The Water Board Monitoring Landscape

Academy Hydromodification Workshop
May 9, 2013

eric berntsen
State Water Resources Control Board

What are WE doing here?

(in terms of hydromodification monitoring)

Tumblr.com

- Rivers and Streams Portal
- CalTrans Permit/401
- Moving towards a Watershed Framework

- Cal/EPA
- Natural Resources Agency
- About the California Water Quality Monitoring Council

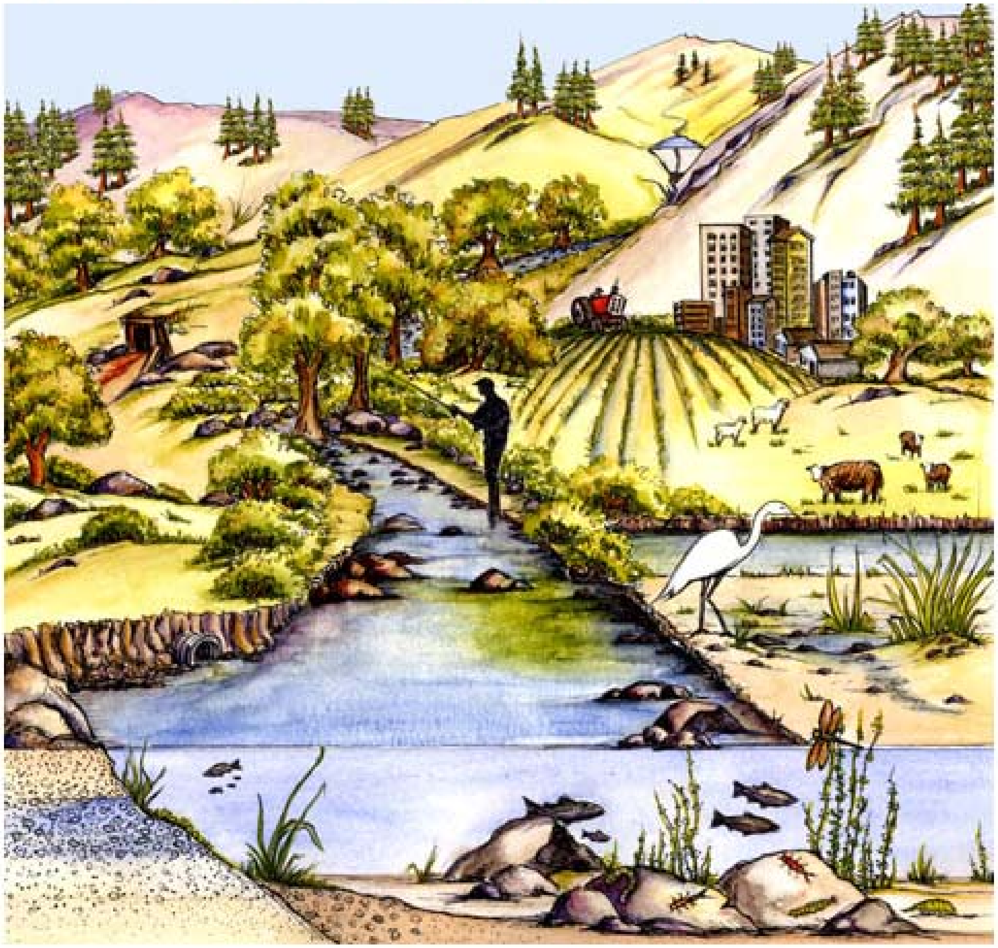
AQUATIC HEALTH LINKS

- Stressors
- Laws, Regulations & Standards
- Regulatory Activities
- Enforcement Actions
- Research
- Monitoring Programs, Data Sources & Reports

California Streams, Rivers and Lakes


Urban | Agriculture | Other Uses | Fines & Sands| Gravels | Cobbles & Boulders | Riffles & Rapids | Buffer | Riparian Cover | Pools | Groundwater | Water Quality | Sediment Quality | Stream Gradient | Channel Stability | Channel Alteration | Algae | Bugs | Fish | Fish Contaminants |

Also see: Hydrologic Connectivity | Hydrologic Sufficiency | Invasive Species | Sediment Balance



Healthy streams, rivers, and lakes provide safe drinking water, recreational opportunities, and important habitat for species ranging from the red-shouldered hawk to steelhead to crayfish and dragonflies. Maintaining healthy streams, rivers, and lakes can reduce the need for water treatment and water supply costs and make landscapes more resilient to climate change. To determine the health of a waterway and the flora and fauna that live there, investigators can use a combination of chemical, biological, and physical assessments. Among the characteristics that may be considered are habitat quality, aquatic life diversity, water chemistry, stream hydrology (water flow processes), the physical channel form, and sediment transport processes of the stream.

Navigation Instructions: Show | Hide .

