Establishing Environmental Flow Criteria for California Streams

Presentation to CTAG – May 14, 2020

Eric Stein – Biology Department

Main Messages

- The California Environmental Flows Framework (CEFF) has been developed by a statewide technical team that includes SCCWRP as a way set instream flow criteria statewide

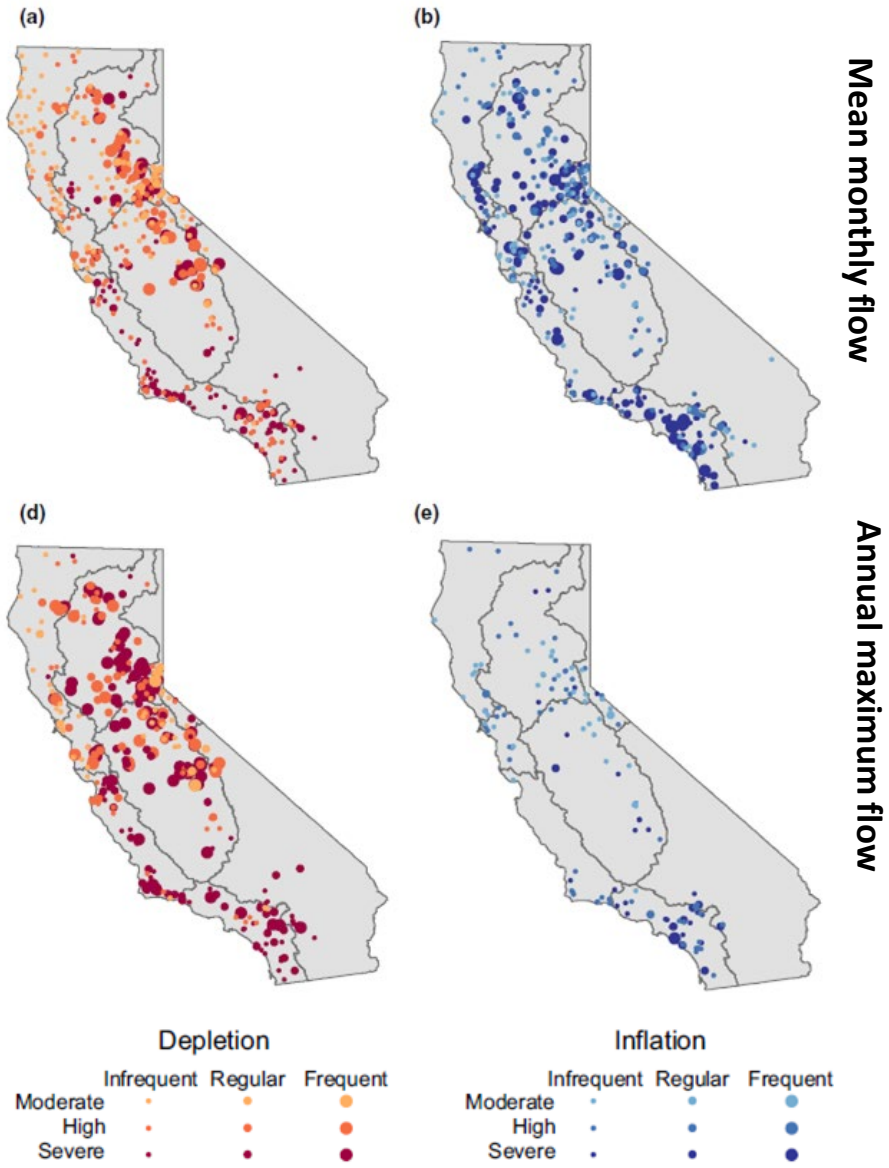
- The State Water Board will consider a resolution to implement CEFF this summer/fall
  - CDFW is already using CEFF in their programs
  - Other programs are considering its use (FERC, SGMA, CWAP)

- SCCWRP is leading two pilot implementation studies in S. CA that will provide lessons for how to implement CEFF in urban watersheds

Roadmap for Today

- Background and motivation
- Overview of CEFF
  - Tiered approach
- Status of CEFF review and endorsement process by SWRCB
- Los Angeles River environmental flows study
- South Orange County unnatural water balance study
  - Part of the Water Quality Improvement Plan

Hydrologic Alteration is Pervasive in CA



95% of gauged locations have at least some altered flows; 11% had pervasive alteration

- What is the biological effect of these impairments?
- When/where is hydrology the predominant stressor?
- What elements of the flow regime are most important to manage?

Zimmerman et al. 2018 *Freshwater Biology*

Statewide Need for Environmental Flow Criteria

- Set instream flow standards to protect biological communities
- Assess vulnerability of streams to future changes in flow conditions
  - Prioritize areas for restoration/management
- Evaluate/inform management actions
  - e.g., reservoir operations, water withdrawals
- Accommodate diversity of California's streams
- Coordinate efforts across agencies and programs

State Water Board Poised to Consider Implementation of Environmental Flows Framework

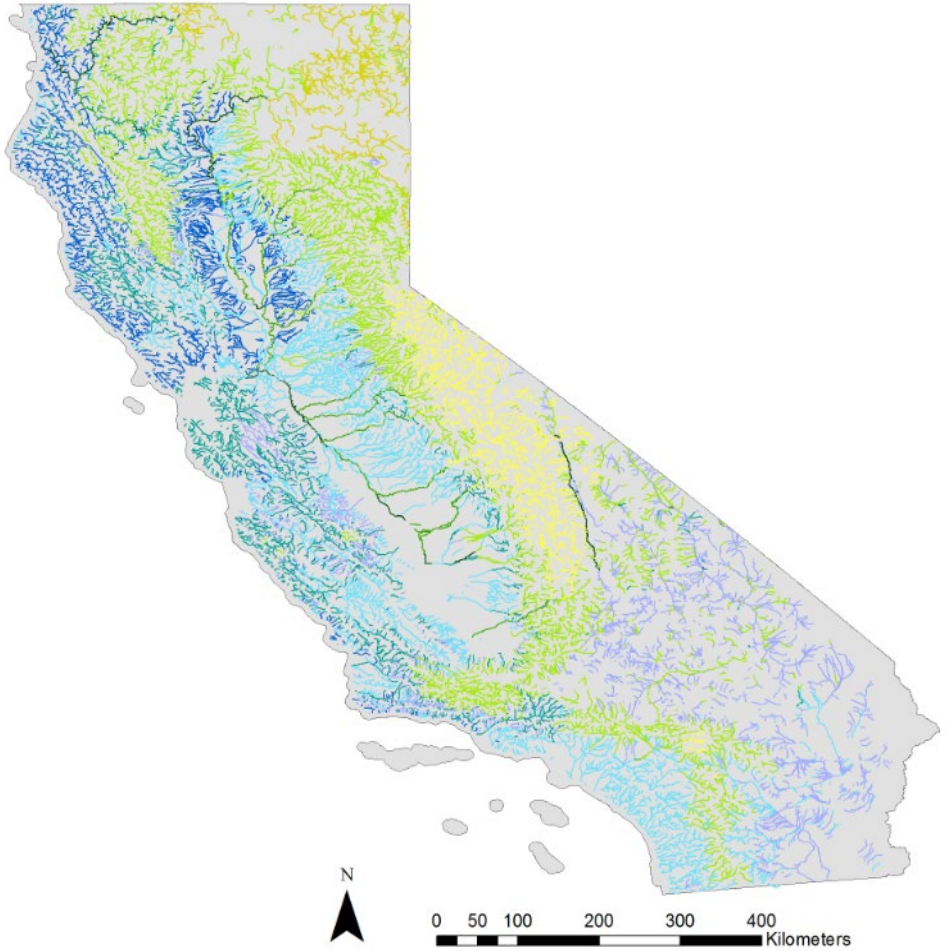
- Framework for setting environmental flows has been largely completed
- Documentation is about to go out for peer review
- State Board to hold public outreach workshops this summer
- Board briefing and workshop in late summer/fall
- Resolution to the Board to implement the framework as the basis for setting future flow objectives planned for fall 2020

What are “Criteria” and How Will They be Used?

- The SWRCB Division of Water Rights is defining “criteria” as a range of flows for different portions of the year necessary to support a broad suite of ecological functions.
- The way ecological flow criteria are used to set regulatory objectives is still to be determined
- Different agencies will likely implement ecological flow criteria differently

California Environmental Flows Framework (CEFF)

The Framework provides guidance, data, and tools for users to interpret and refine hydrologically representative and ecologically-relevant functional flow metrics that can be used to inform the establishment of environmental flow prescriptions aimed at protecting aquatic life while supporting human uses.

