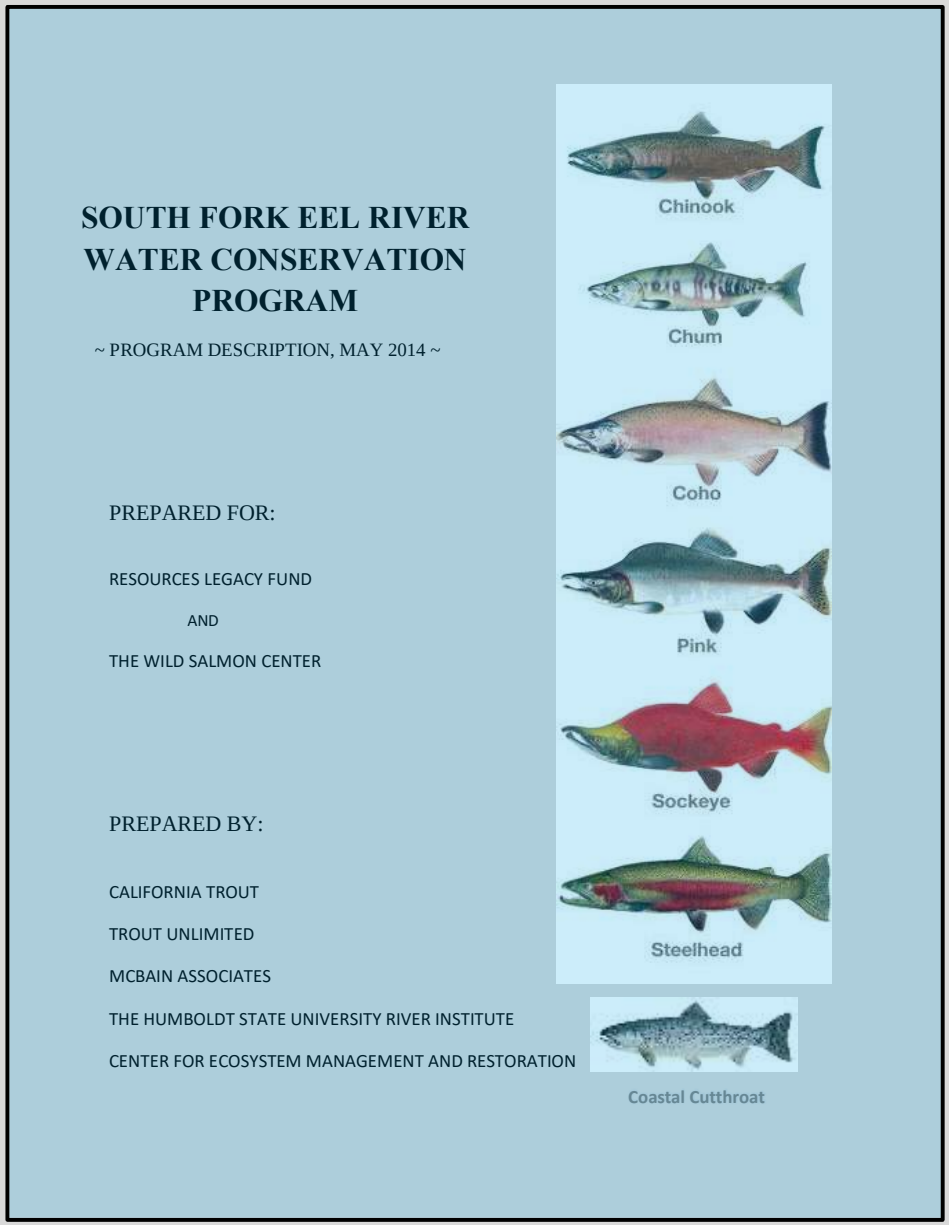
South Fork Eel River
Water Conservation Program

- **Develop policy framework and scientific basis for identifying regional flow objectives**



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SF Eel Sproul Creek Instream Flow Study

Funded by CWA NPS 319(h) Program.

January 2015 Initiation

Objectives:

- Demonstrate how a variable diversion rate strategy is more protective of a stream ecosystem and anadromous salmonid populations, than bypass flow strategy
- Develop and refine site-specific instream flow study methods and water management approaches in collaboration with agency technical committee

