon River at Sample Site RPD-I2.**

Facing upstream from Transect A

Facing downstream from Transect F

Facing upstream from Transect F

Facing downstream from Transect K

**Figure C1-5. Photographs of South Fork Silver Creek at Sample Site IHD-I2.**

Facing upstream from Transect A

Facing downstream from Transect F

Facing upstream from Transect F

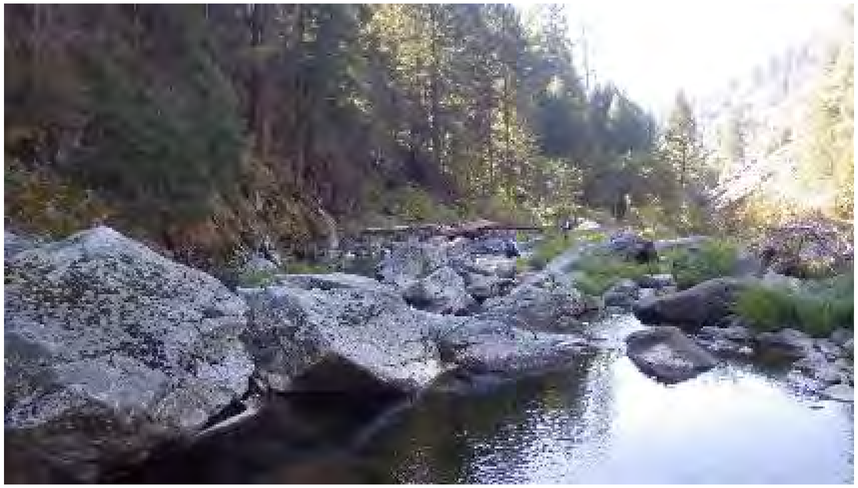
Facing downstream from Transect K

**Figure C1-6. Photographs of Silver Creek at Sample Site JD-I1.**

Facing upstream from Transect A

Facing downstream from Transect F

Facing upstream from Transect F



Facing downstream from Transect K

**Figure C1-7. Photographs of Silver Creek at Sample Site JD-I4.**

Facing upstream from Transect A

Facing downstream from Transect F

Facing upstream from Transect F

Facing downstream from Transect K

**Figure C1-8. Photographs of the Rubicon River at Site CD-I2.**

Facing upstream from Transect A

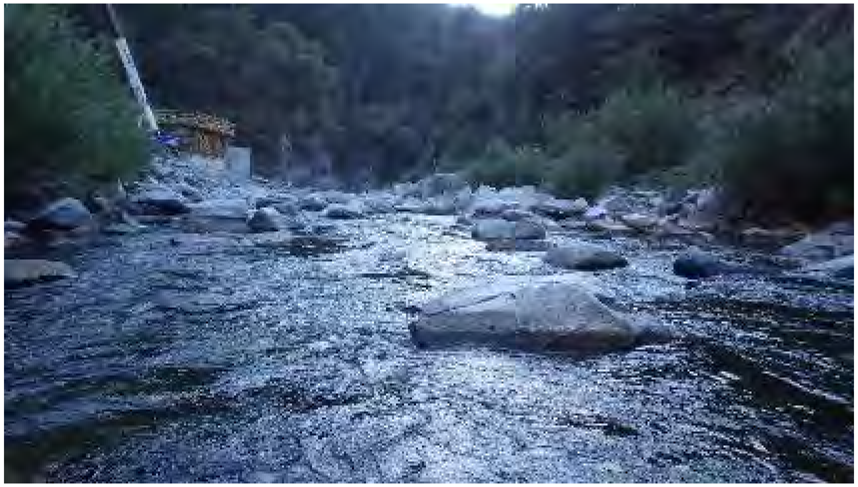
Facing downstream from Transect F

Facing upstream from Transect F

Facing downstream from Transect K

**Figure C1-9. Photographs of Silver Creek at Sample Site CD-I3.**

Facing upstream from Transect A



Facing downstream from Transect F

Facing upstream from Transect F

Facing downstream from Transect K

**Figure C1-10. Photographs of the South Fork American River at Sample Site SCD-I1.**

Facing upstream from Transect A

Facing downstream from Transect F

Facing upstream from Transect F

Facing downstream from Transect K

**Figure C1-11. Photographs of the South Fork American River at Sample Site SCD-I3.**

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# APPENDIX C2

## Interlaboratory Quality Control Report

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# APPENDIX C3

# BENTHIC MACROINVERTEBRATE TAXONOMIC LIST

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**Table C3-1. List of Benthic Macroinvertebrate Taxa Identified by Site for Benthic Macroinvertebrate Samples Collected from the Upper American River Project in 2019.**

| Phylum | Class | Order | Family | Genus species | TV[1] | FFG[2] | RRD-I2 | LLD-I3 | GCD-I2 | RPD-I2 | IHD-I2 | JD-I1 | JD-I4 | CD-I2 | CD-I3 | SCD-I1 | SCD-I3 | SCD-I3 (rep) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arthropoda | Insecta | Coleoptera | Dytiscidae | *Sanfilippodytes* | 5 | p | 1 | | | | | | | | | | | |
| Arthropoda | Insecta | Coleoptera | Dytiscidae | *Stictotarsus* | 5 | p | | | | | | | | | | | | 2 |
| Arthropoda | Insecta | Coleoptera | Elmidae | *Ampumixis dispar* | 4 | cg | | 1 | | | | | | | | | | |
| Arthropoda | Insecta | Coleoptera | Elmidae | *Cleptelmis addenda* | 4 | cg | 1 | | | 2 | 1 | | | | | | | |
| Arthropoda | Insecta | Coleoptera | Elmidae | *Heterlimnius* | 4 | cg | | | | | 6 | | | | | | | |
| Arthropoda | Insecta | Coleoptera | Elmidae | *Microcylloepus* | 4 | cg | | | | | | | | | | 1 | | |
| Arthropoda | Insecta | Coleoptera | Elmidae | *Narpus* | 4 | cg | | | | | | | | | 1 | | | |
| Arthropoda | Insecta | Coleoptera | Elmidae | *Optioservus* | 4 | sc | 1 | 1 | 2 | 2 | | | 2 | 1 | | | 1 | |
| Arthropoda | Insecta | Coleoptera | Elmidae | *Ordobrevia nubifera* | 4 | sc | | 3 | | 1 | | | | 6 | 11 | | 3 | |
| Arthropoda | Insecta | Coleoptera | Elmidae | *Zaitzevia* | 4 | sc | | 8 | | | | | | 4 | 33 | | 1 | 5 |
| Arthropoda | Insecta | Coleoptera | Psephenidae | *Eubrianax edwardsii* | 4 | sc | 27 | 2 | | 1 | | | 1 | | | | | |
| Arthropoda | Insecta | Diptera | Ceratopogonidae | *Atrichopogon* | 6 | cg | | | | | | | | | | | 1 | |
| Arthropoda | Insecta | Diptera | Ceratopogonidae | *Bezzia/ Palpomyia* | 6 | p | | | | | | | | | | 1 | | |
| Arthropoda | Insecta | Diptera | Chironomidae | Chironomidae | 6 | cg | | | | | | | | | | 4 | | |
| Arthropoda | Insecta | Diptera | Chironomidae | Chironomini | 6 | cg | | 9 | 8 | 1 | 2 | 2 | | 11 | 37 | | 297 | 73 |
| Arthropoda | Insecta | Diptera | Chironomidae | Diamesinae | 2 | cg | | 1 | 1 | 1 | | 47 | 3 | | 8 | | 2 | 4 |
| Arthropoda | Insecta | Diptera | Chironomidae | Orthocladiinae | 5 | cg | 26 | 26 | 40 | 39 | 57 | 188 | 106 | 23 | 33 | 27 | 53 | 57 |
| Arthropoda | Insecta | Diptera | Chironomidae | *Pseudochironomus* | 5 | cg | | | | | | | | 16 | 9 | 1 | 2 | 8 |
| Arthropoda | Insecta | Diptera | Chironomidae | Tanypodinae | 7 | p | | 1 | 23 | 6 | 3 | 2 | 2 | 21 | 11 | 16 | 30 | 26 |
| Arthropoda | Insecta | Diptera | Chironomidae | Tanytarsini | 6 | cg | 62 | 189 | 106 | 124 | 36 | 128 | 55 | 221 | 84 | 154 | 67 | 167 |
| Arthropoda | Insecta | Diptera | Dixidae | *Dixa* | 2 | cg | | 1 | 2 | 1 | | | | | | | | |
| Arthropoda | Insecta | Diptera | Dixidae | *Meringodixa chalonensis* | 2 | cg | | | 1 | | | | | | | | | |
| Arthropoda | Insecta | Diptera | Empididae | *Clinocera* | 6 | p | | | | | 1 | | | | | | 3 | 2 |
| Arthropoda | Insecta | Diptera | Empididae | Empididae | 6 | p | | | | | | | 3 | | | | 2 | 2 |
| Arthropoda | Insecta | Diptera | Empididae | *Hemerodromia* | 6 | p | | | | | | | | | | 1 | | 3 |
| Arthropoda | Insecta | Diptera | Empididae | *Neoplasta* | 6 | p | | 1 | | 1 | 2 | | | 6 | 2 | 15 | | 4 |
| Arthropoda | Insecta | Diptera | Empididae | *Wiedemannia* | 6 | p | | 1 | | 1 | | | 3 | 2 | | | | |
| Arthropoda | Insecta | Diptera | Muscidae | Muscidae | 6 | p | | | | | | | | 2 | | | | |
| Arthropoda | Insecta | Diptera | Psychodidae | *Maruina lanceolata* | 2 | sc | | | | | | | | 1 | | | | |
| Arthropoda | Insecta | Diptera | Simuliidae | *Simulium* | 6 | cf | 13 | 25 | 127 | 212 | 42 | 62 | 123 | 7 | 33 | 109 | 1 | 1 |
| Arthropoda | Insecta | Diptera | Stratiomyidae | *Caloparyphus/ Euparyphus* | 8 | cg | | | | | | | | | 1 | | | |
| Arthropoda | Insecta | Diptera | Tipulidae | *Antocha monticola* | 3 | cg | 1 | | | | | | 1 | 8 | | | 1 | |
| Arthropoda | Insecta | Diptera | Tipulidae | *Cryptolabis* | 3 | sh | 1 | 1 | | | | | | | | | | |
| Arthropoda | Insecta | Diptera | Tipulidae | *Dicranota* | 3 | p | | | | 2 | 2 | | | | | | | |
| Arthropoda | Insecta | Diptera | Tipulidae | *Hexatoma* | 2 | p | 12 | 1 | 1 | | | | | | | | | |
| Arthropoda | Insecta | Ephemeroptera | Ameletidae | *Ameletus* | 0 | cg | 7 | 1 | 1 | 2 | 1 | 1 | 2 | 5 | 1 | 1 | | 1 |
| Arthropoda | Insecta | Ephemeroptera | Baetidae | *Acentrella* | 4 | cg | | | | | | | | 2 | 2 | | | |
| Arthropoda | Insecta | Ephemeroptera | Baetidae | *Baetis* | 5 | cg | 39 | 72 | 95 | 55 | 148 | 69 | 58 | 51 | 86 | 61 | 4 | 2 |

| Phylum | Class | Order | Family | Genus species | TV[1] | FFG[2] | RRD-I2 | LLD-I3 | GCD-I2 | RPD-I2 | IHD-I2 | JD-I1 | JD-I4 | CD-I2 | CD-I3 | SCD-I1 | SCD-I3 | SCD-I3 (rep) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arthropoda | Insecta | Ephemeroptera | Baetidae | *Centroptilum* | 2 | cg | 2 | | 1 | | | | | 4 | 5 | | 3 | 3 |
| Arthropoda | Insecta | Ephemeroptera | Baetidae | *Cloeodes excogitatus* | 4 | cg | | | | | | | | | 1 | | | |
| Arthropoda | Insecta | Ephemeroptera | Baetidae | *Diphetor hageni* | 5 | cg | 1 | | 1 | | | | | 2 | 8 | | | |
| Arthropoda | Insecta | Ephemeroptera | Ephemerellidae | *Caudatella* | 1 | cg | | | | | 31 | | 1 | | 1 | | | |
| Arthropoda | Insecta | Ephemeroptera | Ephemerellidae | *Drunella* | 0 | cg | | 10 | | | 6 | | | | 1 | | | |
| Arthropoda | Insecta | Ephemeroptera | Ephemerellidae | *Ephemerella* | 1 | cg | 26 | 4 | | 3 | | | 8 | 3 | 6 | | 2 | 2 |
| Arthropoda | Insecta | Ephemeroptera | Ephemerellidae | Ephemerellidae | 1 | cg | | | 2 | | | 2 | | | 1 | | | |
| Arthropoda | Insecta | Ephemeroptera | Ephemerellidae | *Serratella* | 2 | cg | | | | | 34 | | | | | | | |
| Arthropoda | Insecta | Ephemeroptera | Heptageniidae | *Cinygma* | 2 | sc | | | 3 | | 15 | 11 | 1 | | 2 | | 2 | |
| Arthropoda | Insecta | Ephemeroptera | Heptageniidae | *Cinygmula* | 4 | sc | 18 | 1 | | 2 | | | 22 | | | | | |
| Arthropoda | Insecta | Ephemeroptera | Heptageniidae | *Ecdyonurus criddlei* | 4 | sc | 4 | 4 | | 1 | | | | | | 4 | | |
| Arthropoda | Insecta | Ephemeroptera | Heptageniidae | *Epeorus* | 0 | sc | 1 | 26 | 3 | 1 | 5 | | 5 | 2 | 8 | 1 | 1 | |
| Arthropoda | Insecta | Ephemeroptera | Heptageniidae | Heptageniidae | 4 | sc | | 4 | 7 | | | | | | 7 | | | |
| Arthropoda | Insecta | Ephemeroptera | Heptageniidae | *Ironodes* | 4 | sc | 25 | 13 | 6 | 7 | 22 | 13 | 24 | 1 | 10 | 7 | | |
| Arthropoda | Insecta | Ephemeroptera | Heptageniidae | *Rhithrogena* | 0 | sc | | 4 | | 1 | 12 | | 1 | 8 | 23 | 22 | 3 | 9 |
| Arthropoda | Insecta | Ephemeroptera | Leptohyphidae | *Tricorythodes* | 4 | cg | | | | | | | | | 1 | | 1 | 3 |
| Arthropoda | Insecta | Ephemeroptera | Leptophlebiidae | *Paraleptophlebia* | 4 | cg | 8 | 4 | 43 | 7 | 3 | 6 | 29 | 11 | 17 | 1 | 11 | 31 |
| Arthropoda | Insecta | Megaloptera | Corydalidae | *Orohermes crepusculus* | 0 | p | 2 | | | | 3 | | 2 | | | | | |
| Arthropoda | Insecta | Megaloptera | Sialidae | *Sialis* | 4 | p | | | 4 | | | | 2 | | | | | 1 |
| Arthropoda | Insecta | Odonata | Coenagrionidae | *Argia* | 7 | p | | | | | | | | | | | | 1 |
| Arthropoda | Insecta | Odonata | Gomphidae | Gomphidae | 4 | p | 1 | | | | | | | | | | | |
| Arthropoda | Insecta | Plecoptera | | Plecoptera | 2 | | | | | 3 | | | | | | | | |
| Arthropoda | Insecta | Plecoptera | Capniidae | Capniidae | 1 | sh | | 2 | | | | | 2 | | | | | |
| Arthropoda | Insecta | Plecoptera | Chloroperlidae | Chloroperlidae | 1 | p | | | | | 4 | | | 1 | | | | |
| Arthropoda | Insecta | Plecoptera | Chloroperlidae | *Sweltsa* | 1 | p | 13 | 12 | 17 | 2 | 23 | 1 | 11 | 4 | 1 | | 8 | 4 |
| Arthropoda | Insecta | Plecoptera | Leuctridae | *Despaxia augusta* | 0 | sh | | | | | | 7 | | | | | | |
| Arthropoda | Insecta | Plecoptera | Leuctridae | Leuctridae | 0 | sh | | | 2 | | | | | | | | | |
| Arthropoda | Insecta | Plecoptera | Nemouridae | *Malenka* | 2 | sh | 8 | 5 | 14 | 11 | 37 | 25 | 2 | 2 | 6 | | | |
| Arthropoda | Insecta | Plecoptera | Nemouridae | *Nemoura spinoloba* | 1 | sh | | | | 1 | | | | | | | | |
| Arthropoda | Insecta | Plecoptera | Nemouridae | *Zapada* | 2 | sh | 23 | 43 | 32 | 20 | 51 | 8 | 9 | | 3 | 1 | | |
| Arthropoda | Insecta | Plecoptera | Peltoperlidae | *Yoraperla* | 1 | sh | | 5 | 4 | 5 | 1 | | | | | | | |
| Arthropoda | Insecta | Plecoptera | Perlidae | *Calineuria californica* | 1 | p | 22 | 13 | 9 | 4 | | 1 | 15 | 9 | 13 | | | 2 |
| Arthropoda | Insecta | Plecoptera | Perlidae | *Doroneuria baumanni* | 1 | p | | | | 1 | | | 2 | | 1 | | | |
| Arthropoda | Insecta | Plecoptera | Perlidae | *Hesperoperla* | 2 | p | | | 1 | | | 1 | | | 2 | | 1 | |
| Arthropoda | Insecta | Plecoptera | Perlodidae | *Cultus* | 2 | p | | | | | | | 3 | 4 | 6 | 1 | | |
| Arthropoda | Insecta | Plecoptera | Perlodidae | *Frisonia picticepes* | 2 | p | | | | | 3 | | | | | | | |
| Arthropoda | Insecta | Plecoptera | Perlodidae | *Isoperla* | 2 | p | | | | | | | 2 | | 1 | | 2 | |
| Arthropoda | Insecta | Plecoptera | Perlodidae | *Kogotus/Rickera* | 2 | p | | | | | 6 | 1 | | | | | | |
| Arthropoda | Insecta | Plecoptera | Perlodidae | *Skwala* | 2 | p | 3 | 1 | | | | | 1 | | | 7 | 4 | |
| Arthropoda | Insecta | Trichoptera | Apataniidae | *Apatania* | 1 | sc | 3 | | 1 | 1 | | | | | | | | |

| Phylum | Class | Order | Family | Genus species | TV[1] | FFG[2] | RRD-I2 | LLD-I3 | GCD-I2 | RPD-I2 | IHD-I2 | JD-I1 | JD-I4 | CD-I2 | CD-I3 | SCD-I1 | SCD-I3 | SCD-I3 (rep) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Arthropoda | Insecta | Trichoptera | Apataniidae | *Pedomoecus sierra* | 0 | sc | | | | | 1 | | | | | | | |
| Arthropoda | Insecta | Trichoptera | Brachycentridae | *Amiocentrus aspilus* | 3 | cg | | 3 | | 1 | | | | | | | | |
| Arthropoda | Insecta | Trichoptera | Brachycentridae | *Micrasema* | 1 | mh | 6 | 50 | 4 | 6 | | | 3 | 3 | 1 | | | |
| Arthropoda | Insecta | Trichoptera | Calamoceratidae | *Heteroplectron californicum* | 1 | sh | | | 1 | | | | 1 | | | | | |
| Arthropoda | Insecta | Trichoptera | Glossosomatidae | *Agapetus* | 0 | sc | 2 | | | 1 | | | | | | | | |
| Arthropoda | Insecta | Trichoptera | Glossosomatidae | *Glossosoma* | 1 | sc | 56 | 28 | | | | | | | | | | |
| Arthropoda | Insecta | Trichoptera | Helicopsychidae | *Helicopsyche borealis* | 3 | sc | 5 | | | | | | | | | | | |
| Arthropoda | Insecta | Trichoptera | Hydropsychidae | *Arctopsyche* | 1 | p | 5 | 11 | | 8 | | 3 | 15 | | | | | |
| Arthropoda | Insecta | Trichoptera | Hydropsychidae | *Cheumatopsyche* | 5 | cf | | | | | | | | 1 | 21 | 1 | 11 | 15 |
| Arthropoda | Insecta | Trichoptera | Hydropsychidae | *Hydropsyche* | 4 | cf | 117 | 13 | 6 | 4 | | | 36 | 1 | 55 | 92 | 13 | 6 |
| Arthropoda | Insecta | Trichoptera | Hydropsychidae | Hydropsychidae | 4 | | | | 1 | | | | | | | | | |
| Arthropoda | Insecta | Trichoptera | Hydroptilidae | *Hydroptila* | 6 | ph | | | 2 | 31 | | 1 | 4 | 131 | 34 | 20 | 8 | 10 |
| Arthropoda | Insecta | Trichoptera | Hydroptilidae | *Neotrichia* | 4 | sc | | | | | | | | | 3 | | | |
| Arthropoda | Insecta | Trichoptera | Hydroptilidae | *Nothotrichia shasta* | 4 | ph | 3 | 7 | 1 | 13 | | 5 | 3 | | 2 | | 1 | |
| Arthropoda | Insecta | Trichoptera | Hydroptilidae | *Ochrotrichia* | 4 | ph | 1 | 8 | 1 | 1 | | | | | | | | |
| Arthropoda | Insecta | Trichoptera | Lepidostomatidae | *Lepidostoma* | 1 | sh | 26 | 6 | | 13 | | 3 | 33 | 3 | 1 | 5 | 1 | 7 |
| Arthropoda | Insecta | Trichoptera | Leptoceridae | *Mystacides* | 4 | om | | | | | | | | | | | | 1 |
| Arthropoda | Insecta | Trichoptera | Limnephilidae | *Dicosmoecus* | 1 | sc | 2 | | | | | | | 2 | | | | |
| Arthropoda | Insecta | Trichoptera | Philopotamidae | *Wormaldia* | 3 | cf | 2 | 3 | 11 | 2 | | | 1 | | 20 | 32 | | |
| Arthropoda | Insecta | Trichoptera | Phryganeidae | *Yphria californica* | 1 | p | | | | | 1 | | | | | | | |
| Arthropoda | Insecta | Trichoptera | Polycentropodidae | *Polycentropus* | 6 | p | 5 | | 5 | 1 | | | 1 | | 1 | | | |
| Arthropoda | Insecta | Trichoptera | Rhyacophilidae | *Rhyacophila* | 0 | p | 3 | 10 | 20 | 12 | 18 | | 12 | 1 | 8 | 2 | 2 | 2 |
| Arthropoda | Insecta | Trichoptera | Sericostomatidae | *Gumaga* | 3 | sh | 5 | 2 | | | | | | | | | | |
| Arthropoda | Insecta | Trichoptera | Uenoidae | *Oligophlebodes* | 0 | sc | | 1 | | | | | | | | | | |
| Arthropoda | Arachnoidea | Acari | | Acari | 5 | p | 1 | | | | | | | | | | | |
| Arthropoda | Arachnoidea | Acari | Hygrobatidae | *Hygrobates* | 8 | p | 1 | | | 1 | | | | 8 | 2 | | | |
| Arthropoda | Arachnoidea | Acari | Lebertiidae | *Lebertia* | 8 | p | 2 | 3 | 2 | 1 | 8 | 1 | 2 | 8 | | | 7 | 24 |
| Arthropoda | Arachnoidea | Acari | Mideopsidae | *Mideopsis* | 5 | p | | | 1 | | | | | 2 | | | | |
| Arthropoda | Arachnoidea | Acari | Sperchontidae | *Sperchon* | 8 | p | | | 1 | 1 | 2 | | | 3 | | | | 5 |
| Arthropoda | Arachnoidea | Acari | Sperchontidae | *Sperchonopsis* | 8 | p | | | | | | | | | | | 1 | |
| Arthropoda | Arachnoidea | Acari | Torrenticolidae | *Torrenticola* | 5 | p | | 3 | 1 | 4 | | | | 7 | 1 | | | |
| Arthropoda | Malacostraca | Amphipoda | Crangonyctidae | *Crangonyx* | 4 | cg | | | | | | | | | | 21 | 2 | 7 |
| Arthropoda | Ostracoda | | | Ostracoda | 8 | cg | | | | | | 1 | 1 | | | | | |
| Annelida | Oligochaeta | | | Oligochaeta | 5 | cg | 9 | 2 | 1 | 4 | 32 | 19 | 2 | | 3 | 7 | 51 | 133 |
| Coelenterata | Hydrozoa | Hydroida | Hydridae | *Hydra* | 5 | p | | | | | 1 | | | | | | | |
| Mollusca | Bivalvia | Veneroida | Sphaeriidae | *Pisidium* | 8 | cf | 1 | | 4 | | 7 | | | 1 | | | | |
| Mollusca | Gastropoda | Sorbeoconcha | Pleuroceridae | *Juga* | 7 | sc | | | | | | | | 1 | | | | |
| Nemertea | Enopa | | Tertastemmatidae | *Prostoma* | 8 | p | | | | | | | | | | | 6 | 2 |
| Platyhelminthes | Turbellaria | | | Turbellaria | 4 | p | | 2 | 2 | | 10 | 3 | | | 2 | | | |

[1] Tolerance Value: values ranging from 0-10 were assigned to each taxon and reflect the taxon's sensitivity to perturbations in water and habitat quality; as values increase, sensitivity decreases. Source: SAFIT (http://safit.org/TVFFG.php).
[2] Functional Feeding Group: collector-gatherer (cg); collector-filterer (cf); predator (p); scraper (sc); shredder (sh); macrophyte-herbivore (mh); piercer-herbivore (ph);omnivore (om).

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# APPENDIX C4

# BENTHIC MACROINVERTEBRATE METRIC VALUES

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**Table C4-1. Biological Metric Values for BMI Samples Collected for the Upper American River Project.**

| Metrics | RRD-I2 | LLD-I3 | GCD-I2 | RPD-I2 | IHD-I2 | JD-I1 | JD-I4 | CD-I2 | CD-I3 | SCD-I1 | SCD-I3 | SCD-I3 (rep) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Richness** | | | | | | | | | | | | |
| Taxonomic Richness[1] | 47 | 49 | 45 | 48 | 36 | 27 | 44 | 42 | 50 | 28 | 37 | 35 |
| EPT Taxa | 30 | 29 | 27 | 29 | 19 | 17 | 29 | 21 | 34 | 16 | 18 | 15 |
| Ephemeroptera Taxa | 10 | 10 | 10 | 9 | 10 | 6 | 10 | 10 | 16 | 7 | 8 | 7 |
| Plecoptera Taxa | 5 | 7 | 7 | 7 | 6 | 7 | 9 | 4 | 8 | 3 | 4 | 2 |
| Trichoptera Taxa | 15 | 12 | 10 | 13 | 3 | 4 | 10 | 7 | 10 | 6 | 6 | 6 |
| Coleoptera Taxa | 4 | 5 | 1 | 4 | 2 | 0 | 2 | 3 | 3 | 1 | 3 | 2 |
| Predator Taxa | 13 | 12 | 13 | 15 | 15 | 8 | 15 | 14 | 13 | 7 | 11 | 14 |
| ET Taxa | 25 | 22 | 20 | 22 | 13 | 10 | 20 | 17 | 26 | 13 | 14 | 13 |
| Shredder Taxa[1] | 5.0 | 6.8 | 4.6 | 4.9 | 2.9 | 4.0 | 4.8 | 2.0 | 2.8 | 1.8 | 0.9 | 1.0 |
| **Composition** | | | | | | | | | | | | |
| EPT Index (%) | 73 | 57 | 47 | 35 | 66 | 26 | 50 | 41 | 57 | 42 | 13 | 16 |
| EPT Taxa (%)[1] | 0.7 | 0.7 | 0.7 | 0.7 | 0.6 | 0.7 | 0.7 | 0.6 | 0.8 | 0.7 | 0.6 | 0.5 |
| Sensitive EPT Index (%) | 36 | 37 | 20 | 16 | 39 | 10 | 21 | 8.4 | 18 | 12 | 4.8 | 4.8 |
| Shannon Weaver Diversity Index | 3.0 | 2.8 | 2.7 | 2.4 | 2.8 | 2.2 | 2.8 | 2.4 | 3.1 | 2.4 | 2.0 | 2.4 |
| Dominant Taxon (%) | 19 | 29 | 20 | 34 | 23 | 31 | 20 | 36 | 14 | 25 | 49 | 27 |
| Non-insect Taxa (%) | 11 | 8 | 16 | 10 | 17 | 15 | 7 | 17 | 8 | 7 | 14 | 14 |
| Clinger Taxa (%)[1] | 0.6 | 0.7 | 0.6 | 0.7 | 0.6 | 0.5 | 0.7 | 0.6 | 0.7 | 0.6 | 0.7 | 0.4 |
| Coleoptera Taxa (%)[1] | 0.1 | 0.1 | 0.0 | 0.1 | 0.1 | 0.0 | 0.0 | 0.1 | 0.1 | 0.0 | 0.1 | 0.1 |
| **Tolerance** | | | | | | | | | | | | |
| Tolerance Value | 3.3 | 3.8 | 4.6 | 5.0 | 3.7 | 4.7 | 4.3 | 5.4 | 4.4 | 4.9 | 5.5 | 5.3 |
| Intolerant Organisms (%) | 37 | 36 | 19 | 16 | 40 | 18 | 22 | 8.5 | 16 | 6.5 | 5.1 | 5.4 |
| Intolerant Taxa (%) | 40 | 43 | 44 | 42 | 50 | 48 | 50 | 36 | 42 | 29 | 32 | 26 |
| Intolerant Individuals (%)[1] | 37 | 36 | 19 | 15 | 39 | 11 | 21 | 8.5 | 15 | 6.4 | 4.9 | 4.9 |
| Tolerant Organisms (%) | 0.7 | 0.5 | 1.1 | 0.5 | 2.7 | 0.3 | 0.5 | 3.3 | 0.5 | 0.0 | 2.3 | 5.0 |
| Tolerant Taxa (%) | 6.4 | 2.0 | 6.7 | 6.3 | 8.3 | 7.4 | 4.5 | 9.5 | 4.0 | 0.0 | 8.1 | 8.6 |
| **Functional Feeding Groups** | | | | | | | | | | | | |
| Collector-Gatherers (%) | 30 | 50 | 49 | 38 | 56 | 76 | 43 | 59 | 49 | 45 | 82 | 79 |
| Collector-Filterers (%) | 22 | 6.3 | 24 | 35 | 7.7 | 10 | 26 | 1.6 | 20 | 38 | 4.1 | 3.5 |
| Collector individuals (%) | 52 | 56 | 73 | 73 | 64 | 86 | 69 | 60 | 69 | 83 | 86 | 82 |
| Scrapers (%) | 24 | 15 | 3.5 | 2.9 | 8.6 | 3.9 | 9.1 | 4.3 | 15 | 5.5 | 1.8 | 2.2 |
| Predators (%) | 12 | 9.1 | 14 | 7.7 | 14 | 2.1 | 12 | 13 | 8.1 | 7.0 | 11 | 13 |
| Shredders (%) | 10 | 10 | 8.5 | 8.0 | 14 | 7.0 | 7.6 | 0.8 | 1.6 | 1.0 | 0.2 | 1.1 |
| Other (%) | 1.7 | 10 | 1.3 | 8.2 | 0.0 | 1.0 | 1.6 | 22 | 5.9 | 3.3 | 1.5 | 1.8 |
| non-gastropod sc (%) | 24 | 15 | 3.5 | 2.9 | 8.6 | 3.9 | 9.1 | 4.1 | 15 | 5.5 | 1.8 | 2.2 |
| **Indices** | | | | | | | | | | | | |
| California Stream Condition Index[2] | 1.16 | 1.26 | 1.00 | 1.07 | 0.85 | 0.71 | 1.06 | 0.88 | 0.99 | 0.71 | 0.82 | 0.74 |

1 - Metrics used for California Stream Condition Index (CSCI, Rehn et al. 2015). Metric values reported in the table may differ from metric values calculated through the CSCI computational iterations due to different subsample sizes.
2 - CSCI scores typically range from 0.1 to 1.4; scoring criteria described by Rehn et al. (2015)

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# APPENDIX D1

## Flow Data

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**Table D1-1. Monthly Average Flows for the Rubicon River below Rubicon Dam (USGS 11427960).**

| Water Year | October | November | December | January | February | March | April | May | June | July | August | September | Annual Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2003 | 1.2 | 4.4 | 6.8 | 6.6 | 6.3 | 6.8 | 6.4 | 7.3 | 7.5 | 6.9 | 5.0 | 1.6 | 5.6 |
| 2004 | 1.2 | 1.2 | 5.3 | 6.5 | 6.4 | 6.8 | 7.0 | 7.0 | 6.5 | 6.7 | 4.7 | 1.1 | 5.0 |
| 2005 | 2.7 | 6.8 | 6.8 | 6.7 | 6.6 | 6.7 | 6.9 | 21.0 | 7.7 | 6.9 | 6.7 | 1.1 | 7.2 |
| 2006 | 1.1 | 6.4 | 82.1 | 6.9 | 12.5 | 6.8 | 7.2 | 17.3 | 9.8 | 7.5 | 7.0 | 3.3 | 14.1 |
| 2007 | 1.7 | 13.2 | 7.1 | 7.1 | 7.3 | 6.9 | 6.9 | 7.2 | 7.0 | 5.5 | 0.7 | 0.5 | 5.9 |
| 2008 | 2.4 | 5.0 | 5.7 | 6.5 | 6.6 | 6.7 | 7.0 | 6.8 | 6.7 | 5.9 | 1.3 | 0.5 | 5.1 |
| 2009 | 1.9 | 6.8 | 6.0 | 6.6 | 6.7 | 6.8 | 9.4 | 27.7 | 6.7 | 6.8 | 3.3 | 0.6 | 7.3 |
| 2010 | 6.6 | 6.4 | 7.1 | 7.3 | 6.4 | 6.6 | 6.8 | 6.8 | 60.9 | 6.8 | 5.6 | 1.7 | 10.7 |
| 2011 | 78.2 | 6.7 | 6.9 | 6.7 | 6.6 | 6.7 | 7.1 | 7.6 | 56.1 | 7.9 | 6.7 | 6.1 | 17.0 |
| 2012 | 6.2 | 6.4 | 5.3 | 9.3 | 6.6 | 6.8 | 16.8 | 7.7 | 7.2 | 6.7 | 2.5 | 1.3 | 6.9 |
| 2013 | 1.7 | 6.5 | 26.5 | 6.4 | 6.3 | 6.6 | 7.1 | 7.3 | 12.2 | 6.3 | 3.3 | 0.9 | 7.6 |
| 2014 | 0.7 | 0.8 | 1.7 | 1.6 | 6.3 | 6.3 | 6.6 | 6.5 | 6.4 | 4.5 | 2.0 | 1.0 | 3.7 |
| 2015 | 1.4 | 6.7 | 8.0 | 7.8 | 21.5 | 10.6 | 10.8 | 11.7 | 7.2 | 2.9 | 1.4 | 1.3 | 7.5 |
| 2016 | 1.4 | 6.2 | 6.4 | 21.9 | 6.6 | 15.9 | 21.5 | 35.8 | 15.8 | 6.6 | 3.9 | 1.2 | 11.2 |
| 2017 | 105.7 | 7.9 | 76.1 | 81.9 | 143.9 | 15.9 | 23.2 | 56.9 | 27.0 | 12.2 | 7.3 | 7.0 | 48.0 |
| 2018 | 8.7 | 91.1 | 11.0 | 11.3 | 12.0 | 20.1 | 87.6 | 38.2 | 22.9 | 11.0 | 2.5 | 1.6 | 26.4 |
| 2019 | 2.5 | 3.5 | 9.9 | 10.0 | 11.0 | 21.0 | 27.3 | 39.7 | 3.0 | 6.9 | 7.0 | 6.7 | 21.4 |

**Table D1-2. Monthly Average Flows for Gerle Creek below Loon Lake Dam (USGS 11429500).**

| Water Year | October | November | December | January | February | March | April | May | June | July | August | September | Annual Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2003 | 9.8 | 10.3 | 10.0 | 10.2 | 10.2 | 10.6 | 11.3 | 12.1 | 10.8 | 12.6 | 10.0 | 9.5 | 10.6 |
| 2004 | 11.0 | 9.8 | 9.9 | 9.9 | 10.1 | 11.0 | 11.8 | 10.6 | 10.1 | 9.9 | 9.4 | 9.5 | 10.3 |
| 2005 | 12.3 | 9.4 | 9.4 | 9.5 | 9.3 | 10.1 | 10.6 | 12.3 | 9.5 | 9.2 | 9.0 | 9.5 | 10.0 |
| 2006 | 9.4 | 9.3 | 12.5 | 10.9 | 10.6 | 10.2 | 10.9 | 12.6 | 9.8 | 9.2 | 9.2 | 9.5 | 10.3 |
| 2007 | 8.6 | 8.9 | 9.2 | 9.2 | 9.5 | 9.5 | 9.5 | 8.5 | 8.4 | 8.3 | 8.1 | 8.6 | 8.8 |
| 2008 | 8.8 | 8.9 | 8.9 | 9.1 | 8.8 | 9.2 | 10.1 | 9.6 | 8.9 | 8.8 | 8.5 | 8.6 | 9.0 |
| 2009 | 8.7 | 9.0 | 8.7 | 8.8 | 9.1 | 9.1 | 9.4 | 10.2 | 9.2 | 9.0 | 8.7 | 8.7 | 9.0 |
| 2010 | 8.9 | 8.9 | 8.9 | 9.0 | 9.2 | 9.5 | 10.0 | 10.0 | 9.4 | 9.3 | 9.0 | 8.8 | 9.2 |
| 2011 | 9.3 | 9.1 | 9.1 | 9.1 | 9.2 | 9.1 | 9.2 | 10.0 | 10.8 | 9.2 | 9.0 | 8.8 | 9.3 |
| 2012 | 9.1 | 9.0 | 8.9 | 9.1 | 9.2 | 9.8 | 10.6 | 9.6 | 9.4 | 9.0 | 9.3 | 9.9 | 9.4 |
| 2013 | 9.9 | 10.4 | 10.1 | 9.1 | 9.9 | 10.5 | 10.2 | 10.0 | 9.4 | 8.9 | 9.2 | 9.8 | 9.8 |
| 2014 | 14.1 | 8.7 | 8.5 | 8.5 | 9.7 | 9.8 | 9.0 | 8.9 | 8.9 | 8.9 | 9.1 | 8.9 | 9.4 |
| 2015 | 12.8 | 13.1 | 13.4 | 16.2 | 19.3 | 25.1 | 27.7 | 26.0 | 11.2 | 5.6 | 5.6 | 5.6 | 15.1 |
| 2016 | 7.4 | 7.5 | 8.7 | 12.6 | 19.6 | 31.2 | 53.1 | 57.3 | 91.7 | 28.0 | 18.2 | 18.0 | 29.3 |
| 2017 | 21.0 | 17.5 | 19.4 | 20.2 | 33.6 | 59.5 | 62.5 | 67.5 | 50.9 | 36.4 | 22.9 | 22.6 | 36.1 |
| 2018 | 25.0 | 25.4 | 29.1 | 31.1 | 29.9 | 29.6 | 42.3 | 44.2 | 25.0 | 24.6 | 15.5 | 19.6 | 28.4 |
| 2019 | 19.7 | 18.5 | 20.2 | 21.3 | 25.2 | 47.1 | 64.4 | 111.5 | 38.4 | 35.6 | 23.0 | 22.3 | 37.4 |

**Table D1-3. Monthly Average Flows for South Fork Silver Creek below Ice House Dam (USGS 11441500).**

| Water Year | October | November | December | January | February | March | April | May | June | July | August | September | Annual Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2003 | 14.4 | 9.5 | 5.7 | 6.1 | 6.1 | 4.8 | 5.4 | 10.6 | 10.9 | 18.4 | 19.1 | 20.3 | 11.0 |
| 2004 | 16.2 | 10.0 | 6.6 | 5.2 | 5.4 | 5.8 | 8.6 | 14.0 | 10.1 | 19.5 | 18.7 | 19.1 | 11.3 |
| 2005 | 12.2 | 8.5 | 5.0 | 4.9 | 4.4 | 4.8 | 5.9 | 11.4 | 91.3 | 18.5 | 16.8 | 17.1 | 16.7 |
| 2006 | 169.9 | 16.4 | 6.8 | 5.3 | 4.1 | 4.7 | 8.2 | 10.3 | 9.9 | 18.2 | 17.7 | 17.7 | 24.4 |
| 2007 | 130.6 | 9.1 | 5.5 | 3.8 | 4.2 | 3.9 | 6.0 | 6.0 | 5.5 | 5.8 | 5.8 | 5.7 | 16.2 |
| 2008 | 163.6 | 5.9 | 6.0 | 6.1 | 6.0 | 6.0 | 5.8 | 5.9 | 5.8 | 5.7 | 5.9 | 6.4 | 19.3 |
| 2009 | 6.3 | 5.8 | 5.8 | 6.0 | 6.0 | 6.4 | 4.8 | 9.6 | 9.0 | 16.2 | 17.1 | 16.2 | 9.1 |
| 2010 | 13.4 | 13.6 | 114.7 | 4.5 | 4.0 | 3.9 | 4.4 | 9.0 | 9.5 | 16.0 | 16.0 | 16.0 | 18.9 |
| 2011 | 151.3 | 59.4 | 5.8 | 4.0 | 4.2 | 5.0 | 5.8 | 10.3 | 10.4 | 16.7 | 16.0 | 16.4 | 25.6 |
| 2012 | 15.2 | 8.8 | 4.6 | 3.8 | 3.7 | 4.8 | 6.0 | 8.1 | 9.9 | 16.7 | 17.2 | 11.3 | 9.2 |
| 2013 | 12.5 | 11.6 | 5.9 | 4.2 | 4.3 | 4.3 | 4.7 | 10.1 | 10.5 | 16.3 | 16.4 | 16.7 | 9.8 |
| 2014 | 13.3 | 8.7 | 4.4 | 3.7 | 4.2 | 3.7 | 5.8 | 5.7 | 5.7 | 5.6 | 5.7 | 5.5 | 6.0 |
| 2015 | 9.9 | 8.1 | 8.0 | 12.1 | 12.8 | 16.4 | 21.8 | 34.0 | 26.1 | 22.1 | 14.1 | 10.0 | 16.3 |
| 2016 | 5.5 | 5.4 | 5.8 | 7.2 | 15.3 | 25.9 | 43.2 | 152.3 | 64.7 | 31.3 | 17.6 | 16.0 | 32.6 |
| 2017 | 16.2 | 10.9 | 12.5 | 31.1 | 135.1 | 27.0 | 51.6 | 238.1 | 165.5 | 34.8 | 16.6 | 16.2 | 62.6 |
| 2018 | 16.3 | 9.5 | 12.4 | 20.0 | 20.4 | 22.4 | 46.1 | 145.1 | 68.0 | 34.5 | 16.9 | 18.3 | 35.9 |
| 2019 | 18.9 | 9.5 | 12.5 | 19.8 | 20.3 | 29.5 | 47.2 | 223.4 | 202.7 | 33.3 | 18.2 | 16.5 | 54.3 |

**Table D1-4. Monthly Average Flows for Silver Creek below Camino Dam (USGS 11441900).**

| Water Year | October | November | December | January | February | March | April | May | June | July | August | September | Annual Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2003 | 24.6 | 18.3 | 26.4 | 29.2 | 16.3 | 16.1 | 30.2 | 30.7 | 22.5 | 23.4 | 23.7 | 23.5 | 23.8 |
| 2004 | 26.1 | 18.8 | 17.5 | 18.3 | 24.3 | 16.7 | 10.9 | 17.7 | 16.8 | 15.1 | 15.0 | 24.9 | 18.5 |
| 2005 | 18.2 | 12.8 | 11.5 | 19.2 | 32.0 | 38.7 | 25.0 | 410.2 | 749.2 | 24.0 | 25.1 | 25.8 | 115.5 |
| 2006 | 24.0 | 12.2 | 556.1 | 474.4 | 171.8 | 192.3 | 1431 | 1021 | 198.1 | 28.5 | 26.1 | 27.2 | 345 |
| 2007 | 28.4 | 15.3 | 18.5 | 13.9 | 15.3 | 18.7 | 12.1 | 11.4 | 11.0 | 11.0 | 11.1 | 11.0 | 14.8 |
| 2008 | 11.0 | 7.3 | 7.0 | 8.2 | 12.3 | 17.5 | 10.0 | 11.6 | 11.6 | 11.6 | 11.0 | 11.0 | 10.8 |
| 2009 | 11.0 | 7.7 | 7.4 | 10.6 | 17.2 | 26.5 | 12.2 | 22.5 | 16.7 | 17.2 | 17.0 | 16.8 | 15.2 |
| 2010 | 16.9 | 10.1 | 11.3 | 17.6 | 23.7 | 21.5 | 22.3 | 20.1 | 243.2 | 19.0 | 19.0 | 19.0 | 36.7 |
| 2011 | 44.9 | 10.0 | 271.7 | 19.3 | 10.4 | 313.3 | 834.0 | 528.7 | 314.5 | 327.7 | 21.1 | 24.8 | 228 |
| 2012 | 24.4 | 11.2 | 11.0 | 57.4 | 11.3 | 25.5 | 20.4 | 11.4 | 11.0 | 11.0 | 11.0 | 11.0 | 18.1 |
| 2013 | 11.0 | 8.7 | 24.1 | 12.4 | 10.0 | 11.7 | 10.3 | 18.1 | 18.1 | 18.0 | 18.1 | 18.3 | 14.9 |
| 2014 | 18.1 | 10.2 | 9.3 | 9.4 | 16.8 | 14.7 | 12.9 | 11.0 | 11.0 | 11.1 | 11.7 | 11.2 | 12.3 |
| 2015 | 11.2 | 8.2 | 11.3 | 13.0 | 19.5 | 17.3 | 21.9 | 32.2 | 27.4 | 23.5 | 15.7 | 11.8 | 17.7 |
| 2016 | 6.2 | 6.6 | 32.9 | 71.6 | 26.1 | 243.0 | 44.7 | 182.2 | 59.3 | 34.9 | 18.5 | 10.2 | 61.8 |
| 2017 | 10.3 | 22.1 | 85.3 | 2005 | 3018 | 1148 | 1422 | 1739 | 1021 | 109.5 | 21.2 | 19.4 | 876 |
| 2018 | 16.7 | 22.7 | 22.0 | 22.3 | 22.3 | 73.4 | 106.5 | 72.7 | 54.9 | 33.7 | 17.2 | 16.8 | 40.2 |
| 2019 | 16.8 | 22.2 | 22.3 | 27.3 | 57.5 | 48.6 | 319.1 | 860 | 942.3 | 40.2 | 21.7 | 20.7 | 200 |

**Table D1-5. Monthly Average Flows for South Fork American River below Slab Creek Dam (USGS 11443500).**

| Water Year | October | November | December | January | February | March | April | May | June | July | August | September | Annual Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2003 | 38.4 | 37.2 | 37.5 | 37.3 | 37.3 | 37.5 | 38.0 | 128.0 | 300.7 | 39.2 | 37.0 | 37.0 | 66.9 |
| 2004 | 55.0 | 109.6 | 38.0 | 38.0 | 37.9 | 38.0 | 38.0 | 37.9 | 37.8 | 38.0 | 38.0 | 38.1 | 45.3 |
| 2005 | 38.0 | 38.0 | 38.0 | 38.0 | 38.0 | 38.0 | 37.9 | 1798 | 1155 | 38.2 | 38.6 | 39.2 | 279.4 |
| 2006 | 38.5 | 38.0 | 712.0 | 535.1 | 180.6 | 180.6 | 1826 | 2112 | 384.1 | 38.0 | 37.9 | 38.0 | 503.4 |
| 2007 | 38.0 | 38.0 | 38.0 | 38.0 | 38.0 | 38.0 | 19.8 | 12.4 | 38.0 | 38.0 | 38.0 | 38.0 | 34.3 |
| 2008 | 37.9 | 25.3 | 11.7 | 11.7 | 11.8 | 33.5 | 19.0 | 13.9 | 38.0 | 37.9 | 38.0 | 38.0 | 26.5 |
| 2009 | 38.0 | 26.6 | 11.9 | 12.0 | 12.0 | 81.8 | 38.6 | 51.0 | 39.3 | 38.4 | 38.4 | 38.8 | 35.8 |
| 2010 | 38.7 | 38.8 | 38.5 | 38.0 | 38.0 | 38.0 | 38.0 | 38.2 | 561.2 | 37.9 | 38.0 | 38.0 | 81.2 |
| 2011 | 44.5 | 38.0 | 198.5 | 38.0 | 38.0 | 179.1 | 720.4 | 627.1 | 1129 | 387.8 | 38.2 | 39.0 | 290.7 |
| 2012 | 38.8 | 38.5 | 38.2 | 38.0 | 38.0 | 17.6 | 11.0 | 32.5 | 38.7 | 38.8 | 38.8 | 39.0 | 34.0 |
| 2013 | 39.2 | 39.0 | 90.9 | 38.7 | 39.3 | 38.7 | 41.2 | 38.5 | 38.1 | 38.6 | 38.8 | 38.7 | 43.4 |
| 2014 | 38.7 | 38.1 | 38.5 | 38.4 | 70.7 | 20.1 | 12.0 | 13.3 | 38.1 | 38.4 | 38.4 | 39.0 | 35.1 |
| 2015 | 54.7 | 60.8 | 60.9 | 60.9 | 92.1 | 100.0 | 103.5 | 106.1 | 90.8 | 79.2 | 64.7 | 64.9 | 78.1 |
| 2016 | 65.0 | 65.4 | 75.2 | 139.4 | 79.1 | 239.4 | 257.8 | 257.6 | 177.7 | 98.1 | 77.8 | 77.5 | 133.3 |
| 2017 | 97.0 | 78.4 | 156.8 | 1776 | 6146 | 2078 | 3071 | 3991 | 797.4 | 132.3 | 81.1 | 700.5 | 1574 |
| 2018 | 767.3 | 1023 | 1128 | 493.5 | 97.2 | 318.8 | 599.8 | 294.8 | 189.2 | 96.2 | 76.8 | 76.1 | 430.4 |
| 2019 | 13.1 | 12.7 | 12.2 | 15.7 | 391.3 | 599.3 | 410.2 | 875.8 | 1362.7 | 100.0 | 88.3 | 88.9 | 329.7 |

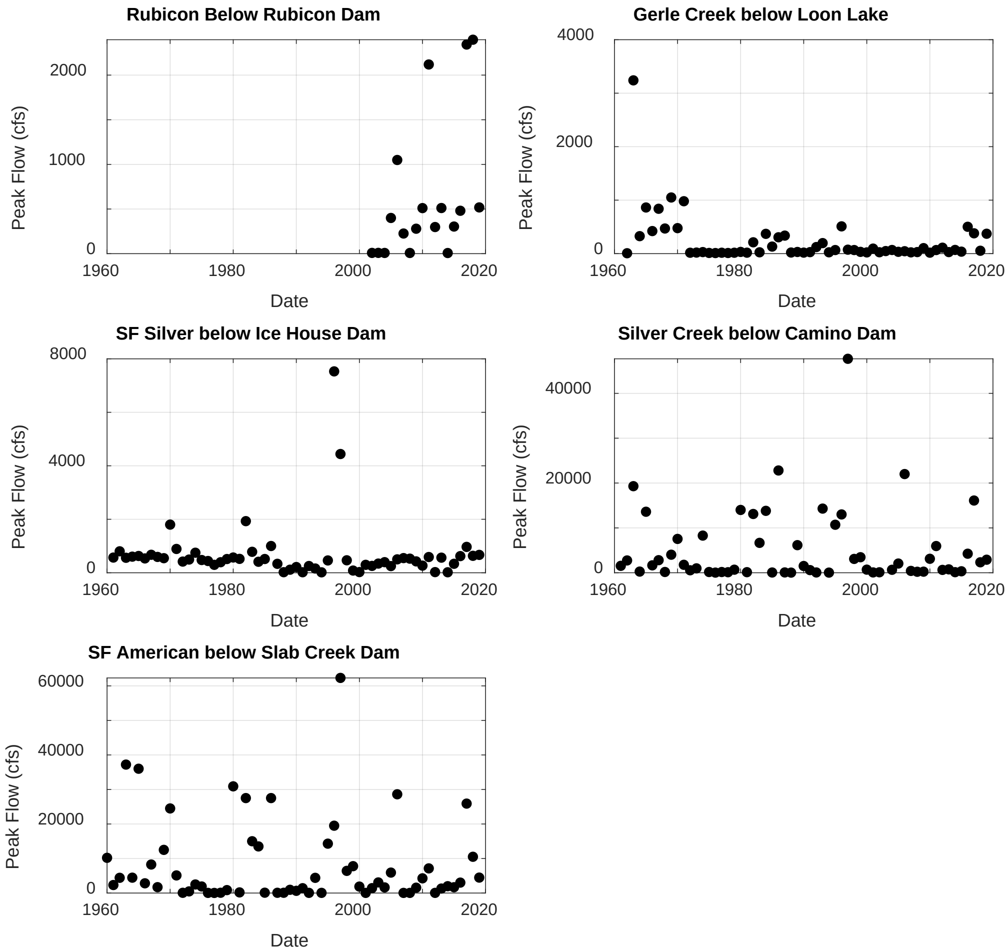


**Figure D1-1. Peak flow hydrographs for four of the gages in the geomorphology study from 1960-2019.**

**Table D1-6. Annual Peak Flow Data for Gages Used in the Geomorphology Study[1].**

| Water Year[2] | Rubicon River below Rubicon Dam + Spill over Rubicon Dam (cfs) | Gerle Creek below Loon Lake Dam (cfs) | SF Silver below Ice House Dam (cfs) | Silver Creek below Camino Dam (cfs) | SF American below Slab Creek Dam (cfs) |
|---|---|---|---|---|---|
| 1923 | - | - | - | - | 7350 |
| 1924 | - | - | - | - | 1970 |
| 1925 | - | - | 785 | - | 18000 |
| 1926 | - | - | 450 | - | 4510 |
| 1927 | - | - | 800 | - | 9350 |
| 1928 | - | - | 1950 | - | 31500 |
| 1929 | - | - | 775 | - | 8300 |
| 1930 | - | - | 409 | - | 4100 |
| 1931 | - | - | 217 | - | 1620 |
| 1932 | - | - | 648 | - | 6200 |
| 1933 | - | - | 692 | - | 5930 |
| 1934 | - | - | 558 | - | 4010 |
| 1935 | - | - | 760 | - | 10700 |
| 1936 | - | - | 828 | - | 11700 |
| 1937 | - | - | 782 | - | 7140 |
| 1938 | - | - | 2640 | - | 34400 |
| 1939 | - | - | 339 | - | 2650 |
| 1940 | - | - | 942 | - | 18400 |
| 1941 | - | - | 750 | - | 6990 |
| 1942 | - | - | 959 | - | 13300 |
| 1943 | - | - | 1110 | - | 23100 |
| 1944 | - | - | 526 | - | 4450 |
| 1945 | - | - | 750 | - | 19100 |
| 1946 | - | - | 636 | - | 7110 |
| 1947 | - | - | 602 | - | 4500 |
| 1948 | - | - | 689 | - | 6580 |
| 1949 | - | - | 792 | - | 6460 |
| 1950 | - | - | 764 | - | 6080 |
| 1951 | - | - | 3900 | - | 46000 |
| 1952 | - | - | 865 | - | 9420 |
| 1953 | - | - | 1090 | - | 10600 |
| 1954 | - | - | 746 | - | 9340 |
| 1955 | - | - | 635 | - | 4950 |
| 1956 | - | - | 3940 | - | 49800 |
| 1957 | - | - | 1070 | - | 10400 |
| 1958 | - | - | 823 | - | 8350 |

| Water Year[2] | Rubicon River below Rubicon Dam + Spill over Rubicon Dam (cfs) | Gerle Creek below Loon Lake Dam (cfs) | SF Silver below Ice House Dam (cfs) | Silver Creek below Camino Dam (cfs) | SF American below Slab Creek Dam (cfs) |
|---|---|---|---|---|---|
| 1959 | - | - | 587 | - | 2850 |
| 1960 | - | - | - | - | 10200 |
| 1961 | - | - | 568 | 1540 | 2320 |
| 1962 | - | 7.7 | 802 | 2740 | 4410 |
| 1963 | - | 3240 | 560 | 19300 | 37200 |
| 1964 | - | 327 | 602 | 259 | 4450 |
| 1965 | - | 863 | 627 | 13600 | 36000 |
| 1966 | - | 422 | 536 | 1650 | 2820 |
| 1967 | - | 839 | 672 | 2800 | 8260 |
| 1968 | - | 470 | 592 | 170 | 1700 |
| 1969 | - | 1050 | 545 | 4020 | 12500 |
| 1970 | - | 477 | 1800 | 7540 | 24500 |
| 1971 | - | 980 | 890 | 1770 | 5100 |
| 1972 | - | 17 | 418 | 550 | 67 |
| 1973 | - | 20 | 494 | 978 | 479 |
| 1974 | - | 29 | 749 | 8280 | 2480 |
| 1975 | - | 13 | 476 | 162 | 1900 |
| 1976 | - | 11 | 439 | 30 | 43 |
| 1977 | - | 17 | 296 | 159 | 30 |
| 1978 | - | 12 | 394 | 115 | 84 |
| 1979 | - | 17 | 513 | 677 | 848 |
| 1980 | - | 32 | 570 | 14000 | 30900 |
| 1981 | - | 18 | 519 | 127 | 184 |
| 1982 | - | 212 | 1930 | 13100 | 27500 |
| 1983 | - | 25 | 783 | 6660 | 15000 |
| 1984 | - | 370 | 411 | 13800 | 13500 |
| 1985 | - | 132 | 514 | 53 | 97 |
| 1986 | - | 306 | 1000 | 22800 | 27500 |
| 1987 | - | 337 | 334 | 67 | 72 |
| 1988 | - | 21 | 21 | 28 | 78 |
| 1989 | - | 31 | 114 | 6150 | 935 |
| 1990 | - | 19 | 214 | 1500 | 639 |
| 1991 | - | 28 | 19 | 586 | 1400 |
| 1992 | - | 123 | 252 | 62 | 50 |
| 1993 | - | 197 | 159 | 14300 | 4400 |
| 1994 | - | 25 | 16 | 28 | 48 |
| 1995 | - | 67 | 460 | 10700 | 14300 |
| 1996 | - | 510 | 7530 | 13000 | 19500 |

| Water Year[2] | Rubicon River below Rubicon Dam + Spill over Rubicon Dam (cfs) | Gerle Creek below Loon Lake Dam (cfs) | SF Silver below Ice House Dam (cfs) | Silver Creek below Camino Dam (cfs) | SF American below Slab Creek Dam (cfs) |
|---|---|---|---|---|---|
| 1997 | - | 74 | 4440 | 47700 | 62300 |
| 1998 | - | 67 | 466 | 3080 | 6420 |
| 1999 | - | 33 | 82 | 3460 | 7780 |
| 2000 | - | 23 | 25 | 688 | 1870 |
| 2001 | - | 94 | 296 | 70 | 41 |
| 2002 | 8.3 | 26 | 256 | 102 | 1410 |
| 2003 | 8.7 | 48 | 343 | - | 3070 |
| 2004 | 7.9 | 68 | 396 | 656 | 1630 |
| 2005 | 400 | 34 | 249 | 2050 | 5920 |
| 2006 | 1049 | 45 | 501 | 22000 | 28600 |
| 2007 | 226 | 24 | 548 | 405 | 39 |
| 2008 | 7.6 | 29 | 527 | 215 | 39 |
| 2009 | 279 | 103 | 425 | 238 | 1550 |
| 2010 | 510 | 18 | 266 | 3110 | 4260 |
| 2011 | 2119 | 67 | 588 | 5950 | 7140 |
| 2012 | 298 | 111 | 24 | 632 | 46 |
| 2013 | 511 | 29 | 564 | 752 | 1300 |
| 2014 | 7.0 | 69 | 18 | 126 | 1980 |
| 2015 | 304 | 37 | 335 | 325 | 1680 |
| 2016 | 480 | 502 | 622 | 4240 | 3020 |
| 2017 | 2342 | 380 | 967 | 16100 | 25900 |
| 2018 | 2397 | 54 | 633 | 2330 | 10500 |
| 2019 | 518 | 371.8 | 668 | 2902 | 44670 |

cfs=cubic feet per second; SF = South Fork

[1] All 2019 Peaks were calculated from Daily Average Data. The Peak Flows for the Rubicon River Were Calculated by Adding the USGS Gage Data to Spill Data Provided By SMUD. The Remainder of the Peak Flow Data Was Downloaded from the USGS.

[2] Water year extends from October 1 to September 30

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# APPENDIX D2

## Cross Section Location Data and Overview Maps

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**Table D2-1. Cross section endpin locations in State Plane Coordinate System Zone 2 (NAD-1983).**

| Site | Cross-Section | Endpin | Endpin recovered (Y/N) | Northing (ft) | Easting (ft) | Elevation (ft) |
|---|---|---|---|---|---|---|
| RRD-G1 | XS-1 | LBP | Y | 2132950.05 | 7065088.94 | 6129.93 |
| RRD-G1 | XS-1 | RBP | Y | 2132934.08 | 7065197.68 | 6131.09 |
| RRD-G1 | XS-2 | LBP | Y | 2133088.83 | 7065082.38 | 6130.10 |
| RRD-G1 | XS-2 | RBP | Y | 2133106.58 | 7065174.30 | 6130.02 |
| RRD-G1 | XS-3 | LBP | Y | 2133187.37 | 7065057.61 | 6131.62 |
| RRD-G1 | XS-3 | RBP | Y | 2133211.04 | 7065164.53 | 6130.91 |
| LLD-G1 | XS-1 | LBP | N | 2133736.58 | 7038608.57 | 6134.79 |
| LLD-G1 | XS-1 | RBP | N | 2133820.54 | 7038548.72 | 6137.71 |
| LLD-G1 | XS-2 | LBP | N | 2133739.90 | 7038431.15 | 6134.89 |
| LLD-G1 | XS-2 | RBP | N | 2133810.33 | 7038462.31 | 6140.13 |
| LLD-G1 | XS-3 | LBP | N | 2133732.61 | 7038470.20 | 6135.54 |
| LLD-G1 | XS-3 | RBP | N | 2133810.33 | 7038462.31 | 6140.13 |
| LLD-G2 | XS-1 | LBP | Y | 2134662.51 | 7030639.47 | 5889.82 |
| LLD-G2 | XS-1 | RBP | Y | 2134758.24 | 7030632.82 | 5885.14 |
| LLD-G2 | XS-2 | LBP | Y | 2134650.97 | 7030549.89 | 5884.69 |
| LLD-G2 | XS-2 | RBP | Y | 2134707.09 | 7030550.94 | 5883.10 |
| LLD-G2 | XS-3 | LBP | Y | 2134604.95 | 7030188.25 | 5878.90 |
| LLD-G2 | XS-3 | RBP | Y | 2134716.69 | 7030168.77 | 5878.48 |
| IHD-G1 | XS-1 | LBP | Y | 2063161.27 | 7022900.42 | 5182.72 |
| IHD-G1 | XS-1 | RBP | Y | 2063269.85 | 7022717.99 | 5183.28 |
| IHD-G1 | XS-2 | LBP | N | 2062986.22 | 7022772.40 | 5181.43 |
| IHD-G1 | XS-2 | RBP | N | 2063018.72 | 7022649.92 | 5180.25 |
| IHD-G1 | XS-3 | LBP | N | 2062737.35 | 7022596.30 | 5180.57 |
| IHD-G1 | XS-3 | RBP | Y | 2062862.59 | 7022521.02 | 5182.56 |
| IHD-G2 | XS-1 | LBP | Y | 2071287.58 | 7005528.87 | 4584.54 |
| IHD-G2 | XS-1 | RBP | Y | 2071364.06 | 7005705.08 | 4582.21 |
| IHD-G2 | XS-2 | LBP | Y | 2071404.92 | 7005431.30 | 4586.62 |
| IHD-G2 | XS-2 | RBP | Y | 2071513.49 | 7005643.36 | 4582.81 |
| IHD-G2 | XS-3 | LBP | Y | 2071916.83 | 7005519.81 | 4578.25 |
| IHD-G2 | XS-3 | RBP | Y | 2071917.17 | 7005519.88 | 4577.90 |
| CD-G1 | XS-1 | LBP | N | 2060396.62 | 6966493.92 | 2333.52 |
| CD-G1 | XS-1 | RBP | N | 2060459.76 | 6966434.50 | 2332.46 |
| CD-G1 | XS-2 | LBP | Y | 2060107.58 | 6966316.48 | 2331.76 |
| CD-G1 | XS-2 | RBP | Y | 2060169.66 | 6966212.90 | 2334.55 |
| CD-G1 | XS-3 | LBP | Y | 2060019.91 | 6966279.68 | 2330.72 |
| CD-G1 | XS-3 | RBP | Y | 2060056.42 | 6966171.85 | 2327.54 |
| SCD-G1 | XS-1 | LBP | N | 2049355.99 | 6911287.10 | 1117.21 |

| Site | Cross-Section | Endpin | Endpin recovered (Y/N) | Northing (ft) | Easting (ft) | Elevation (ft) |
|---|---|---|---|---|---|---|
| SCD-G1 | XS-1 | RBP | N | 2049520.44 | 6911259.28 | 1118.66 |
| SCD-G1 | XS-2 | LBP | Y | 2049303.76 | 6911154.41 | 1116.27 |
| SCD-G1 | XS-2 | RBP | Y | 2049450.74 | 6911016.50 | 1121.81 |
| SCD-G1 | XS-3 | LBP | Y | 2049252.74 | 6910875.16 | 1112.90 |
| SCD-G1 | XS-3 | RBP | Y | 2049349.81 | 6911118.97 | 1108.91 |

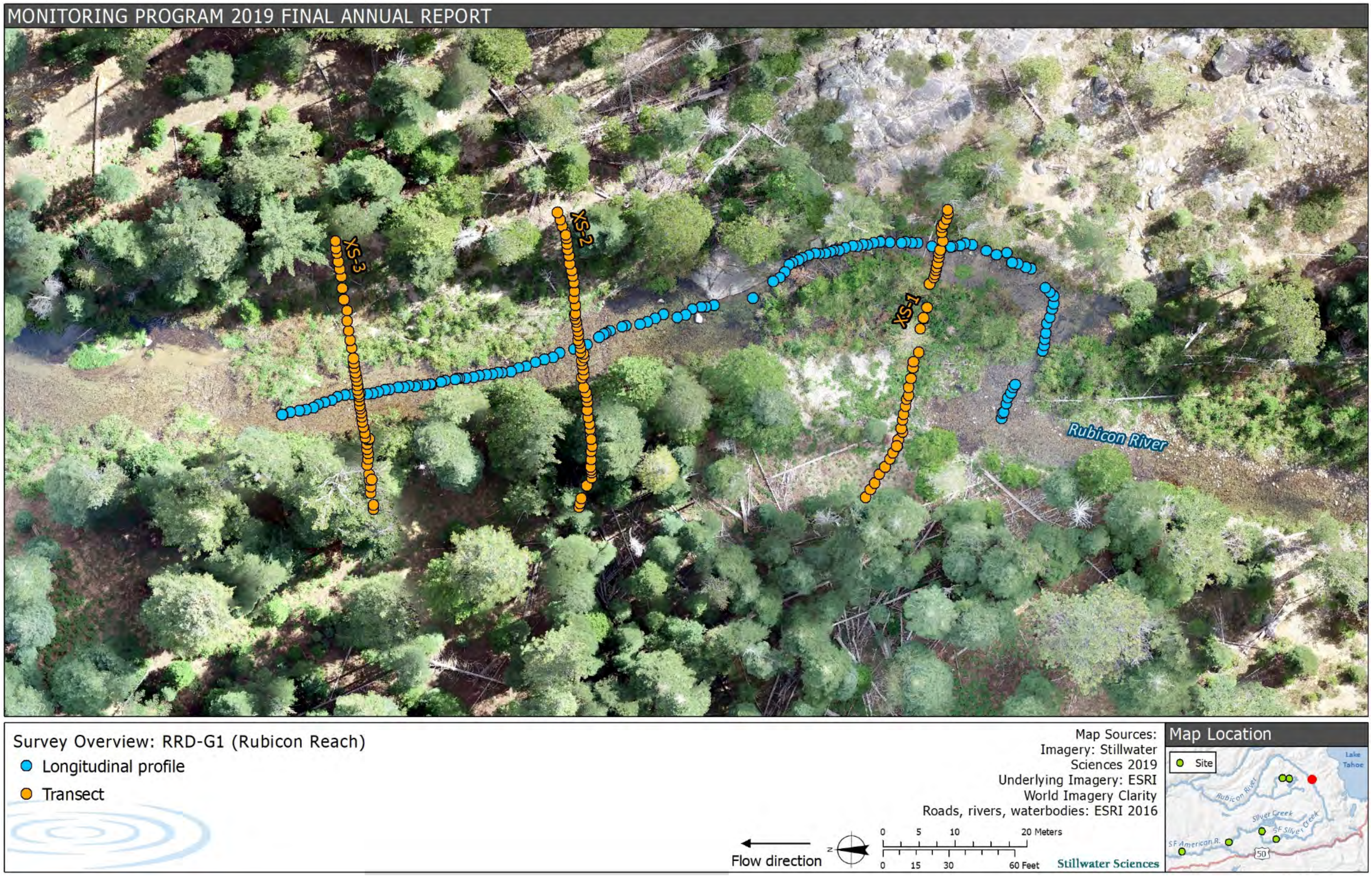


**Figure D2-1. Site RRD-G1 overview map with survey points**

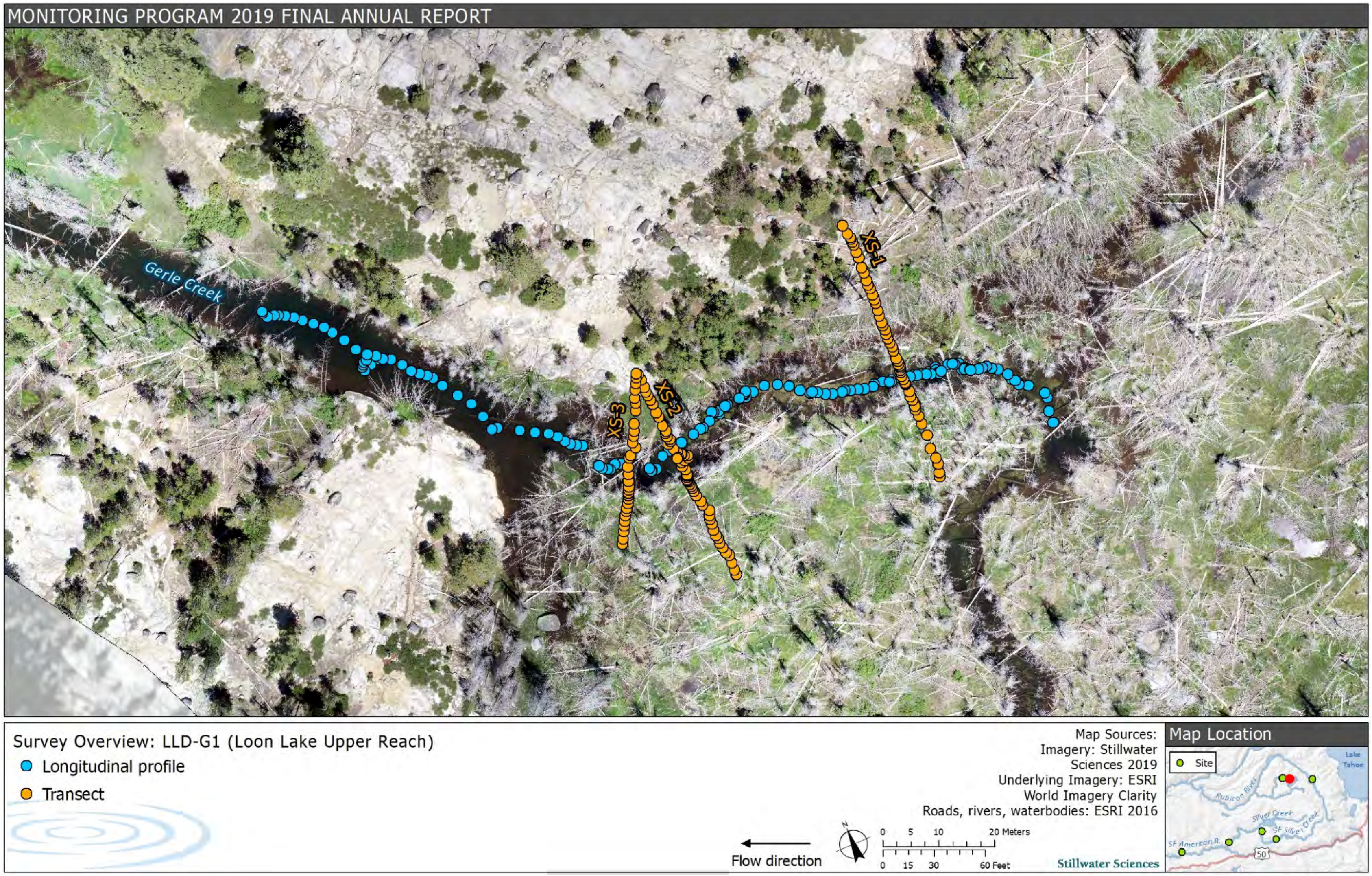


**Figure D2-2. Site LLD-G1 overview map with survey points**

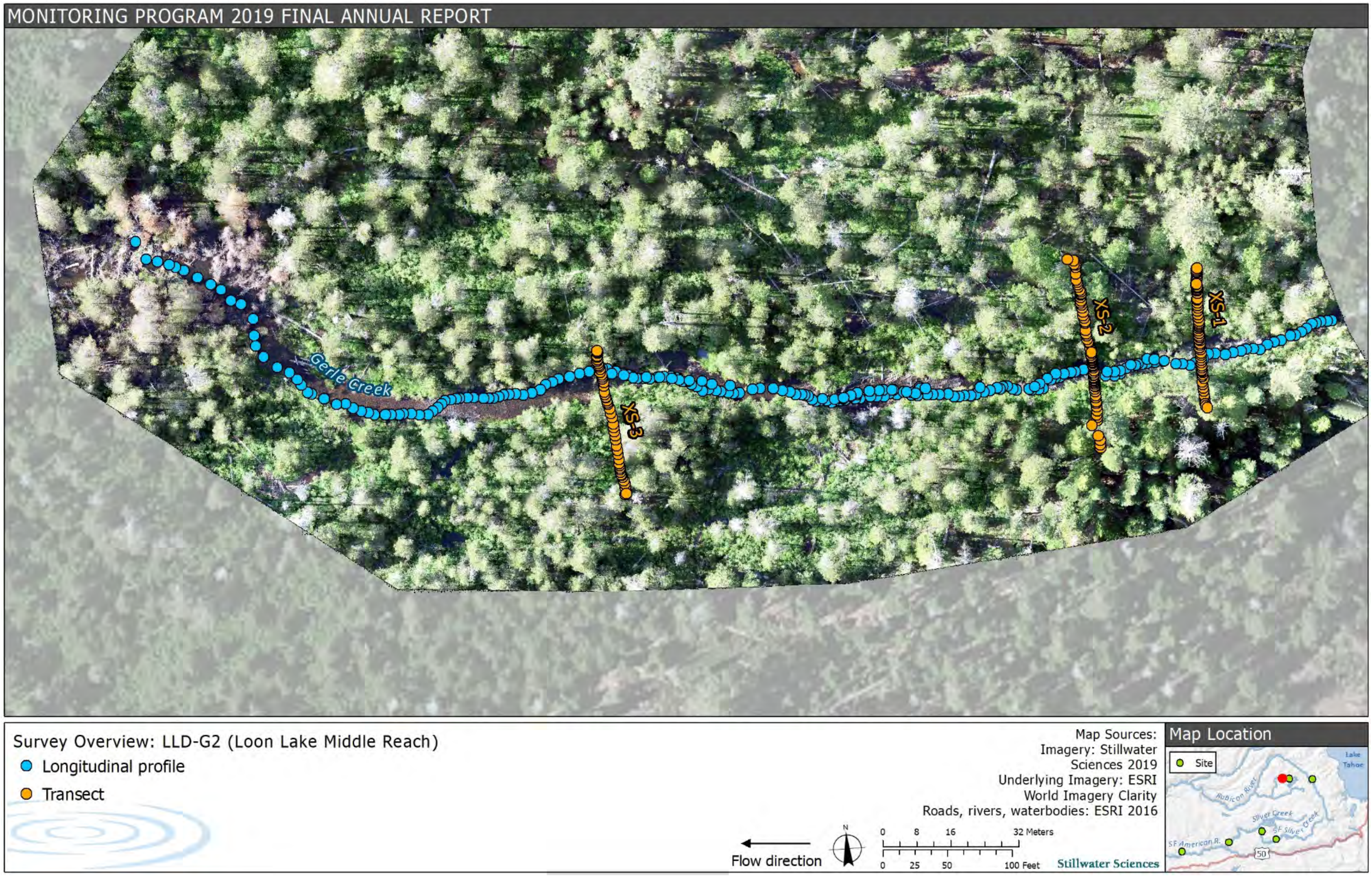


**Figure D2-3. SiteLLD-G2 overview map with survey points**

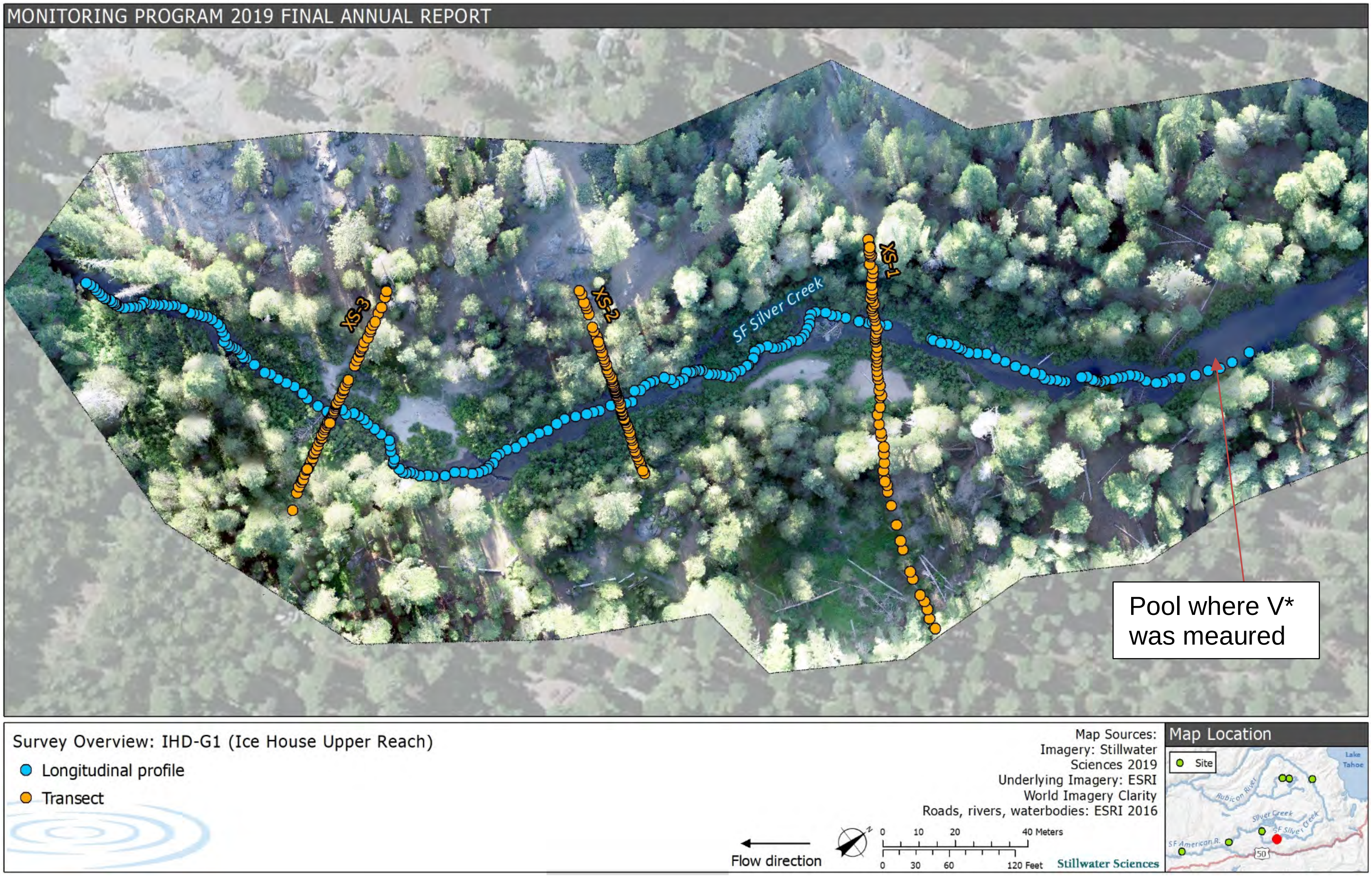


**Figure D2-4. Site IHD-G1 overview map with survey points**

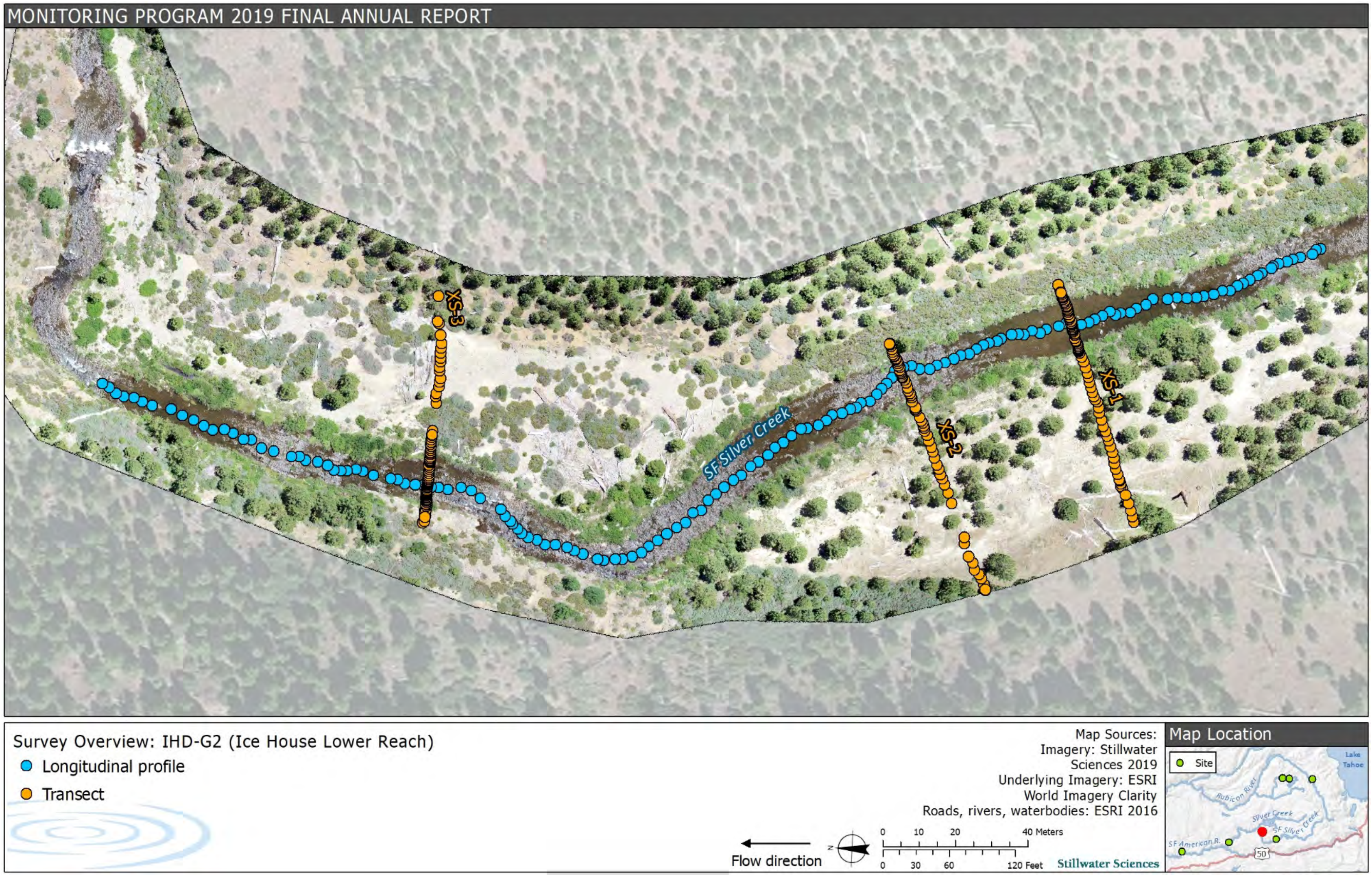


**Figure D2-5. Site IHD-G2 overview map with survey points**

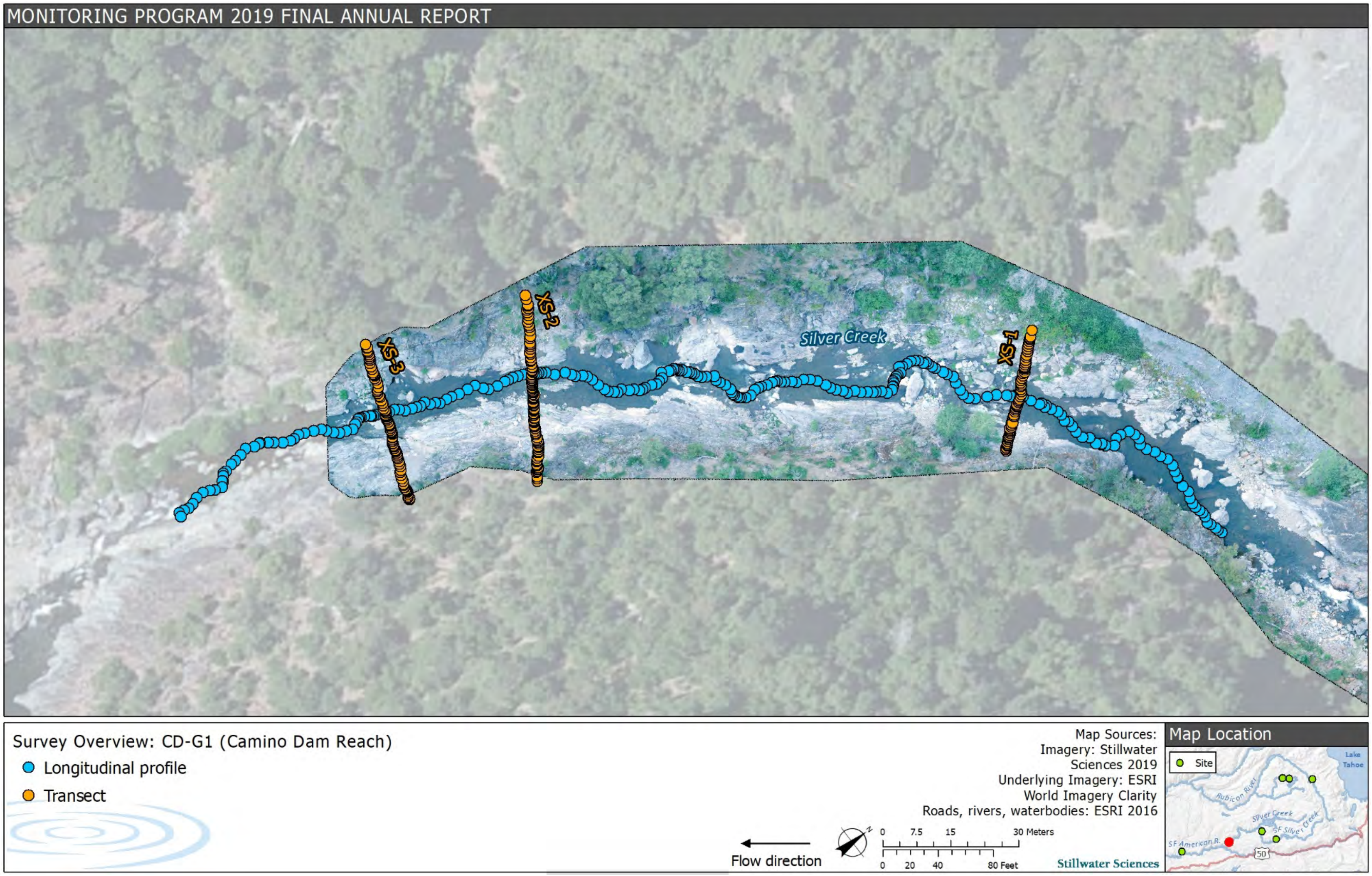


**Figure D2-6. Site CD-G1 overview map with survey points**


**Figure D2-7. Site SCD-G1 overview map with survey points**

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# APPENDIX D3

## Photos

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## Rubicon River Below Rubicon Dam

