

# Napa River Fish Monitoring

Martin Perales  
Napa Resource  
Conservation District





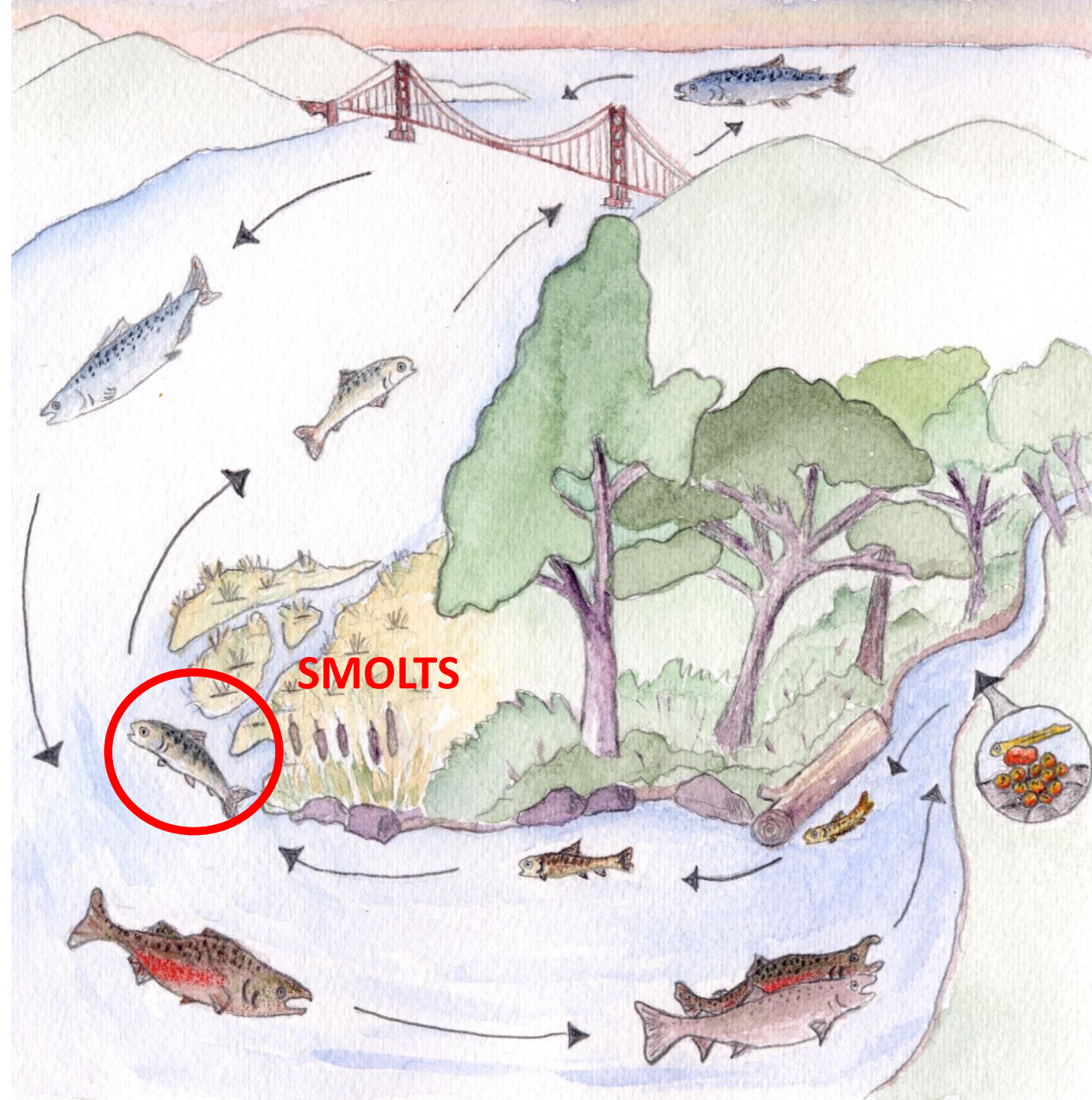
# Steelhead

*Oncorhynchus mykiss*

- Listed as **Threatened** under the Federal Endangered Species Act
- Anadromous form of Rainbow Trout
- Young spend 1-4 years in freshwater









# Napa River Fish Trap



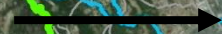


# Napa River Watershed

- 31 major tributaries
- Approx. 146 stream miles with anadromous salmonids

## Napa River Fish Trap

Approximately 66% of salmonid habitat is upstream of this point

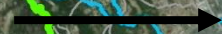


# Napa River Watershed

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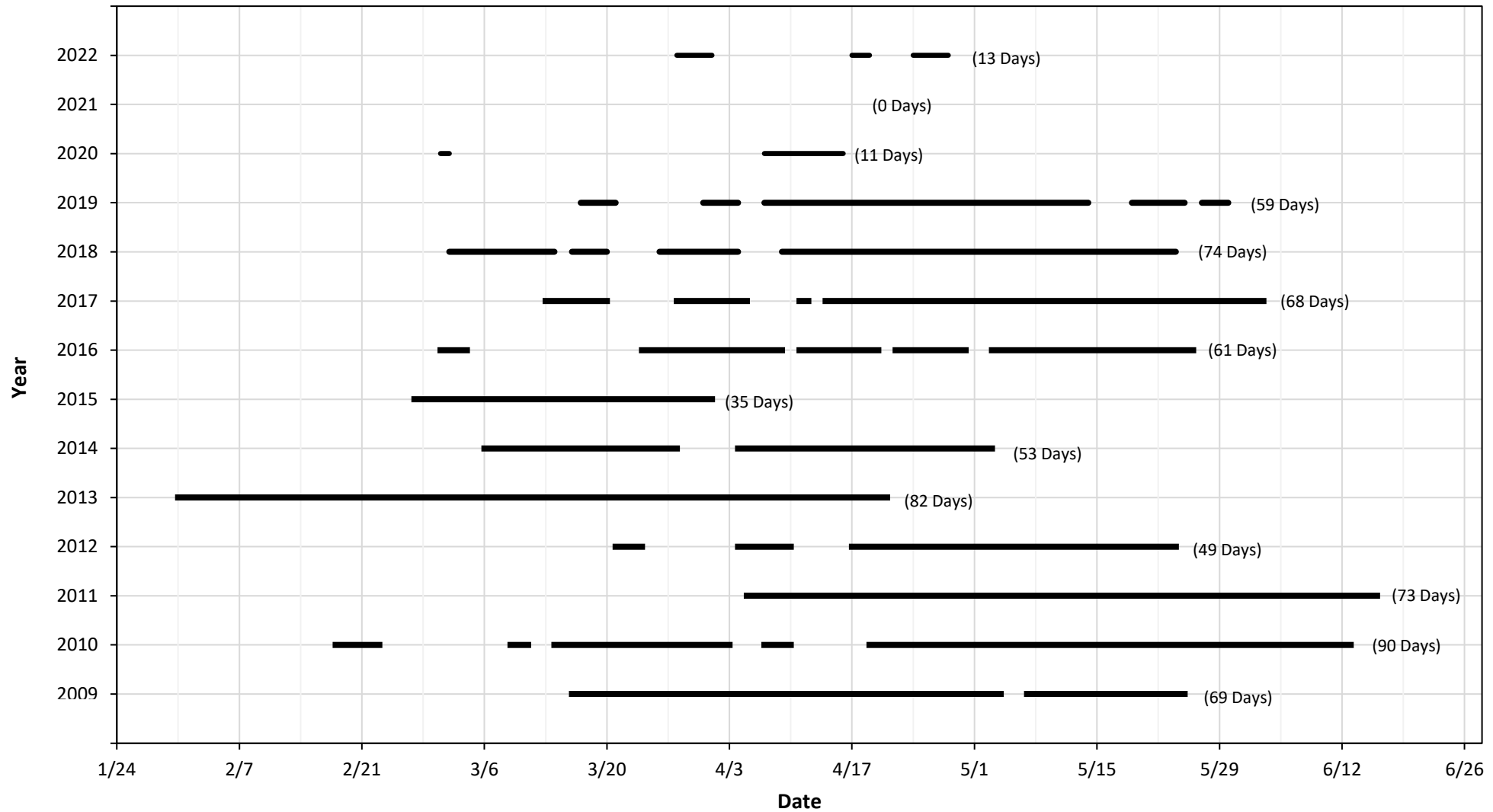
## Napa River Fish Trap

Approximately 66% of salmonid habitat is upstream of this point



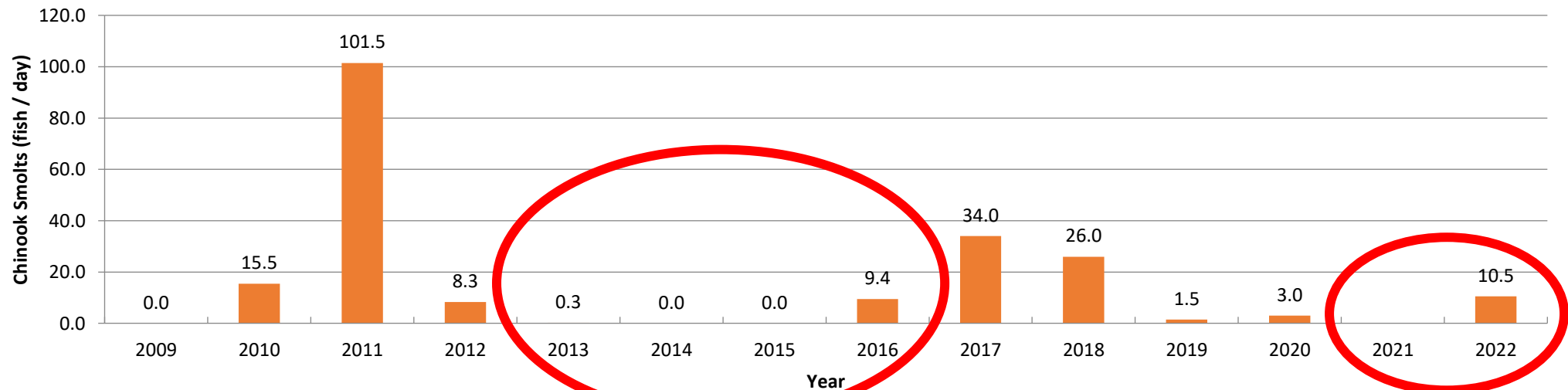
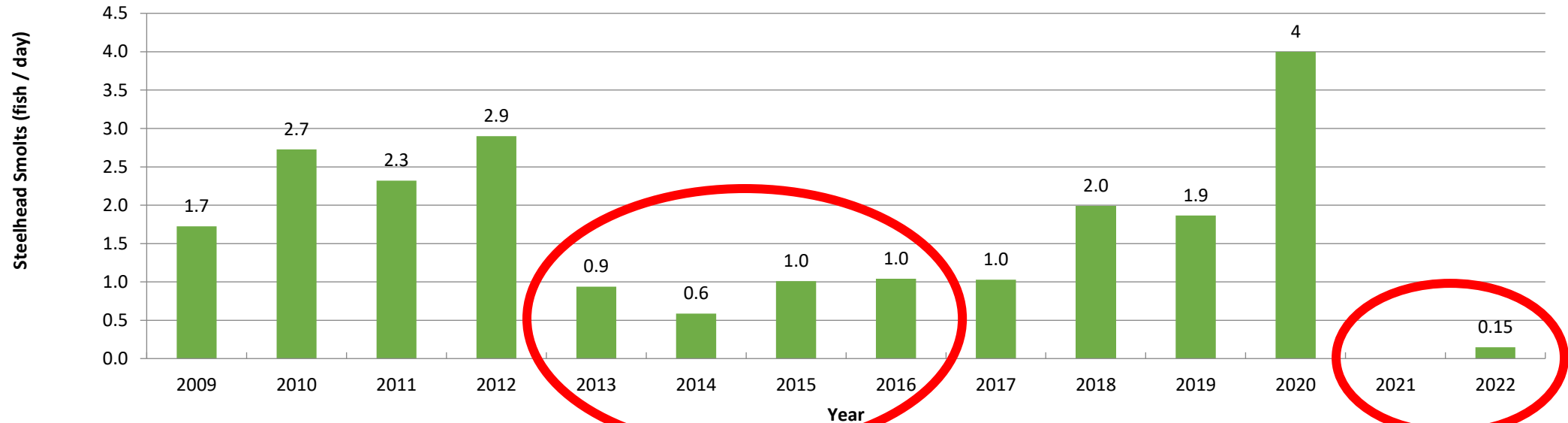


# Sampling dates - Rotary Screw Trap



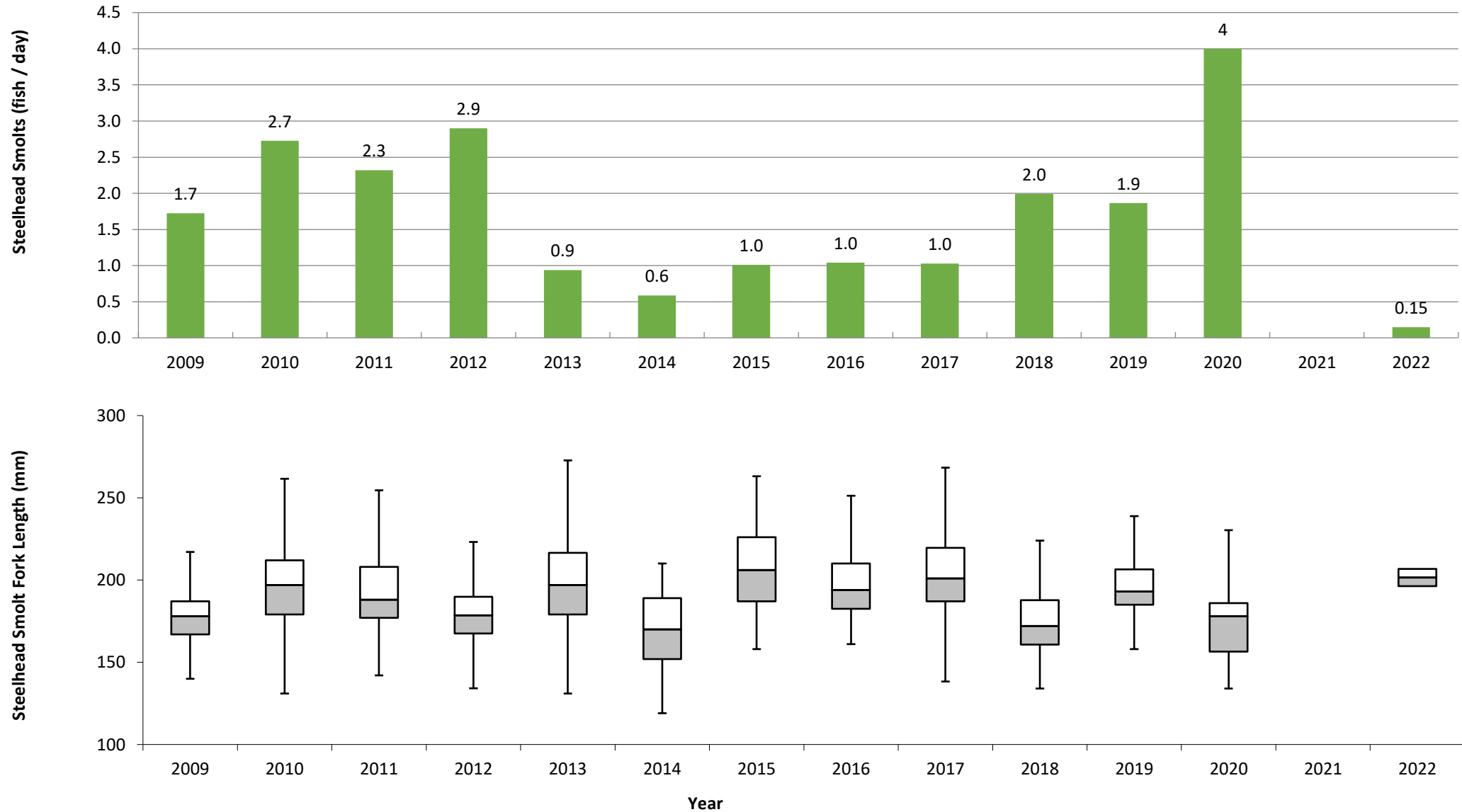


# Steelhead vs Chinook production





# Steelhead smolt catches through time





# PIT tagging





**Table 1.** PIT tagged steelhead re-detected by the Napa River PIT tag antenna in subsequent years.

| Date Tagged | Tagging Location | Length (mm) | Weight (g) | Re-Detection Date | Days between tagging and re-detection |
|-------------|------------------|-------------|------------|-------------------|---------------------------------------|
| 4/1/2016    | Napa River RST   | 192         | 65.1       | 3/1/2018          | 699                                   |
| 4/2/2016    | Napa River RST   | 201         | 85.1       | 3/1/2018          | 698                                   |
| 5/12/2017   | Napa River RST   | 193         | 68.4       | 2/17/2019         | 646                                   |
| 3/18/2018   | Napa River RST   | 190         | 63.5       | 3/11/2020         | 724                                   |
| 4/17/2018   | Napa River RST   | 185         | 68.1       | 2/17/2020         | 671                                   |
| 4/23/2018   | Napa River RST   | 185         | 65.1       | 3/19/2019         | 330                                   |

First  
confirmation of  
self-sustaining  
population





# Napa River Fish Community



**29 species in freshwater streams**

- **15 native species**
  - **2 Salmonids**
    - **Steelhead**
    - **Chinook Salmon**

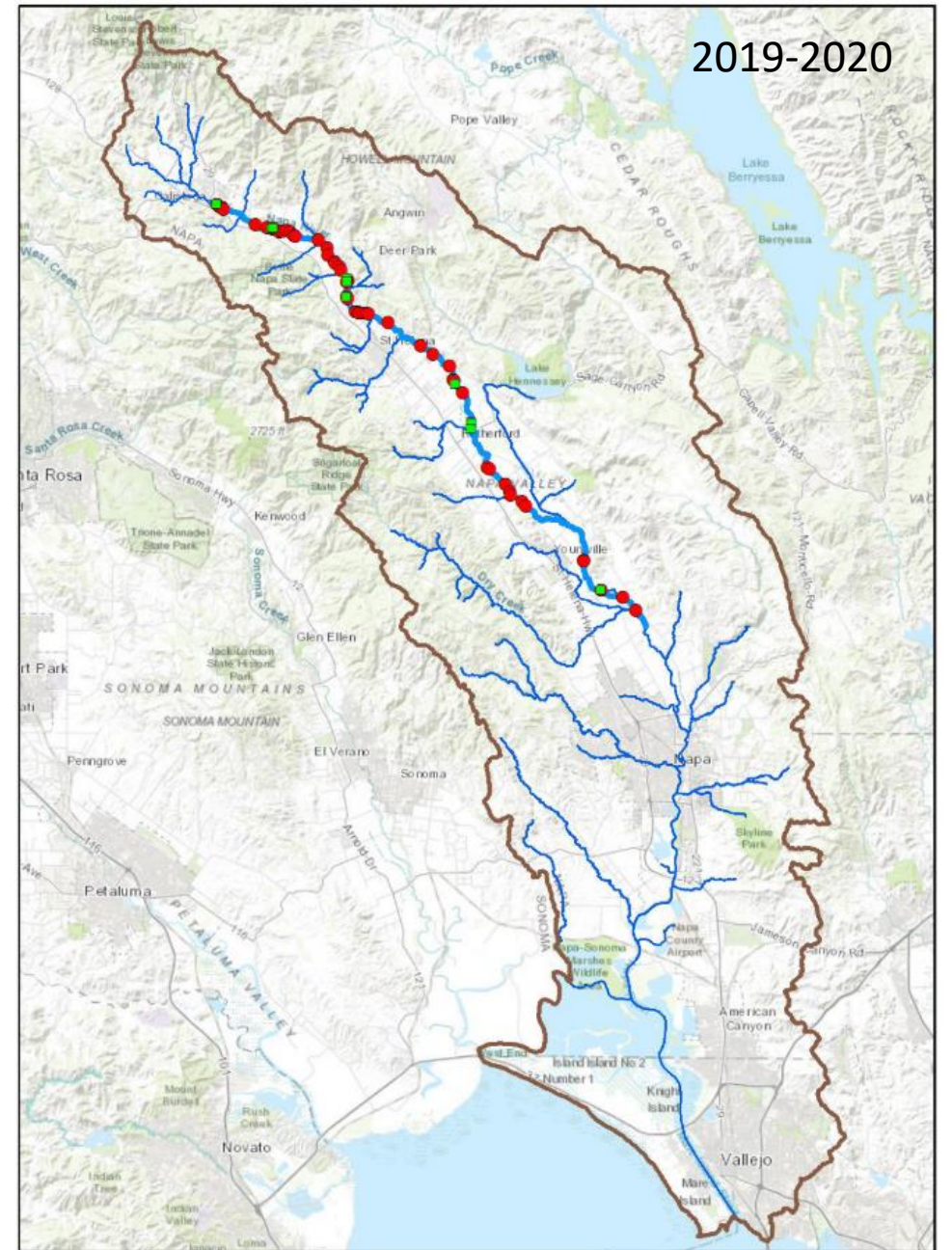
**Assemblage  
dominated by  
native species**

Napa River -  
potentially  
important  
system for  
native lamprey

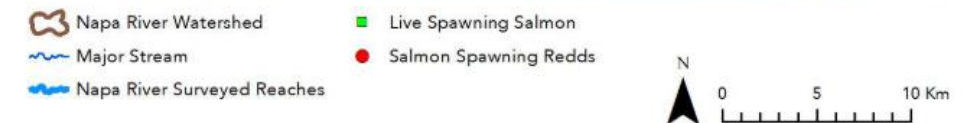




# Adult spawner surveys



2019-2020



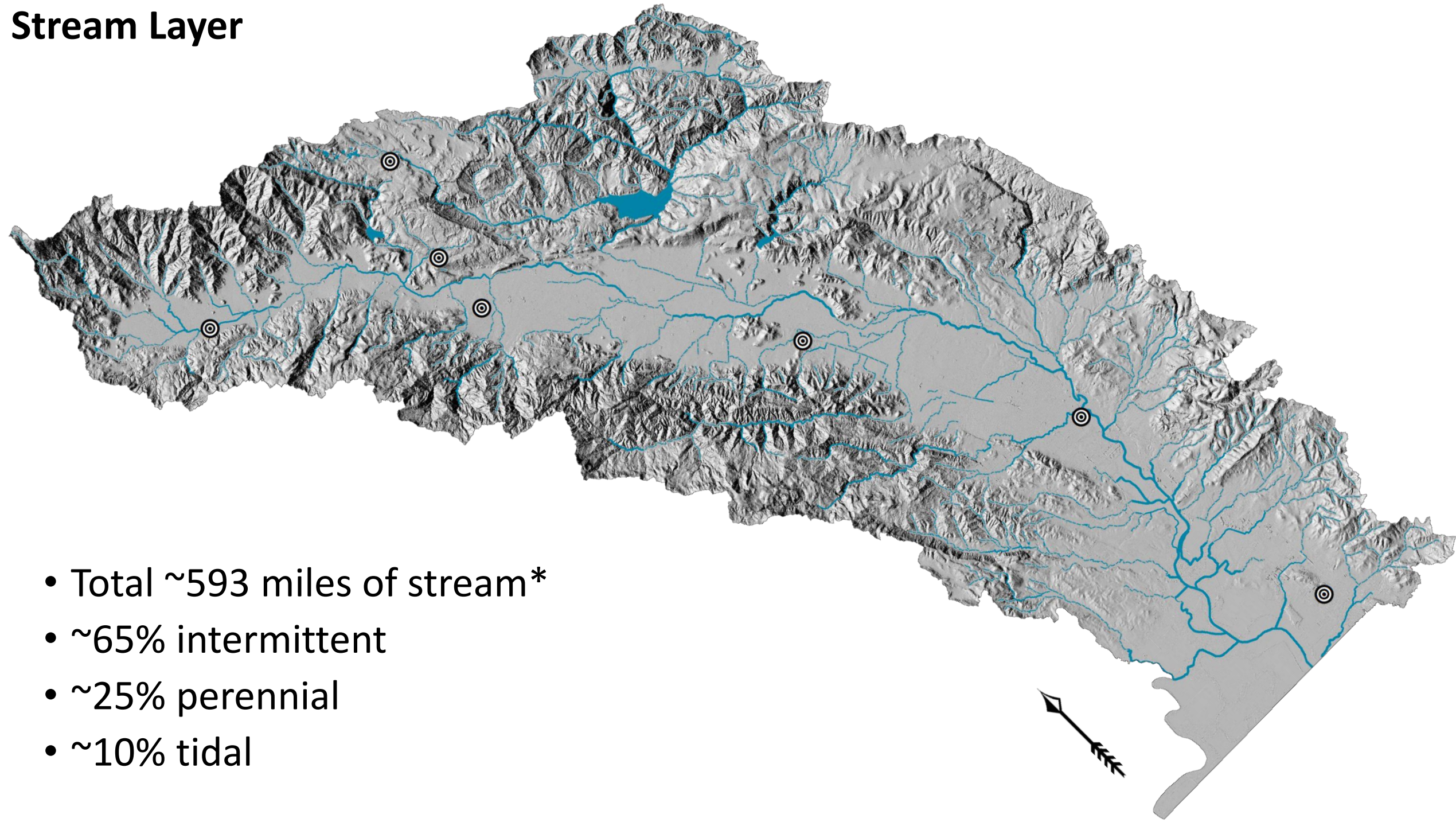




Update on  
collective fish  
barrier  
remediation  
efforts



# Stream Layer



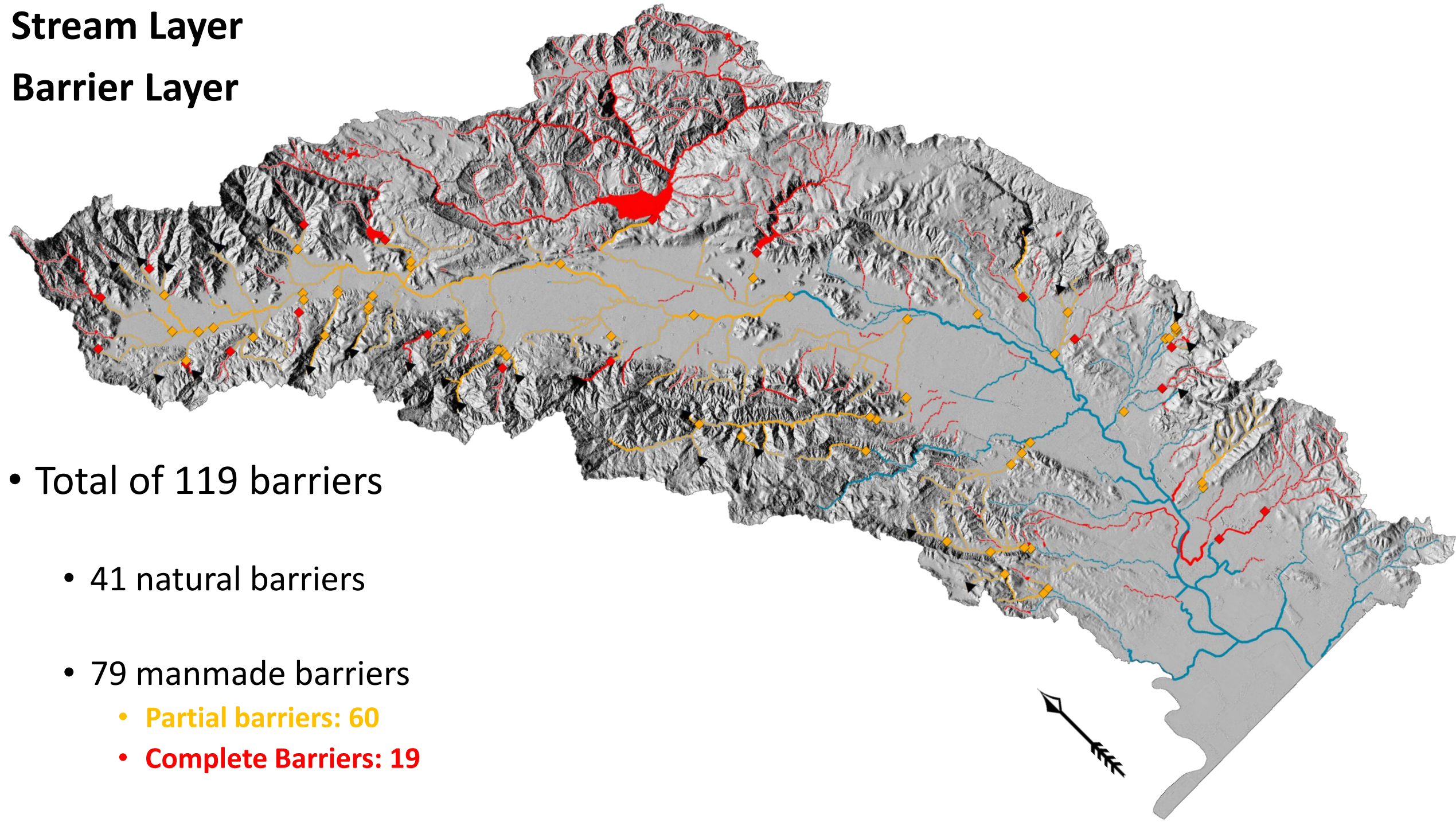
- Total ~593 miles of stream\*
- ~65% intermittent
- ~25% perennial
- ~10% tidal



# Stream Layer

## Barrier Layer

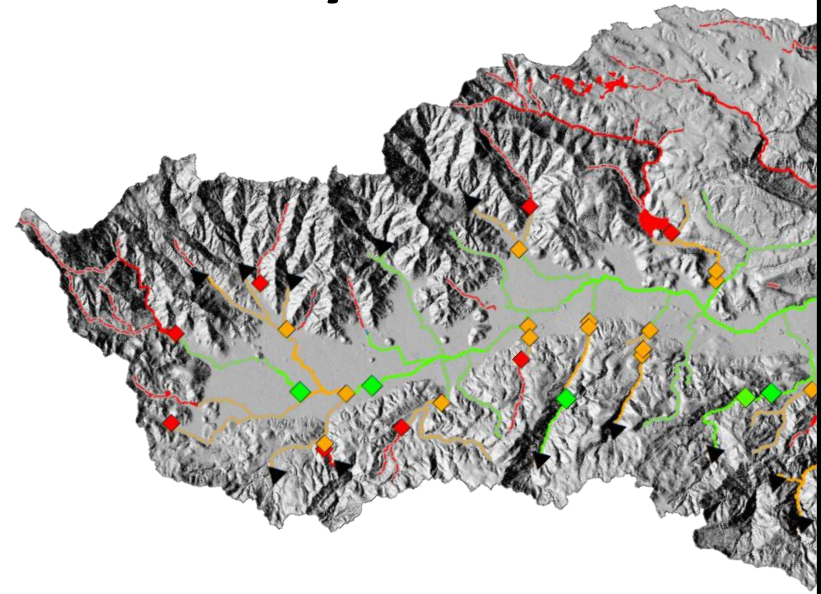
- Total of 119 barriers
  - 41 natural barriers
  - 79 manmade barriers
    - **Partial barriers: 60**
    - **Complete Barriers: 19**



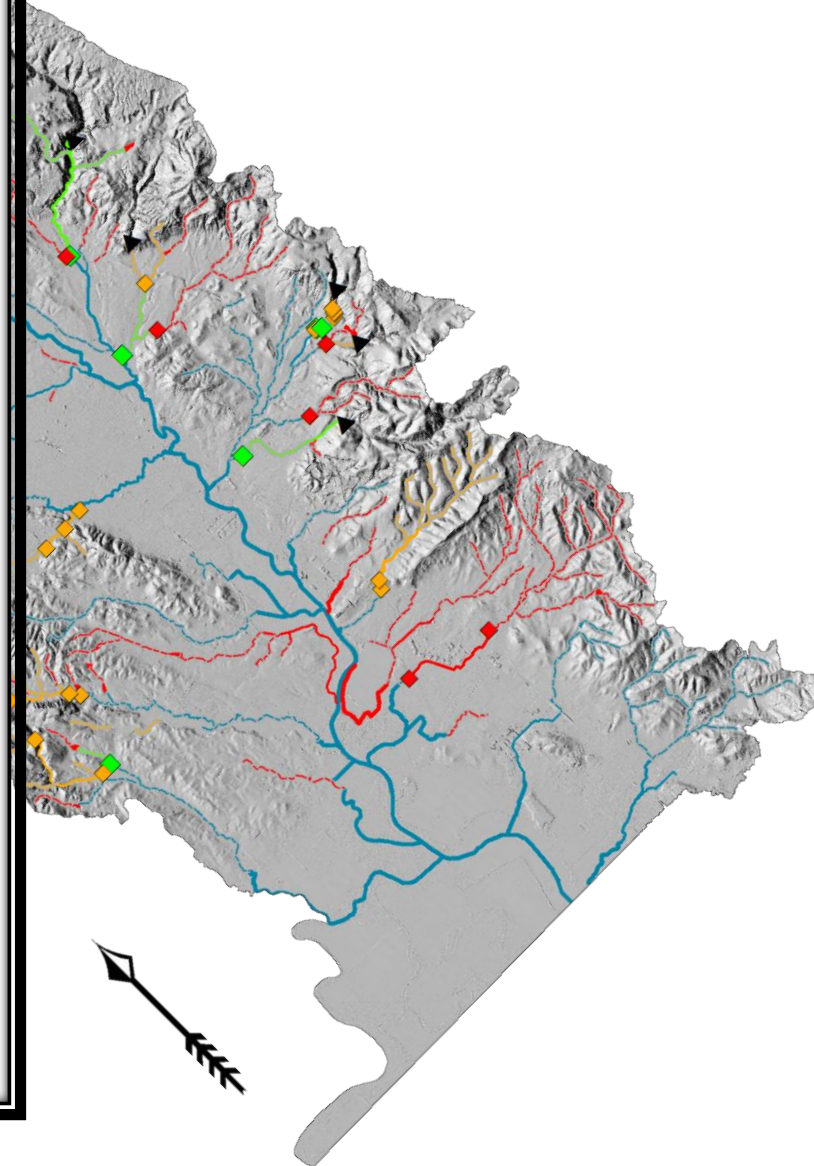
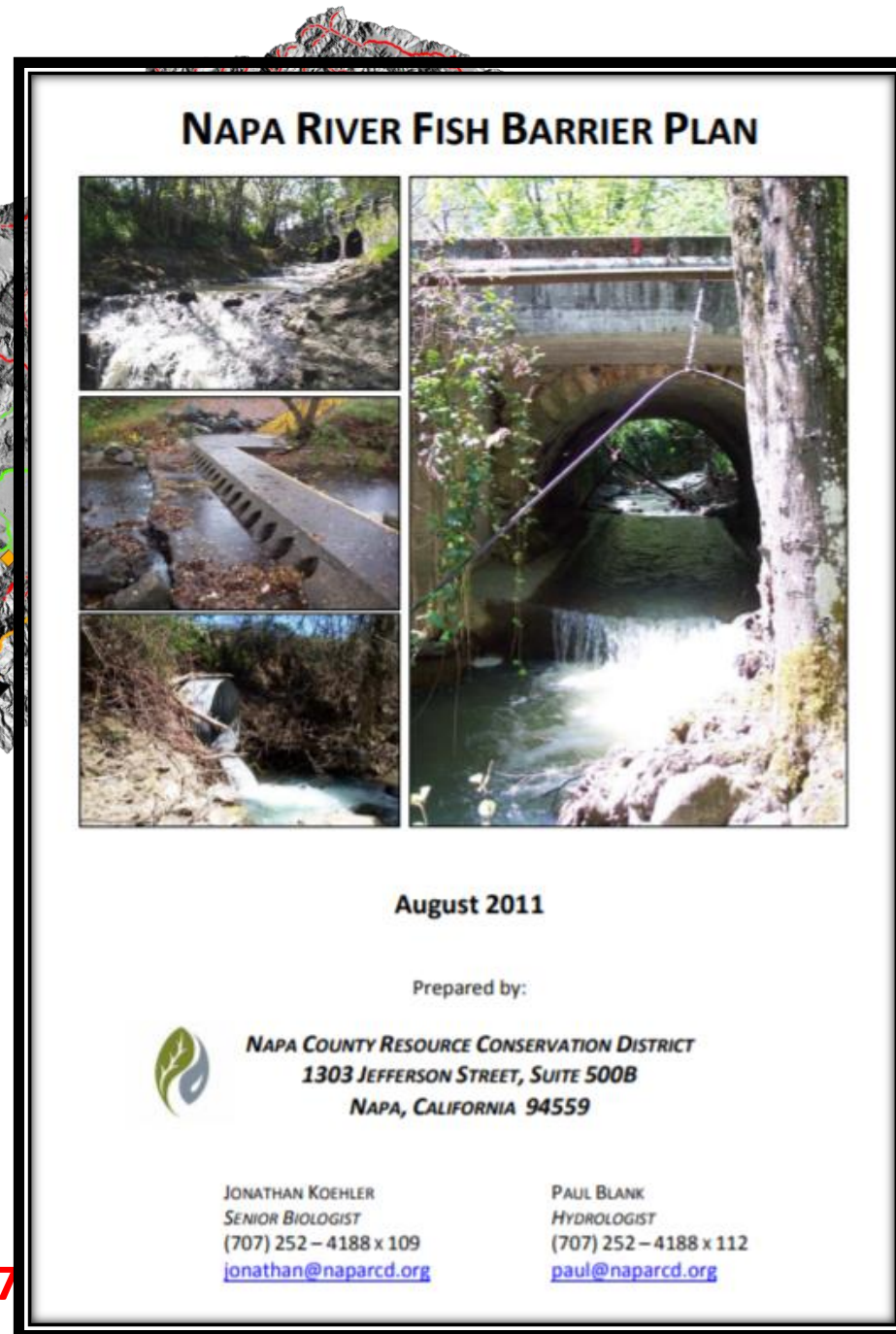