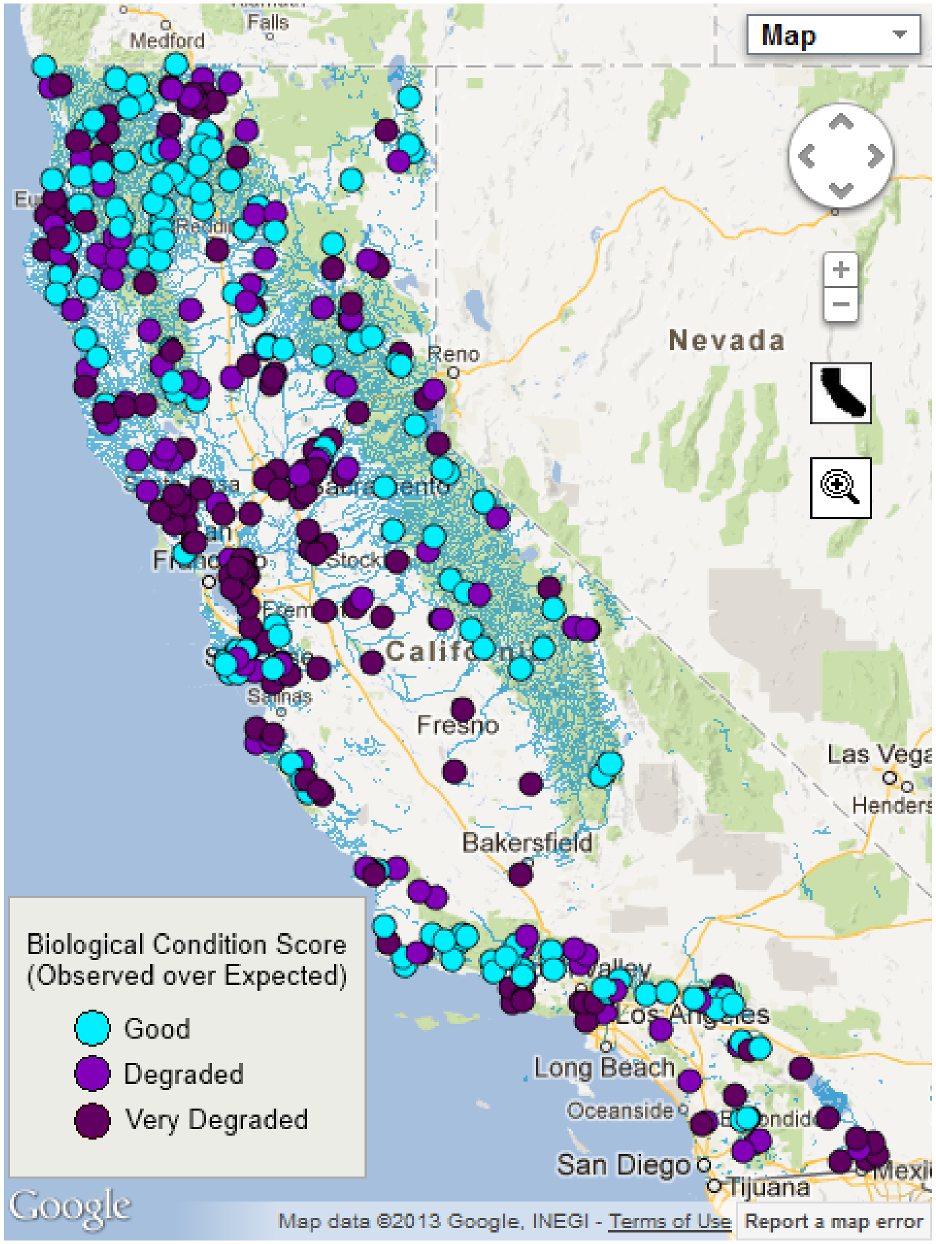
- Portal Fact Sheet

QUESTIONS ANSWERED

- What is the extent of our stream and river resources?
- What is the condition of our streams and rivers?
- What is being done to make our waters healthier?

- California Watersheds Slideshow - Learn about healthy watersheds on the Water Education Foundation website

-- Select a Region Type --



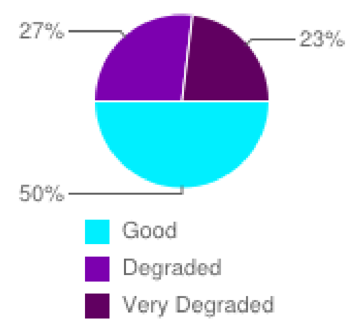
What do Benthic Macroinvertebrates tell us about the health of our streams?

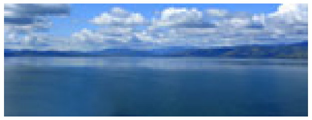
One powerful way to measure stream health is through an assessment of the bugs, or benthic macroinvertebrates, that live there. Benthic macroinvertebrates, which live on the bottom of streams, include early life stages of insects such as dragonflies and mayflies, crustaceans such as crayfish, and worms and snails. The particular species and abundance of invertebrates present in a stream can help scientists determine both the current condition of a stream and the cumulative impact of longer term stressors, such as pollution. For example, a stream with a variety of species that includes sensitive species is considered healthier than one with a few pollution-tolerant species.

Bioassessment is the characterization of environmental conditions through the observation of biological communities of organisms. Two common types of bioassessment are O/E and IBI. O/E stands for observed over expected, which compares the number of certain species observed at a site to the number of those species that were expected to occur, based on data from reference sites that are known to be healthy. IBI is an Index of Biotic Integrity, which combines a variety of individual measures of health of a community of organisms, such as species richness (how diverse the community is) and pollution tolerance (how resistant to pollution they are).

- View reports of the State Water Board's Perennial Streams Assessment (PSA)

Statewide Statistics





California Streams, Rivers and Lakes

Why are channel characteristics important?

Channel characteristics describe what a channel looks like, including width, depth, gradient, substrate, and bank stability. They also describe the processes associated with a channel, particularly the movement of water and sediment. Healthy streams need to create a balance between sediment entering and leaving the stream system. A disruption to sediment movement can result in erosion leading to bank instability or alternately to sediment deposition leading to flooding problems.