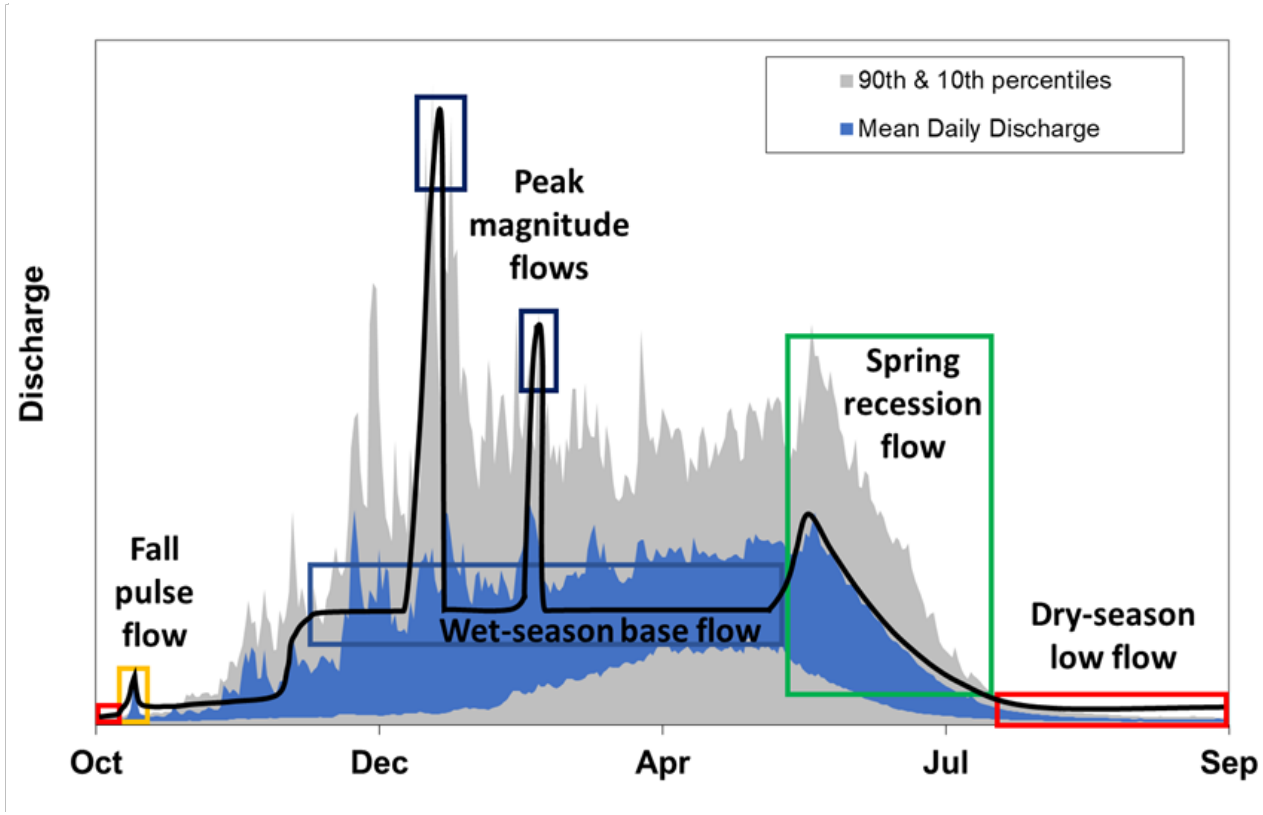


California Environmental Flows Framework (CEFF) Overview

- Establishes *ecological flow criteria* based on functional flows approach
- Tiered structure to provide for consistent statewide application AND adjustment/refinement for regional or local conditions
- Statewide approach based on comparison to reference ranges of 24 functional flow metrics
- Regional/local adjustment allows for customization to account for management issues or specific ecological concerns (e.g. sensitive species)

What Are Functional Flows?

The magnitude, timing, duration, rate of change, and frequency of flows and associated water levels necessary to sustain the biological composition, ecological function, and habitat processes within a water body and its margins



Functional Flow Components

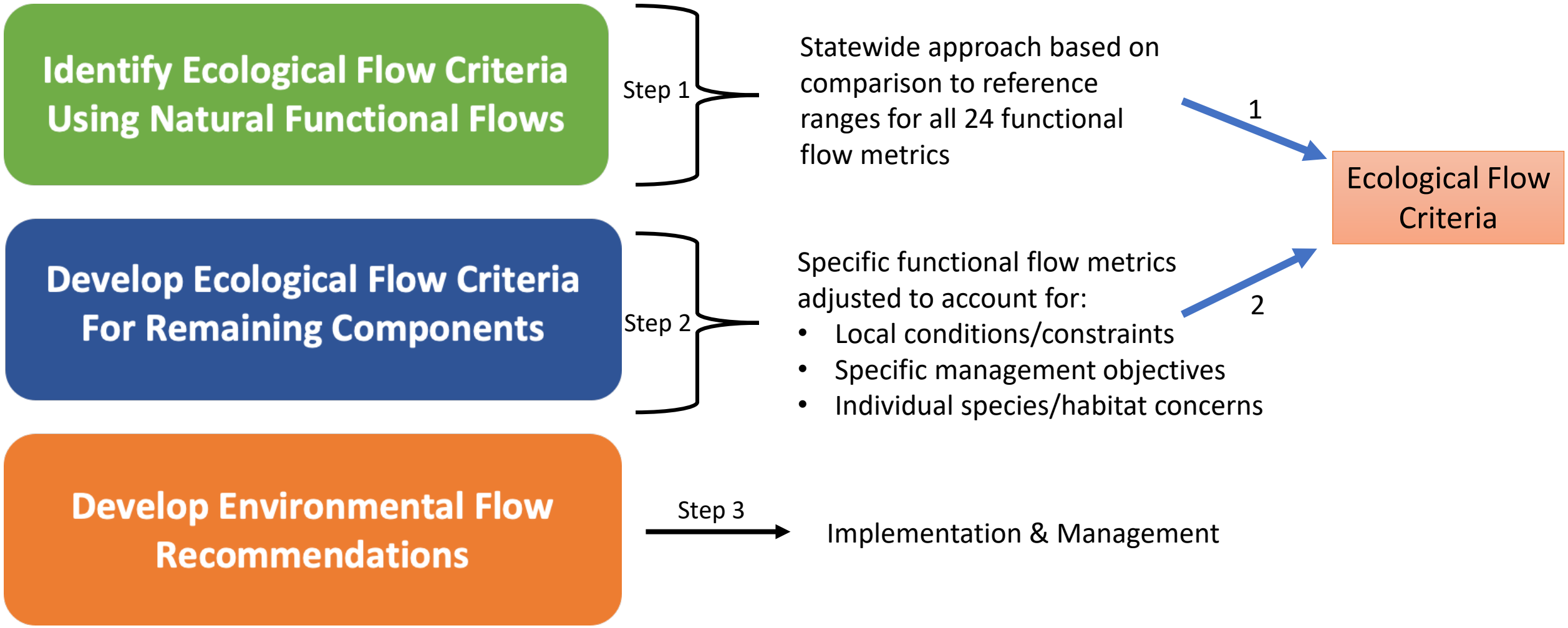
- Fall pulse flow
- Peak magnitude flows
- Wet season base flow
- Spring recession flow
- Dry season low flow

Some stream types don't exhibit all components

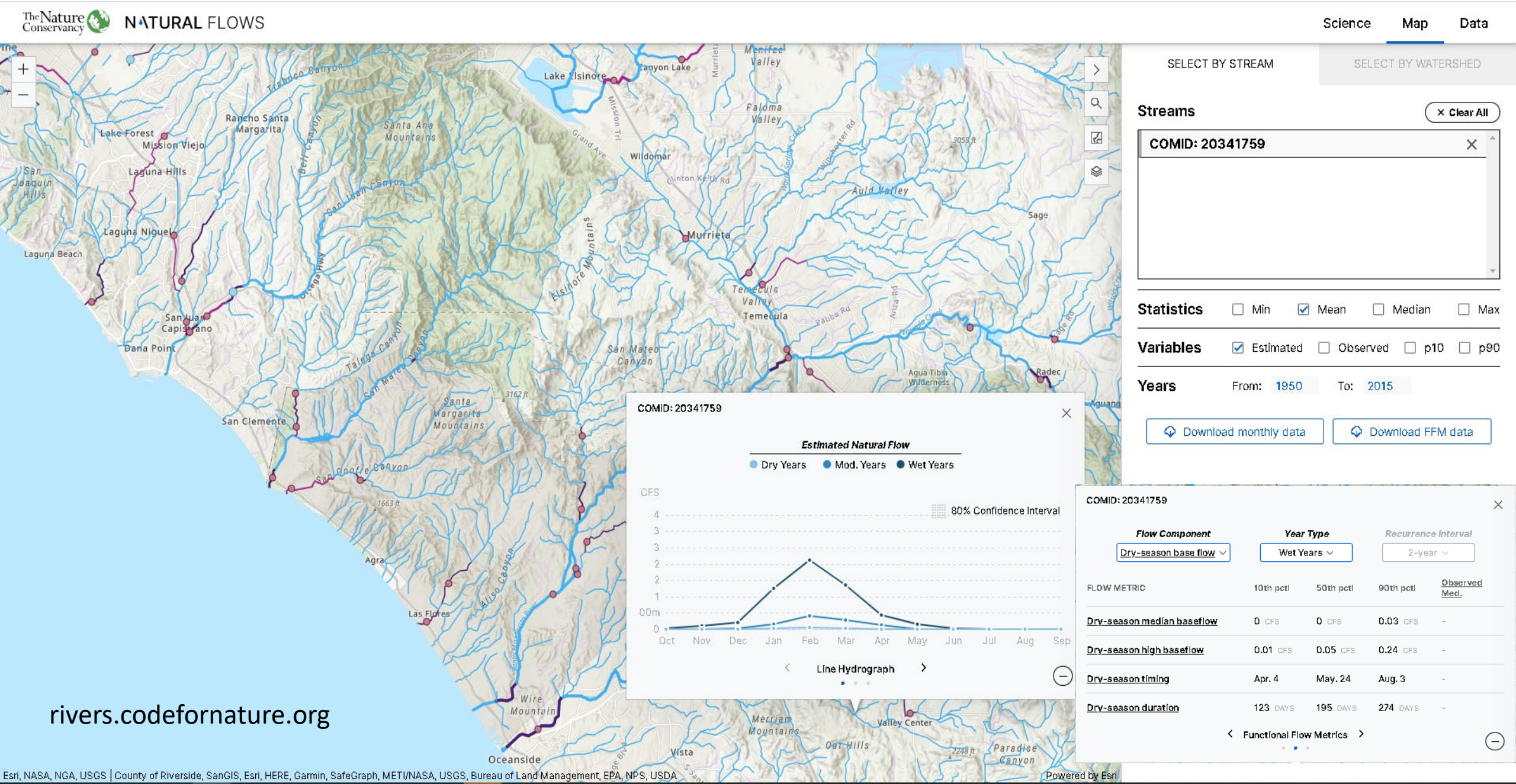
Functional Flow Metrics

Flow Component	Flow Characteristic	Flow Metric
Fall pulse flow	Magnitude (cfs)	Peak magnitude of fall season pulse event (maximum daily peak flow during event)
	Timing (date)	Start date of fall pulse event
	Duration (days)	Duration of fall pulse event (# of days start-end)
Wet-season base flows	Magnitude (cfs)	Magnitude of wet season baseflows (10th and 50th percentile of daily flows within that season, including peak flow events)
	Timing (date)	Start date of wet season
	Duration (days)	Wet season baseflow duration (# of days from start of wet season to start of spring season)
Peak flow	Magnitude (cfs)	Peak-flow magnitude (50%, 20%, 10% exceedance values of annual peak flow --> 2, 5, and 10 year recurrence intervals)
	Duration (days)	Duration of peak flows over wet season (cumulative number of days in which a given peak-flow recurrence interval is exceeded in a year).
	Frequency	Frequency of peak flow events over wet season (number of times in which a given peak-flow recurrence interval is exceeded in a year).
Spring recession flows	Magnitude (cfs)	Spring peak magnitude (daily flow on start date of spring-flow period)
	Timing (date)	Start date of spring (date)
	Duration (days)	Spring flow recession duration (# of days from start of spring to start of summer base flow period)
	Rate of change (%)	Spring flow recession rate (Percent decrease per day over spring recession period)
Dry-season base flows	Magnitude (cfs)	Base flow magnitude (50th and 90th percentile of daily flow within summer season, calculated on an annual basis)
	Timing (date)	Summer timing (start date of summer)
	Duration (days)	Summer flow duration (# of days from start of summer to start of wet season)