**Figure D3-1. Upper cross-section (XS-1), looking downstream from channel center.**

**Figure D3-2. Middle cross-section (XS-2), looking upstream from channel center.**

**Figure D3-3. Middle cross-section (XS-2), looking downstream from channel center.**

**Figure D3-4. Lower cross-section (XS-3), looking upstream from river-right bank.**

**Gerle Creek Below Loon Lake Dam Upper Reach**

**Figure D3-5. Middle cross-section (XS-2), looking downstream from channel center.**

**Figure D3-6. Lower cross-section (XS-3), looking upstream from channel center.**

**Gerle Creek Below Loon Lake Dam Middle Reach**

**Figure D3-7. Upstream extent of longitudinal profile, looking downstream from channel center.**

**Figure D3-8. Upper cross-section (XS-1), looking downstream from river-right bank.**

**Figure D3-9.** **Middle cross-section (XS-2), looking upstream from channel center.**

**Figure D3-10. Middle cross-section (XS-2), looking downstream from channel center.**

**Figure D3-11. Lower cross-section (XS-3), looking upstream from channel center.**

## South Fork Silver Creek Below Ice House Reservoir Upper Reach

**Figure D3-12. Upper cross-section (XS-1), looking downstream from channel center.**

**Figure D3-13. Middle cross-section (XS-2), looking upstream from channel center.**

**Figure D3-14. Middle cross-section (XS-2), looking downstream from channel center.**

**Figure D3-15.** **Lower cross-section (XS-3), looking upstream from channel center.**

**South Fork Silver Creek Below Ice House Reservoir Lower Reach**

**Figure D3-16. Middle cross-section (XS-2), looking downstream from channel center.**

**Figure D3-17. Middle cross-section (XS-2), looking upstream from channel center.**

**Figure D3-18. Middle cross-section (XS-2), looking downstream from channel center.**

**Figure D3-19. Lower cross-section (XS-3), looking upstream from channel center.**

**Silver Creek Below Camino Dam**

**Figure D3-20. Upper cross section (XS-1), looking downstream.**

**Figure D3-21. Middle cross-section (XS-2), looking upstream from river-left bank.**

**Figure D3-22.** **Middle cross-section (XS-2), looking downstream from river-left bank.**

**Figure D3-23. Lower cross-section (XS-3), looking upstream from river-left bank.**

## South Fork American River Below Slab Creek Dam

**Figure D3-24.** **Middle cross-section (XS-2), looking downstream from river-right bank.**

**Figure D3-25. Middle cross-section (XS-2), looking upstream from river-right bank.**

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# APPENDIX D4

## Longitudinal Profiles

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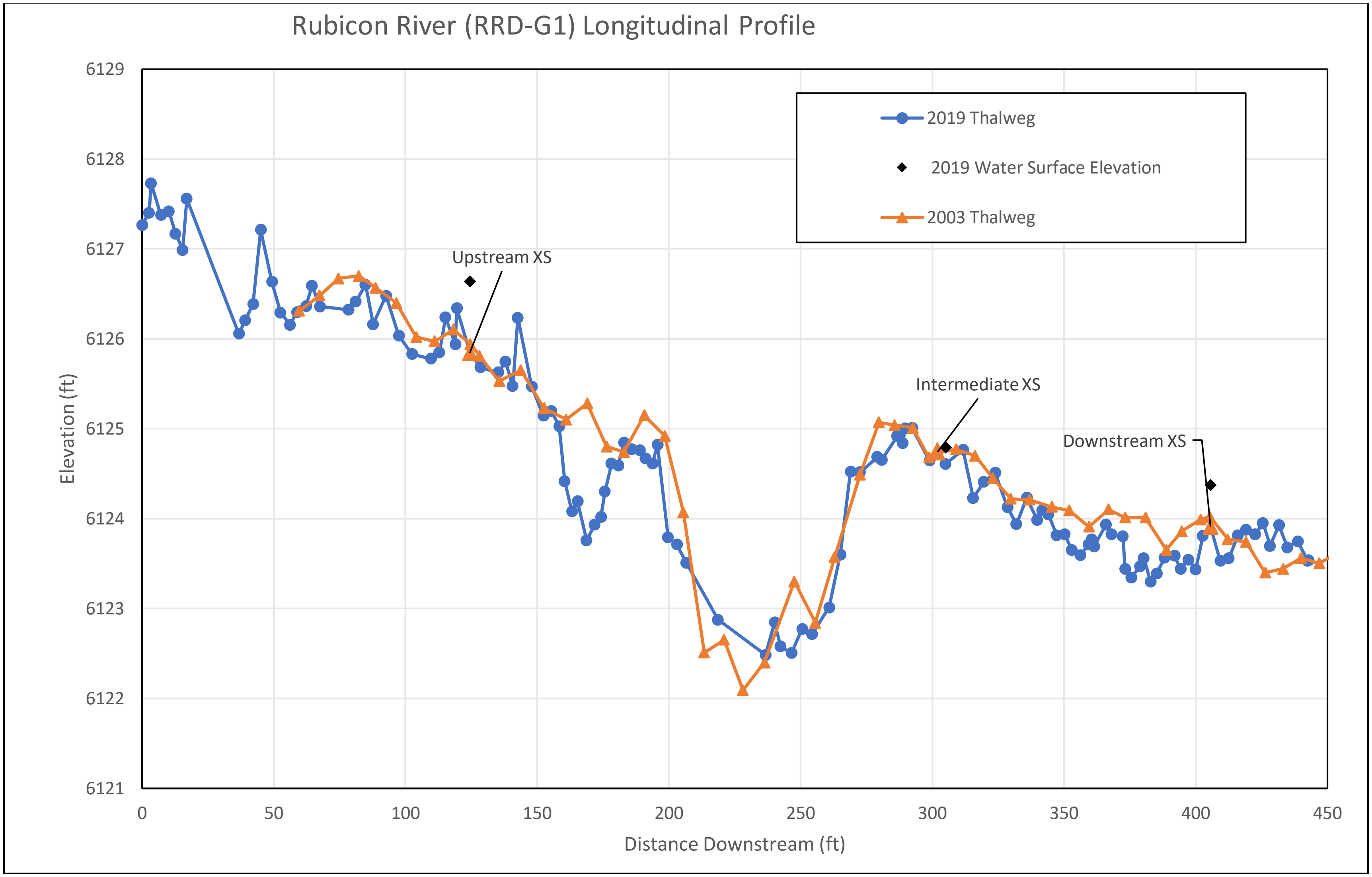


**Figure D4-1. Longitudinal profiles for Site RRD-G1 (Rubicon River) from the 2003 and 2019 surveys.**

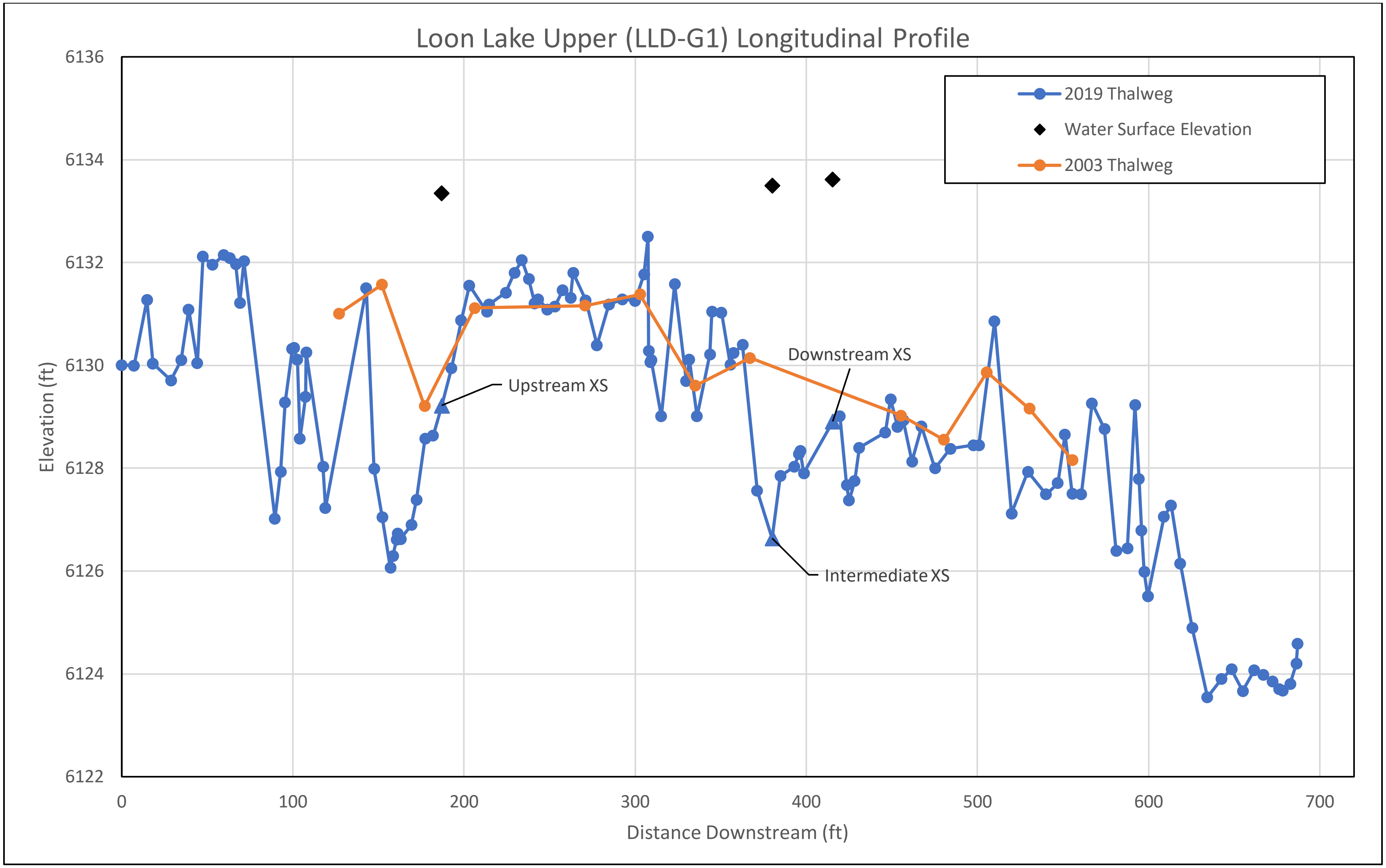


**Figure D4-2. Longitudinal profiles for Site LLD-G1 (Loon Lake Upper) from the 2003 and 2019 surveys.**

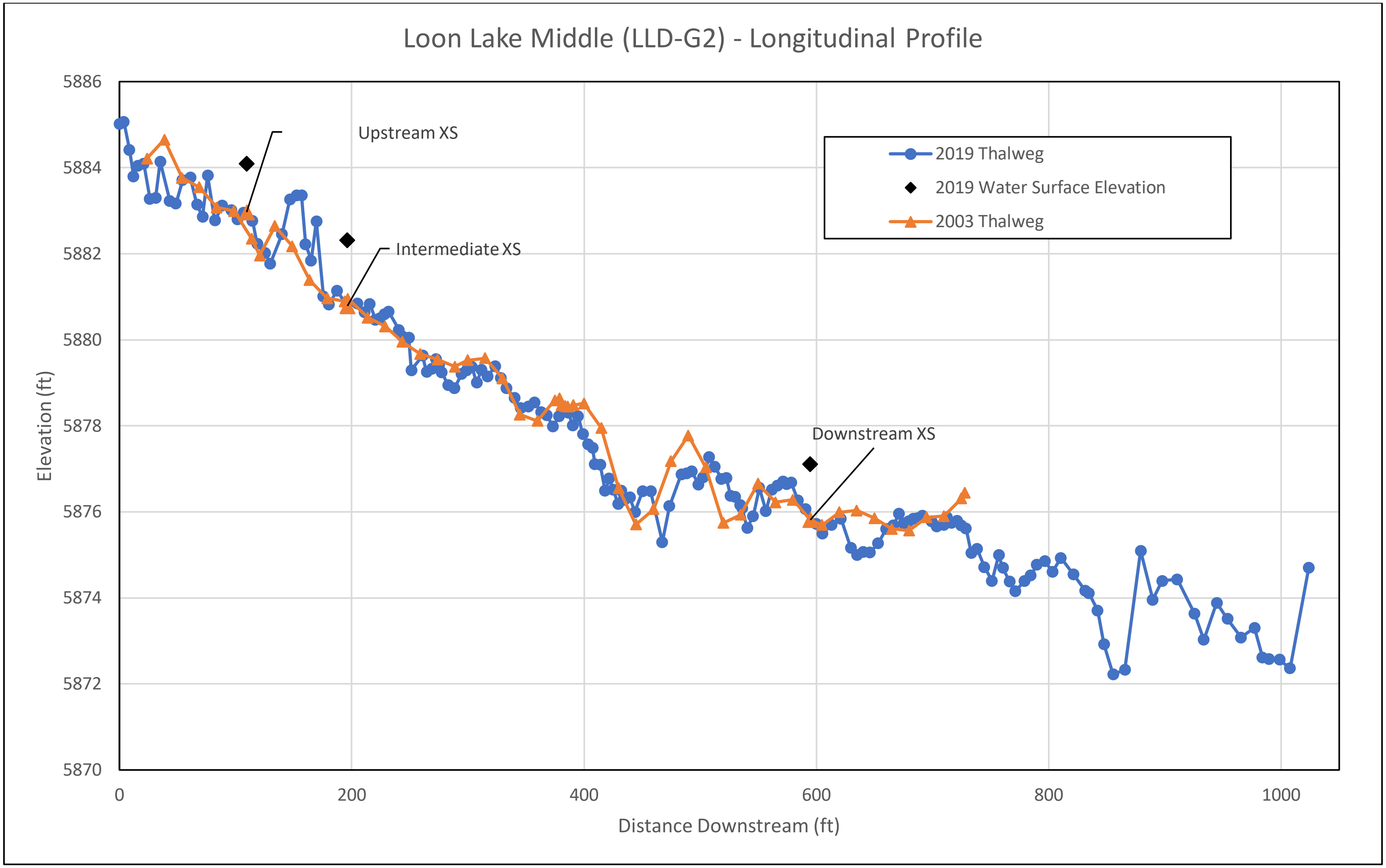


**Figure D4-3. Longitudinal profiles for Site LLD-G2 (Loon Lake Middle) from the 2003 and 2019 surveys.**

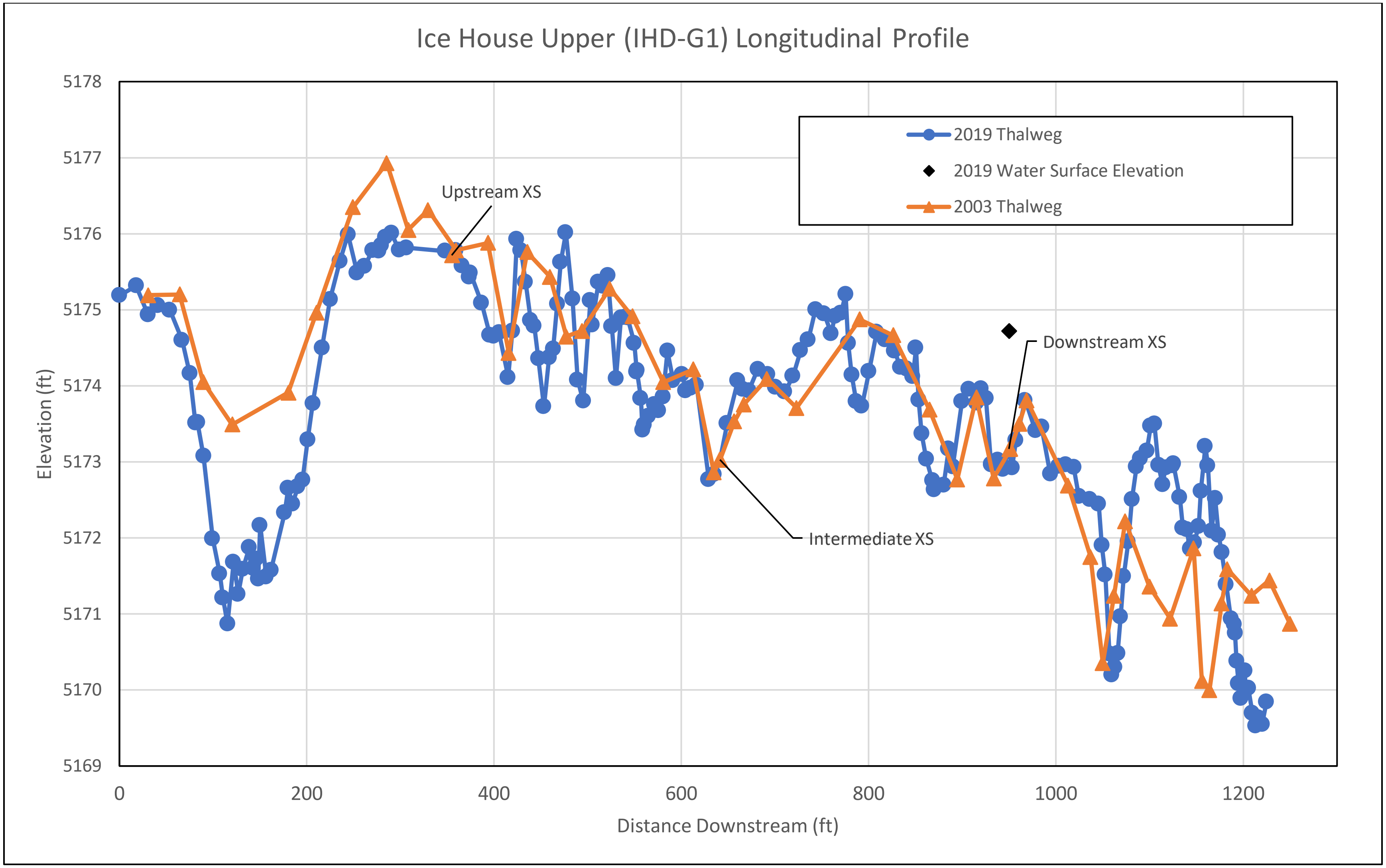


**Figure D4-4. Longitudinal profiles for Site IHD-G1 (Ice House Upper) for the 2003 and 2019 surveys.**

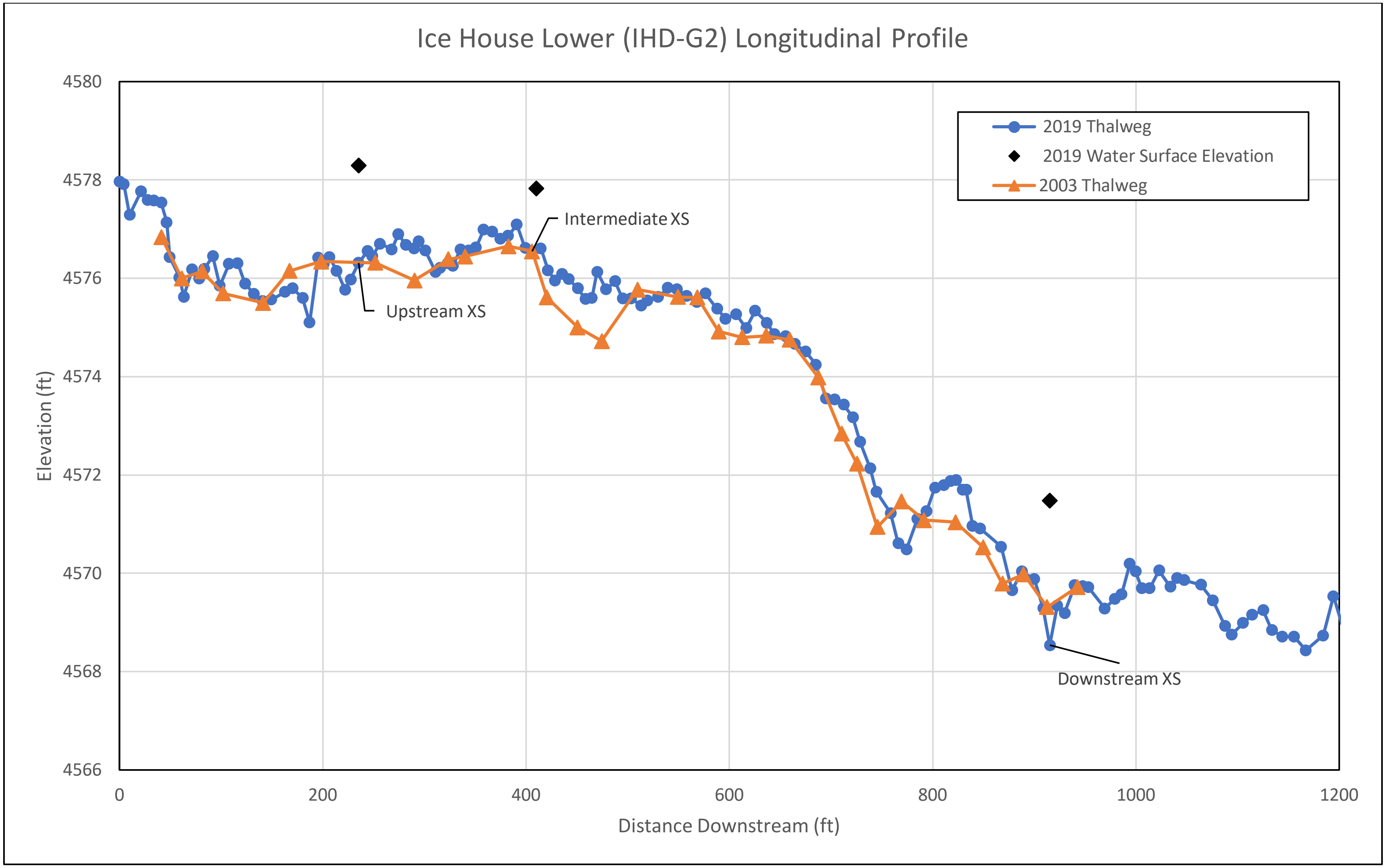


**Figure D4-5. Longitudinal profiles for Site IHD-G2 (Ice House Lower) for the 2003 and 2019 surveys.**

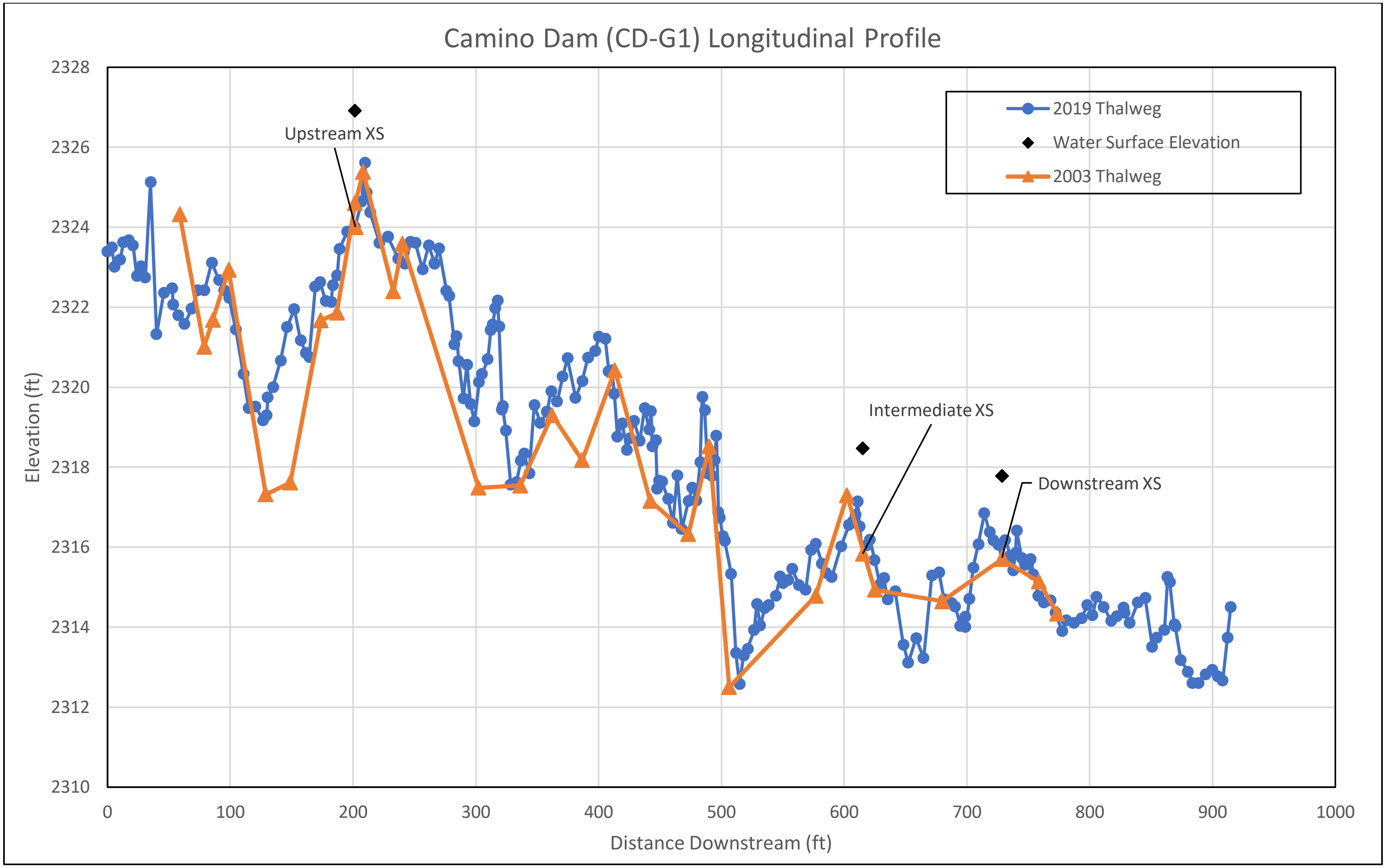


**Figure D4-6. Longitudinal profile for Site CD-G1 (Camino Dam) for the 2003 and 2019 surveys.**

# APPENDIX D5

## Cross-sections

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**Table D5-1. Comparison of 2003 and 2019 channel geometry data.**

| | | 2003 Channel Geometry | | | | | | 2019 Channel Geometry | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Study Site | Cross Section (XS) | $W_{bf}$ (ft) | $W_{fp}$ (ft) | $D_{bf}$ (ft) | $D_{fp}$ (ft) | $W_{bf}/D_{bf}$ | E | $W_{bf}$ (ft) | $W_{fp}$ (ft) | $D_{bf}$ (ft) | $D_{fp}$ (ft) | $W_{bf}/D_{bf}$ | E |
| RRD-G1 | Upper | 73 | 122 | 1.9 | 5.6 | 38.4 | 1.7 | 69 | 127 | 1.1 | 4.6 | 63.1 | 1.8 |
| | Middle | 60 | 78 | 1.4 | 4.3 | 42.9 | 1.3 | 47 | 90 | 1.6 | 4.3 | 29.5 | 1.9 |
| | Lower | 75 | 83 | 1.1 | 2.8 | 68.2 | 1.1 | 41 | 83 | 1.4 | 3.5 | 29.2 | 2.0 |
| LLD-G1 | Upper | 22 | 300 | 2.6 | 6.9 | 8.5 | 14.0 | 25 | 460 | 3.4 | 13.7 | 7.4 | 18.3 |
| | Middle | 34 | 224 | 3.8 | 9.8 | 8.9 | 6.6 | 34 | 260 | 4.7 | 14.0 | 7.2 | 7.6 |
| | Lower | 23 | 125 | 2.7 | 7.4 | 8.5 | 5.4 | 28 | 240 | 3.7 | 10.5 | 7.5 | 8.6 |
| LLD-G2 | Upper | 54 | 294 | 2.1 | 5.2 | 25.7 | 5.4 | 46 | 430 | 1.0 | 4.4 | 47.9 | 9.4 |
| | Middle | 38 | 350 | 1.5 | 5.3 | 25.3 | 9.3 | 30 | 570 | 1.2 | 4.3 | 24.2 | 19.3 |
| | Lower | 51 | 400 | 2.1 | 4.2 | 24.3 | 7.8 | 38 | 960 | 1.1 | 4.4 | 35.2 | 25.4 |
| IHD-G1 | Upper | 53 | 133 | 2.7 | 5.4 | 19.6 | 2.5 | 45 | 136 | 1.6 | 5.0 | 27.8 | 3.0 |
| | Middle | 59 | 320 | 1.8 | 7.7 | 33.1 | 5.0 | 26 | 102 | 3.4 | 5.5 | 7.5 | 4.0 |
| | Lower | 49 | 177 | 2.8 | 10.0 | 17.6 | 3.5 | 26 | 49 | 1.6 | 5.2 | 16.4 | 1.9 |
| IHD-G2 | Upper | 124 | 251 | 2.8 | 13.0 | 44.3 | 2.0 | 53 | 121 | 2.3 | 6.8 | 23.2 | 2.3 |
| | Middle | 62 | 206 | 2.6 | 6.7 | 23.8 | 3.3 | 56 | 126 | 1.7 | 5.1 | 32.9 | 2.2 |
| | Lower | 57 | 180 | 2.6 | 10.0 | 21.9 | 3.1 | 47 | 72 | 1.8 | 7.0 | 26.4 | 1.5 |
| CD-G1 | Upper | 73 | 90 | 2.7 | 10.0 | 27.0 | 1.2 | 57 | 90 | 3.1 | 9.9 | 18.3 | 1.6 |
| | Middle | 89 | 120 | 3.8 | 16.0 | 23.4 | 1.3 | 74 | 113 | 3.0 | 12.8 | 24.6 | 1.5 |
| | Lower | 77 | 120 | 3.2 | 12.0 | 24.1 | 1.6 | 61 | 108 | 2.7 | 11.0 | 22.8 | 1.8 |
| SCD-G1 | Upper | 111 | 159 | 4.4 | 8.9 | 25.2 | 1.4 | 122 | - | - | - | - | - |
| | Middle | 71 | 162 | 5.6 | 11.0 | 12.7 | 2.3 | 163 | - | - | - | - | - |
| | Lower | 62 | 106 | 4.8 | 9.7 | 12.9 | 1.7 | 122 | - | - | - | - | - |

$W_{bf}$=bankfull width, $W_{fp}$=floodprone width, $D_{bf}$=bankfull width, $D_{fp}$=flood-prone width, $W_{bf}/D_{bf}$=width-depth ratio, E=entrenchment ratio, ft=feet. The 2003 parameters were recalculated using the original survey data.

## Rubicon River Below Rubicon Dam (Site RRD-G1)

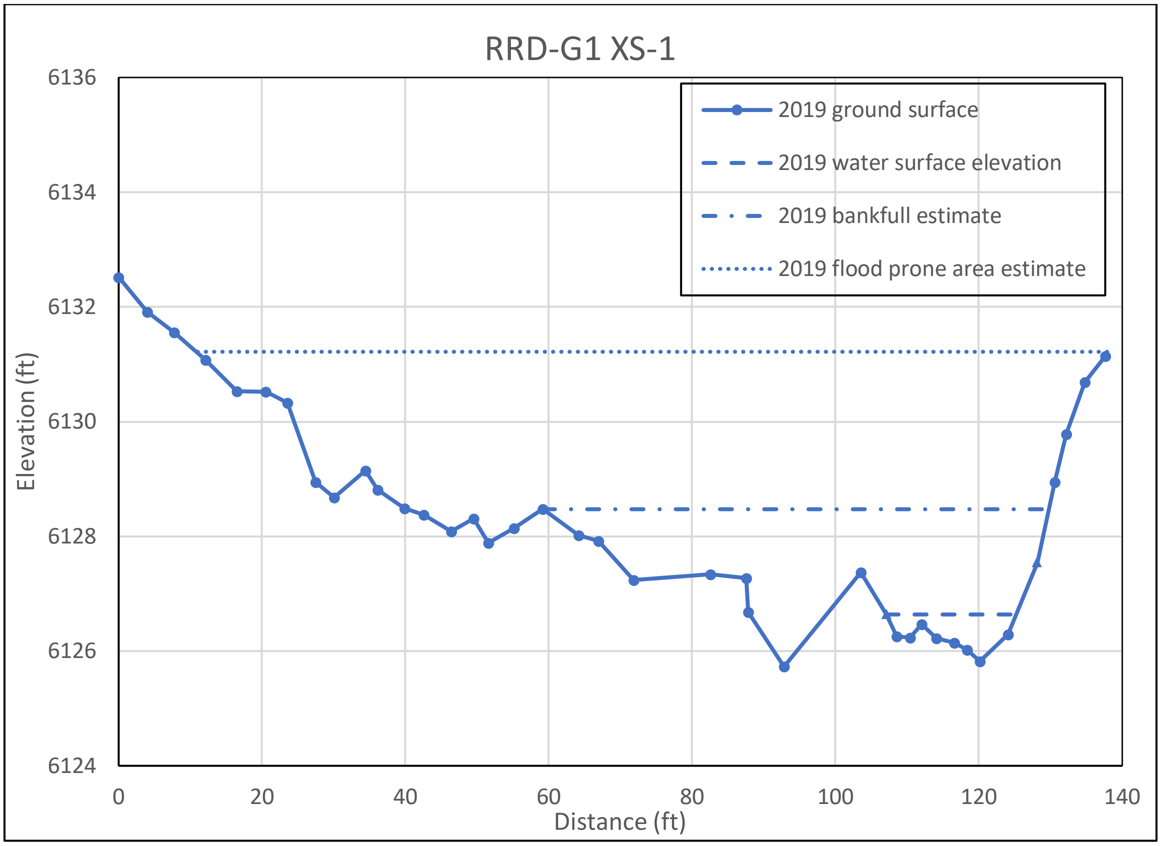


**Figure D5-1. Cross-section Site RRD-G1 XS-1 survey in 2019.**

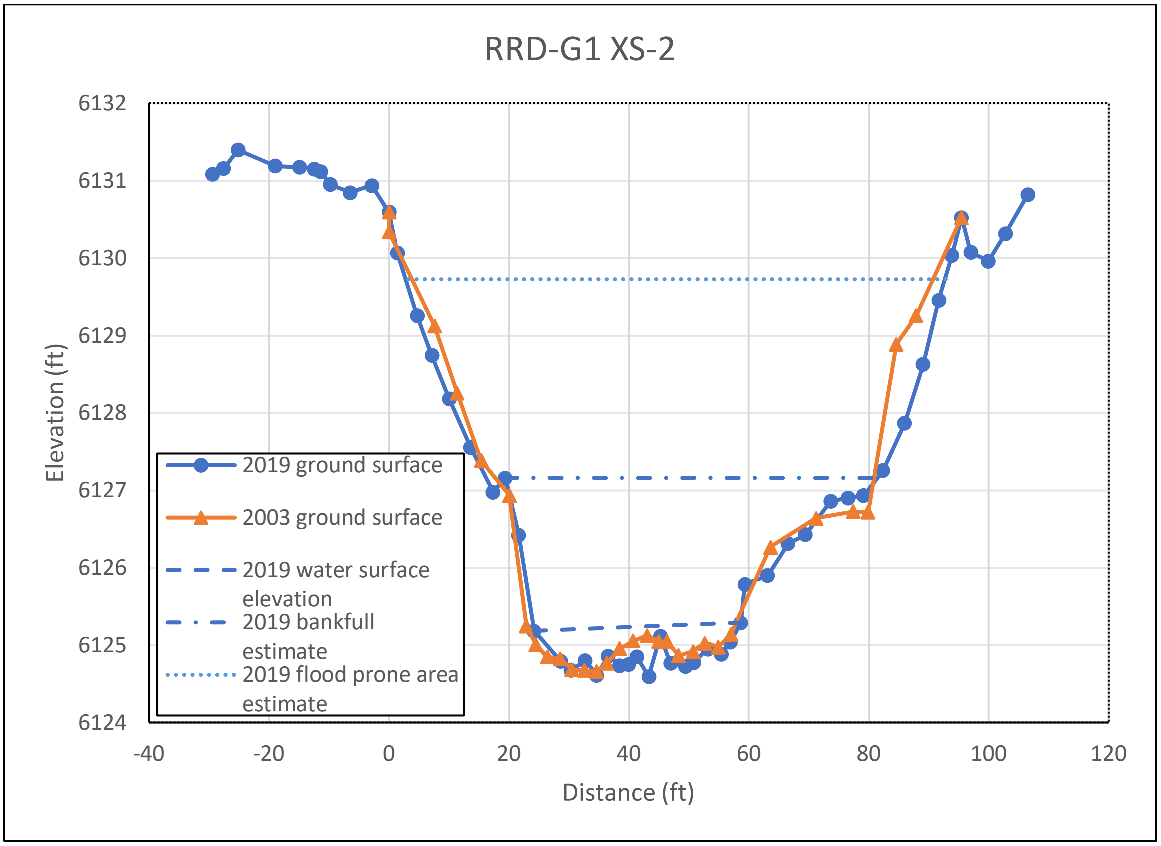


**Figure D5-2. Cross-section Site RRD-G1 XS-2 from the 2003 and 2019 surveys.**

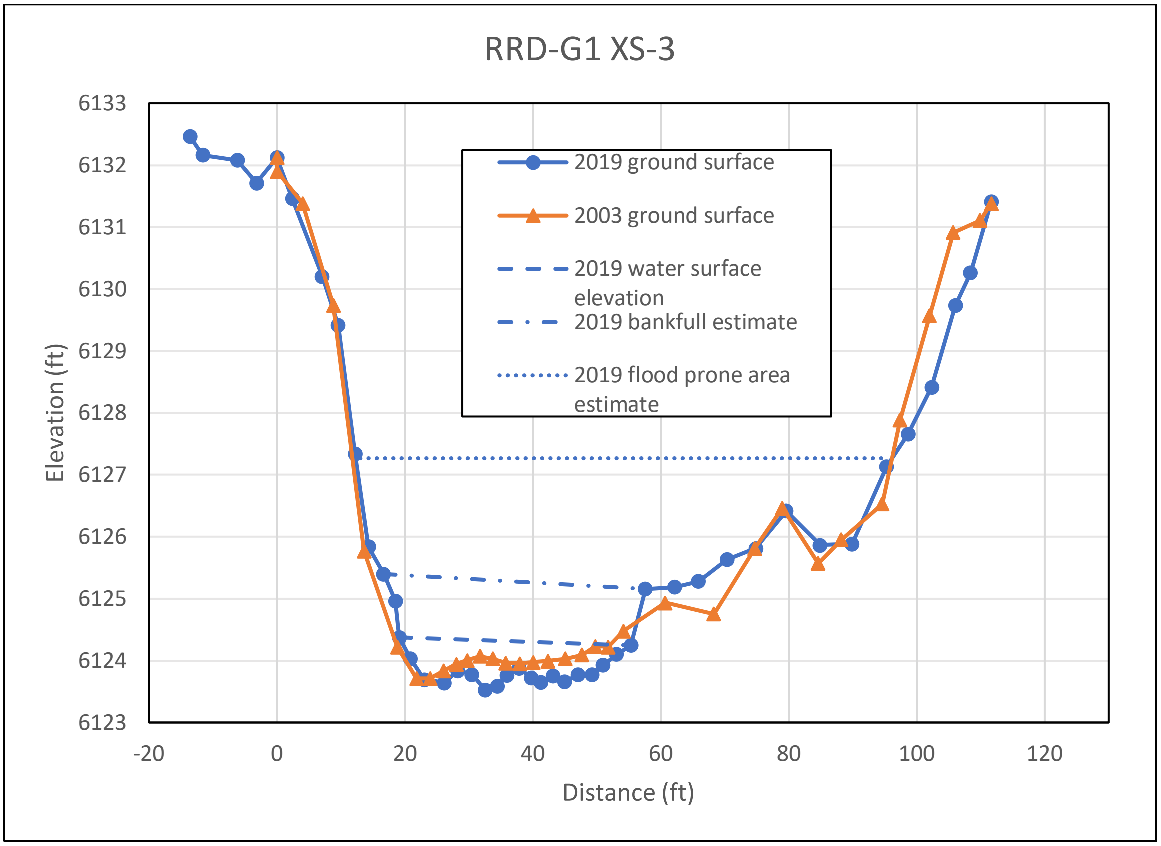


**Figure D5-3. Cross-section Site RRD-G1 XS-2 from the 2003 and 2019 surveys.**

## Gerle Creek Below Loon Lake Upper (Site LLD-G1)

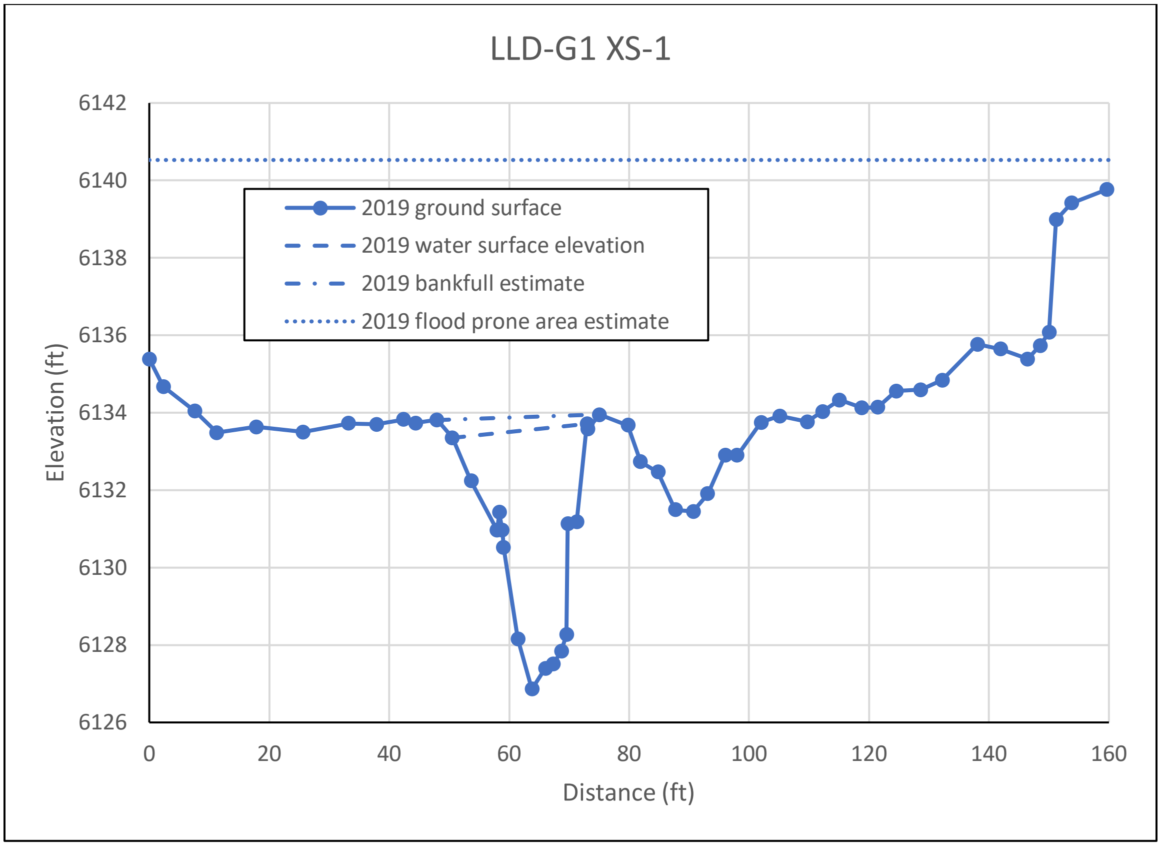


**Figure D5-4. Cross-section Site LLD-G1 XS-1 from the 2019 surveys.**

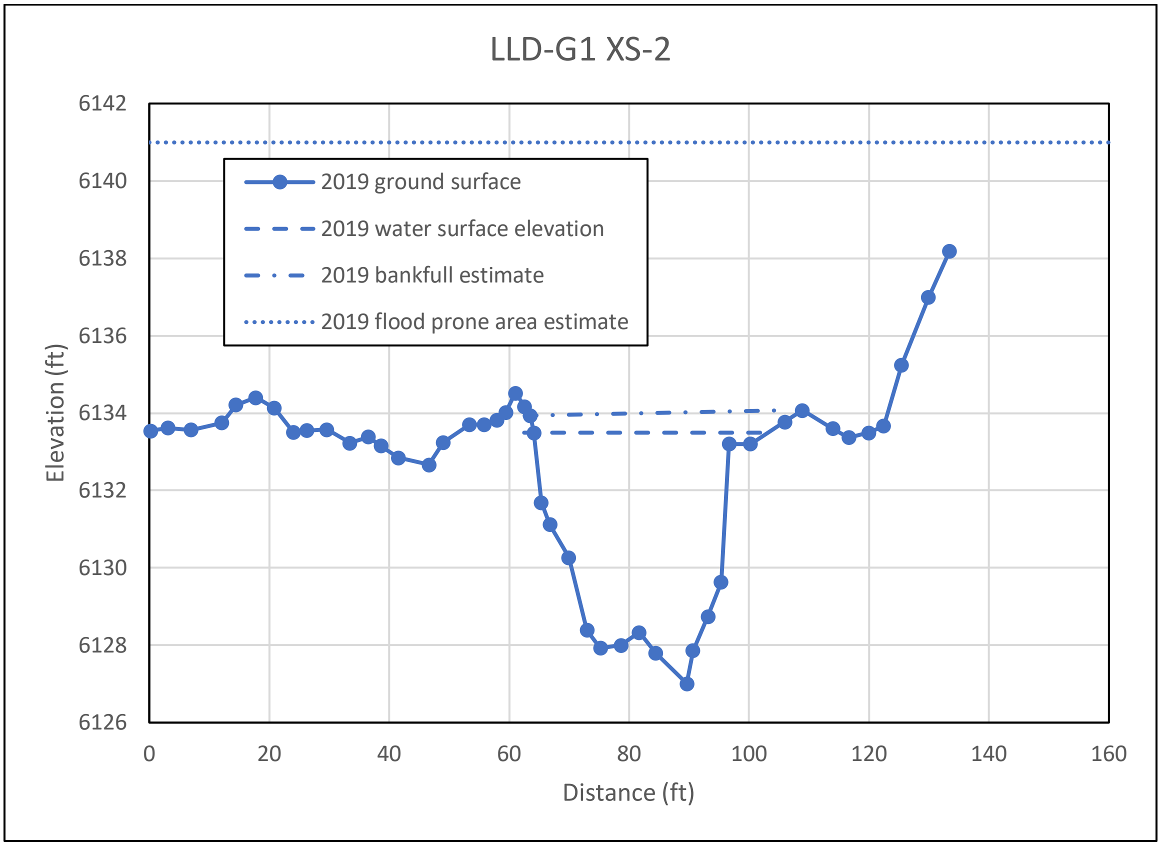


**Figure D5-5. Cross-section Site LLD-G1 XS-2 from the 2019 surveys.**

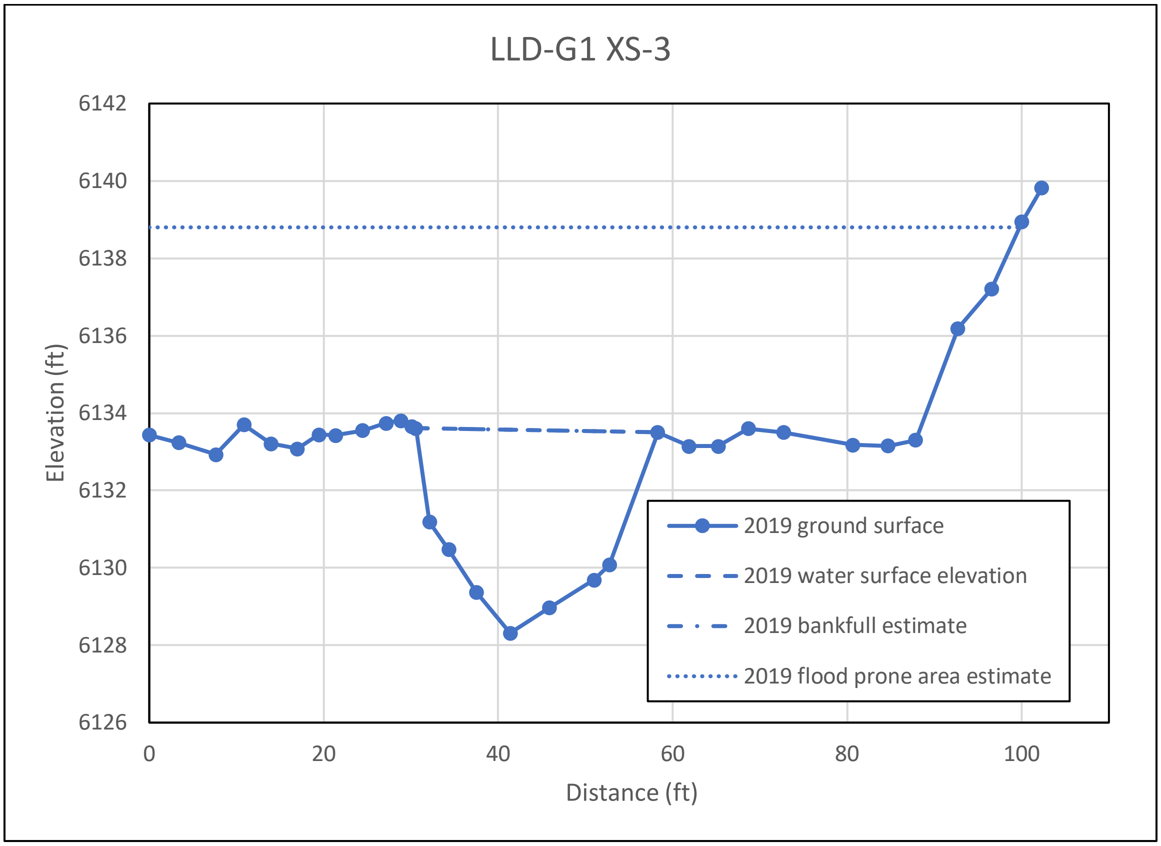


**Figure D5-6. Cross-section Site LLD-G1 XS-3 from the 2019 surveys.**

**Gerle Creek Below Loon Lake Middle (Site LLD-G2)**

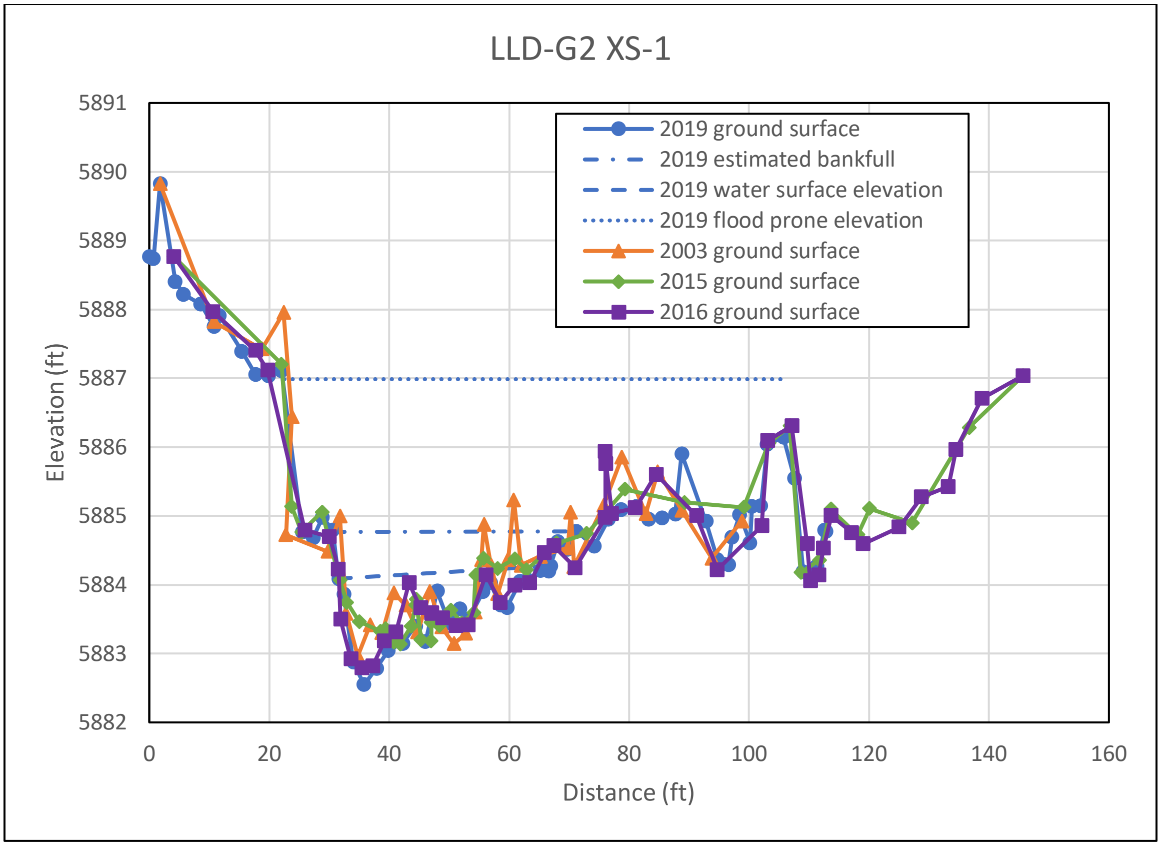


**Figure D5-7. Cross-section Site LLD-G2 XS-1 from the 2019 surveys.**

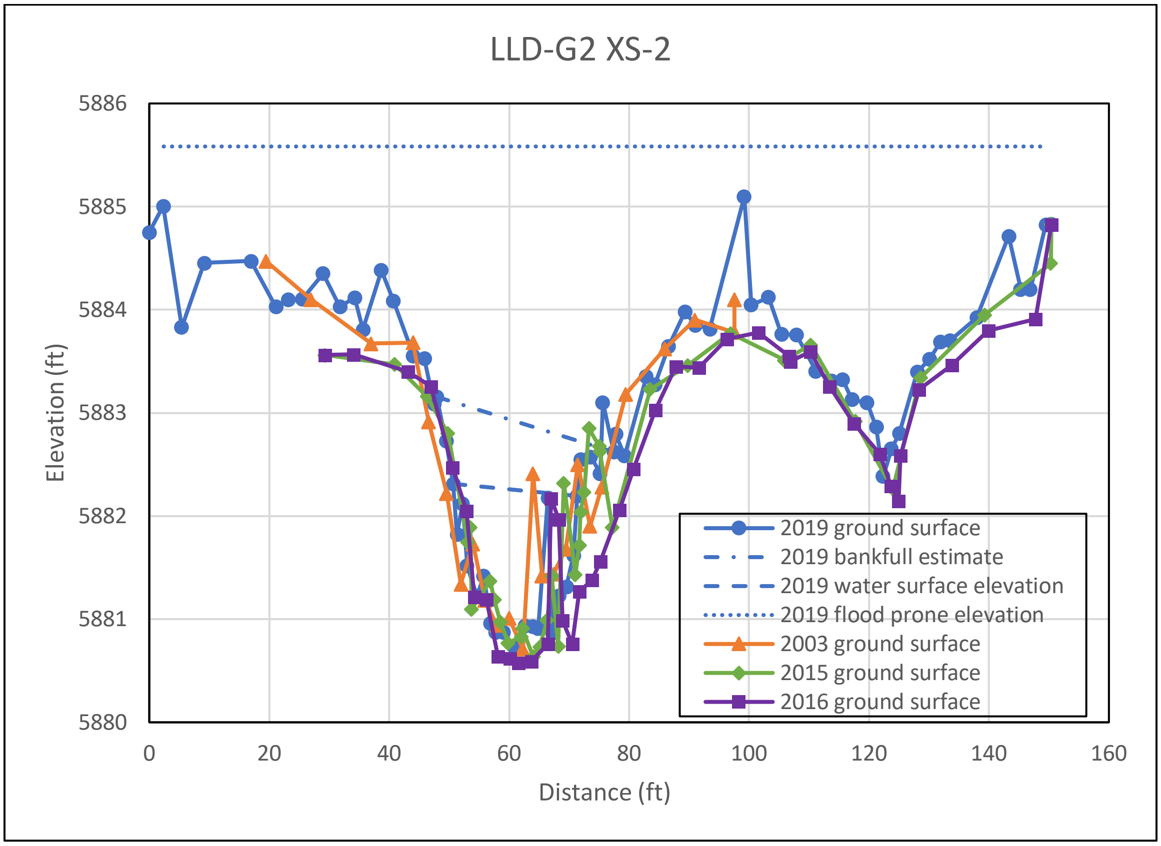


**Figure D5-8. Cross-section Site LLD-G2 XS-2 from the 2019 surveys.**

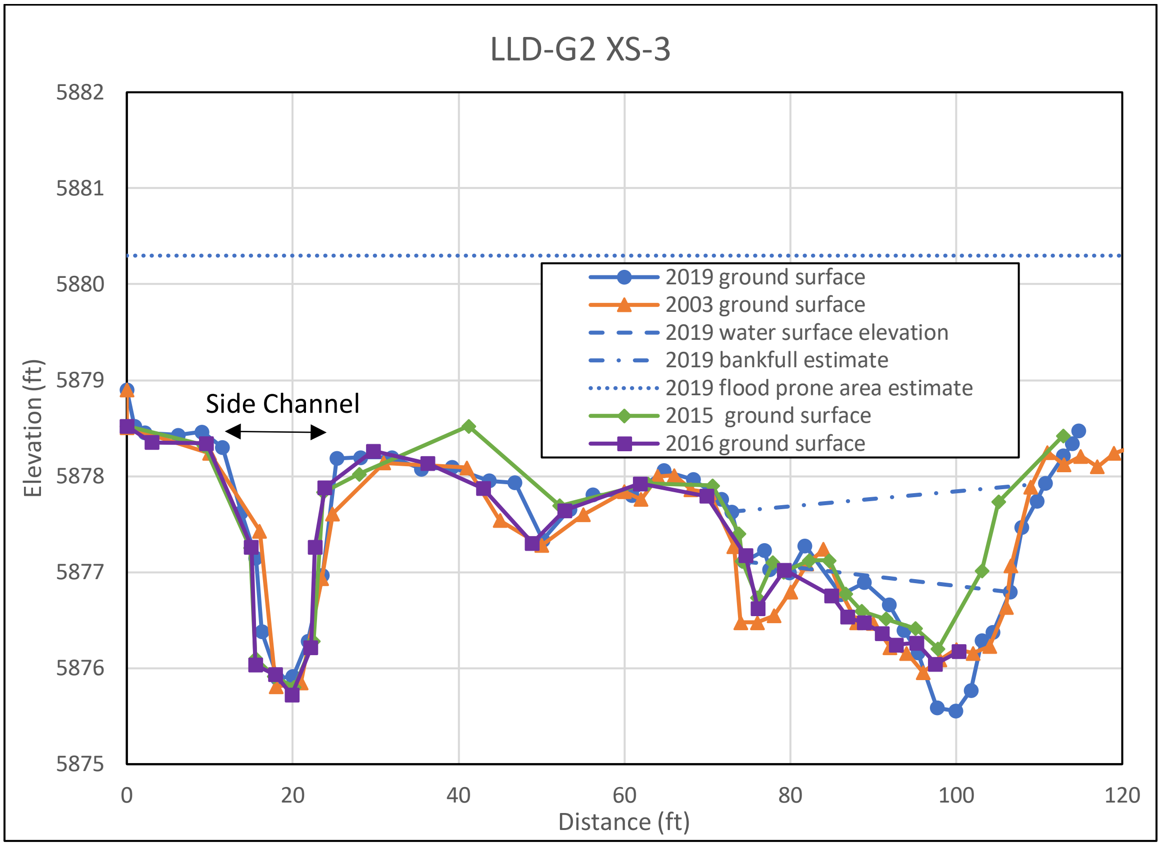


**Figure D5-9. Cross-section Site LLD-G2 XS-3 from the 2003 and 2019 surveys.**

## South Fork Silver Creek Below Ice House Upper (Site IHD-G1)

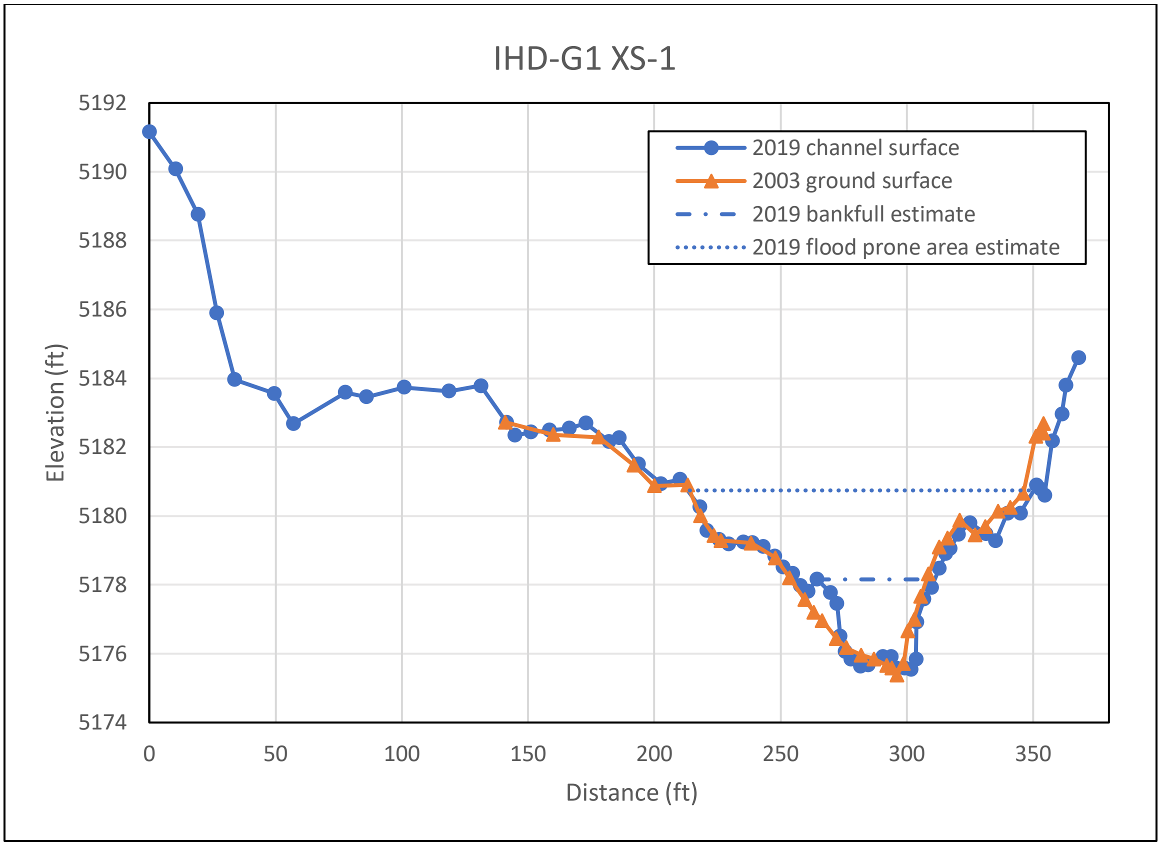


**Figure D5-10. Cross-section Site IHD-G1 XS-1 from the 2003 and 2019 surveys.**

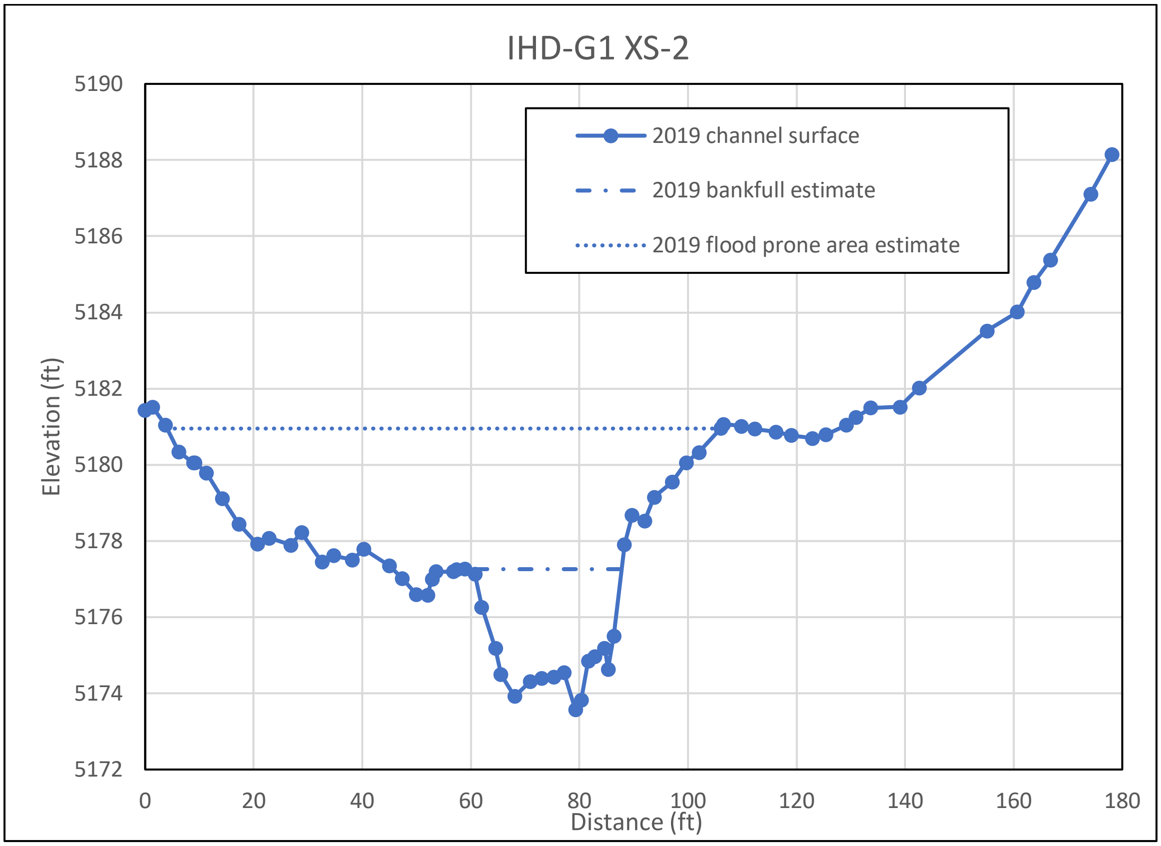


**Figure D5-11. Cross-section Site IHD-G1 XS-2 from the 2019 surveys.**

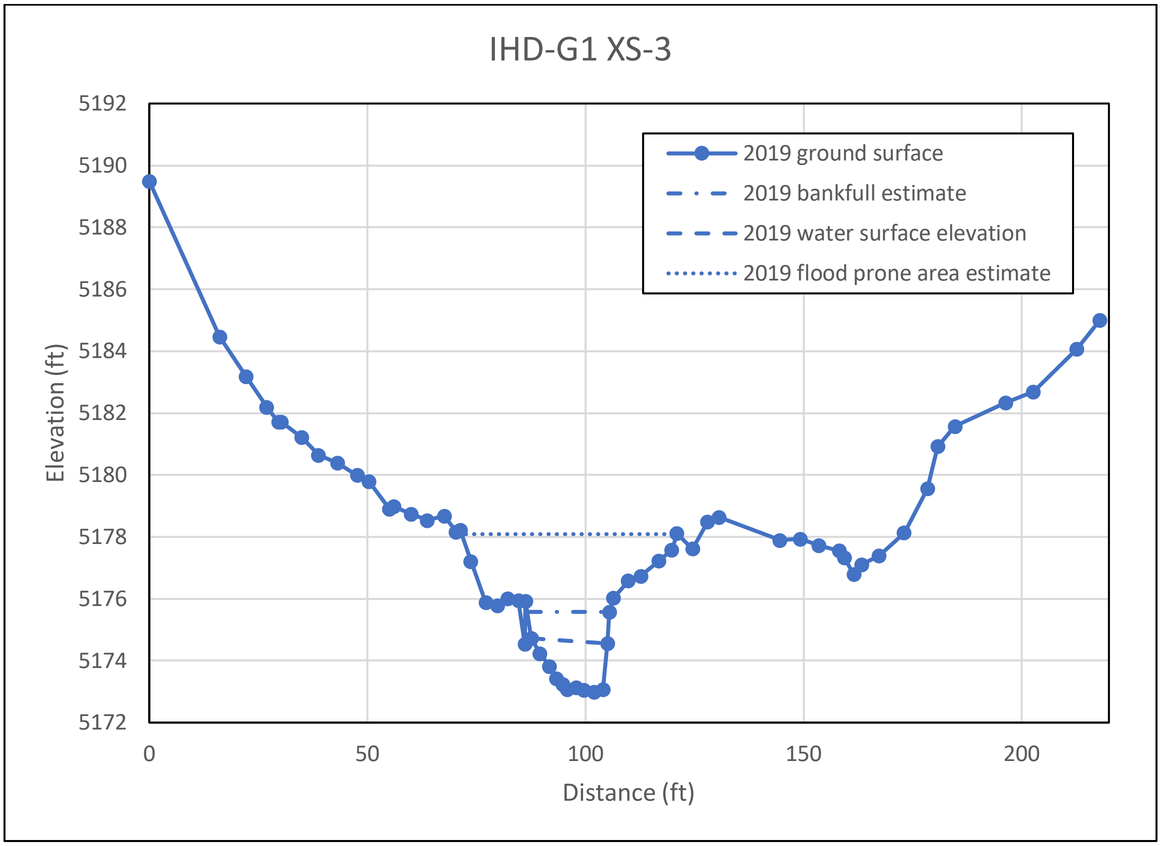


**Figure D5-12. Cross-section Site IHD-G1 XS-3 from the 2019 surveys.**

## South Fork Silver Creek Below Ice House Lower (Site IHD-G2)

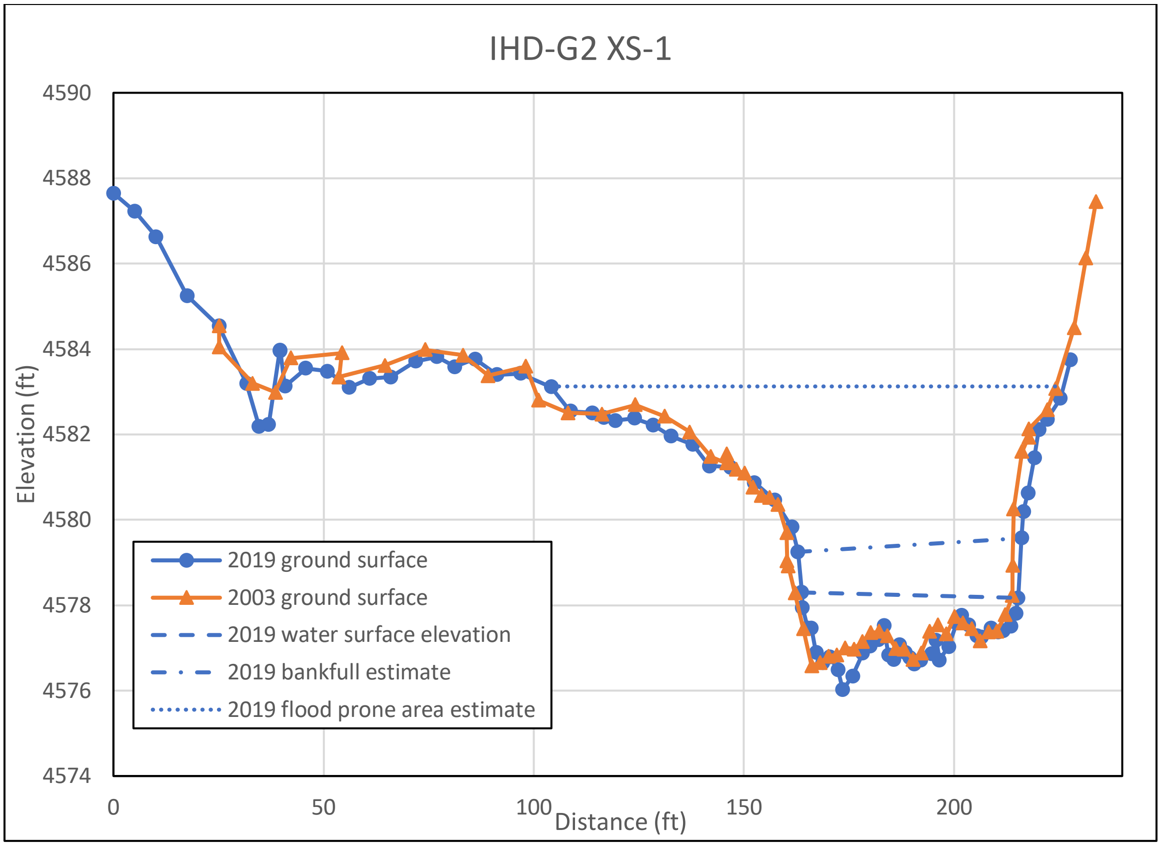


**Figure D5-13. Cross-section Site IHD-G2 XS-1 from the 2003 and 2019 surveys.**

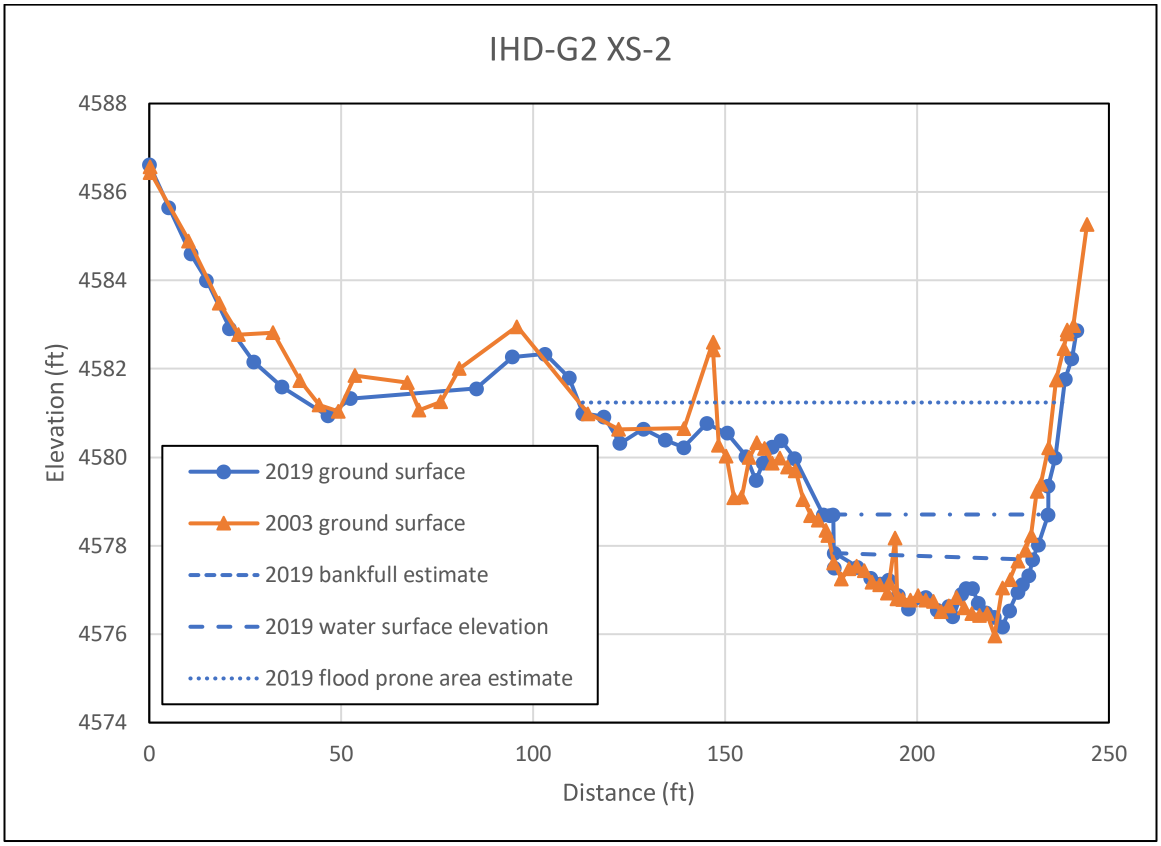


**Figure D5-14. Cross-section Site IHD-G2 XS-2 from the 2003 and 2019 surveys.**

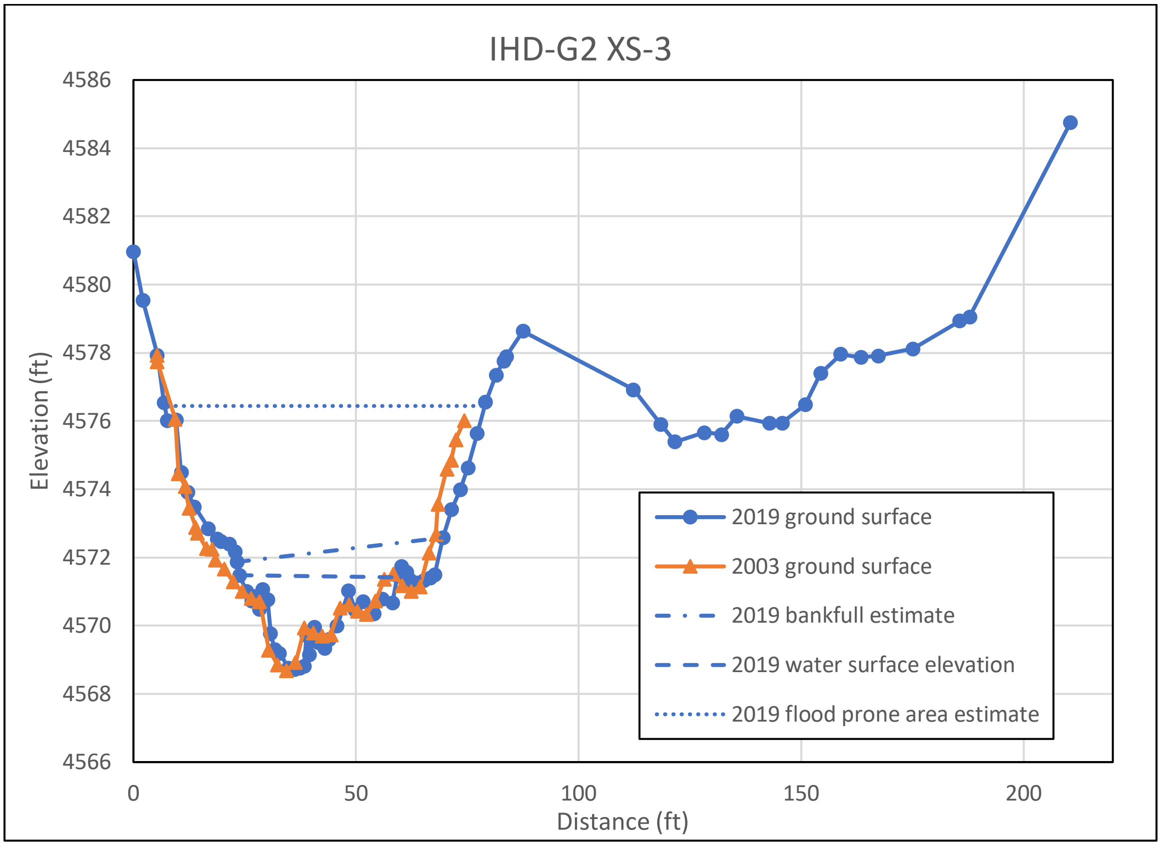


**Figure D5-15. Cross-section Site IHD-G2 XS-3 from the 2003 and 2019 surveys.**

## Silver Creek Below Camino Dam (Site CD-G1)

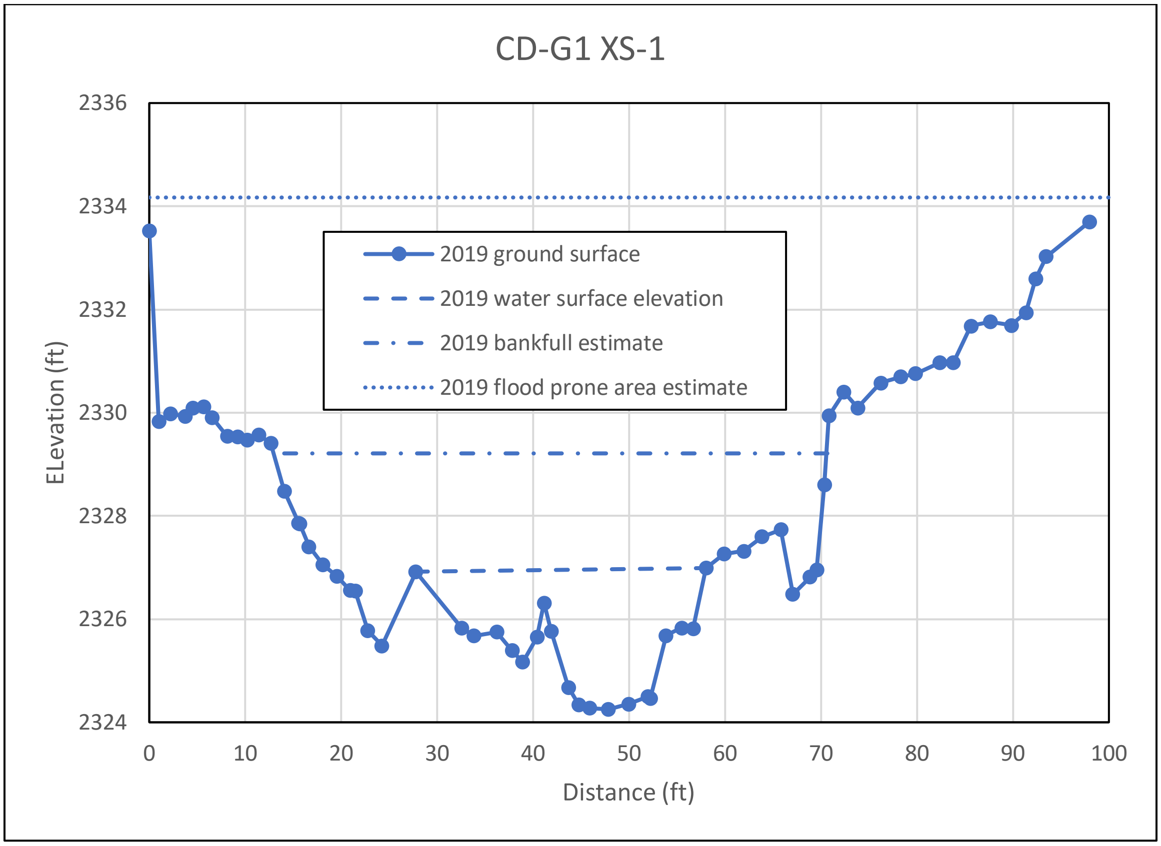


**Figure D5-16. Cross-section Site CD-G1 XS-1 from the 2019 surveys.**

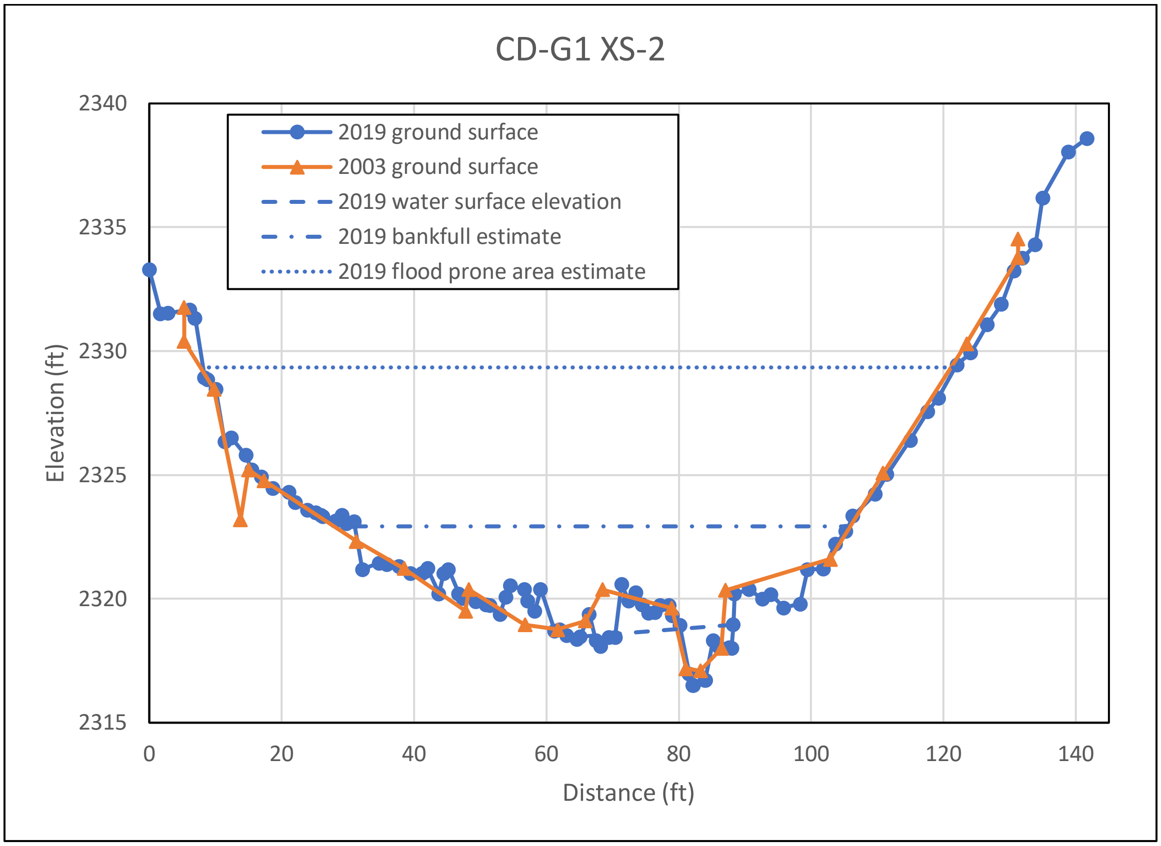


**Figure D5-17. Cross-section Site CD-G1 XS-2 from the 2003 and 2019 surveys.**

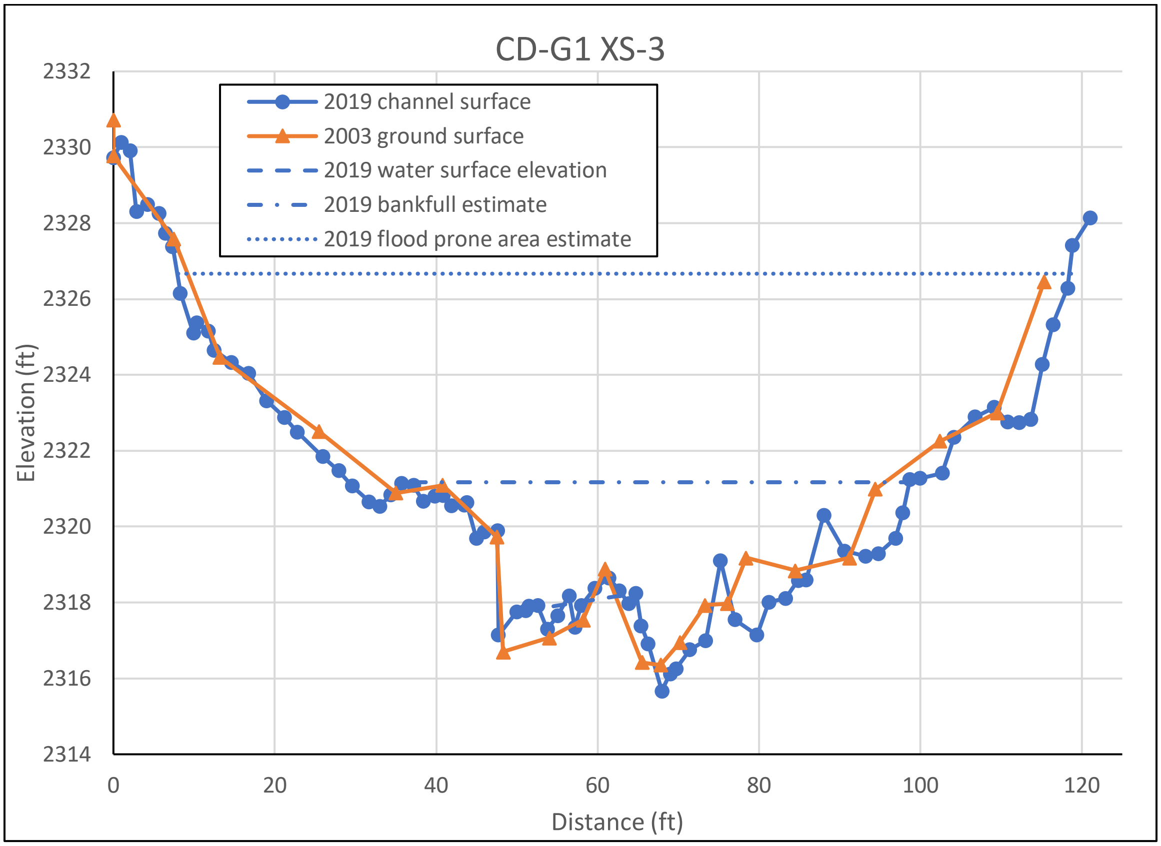


**Figure D5-18. Cross-section Site CD-G1 XS-3 from the 2003 and 2019 surveys.**

**South Fork American River Below Slab Creek (Site SCD-G1)**

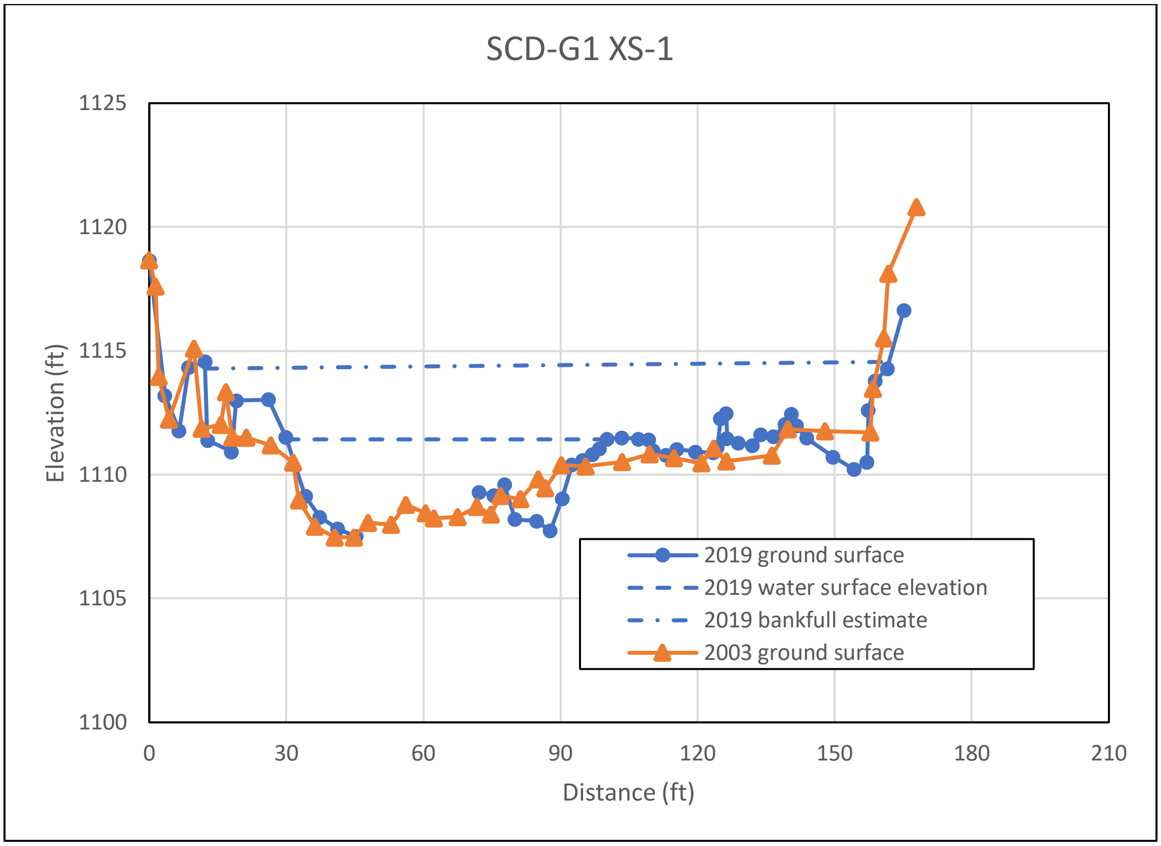


**Figure D5-19. Cross-section Site SCD-G1 XS-1 from the 2019 survey. The gap in the ground surface reflects the part of the channel that could not be surveyed. Flood prone area estimate could not be calculated due to the inability to survey the thalweg.**

