

CHANGING WATERWAYS

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Water Resources Planner

Los Angeles District



**US Army Corps
of Engineers.**



PRESENTATION OUTLINE

California Climate and Waterways

- Drought
- Floods

Water Infrastructure – Water Storage and Transfer

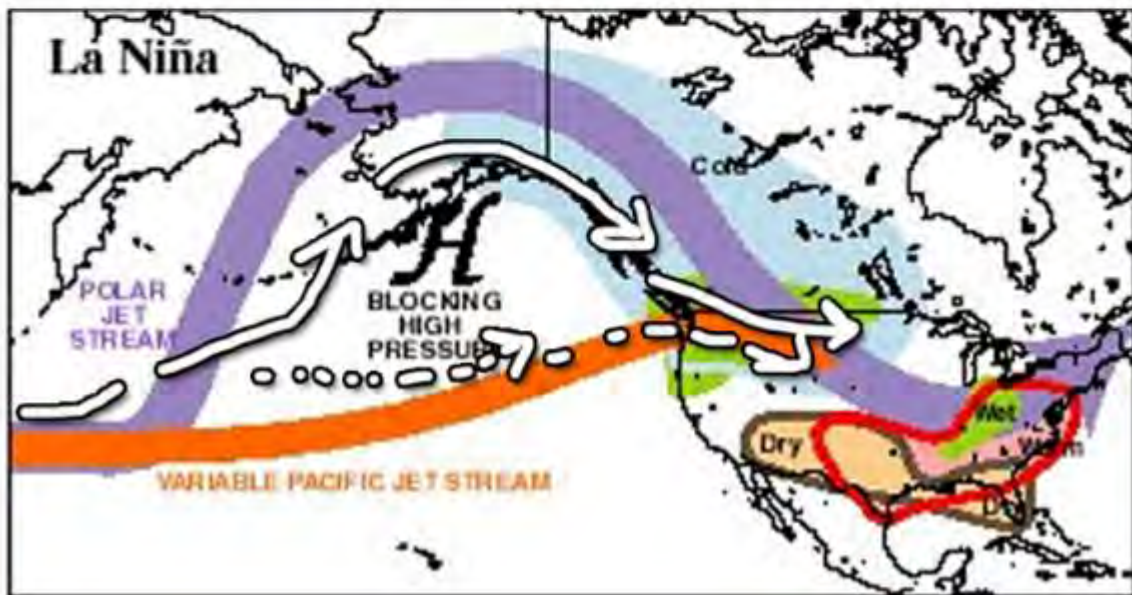
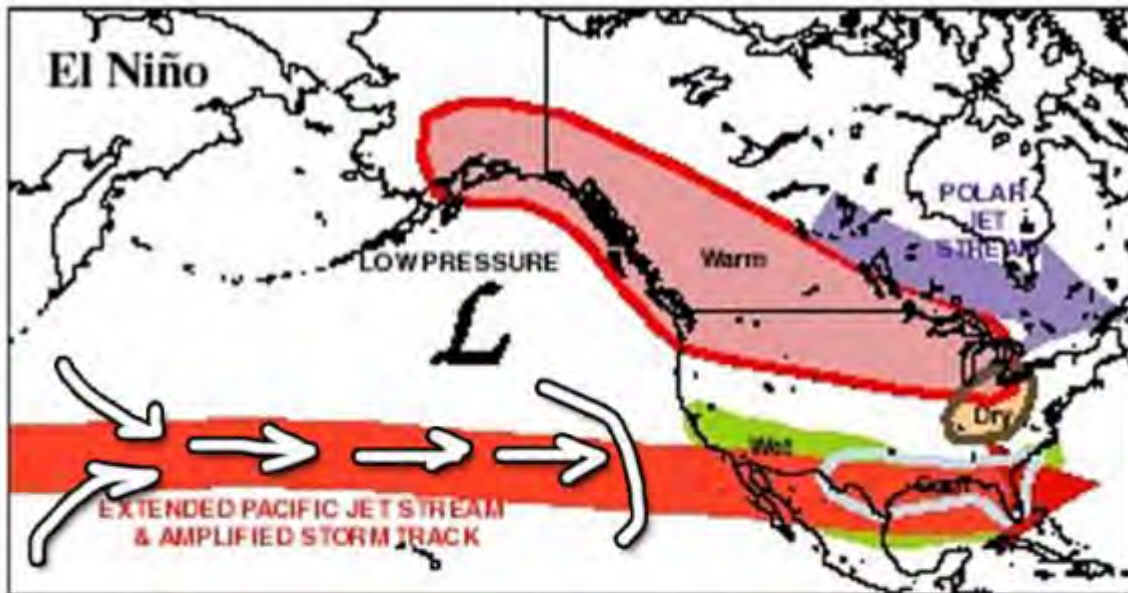
Urban Drainage – Patterns of Development