All streams carry sediment that has eroded from channels and the surrounding landscape. Streams then deposit this sediment further downstream in wetlands, floodplains, or channels. Natural streams carve a shape that allows them to carry their sediment and water loads, and tend to maintain a consistent depth and width over time, even as the stream course may change. The construction of ditches, canals, and levees alters sediment and flow patterns alter the form of channels and can create sediment management problems. Dams or other obstructions prevent sediment from moving downstream, while also blocking the migration of fish and other aquatic organisms. Changes in drainage from the landscape adjacent to streams can alter the speed with which water enters a stream. Impervious surfaces, such as concrete and asphalt, decrease the time it takes for flow to peak in a nearby channel after it rains, driving up the velocity and energy of water in the stream channel. Streams that either carry a low amount of sediment or have high energy due to altered flow are known as "hungry streams" and may erode sediment more rapidly from their channels and banks, threatening bank stability. Particularly aggressive erosion of channel beds is known as incision. In heavily incised streams with deep channels, natural flooding processes may be disrupted because the abnormal depth of the channel precludes water from spilling over the banks. An opposite condition occurs in streams that are overburdened with sediment. These streams may become too murky to support some species and may begin to deposit large amounts of sediment, creating another type of management challenge.

How do we measure channel characteristics?

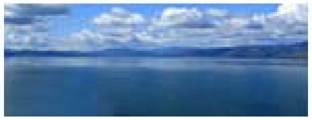
In addition to the indicators listed on other pages, channel characteristics can be assessed through channel stability and sediment balance. Scientists also measure the width to depth ratio or cross section configuration of streams as an indicator of how connected a stream is to its adjacent floodplain.

(Updated 2/28/12)

- Cal/EPA
- Natural Resources Agency
- About the California Water Quality Monitoring Council

AQUATIC HEALTH LINKS

- Stressors
- Laws, Regulations & Standards
- Regulatory Activities
- Enforcement Actions
- Research
- Monitoring Programs, Data Sources & Reports



California Streams, Rivers and Lakes

Why are stream beds important?

The bottom of a stream can be made up of a variety of types of substrate, from fine clays to sands to gravels and even boulders. Each type of sediment provides a distinct type of habitat, best suited to supporting a distinct subset of stream species. Sandy or silty stream beds may support insects or warm water fishes, while gravels and boulders provide places for salmon to spawn and water to infiltrate into the subsurface to recharge the groundwater. In addition, stream beds may be fairly uniform in depth or may have deep pools, shallow riffles, and rapids. The depth and width of a stream control water movement– flows may become turbulent along rocky, shallow beds or calm across deep, silty beds. Stream beds may also support vegetation. Variation in substrate type, depth, vegetation, and bed structure helps streams provide a range of habitats that are important to for different species or different life stages of the same species.

gravels, fines & sands

Modifications to the form of a streambed and the type of substrate in a streambed are common. An excess of fine sediment in particular is a common management challenge because it fills the small spaces among coarse gravels and cobbles that many species rely on for feeding, hiding, and spawning.

How do we measure the condition of a stream bed?

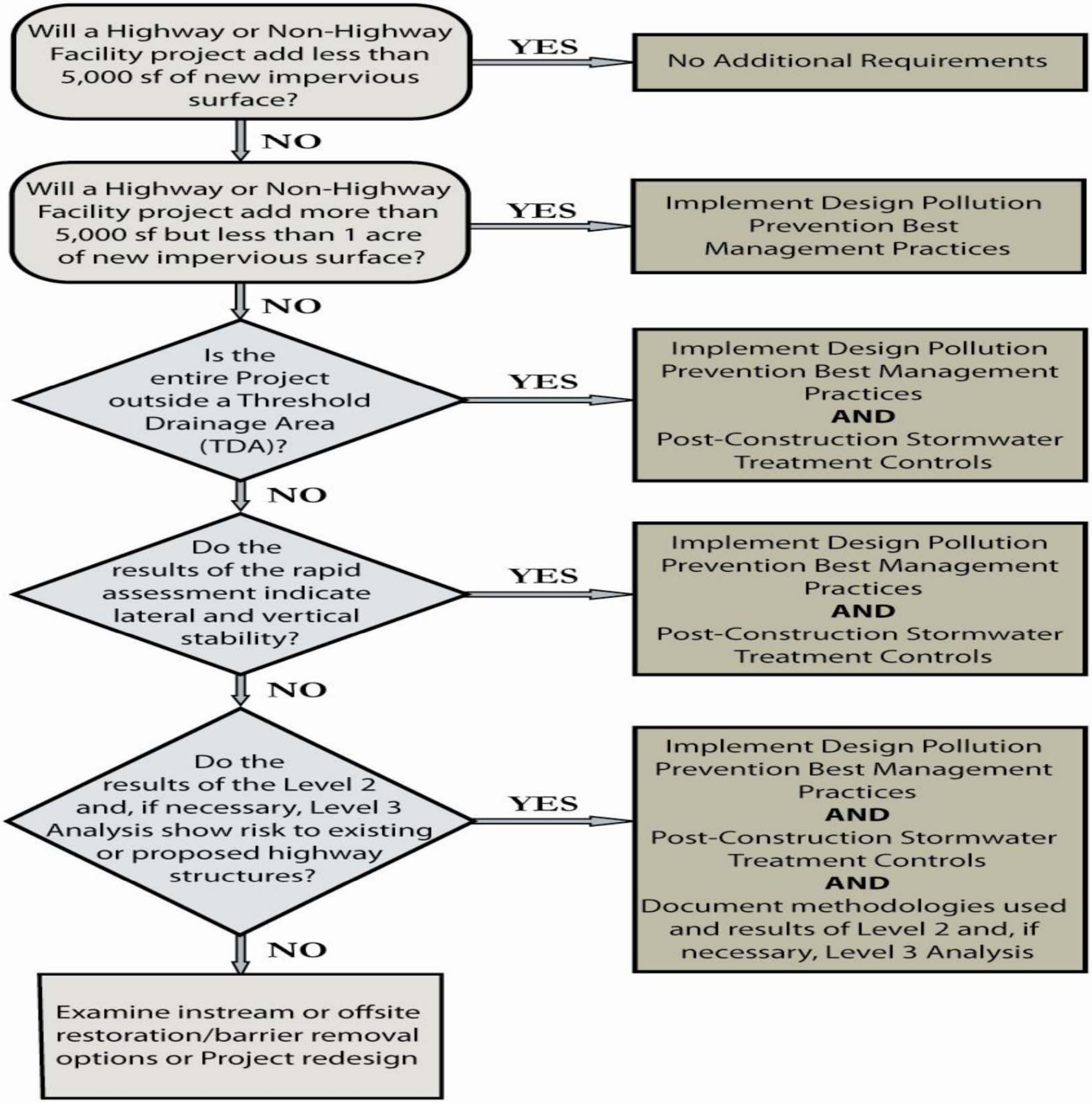
Managers can evaluate the percentage of the streambed that is covered with gravels, fines and sands, cobbles, or boulders, and assess the stream for the presence of riffles, rapids, or pools. The distribution of different grain sizes is frequently measured to understand how well sediment is balanced in a stream system. For instance the value of D50, which identifies the median grain size (that grain size where half the particles are larger and half are smaller), can be used to compare the relative coarseness of streambed material. In the California Rapid Assessment Method (CRAM) for monitoring wetland condition, streambed complexity is assessed during the evaluation of a stream's physical structure. Many different approaches are currently used to characterize stream beds, which limits the availability of standardized datasets.