CEFF Tiered Approach

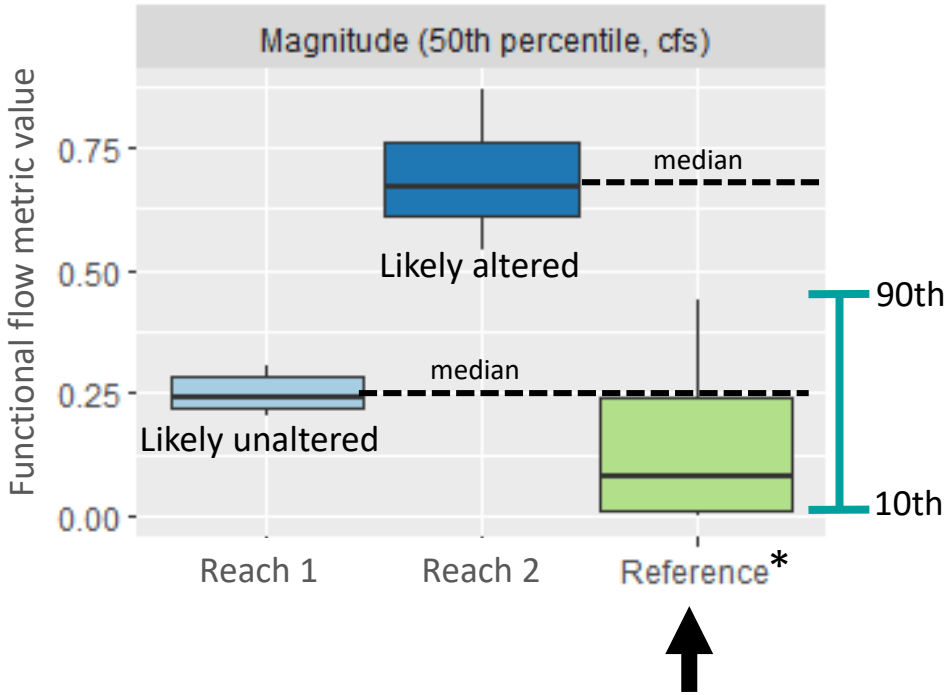


Reference Hydrology Modeled for All Stream Reaches in CA



rivers.codefornature.org

Flow Alteration Based on Comparison to Reference Ranges

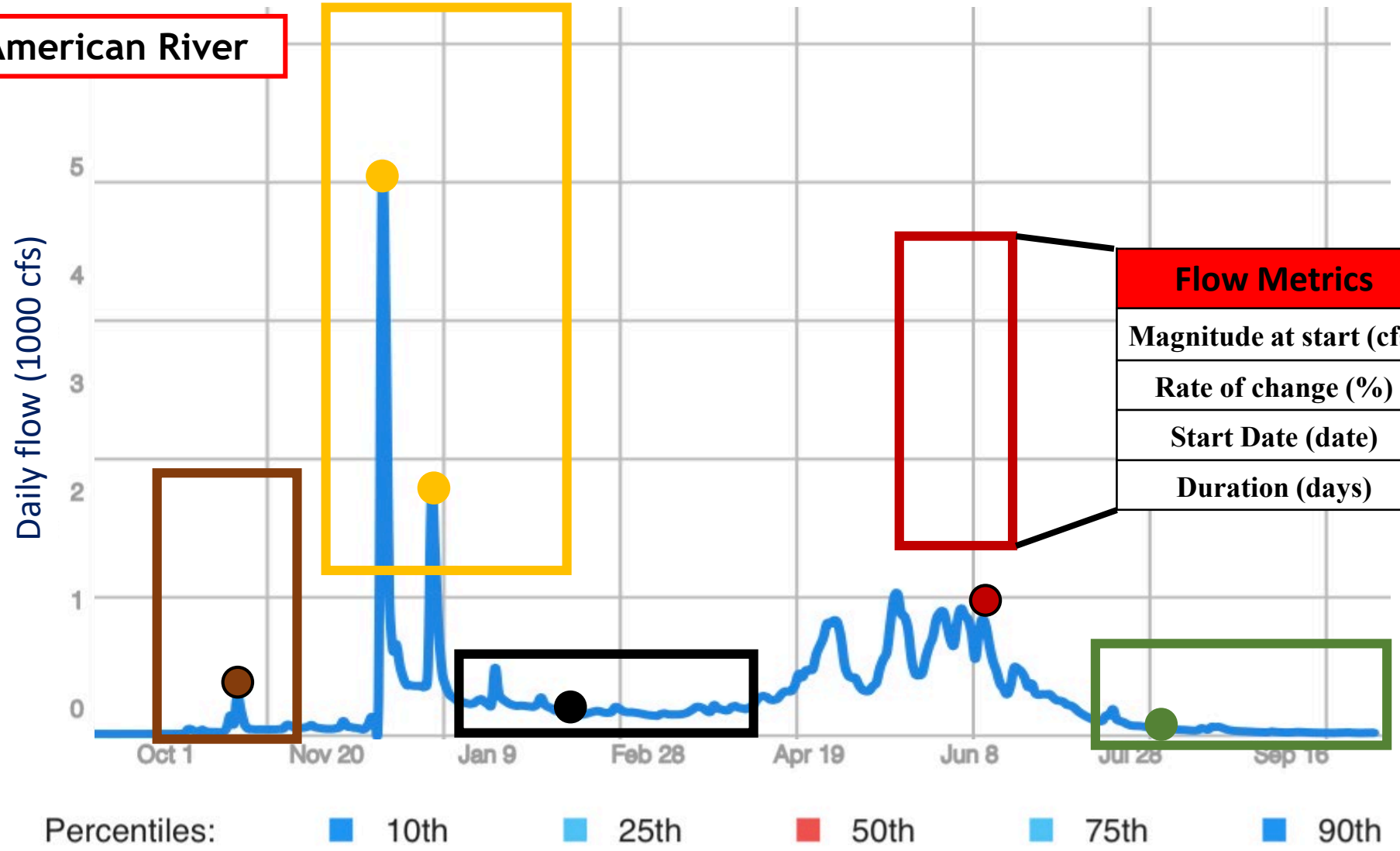


Alteration Status	Determination
Likely Unaltered	If **median falls within 10th-90th** reference distribution and **>50%** current values fall **within 10th-90th** percentile
Indeterminate	If **median falls within 10th-90th** reference distribution and **<50%** current values fall **within 10th-90th** percentile
Likely Altered	If **median falls outside of 10th-90th** reference distribution

*Compare current hydrology to modeled reference range for each functional flow metric

Flow Alteration Based on Hydrograph Comparison

South Fork American River



Flow Metrics	Values
Magnitude at start (cfs)	2028 – 4880 cfs
Rate of change (%)	5 – 8%
Start Date (date)	May 11 – May 27
Duration (days)	36 to 50 days

When is Refinement of Reference-based Ecological Flow Criteria Necessary?

- Reference-based ecological flow criteria are too coarse
- Desire to focus on flow effects on specific ecological conditions (e.g. particular species, communities, or habitats)
- Need to consider specific physical settings or constraints
- Need to address specific management issues

Refined flow criteria are finalized by balancing the ecological flow needs with other (human use) demands

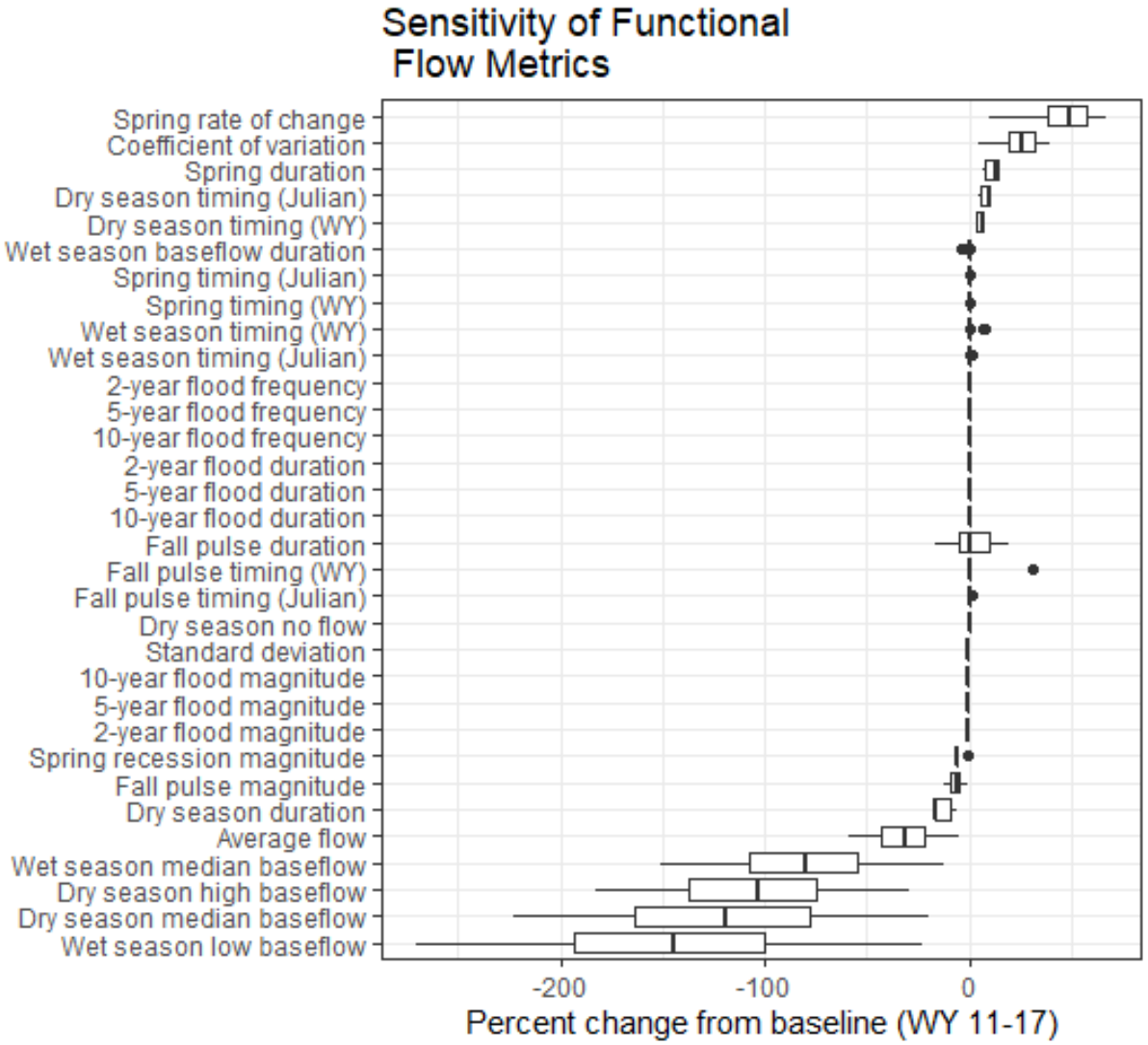
Refining Reference-based Flow Criteria

Steelhead (rainbow) trout

	Temperature	Velocity	Depth
Adult[1,2,4]	optimal: 15-18C	3-3.1 m/s	>0.18 m
Migration[1,3,4]	7.8-11.1C, lethal: <4 & >23C	0.15-0.34 m/s	>0.12 m