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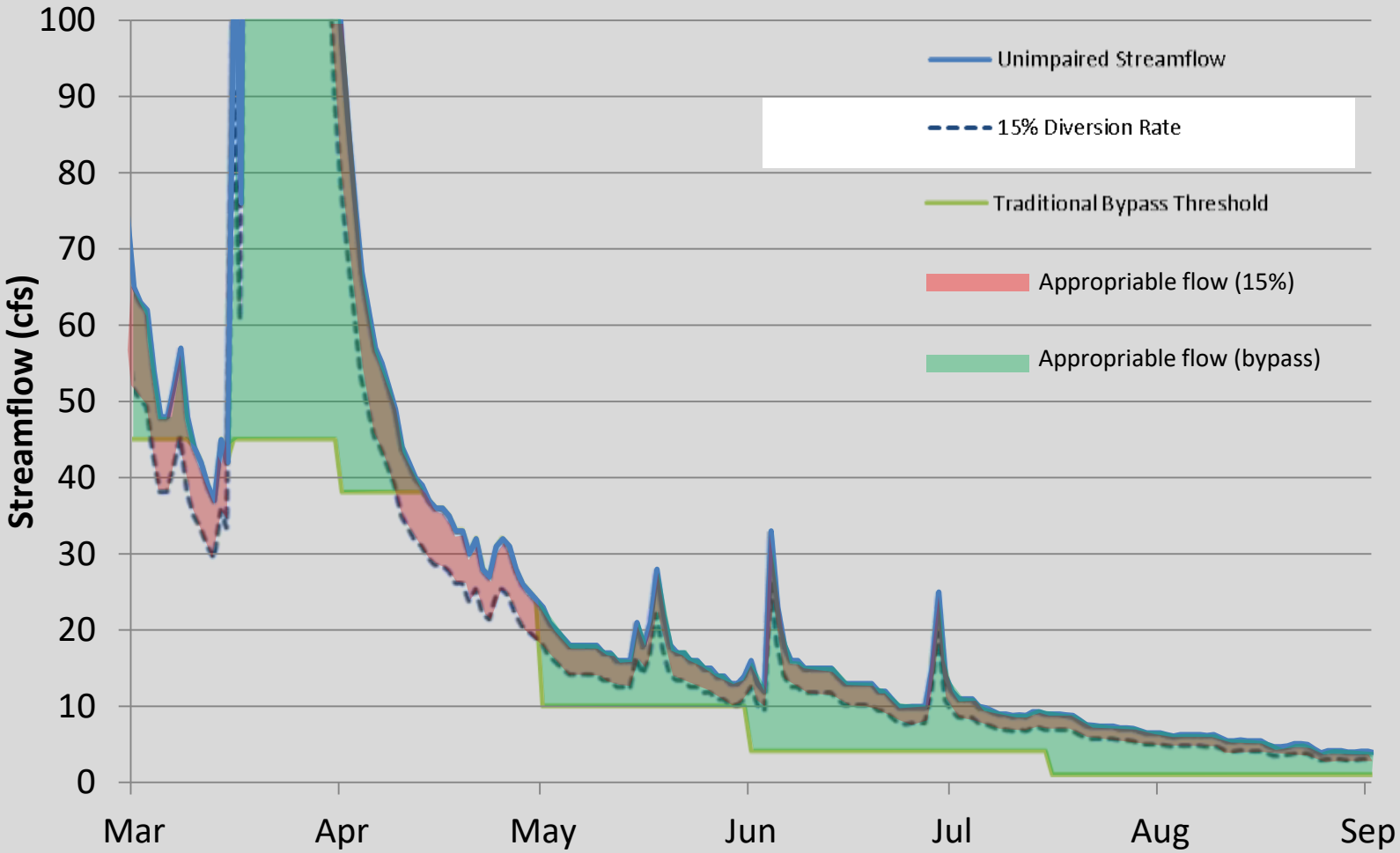

Streamflow (cfs)
100
90
80
70
60
50
40
30
20
10
0
Mar
Apr
May
Jun
Jul
Aug
Sep
Unimpaired Streamflow
15% Diversion Rate
Traditional Bypass Threshold
Appropriable flow (15%)
Appropriable flow (bypass)

Hydraulic Unit

A fundamental geomorphic feature of alluvial channels.

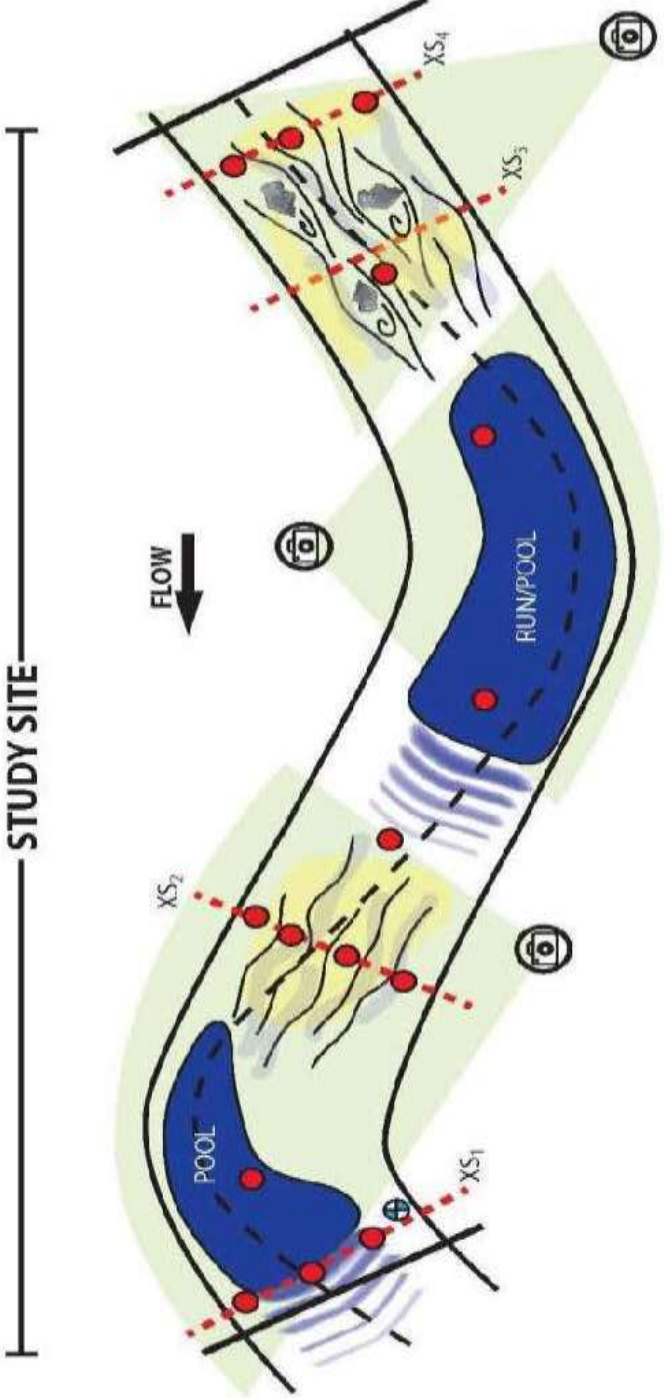
Hydraulic units are naturally delineated by an upstream and a downstream riffle crest.