cobbles & boulders

Caltrans MS4 Monitoring Question

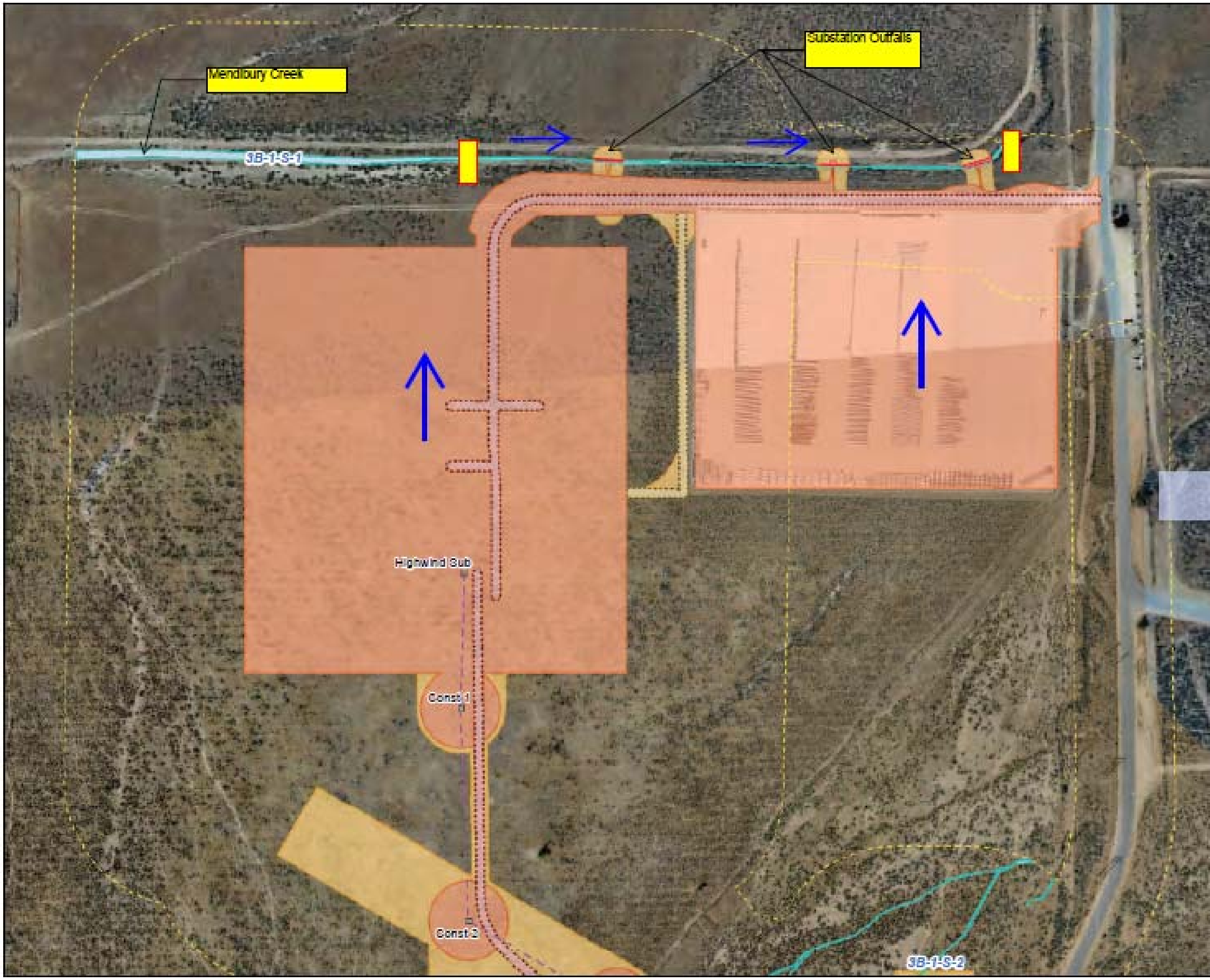
- Do Department new development and redevelopment projects cause a decrease in lateral (bank) and vertical (channel bed) stability in receiving stream channels?
  - What's the analysis domain?