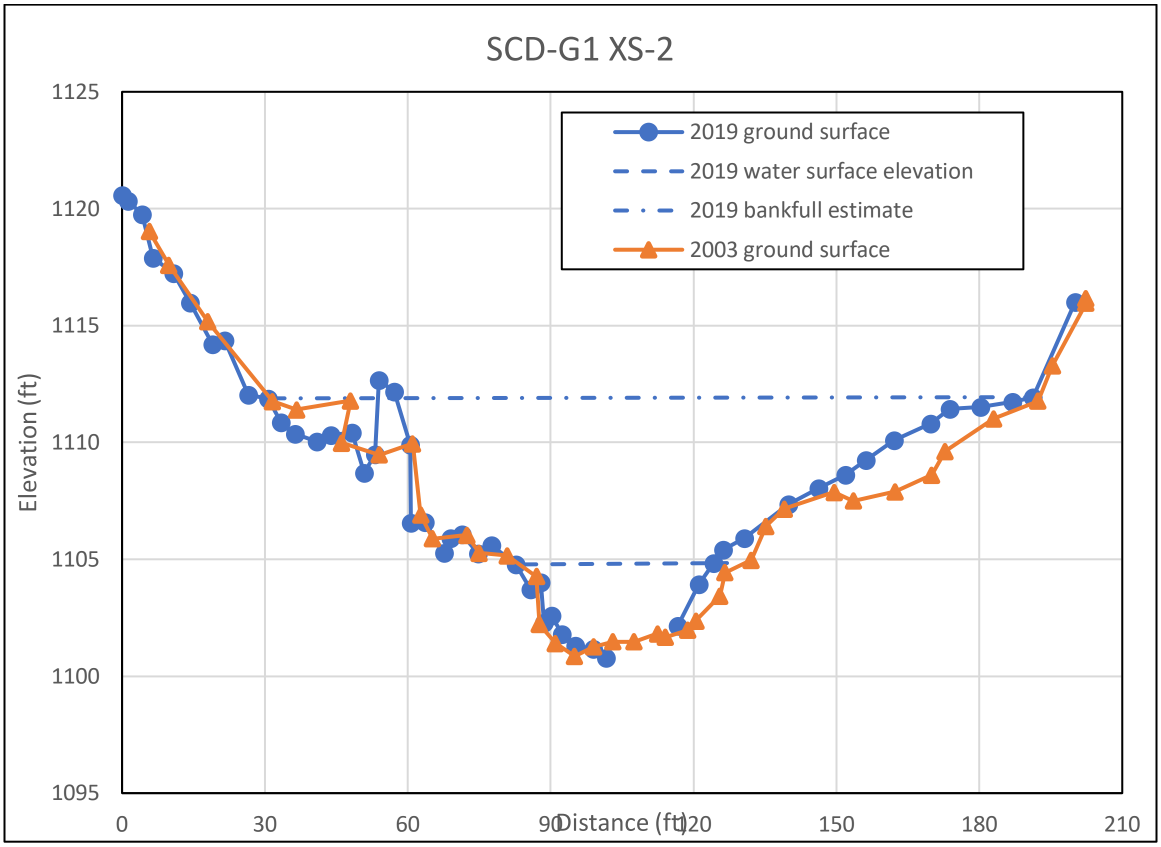


**Figure D5-20. Cross-section Site SCD-G1 XS-2 from the 2019 surveys. The gap in the ground surface reflects the part of the channel that could not be surveyed. Flood prone area estimate could not be calculated due to the inability to survey the thalweg.**

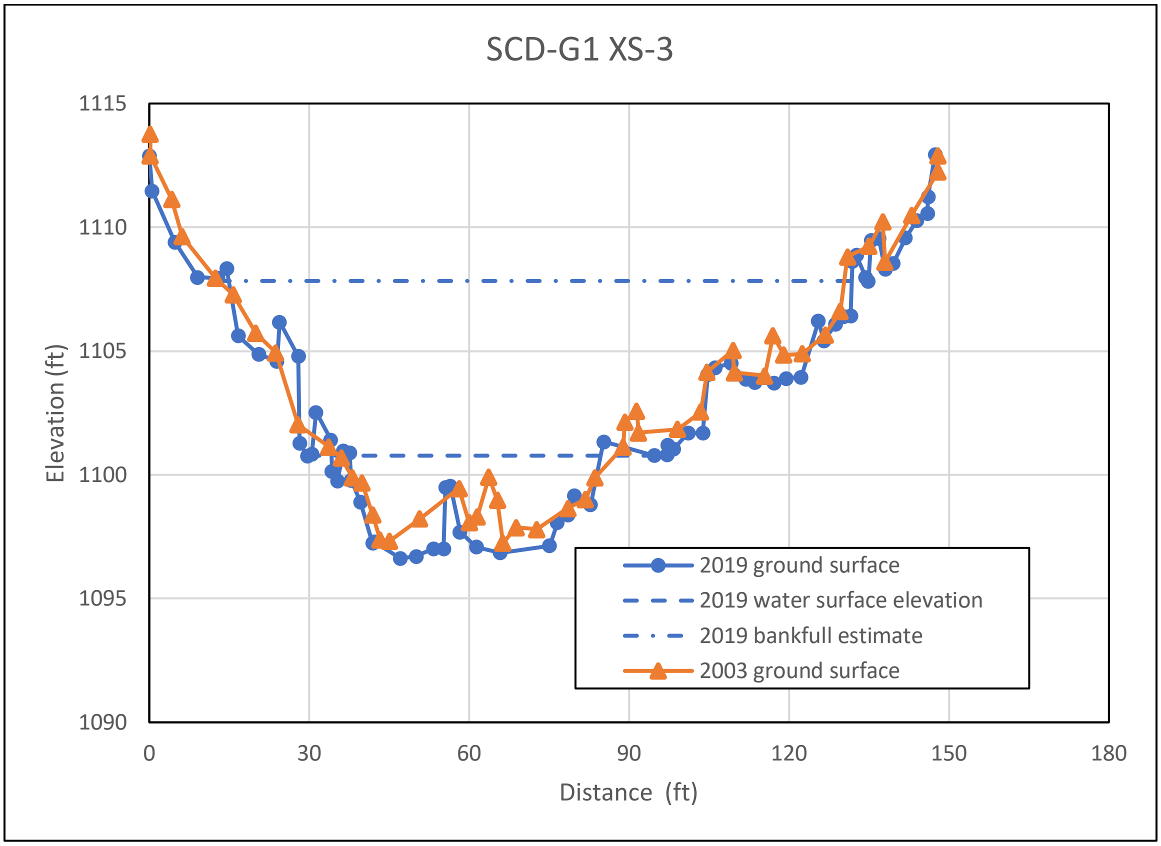


**Figure D5-21. Cross-section Site SCD-G1 XS-3 from the 2003 and 2019 surveys. Flood prone area estimate could not be calculated due to the inability to survey the thalweg.**

# APPENDIX D6

## Pebble Counts

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**Table D6-1. Bed Particle Size Characteristics in 2003 and 2019.**

| Study Site | XS | 2003 Bed Characteristics | | | | 2019 Bed Characteristics | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | $D_{84}$ (mm) | $D_{50}$ (mm) | $D_{16}$ (mm) | Dominant Sediment Facies | $D_{84}$ (mm) | $D_{50}$ (mm) | $D_{16}$ (mm) | Dominant Sediment Facies |
| RRD-G1 | Upper | 60 | 30 | 11 | Cobble | 134 | 39 | 8 | Cobble |
| | Middle | 93 | 34 | 6 | | 121 | 50 | 4 | |
| | Lower | 67 | 31 | 5 | | 136 | 44 | 2 | |
| LLD-G1 | Upper | -- | 3.5 | -- | Sand | - | - | - | Sand |
| | Middle | -- | 0.3 | -- | | - | - | - | |
| | Lower | -- | 3 | -- | | - | - | - | |
| LLD-G2 | Upper | 148 | 40 | 17 | Cobble | 190 | 95 | 39 | Cobble |
| | Middle | 172 | 74 | 14 | | 184 | 90 | 42 | |
| | Lower | 170 | 90 | 40 | | 140 | 85 | 32 | |
| IHD-G1 | Upper | 29 | 16 | 2 | Gravel | 59 | 35 | 14 | Gravel |
| | Middle | 19 | 9 | 1 | | 18 | 11 | 5 | |
| | Lower | 25 | 10 | 1 | | 34 | 16 | 3 | |
| IHD-G2 | Upper | 500 | 45 | 2 | Bedrock/ Boulder | 148 | 85 | 35 | Bedrock |
| | Middle | 350 | 95 | 20 | | 220 | 108 | 55 | |
| | Lower | 400 | 60 | 2 | | - | - | - | |
| CD-G1 | Upper | 156 | 71 | 45 | Bedrock | 157 | 64 | 30 | Bedrock |
| | Middle | 143 | 82 | 46 | | 135 | 80 | 41 | |
| | Lower | 189 | 74 | 38 | | 280 | 103 | 42 | |
| SCD-G1 | Upper | 450 | 240 | 130 | Boulder | - | - | - | Boulder |
| | Middle | 370 | 179 | 100 | | - | - | - | |
| | Lower | 395 | 190 | 90 | | - | - | - | |

mm = millimeters
D16=particle size at which 16% of the bed is finer, D50=particle size at which 50% of the bed is finer, D50=particle size at which 84% of the bed is finer

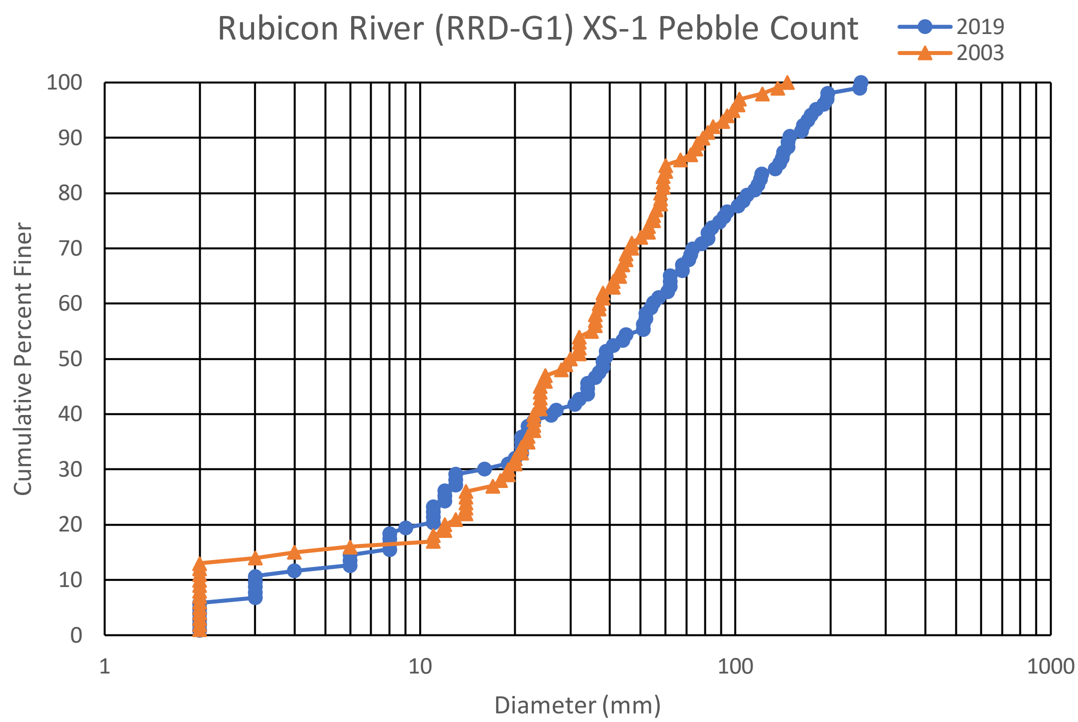


**Figure D6-1. Particle size distribution at Site RRD-G1 XS-1.**

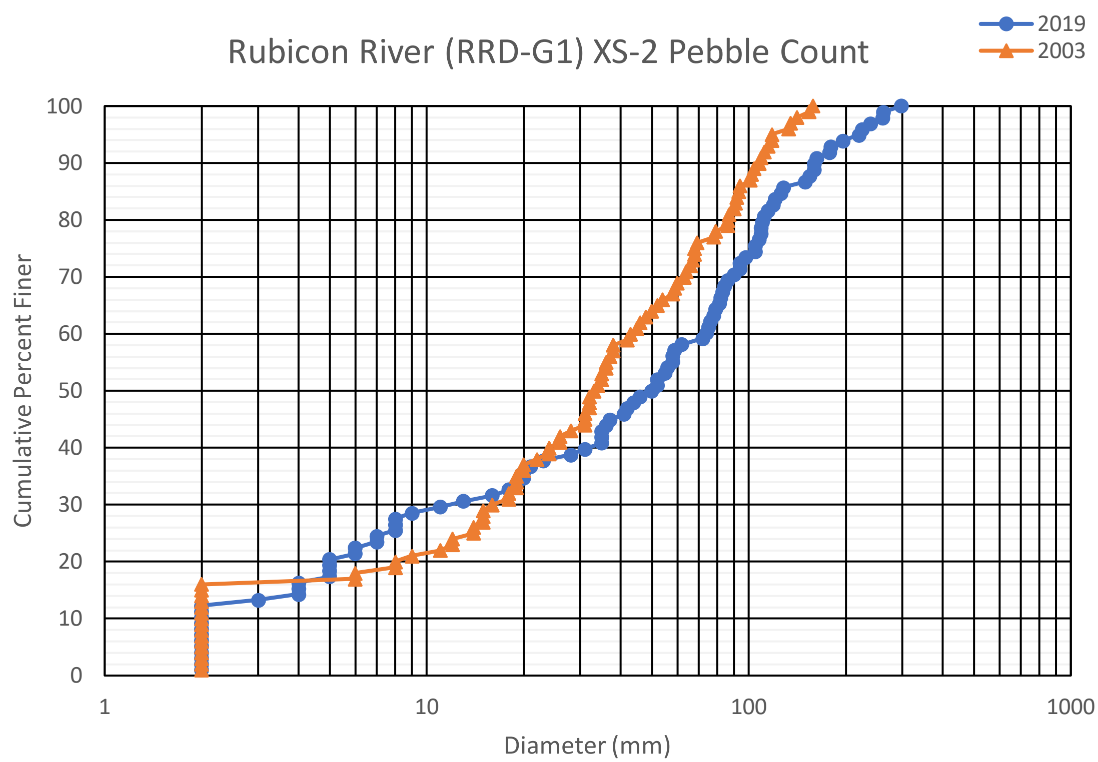


**Figure D6-2. Particle size distribution at Site RRD-G1 XS-2.**

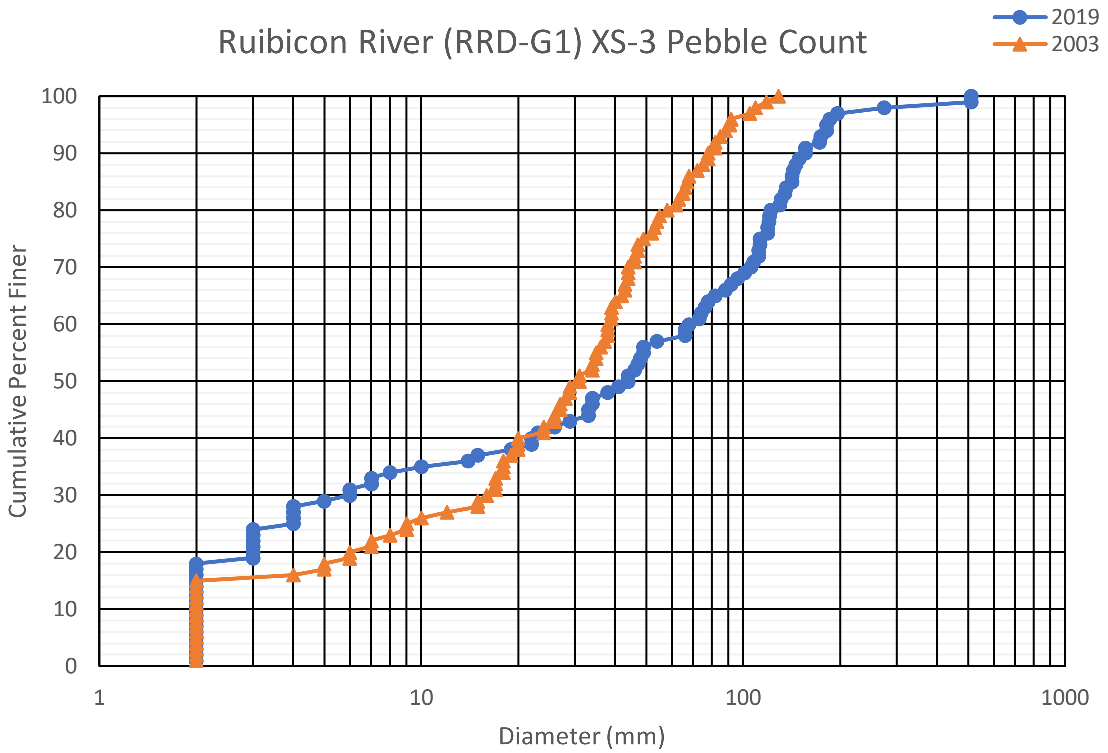


**Figure D6-3. Particle size distribution at Site RRD-G1 XS-3.**

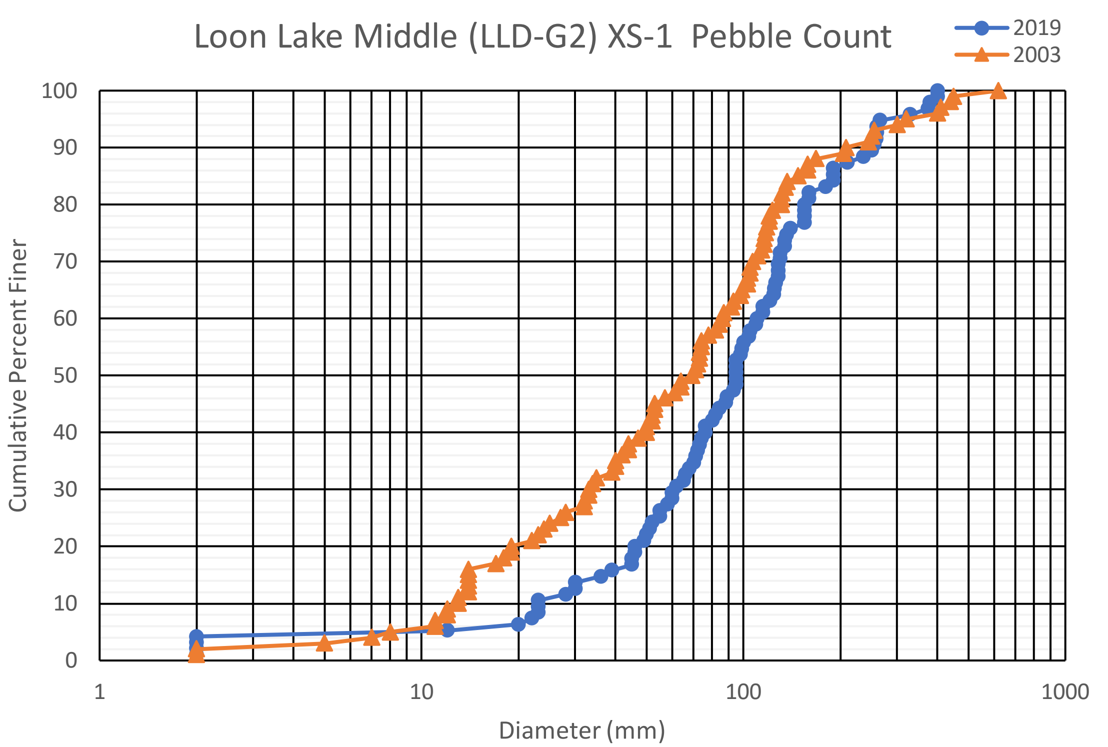


**Figure D6-4. Particle size distribution at Site LLD-G2 XS-1.**

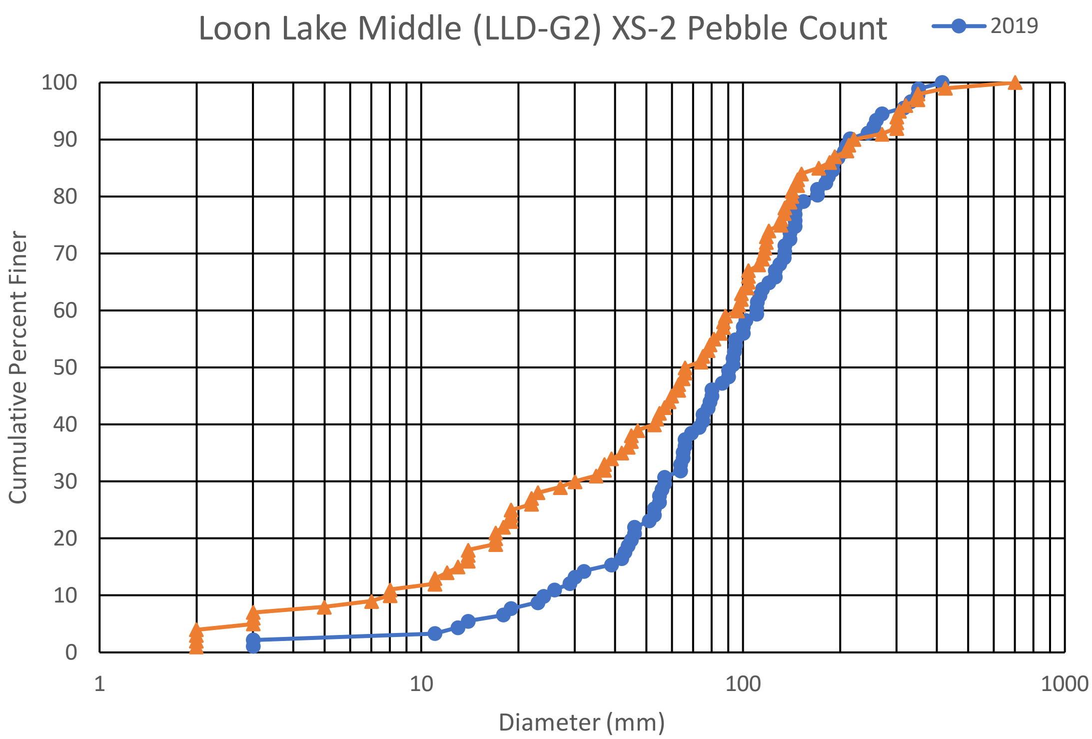


**Figure D6-5. Particle size distribution at Site LLD-G2 XS-2.**

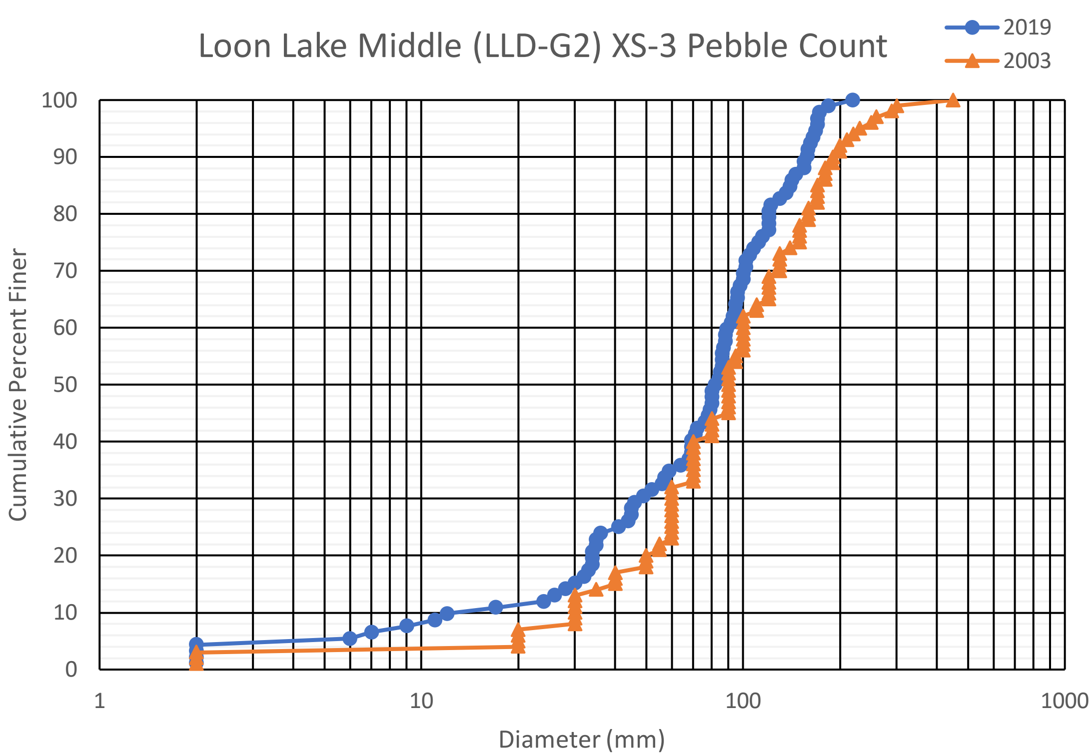


**Figure D6-6. Particle size distribution at Site LLD-G2 XS-3.**

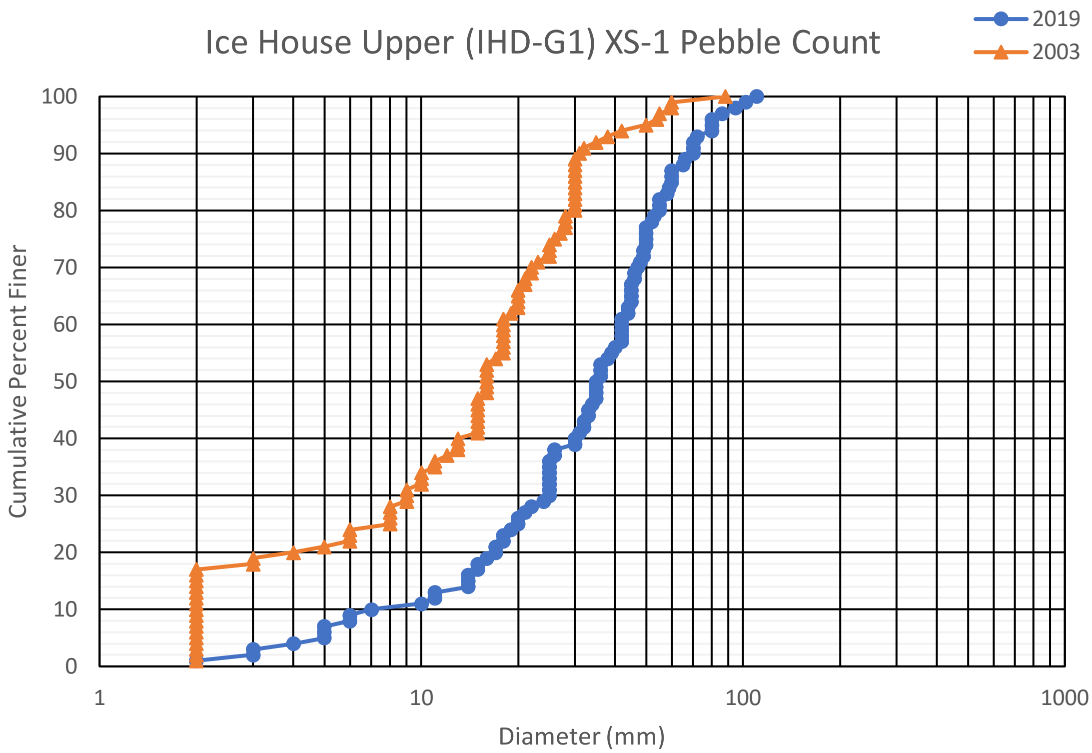


**Figure D6-7. Particle size distribution at Site IHD-G1 XS-1.**

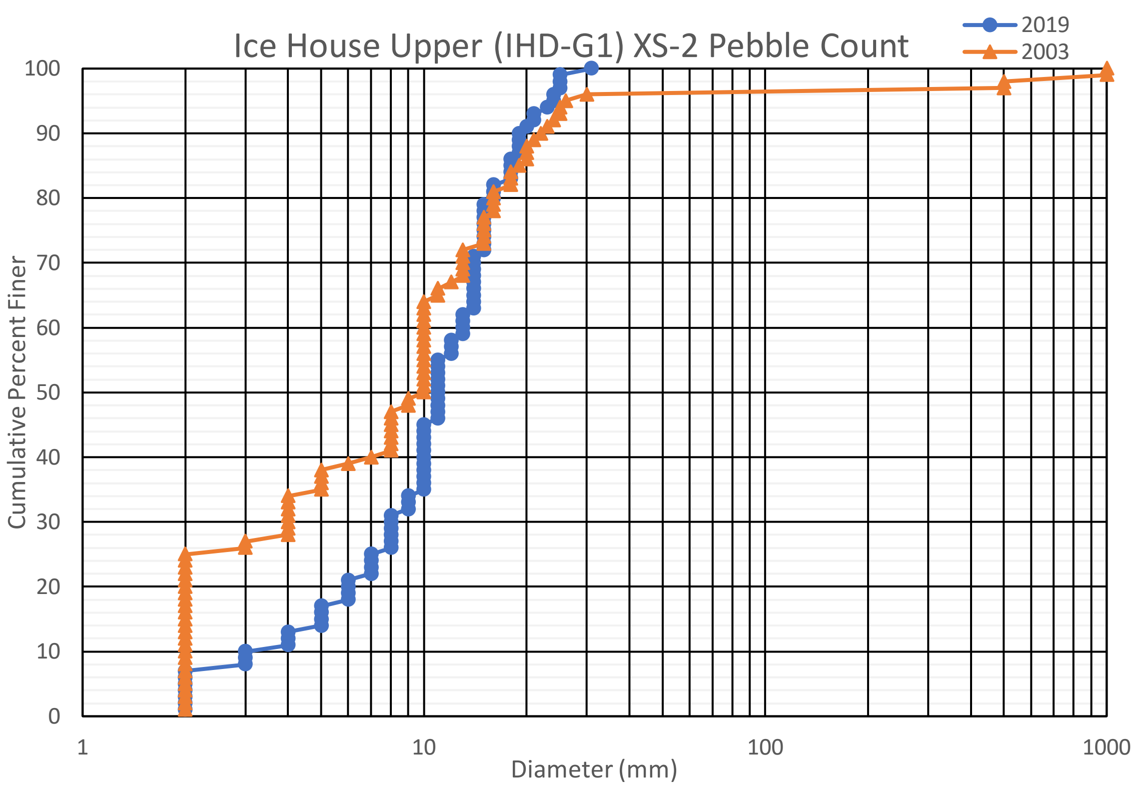


**Figure D6-8. Particle size distribution at Site IHD-G1 XS-2.**

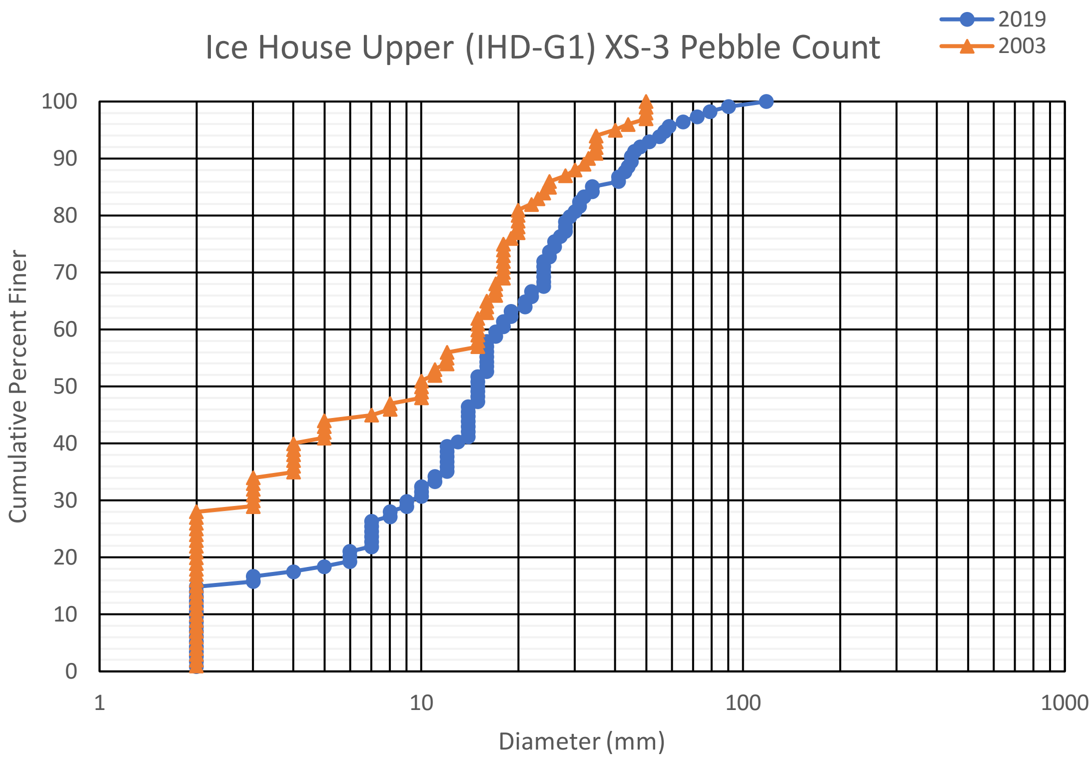


**Figure D6-9. Particle size distribution at Site IHD-G1 XS-3.**

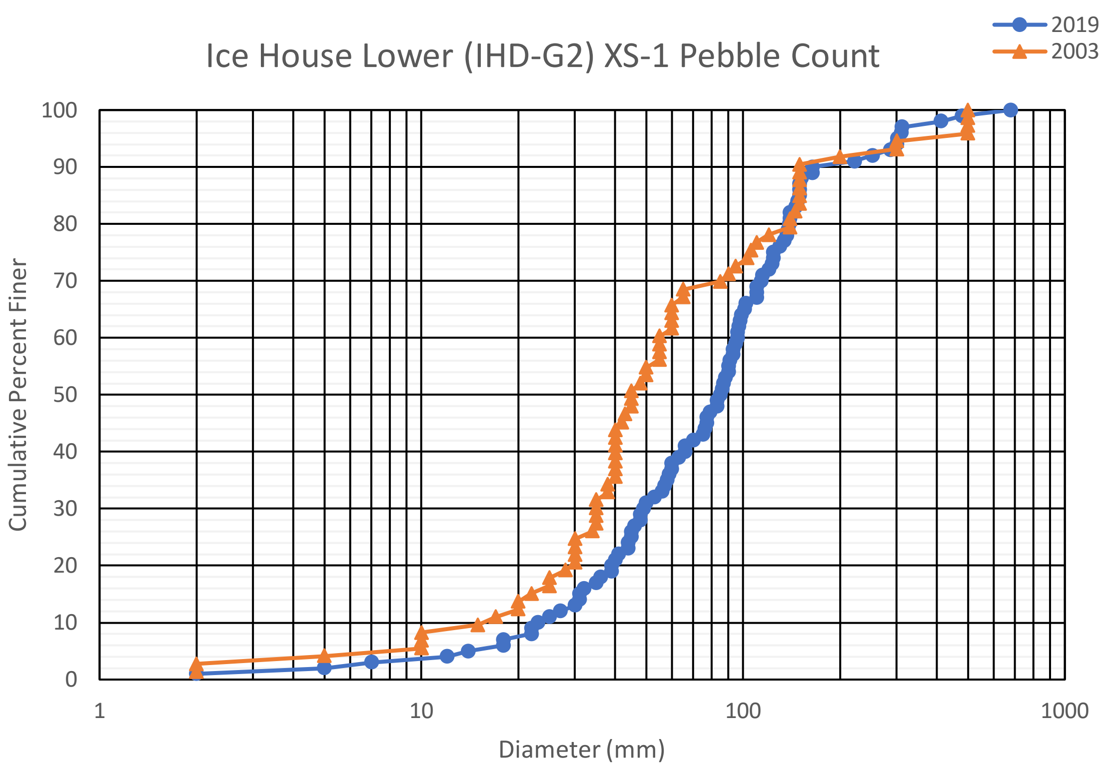


**Figure D6-10. Particle size distribution at Site IHD-G2 XS-1.**

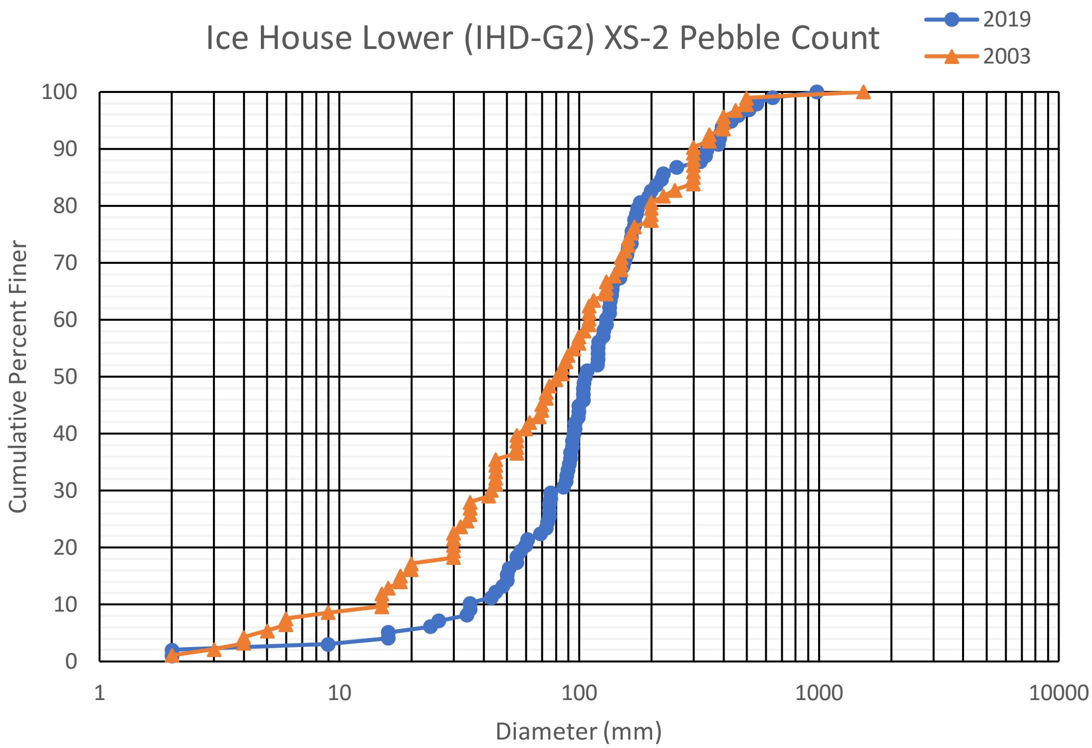


**Figure D6-11. Particle size distribution at Site IHD-G2 XS-2.**

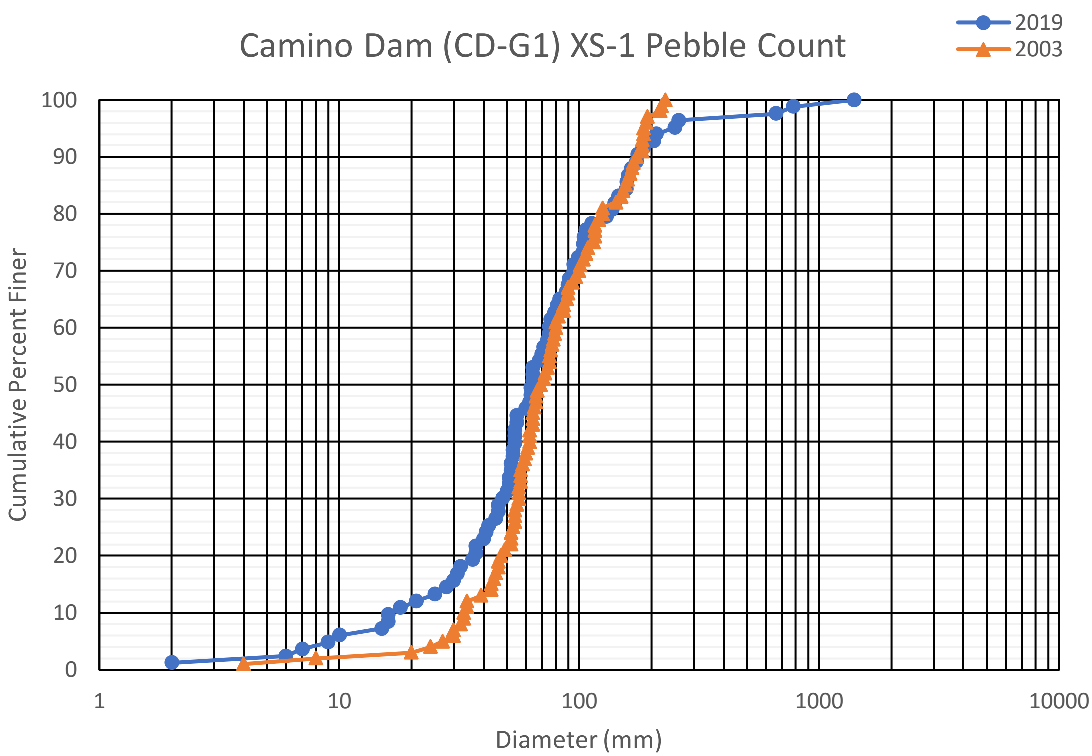


**Figure D6-12. Particle size distribution at Site CD-G1 XS-1.**

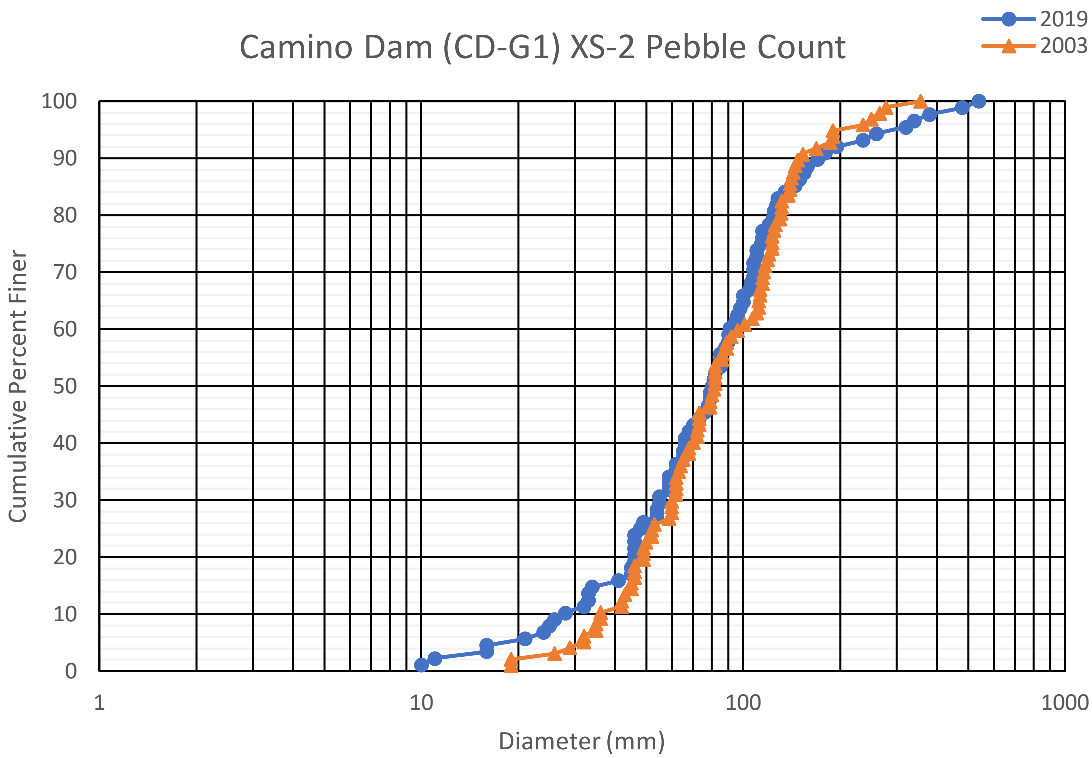


**Figure D6-13. Particle size distribution at Site CD-G1 XS-2.**

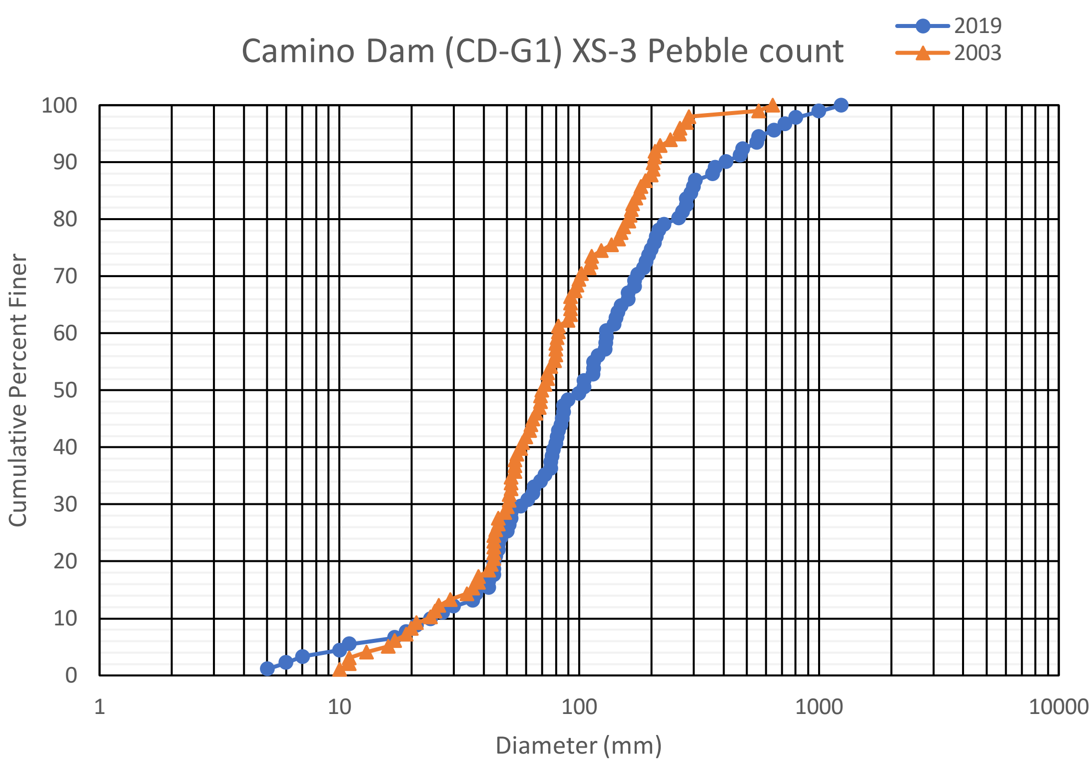


**Figure D6-14. Particle size distribution at Site CD-G1 XS-3.**

# APPENDIX D7

## Facies Maps

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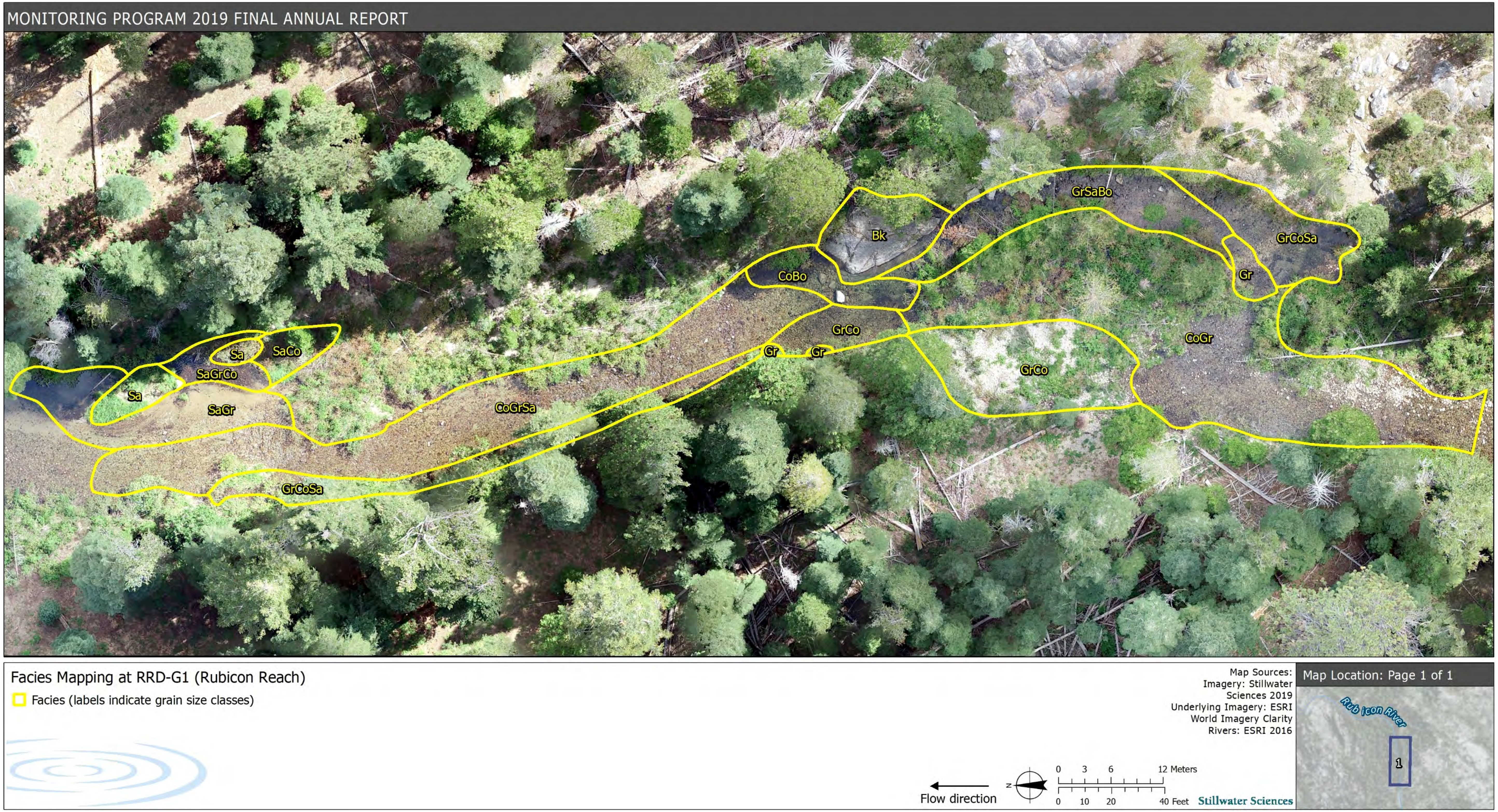


**Figure D7-1. Rubicon River Below Rubicon Dam (Site RRD-G1).**


**Figure D7-2. Gerle Creek Below Loon Lake Middle (Site LLD-G2).**


**Figure D7-3. Gerle Creek Below Loon Lake Middle (Site LLD-G2).**


**Figure D7-4. South Fork Silver Creek Below Ice House Upper (Site IHD-G1).**

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**Figure D7-5. South Fork Silver Creek Below Ice House Upper (Site IHD-G1).**

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**Figure D7-6. South Fork Silver Creek Below Ice House Upper (Site IHD-G1).**

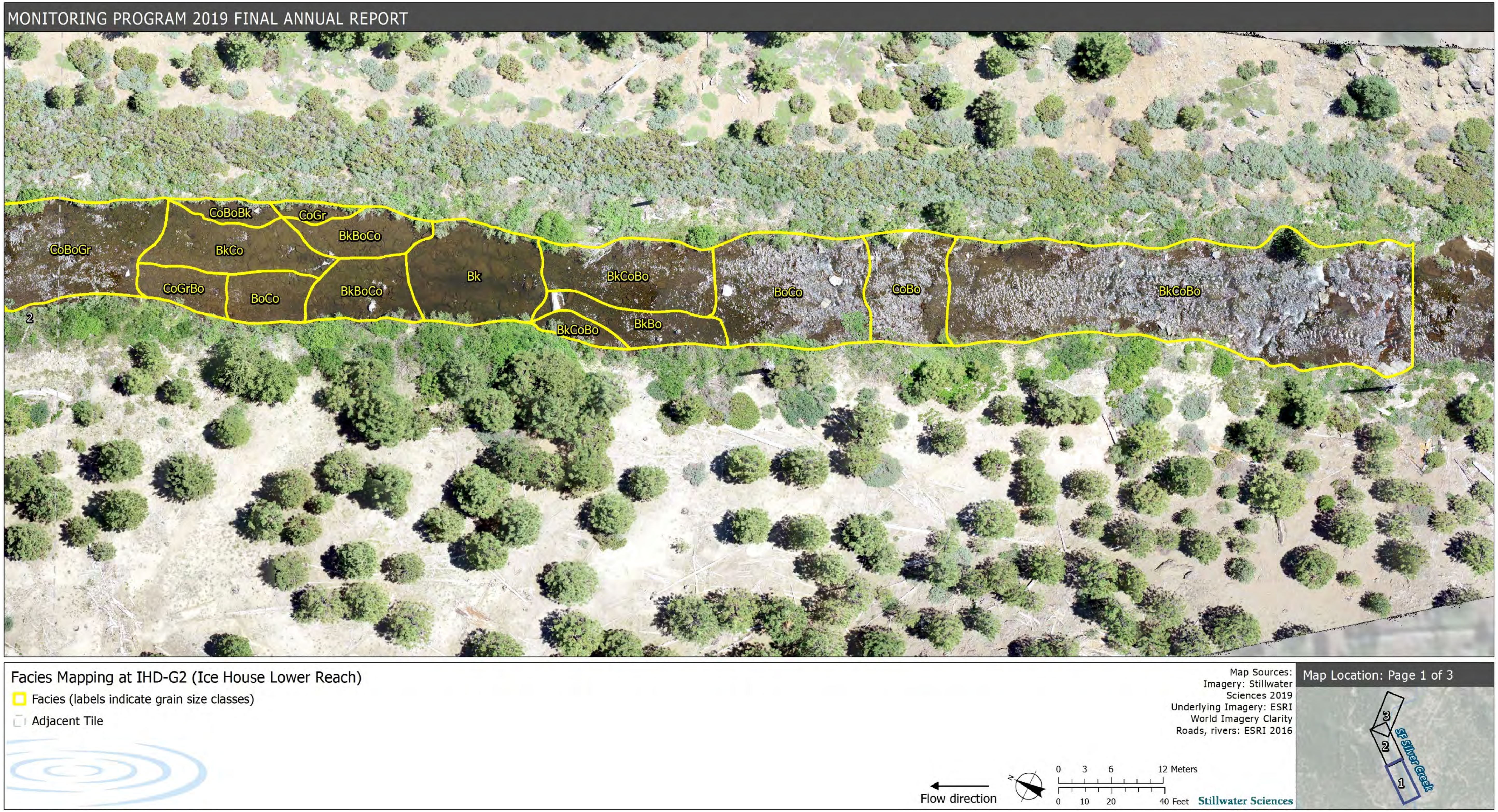


**Figure D7-7. South Fork Silver Creek Below Ice House Lower (Site IHD-G2).**


**Figure D7-8. South Fork Silver Creek Below Ice House Lower (Site IHD-G2).**

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Facies Mapping at IHD-G2 (Ice House Lower Reach)

Facies (labels indicate grain size classes)

Adjacent Tile

Flow direction

0 3 6 12 Meters

0 10 20 40 Feet

Map Sources:
Imagery: Stillwater Sciences 2019
Underlying Imagery: ESRI World Imagery Clarity
Roads, rivers: ESRI 2016

Stillwater Sciences

Map Location: Page 3 of 3

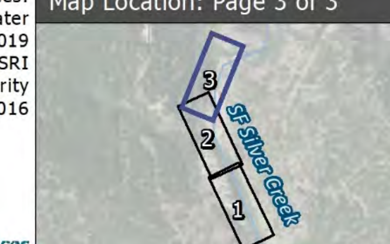


**Figure D7-9. South Fork Silver Creek Below Ice House Lower (Site IHD-G2).**

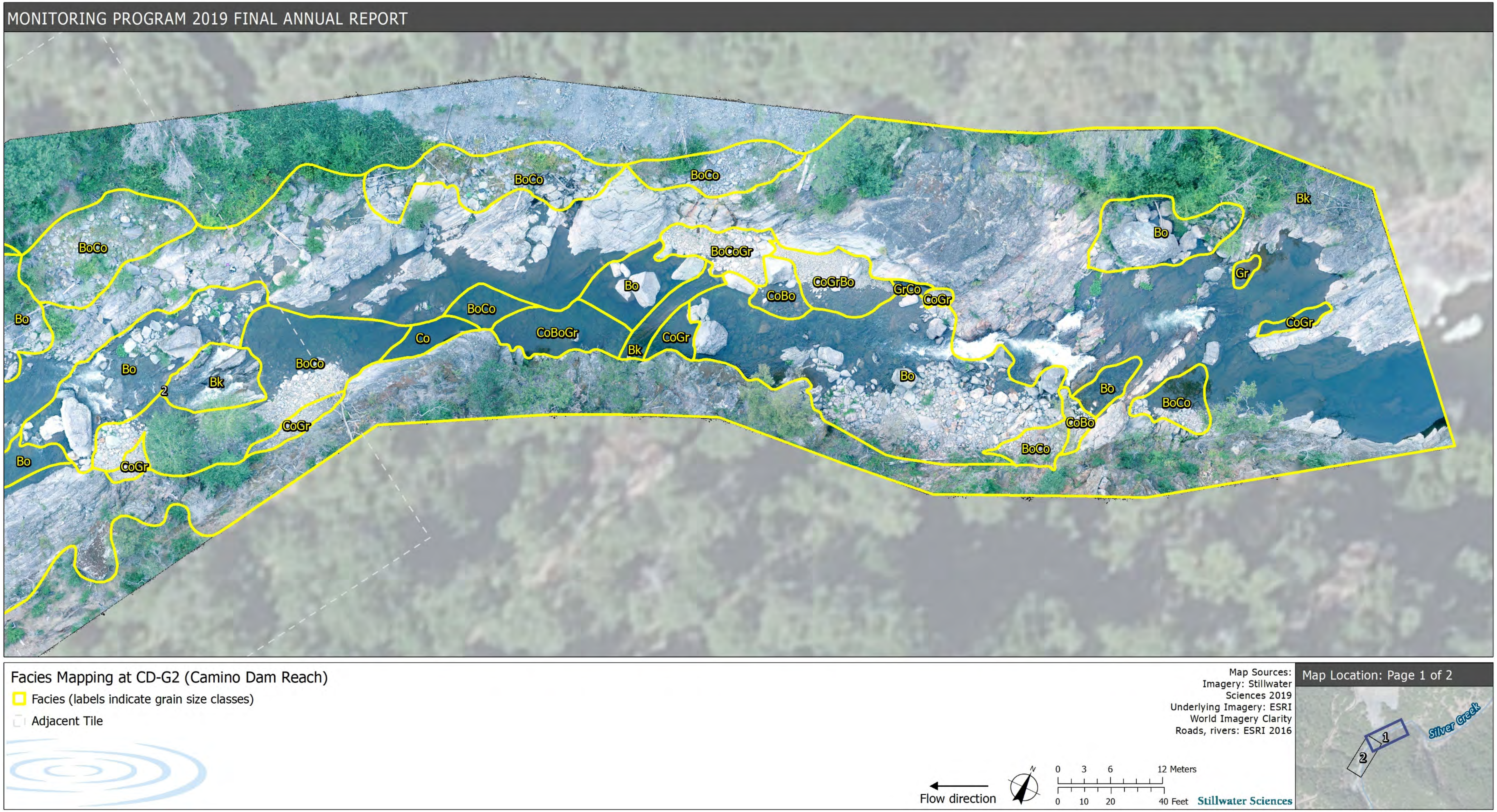


**Figure D7-10. Silver Creek Below Camino Dam (Site CD-G1).**

MONITORING PROGRAM 2019 FINAL ANNUAL REPORT

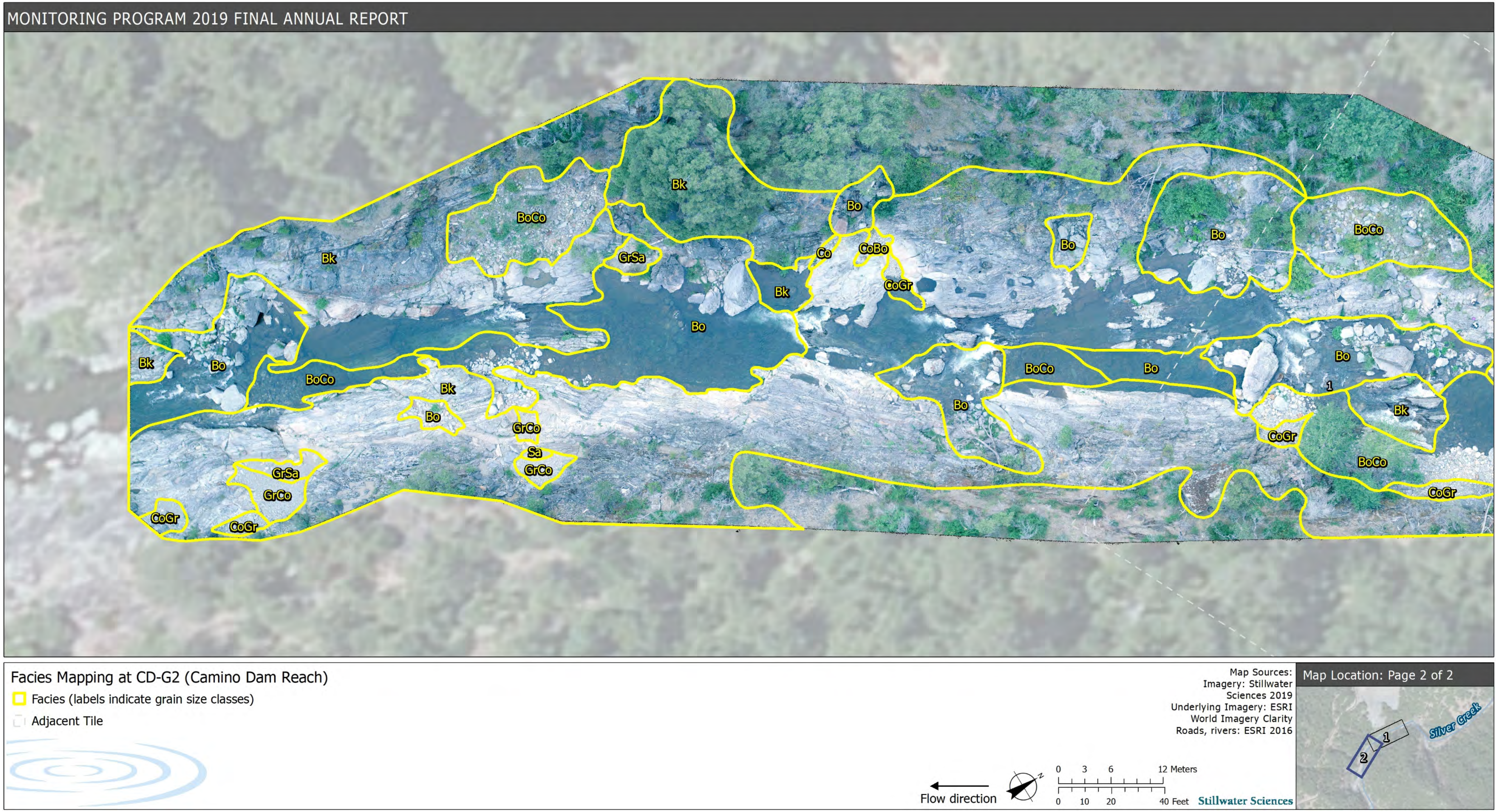


**Figure D7-11. Silver Creek Below Camino Dam (Site CD-G1).**

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**Figure D7-12. South Fork American River Below Slab Creek (Site SCD-G1).**

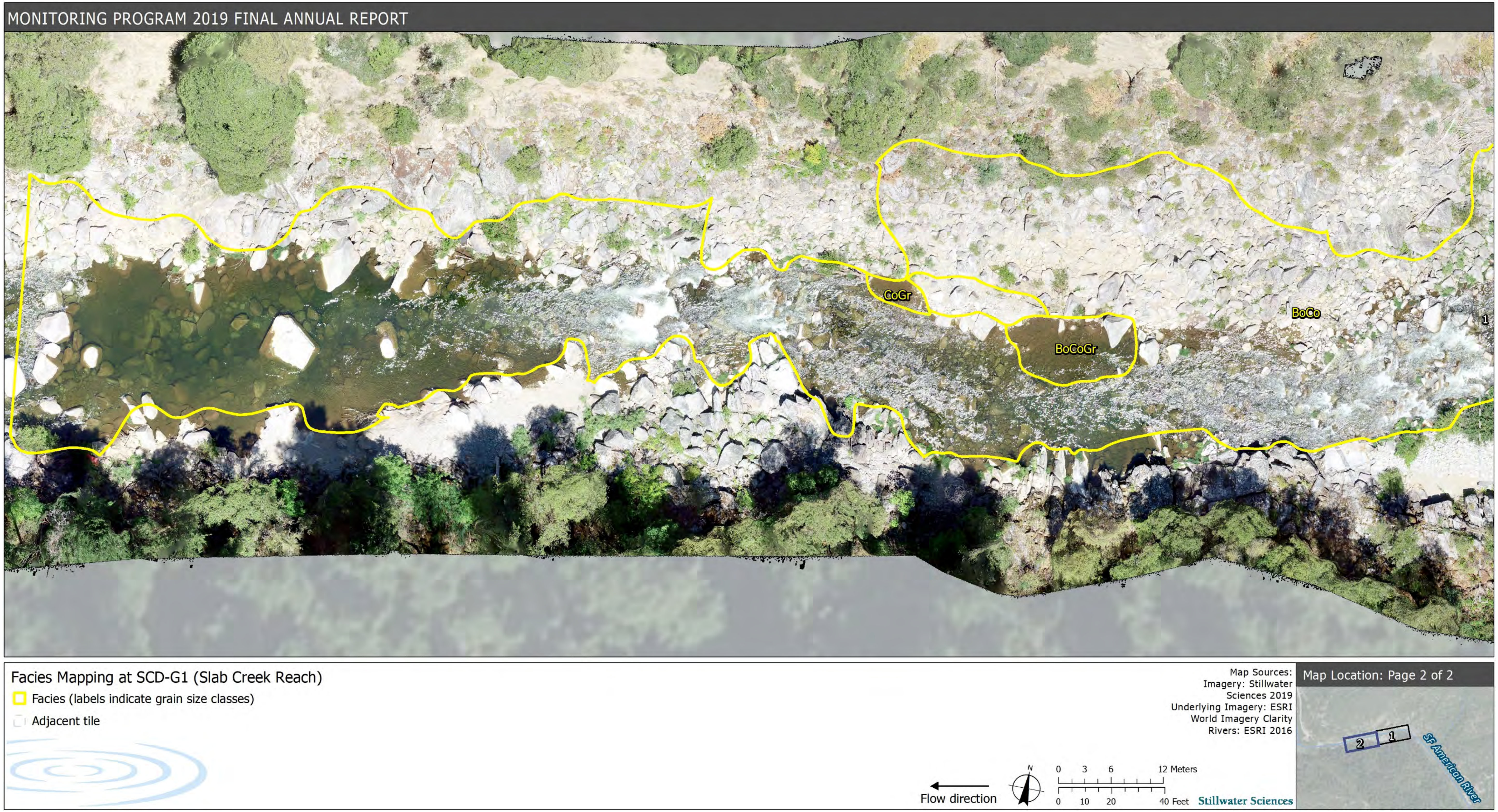


**Figure D7-13. South Fork American River Below Slab Creek (Site SCD-G1).**

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# APPENDIX D8

## Inventory of Large Woody Debris

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**Table D8-1. Results from Large Woody Debris Inventories.**

| Site | Minimum Measured Size (ft) | Reach Length (ft) | Individual Logs | Logs in Jams (Number of Jams) | Logs with Rootwads | Total Number of Logs |
|---|---|---|---|---|---|---|
| RRD-G1 | 12 | 450 | 0 | 0 | 0 | 0 |
| LLD-G1 | 6 | 700 | 564 | 0 | 0 | 564 |
| LLD-G2 | 12 | 1000 | 70 | 38 (4) | 0 | 108 |
| IHD-G1 | 10 | 1200 | 39 | 14 (2) | 5 | 58 |
| IHD-G2 | 14 | 1200 | 2 | 0 | 0 | 2 |
| CD-G1 | 20 | 900 | 4 | 0 | 0 | 4 |
| SC-G1 | 23 | 750 | 0 | 0 | 0 | 0 |

**ft = feet**

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# APPENDIX D9

## V* Fine Sediment Storage Data

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**Table D12-1.V* Survey Data for the Pool at the Upper End of Site IHD-G1 (South Fork Silver Creek Below Ice House Reservoir, Upper Reach).**

| Profile | Distance (ft) | Water depth (ft) | Water+fines depth (ft) | Residual pool+fines (ft) | Thickness of fines (ft) | Fine profile area ($ft^2$) | Residual pool area ($ft^2$) |
|---|---|---|---|---|---|---|---|
| Centerline | 0 | 2.9 | 3.2 | 2.8 | 0.3 | 0.5 | 4.2 |
| Centerline | 3 | 3.6 | 3.8 | 3.4 | 0.2 | 1.6 | 26.4 |
| Centerline | 15.5 | 4.2 | 4.3 | 3.9 | 0.1 | 0.9 | 34.3 |
| Centerline | 20.6 | 4.6 | 5.4 | 5 | 0.8 | 3.8 | 23.8 |
| Centerline | 25 | 6 | 6.3 | 5.9 | 0.3 | 1.26 | 24.8 |
| Centerline | 29 | 6 | 6.4 | 6 | 0.4 | 1.4 | 21 |
| Centerline | 32 | 6.6 | 6.9 | 6.5 | 0.3 | 0.8 | 16.3 |
| Centerline | 34 | 6.8 | 6.8 | 6.4 | 0 | 0 | 12.8 |
| Centerline | 36 | 6.8 | 7.3 | 6.9 | 0.5 | 3 | 41.4 |
| Centerline | 46 | 6.8 | 7.6 | 7.2 | 0.8 | 7.2 | 64.8 |
| Centerline | 54 | 6.5 | 7.5 | 7.1 | 1 | 9.5 | 67.5 |
| Centerline | 65 | 5.3 | 6.9 | 6.5 | 1.6 | 14.4 | 58.5 |
| Centerline | 72 | 4.5 | 7.3 | 6.9 | 2.8 | 15.4 | 38.0 |
| Centerline | 76 | 3.8 | 7 | 6.6 | 3.2 | 12.8 | 26.4 |
| Centerline | 80 | 3.6 | 7.3 | 6.9 | 3.7 | 29.6 | 55.2 |
| Centerline | 92 | 1.7 | 4.9 | 4.5 | 3.2 | 56 | 78.8 |
| Centerline | 115 | 0.4 | 0.4 | 0 | 0 | 0 | 0 |
| River Right | 5 | 2.7 | 2.7 | 2.3 | 0 | 0 | 5.75 |
| River Right | 15 | 3.1 | 3.1 | 2.7 | 0 | 0 | 24.3 |
| River Right | 23 | 5.4 | 5.9 | 5.5 | 0.5 | 4.5 | 49.5 |
| River Right | 33 | 6.9 | 6.9 | 6.5 | 0 | 0 | 130 |
| River Right | 43 | >8ft | – | – | – | – | – |
| River Right | 53 | >8ft | – | – | – | – | – |
| River Right | 63 | 6.3 | 7.9 | 7.5 | 1.6 | 34.4 | 161.3 |
| River Right | 76 | 4.4 | 6.7 | 6.3 | 2.3 | 26.5 | 72.5 |
| River Right | 86 | 2.5 | 5.9 | 5.5 | 3.4 | 34 | 55 |
| River Right | 96 | 1.8 | 5.3 | 4.9 | 3.5 | 36.8 | 51.5 |
| River Right | 107 | 0.3 | 1.2 | 0.8 | 0.9 | 5.0 | 4.4 |
| River Left | 3 | 1.8 | 3.1 | 2.7 | 1.3 | 4.55 | 9.45 |
| River Left | 13 | 2.7 | 5.4 | 5 | 2.7 | 27 | 50 |
| River Left | 23 | 4.4 | 5.3 | 4.9 | 0.9 | 9 | 49 |
| River Left | 33 | 4.7 | 6.5 | 6.1 | 1.8 | 18 | 61 |
| River Left | 43 | 4.4 | 7.6 | 7.2 | 3.2 | 32 | 72 |

| Profile | Distance (ft) | Water depth (ft) | Water+fines depth (ft) | Residual pool+fines (ft) | Thickness of fines (ft) | Fine profile area ($ft^2$) | Residual pool area ($ft^2$) |
|---|---|---|---|---|---|---|---|
| River Left | 53 | 4.5 | 6.5 | 6.1 | 2 | 20 | 61 |
| River Left | 63 | 3.7 | 5.1 | 4.7 | 1.4 | 14 | 47 |
| River Left | 73 | 2.5 | 5.3 | 4.9 | 2.8 | 28 | 49 |
| River Left | 83 | 1.9 | 4 | 3.6 | 2.1 | 21 | 36 |
| River Left | 93 | 1.5 | 3.6 | 3.2 | 2.1 | 21 | 32 |
| River Left | 103 | 0.6 | 3.2 | 2.8 | 2.6 | 13 | 14 |

ft = feet; $ft^2$ = square feet

# APPENDIX D10

## Rosgen Level III Analyses

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**Rubicon River Below Rubicon Dam**
**(Site RRD-G1)**

Survey Date: 9/10/2019 Survey Crew: Karley Rodriguez, Joey Verdian, Chris Lyle, Christian Braudrick

Depositional Features ("x" indicates assigned category)

| | | |
|---|---|---|
| | B-1 | Point bars |
| | B-2 | Point bars with few mid channel bars |
| x | B-3 | Many mid channel bars |
| | B-4 | Side bars |
| | B-5 | Diagonal bars |
| | B-6 | Main branching with many mid channel bars and islands |
| | B-7 | Mixed side bar and mid channel bars exceeding 2-3X width |
| | B-8 | Delta bars |

Description: some vegetated mid channel bars

Meander Pattern ("x" indicates assigned category)

| | | |
|---|---|---|
| x | M-1 | Regular meander |
| | M-2 | Tortuous meander |
| | M-3 | Irregular meander |
| | M-4 | Truncated meander |
| | M-5 | Unconfined meander scrolls |
| | M-6 | Confined meander scrolls |
| | M-7 | Distorted meander loops |
| | M-8 | Irregular with oxbows |

Description: The channel is straight.

| | | | |
|---|---|---|---|
| | STREAM CHANNEL DEBRIS/BLOCKAGES ("x" indicates assigned category) | | |
| | Description/Extent | | Materials, which upon placement into the active channel or floodprone area may cause and adjustment in channel dimensions or conditions, due to influences on the existing flow regime |
| x | D-1 | None | Minor amounts of small, floatable material |
| | D-2 | Infrequent | Debris consists of small, easily moved, floatable material, i.e. leaves, needles, small limbs, twigs, etc.. |
| | D-3 | Moderate | Increasing frequency of small to medium sized material, i.e. large limbs, branches, small logs that when accumulated effect 10% or less of the active channel cross-sectional area. |
| | D-4 | Numerous | Significant buildup of medium to large sized materials, i.e. large limbs, branches, small logs, or portions of trees that may occupy 10 to 30% of the active cross-sectional area. |
| | D-5 | Extensive | Debris "dams" of predominantly larger materials, i.e. branches, logs, trees, etc., occupying 30 to 50% of the active channel cross-section, often extending across the width of the active channel. |
| | D-6 | Dominating | Large, somewhat continuous debris "dams," extensive in nature and occupying over 50% of the active channel cross-section. Such accumulations may divert water into floodprone areas and form fish migration barriers, even when flows are at less than bankfull. |
| | D-7 | Beaver Dams - Few | An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams. |
| | D-8 | Beaver Dams - Frequent | Frequency of dams is such that backwater conditions exist for channel reaches between structures; where streamflow velocities are reduced, and channel dimensions or conditions are influenced. |
| | D-9 | Beaver Dams - Abandoned | Numerous abandoned dams, many of which have filled with sediment and/or breached, initiating a series of channel adjustments such as bank erosion, lateral migration, evulsion, aggradations and degradation. |
| | D-10 | Human Influences | Structures, facilities, or materials related to land uses or development located within the floodprone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures, and various transportation encroachments that have influence on the existing flow regime, such that significant channel adjustments occur. |

Notes: No debris blockages

**Gerle Creek Below Loon Lake Dam**
**Upper Reach (Site LLD-G1)**

Survey Date: 7/18/2019 Survey Crew: Joey Verdian, Ryley Tauzer, Ian Pryor

Depositional Features ("x" indicates assigned category)

| | | |
|---|---|---|
| | B-1 | Point bars |
| | B-2 | Point bars with few mid channel bars |
| | B-3 | Many mid channel bars |
| | B-4 | Side bars |
| | B-5 | Diagonal bars |
| | B-6 | Main branching with many mid channel bars and islands |
| | B-7 | Mixed side bar and mid channel bars exceeding 2-3X width |
| | B-8 | Delta bars |

Description: Bars were not observed at the site (low width-depth ratio), morphology dominated by wood.

