Development of Recommended Flow Targets to Support Biological Integrity Based on Regional Flow-Ecology Relationships for Benthic Macroinvertebrates in Southern California Streams

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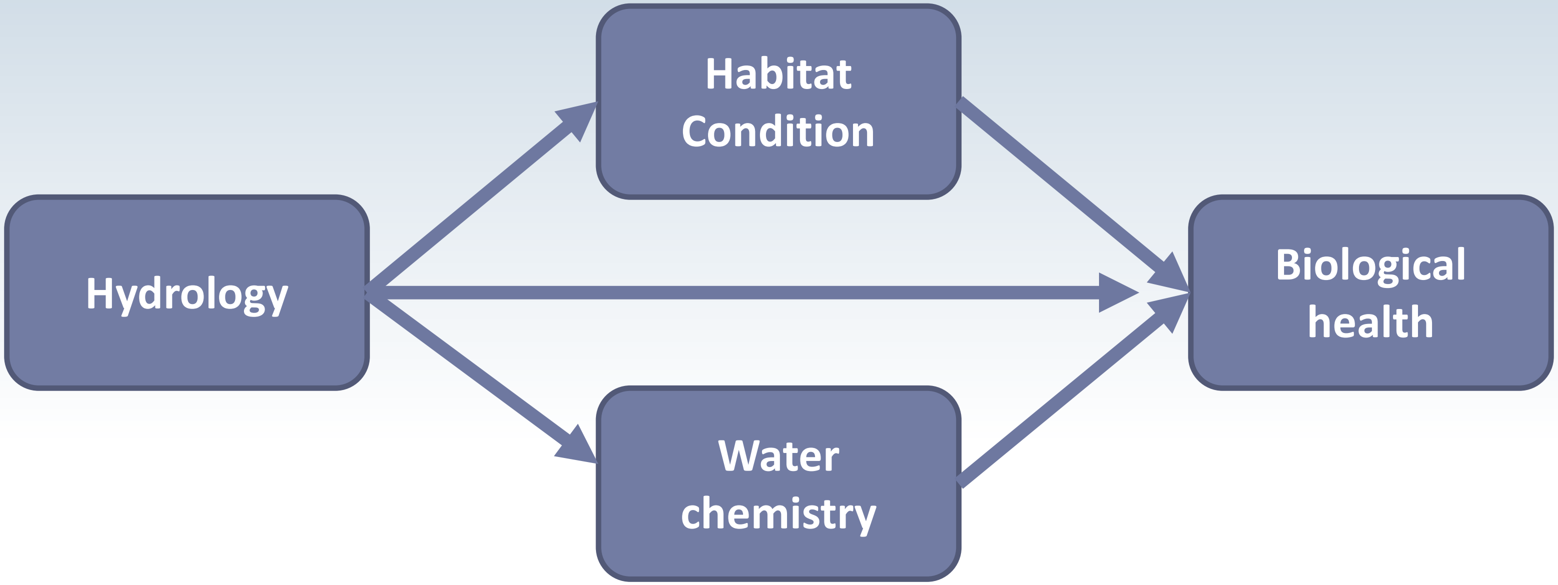
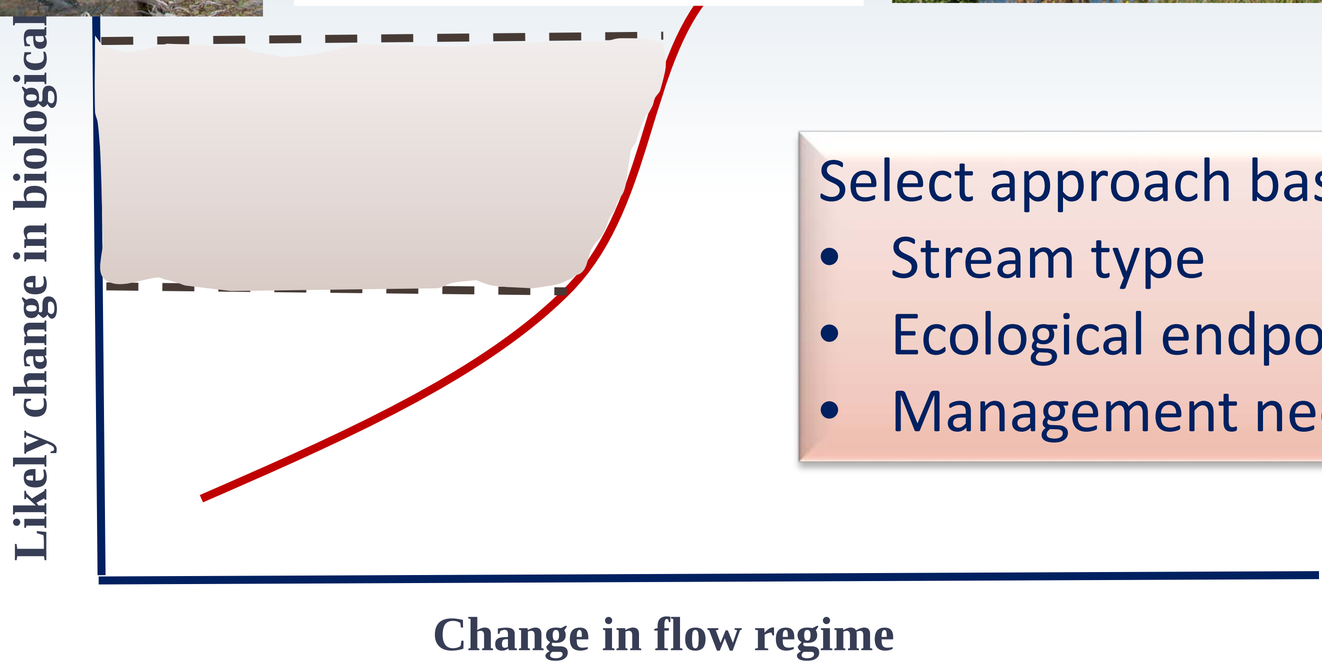
Hydrology is an Integrative Driver of Stream Health