FIGURE 1: Hydromodification Flowchart



Mendibury Creek Monitoring Question

- Will the project cause a decrease in lateral (bank) and vertical (channel bed) stability in Mendibury Creek?
  - What's the analysis domain?
  - Monitoring methodology?



Legend

- Segment 3B
- Segment 3A
- Segment 2
- New Structure

Jurisdictional Waters

- State Streambed (CDFG/SWRCB)
- CDFG Riparian
- Wetland
- Survey Area

Impacts

- Avoided - No Impact
- Impacts to Jurisdictional Waters
- Permanent
- Temporary
- Permanent Road
- Temporary Road

Cross Section Location

Flow Direction

Source: Sheet 1 of Figure 3, WDR Permit Application Package

N

0 100 200

Feet

Representative Map of Impacts to Waters under the Water Board and CDFG Jurisdictions (Highwind Substation – outfall structures)

Antelope Transmission Project – Segment 3B

Channel Stability Index Rating[1]

Score

1. Primary bed material

	Bedrock	Boulder/Cobble	Gravel	Sand	Silt Clay	Score
	0	1	2	3	4	

2. Bed/bank protection

	Yes	No	(with)	1 bank protected	2 banks	Score
	0	1		2	3	

3. Degree of incision (Relative ele. Of "normal" low water; floodplain/terraces @ 100%)

	0-10%	11-25%	26-50%	51-75%	76-100%	Score
	4	3	2	1	0	

4. Degree of constriction (Relative decrease in top-bank width from up to downstream)

	0-10%	11-25%	26-50%	51-75%	76-100%	Score
	0	1	2	3	4	

5. Streambank erosion (Each Bank)

	None	Fluvial	Mass Wasting	(failures)		Score
Left	0	1	2			
Right	0	1	2			

6. Streambank instability (Percent of each bank failing)

	0-10%	11-25%	26-50%	51-75%	76-100%	Score
Left	0	0.5	1	1.5	2	
Right	0	0.5	1	1.5	2	

7. Established riparian woody-vegetative cover (Each bank)

	0-10%	11-25%	26-50%	51-75%	76-100%	Score
Left	2	1.5	1	0.5	0	
Right	2	1.5	1	0.5	0	

8. Occurrence of bank accretion (Percent of each bank with fluvial deposition)

	0-10%	11-25%	26-50%	51-75%	76-100%	Score
Left	2	1.5	1	0.5	0	
Right	2	1.5	1	0.5	0	

9. Stage of channel evolution

I	II	III	IV	V	VI	Score
0	1	2	4	3	1.5	

10. Composition of adjacent side slope

	N/A	Bedrock	Boulders	Gravel-SP	Fines	Score
Left	0	0.5	1	1.5	2	
Right	0	0.5	1	1.5	2	

11. Percent of slope (length) contributing sediment

	0-10%	11-25%	26-50%	51-75%	76-100%	Score
Left	0	0.5	1	1.5	2	
Right	0	0.5	1	1.5	2	

12. Severity of side-slope erosion

	None	Low	Moderate	High	Score
Left	0	0.5	1.5	2	
Right	0	0.5	1.5	2	

Total Score = ______

[1] The length of stream channel to be analyzed depends on the width and length of the channel. Data shall be collected at two sites at each transect within a distance of 30 bankfull channel widths. The sites shall be located in portions of the channel reach with relatively uniform width and gradient. For example, a 20 foot-wide channel would require data from at least two sites within a 600 foot distance. If sections of channel within the 30 bankfull width distance are immediately upstream or downstream of steps, culverts, grade controls, tributary junctions, or other features and structures that significantly affect the shape and behavior of the channel, a distance of longer than 30 bankfull widths must be analyzed. A total score of 10 or less indicates a stable channel; scores of 20 or more are indicative of severe instability.

Geomorphic Monitoring for Mendibury Creek

Geomorphic Monitoring shall occur at one (1) site in Mendibury Creek downstream of the most downstream outlet from the proposed vegetated swale (see location on Figure xx). Data will be collected after the runoff season (generally the end of May or early June) for a 10-year period.

- A cross section shall be established. The end points of the cross section will be monumented with an aluminum cap attached to a metal rod. Each cap with be identified (stamped) with the cross section number.

- Cross sectional data will be collected at the appropriate, repeatable interval along the cross section so that topographic changes are captured over the monitoring period. Water surface elevations, if applicable, will be recorded through the cross section.

- A longitudinal profile along the channel thalweg will be collected for a length equal to 10x the bankfull width (i.e., channel width at the 5-year flood elevation) with the cross section falling at, or near, the midpoint of the profile. The survey interval is dependent upon the number of data points required to characterize changes in channel morphology. Water surface elevations, if applicable, will be recorded along the profile.