Two Hydraulic Units form an Alternate Bar Sequence (Leopold, Deitrich, Lisle)

Ecological functionality

- A basic template linking streamflow hydraulics to salmonid habitat features
- e.g., riffles produce invertebrates, drift downstream, fish eat them

A replicate measurement unit (need 8-12 HU's per study site)



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SPECIAL ISSUE

WILEY Freshwater Biology

Managing diversions in unregulated streams using a modified percent-of-flow approach

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Abstract

1. In Mediterranean-type river systems, naturally low seasonal stream flows are often overexploited, which has implications for managing flows for environmental as well as human needs.
2. Traditional approaches to instream flow management are not well suited to unregulated systems with strong seasonal patterns of water availability and many water diverters, and are challenging to implement in such systems. They often do not protect the full range of variability in the annual hydrograph, require extensive site-specific data, expensive modelling or both.
3. In contrast, holistic flow management strategies, such as percent-of-flow (POF) strategies are designed to protect multiple ecological processes and preserve inter-annual flow variability. However, POF approaches typically require real-time streamflow gauging, and often lack a robust metric relating a diversion rate to ecological processes in the stream.
4. To address these challenges, we present a modified percent-of-flow (MPOF) diversion approach where diversions are allocated from a streamflow baseline which is derived from a regional relationship between a conservative streamflow exceedance and date. The streamflow baseline remains the same from year to year, and is independent of water-year type. This approach protects inter-annual flow variability and provides a predictable daily allowable volume of diversion at any diversion point supporting efficient water management planning.
5. The allowable diversion rate in the MPOF approach is based not on a fixed percentage of the ambient streamflow, but rather on a maximum allowable percentage change in riffle crest thalweg depth, an ecologically meaningful, common hydraulic measurement.
6. In this paper, we demonstrate that the MPOF approach is a holistic approach well suited to manage diversions in unregulated streams typical of California's Mediterranean-type coastal drainages.

KEYWORDS
environmental flows, hydroecology, instream flows, Mediterranean rivers, water diversion

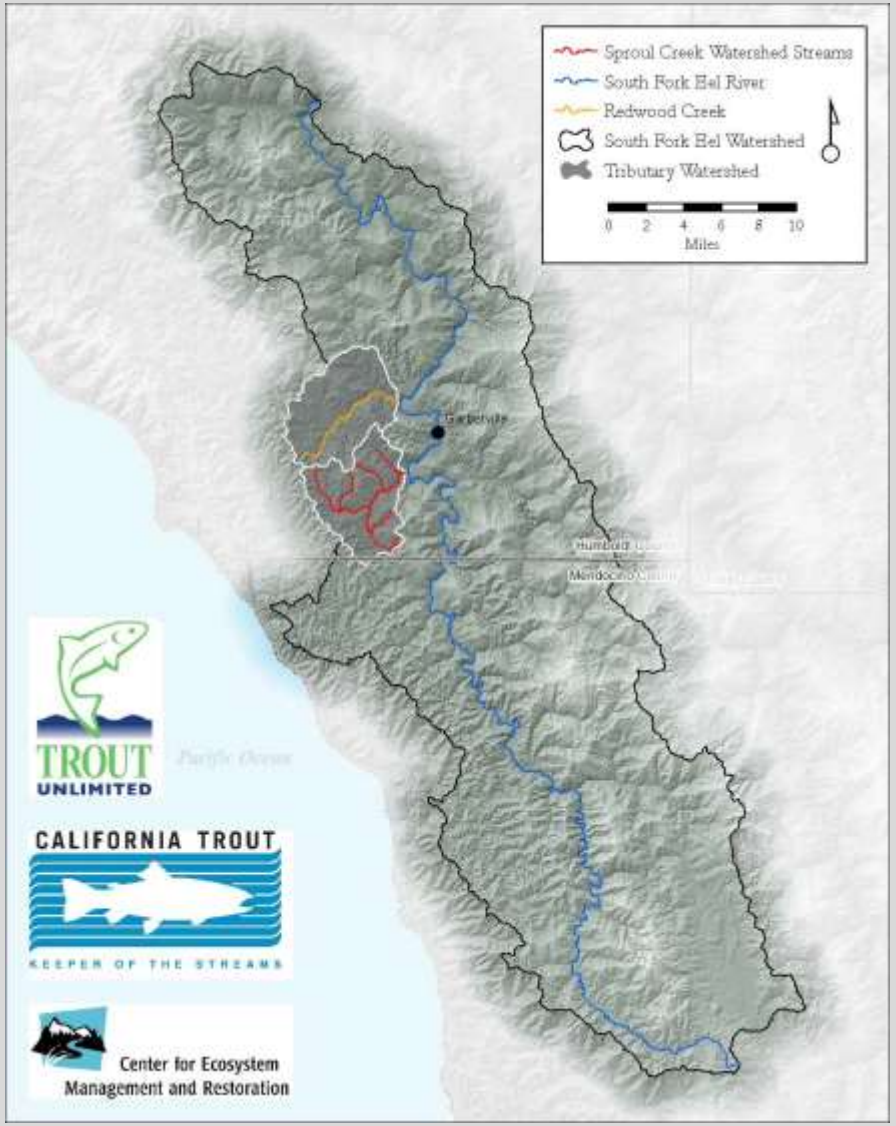
Flow Study Overview

The Sproul Creek flow study will

- Install and operate flow gages
- Install study sites covering a range of watershed scales
- Conduct two field seasons of data collection
- Focus on late winter through summer to observe range of streamflows
- Target approximately 7-10 streamflows ranging from ~0.1 cfs to ~100-200 cfs