If you can mitigate hydrologic alteration, you'll solve a lot of other problems

Setting Flow Targets to Inform Management Decisions

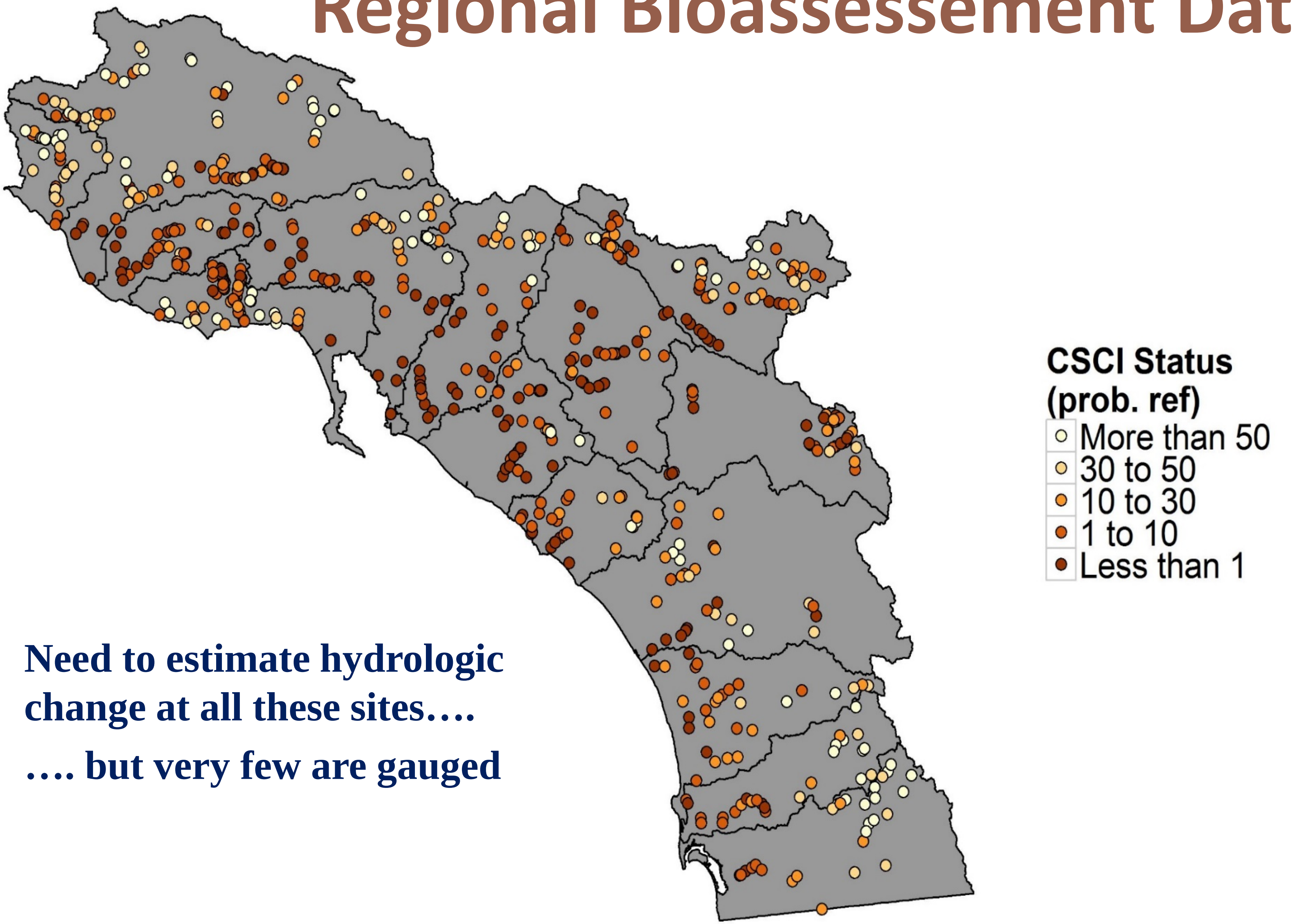


Select approach based on
- Stream type
- Ecological endpoint
- Management need

Ecological Limits of Hydrologic Alteration (ELOHA)

- Estimate degree of hydrologic alteration
  - Calculate a series of flow metrics
  - Current vs. “natural” conditions
- Compare hydrologic change to response of the biological community
  - Based on benthic invertebrate CSCI
  - Establish thresholds of biological response
- Develop a regional index of hydrologic alteration based on priority metrics
- *Apply index to evaluate management options in terms of their likely effect on biological communities*