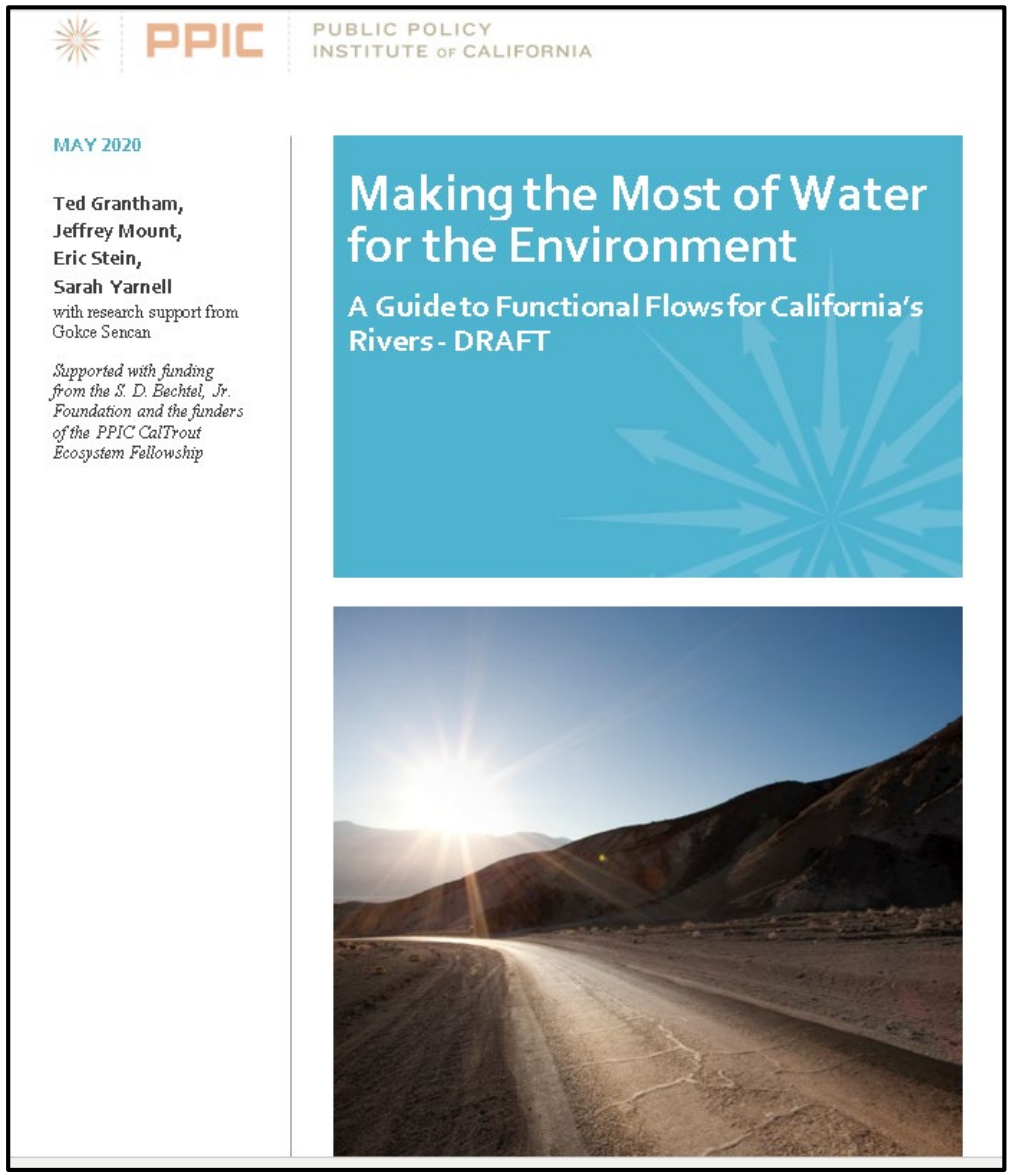
Bjornn & Reiser (1991)
Hofflander, & Dagit, (2015)
Oroville Facilities Relicensing. (2004)
Raleigh,et a l. 1984

Refinement based on species needs



Refinement based management needs

PPIC Proposed Water Allocation Approaches


PPIC PUBLIC POLICY INSTITUTE OF CALIFORNIA

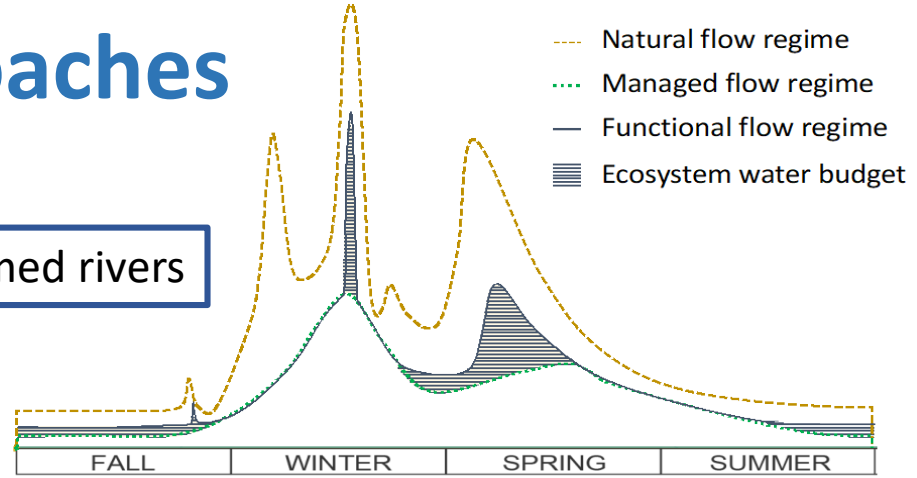
MAY 2020

Ted Grantham,
Jeffrey Mount,
Eric Stein,
Sarah Yarnell
with research support from Gokce Sencan

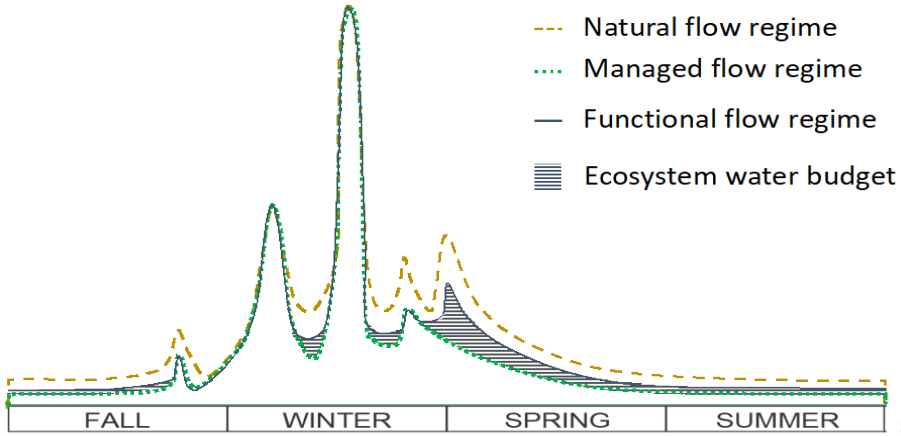
Supported with funding from the S. D. Bechtel, Jr. Foundation and the funders of the PPIC CalTrout Ecosystem Fellowship

Making the Most of Water for the Environment

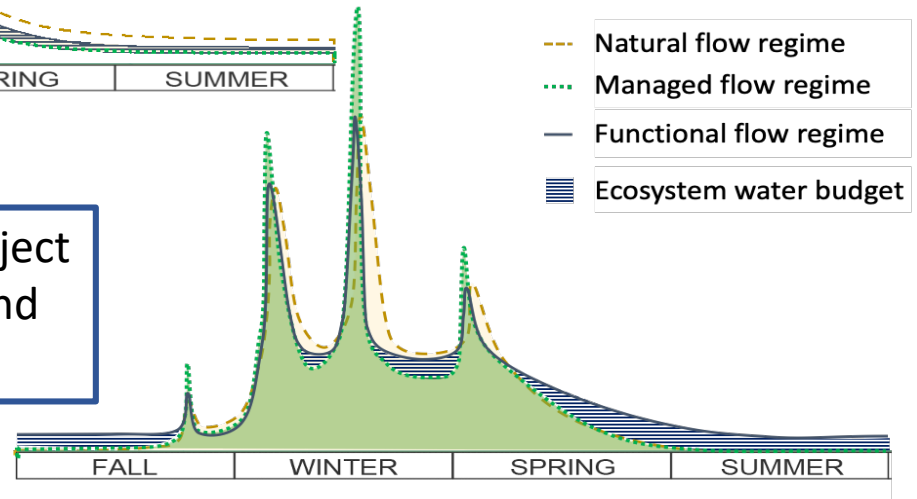
A Guide to Functional Flows for California's Rivers - DRAFT