Meander Pattern ("x" indicates assigned category)

| | | |
|---|---|---|
| | M-1 | Regular meander |
| | M-2 | Tortuous meander |
| x | M-3 | Irregular meander |
| | M-4 | Truncated meander |
| | M-5 | Unconfined meander scrolls |
| | M-6 | Confined meander scrolls |
| | M-7 | Distorted meander loops |
| | M-8 | Irregular with oxbows |

Description: Meander structure is largely a product of spatial distribution of LWD in conjunction with highly erodible banks where bedrock is absent.

| | STREAM CHANNEL DEBRIS/BLOCKAGES (“x” indicates assigned category) | | |
|---|---|---|---|
| | Description/Extent | | Materials, which upon placement into the active channel or floodprone area may cause and adjustment in channel dimensions or conditions, due to influences on the existing flow regime |
| | D-1 | None | Minor amounts of small, floatable material |
| | D-2 | Infrequent | Debris consists of small, easily moved, floatable material, i.e. leaves, needles, small limbs, twigs, etc.. |
| | D-3 | Moderate | Increasing frequency of small to medium sized material, i.e. large limbs, branches, small logs that when accumulated effect 10% or less of the active channel cross-sectional area. |
| x | D-4 | Numerous | Significant buildup of medium to large sized materials, i.e. large limbs, branches, small logs, or portions of trees that may occupy 10 to 30% of the active cross-sectional area. |
| | D-5 | Extensive | Debris "dams" of predominantly larger materials, i.e. branches, logs, trees, etc., occupying 30 to 50% of the active channel cross-section, often extending across the width of the active channel. |
| | D-6 | Dominating | Large, somewhat continuous debris "dams," extensive in nature and occupying over 50% of the active channel cross-section. Such accumulations may divert water into floodprone areas and form fish migration barriers, even when flows are at less than bankfull. |
| | D-7 | Beaver Dams - Few | An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams. |
| | D-8 | Beaver Dams - Frequent | Frequency of dams is such that backwater conditions exist for channel reaches between structures; where streamflow velocities are reduced, and channel dimensions or conditions are influenced. |
| | D-9 | Beaver Dams - Abandoned | Numerous abandoned dams, many of which have filled with sediment and/or breached, initiating a series of channel adjustments such as bank erosion, lateral migration, evulsion, aggradations and degradation. |
| | D-10 | Human Influences | Structures, facilities, or materials related to land uses or development located within the floodprone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures, and various transportation encroachments that have influence on the existing flow regime, such that significant channel adjustments occur. |

Notes: This study reach is located in a previously dense grove that has transitioned to a meadow. 95% of trees around the active channel are dead, downed, and decaying. LWD dams raising water surface elevation and creating deep scour pools. LWD dominates channel morphology.

**Gerle Creek Below Loon Lake Dam**
**Middle Reach (Site LLD-G2)**

Survey Date: 8/7/2019 Survey Crew: Ryley Tauzer, Joey Verdian, Chris Lyle

Depositional Features ("x" indicates assigned category)

| | | |
|---|---|---|
| | B-1 | Point bars |
| | B-2 | Point bars with few mid channel bars |
| | B-3 | Many mid channel bars |
| x | B-4 | Side bars |
| | B-5 | Diagonal bars |
| | B-6 | Main branching with many mid channel bars and islands |
| | B-7 | Mixed side bar and mid channel bars exceeding 2-3X width |
| | B-8 | Delta bars |

Description: Sparse alternate bars with dense vegetation. One mid channel bar stabilized by a stump.

Meander Pattern ("x" indicates assigned category)

| | | |
|---|---|---|
| x | M-1 | Regular meander |
| | M-2 | Tortuous meander |
| | M-3 | Irregular meander |
| | M-4 | Truncated meander |
| | M-5 | Unconfined meander scrolls |
| | M-6 | Confined meander scrolls |
| | M-7 | Distorted meander loops |
| | M-8 | Irregular with oxbows |

Description: Relatively straight channel with some small-amplitude bends.

| | | | |
|---|---|---|---|
| | STREAM CHANNEL DEBRIS/BLOCKAGES ("x" indicates assigned category) | | |
| | Description/Extent | | Materials, which upon placement into the active channel or floodprone area may cause and adjustment in channel dimensions or conditions, due to influences on the existing flow regime |
| | D-1 | None | Minor amounts of small, floatable material |
| | D-2 | Infrequent | Debris consists of small, easily moved, floatable material, i.e. leaves, needles, small limbs, twigs, etc.. |
| x | D-3 | Moderate | Increasing frequency of small to medium sized material, i.e. large limbs, branches, small logs that when accumulated effect 10% or less of the active channel cross-sectional area. |
| | D-4 | Numerous | Significant buildup of medium to large sized materials, i.e. large limbs, branches, small logs, or portions of trees that may occupy 10 to 30% of the active cross-sectional area. |
| | D-5 | Extensive | Debris "dams" of predominantly larger materials, i.e. branches, logs, trees, etc., occupying 30 to 50% of the active channel cross-section, often extending across the width of the active channel. |
| | D-6 | Dominating | Large, somewhat continuous debris "dams," extensive in nature and occupying over 50% of the active channel cross-section. Such accumulations may divert water into floodprone areas and form fish migration barriers, even when flows are at less than bankfull. |
| | D-7 | Beaver Dams - Few | An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams. |
| | D-8 | Beaver Dams - Frequent | Frequency of dams is such that backwater conditions exist for channel reaches between structures; where streamflow velocities are reduced, and channel dimensions or conditions are influenced. |
| | D-9 | Beaver Dams - Abandoned | Numerous abandoned dams, many of which have filled with sediment and/or breached, initiating a series of channel adjustments such as bank erosion, lateral migration, evulsion, aggradations and degradation. |
| | D-10 | Human Influences | Structures, facilities, or materials related to land uses or development located within the floodprone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures, and various transportation encroachments that have influence on the existing flow regime, such that significant channel adjustments occur. |

Notes: none

## South Fork Silver Creek Below Ice House Reservoir
## Upper Reach (Site IHD-G1)

Survey Date: 8/9/2019 Survey Crew: Ryley Tauzer, Joey Verdian, Chris Lyle

Depositional Features ("x" indicates assigned category)

| | | |
|---|---|---|
| | B-1 | Point bars |
| x | B-2 | Point bars with few mid channel bars |
| | B-3 | Many mid channel bars |
| | B-4 | Side bars |
| | B-5 | Diagonal bars |
| | B-6 | Main branching with many mid channel bars and islands |
| | B-7 | Mixed side bar and mid channel bars exceeding 2-3X width |
| | B-8 | Delta bars |

Description: Three side bars, four mid channel bars, floodplain deposits with evidence of recent inundation, i.e., racked vegetation in tree branches.

Meander Pattern ("x" indicates assigned category)

| | | |
|---|---|---|
| x | M-1 | Regular meander |
| | M-2 | Tortuous meander |
| | M-3 | Irregular meander |
| | M-4 | Truncated meander |
| | M-5 | Unconfined meander scrolls |
| | M-6 | Confined meander scrolls |
| | M-7 | Distorted meander loops |
| | M-8 | Irregular with oxbows |

Description: Low sinuosity, meander structure appears stable due to buried boulders on channel banks

| | STREAM CHANNEL DEBRIS/BLOCKAGES ("x" indicates assigned category) | | |
|---|---|---|---|
| | Description/Extent | | Materials, which upon placement into the active channel or floodprone area may cause and adjustment in channel dimensions or conditions, due to influences on the existing flow regime |
| | D-1 | None | Minor amounts of small, floatable material |
| | D-2 | Infrequent | Debris consists of small, easily moved, floatable material, i.e. leaves, needles, small limbs, twigs, etc.. |
| | D-3 | Moderate | Increasing frequency of small to medium sized material, i.e. large limbs, branches, small logs that when accumulated effect 10% or less of the active channel cross-sectional area. |
| x | D-4 | Numerous | Significant buildup of medium to large sized materials, i.e. large limbs, branches, small logs, or portions of trees that may occupy 10 to 30% of the active cross-sectional area. |
| | D-5 | Extensive | Debris "dams" of predominantly larger materials, i.e. branches, logs, trees, etc., occupying 30 to 50% of the active channel cross-section, often extending across the width of the active channel. |
| | D-6 | Dominating | Large, somewhat continuous debris "dams," extensive in nature and occupying over 50% of the active channel cross-section. Such accumulations may divert water into floodprone areas and form fish migration barriers, even when flows are at less than bankfull. |
| | D-7 | Beaver Dams - Few | An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams. |
| | D-8 | Beaver Dams - Frequent | Frequency of dams is such that backwater conditions exist for channel reaches between structures; where streamflow velocities are reduced, and channel dimensions or conditions are influenced. |
| | D-9 | Beaver Dams - Abandoned | Numerous abandoned dams, many of which have filled with sediment and/or breached, initiating a series of channel adjustments such as bank erosion, lateral migration, evulsion, aggradations and degradation. |
| | D-10 | Human Influences | Structures, facilities, or materials related to land uses or development located within the floodprone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures, and various transportation encroachments that have influence on the existing flow regime, such that significant channel adjustments occur. |

Notes: none

## South Fork Silver Creek Below Ice House Reservoir
## Lower Reach (Site IHD-G2)

Survey Date: 8/9/2019 Survey Crew: Ryley Tauzer, Joey Verdian, Chris Lyle

Depositional Features ("x" indicates assigned category)

| | | |
|---|---|---|
| | B-1 | Point bars |
| x | B-2 | Point bars with few mid channel bars |
| | B-3 | Many mid channel bars |
| | B-4 | Side bars |
| | B-5 | Diagonal bars |
| | B-6 | Main branching with many mid channel bars and islands |
| | B-7 | Mixed side bar and mid channel bars exceeding 2-3X width |
| | B-8 | Delta bars |

Description: Point bars comprised of gravels and cobbles and mid channel bars are well vegetated

Meander Pattern ("x" indicates assigned category)

| | | |
|---|---|---|
| x | M-1 | Regular meander |
| | M-2 | Tortuous meander |
| | M-3 | Irregular meander |
| x | M-4 | Truncated meander |
| | M-5 | Unconfined meander scrolls |
| | M-6 | Confined meander scrolls |
| | M-7 | Distorted meander loops |
| | M-8 | Irregular with oxbows |

Description: Downstream part of reach exhibits truncated meander due to large bedrock outcrop that comprises ~ 200' of left bank on outside bend.

| | | | |
|---|---|---|---|
| | STREAM CHANNEL DEBRIS/BLOCKAGES ("x" indicates assigned category) | | |
| | Description/Extent | | Materials, which upon placement into the active channel or floodprone area may cause and adjustment in channel dimensions or conditions, due to influences on the existing flow regime |
| x | D-1 | None | Minor amounts of small, floatable material |
| | D-2 | Infrequent | Debris consists of small, easily moved, floatable material, i.e. leaves, needles, small limbs, twigs, etc.. |
| | D-3 | Moderate | Increasing frequency of small to medium sized material, i.e. large limbs, branches, small logs that when accumulated effect 10% or less of the active channel cross-sectional area. |
| | D-4 | Numerous | Significant buildup of medium to large sized materials, i.e. large limbs, branches, small logs, or portions of trees that may occupy 10 to 30% of the active cross-sectional area. |
| | D-5 | Extensive | Debris "dams" of predominantly larger materials, i.e. branches, logs, trees, etc., occupying 30 to 50% of the active channel cross-section, often extending across the width of the active channel. |
| | D-6 | Dominating | Large, somewhat continuous debris "dams," extensive in nature and occupying over 50% of the active channel cross-section. Such accumulations may divert water into floodprone areas and form fish migration barriers, even when flows are at less than bankfull. |
| | D-7 | Beaver Dams - Few | An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams. |
| | D-8 | Beaver Dams - Frequent | Frequency of dams is such that backwater conditions exist for channel reaches between structures; where streamflow velocities are reduced, and channel dimensions or conditions are influenced. |
| | D-9 | Beaver Dams - Abandoned | Numerous abandoned dams, many of which have filled with sediment and/or breached, initiating a series of channel adjustments such as bank erosion, lateral migration, evulsion, aggradations and degradation. |
| | D-10 | Human Influences | Structures, facilities, or materials related to land uses or development located within the floodprone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures, and various transportation encroachments that have influence on the existing flow regime, such that significant channel adjustments occur. |

Notes: none

**Silver Creek Below Camino Dam
(Site CD-G1)**

Survey Date: 8/6/2019 Survey Crew: Ryley Tauzer, Joey Verdian, Chris Lyle

Depositional Features (“x” indicates assigned category)

| | | |
|---|---|---|
| | B-1 | Point bars |
| | B-2 | Point bars with few mid channel bars |
| | B-3 | Many mid channel bars |
| x | B-4 | Side bars |
| | B-5 | Diagonal bars |
| | B-6 | Main branching with many mid channel bars and islands |
| | B-7 | Mixed side bar and mid channel bars exceeding 2-3X width |
| | B-8 | Delta bars |

Description: Very few bars present, reach is predominately bedrock.

Meander Pattern (“x” indicates assigned category)

| | | |
|---|---|---|
| | M-1 | Regular meander |
| | M-2 | Tortuous meander |
| | M-3 | Irregular meander |
| x | M-4 | Truncated meander |
| | M-5 | Unconfined meander scrolls |
| | M-6 | Confined meander scrolls |
| | M-7 | Distorted meander loops |
| | M-8 | Irregular with oxbows |

Description: Meander structure is limited by bedrock banks.

| | STREAM CHANNEL DEBRIS/BLOCKAGES (“x” indicates assigned category) | | |
|---|---|---|---|
| | Description/Extent | | Materials, which upon placement into the active channel or floodprone area may cause and adjustment in channel dimensions or conditions, due to influences on the existing flow regime |
| | D-1 | None | Minor amounts of small, floatable material |
| x | D-2 | Infrequent | Debris consists of small, easily moved, floatable material, i.e. leaves, needles, small limbs, twigs, etc.. |
| | D-3 | Moderate | Increasing frequency of small to medium sized material, i.e. large limbs, branches, small logs that when accumulated effect 10% or less of the active channel cross-sectional area. |
| | D-4 | Numerous | Significant buildup of medium to large sized materials, i.e. large limbs, branches, small logs, or portions of trees that may occupy 10 to 30% of the active cross-sectional area. |
| | D-5 | Extensive | Debris "dams" of predominantly larger materials, i.e. branches, logs, trees, etc., occupying 30 to 50% of the active channel cross-section, often extending across the width of the active channel. |
| | D-6 | Dominating | Large, somewhat continuous debris "dams," extensive in nature and occupying over 50% of the active channel cross-section. Such accumulations may divert water into floodprone areas and form fish migration barriers, even when flows are at less than bankfull. |
| | D-7 | Beaver Dams - Few | An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams. |
| | D-8 | Beaver Dams - Frequent | Frequency of dams is such that backwater conditions exist for channel reaches between structures; where streamflow velocities are reduced, and channel dimensions or conditions are influenced. |
| | D-9 | Beaver Dams - Abandoned | Numerous abandoned dams, many of which have filled with sediment and/or breached, initiating a series of channel adjustments such as bank erosion, lateral migration, evulsion, aggradations and degradation. |
| | D-10 | Human Influences | Structures, facilities, or materials related to land uses or development located within the floodprone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures, and various transportation encroachments that have influence on the existing flow regime, such that significant channel adjustments occur. |

Notes: Very little/infrequent debris in channel and no channel spanning LWD. Predominately small, transportable, and easily floatable organic materials.

## South Fork American River Below Slab Creek Dam (Site SCD-G1)

Survey Date: 7/15/2019 Survey Crew: Joey Verdian, Ryley Tauzer, Ian Pryor

Depositional Features ("x" indicates assigned category)

| | | |
|---|---|---|
| | B-1 | Point bars |
| | B-2 | Point bars with few mid channel bars |
| | B-3 | Many mid channel bars |
| x | B-4 | Side bars |
| | B-5 | Diagonal bars |
| | B-6 | Main branching with many mid channel bars and islands |
| | B-7 | Mixed side bar and mid channel bars exceeding 2-3X width |
| | B-8 | Delta bars |

Description: 1 alternate bar on upstream end of site composed of boulders.

Meander Pattern ("x" indicates assigned category)

| | | |
|---|---|---|
| x | M-1 | Regular meander |
| | M-2 | Tortuous meander |
| | M-3 | Irregular meander |
| x | M-4 | Truncated meander |
| | M-5 | Unconfined meander scrolls |
| | M-6 | Confined meander scrolls |
| | M-7 | Distorted meander loops |
| | M-8 | Irregular with oxbows |

Description: The channel reach is straight, with planform confined by the valley with extensive bedrock and large boulders stabilizing the channel and limiting sinuosity.

| | | | |
|---|---|---|---|
| | STREAM CHANNEL DEBRIS/BLOCKAGES (“x” indicates assigned category) | | |
| | Description/Extent | | Materials, which upon placement into the active channel or floodprone area may cause and adjustment in channel dimensions or conditions, due to influences on the existing flow regime |
| | D-1 | None | Minor amounts of small, floatable material |
| x | D-2 | Infrequent | Debris consists of small, easily moved, floatable material, i.e. leaves, needles, small limbs, twigs, etc.. |
| | D-3 | Moderate | Increasing frequency of small to medium sized material, i.e. large limbs, branches, small logs that when accumulated effect 10% or less of the active channel cross-sectional area. |
| | D-4 | Numerous | Significant buildup of medium to large sized materials, i.e. large limbs, branches, small logs, or portions of trees that may occupy 10 to 30% of the active cross-sectional area. |
| | D-5 | Extensive | Debris "dams" of predominantly larger materials, i.e. branches, logs, trees, etc., occupying 30 to 50% of the active channel cross-section, often extending across the width of the active channel. |
| | D-6 | Dominating | Large, somewhat continuous debris "dams," extensive in nature and occupying over 50% of the active channel cross-section. Such accumulations may divert water into floodprone areas and form fish migration barriers, even when flows are at less than bankfull. |
| | D-7 | Beaver Dams - Few | An infrequent number of dams spaced such that normal streamflow and expected channel conditions exist in the reaches between dams. |
| | D-8 | Beaver Dams - Frequent | Frequency of dams is such that backwater conditions exist for channel reaches between structures; where streamflow velocities are reduced, and channel dimensions or conditions are influenced. |
| | D-9 | Beaver Dams - Abandoned | Numerous abandoned dams, many of which have filled with sediment and/or breached, initiating a series of channel adjustments such as bank erosion, lateral migration, evulsion, aggradations and degradation. |
| | D-10 | Human Influences | Structures, facilities, or materials related to land uses or development located within the floodprone area, such as diversions or low-head dams, controlled by-pass channels, velocity control structures, and various transportation encroachments that have influence on the existing flow regime, such that significant channel adjustments occur. |

Notes: Very small quantities of debris in channel, limited to easily transportable organic materials.

# APPENDIX D11

## Bank Erosion and Vegetation

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# Rubicon River Below Rubicon Dam
# (Site RRD-G1)

Survey Date: 9/10/2019 Survey Crew: Karley Rodriguez, Joey Verdian, Christian Braudrick, Chris Lyle

| **Bank Erosion Potential** | | | | |
|---|---|---|---|---|
| *Table not completed if banks are composed of bedrock or boulders* | | | | |
| | **Bank a** | **Bank b** | **Bank c** | **Bank d** |
| **Bank height (ft)** | 3 | 2 | 8 | 5 |
| **Bankfull height (ft)** | 3 | 2 | 3 | 3 |
| **Root depth (ft)** | >3 | >2 | 4 | 4 |
| **Root Density (%)** | 100 | 60 | 70 | 25 |
| **Bank angle (degrees)** | 90 | 15 | 70-90 | 80 |
| **Surface protection (%)** | 95 | 80 | 40 | 15 |
| **% of total study reach** | 40 | 45 | 10 | 5 |

**Notes:** none

**Stratification of unstable layers in banks (below bankfull):** Bottom of bank

**Bank material:** Cobble and sand

**Sediment supply:** low (sand supply may be high)

**Vertical streambed stability:** Stable

**Bank and channel bed condition notes:** Vegetation is continuous along both banks. Some cobbles are embedded in the banks. The bed is sandy gravel. Mid-channel bars are vegetated and sandy.

| **Riparian Vegetation** | | | | |
|---|---|---|---|---|
| **Vegetation type** | **Density (indicate all that apply)** | | | |
| | **Low** | **Moderate** | **High** | **Notes** |
| **Bare** | 1 | | | |
| **Forbs only** | 2a | | | |
| **Annual grass w/ forbs** | 3a | | | |
| **Perennial grass** | | 4b | | |
| **Rhizomatous grasses** | 5a | | | |
| **Riparian shrubs** | | 6b | | |
| **High brush** | | | | ALIN, Cornus, Spirea |
| **Combination grass/brush** | | 8b | | Perennial grasses under Alin, Cornus |
| **Deciduous overstory** | 9a | | | Not present |
| **Deciduous w/ brush/grass understory** | 10b | | | Not present |
| **Perennial overstory** | | | 11c | High cover of CADE, PICO, PILA |
| **Wetland vegetation community** | | | | |

**Notes:** Vegetated mid-channel bars w/ lodgepole and cedar, lots of perennial vegetation. Conifers encroaching on channel. The overstory is dominated by conifers with deciduous shrubs dominating the understory.

# Gerle Creek Below Loon Lake Dam
# Upper Reach (Site LLD-G1)

Survey Date: 7/18/2019 Survey Crew: Joey Verdian, Ryley Tauzer, Ian Pryor

| **Bank Erosion Potential** | | | | |
|---|---|---|---|---|
| *Table not completed if banks are composed of bedrock or boulders* | | | | |
| | **Bank a** | **Bank b** | **Bank c** | **Bank d** |
| **Bank height (ft)** | 3 | 3 | 3 | - |
| **Bankfull height (ft)** | 10 | 10 | 10 | - |
| **Root depth (ft)** | NA | 3 | 1-5 | - |
| **Root Density (%)** | NA | 90 | 40 | - |
| **Bank angle (degrees)** | 30-90 | 90 | 90 | - |
| **Surface protection (%)** | 70 | 20 | 25 | - |
| **% of total study reach** | 5 | 20 | 75 | - |

**Notes:** none

**Stratification of unstable layers in banks (below bankfull):**

**Bank material:** Sand

**Sediment supply:** Low

**Vertical streambed stability:** Degrading

**Bank and channel bed condition notes:** Bank a = bedrock, Bank b = root mats, Bank c = meadow

| **Riparian Vegetation** | | | | |
|---|---|---|---|---|
| **Vegetation type** | **Density (indicate all that apply)** | | | |
| | **Low** | **Moderate** | **High** | **Notes** |
| **Bare** | | | | |
| **Forbs only** | | | | |
| **Annual grass w/ forbs** | | 3b | | Very low variety and relatively low density |
| **Perennial grasses** | | 4b | | |
| **Riparian shrubs** | | | | |
| **High brush** | | | | |
| **Combination grass/brush** | | | | |
| **Deciduous overstory** | | | | |
| **Deciduous w/ brush/grass understory** | | | | |
| **Perennial overstory** | | | | |
| **Wetland vegetation community** | | | | |

**Notes:** Saturated wetland meadows, relatively low variety of vegetation, some grasses encroaching on channel. Some aquatic grasses present on channel bottom.

## Gerle Creek Below Loon Lake Dam
## Middle Reach (Site LLD-G2)

Survey Date: 8/7/2019 Survey Crew: Ryley Tauzer, Joey Verdian, Chris Lyle

| **Bank Erosion Potential** | | | | |
|---|---|---|---|---|
| *Table not completed if banks are composed of bedrock or boulders* | | | | |
| | **Bank a** | **Bank b** | **Bank c** | **Bank d** |
| **Bank height (ft)** | 1-2 | 4 | - | - |
| **Bankfull height (ft)** | 0.5-1 | 3.5 | - | - |
| **Root depth (ft)** | 1-2 | 1-2 | - | - |
| **Root Density (%)** | 35-40 | 35-40 | - | - |
| **Bank angle (degrees)** | 45-85 | 60-80 | - | - |
| **Surface protection (%)** | 90 | 90 | - | - |
| **% of total study reach** | 40 | 60 | - | - |

**Notes:** none

**Stratification of unstable layers in banks (below bankfull):**

**Bank material:** Cobble and gravel with moderate sand

**Sediment supply:** Low

**Vertical streambed stability:** Stable

**Bank and channel bed condition notes:** Bank a = soil/sand floodplain in downstream end of reach. Bank b = cobble dominant banks at upstream end of reach

| **Riparian Vegetation** | | | | |
|---|---|---|---|---|
| **Vegetation type** | **Density (indicate all that apply)** | | | |
| | **Low** | **Moderate** | **High** | **Notes** |
| **Bare** | | | | |
| **Forbs only** | | | | |
| **Annual grass w/ forbs** | | | | |
| **Perennial grass** | | | | |
| **Rhizomatous grasses** | | | | |
| **Riparian shrubs** | | | a,b | |
| **High brush** | | | | |
| **Combination grass/brush** | | | | |
| **Deciduous overstory** | | | | |
| **Deciduous w/ brush/grass understory** | | | | |
| **Perennial overstory** | | | a,b | |
| **Wetland vegetation community** | | | | |

**Notes:** None

# South Fork Silver Creek Below Ice House Reservoir
# Upper Reach (Site IHD-G1)

Survey Date:8/8/2019 Survey Crew: Joey Verdian, Ryley Tauzer, Chris Lyle

| **Bank Erosion Potential** | | | | |
|---|---|---|---|---|
| *Table not completed if banks are composed of bedrock or boulders* | | | | |
| | **Bank a** | **Bank b** | **Bank c** | **Bank d** |
| **Bank height (ft)** | 3.5 | 2.5 | - | - |
| **Bankfull height (ft)** | 3.5 | 2.5 | - | - |
| **Root depth (ft)** | 2-3 | 3-5 | - | - |
| **Root Density (%)** | 35-45 | 20-30 | - | - |
| **Bank angle (degrees)** | 80 | 80 | - | - |
| **Surface protection (%)** | 30 | 55 | - | - |
| **% of total study reach** | 65 | 35 | - | - |

**Notes:** none

**Stratification of unstable layers in banks (below bankfull):** Middle of bank

**Bank material:** Sand

**Sediment supply:** Moderate (sand supply is high). Evidence of gravel transport.

**Vertical streambed stability:** Aggrading

**Bank and channel bed condition notes:** Bank a = sandy banks w/ dense roots and veg. Bank b= boulders buried in sand

| **Riparian Vegetation** | | | | |
|---|---|---|---|---|
| **Vegetation type** | **Density (indicate all that apply)** | | | |
| | **Low** | **Moderate** | **High** | **Notes** |
| **Bare** | 1 | | | |
| **Forbs only** | | 2b | | |
| **Annual grass w/ forbs** | | 3b | | |
| **Perennial grass** | | 4b | | |
| **Rhizomatous grasses** | | 5b | | |
| **Low brush** | 6a | | | |
| **High brush** | | 7b | | |
| **Combination grass/brush** | | | 8c | |
| **Deciduous overstory** | | | 9c | |
| **Deciduous w/ brush/grass understory** | | 10b | | |
| **Perennial overstory** | | | | |
| **Wetland vegetation community** | | | | |

**Notes:** none

## South Fork Silver Creek Below Ice House Reservoir
## Lower Reach (Site IHD-G2)

Survey Date: 8/9/2019    Survey Crew: Chris Lyle, Ryley Tauzer, Joey Verdian

| **Bank Erosion Potential** | | | | |
|---|---|---|---|---|
| *Table not completed if banks are composed of bedrock or boulders* | | | | |
| | **Bank a** | **Bank b** | **Bank c** | **Bank d** |
| **Bank height (ft)** | - | - | - | - |
| **Bankfull height (ft)** | - | - | - | - |
| **Root depth (ft)** | - | - | - | - |
| **Root Density (%)** | - | - | - | - |
| **Bank angle (degrees)** | - | - | - | - |
| **Surface protection (%)** | - | - | - | - |
| **% of total study reach** | - | - | - | - |

**Notes:** none

**Stratification of unstable layers in banks (below bankfull):**

**Bank material:** Bedrock, cobble, sand

**Sediment supply:** Low

**Vertical streambed stability:** Stable

**Bank and channel bed condition notes:**

| **Riparian Vegetation** | | | | |
|---|---|---|---|---|
| **Vegetation type** | **Density (indicate all that apply)** | | | |
| | **Low** | **Moderate** | **High** | **Notes** |
| **Bare** | 1 | | | |
| **Forbs only** | | 2b | | |
| **Annual grass w/ forbs** | | | | |
| **Perennial grass** | 4a | | | |
| **Rhizomatous grasses** | | 5b | | |
| **Low brush** | 6a | | | |
| **High brush** | | | | |
| **Combination grass/brush** | | | | |
| **Deciduous overstory** | | | | |
| **Deciduous w/ brush/grass understory** | | | | |
| **Perennial overstory** | | | | |
| **Wetland vegetation community** | | | | |

**Notes:** none

# Silver Creek Below Camino Dam
# (Site CD-G1)

Survey Date: Survey Crew: Joey Verdian, Chris Lyle, Ryley Tauzer

| **Bank Erosion Potential** | | | | |
|---|---|---|---|---|
| *Banks are comprised of bedrock and boulders, therefore the table was not completed* | | | | |
| | **Bank a** | **Bank b** | **Bank c** | **Bank d** |
| **Bank height (ft)** | - | - | - | - |
| **Bankfull height (ft)** | - | - | - | - |
| **Root depth (ft)** | - | - | - | - |
| **Root Density (%)** | - | - | - | - |
| **Bank angle (degrees)** | - | - | - | - |
| **Surface protection (%)** | - | - | - | - |
| **% of total study reach** | - | - | - | - |

**Notes:** none

**Stratification of unstable layers in banks (below bankfull):** n/a

**Bank material:** Bedrock

**Sediment supply:** Low

**Vertical streambed stability:** Stable

**Bank and channel bed condition notes:**

| **Riparian Vegetation** | | | | |
|---|---|---|---|---|
| **Vegetation type** | **Density (indicate all that apply)** | | | |
| | **Low** | **Moderate** | **High** | **Notes** |
| **Bare** | | 1 | | |
| **Forbs only** | | | | |
| **Annual grass w/ forbs** | 3a | | | |
| **Perennial grass** | | | | |
| **Rhizomatous grasses** | | | | |
| **Riparian shrubs** | | | | |
| **High brush** | | | | |
| **Combination grass/brush** | | | | |
| **Deciduous overstory** | | | | |
| **Deciduous w/ brush/grass understory** | 10a | | | |
| **Perennial overstory** | | | | |
| **Wetland vegetation community** | | | | |

**Notes:** none

# South Fork American River Below Slab Creek Dam (Site SCD-G1)

Survey Date: 7/15/2019 Survey Crew: Ryley Tauzer, Ian Pryor, Joey Verdian

| **Bank Erosion Potential** | | | | |
|---|---|---|---|---|
| *Banks are composed of bedrock or boulders, therefore table not completed.* | | | | |
| | **Bank a** | **Bank b** | **Bank c** | **Bank d** |
| **Bank height (ft)** | - | - | - | - |
| **Bankfull height (ft)** | - | - | - | - |
| **Root depth (ft)** | - | - | - | - |
| **Root Density (%)** | - | - | - | - |
| **Bank angle (degrees)** | - | - | - | - |
| **Surface protection (%)** | - | - | - | - |
| **% of total study reach** | - | - | - | - |

**Notes:** none

**Stratification of unstable layers in banks (below bankfull):**

**Bank material:** Bedrock

**Sediment supply:** Low

**Vertical streambed stability:** Stable

**Bank and channel bed condition notes:**

| **Riparian Vegetation** | | | | |
|---|---|---|---|---|
| **Vegetation type** | **Density (indicate all that apply)** | | | |
| | **Low** | **Moderate** | **High** | **Notes** |
| **Bare** | | | | |
| **Forbs only** | | | | |
| **Annual grass w/ forbs** | | | | |
| **Rhizomatous grasses** | 5a | | | |
| **Perennial grass** | | | | |
| **Low brush** | 6a | | | |
| **High brush** | | | | |
| **Combination grass/brush** | | | | |
| **Deciduous overstory** | | | | |
| **Deciduous w/ brush/grass understory** | 10a | | | |
| **Perennial overstory** | | | | |
| **Wetland vegetation community** | | | | |

**Notes:** none

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# APPENDIX D12

## Channel Stability (Pfankuch)

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## Rubicon River Below Rubicon Dam (Site RRD-G1)

| Survey Date: 9/10/2019 | | | Survey Crew: Karley Rodriguez, Joey Verdian, Chris Lyle, Christian Braudrick | | |
|---|---|---|---|---|---|
| | | **Category** | **"x" indicates the assigned value** | | |
| **Upper Banks** | 1 | Landform slope | Bank slope gradient <30% | 2 | |
| | | | Bank slope gradient 30-40% | 4 | |
| | | | Bank slope gradient 40-60% | 6 | |
| | | | Bank slope gradient 60+% | 8 | x |
| | 2 | Mass wasting | No evidence of past or future mass wasting | 3 | x |
| | | | Infrequent. Most likely healed over. Low future potential | 6 | |
| | | | Frequent or large, causing sediment nearly year long | 9 | |
| | | | Frequent or large causing sediment nearly year long or imminent danger of same | 12 | |
| | 3 | Debris jam potential | Essentially absent from immediate channel area | 2 | |
| | | | Present, but mostly small twigs and limbs | 4 | x |
| | | | Moderate to heavy amounts, mostly larger sizes | 6 | |
| | | | Moderate to heavy amounts, predominately lager sizes | 8 | |
| | 4 | Vegetative bank protection | 90%+ plant density. Vigor and variety suggest a deep, dense soil binding root mass | 3 | x |
| | | | 70-90% density. Fewer species or less vigor suggest less dense or deep root mass | 6 | |
| | | | <50-70% density. Lower vigor and fewer species from a shallow, discontinuous root mass | 9 | |
| | | | <50% density, fewer species and less vigor indicate poor, discontinuous and shallow root mass | 12 | |
| **Lower Banks** | 5 | Channel capacity | Ample for present plus some increases. Peak flows contained. W/D ration <7 | 1 | |
| | | | Adequate. Bank overflows rare. W/D ratio 8-15 | 2 | x |
| | | | Barely contains present peaks. Occasional overbank floods. W/D ratio 15 to 25 | 3 | |
| | | | Inadequate. Overbank flows common. W/D ratio >25 | 4 | |
| | 6 | Bank rock content | 65%+ with large angular boulders. 12"+ common. | 2 | |
| | | | 40-65%. Mostly small boulders to cobbles 6-12" | 4 | |
| | | | 20-40%. With most in the 3-6" diameter class | 6 | |
| | | | 20% rock fragments of gravel sizes, 1-3" or less | 8 | x |
| | 7 | Obstructions to flow | Rocks and logs firmly embedded. Flow pattern w/out cutting or deposition. Stable Bed | 2 | x |
| | | | Some present causing erosive cross currents and minor pool filling. Obstructions newer and less firm | 4 | |

| | | | | | |
|---|---|---|---|---|---|
| | | | Moderately frequent, unstable obstructions move with high flows causing bank cutting and pool filling | 6 | |
| | | | Sediment traps full, channel migration occurring | | |
| | 8 | Cutting | Little or none. Infrequent raw banks less than 6” | 4 | x |
| | | | Some, intermittently at outcurves and constrictions. Raw banks may be up to 12” | 6 | |
| | | | Significant. Cuts 12-24” high. Root mat overhangs and sloughing evident | 12 | |
| | | | Almost continuous cuts, some over 24” high. Failure of overhangs frequent | 16 | |
| | 9 | Deposition | Little or no enlargement of channel or point bars | 4 | x |
| | | | Some new bar increase, mostly from coarse gravel | 8 | |
| | | | Moderate deposition of new gravel and course sand on old and some new bars | 12 | |
| | | | Extensive deposits of predominately fine particles. Accelerated bar development | 16 | |
| **Bottom** | 10 | Rock angularity | Sharp edges and corners. Plane surfaces rough. | 1 | |
| | | | Rounded corners and edges, surfaces smooth, flat | 2 | |
| | | | Corners and edges well rounded in two dimensions | 3 | |
| | | | Well rounded in all dimensions, surfaces smooth | 4 | x |
| | 11 | Brightness | Surfaces dull, dark, or stained. Generally not bright | 1 | |
| | | | Mostly dull, but may have <35% bright surfaces | 2 | x |
| | | | Mixture dull and bright, ie 35-65% mixture range | 3 | |
| | | | Predominately bright, 65% exposed or scoured surfaces | 4 | |
| | 12 | Consolidation of particles | Assorted sizes tightly packed or overlapping | 2 | |
| | | | Moderately packed with some overlapping | 4 | x |
| | | | Mostly loose assortment with no apparent overlap | 6 | |
| | | | No packing evident. Loose assortment easily moved | 8 | |
| | 13 | Bottom size distribution | No size change evident. Stable mater. 80-100% | 4 | |
| | | | Distribution shift light. Stable material 50-80% | 8 | x |
| | | | Moderate changes in sizes. Stable materials 20-50% | 12 | |
| | | | Marked distribution change. Stable materials 0-20% | 16 | |
| | 14 | Scouring and deposition | <5% of bottom affected by scour or deposition | 6 | |

| | | | | | |
|---|---|---|---|---|---|
| | | | 5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools | 12 | |
| | | | 30-50% affected. Deposits and scour at obstructions, constrictions, and bends. Some filling of pools | 18 | x |
| | | | More than 50% of the bottom in a state of flux or change nearly year long | 24 | |
| | 15 | Aquatic vegetation | Abundant growth moss-like, dark green perennial. In swift water too. | 1 | |
| | | | Common. Algae forms in low velocity and pool areas. Moss here too | 2 | |
| | | | Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick | 3 | |
| | | | Perennial types scare or absent. Yellow-green, short term bloom may be present | 4 | x |

**Score guidelines:** <38 Excellent, 39-76 Good, 77-114 Fair, >114 Poor
**Score:** 76 (Good)

# Gerle Creek Below Loon Lake Dam
# Upper Reach (Site LLD-G1)

| | | | | | |
|---|---|---|---|---|---|
| | | **Survey Date: 7/8/2019** | **Survey Crew: Joey Verdian, Ryley Tauzer, Ian Pryor** | | |
| | | **Category** | **"x" indicates the assigned value** | | |
| **Upper Banks** | 1 | Landform slope | Bank slope gradient <30% | 2 | |
| | | | Bank slope gradient 30-40% | 4 | |
| | | | Bank slope gradient 40-60% | 6 | x |
| | | | Bank slope gradient 60+% | 8 | |
| | 2 | Mass wasting | No evidence of past or future mass wasting | 3 | |
| | | | Infrequent. Most likely healed over. Low future potential | 6 | x |
| | | | Frequent or large, causing sediment nearly year long | 9 | |
| | | | Frequent or large causing sediment nearly year long or imminent danger of same | 12 | |
| | 3 | Debris jam potential | Essentially absent from immediate channel area | 2 | |
| | | | Present, but mostly small twigs and limbs | 4 | |
| | | | Moderate to heavy amounts, mostly larger sizes | 6 | |
| | | | Moderate to heavy amounts, predominately lager sizes | 8 | x |
| | 4 | Vegetative bank protection | 90%+ plant density. Vigor and variety suggest a deep, dense soil binding root mass | 3 | |
| | | | 70-90% density. Fewer species or less vigor suggest less dense or deep root mass | 6 | |
| | | | <50-70% density. Lower vigor and fewer species from a shallow, discontinuous root mass | 9 | x |
| | | | <50% density, fewer species and less vigor indicate poor, discontinuous and shallow root mass | 12 | |
| **Lower Banks** | 5 | Channel capacity | Ample for present plus some increases. Peak flows contained. W/D ration <7 | 1 | |
| | | | Adequate. Bank overflows rare. W/D ratio 8-15 | 2 | |
| | | | Barely contains present peaks. Occasional overbank floods. W/D ratio 15 to 25 | 3 | |
| | | | Inadequate. Overbank flows common. W/D ratio >25 | 4 | x |
| | 6 | Bank rock content | 65%+ with large angular boulders. 12"+ common. | 2 | |
| | | | 40-65%. Mostly small boulders to cobbles 6-12" | 4 | |
| | | | 20-40%. With most in the 3-6" diameter class | 6 | |
| | | | 20% rock fragments of gravel sizes, 1-3" or less | 8 | x |
| | 7 | Obstructions to flow | Rocks and logs firmly embedded. Flow pattern w/out cutting or deposition. Stable Bed | 2 | |
| | | | Some present causing erosive cross currents and minor pool filling. Obstructions newer and less firm | 4 | |
| | | | Moderately frequent, unstable obstructions move with high flows causing bank cutting and pool filling | 6 | x |
| | | | Sediment traps full, channel migration occurring | | |
| | 8 | Cutting | Little or none. Infrequent raw banks less than 6" | 4 | |
| | | | Some, intermittently at outcurves and constrictions. Raw banks may be up to 12" | 6 | x |
| | | | Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident | 12 | |

| | | | | | |
|---|---|---|---|---|---|
| | | | Almost continuous cuts, some over 24" high. Failure of overhangs frequent | 16 | |
| | | | Little or no enlargement of channel or point bars | 4 | x |
| | | | Some new bar increase, mostly from coarse gravel | 8 | |
| | | | Moderate deposition of new gravel and course sand on old and some new bars | 12 | |
| | | | Extensive deposits of predominately fine particles. Accelerated bar development | 16 | |
| **Bottom** | 10 | Rock angularity | Sharp edges and corners. Plane surfaces rough. | 1 | |
| | | | Rounded corners and edges, surfaces smooth, flat | 2 | |
| | | | Corners and edges well rounded in two dimensions | 3 | |
| | | | Well rounded in all dimensions, surfaces smooth | 4 | x |
| | 11 | Brightness | Surfaces dull, dark, or stained. Generally not bright | 1 | |
| | | | Mostly dull, but may have <35% bright surfaces | 2 | |
| | | | Mixture dull and bright, ie 35-65% mixture range | 3 | |
| | | | Predominately bright, 65% exposed or scoured surfaces | 4 | x |
| | 12 | Consolidation of particles | Assorted sizes tightly packed or overlapping | 2 | |
| | | | Moderately packed with some overlapping | 4 | |
| | | | Mostly loose assortment with no apparent overlap | 6 | x |
| | | | No packing evident. Loose assortment easily moved | 8 | |
| | 13 | Bottom size distribution | No size change evident. Stable mater. 80-100% | 4 | x |
| | | | Distribution shift light. Stable material 50-80% | 8 | |
| | | | Moderate changes in sizes. Stable materials 20-50% | 12 | |
| | | | Marked distribution change. Stable materials 0-20% | 16 | |
| | 14 | Scouring and deposition | <5% of bottom affected by scour or deposition | 6 | |
| | | | 5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools | 12 | |
| | | | 30-50% affected. Deposits and scour at obstructions, constrictions, and bends. Some filling of pools | 18 | |
| | | | More than 50% of the bottom in a state of flux or change nearly year long | 24 | x |
| | 15 | Aquatic vegetation | Abundant growth moss-like, dark green perennial. In swift water too. | 1 | |
| | | | Common. Algae forms in low velocity and pool areas. Moss here too | 2 | x |
| | | | Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick | 3 | |
| | | | Perennial types scare or absent. Yellow-green, short term bloom may be present | 4 | |

**Score guidelines:** <38 Excellent, 39-76 Good, 77-114 Fair, >114 Poor
**Score:** 101 (Fair)

## Gerle Creek Below Loon Lake Dam
## Middle Reach (Site LLD-G2)

| Survey Date: 8/7/2019 Survey Crew: Ryley Tauzer, Joey Verdian, Chris Lyle | | | | | |
|---|---|---|---|---|---|
| | | **Category** | **“x” indicates the assigned value** | | |
| **Upper Banks** | 1 | Landform slope | Bank slope gradient <30% | 2 | |
| | | | Bank slope gradient 30-40% | 4 | x |
| | | | Bank slope gradient 40-60% | 6 | |
| | | | Bank slope gradient 60+% | 8 | |
| | 2 | Mass wasting | No evidence of past or future mass wasting | 3 | |
| | | | Infrequent. Most likely healed over. Low future potential | 6 | x |
| | | | Frequent or large, causing sediment nearly year long | 9 | |
| | | | Frequent or large causing sediment nearly year long or imminent danger of same | 12 | |
| | 3 | Debris jam potential | Essentially absent from immediate channel area | 2 | |
| | | | Present, but mostly small twigs and limbs | 4 | x |
| | | | Moderate to heavy amounts, mostly larger sizes | 6 | |
| | | | Moderate to heavy amounts, predominately lager sizes | 8 | |
| | 4 | Vegetative bank protection | 90%+ plant density. Vigor and variety suggest a deep, dense soil binding root mass | 3 | x |
| | | | 70-90% density. Fewer species or less vigor suggest less dense or deep root mass | 6 | |
| | | | <50-70% density. Lower vigor and fewer species from a shallow, discontinuous root mass | 9 | |
| | | | <50% density, fewer species and less vigor indicate poor, discontinuous and shallow root mass | 12 | |
| **Lower Banks** | 5 | Channel capacity | Ample for present plus some increases. Peak flows contained. W/D ration <7 | 1 | |
| | | | Adequate. Bank overflows rare. W/D ratio 8-15 | 2 | |
| | | | Barely contains present peaks. Occasional overbank floods. W/D ratio 15 to 25 | 3 | x |
| | | | Inadequate. Overbank flows common. W/D ratio >25 | 4 | |
| | 6 | Bank rock content | 65%+ with large angular boulders. 12”+ common. | 2 | x |
| | | | 40-65%. Mostly small boulders to cobbles 6-12” | 4 | |
| | | | 20-40%. With most in the 3-6” diameter class | 6 | |
| | | | 20% rock fragments of gravel sizes, 1-3” or less | 8 | |
| | 7 | Obstructions to flow | Rocks and logs firmly embedded. Flow pattern w/out cutting or deposition. Stable Bed | 2 | |
| | | | Some present causing erosive cross currents and minor pool filling. Obstructions newer and less firm | 4 | x |

| | | | | | |
|---|---|---|---|---|---|
| | | | Moderately frequent, unstable obstructions move with high flows causing bank cutting and pool filling | 6 | |
| | | | Sediment traps full, channel migration occurring | | |
| | 8 | Cutting | Little or none. Infrequent raw banks less than 6” | 4 | x |
| | | | Some, intermittently at outcurves and constrictions. Raw banks may be up to 12” | 6 | |
| | | | Significant. Cuts 12-24” high. Root mat overhangs and sloughing evident | 12 | |
| | | | Almost continuous cuts, some over 24” high. Failure of overhangs frequent | 16 | |
| | 9 | Deposition | Little or no enlargement of channel or point bars | 4 | x |
| | | | Some new bar increase, mostly from coarse gravel | 8 | |
| | | | Moderate deposition of new gravel and course sand on old and some new bars | 12 | |
| | | | Extensive deposits of predominately fine particles. Accelerated bar development | 16 | |
| **Bottom** | 10 | Rock angularity | Sharp edges and corners. Plane surfaces rough. | 1 | |
| | | | Rounded corners and edges, surfaces smooth, flat | 2 | |
| | | | Corners and edges well rounded in two dimensions | 3 | x |
| | | | Well rounded in all dimensions, surfaces smooth | 4 | |
| | 11 | Brightness | Surfaces dull, dark, or stained. Generally not bright | 1 | x |
| | | | Mostly dull, but may have <35% bright surfaces | 2 | |
| | | | Mixture dull and bright, ie 35-65% mixture range | 3 | |
| | | | Predominately bright, 65% exposed or scoured surfaces | 4 | |
| | 12 | Consolidation of particles | Assorted sizes tightly packed or overlapping | 2 | |
| | | | Moderately packed with some overlapping | 4 | x |
| | | | Mostly loose assortment with no apparent overlap | 6 | |
| | | | No packing evident. Loose assortment easily moved | 8 | |
| | 13 | Bottom size distribution | No size change evident. Stable mater. 80-100% | 4 | x |
| | | | Distribution shift light. Stable material 50-80% | 8 | |
| | | | Moderate changes in sizes. Stable materials 20-50% | 12 | |
| | | | Marked distribution change. Stable materials 0-20% | 16 | |
| | 14 | Scouring and deposition | <5% of bottom affected by scour or deposition | 6 | x |
| | | | 5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools | 12 | |

| | | | | | |
|---|---|---|---|---|---|
| | | | 30-50% affected. Deposits and scour at obstructions, constrictions, and bends. Some filling of pools | 18 | |
| | | | More than 50% of the bottom in a state of flux or change nearly year long | 24 | |
| | 15 | Aquatic vegetation | Abundant growth moss-like, dark green perennial. In swift water too. | 1 | |
| | | | Common. Algae forms in low velocity and pool areas. Moss here too | 2 | |
| | | | Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick | 3 | |
| | | | Perennial types scare or absent. Yellow-green, short term bloom may be present | 4 | x |

**Score guidelines:** <38 Excellent, 39-76 Good, 77-114 Fair, >114 Poor
**Score:** 56 (Good)

## South Fork Silver Creek Below Ice House Reservoir
## Upper Reach (Site IHD-G1)

| Survey Date: 8/8/2019 | | | Survey Crew: Ryley Tauzer, Chris Lyle, Joey Verdian | | |
|---|---|---|---|---|---|
| | | **Category** | **"x" indicates the assigned value** | | |
| **Upper Banks** | 1 | Landform slope | Bank slope gradient <30% | 2 | x |
| | | | Bank slope gradient 30-40% | 4 | |
| | | | Bank slope gradient 40-60% | 6 | |
| | | | Bank slope gradient 60+% | 8 | |
| | 2 | Mass wasting | No evidence of past or future mass wasting | 3 | |
| | | | Infrequent. Most likely healed over. Low future potential | 6 | x |
| | | | Frequent or large, causing sediment nearly year long | 9 | |
| | | | Frequent or large causing sediment nearly year long or imminent danger of same | 12 | |
| | 3 | Debris jam potential | Essentially absent from immediate channel area | 2 | |
| | | | Present, but mostly small twigs and limbs | 4 | |
| | | | Moderate to heavy amounts, mostly larger sizes | 6 | x |
| | | | Moderate to heavy amounts, predominately lager sizes | 8 | |
| | 4 | Vegetative bank protection | 90%+ plant density. Vigor and variety suggest a deep, dense soil binding root mass | 3 | x |
| | | | 70-90% density. Fewer species or less vigor suggest less dense or deep root mass | 6 | |
| | | | <50-70% density. Lower vigor and fewer species from a shallow, discontinuous root mass | 9 | |
| | | | <50% density, fewer species and less vigor indicate poor, discontinuous and shallow root mass | 12 | |
| **Lower Banks** | 5 | Channel capacity | Ample for present plus some increases. Peak flows contained. W/D ration <7 | 1 | |
| | | | Adequate. Bank overflows rare. W/D ratio 8-15 | 2 | |
| | | | Barely contains present peaks. Occasional overbank floods. W/D ratio 15 to 25 | 3 | |
| | | | Inadequate. Overbank flows common. W/D ratio >25 | 4 | |
| | 6 | Bank rock content | 65%+ with large angular boulders. 12"+ common. | 2 | x |
| | | | 40-65%. Mostly small boulders to cobbles 6-12" | 4 | |
| | | | 20-40%. With most in the 3-6" diameter class | 6 | |
| | | | 20% rock fragments of gravel sizes, 1-3" or less | 8 | x |
| | 7 | Obstructions to flow | Rocks and logs firmly embedded. Flow pattern w/out cutting or deposition. Stable Bed | 2 | |
| | | | Some present causing erosive cross currents and minor pool filling. Obstructions newer and less firm | 4 | x |
| | | | Moderately frequent, unstable obstructions move with high flows causing bank cutting and pool filling | 6 | |
| | | | Sediment traps full, channel migration occurring | | |
| | 8 | Cutting | Little or none. Infrequent raw banks less than 6" | 4 | x |
| | | | Some, intermittently at outcurves and constrictions. Raw banks may be up to 12" | 6 | |
| | | | Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident | 12 | |

| | | | | | |
|---|---|---|---|---|---|
| | | | Almost continuous cuts, some over 24” high. Failure of overhangs frequent | 16 | |
| | 9 | Deposition | Little or no enlargement of channel or point bars | 4 | |
| | | | Some new bar increase, mostly from coarse gravel | 8 | |
| | | | Moderate deposition of new gravel and course sand on old and some new bars | 12 | x |
| | | | Extensive deposits of predominately fine particles. Accelerated bar development | 16 | |
| Bottom | 10 | Rock angularity | Sharp edges and corners. Plane surfaces rough. | 1 | |
| | | | Rounded corners and edges, surfaces smooth, flat | 2 | |
| | | | Corners and edges well rounded in two dimensions | 3 | x |
| | | | Well rounded in all dimensions, surfaces smooth | 4 | |
| | 11 | Brightness | Surfaces dull, dark, or stained. Generally not bright | 1 | |
| | | | Mostly dull, but may have <35% bright surfaces | 2 | |
| | | | Mixture dull and bright, ie 35-65% mixture range | 3 | x |
| | | | Predominately bright, 65% exposed or scoured surfaces | 4 | |
| | 12 | Consolidation of particles | Assorted sizes tightly packed or overlapping | 2 | |
| | | | Moderately packed with some overlapping | 4 | |
| | | | Mostly loose assortment with no apparent overlap | 6 | x |
| | | | No packing evident. Loose assortment easily moved | 8 | |
| | 13 | Bottom size distribution | No size change evident. Stable mater. 80-100% | 4 | |
| | | | Distribution shift light. Stable material 50-80% | 8 | |
| | | | Moderate changes in sizes. Stable materials 20-50% | 12 | |
| | | | Marked distribution change. Stable materials 0-20% | 16 | |
| | 14 | Scouring and deposition | <5% of bottom affected by scour or deposition | 6 | x |
| | | | 5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools | 12 | |
| | | | 30-50% affected. Deposits and scour at obstructions, constrictions, and bends. Some filling of pools | 18 | |
| | | | More than 50% of the bottom in a state of flux or change nearly year long | 24 | x |
| | 15 | Aquatic vegetation | Abundant growth moss-like, dark green perennial. In swift water too. | 1 | |
| | | | Common. Algae forms in low velocity and pool areas. Moss here too | 2 | |
| | | | Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick | 3 | |
| | | | Perennial types scare or absent. Yellow-green, short term bloom may be present | 4 | x |

**Score guidelines:** <38 Excellent, 39-76 Good, 77-114 Fair, >114 Poor
**Score:** 105 (Fair)

## South Fork Silver Creek Below Ice House Reservoir
## Lower Reach (Site IHD-G2)

| | | Survey Date: 8/9/2019 | Survey Crew: Chris Lyle, Joey Verdian, Ryley Tauzer | | |
|---|---|---|---|---|---|
| | | **Category** | **"x" indicates the assigned value** | | |
| **Upper Banks** | 1 | Landform slope | Bank slope gradient <30% | 2 | |
| | | | Bank slope gradient 30-40% | 4 | x |
| | | | Bank slope gradient 40-60% | 6 | |
| | | | Bank slope gradient 60+% | 8 | |
| | 2 | Mass wasting | No evidence of past or future mass wasting | 3 | x |
| | | | Infrequent. Most likely healed over. Low future potential | 6 | |
| | | | Frequent or large, causing sediment nearly year long | 9 | |
| | | | Frequent or large causing sediment nearly year long or imminent danger of same | 12 | |
| | 3 | Debris jam potential | Essentially absent from immediate channel area | 2 | x |
| | | | Present, but mostly small twigs and limbs | 4 | |
| | | | Moderate to heavy amounts, mostly larger sizes | 6 | |
| | | | Moderate to heavy amounts, predominately lager sizes | 8 | |
| | 4 | Vegetative bank protection | 90%+ plant density. Vigor and variety suggest a deep, dense soil binding root mass | 3 | |
| | | | 70-90% density. Fewer species or less vigor suggest less dense or deep root mass | 6 | x |
| | | | <50-70% density. Lower vigor and fewer species from a shallow, discontinuous root mass | 9 | |
| | | | <50% density, fewer species and less vigor indicate poor, discontinuous and shallow root mass | 12 | |
| **Lower Banks** | 5 | Channel capacity | Ample for present plus some increases. Peak flows contained. W/D ration <7 | 1 | x |
| | | | Adequate. Bank overflows rare. W/D ratio 8-15 | 2 | |
| | | | Barely contains present peaks. Occasional overbank floods. W/D ratio 15 to 25 | 3 | |
| | | | Inadequate. Overbank flows common. W/D ratio >25 | 4 | |
| | 6 | Bank rock content | 65%+ with large angular boulders. 12"+ common. | 2 | |
| | | | 40-65%. Mostly small boulders to cobbles 6-12" | 4 | x |
| | | | 20-40%. With most in the 3-6" diameter class | 6 | |
| | | | 20% rock fragments of gravel sizes, 1-3" or less | 8 | |
| | 7 | Obstructions to flow | Rocks and logs firmly embedded. Flow pattern w/out cutting or deposition. Stable Bed | 2 | x |
| | | | Some present causing erosive cross currents and minor pool filling. Obstructions newer and less firm | 4 | |
| | | | Moderately frequent, unstable obstructions move with high flows causing bank cutting and pool filling | 6 | |
| | | | Sediment traps full, channel migration occurring | | |
| | 8 | Cutting | Little or none. Infrequent raw banks less than 6" | 4 | x |
| | | | Some, intermittently at outcurves and constrictions. Raw banks may be up to 12" | 6 | |
| | | | Significant. Cuts 12-24" high. Root mat overhangs and sloughing evident | 12 | |

| | | | | | |
|---|---|---|---|---|---|
| | | | Almost continuous cuts, some over 24” high. Failure of overhangs frequent | 16 | |
| | 9 | Deposition | Little or no enlargement of channel or point bars | 4 | x |
| | | | Some new bar increase, mostly from coarse gravel | 8 | |
| | | | Moderate deposition of new gravel and course sand on old and some new bars | 12 | |
| | | | Extensive deposits of predominately fine particles. Accelerated bar development | 16 | |
| **Bottom** | 10 | Rock angularity | Sharp edges and corners. Plane surfaces rough. | 1 | |
| | | | Rounded corners and edges, surfaces smooth, flat | 2 | |
| | | | Corners and edges well rounded in two dimensions | 3 | x |
| | | | Well rounded in all dimensions, surfaces smooth | 4 | |
| | 11 | Brightness | Surfaces dull, dark, or stained. Generally not bright | 1 | x |
| | | | Mostly dull, but may have <35% bright surfaces | 2 | |
| | | | Mixture dull and bright, ie 35-65% mixture range | 3 | |
| | | | Predominately bright, 65% exposed or scoured surfaces | 4 | |
| | 12 | Consolidation of particles | Assorted sizes tightly packed or overlapping | 2 | |
| | | | Moderately packed with some overlapping | 4 | x |
| | | | Mostly loose assortment with no apparent overlap | 6 | |
| | | | No packing evident. Loose assortment easily moved | 8 | |
| | 13 | Bottom size distribution | No size change evident. Stable mater. 80-100% | 4 | x |
| | | | Distribution shift light. Stable material 50-80% | 8 | |
| | | | Moderate changes in sizes. Stable materials 20-50% | 12 | |
| | | | Marked distribution change. Stable materials 0-20% | 16 | |
| | 14 | Scouring and deposition | <5% of bottom affected by scour or deposition | 6 | |
| | | | 5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools | 12 | x |
| | | | 30-50% affected. Deposits and scour at obstructions, constrictions, and bends. Some filling of pools | 18 | |
| | | | More than 50% of the bottom in a state of flux or change nearly year long | 24 | |
| | 15 | Aquatic vegetation | Abundant growth moss-like, dark green perennial. In swift water too. | 1 | |
| | | | Common. Algae forms in low velocity and pool areas. Moss here too | 2 | |
| | | | Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick | 3 | |
| | | | Perennial types scare or absent. Yellow-green, short term bloom may be present | 4 | x |

**Score guidelines:** <38 Excellent, 39-76 Good, 77-114 Fair, >114 Poor
**Score:** 52 (Good)

## Silver Creek Below Camino Dam
## (Site CD-G1)

| | | | | | |
|---|---|---|---|---|---|
| | | **Survey Date: 8/6/2019** | **Survey Crew: Joey Verdian, Chris Lyle, Ryley Tauzer** | | |
| | | **Category** | **“x” indicates the assigned value** | | |
| **Upper Banks** | 1 | Landform slope | Bank slope gradient <30% | 2 | |
| | | | Bank slope gradient 30-40% | 4 | x |

| | | | | | |
|---|---|---|---|---|---|
| | | | Bank slope gradient 40-60% | 6 | |
| | | | Bank slope gradient 60+% | 8 | |
| | 2 | Mass wasting | No evidence of past or future mass wasting | 3 | |
| | | | Infrequent. Most likely healed over. Low future potential | 6 | x |
| | | | Frequent or large, causing sediment nearly year long | 9 | |
| | | | Frequent or large causing sediment nearly year long or imminent danger of same | 12 | |
| | 3 | Debris jam potential | Essentially absent from immediate channel area | 2 | |
| | | | Present, but mostly small twigs and limbs | 4 | x |
| | | | Moderate to heavy amounts, mostly larger sizes | 6 | |
| | | | Moderate to heavy amounts, predominately lager sizes | 8 | |
| | 4 | Vegetative bank protection | 90%+ plant density. Vigor and variety suggest a deep, dense soil binding root mass | 3 | |
| | | | 70-90% density. Fewer species or less vigor suggest less dense or deep root mass | 6 | |
| | | | <50-70% density. Lower vigor and fewer species from a shallow, discontinuous root mass | 9 | |
| | | | <50% density, fewer species and less vigor indicate poor, discontinuous and shallow root mass | 12 | x |
| **Lower Banks** | 5 | Channel capacity | Ample for present plus some increases. Peak flows contained. W/D ration <7 | 1 | x |
| | | | Adequate. Bank overflows rare. W/D ratio 8-15 | 2 | |
| | | | Barely contains present peaks. Occasional overbank floods. W/D ratio 15 to 25 | 3 | |
| | | | Inadequate. Overbank flows common. W/D ratio >25 | 4 | |
| | 6 | Bank rock content | 65%+ with large angular boulders. 12”+ common. | 2 | x |
| | | | 40-65%. Mostly small boulders to cobbles 6-12” | 4 | |
| | | | 20-40%. With most in the 3-6” diameter class | 6 | |
| | | | 20% rock fragments of gravel sizes, 1-3” or less | 8 | |
| | 7 | Obstructions to flow | Rocks and logs firmly embedded. Flow pattern w/out cutting or deposition. Stable Bed | 2 | x |
| | | | Some present causing erosive cross currents and minor pool filling. Obstructions newer and less firm | 4 | |
| | | | Moderately frequent, unstable obstructions move with high flows causing bank cutting and pool filling | 6 | |
| | | | Sediment traps full, channel migration occurring | | |
| | 8 | Cutting | Little or none. Infrequent raw banks less than 6” | 4 | x |
| | | | Some, intermittently at outcurves and constrictions. Raw banks may be up to 12” | 6 | |
| | | | Significant. Cuts 12-24” high. Root mat overhangs and sloughing evident | 12 | |
| | | | Almost continuous cuts, some over 24” high. Failure of overhangs frequent | 16 | |
| | 9 | Deposition | Little or no enlargement of channel or point bars | 4 | x |
| | | | Some new bar increase, mostly from coarse gravel | 8 | |
| | | | Moderate deposition of new gravel and course sand on old and some new bars | 12 | |

| | | | | | |
|---|---|---|---|---|---|
| | | | Extensive deposits of predominately fine particles. Accelerated bar development | 16 | |
| Bottom | 10 | Rock angularity | Sharp edges and corners. Plane surfaces rough. | 1 | |
| | | | Rounded corners and edges, surfaces smooth, flat | 2 | x |
| | | | Corners and edges well rounded in two dimensions | 3 | |
| | | | Well rounded in all dimensions, surfaces smooth | 4 | |
| | 11 | Brightness | Surfaces dull, dark, or stained. Generally not bright | 1 | |
| | | | Mostly dull, but may have <35% bright surfaces | 2 | |
| | | | Mixture dull and bright, ie 35-65% mixture range | 3 | x |
| | | | Predominately bright, 65% exposed or scoured surfaces | 4 | |
| | 12 | Consolidation of particles | Assorted sizes tightly packed or overlapping | 2 | |
| | | | Moderately packed with some overlapping | 4 | x |
| | | | Mostly loose assortment with no apparent overlap | 6 | |
| | | | No packing evident. Loose assortment easily moved | 8 | |
| | 13 | Bottom size distribution | No size change evident. Stable mater. 80-100% | 4 | x |
| | | | Distribution shift light. Stable material 50-80% | 8 | |
| | | | Moderate changes in sizes. Stable materials 20-50% | 12 | |
| | | | Marked distribution change. Stable materials 0-20% | 16 | |
| | 14 | Scouring and deposition | <5% of bottom affected by scour or deposition | 6 | x |
| | | | 5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools | 12 | |
| | | | 30-50% affected. Deposits and scour at obstructions, constrictions, and bends. Some filling of pools | 18 | |
| | | | More than 50% of the bottom in a state of flux or change nearly year long | 24 | |
| | 15 | Aquatic vegetation | Abundant growth moss-like, dark green perennial. In swift water too. | 1 | |
| | | | Common. Algae forms in low velocity and pool areas. Moss here too | 2 | |
| | | | Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick | 3 | x |
| | | | Perennial types scare or absent. Yellow-green, short term bloom may be present | 4 | |

**Score guidelines:** <38 Excellent, 39-76 Good, 77-114 Fair, >114 Poor
**Score:** 61 (Good)

## South Fork American River Below Slab Creek Dam (Site SCD-G1)

| | | Survey Date: 7/15/2019 | Survey Crew: Ryley Tauzer, Joey Verdian, Ian Pryor | | |
|---|---|---|---|---|---|
| | | **Category** | **"x" indicates the assigned value** | | |
| Upper Banks | 1 | Landform slope | Bank slope gradient <30% | 2 | |
| | | | Bank slope gradient 30-40% | 4 | |
| | | | Bank slope gradient 40-60% | 6 | |
| | | | Bank slope gradient 60+% | 8 | x |
| | 2 | Mass wasting | No evidence of past or future mass wasting | 3 | |
| | | | Infrequent. Most likely healed over. Low future potential | 6 | x |
| | | | Frequent or large, causing sediment nearly year long | 9 | |

| | | | | | |
|---|---|---|---|---|---|
| | | | Frequent or large causing sediment nearly year long or imminent danger of same | 12 | |
| | 3 | Debris jam potential | Essentially absent from immediate channel area | 2 | x |
| | | | Present, but mostly small twigs and limbs | 4 | |
| | | | Moderate to heavy amounts, mostly larger sizes | 6 | |
| | | | Moderate to heavy amounts, predominately lager sizes | 8 | |
| | 4 | Vegetative bank protection | 90%+ plant density. Vigor and variety suggest a deep, dense soil binding root mass | 3 | |
| | | | 70-90% density. Fewer species or less vigor suggest less dense or deep root mass | 6 | |
| | | | <50-70% density. Lower vigor and fewer species from a shallow, discontinuous root mass | 9 | |
| | | | <50% density, fewer species and less vigor indicate poor, discontinuous and shallow root mass | 12 | x |
| **Lower Banks** | 5 | Channel capacity | Ample for present plus some increases. Peak flows contained. W/D ration <7 | 1 | x |
| | | | Adequate. Bank overflows rare. W/D ratio 8-15 | 2 | |
| | | | Barely contains present peaks. Occasional overbank floods. W/D ratio 15 to 25 | 3 | |
| | | | Inadequate. Overbank flows common. W/D ratio >25 | 4 | |
| | 6 | Bank rock content | 65%+ with large angular boulders. 12”+ common. | 2 | x |
| | | | 40-65%. Mostly small boulders to cobbles 6-12” | 4 | |
| | | | 20-40%. With most in the 3-6” diameter class | 6 | |
| | | | 20% rock fragments of gravel sizes, 1-3” or less | 8 | |
| | 7 | Obstructions to flow | Rocks and logs firmly embedded. Flow pattern w/out cutting or deposition. Stable Bed | 2 | x |
| | | | Some present causing erosive cross currents and minor pool filling. Obstructions newer and less firm | 4 | |
| | | | Moderately frequent, unstable obstructions move with high flows causing bank cutting and pool filling | 6 | |
| | | | Sediment traps full, channel migration occurring | | |
| | 8 | Cutting | Little or none. Infrequent raw banks less than 6” | 4 | x |
| | | | Some, intermittently at outcurves and constrictions. Raw banks may be up to 12” | 6 | |
| | | | Significant. Cuts 12-24” high. Root mat overhangs and sloughing evident | 12 | |
| | | | Almost continuous cuts, some over 24” high. Failure of overhangs frequent | 16 | |
| | 9 | Deposition | Little or no enlargement of channel or point bars | 4 | x |
| | | | Some new bar increase, mostly from coarse gravel | 8 | |
| | | | Moderate deposition of new gravel and course sand on old and some new bars | 12 | |
| | | | Extensive deposits of predominately fine particles. Accelerated bar development | 16 | |
| **Bottom** | 10 | Rock angularity | Sharp edges and corners. Plane surfaces rough. | 1 | |
| | | | Rounded corners and edges, surfaces smooth, flat | 2 | x |
| | | | Corners and edges well rounded in two dimensions | 3 | |
| | | | Well rounded in all dimensions, surfaces smooth | 4 | |
| | 11 | Brightness | Surfaces dull, dark, or stained. Generally not bright | 1 | |
| | | | Mostly dull, but may have <35% bright surfaces | 2 | |

| | | | | | |
|---|---|---|---|---|---|
| | | | Mixture dull and bright, ie 35-65% mixture range | 3 | |
| | | | Predominately bright, 65% exposed or scoured surfaces | 4 | x |
| | 12 | Consolidation of particles | Assorted sizes tightly packed or overlapping | 2 | |
| | | | Moderately packed with some overlapping | 4 | x |
| | | | Mostly loose assortment with no apparent overlap | 6 | |
| | | | No packing evident. Loose assortment easily moved | 8 | |
| | 13 | Bottom size distribution | No size change evident. Stable mater. 80-100% | 4 | x |
| | | | Distribution shift light. Stable material 50-80% | 8 | |
| | | | Moderate changes in sizes. Stable materials 20-50% | 12 | |
| | | | Marked distribution change. Stable materials 0-20% | 16 | |
| | 14 | Scouring and deposition | <5% of bottom affected by scour or deposition | 6 | x |
| | | | 5-30% affected. Scour at constrictions and where grades steepen. Some deposition in pools | 12 | |
| | | | 30-50% affected. Deposits and scour at obstructions, constrictions, and bends. Some filling of pools | 18 | |
| | | | More than 50% of the bottom in a state of flux or change nearly year long | 24 | |
| | 15 | Aquatic vegetation | Abundant growth moss-like, dark green perennial. In swift water too. | 1 | |
| | | | Common. Algae forms in low velocity and pool areas. Moss here too | 2 | |
| | | | Present but spotty, mostly in backwater. Seasonal algae growth makes rocks slick | 3 | x |
| | | | Perennial types scare or absent. Yellow-green, short term bloom may be present | 4 | |