[0.1, 0.5, 1.0, 2.0, 5.0 10.0 20, 50, 100…

measured at our downstream POI]

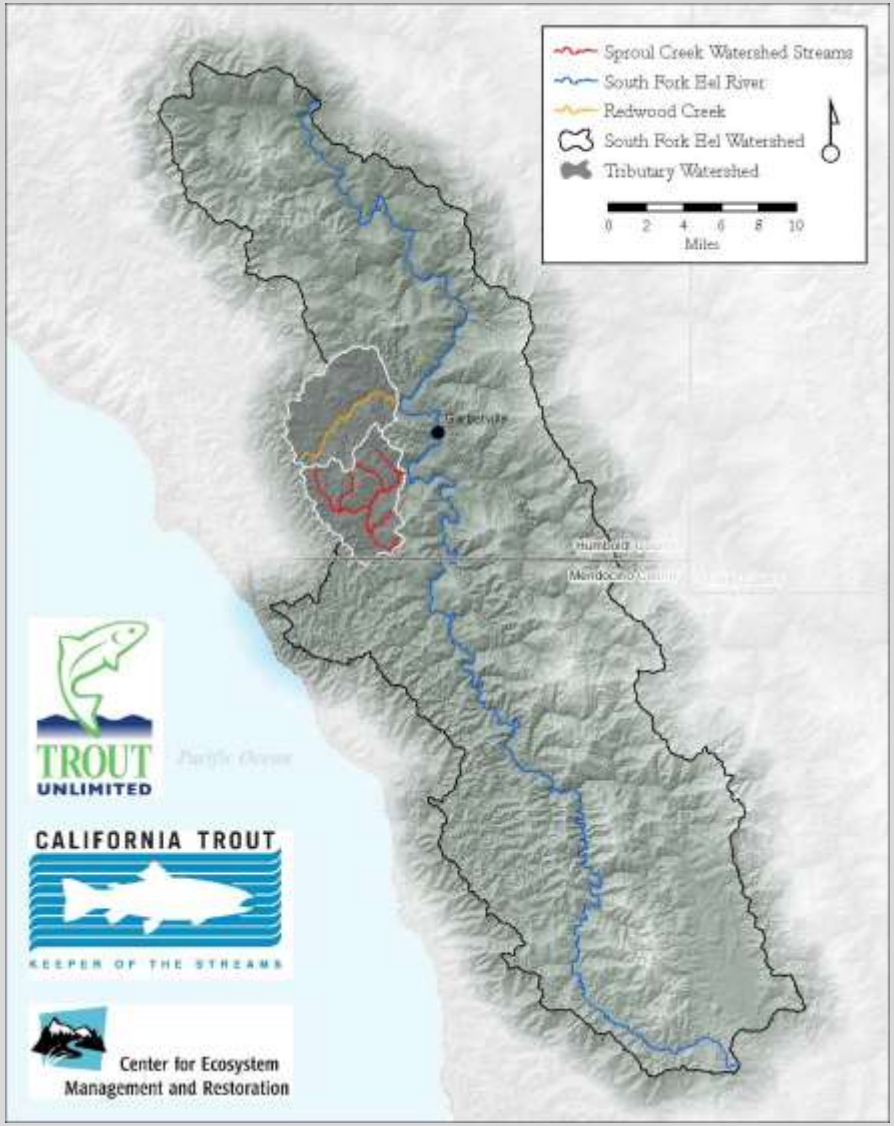


Flow Study Methods

- Critical Riffle Analysis (CDFW SOP)
- Wetted Perimeter (CDFW SOP)
- Riffle Crest Thalweg
- Two methods in development:
  - 2-Pin Spawning method
  - Velocity Core method
- 1D and 2D PHABSIM Habitat Modeling