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CLIMATE: EL NIÑO– SOUTHERN OSCILLATION



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HISTORIC RECORD OF EL NINO

California Precipitation During Prior "Strong" El Niño Events

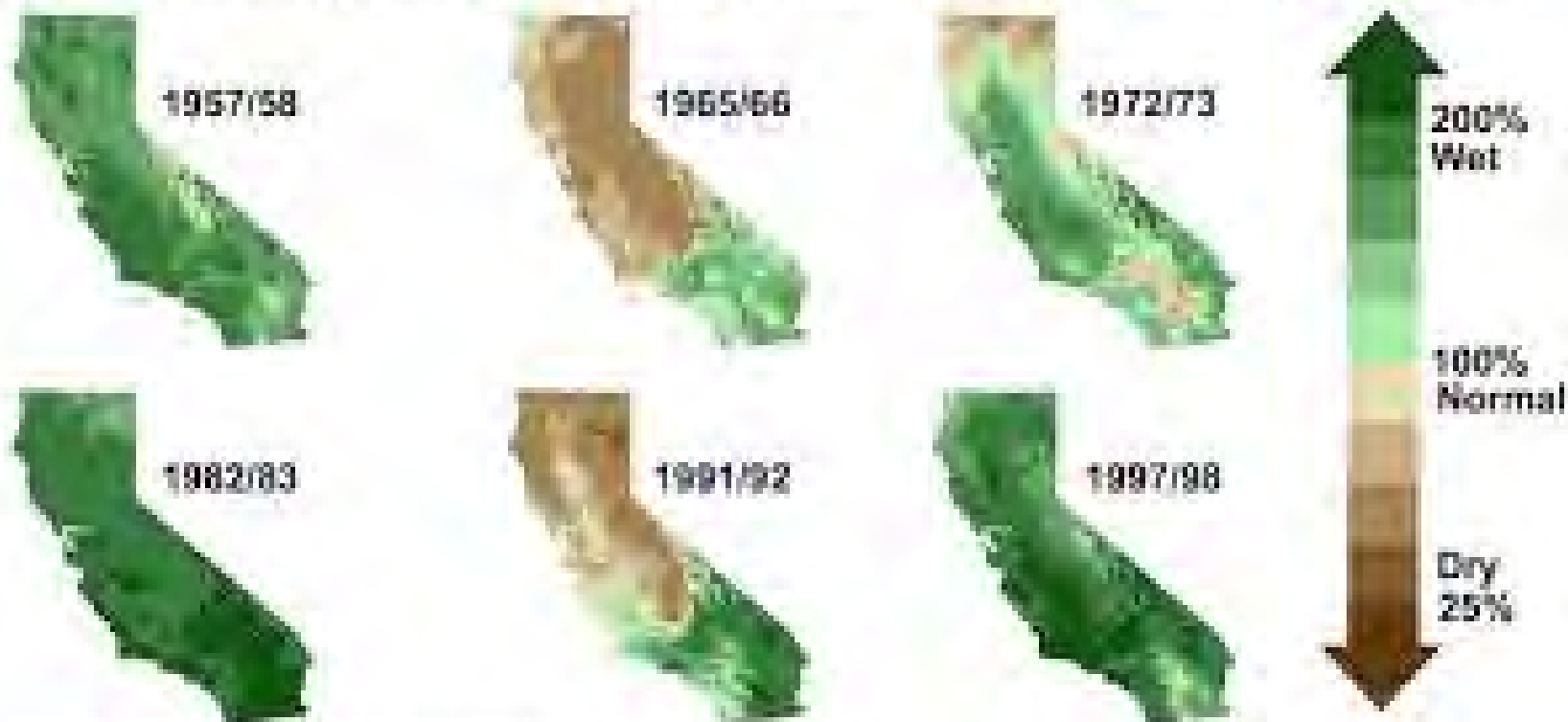


Image courtesy of NWS Sacramento Data: PRISM, CSU