**Score guidelines:** <38 Excellent, 39-76 Good, 77-114 Fair, >114 Poor
**Score:** 64 (Good)

# APPENDIX E1

## 2019 Riparian Site Photos

**Figure E1-1. Representative photo of Site LLD-RV17.**

**Figure E1-2. Representative photo of Site LLD-RV10.**

**Figure E1-3. Representative photo of Site LLD-RV3.**

**Figure E1-4. Representative photo of Site GCD-RV1.**

**Figure E1-5. Representative photo of Site IHD-RV5.**

**Figure E1-6. Representative photo of Site IHD-RV1.**

**Figure E1-7. Representative photo of Site CD-RV4.**

**Figure E1-8. Representative photo of Site SCD-RV5.**

**Figure E1-9. Representative photo of Site SCD-RV3.**

**Figure E1-10. Representative photo of Site SCD-RV1.**

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# APPENDIX E2

## 2019 Riparian Vegetation Map

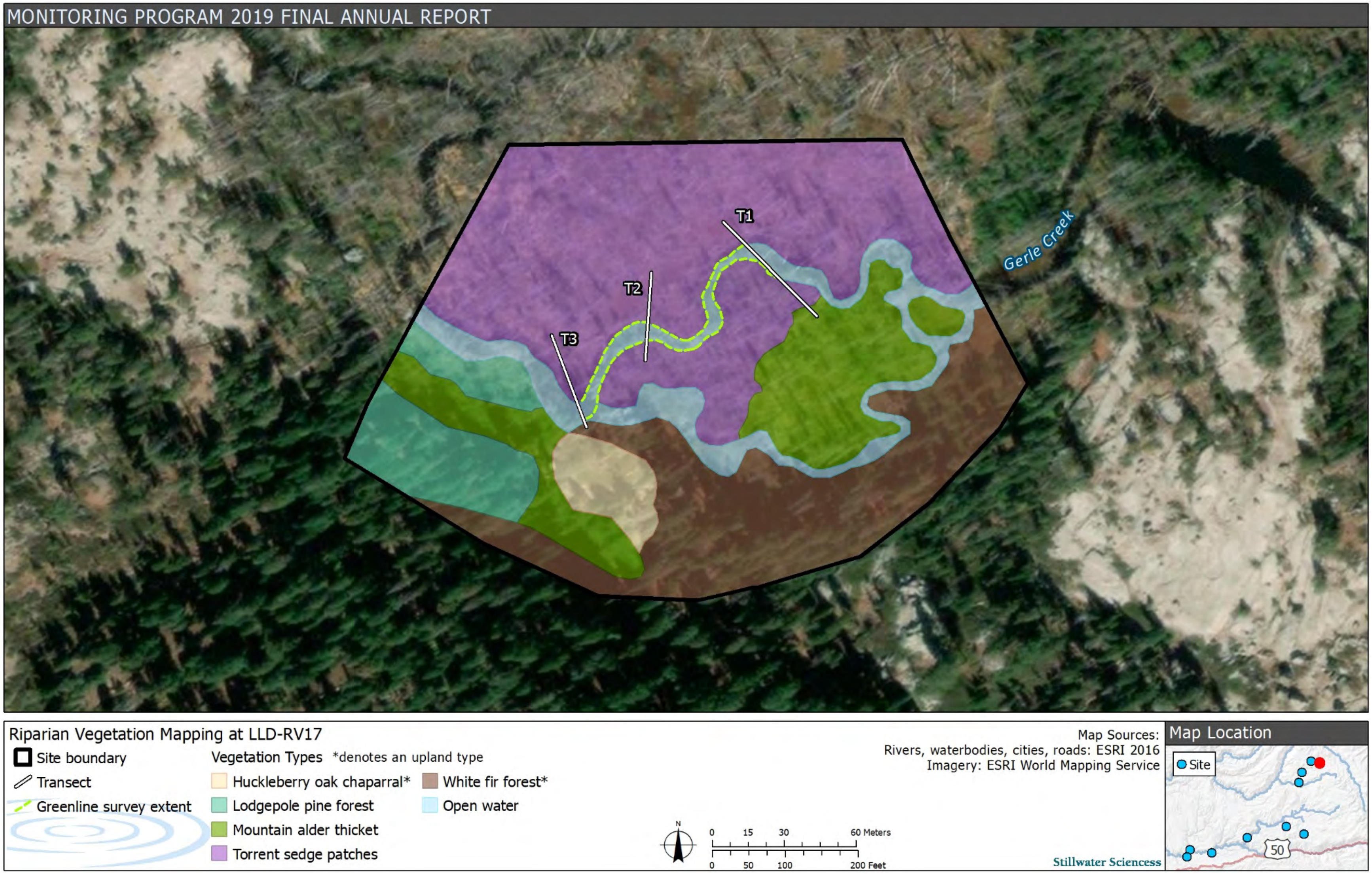


**Figure E2-1. Vegetation mapping, greenline survey extent, and location of riparian transects at Site LLD-RV17.**

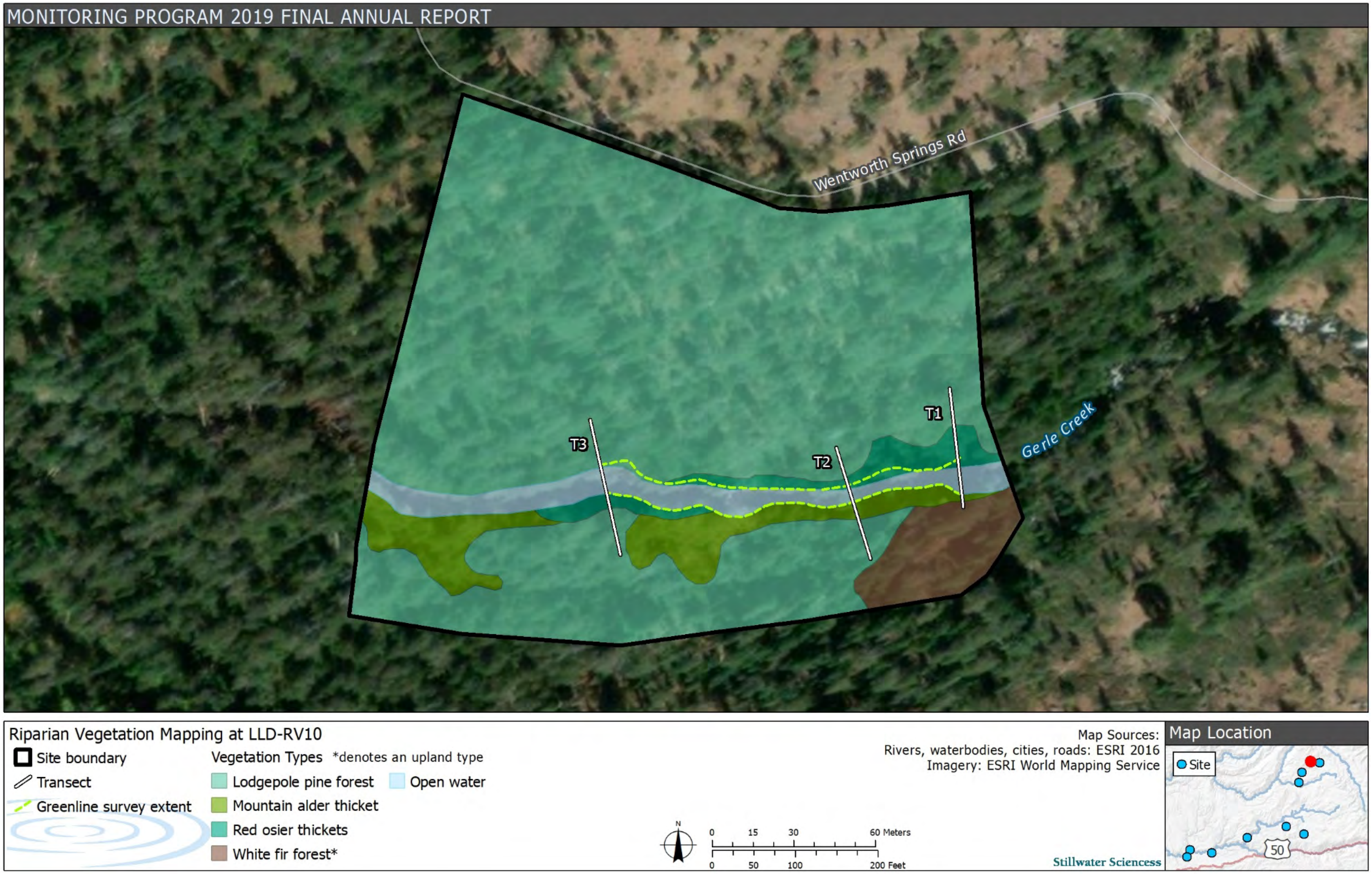


**Figure E2-2. Vegetation mapping, greenline survey extent, and location of riparian transects at Site LLD-RV10.**

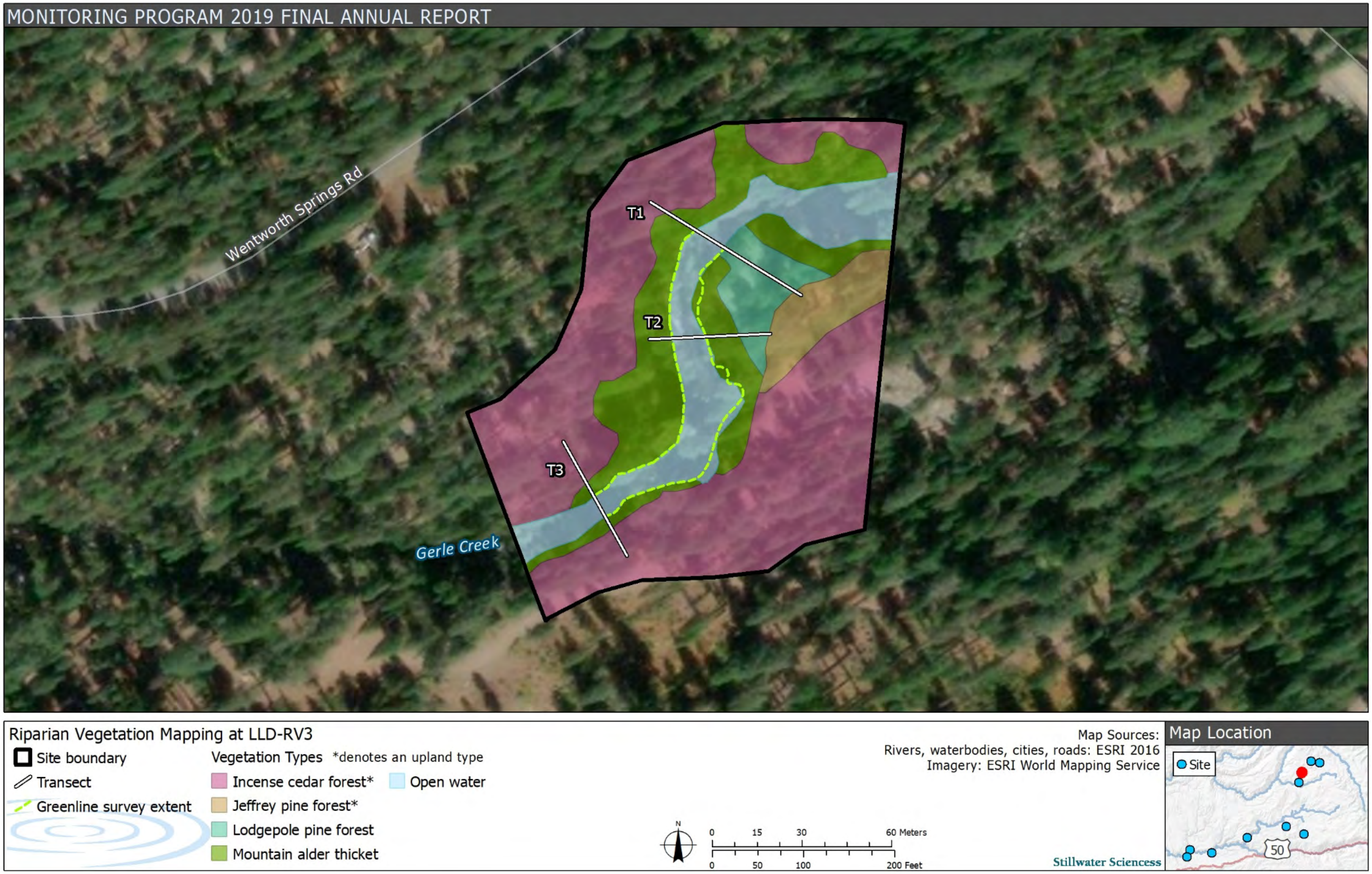


**Figure E2-3. Vegetation mapping, greenline survey extent, and location of riparian transects at Site LLD-RV3.**

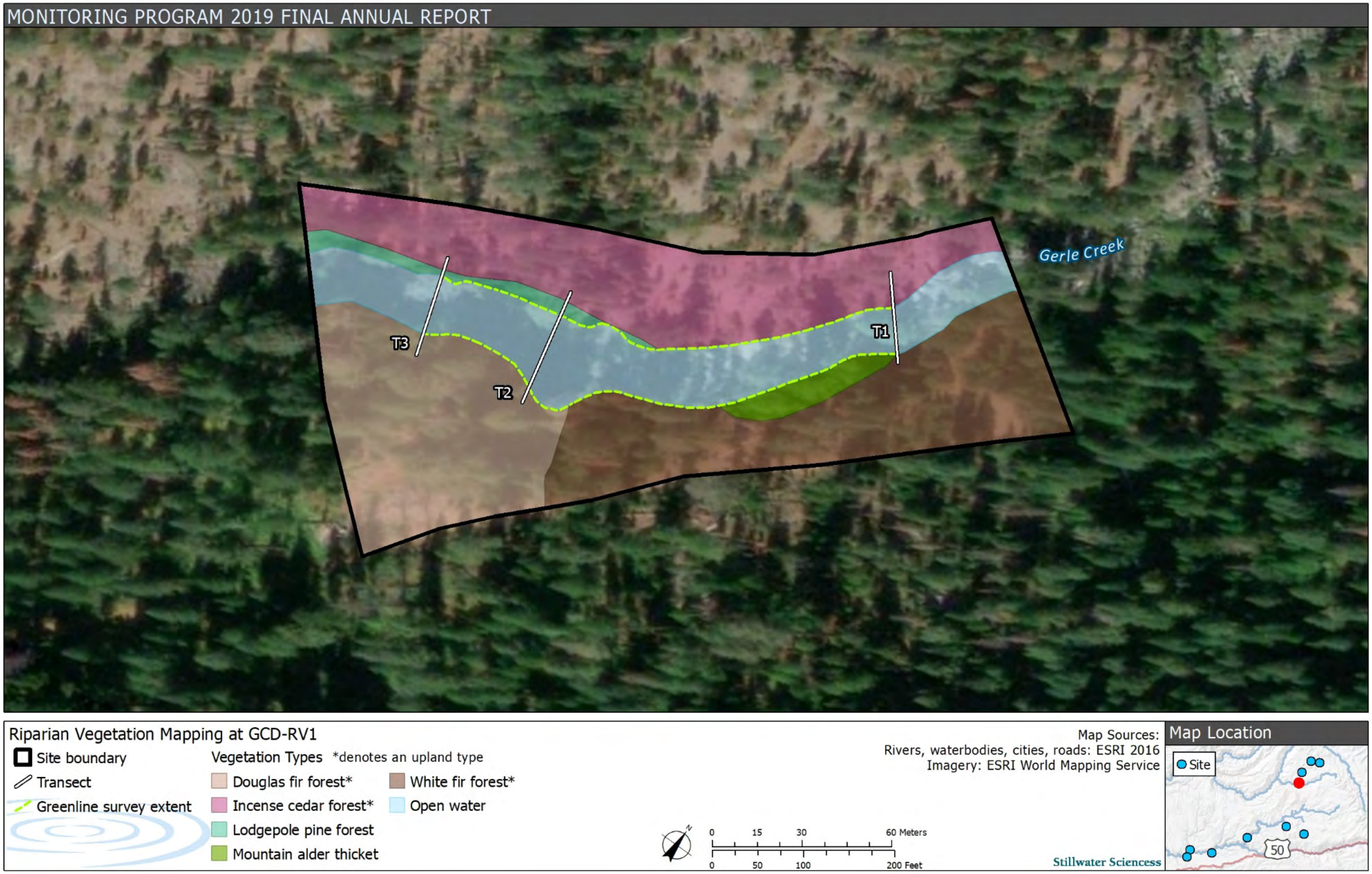


**Figure E2-4. Vegetation mapping, greenline survey extent, and location of riparian transects at Site GCD-RV1.**

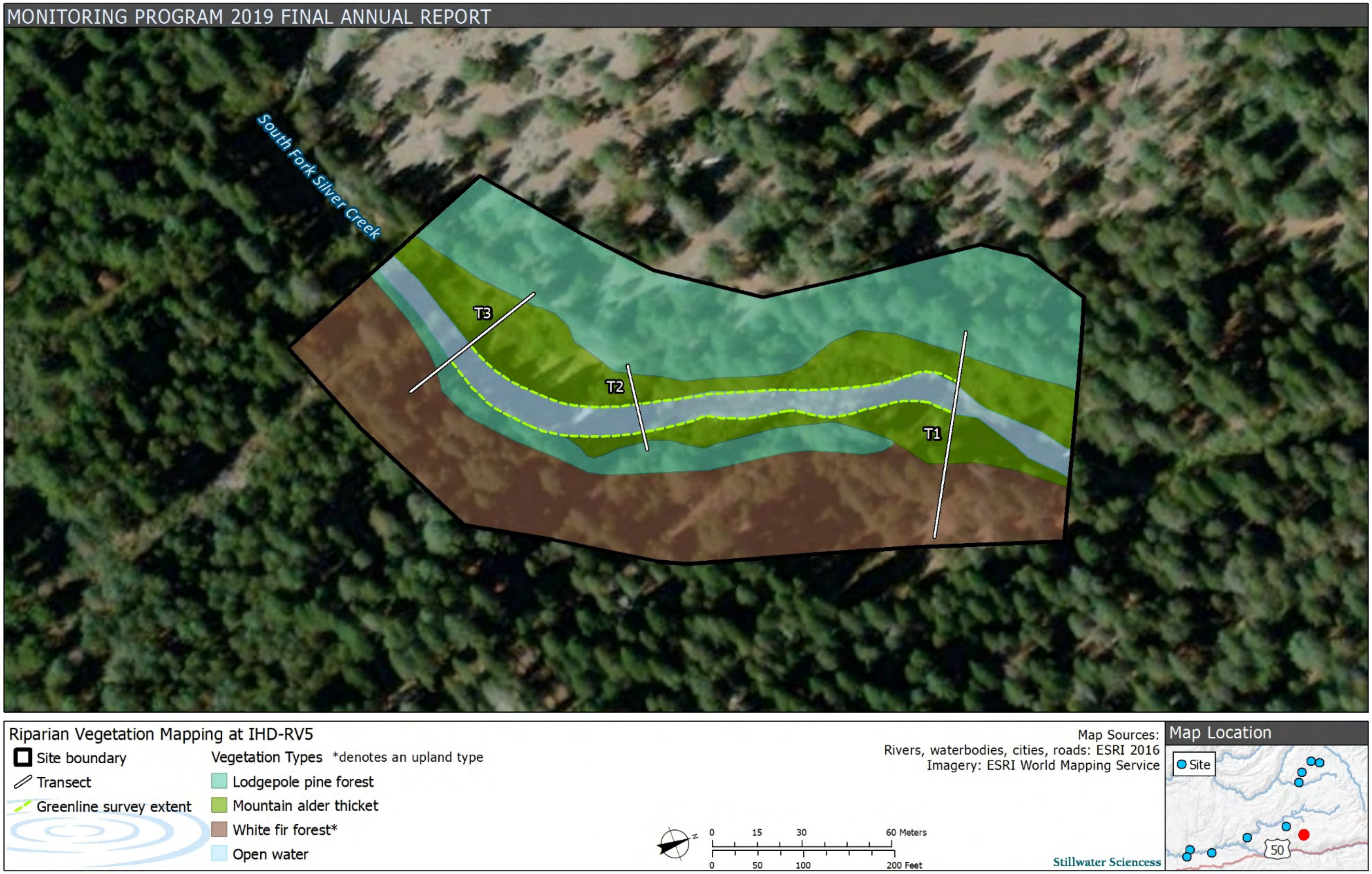


**Figure E2-5. Vegetation mapping, greenline survey extent, and location of riparian transects at Site IHD-RV5.**

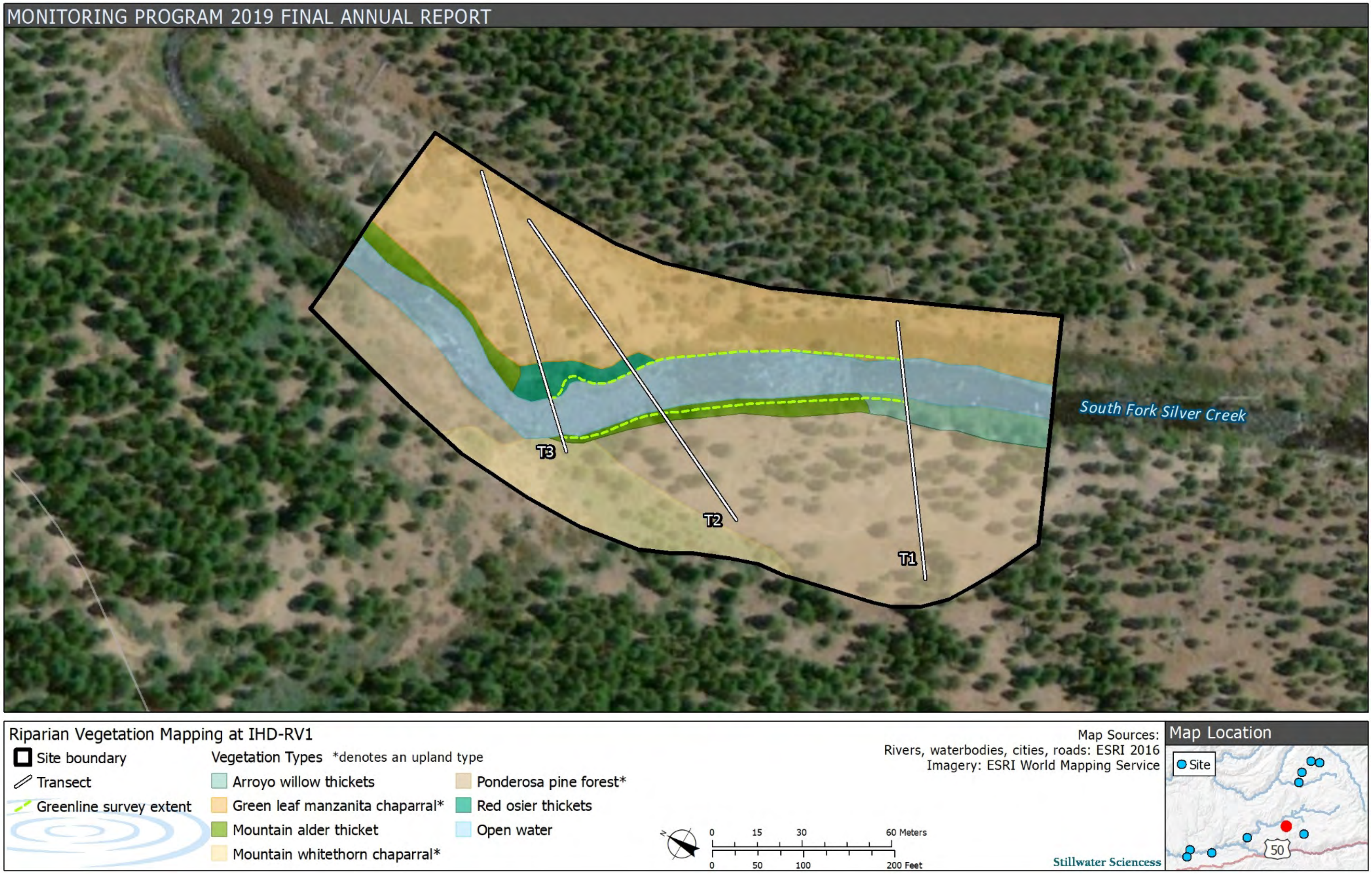


**Figure E2-6. Vegetation mapping, greenline survey extent, and location of riparian transects at Site IHD-RV1.**

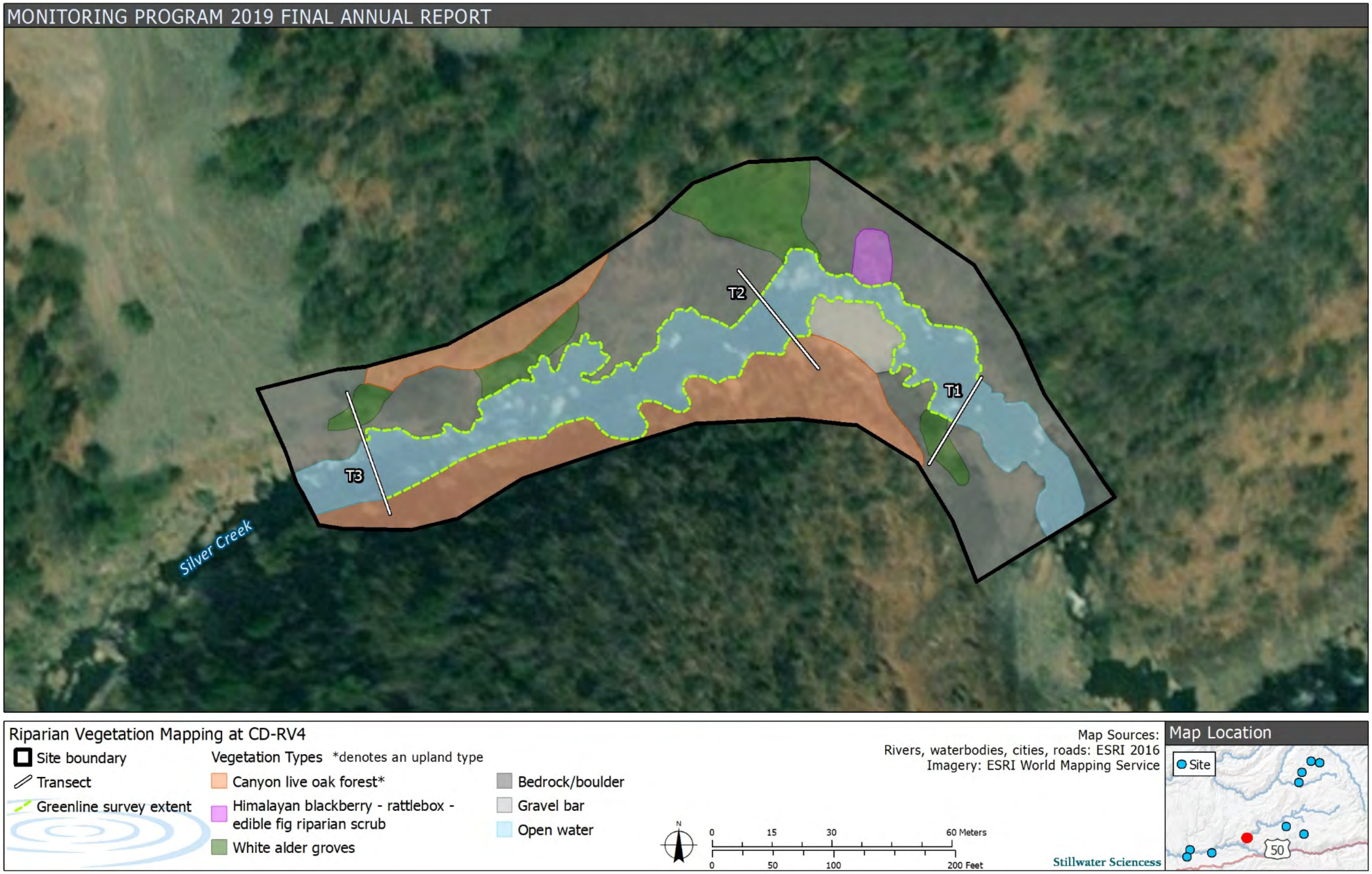


**Figure E2-7. Vegetation mapping, greenline survey extent, and location of riparian transects at Site CD-RV4.**

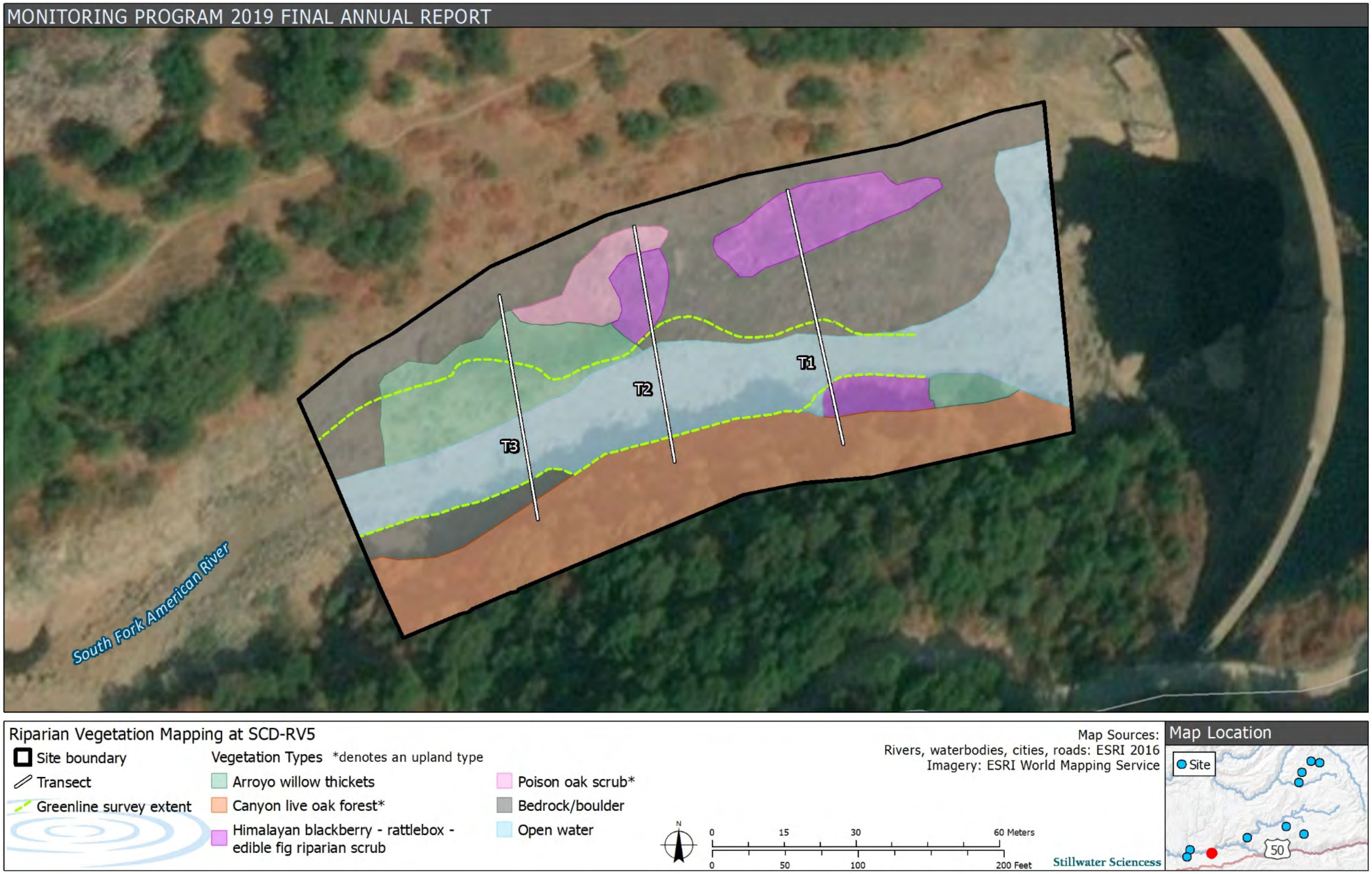


**Figure E2-8. Vegetation mapping, greenline survey extent, and location of riparian transects at Site SCD-RV5.**

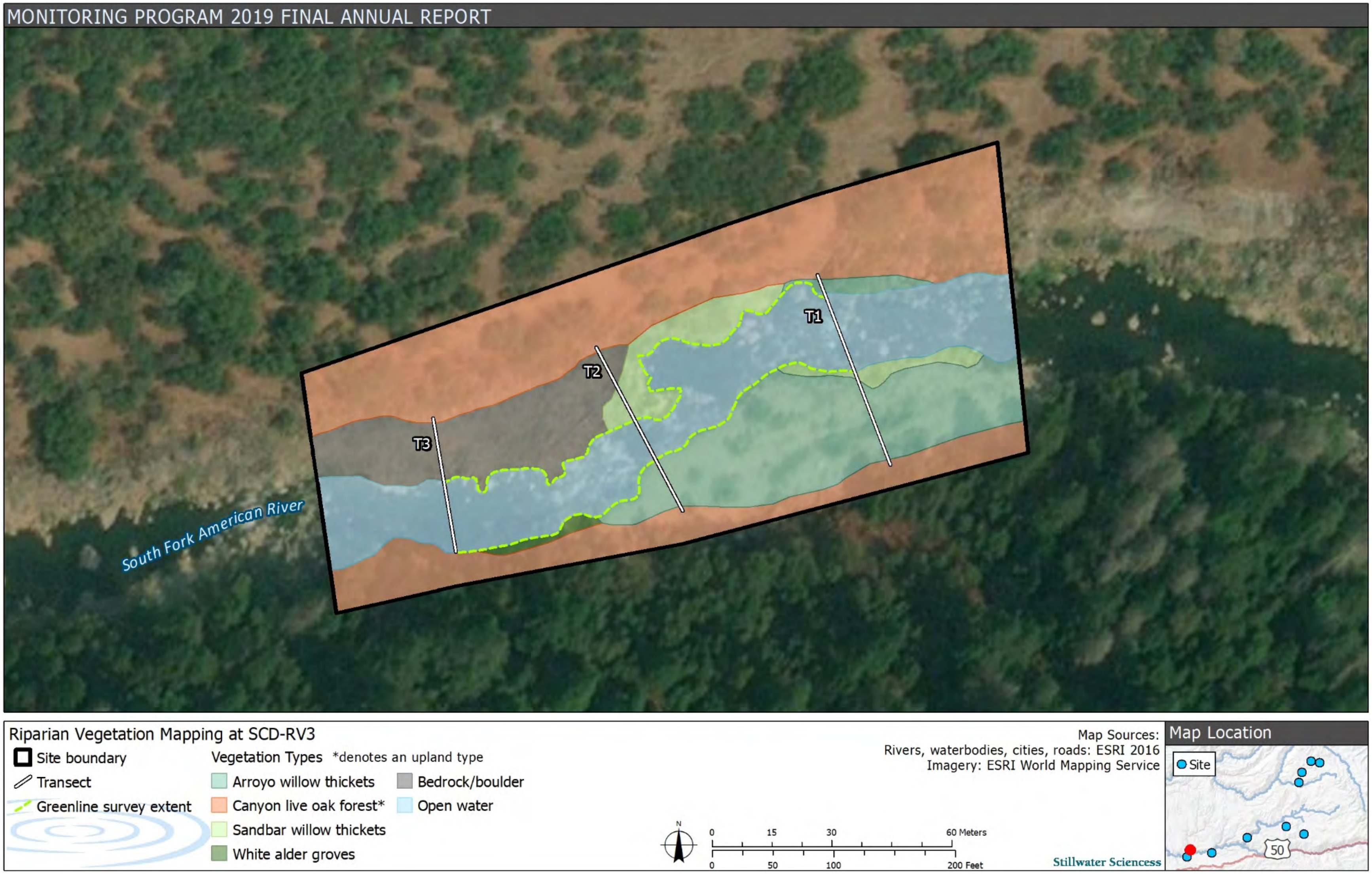


**Figure E2-9. Vegetation mapping, greenline survey extent, and location of riparian transects at Site SCD-RV3.**

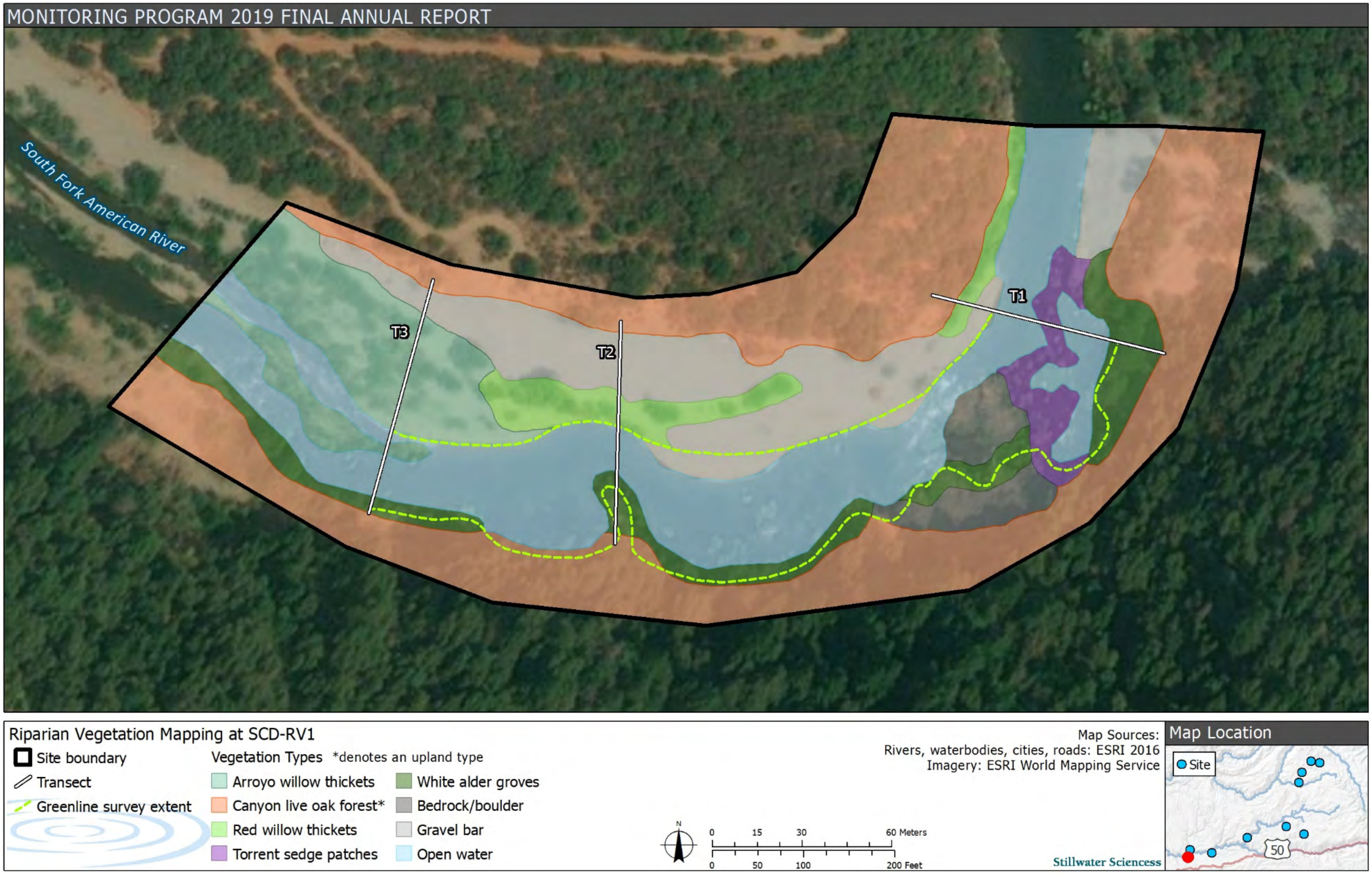


**Figure E2-10. Vegetation mapping, greenline survey extent, and location of riparian transects at Site SCD-RV1.**

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# APPENDIX E3

## 2019 Riparian Vegetation Line-point Intercept Results

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**Table E3-1. 2019 UARP Riparian Vegetation Line-Point Intercept Results for Nativity, Wetland Indicator Status, and Percent Relative Cover of Each Species by Canopy Class.**

| Site | Scientific name | Common name | Native? | Wetland indicator status[1] | < 1 m | | 1 to 5 m | | > 5 m | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Occurrences | Relative cover | Occurrences | Relative cover | Occurrences | Relative cover |
| LLD-RV17 | *Agrostis gigantea* | redtop | no | FACW | 1 | 2% | – | 0% | – | 0% |
| | *Alnus incana* subsp. *tenuifolia* | mountain alder | yes | FACW | 2 | 3% | 1 | 2% | | 0% |
| | *Calamagrostis canadensis* var. *canadensis* | bluejoint reed grass | yes | FACW | 1 | 2% | – | 0% | – | 0% |
| | *Carex nudata* | torrent sedge | yes | FACW | 33 | 55% | – | 0% | – | 0% |
| | *Carex utriculata* | southern beaked sedge | yes | OBL | 12 | 20% | – | 0% | – | 0% |
| | *Glyceria elata* | fowl manna grass | yes | OBL | 3 | 5% | – | 0% | – | 0% |
| | *Juncus effusus* | soft or lamp rush | yes | FACW | 1 | 2% | – | 0% | – | 0% |
| | *Juncus xiphioides* | iris-leaved rush | yes | OBL | 6 | 10% | – | 0% | – | 0% |
| | *Pteridium aquilinum* var. *pubescens* | hairy brackenfern | yes | FACU | 1 | 2% | – | 0% | – | 0% |
| LLD-RV10 | *Abies concolor* | white fir | yes | NL | 1 | 1% | 6 | 7% | 2 | 2% |
| | *Alnus incana* subsp. *tenuifolia* | mountain alder | yes | FACW | 14 | 17% | 20 | 25% | – | 0% |
| | *Anthoxanthum odoratum* | sweet vernal grass | no | FAC | 2 | 2% | – | 0% | – | 0% |
| | *Athyrium filix-femina* var. *cyclosorum* | subarctic ladyfern | yes | FAC | 2 | 2% | – | 0% | – | 0% |
| | *Calocedrus decurrens* | incense cedar | yes | NL | – | 0% | 6 | 7% | 3 | 4% |
| | *Cornus sericea* | American dogwood | yes | FACW | 29 | 36% | 28 | 35% | – | 0% |
| | *Hosackia oblongifolia* var. *oblongifolia* | streambank bird's-foot trefoil | yes | OBL | 7 | 9% | – | 0% | – | 0% |
| | *Juncus xiphioides* | iris-leaved rush | yes | OBL | 5 | 6% | – | 0% | – | 0% |
| | *Mentha pulegium* | pennyroyal | no | OBL | 2 | 2% | – | 0% | – | 0% |
| | *Pinus contorta* | lodgepole pine | yes | FAC | 1 | 1% | 25 | 31% | 37 | 46% |
| | *Pinus jeffreyi* | Jeffrey pine | yes | NL | – | 0% | – | 0% | 5 | 6% |
| | *Populus tremuloides* | quaking aspen | yes | FACU | – | 0% | 2 | 2% | 26 | 32% |
| | *Pseudotsuga menziesii* var. *menziesii* | Douglas-fir | yes | FACU | – | 0% | – | 0% | 4 | 5% |
| | *Quercus vacciniifolia* | huckleberry oak | yes | NL | 1 | 1% | – | 0% | – | 0% |
| | *Senecio triangularis* | arrowleaf ragwort | yes | FACW | 8 | 10% | 2 | 2% | – | 0% |
| | *Sidalcea glaucescens* | waxy checkerbloom | yes | NL | 1 | 1% | – | 0% | – | 0% |
| | *Spiraea splendens* | rose meadowsweet | yes | FAC | 3 | 4% | – | 0% | – | 0% |
| | *Vaccinium uliginosum* subsp. *occidentale* | western blueberry | yes | FACW | 1 | 1% | – | 0% | – | 0% |
| | *Veratrum californicum* var. *californicum* | California false hellebore | yes | FACW | 3 | 4% | – | 0% | – | 0% |
| | *Viola* sp. | violet | yes | unk | 1 | 1% | – | 0% | – | 0% |

| Site | Scientific name | Common name | Native? | Wetland indicator status[1] | < 1 m | | 1 to 5 m | | > 5 m | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Occurrences | Relative cover | Occurrences | Relative cover | Occurrences | Relative cover |
| LLD-RV3 | *Abies concolor* | white fir | yes | NL | 1 | 2% | 8 | 15% | 9 | 16% |
| | *Alnus incana* subsp. *tenuifolia* | mountain alder | yes | FACW | 4 | 7% | 15 | 27% | – | 0% |
| | *Anthoxanthum odoratum* | sweet vernal grass | no | FAC | 1 | 2% | – | 0% | – | 0% |
| | *Athyrium filix-femina* var. *cyclosorum* | subarctic ladyfern | yes | FAC | 1 | 2% | – | 0% | – | 0% |
| | *Calocedrus decurrens* | incense cedar | yes | NL | 5 | 9% | 6 | 11% | 21 | 38% |
| | *Carex nudata* | torrent sedge | yes | FACW | 4 | 7% | – | 0% | – | 0% |
| | *Cornus sericea* | American dogwood | yes | FACW | 4 | 7% | 3 | 5% | 0 | 0% |
| | *Equisetum arvense* | common horsetail | yes | FAC | 3 | 5% | – | 0% | – | 0% |
| | *Hosackia oblongifolia* var. *oblongifolia* | streambank bird's-foot trefoil | yes | OBL | 4 | 7% | – | 0% | – | 0% |
| | *Juncus xiphioides* | iris-leaved rush | yes | OBL | 4 | 7% | – | 0% | – | 0% |
| | *Mentha pulegium* | pennyroyal | no | OBL | 2 | 4% | – | 0% | – | 0% |
| | *Pinus contorta* | lodgepole pine | yes | FAC | 7 | 13% | 12 | 22% | 7 | 13% |
| | *Pinus jeffreyi* | Jeffrey pine | yes | NL | 2 | 4% | 7 | 13% | 5 | 9% |
| | *Pteridium aquilinum* var. *pubescens* | hairy brackenfern | yes | FACU | 5 | 9% | – | 0% | – | 0% |
| | *Quercus vacciniifolia* | huckleberry oak | yes | NL | 1 | 2% | – | 0% | – | 0% |
| | *Salix jepsonii* | Jepson's willow | yes | OBL | 1 | 2% | – | 0% | – | 0% |
| | *Scirpus diffusus* | umbrella bulrush | yes | FACW | 1 | 2% | – | 0% | – | 0% |
| | *Senecio triangularis* | arrowleaf ragwort | yes | FACW | 1 | 2% | – | 0% | – | 0% |
| | *Spiraea splendens* | rose meadowsweet | yes | FAC | 4 | 7% | – | 0% | – | 0% |

| Site | Scientific name | Common name | Native? | Wetland indicator status[1] | < 1 m | | 1 to 5 m | | > 5 m | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Occurrences | Relative cover | Occurrences | Relative cover | Occurrences | Relative cover |
| GCD-RV1 | *Abies concolor* | white fir | yes | NL | – | 0% | 4 | 13% | 6 | 18% |
| | *Alnus incana* subsp. *tenuifolia* | mountain alder | yes | FACW | 7 | 14% | 10 | 31% | 0 | 0% |
| | *Amelanchier utahensis* | Utah service-berry | yes | FACU | 1 | 2% | – | 0% | – | 0% |
| | *Boykinia occidentalis* | coastal brookfoam | yes | FAC | 3 | 6% | – | 0% | – | 0% |
| | *Calocedrus decurrens* | incense cedar | yes | NL | 0 | 0% | 6 | 19% | 1 | 3% |
| | *Carex nudata* | torrent sedge | yes | FACW | 4 | 8% | – | 0% | – | 0% |
| | *Cornus sericea* | American dogwood | yes | FACW | 3 | 6% | 2 | 6% | 0 | 0% |
| | *Darmera peltata* | Indian rhubarb | yes | OBL | 14 | 29% | 2 | 6% | – | 0% |
| | *Juncus xiphioides* | iris-leaved rush | yes | OBL | 2 | 4% | 0 | 0% | 0 | 0% |
| | *Lonicera conjugialis* | purpleflower honeysuckle | yes | FAC | 2 | 4% | 1 | 3% | – | 0% |
| | *Pinus contorta* | lodgepole pine | yes | FAC | – | 0% | 1 | 3% | 5 | 15% |
| | *Pinus ponderosa* | ponderosa pine | yes | FACU | – | 0% | 2 | 6% | 4 | 12% |
| | *Pseudotsuga menziesii* var. *menziesii* | Douglas-fir | yes | FACU | – | 0% | 2 | 6% | 14 | 42% |
| | *Pteridium aquilinum* var. *pubescens* | hairy brackenfern | yes | FACU | 6 | 12% | 0 | 0% | 0 | 0% |
| | *Quercus kelloggii* | California black oak | yes | NL | 3 | 6% | 1 | 3% | 3 | 9% |
| | *Quercus vacciniifolia* | huckleberry oak | yes | NL | 1 | 2% | – | 0% | – | 0% |
| | *Rosa californica* | California rose | yes | FAC | 1 | 2% | – | 0% | – | 0% |
| | *Rosa pisocarpa* subsp. *ahartii* | Ahart rose | yes | FAC | 1 | 2% | 1 | 3% | – | 0% |
| | *Salix jepsonii* | Jepson's willow | yes | OBL | 1 | 2% | – | 0% | – | 0% |

| Site | Scientific name | Common name | Native? | Wetland indicator status[1] | < 1 m | | 1 to 5 m | | > 5 m | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Occurrences | Relative cover | Occurrences | Relative cover | Occurrences | Relative cover |
| IHD-RV5 | *Abies concolor* | white fir | yes | NL | 5 | 4% | 15 | 12% | 14 | 11% |
| | *Agrostis exarata* | spike bent grass | yes | FACW | 1 | 1% | – | 0% | – | 0% |
| | *Alnus incana* subsp. *tenuifolia* | mountain alder | yes | FACW | 23 | 18% | 27 | 21% | – | 0% |
| | *Aquilegia formosa* | western columbine | yes | FAC | 1 | 1% | | 0% | – | 0% |
| | *Artemisia douglasiana* | mugwort | yes | FAC | 5 | 4% | – | 0% | – | 0% |
| | *Athyrium filix-femina* var. *cyclosorum* | subarctic ladyfern | yes | FAC | 1 | 1% | – | 0% | – | 0% |
| | *Bromus suksdorfii* | Suksdorf's brome | yes | NL | 1 | 1% | – | 0% | – | 0% |
| | *Carex fracta* | fragile-sheathed sedge | yes | FAC | 1 | 1% | – | 0% | – | 0% |
| | *Carex leptopoda* | slender-footed sedge | yes | FAC | 2 | 2% | – | 0% | – | 0% |
| | *Carex nudata* | torrent sedge | yes | FACW | 2 | 2% | – | 0% | – | 0% |
| | *Carex pellita* | woolly sedge | yes | OBL | 3 | 2% | – | 0% | – | 0% |
| | *Circaea alpina* subsp. *pacifica* | small enchanter's nightshade | yes | FAC | 1 | 1% | – | 0% | – | 0% |
| | *Cornus sericea* | American dogwood | yes | FACW | 7 | 5% | 6 | 5% | – | 0% |
| | *Elymus glaucus* | blue or western wild-rye | yes | FACU | 11 | 9% | – | 0% | – | 0% |
| | *Epilobium ciliatum* | fringed willowherb | yes | FACW | 1 | 1% | – | 0% | – | 0% |
| | *Epilobium* sp. | willowherb | unk | NL | 1 | 1% | – | 0% | – | 0% |
| | *Erythranthe moschata* | musk monkeyflower | yes | FACW | 1 | 1% | – | 0% | – | 0% |
| | *Festuca rubra* | red fescue | yes | FAC | 7 | 5% | – | 0% | – | 0% |
| | *Glyceria elata* | fowl manna grass | yes | OBL | 7 | 5% | – | 0% | – | 0% |
| | *Heracleum maximum* | cow parsnip, giant hogweed | yes | FACW | 2 | 2% | – | 0% | – | 0% |
| | *Hieracium albiflorum* | white hawkweed | yes | NL | 1 | 1% | – | 0% | – | 0% |
| | *Hypericum perforatum* subsp. *perforatum* | Klamathweed | no | FACU | 1 | 1% | – | 0% | – | 0% |
| | *Juncus xiphioides* | iris-leaved rush | yes | OBL | 1 | 1% | – | 0% | – | 0% |
| | *Lathyrus nevadensis* var. *nevadensis* | Sierra pea | yes | NL | 2 | 2% | – | 0% | – | 0% |
| | *Lonicera conjugialis* | purpleflower honeysuckle | yes | FAC | 3 | 2% | 2 | 2% | – | 0% |
| | *Myrica hartwegii* | Sierra sweet bay | yes | FAC | 1 | 1% | – | 0% | – | 0% |
| | *Osmorhiza berteroi* | sweetcicely | yes | FACU | 1 | 1% | – | 0% | – | 0% |
| | *Phacelia heterophylla* var. *virgata* | varied leaf phacelia | yes | FACU | 2 | 2% | – | 0% | – | 0% |
| | *Pinus contorta* | lodgepole pine | yes | FAC | 4 | 3% | 29 | 22% | 23 | 18% |
| | *Pinus jeffreyi* | Jeffrey pine | yes | NL | – | 0% | 3 | 2% | 6 | 5% |
| | *Populus tremuloides* | quaking aspen | yes | FACU | 2 | 2% | 2 | 2% | – | 0% |
| | *Ribes nevadense* | mountain pink currant | yes | FAC | 2 | 2% | – | 0% | – | 0% |
| | *Salix laevigata* | red willow | yes | FACW | 2 | 2% | 3 | 2% | – | 0% |
| | *Salix lasiolepis* | arroyo willow | yes | FACW | 11 | 9% | 6 | 5% | – | 0% |
| | *Senecio triangularis* | arrowleaf ragwort | yes | FACW | 1 | 1% | – | 0% | – | 0% |
| | *Solidago elongata* | West Coast Canada goldenrod | yes | FACU | 9 | 7% | – | 0% | – | 0% |
| | *Thalictrum fendleri* var. *fendleri* | Fendler's meadow rue | yes | FAC | 2 | 2% | – | 0% | – | 0% |
| | *Vaccinium uliginosum* subsp. *occidentale* | western blueberry | yes | FACW | 1 | 1% | – | 0% | – | 0% |

| Site | Scientific name | Common name | Native? | Wetland indicator status[1] | < 1 m | | 1 to 5 m | | > 5 m | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Occurrences | Relative cover | Occurrences | Relative cover | Occurrences | Relative cover |
| IHD-RV1 | *Acmispon parviflorus* | desert deervetch | yes | NL | 1 | 1% | – | 0% | – | 0% |
| | *Alnus incana* subsp. *tenuifolia* | mountain alder | yes | FACW | 4 | 3% | 1 | 1% | – | 0% |
| | *Amelanchier alnifolia* | Saskatoon serviceberry | yes | FACU | 1 | 1% | – | 0% | – | 0% |
| | *Arctostaphylos patula* | greenleaf manzanita | yes | NL | 12 | 10% | – | 0% | – | 0% |
| | *Artemisia douglasiana* | mugwort | yes | FAC | 3 | 3% | – | 0% | – | 0% |
| | *Boykinia occidentalis* | coastal brookfoam | yes | FAC | 2 | 2% | – | 0% | – | 0% |
| | *Carex nudata* | torrent sedge | yes | FACW | 1 | 1% | – | 0% | – | 0% |
| | *Ceanothus cordulatus* | mountain whitethorn | yes | NL | 18 | 15% | – | 0% | – | 0% |
| | *Ceanothus prostratus* | prostrate ceanothus | yes | NL | 1 | 1% | – | 0% | – | 0% |
| | *Cornus sericea* | American dogwood | yes | FACW | 7 | 6% | 4 | 3% | – | 0% |
| | *Diplacus torreyi* | Torrey's monkeyflower | yes | NL | 2 | 2% | – | 0% | – | 0% |
| | *Elymus elymoides* | squirreltail | yes | FACU | 2 | 2% | – | 0% | – | 0% |
| | *Elymus glaucus* | blue or western wild-rye | yes | FACU | 4 | 3% | – | 0% | – | 0% |
| | *Festuca rubra* | red fescue | yes | FAC | 4 | 3% | – | 0% | – | 0% |
| | *Gayophytum diffusum* | spreading groundsmoke | yes | NL | 5 | 4% | – | 0% | – | 0% |
| | *Heracleum maximum* | cow parsnip, giant hogweed | yes | FACW | 3 | 3% | – | 0% | – | 0% |
| | *Hosackia oblongifolia* var. *oblongifolia* | streambank bird's-foot trefoil | yes | OBL | 2 | 2% | – | 0% | – | 0% |
| | *Juncus xiphioides* | iris-leaved rush | yes | OBL | 1 | 1% | – | 0% | – | 0% |
| | *Lupinus microcarpus* | chick lupine | yes | NL | 2 | 2% | – | 0% | – | 0% |
| | *Myrica hartwegii* | Sierra sweet bay | yes | FAC | 6 | 5% | – | 0% | – | 0% |
| | *Pinus contorta* | lodgepole pine | yes | FAC | – | 0% | 1 | 1% | – | 0% |
| | *Pinus ponderosa* | ponderosa pine | yes | FACU | 4 | 3% | 14 | 12% | 2 | 2% |
| | *Rhododendron occidentale* | California azalea | yes | FAC | 2 | 2% | – | 0% | – | 0% |
| | *Rosa pisocarpa* subsp. *ahartii* | Ahart rose | yes | FAC | 1 | 1% | – | 0% | – | 0% |
| | *Rumex acetosella* | sheep sorrel | no | FACU | 1 | 1% | – | 0% | – | 0% |
| | *Salix jepsonii* | Jepson's willow | yes | OBL | – | 0% | 1 | 1% | – | 0% |
| | *Salix laevigata* | red willow | yes | FACW | 2 | 2% | – | 0% | – | 0% |
| | *Salix lasiolepis* | arroyo willow | yes | FACW | 2 | 2% | 2 | 2% | – | 0% |
| | *Salix scouleriana* | Scouler's willow | yes | FAC | 1 | 1% | 4 | 3% | – | 0% |
| | *Scirpus diffusus* | umbrella bulrush | yes | FACW | 3 | 3% | – | 0% | – | 0% |
| | *Solidago elongata* | West Coast Canada goldenrod | yes | FACU | 12 | 10% | – | 0% | – | 0% |
| | *Spiraea splendens* | rose meadowsweet | yes | FAC | 2 | 2% | – | 0% | – | 0% |
| | *Stipa occidentalis* var. *californica* | California needle grass | yes | NL | 8 | 7% | – | 0% | – | 0% |
| | *Symphoricarpos mollis* | creeping snowberry, trip vine | yes | FACU | 1 | 1% | – | 0% | – | 0% |

| Site | Scientific name | Common name | Native? | Wetland indicator status[1] | < 1 m | | 1 to 5 m | | > 5 m | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Occurrences | Relative cover | Occurrences | Relative cover | Occurrences | Relative cover |
| CD-RV4 | *Acer macrophyllum* | big-leaf maple | yes | FAC | – | 0% | 2 | 8% | 2 | 12% |
| | *Alnus rhombifolia* | white alder | yes | FACW | 5 | 31% | 16 | 67% | 4 | 24% |
| | *Athyrium filix-femina* var. *cyclosorum* | subarctic ladyfern | yes | FAC | 1 | 6% | 0 | 0% | 0 | 0% |
| | *Carex nudata* | torrent sedge | yes | FACW | 1 | 6% | – | 0% | – | 0% |
| | *Cornus sericea* | American dogwood | yes | FACW | – | 0% | 1 | 4% | – | 0% |
| | *Drymocallis glandulosa* var. *glandulosa* | sticky cinquefoil | yes | FAC | 2 | 13% | – | 0% | – | 0% |
| | *Panicum acuminatum* var. *fasciculatum* | Pacific panic grass | yes | FAC | 2 | 13% | – | 0% | – | 0% |
| | *Pinus contorta* | lodgepole pine | yes | FAC | – | 0% | – | 0% | – | 0% |
| | *Pinus jeffreyi* | Jeffrey pine | yes | NL | – | 0% | – | 0% | 4 | 24% |
| | *Quercus chrysolepis* | maul oak, canyon live oak | yes | NL | – | 0% | – | 0% | 6 | 35% |
| | *Salix lasiandra* | Pacific willow | yes | FACW | – | 0% | – | 0% | 1 | 6% |
| | *Salix lasiolepis* | arroyo willow | yes | FACW | 2 | 13% | 2 | 8% | – | 0% |
| | *Symphyotrichum bracteolatum* | Eaton's aster | yes | FAC | 1 | 6% | – | 0% | – | 0% |
| | *Toxicodendron diversilobum* | western poison oak | yes | FACU | 2 | 13% | 3 | 13% | – | 0% |
| SCD-RV5 | *Epilobium canum* | California fuchsia, zauschneria | yes | NL | 1 | 3% | – | 0% | – | 0% |
| | *Frangula californica* | California coffee berry | yes | NL | 1 | 3% | 1 | 3% | – | 0% |
| | *Fraxinus latifolia* | Oregon ash | yes | FACW | 1 | 3% | – | 0% | – | 0% |
| | *Philadelphus lewisii* | wild mock orange | yes | NL | 1 | 3% | – | 0% | – | 0% |
| | *Quercus chrysolepis* | maul oak, canyon live oak | yes | NL | – | 0% | 1 | 3% | – | 0% |
| | *Rubus armeniacus* | Himalayan blackberry | no | FAC | 21 | 55% | – | 0% | – | 0% |
| | *Salix lasiolepis* | arroyo willow | yes | FACW | 10 | 26% | 11 | 29% | – | 0% |
| | *Toxicodendron diversilobum* | western poison oak | yes | FACU | 3 | 8% | 2 | 5% | – | 0% |

| Site | Scientific name | Common name | Native? | Wetland indicator status[1] | < 1 m | | 1 to 5 m | | > 5 m | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Occurrences | Relative cover | Occurrences | Relative cover | Occurrences | Relative cover |
| SCD-RV3 | *Alnus rhombifolia* | white alder | yes | FACW | – | 0% | 7 | 10% | 10 | 14% |
| | *Carex nudata* | torrent sedge | yes | FACW | 10 | 14% | – | 0% | – | 0% |
| | *Cyperus eragrostis* | tall flatsedge | yes | FACW | 1 | 1% | – | 0% | – | 0% |
| | *Cytisus scoparius* | Scotch broom | no | NL | 1 | 1% | – | 0% | – | 0% |
| | *Erythranthe guttata* | seep monkeyflower | yes | OBL | 1 | 1% | – | 0% | – | 0% |
| | *Heteromeles arbutifolia* | toyon | yes | NL | – | 0% | 1 | 1% | – | 0% |
| | *Heuchera micrantha* | crevice alumroot | yes | NL | 1 | 1% | – | 0% | – | 0% |
| | *Juncus xiphioides* | iris-leaved rush | yes | OBL | 1 | 1% | – | 0% | – | 0% |
| | *Leersia oryzoides* | rice cutgrass | yes | OBL | 2 | 3% | – | 0% | – | 0% |
| | *Melilotus albus* | white sweetclover | no | FACU | 1 | 1% | – | 0% | – | 0% |
| | *Pseudotsuga menziesii* var. *menziesii* | Douglas-fir | yes | FACU | 1 | 1% | 4 | 6% | – | 0% |
| | *Quercus agrifolia* | coast live oak, encina | yes | NL | 2 | 3% | – | 0% | – | 0% |
| | *Quercus chrysolepis* | maul oak, canyon live oak | yes | NL | – | 0% | 1 | 1% | 3 | 4% |
| | *Rubus armeniacus* | Himalayan blackberry | no | FAC | 20 | 28% | 9 | 13% | – | 0% |
| | *Rumex transitorius* | willow dock | yes | FACW | 1 | 1% | – | 0% | – | 0% |
| | *Salix exigua* | narrowleaf willow | yes | FACW | 6 | 8% | 6 | 8% | – | 0% |
| | *Salix gooddingii* | Goodding's black willow | yes | FACW | 1 | 1% | – | 0% | – | 0% |
| | *Salix laevigata* | red willow | yes | FACW | 6 | 8% | 8 | 11% | – | 0% |
| | *Salix lasiolepis* | arroyo willow | yes | FACW | 11 | 15% | 8 | 11% | – | 0% |
| | *Toxicodendron diversilobum* | western poison oak | yes | FACU | 3 | 4% | 1 | 1% | – | 0% |
| | *Umbellularia californica* | California laurel | yes | FAC | – | 0% | 1 | 1% | – | 0% |
| | *Vitis californica* | California wild grape | yes | FACU | 2 | 3% | – | 0% | – | 0% |

| Site | Scientific name | Common name | Native? | Wetland indicator status[1] | < 1 m | | 1 to 5 m | | > 5 m | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Occurrences | Relative cover | Occurrences | Relative cover | Occurrences | Relative cover |
| SCD-RV1 | *Alnus rhombifolia* | white alder | yes | FACW | – | 0% | 7 | 10% | 10 | 14% |
| | *Carex nudata* | torrent sedge | yes | FACW | 10 | 14% | – | 0% | – | 0% |
| | *Cyperus eragrostis* | tall flatsedge | yes | FACW | 1 | 1% | – | 0% | – | 0% |
| | *Cytisus scoparius* | Scotch broom | no | NL | 1 | 1% | – | 0% | – | 0% |
| | *Erythranthe guttata* | seep monkeyflower | yes | OBL | 1 | 1% | – | 0% | – | 0% |
| | *Heteromeles arbutifolia* | toyon | yes | NL | – | 0% | 1 | 1% | – | 0% |
| | *Heuchera micrantha* | crevice alumroot | yes | NL | 1 | 1% | – | 0% | – | 0% |
| | *Juncus xiphioides* | iris-leaved rush | yes | OBL | 1 | 1% | – | 0% | – | 0% |
| | *Leersia oryzoides* | rice cutgrass | yes | OBL | 2 | 3% | – | 0% | – | 0% |
| | *Melilotus albus* | white sweetclover | no | FACU | 1 | 1% | – | 0% | – | 0% |
| | *Pseudotsuga menziesii* var. *menziesii* | Douglas-fir | yes | FACU | 1 | 1% | 4 | 6% | – | 0% |
| | *Quercus agrifolia* | coast live oak, encina | yes | NL | 2 | 3% | – | 0% | – | 0% |
| | *Quercus chrysolepis* | maul oak, canyon live oak | yes | NL | – | 0% | 1 | 1% | 3 | 4% |
| | *Rubus armeniacus* | Himalayan blackberry | no | FAC | 20 | 28% | 9 | 13% | – | 0% |
| | *Rumex transitorius* | willow dock | yes | FACW | 1 | 1% | – | 0% | – | 0% |
| | *Salix exigua* | narrowleaf willow | yes | FACW | 6 | 8% | 6 | 8% | – | 0% |
| | *Salix gooddingii* | Goodding's black willow | yes | FACW | 1 | 1% | – | 0% | – | 0% |
| | *Salix laevigata* | red willow | yes | FACW | 6 | 8% | 8 | 11% | – | 0% |
| | *Salix lasiolepis* | arroyo willow | yes | FACW | 11 | 15% | 8 | 11% | – | 0% |
| | *Toxicodendron diversilobum* | western poison oak | yes | FACU | 3 | 4% | 1 | 1% | – | 0% |
| | *Umbellularia californica* | California laurel | yes | FAC | – | 0% | 1 | 1% | – | 0% |
| | *Vitis californica* | California wild grape | yes | FACU | 2 | 3% | – | 0% | – | 0% |

1 Wetland indicator status (Lichvar 2016):
- OBL = obligate; almost always occur in wetland
- FACW = facultative wetland; usually occur in wetland, but may occur in non-wetland
- FAC = facultative; occur in wetland and non-wetland
- FACU = facultative upland; usually occur in non-wetland, but may occur in wetland
- UPL = upland; almost never occur in wetland
- NL = not listed; generally assumed to be an upland species
- unk = unknown; identification to species was not feasible, therefore the wetland indicator status could not be determined

**Table E3-2. Line-Point Intercept Results in Each Site and Transect for Absolute Cover by Canopy Class.**

| Site | Transect | Transect points with vegetation (< 1 m) | Transect points with vegetation (1 to 5 m) | Transect points with vegetation (> 5 m) | Total transect points |
|---|---|---|---|---|---|
| LLD-RV17 | 1 | 7 | 1 | – | 57 |
| | 2 | 26 | – | – | 38 |
| | 3 | 27 | – | – | 43 |
| | Total vegetated points | 60 | 1 | – | – |
| | Percent vegetated (absolute) | 43% | 1% | 0% | – |
| LLD-RV10 | 1 | 22 | 22 | 24 | 45 |
| | 2 | 26 | 35 | 22 | 45 |
| | 3 | 33 | 32 | 31 | 52 |
| | Total vegetated points | 81 | 89 | 77 | – |
| | Percent vegetated (absolute) | 57% | 63% | 54% | |
| LLD-RV3 | 1 | 23 | 17 | 8 | 63 |
| | 2 | 23 | 21 | 12 | 43 |
| | 3 | 9 | 13 | 22 | 42 |
| | Total vegetated points | 55 | 51 | 42 | – |
| | Percent vegetated | 37% | 34% | 28% | – |
| GCD-RV1 | 1 | 16 | 11 | 4 | 31 |
| | 2 | 18 | 14 | 12 | 39 |
| | 3 | 15 | 7 | 17 | 37 |
| | Total vegetated points | 49 | 32 | 33 | – |
| | Percent vegetated | 46% | 30% | 31% | – |
| IHD-RV5 | 1 | 54 | 45 | 26 | 72 |
| | 2 | 37 | 19 | 1 | 38 |
| | 3 | 38 | 29 | 16 | 38 |
| | Total vegetated points | 129 | 93 | 43 | – |
| | Percent vegetated | 87% | 63% | 29% | – |

| Site | Transect | Transect points with vegetation (< 1 m) | Transect points with vegetation (1 to 5 m) | Transect points with vegetation (> 5 m) | Total transect points |
|---|---|---|---|---|---|
| IHD-RV1 | 1 | 36 | – | – | 79 |
| | 2 | 41 | 15 | 2 | 101 |
| | 3 | 43 | 12 | – | 101 |
| | Total vegetated points | 120 | 27 | 2 | – |
| | Percent vegetated | 43% | 10% | 1% | – |
| CD-RV4 | 1 | 3 | 1 | 5 | 26 |
| | 2 | 3 | 10 | 2 | 34 |
| | 3 | 10 | 13 | 10 | 36 |
| | Total vegetated points | 16 | 24 | 17 | – |
| | Percent vegetated | 17% | 25% | 18% | – |
| SCD-RV5 | 1 | 9 | 1 | – | 56 |
| | 2 | 19 | 7 | – | 51 |
| | 3 | 10 | 7 | – | 50 |
| | Total vegetated points | 38 | 15 | – | – |
| | Percent vegetated | 24% | 10% | 0% | – |
| SCD-RV3 | 1 | 15 | 3 | 2 | 26 |
| | 2 | 11 | 6 | – | 47 |
| | 3 | 8 | 1 | – | 37 |
| | Total vegetated points | 34 | 10 | 2 | – |
| | Percent vegetated | 31% | 9% | 2% | – |
| SCD-RV1 | 1 | 35 | 25 | 13 | 86 |
| | 2 | 11 | 7 | – | 76 |
| | 3 | 25 | 14 | – | 83 |
| | Total vegetated points | 71 | 46 | 13 | – |
| | Percent vegetated | 29% | 19% | 5% | – |

# APPENDIX E4

## 2019 Riparian Vegetation Point-Centered Quarter Results

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**Table E4-1. 2019 UARP Riparian Vegetation Results of Point-Centered Quarter Analysis by Site.**

| Site | Scientific name | Common name | No. of individuals | Composition | Mean age class[1] | Mean vigor[2] | Mean no. of stems | Avg. DBH per stem (in) | Mean basal area ($in^2$) | Density (individuals/ac) | Cover ($ft^2/ac$) | Relative cover | Frequency |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LLD-RV17 | *Alnus incana* subsp. *tenuifolia* | mountain alder | 10 | 91% | 2.5 | 5.6 | 2.1 | 0.11 | 0.18 | 31 | 0.02 | 2% | 19% |
| | *Pinus contorta* | lodgepole pine | 1 | 9% | 5.0 | 4.0 | 2.0 | 7.00 | 102.10 | 2 | 1.06 | 98% | 5% |
| | Total | | 11 | 100% | 2.7 | 5.5 | N/A | N/A | N/A | 90 | 1.08 | 100% | 38% |
| LLD-RV10 | *Abies concolor* | white fir | 8 | 10% | 2.6 | 5.1 | 1.0 | 3.08 | 10.97 | 76 | 3.87 | 1% | 33% |
| | *Alnus incana* subsp. *tenuifolia* | mountain alder | 29 | 35% | 2.8 | 3.8 | 1.8 | 0.83 | 2.18 | 382 | 2.96 | 1% | 76% |
| | *Calocedrus decurrens* | incense cedar | 5 | 6% | 3.2 | 4.6 | 0.8 | 5.30 | 44.65 | 31 | 9.49 | 2% | 24% |
| | *Cornus sericea* | American dogwood | 4 | 5% | 3.3 | 4.5 | 1.3 | 0.10 | 0.04 | 126 | 0.03 | 0% | 14% |
| | *Pinus contorta* | lodgepole pine | 34 | 41% | 3.7 | 3.3 | 1.0 | 7.19 | 72.09 | 566 | 330.37 | 82% | 76% |
| | *Populus trichocarpa* | black cottonwood | 3 | 4% | 3.7 | 4.3 | 0.7 | 12.33 | 185.62 | 45 | 55.82 | 14% | 14% |
| | Total | | 83 | 100% | 3.2 | 3.8 | N/A | N/A | N/A | 1226 | 402.55 | 100% | 238% |
| LLD-RV3 | *Alnus incana* subsp. *tenuifolia* | mountain alder | 37 | 53% | 2.9 | 3.4 | 2.7 | 1.52 | 6.36 | 129 | 5.72 | 98% | 76% |
| | *Cornus sericea* | American dogwood | 3 | 4% | 3.0 | 5.7 | 2.0 | 0.66 | 1.62 | 12 | 0.11 | 2% | 10% |
| | *Pinus contorta* | lodgepole pine | 1 | 1% | 2.0 | 4.0 | 0.0 | 0.00 | 0.00 | 1 | 0.00 | 0% | 5% |
| | *Salix exigua* | narrowleaf willow | 6 | 9% | 2.0 | 4.8 | 0.2 | 0.02 | 0.00 | 34 | 0.00 | 0% | 14% |
| | *Salix jepsonii* | Jepson's willow | 3 | 4% | 3.0 | 2.3 | 0.0 | 0.00 | 0.00 | 17 | 0.00 | 0% | 14% |
| | *Spiraea splendens* | rose meadowsweet | 1 | 1% | 2.0 | 6.0 | 0.0 | 0 | 0.00 | 6 | 0.00 | 0% | 5% |
| | n/a | upland | 19 | 27% | N/A | N/A | N/A | N/A | N/A | 49 | N/A | N/A | 43% |
| | Total | | 70 | 100% | 2.7 | 3.7 | N/A | N/A | N/A | 248 | 5.84 | 100% | 167% |
| GCD-RV1 | *Alnus incana* subsp. *tenuifolia* | mountain alder | 43 | 74% | 3.5 | 3.8 | 1.9 | 0.58 | 1.53 | 120 | 1.81 | 100% | 71% |
| | *Calocedrus decurrens* | incense cedar | 2 | 3% | 2.0 | 3.5 | 0.0 | 0.00 | 0.00 | 3 | 0.00 | 0% | 14% |
| | *Cornus sericea* | American dogwood | 4 | 7% | 3.5 | 5.3 | 2.0 | 0.10 | 0.06 | 8 | 0.00 | 0% | 19% |
| | *Salix jepsonii* | Jepson's willow | 3 | 5% | 3.7 | 4.0 | 4.7 | 0.13 | 0.15 | 3 | 0.00 | 0% | 14% |
| | *Rhododendron occidentale* | California azalea | 1 | 2% | 2.0 | 5.0 | 1.0 | 0.10 | 0.01 | 4 | 0.00 | 0% | 5% |
| | n/a | upland | 5 | 9% | N/A | N/A | N/A | N/A | N/A | 22 | N/A | N/A | 10% |
| | Total | | 58 | 100% | 3.4 | 4.0 | N/A | N/A | N/A | 161 | 1.81 | 100% | 133% |
| IHD-RV5 | *Abies concolor* | white fir | 3 | 4% | 2.3 | 5.3 | 0.3 | 1.93 | 8.81 | 21 | 2.09 | 8% | 10% |
| | *Alnus incana* subsp. *tenuifolia* | mountain alder | 37 | 46% | 3.9 | 4.6 | 3.5 | 0.78 | 2.36 | 321 | 4.86 | 19% | 76% |
| | *Cornus sericea* | American dogwood | 3 | 4% | 3.7 | 6.0 | 11.7 | 0.43 | 4.33 | 34 | 1.03 | 4% | 10% |
| | *Pinus contorta* | lodgepole pine | 15 | 19% | 2.8 | 5.0 | 0.7 | 2.74 | 14.90 | 149 | 12.62 | 50% | 48% |
| | *Pinus jeffreyi* | Jeffrey pine | 1 | 1% | 5.0 | 3.0 | 1.0 | 13.00 | 132.73 | 5 | 4.27 | 17% | 5% |
| | *Pinus ponderosa* | ponderosa pine | 1 | 1% | 1.0 | 6.0 | 0.0 | 0.00 | 0.00 | 11 | 0.00 | 0% | 5% |
| | *Populus tremuloides* | quaking aspen | 1 | 1% | 3.0 | 5.0 | 1.0 | 1.3 | 1.3 | 5 | 0.04 | 0% | 5% |
| | *Salix jepsonii* | Jepson's willow | 4 | 5% | 4.0 | 6.0 | 12.8 | 0.25 | 0.70 | 19 | 0.09 | 0% | 14% |
| | *Salix laevigata* | red willow | 1 | 1% | 3.0 | 2.0 | 1.0 | 0.40 | 0.13 | 11 | 0.01 | 0% | 5% |
| | *Salix lasiolepis* | arroyo willow | 14 | 18% | 3.6 | 5.4 | 3.1 | 0.32 | 0.41 | 134 | 0.34 | 1% | 38% |
| | Total | | 80 | 100% | 3.6 | 4.9 | N/A | N/A | N/A | 709 | 25.35 | 100% | 214% |

| Site | Scientific name | Common name | No. of individuals | Composition | Mean age class[1] | Mean vigor[2] | Mean no. of stems | Avg. DBH per stem (in) | Mean basal area ($in^2$) | Density (individuals/ac) | Cover ($ft^2$/ac) | Relative cover | Frequency |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IHD-RV1 | *Abies concolor* | white fir | 1 | 2% | 2.0 | 6.0 | 0.0 | 0.00 | 0.00 | 3 | 0.00 | 0% | 5% |
| | *Alnus incana* subsp. *tenuifolia* | mountain alder | 18 | 33% | 3.1 | 4.9 | 1.7 | 0.17 | 0.57 | 212 | 0.20 | 5% | 52% |
| | *Cornus sericea* | American dogwood | 6 | 11% | 3.3 | 5.8 | 5.2 | 0.17 | 0.63 | 79 | 0.47 | 11% | 24% |
| | *Pinus contorta* | lodgepole pine | 1 | 2% | 4.0 | 6.0 | 1.0 | 4.00 | 12.57 | 1 | 0.10 | 2% | 5% |
| | *Pinus ponderosa* | ponderosa pine | 5 | 9% | 3.4 | 5.6 | 0.8 | 5.74 | 36.91 | 13 | 3.25 | 77% | 14% |
| | *Salix jepsonii* | Jepson's willow | 1 | 2% | 2.0 | 4.0 | 0.0 | 0.00 | 0.00 | 18 | 0.00 | 0% | 5% |
| | *Salix laevigata* | red willow | 18 | 33% | 2.7 | 4.9 | 2.0 | 0.07 | 0.08 | 186 | 0.17 | 4% | 57% |
| | *Salix lasiolepis* | arroyo willow | 2 | 4% | 2.5 | 5.0 | 0.0 | 0.00 | 0.00 | 2 | 0.00 | 0% | 5% |
| | *Salix scouleriana* | Scouler's willow | 1 | 2% | 4.0 | 4.0 | 7.0 | 0.50 | 1.37 | 3 | 0.03 | 1% | 5% |
| | n/a | upland | 2 | 4% | N/A | N/A | N/A | N/A | N/A | 2 | N/A | N/A | 5% |
| | Total | | 55 | 100% | 3.0 | 5.1 | N/A | N/A | N/A | 519 | 4.22 | 100% | 176% |
| CD-RV4 | *Alnus rhombifolia* | white alder | 8 | 57% | 3.0 | 4.6 | 1.6 | 5.11 | 49.93 | 18 | 13.11 | 99% | 33% |
| | *Cornus sericea* | American dogwood | 2 | 14% | 2.5 | 4.0 | 2.0 | 0.40 | 1.01 | 2 | 0.01 | 0% | 10% |
| | *Salix lasiandra* | Pacific willow | 1 | 7% | 3.0 | 4.0 | 1.0 | 5.00 | 19.63 | 1 | 0.13 | 1% | 5% |
| | *Umbellularia californica* | California laurel | 2 | 14% | 1.5 | 5.5 | 0.5 | 0.05 | 0.00 | 2 | 0.00 | 0% | 10% |
| | n/a | upland | 1 | 7% | N/A | N/A | N/A | N/A | N/A | 1 | N/A | N/A | 5% |
| | Total | | 14 | 100% | 2.7 | 4.6 | N/A | N/A | N/A | 24 | 13.24 | 100% | 62% |
| SCD-RV5 | *Frangula californica* | California coffee berry | 2 | 13% | 3.0 | 5.0 | 0.5 | 0.05 | 0.00 | 1 | 0.00 | 0% | 5% |
| | *Prunus emarginata* | bitter cherry | 1 | 7% | 3.0 | 5.0 | 0.0 | 0.00 | 0.00 | 1 | 0.00 | 0% | 5% |
| | *Salix lasiolepis* | arroyo willow | 10 | 67% | 3.7 | 5.6 | 25.1 | 0.39 | 4.47 | 7 | 0.22 | 100% | 33% |
| | n/a | upland | 2 | 13% | N/A | N/A | N/A | N/A | N/A | 1 | N/A | N/A | 5% |
| | Total | | 15 | 100% | 3.5 | 5.5 | N/A | N/A | N/A | 10 | 0.22 | 100% | 48% |
| SCD-RV3 | *Alnus rhombifolia* | white alder | 2 | 6% | 3.5 | 3.5 | 2.5 | 3.50 | 7.85 | 4 | 0.26 | 17% | 10% |
| | *Salix exigua* | narrowleaf willow | 10 | 32% | 2.0 | 5.4 | 0.1 | 0.01 | 0.00 | 21 | 0.00 | 0% | 29% |
| | *Salix laevigata* | red willow | 5 | 16% | 3.2 | 5.0 | 3.6 | 1.00 | 6.30 | 10 | 0.49 | 32% | 24% |
| | *Salix lasiolepis* | arroyo willow | 14 | 45% | 3.0 | 5.3 | 6.9 | 0.46 | 4.33 | 26 | 0.80 | 52% | 52% |
| | Total | | 31 | 100% | 2.7 | 5.2 | N/A | N/A | N/A | 61 | 1.55 | 100% | 114% |
| SCD-RV1 | *Alnus rhombifolia* | white alder | 11 | 16% | 3.9 | 4.5 | 1.2 | 4.01 | 8.98 | 46 | 3.73 | 44% | 41% |
| | *Cephalanthus occidentalis* | California button willow | 2 | 3% | 4.0 | 3.5 | 1.5 | 0.30 | 0.14 | 16 | 0.02 | 0% | 9% |
| | *Fraxinus latifolia* | Oregon ash | 1 | 1% | 3.0 | 4.0 | 1.0 | 2.60 | 5.31 | 8 | 0.29 | 3% | 5% |
| | *Salix exigua* | narrowleaf willow | 17 | 25% | 2.5 | 6.0 | 2.3 | 0.41 | 0.48 | 66 | 0.26 | 3% | 36% |
| | *Salix laevigata* | red willow | 20 | 29% | 2.5 | 5.7 | 1.8 | 0.87 | 5.10 | 108 | 3.13 | 37% | 45% |
| | *Salix lasiandra* | Pacific willow | 1 | 1% | 2.0 | 4.0 | 2.0 | 0.20 | 0.00 | 3 | 0.00 | 0% | 5% |
| | *Salix lasiolepis* | arroyo willow | 15 | 22% | 3.7 | 5.2 | 8.1 | 0.39 | 1.76 | 80 | 1.00 | 12% | 32% |
| | n/a | upland | 1 | 1% | N/A | N/A | N/A | N/A | N/A | 3 | N/A | N/A | 5% |
| | Total | | 68 | 100% | 3.0 | 5.4 | N/A | N/A | N/A | 329 | 8.44 | 100% | 177% |

[1] Age classes (SMUD 2016):
1 = tree and shrub seedlings ≤1 year old
2 = trees and shrubs 2–4 years old

3 = young trees (i.e., 4–10 years old) and mature shrubs (i.e., >4 years old and <20% dead)
4 = mature trees (i.e., >10 years old and <20% dead) and decadent shrubs (i.e., >4 years old and ≥20% dead)
5 = decadent trees (i.e., >10 years old and ≥20% dead)

[2] Vigor classes (SMUD 2016):
1 = dead; complete leaf death that is not attributable to normal winter or summer deciduous species
2 = critically stressed; major leaf death and/or branch die back (i.e., >50% of canopy affected)
3 = significantly stressed; prominent leaf death and/or branch die back (i.e., 21–50% of canopy affected)
4 = stressed; minimal leaf death and/or branch die back (i.e., 11–20% of canopy affected)
5 = normal; little or no sign of leaf stress (i.e., 5–10% of canopy affected)
6 = vigorous; no sign of leaf stress/very healthy-looking canopy (i.e., <5% of canopy affected)

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# APPENDIX E5

## 2019 Riparian Vegetation Greenline Results

**Table E5-1. 2019 UARP Riparian Vegetation Greenline Data Results for Stability Class and Successional Status by Site.**

| Site | Component | Common name (if applicable) | Proportion of greenline | Stability class[1] | Successional status[1] |
|---|---|---|---|---|---|
| **LLD-RV17** | *Carex nudata* | torrent sedge | 51% | 9 | L |
| | *Carex utriculata* | southern beaked sedge | 21% | 9 | L |
| | *Juncus xiphioides* | iris-leaved rush | 14% | 7 | L |
| | Wood | | 14% | 10 | L |
| | **Totals** | | **100%** | **8.9** | **L (100%)** |
| **LLD-RV10** | *Alnus incana* subsp. *tenuifolia* | mountain alder | 39% | 7 | L |
| | *Anthoxanthum odoratum* | sweet vernal grass | 3% | 3 | E |
| | Boulder | | 1% | 10 | L |
| | *Carex nudata* | torrent sedge | 3% | 9 | L |
| | *Cornus sericea* | American dogwood | 41% | 7 | L |
| | *Hosackia oblongifolia* | | 10% | 4 | E |
| | Wood | | 2% | 10 | L |
| | **Totals** | | **100%** | **6.7** | **L (87%), E (13%)** |

| Site | Component | Common name (if applicable) | Proportion of greenline | Stability class[1] | Successional status[1] |
|---|---|---|---|---|---|
| LLD-RV3 | *Alnus incana* subsp. *tenuifolia* | mountain alder | 26% | 7 | L |
| | Bedrock | | 4% | 10 | L |
| | Boulder | | 6% | 10 | L |
| | *Carex nudata* | torrent sedge | 16% | 9 | L |
| | *Carex utriculata* | southern beaked sedge | 7% | 9 | L |
| | *Cornus sericea* | American dogwood | 5% | 7 | L |
| | *Hosackia oblongifolia* | | 5% | 4 | E |
| | *Juncus xiphioides* | iris-leaved rush | 14% | 7 | L |
| | No greenline | | 6% | 1 | E |
| | *Salix lasiandra* | Pacific willow | 1% | 6 | L |
| | *Salix lasiolepis* | arroyo willow | 2% | 6 | E |
| | *Spiraea splendens* | rose meadowsweet | 4% | 5 | E/L |
| | Wood | | 5% | 10 | L |
| | **Totals** | | **100%** | **7.3** | **L (83%), E/L (4%), E (13%)** |
| GCD-RV1 | Alnus incana subsp. tenuifolia | mountain alder | 11% | 7 | L |
| | Bedrock/boulder | | 58% | 10 | L |
| | Boulder | | 16% | 10 | L |
| | *Boykinia occidentalis* | coastal brookfoam | 2% | 6 | L |
| | *Carex nudata* | torrent sedge | 2% | 9 | L |
| | *Darmera peltata* | Indian rhubarb | 5% | 6 | L |
| | *Glyceria elata* | fowl manna grass | 0% | 8 | E/L |
| | *Juncus xiphioides* | iris-leaved rush | 0% | 7 | L |
| | *Pinus contorta* | lodgepole pine | 0% | 8 | E/L |
| | *Rhododendron occidentale* | California azalea | 4% | 6 | L |
| | *Rosa pisocarpa* subsp. *ahartii* | | t | 6 | E |
| | *Salix jepsonii* | Jepson's willow | 0% | 7 | L |
| | *Spiraea splendens* | rose meadowsweet | 1% | 5 | E/L |

| Site | Component | Common name (if applicable) | Proportion of greenline | Stability class[1] | Successional status[1] |
|---|---|---|---|---|---|
| | **Totals** | | **100%** | **9.2** | **L (99%), E/L (1%), E (t)** |
| **IHD-RV5** | *Alnus incana* subsp. *tenuifolia* | mountain alder | 35% | 7 | L |
| | *Athyrium filix-femina* var. *cyclosorum* | subarctic ladyfern | 1% | 5 | E |
| | Boulder | | 4% | 10 | L |
| | *Boykinia occidentalis* | coastal brookfoam | 1% | 6 | L |
| | *Carex nudata* | torrent sedge | 1% | 9 | L |
| | *Carex pellita* | woolly sedge | 4% | 8 | L |
| | *Cornus sericea* | American dogwood | 1% | 7 | L |
| | *Glyceria elata* | fowl manna grass | 7% | 8 | E/L |
| | *Juncus xiphioides* | iris-leaved rush | 21% | 7 | L |
| | *Salix laevigata* | red willow | 8% | 6 | L |
| | *Salix lasiolepis* | arroyo willow | 8% | 6 | E |
| | *Scirpus diffusus* | umbrella bulrush | 8% | 9 | E |
| | Wood | | 2% | 10 | L |
| | **Totals** | | **100%** | **7.3** | **L (76%), E/L (7%), E (17%)** |

| Site | Component | Common name (if applicable) | Proportion of greenline | Stability class[1] | Successional status[1] |
|---|---|---|---|---|---|
| IHD-RV1 | *Alnus incana* subsp. *tenuifolia* | mountain alder | 16% | 7 | L |
| | Bedrock/boulder | | 2% | 10 | L |
| | Boulder | | 6% | 10 | L |
| | *Boykinia occidentalis* | coastal brookfoam | 3% | 6 | L |
| | *Cornus sericea* | American dogwood | 3% | 7 | L |
| | *Darmera peltata* | Indian rhubarb | 3% | 6 | L |
| | *Juncus xiphioides* | iris-leaved rush | 22% | 7 | L |
| | *Myrica hartwegii* | Sierra sweet bay | 18% | 6 | L |
| | *Rhododendron occidentale* | California azalea | 6% | 6 | L |
| | *Rosa pisocarpa* subsp. *ahartii* | Ahart rose | 2% | 6 | #N/A |
| | *Salix laevigata* | red willow | 11% | 6 | L |
| | *Salix lasiolepis* | arroyo willow | 5% | 6 | E |
| | *Scirpus diffusus* | umbrella bulrush | 3% | 9 | E |
| | Wood | | 1% | 10 | L |
| | **Totals** | | **100%** | **6.9** | **L (90%, E (10%)** |
| CD-RV4 | *Acer macrophyllum* | big-leaf maple | 1% | 8 | L |
| | *Alnus rhombifolia* | white alder | 2% | 8 | L |
| | *Athyrium filix-femina* var. *cyclosorum* | subarctic ladyfern | 1% | 5 | E |
| | Bedrock | | 13% | 10 | L |
| | *Carex nudata* | torrent sedge | 6% | 9 | L |
| | *Darmera peltata* | Indian rhubarb | 0% | 6 | L |
| | No greenline | | 75% | 1 | E |
| | *Pinus jeffreyi* | Jeffrey pine | 1% | 7 | L |
| | *Salix lasiandra* | Pacific willow | 1% | 6 | L |
| | *Salix lasiolepis* | arroyo willow | 0% | 6 | E |
| | **Totals** | | **100%** | **3.0** | **L (24%), E (76%)** |

| Site | Component | Common name (if applicable) | Proportion of greenline | Stability class[1] | Successional status[1] |
|---|---|---|---|---|---|
| **SCD-RV5** | Bedrock | | 26% | 10 | L |
| | Boulder | | 65% | 10 | L |
| | *Rubus armeniacus* | Himalayan blackberry | 0% | 7 | E |
| | *Salix lasiolepis* | arroyo willow | 8% | 6 | E |
| | **Totals** | | **100%** | **9.7** | **L (91%), E (9%)** |
| **SCD-RV3** | Bedrock | | 19% | 10 | L |
| | Boulder | | 43% | 10 | L |
| | *Carex nudata* | torrent sedge | 13% | 9 | L |
| | *Darmera peltata* | Indian rhubarb | 1% | 6 | L |
| | No greenline | | 19% | 1 | E |
| | *Salix exigua* var. *hindsiana* | Hinds' willow | 2% | 6 | E |
| | *Salix laevigata* | red willow | 2% | 6 | L |
| | *Salix lasiolepis* | arroyo willow | 2% | 6 | E |
| | *Scirpus diffusus* | umbrella bulrush | 0% | 8 | E |
| | **Totals** | | **100%** | **7.9** | **L (L (77%), E (23%)** |

| Site | Component | Common name (if applicable) | Proportion of greenline | Stability class[1] | Successional status[1] |
|---|---|---|---|---|---|
| **SCD-RV1** | *Alnus rhombifolia* | white alder | 4% | 8 | L |
| | Bedrock | | 43% | 10 | L |
| | Bedrock/boulder | | 2% | 10 | L |
| | *Carex nudata* | torrent sedge | 6% | 9 | L |
| | No greenline | | 25% | 1 | E |
| | *Rubus armeniacus* | Himalayan blackberry | 4% | 7 | E |
| | *Salix exigua* | narrowleaf willow | 0% | 6 | E |
| | *Salix laevigata* | red willow | 4% | 6 | L |
| | *Salix lasiolepis* | arroyo willow | 6% | 6 | E |
| | *Vitis californica* | California wild grape | 0% | 6 | L |
| | Wood | | 5% | 10 | L |
| | **Totals** | | **100%** | **7.1** | **L (65%), E (35%)** |

[1] From Winward (2000) when available; otherwise interpreted based on nearest equivalent and professional experience with the component's successional status in the UARP ecosystems.