And…

Water Supply and Demand Analyses



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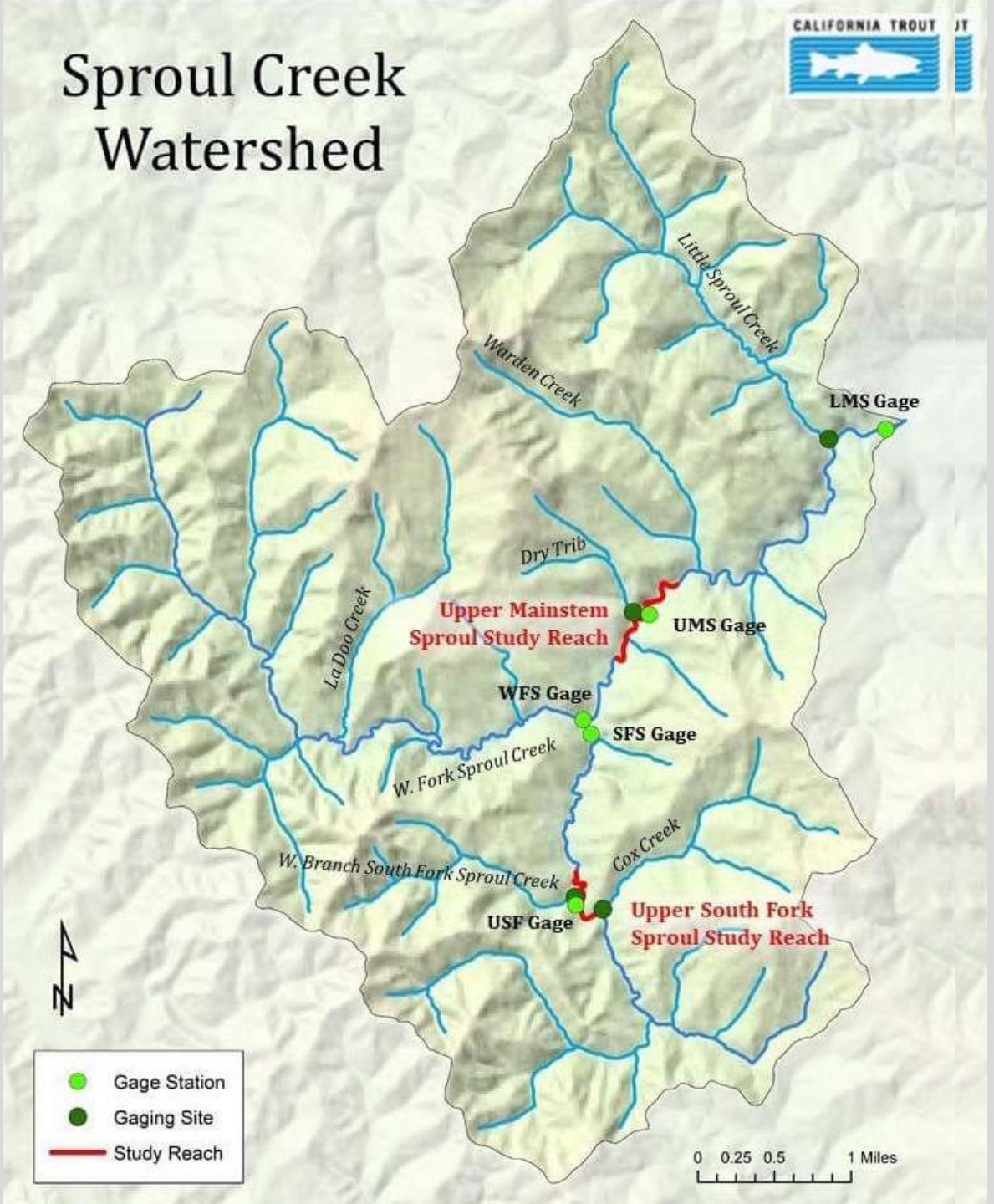
Gage and Study Site Locations

- 3-5 gages deployed in WYs 2015-2018
- 2 study sites nested at different watershed scales
- Habitat Mapping
  - Meso
  - HU