# Stream Layer

## Barrier Layer



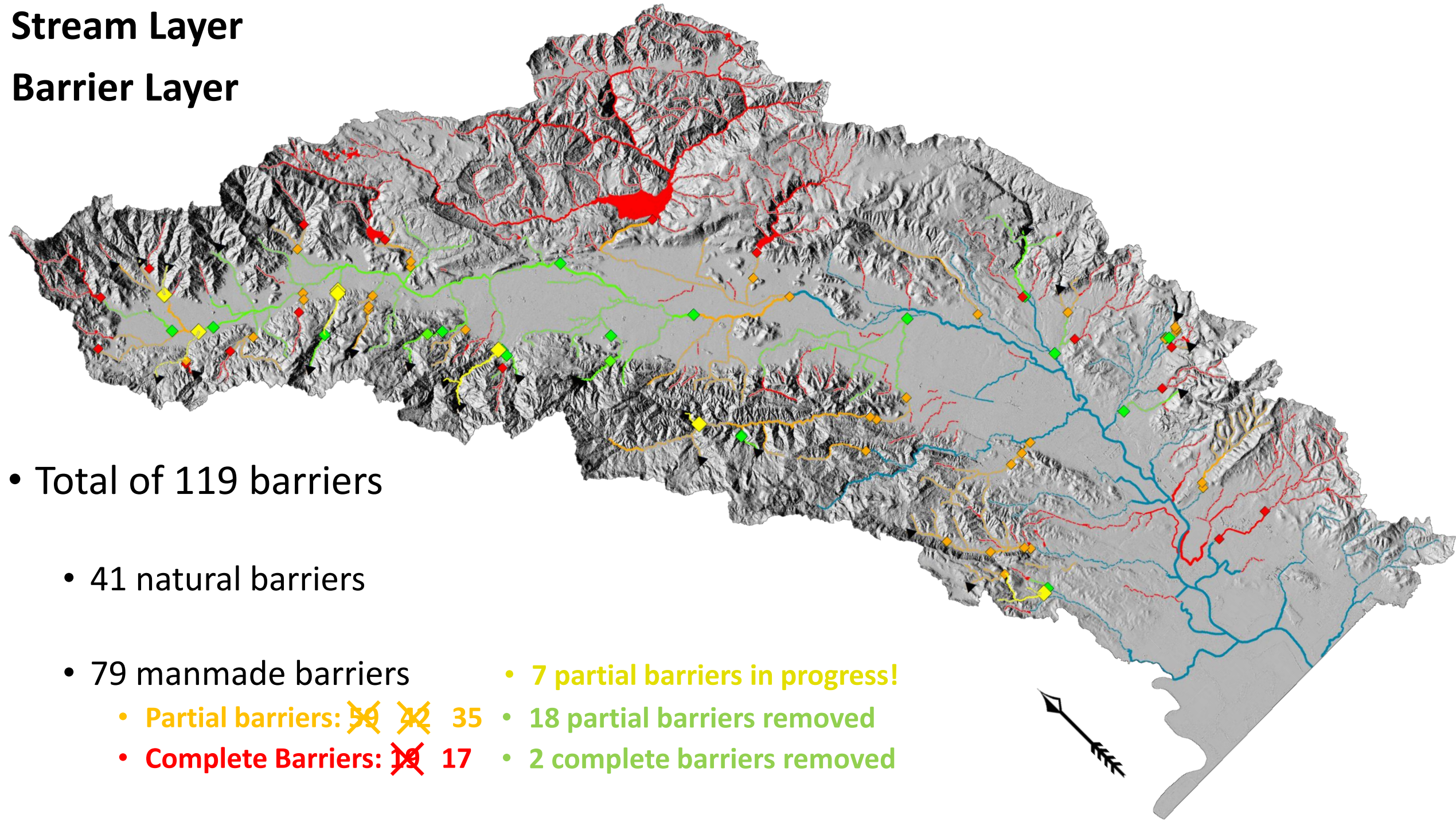
- Total of 119 barriers
  - 41 natural barriers
  - 79 manmade barriers
    - Partial barriers: ~~60~~ 42
    - Complete Barriers: ~~19~~ 17





# Stream Layer

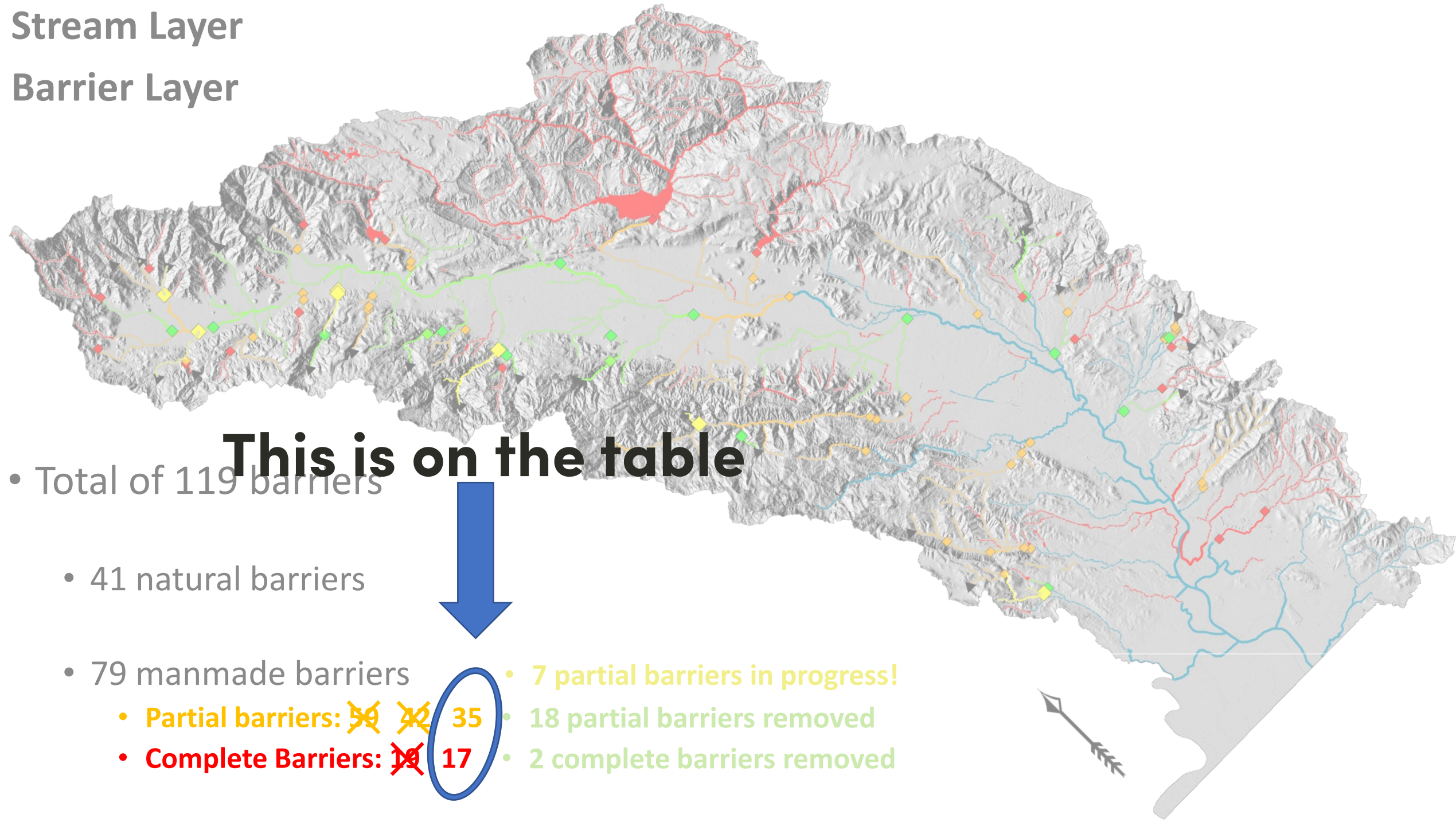
## Barrier Layer





# Stream Layer

## Barrier Layer





# Formed advisory committee to develop a watershed strategy for fish habitat enhancement

- Bringing together local, state, federal and private partners
  - Proof-of-concept Barrier remediation
    - 6 barriers to remediate ASAP
  - Watershed wide fish passage barrier assessment
  - Scale up monitoring efforts
    - Fish and flows



# Stream Watch

## Community Science Streamflow Monitoring Program Napa River Watershed

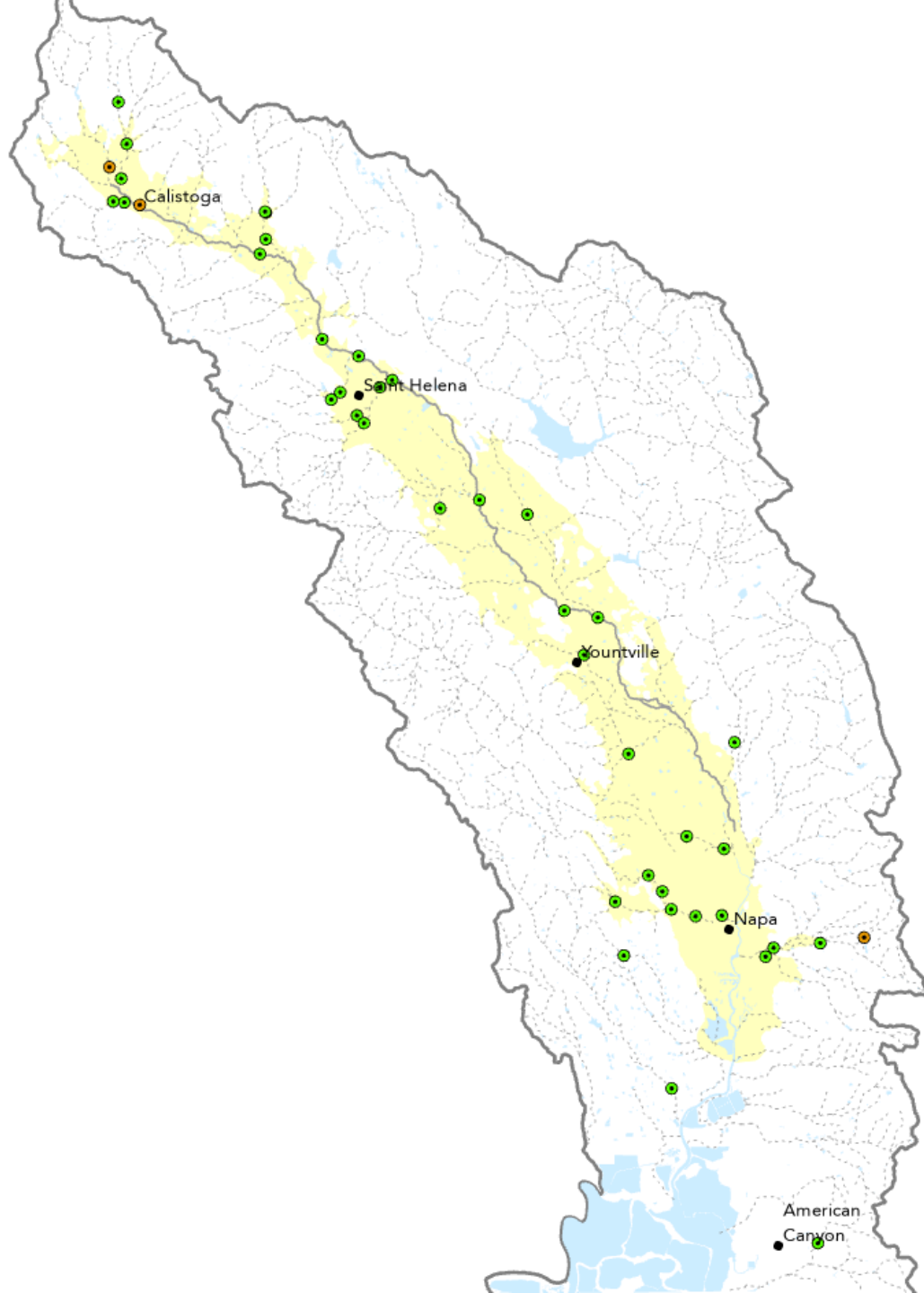
- Flow is the most fundamental factor to the health of a stream
- Natural drying of certain reaches is a characteristic of Mediterranean climates and the Napa River system
- Climate change, land development, groundwater pumping, flow diversion increase the degree, extent, and duration of drying resulting in loss of habitat
- Anecdotal evidence of widespread and substantial reductions of dry-season flow
- Need better understanding of location and severity of drying channels and changes through time





# Stream Watch

Community Science Streamflow Monitoring Program  
Napa River Watershed



- Napa County and Napa RCD collaboration
- Cost-effective collection of simple high-quality wetted channel information by volunteer observers
- 39 active stations, 3 retired, covering approx. 50 miles of stream channel



**Dry**



**Isolated Pools**



**Flowing**





Napa Co. Stream Watch Observ...

experience.arcgis.com/experience/6e3ff2bf06d34a718441a8cda7ee18d8

OneRain ArcGIS Online sharepoint NWS Oak Knoll Forecast Pope Forecast NSH Summary StreamStats

NAPA RCD



Stream Watch Observation Mobile App v1.2

Please choose a site below to get started.

SELECT A SITE FROM THE LIST BELOW:

A-Z |

Site 1

Napa River at Yountville Eco-Reserve

Site 2

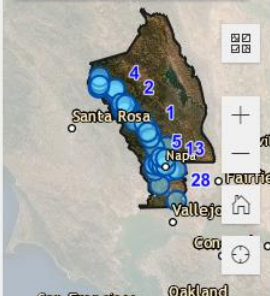
Napa River at Pope St

Site 3

Napa River at Rutherford Rd

MAP

Find address ...



SITE INFORMATION

Napa Co. Stream Watch Observ...

StreamWatch

survey123.arcgis.com/share/226fcab353dd4ae38ab072d106fb1a6b?field:ObsID=ff0a8b0...

OneRain ArcGIS Online sharepoint NWS Oak Knoll Forecast Pope Forecast NSH Summary StreamStats

StreamWatch

Stream Watch is a community science program in partnership with Napa County and Napa County Resource Conservation District

NAPA RCD



Please enter your information below

Your information is kept private.

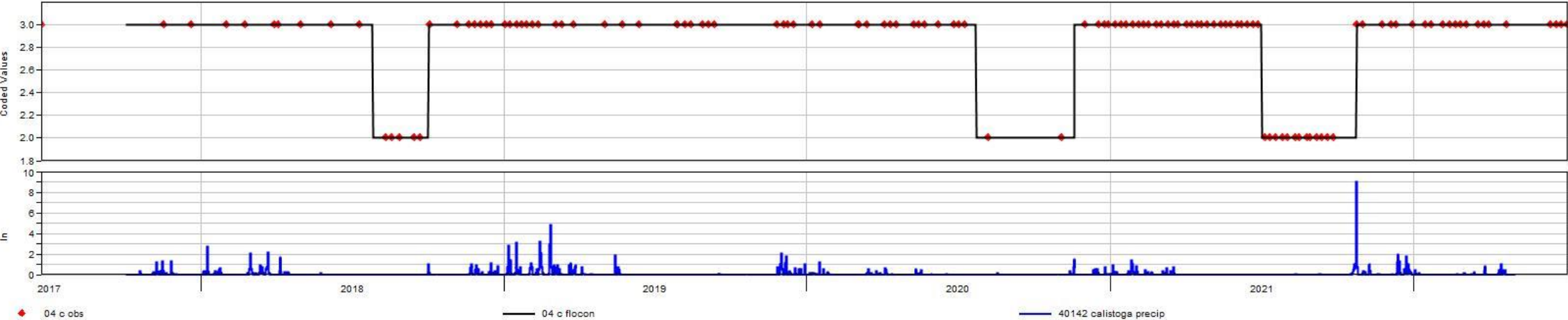
Observer Name\*

Observer Organization

Observer Email

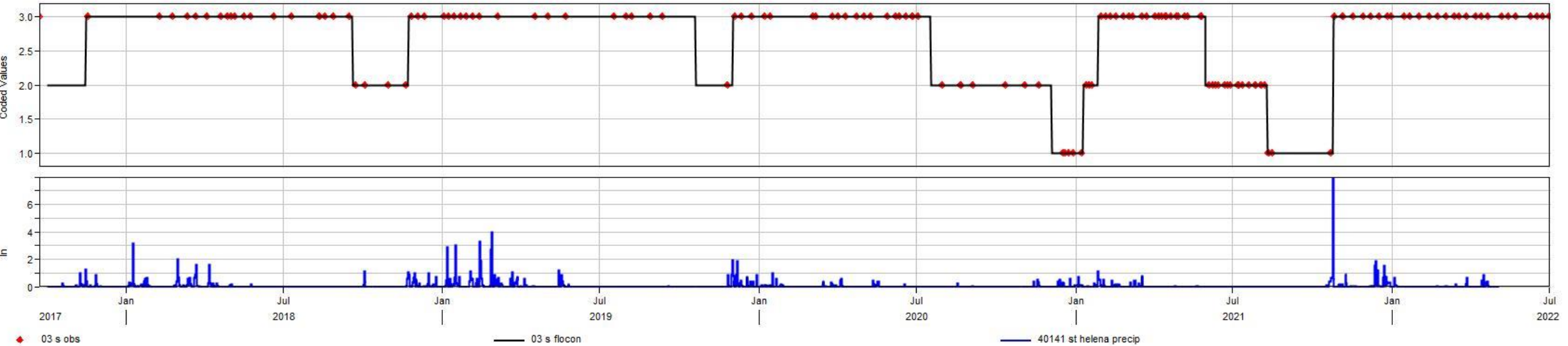
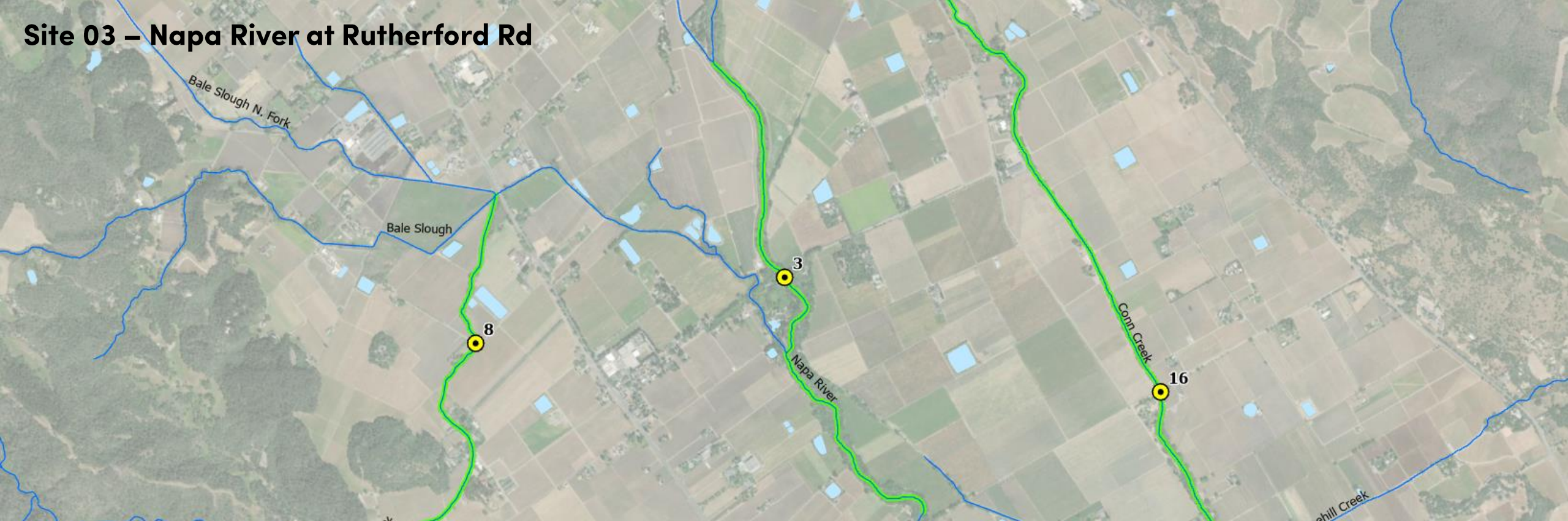


Site 04 – Napa River at Larkmead Ln



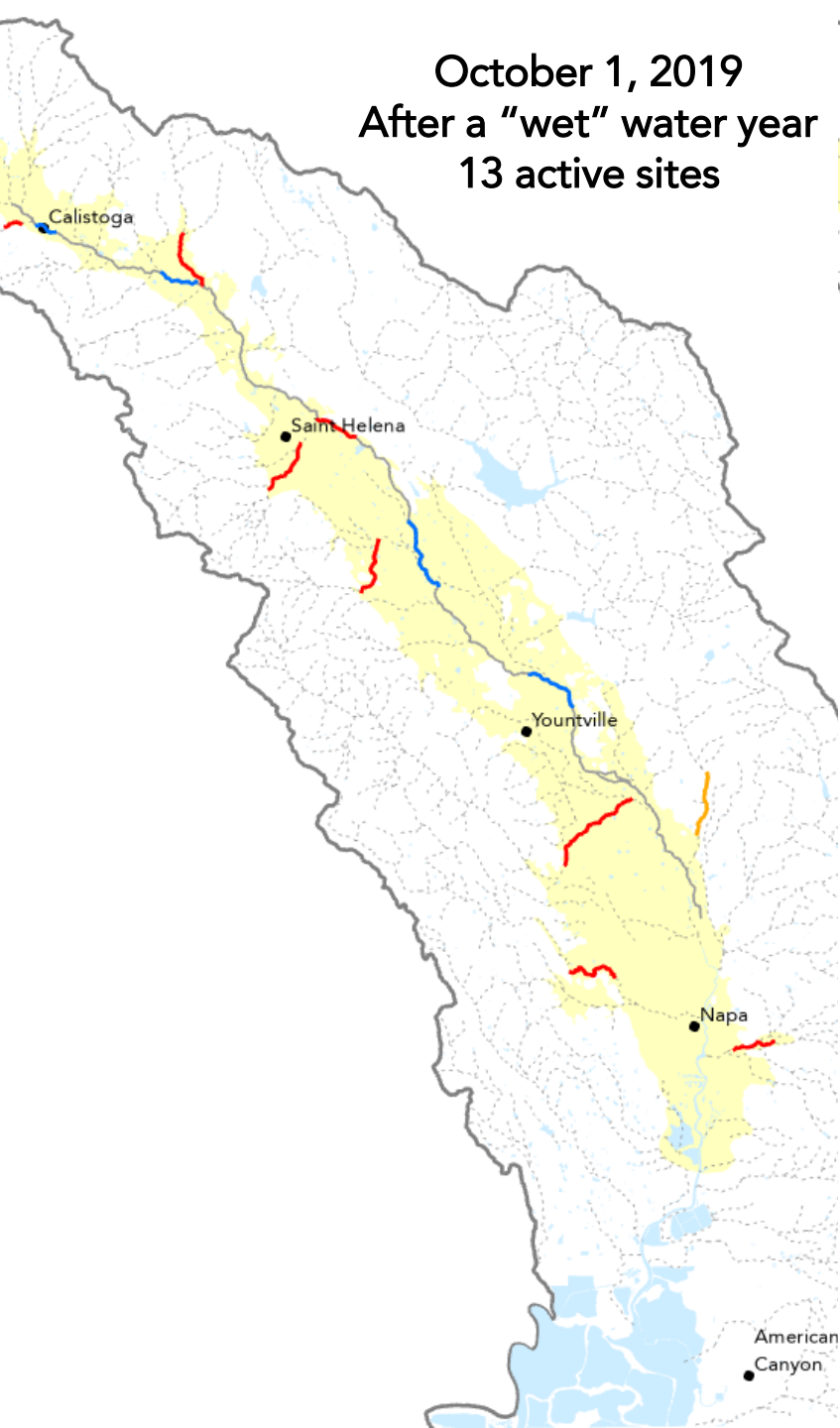


# Site 03 – Napa River at Rutherford Rd

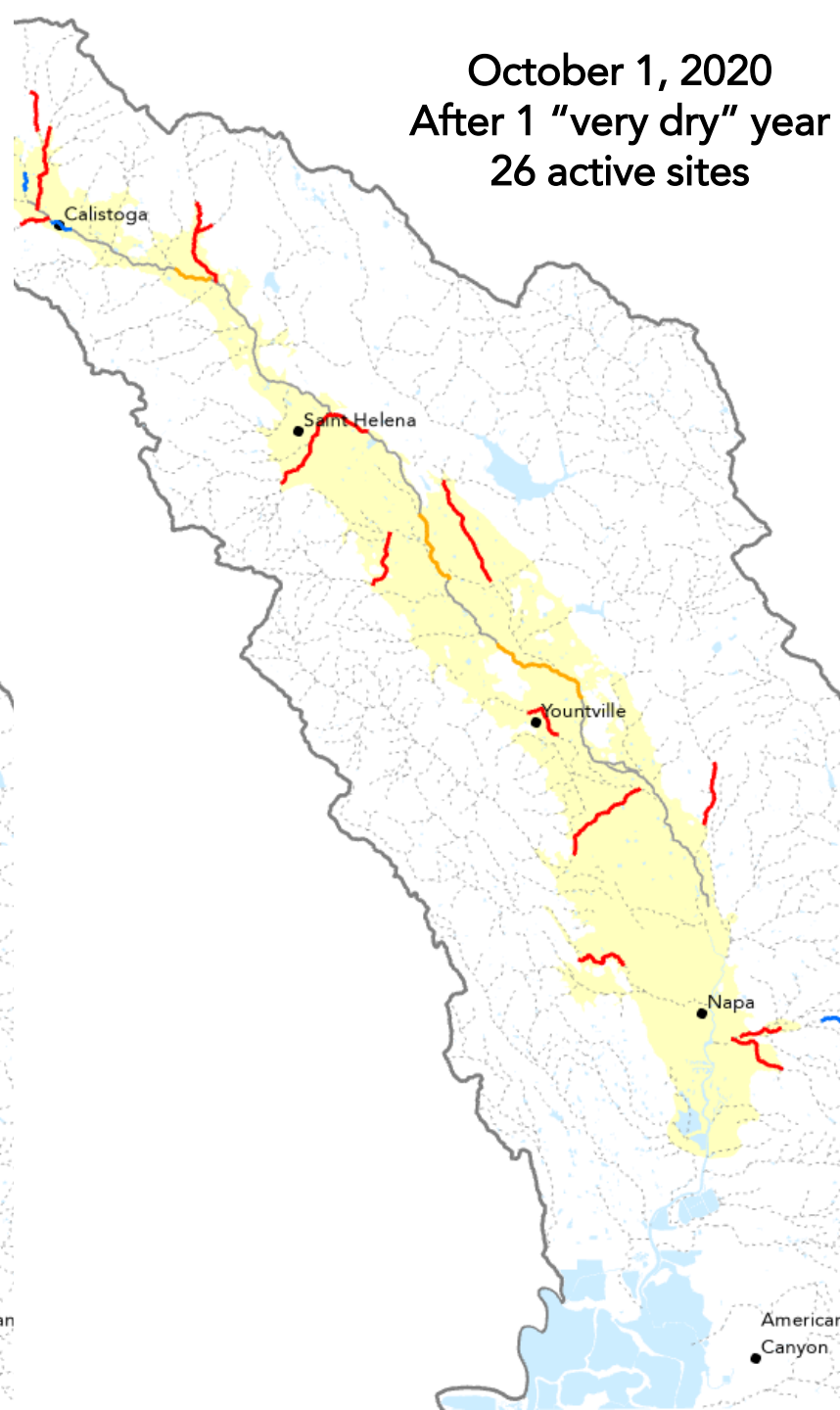




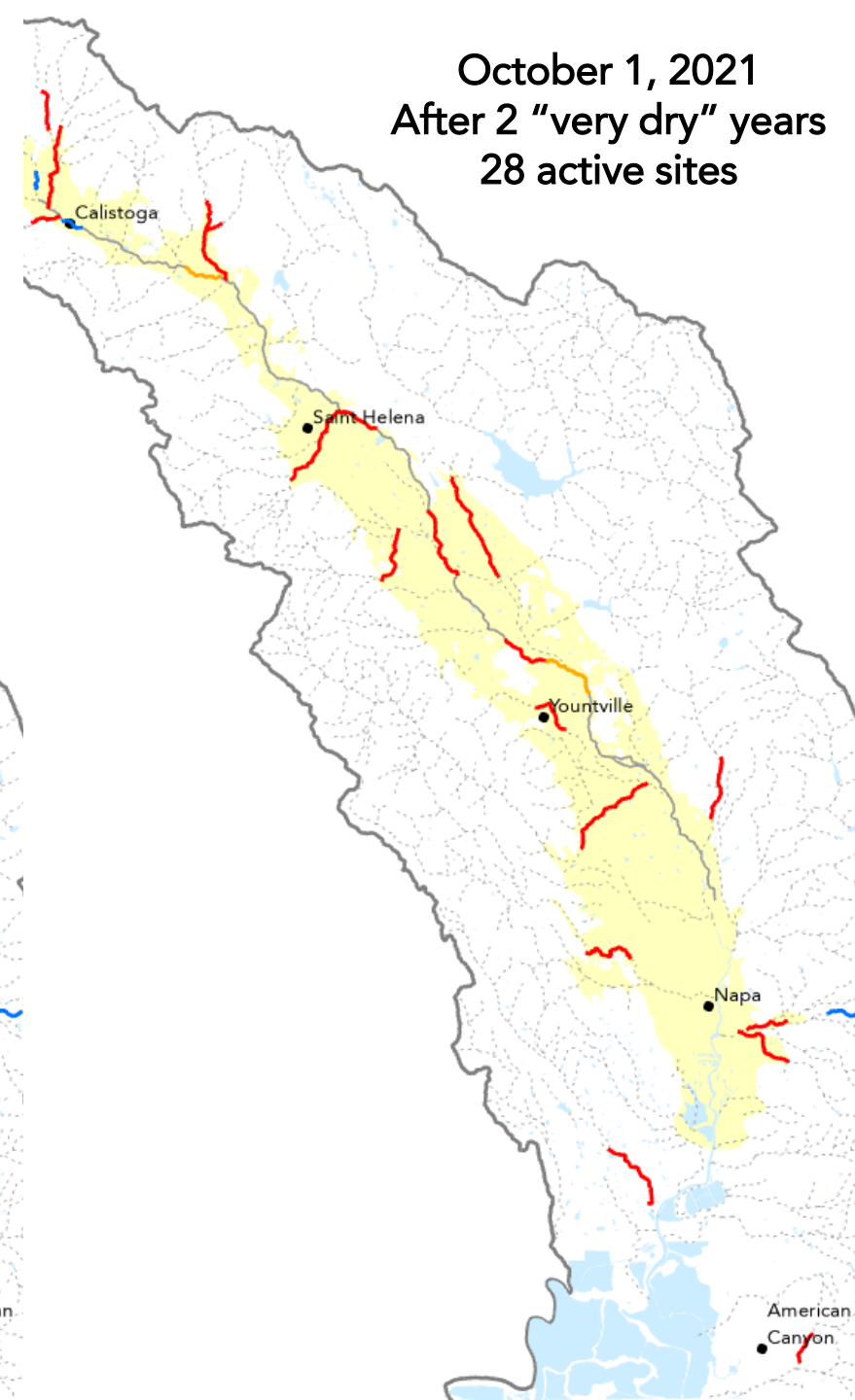
October 1, 2019  
After a "wet" water year  
13 active sites



October 1, 2020  
After 1 "very dry" year  
26 active sites



October 1, 2021  
After 2 "very dry" years  
28 active sites

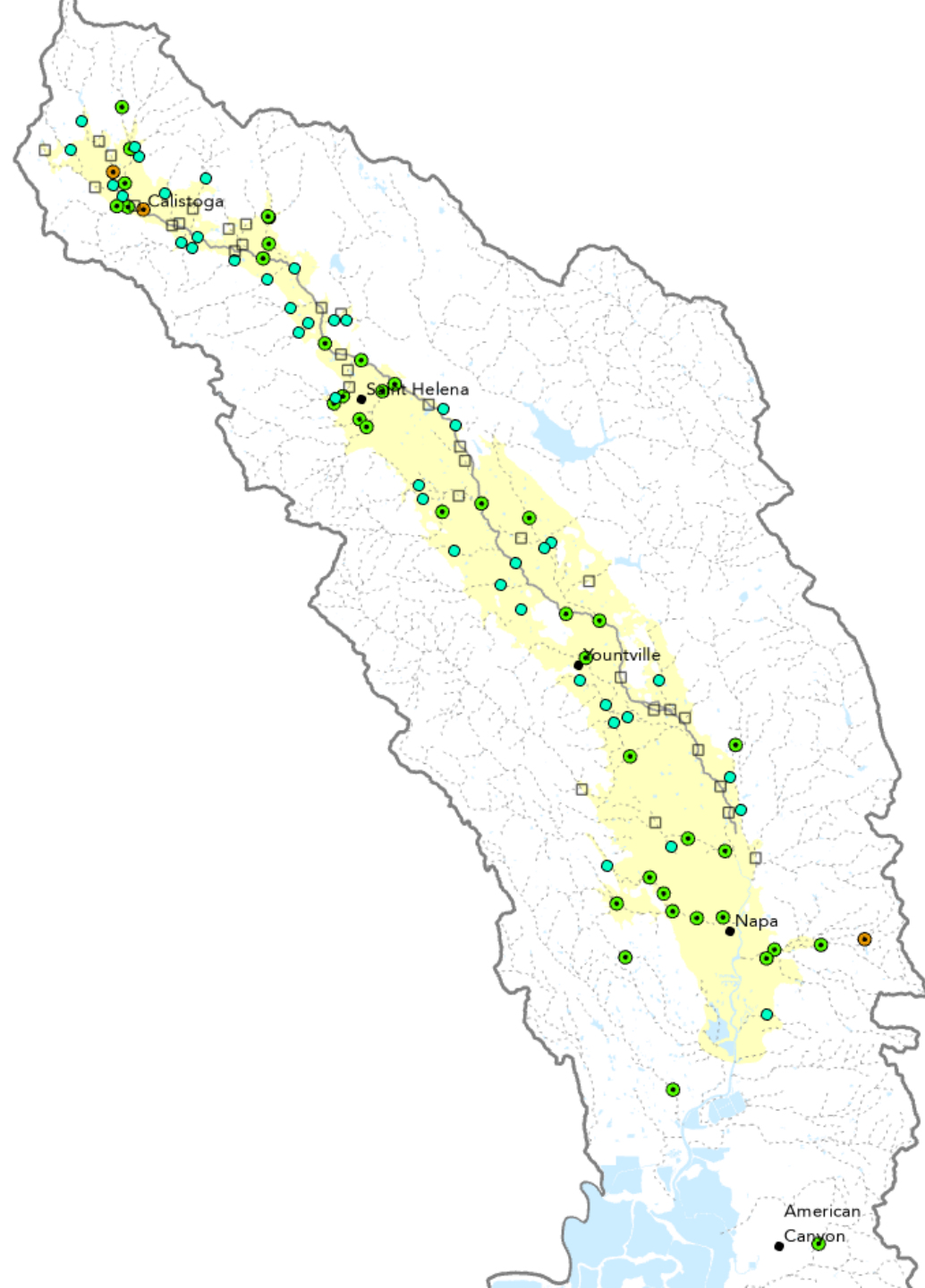




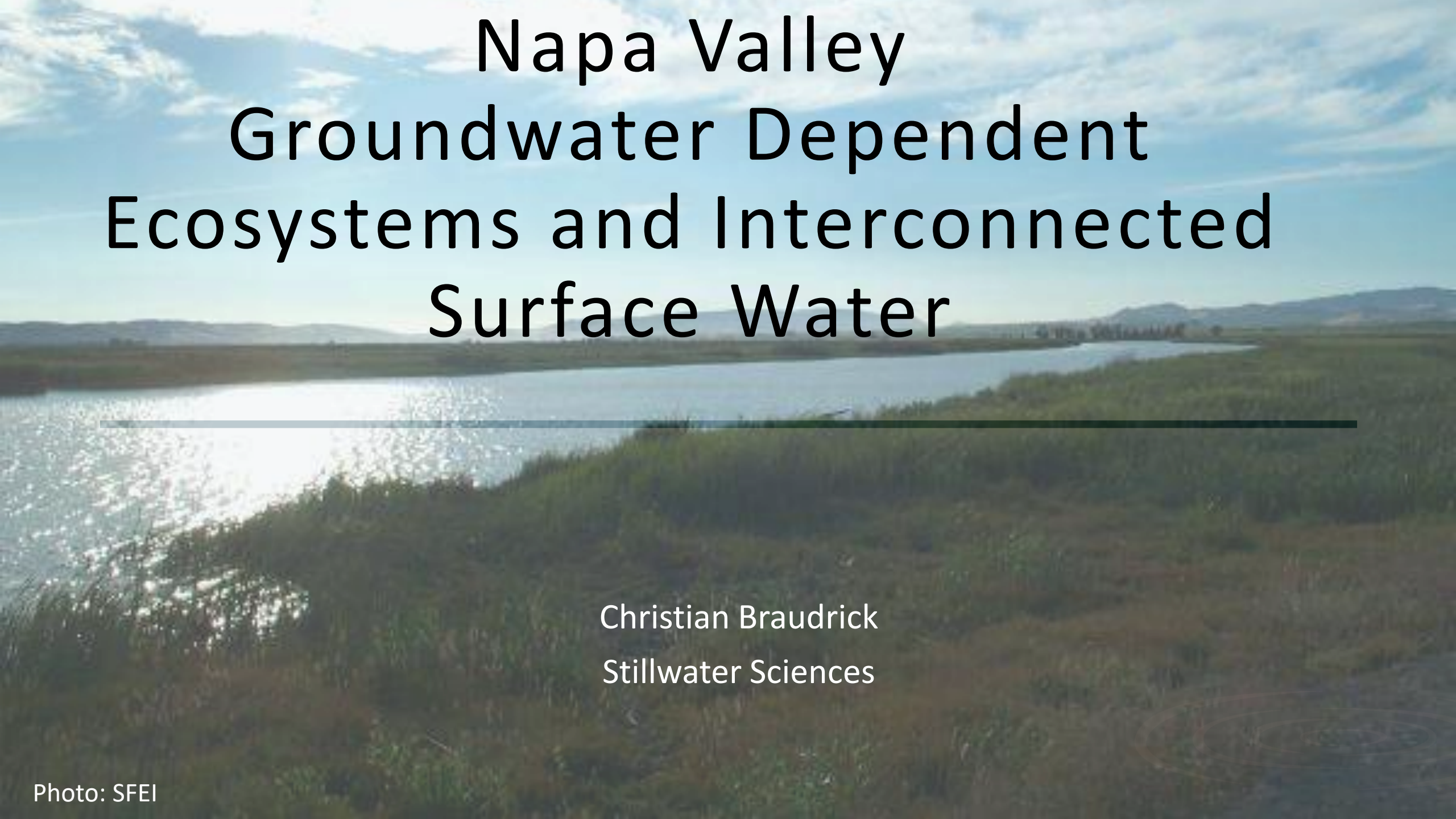
# Stream Watch

Community Science Streamflow Monitoring Program  
Napa River Watershed

- Network can be expanded with up to 40 additional volunteer stations
- Up to 30 camera stations
- Sep/Oct wetted channel mapping of select reaches
- Expand network to upland areas
- Water quality monitoring at select stations





A scenic landscape of Napa Valley featuring a calm lake reflecting the sky, surrounded by green fields and distant mountains under a blue sky with light clouds.