EXTREME EVENTS: MULTI-YEAR DROUGHT

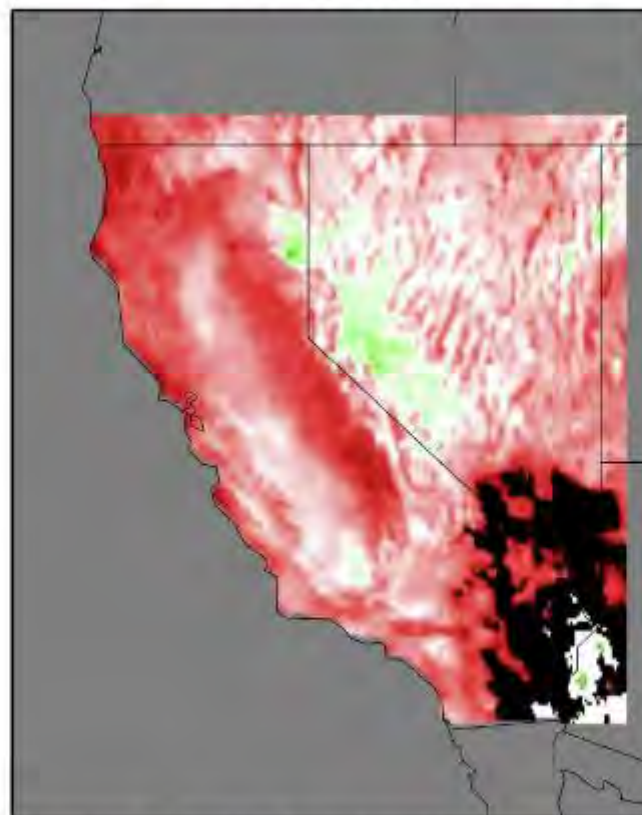
NET PRECIPITATION CONTRIBUTION TO DROUGHT WY2012-2015

$$\Delta P = \sum P - 4 * \langle P \rangle$$

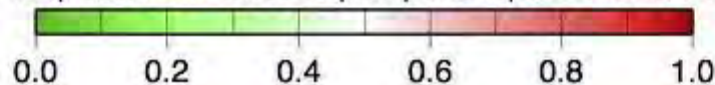
$$\Delta ET_o = \sum ET - 4 * \langle ET \rangle$$

Plotted here:

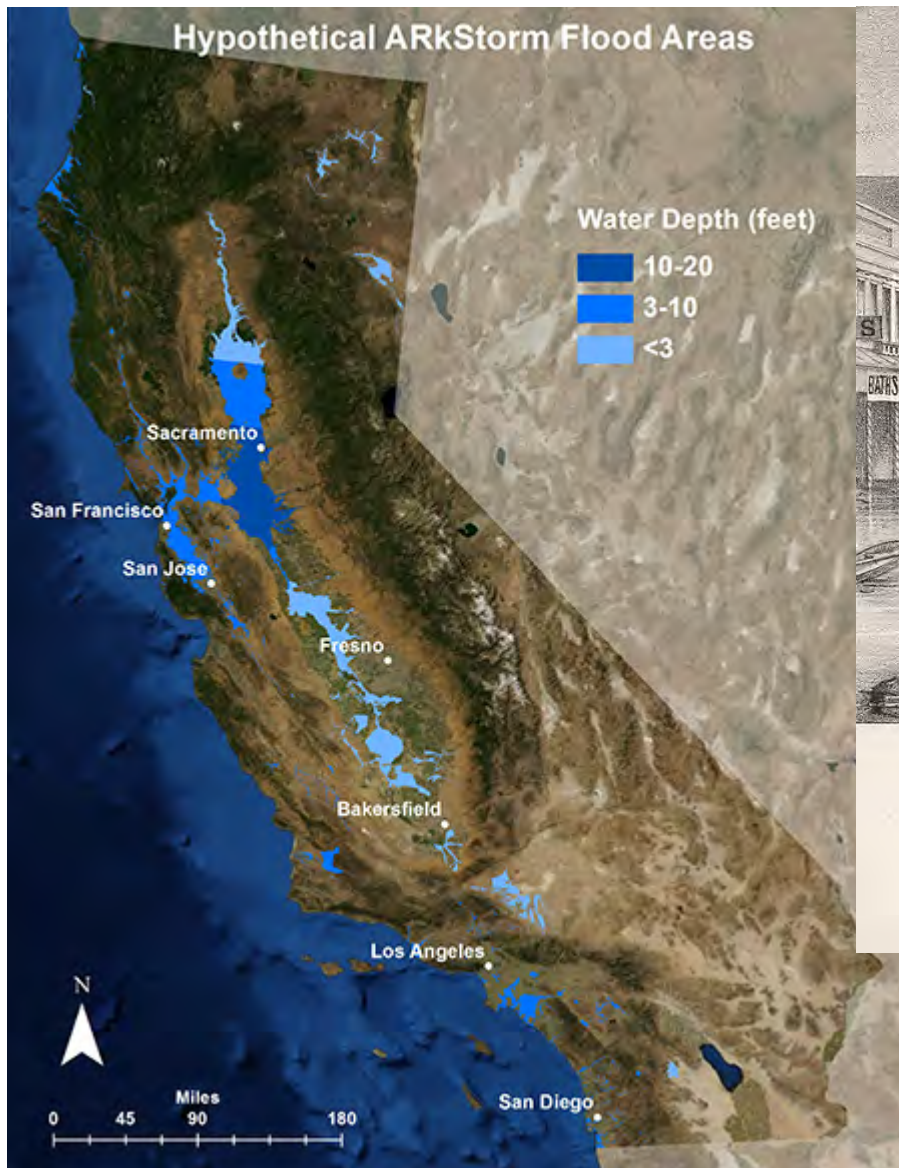
$$-\Delta P / (\Delta P - \Delta ET_o)$$



Precipitation as fraction of precipitation-plus-ET_o contribs



EXTREME EVENTS: ARKSTORM (HISTORICAL PRECEDENT 1862)



K, STREET, FROM THE LEVEE.

**INUNDATION OF THE STATE CAPITOL,
City of Sacramento, 1862.**

Published by AROSENFIELD, San Francisco.