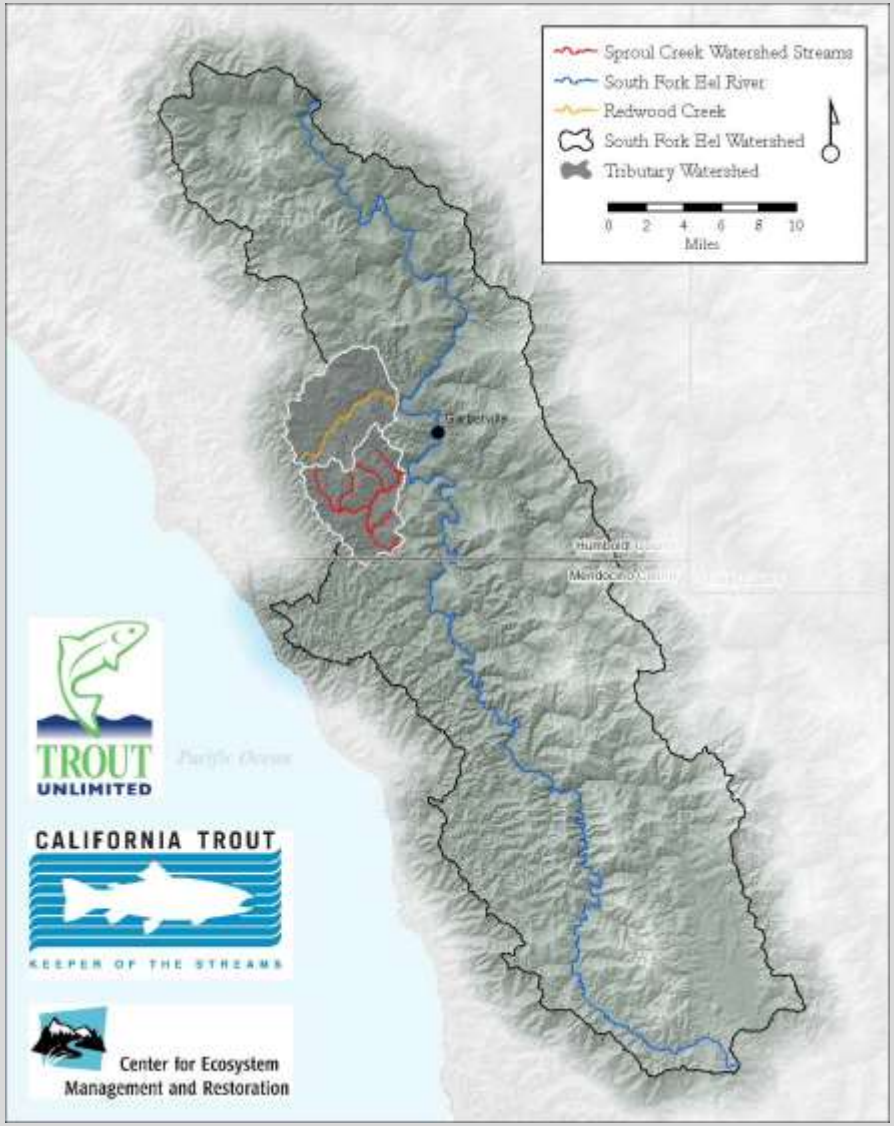


Sproul Creek Watershed

Hydrology

The flow study assembled a hydrology dataset, including:

- Ambient flows (and water temps) measured at several gaging sites
- Estimates of unimpaired flows
- Estimates of unit runoff (cfs/mi2) at a selection of sub-watersheds to assess variability within the watershed
- Analysis of rainfall data (for regionalization)
- Estimates of annual human water consumption within the watershed



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Sproul Creek Low-Flow Hydrology

Observations from Sproul Creek 2015

- Major disconnection in tributaries, forks and mainstem
- The ultra low-flow range is challenging to quantify accurately
- Subsurface flows quite apparent

- After disconnection, pools continue to recede below Residual Pool elevation until completely dry

An example from October 2015…

General Observations

- Very healthy watershed (where we observed)
- Legacy sediment conditions seem to be in advanced recovery stages
- Road network is relatively well-maintained
- Large wood is lacking
- Water quality is excellent
- Salmonid habitat is abundant
- Watershed appears relatively “under-seeded”

Sproul Creek Mainstem 10/28/15 **RCT depth = ~0.25 ft**

Sproul Creek Mainstem 10/28/15 **0.2 cfs = 90 gpm = 129,000 gpd**

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SPROUL CREEK INSTREAM FLOW STUDY FINAL REPORT

Prepared by:
California Trout North Coast Region
Humboldt State University: Institute for River Ecosystems

Prepared for:
North Coast Regional Water Quality Control Board and State Water Resources Control Board
Grant Agreement No. 14-420-251

Water Boards

Funding for this project has been provided in part through an Agreement with the State Water Resources Control Board and the US Environmental Protection Agency under the Federal Nonpoint Source Pollution Control Program (Clean Water Act Section 319). The contents of this document do not necessarily reflect the views and policies of the State Water Resources Control Board, nor does mention of the trade names or commercial products constitute endorsement or recommendations for use.