Dammed rivers

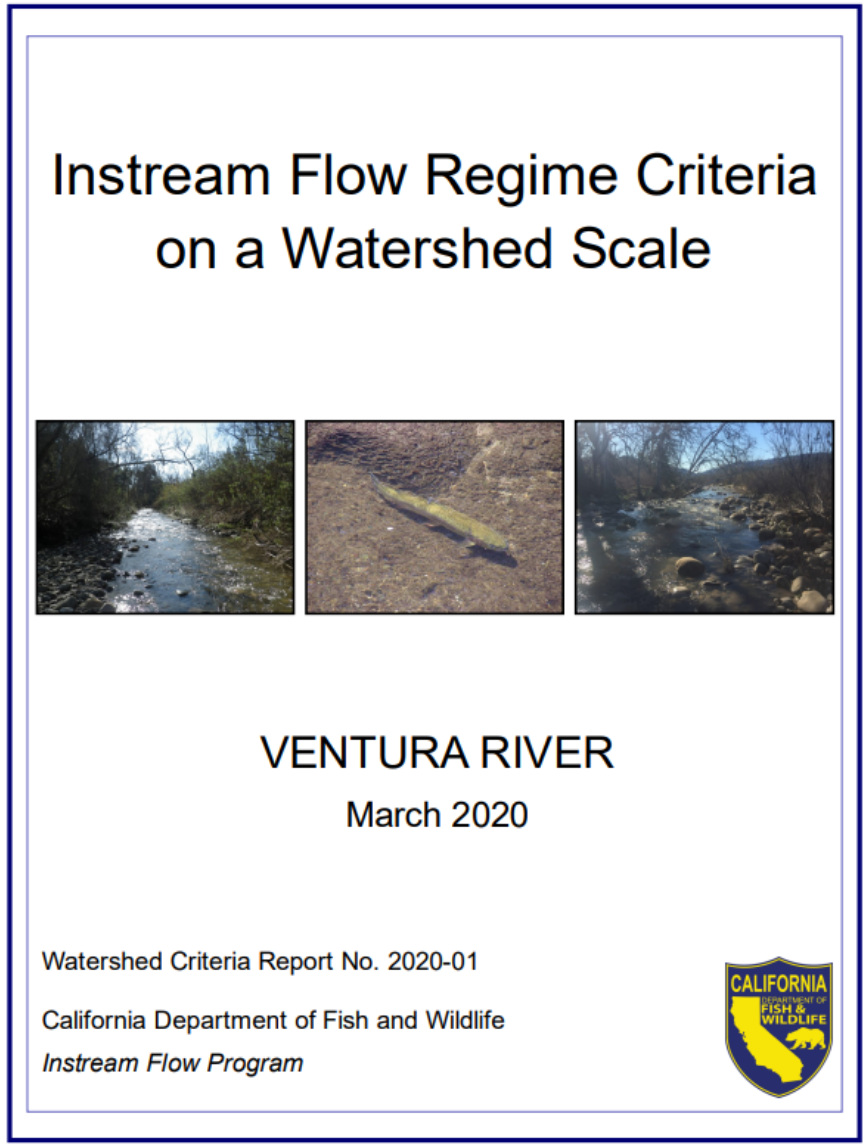


Undammed rivers, subject to diversions



Urban rivers, subject to discharges and diversions

CDFW Implementation of CEFF via Instream Flows Program



- Flow Variation
- Natural Flows
- Functional Flows
- Ecosystem Baseflows
- Sensitive Period Indicators
- Salmonid Habitat Optimum Flows
- Salmonid Passage Flows

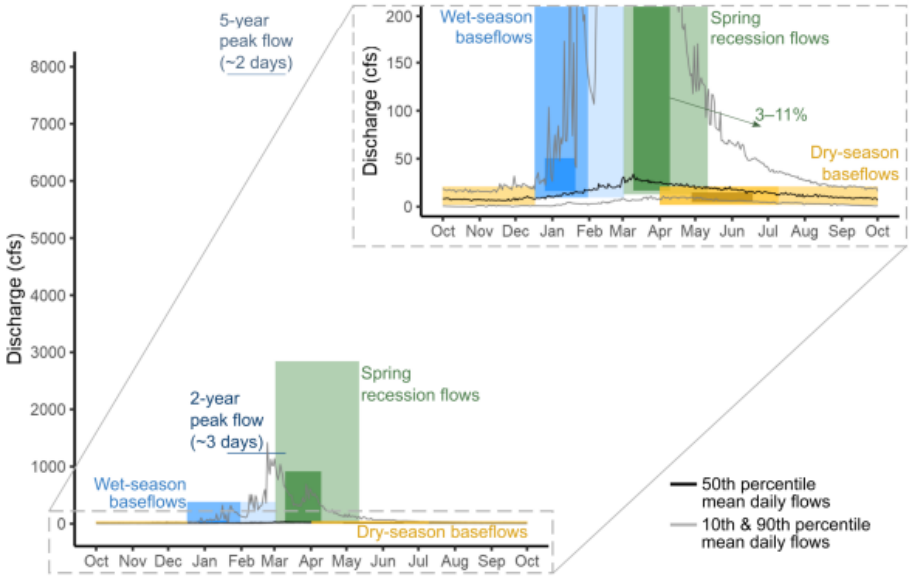
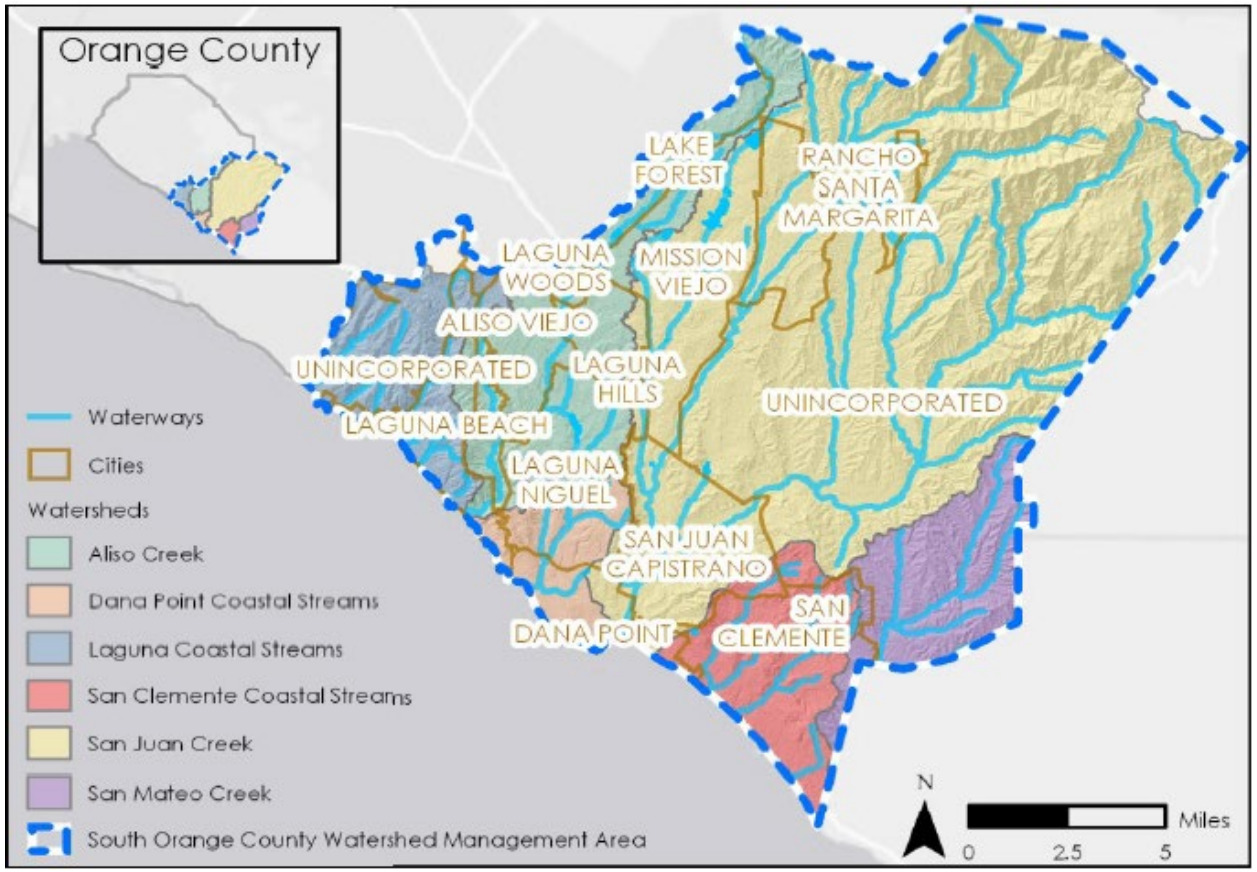


Figure 5. Timing and magnitude of lower Ventura River Functional Flows.