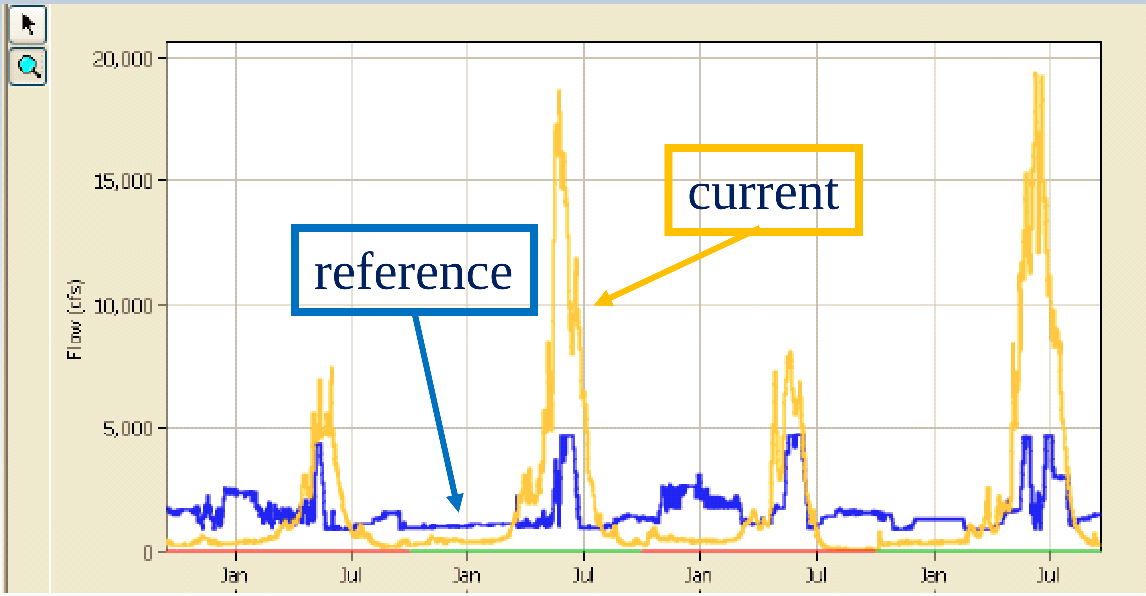
Regional Bioassessement Data



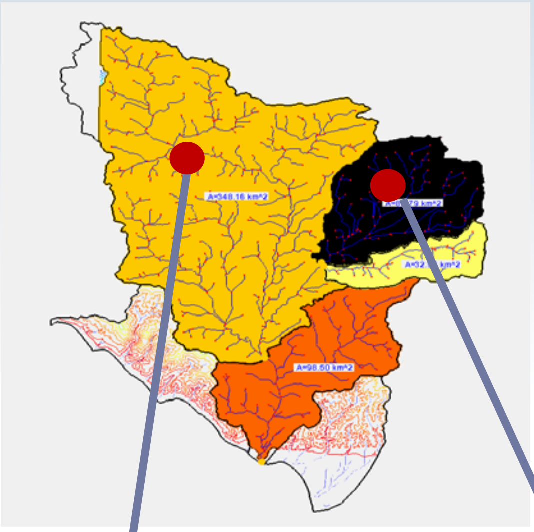
Need to estimate hydrologic change at all these sites….

…. but very few are gauged

Estimating Hydrologic Change



Regional model ensemble



Compare reference vs. current flow to produce measures of hydrologic change

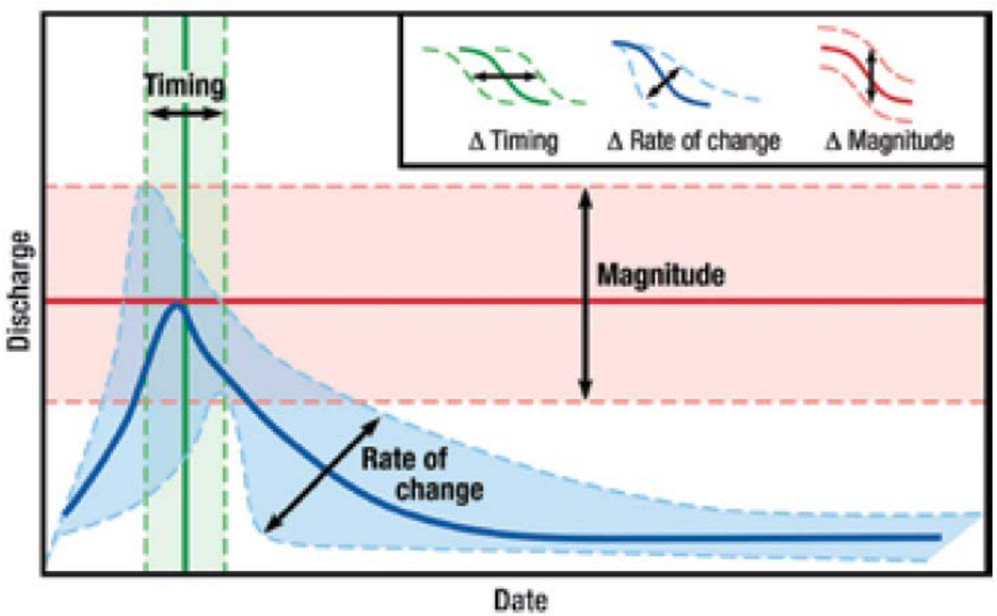
Bin 1
Bin 2
Bin 3
Bin 4
Bin 5
Bin 6
Bin 7
Bin 8
Bin 9
Bin 10

Consider a Broad Suite of Flow Metrics

- Magnitude
  - streamflow (mean, max)
  - median annual number of high flow events
- Variability
  - median percent daily change in streamflow
  - Interannual variability (min, max, median)
- Duration
  - Storm flow recession
  - Duration above baseflow
- Timing
  - month of minimum streamflow
  - Frequency of high flow events