# Napa Valley Groundwater Dependent Ecosystems and Interconnected Surface Water

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Christian Braudrick  
Stillwater Sciences

# Outline

- GDE overview
- Stillwater Sciences studies in the Napa Basin
- Lifecycle of fish and interconnected surface water (ISW) reliance
- Examples of ISW and groundwater from other basins
- Assessing other aquatic species flow needs

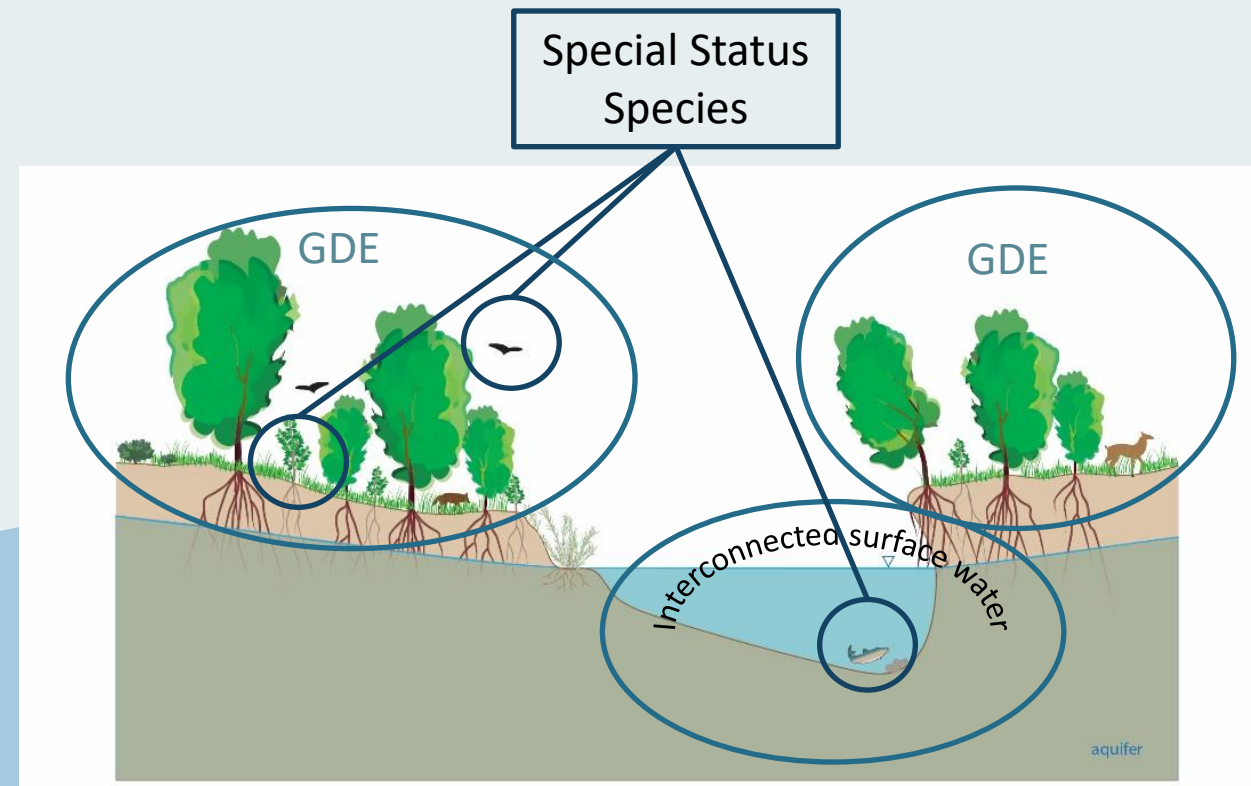




# Groundwater Dependent Ecosystems (GDEs)

DWR defines GDEs as ecological communities or species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface for some of their water needs.

*GDEs occur in a variety of different environments ranging from seeps and springs, to groundwater-dependent wetlands, to aquatic and riparian ecosystems associated with rivers that partially or entirely rely on groundwater.*

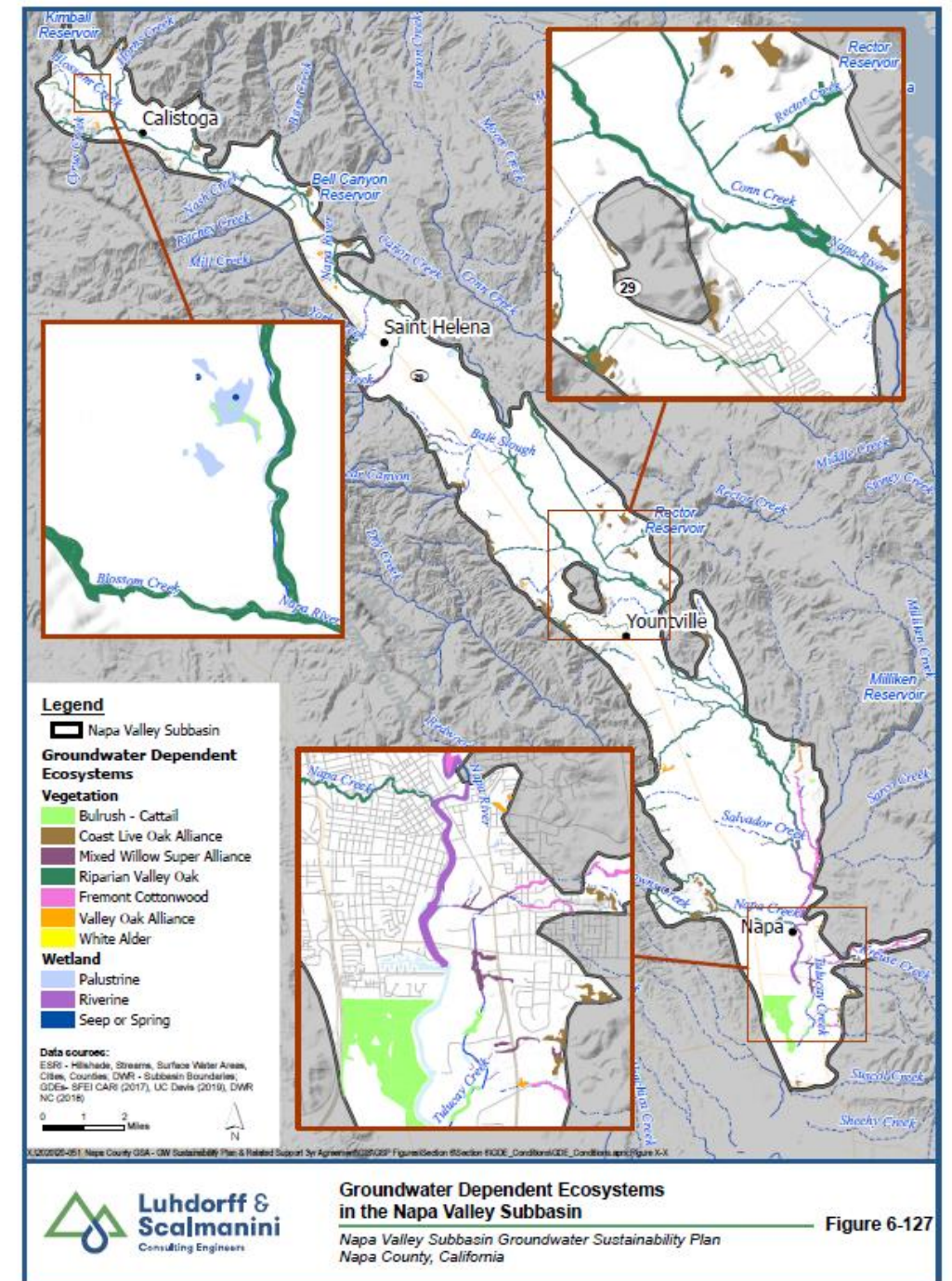


# GDEs

- Most of the GDEs were valley oak with bullrush cattail GDEs in the Napa and Napa River marshes subareas

Critical habitat in the basin

- 23 miles of critical habitat for central coast steelhead
- 230 acres of critical habitat for Contra Costa goldfields



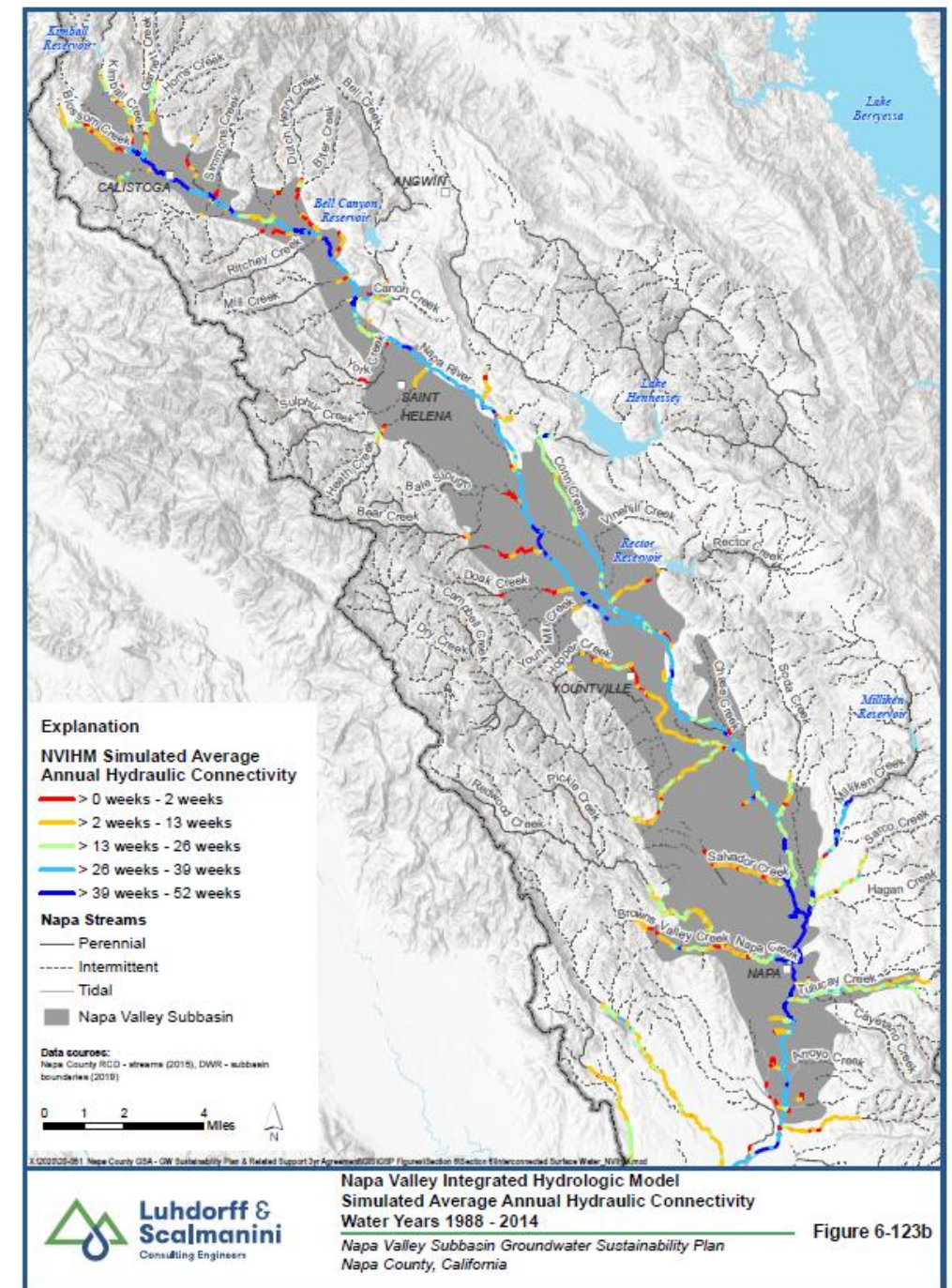


# Interconnected surface water (ISW)

## Limited surface water data

## Data includes

- Modeling results from the GSP
- Wet dry mapping from Stillwater (2002)
- Planned wet dry mapping from the RCD

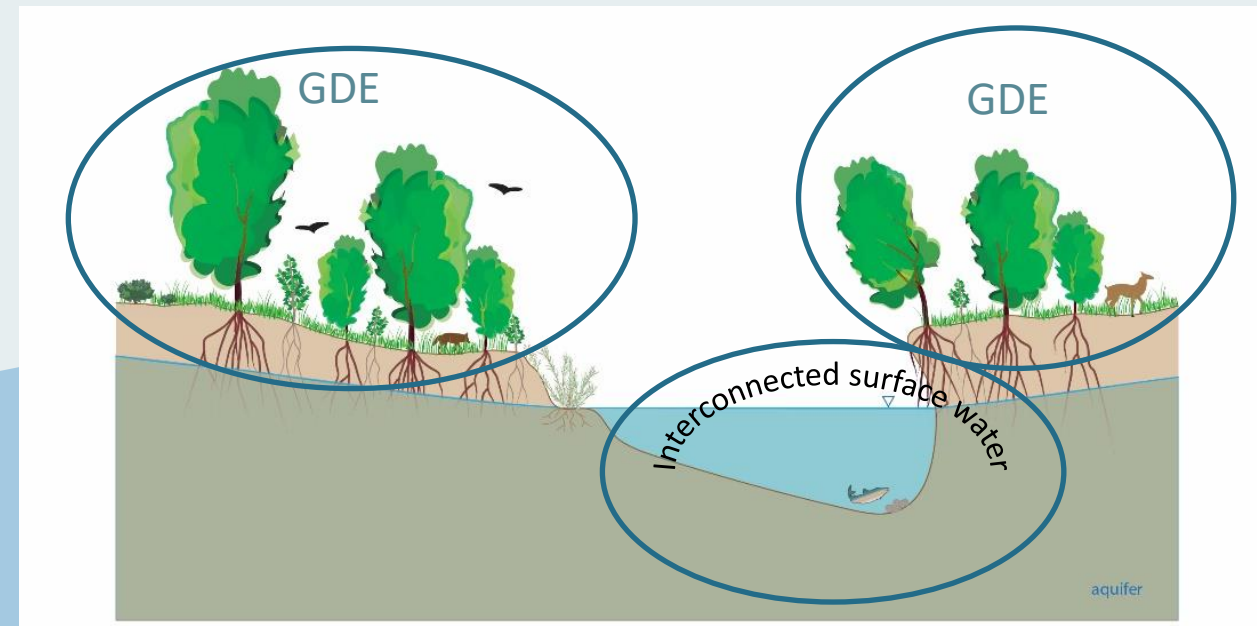


# GDEs

1. How does managed groundwater levels affect GDEs
2. Are the plant species likely to be connected to groundwater ?
  - How deep are their roots?
  - How deep is the groundwater?
3. What is the extent of interconnected surface water?



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Braudrick et al., 2018 (figure by K. Rodriguez and A. Merrill)



# Stillwater Studies in the Napa Basin



## Napa River Basin Limiting Factors Analysis

### FINAL TECHNICAL REPORT

Prepared for  
San Francisco Bay Water Quality Control Board  
1515 Clay St, Suite 1400  
Oakland, CA 94612

and  
California State Coastal Conservancy  
1330 Broadway Ave, Suite 1100  
Oakland, CA 94612

Prepared by  
Stillwater Sciences  
2532 Durant Avenue  
Berkeley, CA 94704

and

Professor William Dietrich  
Department of Earth and Planetary Science  
University of California, Berkeley 94720

14 June 2002



## Napa River Tributary Steelhead Growth Analysis

### Final Report

Prepared for  
U.S. Army Corps of Engineers  
San Francisco Division

Prepared by  
Stillwater Sciences  
Berkeley, California

June 2007



TECHNICAL MEMORANDUM • MAY 2021

## Rector Creek Water Year Type and Watershed Model Technical Memorandum



PREPARED FOR  
California Department of Veteran Affairs  
1227 O Street  
Sacramento CA, 95814

PREPARED BY  
Stillwater Sciences  
279 Cousteau Place, Suite 400  
Davis, CA 95618

# Napa River Basin Limiting Factors Analysis



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Stillwater Sciences and Dietrich (2002)

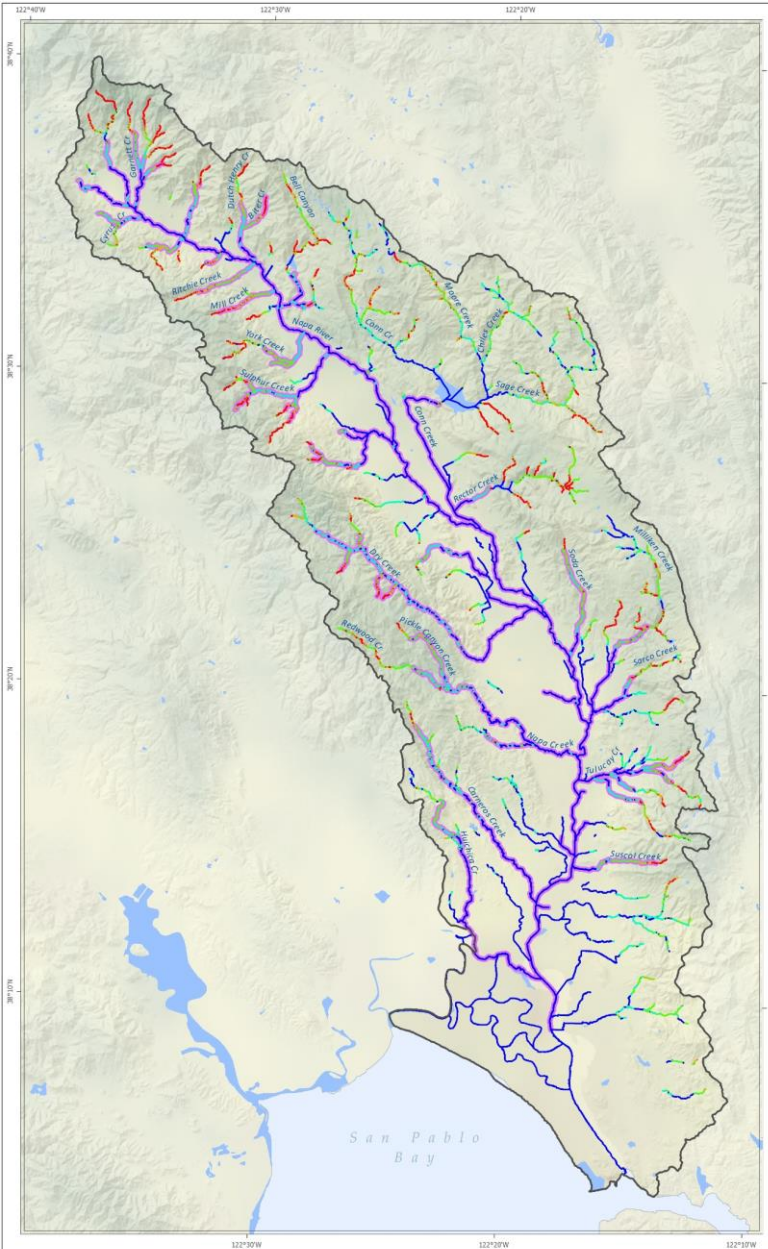
## Measurements

- Stream temperature (22 sites)
- Pool filling with fine sediment (136 sites)
- Spawning gravel permeability (59 sites)
- Turbidity following storms (18 sites)
- Qualitative summer surface flow (148 sites)

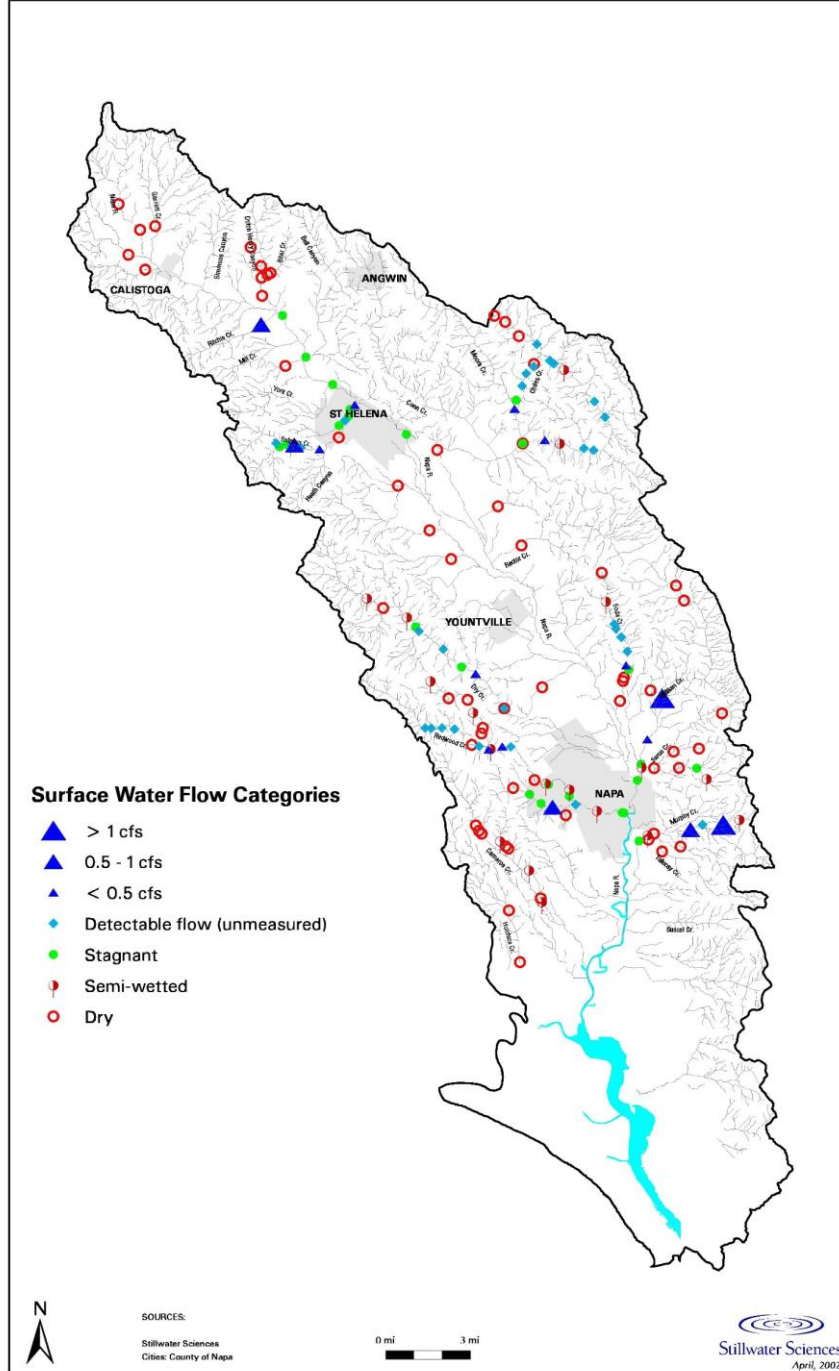
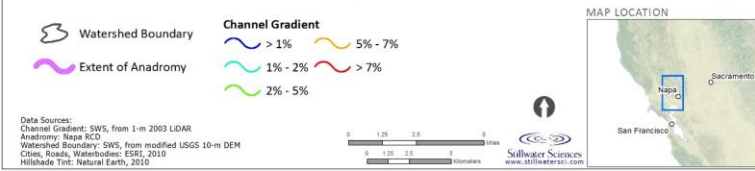
## Findings

- Fine sediment deposition in salmonid redds may reduce the number of juveniles (high sediment loading)-likely not limiting steelhead population
- High stream temperatures limit summer growth
- Little LWD in the channels
- Extensive barriers to migration
- Simplified channel form limits habitat diversity and cover





NAPA RIVER: CHANNEL GRADIENT AND EXTENT OF ANADROMY



### Surface Water Flow Categories

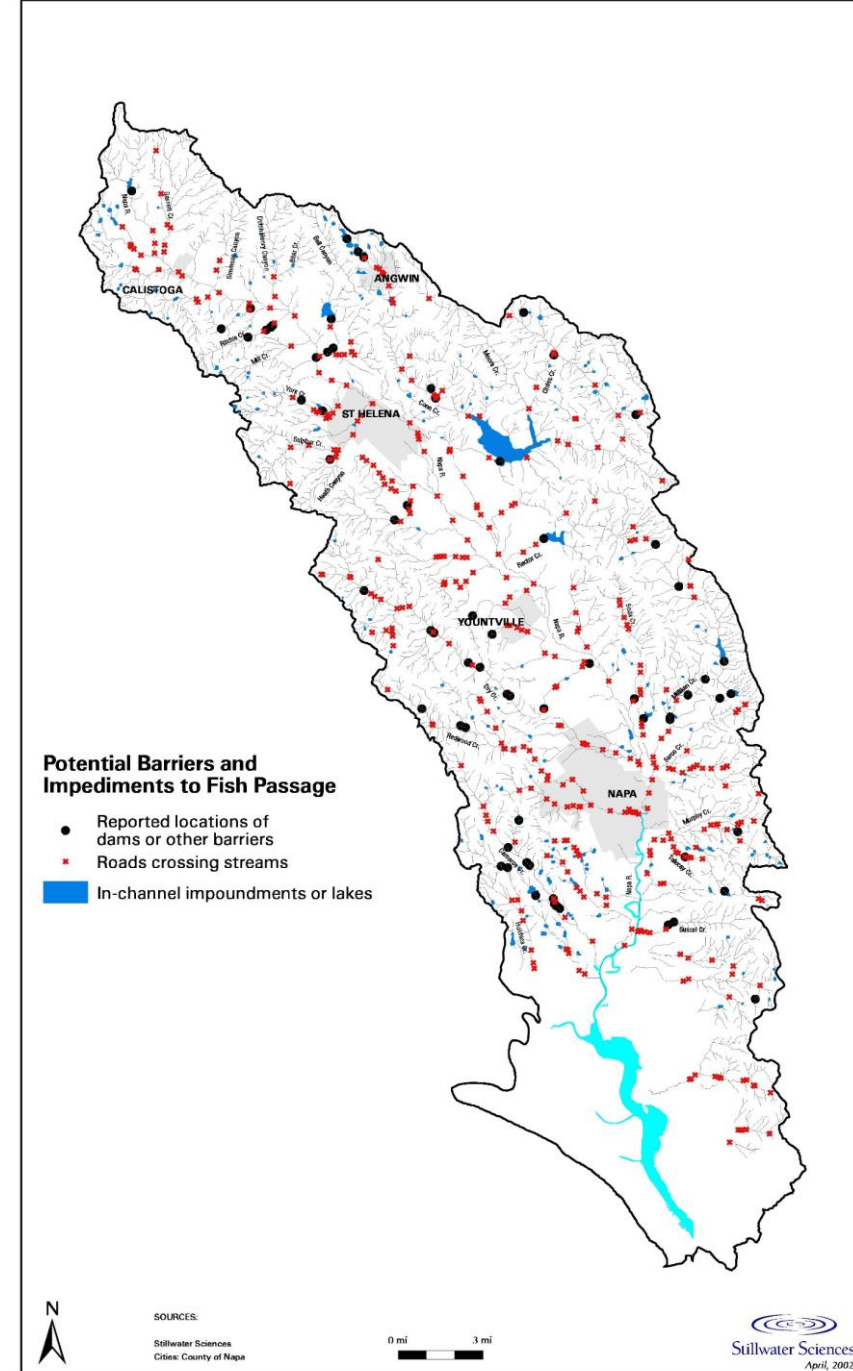
- ▲ > 1 cfs
- ▲ 0.5 - 1 cfs
- ▲ < 0.5 cfs
- ◆ Detectable flow (unmeasured)
- Stagnant
- Semi-wetted
- Dry



**SOURCES:**  
 Stillwater Sciences  
 Cities: County of Napa

0 mi 3 mi

**Stillwater Sciences**  
 April, 2002



### Potential Barriers and Impediments to Fish Passage

- Reported locations of dams or other barriers
- × Roads crossing streams
- In-channel impoundments or lakes



**SOURCES:**  
 Stillwater Sciences  
 Cities: County of Napa

0 mi 3 mi

**Stillwater Sciences**  
 April, 2002

# Napa River Tributary Growth Analysis (Phase 2 report)



Napa River Tributary Steelhead Growth Analysis

*Final Report*

*Prepared for*  
U.S. Army Corps of Engineers  
San Francisco Division

*Prepared by*  
Stillwater Sciences  
Berkeley, California

June 2007



## Measurements

- 12 study reaches in 5 tributaries
- Measured juvenile growth in summer/fall, winter, and spring
- Food availability
- Channel morphology
- Water temperature

## Findings

- High stream temperatures and low food availability limited summer juvenile steelhead growth
- This was somewhat balanced by growth in the subsequent spring when food was more available (during a wet year)





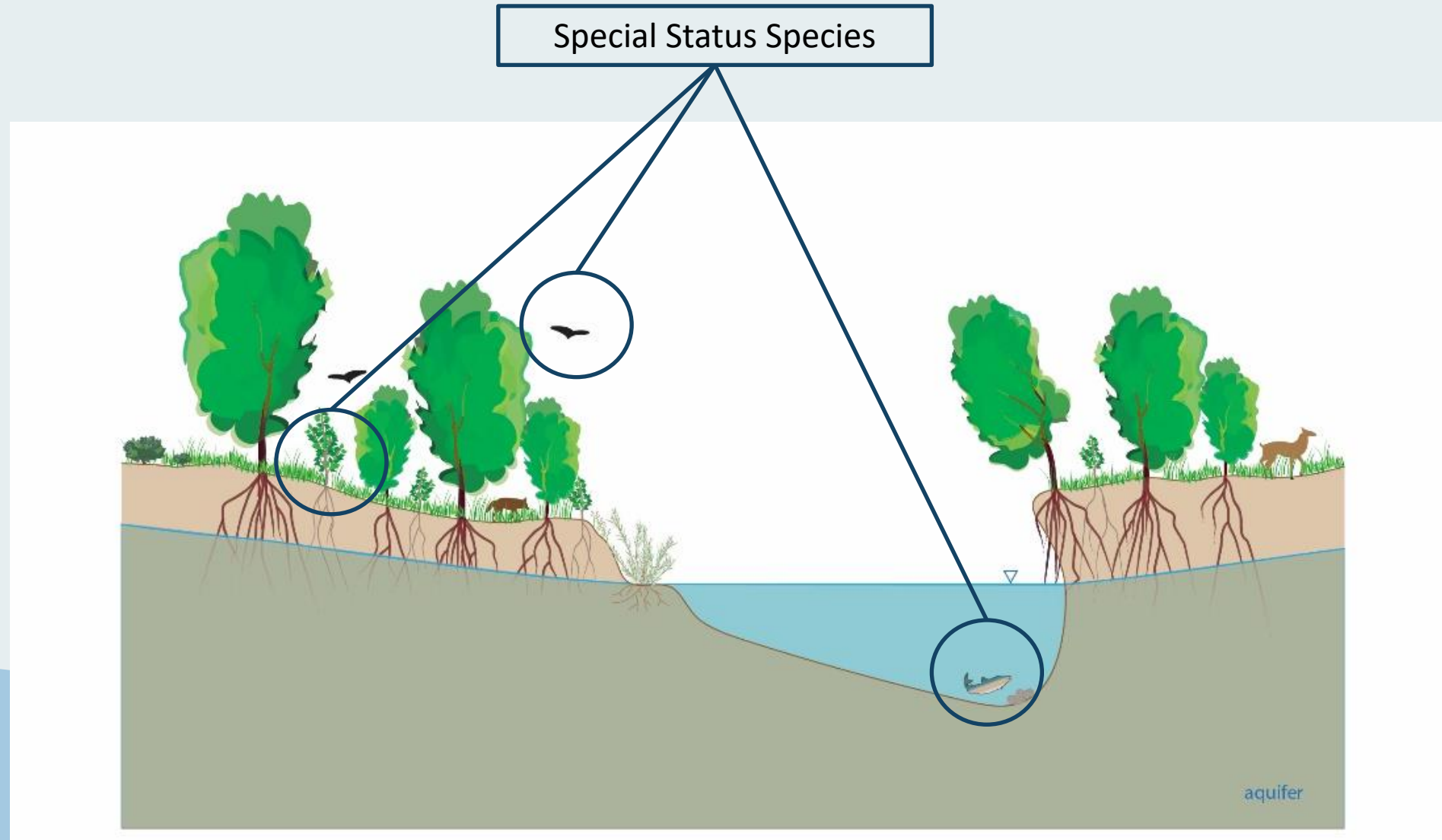


# Rector Creek

- Stillwater Sciences has been studying the hydrology, fish occurrence, and connectivity of Rector Creek downstream of Rector Dam since 2018.
- Generally connected in the winter
- Supports disconnected isolated pools at its downstream end in the summer
- Native fish present with few exotics
- No observed steelhead spawning habitat but some rearing habitat was identified



# Sensitive Species





# Fish and Wildlife-Special Status species

(Source: Napa GSP)

Foothill yellow-legged  
frog



Saltmarsh common yellowthroat

Longfin smelt



Tricolored blackbird



California freshwater shrimp





# Plants –Special Status

(Source: Napa GSP)

Contra Costa Goldfields



©2011 Aaron Arthur

Calistoga Popcornflower



Photo: The watershed nursery

Sebastopol Meadowfoam



CDFW photo by Jeb Bjerke

Napa Blue grass



CDFW photo by Marianne  
McDermon



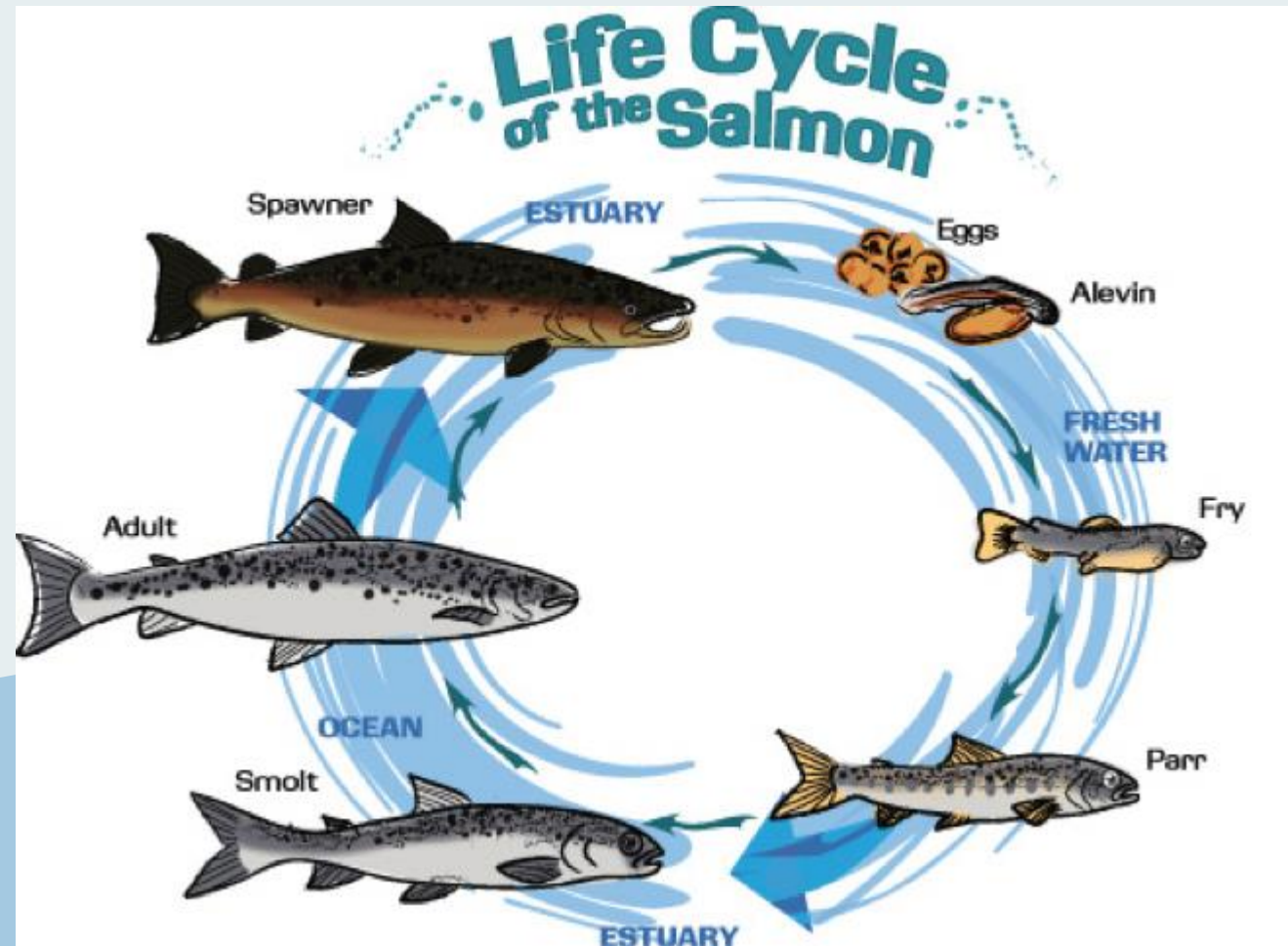
# Focus on steelhead



• Source: Napa County RCD

# Assess flow requirements for each lifestage

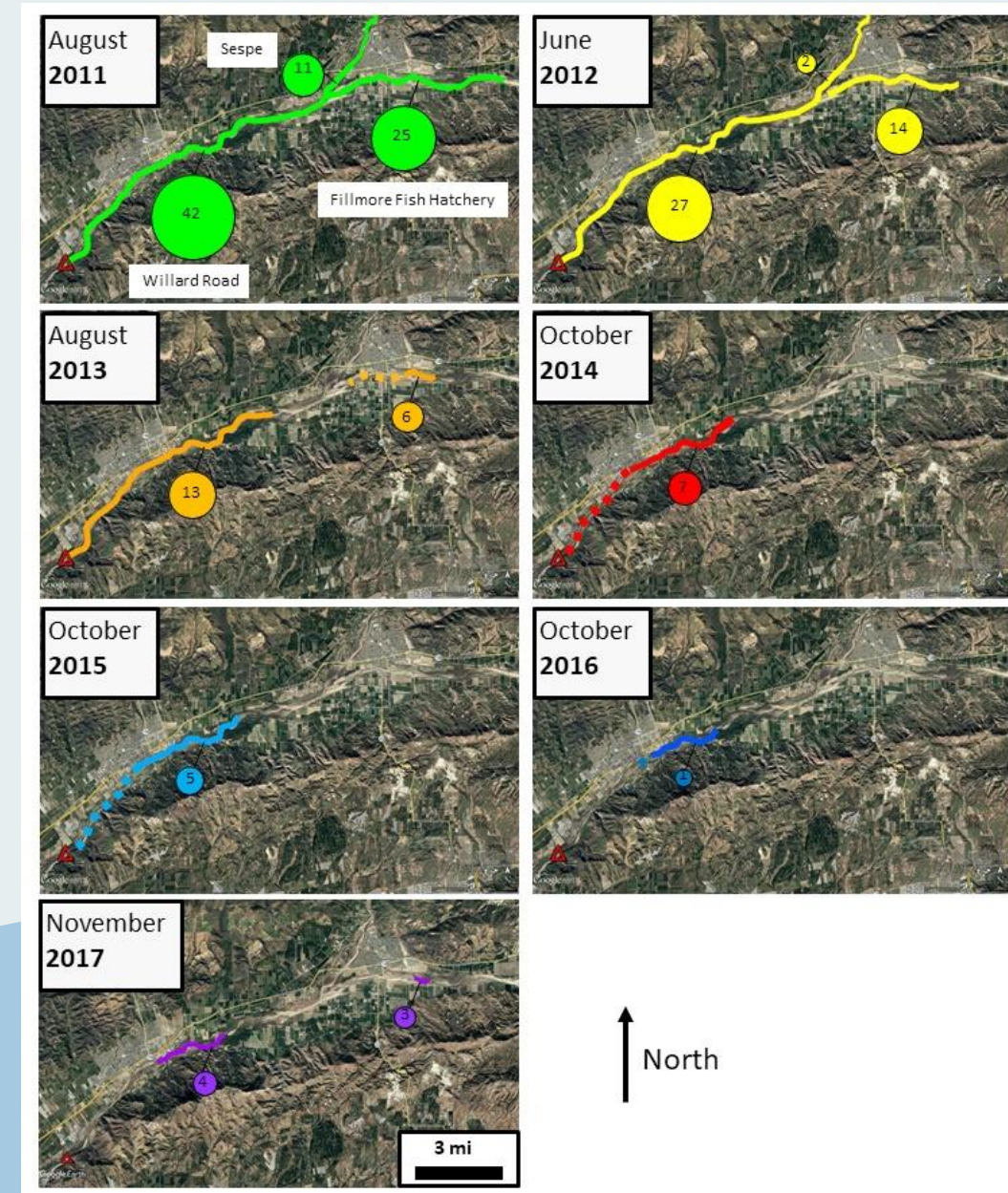
- Assess the spatial distribution of fish usage for each life stage (e.g., spawning, rearing, passage, etc.)
- Assess the role of surface flows and interconnected water on each lifestage.
- Can use the groundwater model to assess the effects of groundwater management on surface discharge...then need to use a different model to assess the effects of fish passage.