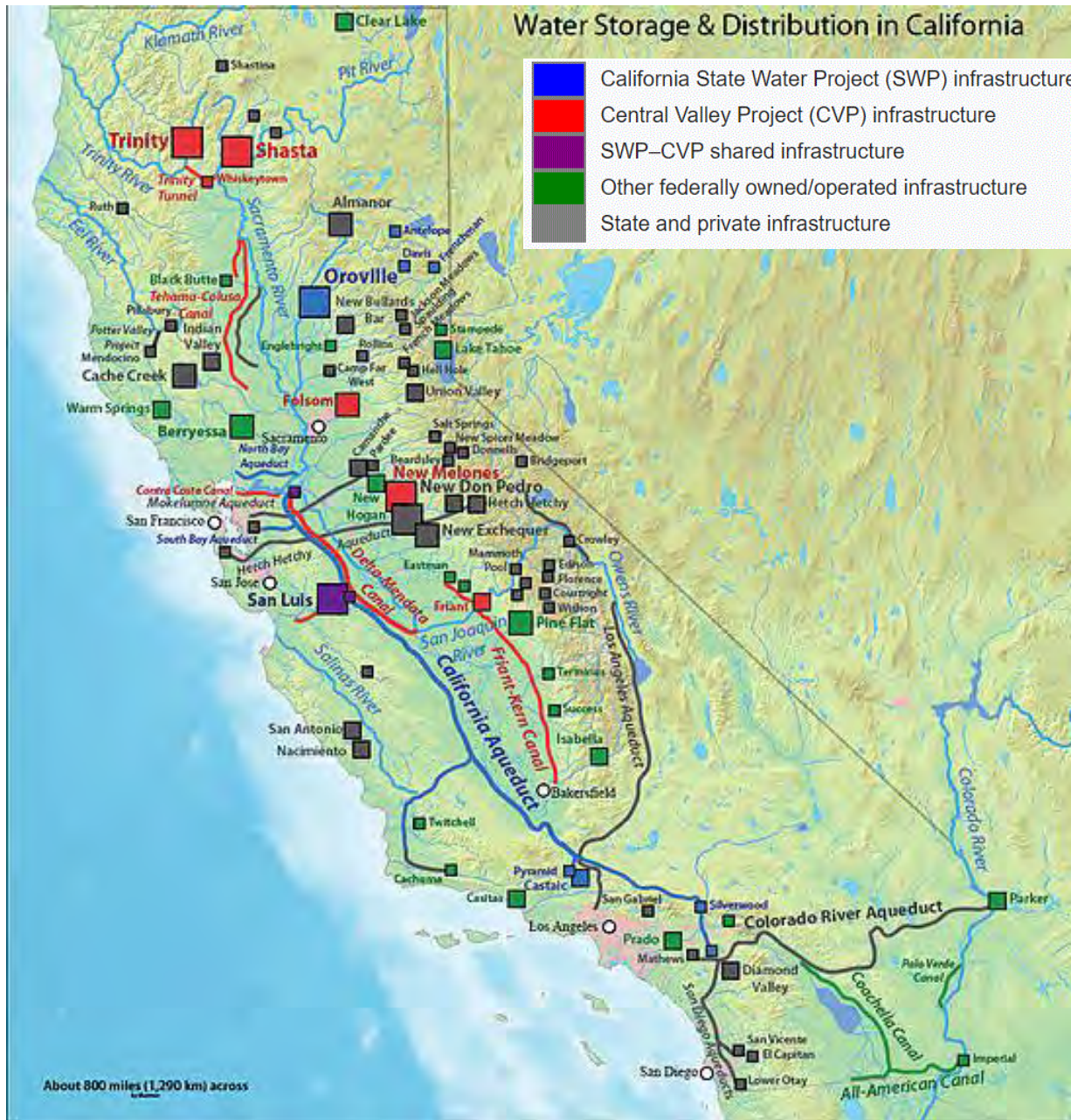
CALIFORNIA WATER SYSTEM AND COLORADO RIVER



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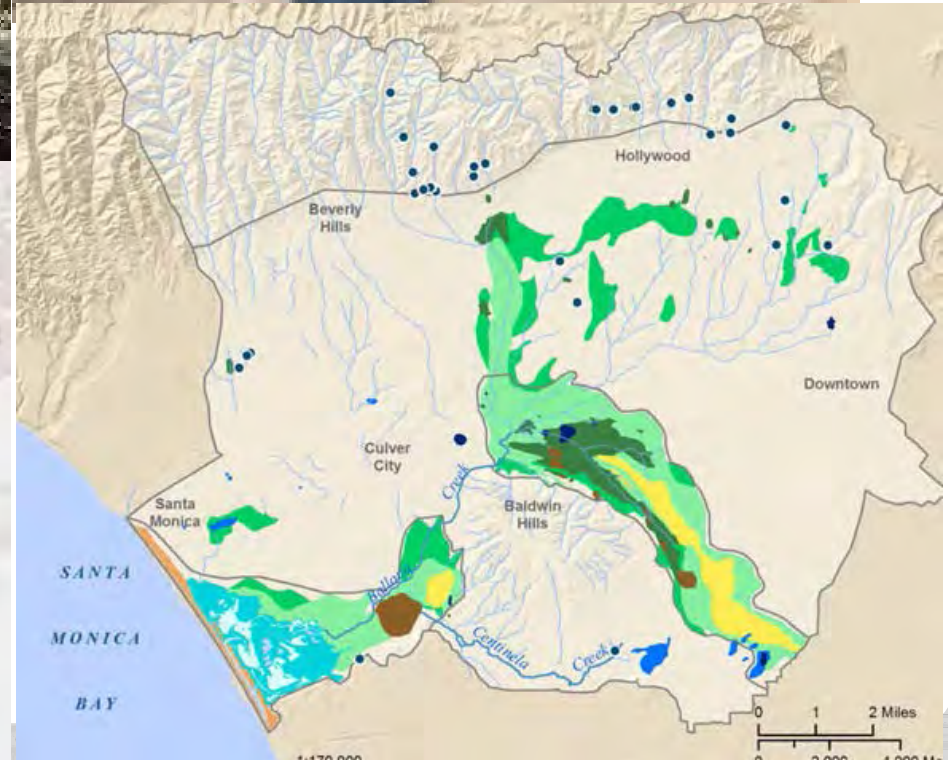
WATER STORAGE AND DISTRIBUTION IN CALIFORNIA



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LOS ANGELES RIVER URBAN DRAINAGE



HISTORICAL AND RECENT FLOODING

2018

Debris Flows Likely Across Recent Burn Areas Tue-Thu



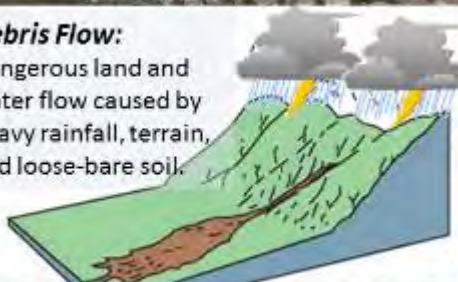
- POTENTIALLY DANGEROUS SITUATION ACROSS RECENT BURN AREAS!**
- Thomas, Creek, and LaTuna Burn Areas - *Mod-high risk of debris flows*
 - 5-10" rain expected for foothills & Mtns with high hourly rainfall rates
 - *Flash flooding also possible outside burn areas due to sustained heavy rainfall*
 - **Stay alert to the forecast and listen to your local emergency managers**



1938

Debris Flow:

Dangerous land and water flow caused by heavy rainfall, terrain, and loose-bare soil.



Weather Forecast Office
Los Angeles/Oxnard, CA

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FLOOD IMPACTS – NOT JUST WATER