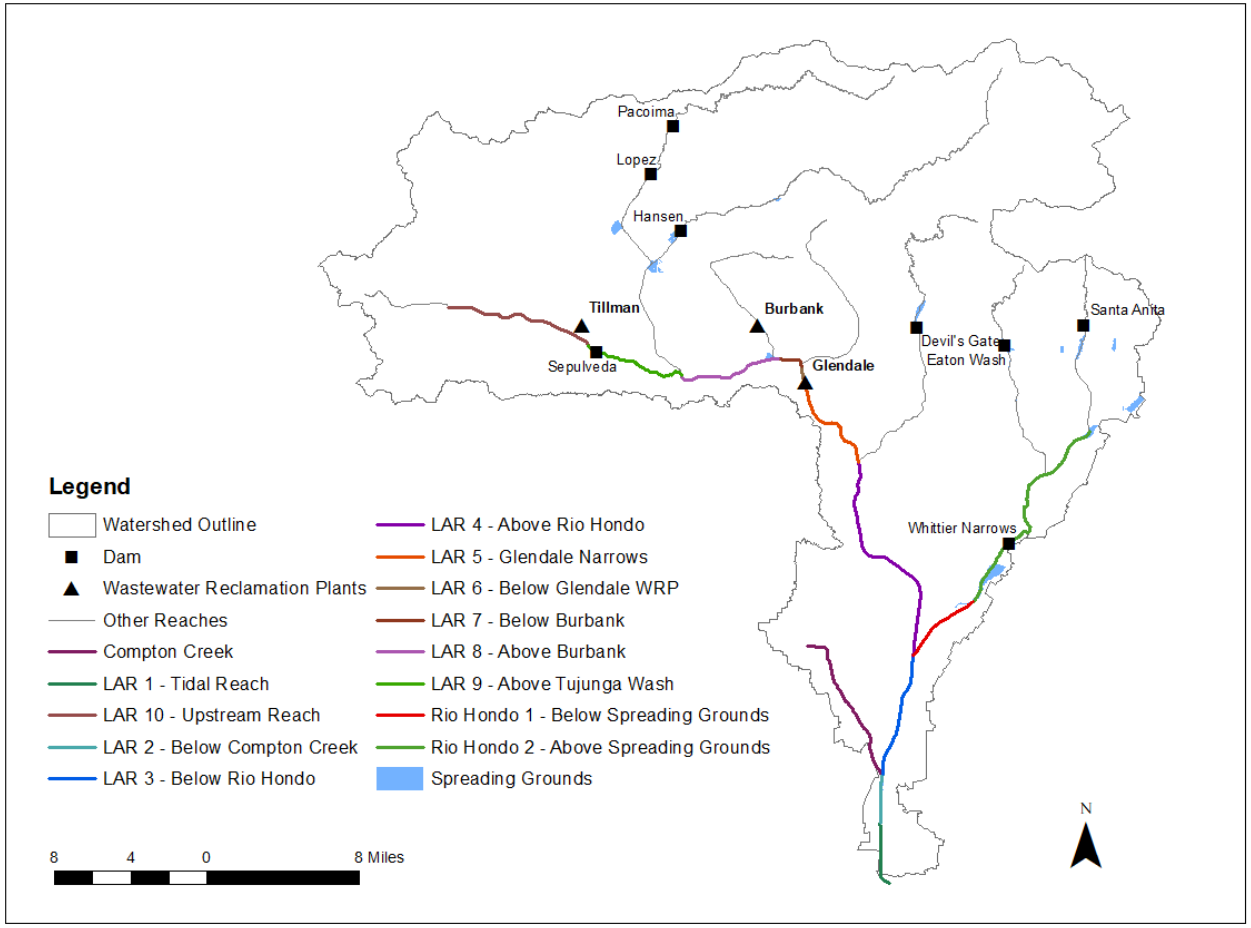
Table 2. Lower Ventura River Functional Flow metric median values (10th–90th percentile in parentheses).

Metric	Start Timing (in wet years)	Duration (total days per year, when present)	Magnitude (cfs)	Frequency (events per year, when present)	Rate of Change (percent per day)
Wet-season baseflows	Jan 10 (Dec 17–Jan 30)	-	23 (10–380)	-	-
2-year peak flow	-	3 (1–20)	1,230	2 (1–5)	-
5-year peak flow	-	2 (1–3)	7,860	2 (1–2)	-
10-year peak flow	-	1 (1–3)	16,320	1 (1–2)	-
Spring recession flows	Mar 28 (Mar 1–May 11)	79 (23–153)	36 (13–2,840)	-	6 (3–11)
Dry-season baseflows	Jun 2 (Apr 1–Jul 9)	156 (86–260)	8 (2–21)	-	-

Southern California Case Studies



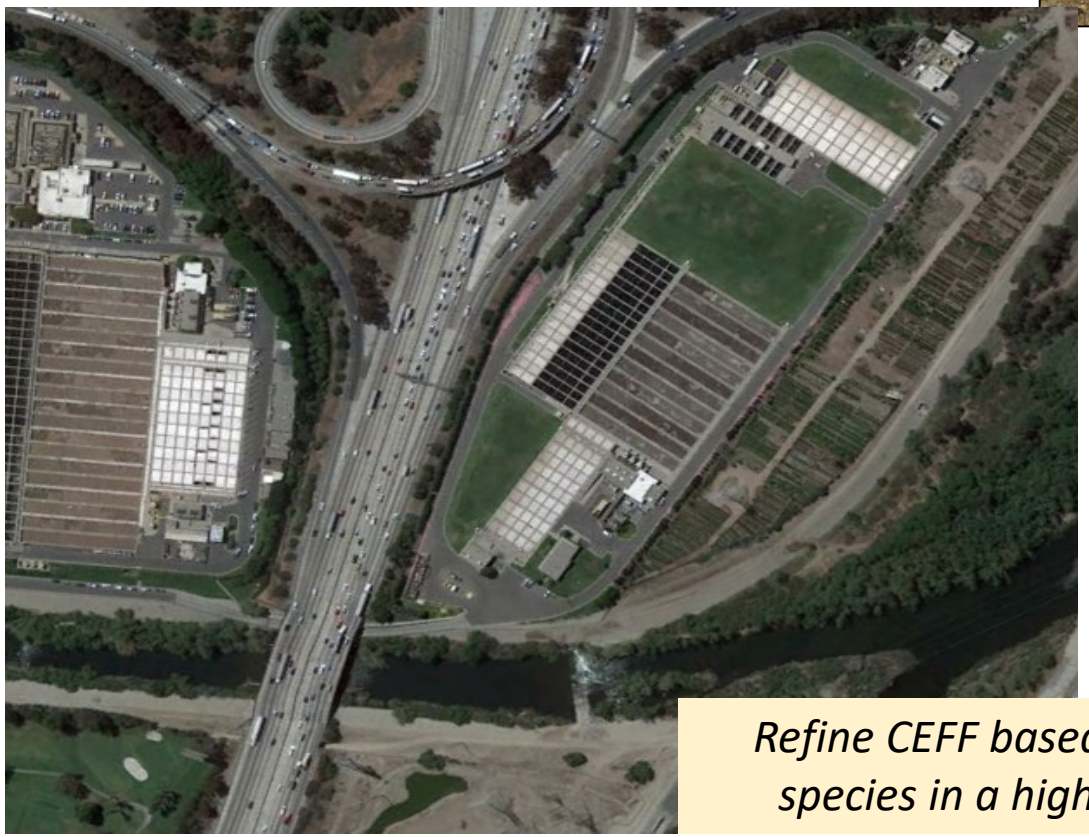
South Orange County Unnatural Water Balance Study



Los Angeles River Environmental Flows Study

LA River Changing Water Use Practices

What are the potential impacts (+ or -) to existing and potential future instream beneficial uses in the Los Angeles River caused by reductions of wastewater treatment plant discharges and/or stormwater capture?



Refine CEFF based on needs of specific species in a highly managed system

Los Angeles River Watershed

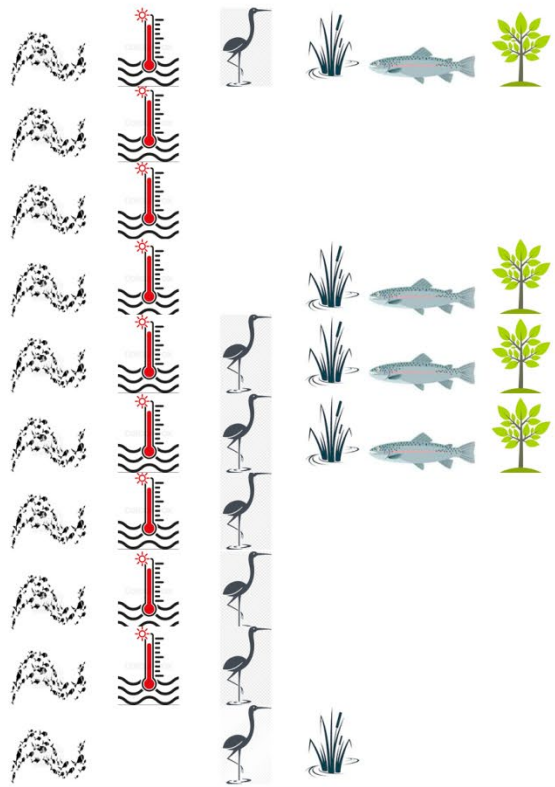
■ Dams ▲ WRP — Tribs Outside Study Area ■ Spreading Grounds (SG)

Habitat

Migration | Warm Water | Wading Shore Bird | Freshwater Marsh | Cold Water | Riparian

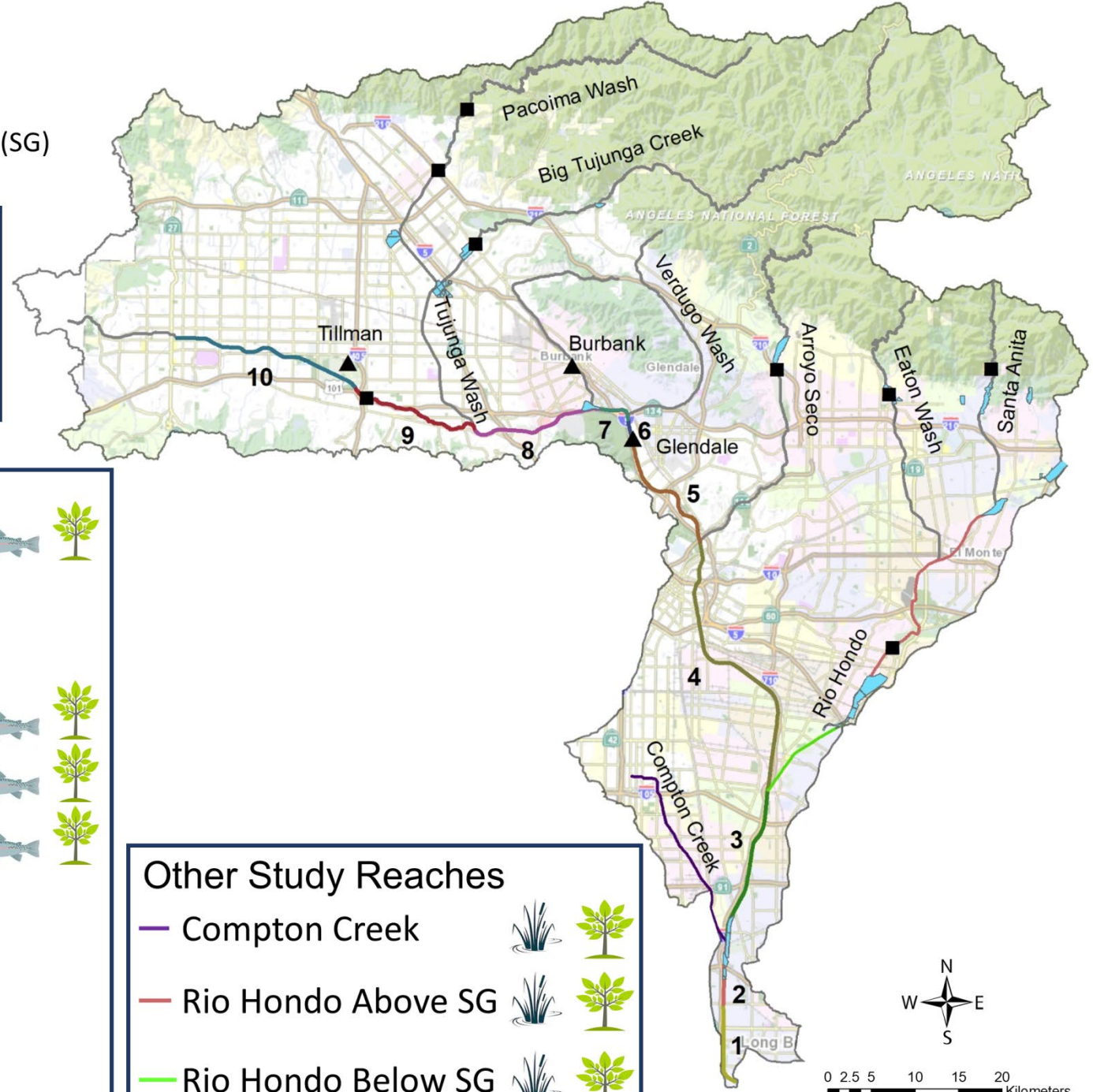
Study Reaches

- 10 - Upstream Reach
- 9 - Above Tujunga Wash
- 8 - Above Burbank
- 7 - Below Burbank
- 6 - Below Glendale WRP
- 5 - Glendale Narrows
- 4 - Above Rio Hondo
- 3 - Below Rio Hondo
- 2 - Below Compton Creek
- 1 - Tidal Reach