FEBRUARY 28, 2018

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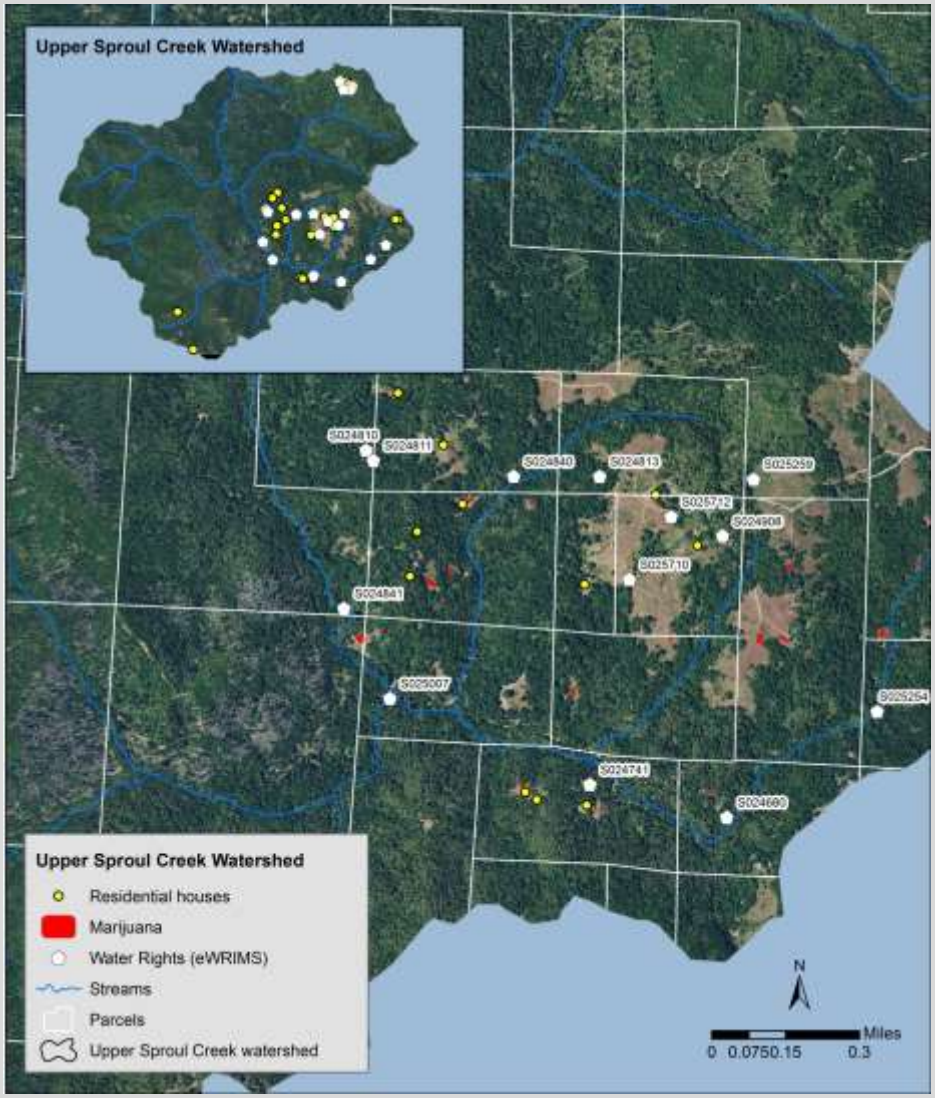
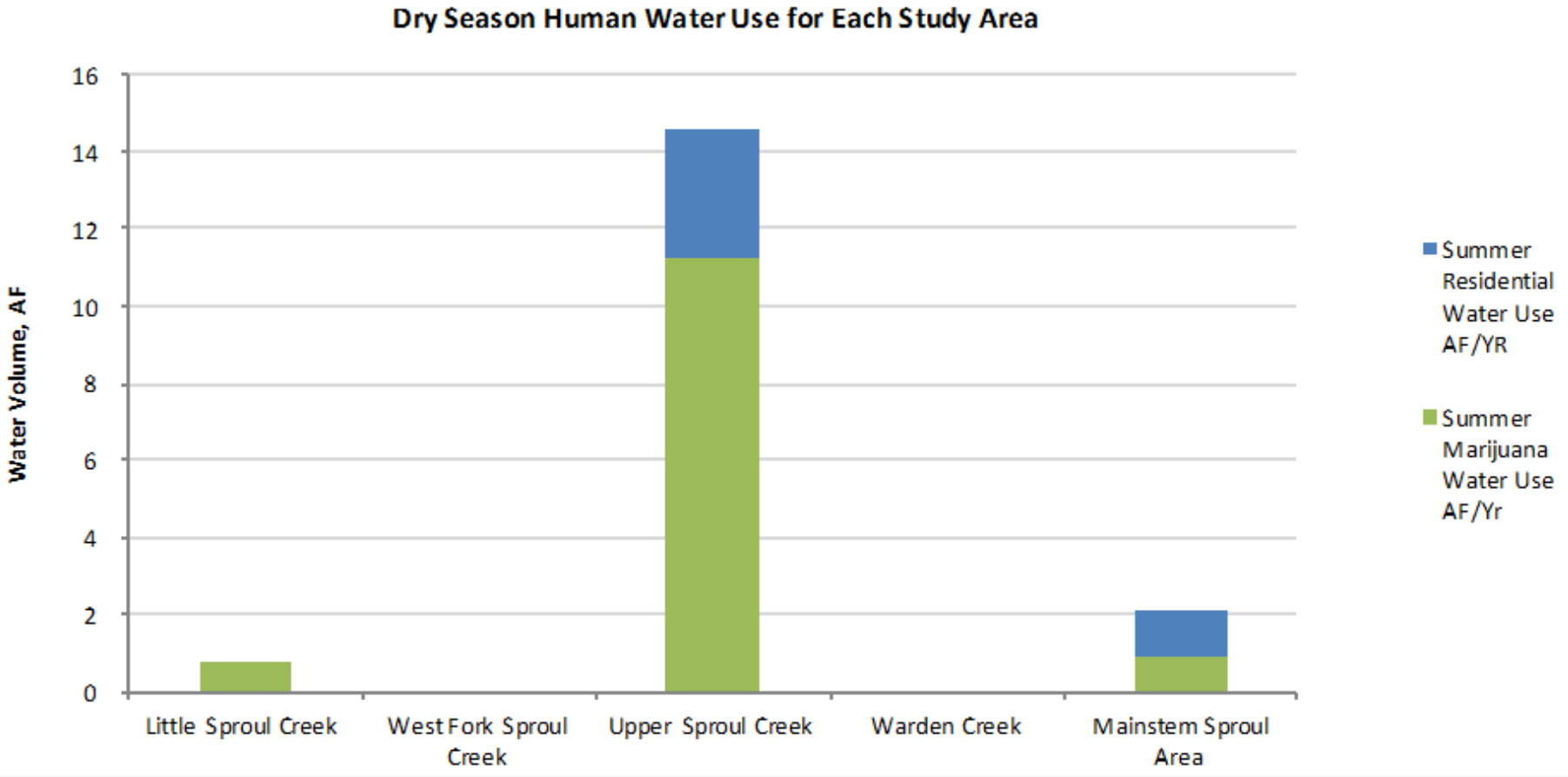
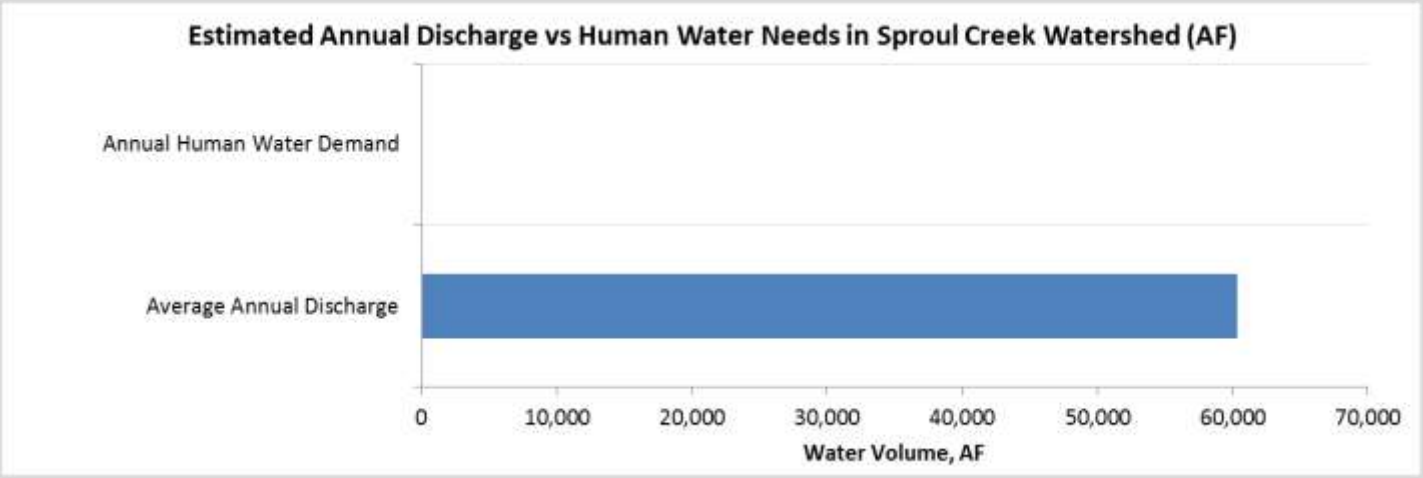