Stability class is a rating of a component's ability to buffer the forces of moving water

- 1–2 = very low
- 3–4 = low
- 5–6 = mid
- 7–8 = high
- 9–10 excellent

Successional status is defined as the present state of vegetation on an area in relation to the potential natural community(ies) that could occur on that area

- E = early; community type is known to occur in the earlier stage of succession along the greenline
- L = late; community type is known to occur in the latter successional stages along the greenline

**Table E5-2. Crosswalk of UARP Riparian Vegetation Greenline Components (2004 and 2019) to Nearest Winward (2000) Riparian Community Type, Stability Class, and Successional Stage.**

| Greenline component | Winward 2000 equivalent[1] | Stability Class | Successional stage |
|---|---|---|---|
| *Acer macrophyllum* | (*Acer negundo*/*Equisetum arvense*) | 8 | L |
| *Agrostis gigantea-Panicum acuminatum* | (*Agrostis stolonifera*) | 3 | E |
| *Alnus incana* subsp. *tenuifolia* | (*Alnus incana*/*Cornus sericea*) | 8 | L |
| *Alnus incana-Athyrium filix-femina* | (*Alnus incana*/*Equisetum arvense*) | 7 | L |
| *Alnus incana-Carex aquatilis* | (*Alnus incana*/Mesic Graminoid) | 7 | L |
| *Alnus incana-Carex aquatilis-Darmera peltata* | (*Alnus incana*/Mesic Graminoid) | 7 | L |
| *Alnus incana-Carex vesicaria* | (*Alnus incana*/Mesic Graminoid) | 7 | L |
| *Alnus incana-Cornus sericea* | (*Alnus incana*/*Cornus sericea*) | 8 | L |
| *Alnus incana-Darmera peltata* | (*Alnus incana*/Mesic Forb) | 7 | L |
| *Alnus incana-Glyceria elata* | (*Alnus incana*/Mesic Graminoid) | 7 | L |
| *Alnus incana-Juncus xiphioides* | (*Alnus incana*/Mesic Graminoid) | 7 | L |
| *Alnus incana-Juncus xiphioides-Darmera peltata* | (*Alnus incana*/Mesic Graminoid) | 7 | L |
| *Alnus incana-Lotus pinnatus-Helenium bigelovii* | (*Alnus incana*/Mesic Forb) | 7 | L |
| *Alnus incana-Pinus contorta* | (*Alnus incana*/*Cornus sericea*) | 8 | L |
| *Alnus incana-Pinus contorta-Calocedrus decurrens* | (*Alnus incana*/*Cornus sericea*) | 8 | L |
| *Alnus incana-Pinus contorta-Spiraea densiflora* | (*Alnus incana*/*Cornus sericea*) | 8 | L |
| *Alnus incana-Populus balsamifera* var. *trichocarpa* | (*Alnus incana*/*Cornus sericea*) | 8 | L |
| *Alnus incana-Pteridium aquilinum* | (*Alnus incana*/*Equisetum arvense*) | 7 | L |
| *Alnus incana-Salix lucida* | (*Alnus incana*/*Cornus sericea*) | 8 | L |
| *Alnus incana-Salix* sp. | (*Alnus incana*/*Cornus sericea*) | 8 | L |
| *Alnus incana-Scirpus microcarpus* | (*Alnus incana*/Mesic Graminoid) | 7 | L |
| *Alnus incana-Spiraea densiflora* | (*Alnus incana*/*Ribes hudsonianum*) | 7 | L |
| *Alnus rhombifolia* | (*Populus*/*Betula occidentalis*) | 8 | L |
| *Alnus rhombifolia-Apocynum cannabinum* | (*Populus angustifolia*/*Poa pratensis*) | 6 | E |
| *Alnus rhombifolia-Carex aquatilis* | (*Populus*/*Betula occidentalis*) | 8 | L |

| Greenline component | Winward 2000 equivalent[1] | Stability Class | Successional stage |
|---|---|---|---|
| *Alnus rhombifolia-Mimulus guttatus* | (*Populus angustifolia*/*Poa pratensis*) | 6 | E |
| *Alnus rhombifolia-Paspalum dilatatum.* | (*Populus angustifolia*/*Poa pratensis*) | 6 | E |
| *Alnus rhombifolia-Rubus discolor* | (*Populus*/*Cornus sericea*) | 8 | L |
| *Alnus rhombifolia-Salix exigua* | (*Populus*/*Salix*) | 8 | L |
| *Alnus rhombifolia-Salix exigua-Carex aquatilis* | (*Populus*/*Salix*) | 8 | L |
| *Alnus rhombifolia-Salix exigua-Paspalum dilatatum* | (*Populus*/*Salix*) | 8 | L |
| *Alnus rhombifolia-Salix exigua-Paspalum dilatatum-Carex aquatilis* | (*Populus*/*Salix*) | 8 | L |
| *Alnus rhombifolia-Salix exigua-Rubus discolor* | (*Populus*/*Salix*) | 8 | L |
| *Alnus rhombifolia-Salix exigua-Salix lucida-Carex aquatilis* | (*Populus*/*Salix*) | 8 | L |
| *Alnus rhombifolia-Salix lucida* | (*Populus*/*Salix*) | 8 | L |
| *Alnus rhombifolia-Salix lucida-Carex aquatilis* | (*Populus*/*Salix*) | 8 | L |
| *Alnus rhombifolia-Salix lucida-Carex aquatilis-Solidago occidentalis* | (*Populus*/*Salix*) | 8 | L |
| *Alnus rhombifolia-Salix lucida-Paspalum dilatatum.* | (*Populus*/*Salix*) | 8 | L |
| *Alnus rhombifolia-Salix lucida-Salix exigua* | (*Populus*/*Salix*) | 8 | L |
| *Ambrosia psilostachya* | (Mesic Forb Meadow) | 5 | E |
| *Anthoxanthum odoratum* | (*Alopecurus arundinaceus*) | 6 | E |
| *Athyrium filix-femina* var. *cyclosorum* | (*Equisetum arvense*) | 5 | E |
| Bedrock | Anchored Rock | 10 | L |
| Bedrock- sparse *Alnus incana* | Anchored Rock | 10 | L |
| Bedrock- sparse *Darmera peltata* | Anchored Rock | 10 | L |
| Bedrock- sparse *Salix lucida* and *Carex aquatilis* | Anchored Rock | 10 | L |
| Bedrock with sparse herbs | Anchored Rock | 10 | L |
| Bedrock/Boulder | Anchored Rock | 10 | L |
| Boulder | Anchored Rock | 10 | L |

| Greenline component | Winward 2000 equivalent[1] | Stability Class | Successional stage |
|---|---|---|---|
| Boulder/cobble | Anchored Rock | 10 | L |
| *Boykinia occidentalis* | (*Caltha leptosepala*) | 6 | L |
| *Brickellia californica-Agrostis gigantea-Panicum acuminatum- Mimulus guttatus* | (*Artemisia cana*/Mesic Graminoid) | 5 | E |
| *Carex aquatilis* | *Carex aquatilis* | 9 | L |
| *Carex aquatilis-Carex vesicaria* | *Carex aquatilis* | 9 | L |
| *Carex aquatilis-Darmera peltata* | *Carex aquatilis* | 9 | L |
| *Carex aquatilis-Darmera peltata.* | *Carex aquatilis* | 9 | L |
| *Carex aquatilis-Geum macrophyllum* | *Carex aquatilis* | 9 | L |
| *Carex aquatilis-Glyceria elata* | *Carex aquatilis* | 9 | L |
| *Carex aquatilis-Hypericum mutilum* | *Carex aquatilis* | 9 | L |
| *Carex aquatilis-Juncus effusus* | *Carex aquatilis* | 9 | L |
| *Carex aquatilis-Juncus xiphioides* | *Carex aquatilis* | 9 | L |
| *Carex aquatilis-Lotus oblongifolius* | *Carex aquatilis* | 9 | L |
| *Carex aquatilis-Paspalum dilatatum.* | *Carex aquatilis* | 9 | L |
| *Carex aquatilis-Scirpus microcarpus* | *Carex aquatilis* | 9 | L |
| *Carex aquatilis-Setaria* sp. | *Carex aquatilis* | 9 | L |
| *Carex aquatilis-Solidago occidentalis* | *Carex aquatilis* | 9 | L |
| *Carex nudata* | (*Carex aquatilis*) | 9 | L |
| *Carex pellita* | (*Carex saxatilis*) | 8 | L |
| *Carex* sp. | *Carex aquatilis* | 9 | L |
| *Carex* sp.-*Solidago canadensis* | *Carex aquatilis* | 9 | L |
| *Carex utriculata* | *Carex utriculata* | 9 | L |
| *Carex vesicaria* | (*Carex aquatilis*) | 9 | L |
| *Carex vesicaria-Juncus xiphioides* | (*Carex aquatilis*) | 9 | L |
| *Cephalanthus occidentalis* | (*Cornus sericea*) | 7 | L |
| Cobble with sparse herbs | Barren | 1 | E |

| Greenline component | Winward 2000 equivalent[1] | Stability Class | Successional stage |
|---|---|---|---|
| Cobble/gravel (no vegetation) | Barren | 1 | E |
| Cobbles- sparsely vegetated | Barren | 1 | E |
| *Cornus sericea* | *Cornus sericea* | 7 | L |
| *Cornus sericea-Lotus pinnatus* | *Cornus sericea* | 7 | L |
| *Cornus sericea-Pinus contorta* | *Cornus sericea* | 7 | L |
| *Cornus sericea-Populus balsamifera* var. *trichocarpa* | *Cornus sericea* | 7 | L |
| *Darmera peltata* | (*Typha latifolia*) | 9 | L |
| *Darmera peltata-Carex aquatilis* | (*Typha latifolia*) | 9 | L |
| *Darmera peltata-Glyceria elata* | (*Typha latifolia*) | 9 | L |
| *Darmera peltata-Lotus oblongifolius* | (*Typha latifolia*) | 9 | L |
| *Disturbed* (no vegetation) | Barren | 1 | E |
| *Disturbed* (trail) (no vegetation) | Barren | 1 | E |
| *Dryopteris* sp. | (Mesic Forb Meadow) | 5 | E |
| *Euthamia occidentalis* | (*Solidago canadensis*) | 8 | L |
| Forbs/grass – dense | Mesic Forb Meadow | 5 | E |
| Forbs/grass – sparse | Mesic Forb Meadow | 5 | E |
| *Fraxinus latifolia* | (*Populus tremuloides*/Mesic Forb) | 7 | L |
| *Glyceria elata* | *Glyceria* spp. | 8 | E/L |
| Grass | (Mesic Forb Meadow) | 5 | E |
| Grass-*Galium trifidum* | (Mesic Forb Meadow) | 5 | E |
| *Helenium bigelovii* | (Mesic Forb Meadow) | 5 | E |
| *Hosackia oblongifolia* | (Mesic Forb Meadow) | 5 | E |
| *Hypericum mutilum – Cephalanthus occidentalis* | (*Cornus sericea*) | 7 | L |
| *Hypericum mutilum* – w/Boulders | (Rock) | 10 | |
| *Juncus effusus* | (*Juncus balticus*) | 9 | L |
| *Juncus xiphioides* | (*Juncus ensifolius*) | 7 | L |

| Greenline component | Winward 2000 equivalent[1] | Stability Class | Successional stage |
|---|---|---|---|
| *Juncus xiphioides -Scirpus microcarpus - Carex* sp. | (*Juncus ensifolius*) | 7 | L |
| *Juncus xiphioides-Carex aquatilis* | (*Juncus ensifolius*) | 7 | L |
| *Juncus xiphioides-Carex aquatilis-Lotus oblongifolius* | (*Juncus ensifolius*) | 7 | L |
| *Juncus xiphioides-Eleocharis acicularis* | (*Juncus ensifolius*) | 7 | L |
| *Juncus xiphioides-Geum macrophyllum* | (*Juncus ensifolius*) | 7 | L |
| *Juncus xiphioides-Glyceria* sp. | (*Juncus ensifolius*) | 7 | L |
| *Juncus xiphioides-Hypericum anagalloides* | (*Juncus ensifolius*) | 7 | L |
| *Juncus xiphioides-Lotus oblongifolius* | (*Juncus ensifolius*) | 7 | L |
| *Juncus xiphioides-Lotus pinnatus* | (*Juncus ensifolius*) | 7 | L |
| *Juncus xiphioides-Lotus pinnatus-Senecio triangularis* | (*Juncus ensifolius*) | 7 | L |
| *Juncus xiphioides-Poa* sp. | (*Juncus ensifolius*) | 7 | L |
| *Juncus xiphioides-Scirpus microcarpus* | (*Juncus ensifolius*) | 7 | L |
| *Juncus xiphioides-Scirpus microcarpus-Equisetum arvense* | (*Juncus ensifolius*) | 7 | L |
| Large Woody Debris (logs) | Anchored Log | 10 | L |
| *Lotus oblongifolius* | (Mesic Forb Meadow) | 5 | E |
| *Lotus oblongifolius-Stachys alba* | (Mesic Forb Meadow) | 5 | E |
| *Lotus pinnatus* | (Mesic Forb Meadow) | 5 | E |
| *Lotus* sp. | (Mesic Forb Meadow) | 5 | E |
| *Ludwigia* sp. | (*Nasturtium officinale*) | 4 | E |
| *Ludwigia* sp. – *Eleocharis* sp.-*Polygonum* sp. | (*Nasturtium officinale*) | 4 | E |
| *Lupinus* sp. | (*Lupinus polyphyllus-Senecio triangularis*) | 5 | E |
| *Lycopus americanus – Paspalum dilatatum* | (*Mentha arvensis*) | 4 | E |
| *Mimulus guttatus* | *Mimulus guttatus* | 3 | E/L |
| *Mimulus guttatus-Equisetum arvense* | *Mimulus guttatus* | 3 | E/L |
| Mixed Forbs – (*Prunella vulgaris, Panicum acuminatum, Mimulus guttatus, Xanthium strumarium, Solidago occidentalis, Bidens* sp., *Mentha arvensis, Aster campestris*) | Mesic Forb Meadow | 5 | E/L |

| Greenline component | Winward 2000 equivalent[1] | Stability Class | Successional stage |
|---|---|---|---|
| Mixed herb community (8 co-dominant sp.) | (Mesic Forb Meadow) | 5 | E |
| *Myrica hartwegii* | (Low *Salix* / Mesic Forb) | 8 | L |
| *Myrica hartwegii-Darmera peltata* | (Low *Salix* / Mesic Forb) | 8 | L |
| *Myrica hartwegii-Juncus xiphioides* | (Low *Salix* / Mesic Forb) | 8 | L |
| *Myrica hartwegii-Rhododendron occidentale* | (Low *Salix* / Mesic Forb) | 8 | L |
| *Myrica hartwegii-Scirpus macrocarpus* | (Low *Salix* / Mesic Forb) | 8 | L |
| *No greenline* | Barren | 1 | E |
| *Palustrine emergent* community (10 co-dominant sp.) | (*Scirpus microcarpus*) | 9 | L |
| *Panicum* sp. | (*Agrostis scabra*) | 2 | E |
| *Paspalum dilatatum* | (*Alopecurus arundinaceaus*) | 6 | E |
| *Paspalum dilatatum-Bidens frondosa-Polygonum* sp.-*Typha* | (Mesic Forb Meadow) | 5 | E |
| *Paspalum dilatatum-Hypericum mutilum* | (Mesic Forb Meadow) | 5 | E |
| *Pinus contorta* | *Pinus contorta/Carex scopulorum* | 8 | L |
| *Pinus contorta-Alnus incana* | Conifer/*Cornus sericea* | 8 | L |
| *Pinus contorta-Alnus incana-Spiraea densiflora* | Conifer/*Cornus sericea* | 8 | L |
| *Pinus contorta-Carex aquatilis* | *Pinus contorta/Carex scopulorum* | 8 | L |
| *Pinus contorta-Glyceria elata* | *Pinus contorta/Carex scopulorum* | 8 | L |
| *Pinus contorta-Spiraea densiflora* | Conifer/*Rosa woodsii* | 7 | E |
| *Pinus jeffreyi* | (Conifer/Mesic Forb) | 6 | L |
| *Poa* sp. | (*Poa pratensis*) | 3 | E |
| *Polygonum persicaria* | (*Equisetum* spp.) | 7 | E |
| *Pteridium aquilinum* | (*Equisetum* spp.) | 7 | E |
| Recreation disturbed (no vegetation) | Barren | 1 | E |
| *Rhododendron occidentale* | (*Rosa woodsii*) | 6 | L |
| *Rhododendron occidentale - Pteridium aquilinum* | (*Rosa woodsii*) | 6 | L |

| Greenline component | Winward 2000 equivalent[1] | Stability Class | Successional stage |
|---|---|---|---|
| *Rhododendron occidentale –Myrica hartwegii- Spiraea densiflora* | (*Rosa woodsii*) | 6 | L |
| *Rosa pisocarpa* subsp. *ahartii* | (*Rosa woodsii*) | 7 | L |
| *Rosa* sp.-*Glyceria elata* | (*Rosa woodsii*) | 6 | E |
| *Rubus armeniacus* | (*Salix exigua*/*Rosa woodsii*) | 8 | E |
| *Salix exigua* | (*Salix exigua*/Barren) | 6 | E |
| *Salix exigua* – w/boulders | (*Salix exigua*/Barren) | 6 | E |
| *Salix exigua* var. *hindsiana* | (*Salix exigua*/Mesic Graminoid) | 8 | E |
| *Salix exigua-Carex aquatilis* | (*Salix exigua*/Mesic Graminoid) | 8 | E |
| *Salix exigua-Rubus discolor* | (*Salix exigua*/*Rosa woodsii*) | 8 | E |
| *Salix exigua-Rubus discolor-Paspalum dilatatum* | (*Salix exigua*/*Rosa woodsii*) | 8 | E |
| *Salix exigua-Salix lucida* | (*Salix exigua*/*Rosa woodsii*) | 8 | E |
| *Salix exigua-Solidago occidentalis* | (*Salix exigua*/Mesic Forb) | 7 | E |
| *Salix geyeriana* | (*Salix geyeriana*/Mesic Graminoid) | 8 | L |
| *Salix jepsonii* | (*Salix lemmonii*/Mesic Forb) | 7 | L |
| *Salix jepsonii-Darmera peltata* | (*Salix*/Tall Forb) | 7 | L |
| *Salix laevigata* | (*Salix lasiandra*/Mesic Forb) | 7 | E |
| *Salix lasiandra* | *Salix lasiandra*/Mesic Forb | 7 | E |
| *Salix lasiolepis* | *Salix lasiolepis*/Barren | 6 | E |
| *Salix lasiolepis /Verbena hastata* | *Salix lasiolepis*/Barren | 6 | E |
| *Salix lasiolepis /Verbena hastata/Fraxinus latifolia* | *Salix lasiolepis*/Barren | 6 | E |
| *Salix lasiolepis*-mixed forbs (*Prunella vulgaris, Panicum acuminatum, Mimulus guttatus, Xanthium* sp., *Solidago occidentalis, Bidens* sp., *Mentha arvensis, Aster campestris*) | *Salix lasiolepis*/Barren | 6 | E |
| *Salix lucida* | *Salix lasiandra*/Mesic Forb | 7 | E |
| *Salix lucida-Carex aquatilis* | *Salix lasiandra*/Mesic Forb | 7 | E |
| *Salix lucida-Populus fremontii* (saplings) | *Salix lasiandra*/Mesic Forb | 7 | E |

| Greenline component | Winward 2000 equivalent[1] | Stability Class | Successional stage |
|---|---|---|---|
| *Salix lucida-Rubus discolor* | *Salix lasiandra*/Mesic Forb | 7 | E |
| *Salix lucida-Salix exigua-Carex aquatilis-Melilotus alba* | *Salix lasiandra*/Mesic Forb | 7 | E |
| *Salix lucida-Salix exigua-Rubus discolor-Carex aquatilis* | *Salix lasiandra*/Mesic Forb | 7 | E |
| *Salix* sp. | (*Salix*/Mesic Graminoid) | 8 | L |
| *Salix* sp. (saplings)-*Juncus xiphioides* | *Salix*/Mesic Graminoid | 8 | L |
| *Salix* sp.- *Scirpus microcarpus* | *Salix*/Mesic Graminoid | 8 | L |
| *Salix* sp.-*Scirpus microcarpus-Juncus xiphioides* | *Salix*/Mesic Graminoid | 8 | L |
| *Scirpus diffusus* | (*Scirpus microcarpus*) | 9 | L |
| *Scirpus microcarpus* | *Scirpus microcarpus* | 9 | L |
| *Scirpus microcarpus* – grass | *Scirpus microcarpus* | 9 | L |
| *Scirpus microcarpus-Eleocharis acicularis* | *Scirpus microcarpus* | 9 | L |
| *Scirpus microcarpus-Juncus effusus* | *Scirpus microcarpus* | 9 | L |
| *Scirpus microcarpus-Juncus effusus-Glyceria elata* | *Scirpus microcarpus* | 9 | L |
| *Scirpus microcarpus-Juncus effusus-Juncus xiphioides* | *Scirpus microcarpus* | 9 | L |
| *Scirpus microcarpus-Solidago canadensis* | *Scirpus microcarpus* | 9 | L |
| *Senecio triangularis* | (Mesic Forb Meadow) | 5 | E |
| *Senecio triangularis*-grass | (Mesic Forb Meadow) | 5 | E |
| *Solidago canadensis* | *Solidago canadensis* | 8 | L |
| *Spiraea densiflora* | (*Rosa woodsii*) | 6 | E |
| *Spiraea densiflora-Carex aquatilis* | (*Rosa woodsii*) | 6 | E |
| *Spiraea densiflora-Lotus pinnatus* | (*Rosa woodsii*) | 6 | E |
| *Spiraea densiflora-Lotus pinnatus-Juncus xiphioides-Glyceria elata* | (*Rosa woodsii*) | 6 | E |
| *Spiraea densiflora-Pinus contorta* | (*Rosa woodsii*) | 6 | E |
| *Spiraea splendens* | (*Rosa woodsii*) | 6 | E |
| Unidentified grass | (Mesic Forb Meadow) | 5 | E |

| Greenline component | Winward 2000 equivalent[1] | Stability Class | Successional stage |
|---|---|---|---|
| *Verbena hastata* | (Mesic Forb Meadow) | 5 | E |
| *Verbena hastata – Hypericum mutilum* | (Mesic Forb Meadow) | 5 | E |
| *Verbena hastata* – sparse with boulders | (Anchored Rock) | 9 | L |
| *Verbena hastata* – w/ boulder | (Anchored Rock) | 9 | L |
| *Vitis californica* | (*Rosa woodsii*) | 6 | E |
| Wood | Anchored Log | 10 | L |

[1] Source: Appendix B in Winward (2000); those in parentheses were not listed in Winward (2000) and therefore were translated based on equivalent species and professional determination.

# APPENDIX F1

## Incidental Observations of Avian Species in the Study Area

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## Incidental Observations of Avian Species in the Study Area (2016–2019)

| Common Name | Scientific Name |
|---|---|
| Canada goose | *Branta canadensis* |
| mallard | *Anas platyrhynchos* |
| cinnamon teal | *Spatula cyanoptera* |
| bufflehead | *Bucephala albeola* |
| common merganser | *Mergus merganser* |
| mountain quail | *Oreortyx pictus* |
| common loon | *Gavia immer* |
| pied-billed grebe | *Podilymbus podiceps* |
| eared grebe | *Podiceps nigricollis* |
| western grebe | *Aechmophorus occidentalis* |
| red-necked grebe | *Podiceps grisegena* |
| turkey vulture | *Cathartes aura* |
| osprey | *Pandion haliaetus* |
| sharp-shinned hawk | *Accipiter striatus* |
| northern goshawk | *Accipiter gentillis* |
| Cooper's hawk | *Accipiter cooperii* |
| red-tailed hawk | *Buteo jamaicensis* |
| American kestrel | *Falco sparverius* |
| peregrine falcon | *Falco peregrinus* |
| killdeer | *Charadrius vociferus* |
| spotted sandpiper | *Actitis macularius* |
| band-tailed pigeon | *Patagioenas fasciata* |
| California spotted owl | *Strix occidentalis occidentalis* |
| common nighthawk | *Chordeiles minor* |
| Vaux’s swift | *Chaetura vauxi* |
| red-breasted sapsucker | *Sphyrapicus ruber* |
| hairy woodpecker | *Picoides villosus* |
| white-headed woodpecker | *Picoides albolarvatus* |
| northern flicker | *Colaptes auratus* |
| pileated woodpecker | *Dryocopus pileatus* |
| olive-sided flycatcher | *Contopus cooperi* |
| western wood-pewee | *Contopus sordidulus* |
| dusky flycatcher | *Empidonax oberholseri* |
| black phoebe | *Sayornis nigricans* |
| Cassin’s vireo | *Vireo cassinii* |
| warbling vireo | *Vireo gilvus* |
| Steller's jay | *Cyanocitta stelleri* |
| Clark’s nutcracker | *Nucifraga columbiana* |
| American crow | *Corvus brachyrhynchos* |
| common raven | *Corvus corax* |
| northern rough-winged swallow | *Stelgidopteryx serripennis* |
| tree swallow | *Tachycineta bicolor* |

| Common Name | Scientific Name |
|---|---|
| bushtit | *Psaltriparus minimus* |
| mountain chickadee | *Poecile gambeli* |
| brown creeper | *Certhia americana* |
| red-breasted nuthatch | *Sitta canadensis* |
| white-breasted nuthatch | *Sitta carolinensis* |
| rock wren | *Salpinctes obsoletus* |
| golden-crowned kinglet | *Regulus satrapa* |
| Townsend's solitaire | *Myadestes townsendi* |
| mountain bluebird | *Sialia currucoides* |
| hermit thrush | *Catharus guttatus* |
| American robin | *Turdus migratorius* |
| orange-crowned warbler | *Oreothlypis celata* |
| Nashville warbler | *Oreothlypis ruficapilla* |
| yellow warbler | *Dendroica petechia* |
| yellow-rumped warbler | *Setophaga coronata* |
| hermit warbler | *Setophaga occidentalis* |
| MacGillivray's warbler | *Geothlypis tolmiei* |
| Wilson's warbler | *Cardellina pusilla* |
| western tanager | *Piranga ludoviciana* |
| spotted towhee | *Pipilo maculatus* |
| California towhee | *Melozone crissalis* |
| rufous-crowned sparrow | *Aimophila ruficeps* |
| chipping sparrow | *Spizella passerina* |
| fox sparrow | *Passerella iliaca* |
| dark-eyed junco | *Junco hyemalis* |
| Brewer’s blackbird | *Euphagus cyanocephalus* |
| black-headed grosbeak | *Pheucticus melanocephalus* |
| evening grosbeak | *Coccothraustes vespertinus* |
| Cassin’s finch | *Haemorhous cassinii* |
| purple finch | *Haemorhous purpureus* |

# APPENDIX F2

## Bald Eagle Survey Forms

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STATE OF CALIFORNIA THE
RESOURCE AGENCY
DEPARTMENT OF FISH AND GAME

# BALD EAGLE BREEDING SURVEY INSTRUCTIONS

The breeding season of bald eagles in California extends primarily from February through July. Each year cooperating agencies, organizations, and private individuals participate in a statewide monitoring program to document nesting activities at each nesting territory. In 1997, 160 recently active breeding territories were surveyed, and the number increases yearly.

Annual breeding season surveys are an important part of the population recovery effort. Survey information is used by resource agencies to aid breeding territory management or protection activities. Additionally, population status and trends must be monitored annually to provide the data needed for assessing population recovery.

Specific assignments and scheduling of observer time are usually handled at the agency district or regional office level. In general, agencies are responsible for surveys or territories on or near their own lands, with Department of Fish and Game also surveying on private lands. Field personnel should coordinate with other agencies or volunteers to avoid duplication of effort or to arrange for survey help.

The bald eagle breeding population is increasing annually. So, it is important that suspected new nesting territories be adequately checked, especially early in the breeding season.

Territories should be checked at least three times during the nesting season, although more frequent checking is preferred. Emphasis should be placed on checking during incubation and early nesting periods.

1. **Early March (early incubation)** – Territories in northern California should be checked in the first half of March, if possible, or as soon thereafter as road or weather conditions allow. The purpose of the first check is to determine whether a territory is occupied (record presence of adults, courtship behavior, evidence of nest repair or construction, incubation).
2. **Late April or early May (early nesting period)** – This check is needed to confirm that a territory is unoccupied, or if occupied in March, to determine whether the breeding pair is still tending the nest (incubating eggs or tending young nestlings).
3. **Mid-June (late nesting period)** – The main purpose of this check is to determine how many nestlings are approaching fledgling age.

Survey dates maybe modified from these recommended time periods if the territories can be checked more frequently or if particular breeding pairs are known to begin nesting especially early or late in the season.

We recommend that observers report the stage of development of nestlings in accordance with An Illustrated Guide for Identifying Developmental Stages of Bald Eagle Nestlings in the Field, by G.P. Carpenter (April 1990). This booklet is available from the San Francisco Zoological Society, Sloat Blvd. At the Pacific Ocean, San Francisco, CA  94132 (415-753-7080).

## SUBMITTAL OF SURVEY FORMS

Please report observations on the **CALIFORNIA BALD EALGE NESTING TERRITORY FORM (revised 4/2010)**.

Please mail all completed forms by September 1 of the survey year to:

California Department of Fish and Game
Wildlife Branch
1812 Ninth St.
Sacramento, CA 95814
ATTN: Carie Battistone

Forms will be maintained in Department files and annual survey results will be compiled on the basis of these reports.  If you have any questions, please contact Carie Battistone at the above address or at cbattistone@dfg.ca.gov. Electronic forms can be found at http://www.dfg.ca.gov/wildlife/nongame/survey_monitor.html.

**California Department of Fish and Game**
**CALIFORNIA BALD EAGLE NESTING**

**TERRITORY SURVEY FORM**

Revised 4/2010

**Territory Code:** IHR

**County:** El Dorado **Survey Year:** 2019

**Property Owner:** USFS **If USFS:** El Dorado National Forest

**Name (or general location of territory):** Ice House Reservoir

**Name of nearest water body:** Ice House Reservoir

**Location of Nest Site:**

**UTM E:** N/A **UTM N**: N/A **Zone:** N/A

**No. of nests in territory -** **Intact:** 0 **Remnant:** 0

**Nest Tree: Species:** N/A **Year Last Used:** N/A

**NOTE: Please attach a map showing the location of any newly documented nest tree.**

**Describe tree and nest condition and size and add other remarks**: No evidence of BAEA nesting observed.

For each visit to a territory, note, in detail, the times, number and age of birds, behavior of birds (lying, perching, etc.), evidence of nesting (nest maintenance, courtship, incubation posture), disturbances, and other pertinent information:

| Observers | Date | Observations/Notes |
|---|---|---|
| Krista Orr<br>Steven Wood | 03.25.19<br>(07:00 to 11:30) | Early Breeding Season Survey:<br>• Reservoir fully covered with snow and ice; survey conducted from vantage points on dam and parking lot for boat ramp on west end of reservoir.<br>• No BAEA activity observed.<br>• No recreational activity. |
| Eric Sommerauer<br>Krista Orr<br>Michael Scaffidi<br>Steven Wood | 05.13.19<br>(14:00 to 18:30) | Incidental BAEA observations made during preconstruction nesting raptor surveys on Lakeshore Road along northern perimeter of Ice House Reservoir:<br>• 17:30 – Adult BAEA flying W from SE end of reservoir, perching in fir on south shore of reservoir.<br>• 18:15 – Adult BAEA departing perch in fir and flying NE over reservoir. |

| Observers | Date | Observations/Notes |
|---|---|---|
| Eric Sommerauer<br>Michael Scaffidi<br>Krista Orr<br>Steven Wood | 05.14.19<br>(09:45 to 20:15) | Mid Breeding Season Survey:<br>• After visiting the potentially failed nest at Union Valley Reservoir for an additional reproductive status check, surveyors (2) observed from land-based vantage points and while in boat on reservoir; additional surveyors (2) joined at 14:15 after completing BAEA surveys at Loon Lake.<br>• 16:30 – Adult BAEA (male) perched in snag located on SE perimeter of reservoir.<br>• 17:30 – Adult BAEA (male) departing perch after altercation with osprey (osprey nest noted approximately 0.25 mi W) and relocating to perch approximately 300 ft W. BAEA vocalizations heard from farther SW, indicating presence of additional bird.<br>• 18:00 – Adult BAEA (female) observed in large snag on S side of reservoir.<br>• 18:25 – Adult BAEA (female) departing snag on S side of reservoir and relocating to dominant sugar pine on S side of reservoir across from Strawberry Point. Surrounding area thoroughly canvassed by foot for further evidence of BAEA activity and indication of nesting: whitewash noted under snag and sugar pine, but no nest located.<br>• Survey concluded at 20:15, with both adult BAEA remaining in their separate, respective locations after sunset.<br>• Recreation activity low (3 fishing boats); no BAEA disturbance observed. |

| Observers | Date | Observations/Notes |
|---|---|---|
| Krista Orr<br>Eric Sommerauer<br>Steven Wood<br>Emily Applequist | 06.11.19<br>(07:00 to 12:00)<br>(19:00 to 20:30) | Late Season Survey:<br>• SMUD staff (E. Koenigs) reported an altercation between an adult BAEA and an osprey at Ice House Reservoir on 06.05.19.<br>• Late breeding season surveys conducted in conjunction with preconstruction nesting raptor surveys along North Union Valley Road (staff split between objectives with 2 to 3 surveyors observing from established vantage points on Ice House Reservoir at times indicated).<br>• Suitable habitat around Ice House Reservoir surveyed for indication of BAEA presence and nesting by boat and foot, including area on S perimeter of reservoir across from Strawberry Point where multiple BAEA observations made in previous surveys.<br>• No BAEA observations during morning observations.<br>• 19:10 – Pair of adult BAEA perched in previously documented tree on S side of reservoir across from Strawberry Point.<br>• 19:45 – Adult BAEA (male) departing perch and relocating in small fir approximately 150 ft E.<br>• 20:05 – Adult BAEA (female) departing perch and flying west approximately 0.25 mi.<br>• Recreational activity heavy (approximately 10 multi-passenger boats and many SUPs, tubers, and kayaks); no BAEA disturbance observed. |

<table>
<tr><th>Observers</th><th>Date</th><th>Observations/Notes</th></tr>
<tr><td>Krista Orr<br>Steven Wood</td><td>06.12.19<br>(06:30 to 07:15)<br>(17:55 to 19:00)</td><td><u>Additional reproductive status check during late breeding season</u>:<br>• While in the area for mid breeding season survey at Loon Lake (delayed due to elevation), surveyors stopped by in early morning and late evening at indicated times for additional observation of area S of Strawberry Point due to repeat BAEA observations in the vicinity. Observations made from land-based vantage point on Strawberry Point.<br>• 07:00 – Adult BAEA (female) perched in snag with broken top upslope and approximately 100 ft E of previously documented dominant sugar pine across from Strawberry Point.<br>• 07:10 – Adult BAEA (female) departing perch and relocating to previously documented dominant sugar pine.<br>• 18:15 – Adult BAEA (female) perched in previously documented dominant sugar pine across from Strawberry Point.<br>• 19:00 – Adult BAEA (female) departing perch and relocating to sugar pine (newly documented perch) approximately 0.5 mi W.</td></tr>
<tr><td>Krista Orr<br>Steven Wood</td><td>07.09.19<br>(17:45 to 20:15)</td><td><u>Additional reproductive status check during late breeding season</u>:<br>• While in the area for late breeding season survey at Loon Lake (delayed due to elevation), surveyors returned in late evening at indicated time for additional observation of area S of Strawberry Point due to repeat BAEA observations in the vicinity. Observations made from boat and on foot in areas accessed by boat.<br>• 18:15 – Adult BAEA (female) perched in previously documented dominant sugar pine across from Strawberry Point.<br>• 19:00 – Adult BAEA (male) perched in prominent snag on SE end of reservoir.<br>• S side of reservoir across from Strawberry Point thoroughly canvassed again by foot for further evidence of BAEA activity: no indication of nesting.</td></tr>
</table>

**SUMMARY:**

**A. Successful Nestings:** 0 **No. of young known fledged:** 0 **or probably fledged:** 0

**B. If no fledglings were produced this season please answer the following:**

**How many adults seen in the territory**? 2

**Was there evidence of nest repair or construction?** No

**Were adults seen in the nest?** No

**Were adults in incubating posture?** No

**Number of nestlings observed?** 0

**Failed during incubation or nesting stage?** N/A

**Other remarks:** Territory last surveyed in 2016 in accordance with frequency outlined in SMUD's monitoring plan.

**Observer Contact Information:**

Surveys conducted by Stillwater Sciences, contractors for the Sacramento Municipal Utility District. For additional information contact Ethan Koenigs, SMUD Project Manager (Ethan.Koenigs@smud.org).

STATE OF CALIFORNIA THE
RESOURCE AGENCY
DEPARTMENT OF FISH AND GAME

# BALD EAGLE BREEDING SURVEY INSTRUCTIONS

The breeding season of bald eagles in California extends primarily from February through July. Each year cooperating agencies, organizations, and private individuals participate in a statewide monitoring program to document nesting activities at each nesting territory. In 1997, 160 recently active breeding territories were surveyed, and the number increases yearly.

Annual breeding season surveys are an important part of the population recovery effort. Survey information is used by resource agencies to aid breeding territory management or protection activities. Additionally, population status and trends must be monitored annually to provide the data needed for assessing population recovery.

Specific assignments and scheduling of observer time are usually handled at the agency district or regional office level. In general, agencies are responsible for surveys or territories on or near their own lands, with Department of Fish and Game also surveying on private lands. Field personnel should coordinate with other agencies or volunteers to avoid duplication of effort or to arrange for survey help.

The bald eagle breeding population is increasing annually. So, it is important that suspected new nesting territories be adequately checked, especially early in the breeding season.

Territories should be checked at least three times during the nesting season, although more frequent checking is preferred. Emphasis should be placed on checking during incubation and early nesting periods.

1. **Early March (early incubation)** – Territories in northern California should be checked in the first half of March, if possible, or as soon thereafter as road or weather conditions allow. The purpose of the first check is to determine whether a territory is occupied (record presence of adults, courtship behavior, evidence of nest repair or construction, incubation).
2. **Late April or early May (early nesting period)** – This check is needed to confirm that a territory is unoccupied, or if occupied in March, to determine whether the breeding pair is still tending the nest (incubating eggs or tending young nestlings).
3. **Mid-June (late nesting period)** – The main purpose of this check is to determine how many nestlings are approaching fledgling age.

Survey dates maybe modified from these recommended time periods if the territories can be checked more frequently or if particular breeding pairs are known to begin nesting especially early or late in the season.

We recommend that observers report the stage of development of nestlings in accordance with An Illustrated Guide for Identifying Developmental Stages of Bald Eagle Nestlings in the Field, by G.P. Carpenter (April 1990). This booklet is available from the San Francisco Zoological Society, Sloat Blvd. At the Pacific Ocean, San Francisco, CA  94132 (415-753-7080).

## SUBMITTAL OF SURVEY FORMS

Please report observations on the **CALIFORNIA BALD EALGE NESTING TERRITORY FORM (revised 4/2010**).

Please mail all completed forms by September 1 of the survey year to:

California Department of Fish and Game
Wildlife Branch
1812 Ninth St.
Sacramento, CA 95814
ATTN: Carie Battistone

Forms will be maintained in Department files and annual survey results will be compiled on the basis of these reports.  If you have any questions, please contact Carie Battistone at the above address or at cbattistone@dfg.ca.gov. Electronic forms can be found at http://www.dfg.ca.gov/wildlife/nongame/survey_monitor.html.

**California Department of Fish and Game**
**CALIFORNIA BALD EAGLE NESTING**

**TERRITORY SURVEY FORM**

Revised 4/2010

**Territory Code:** LLR

**County:** El Dorado **Survey Year:** 2019

**Property Owner:** USFS **If USFS:** El Dorado National Forest

**Name (or general location of territory):** Loon Lake Reservoir

**Name of nearest water body:** Loon Lake Reservoir

**Location of Nest Site:**

**UTM E:** 733613 **UTM N**: 4319278 **Zone:** 10S

**No. of nests in territory - Intact:** ____ **Remnant:** 1

**Nest Tree: Species:** Jeffrey Pine **Year Last Used:** 2018

**NOTE: Please attach a map showing the location of any newly documented nest tree.**

**Describe tree and nest condition and size and add other remarks**: Dominant Jeffrey pine located on south side of Loon Lake west of the summer camp; nest structure deteriorated and unused in 2019.

For each visit to a territory, note, in detail, the times, number and age of birds, behavior of birds (lying, perching, etc.), evidence of nesting (nest maintenance, courtship, incubation posture), disturbances, and other pertinent information:

| Observers | Date | Observations/Notes |
|---|---|---|
| Krista Orr<br>Steven Wood | 05.14.19<br>(07:15 to 13:00) | Early Breeding Season Survey (postponed due to elevation and weather conditions):<br>• Main body of Loon Lake approximately 90% iced over, but far eastern portion (i.e., Pleasant Lake) mostly free of ice at time of survey.<br>• Nest from previous year appeared empty with notable amount of snow on top.<br>• 09:10 – Adult BAEA observed flying east to west toward dam.<br>• 10:15 – Adult BAEA observed perched in snag on NW side of reservoir.<br>• No additional BAEA activity observed on lake or at nest tree from previous year.<br>• Survey ended early due to inaccessibility of other land-based vantage points and unsafe conditions for boating on lake.<br>• No recreational activity observed. |

| Observers | Date | Observations/Notes |
|---|---|---|
| Steven Wood<br>Krista Orr | 06.12.19<br>(08:00 to 16:45) | <u>Mid Breeding Season Survey:</u><br>• 08:00 – Surveyors split up and alternate observations from dam and spillway.<br>• No BAEA activity observed over lake or at nest site from previous year.<br>• 10:45 – Surveyors launch boat from vantage point west of spillway; suitable habitat around Loon Lake and Pleasant Lake, including previously documented roosts and perches, surveyed for BAEA and/or evidence of BAEA presence by boat and foot.<br>• No BAEA activity or evidence of nesting observed.<br>• 13:00 – Surveyors land boat at vantage point on south shore, observe lake, and cross-country hike to nest site from previous year.<br>• 13:45 – Nest from previous year present but deteriorated in comparison to previous year and determined to be inactive (no BAEA activity and lack of evidence of occupancy or attempted nest building); suitable habitat in surrounding area surveyed for BAEA and/or evidence of BAEA presence by foot.<br>• 15:45 – Surveyors launch boat from vantage point on south shore, observe from lake, and return to launching point.<br>• No BAEA activity observed.<br>• Recreational activity low (3 fishing boats and 2 kayaks); maintenance activity at North Shore Campground with moderate noise; no BAEA disturbance observed.<br>• 16:45 – Surveyors split up and observe from two vantage points on nearby Gerle Reservoir due to anecdotal reports from SMUD staff of BAEA activity in area; suitable habitat around reservoir surveyed for evidence of nesting attempt. No BAEA or evidence of BAEA nesting observed. |

| Observers | Date | Observations/Notes |
|---|---|---|
| Krista Orr<br>Steven Wood | 07.09.19<br>(07:30 to 16:30) | Late Breeding Season Survey:<br>• 07:30 – Surveyors split up and alternate observations from dam and spillway.<br>• No BAEA activity observed over lake or at nest site from previous year.<br>• 09:45 – Surveyors launch boat from spillway; suitable habitat around Loon Lake and Pleasant Lake surveyed for BAEA and/or evidence of BAEA presence by boat.<br>• 11:30 – Adult BAEA flying W to E in southern section of Pleasant Lake.<br>• 11:50 – Adult BAEA flying S to N toward northern section of Pleasant Lake.<br>• 12:30 – Area surrounding Pleasant Lake, including previously documented roosts and perches around Pleasant Lake, canvassed for BAEA and/or evidence of BAEA nesting (no additional BAEA activity and no evidence of nesting attempt).<br>• 14:00 – Surveyors land boat at vantage point on south shore, observe lake, and cross-country hike to nest site from previous year: site unchanged from previous visit and no evidence of nesting or BAEA presence.<br>• 16:00 – Surveyors launch boat from vantage point on south shore, observe from lake, and return to launching point.<br>• No additional BAEA activity observed.<br>• Recreational activity moderate to high (8 fishing boats, 5 kayaks, 3 people fishing from spillway, and approximately 10 jeepers); maintenance activity at North Shore Campground with moderate noise; no BAEA disturbance observed. |

**SUMMARY:**

**A. Successful Nestings:** 0 **No. of young known fledged:** 0 **or probably fledged:** N/A

**B. If no fledglings were produced this season please answer the following:**

**How many adults seen in the territory**? 2

**Was there evidence of nest repair or construction?** No

**Were adults seen in the nest?** No

**Were adults in incubating posture?** No

**Number of nestlings observed?** 0

**Failed during incubation or nesting stage?** N/A

**Other remarks:** No evidence of nesting attempt observed (e.g., nest building or courtship behavior)

**Observer Contact Information:**

Surveys conducted by Stillwater Sciences, contractors for the Sacramento Municipal Utility District. For additional information contact Ethan Koenigs, SMUD Project Manager (Ethan.Koenigs@smud.org).

STATE OF CALIFORNIA THE
RESOURCE AGENCY
DEPARTMENT OF FISH AND GAME

# BALD EAGLE BREEDING SURVEY INSTRUCTIONS

The breeding season of bald eagles in California extends primarily from February through July. Each year cooperating agencies, organizations, and private individuals participate in a statewide monitoring program to document nesting activities at each nesting territory. In 1997, 160 recently active breeding territories were surveyed, and the number increases yearly.

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The bald eagle breeding population is increasing annually. So, it is important that suspected new nesting territories be adequately checked, especially early in the breeding season.

Territories should be checked at least three times during the nesting season, although more frequent checking is preferred. Emphasis should be placed on checking during incubation and early nesting periods.

1. **Early March (early incubation)** – Territories in northern California should be checked in the first half of March, if possible, or as soon thereafter as road or weather conditions allow. The purpose of the first check is to determine whether a territory is occupied (record presence of adults, courtship behavior, evidence of nest repair or construction, incubation).
2. **Late April or early May (early nesting period)** – This check is needed to confirm that a territory is unoccupied, or if occupied in March, to determine whether the breeding pair is still tending the nest (incubating eggs or tending young nestlings).
3. **Mid-June (late nesting period)** – The main purpose of this check is to determine how many nestlings are approaching fledgling age.

Survey dates maybe modified from these recommended time periods if the territories can be checked more frequently or if particular breeding pairs are known to begin nesting especially early or late in the season.

We recommend that observers report the stage of development of nestlings in accordance with An Illustrated Guide for Identifying Developmental Stages of Bald Eagle Nestlings in the Field, by G.P. Carpenter (April 1990). This booklet is available from the San Francisco Zoological Society, Sloat Blvd. At the Pacific Ocean, San Francisco, CA 94132 (415-753-7080).

## SUBMITTAL OF SURVEY FORMS

Please report observations on the **CALIFORNIA BALD EALGE NESTING TERRITORY FORM (revised 4/2010)**.

Please mail all completed forms by September 1 of the survey year to:

California Department of Fish and Game
Wildlife Branch
1812 Ninth St.
Sacramento, CA 95814
ATTN: Carie Battistone

Forms will be maintained in Department files and annual survey results will be compiled on the basis of these reports. If you have any questions, please contact Carie Battistone at the above address or at cbattistone@dfg.ca.gov. Electronic forms can be found at http://www.dfg.ca.gov/wildlife/nongame/survey_monitor.html.

**California Department of Fish and Game**
**CALIFORNIA BALD EAGLE NESTING**

**TERRITORY SURVEY FORM**

Revised 4/2010

**Territory Code:** UVR

**County:** El Dorado **Survey Year:** 2019

**Property Owner:** USFS **If USFS:** El Dorado National Forest

**Name (or general location of territory):** Union Valley Reservoir

**Name of nearest water body:** Union Valley Reservoir

**Location of Nest Site:**

**UTM E:** 725334 **UTM N**: 4305602 **Zone:** 10S

**No. of nests in territory - Intact:** ____ **Remnant:** 1

**Nest Tree: Species:** Ponderosa Pine **Year Last Used:** 2017

**NOTE: Please attach a map showing the location of any newly documented nest tree.**

**Describe tree and nest condition and size and add other remarks**: Dominant ponderosa pine located NW of site #19 in Sunset Campground with remnant nest in moderate condition.

For each visit to a territory, note, in detail, the times, number and age of birds, behavior of birds (lying, perching, etc.), evidence of nesting (nest maintenance, courtship, incubation posture), disturbances, and other pertinent information:

| Observers | Date | Observations/Notes |
|---|---|---|
| Krista Orr<br>Steven Wood | 03.24.19<br>(07:00 to 17:30) | Early Breeding Season Survey:<br>• Reservoir largely free of ice (approximately 75%); approximately 2 to 3 feet of snow on surrounding ground. Surveys conducted by boat launched from Union Valley Dam and by snowshoeing on Fashoda Sunset Peninsula.<br>• 10:15 – Adult BAEA observed in foraging perch on SE side of Union Valley Dam.<br>• 11:45 – Adult BAEA departing foraging perch on SE side of Union Valley Dam, flying W toward Fashoda Sunset Peninsula.<br>• Nest in dominant ponderosa pine in Sunset Campground notably larger in size in comparison with previous season with occasional and slightly perceptible movement, suggesting occupancy.<br>• 13:30 – Adult BAEA observed in nest, actively lining nest with fresh greenery.<br>• 15:00 – Adult BAEA (male) first heard vocalizing then seen in previously documented roost S of nest tree.<br>• Other suitable habitat around Union Valley Reservoir surveyed for evidence of BAEA nesting by boat.<br>• No additional BAEA activity observed.<br>• Recreational activity low (~8 people fishing from Union Valley Dam and approximately 3 to 4 fishing boats on reservoir); no BAEA disturbance observed. |

| Observers | Date | Observations/Notes |
|---|---|---|
| Krista Orr<br>Eric Sommerauer<br>Michael Scaffidi<br>Steven Wood | 05.13.19<br>(06:45 to 13:30)<br>(18:45 to 20:00) | <u>Mid Breeding Season Survey</u>:<br>• SMUD staff (E. Koenigs) reported an adult BAEA perched for approximately 30 minutes above the nest identified during previous survey in Sunset Campground on 05.06.19.<br>• Mid breeding season surveys conducted in conjunction with preconstruction nesting raptor surveys on Lakeshore Road north of Ice House Reservoir (staff split between objectives with at least 1 surveyor stationed at the Sunset Campground nest tree and/or on Granlees Point during times indicated).<br>• 11:25 – Adult BAEA (male) flying in from N and landing in previously documented foraging perch along reservoir shore, approximately 500 ft from nest tree.<br>• 11:30 – Adult BAEA (male) departing foraging perch, flying over nest, and continuing SW towards Jones Fork.<br>• USFS nest platform at Granlees Point visited: no evidence of BAEA activity at platform, but evidence of roosting (e.g., feathers and whitewash) in nearby snag approximately 250 ft NE of platform.<br>• Other suitable habitat around Union Valley Reservoir surveyed for indication of BAEA nesting by vehicle and foot.<br>• No additional BAEA activity observed at Sunset Campground or elsewhere on Union Valley Reservoir until surveyor departure at 13:30.<br>• 18:45 – Surveyors (2) returned to Sunset Campground for further observation, remaining until after sunset to look for evidence of nest occupancy and/or nearby roosting.<br>• No evidence of nest occupancy, nearby roosting, or other BAEA activity observed.<br>• Recreational activity low (3 fishing boats); no BAEA disturbance observed. |
| Eric Sommerauer<br>Michael Scaffidi | 05.14.19<br>(06:45 to 09:15) | <u>Additional reproductive status check during mid breeding season</u>:<br>• Surveyors returned to nest tree at Sunset Campground during time indicated for further observation while in the area for pre-construction nesting raptor surveys (along Lakeshore Road) and BAEA surveys at Ice House Reservoir.<br>• No evidence of nest occupancy, nearby roosting, or other BAEA activity observed. |

<table>
<tr><th>Observers</th><th>Date</th><th>Observations/Notes</th></tr>
<tr><td>Krista Orr<br>Eric Sommerauer<br>Steven Wood<br>Mike Davis</td><td>06.10.19<br>(06:45 to 11:00)<br>(19:00 to 20:15)</td><td><u>Late Season Survey:</u><ul><li>Late breeding season surveys conducted in conjunction with preconstruction nesting raptor surveys along North Union Valley Road (staff split between objectives with at least one surveyor stationed at the Sunset nest tree and/or on Granlees Point during times indicated).</li><li>No evidence of nest occupancy, nearby roosting, or other BAEA activity observed at Sunset Campground.</li><li>USFS nest platform at Granlees Point visited: no evidence of BAEA activity at platform, but continued evidence of roosting in nearby snag approximately 250 ft NE of platform.</li></ul></td></tr>
<tr><td>Mike Davis</td><td>06.11.19<br>(06:30 to 09:30)</td><td><u>Additional reproductive status check during late breeding season</u>:<ul><li>Surveyor returned to nest tree at Sunset Campground during time indicated for further observation while in the area for pre-construction nesting raptor surveys along North Union Valley Road.</li><li>No evidence of nest occupancy, nearby roosting, or other BAEA activity observed.</li></ul></td></tr>
<tr><td>Krista Orr<br>Steven Wood</td><td>06.12.19<br>(19:20 to 20:30)</td><td><u>Additional reproductive status check during late breeding season</u>:<ul><li>Surveyors returned to nest tree at Sunset Campground during time indicated for further observation while in the area for mid breeding season survey (delayed due to elevation) at Loon Lake.</li><li>No evidence of nest occupancy, nearby roosting, or other BAEA activity observed.</li></ul></td></tr>
</table>

**SUMMARY:**

**A. Successful Nestings:** 0 **No. of young known fledged:** 0 **or probably fledged:** 0

**B. If no fledglings were produced this season please answer the following:**

**How many adults seen in the territory**? 2

**Was there evidence of nest repair or construction?** Nesting building observed during the early breeding season survey; nest was intact during subsequent surveys but unoccupied.

**Were adults seen in the nest?** Yes, during the early breeding season survey only.

**Were adults in incubating posture?** Yes.

**Number of nestlings observed?** 0

**Failed during incubation or nesting stage?** Unknown

**Other remarks:** Successful nesting in 2016 and 2017 with two fledged juveniles in each respective year; failed attempt in 2018 (courtship and nesting building observed in early breeding season, but no activity during subsequent visits); failed attempt in 2019 (nesting building and adult in incubation posture observed during early breeding season, but no activity observed during subsequent visits).

**Observer Contact Information:**

Surveys conducted by Stillwater Sciences, contractors for the Sacramento Municipal Utility District. For additional information contact Ethan Koenigs, SMUD Project Manager (Ethan.Koenigs@smud.org).

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# APPENDIX H1

## 2019 Representative Amphibian and Aquatic Reptile Habitat Photos

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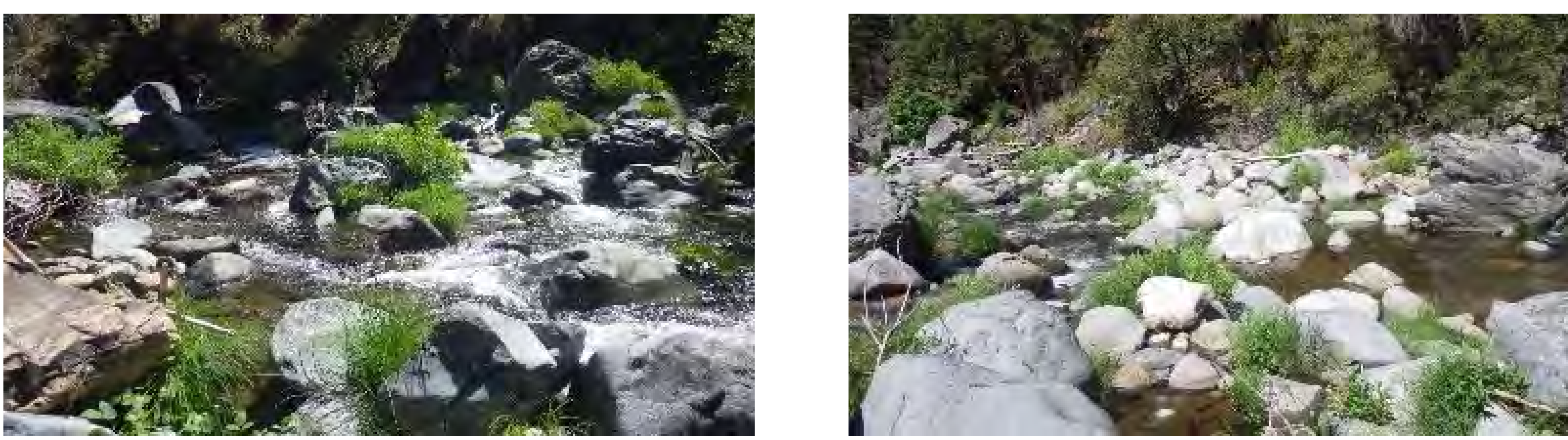
**Figure H-1. Junction Dam Reach (on Silver Creek)(JD-A15) amphibian and aquatic reptile monitoring site habitat photographs, 2019.**

**Figure H-2. Silver Creek at adit (Below Camino Reservoir Dam)(CD-A3) amphibian and aquatic reptile monitoring site habitat photographs, 2019.**



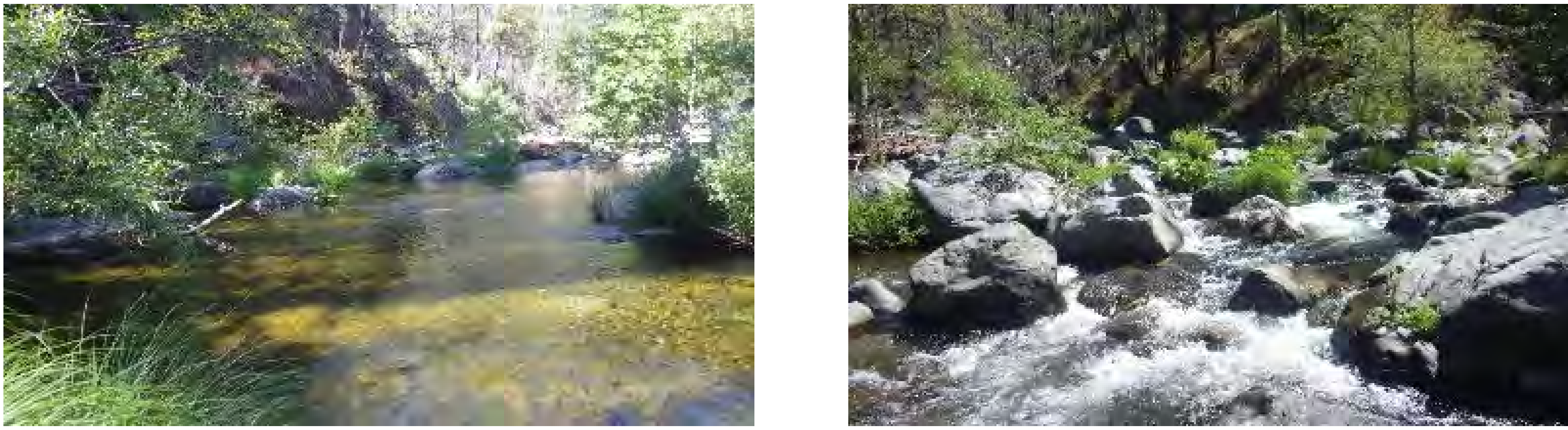


**Figure H-3. Silver Creek at South Fork American River (Below Camino Dam)(CD-A4) amphibian and aquatic reptile monitoring site habitat photographs, 2019.**

**Figure H-4. South Fork American River (Slab Creek Dam Reach)(SCD-A1) amphibian and aquatic reptile monitoring site habitat photographs, 2019.**

Edgewater 1

Edgewater 2

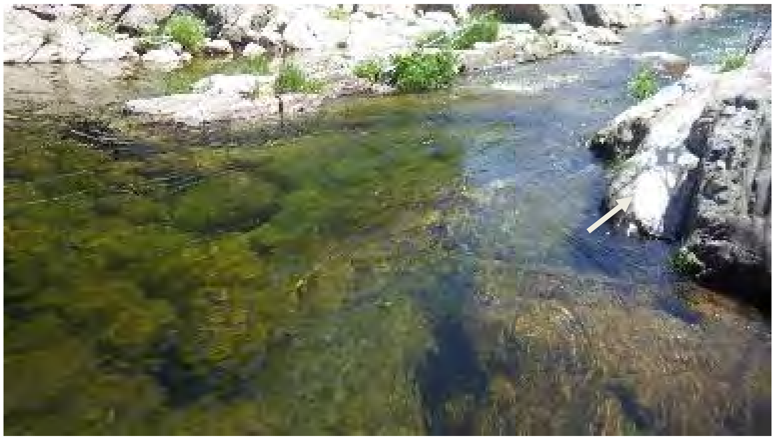
Edgewater 3

Edgewater 4

**Figure H-5. Edgewater thermograph habitat photographs at Silver Creek below Camino Reservoir Dam (near Camino Adit) (CD-A3), 2019 (1 of 2).**

Edgwater 5

Edgewater 6



Thalweg (over winter deployment)

**Figure H-6. Edgewater thermograph habitat photographs at Silver Creek below Camino Reservoir Dam (near Camino Adit) (CD-A3), 2019 (2 of 2).**

Edgewater 1 (over winter deployment)

Edgewater 2 (overwinter deployment)

Edgewater 3

Edgewater 4

**Figure H-7. Edgewater thermograph habitat photographs at Silver Creek Below Camino Reservoir Dam (Near Confluence with SF American River) (CD-A4), 2019 (1 of 2).**

Edgewater 5

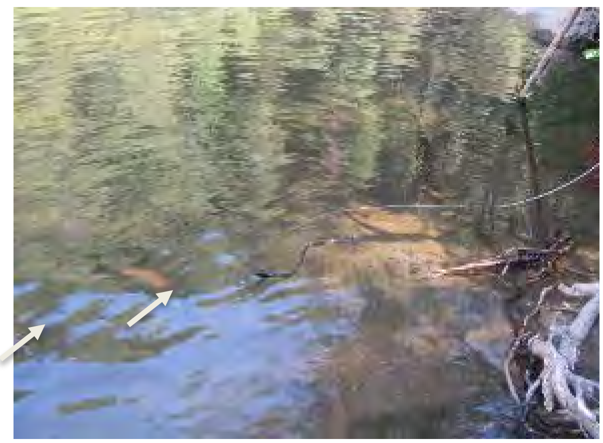
Edgewater 6

**Figure H-8. Edgewater thermograph habitat photographs at Silver Creek below Camino Reservoir Dam (Near Confluence with SF American River) (CD-A4), 2019 (2 of 2).**

Edgewater 1

Edgewater 2

Edgewater 3



Edgewater 4

**Figure H-9. Edgewater thermograph habitat photographs at SF American River below Slab Creek Reservoir Dam (SCD-A1), 2019 (1 of 2).**

Edgewater 5 (over winter deployment)

Edgewater 6 (over winter deployment)

**Figure H-10. Edgewater thermograph habitat photographs at SF American River below Slab Creek Reservoir Dam (SCD-A1), 2019 (2 of 2).**

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# APPENDIX I

## Sierra Nevada Yellow-legged Frog Habitat Photo Points

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Table I1-1. Sierra Nevada Yellow-legged Frog Photo Point Locations and Descriptions.

| Site Code | Aquatic Feature | Photo Point Code | Photo ID[a] | Photo Point Description Notes | UTM[b] | |
|---|---|---|---|---|---|---|
| | | | | | Northing | Easting |
| **Rubicon Reservoir Inlet Monitoring Area** | | | | | | |
| RUB-A1 | Rubicon River | RR-100 | - | From Rubicon Reservoir Inlet looking upstream towards confluence with the Rubicon River | 4318288 | 740875 |
| RUB-A1 | Rubicon River | RR-101 | - | From river right at the Rubicon River and Rubicon Reservoir Inlet confluence, looking downstream towards confluence | 4318279 | 740965 |
| RUB-A1 | Rubicon River | RR-102 | a | Near downstream survey start, looking downstream | 4318221 | 740932 |
| RUB-A1 | Rubicon River | RR-102 | b | Looking upstream towards backwater pool | 4318221 | 740932 |
| RUB-A1 | Rubicon River | RR-103 | - | Looking downstream | 4318219 | 740992 |
| RUB-A1 | Rubicon River | RR-104 | - | Looking upstream | 4318223 | 741003 |
| RUB-A1 | Rubicon River | RR-105 | a | At the upstream end of the river reach; looking downstream | 4318228 | 741049 |
| RUB-A1 | Rubicon River | RR-105 | b | Looking upstream | 4318228 | 741049 |
| RUB-A1 | Rubicon Reservoir Inlet | RubI-1 | a | At the downstream end of the inlet on the granite boulder/outcropping, looking downstream | 740647 | 4318414 |
| RUB-A1 | Rubicon Reservoir Inlet | RubI-1 | b | Looking northeast towards other side of inlet | 740647 | 4318414 |
| RUB-A1 | Rubicon Reservoir Inlet | RubI-2 | - | Looking towards the Rubicon Reservoir (downstream) from the river left bank | 4318349 | 740633 |
| RUB-A1 | Rubicon Reservoir Inlet | RubI-3 | a | Looking downstream | 4318367 | 740673 |
| RUB-A1 | Rubicon Reservoir Inlet | RubI-3 | b | Looking upstream | 4318367 | 740673 |
| RUB-A1 | Rubicon Reservoir Inlet | RubI-4 | - | Looking northwest from the Rubicon Reservoir side of the Rubicon Reservoir Inlet island | 4318418 | 740721 |
| RUB-A1 | Rubicon Reservoir Inlet | RubI-5 | a | Looking downstream | 4318198 | 740740 |
| RUB-A1 | Rubicon Reservoir Inlet | RubI-5 | b | Looking upstream | 4318198 | 740740 |
| RUB-A1 | Rubicon Reservoir Inlet | RubI-6 | a | From downstream of the cascade, looking downstream | 4318236 | 740873 |
| RUB-A1 | Rubicon Reservoir Inlet | RubI-6 | b | Looking upstream | 4318236 | 740873 |

| Site Code | Aquatic Feature | Photo Point Code | Photo ID[a] | Photo Point Description Notes | UTM[b] Northing | UTM[b] Easting |
|---|---|---|---|---|---|---|
| | | | c | Looking across the inlet channel (to the northwest) | | |
| | | RubI-7 | - | Looking downstream towards the Rubicon Reservoir | 4318326 | 740813 |
| RUB-A1 | Pond (perennial) | P-1 | - | At north end of the pond, looking towards center of the pond (south) | 4318468 | 740893 |
| | | P-2 | - | Looking east | 4318424 | 740873 |
| | | P-3 | - | At south end of pond, looking towards the center of the pond (north) | 4318379 | 740848 |
| **Rubicon Reservoir Outlet Monitoring Area** | | | | | | |
| RUB-A2 | Rubicon River | RR-1 | a | At the downstream end of the Rubicon river, looking downstream | 4319446 | 740679 |
| | | | b | Looking upstream | | |
| | | RR-2 | - | At riffle with suitable habitat, looking downstream, July 2019 photo is taken from a different location in the same habitat unit | 4319416 | 740603 |
| | | RR-3 | - | At the downstream end of the gage pool, looking upstream | 4319405 | 740571 |
| | | RR-4 | - | In the vicinity of the habitat switch on the Rubicon River, looking downstream | 4319412 | 740458 |
| | | RR-5 | - | In the vicinity of the habitat switch on the Rubicon River, looking upstream | 4319403 | 740457 |
| | | RR-6 | a | Looking downstream | 4319334 | 740414 |
| | | | b | Looking upstream | | |
| | | RR-7 | a | Near the top of the reach, looking downstream | 4319289 | 740513 |
| | | | b | Looking upstream towards the dam | | |
| | | RR-8 | - | At top of the reach near dam, looking downstream at pool below the dam | 4319224 | 740516 |
| RUB-A2 | Rubicon Dam Seep | DS-1 | - | At the downstream end of the dam seep, looking upstream | 4319368 | 740654 |
| | | DS-2 | - | Looking upstream | 4319339 | 740658 |
| | | DS-3 | - | Looking upstream, July 2019 photo is taken from a different location and looking downstream in the same habitat unit | 4319306 | 740673 |

| Site Code | Aquatic Feature | Photo Point Code | Photo ID[a] | Photo Point Description Notes | UTM[b] Northing | UTM[b] Easting |
|---|---|---|---|---|---|---|
| | | DS-4 | - | Looking upstream towards the dam at the end of the reach | 4319283 | 740677 |
| | | DS-4 (July) | - | Looking upstream towards dam at the end of the reach, July photo location was upstream | 4319263 | 740690 |
| RUB-A2 | Pond (ephemeral) | PE-1 | - | Looking towards the center of pond. | 4319423 | 740281 |
| **Rockbound Lake Inlet Monitoring Area** | | | | | | |
| RCK-A1 | Rockbound Lake Inlet | RCKI-1 | a | From top of the bank in the upland area at the downstream end of the Rockbound Lake Inlet, looking upstream | 4319605 | 739534 |
| | | | b | Looking downstream | | |
| | | RCKI-2 | a | From in the channel at the downstream end of the Rockbound Lake Inlet, looking upstream towards confluence with Highland Creek, no July photo | 4319570 | 739516 |
| | | | b | Looking across channel towards marsh area, July photo is representative of habitat but taken at a different location | | |
| | | | c | Looking downstream towards Rockbound Reservoir, no July photo | | |
| | | RCKI-3 | a | Looking downstream, July photo is representative of habitat but taken at a different location | 4319551 | 739544 |
| | | | b | Looking upstream, July photo is representative of habitat but taken at a different location | | |
| | | RCKI-4 | a | Looking downstream | 4319524 | 739620 |
| | | | b | Looking upstream | | |
| | | RCKI-5 | a | At upstream end of the Rockbound Lake Inlet from river left bank, looking upstream | 4319497 | 739731 |
| | | | b | Looking downstream | | |
| | | | c | Looking across the channel towards backwater pond | | |

| Site Code | Aquatic Feature | Photo Point Code | Photo ID[a] | Photo Point Description Notes | UTM[b] | |
|---|---|---|---|---|---|---|
| | | | | | Northing | Easting |
| | | RCKI-6 | - | At upstream end of the Rockbound Lake Inlet from river right bank near the confluence with the pond, looking upstream | 4319510 | 739719 |
| | | RCKI-7 | - | From the pool and river confluence, looking towards backwater pool | 4319518 | 739728 |
| | | RCKI-8 | - | Looking towards center of backwater pool; July photo is representative of habitat but taken at a different location | 4319541 | 739751 |
| | | RCKI-9 | - | Backwater pond bank habitat, looking north | 4319609 | 739789 |
| | | RCKI-10 | a | From Island and north end of the pond, looking south towards confluence with channel | 4319669 | 739735 |
| | | | b | Looking west on side channel bank habitat | | |
| | | RCKI-11 | a | From west most bank of backwater pond (not on the island), looking south towards main pool | 4319677 | 739711 |
| | | | b | Looking upstream | | |
| | | | c | Looking across channel towards island | | |
| RCK-A1 | Upper Highland Creek | HC-101 | a | At the downstream end of Highland Creek near the confluence with Rockbound Lake Inlet, looking downstream | 4319498 | 739585 |
| | | | b | Looking upstream | | |
| | | HC-102 | - | Log debris jam, looking downstream, no July photo | 4319484 | 739588 |
| | | HC-103 | a | At hiking trail crossing, looking downstream | 4319336 | 739592 |
| | | | b | Looking upstream | | |
| | | HC-104 | - | At pool above hiking trail, looking upstream towards cascade | 4319336 | 739582 |
| | | HC-105 | - | Looking upstream towards cascade | 4319258 | 739561 |
| | | HC-106 | a | At upstream end of stream reach, looking downstream | 4319183 | 739576 |
| | | | b | Looking upstream at cascade | | |

| Site Code | Aquatic Feature | Photo Point Code | Photo ID[a] | Photo Point Description Notes | UTM[b] Northing | UTM[b] Easting |
|---|---|---|---|---|---|---|
| **Highland Creek Monitoring Area** | | | | | | |
| HC-A1 | Lower Highland Creek | HC-1 | | From upland habitat looking northwest towards Buck Island Reservoir | 4320466 | 738260 |
| | | HC-2 | | At river left looking towards channel split | 4320454 | 738277 |
| | | HC-3 | a | Representative start and stop overview photo, looking downstream towards pool and channel split | 4320462 | 738297 |
| | | | b | Looking upstream towards cascade | | |
| | | HC-4 | - | Looking upstream | 4320438 | 738300 |
| | | HC-5 | a | Looking downstream of cascade | 4320354 | 738367 |
| | | | b | Looking upstream towards pool | | |
| | | HC-6 | - | Backwater pool area, looking upstream towards river right | 4320343 | 738454 |
| | | HC-7 | a | Looking upstream towards cascade | 4320337 | 738500 |
| | | | b | Looking downstream towards pool, no July photo | | |
| | | HC-8 | - | Near upstream end of river reach looking towards dam | 4320303 | 738545 |
| | | HC-9 | a | At the end of river reach, looking downstream | 4320307 | 738572 |
| | | | b | Looking upstream | | |

[a] Photo identifiers (ID) were used to distinguish photo directions if multiple photos were taken at one photo point.
[b] Projection: NAD83 UTM Zone 10 North

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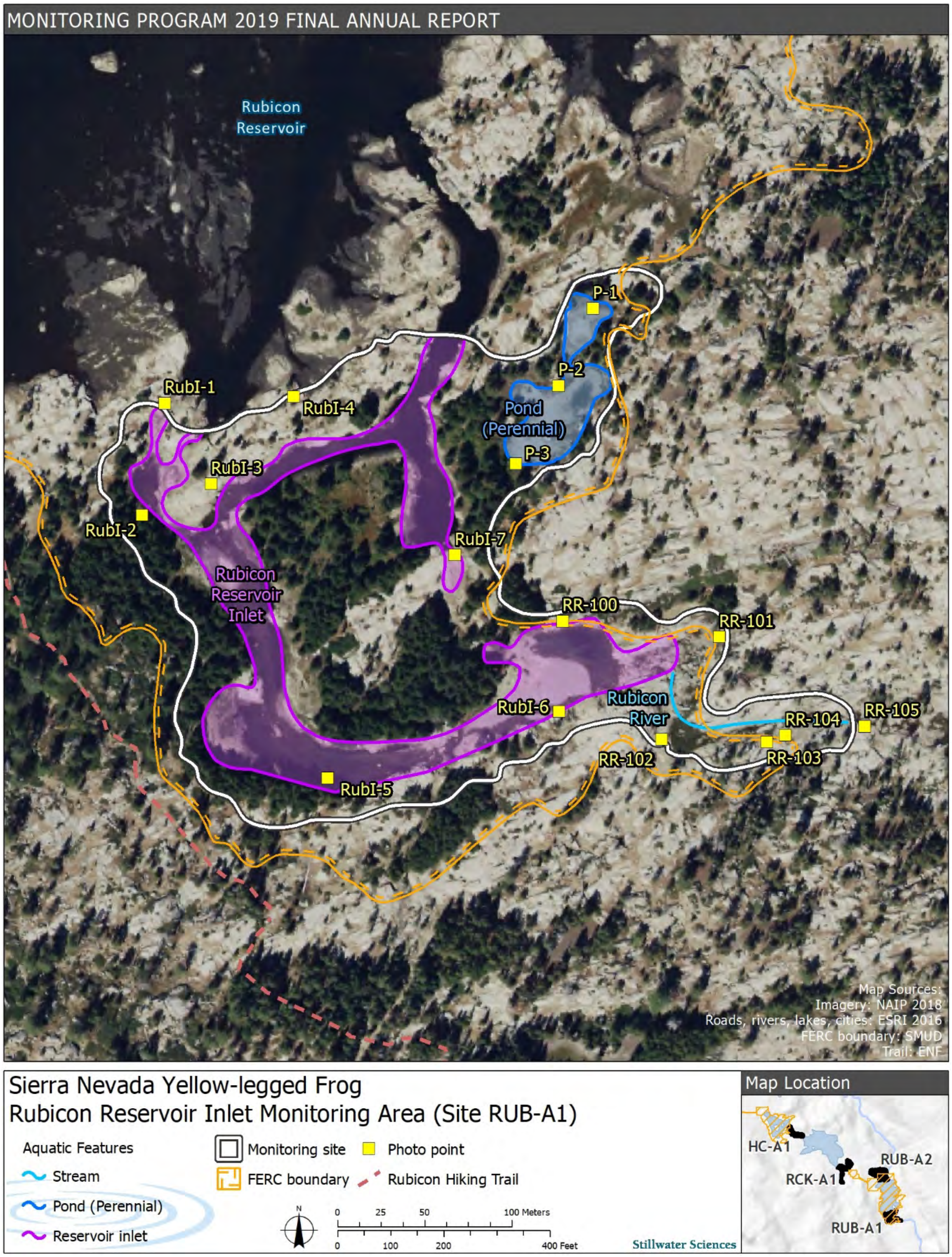



**Figure I1-1. Photo Points at the Rubicon Reservoir Inlet Monitoring Area (Site RUB-A1), 2019.**

| RR-100 | RR-101 |
|---|---|
|  10 July 2019 |  10 July 2019 |
|  14 August 2019 |  14 August 2019 |
|  24 September 2019 |  24 September 2019 |

**Figure I1-2. Photos along the Rubicon River at the Rubicon Reservoir Inlet Monitoring Area (Site RUB-A1) photo points.**

| RR-102(a) | RR-102(b) |
|---|---|
|  10 July 2019 |  10 July 2019 |
|  14 August 2019 |  14 August 2019 |
|  24 September 2019 |  24 September 2019 |

**Figure I1-2. Photos along the Rubicon River at the Rubicon Reservoir Inlet Monitoring Area (Site RUB-A1) photo points (continued).**

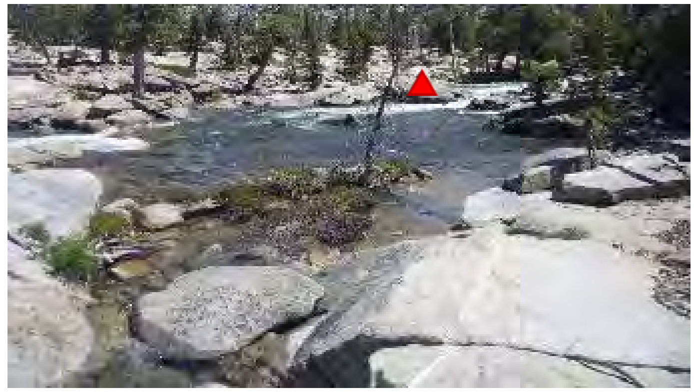
| RR-103 | RR-104 |
|---|---|
|  10 July 2019 |  10 July 2019 |
|  14 August 2019 |  14 August 2019 |
|  24 September 2019 |  24 September 2019 |

**Figure I1-2. Photos along the Rubicon River at the Rubicon Reservoir Inlet Monitoring Area (Site RUB-A1) photo points (continued).**

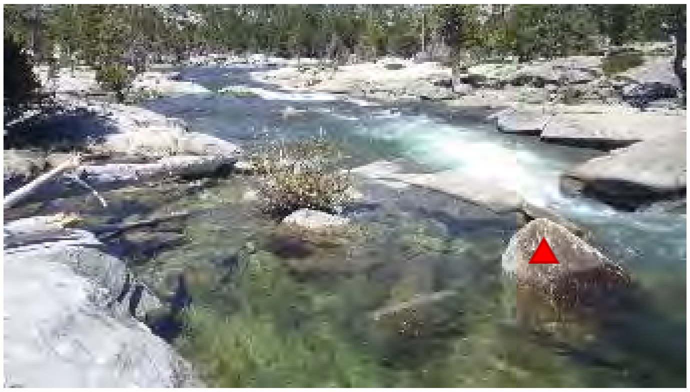
| | |
|---|---|
| <br>10 July 2019 | <br>10 July 2019 |
| <br>14 August 2019 | <br>14 August 2019 |
| <br>24 September 2019 | <br>24 September 2019 |
| **RR-105 (a)** | **RR-105 (b)** |

**Figure I1-2. Photos along the Rubicon River at the Rubicon Reservoir Inlet Monitoring Area (Site RUB-A1) photo points (continued).**

10 July 2019

10 July 2019

14 August 2019

14 August 2019

24 September 2019

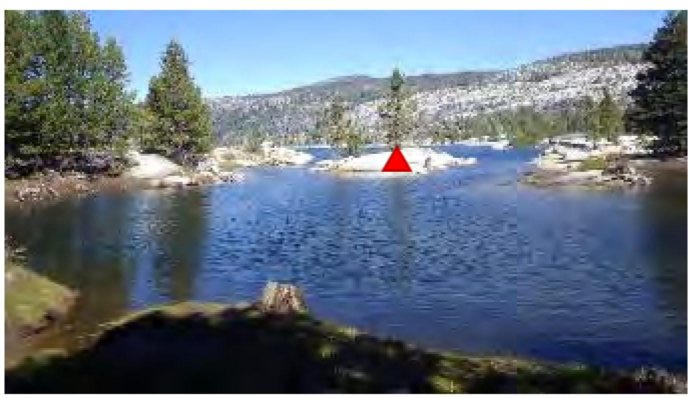
24 September 2019

**RubI-1 (a)** | **Rub-1 (b)**

**Figure I1-3. Photos along the Rubicon Reservoir Inlet at the Rubicon Reservoir Inlet Monitoring Area (Site RUB-A1) photo points.**

10 July 2019

14 August 2019



24 September 2019

**RubI-2**

**Figure I1-3. Photos along the Rubicon Reservoir Inlet at the Rubicon Reservoir Inlet Monitoring Area (Site RUB-A1) photo points (continued).**

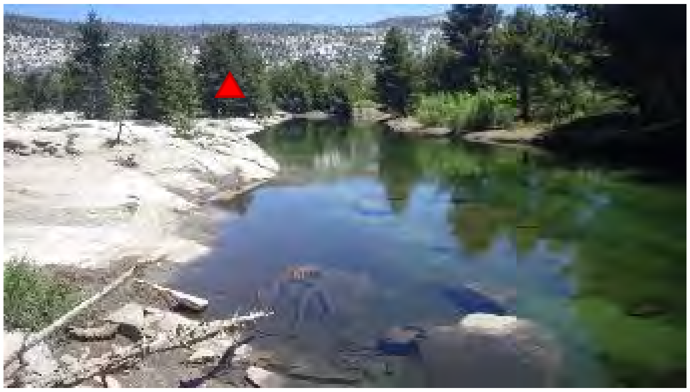
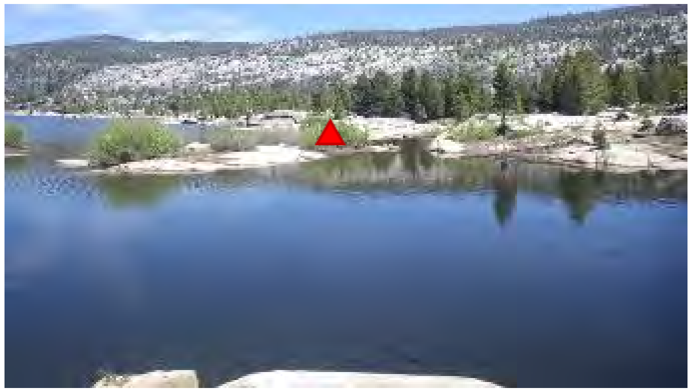
| RubI-3 (a) | RubI-3 (b) |
|---|---|
|  10 July 2019 |  10 July 2019 |
|  14 August 2019 |  14 August 2019 |
|  24 September 2019 |  24 September 2019 |

**Figure I1-3. Photos along the Rubicon Reservoir Inlet at the Rubicon Reservoir Inlet Monitoring Area (Site RUB-A1) photo points (continued).**



10 July 2019

14 August 2019

24 September 2019

**RubI-4**

**Figure I1-3. Photos along the Rubicon Reservoir Inlet at the Rubicon Reservoir Inlet Monitoring Area (Site RUB-A1) photo points (continued).**

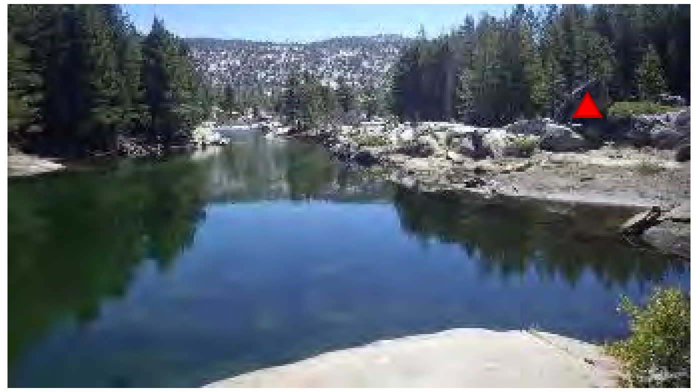
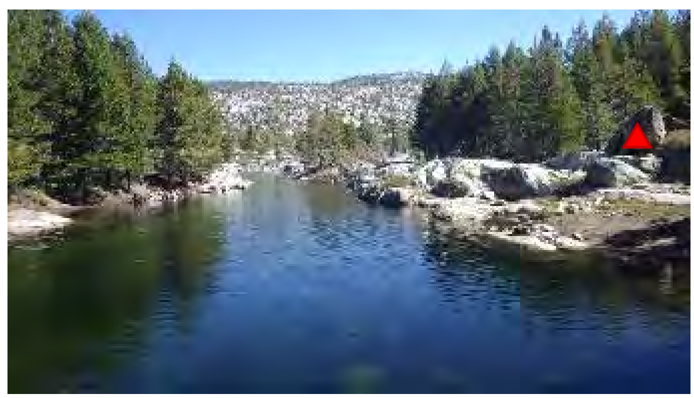
| RubI-5 (a) | RubI-5 (b) |
|---|---|
|  10 July 2019 |  10 July 2019 |
|  14 August 2019 |  14 August 2019 |
|  24 September 2019 |  24 September 2019 |

**Figure I1-3. Photos along the Rubicon Reservoir Inlet at the Rubicon Reservoir Inlet Monitoring Area (Site RUB-A1) photo points (continued).**

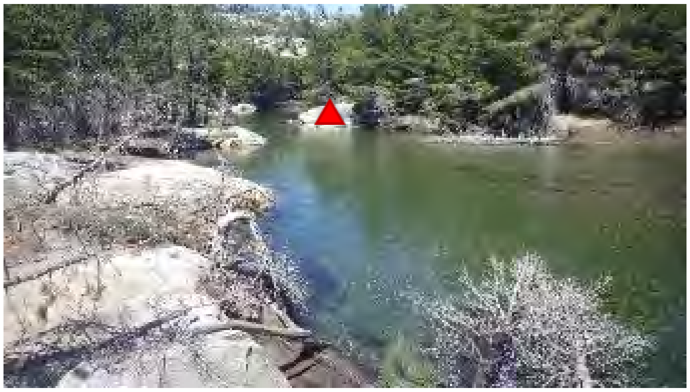
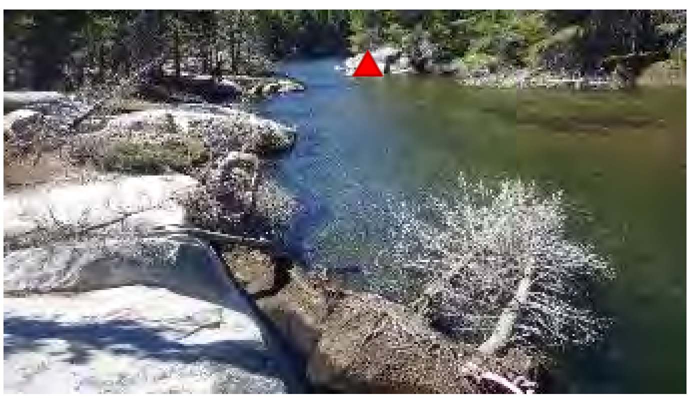
| RubI-6 (a) | RubI-6 (b) |
|---|---|
|  10 July 2019 |  10 July 2019 |
|  14 August 2019 |  14 August 2019 |
|  24 September 2019 |  24 September 2019 |

**Figure I1-3. Photos along the Rubicon Reservoir Inlet at the Rubicon Reservoir Inlet Monitoring Area (Site RUB-A1) photo points (continued).**

10 July 2019

14 August 2019

24 September 2019

**RubI-6 (c)**

**Figure I1-3. Photos along the Rubicon Reservoir Inlet at the Rubicon Reservoir Inlet Monitoring Area (Site RUB-A1) photo points (continued).**

10 July 2019

14 August 2019

24 September 2019

**RubI-7**

**Figure I1-3. Photos along the Rubicon Reservoir Inlet at the Rubicon Reservoir Inlet Monitoring Area (Site RUB-A1) photo points (continued).**

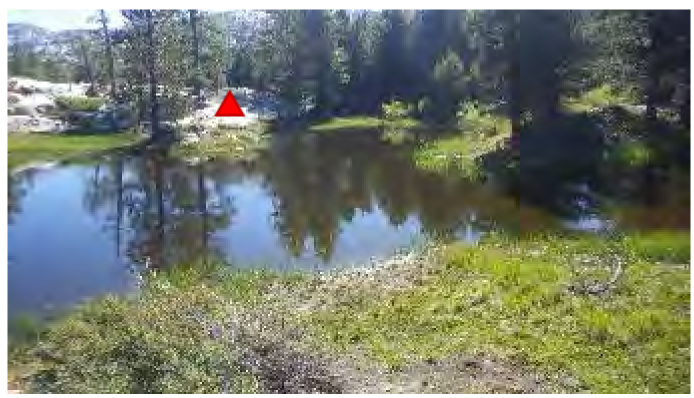
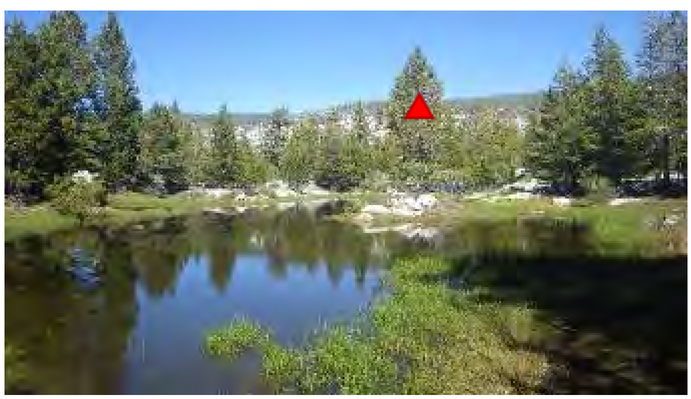
| P-1 | P-2 |
|---|---|
|  10 July 2019 |  10 July 2019 |
|  14 August 2019 |  14 August 2019 |
|  24 September 2019 |  24 September 2019 |

**Figure I1-4. Photos at the perennial pond at the Rubicon Reservoir Inlet Monitoring Area (Site RUB-A1) photo points.**

10 July 2019

14 August 2019



24 September 2019

**P-3**

**Figure I1-4. Photos at the perennial pond at the Rubicon Reservoir Inlet Monitoring Area (Site RUB-A1) photo points (continued).**