# Examples from other projects

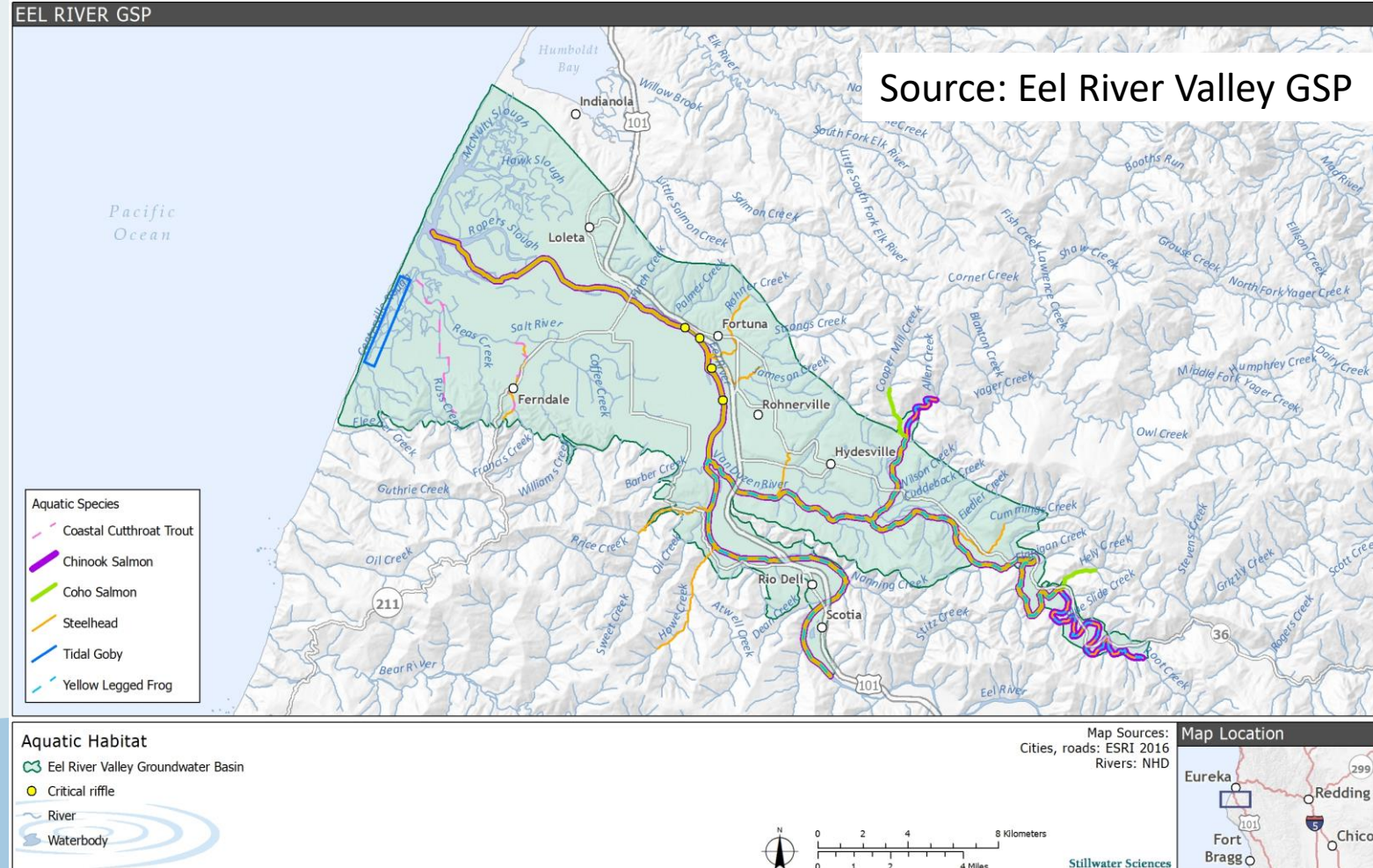
1. Fillmore and Piru groundwater basins (Santa Clara River, CA). Approach used the groundwater model to assess the effect of pumping on fish passage. The maximum pumping effect was a small fraction of the 800 cfs required to get fish into the reach.
2. Groundwater models and passage models occur at different temporal scales (in this case it ended up not mattering)





# Examples from other projects-Eel River

1. Eel River groundwater subbasin. Used a groundwater model to assess pumping effects of flow (and stage), to assess known fish passage discharge. Annual changes to channel morphology had a profound effect on flow requirements at critical riffles





# What about other species?

- Need to develop maps of species occurrence (if not already completed)
- Assess water sources and role of groundwater for different lifestages
- Use literature to develop any thresholds (flow, temperature, timing, etc.) for either species or habitats they depend on (e.g., wetlands)
- Assess effect of groundwater pumping



# Summary

- The Napa Valley groundwater basin supports aquatic and terrestrial GDEs
- Limiting factors for steelhead in the Napa Basin related to ISW include water temperature and food availability (due to connectivity) among other factors
- Models can be used to assess habitat availability for different life stages of steelhead depending on usage in the basin
- A similar approach can be used to assess other species, depending on information about habitat needs





# CEFF APPLICATIONS: INSTREAM FLOWS & CDFW



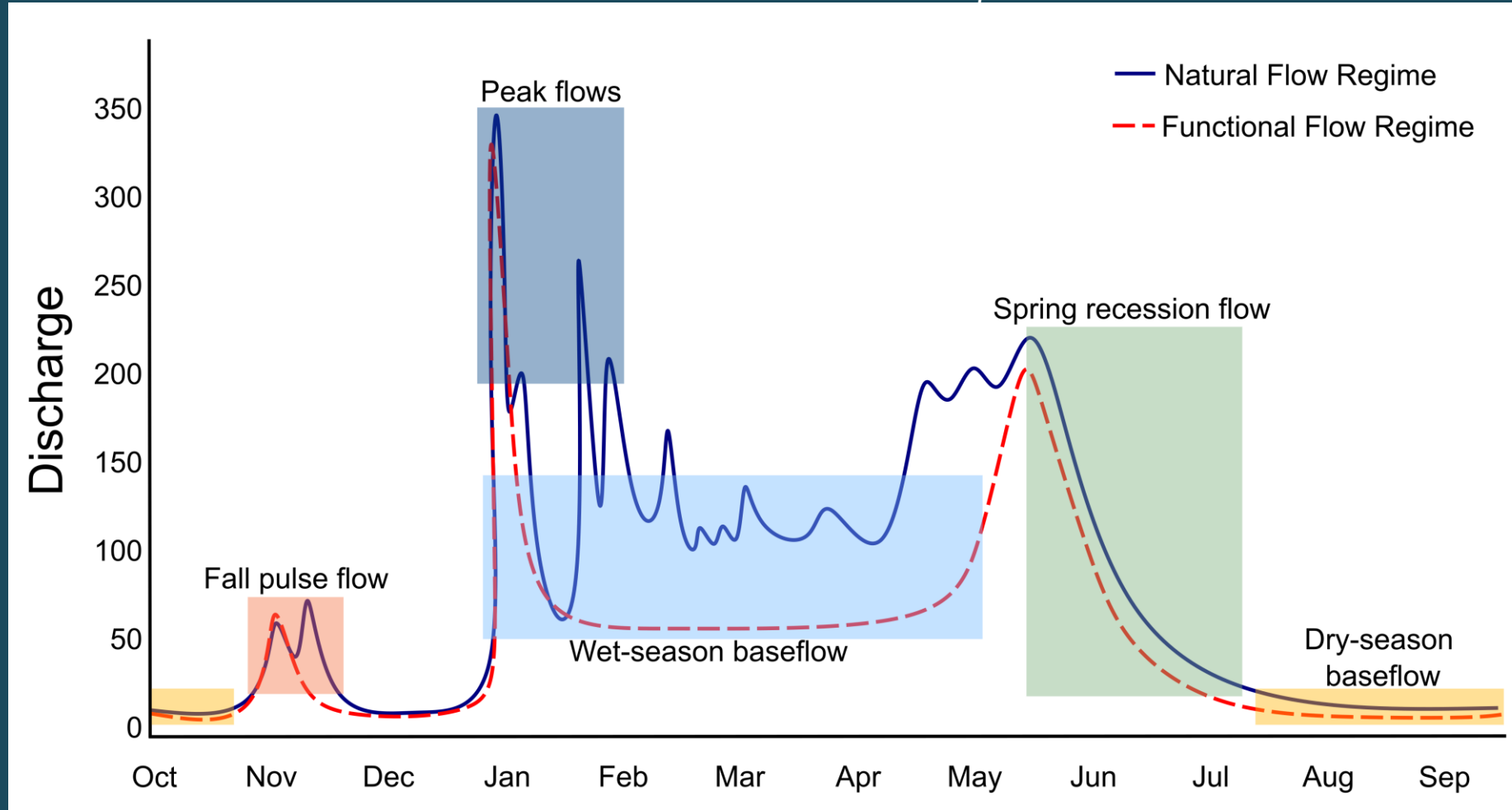
Alyssa Obester & Alex Milward  
CDFW Water Branch  
Instream Flow Program

September 8, 2022



# FUNCTIONAL FLOWS

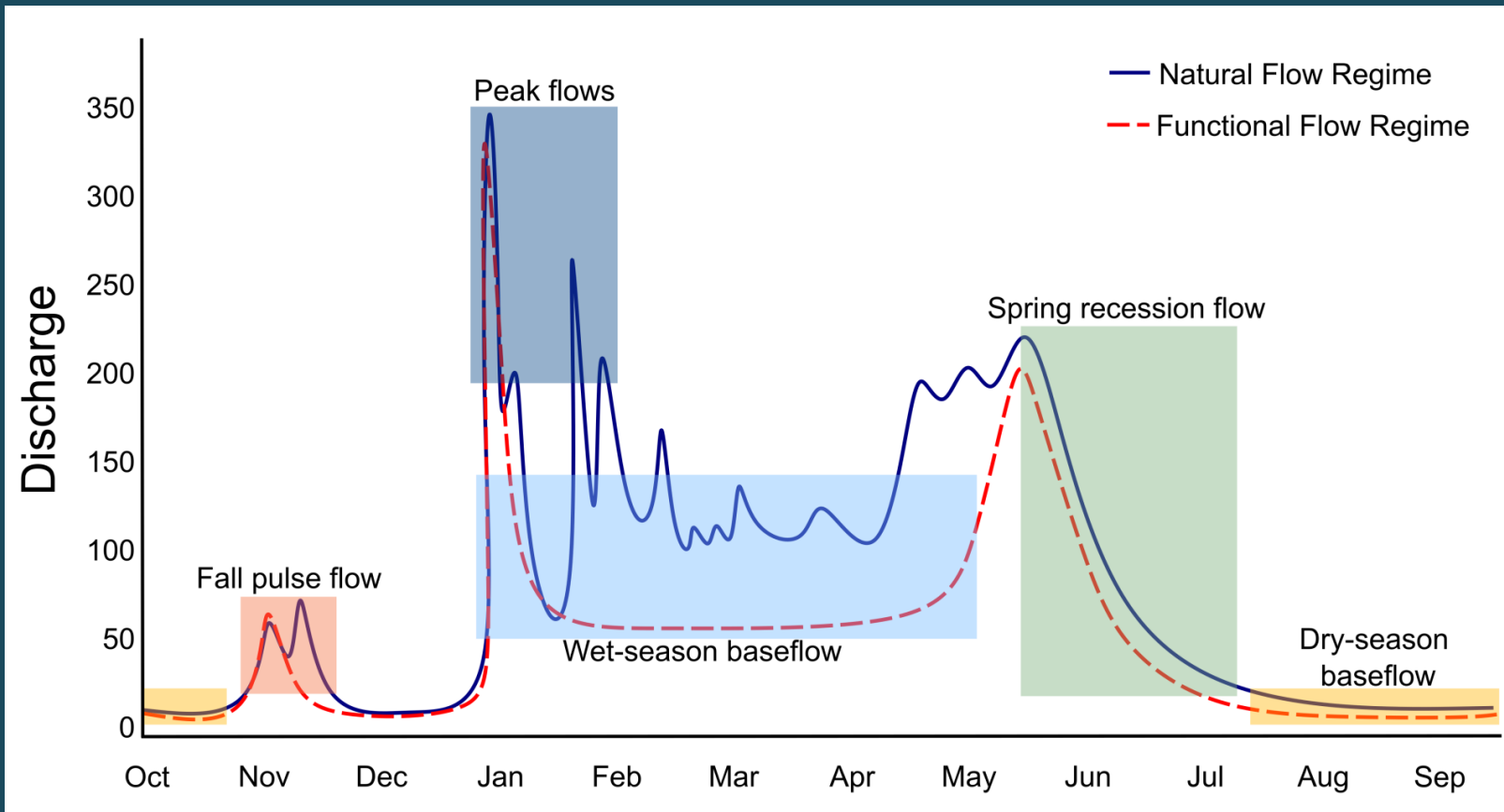
Adapted from Yarnell et al. 2020



Key functions and flows that would exist under **natural conditions**



# FUNCTIONAL FLOWS



| Flow Component        | Flow Metric                  |
|-----------------------|------------------------------|
| Fall pulse flow       | Magnitude (cfs)              |
|                       | Timing (date)                |
|                       | Duration (days)              |
| Wet-season base flow  | Magnitude (cfs)              |
|                       | Timing (date)                |
|                       | Duration (days)              |
| Wet-season peak flow  | Magnitude (cfs)              |
|                       | Duration (days)              |
|                       | Frequency (# of occurrences) |
| Spring recession flow | Magnitude (cfs)              |
|                       | Timing (date)                |
|                       | Duration (days)              |
| Dry-season base flow  | Rate of change (%)           |
|                       | Magnitude (cfs)              |
|                       | Timing (date)                |
|                       | Duration (days)              |

Functional flow metrics available at [rivers.codefornature.org](https://rivers.codefornature.org)

Metrics quantify flow components

# FUNCTIONAL FLOWS

| Metric                                                        | Wet Years                | Moderate Years            | Dry Years                 |
|---------------------------------------------------------------|--------------------------|---------------------------|---------------------------|
| Fall pulse flow magnitude (cfs)                               | 534 (150–3,600)          | 490 (423–948)             | 402 (269–609)             |
| Fall pulse flow duration (total days per year, when present)  | 3 (2–6)                  | 4 (2–6)                   | 5 (3–6)                   |
| Fall pulse flow start timing                                  | Oct 11<br>(Oct 5–Oct 29) | Oct 23<br>(Oct 13–Nov 8)  | Oct 18<br>(Oct 7–Nov 15)  |
| Wet-season baseflow magnitude (cfs)                           | 1,004<br>(604–1,309)     | 654<br>(401–916)          | 414<br>(331–672)          |
| Median wet-season flow magnitude (cfs)                        | 3,725<br>(2,394–5,722)   | 2,290<br>(1,360–2,650)    | 1,300<br>(913–1,804)      |
| Wet-season duration (days)                                    | 135 (102–164)            | 153 (119–187)             | 131 (113–164)             |
| Wet-season start timing                                       | Nov 16<br>(Oct 19–Dec 5) | Nov 21<br>(Oct 15–Dec 23) | Nov 22<br>(Nov 3–Jan 1)   |
| 2-year peak flow magnitude (cfs)                              | 40,300                   | 40,300                    | 40,300                    |
| 2-year peak flow duration (total days per year, when present) | 4 (1–6)                  | 2 (1–2)                   | 1                         |
| 2-year peak flow frequency (events per year, when present)    | 2 (1–3)                  | 1 (1–2)                   | 1                         |
| 5-year peak flow magnitude (cfs)                              | 70,000                   | 70,000                    | –                         |
| 5-year peak flow duration (total days per year, when present) | 2 (1–3)                  | 1                         | –                         |
| 5-year peak flow frequency (events per year, when present)    | 1 (1–2)                  | 1                         | –                         |
| Spring recession flow magnitude (cfs)                         | 8,430<br>(4,424–36,690)  | 4,680<br>(2,940–12,100)   | 4,870<br>(2,602–9,770)    |
| Spring recession flow duration (days)                         | 34 (28–73)               | 40 (26–49)                | 39 (30–54)                |
| Spring recession flow start timing                            | Mar 29<br>(Mar 3–Apr 22) | Apr 17<br>(Apr 9–May 26)  | Apr 3<br>(Mar 19–May 13)  |
| Spring recession flow rate of change (%)                      | 6 (5–8)                  | 5 (4–7)                   | 5                         |
| Dry-season baseflow magnitude (cfs)                           | 92 (68–122)              | 93 (63–110)               | 69 (59–97)                |
| Dry-season duration (days)                                    | 218 (183–240)            | 165 (139–178)             | 190 (150–226)             |
| Dry-season start timing                                       | May 9<br>(Apr 21–May 31) | Jun 1<br>(May 11–Jun 24)  | May 14<br>(Apr 23–Jun 18) |

Functional flow metrics available at  
[rivers.codefornature.org](https://rivers.codefornature.org)



# FUNCTIONAL FLOWS SUMMARY

- Function and process-focused approach
- Based on natural hydrologic patterns
- Broadly ecologically protective
  - Not species or life-stage specific
- Does not account for human water use



# CALIFORNIA ENVIRONMENTAL FLOWS FRAMEWORK (CEFF)

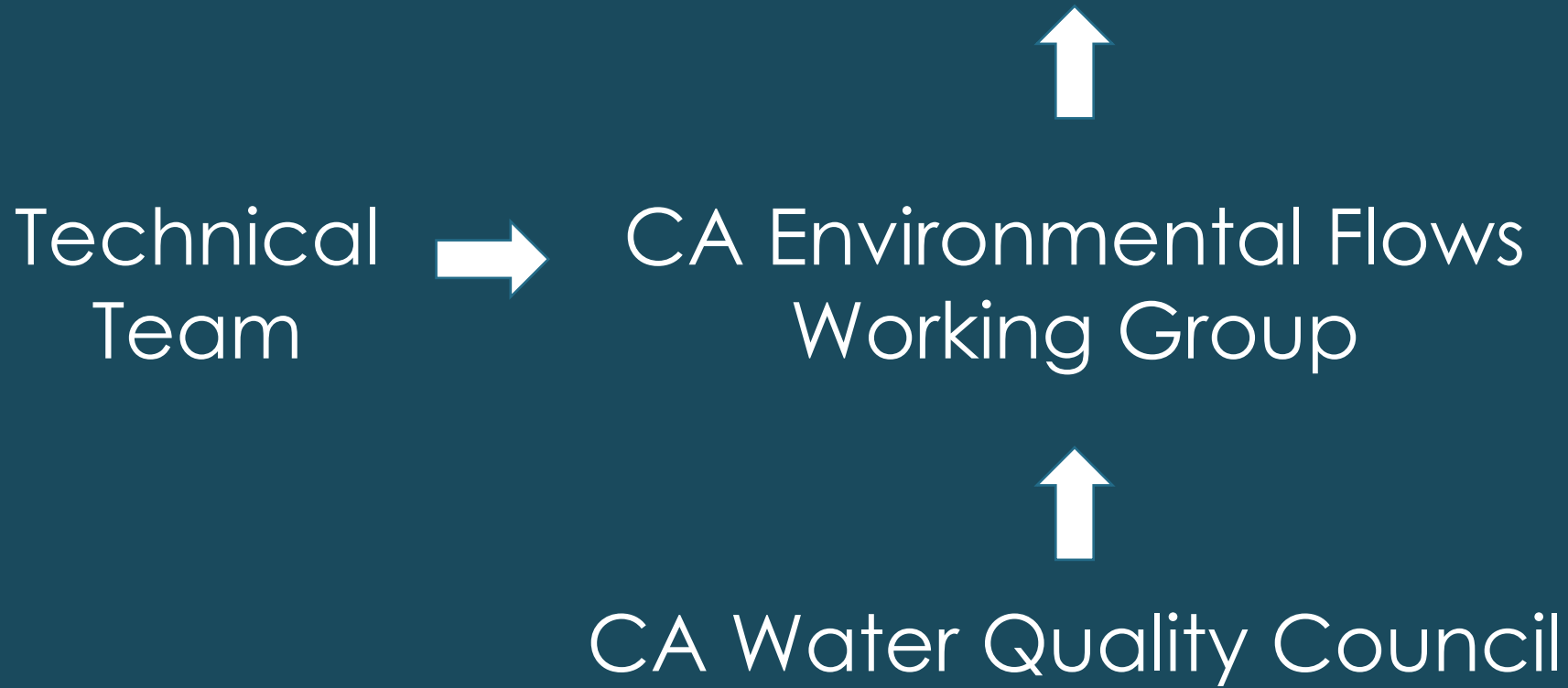
- Uses functional flows to represent ecological flow needs
- Provides technical guidance and tools for managers to develop environmental flows
- Not regulatory or prescriptive

<https://ceff.ucdavis.edu>





# CA Environmental Flows Framework (CEFF)



You're welcome to join the CA Environmental Flows Working Group quarterly meetings (open to the public)  
[https://www.waterboards.ca.gov/resources/email\\_subscriptions/swrcb\\_subscribe.html](https://www.waterboards.ca.gov/resources/email_subscriptions/swrcb_subscribe.html) > "General Interests"

See previous meetings

[https://mywaterquality.ca.gov/monitoring\\_council/environmental\\_flows\\_workgroup/meetings.html](https://mywaterquality.ca.gov/monitoring_council/environmental_flows_workgroup/meetings.html)

# CEFF Overview

SCIENCE-BASED ASSESSMENT

SOCIOPOLITICAL  
CONSIDERATIONS

## Section A

*At my location(s) of interest, what are the natural ranges of flow metrics for each of my five functional flow components?*

Identify range of natural functional flows

Do any of my five functional flow components require additional assessment due to non-flow factors?

No Yes



# CEFF Overview

SCIENCE-BASED ASSESSMENT

## Section A

*At my location(s) of interest, what are the natural ranges of flow metrics for each of my five functional flow components?*

**Identify range of natural functional flows**

Do any of my five functional flow components require additional assessment due to non-flow factors?

No

Yes

## Section B

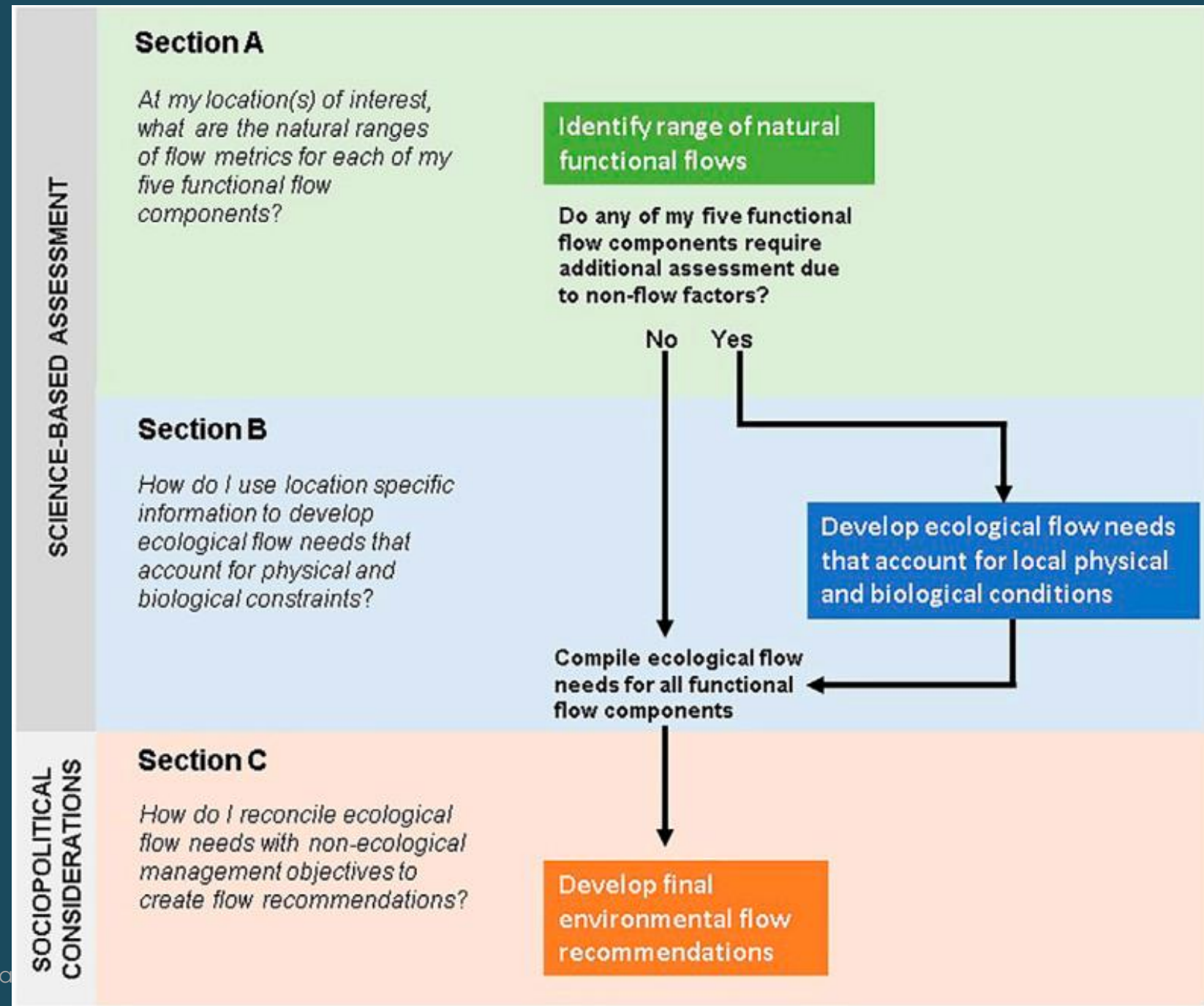
*How do I use location specific information to develop ecological flow needs that account for physical and biological constraints?*

**Develop ecological flow needs that account for local physical and biological conditions**

Compile ecological flow needs for all functional flow components

SOCIOPOLITICAL  
CONSIDERATIONS

# CEFF Overview





# Tools associated with CEFF

- Hydrologic classification of stream types available at [eflows.ucdavis.edu](http://eflows.ucdavis.edu)
- Modeled natural functional flow metrics available at [rivers.codefornature.org](http://rivers.codefornature.org)
- Modeled monthly natural flows available at [rivers.codefornature.org](http://rivers.codefornature.org)

*Modeled natural flows and functional flow metrics available at [rivers.codefornature.org](http://rivers.codefornature.org)*

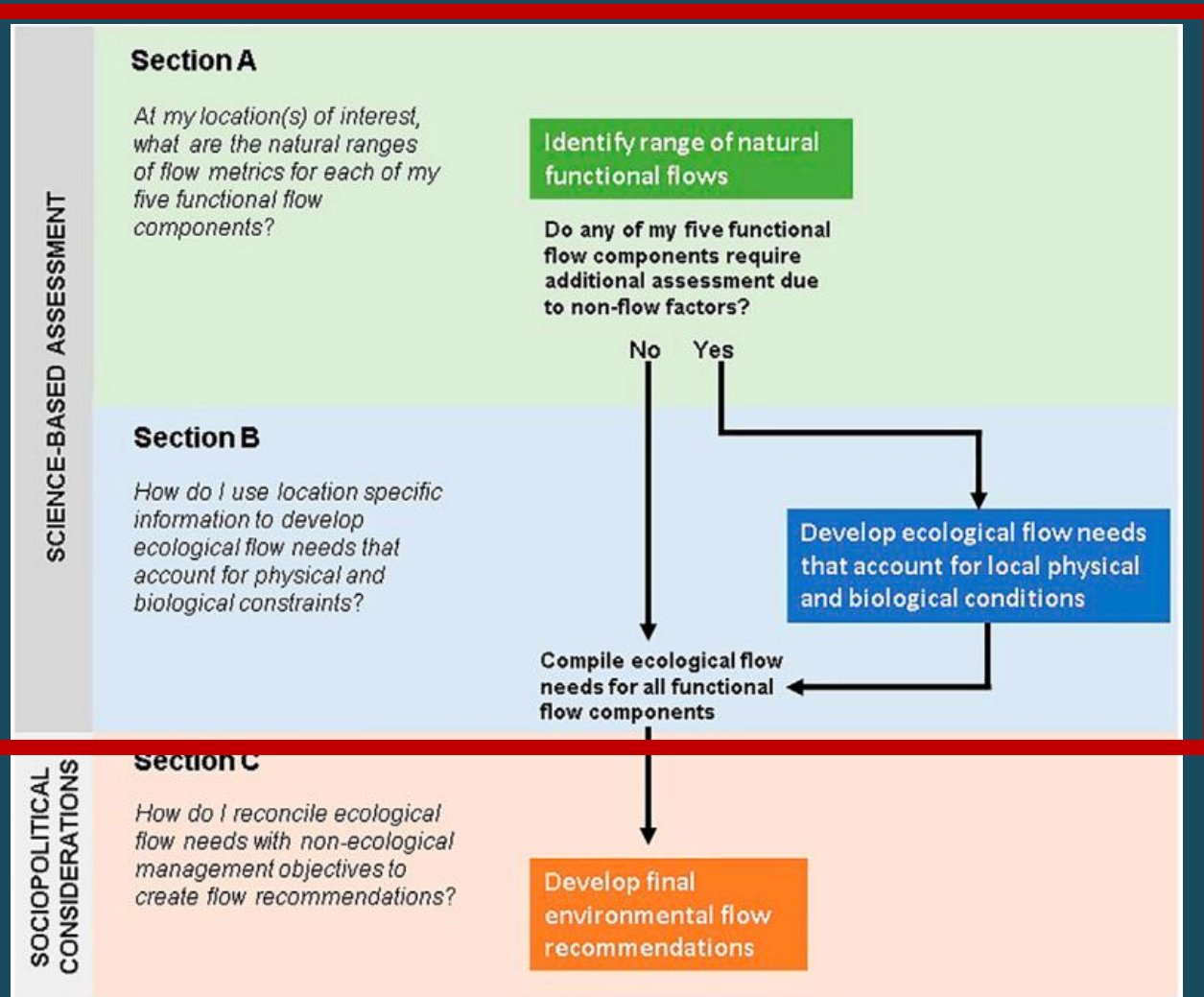
# CDFW's INSTREAM FLOW PROGRAM

- Develop instream flows required to maintain healthy conditions for aquatic and riparian species
- Provide technical, flow-related support to CDFW regional staff
  - Site-specific, technical instream flow studies
  - Desktop-based flow criteria
  - Flow information to support drought, other regulatory processes





# CDFW's INSTREAM FLOW PROGRAM



**CDFW  
involvement**

**Flow study**  
↓  
**Flow criteria**  
↓  
**Flow recommendations**

↓  
**Flow objectives &  
other water allocation  
decisions**

# CDFW CEFF INVOLVEMENT

- Member of Technical Team
  - Assist in Framework development, provide feedback, test tools
- Participate in Eflows Workgroup Meetings
- Serve as CDFW's "CEFF resource"
  - Provide CEFF trainings to staff





# CEFF APPLICATIONS: WATERSHED CRITERIA REPORTS

- Rapid approach for developing watershed-wide flow criteria
- Developed using hydrologic and modeling tools – no data collection required
- Can be combined with site-specific data, when available



# CEFF APPLICATIONS: WATERSHED CRITERIA REPORTS

## Functional Flows

What are the flows that preserve the ecological and physical processes throughout the year and across years?

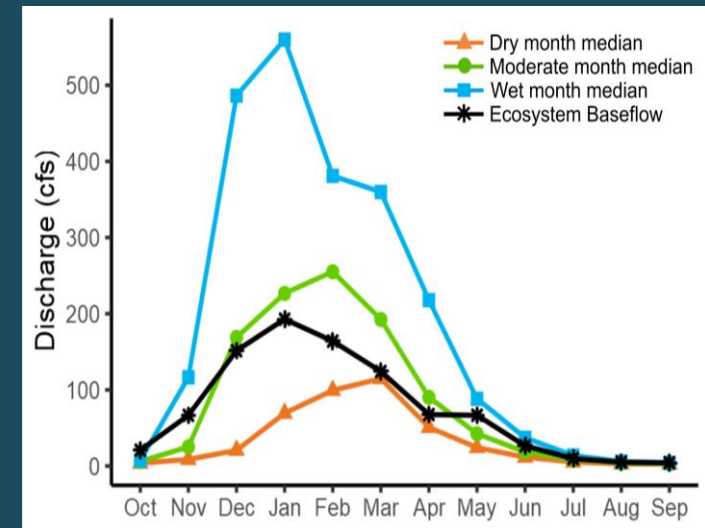
| Metric                                                       | Wet Years              | Moderate Years        | Dry Years             |
|--------------------------------------------------------------|------------------------|-----------------------|-----------------------|
| Fall pulse flow magnitude (cfs)                              | 400 (180–1,400)        | 300(185–1,400)        | 150 (75–450)          |
| Fall pulse flow duration (total days per year, when present) | 3 (2–6)                | 3 (2–5)               | 6 (3–9)               |
| Fall pulse flow start timing                                 | Oct 20 (Oct 11–Oct 31) | Oct 15 (Oct 3–Nov 13) | Oct 16 (Oct 9–Nov 11) |
| Wet-season baseflow magnitude (cfs)                          | 1500 (1,096–2,502)     | 900 (605–1,217)       | 500 (300–700)         |
| Median wet-season flow magnitude (cfs)                       | 400 (250–700)          | 300 (200–450)         | 130 (75–230)          |
| Wet-season duration (days)                                   | 150 (97–175)           | 140 (118–176)         | 120 (70–163)          |
| Wet-season start timing                                      | Nov 15 (Oct 20–Dec 15) | Nov 20 (Nov 6–Dec 28) | Dec 15 (Nov 13–Jan 3) |



## Additional Analyses

What are specific ecosystem and species-specific flow targets?