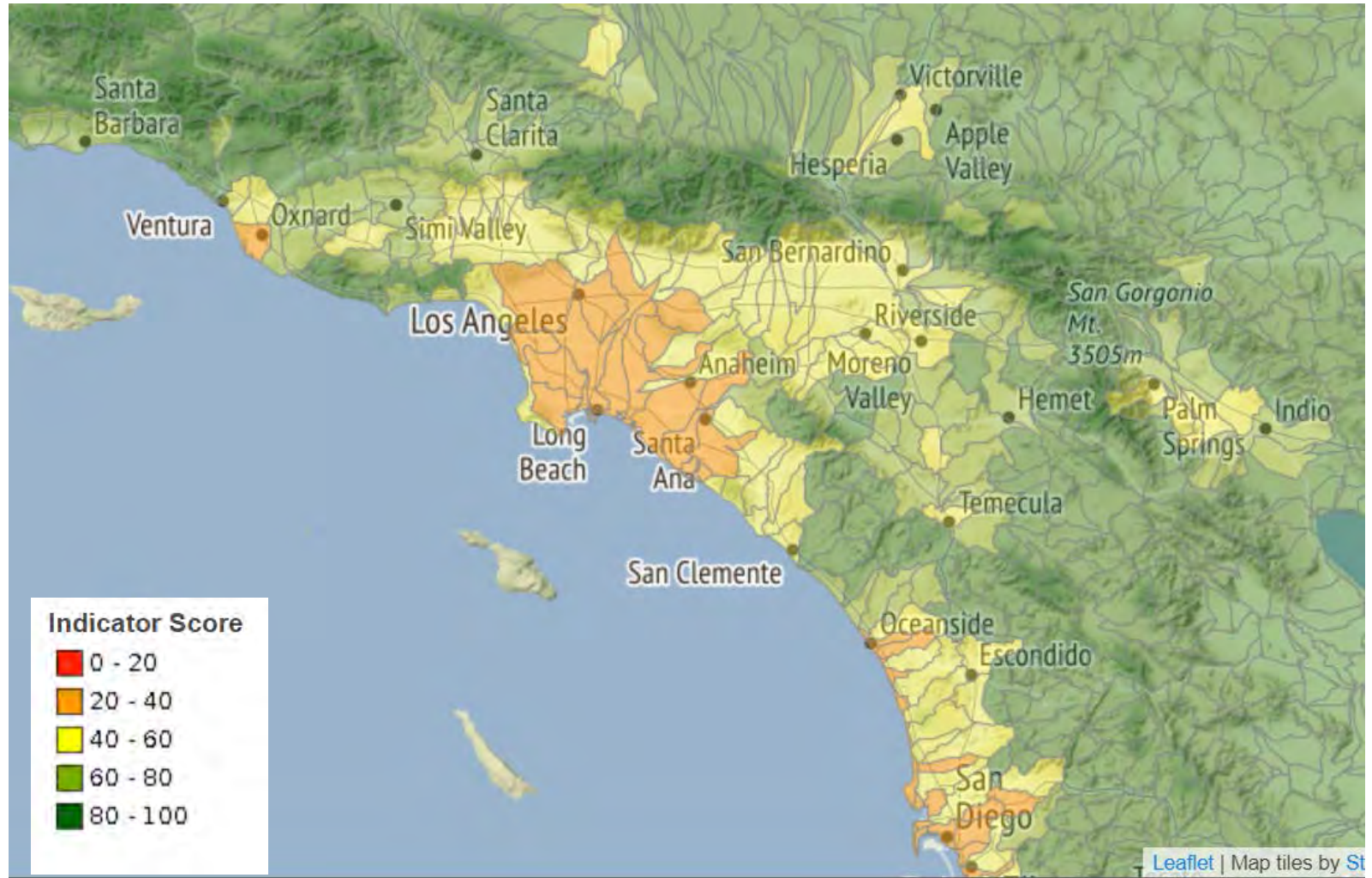
- Landslides and debris flows can cause extensive damage
- Many streams do not have stable banks without engineering control, and bank failure during flood events can damage property and pose a safety hazard
- Factors affecting bank stability
 - Steep slopes and fault-controlled uplift
 - Loose sediment and poorly consolidated formations in stream banks
 - Sudden, high stream flows in flood events
 - Bed load dominated sediment transport