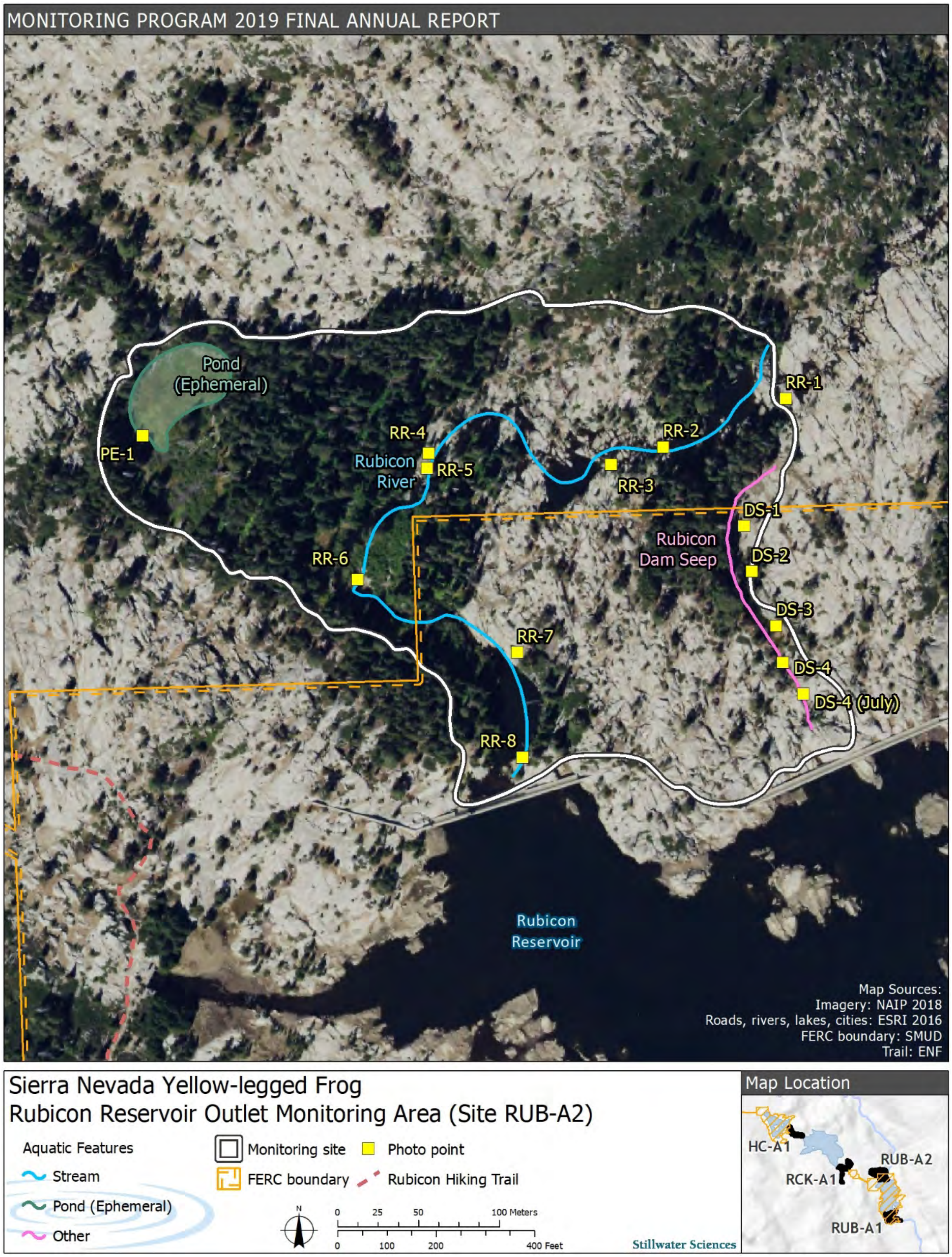



**Figure I1-5. Photo points at the Rubicon Reservoir Outlet Monitoring Area (Site RUB-A2), 2019**

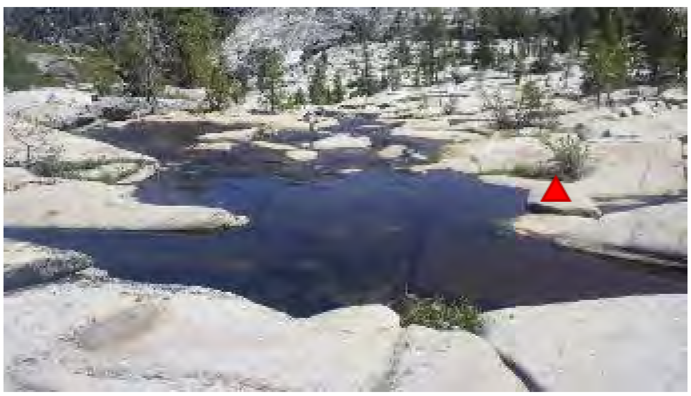
| RR-1 (a) | RR-1 (b) |
|---|---|
|  9 July 2019 |  9 July 2019 |
|  13 August 2019 |  13 August 2019 |
|  25 September 2019 |  25 September 2019 |

**Figure I1-6. Photos along the Rubicon River at the Rubicon Reservoir Outlet Monitoring Area (Site RUB-A2) photo points.**

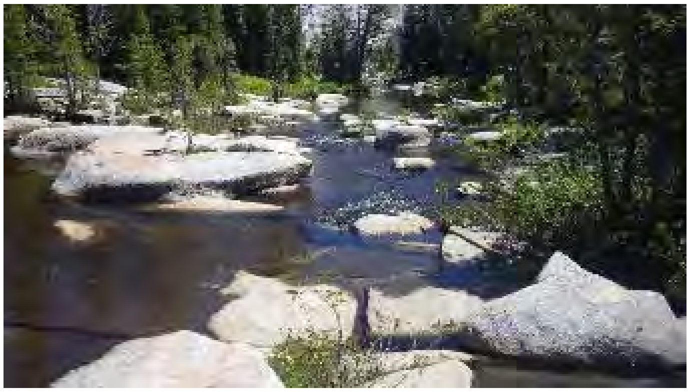
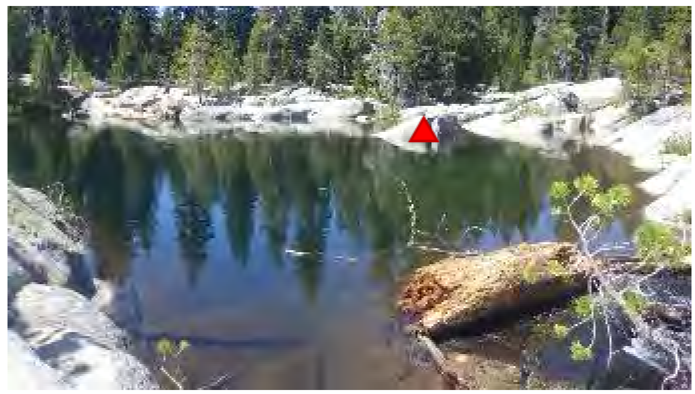
| | |
|---|---|
|  9 July 2019 |  9 July 2019 |
|  13 August 2019 |  13 August 2019 |
|  25 September 2019 |  25 September 2019 |
| **RR-2** | **RR-3** |

**Figure I1-6. Photos along the Rubicon River at the Rubicon Reservoir Outlet Monitoring Area (Site RUB-A2) photo points (continued).**

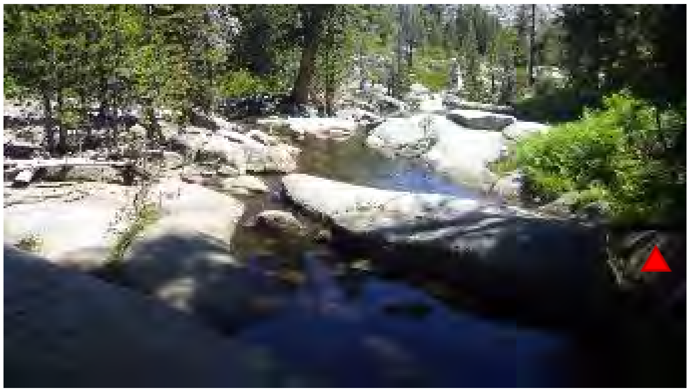
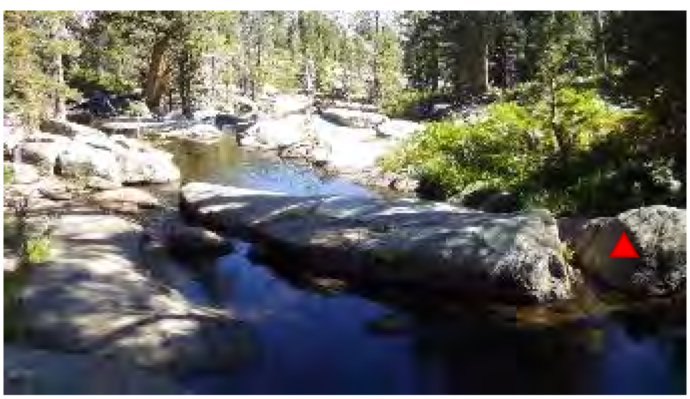
| | |
|---|---|
|  9 July 2019 |  9 July 2019 |
|  13 August 2019 |  13 August 2019 |
|  25 September 2019 |  25 September 2019 |
| **RR-4** | **RR-5** |

**Figure I1-6. Photos along the Rubicon River at the Rubicon Reservoir Outlet Monitoring Area (Site RUB-A2) photo points (continued).**

| | |
|---|---|
|  9 July 2019 |  9 July 2019 |
|  13 August 2019 |  13 August 2019 |
|  25 September 2019 |  25 September 2019 |
| **RR-6 (a)** | **RR-6 (b)** |

**Figure I1-6. Photos along the Rubicon River at the Rubicon Reservoir Outlet Monitoring Area (Site RUB-A2) photo points (continued).**

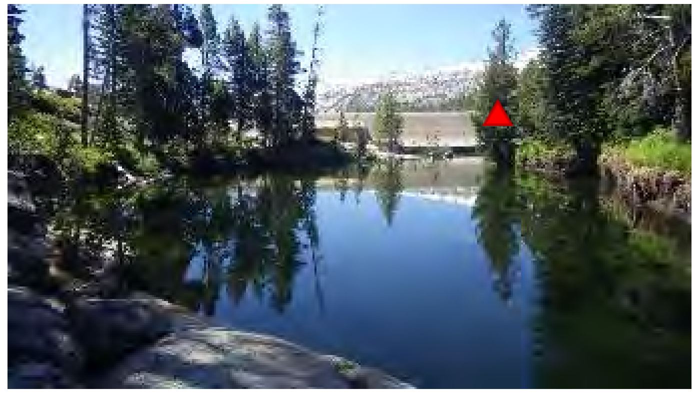
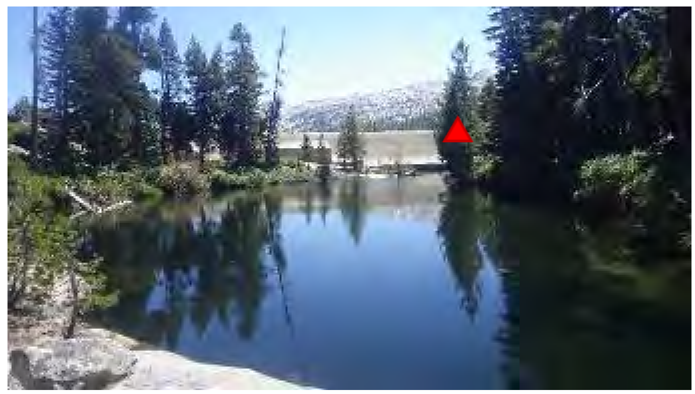
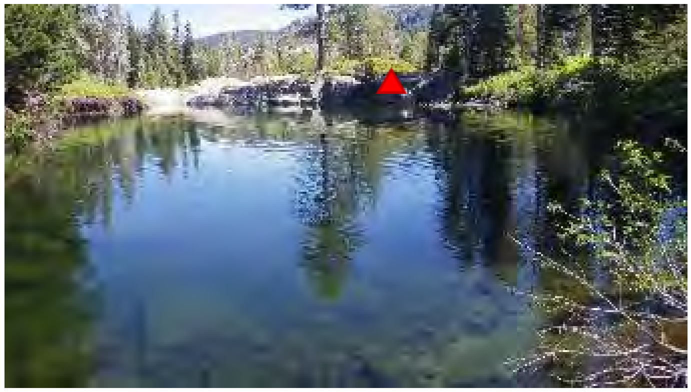
| | |
|---|---|
|  9 July 2019 |  9 July 2019 |
|  13 August 2019 |  13 August 2019 |
|  25 September 2019 |  25 September 2019 |
| **RR-7 (a)** | **RR-7 (b)** |

**Figure I1-6. Photos along the Rubicon River at the Rubicon Reservoir Outlet Monitoring Area (Site RUB-A2) photo points (continued).**



9 July 2019

13 August 2019

25 September 2019

**RR-8**

**Figure I1-6. Photos along the Rubicon River at the Rubicon Reservoir Outlet Monitoring Area (Site RUB-A2) photo points (continued).**

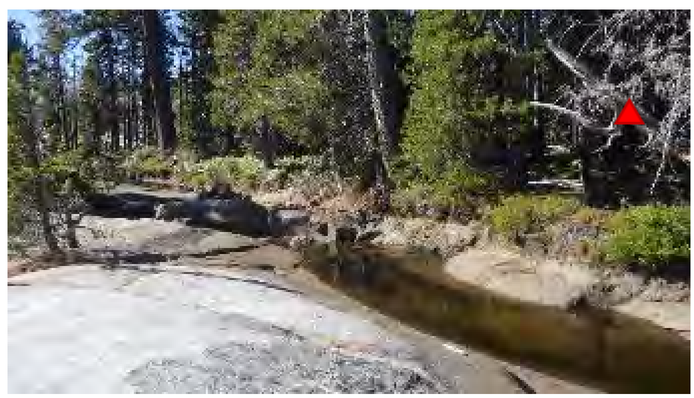
| | |
|---|---|
| <br>9 July 2019 | <br>9 July 2019 |
| <br>13 August 2019 | <br>13 August 2019 |
| <br>25 September 2019 | <br>25 September 2019 |
| **DS-1** | **DS-2** |

**Figure I1-7. Photos along the Rubicon Dam Seep at the Rubicon Reservoir Outlet Monitoring Area (Site RUB-A2) photo points.**

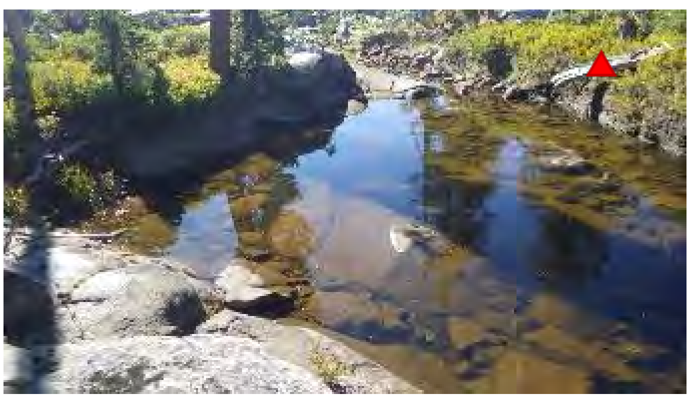
| | |
|---|---|
|  9 July 2019 |  9 July 2019 |
|  13 August 2019 |  13 August 2019 |
|  25 September 2019 |  25 September 2019 |
| **DS-3** | **DS-4** |

**Figure I1-7. Photos along the Rubicon Dam Seep at the Rubicon Reservoir Outlet Monitoring Area (Site RUB-A2) photo points (continued).**

9 July 2019

13 August 2019

no photo

25 September 2019

**PE-1**

**Figure I1-8. Photos at the ephemeral pond at the Rubicon Reservoir Outlet Monitoring Area (Site RUB-A2) photo points.**

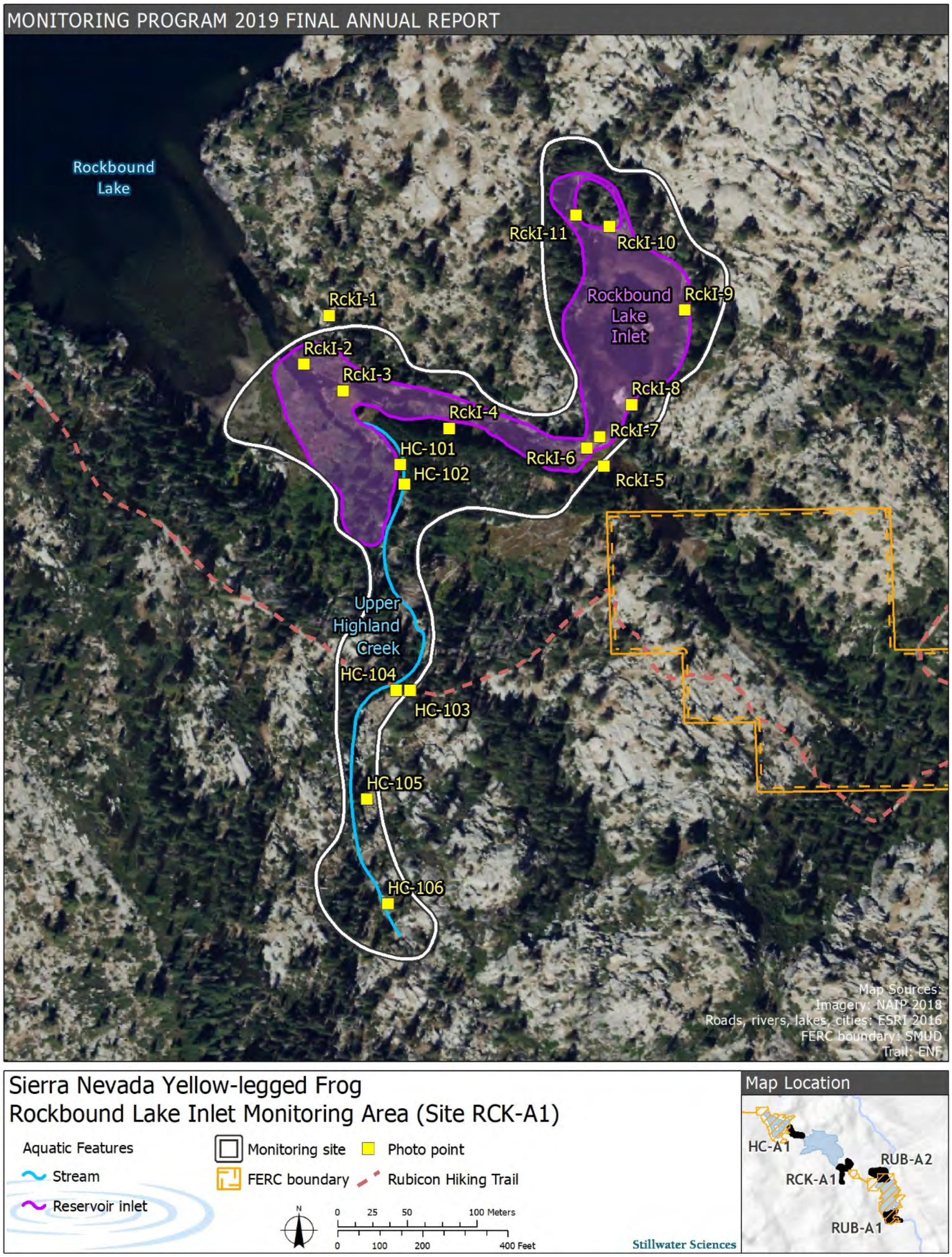



**Figure I1-9. Photo points at the Rockbound Lake Inlet Monitoring Area (Site RCK-A1), 2019**

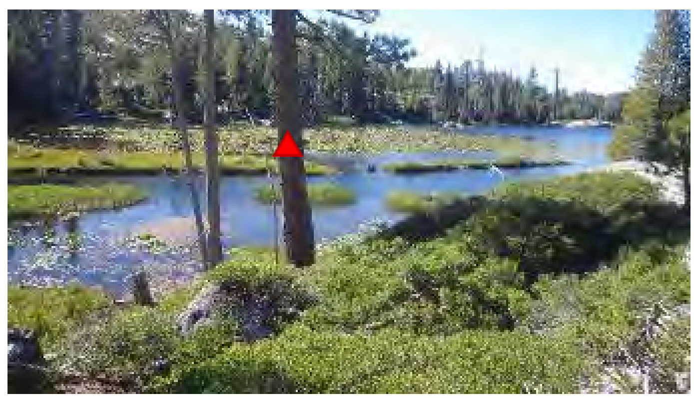
| | |
|---|---|
|  11 July 2019 |  11 July 2019 |
|  15 August 2019 |  15 August 2019 |
|  25 September 2019 |  25 September 2019 |
| **RckI-1 (a)** | **RckI (b)** |

**Figure I1-10. Photos along the Rockbound Lake Inlet at the Rockbound Lake Inlet Monitoring Area (Site RCK-A1) photo points.**

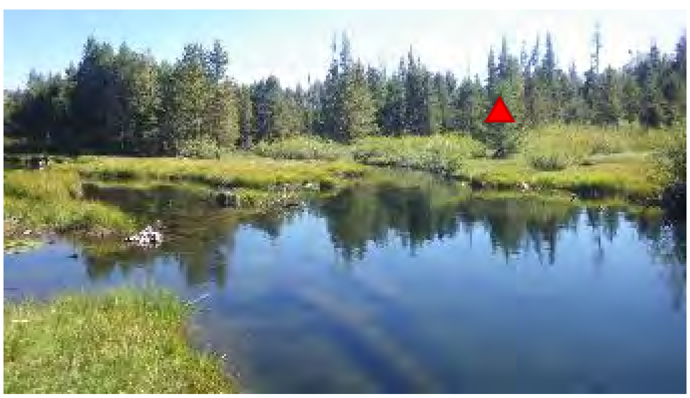
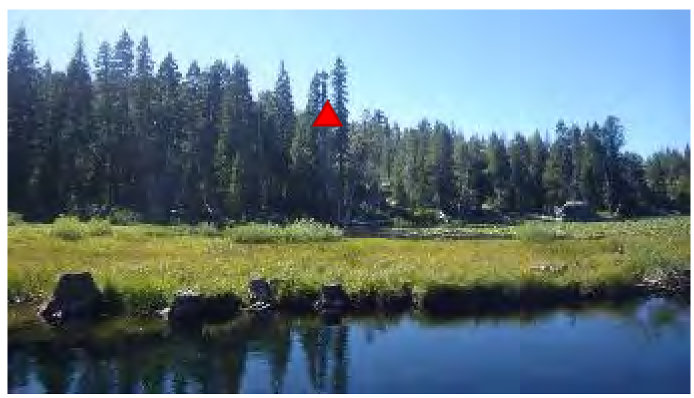
| RckI-2 (a) | RckI-2 (b) |
|---|---|
| no photo<br>11 July 2019 | <br>11 July 2019 |
| <br>15 August 2019 | <br>15 August 2019 |
| <br>25 September 2019 | <br>25 September 2019 |

**Figure I1-10. Photos along the Rockbound Lake Inlet at the Rockbound Lake Inlet Monitoring Area (Site RCK-A1) photo points (continued).**

no photo

11 July 2019

15 August 2019

25 September 2019

**RckI-2 (c)**

**Figure I1-10. Photos along the Rockbound Lake Inlet at the Rockbound Lake Inlet Monitoring Area (Site RCK-A1) photo points (continued).**

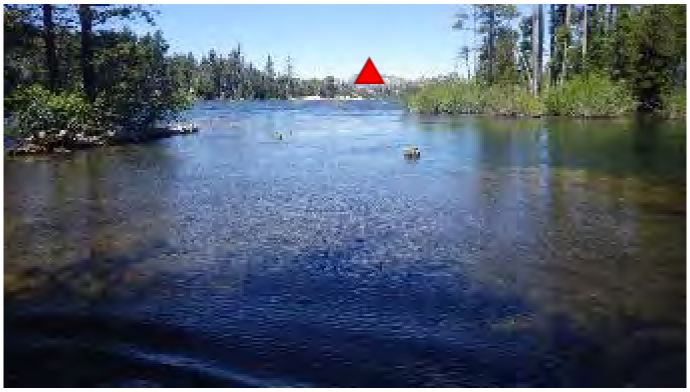
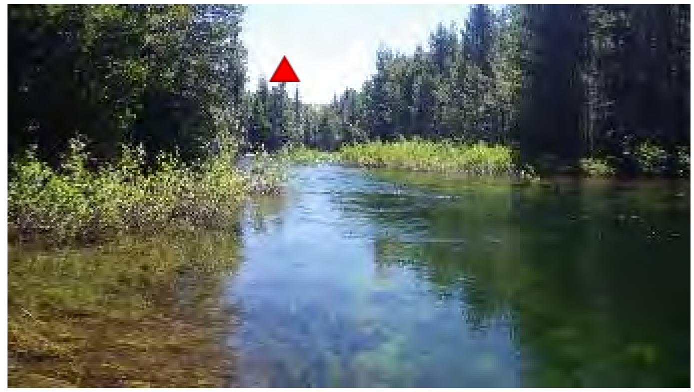
| RckI-3 (a) | RckI-3 (b) |
| --- | --- |
|  11 July 2019 |  11 July 2019 |
|  15 August 2019 |  15 August 2019 |
|  25 September 2019 |  25 September 2019 |

**Figure I1-10. Photos along the Rockbound Lake Inlet at the Rockbound Lake Inlet Monitoring Area (Site RCK-A1) photo points (continued).**

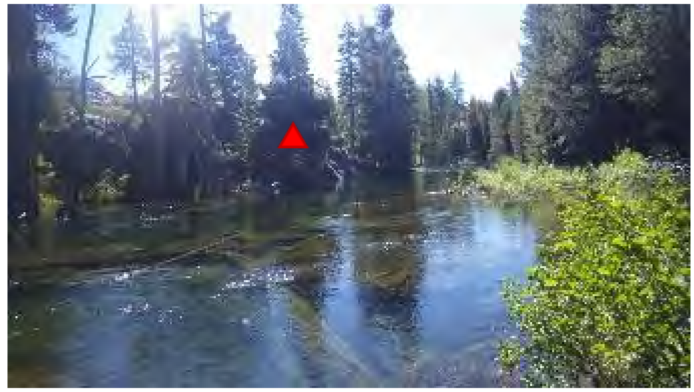
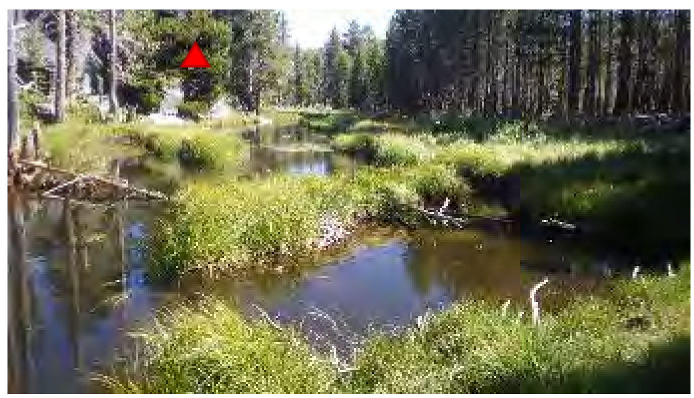
| | |
|---|---|
|  11 July 2019 |  11 July 2019 |
|  15 August 2019 |  15 August 2019 |
|  25 September 2019 |  25 September 2019 |
| **RckI-4 (a)** | **RckI-4 (b)** |

**Figure I1-10. Photos along the Rockbound Lake Inlet at the Rockbound Lake Inlet Monitoring Area (Site RCK-A1) photo points (continued).**

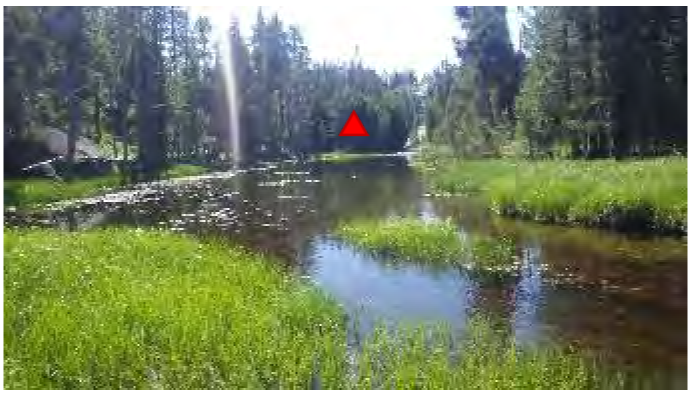
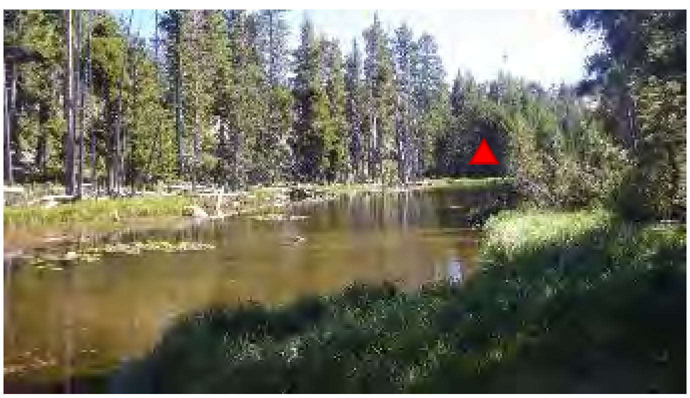
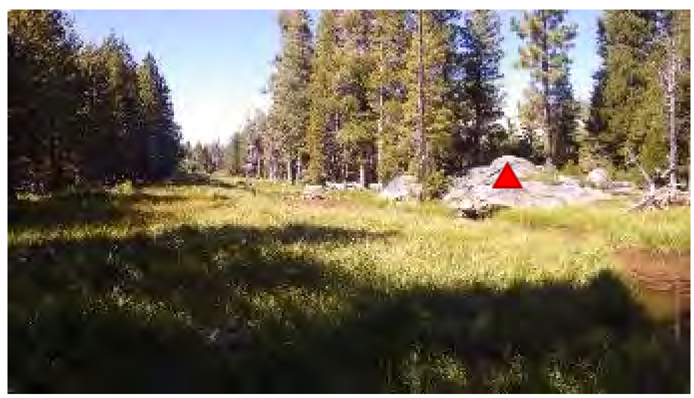
| RckI-5 (a) | RckI-5 (b) |
|---|---|
|  11 July 2019 |  11 July 2019 |
|  15 August 2019 |  15 August 2019 |
|  25 September 2019 |  25 September 2019 |

**Figure I1-10. Photos along the Rockbound Lake Inlet at the Rockbound Lake Inlet Monitoring Area (Site RCK-A1) photo points (continued).**

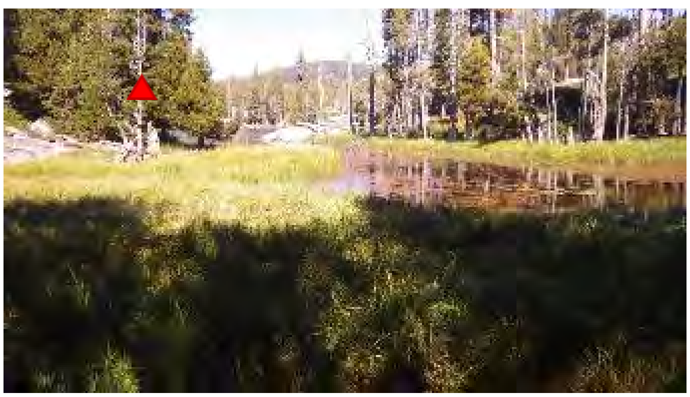
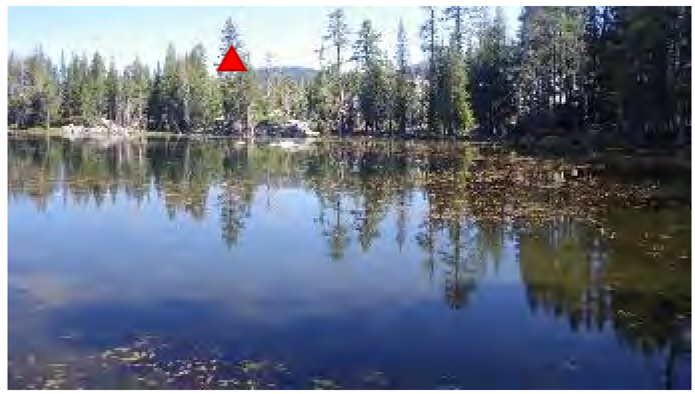
| | |
|---|---|
|  11 July 2019 |  11 July 2019 |
|  15 August 2019 |  15 August 2019 |
|  25 September 2019 |  25 September 2019 |
| **RckI-5 (b)** | **RckI-6** |

**Figure I1-10. Photos along the Rockbound Lake Inlet at the Rockbound Lake Inlet Monitoring Area (Site RCK-A1) photo points (continued).**

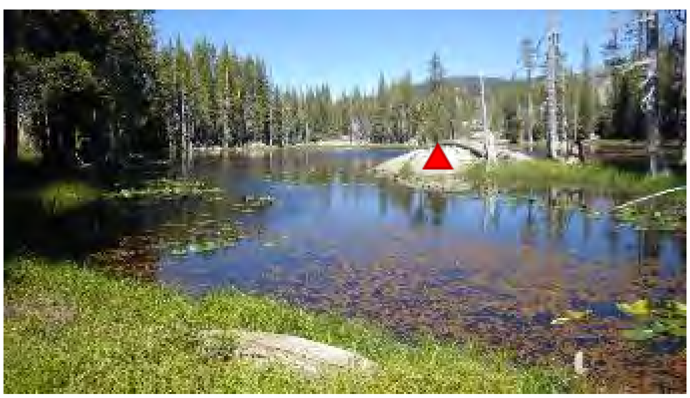
11 July 2019

11 July 2019

15 August 2019



15 August 2019



25 September 2019

25 September 2019

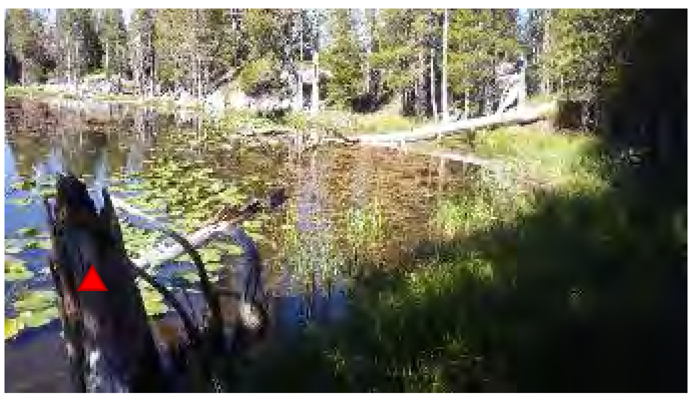
| RckI-7 | RckI-8 |
| --- | --- |

**Figure I1-10. Photos along the Rockbound Lake Inlet at the Rockbound Lake Inlet Monitoring Area (Site RCK-A1) photo points (continued).**

no photo

11 July 2019

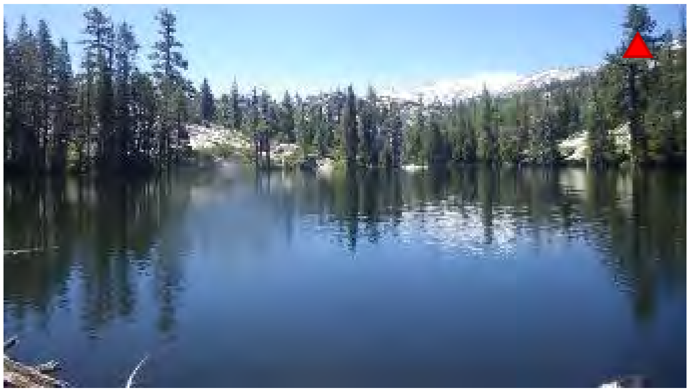
15 August 2019



25 September 2019

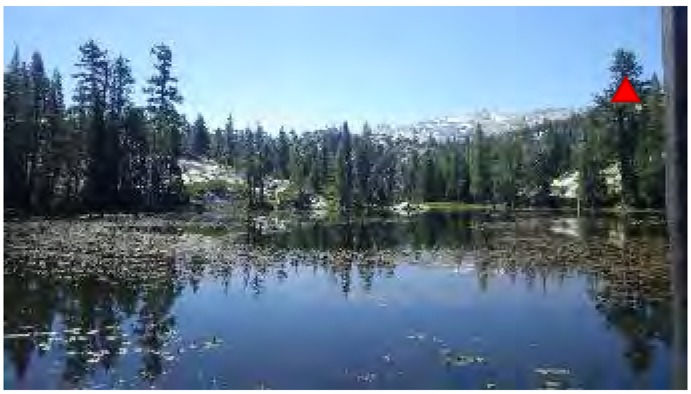
**RckI-9**

**Figure I1-10. Photos along the Rockbound Lake Inlet at the Rockbound Lake Inlet Monitoring Area (Site RCK-A1) photo points (continued).**



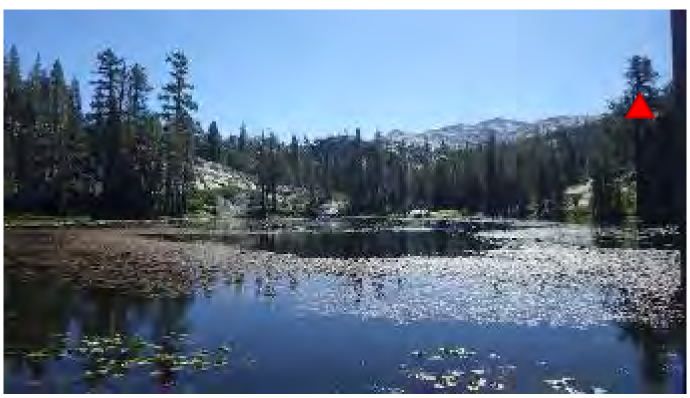
11 July 2019

11 July 2019

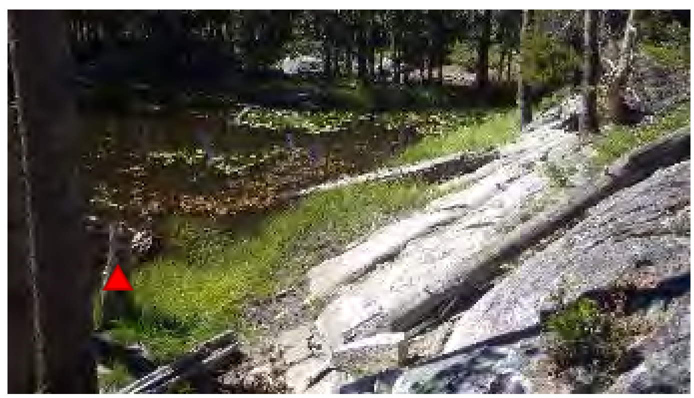


15 August 2019

15 August 2019



25 September 2019



25 September 2019

| RckI-10 (a) | RckI-10 (b) |
| --- | --- |

**Figure I1-10. Photos along the Rockbound Lake Inlet at the Rockbound Lake Inlet Monitoring Area (Site RCK-A1) photo points (continued).**

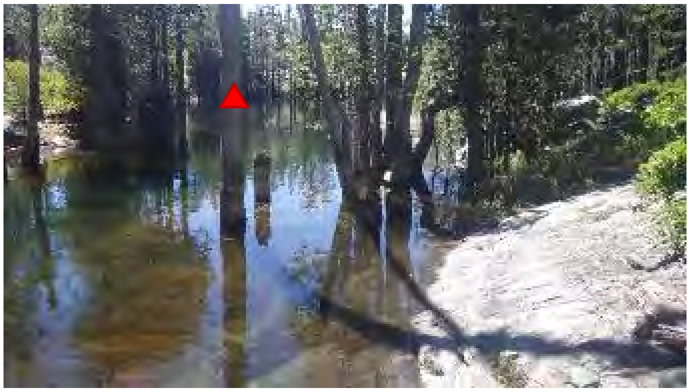
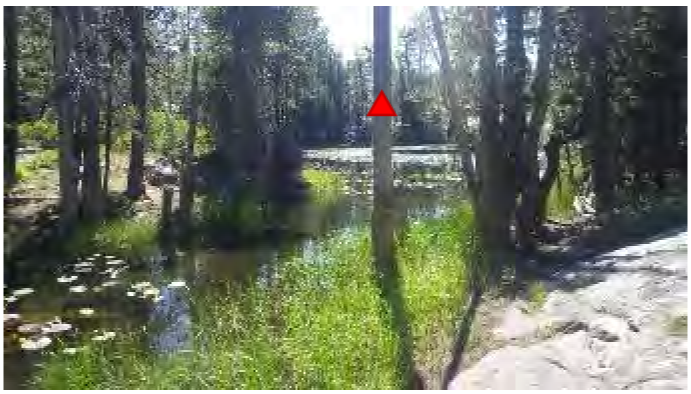
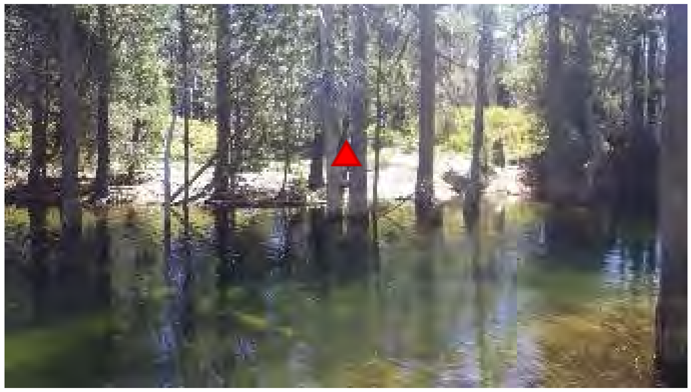
| | |
|---|---|
|  11 July 2019 |  11 July 2019 |
|  15 August 2019 |  15 August 2019 |
|  25 September 2019 |  25 September 2019 |
| **RckI-11 (a)** | **RckI-11 (b)** |

**Figure I1-10. Photos along the Rockbound Lake Inlet at the Rockbound Lake Inlet Monitoring Area (Site RCK-A1) photo points (continued).**



11 July 2019

15 August 2019

25 September 2019

**RckI-11 (c)**

**Figure I1-10. Photos along the Rockbound Lake Inlet at the Rockbound Lake Inlet Monitoring Area (Site RCK-A1) photo points (continued).**

| HC-101 (a) | HC-101 (b) |
|---|---|
| <br>11 July 2019 | <br>11 July 2019 |
| <br>15 August 2019 | <br>15 August 2019 |
| <br>25 September 2019 | <br>25 September 2019 |

**Figure I1-11. Photos along upper Highland Creek at the Rockbound Lake Inlet Monitoring Area (Site RCK-A1) photo points.**

no photo

11 July 2019

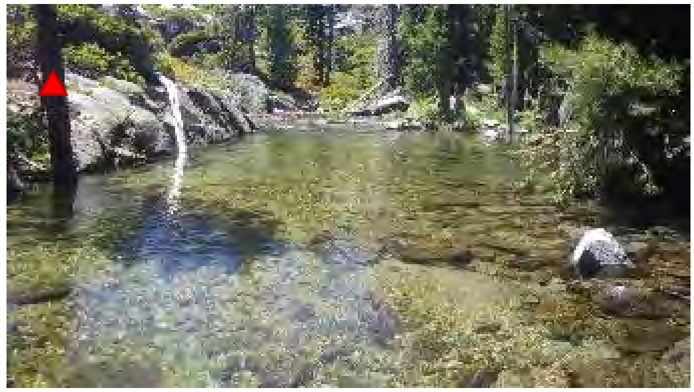
15 August 2019

25 September 2019

**HC-102**

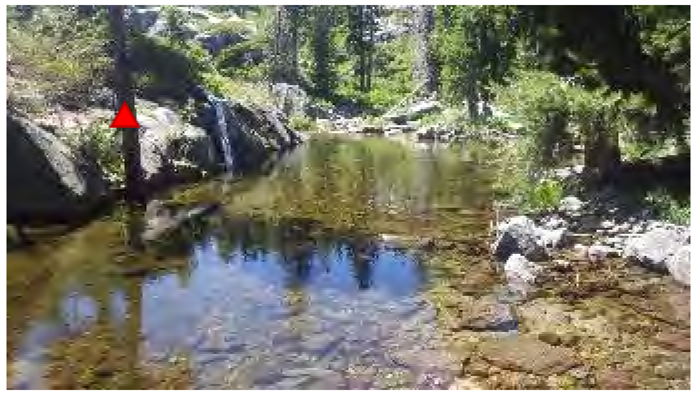
**Figure I1-11. Photos along upper Highland Creek at the Rockbound Lake Inlet Monitoring Area (Site RCK-A1) photo points (continued).**

11 July 2019



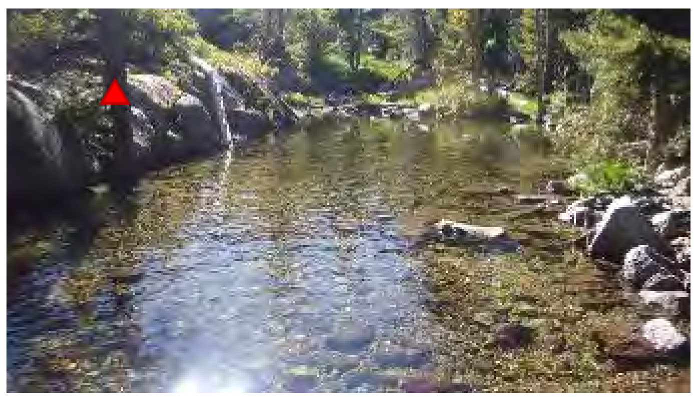
11 July 2019

15 August 2019



15 August 2019

25 September 2019



25 September 2019

| HC-103 (a) | HC-103 (b) |
|---|---|

**Figure I1-11. Photos along upper Highland Creek at the Rockbound Lake Inlet Monitoring Area (Site RCK-A1) photo points (continued).**

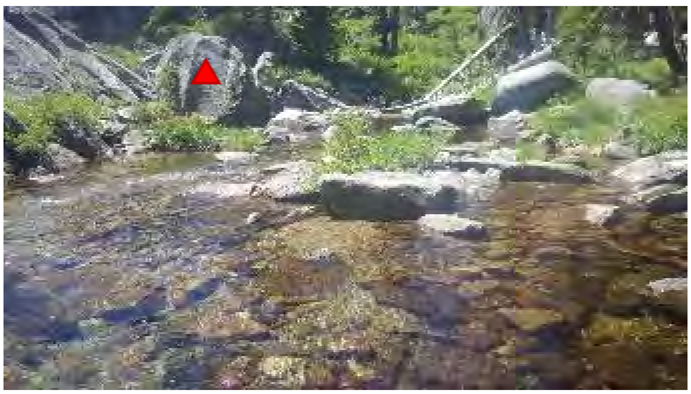
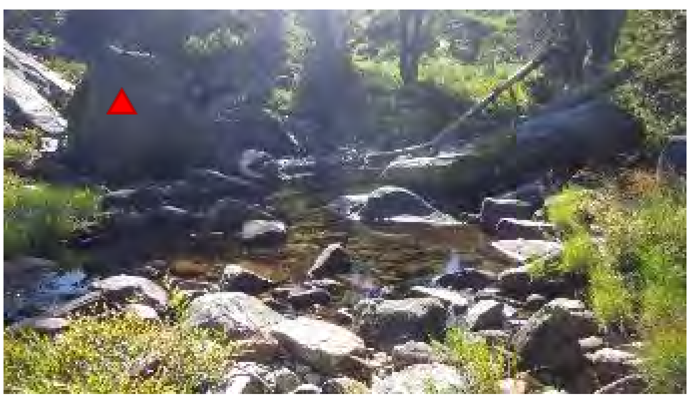
| HC-104 | HC-105 |
|---|---|
|  11 July 2019 |  11 July 2019 |
|  15 August 2019 |  15 August 2019 |
|  25 September 2019 |  25 September 2019 |

**Figure I1-11. Photos along upper Highland Creek at the Rockbound Lake Inlet Monitoring Area (Site RCK-A1) photo points (continued).**

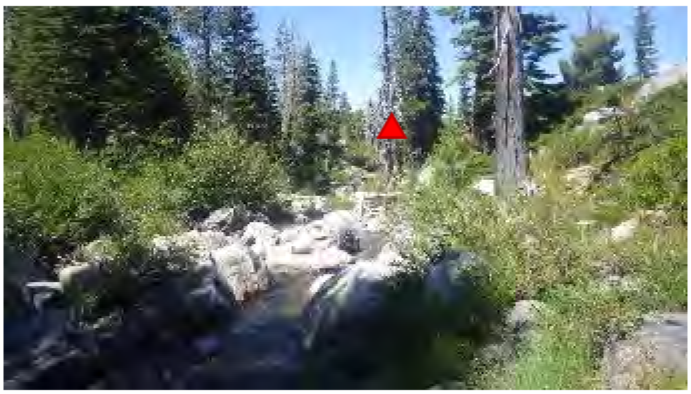
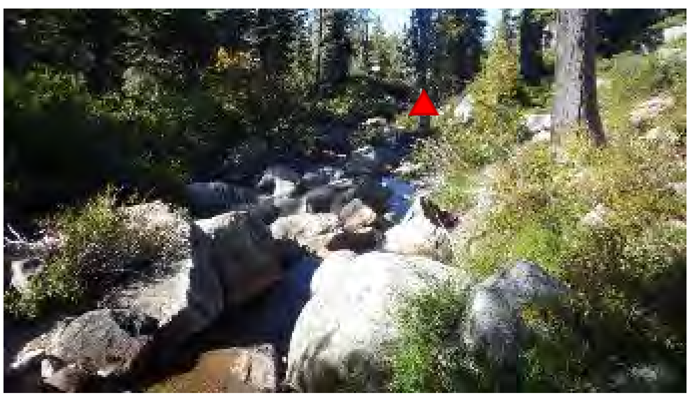
| HC-106 (a) | HC-106 (b) |
|---|---|
|  11 July 2019 |  11 July 2019 |
|  15 August 2019 |  15 August 2019 |
|  25 September 2019 |  25 September 2019 |

**Figure I1-11. Photos along upper Highland Creek at the Rockbound Lake Inlet Monitoring Area (Site RCK-A1) photo points (continued).**

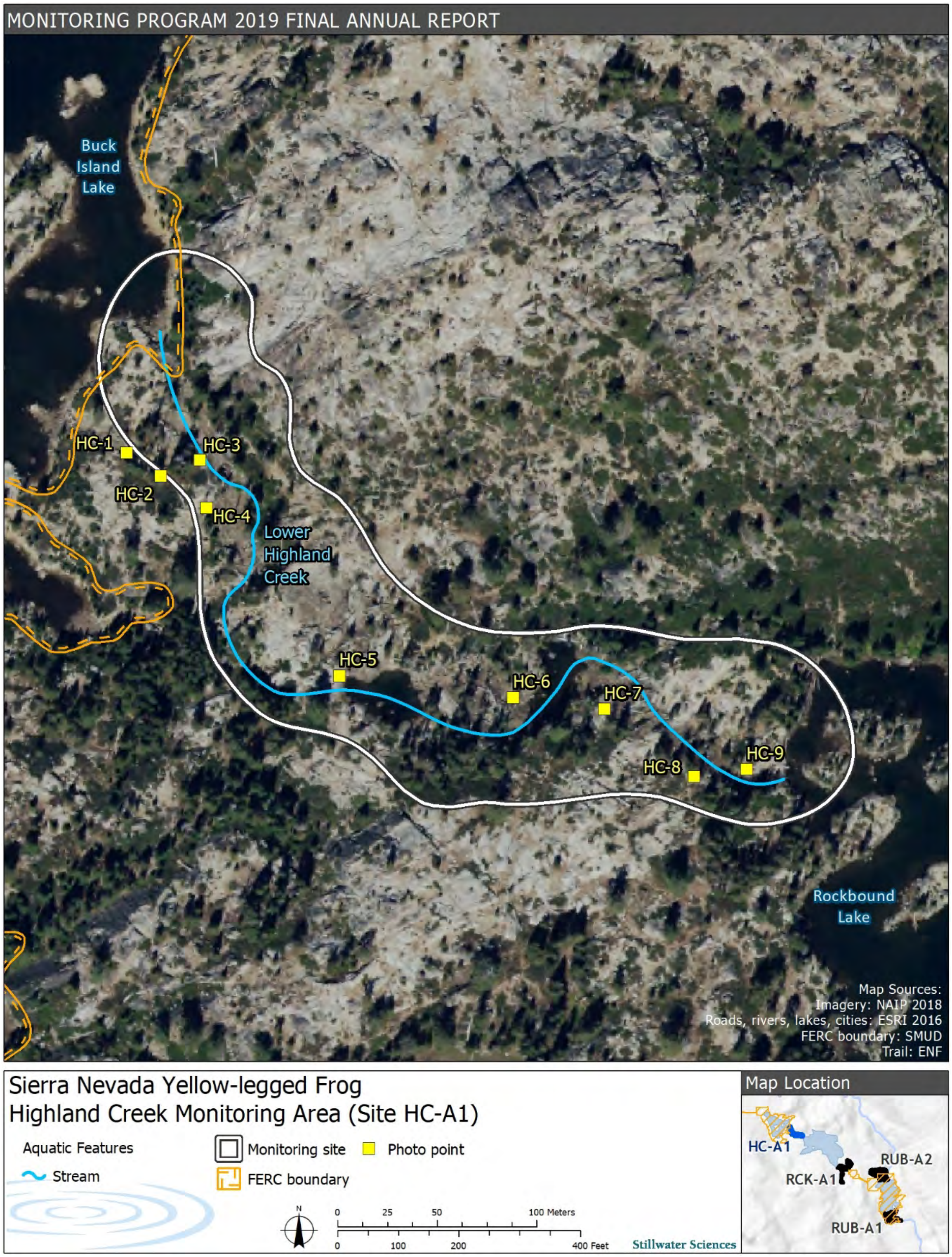



**Figure I1-12. Photo points at the Highland Creek Monitoring Area (Site HC-A1), 2019.**

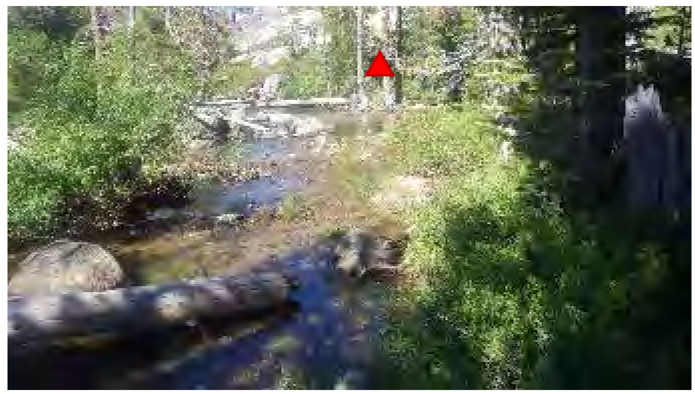
| | |
|---|---|
|  11 July 2019 |  11 July 2019 |
|  15 August 2019 |  15 August 2019 |
|  26 September 2019 |  26 September 2019 |
| **HC-1** | **HC-2** |

**Figure I1-13. Photos along lower Highland Creek at the Highland Creek Monitoring Area (Site HC-A1) photo points.**


11 July 2019


11 July 2019


15 August 2019

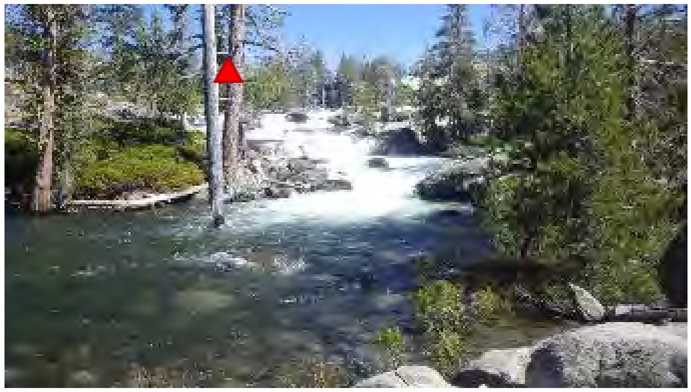

15 August 2019


26 September 2019


26 September 2019

| HC-3 (a) | HC-3 (b) |
|---|---|

**Figure I1-13. Photos along lower Highland Creek at the Highland Creek Monitoring Area (Site HC-A1) photo points (continued).**



11 July 2019

15 August 2019

26 September 2019

**HC-4**

**Figure I1-13. Photos along lower Highland Creek at the Highland Creek Monitoring Area (Site HC-A1) photo points (continued).**

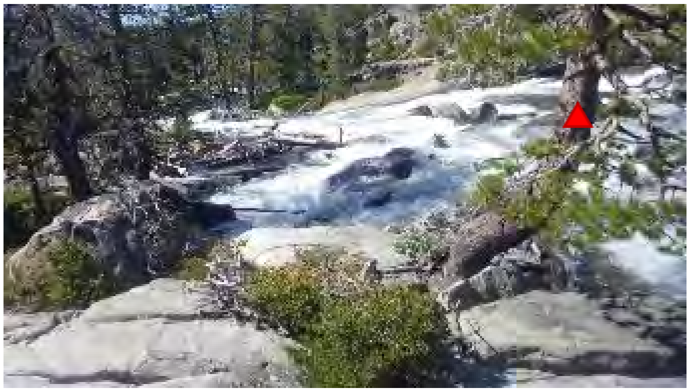
| HC-5 (a) | HC-5 (b) |
|---|---|
|  11 July 2019 |  11 July 2019 |
|  15 August 2019 |  15 August 2019 |
|  26 September 2019 |  26 September 2019 |

**Figure I1-13. Photos along lower Highland Creek at the Highland Creek Monitoring Area (Site HC-A1) photo points (continued).**

no photo

11 July 2019

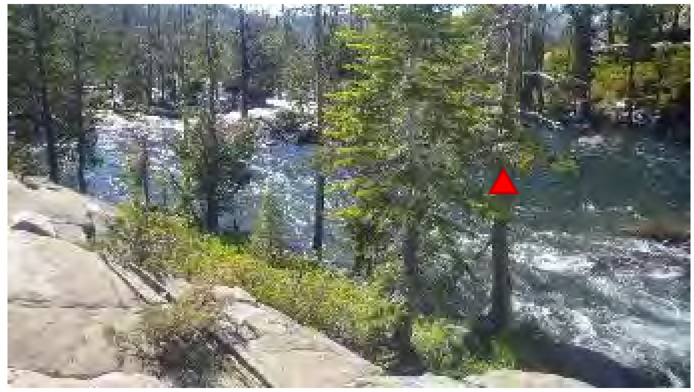
15 August 2019

26 September 2019

**HC-6**

**Figure I1-13. Photos along lower Highland Creek at the Highland Creek Monitoring Area (Site HC-A1) photo points (continued).**

11 July 2019



11 July 2019

15 August 2019

15 August 2019

26 September 2019

26 September 2019

**HC-7 (a)** | **HC-7 (b)**

**Figure I1-13. Photos along lower Highland Creek at the Highland Creek Monitoring Area (Site HC-A1) photo points (continued).**

11 July 2019

15 August 2019

26 September 2019

**HC-8**

**Figure I1-13. Photos along lower Highland Creek at the Highland Creek Monitoring Area (Site HC-A1) photo points (continued).**

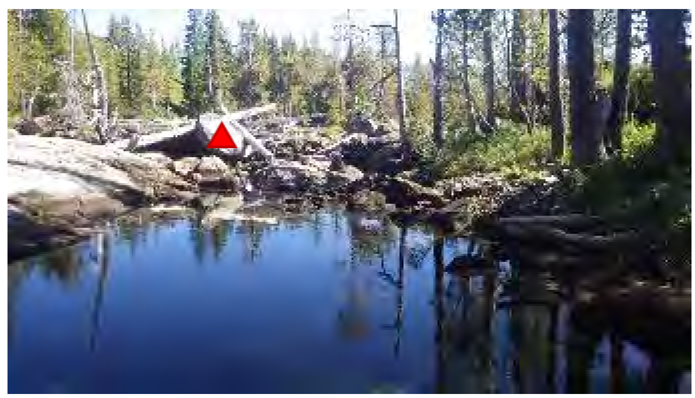
| | |
|---|---|
| no photo | no photo |
| 11 July 2019 | 11 July 2019 |
|  |  |
| 15 August 2019 | 15 August 2019 |
|  |  |
| 26 September 2019 | 26 September 2019 |
| **HC-9 (a)** | **HC-9 (b)** |

**Figure I1-13. Photos along lower Highland Creek at the Highland Creek Monitoring Area (Site HC-A1) photo points (continued).**

# APPENDIX J1

## 2019 Bear Forms

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For office use only:

Report collected by: ______________________ (USFS/camp host)

Date: __________



7/17 Day Use dumpster tipped

# BEAR ENCOUNTER FORM

## Bear Management Monitoring
## Crystal Basin Recreation Area

KEEP ME WILD

***Use a separate form for each individual incident.*** *For example, if the same bear enters two campsites while people are present, a person from each campsite should report the specifics of their encounter. Give completed forms to campground hosts. If your recreation site has no host, forms should be placed in the appropriate receptacle at the site or dropped off at the Crystal Basin Information Station on Ice House Road between Ice House Reservoir and Union Valley Reservoir. Forms also can be dropped off at the Pacific Ranger Station at 7887 Highway 50, Pollock Pines, CA 95726.*

**1. Person(s) involved:**

Name: [redacted]

Address:

City: [redacted] State: [redacted]

Zip code: [redacted] Phone: [redacted]

Country: [redacted]

**2. Describe yourself:**

a. Visitor
b. Camp host
c. USFS employee
d. Contractor
e. Other ______

**3. Visitor activity:**

a. Camping – developed campground → SITE 26
b. Camping – undeveloped campsite/wilderness
c. Day use area
d. Hiking on maintained trail
e. Other ______

**4. Group size:** 6
(number of people who encountered the bear)

**5. Time of encounter:** Month: 07 Day: 07 Year: 2019 Time: 10:30 am/pm

**6. Location of encounter:**

a. Airport Flat campground
b. Angel Creek day use area
c. Azalea Cove campground
d. Big Silver group campground
e. Camino Cove campground
f. Fashoda campground
g. Gerle Creek campground complex
h. Ice House campground/ boat launch/day use area
i. Jones Fork campground
j. Junction Reservoir boat launch
k. Lone Rock campground
l. Loon Lake campground/boat ramp
m. Loon Lake chalet
n. Northshore campground
o. Northshore RV campground
p. Pleasant campground
q. Red Fir group campground
r. Strawberry Point campground
s. Sunset campground/boat launch
t. Union Valley bike trail
u. Wench Creek campground
v. Wench Creek group campground
w. West Point campground/boat launch
x. Wolf Creek campground
y. Wolf Creek group campground
z. Yellowjacket campground/boat launch
Other ______________________

**7. Number and description of bears** (how many, what color, size, adult or cub, sex?):

UNKNOWN (WE BELIEVE ONLY ONE BEAR WAS IN OUR SITE)

**8. Did the bear(s) harm anyone?**

a. No b. Yes* (describe) ______________________

**9. What were you doing before you saw the bear?**

DID NOT SEE BEAR, CAMP WAS RANSACKED BY BEAR WHILE WE WERE AT THE PIER,

**10. What was the bear doing when you first saw it?**

N/A

* If there was a physical encounter with the bear or a bear was harmed in the incident, please report to the USFS Ranger and California Department of Fish and Wildlife.

**11. How did the bear react to you?**

N/A

**12. What did you do then?**

N/A

**13. How did the bear react to your response?**

N/A

**14. How close did you come to the bear** (how many feet)**?**

N/A

**15. Was human food present?**

a. Food not in bear resistant container
b. Food in bear resistant container
c. Food odor only
d. Food hung in tree → TRASH BAG HUNG IN TREE
e. No food present
f. Unknown

**16. Did the bear eat any human food?**

a. No b. Yes (what?) BAGELS
c. Unknown

**17. Did the bear damage property?**

a. No b. Yes (list property and estimate costs) ______________

**18. Details of bear-human interaction** (optional):

DID NOT ACTUALLY COME INTO CONTACT W/ BEAR. HEARD NOISES IN THE TREELINE BEFORE BEAR RANSACKED CAMPSITE. WE CAME BACK TO THE SITE TO FIND THE TRASH BAG SHREDDED & OUR BAGELS EATEN & BEAR SLOBBER ALL OVER THE TABLE.

For office use only:

Report collected by: ______________________ (USFS/camp host)

Date: __________



5/26 3 dumpsters tipped over
Nita Campbell – host

# BEAR ENCOUNTER FORM

## Bear Management Monitoring
## Crystal Basin Recreation Area

5/31 – 1 dumpster tipped

***Use a separate form for each individual incident.*** *For example, if the same bear enters two campsites while people are present, a person from each campsite should report the specifics of their encounter. Give completed forms to campground hosts. If your recreation site has no host, forms should be placed in the appropriate receptacle at the site or dropped off at the Crystal Basin Information Station on Ice House Road between Ice House Reservoir and Union Valley Reservoir. Forms also can be dropped off at the Pacific Ranger Station at 7887 Highway 50, Pollock Pines, CA 95726.*

**1. Person(s) involved:**

Name: [redacted]

Address: [redacted]

City: [redacted] State: [redacted]

Zip code: [redacted] Phone: [redacted]

Country: [redacted]

**2. Describe yourself:**

a. Visitor
b. Camp host
c. USFS employee
d. Contractor
e. Other ______________

**3. Visitor activity:**

a. Camping – developed campground
b. Camping – undeveloped campsite/wilderness
c. Day use area
d. Hiking on maintained trail
e. Other ______________

**4. Group size:** JUST ME – 6 OTHERS WERE SLEEPING
(number of people who encountered the bear)

**5. Time of encounter:** Month: 5 Day: 25 Year: 2019 Time: 3 am/pm

**6. Location of encounter:**

a. Airport Flat campground
b. Angel Creek day use area
c. Azalea Cove campground
d. Big Silver group campground
e. Camino Cove campground
f. Fashoda campground
g. Gerle Creek campground complex
h. Ice House campground/ boat launch/day use area
i. Jones Fork campground
j. Junction Reservoir boat launch
k. Lone Rock campground
l. Loon Lake campground/boat ramp
m. Loon Lake chalet
n. Northshore campground
o. Northshore RV campground
p. Pleasant campground
q. Red Fir group campground
r. Strawberry Point campground
s. Sunset campground/boat launch
t. Union Valley bike trail
u. Wench Creek campground
v. Wench Creek group campground
w. West Point campground/boat launch
x. Wolf Creek campground
y. Wolf Creek group campground
z. Yellowjacket campground/boat launch
Other ____________

**7. Number and description of bears** (how many, what color, size, adult or cub, sex?):

1 BROWN HUGE MALE

**8. Did the bear(s) harm anyone?**

a. No b. Yes* (describe) ____________

**9. What were you doing before you saw the bear?**

CLEANING UP HIS MESS

**10. What was the bear doing when you first saw it?**

SNEAKING UP ON ME

* If there was a physical encounter with the bear or a bear was harmed in the incident, please report to the USFS Ranger and California Department of Fish and Wildlife.

**11. How did the bear react to you?**

WE LOCKED EYES

**12. What did you do then?**

HIT THE BEAR BOX WITH GOLF CLUB.

**13. How did the bear react to your response?**

HE LEFT

**14. How close did you come to the bear** (how many feet)?

6 FEET

**15. Was human food present?**

a. Food not in bear resistant container
b. Food in bear resistant container
c. Food odor only
d. Food hung in tree
e. No food present
f. Unknown

**16. Did the bear eat any human food?**

a. No b. Yes (what?) SALAD SALAMI
c. Unknown

**17. Did the bear damage property?**

a. No b. Yes (list property and estimate costs) COOLER $30

**18. Details of bear-human interaction** (optional):

I NOW HAVE A STORY TO TELL FOR LIFE.

**For office use only:**

Report collected by: Liz Carroll (USFS/camp host)

Date: 7/10/19



# BEAR ENCOUNTER FORM

## Bear Management Monitoring
## Crystal Basin Recreation Area

***Use a separate form for each individual incident.*** *For example, if the same bear enters two campsites while people are present, a person from each campsite should report the specifics of their encounter. Give completed forms to campground hosts. If your recreation site has no host, forms should be placed in the appropriate receptacle at the site or dropped off at the Crystal Basin Information Station on Ice House Road between Ice House Reservoir and Union Valley Reservoir.*

**1. Person(s) involved:**

Name: [redacted]

**2. Describe yourself:**

a. Visitor
b. Camp host
c. USFS employee
d. Contractor
e. Other ____________

**3. Visitor activity:**

a. Camping – developed campground
b. Camping – undeveloped campsite/wilderness
c. Day use area
d. Hiking on maintained trail
e. Other ____________

**4. Group size:** 2
(number of people who encountered the bear)

**5. Time of encounter:** Month: 7 Day: 10 Year: 19 Time: 1:00 am/pm

**6. Location of encounter:**

a. Airport Flat campground
b. Angel Creek day use area
c. Azalea Cove campground
d. Big Silver group campground
e. Camino Cove campground
f. Fashoda campground
g. Gerle Creek campground complex
h. Ice House campground/
boat launch/day use area
i. Jones Fork campground
j. Junction Reservoir boat launch
k. Lone Rock campground
l. Loon Lake campground/boat ramp
m. Loon Lake chalet
n. Northshore campground
o. Northshore RV campground
p. Pleasant campground
q. Red Fir group campground
r. Strawberry Point campground
s. Sunset campground/boat launch
t. Union Valley bike trail
u. Wench Creek campground
v. Wench Creek group campground
w. West Point campground/boat launch
x. Wolf Creek campground
y. Wolf Creek group campground
z. Yellowjacket campground/boat launch
Other Millionare Campground

**7. Number and description of bears** (how many, what color, size, adult or cub, sex?):

1 large adult dark

**8. What was the bear doing when you first saw it?**

Trying to open my cooler

**9. Did you react to the bear?**

Yelled @ bear and then shot into ground to scare

**10. How did the bear react to your response?**

Tried to drag cooler away

**11. Was human food present?**

a. Some food/trash NOT in bear resistant container
b. All food/trash in bear resistant container
c. No food present/ordor only
d. Food hung in tree
e. Unknown
f. Some food in vehicle

**12. Did the bear eat any human food?**

a. No b. Yes (what?)
c. Unknown

**13. Did the bear damage property?**

a. No b. Yes (list property and estimate costs) teeth holes in cooler

**14. Did the bear(s) harm anyone?**

a. No b. Yes* (describe)

**15. Details of bear-human interaction** (optional)**:**

Tried to scare by yelling at it w/ flashlight started to drag off cooler fired shot into ground and it bolted off.

* If there was a physical encounter with the bear or a bear was harmed in the incident, please report to the USFS Ranger and California Department of Fish and Wildlife.

For office use only:

Report collected by: ______________________ (USFS/camp host)

Date: ______________



# BEAR ENCOUNTER FORM

## Bear Management Monitoring
## Crystal Basin Recreation Area

***Use a separate form for each individual incident.*** *For example, if the same bear enters two campsites while people are present, a person from each campsite should report the specifics of their encounter. Give completed forms to campground hosts. If your recreation site has no host, forms should be placed in the appropriate receptacle at the site or dropped off at the Crystal Basin Information Station on Ice House Road between Ice House Reservoir and Union Valley Reservoir.*

**1. Person(s) involved:**

Name: [redacted]

**2. Describe yourself:**

a. Visitor

b. Camp host

c. USFS employee

d. Contractor

e. Other ______________

**3. Visitor activity:**

a. Camping – developed campground

b. Camping – undeveloped campsite/wilderness

c. Day use area

d. Hiking on maintained trail

e. Other ______________

**4. Group size:** 1
(number of people who encountered the bear)

**5. Time of encounter:** Month: 7 Day: 8 Year: 2019 Time: 9:00 am/pm

**6. Location of encounter:**

a. Airport Flat campground
b. Angel Creek day use area
c. Azalea Cove campground
d. Big Silver group campground
e. Camino Cove campground
f. Fashoda campground
g. Gerle Creek ~~campground complex~~
h. Ice House campground/ boat launch/day use area
i. Jones Fork campground
j. Junction Reservoir boat launch
k. Lone Rock campground
l. Loon Lake campground/boat ramp
m. Loon Lake chalet
n. Northshore campground
o. Northshore RV campground
p. Pleasant campground
q. Red Fir group campground
r. Strawberry Point campground
s. Sunset campground/boat launch
t. Union Valley bike trail
u. Wench Creek campground
v. Wench Creek group campground
w. West Point campground/boat launch
x. Wolf Creek campground
y. Wolf Creek group campground
z. Yellowjacket campground/boat launch
Other ______________________

**7. Number and description of bears** (how many, what color, size, adult or cub, sex?):

3 - Brown 100 LB Black# 110 - Red 160#

**8. What was the bear doing when you first saw it?**

walking

**9. Did you react to the bear?**

no

**10. How did the bear react to your response?**

n/A

**11. Was human food present?**

a. Some food/trash NOT in bear resistant container
b. All food/trash in bear resistant container
c. No food present/ordor only
d. Food hung in tree
e. Unknown
f. Some food in vehicle

**12. Did the bear eat any human food?**

a. No b. Yes (what?)
c. Unknown ______________________

**13. Did the bear damage property?**

a. No b. Yes (list property and estimate costs) ______________

**14. Did the bear(s) harm anyone?**

a. No b. Yes* (describe) ______________________

**15. Details of bear-human interaction** (optional):

☺

* If there was a physical encounter with the bear or a bear was harmed in the incident, please report to the USFS Ranger and California Department of Fish and Wildlife.

For office use only:

Report collected by: ______________________ (USFS/camp host)

Date: __________



3dumpsters tipped 7/7
3 dumpsters tipped 7/10

# BEAR ENCOUNTER FORM

## Bear Management Monitoring
## Crystal Basin Recreation Area

***Use a separate form for each individual incident.*** *For example, if the same bear enters two campsites while people are present, a person from each campsite should report the specifics of their encounter. Give completed forms to campground hosts. If your recreation site has no host, forms should be placed in the appropriate receptacle at the site or dropped off at the Crystal Basin Information Station on Ice House Road between Ice House Reservoir and Union Valley Reservoir. Forms also can be dropped off at the Pacific Ranger Station at 7887 Highway 50, Pollock Pines, CA 95726.*

**1. Person(s) involved:**

Name: [redacted]

Address: [redacted]

City: [redacted] State: [redacted]

Zip code: [redacted] Phone: [redacted]

Country: [redacted]

**2. Describe yourself:**

a. Visitor
b. Camp host
c. USFS employee
d. Contractor
e. Other ____________

**3. Visitor activity:**

a. Camping – developed campground
b. Camping – undeveloped campsite/wilderness
c. Day use area
d. Hiking on maintained trail
e. Other ____________

**4. Group size:** 8
(number of people who encountered the bear)

**5. Time of encounter:** Month: 7 Day: 7 Year: 19 Time: 10:30 am/pm

**6. Location of encounter:**

a. Airport Flat campground
b. Angel Creek day use area
c. Azalea Cove campground
d. Big Silver group campground
e. Camino Cove campground
f. Fashoda campground
g. Gerle Creek campground complex
h. Ice House campground/ boat launch/day use area
i. Jones Fork campground
j. Junction Reservoir boat launch
k. Lone Rock campground
l. Loon Lake campground/boat ramp
m. Loon Lake chalet
n. Northshore campground
o. Northshore RV campground
p. Pleasant campground
q. Red Fir group campground
r. Strawberry Point campground
s. Sunset campground/boat launch
t. Union Valley bike trail
u. Wench Creek campground
v. Wench Creek group campground
w. West Point campground/boat launch
x. Wolf Creek campground
y. Wolf Creek group campground
z. Yellowjacket campground/boat launch
Other ______

**7. Number and description of bears** (how many, what color, size, adult or cub, sex?):

2 Bears / Dark Brown / huge / adult

**8. Did the bear(s) harm anyone?**

a. No b. Yes* (describe) ______

**9. What were you doing before you saw the bear?**

Getting ready for bed.

**10. What was the bear doing when you first saw it?**

Bear flipped over the dumpster - went to look - yelled at it.

* If there was a physical encounter with the bear or a bear was harmed in the incident, please report to the USFS Ranger and California Department of Fish and Wildlife.

**11. How did the bear react to you?**

Dumpster bear (bear#1) walked away when I yelled. Bear just looked at me.

**12. What did you do then?**

Yelled at it - It walked away so I walked away. Then bear#2 walked behind Campground #18 and #19. Horn was used on that

**13. How did the bear react to your response?**

One it just continued to walk.

**14. How close did you come to the bear** (how many feet)**?**

About 50 feet from bear

**15. Was human food present?**

a. Food not in bear resistant container
b. Food in bear resistant container
c. Food odor only
d. Food hung in tree
e. No food present
f. Unknown

**16. Did the bear eat any human food?**

a. No b. Yes (what?) ______
c. Unknown

**17. Did the bear damage property?**

a. No b. Yes (list property and estimate costs) ______

**18. Details of bear-human interaction** (optional)**:**

Bear and human interaction was just using the horn and voice to scare them away. They did move on..

KEEP ME WILD

**For office use only:**

Report collected by: ____________________ (USFS/camp host)

Date: __________



KEEP ME WILD

# BEAR ENCOUNTER FORM

## Bear Management Monitoring
## Crystal Basin Recreation Area

***Use a separate form for each individual incident.*** *For example, if the same bear enters two campsites while people are present, a person from each campsite should report the specifics of their encounter. Give completed forms to campground hosts. If your recreation site has no host, forms should be placed in the appropriate receptacle at the site or dropped off at the Crystal Basin Information Station on Ice House Road between Ice House Reservoir and Union Valley Reservoir. Forms also can be dropped off at the Pacific Ranger Station at 7887 Highway 50, Pollock Pines, CA 95726.*

**1. Person(s) involved:**

Name: [redacted]

Address: [redacted]

City: [redacted] State: [redacted]

Zip code: [redacted] Phone: [redacted]

Country: [redacted]

**2. Describe yourself:**

a. Visitor
b. Camp host
c. USFS employee
d. Contractor
e. Other __________

**3. Visitor activity:**

a. Camping – developed campground
b. Camping – undeveloped campsite/wilderness
c. Day use area
d. Hiking on maintained trail
e. Other __________

**4. Group size:** 1 one
(number of people who encountered the bear)

**5. Time of encounter:** Month: 7 Day: 15 Year: 2019 Time: 12:37 am/pm

**6. Location of encounter:**

a. Airport Flat campground
b. Angel Creek day use area
c. Azalea Cove campground
d. Big Silver group campground
e. Camino Cove campground
f. Fashoda campground
g. Gerle Creek campground complex
h. Ice House campground/ boat launch/day use area
i. Jones Fork campground
j. Junction Reservoir boat launch
k. Lone Rock campground
l. Loon Lake campground/boat ramp
m. Loon Lake chalet
n. Northshore campground
o. Northshore RV campground
p. Pleasant campground
q. Red Fir group campground
r. Strawberry Point campground
s. Sunset campground/boat launch
t. Union Valley bike trail
u. Wench Creek campground
v. Wench Creek group campground
w. West Point campground/boat launch
x. Wolf Creek campground
y. Wolf Creek group campground
z. Yellowjacket campground/boat launch
Other ______

**7. Number and description of bears** (how many, what color, size, adult or cub, sex?):

1 - Blond/Brown Adult 200 ish LB

**8. Did the bear(s) harm anyone?**

a. No b. Yes* (describe) ______

**9. What were you doing before you saw the bear?**

Sleeping

**10. What was the bear doing when you first saw it?**

Stoped/Ran after I Talked to him/her

* If there was a physical encounter with the bear or a bear was harmed in the incident, please report to the USFS Ranger and California Department of Fish and Wildlife.

**11. How did the bear react to you?**

Calm

**12. What did you do then?**

Talked to Him/her

**13. How did the bear react to your response?**

Took off Running

**14. How close did you come to the bear** (how many feet)**?**

20'

**15. Was human food present?**

a. Food not in bear resistant container
b. Food in bear resistant container
c. Food odor ~~only~~ fishing net
d. Food hung in tree
e. No food present
f. Unknown

**16. Did the bear eat any human food?**

a. No b. Yes (what?) ______
c. Unknown

**17. Did the bear damage property?**

a. No b. Yes (list property and estimate costs) ______

**18. Details of bear-human interaction** (optional)**:**

Good no Problems. Bear was afaid of people

For office use only:

Report collected by: ______________________ (USFS/camp host)

Date: ______________



# BEAR ENCOUNTER FORM

## Bear Management Monitoring
## Crystal Basin Recreation Area

***Use a separate form for each individual incident.*** *For example, if the same bear enters two campsites while people are present, a person from each campsite should report the specifics of their encounter. Give completed forms to campground hosts. If your recreation site has no host, forms should be placed in the appropriate receptacle at the site or dropped off at the Crystal Basin Information Station on Ice House Road between Ice House Reservoir and Union Valley Reservoir.*

**1. Person(s) involved:**

Name: [redacted]

**2. Describe yourself:**

a. Visitor /LE.

b. Camp host

c. USFS employee

d. Contractor

e. Other ______________

**3. Visitor activity:**

a. Camping – developed campground

b. Camping – undeveloped campsite/wilderness

c. Day use area

d. Hiking on maintained trail

e. Other ______________

**4. Group size:** 6
(number of people who encountered the bear)

**5. Time of encounter:** Month: 8 Day: 3 Year: 19 Time: 0130 am/pm

**6. Location of encounter:**

a. Airport Flat campground
b. Angel Creek day use area
c. Azalea Cove campground
d. Big Silver group campground
e. Camino Cove campground
f. Fashoda campground
g. Gerle Creek campground complex
h. Ice House campground/ boat launch/day use area
i. Jones Fork campground
j. Junction Reservoir boat launch
k. Lone Rock campground
l. Loon Lake campground/boat ramp
m. Loon Lake chalet
n. Northshore campground
o. Northshore RV campground
p. Pleasant campground
q. Red Fir group campground
r. Strawberry Point campground
s. Sunset campground/boat launch
t. Union Valley bike trail
u. Wench Creek campground
v. Wench Creek group campground
w. West Point campground/boat launch
x. Wolf Creek campground
y. Wolf Creek group campground
z. Yellowjacket campground/boat launch
Other ______________

**7. Number and description of bears** (how many, what color, size, adult or cub, sex?)**:**
1 BROWN, MALE 650-750 LBS

**8. What was the bear doing when you first saw it?**
INVESTIGATING OUR CAMPSITE.

**9. Did you react to the bear?**
POINTED FLASHLIGHT/STAYED CALM LET HIM DO HIS THING.

**10. How did the bear react to your response?**
CONTINUED LIKE IT WAS HIS JOB

**11. Was human food present?**

a. Some food/trash NOT in bear resistant container
b. All food/trash in bear resistant container
c. No food present/ordor only
d. Food hung in tree
e. Unknown
f. Some food in vehicle

**12. Did the bear eat any human food?**
a. No b. Yes (what?) NON-DAIRY CREAMER SUGAR FREE HE TASTED ONLY DIDN'T LIKE MUCH!! HAHA
c. Unknown ______________

**13. Did the bear damage property?**
a. No b. Yes (list property and estimate costs) ______________

**14. Did the bear(s) harm anyone?**
a. No b. Yes* (describe)______________

**15. Details of bear-human interaction** (optional)**:**
IN OUR GROUP WE UNDERSTAND WE ARE IN HIS HOUSE AND RESPECT THAT

* If there was a physical encounter with the bear or a bear was harmed in the incident, please report to the USFS Ranger and California Department of Fish and Wildlife.

For office use only:

Report collected by: ______________________ (USFS/camp host)

Date: ______________



4 dumpsters tipped over this week - including a 4 yard (not happened before)

# BEAR ENCOUNTER FORM

## Bear Management Monitoring

## Crystal Basin Recreation Area

Ditch Campbell host

*Use a separate form for each individual incident. For example, if the same bear enters two campsites while people are present, a person from each campsite should report the specifics of their encounter. Give completed forms to campground hosts. If your recreation site has no host, forms should be placed in the appropriate receptacle at the site or dropped off at the Crystal Basin Information Station on Ice House Road between Ice House Reservoir and Union Valley Reservoir.*

**1. Person(s) involved:**

Name: [redacted]

**2. Describe yourself:**

a. Visitor

b. Camp host

c. USFS employee

d. Contractor

e. Other ______________

**3. Visitor activity:**

a. Camping – developed campground

b. Camping – undeveloped campsite/wilderness

c. Day use area

d. Hiking on maintained trail

e. Other ______________

**4. Group size:** entered campsite only - campers sleeping
(number of people who encountered the bear)

**5. Time of encounter:** Month: 7 Day: 25 Year: 2019 Time: ______ am/pm
midnight - 3am approx.

**6. Location of encounter:**

a. Airport Flat campground
b. Angel Creek day use area
c. Azalea Cove campground
d. Big Silver group campground
e. Camino Cove campground
f. Fashoda campground
g. Gerle Creek campground complex
h. Ice House campground/ boat launch/day use area
i. Jones Fork campground
j. Junction Reservoir boat launch
k. Lone Rock campground
l. Loon Lake campground/boat ramp
m. Loon Lake chalet
n. Northshore campground
o. Northshore RV campground
p. Pleasant campground
q. Red Fir group campground
r. Strawberry Point campground
s. Sunset campground/boat launch
t. Union Valley bike trail
u. Wench Creek campground
v. Wench Creek group campground
w. West Point campground/boat launch
x. Wolf Creek campground
y. Wolf Creek group campground
z. Yellowjacket campground/boat launch
Other ______

**7. Number and description of bears** (how many, what color, size, adult or cub, sex?):

possibly one only - adult

**8. What was the bear doing when you first saw it?**

We didn't see it - entered campsite and knocked over items on table and tried to get into bin (without food)

**9. Did you react to the bear?**

No - we were sleeping

**10. How did the bear react to your response?**

N/A

**11. Was human food present?**

a. Some food/trash NOT in bear resistant container
b. All food/trash in bear resistant container
c. No food present/ordor only
d. Food hung in tree
e. Unknown
f. Some food in vehicle

**12. Did the bear eat any human food?**

a. No b. Yes (what?)
c. Unknown ______

**13. Did the bear damage property?**

a. No b. Yes (list property and estimate costs) just a bin $10.00

**14. Did the bear(s) harm anyone?**

a. No b. Yes* (describe)______

**15. Details of bear-human interaction** (optional):

______

* If there was a physical encounter with the bear or a bear was harmed in the incident, please report to the USFS Ranger and California Department of Fish and Wildlife.