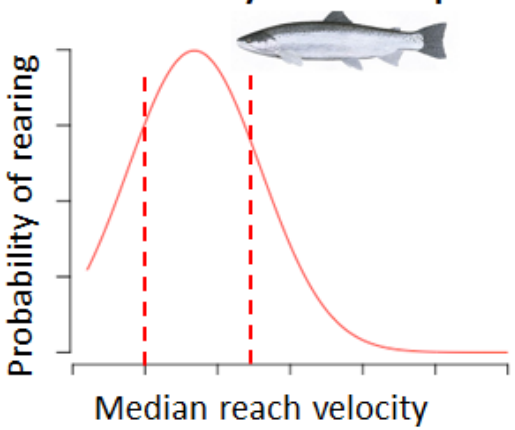
Other Study Reaches

- Compton Creek
- Rio Hondo Above SG
- Rio Hondo Below SG

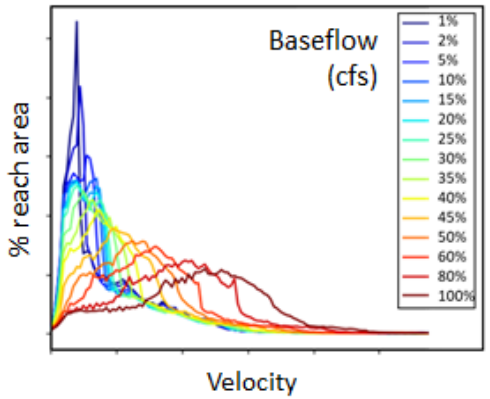


LA River Analysis

(a) **Habitat suitability relationship**



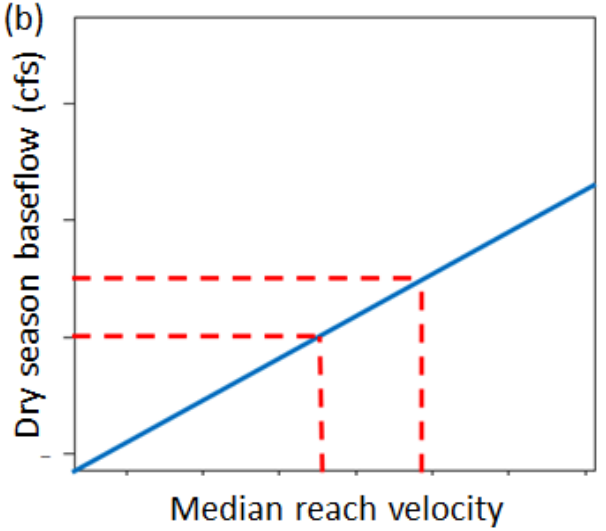
Hydraulic response relationships



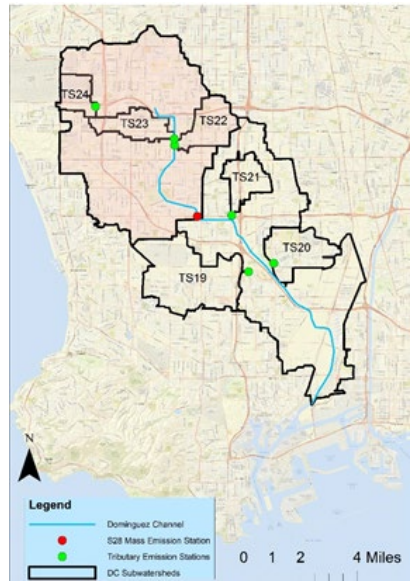
Relate FFM to hydraulic conditions

**For each LOI and WYT*

(b)

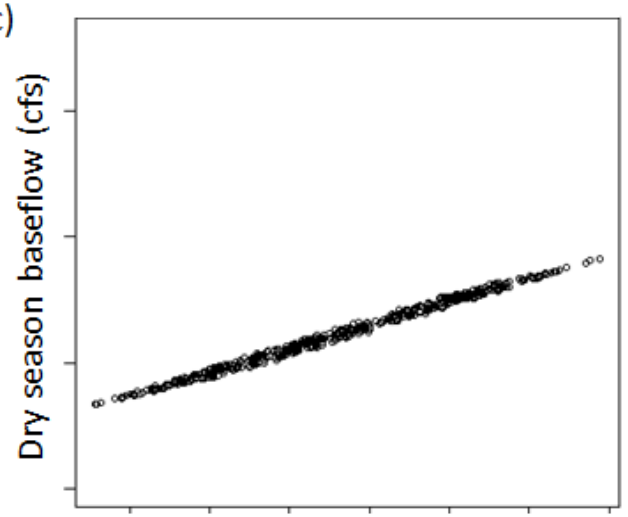


Models



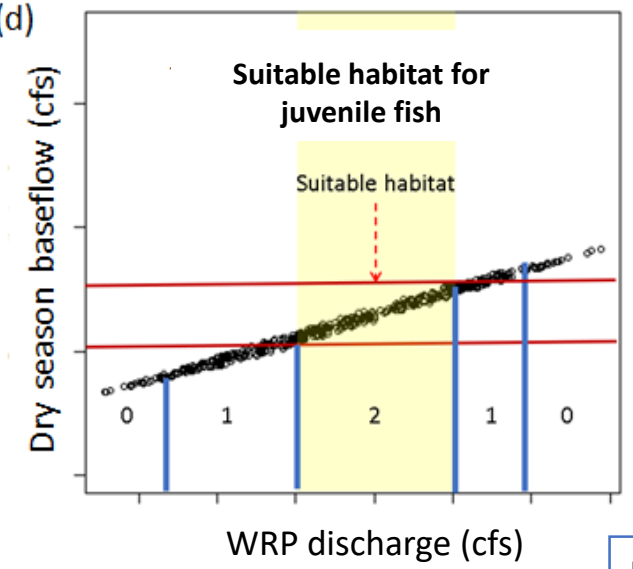
Evaluate change in FFM with flow requirements (diversion limits)

(c)

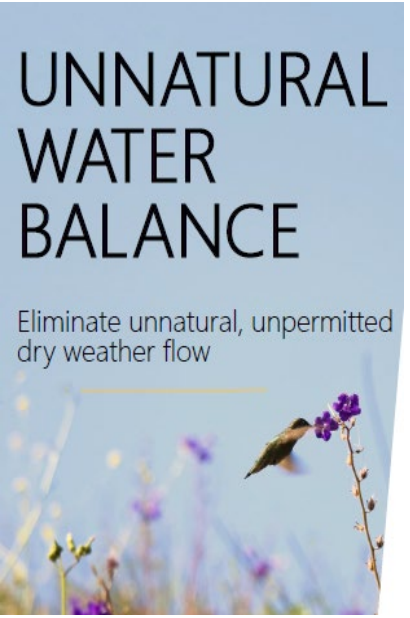


Set FFM range based on desired ecological outcome

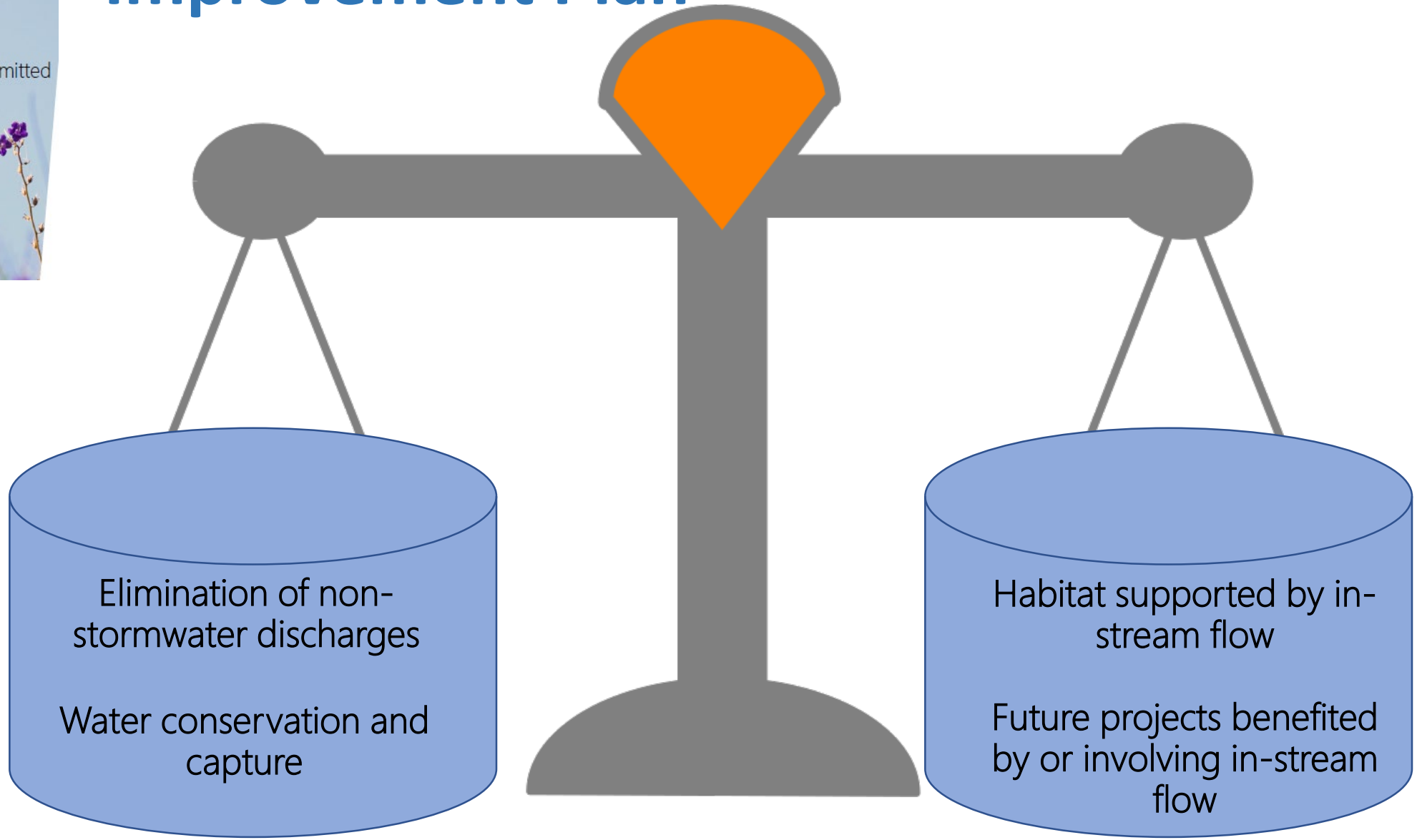
(d)