Upper Sproul Creek Watershed
S024810
S024811
S024840
S024813
S025259
S025712
S024908
S025710
S024841
S025007
S025254
S024741
S024690
Upper Sproul Creek Watershed
Residential houses
Marijuana
Water Rights (eWRIMS)
Streams
Parcels
Upper Sproul Creek watershed
N
Miles
0 0.0750.15 0.3


Dry Season Human Water Use for Each Study Area
Water Volume, AF
16
14
12
10
8
6
4
2
0
Little Sproul Creek
West Fork Sproul Creek
Upper Sproul Creek
Warden Creek
Mainstem Sproul Area
Summer Residential Water Use AF/YR
Summer Marijuana Water Use AF/Yr


Estimated Annual Discharge vs Human Water Needs in Sproul Creek Watershed (AF)
Annual Human Water Demand
Average Annual Discharge
0
10,000
20,000
30,000
40,000
50,000
60,000
70,000
Water Volume, AF

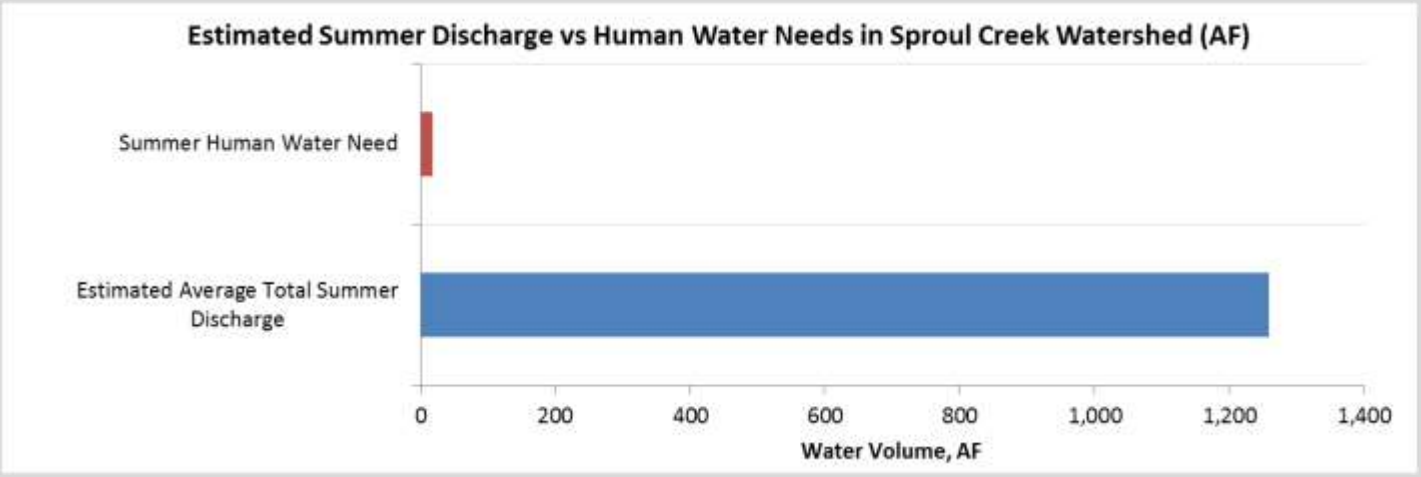

Estimated Summer Discharge vs Human Water Needs in Sproul Creek Watershed (AF)
Summer Human Water Need
Estimated Average Total Summer Discharge
0
200
400
600
800
1,000
1,200
1,400
Water Volume, AF

Table 10. *Comparison of estimated water supply from Sproul Creek's modeled unimpaired streamflow record to the estimated water demand from rural residential uses and cannabis farming operations.*

	Mean (af)	Min (af)	Max (af)
Annual Water Supply	12,577	1,058	31,932
Winter (Nov-May)	12,246	916	31,235
Summer (Jun-Oct)	331	76	1,554
Summer Supply Percent of Total	3%	0.7%	13.8%
Summer Residential Water Demand	4.47		
Summer Cannabis Water Demand	12.94		
Summer Total Water Demand	17.41		
Annual Water Demand	20.15		
Annual Demand Percent of Total	0.16%		
Summer Demand Percent of Supply	5.25%		