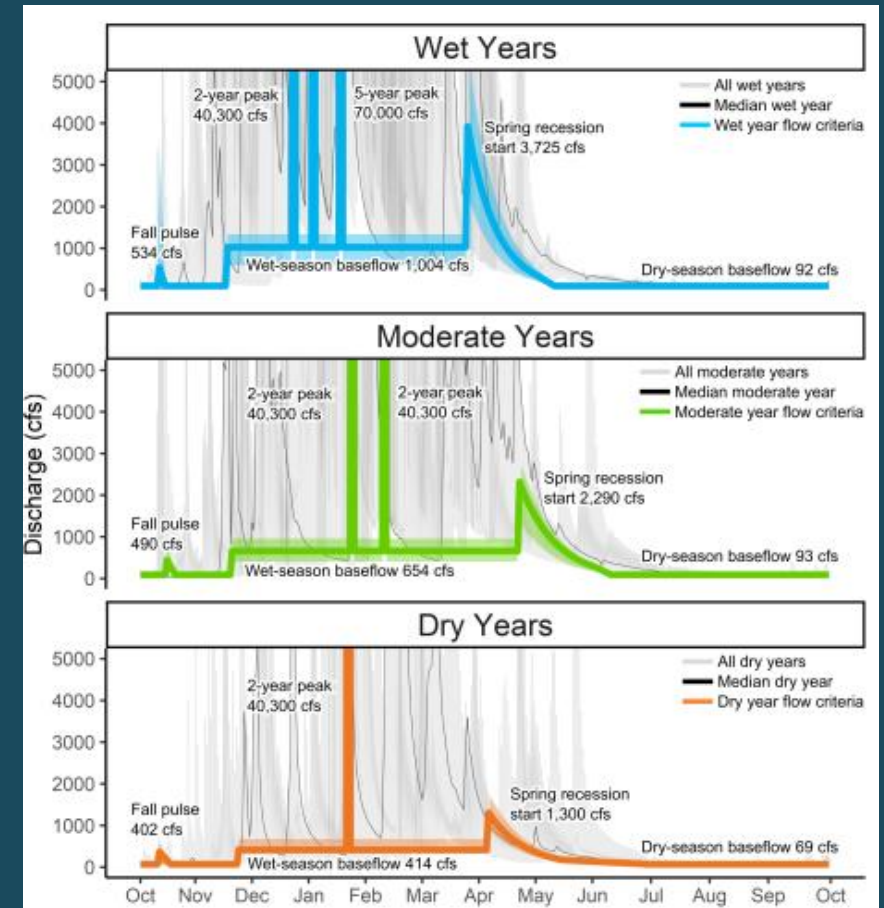
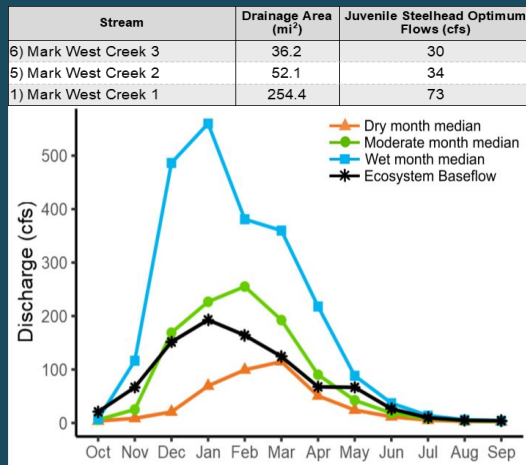
| Stream               | Drainage Area (mi <sup>2</sup> ) | Juvenile Steelhead Optimum Flows (cfs) |
|----------------------|----------------------------------|----------------------------------------|
| 6) Mark West Creek 3 | 36.2                             | 30                                     |
| 5) Mark West Creek 2 | 52.1                             | 34                                     |
| 1) Mark West Creek 1 | 254.4                            | 73                                     |





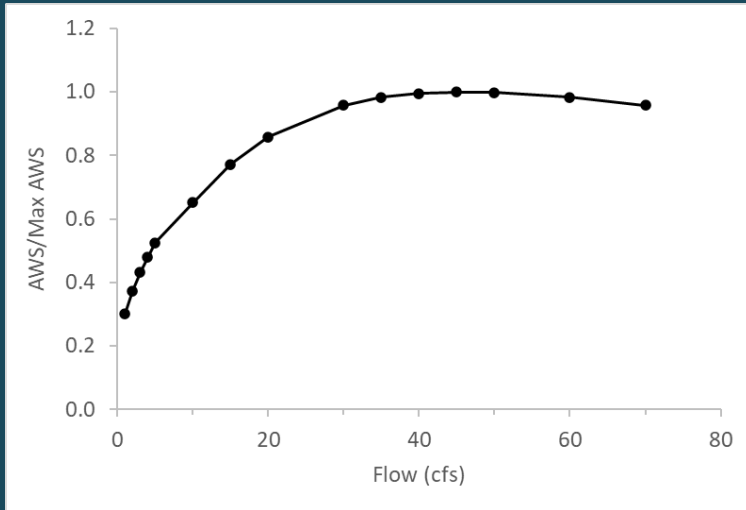
# CEFF APPLICATIONS: WATERSHED CRITERIA REPORTS

| Metric                                                       | Wet Years              | Moderate Years        | Dry Years             |
|--------------------------------------------------------------|------------------------|-----------------------|-----------------------|
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| Wet-season start timing                                      | Nov 15 (Oct 20–Dec 15) | Nov 20 (Nov 6–Dec 28) | Dec 15 (Nov 13–Jan 3) |

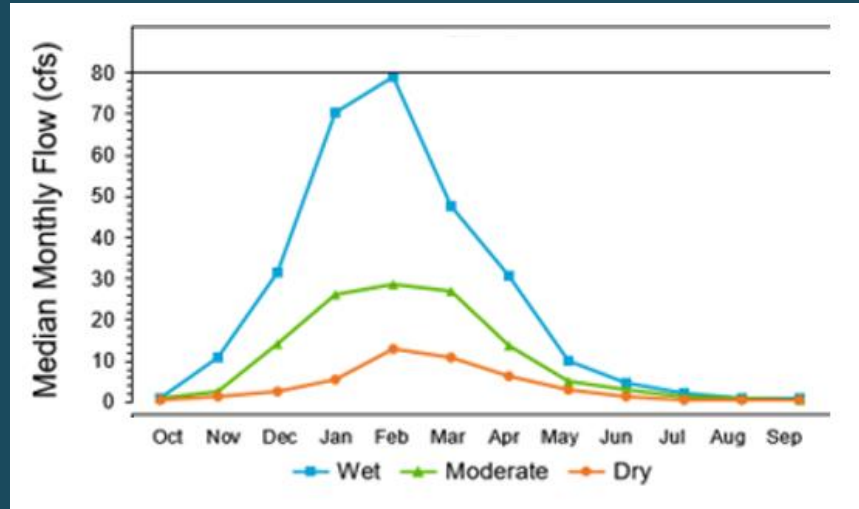


| Water Year Type | Wet Season Nov-Mar | Spring Recession Week 1 | Spring Recession Week 2 | Spring Recession Week 3 | Spring Recession Week 4 | Spring Recession Week 5 | Spring Recession Week 6 | Spring Recession Week 7 | Spring Recession Week 8 | Spring Recession Week 9 | Spring Recession Week 10 | Dry Season May-Oct |
|-----------------|--------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|--------------------------|--------------------|
| Wet             | 1,004 <sup>†</sup> | 3,118                   | 2,022                   | 1,311                   | 850                     | 551                     | 358                     | 232                     | 150                     | 97                      | -                        | 92 <sup>‡</sup>    |
| Moderate        | 654 <sup>†</sup>   | 1,974                   | 1,378                   | 963                     | 672                     | 469                     | 328                     | 229                     | 160                     | 112                     | 78                       | 93 <sup>‡</sup>    |
| Dry             | 414 <sup>†</sup>   | 1,120                   | 782                     | 546                     | 382                     | 266                     | 186                     | 130                     | 91                      | -                       | -                        | 69 <sup>‡</sup>    |

# CEFF APPLICATIONS: REFINING FIELD-BASED HABITAT-FLOW RELATIONSHIPS



Streamflow - habitat suitability relationship



Estimated natural hydrology from Natural Flows Database



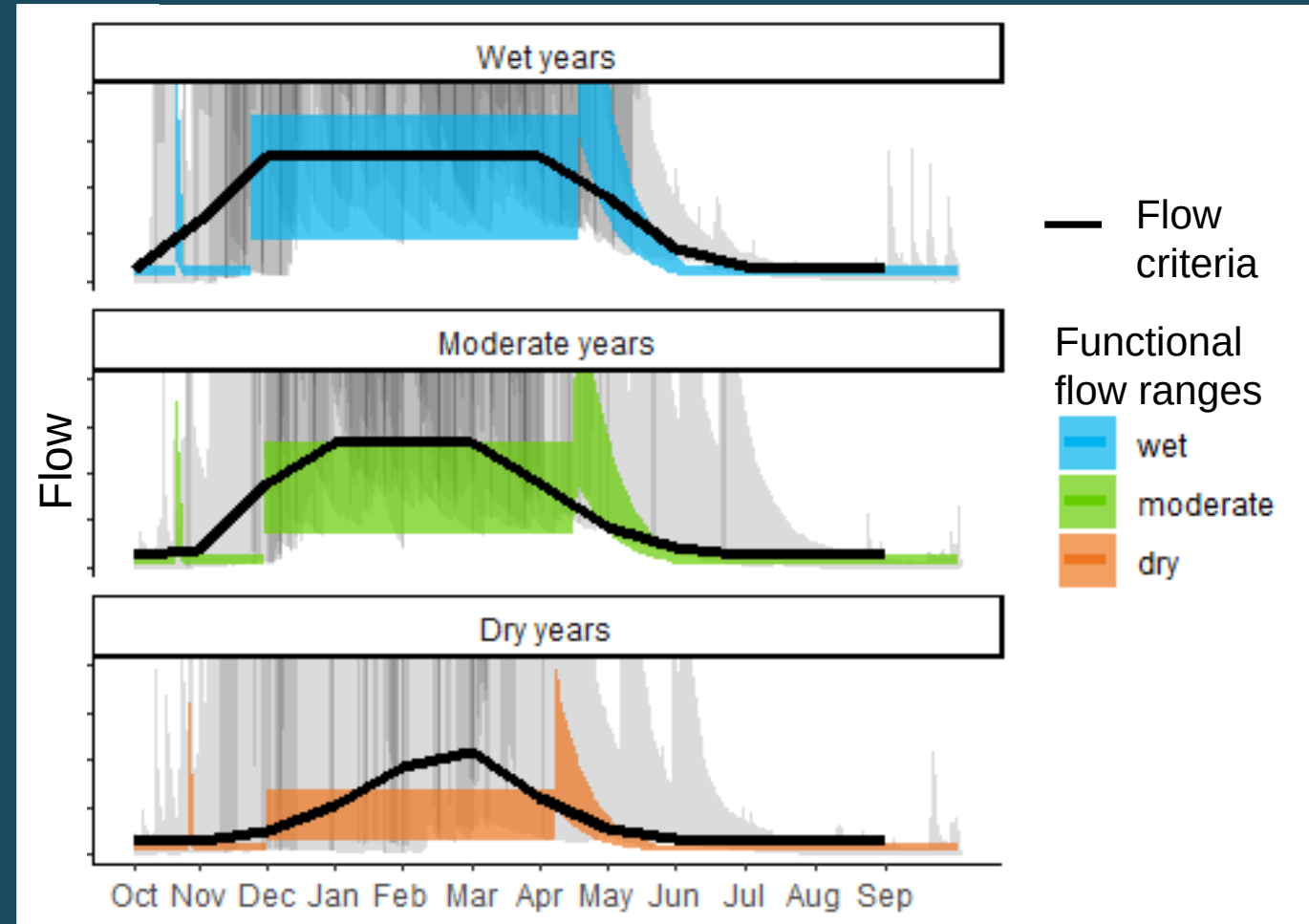
| Month     | Moderate Water Month Type |
|-----------|---------------------------|
| January   | 26                        |
| February  | 29                        |
| March     | 27                        |
| April     | 14                        |
| May       | 5                         |
| June      | 3                         |
| July      | 1                         |
| August    | 1                         |
| September | 1                         |
| October   | 1                         |
| November  | 3                         |
| December  | 14                        |

Green Line Results table



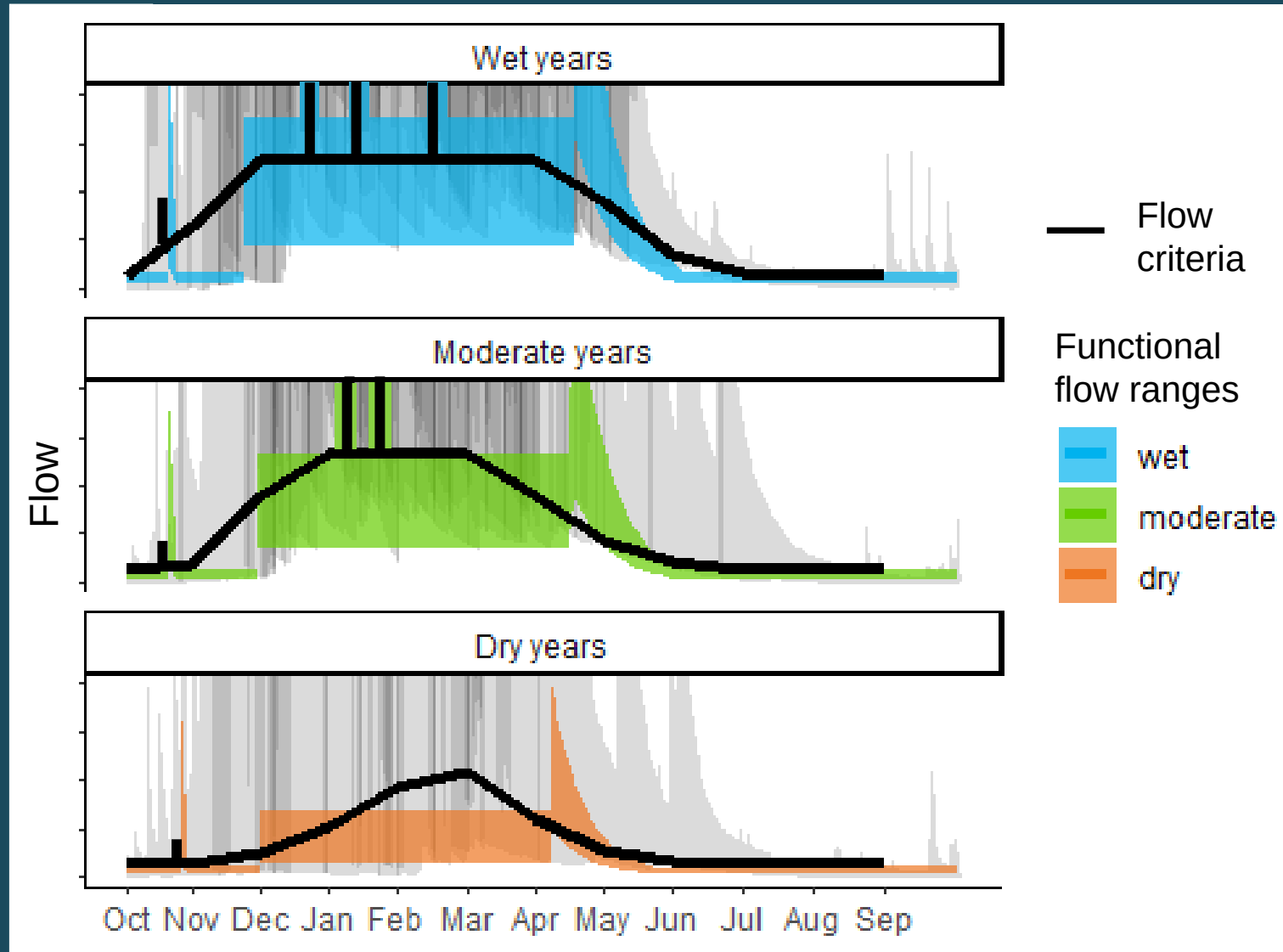
# CEFF APPLICATIONS: REFINING FIELD-BASED FLOW CRITERIA

- Assessing whether field-based flow criteria match natural hydrology



# CEFF APPLICATIONS: REFINING FIELD-BASED FLOW CRITERIA

- Incorporating variability (pulse and peak flows) to baseflow-focused criteria



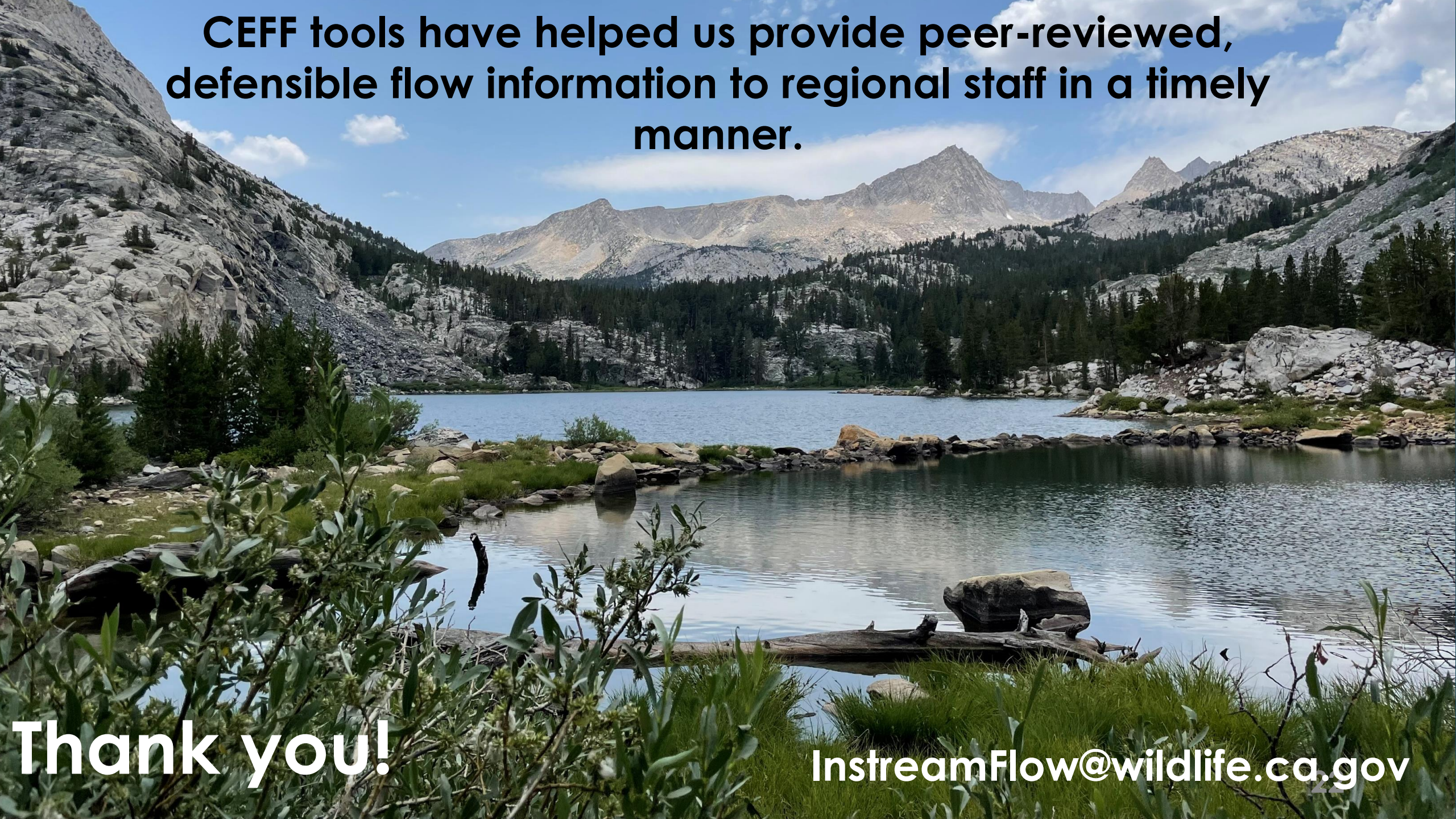


# ADDITIONAL APPLICATIONS

- Assisting regions in drafting conditions for FERC licenses
- Providing flow information for water management
- Providing flow information support to regions during drought to assist with water management discussions







**CEFF tools have helped us provide peer-reviewed,  
defensible flow information to regional staff in a timely  
manner.**

**Thank you!**

**[InstreamFlow@wildlife.ca.gov](mailto:InstreamFlow@wildlife.ca.gov)**



# South Orange County Flow Ecology Study

South Orange County Watershed Management Area  
California Environmental Flows Framework (CEFF) Application

**Napa County GSA Technical Advisory Group Meeting  
September 8, 2022**

# CEFF Application Highlights

- Highly modified watershed where establishing reference-based flows may be challenging
- Flow modifications are from diffuse non-point sources
- Groundwater may be a significant contributor to summer baseflows





# Study Objectives

## **Develop tools and datasets to inform decisions regarding flow management activities**

- Identify when and where flows are altered
- Evaluate degree to which alteration is impacting ecology
- Prioritize areas for flow management

Incorporate input from local stakeholders and technical experts

Provide ready access to data, tools, and products

# Stakeholder Engagement

- **Online Webinar: July 17, 2019**
  - Overview of the study and context
- **Stakeholder Advisory Group (SAG) Meeting: August 5, 2019**
  - Webinar Q&A summary and discussion
- **Technical Advisory Group (TAG) Meeting: October 22, 2019**
  - Project overview, roles and expectations of TAG
  - Technical approach, including hydrologic model development and calibration
- **TAG/SAG Meeting: January 8, 2020**
  - Tiered approach for ecological assessment
  - Update on hydrologic model development
- **TAG Meeting: June 3, 2020**
  - Hydrologic model calibration
- **SAG Meeting: June 16, 2020**
  - Tier 1 and 2 example outputs
  - Focal species discussion
- **TAG/SAG Meeting: November 12, 2020**
  - Hydrologic model recalibration
- **TAG/SAG Meeting: December 3, 2020**
  - Tiers 1-3 development and interpretation
  - Synthesis of data and key decisions



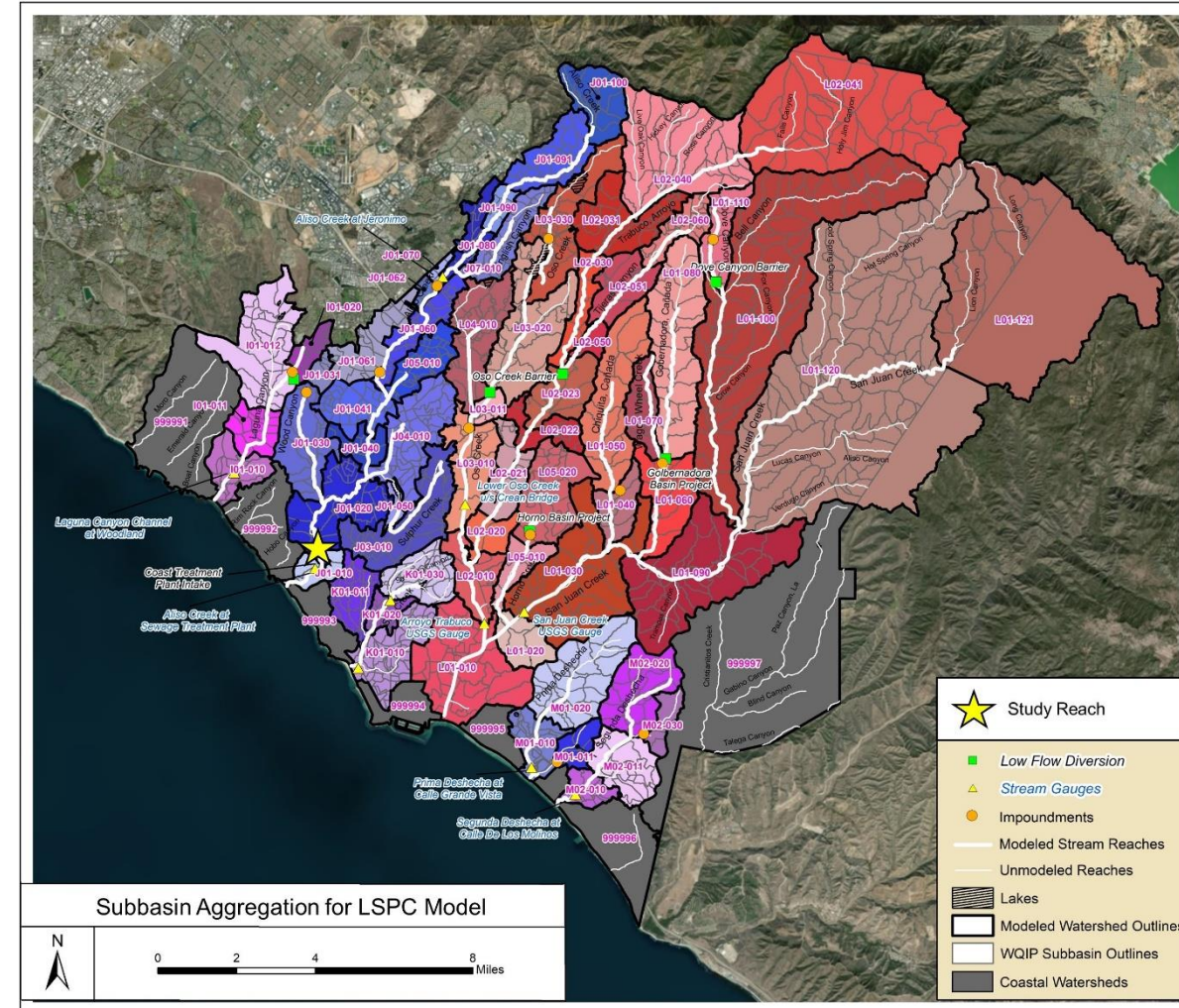
# Study Area

South Orange County, CA  
Watershed Management Area

Altered hydrology and  
channel erosion identified as  
the highest priority water  
quality conditions<sup>1</sup>

<sup>1</sup>South OC Watershed Management Area Water  
Quality Improvement Plan, 2018

Southern  
CA, USA



# Ecological Management Objectives

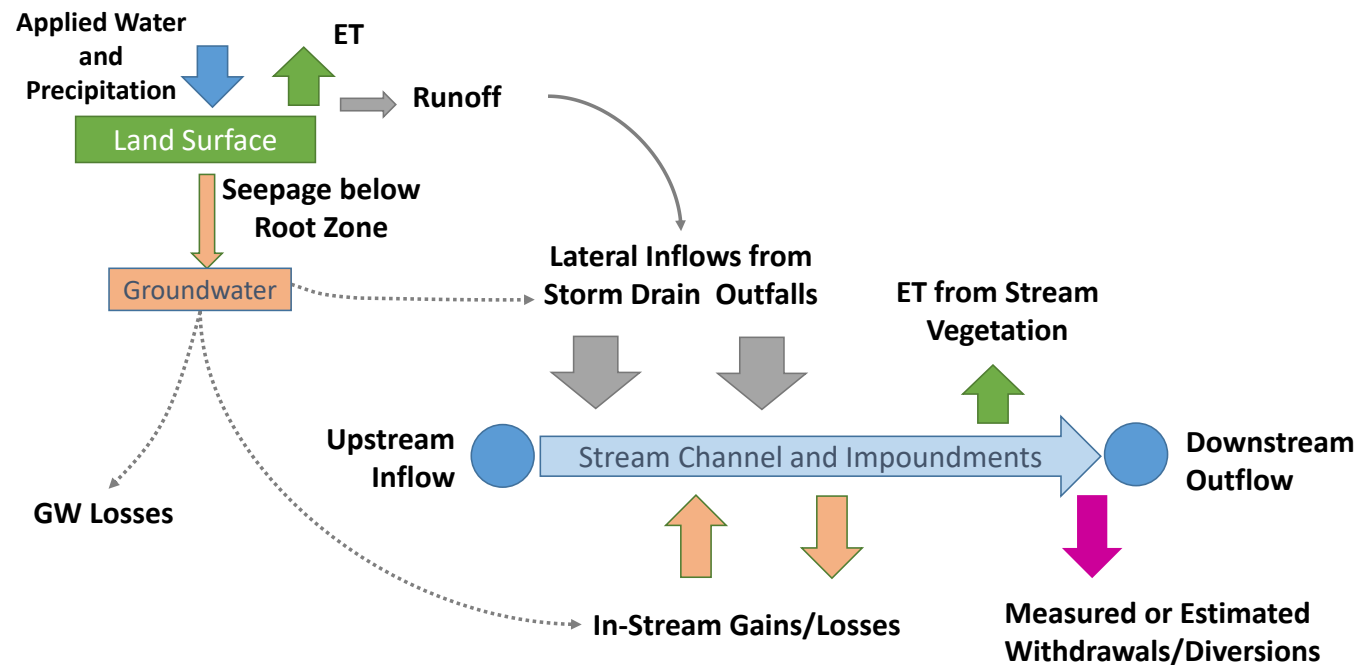
- Improve stream flow conditions to benefit overall stream ecosystem health
- Reduce unnatural flows that favor invasive species
- Provide habitat to support federally endangered least Bell's vireo
- Restore habitat for native fish populations





# Hydrologic Modeling

- Provided finer temporal and spatial resolution
- Allowed for evaluation of future scenarios
- Utilized isotope analysis to quantify natural versus unnatural water contributions



## Current condition

- Current land use and flow management measures
- Recent climate: 1990-2019; Recent irrigation patterns: 2010-2019
- Calibrated to streamflow gages, outfall monitoring, and water isotope data

## Reference condition

- Remove urban land, irrigated agriculture, diversions, and impoundments
- Same time period

## Future scenarios

- Climate change at mid-century
- Increased water conservation progress

Used Loading Simulation Program in C++

# Tiered Flow Ecology Analysis

1 - Hydrologic alteration  
based on deviation from  
reference condition



2 - Biologic alteration  
based on Bioassessment  
Indices (CSCI and ASCI)



3 - Biologic alteration  
based on higher trophic  
level species



| Flow Component         | Flow Metric                      | Natural Range of Flow Metrics<br>median (10th - 90th) | Ecological Flow Criteria:<br>Black Willow | Ecological Flow Criteria:<br>Arroyo Chub |
|------------------------|----------------------------------|-------------------------------------------------------|-------------------------------------------|------------------------------------------|
| Fall pulse flow        | Fall pulse magnitude             | 2.4 (1.7 - 5) cfs                                     | Same as natural range                     | Same as natural range                    |
|                        | Fall pulse timing                | Nov 29 (Oct 24 - Dec 3)                               | Same as natural range                     | Same as natural range                    |
|                        | Fall pulse duration              | 11 (3 - 16) days                                      | Same as natural range                     | Same as natural range                    |
| Wet-season baseflow    | Wet-season baseflow magnitude    | 3 (2 – 5) cfs                                         | <b>0.1 – 12 cfs</b>                       | <b>&gt; 120 cfs<sup>a</sup></b>          |
|                        | Wet-season timing                | Dec 15 (Oct 10 – Jan 25)                              | Same as natural range                     | Same as natural range                    |
|                        | Wet-season duration              | 67 (30 - 133) days                                    | Same as natural range                     | Same as natural range                    |
| Peak flows             | 2-year peak flow magnitude       | 31 cfs                                                | Same as natural range                     | Same as natural range                    |
|                        | 2-year peak flow duration        | 4 (1 – 25) days                                       | Same as natural range                     | Same as natural range                    |
|                        | 2-year peak flow frequency       | 2 (1 – 8)                                             | Same as natural range                     | Same as natural range                    |
|                        | 5-year peak flow magnitude       | 423 cfs                                               | Same as natural range                     | Same as natural range                    |
|                        | 5-year peak flow duration        | 3 (1 - 6) days                                        | Same as natural range                     | Same as natural range                    |
|                        | 5-year peak flow frequency       | 3 (1 - 4) event(s)                                    | Same as natural range                     | Same as natural range                    |
| Spring recession flows | Spring recession start magnitude | 15 (3 - 528) cfs                                      | <b>33 - 528 cfs</b>                       | Same as natural range                    |
|                        | Spring timing                    | Mar 3 (Feb 22 - Mar 18)                               | Same as natural range                     | Same as natural range                    |
|                        | Spring duration                  | 109 (76 - 125) days                                   | Same as natural range                     | Same as natural range                    |
|                        | Spring rate of change            | 1.4 (0.9 – 1.9) % decline per day                     | Same as natural range                     | Same as natural range                    |
| Dry-season baseflow    | Dry-season baseflow magnitude    | 2 (0.5 – 4) cfs                                       | <b>0.1 – 12 cfs</b>                       | <b>&gt; 120 cfs<sup>a</sup></b>          |
|                        | Dry-season timing                | June 20 (May 9 - Jul 10)                              | Same as natural range                     | Same as natural range                    |
|                        | Dry-season duration              | 198 (116 - 220) days                                  | Same as natural range                     | Same as natural range                    |



# Ecological Flow Criteria for Species of Concern

<sup>a</sup> High baseflow criteria due to widened channel morphology. Channel modifications needed for suitable baseflow depths



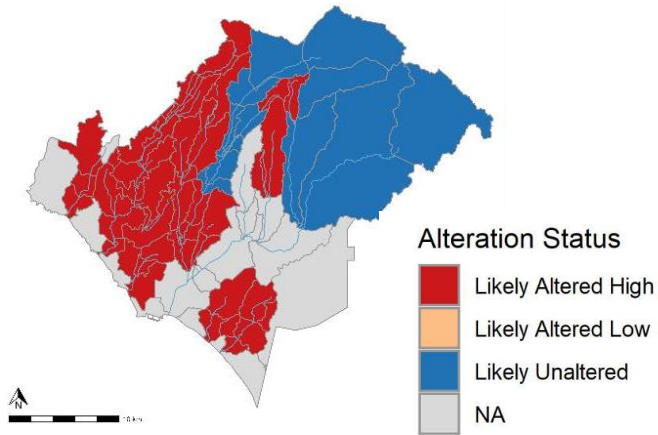
Photo: Barrett Paul, USFWS

# Data Products

## Where are flows altered?

Spring Recession Flow

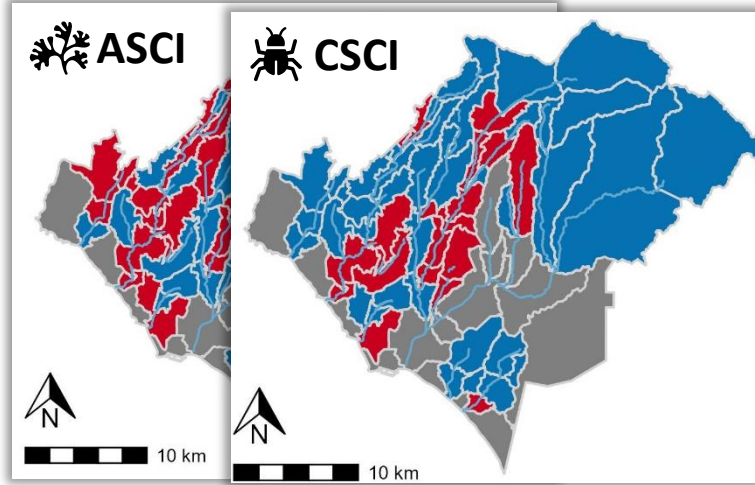
Rate of Change (% decrease per day)



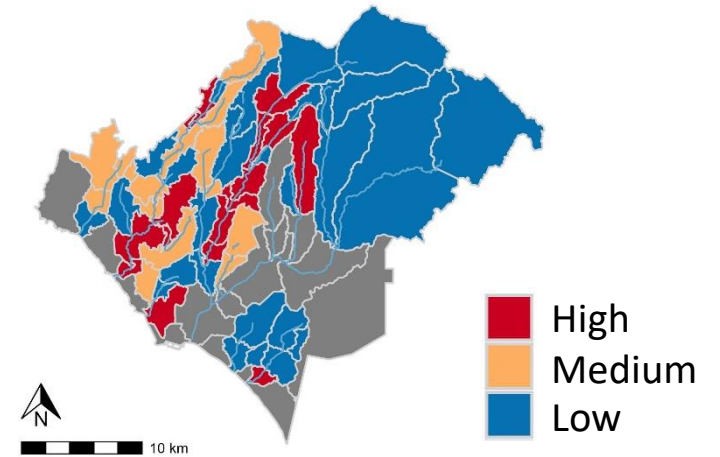
## Where is alteration impacting biology?

ASCI

CSCI



## Where are priority areas for flow management?



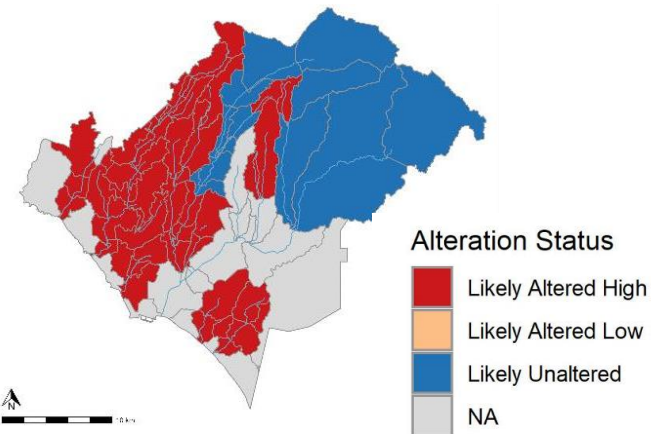


# Data Products Inform Management Decisions

## Where are flows altered?

Spring Recession Flow

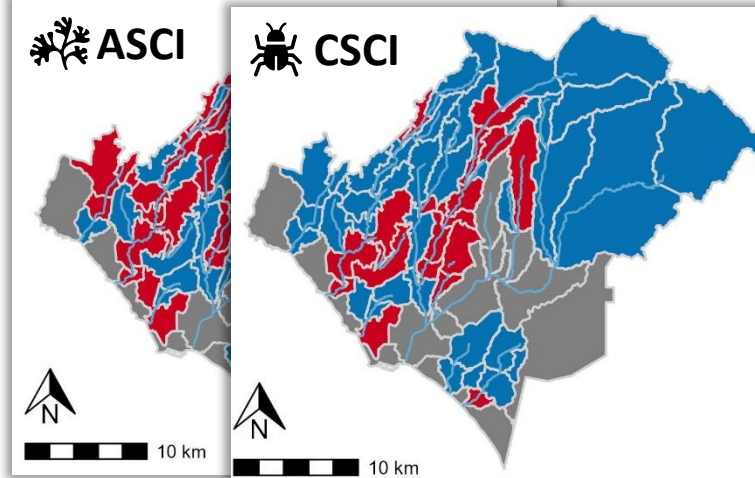
Rate of Change (% decrease per day)



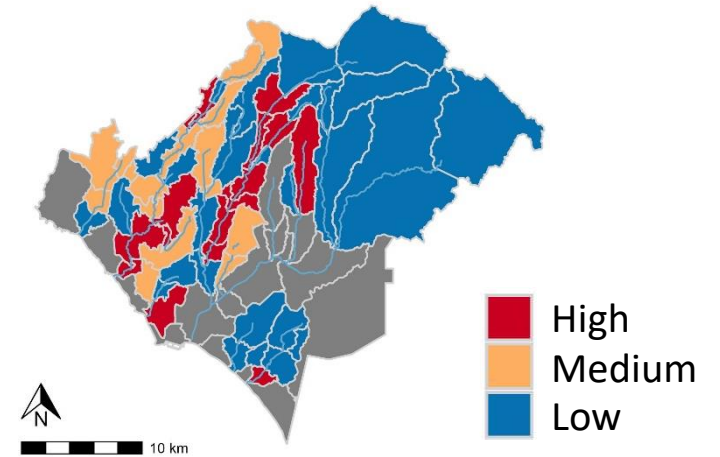
## Where is alteration impacting biology?

ASCI

CSCI



## Where are priority areas for flow management?



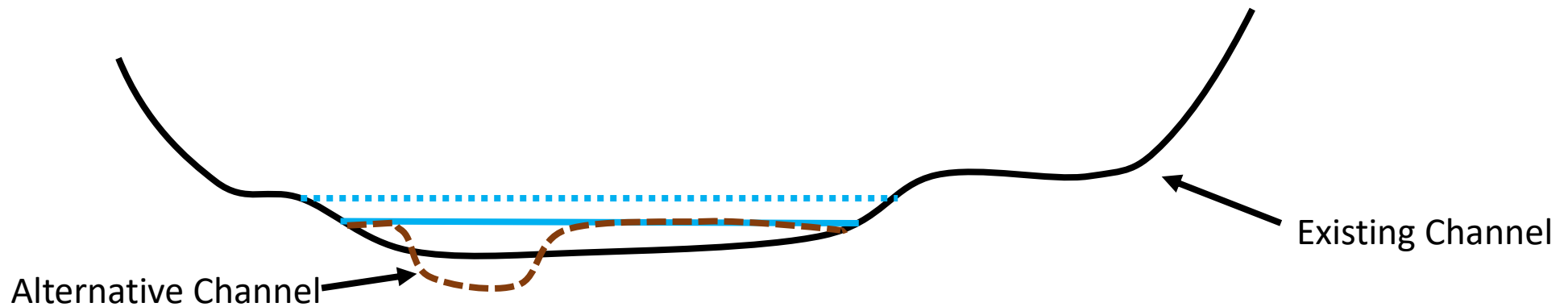
Where should flow management be prioritized?

Where should channel restoration be prioritized?

How should flows and morphology be in restored stream reaches?

# Can we get more out of the water we have?

- Existing channel too wide to provide suitable depths for arroyo chub



*Can changes to the channel morphology be made to provide more suitable habitat conditions?*

- Example design with narrower channel and inset floodplain



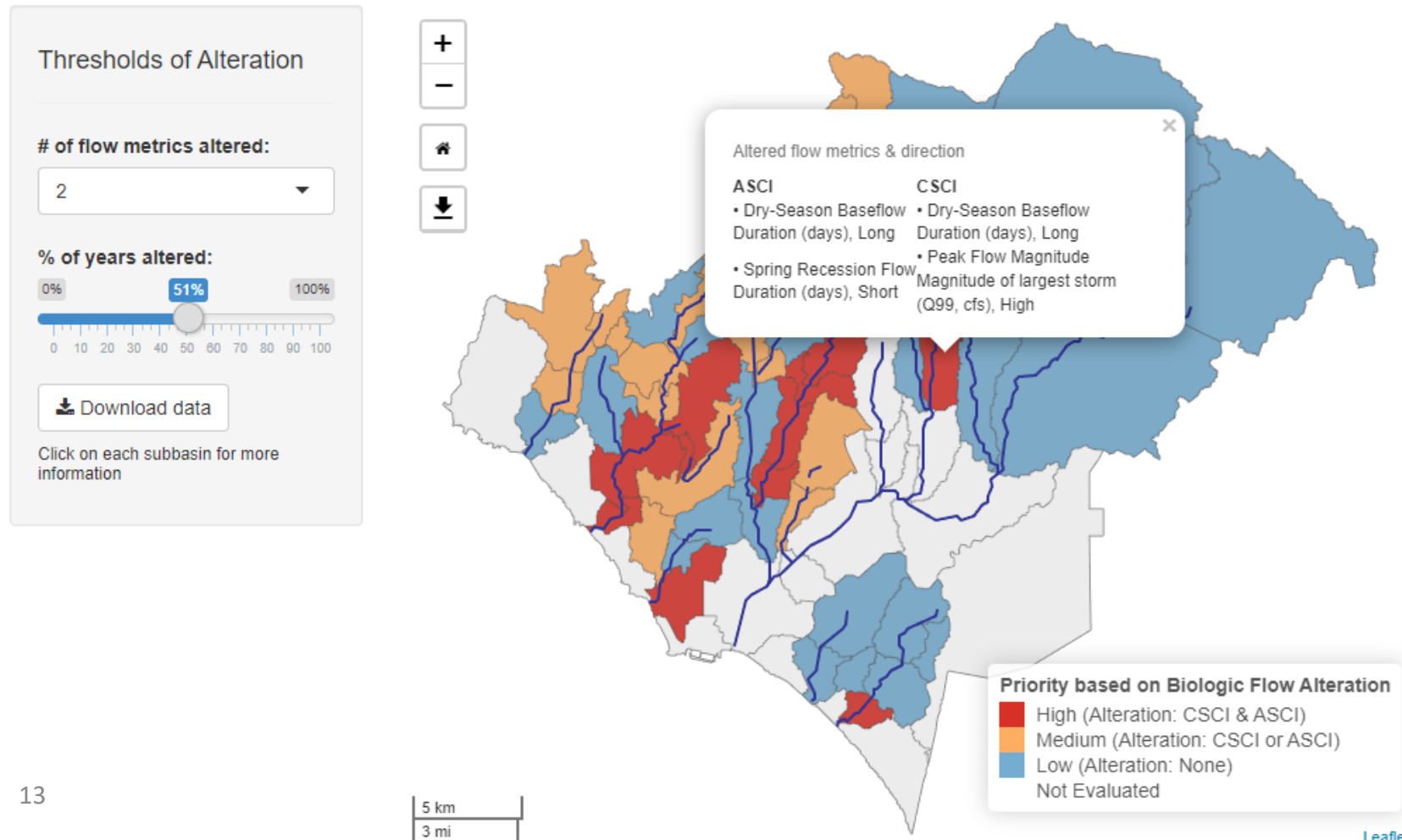
What areas should be prioritized for management?