- A pebble count will be performed at the cross section to quantitatively assess channel substrate. Particles will be sampled from left bank to right bank up to the bankfull elevation. A minimum of one hundred particles will be sampled.

- A Rapid Geomorphic Assessment (RGA) will be performed at two sites within the longitudinal profile using the attached methodology (Simon et al).

- A total of four (4) photographs will be taken at the monitoring site. One photograph will be taken from each of the cross section end points (markers) looking across the cross section. Two (2) in-stream photos will be taken. One from a distance of 10m upstream of the cross section with a downstream view. A second from a distance of 10m downstream from the cross section with an upstream view.

- Data will be compiled in a relational data base (spreadsheet) so that multiple years of data may be displayed on a single chart and analyzed.

- Values will be calculated for each of the following metrics. Values are estimated at the 5-year flood elevation unless otherwise noted.

  - Cross sectional area
  - Channel width
  - Maximum depth
  - Average depth
  - Flood prone width
  - Channel slope
  - Entrenchment ratio (ER)
  - Width-to-depth ratio (W/D)
  - Manning's n
  - Particle size distribution for the site and estimates for: d_{50}, d_{84}, threshold grain size.
  - Critical Shear stress (lb/ft^2)

- All data shall be compiled into a report detailing any changes in channel morphology from the previous year(s), amount of change (percent change), direction of change (aggradation/degradation), and any obvious or potential causes of the change. The report shall include charts illustrating the cross sectional area up to and including the flood prone width, longitudinal profile displaying channel bottom and water surface, particle size distribution for the cross section site, and maps of geomorphic features within the longitudinal profile assessed using the RGA..

State Water Board’s Watershed Management Initiative (1996)

“water quality and ecosystem problems are best prioritized, addressed, and solved at the local watershed level rather than at the individual discharger, waterbody, or state agency level……”

Thanks Dominic Roques

IN AN UNDISTURBED ("INTACT") LANDSCAPE:

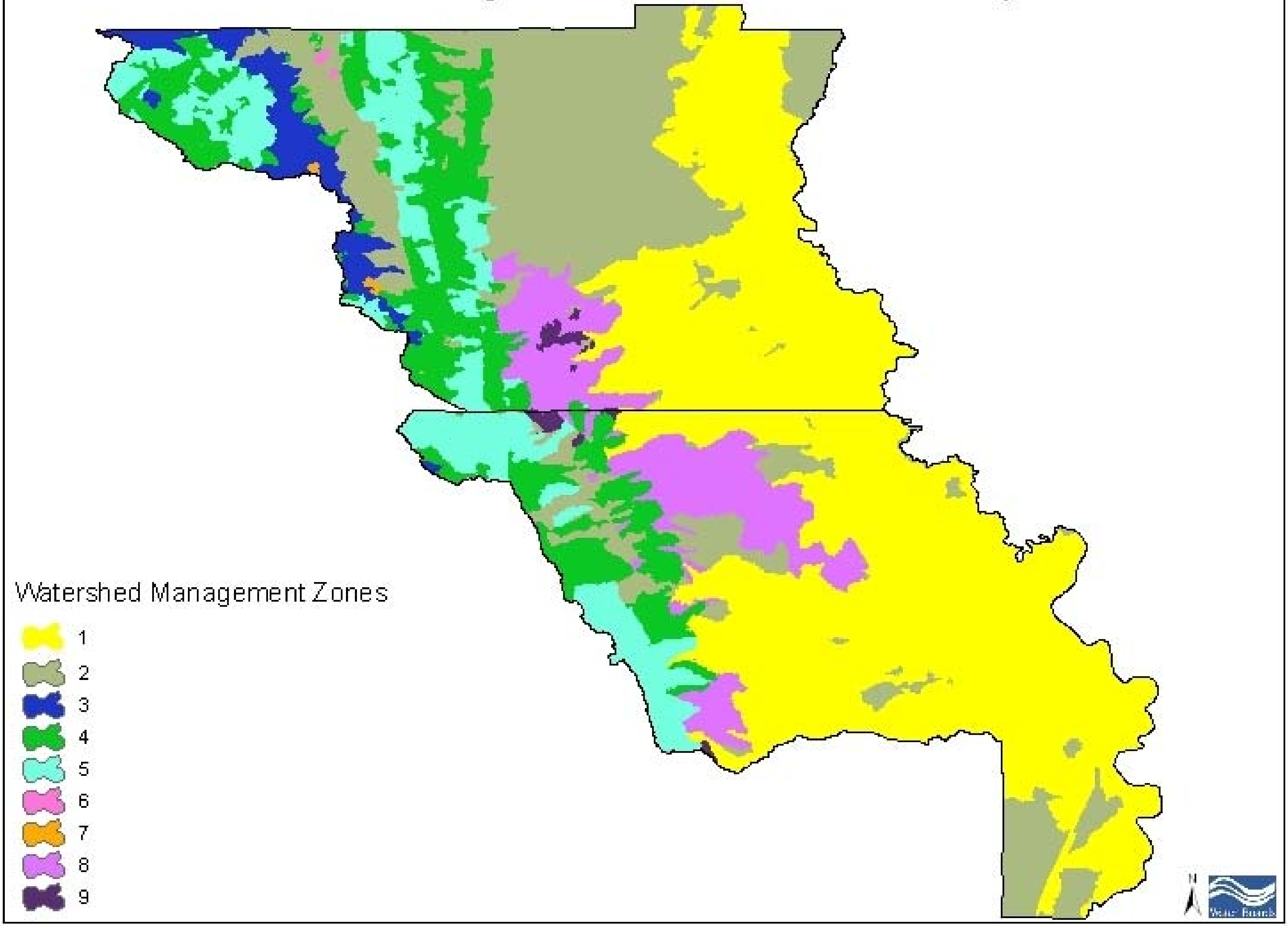
The Physical Landscape →
Watershed Processes →
Receiving Water Conditions