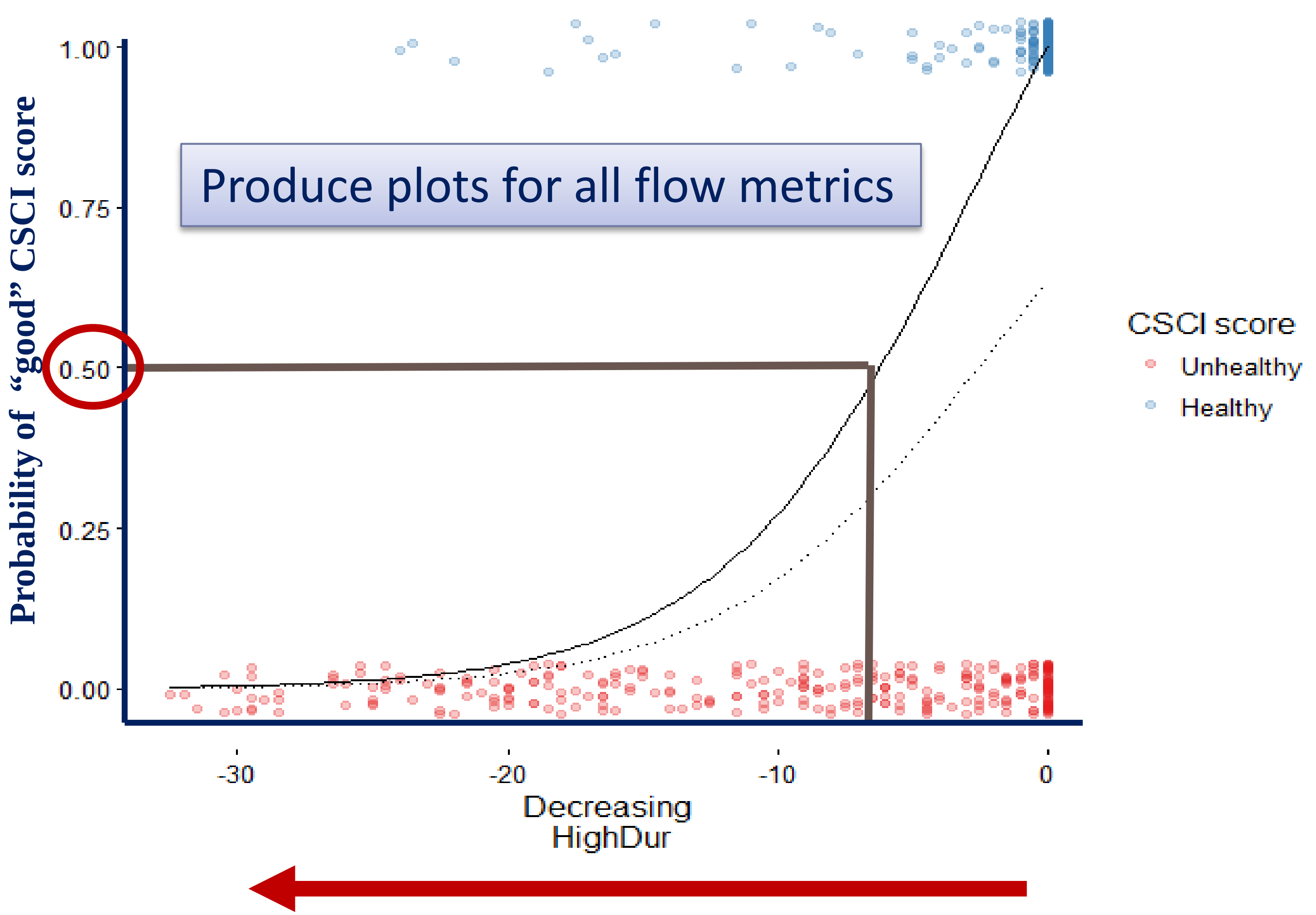
Evaluate for multiple climatic conditions

- Average years
- Wet years
- Dry years
- All years

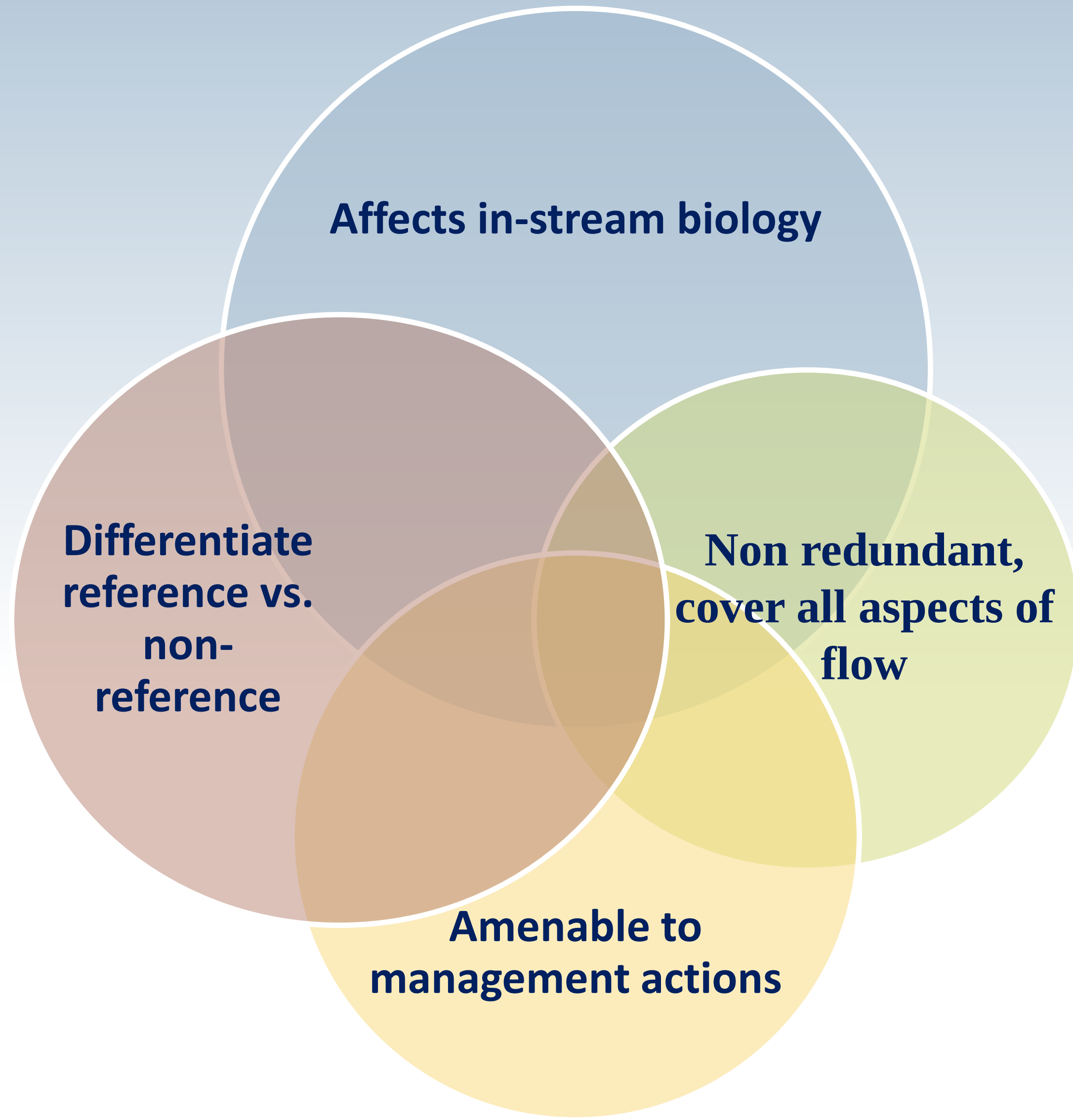


Establish Thresholds; example High Duration (days)