Draft report – Feb. 2021



South Orange County Water Quality Improvement Plan



South Orange County Study Objective

Develop tools and datasets to inform decisions regarding flow management activities

1. Where and when are flows altered?

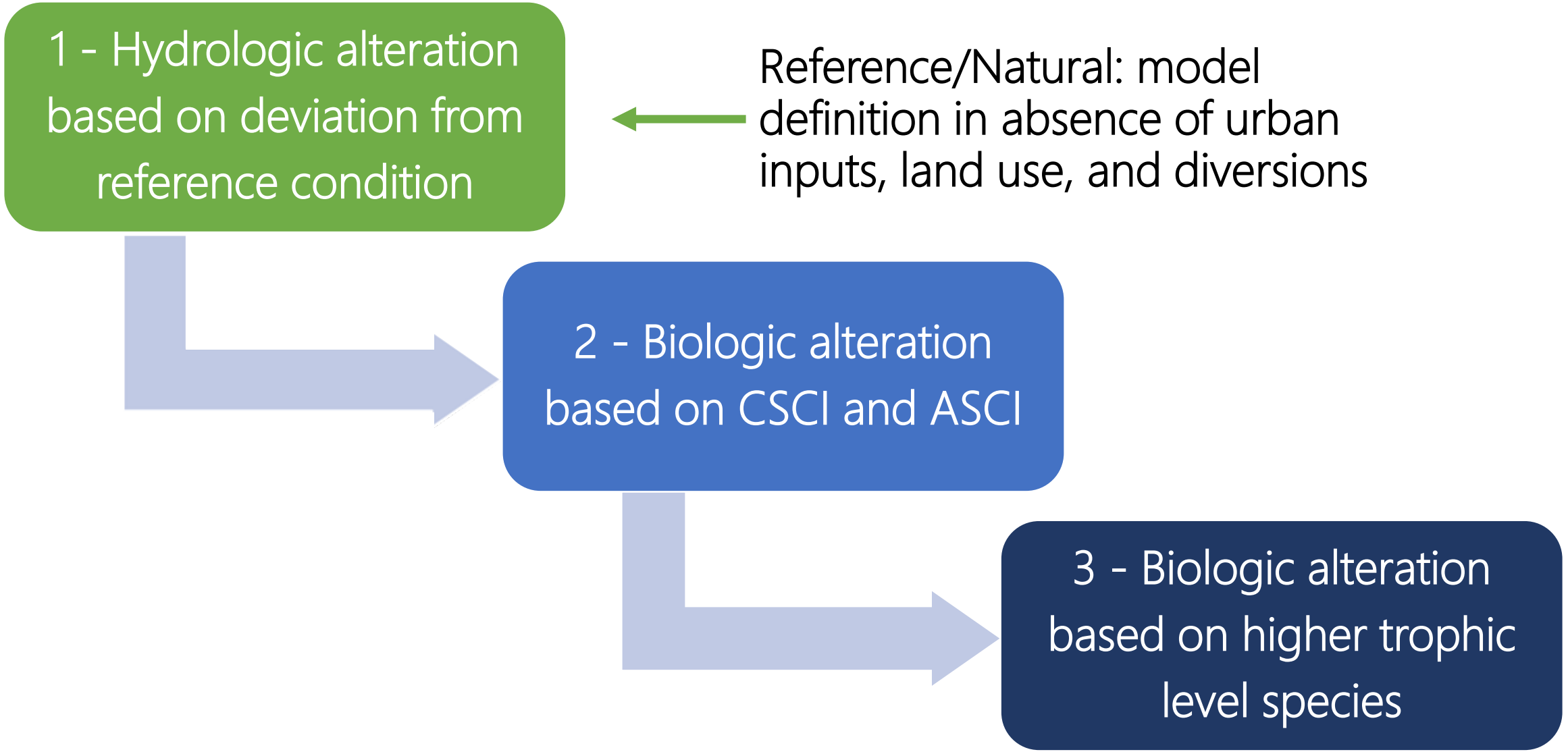
2. If flows are altered, is it biologically important?

3. What locations would benefit the most from in-stream flow management measures?

4. What is a measure of success of management actions?

Demonstration of CEFF application for water conservation efforts

Tiered Flow Ecology Analysis



Scenario Analysis

Three areas of focus:

1. **Climate Change** – Streamflow will change in the absence of management intervention.

2. **Water Conservation** – Dry weather runoff from urban areas will decrease. County actions may have limited influence.

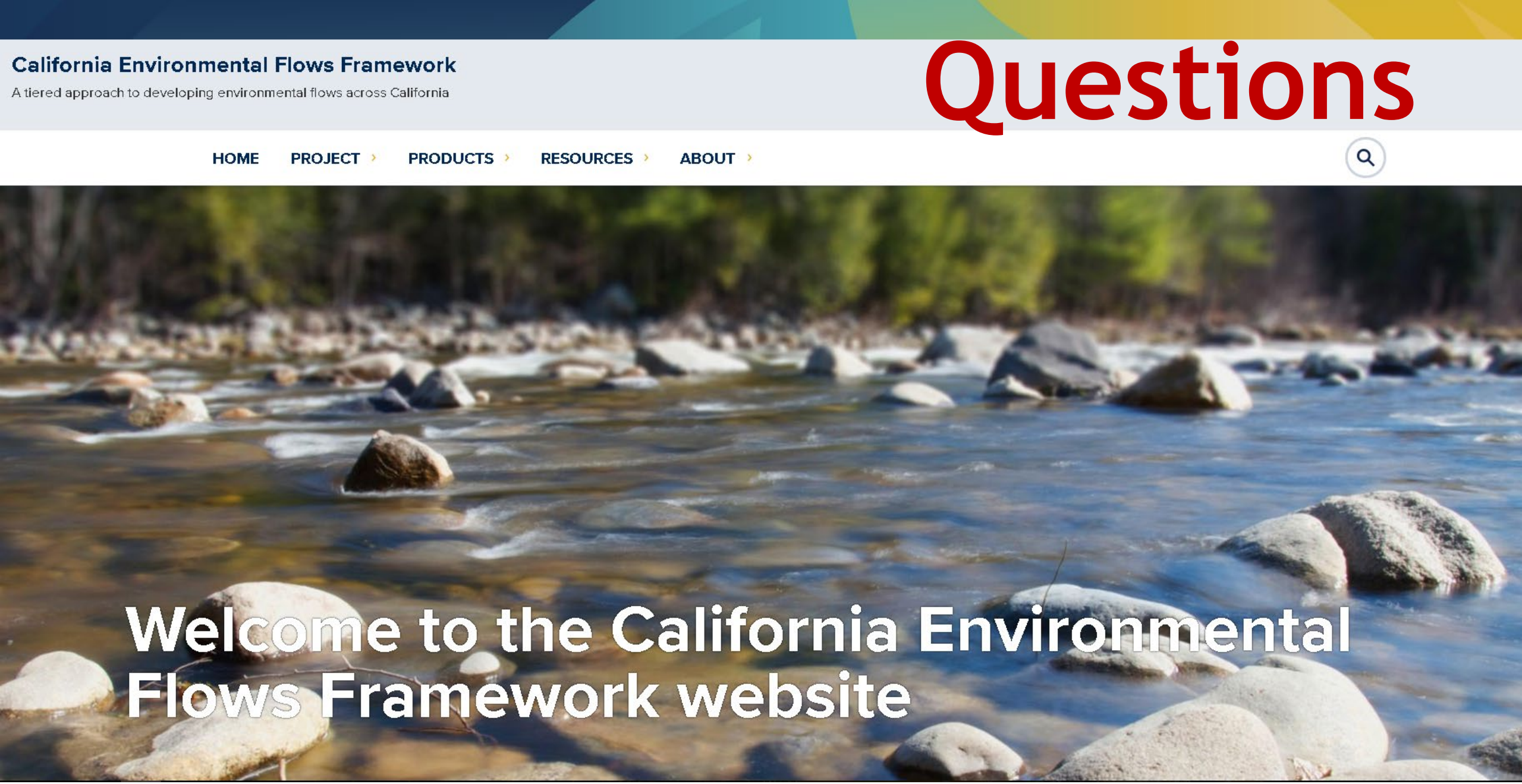
3. **Structural Flow Management** – In-stream projects are controlled by the county and water agencies.

   Examples: Flow diversion, detention, stream recharge. These tend to occur in specific locations.

Final Thoughts

- CEFF provides a consistent approach to establishing environmental flows statewide
  - Tiered approach provides comprehensive applicability AND regional/local flexibility
  - Multiple agencies have cooperated on development of CEFF
  - Implementation process is still being developed
- Public review will likely occur this summer, but advance briefings on technical elements available to SCCWRP member agencies
- Local pilot studies are providing valuable lessons for CEFF implementation

Questions



ceff.ucdavis.edu