IN A DISTURBED (SPECIFICALLY, URBANIZED) LANDSCAPE:

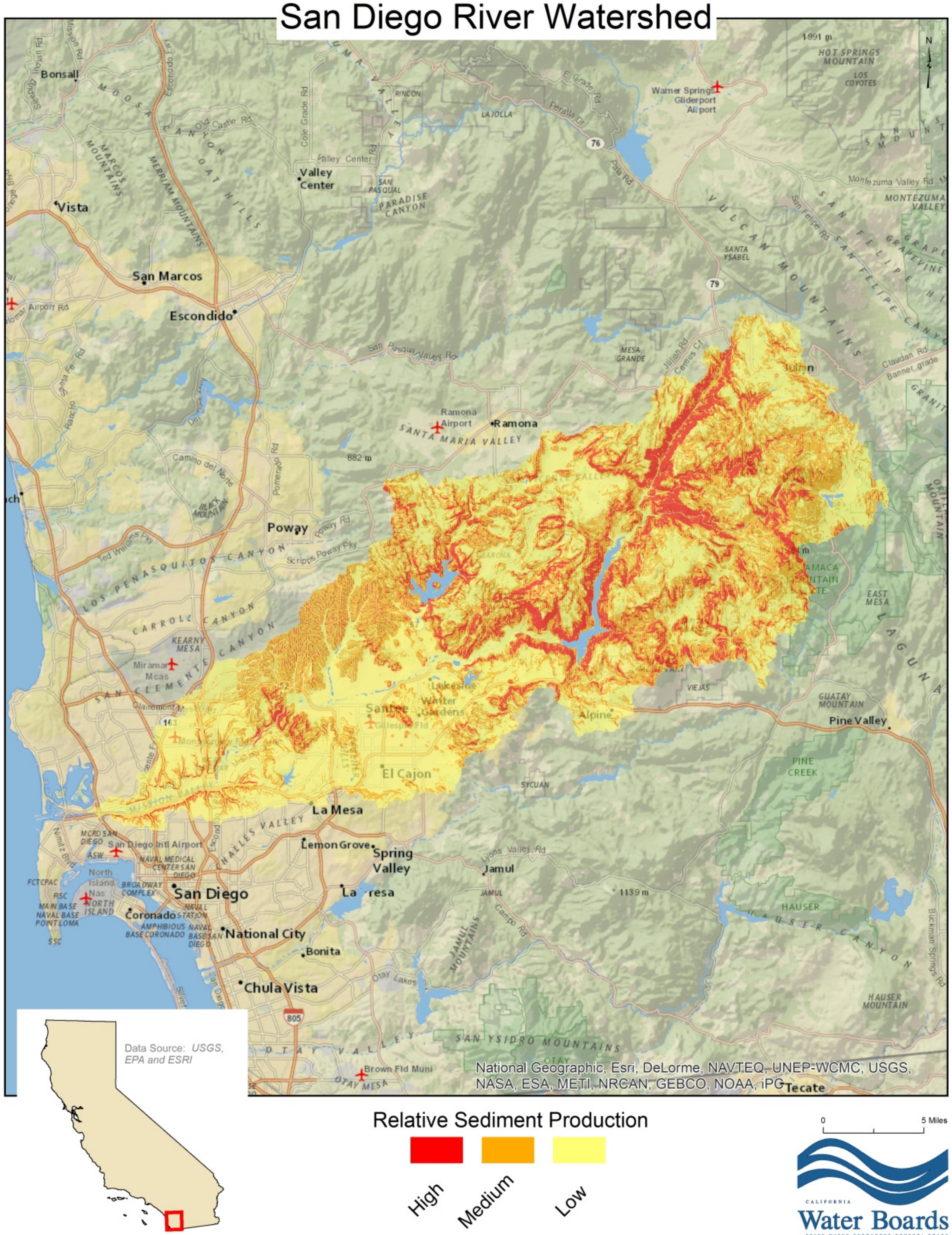
The Physical Landscape →
Disturbance →
Disturbed Watershed Processes →
Disturbed Receiving Water Conditions

	Overland flow, rilling & gullying (OF)	Infiltration and groundwater recharge (GW)	Interflow (shallow groundwater mvmt.) (IF)	Evapotranspiration (ET)	Delivery of sediment to waterbody (DS)	Delivery of organic matter to waterbody (DO)	Chemical/biological transformations (CBT)
Streams	X	X	X	X	X	X	X
Wetland	X	X	X	X		X	X
Lake						X	X
Large rivers					X		X
Marine nearshore					X		X
Groundwater aquifers		X					X