Logistic regression: <u>Likelihood</u> of healthy biology at each level of hydrologic alteration



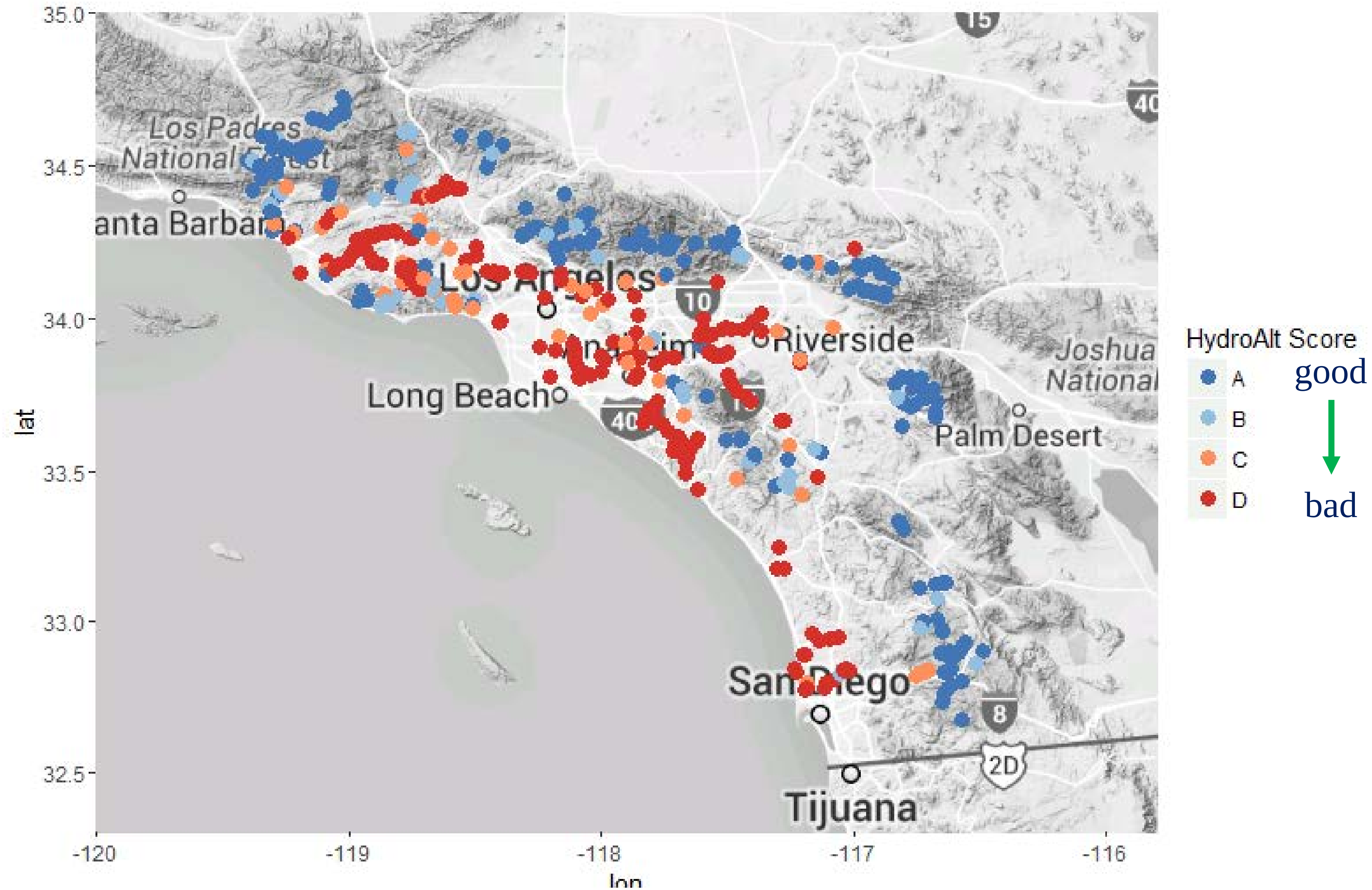
Select Priority Metrics



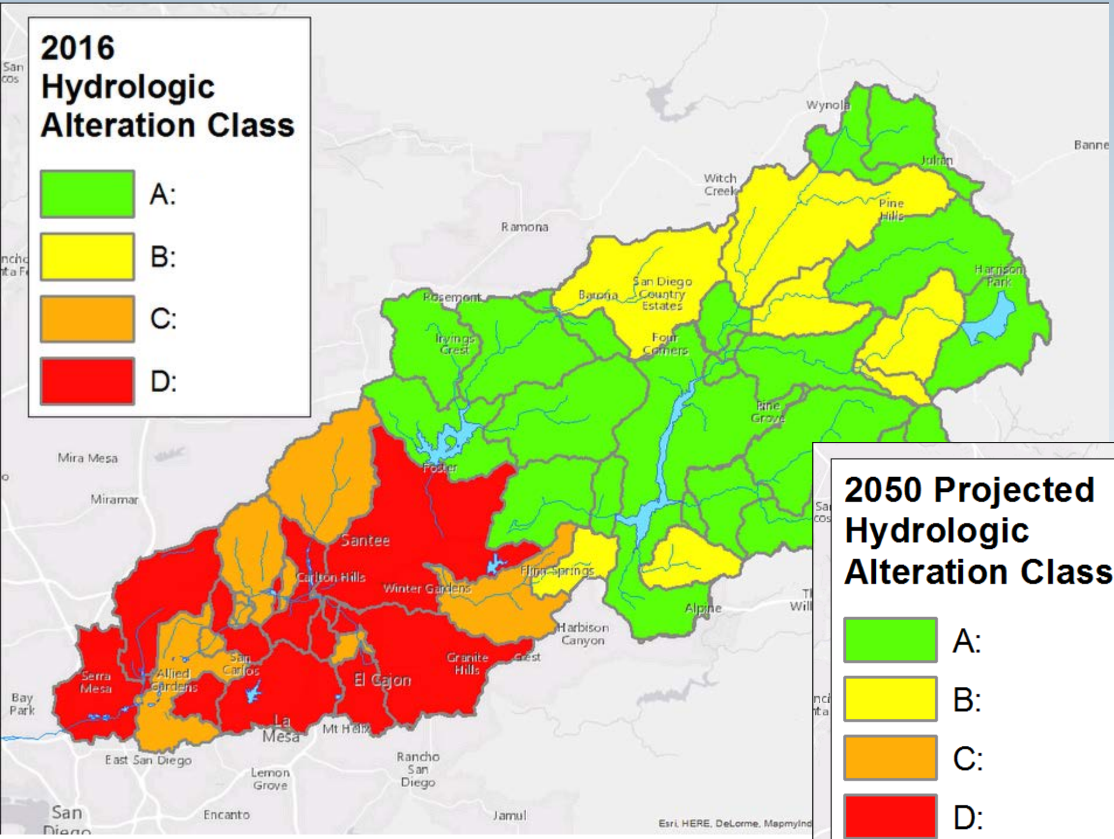
Priority Metrics (expressed as CHANGE in metric value)