# Web-based Application

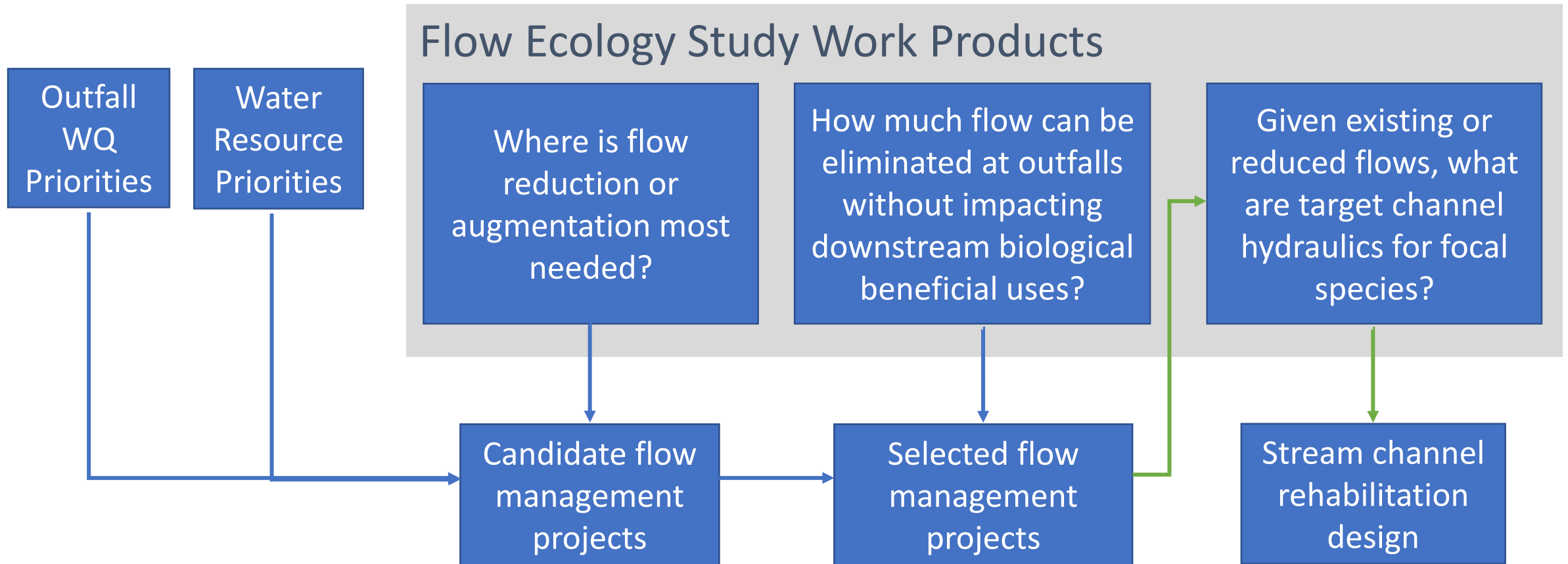
[https://sccwrp.shinyapps.io/socfess\\_shinyapp/](https://sccwrp.shinyapps.io/socfess_shinyapp/)

## Prioritization for Additional Analysis

Based on Biologically-Relevant Flow Alteration



# How can the products be used locally?





# What did we learn?

- Hydrologic alteration affects biological condition to varying degrees
- Flow ecology tools can be used to prioritize subbasins for management
  - Approximately 40% of subbasins prioritized for flow management
- CEFF provides flexible guidance that can be applied in highly altered systems
  - More detailed local hydrologic modeling may be necessary
  - Consideration of mediating factors (i.e., channel alteration) is important
  - Non-flow management actions may be necessary to achieve ecological flow criteria

# More Information

<https://www.southocwqip.org/pages/flow-ecology-study>

← → ↻ 🏠 southocwqip.org/pages/flow-ecology-study 🔍 ☆ 👤 ⋮

☰ 🔍 Sign In

SOC WQIP WQIP Background HPWQC Special Studies Monitoring Reporting & Adaptive Management Clearinghouse

## Who is conducting the study?



**OC Public Works**  
Overseeing the study on behalf of the municipalities of South OC WMA

**Geosyntec Consultants**  
Serves as one of two study leads with their efforts focused on hydrology

**SCCWRP**  
Serves as one of two study leads with their efforts focused on ecology

## How can I get involved?

Currently, input on this study is solicited through two groups: (1) the Stakeholder Advisory Group (SAG), which provides input on the overall study process and (2) the Technical Advisory Group (TAG), which provides technical input on the approach, methods, and study endpoints. All SAG and TAG meeting materials are available by clicking the links below.

**December 2, 2020**

### SAG/TAG Webinar Workshop

Focus: flow ecology analyses and synthesis.

**November 12, 2020**

### SAG/TAG Webinar Workshop

Focus: isotope study findings, hydrologic model recalibration, and water conservation and climate change scenario analysis.

**July 16, 2020**

### SAG/TAG Webinar Workshop

Focus: hydrologic assessment results and the proposed flow ecology evaluation approach.

**July 3, 2020**

### TAG Webinar Workshop

Focus: hydrologic model, its calibration, and its output

**January 8, 2020**

### SAG/TAG In-person Workshop

Focus: update on study progress and address action items from previous meetings

**October 22, 2019**

### TAG In-person Workshop

Focus: discuss technical processes within the study and opportunities for TAG input

**August 5, 2019**

### SAG In-person Workshop

Focus: discuss the study and opportunities for SAG input

**July 17, 2019**

### SAG Webinar Workshop

Focus: introduce the special study

Open Data Portal:

<https://ocgov.app.box.com/v/20-21WQIPAppendixH>

← → ↻ 🏠 ocgov.app.box.com/v/20-21WQIPAppendixH 🔍

 COUNTY OF ORANGE CALIFORNIA

## Appendix H - Special Study Work Plan

Name



Final Report Data Products

🔗 South OC WQIP, 2 Others



Appendix H.1 - Flow Ecology Special Study Final Report.pdf

🔗 South OC WQIP, 2 Others



# Additional Resources

Taniguchi-Quan, K. T., Irving, K., Stein, E. D., Poresky, A., Wildman Jr, R. A., Aprahamian, A., Rivers, C., Sharp, G., Yarnell, S. M., & Feldman, J. R. (2022). Developing Ecological Flow Needs in a Highly Altered Region: Application of California Environmental Flows Framework in Southern California, USA. *Frontiers in Environmental Science*, 1–18. <https://doi.org/10.3389/fenvs.2022.787631>

Irving, K., Taniguchi-Quan, K. T., Aprahamian, A., Rivers, C., Sharp, G., Mazor, R. D., Theroux, S., Holt, A., Peek, R., & Stein, E. D. (2022). Application of Flow-Ecology Analysis to Inform Prioritization for Stream Restoration and Management Actions. *Frontiers in Environmental Science*, 1–18. <https://doi.org/10.3389/fenvs.2021.787462>

# Questions?

Kris Taniguchi-Quan  
[kristinetq@sccwrp.org](mailto:kristinetq@sccwrp.org)

Eric Stein  
[erics@sccwrp.org](mailto:erics@sccwrp.org)





# Napa County Groundwater Sustainability Agency

## Technical Advisory Group

### *Groundwater Conditions and Potential Recharge Areas of Interest*

September 8, 2022



**Luhdorff &  
Scalmanini**  
Consulting Engineers







# Current Conditions and RMS Templates

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# SMC for Chronic Lowering of Groundwater Levels

## Minimum Threshold

Minimum static October groundwater elevation prior to 2015

## Undesirable Result

20% of designated RMS well levels fall below the MT in fall (October) for 3 consecutive years of fall measurements in non-drought years

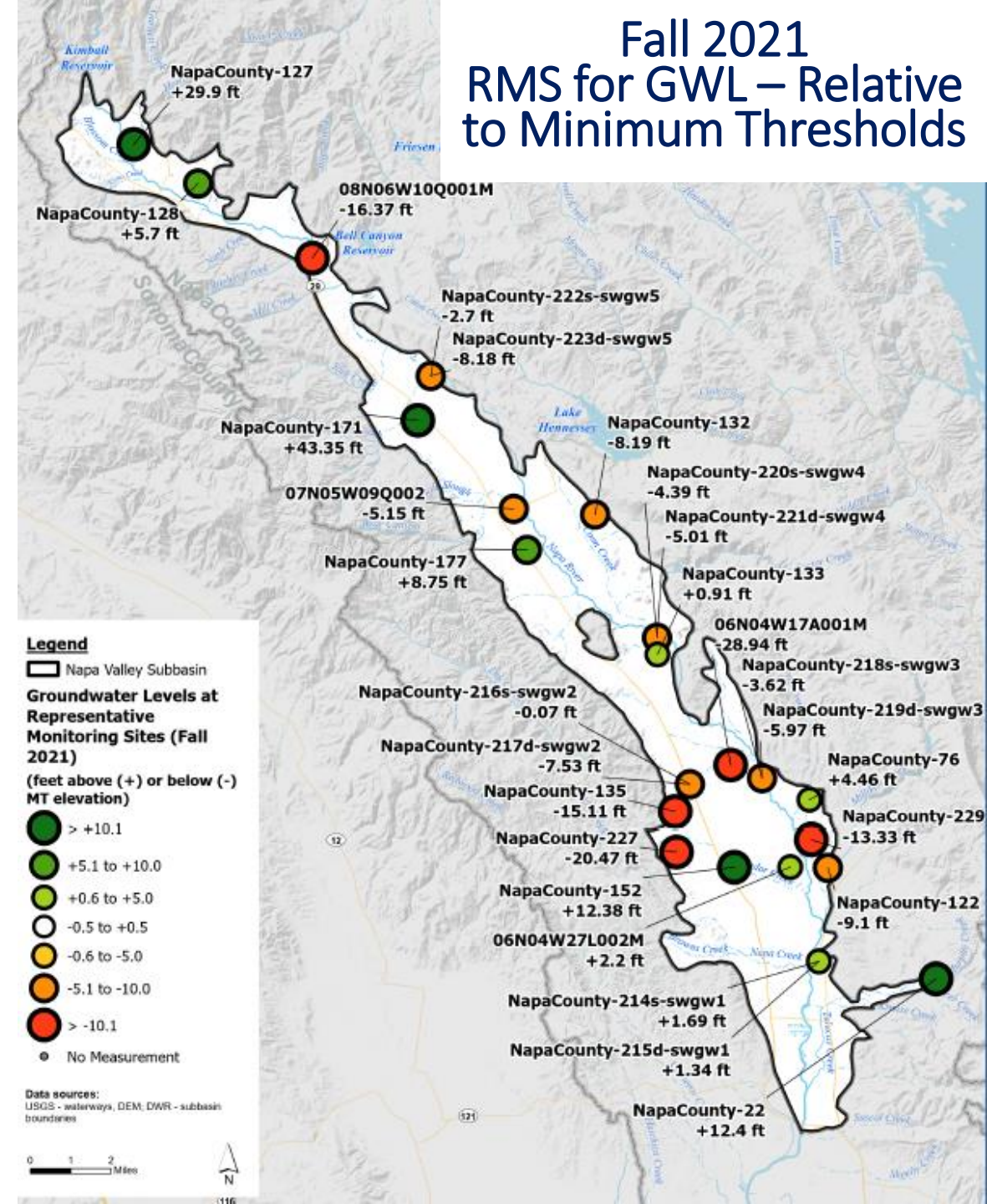
## Trigger

20% of designated RMS well levels fall below the MT in fall during a single year

# RMS Groundwater Levels- Fall 2021

- 27 RMS wells measured
- 16 of the 27 wells (59%) had exceedances
  - 5 well had exceedance of > 10 feet
  - 7 wells had exceedances of 5-10 ft
  - 3 wells had exceedances of 2-5ft
  - 1 well had exceedances of 0-1ft

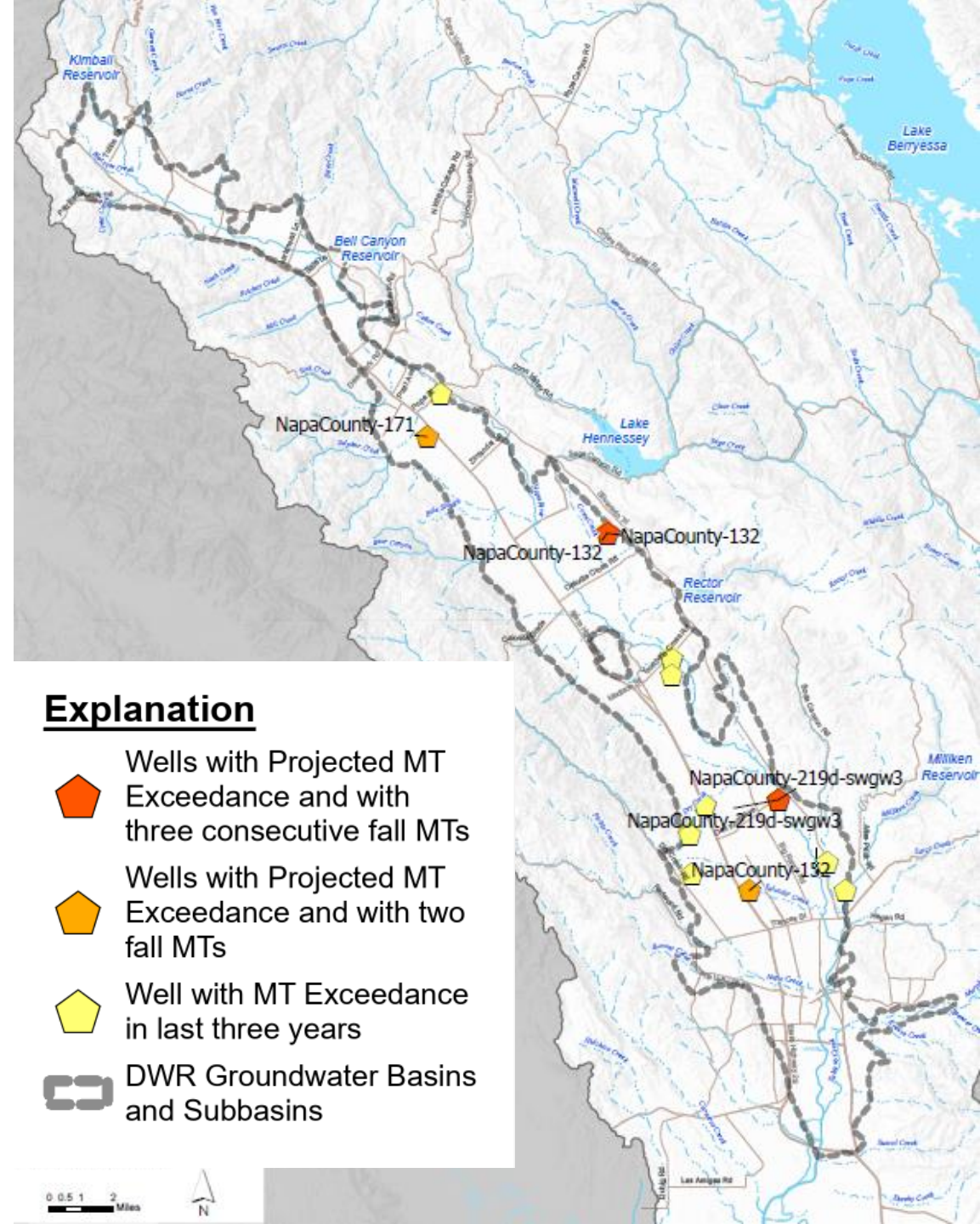
Fall 2021  
RMS for GWL – Relative  
to Minimum Thresholds





# RMS Groundwater Levels- Response Action Required

- Four wells on track to have a Fall MT exceedance
- Two of the wells will have had three consecutive years of MT Exceedance
- Three wells have been dropped from a monitoring network
  - Letters for re-recruitment have been drafted



# RMS Template

- Data sheets are provided for all RMS Wells that monitor groundwater levels in Napa Valley.
- Information pertaining to location, Sustainability Indicator(s), construction information, and nearby features are included.
- These are living documents and can be updated and modified based on requests.

## Well Name: NapaCounty-127

### Monitoring Network

SGMA Representative Monitoring Network

### SGMA Sustainability Indicator(s)

Groundwater Levels (GWL)

### Supplemental Indicator(s)

NA

### Well Identification

SWN: 009N007W25N001M

MNM: 385926N1225938W001

### Well Construction

Well Type: Domestic well

Well Depth (ft bgs): 149

Top of Perforation (ft bgs): NA

Bottom of Perforation (ft bgs): NA

Well Completion Report Available? Yes

### Monitoring Information

Monitoring Frequency: Semi-Annual GWL

Measurable Objectives (MO) and Minimum Thresholds (MT) (ft amsl):

GWL MO = 374.0; MT = 351.0

### Groundwater Level Observation

Most Recent Water Level:

Measurement Date: 3/7/2022

Depth below ground surface (ft): 9.33

Elevation (ft amsl): 382.67

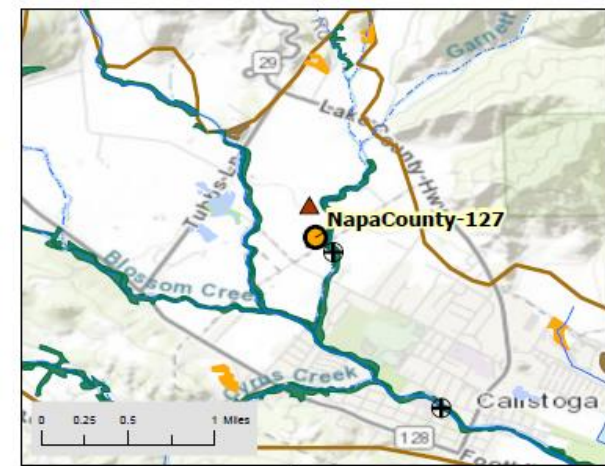
### Location Description

Latitude/Longitude: 38.593241/-122.592484

Ground Surface Elevation (ft amsl): 392.00

Distance to Perennial Stream (ft): 300

Alluvial Thickness (ft): 70



### Explanation

● RMS Sites in Focus

Other RMS Sites

▲ Groundwater Well

⊗ Stream Flow/Stage

▲ Benchmark (Land Subsidence)

Non-RMS Monitoring Sites

■ Groundwater Well

⊗ Stream Flow/Stage

▲ Benchmark (Land Subsidence)

Subbasin Boundary

Groundwater Dependent Ecosystems

■ Bulrush - Cattail

■ Coast Live Oak Alliance

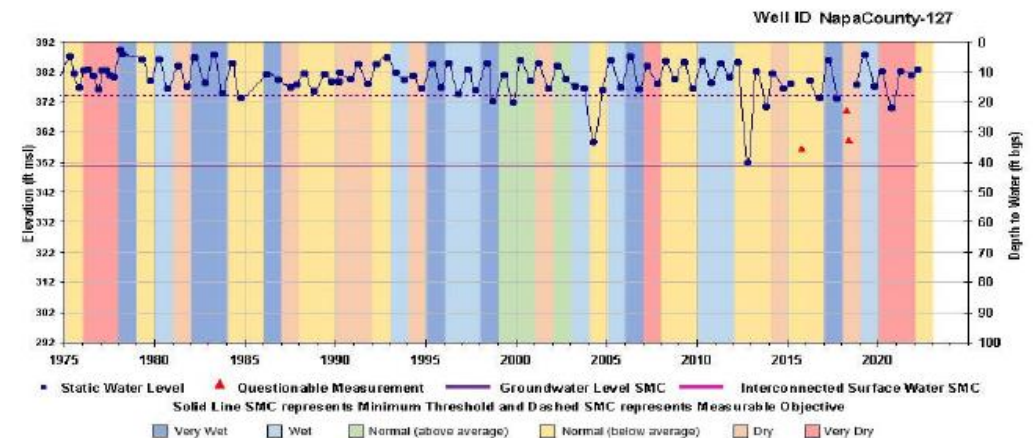
■ Riparian Valley Oak

Valley Oak Alliance

Wetlands

— River/Creek - Perennial

--- River/Creek - Intermittent





# MT Exceedance Summary



| Well ID               | MT<br>(ft msl) | Fall 2020<br>(ft msl) | Fall 2021<br>(ft msl) | Spring<br>2022<br>(ft msl) | Summer<br>2022<br>(ft msl) | Response Action                         |
|-----------------------|----------------|-----------------------|-----------------------|----------------------------|----------------------------|-----------------------------------------|
| 06N04W17A001M         | 42             | -11.44                | -28.94                |                            |                            | Working to re-recruit                   |
| 07N05W09Q002M         | 126            | 2.34                  | -5.15                 |                            |                            | Working to re-recruit                   |
| 08N06W10Q001M         | 270            | -21.57                | -16.37                |                            |                            | Working to re-recruit                   |
| NapaCounty-122        | -45            | -7.35                 | -9.1                  | 9.67                       |                            |                                         |
| NapaCounty-132        | 109            | -2.7                  | -8.19                 | 3.8                        | -0.65                      | Yes, on track to have a fall exceedance |
| NapaCounty-133        | 73             | -1.2                  | 0.91                  | 8.52                       | 1.08                       |                                         |
| NapaCounty-135        | 33             | 19.68                 | -15.11                | 19.73                      | 6.63                       |                                         |
| NapaCounty-152        | 55             | 5.16                  | 12.38                 | 11.96                      | -55                        | Yes, on track to have a fall exceedance |
| NapaCounty-171        | 165            | -6.73                 | 43.35                 | 38.83                      | -4.2                       | Yes, on track to have a fall exceedance |
| NapaCounty-216s-swgw2 | 66             | 4.995                 | -0.07                 | 20.11                      | 18.51                      |                                         |
| NapaCounty-217d-swgw2 | 60             | -0.373                | -7.53                 | 12.87                      | 7.97                       |                                         |
| NapaCounty-218s-swgw3 | 29             | 0.04                  | -3.62                 | 3.47                       | -1.38                      | Yes, on track to have a fall exceedance |
| NapaCounty-219d-swgw3 | 29             | -0.41                 | -5.97                 | 3.47                       | -1.8                       | Yes, on track to have a fall exceedance |
| NapaCounty-220s-swgw4 | 75             | -0.129                | -4.39                 | 7.49                       | 4.13                       |                                         |
| NapaCounty-221d-swgw4 | 75             | -0.795                | -5.01                 | 7.83                       | 3.41                       |                                         |
| NapaCounty-222s-swgw5 | 185            | 0.47                  | -2.7                  | 7.6                        | 7.16                       |                                         |
| NapaCounty-223d-swgw5 | 164            | -7.88                 | -8.18                 | 15.04                      | 10.11                      |                                         |
| NapaCounty-227        | 59             | N/A                   | -20.47                | 8.1                        |                            |                                         |
| NapaCounty-229        | -69            | -18.59                | -13.33                | 8.37                       |                            |                                         |

Orange on track to have three consecutive MT exceedances in the Fall

Yellow on track to have MT exceedance in the Fall



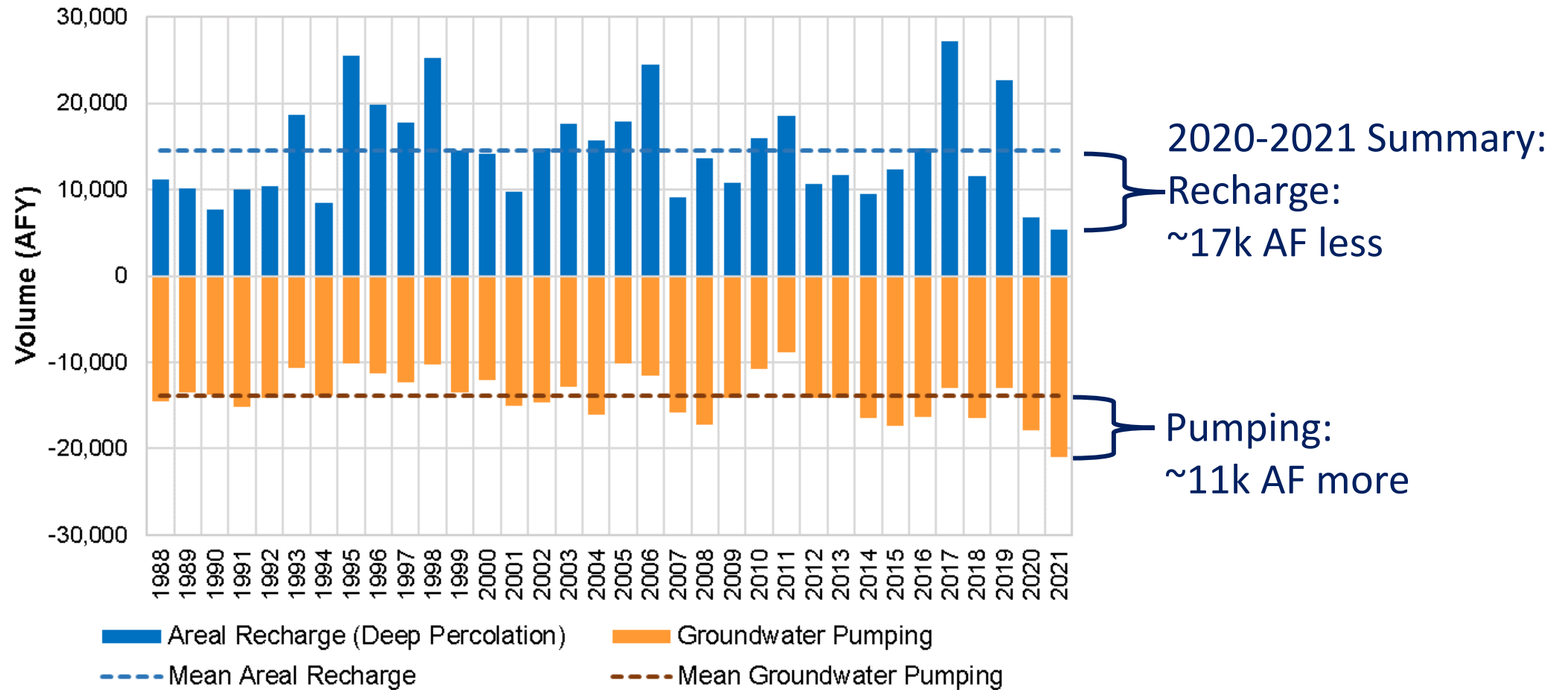
# Quantifying Existing Recharge and Pumping

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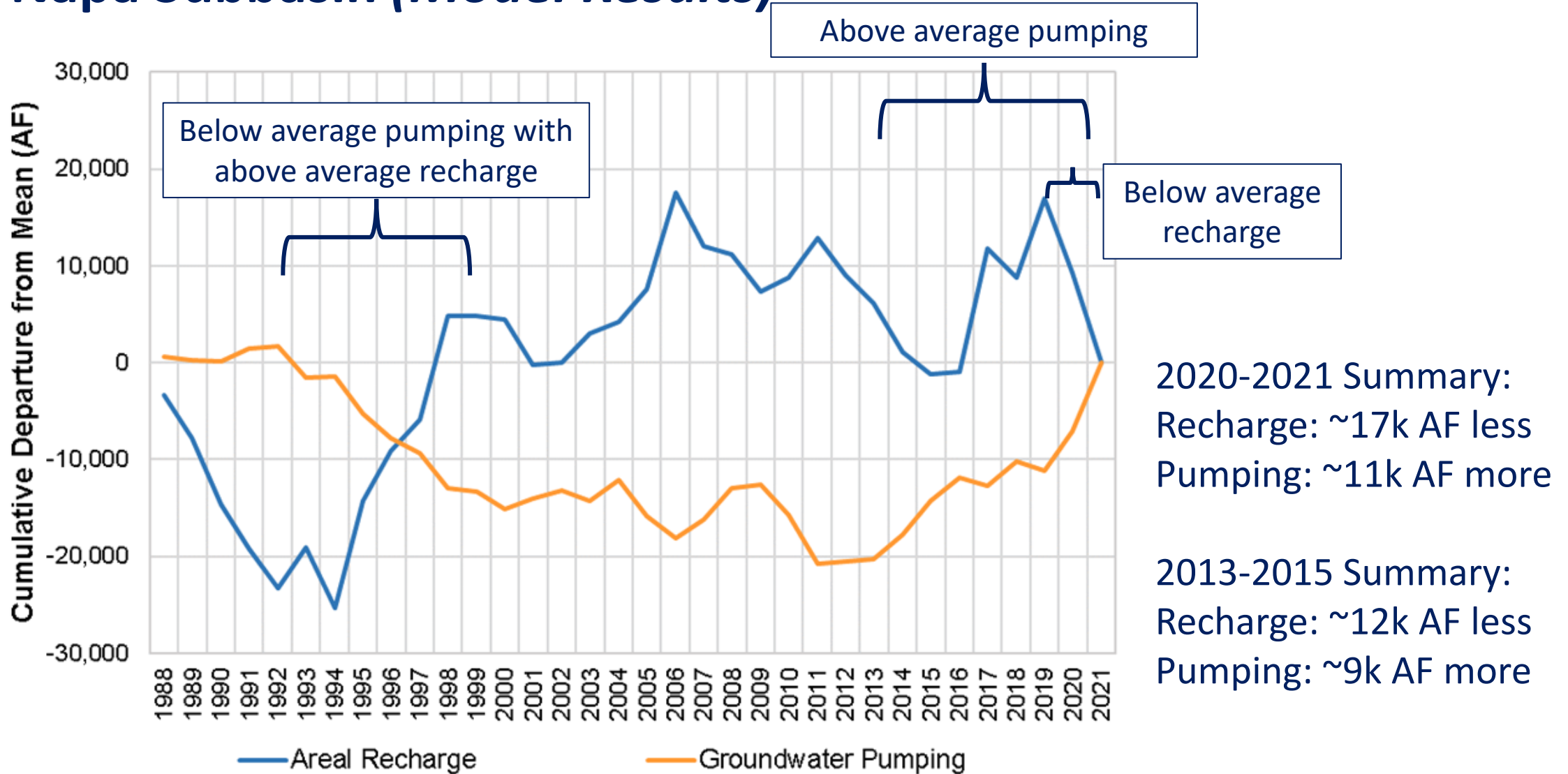


# Pumping and Recharge in the Current Drought: Napa Subbasin (*Model Results*)





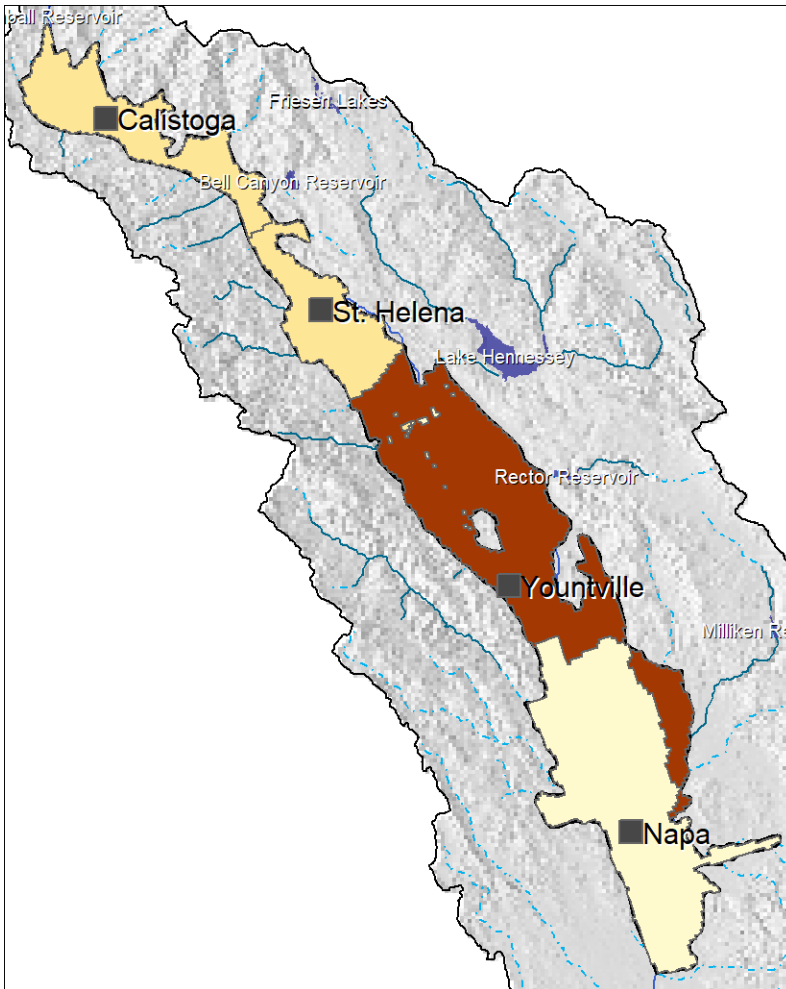
# Pumping and Recharge in the Current Drought: Napa Subbasin (*Model Results*)





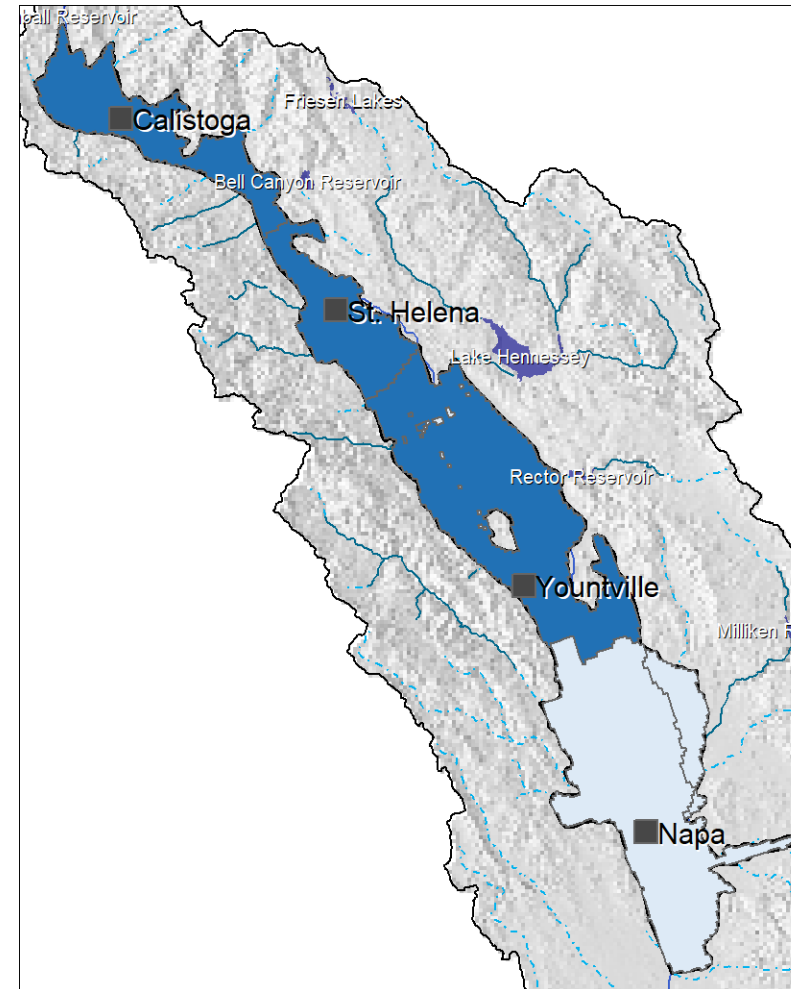
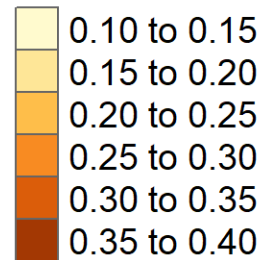


# Pumping and Recharge in the Current Drought: Napa Subbasin – Pumping & Recharge (AF/acre)



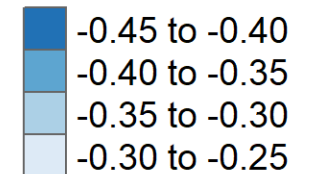
- Napa River
- - - Intermittent Streams
- Perennial Streams
- Napa River Watershed
- Napa Valley Subbasin

Pumping Above  
Average (AF/acre)