For office use only:

Report collected by: ______________________(USFS/camp host)

Date: ______________



# BEAR ENCOUNTER FORM

## Bear Management Monitoring
## Crystal Basin Recreation Area

***Use a separate form for each individual incident.*** *For example, if the same bear enters two campsites while people are present, a person from each campsite should report the specifics of their encounter. Give completed forms to campground hosts. If your recreation site has no host, forms should be placed in the appropriate receptacle at the site or dropped off at the Crystal Basin Information Station on Ice House Road between Ice House Reservoir and Union Valley Reservoir.*

**1. Person(s) involved:** [redacted]

Name: ______

**2. Describe yourself:**

a. Visitor

b. Camp host

c. USFS employee

d. Contractor

e. Other ______

**3. Visitor activity:**

a. Camping – developed campground

b. Camping – undeveloped campsite/wilderness

c. Day use area

d. Hiking on maintained trail

e. Other ______

**4. Group size:** 6
(number of people who encountered the bear)

**5. Time of encounter:** Month: 08 Day: 01 Year: 19 Time: 12:00 am/pm

**6. Location of encounter:**

a. Airport Flat campground
b. Angel Creek day use area
c. Azalea Cove campground
d. Big Silver group campground
e. Camino Cove campground
f. Fashoda campground
g. Gerle Creek campground complex
h. Ice House campground/ boat launch/day use area
i. Jones Fork campground
j. Junction Reservoir boat launch
k. Lone Rock campground
l. Loon Lake campground/boat ramp
m. Loon Lake chalet
n. Northshore campground
o. Northshore RV campground
p. Pleasant campground
q. Red Fir group campground
r. Strawberry Point campground
s. Sunset campground/boat launch
t. Union Valley bike trail
u. Wench Creek campground
v. Wench Creek group campground
w. West Point campground/boat launch
x. Wolf Creek campground
y. Wolf Creek group campground
z. Yellowjacket campground/boat launch
Other ____________________

**7. Number and description of bears** (how many, what color, size, adult or cub, sex?):

ONE BLACK 300lb (est)

**8. What was the bear doing when you first saw it?**

SNIFFING AT BEAR BIN

**9. Did you react to the bear?**

YES - MADE NOISE

**10. How did the bear react to your response?**

NO RESPONSE

**11. Was human food present?**

a. Some food/trash NOT in bear resistant container
b. All food/trash in bear resistant container
c. No food present/ordor only
d. Food hung in tree
e. Unknown
f. Some food in vehicle

**12. Did the bear eat any human food?**

a. No b. Yes (what?)
c. Unknown ____________________

**13. Did the bear damage property?**

a. No b. Yes (list property and estimate costs) ____________

**14. Did the bear(s) harm anyone?**

a. No b. Yes* (describe) NO

**15. Details of bear-human interaction** (optional):

NO INTERACTION - BEAR DID NOT SEEMED AFFECTED BY NOISES - APPEARED TO BE GOING CAMP TO CAMP LOOKING FOR ACCESSIBLE FOOD

* If there was a physical encounter with the bear or a bear was harmed in the incident, please report to the USFS Ranger and California Department of Fish and Wildlife.

KEEP ME WILD

**For office use only:**

Report collected by: ______________________ (USFS/camp host)

Date: ______________



KEEP ME WILD

# BEAR ENCOUNTER FORM

## Bear Management Monitoring
## Crystal Basin Recreation Area

***Use a separate form for each individual incident.*** *For example, if the same bear enters two campsites while people are present, a person from each campsite should report the specifics of their encounter. Give completed forms to campground hosts. If your recreation site has no host, forms should be placed in the appropriate receptacle at the site or dropped off at the Crystal Basin Information Station on Ice House Road between Ice House Reservoir and Union Valley Reservoir.*

**1. Person(s) involved:**

Name: [redacted]

**2. Describe yourself:**

a. Visitor

b. Camp host

c. USFS employee

d. Contractor

e. Other ______________

**3. Visitor activity:**

a. Camping – developed campground

b. Camping – undeveloped campsite/wilderness

c. Day use area

d. Hiking on maintained trail

e. Other ______________

**4. Group size:** 7
(number of people who encountered the bear)

**5. Time of encounter:** Month: 07 Day: 17 Year: 19 Time: 6:30 am/pm

**6. Location of encounter:**

a. Airport Flat campground
b. Angel Creek day use area
c. Azalea Cove campground
d. Big Silver group campground
e. Camino Cove campground
f. Fashoda campground
g. Gerle Creek campground complex
h. Ice House campground/
boat launch/day use area
i. Jones Fork campground
j. Junction Reservoir boat launch
k. Lone Rock campground
l. Loon Lake campground/boat ramp
m. Loon Lake chalet
n. Northshore campground
o. Northshore RV campground
p. Pleasant campground
q. Red Fir group campground
r. Strawberry Point campground
s. Sunset campground/boat launch
t. Union Valley bike trail
u. Wench Creek campground
v. Wench Creek group campground
w. West Point campground/boat launch
x. Wolf Creek campground
y. Wolf Creek group campground
z. Yellowjacket campground/boat launch
Other ______________________

**7. Number and description of bears** (how many, what color, size, adult or cub, sex?):

One Black Bear adult

**8. What was the bear doing when you first saw it?**

It was in our ice chest.

**9. Did you react to the bear?**

Yes we yelled at it

**10. How did the bear react to your response?**

Not scared of Humans or dogs

**11. Was human food present?**

a. Some food/trash NOT in bear resistant container
b. All food/trash in bear resistant container
c. No food present/ordor only
d. Food hung in tree
e. Unknown
f. Some food in vehicle

**12. Did the bear eat any human food?**

a. No b. Yes (what?)
c. Unknown Mayo, chocolate, ketchup, Marshmellos, Capri sun, Mac and cheese, Potatoes, graves,

**13. Did the bear damage property?**

a. No b. Yes (list property and estimate costs) Tore lid off ice chest, but didn't break it,

**14. Did the bear(s) harm anyone?**

a. No b. Yes* (describe)______________________

**15. Details of bear-human interaction** (optional):

______________________

* If there was a physical encounter with the bear or a bear was harmed in the incident, please report to the USFS Ranger and California Department of Fish and Wildlife.

KEEP ME WILD

**For office use only:**

Report collected by: ______________________ (USFS/camp host)

Date: ______________



KEEP ME WILD

# BEAR ENCOUNTER FORM

## Bear Management Monitoring
## Crystal Basin Recreation Area

***Use a separate form for each individual incident.*** *For example, if the same bear enters two campsites while people are present, a person from each campsite should report the specifics of their encounter. Give completed forms to campground hosts. If your recreation site has no host, forms should be placed in the appropriate receptacle at the site or dropped off at the Crystal Basin Information Station on Ice House Road between Ice House Reservoir and Union Valley Reservoir.*

**1. Person(s) involved:**

Name: [redacted]

**2. Describe yourself:**

a. Visitor

b. Camp host

c. USFS employee

d. Contractor

e. Other ______________

**3. Visitor activity:**

a. Camping – developed campground 17N12

b. Camping – undeveloped campsite/wilderness

c. Day use area

d. Hiking on maintained trail

e. Other ______________

**4. Group size:** 3
(number of people who encountered the bear)

**5. Time of encounter:** Month: 7 Day: 18 Year: 2019 Time: 10:30 pm am/pm
and again at 1:30 am

**6. Location of encounter:** 17N12 across bridge from Airport flats

a. Airport Flat campground

b. Angel Creek day use area

c. Azalea Cove campground

d. Big Silver group campground

e. Camino Cove campground

f. Fashoda campground

g. Gerle Creek campground complex

h. Ice House campground/ boat launch/day use area

i. Jones Fork campground

j. Junction Reservoir boat launch

k. Lone Rock campground

l. Loon Lake campground/boat ramp

m. Loon Lake chalet

n. Northshore campground

o. Northshore RV campground

p. Pleasant campground

q. Red Fir group campground

r. Strawberry Point campground

s. Sunset campground/boat launch

t. Union Valley bike trail

u. Wench Creek campground

v. Wench Creek group campground

w. West Point campground/boat launch

x. Wolf Creek campground

y. Wolf Creek group campground

z. Yellowjacket campground/boat launch

Other ______________

**7. Number and description of bears** (how many, what color, size, adult or cub, sex?):

1 bear, brown, huge 400lbs plus, Adult, Not sure about sex it didn't ask.

**8. What was the bear doing when you first saw it?**

Riping my cooler to pieces.

**9. Did you react to the bear?**

Honked my car horn and yelled at it,

**10. How did the bear react to your response?**

Looked at me briefly then continued to help its self to my food.

**11. Was human food present?**

a. Some food/trash NOT in bear resistant container

b. All food/trash in bear resistant container

c. No food present/ordor only

d. Food hung in tree

e. Unknown

f. Some food in vehicle

**12. Did the bear eat any human food?**

a. No b. Yes (what?) 16 really tasty expensive hot dogs ☹, 1 chicken breast, 3 freeze dried foods packets 1,200 caleries a packet.

c. Unknown

**13. Did the bear damage property?**

a. No b. Yes (list property and estimate costs) ice chest, cheap

**14. Did the bear(s) harm anyone?**

a. No b. Yes* (describe) Not aggressive just hungry

**15. Details of bear-human interaction** (optional):

I honked my horn and yelled at it. Bear looked at me and continued to eat.

* If there was a physical encounter with the bear or a bear was harmed in the incident, please report to the USFS Ranger and California Department of Fish and Wildlife.

KEEP ME WILD

**For office use only:**

Report collected by: ______________________ (USFS/camp host)

Date: ____________



2 dumpsters tipped this week
N. Campbell
host

KEEP ME WILD

# BEAR ENCOUNTER FORM

## Bear Management Monitoring
## Crystal Basin Recreation Area

***Use a separate form for each individual incident.*** *For example, if the same bear enters two campsites while people are present, a person from each campsite should report the specifics of their encounter. Give completed forms to campground hosts. If your recreation site has no host, forms should be placed in the appropriate receptacle at the site or dropped off at the Crystal Basin Information Station on Ice House Road between Ice House Reservoir and Union Valley Reservoir. Forms also can be dropped off at the Pacific Ranger Station at 7887 Highway 50, Pollock Pines, CA 95726.*

**1. Person(s) involved:**

Name: [redacted]

Address: 

City: [redacted] State: [redacted]

Zip code: [redacted] Phone: [redacted]

Country: [redacted]

**2. Describe yourself:**

a. Visitor
b. Camp host
c. USFS employee
d. Contractor
e. Other ____________

**3. Visitor activity:**

a. Camping – developed campground
b. Camping – undeveloped campsite/wilderness
c. Day use area
d. Hiking on maintained trail
e. Other ____________

**4. Group size:** Ø
(number of people who encountered the bear)

**5. Time of encounter:** Month: 8 Day: 9 Year: 19 Time: APRX 2230 am/pm

**6. Location of encounter:**

a. Airport Flat campground
b. Angel Creek day use area
c. Azalea Cove campground
d. Big Silver group campground
e. Camino Cove campground
f. Fashoda campground
g. Gerle Creek campground complex
h. Ice House campground/ boat launch/day use area
i. Jones Fork campground
j. Junction Reservoir boat launch
k. Lone Rock campground
l. Loon Lake campground/boat ramp
m. Loon Lake chalet
n. Northshore campground
o. Northshore RV campground
p. Pleasant campground
q. Red Fir group campground
r. Strawberry Point campground
s. Sunset campground/boat launch
t. Union Valley bike trail
u. Wench Creek campground
v. Wench Creek group campground
w. West Point campground/boat launch
x. Wolf Creek campground
y. Wolf Creek group campground
z. Yellowjacket campground/boat launch
Other ____________________

**7. Number and description of bears** (how many, what color, size, adult or cub, sex?):

UNKNOWN - DID NOT SEE THE BEAR

**8. Did the bear(s) harm anyone?**

a. No b. Yes* (describe) ____________________

**9. What were you doing before you saw the bear?**

BEAR WENT INBETWEEN THREE SITES WHERE PEOPLE WERE AT CAMPFIRES, BUT WASN'T SEEN

**10. What was the bear doing when you first saw it?**

EMPTIED AN ICE CHEST BUT NEVER SEEN

* If there was a physical encounter with the bear or a bear was harmed in the incident, please report to the USFS Ranger and California Department of Fish and Wildlife.

**11. How did the bear react to you?**

____________________

**12. What did you do then?**

____________________

**13. How did the bear react to your response?**

____________________

**14. How close did you come to the bear** (how many feet)**?**

____________________

**15. Was human food present?**

a. Food not in bear resistant container
b. Food in bear resistant container
c. Food odor only
d. Food hung in tree
e. No food present
f. Unknown

**16. Did the bear eat any human food?**

a. No b. Yes (what?) ____________________
c. Unknown

**17. Did the bear damage property?**

a. No b. Yes (list property and estimate costs) ____________________

**18. Details of bear-human interaction** (optional)**:**

____________________

____________________

____________________

KEEP ME WILD

**For office use only:**

Report collected by: ______________________(USFS/camp host)

Date: ______________



KEEP ME WILD

# BEAR ENCOUNTER FORM

## Bear Management Monitoring
## Crystal Basin Recreation Area

***Use a separate form for each individual incident.*** *For example, if the same bear enters two campsites while people are present, a person from each campsite should report the specifics of their encounter. Give completed forms to campground hosts. If your recreation site has no host, forms should be placed in the appropriate receptacle at the site or dropped off at the Crystal Basin Information Station on Ice House Road between Ice House Reservoir and Union Valley Reservoir.*

**1. Person(s) involved:**

Name: [redacted]

**2. Describe yourself:**

a. Visitor

b. Camp host

c. USFS employee

d. Contractor

e. Other ______________

**3. Visitor activity:**

a. Camping – developed campground

b. Camping – undeveloped campsite/wilderness

c. Day use area

d. Hiking on maintained trail

e. Other ______________

**4. Group size:** 6
(number of people who encountered the bear)

**5. Time of encounter:** Month: 6 Day: 9 Year: 2019 Time: 10:00 am/pm

**6. Location of encounter:**

a. Airport Flat campground
b. Angel Creek day use area
c. Azalea Cove campground
d. Big Silver group campground
e. Camino Cove campground
f. Fashoda campground
g. Gerle Creek campground complex
h. Ice House campground/ boat launch/day use area
i. Jones Fork campground
j. Junction Reservoir boat launch
k. Lone Rock campground
l. Loon Lake campground/boat ramp
m. Loon Lake chalet
n. Northshore campground
o. Northshore RV campground
p. Pleasant campground
q. Red Fir group campground
r. Strawberry Point campground
s. Sunset campground/boat launch
t. Union Valley bike trail
u. Wench Creek campground
v. Wench Creek group campground
w. West Point campground/boat launch
x. Wolf Creek campground
y. Wolf Creek group campground
z. Yellowjacket campground/boat launch
Other ____________

**7. Number and description of bears** (how many, what color, size, adult or cub, sex?):

1 LARGE TAN ADULT MALE

**8. What was the bear doing when you first saw it?**

WALKING AWAY

**9. Did you react to the bear?**

YES YELLED AT IT

**10. How did the bear react to your response?**

WALKED AWAY

**11. Was human food present?**

a. Some food/trash NOT in bear resistant container
b. All food/trash in bear resistant container
c. No food present/ordor only
d. Food hung in tree
e. Unknown
f. Some food in vehicle

**12. Did the bear eat any human food?**

a. No b. Yes (what?)
c. Unknown CHOCOLATE PACKAGE FOUND NEXT DAY

**13. Did the bear damage property?**

a. No b. Yes (list property and estimate costs) ____________

**14. Did the bear(s) harm anyone?**

a. No b. Yes* (describe) ____________

**15. Details of bear-human interaction** (optional):

3 OTHER CAMPERS YELLED AT IT.

* If there was a physical encounter with the bear or a bear was harmed in the incident, please report to the USFS Ranger and California Department of Fish and Wildlife.

KEEP ME WILD

**For office use only:**

Report collected by: ______________________ (USFS/camp host)

Date: ______________



KEEP ME WILD

# BEAR ENCOUNTER FORM

## Bear Management Monitoring Crystal Basin Recreation Area

***Use a separate form for each individual incident.*** *For example, if the same bear enters two campsites while people are present, a person from each campsite should report the specifics of their encounter. Give completed forms to campground hosts. If your recreation site has no host, forms should be placed in the appropriate receptacle at the site or dropped off at the Crystal Basin Information Station on Ice House Road between Ice House Reservoir and Union Valley Reservoir.*

**1. Person(s) involved:**

Name: [redacted]

**2. Describe yourself:**

a. Visitor

b. Camp host

c. USFS employee

d. Contractor

e. Other ______________

**3. Visitor activity:**

a. Camping – developed campground

b. Camping – undeveloped campsite/wilderness

c. Day use area

d. Hiking on maintained trail

e. Other ______________

**4. Group size:** 2
(number of people who encountered the bear)

**5. Time of encounter:** Month: 8 Day: 9 Year: 19 Time: 10:30 am/pm

**6. Location of encounter:**

a. Airport Flat campground
b. Angel Creek day use area
c. Azalea Cove campground
d. Big Silver group campground
e. Camino Cove campground
f. Fashoda campground
g. Gerle Creek campground complex
h. Ice House campground/
boat launch/day use area
i. Jones Fork campground
j. Junction Reservoir boat launch
k. Lone Rock campground
l. Loon Lake campground/boat ramp
m. Loon Lake chalet
n. Northshore campground
o. Northshore RV campground
p. Pleasant campground
q. Red Fir group campground
r. Strawberry Point campground
s. Sunset campground/boat launch
t. Union Valley bike trail
u. Wench Creek campground
v. Wench Creek group campground
w. West Point campground/boat launch
x. Wolf Creek campground
y. Wolf Creek group campground
z. Yellowjacket campground/boat launch
Other ______________

**7. Number and description of bears** (how many, what color, size, adult or cub, sex?):

1 male-maybe, adult, brown (dark)

**8. What was the bear doing when you first saw it?**

It was behind the tent walking, very close, turned and looked at us and just kinda stod there

**9. Did you react to the bear?**

yes, yelled

**10. How did the bear react to your response?**

walked slowly away, - we were still awake

**11. Was human food present?**

a. Some food/trash NOT in bear resistant container
b. All food/trash in bear resistant container
c. No food present/ordor only
d. Food hung in tree
e. Unknown
f. Some food in vehicle

**12. Did the bear eat any human food?**

a. No b. Yes (what?)
c. Unknown not out of our camp

**13. Did the bear damage property?**

a. No b. Yes (list property and estimate costs) ______________

**14. Did the bear(s) harm anyone?**

a. No b. Yes* (describe)______________

**15. Details of bear-human interaction** (optional):

Shoed away from behind tent.

* If there was a physical encounter with the bear or a bear was harmed in the incident, please report to the USFS Ranger and California Department of Fish and Wildlife.

**For office use only:**

Report collected by: ______________________(USFS/camp host)

Date: ______________



8/11 3

6 dumpsters tipped this week 8/15 3

# BEAR ENCOUNTER FORM

## Bear Management Monitoring
## Crystal Basin Recreation Area

***Use a separate form for each individual incident.*** *For example, if the same bear enters two campsites while people are present, a person from each campsite should report the specifics of their encounter. Give completed forms to campground hosts. If your recreation site has no host, forms should be placed in the appropriate receptacle at the site or dropped off at the Crystal Basin Information Station on Ice House Road between Ice House Reservoir and Union Valley Reservoir.*

**1. Per**[redacted]

Name: [redacted]

**2. Describe yourself:**

a. Visitor

b. Camp host

c. USFS employee

d. Contractor

e. Other ______________

**3. Visitor activity:**

a. Camping – developed campground

b. Camping – undeveloped campsite/wilderness

c. Day use area

d. Hiking on maintained trail

e. Other ______________

**4. Group size:** 2
(number of people who encountered the bear)

**5. Time of encounter:** Month: 8 Day: 12 Year: 19 Time: 2:02 am/pm

**6. Location of encounter:**

a. Airport Flat campground
b. Angel Creek day use area
c. Azalea Cove campground
d. Big Silver group campground
e. Camino Cove campground
f. Fashoda campground
g. Gerle Creek campground complex
h. Ice House campground/ boat launch/day use area
i. Jones Fork campground
j. Junction Reservoir boat launch
k. Lone Rock campground
l. Loon Lake campground/boat ramp
m. Loon Lake chalet
n. Northshore campground
o. Northshore RV campground
p. Pleasant campground
q. Red Fir group campground
r. Strawberry Point campground
s. Sunset campground/boat launch
t. Union Valley bike trail
u. Wench Creek campground
v. Wench Creek group campground
w. West Point campground/boat launch
x. Wolf Creek campground
y. Wolf Creek group campground
z. Yellowjacket campground/boat launch
Other ____________

**7. Number and description of bears** (how many, what color, size, adult or cub, sex?):

one large adult

**8. What was the bear doing when you first saw it?**

digging in a cooler

**9. Did you react to the bear?**

we clapped several times

**10. How did the bear react to your response?**

he stopped what he was doing & walked away

**11. Was human food present?**

a. Some food/trash NOT in bear resistant container
b. All food/trash in bear resistant container
c. No food present/ordor only
d. Food hung in tree
e. Unknown
f. Some food in vehicle

**12. Did the bear eat any human food?**

a. No b. Yes (what?)
c. Unknown ____________

**13. Did the bear damage property?**

a. No b. Yes (list property and estimate costs) ____________

**14. Did the bear(s) harm anyone?**

a. No b. Yes* (describe) ____________

**15. Details of bear-human interaction** (optional):

cooler only held beverages, but a bottle of Ketchup was left in there. He opened two coolers, but only removed the Ketchup. He left it on the ground and walked away

* If there was a physical encounter with the bear or a bear was harmed in the incident, please report to the USFS Ranger and California Department of Fish and Wildlife.

# APPENDIX J2

## 2019 Bear Encounter Results

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Bear Encounter Form - Bear Management Monitoring, Crystal Basin Recreation Area - UARP, Eldorado National Forest

2019 Results Summary - Compiled by Ethan Koenigs, SMUD

| 1. Name | 2. Description | 3. Visitor Activity | 4. Group Size | 5. Date/Time of Encounter | 6. Location | 7. Number / description of bear(s) | 8-14 - Description of interaction w/ bear | 15. Food Present | 16.Consumption by Bear | 17. Property Damage | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Adam Z. | Visitor | Camping - Undeveloped | 3 | 7/18/2019 | Airport Flat | 1 large brown | Bear got into cooler and ate food; campers could not scare bear away | Yes - no container | Yes | Yes | Camper was near Airport Flat. Bear ate 2 packs of hot dogs, chicken breast, 3 packs of freeze-dried food; cooler was damaged |
| David W. | Visitor | Camping - developed | 7 | 7/17/2019 | Airport Flat | 1 black | Bear got into cooler and ate food; campers could not scare bear away | Yes - no container | Yes | Yes | Bear ate a variety of food, tore lid off ice chest; was not scared of humans or dogs |
| Michael P. | Visitor | Camping - developed | 2 | 8/12/2019 | Gerle Creek | 1 adult brown | Bear rumaging through cooler; campers made noise to get bear to leave | Yes | No | No | Bear was in beverage cooler with ketchup |
| Ken W. | Visitor | Camping - developed | 2 | 8/9/2019 | Gerle Creek | 1 adult brown | Bear walking through camp | Yes - in resistant container | No | No | Campers were awake and were able to get bear to leave |
| Chris M. | Visitor | Camping - developed | 6 | 8/9/2019 | Gerle Creek | 1 adult tan | Bear waling through camp | Yes - in resistant container | Unknown | No | Bear walked off when campers confronted it; chocolate package found next day |
| Skylar W. | Visitor | Camping - developed | 1 | 8/9/2019 | Gerle Creek | Unknown | Bear emptied an ice chest but was not seen | Yes - no container | Unknown | No | Bear was not seen by reporter; only evidence of bear was cooler emptied. |
| Richard B. | Visitor | Camping -developed | 6 | 8/1/2019 | Gerle Creek | 1 - large black | Bear sniffing around near bear locker | Yes - no container | Unknown | No | Bear not dertered by noise or campers activities to scare it away. |
| Michael C. | Visitor | Camping - developed | ? | 7/25/2019 | Gerle Creek | Unknown | Bear went through camp and knocked things over | Yes - in resistant container | No | Yes | Bear damaged 10 dollar bin |
| Kohlstedt | Visitor | Camping - developed | 6 | 8/3/2019 | Gerle Creek | 1 - large brown | Bear passed through camp looking for food | Yes - no container | Yes | No | Bear did try to eat non-dairy , sugar free creamer but moved on. |
| Mark K. | Visitor | Camping - developed | 1 | 7/15/2019 | Gerle Creek | 1 blonde/brown | Bear investigating camp at night | Yes - in resistant container | No | No | Visitor's experience was positive; bear was afraid of people and ran off when seen |
| Blandon R. | Visitor | Camping - developed | 8 | 7/7/2019 | Gerle Creek | 2 - large brown | Bear knocking over dumpter and passing through camp | Yes - no container | no | No | Camper yelled and used horn; 1 bear walked away and 1 continued to do its thing. |
| Mark K. | Visitor | Camping - developed | 1 | 7/8/2019 | Gerle Creek | 3 - 100-160lbs/ 1 brown, 1 black, 1 red | Bears just observed | No | No | No | Just a sighting; visitor expressed positive experience |
| Christopher L. | Visitor | Camping - developed | 7 | 5/25/2019 | Gerle Creek | 1 Huge brown male | Bear in camp getting food from cooler. | Yes - no container | Yes | Yes | Bear got into cooler and damaged it; ate salami and salad; bear got within 6 feet; camper scared bear off with golf club hitting bear box |
| Steven S. | Visitor | Camping - developed | 6 | 7/7/2019 | Gerle Creek | Unknown | Campers did not see bear but camp was plundered. | Yes - no container | Yes | No | Bear got into trash bag; ate bagels. |
| Russel K | Visitor | :ampground - undevlope | 2 | 7/18/2019 | Millionaire Camp | 1 - large, dark | Bear attempting to get into cooler | Yes - in resistant container | No | Yes | Bear did not respond to yelling, tried to drag off cooler; Camper fired a shot into ground near bear and bear ran off. |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
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# APPENDIX K1

## 2019 Water Temperature Graphs

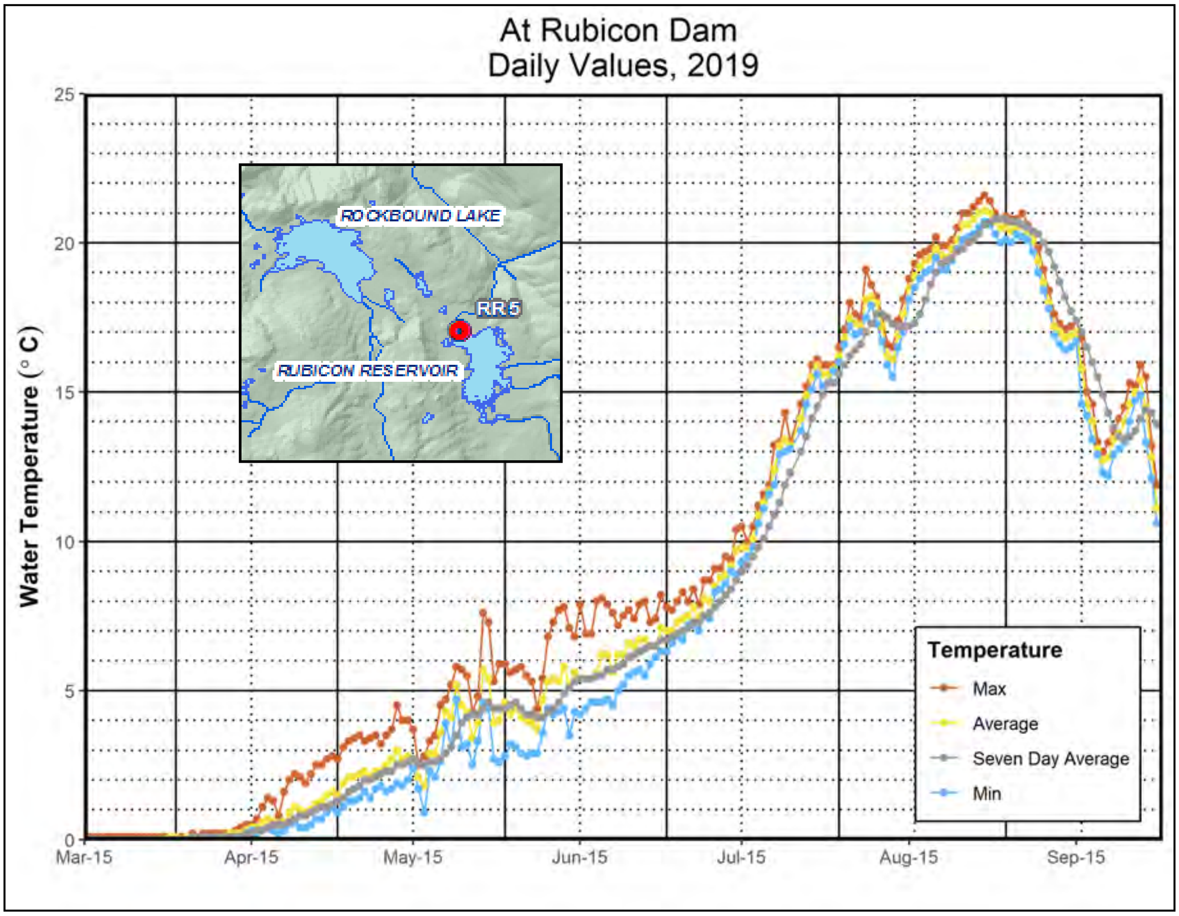


**Figure K1-1. Rubicon River immediately below Rubicon Reservoir Dam (RR5)**

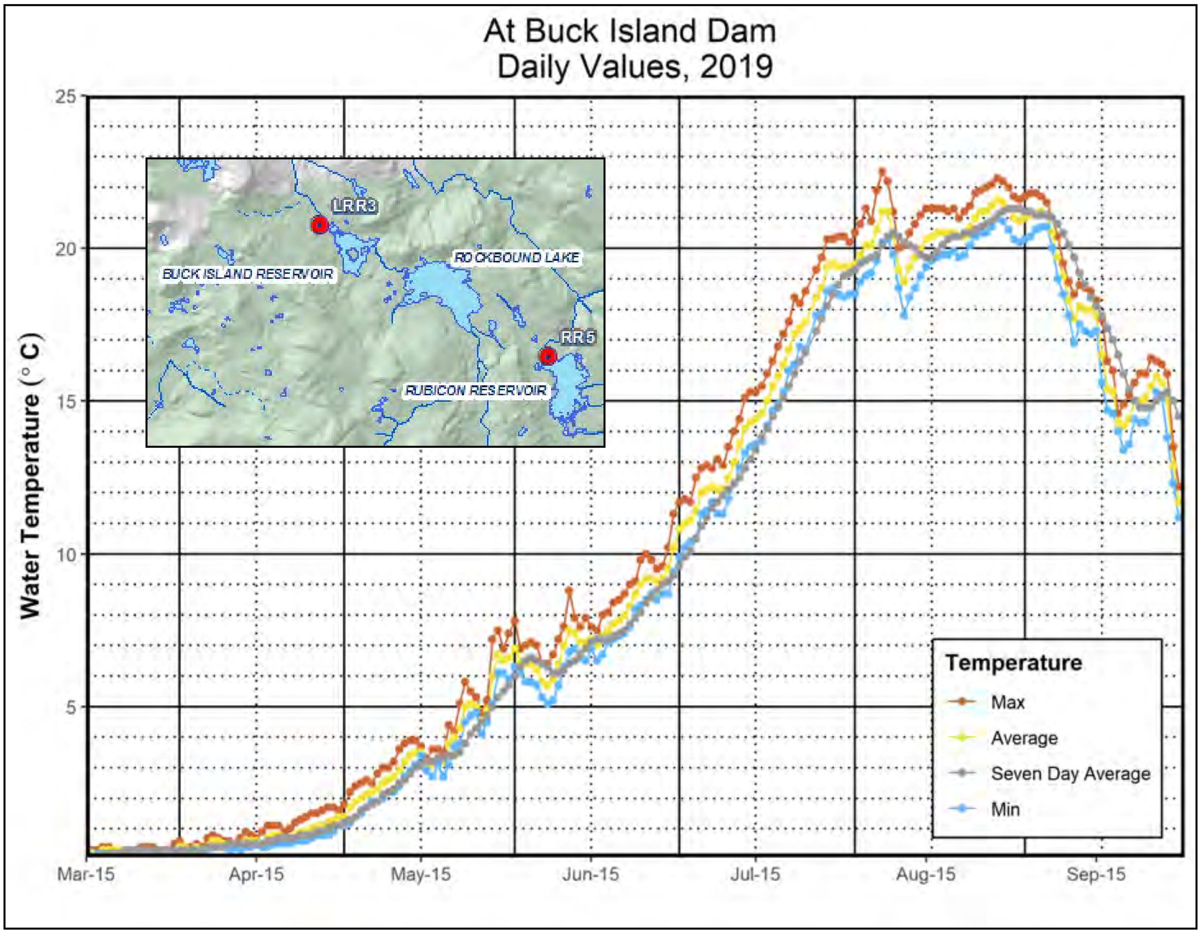


**Figure K1-2. Little Rubicon River Immediately below Buck Island Reservoir Dam (LRR3)**

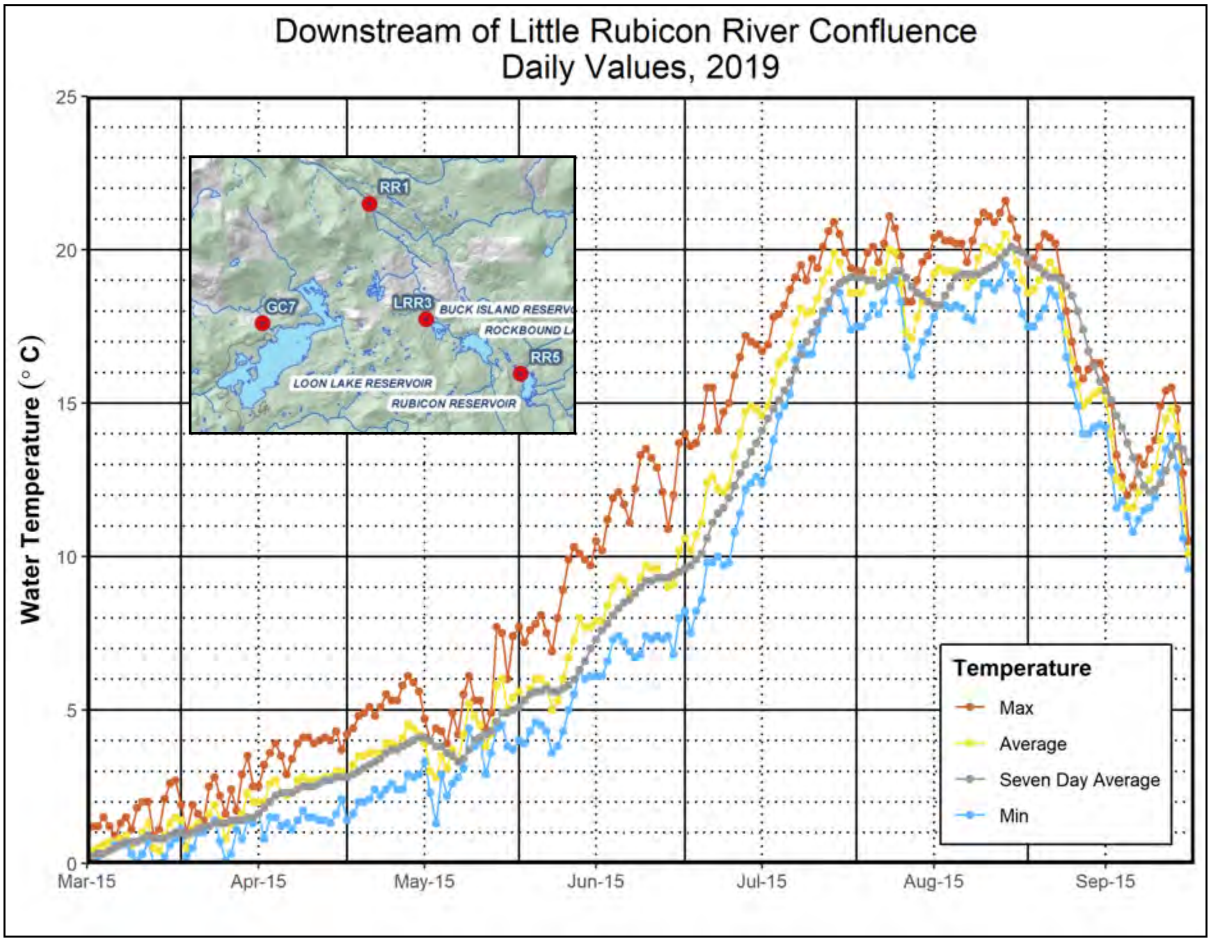


**Figure K1-3. Rubicon River below confluence of Little Rubicon River at the Project boundary (RR1)**

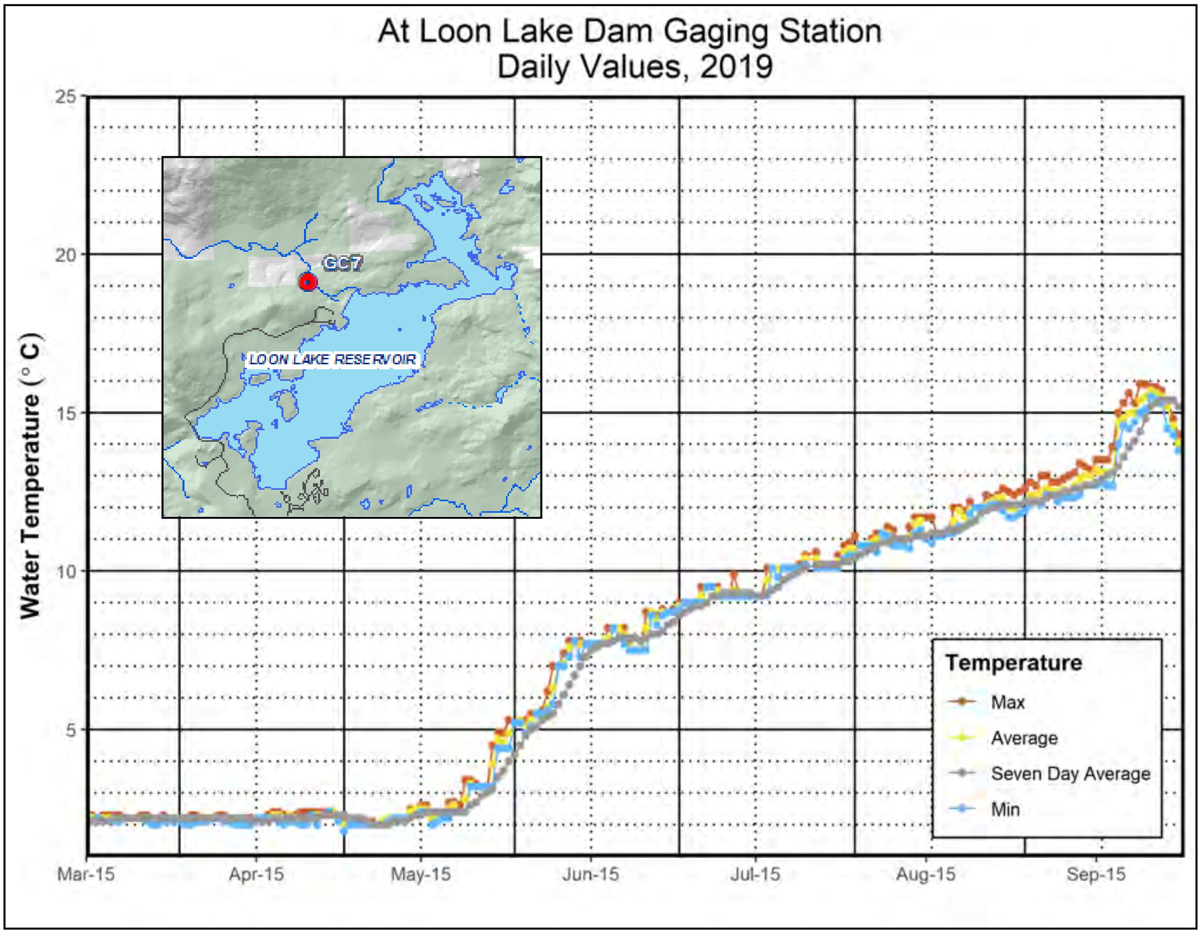


**Figure K1-4. Gerle Creek Immediately below Loon Lake Reservoir Dam (GC7)**

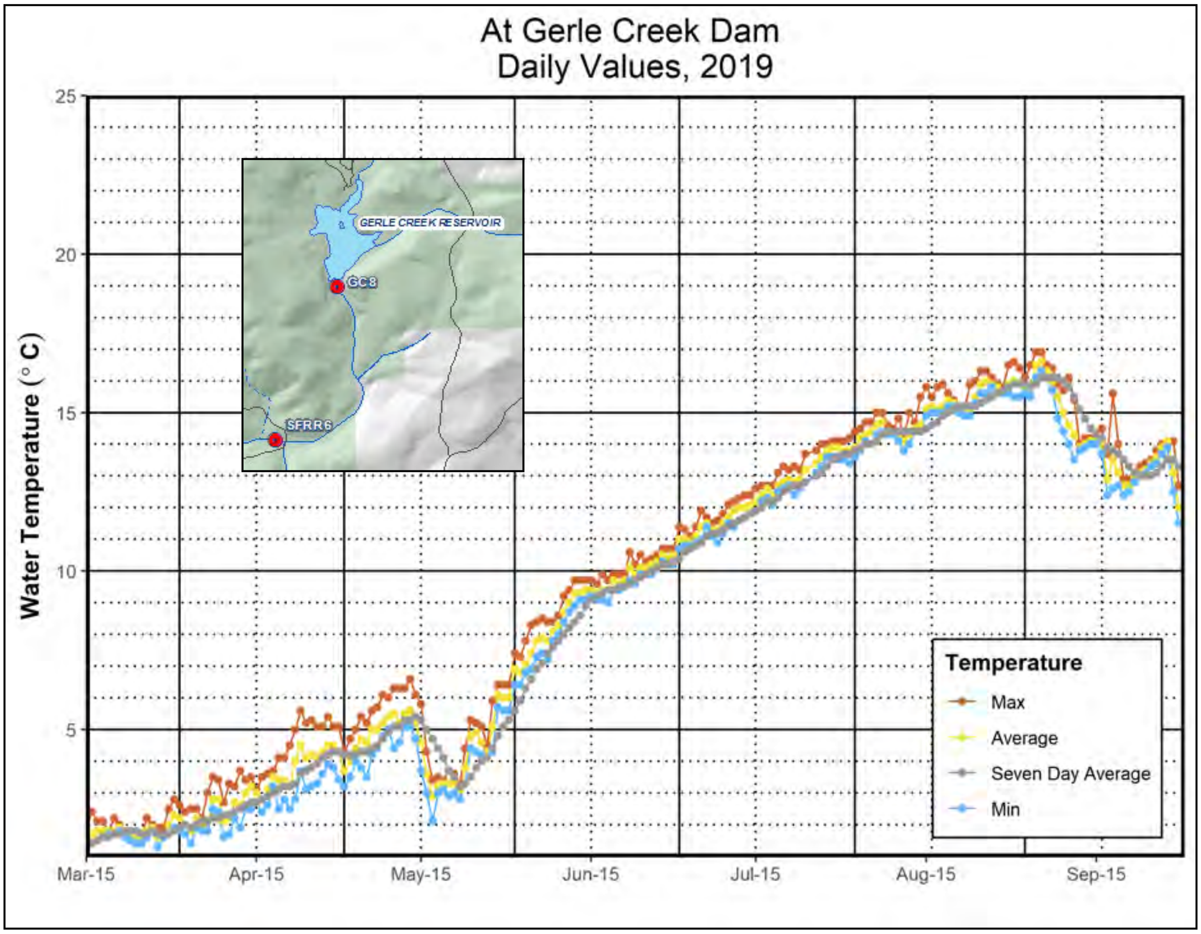


**Figure K1-5. Gerle Creek immediately below Gerle Creek Reservoir Dam (GC8)**

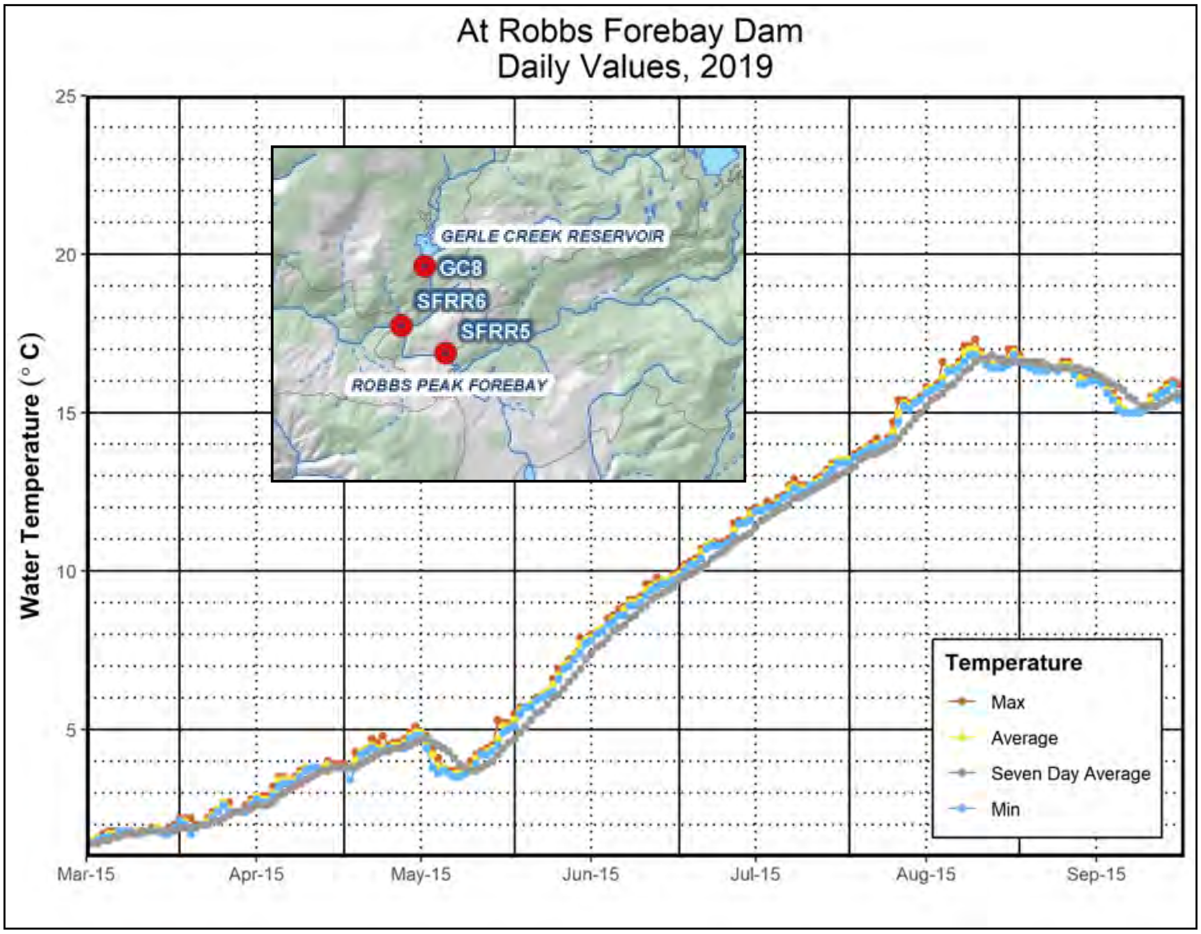


**Figure K1-6, SF Rubicon River immediately below Robbs Peak Reservoir Dam (SFRR5)**

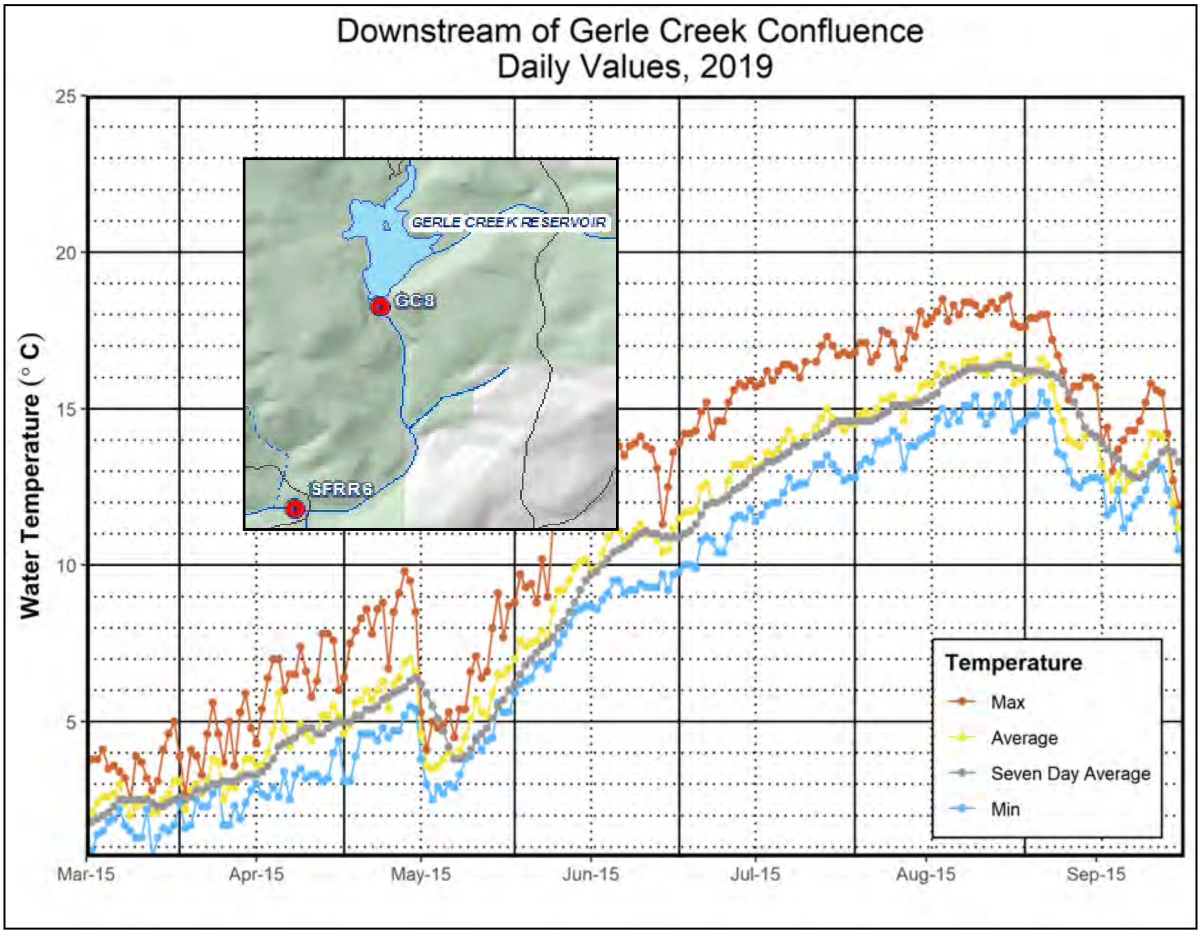


**Figure K1-7. SF Rubicon River below confluence of Gerle Creek (SFRR6)**

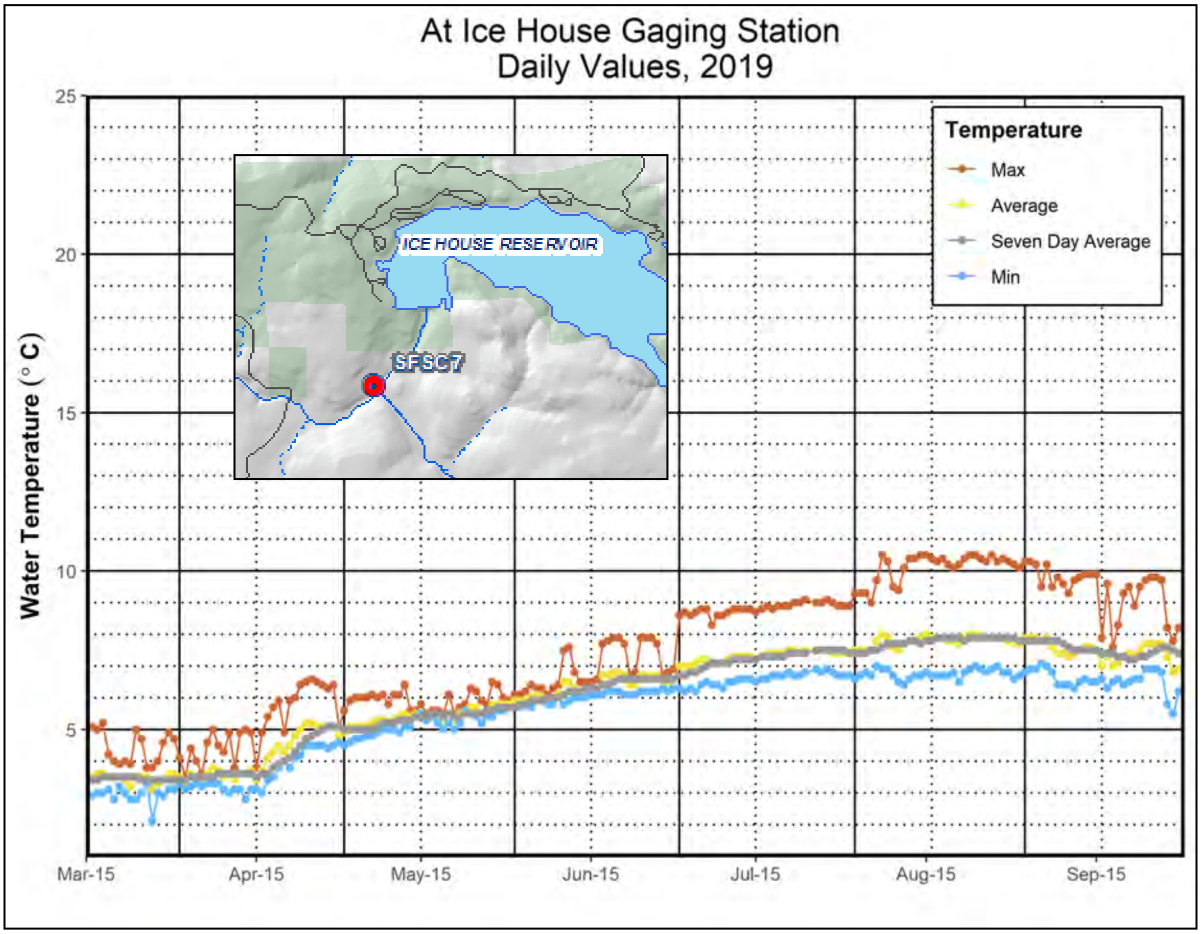


**Figure K1-8. South Fork Silver Creek immediately below Ice House Reservoir Dam (SFSC7)**

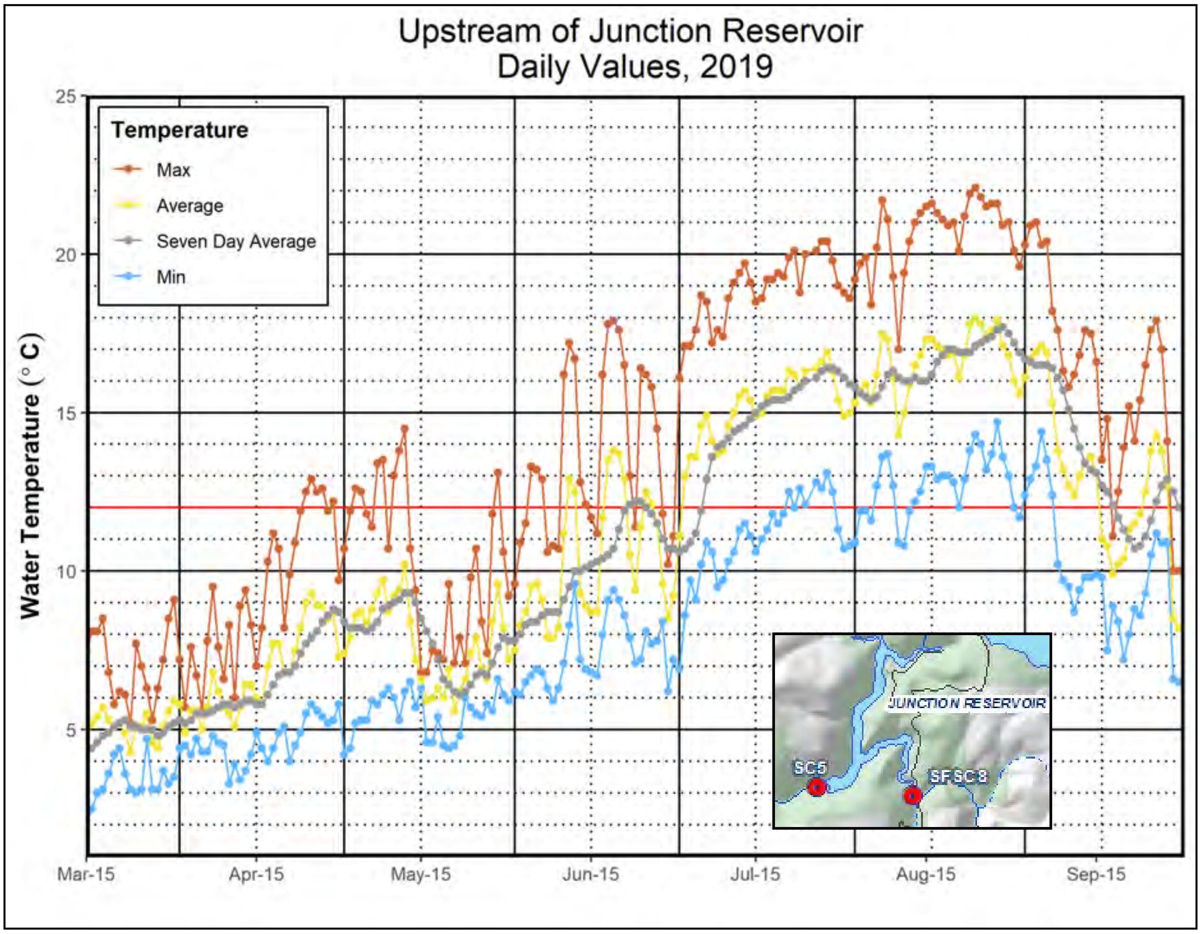


**Figure K1-9. South Fork Silver Creek immediately upstream of Junction Reservoir (SFSC8)**

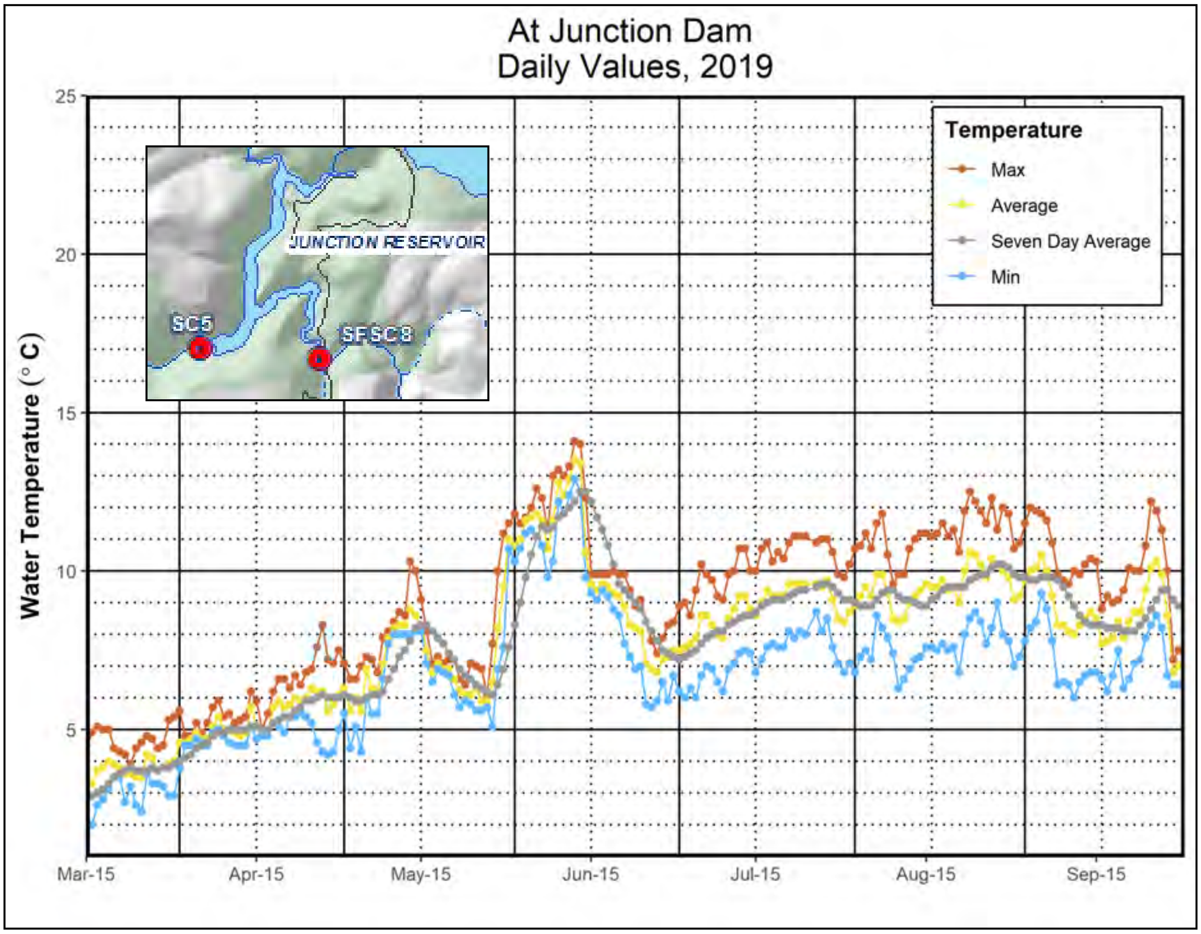


**Figure K1-10. Silver Creek immediately below Junction Reservoir Dam (SC5)**

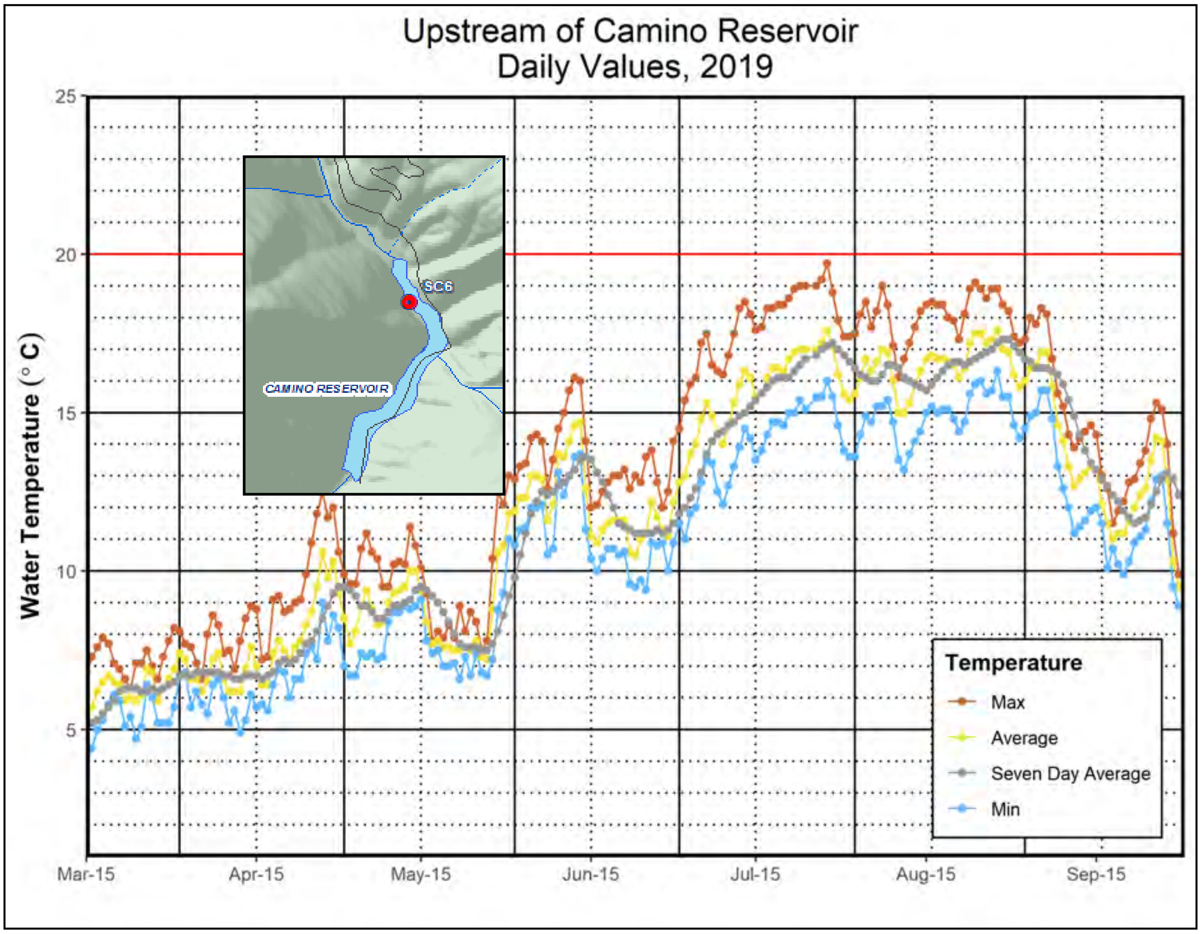


**Figure K1-11. Silver Creek immediately above Camino Reservoir Dam (SC6)**

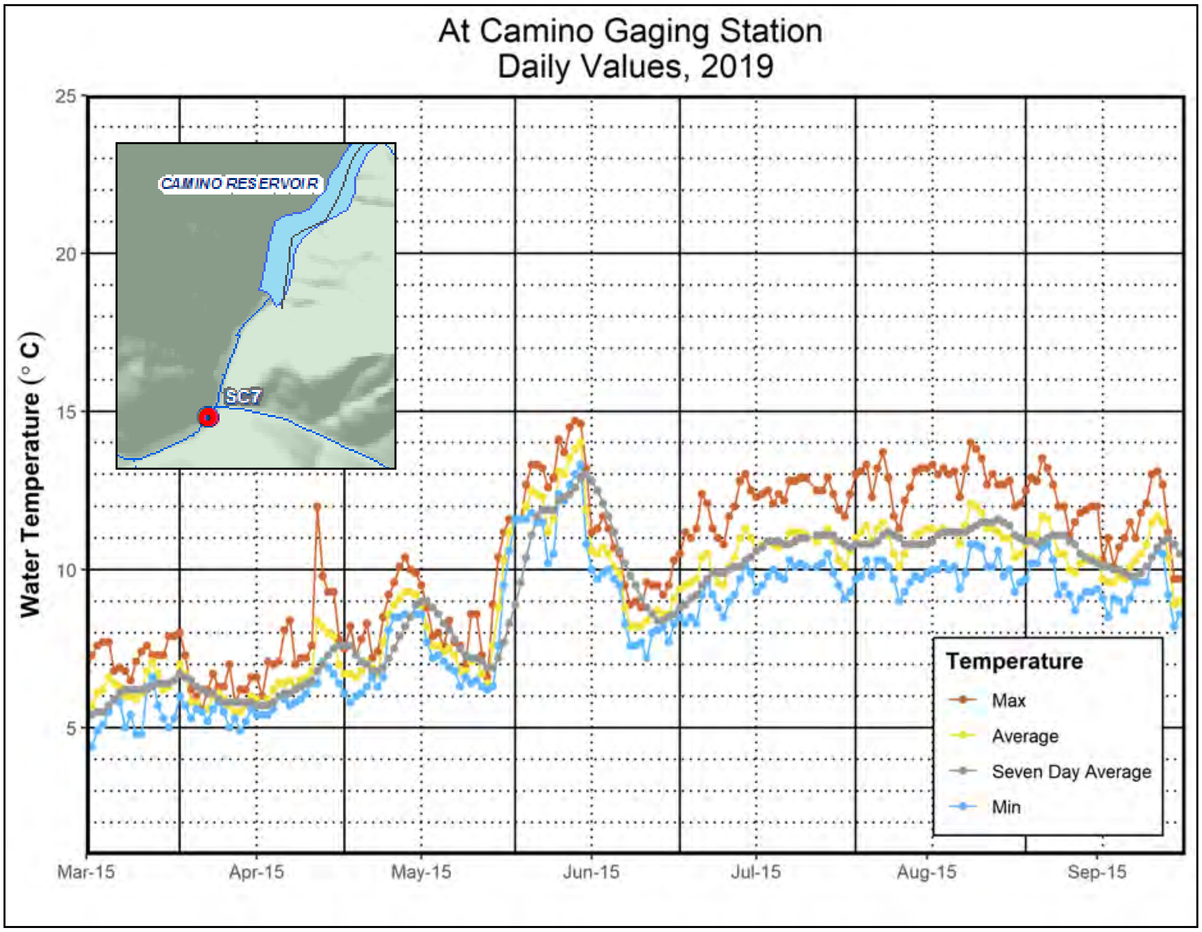


**Figure K1-13: Silver Creek immediately below Camino Reservoir Dam (SC7)**

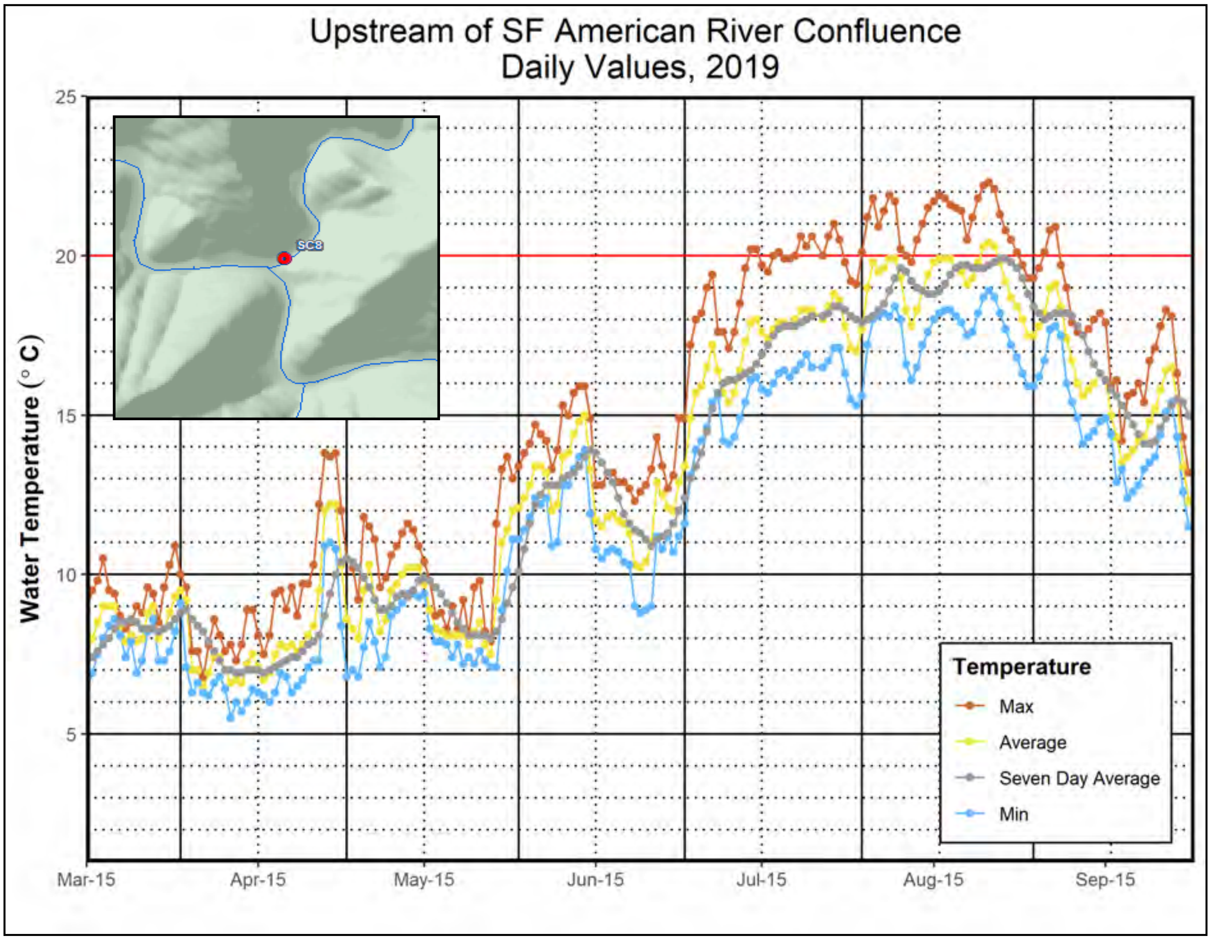


**Figure K1-14: Silver Creek immediately upstream of SF American River (SC8)**

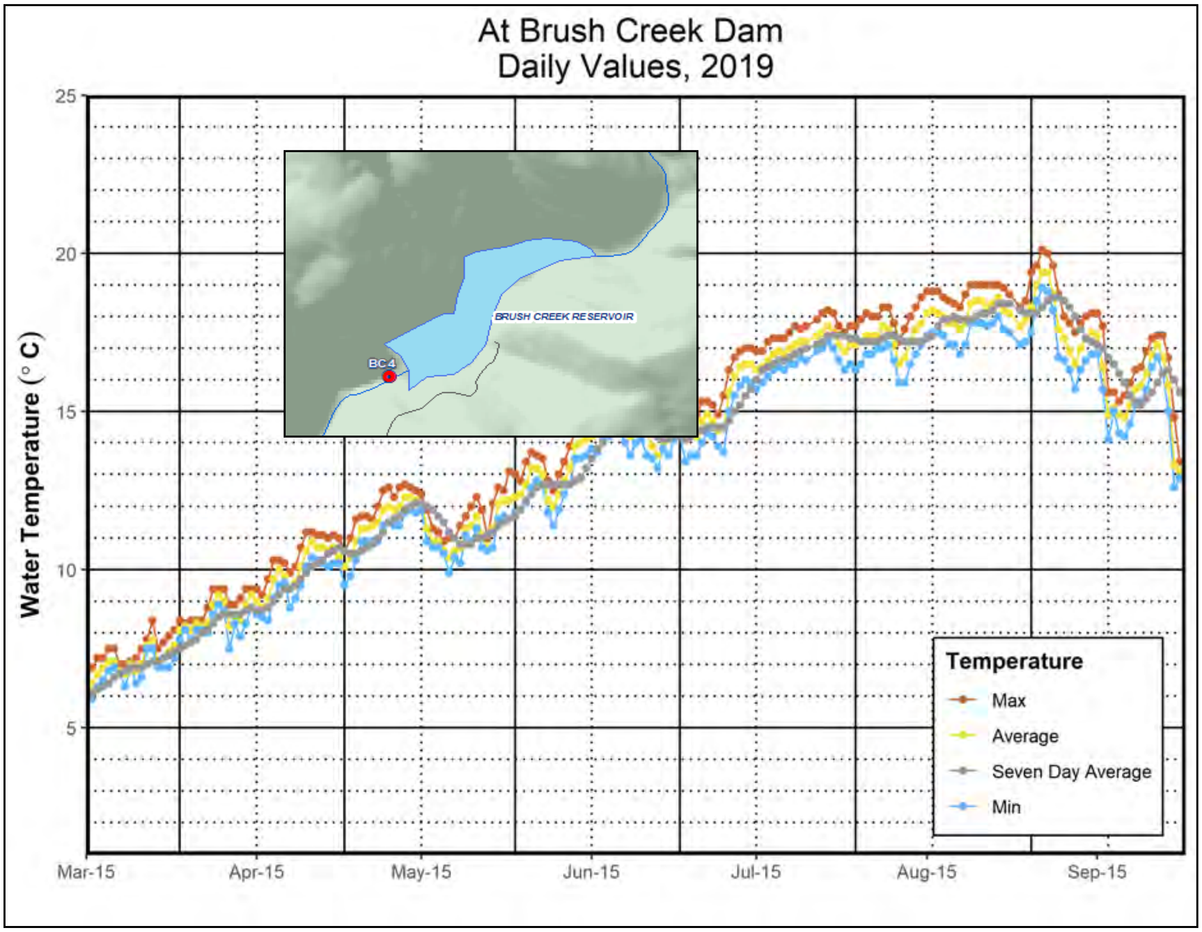


**Figure K1-15: Brush Creek immediately below Brush Creek Reservoir Dam (BC4)**

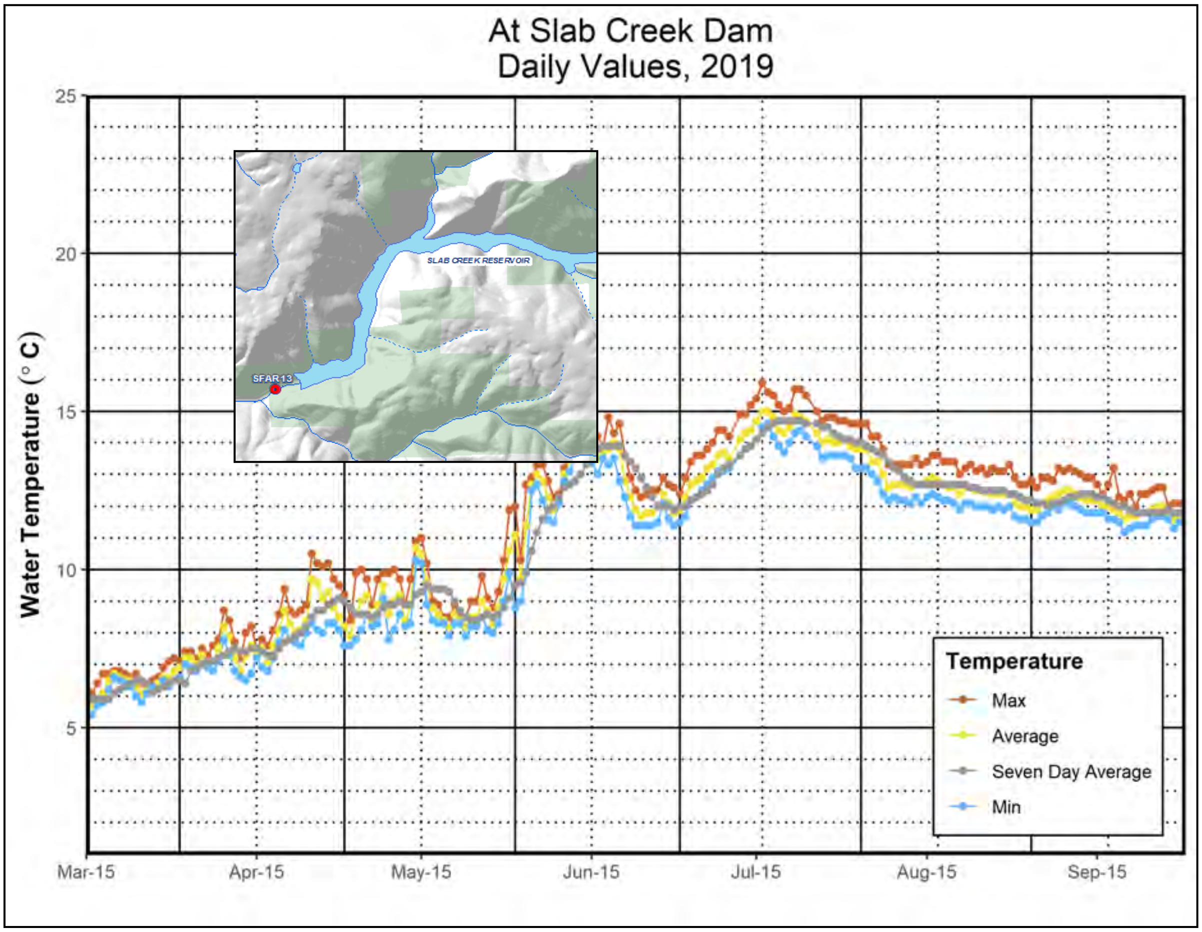


**Figure K1-16: SF American River immediately below Slab Creek Reservoir Dam (SFAR13)**

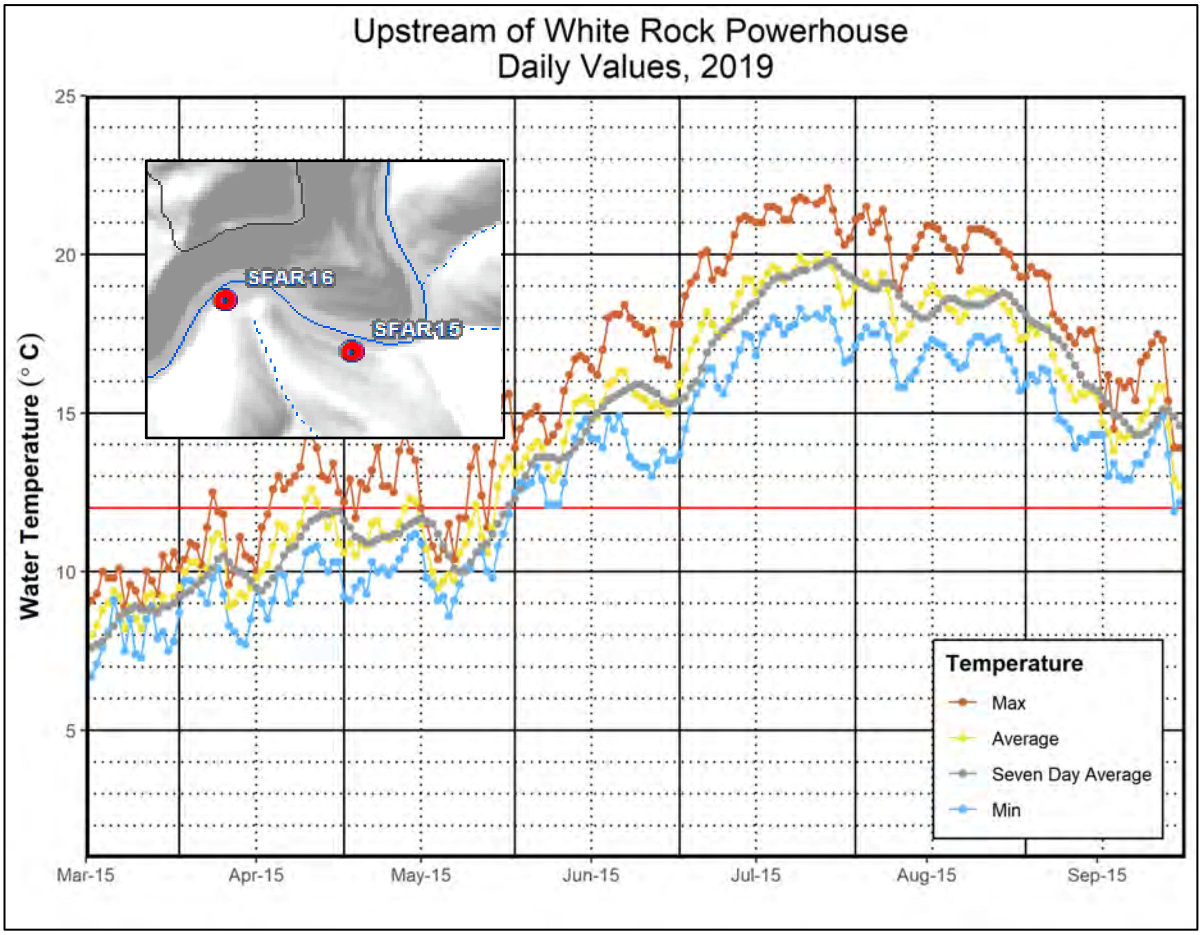


**Figure K1-17. SF American River approximately ½ mile upstream of White Rock Powerhouse (SFAR15)**

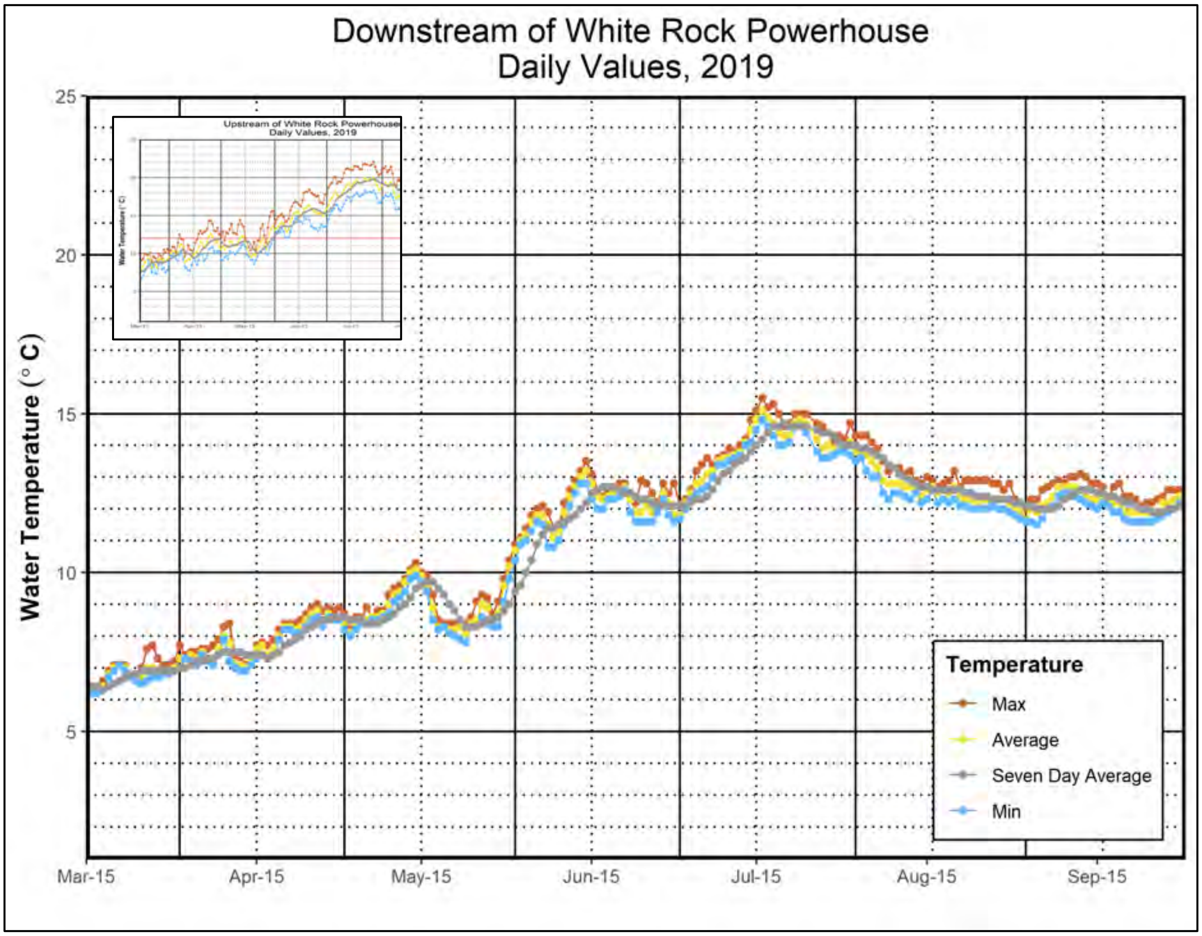


**Figure K1-18: SF American River to record White Rock Powerhouse discharge temps (SFAR16)**