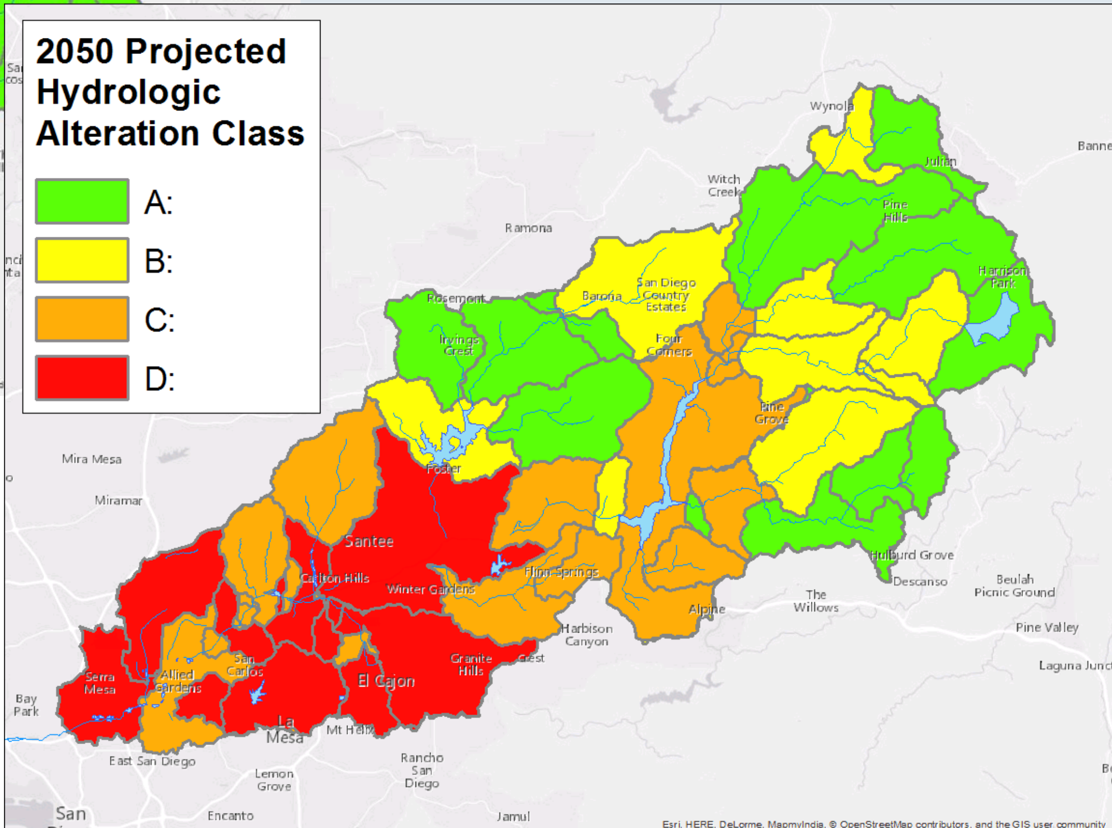
Hydrograph Component	Metric Definition	Critical precipitation condition	Decreasing Threshold	Increasing Threshold
Duration (days)	longest number of consecutive days that flow is between the low and high flow threshold	Average	-64	NT
	longest number of consecutive days that flow was greater than the high flow threshold	Wet	-3	24
Magnitude (cms)	Maximum mean monthly streamflow	Wet	NT	1.5
	streamflow exceeded 99% of the time	Wet	NT	32
Variability (unitless)	Richards-Baker index of stream flashiness	Dry	NT	0.25
Frequency (# of events)	number of events that flow was greater than high flow threshold	Dry	NT	3