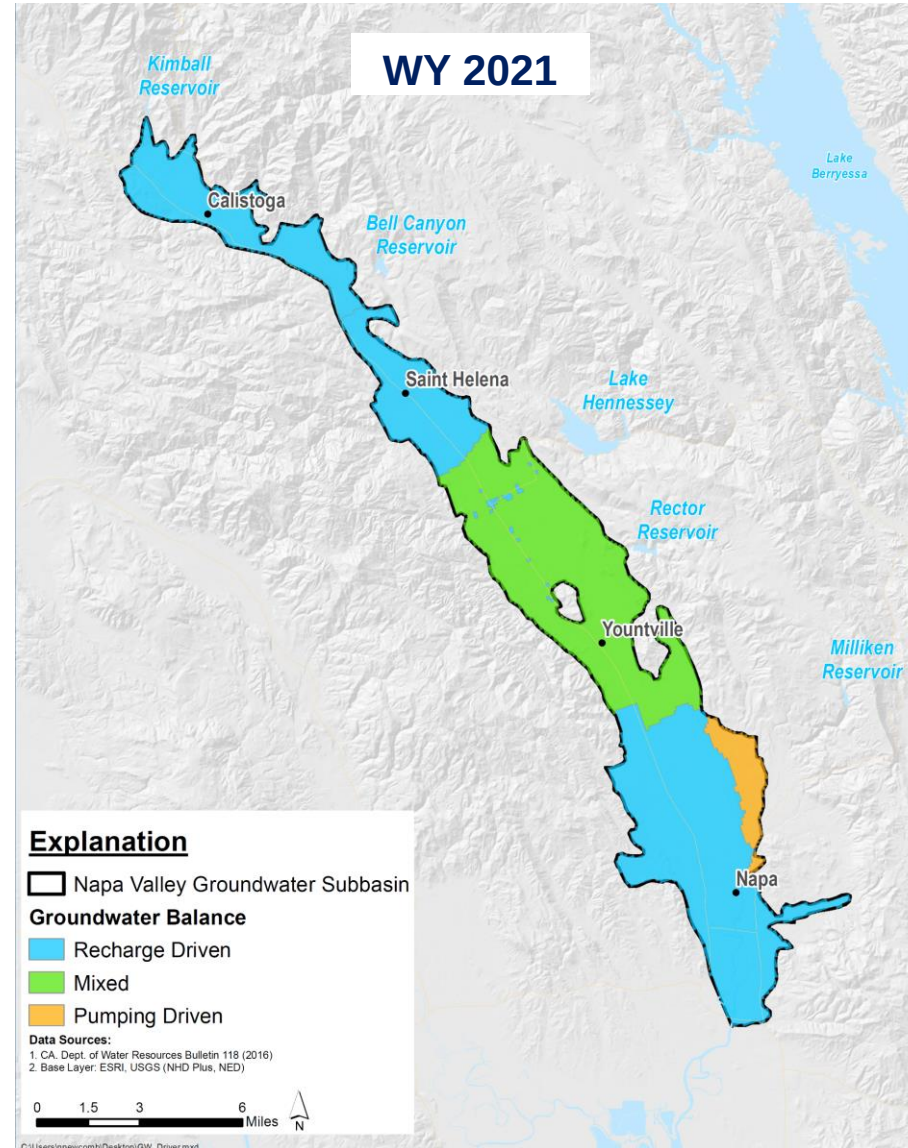
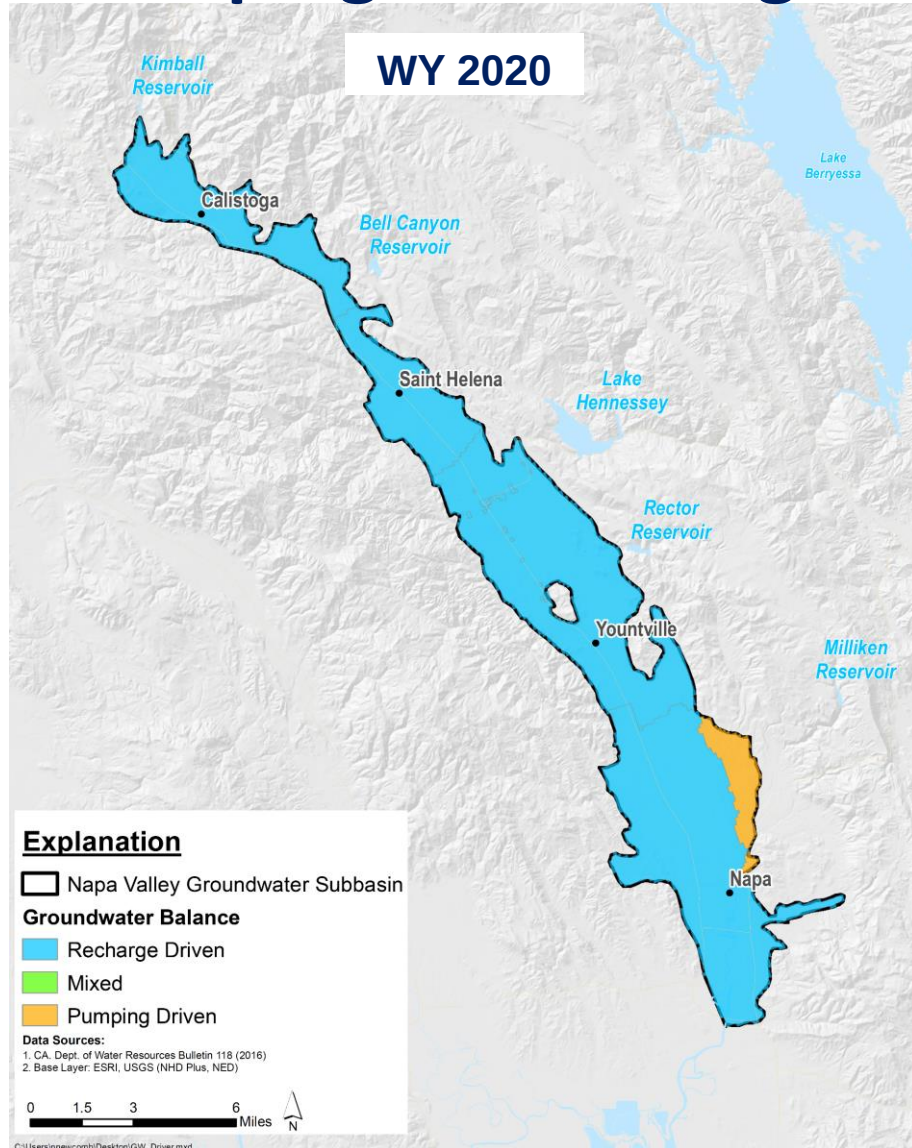
- Napa River
- - - Intermittent Streams
- Perennial Streams
- Napa River Watershed
- Napa Valley Subbasin

Recharge Below  
Average (AF/acre)





# Quantifying the Relative Impact of Pumping vs. Recharge



$\Delta Q$  Difference in Pumping Relative to 1988-2019 Average

$\Delta R$  Difference in Recharge Relative to 1988-2019 Average

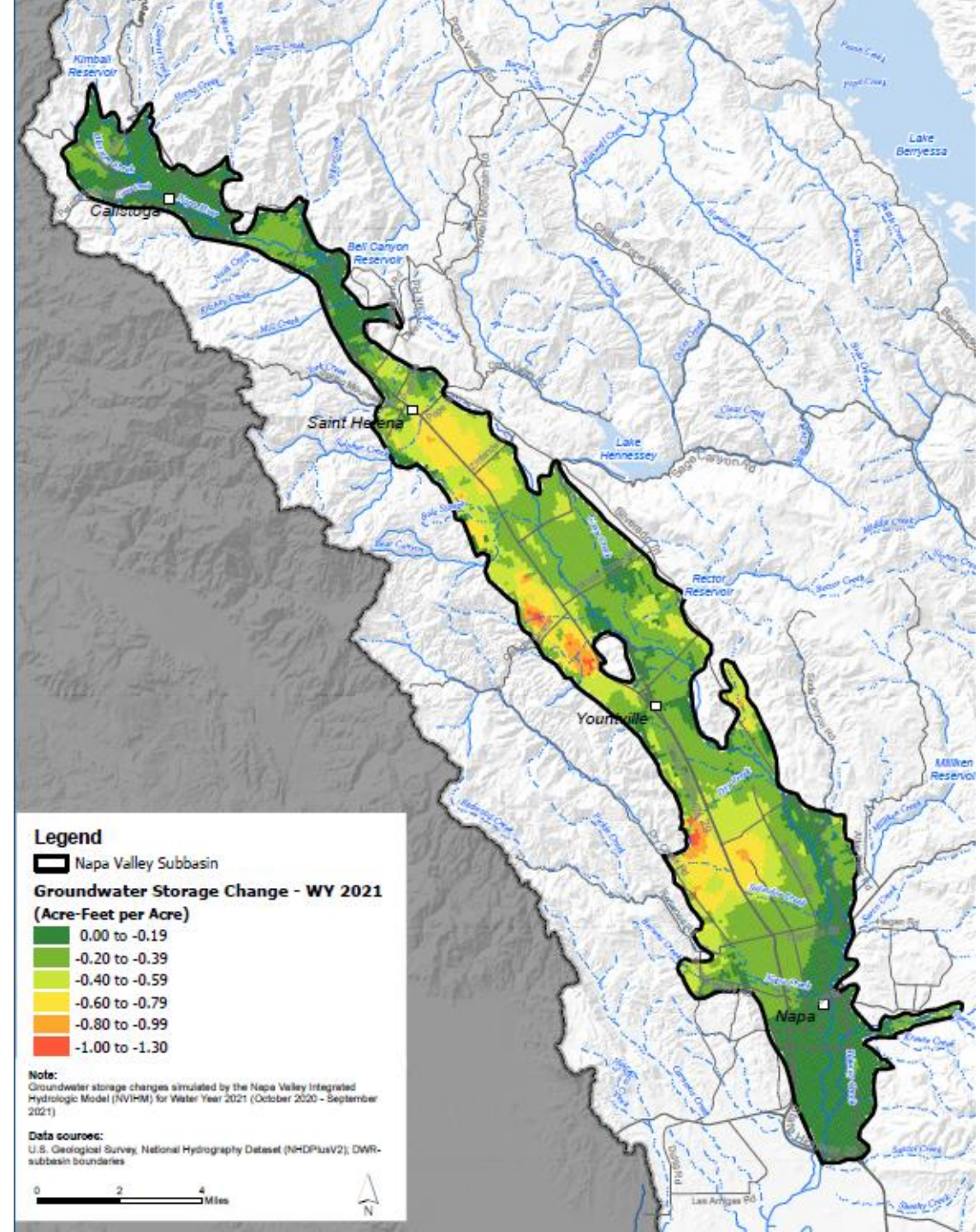
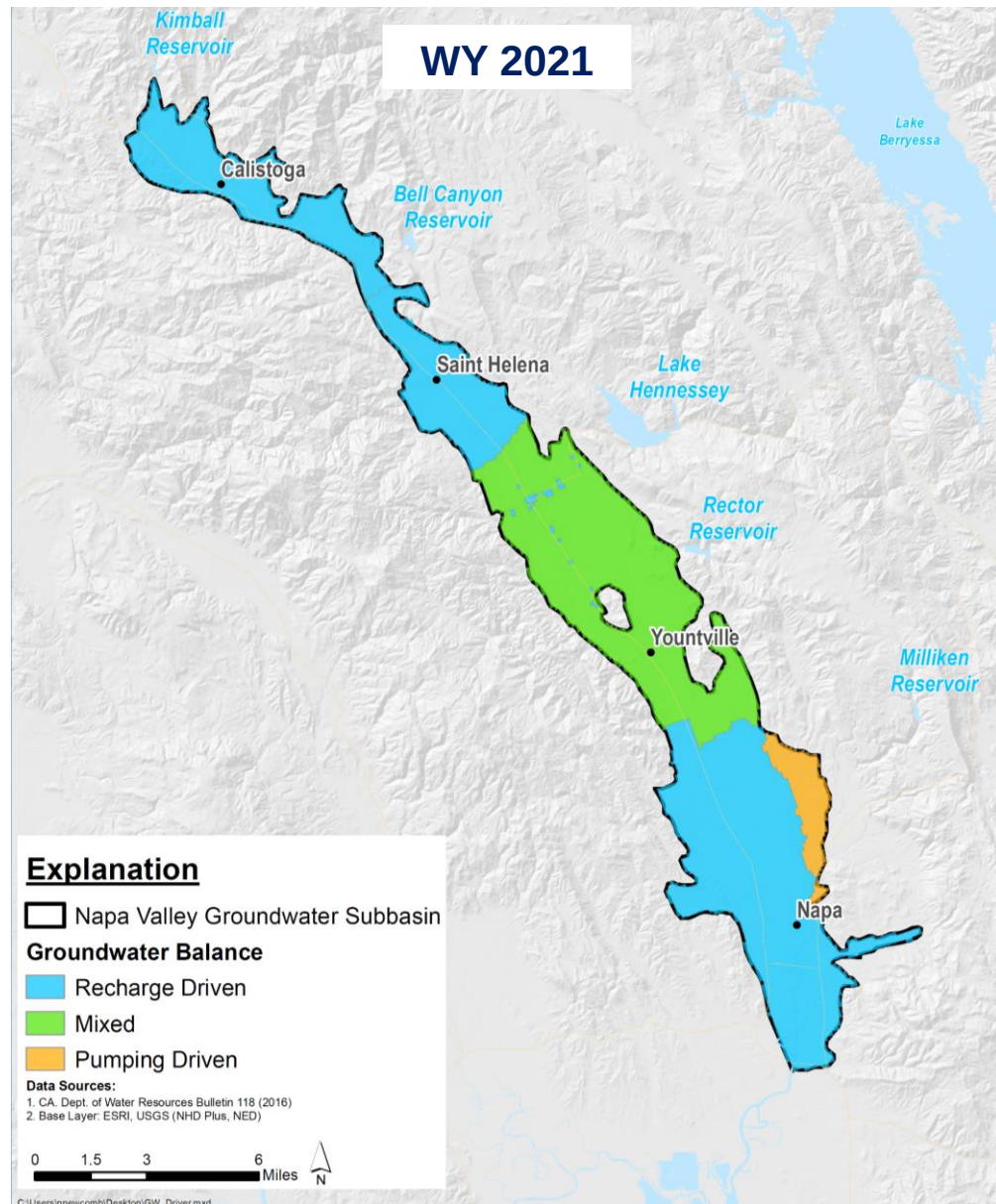
$\frac{\Delta Q}{\Delta R} \leq 0.75$  Recharge Driven

$0.75 < \frac{\Delta Q}{\Delta R} \leq 1.25$  Mixed

$\frac{\Delta Q}{\Delta R} > 1.25$  Pumping Driven



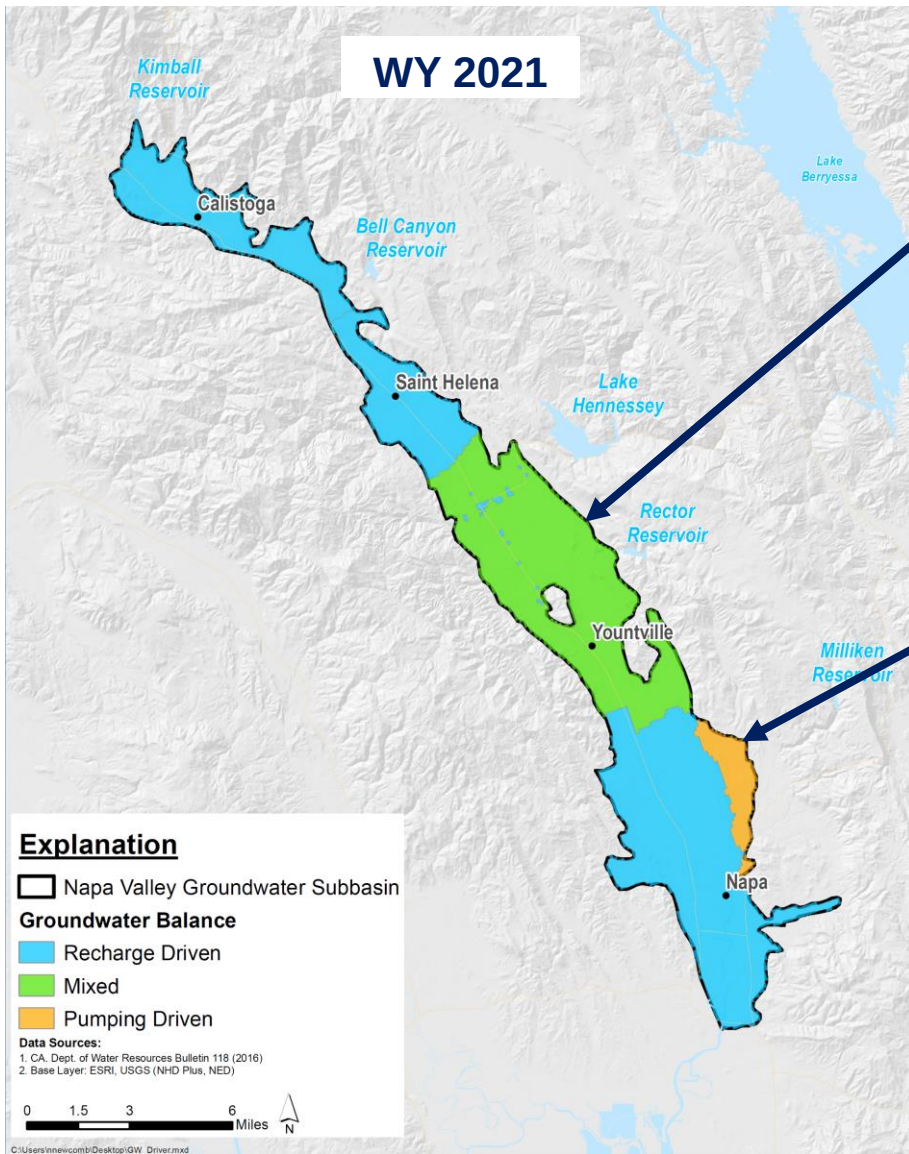
# Pumping and Recharge Changes Compared to Storage Changes





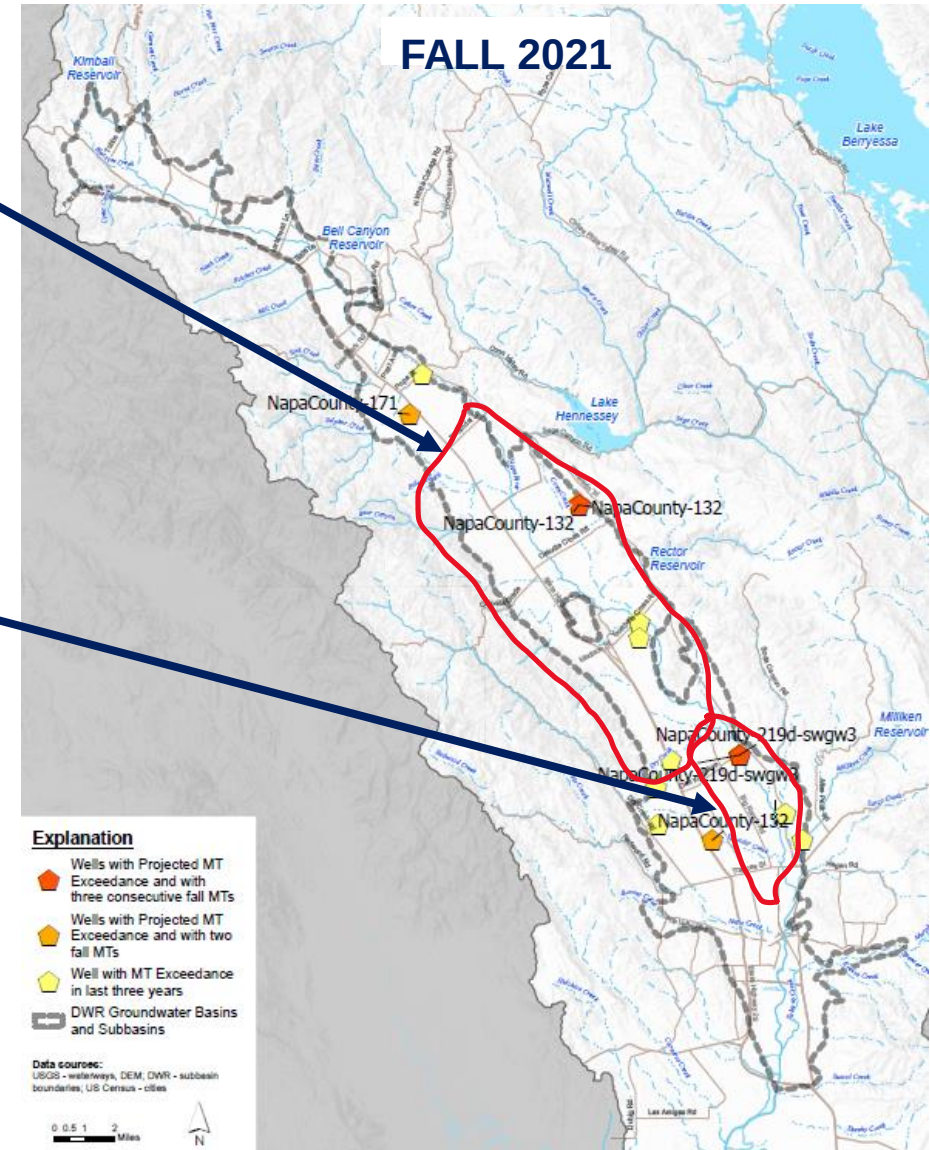


# Drought Impacts by Areas



Drought Effects:  
Mixed impacts of both  
diminished recharge and  
additional pumping. Relative  
to average.

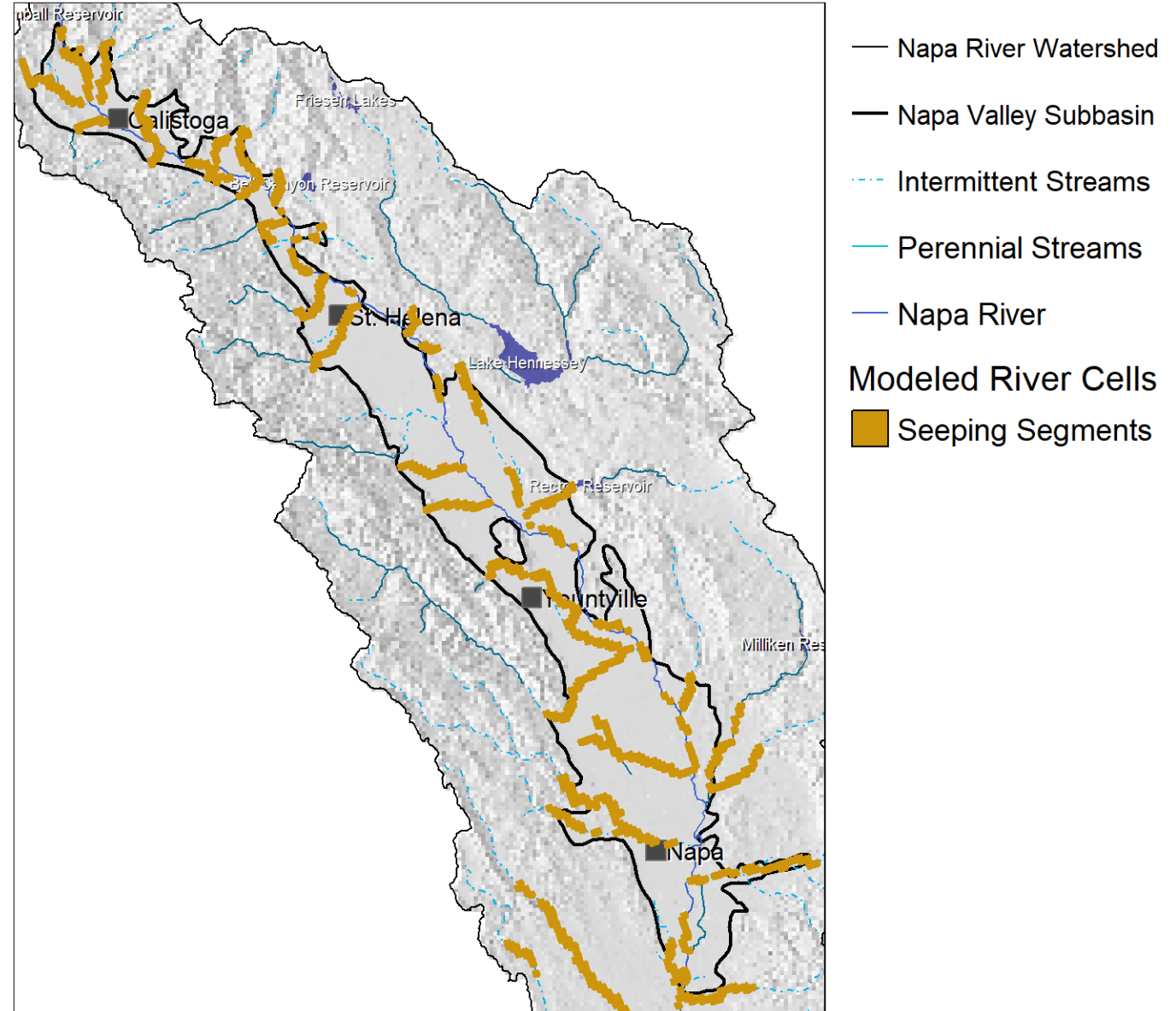
Northeast Napa  
Management Area:  
Predominately pumping  
driven impacts.





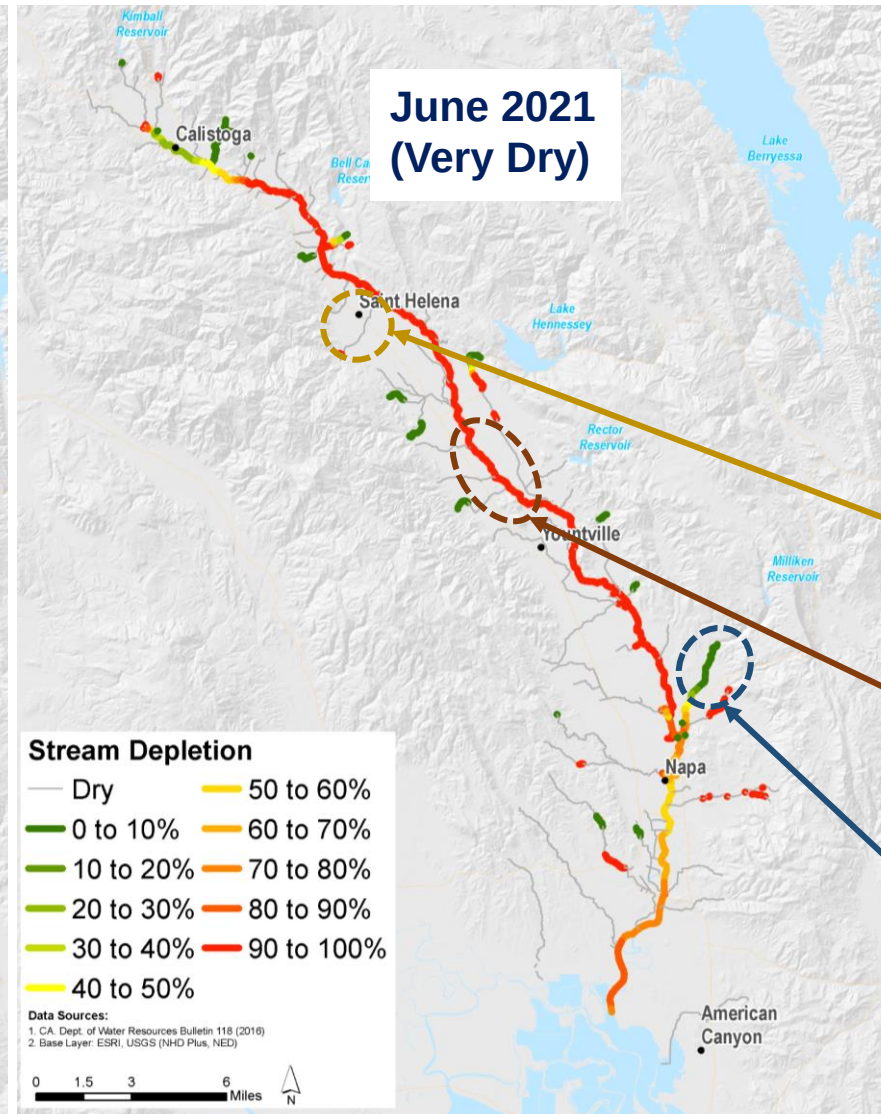
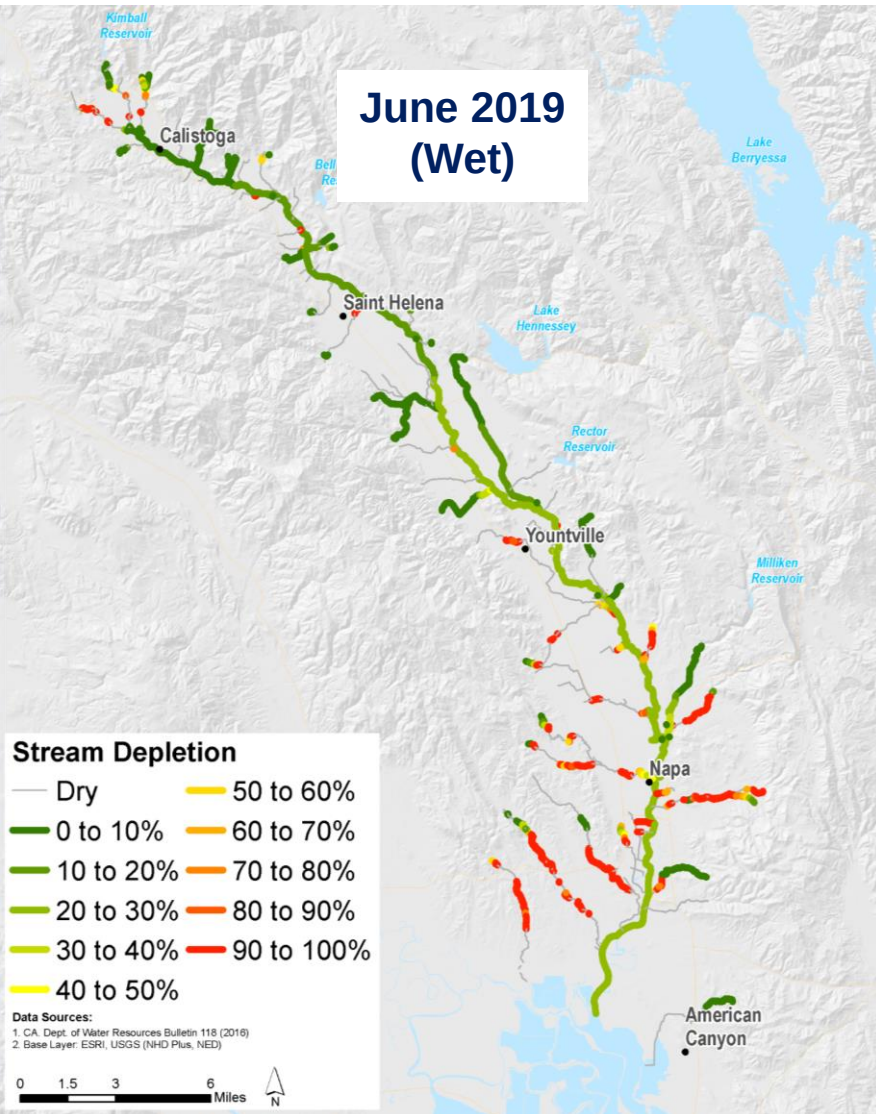
# Modeled Stream Reaches with High Seepage

- Infiltration based on historic groundwater model run (NVIHM).
- Infiltration potential based on amount of infiltration (from river to aquifer) when water was in the stream.
- Scenario analysis for pumping is used to explore effects of groundwater pumping on streams.
  - No Pumping Scenario: Pumping never occurred in Napa Valley
  - Pumping: Normal as-is conditions





# Climate, Pumping, and Stream Flow - June



$$\text{Stream Depletion} = \frac{\text{Flow}_{\text{No Pumping}} - \text{Flow}_{\text{Pumping}}}{\text{Flow}_{\text{No Pumping}}}$$

Stream Depletion is 'Dry' -  
No Pumping scenario flow is 0

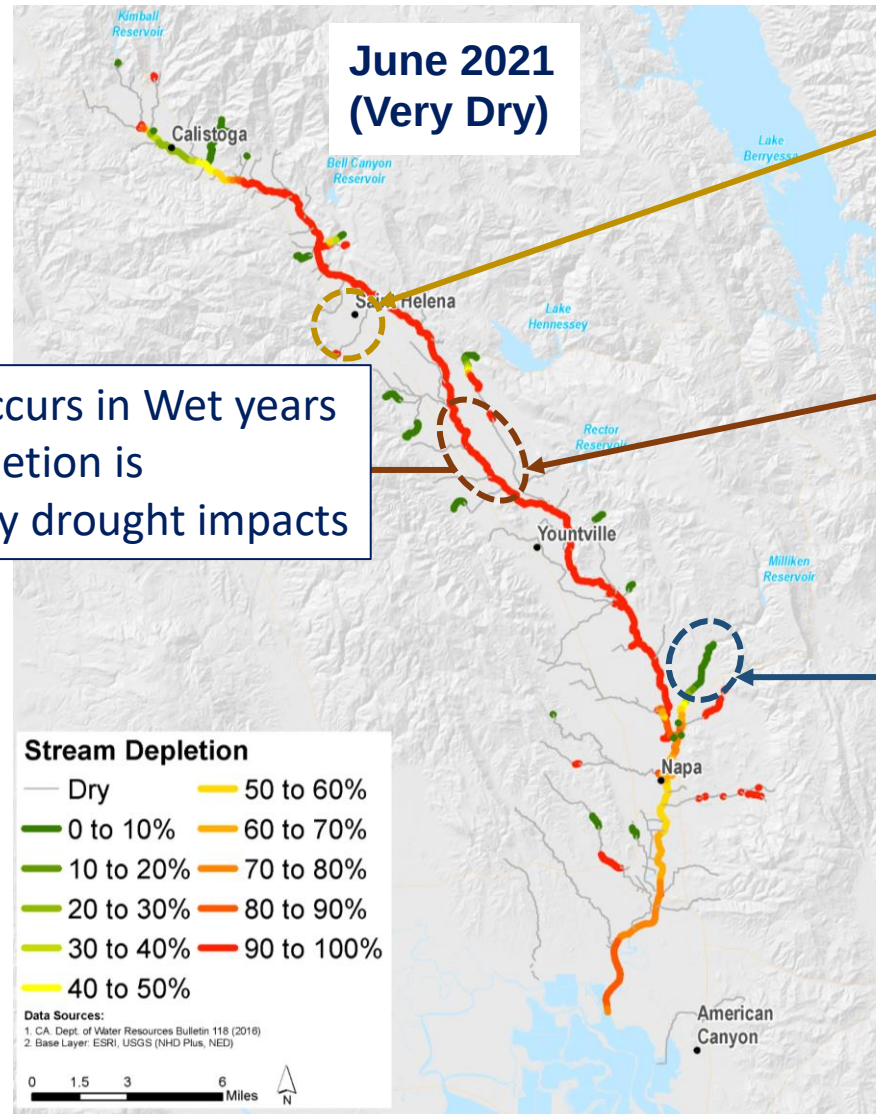
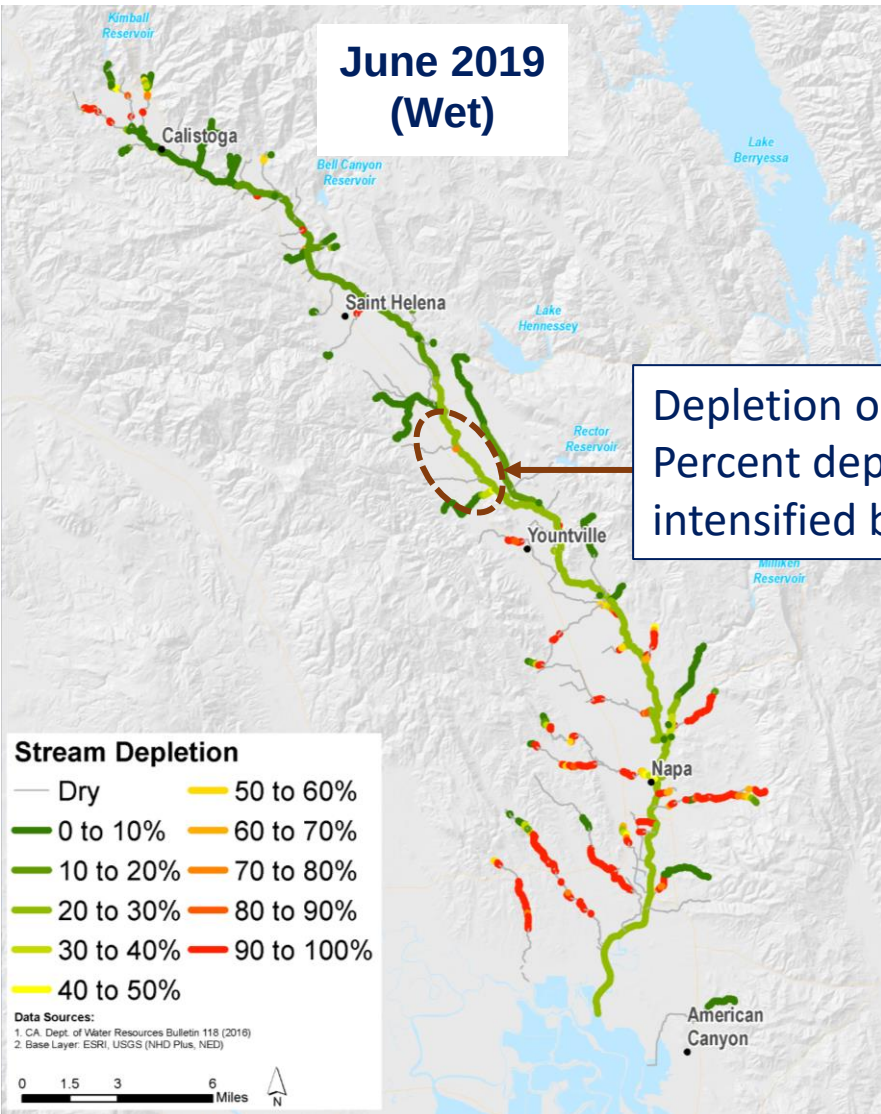
Stream Depletion ~100% -  
Pumping flow is 0 (dry channel)

Stream Depletion ~0% -  
Pumping flow is equal to No Pumping scenario





# Climate, Pumping, and Stream Flow - June



Depletion occurs in Wet years  
Percent depletion is  
intensified by drought impacts

Stream Depletion is 'Dry':  
Pumping reductions will not  
add flow to these reaches.