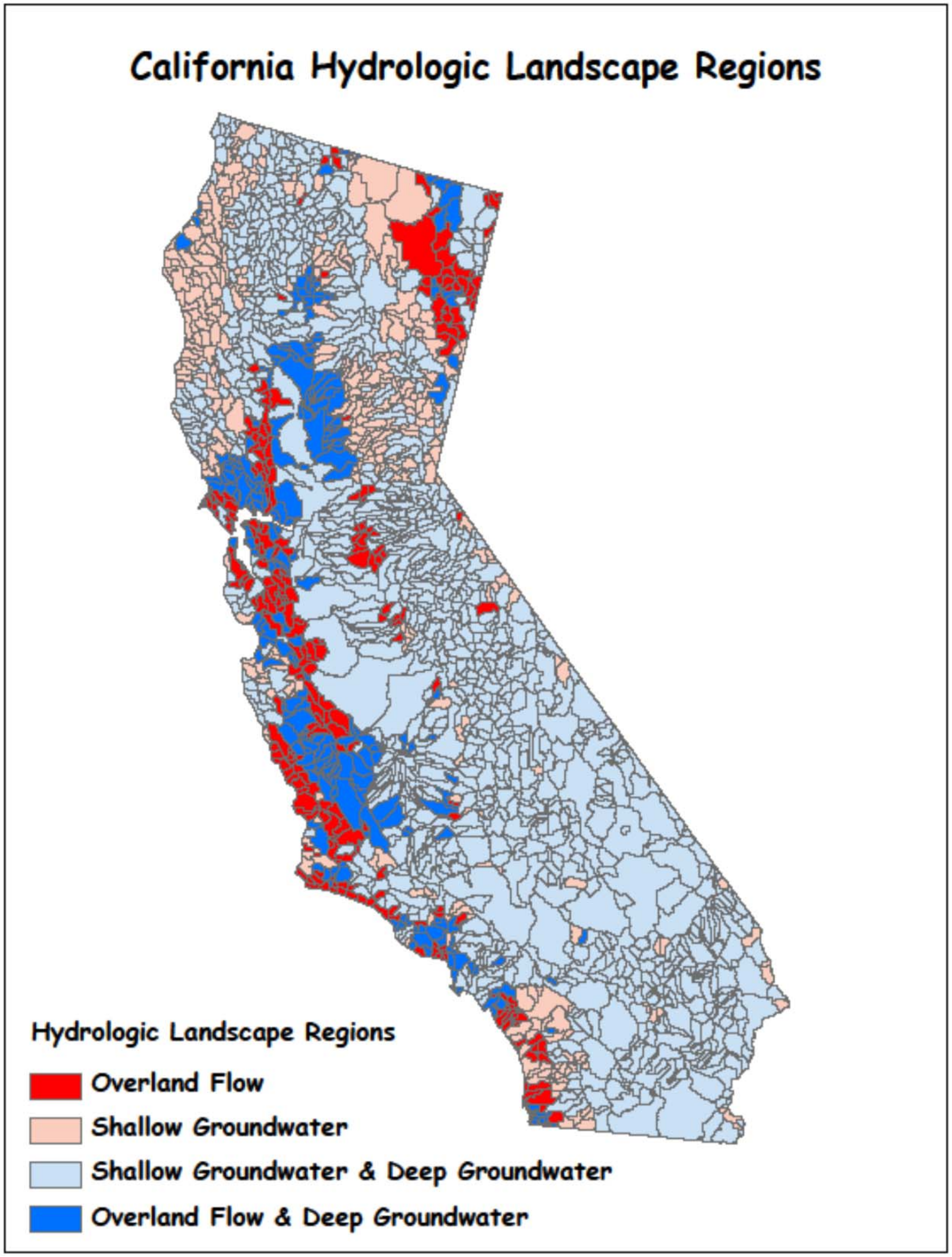
Watershed Management Zones for Colusa and Yolo County



San Diego River Watershed

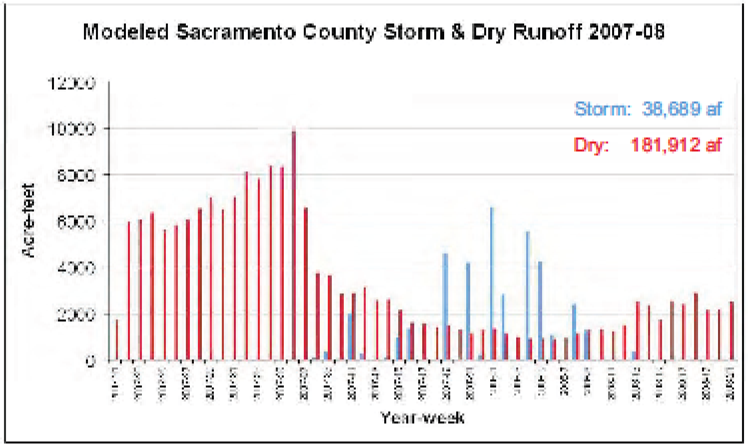


CALIFORNIA
Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS


California Hydrologic Landscape Regions
Hydrologic Landscape Regions
Overland Flow
Shallow Groundwater
Shallow Groundwater & Deep Groundwater
Overland Flow & Deep Groundwater

Oki 2009

Storm + Dry weather runoff… It adds up!



Dry Weather Runoff: 181,912 af

- Is approximately equivalent to:
  - Pyramid Lake (SoCal)… 171,000 af
  - Lake Matthews ………… 182,000 af
  - New Spicer ……………… 189,000 af
  - Pardee …………………… 198,000 af
- …Or about half of:
  - Hetch Hetchy ………….. 360,000 af
  - Lake Sonoma ………….. 381,000 af

1 af = 1 family per year


Eric Berntsen
916-341-5911
eberntsen@waterboards.ca.gov