Regional Hydrologic Condition



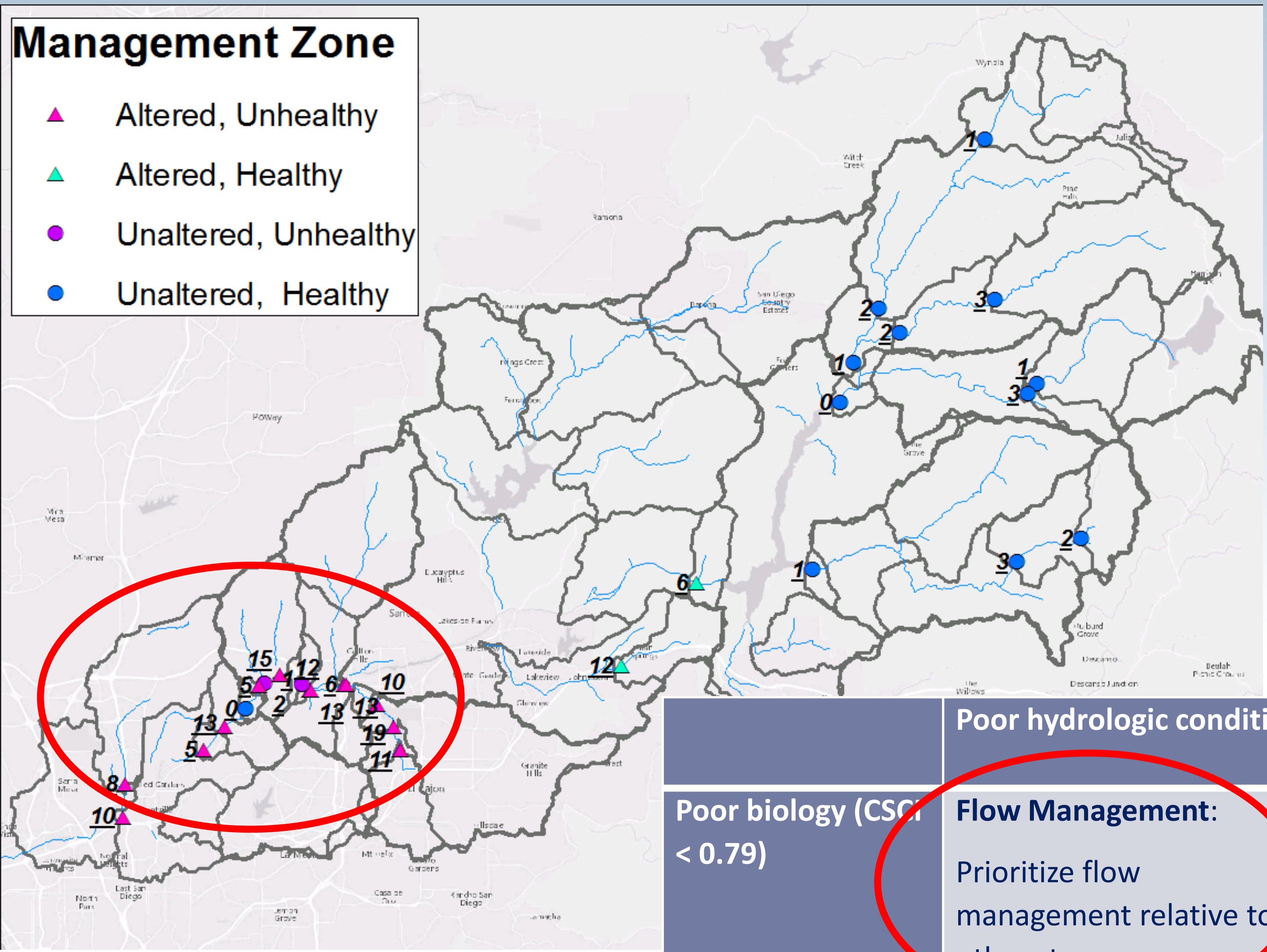
Map Hydrologic Alteration





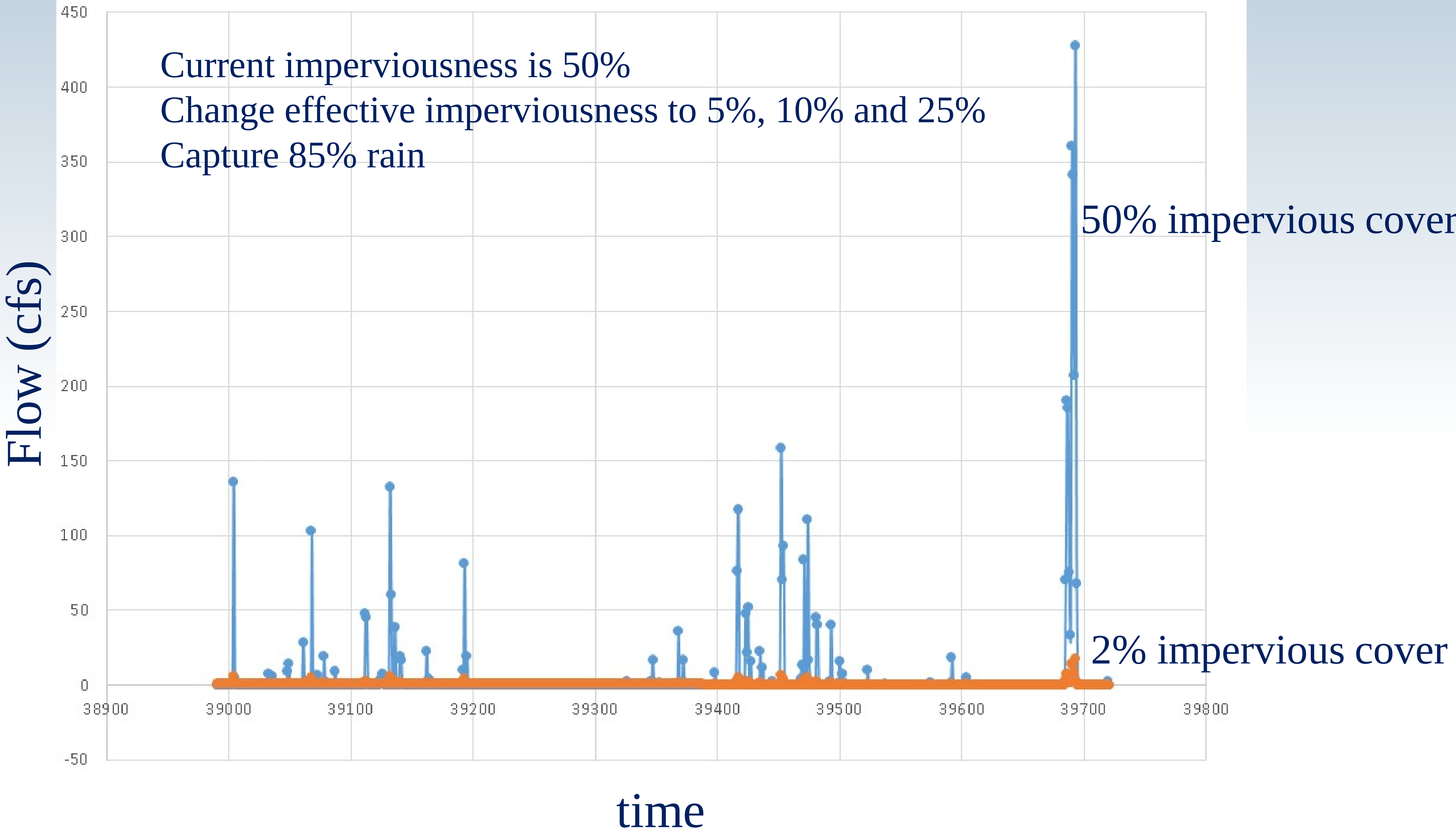
Inform land planning process

Flow Management Zones



	Poor hydrologic condition	Good hydrologic condition
Poor biology (CSCI < 0.79)	**Flow Management**: Prioritize flow management relative to other stressors	**Other Stressors** Management/Causal Assessment:
Good biology (CSCI > 0.79)	**Monitor**	**Protect**

Scenario Analysis: Alvarado Creek Stormwater Management



Alvarado Creek Results

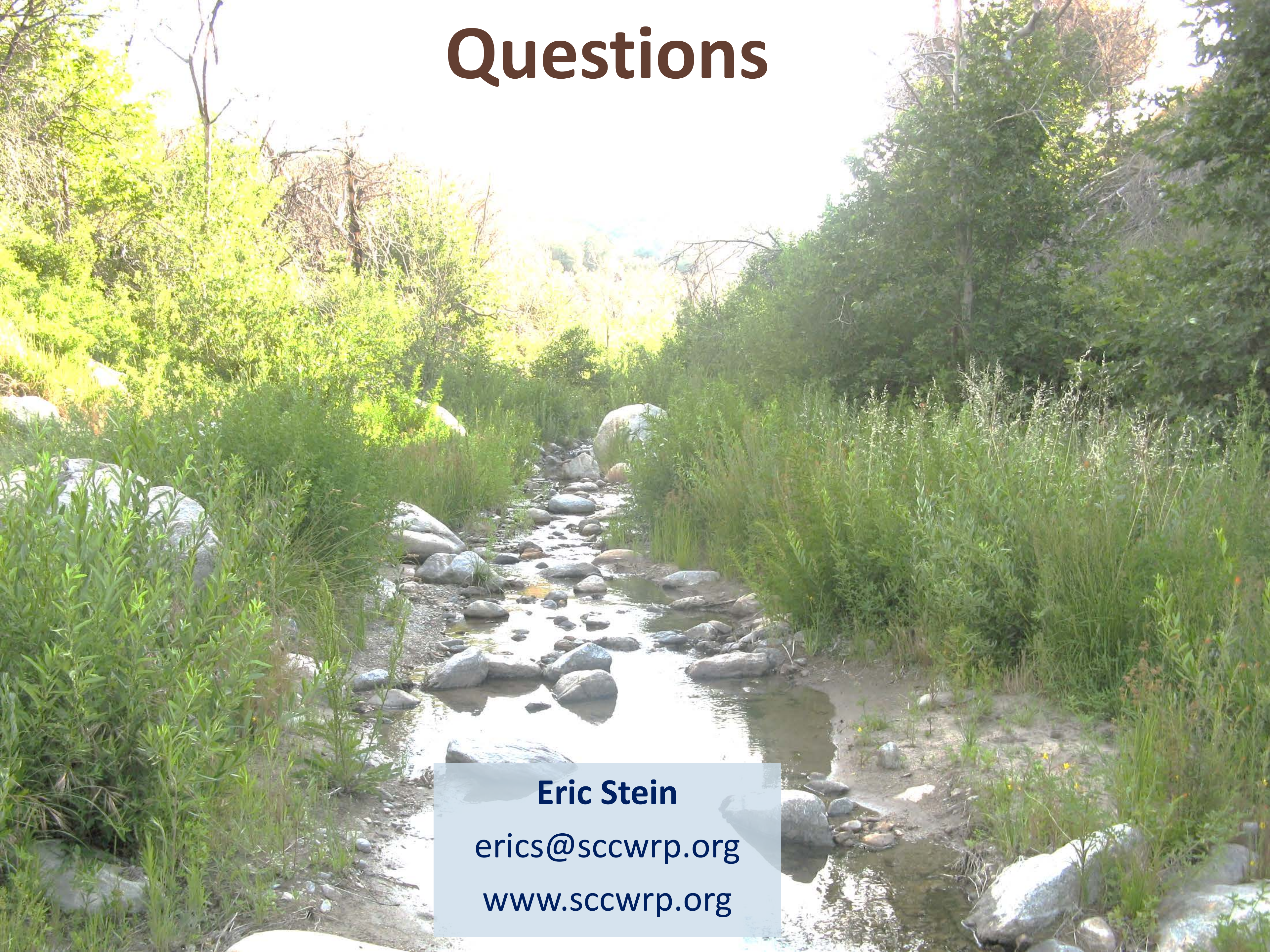
Metric	Units	Imperviousness					Target
		2%	5%	10%	25%		Upper threshold
MaxMonthQ	cms	0.22	0.56	1.12	2.81		0.2
Q99	cms	6	31	69	71		70
RBI	unitless	0.15	0.25	0.33	0.41		1.4

- 85% capture produces hydrologic conditions associated with healthy invertebrates
- Must reduce effective imperviousness to 2-5% to provide optimal hydrologic conditions
- Flashiness not an issue for this site

Future Directions to Inform Water Resources Management

- Develop flow-ecology relationships for other biological endpoints in addition to benthic invertebrates
  - Algae, fish, riparian habitat
  - Framework to inform tool selection based on situation
- Improve ability to discern flow effects vs. habitat effects
- Investigate implications of "shifting baselines"
  - Changes in perenniality of streams
  - Drought and climate change
- Incorporate flow considerations into technical work on State's Biointegrity and Biostimulatory Policy
  - Case study applications in local watershed efforts

Questions



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