Stream Depletion ~100% -  
Pumping reductions will have  
the greatest impact to  
increasing flow

Stream Depletion ~0% -  
Pumping has little to no effect  
on stream flow





# Potential Recharge Areas of Interest

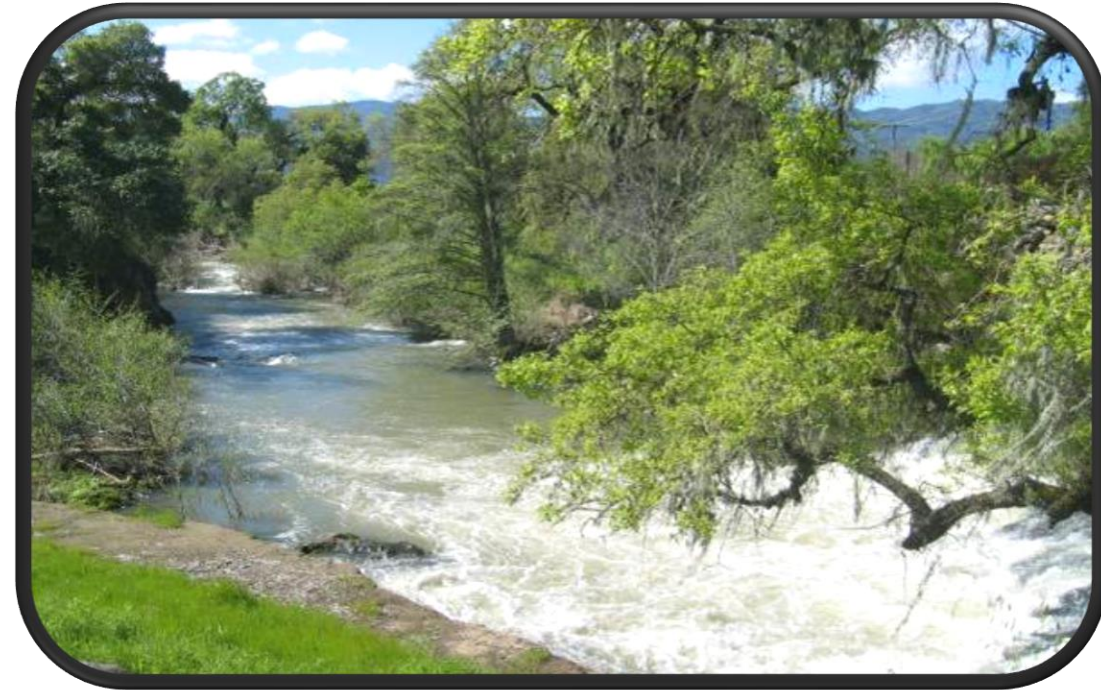
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# Technical Memo on Potential Recharge Areas



- GIS spatial analysis of currently available information
  - Stream network, including significant streams within the Napa River Watershed
  - Surficial and subsurface geology
  - Fish and other ecological habitat status and/or priority (biological value)
  - Stream Watch network observations
  - Other existing observations/prior studies that inform recharge site prioritization



# Recharge Overview



Goals for Recharge



Physical Limitations



Prioritizing Need



Discussion







# Reasons and Goals for Recharge



- Reasons that an area may benefit from additional recharge:
  - Climate impacts
    - Areas that have diminished recharge due to ongoing drought
  - Areas of high pumping
    - Mitigate groundwater decline due to prolonged pumping
  - Additional ecosystem benefits
    - Increased baseflow to river segments
    - Higher groundwater elevation for phreatophytes or other GDE



# Recharge Considerations

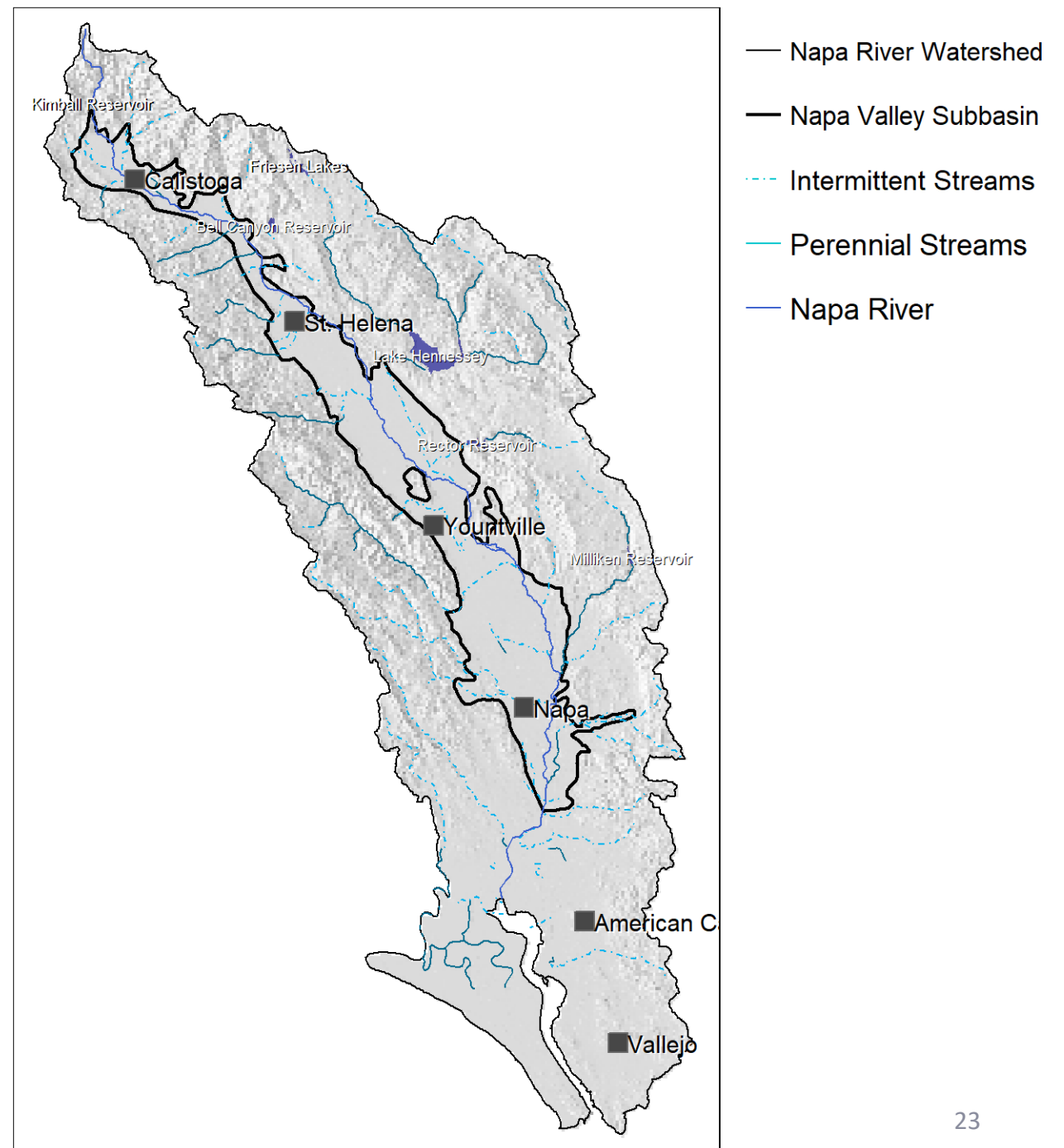
## – Where is it needed?

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# Significant Stream Network

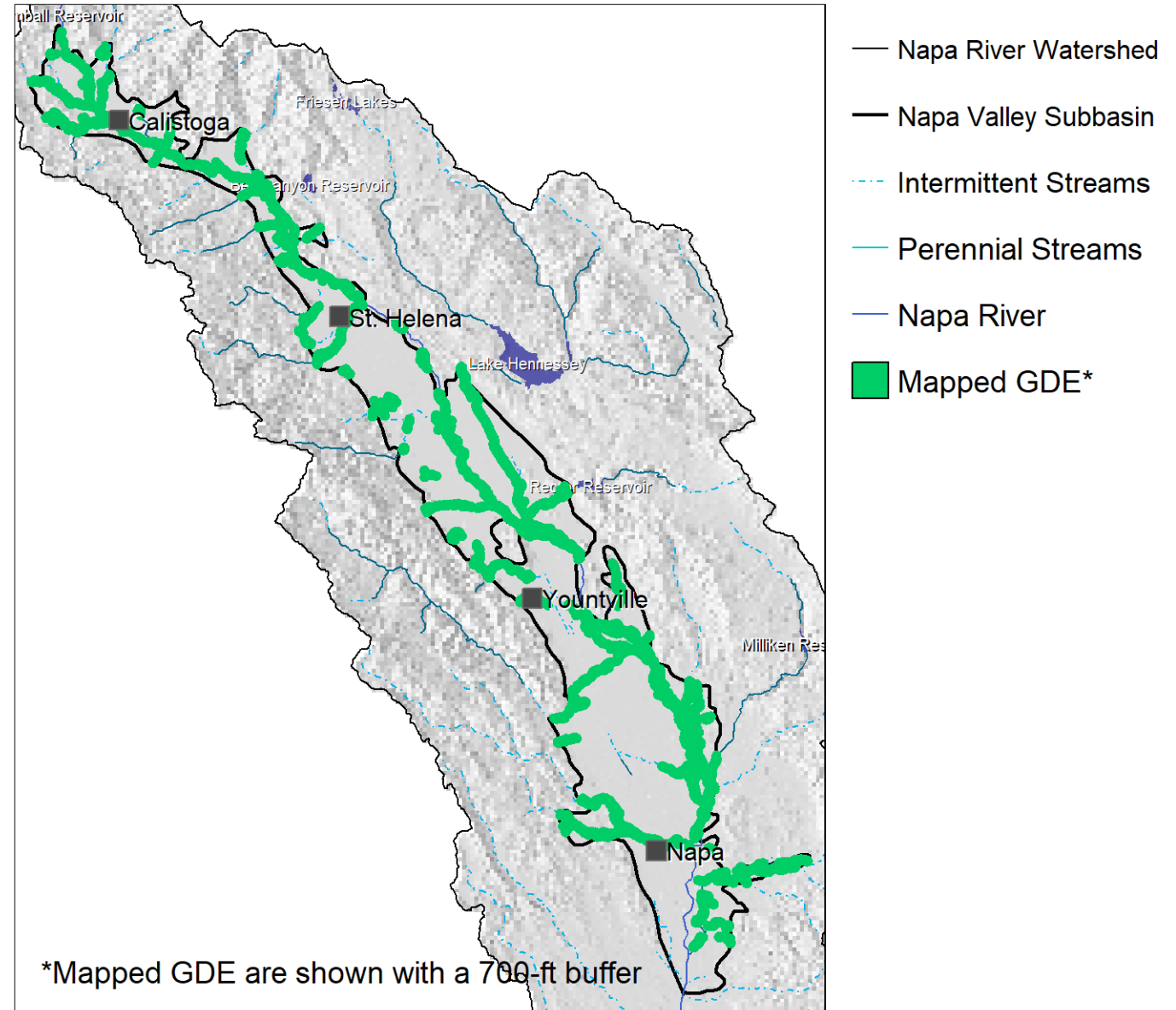
- Streams based on Napa County Stream Network
- Stream Network based on biological habitat as well as perennial rivers



# Groundwater Dependent Ecosystems (GDEs)

## Identification/Delineation

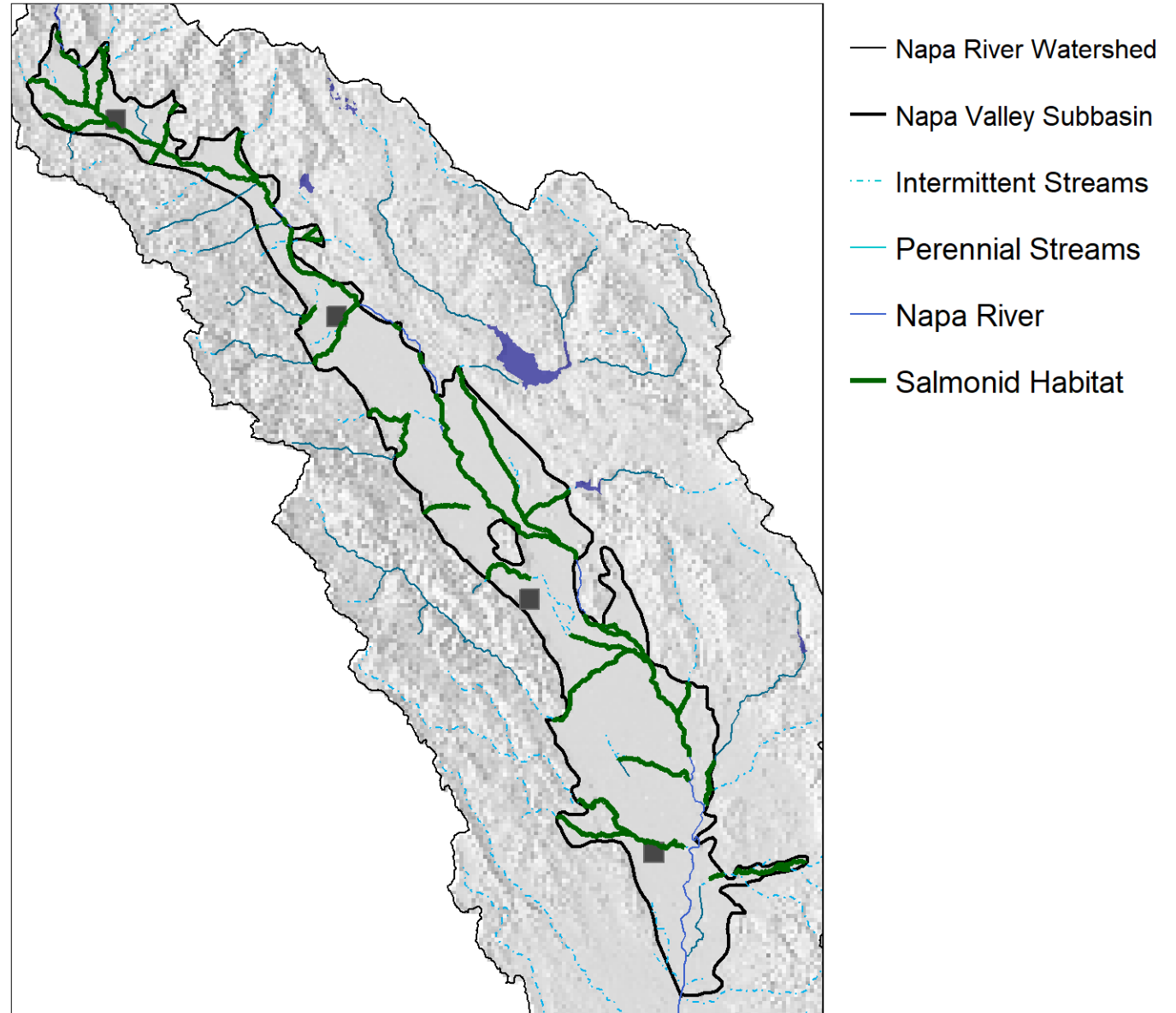
- 2,663 acres delineated in 2019
- 12 freshwater species and 9 other species identified as potentially GW dependent.
- Possible metrics for prioritization:
  - Specific species that are more sensitive to groundwater fluctuations.
  - Changes in remotely sensed health, i.e., NDVI and NDMI
  - Others?





# Fish Habitat

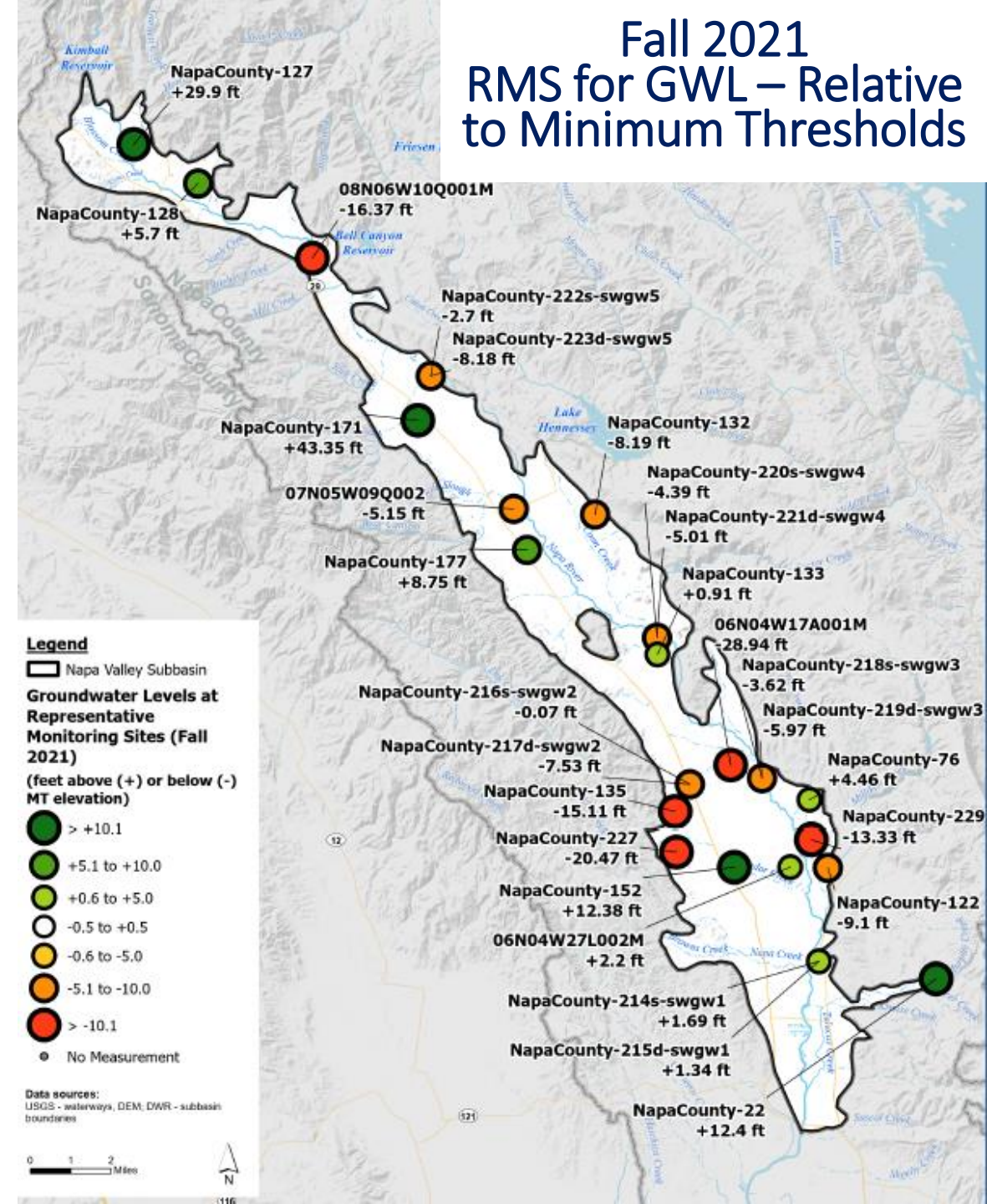
- RCD work to quantify known or potential habitat for salmonids.
- Habitat is for both spawning and rearing.
- Ongoing coordination with RCD is needed to assess which stream reaches may require additional baseflow for better habitat.



# Fall 2021 Groundwater Levels

- Representative Monitoring Sites (RMS) are used to measure the sustainability of an area.
- Fall 2021, multiple wells were below the Minimum Threshold (MT).
- RMS below the MT can be used to identify general areas that would benefit from additional recharge.

Fall 2021  
RMS for GWL – Relative  
to Minimum Thresholds







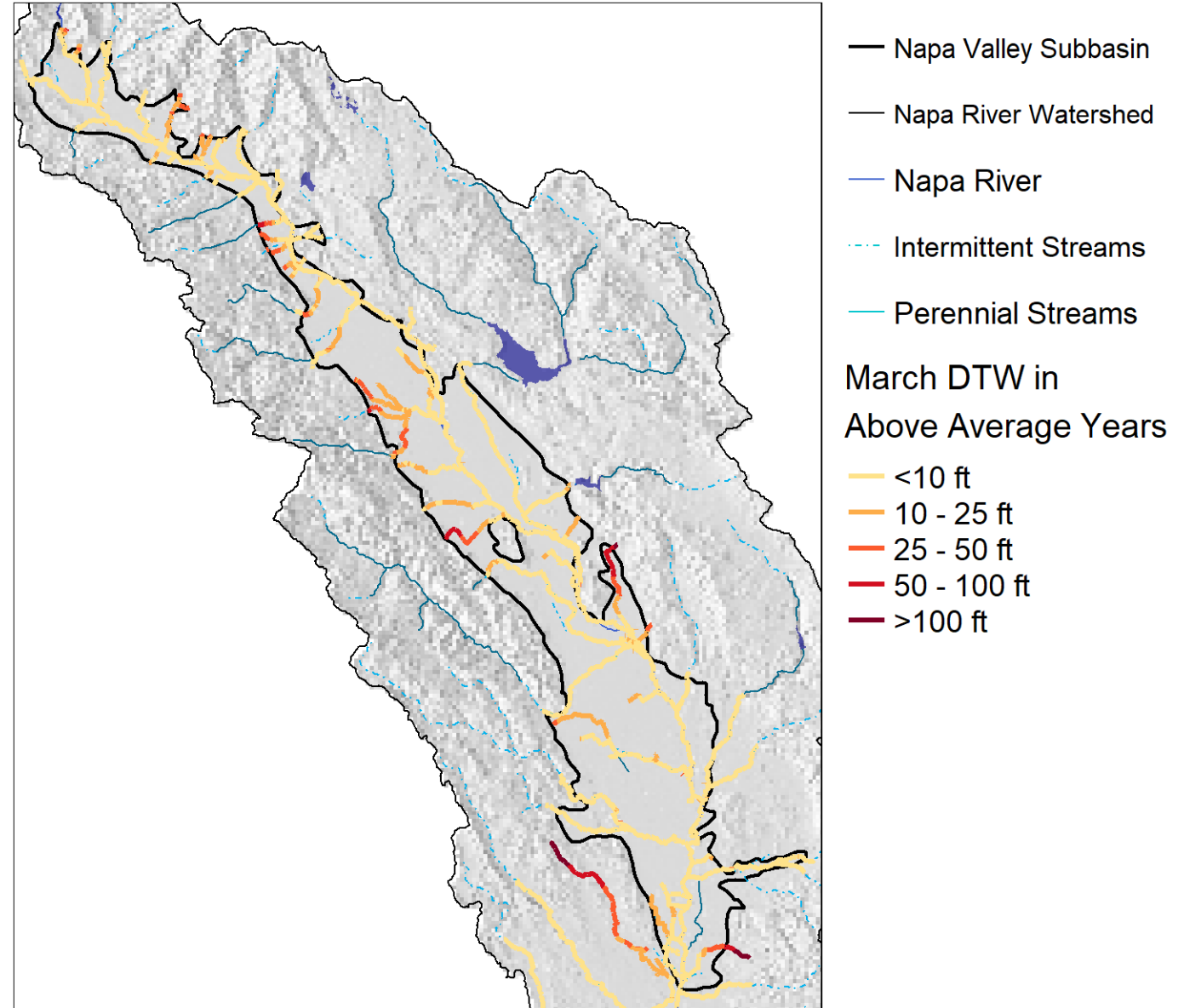
# Physical Characteristics Related to Recharge

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# Depth to Water in Aquifer System below the Stream

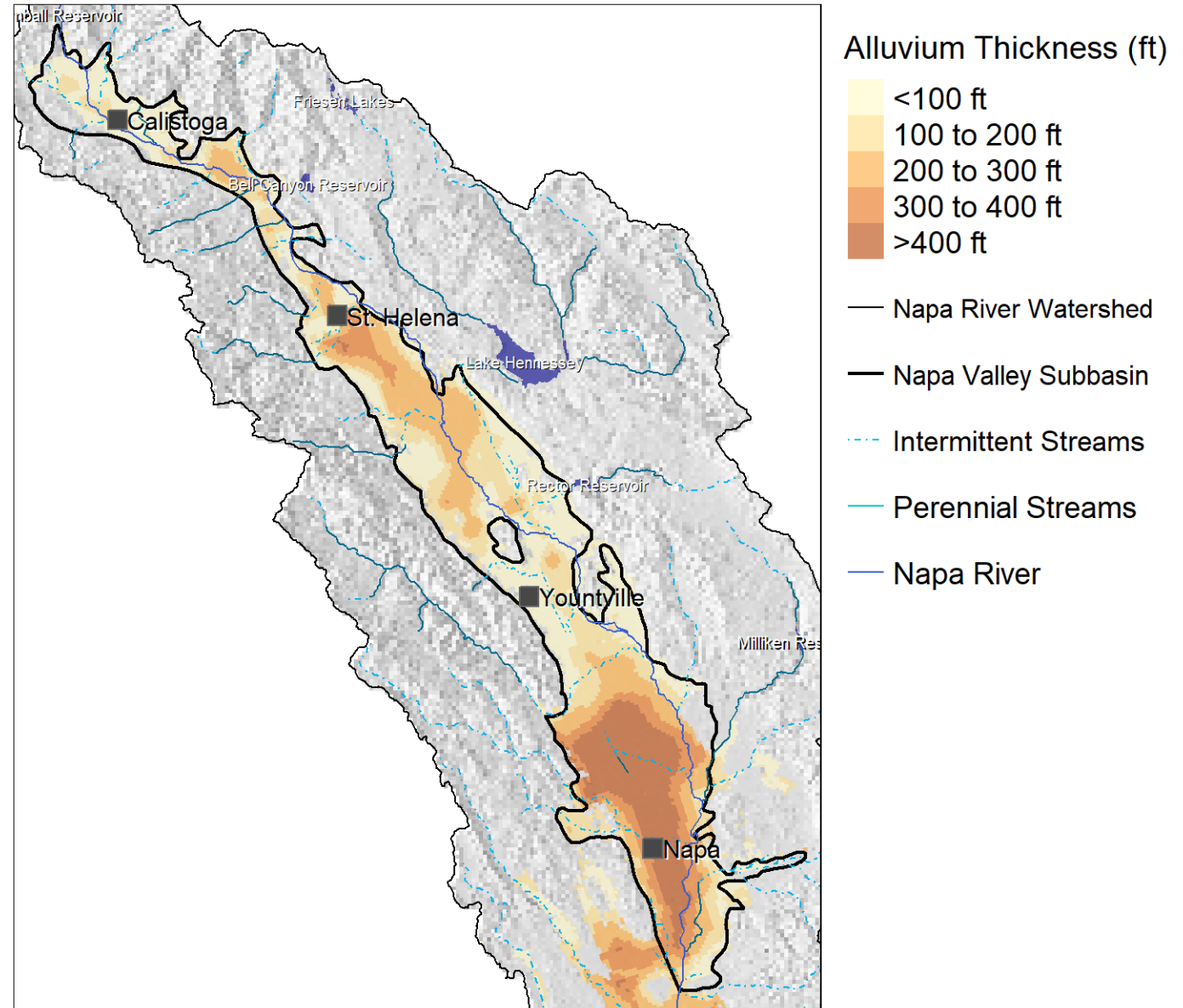
- Depth to water below stream reaches based on historic groundwater model run (NVIHM).
- Average depth to water in March in climate years that are Above Average shows where there is capacity for recharge when there is water available.





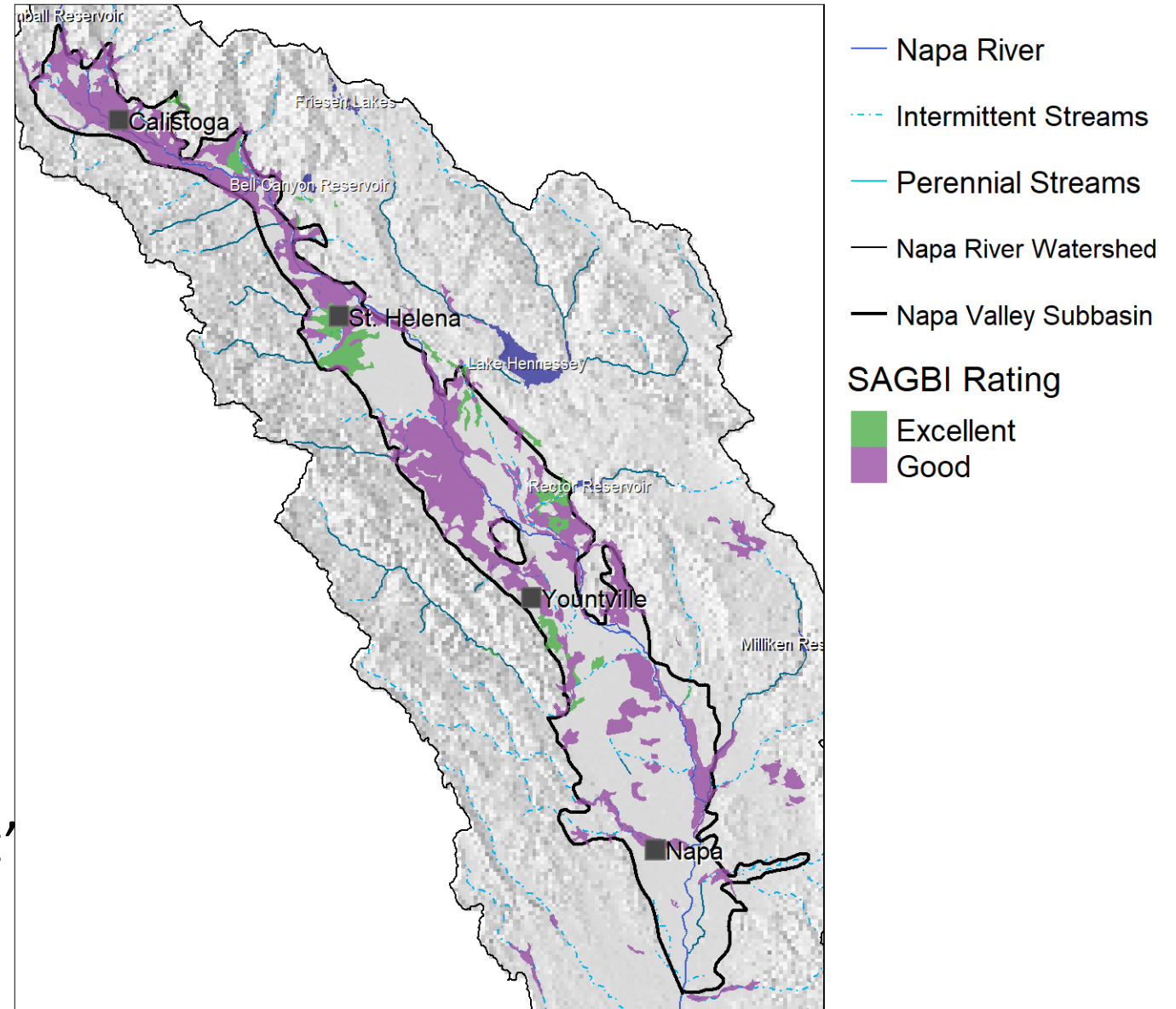
# Alluvium Thickness

- Alluvial thickness affects the amount of recharge that can occur in a region.
- Alluvium is the uppermost geologic unit in the Napa Valley, in general, lower conductivity volcanic rocks are under the alluvium.
- If there is not enough storage space in the alluvium, additional recharge may immediately flow out of the alluvium or be rejected.



# SAGBI Data

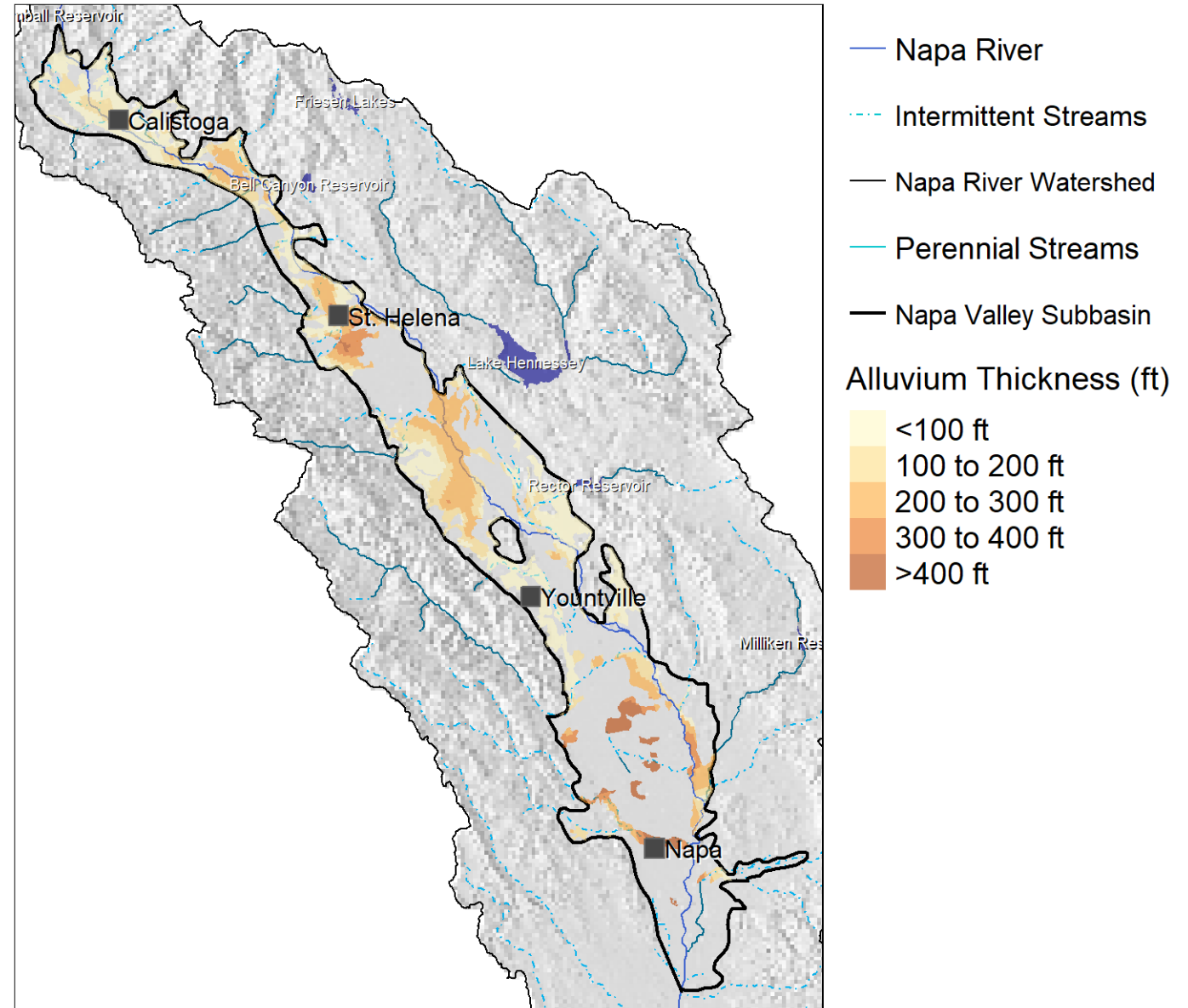
- Soil Agricultural Groundwater Banking Index
- Soil recharge potential characteristics: *permeability*, *topography*, drainage, salinity, crusting/erosion.
- These areas generally have high permeability soil and low topographic relief. Giving water time and ability to infiltrate down.
- Only showing 'Good' and 'Excellent' categories.





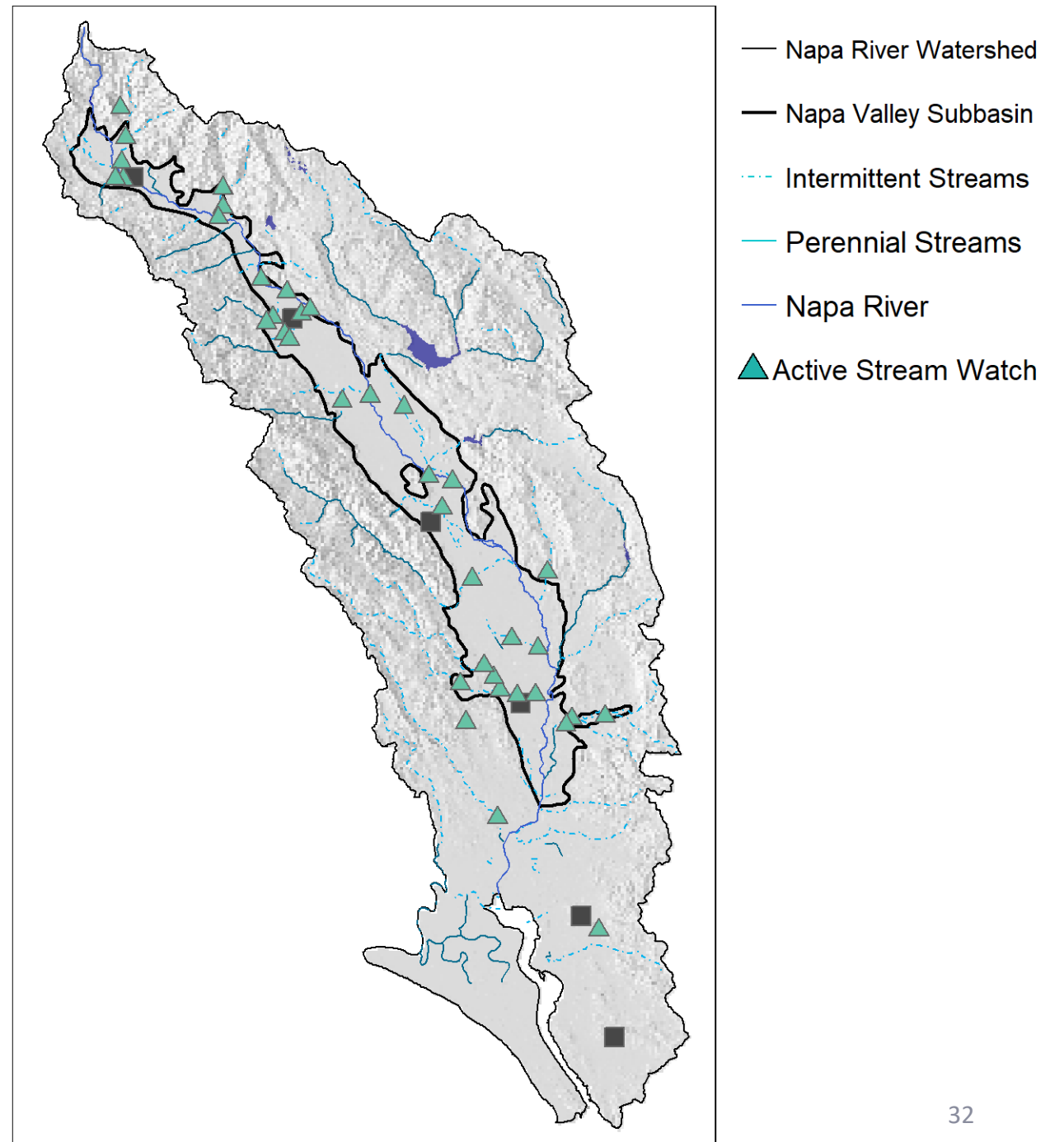
# SAGBI Areas with Additional Information

- Total area of ~12,000 acres within Napa Subbasin
- Median alluvial thickness ~150 feet.
- Land use for high priority SAGBI areas (based on DWR/LandIQ 2019 data):
  - 76.4% Vineyards
  - 21.5% Urban
- Additional considerations of groundwater elevations and proximity to stream reaches required.



# Additional Data Sources

- Napa RCD
  - Stream Watch
  - Historic Stream Temperatures in Napa Valley
- Pacific Fishery Management Council
- Infrastructure Requirements
- Stormwater Availability
- Land Use





# Response Actions: Near-Term and Subsequent

## Very Near-Term



- Voluntary Drought Measures
- GSA: Subbasin
- County: Watershed/County
- Local: Cities/Communities
- Agricultural/Wineries

## Short Term



- Storm Water Resource
- Water Conservation
- Groundwater Pumping Reduction
- Interconnected Surface Water & GDEs

## Mid-Term



- ID Recharge Areas of Interest
- Explore Recharge Opportunities
- Implement Workplans
- GW Pumping Reduction Options

# Drought Response Actions: TAG Input

- What drought response measures might be implemented soon to address drought effects on Interconnected Surface Water?
- What kind of outreach might be most effective?
- What additional interim monitoring (available to implement now) might be useful while data gaps are being addressed (takes longer)?





# October 2022: Tentative Topics



- Water Conservation Workplan
  - Summary of survey results on water conservation approaches (Napa Valley Grapegrowers)
  - Irrigation system evaluations (RCD and Napa Green)
  - OpenET
  - Tule Technologies: local stations
- Groundwater Pumping Reduction Workplan
  - Well inventory planning
- RMS exceedances and TAG input on potential response actions
- Potential recharge areas of interest (continuing discussion)





# Thank You

**Vicki Kretsinger Grabert**

Luhdorff & Scalmanini, C. E.

[vkretsinger@lsce.com](mailto:vkretsinger@lsce.com)

(530) 661-0109



**Luhdorff &  
Scalmanini**  
Consulting Engineers

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## Napa County Groundwater Sustainability Agency

**Jamison Crosby**, Natural Resources Conservation Manager

Planning, Building, and Environmental  
Services Department

1195 Third Street

Suite 210

Napa, CA 94559

[jamison.crosby@countyofnapa.org](mailto:jamison.crosby@countyofnapa.org)



**Minh Tran**, *Executive Officer*

Napa County Groundwater  
Sustainability Agency

1195 Third Street

Suite 310

Napa, CA 94559

[minh.tran@countyofnapa.org](mailto:minh.tran@countyofnapa.org)

**David Morrison**, *Director*

Planning, Building, and  
Environmental Services Department

1195 Third Street

Suite 210

Napa, CA 94559

[david.morrison@countyofnapa.org](mailto:david.morrison@countyofnapa.org)