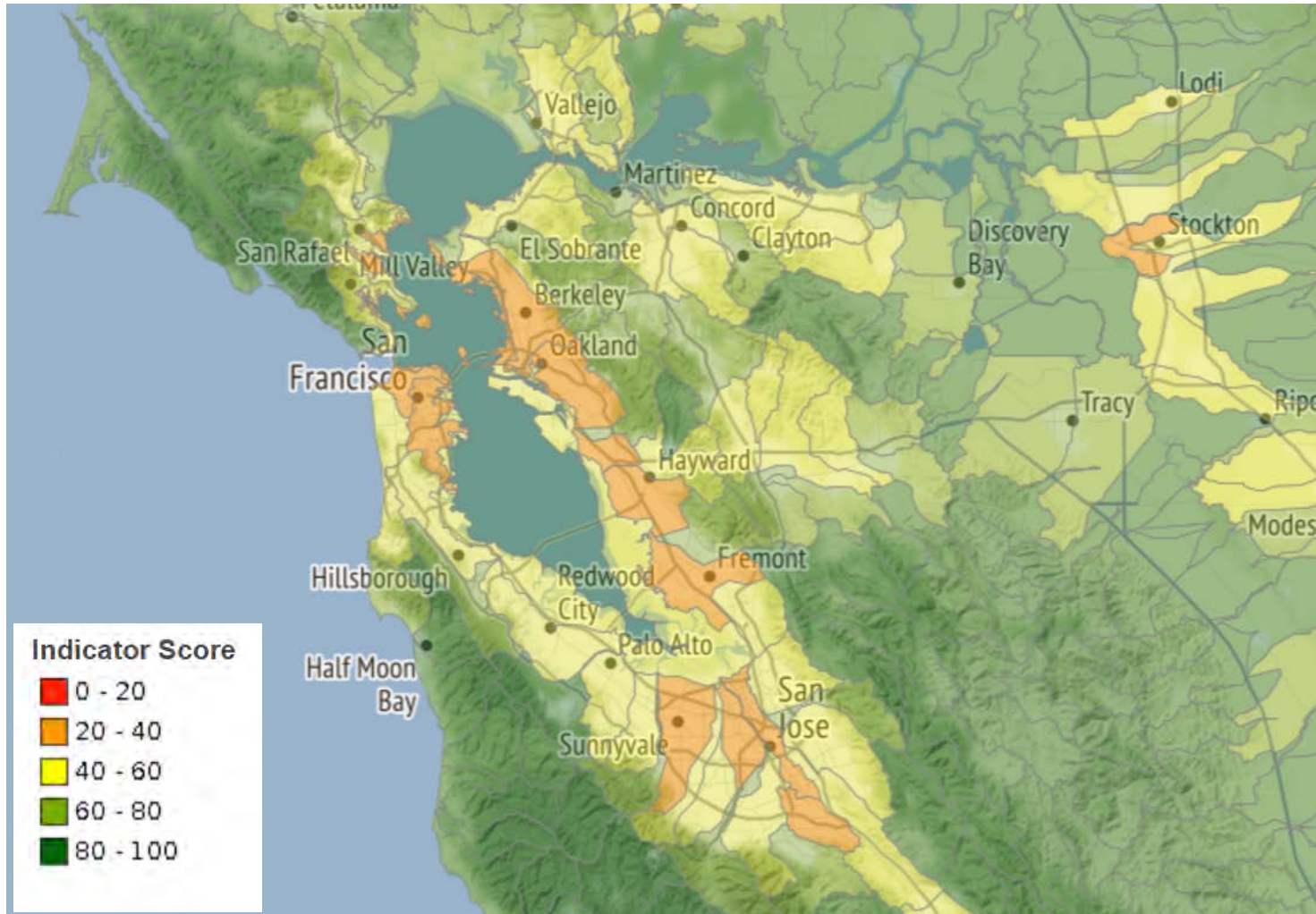
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UC DAVIS STREAM WATER SUSTAINABILITY INDICATORS – GEOMORPHIC CONDITIONS



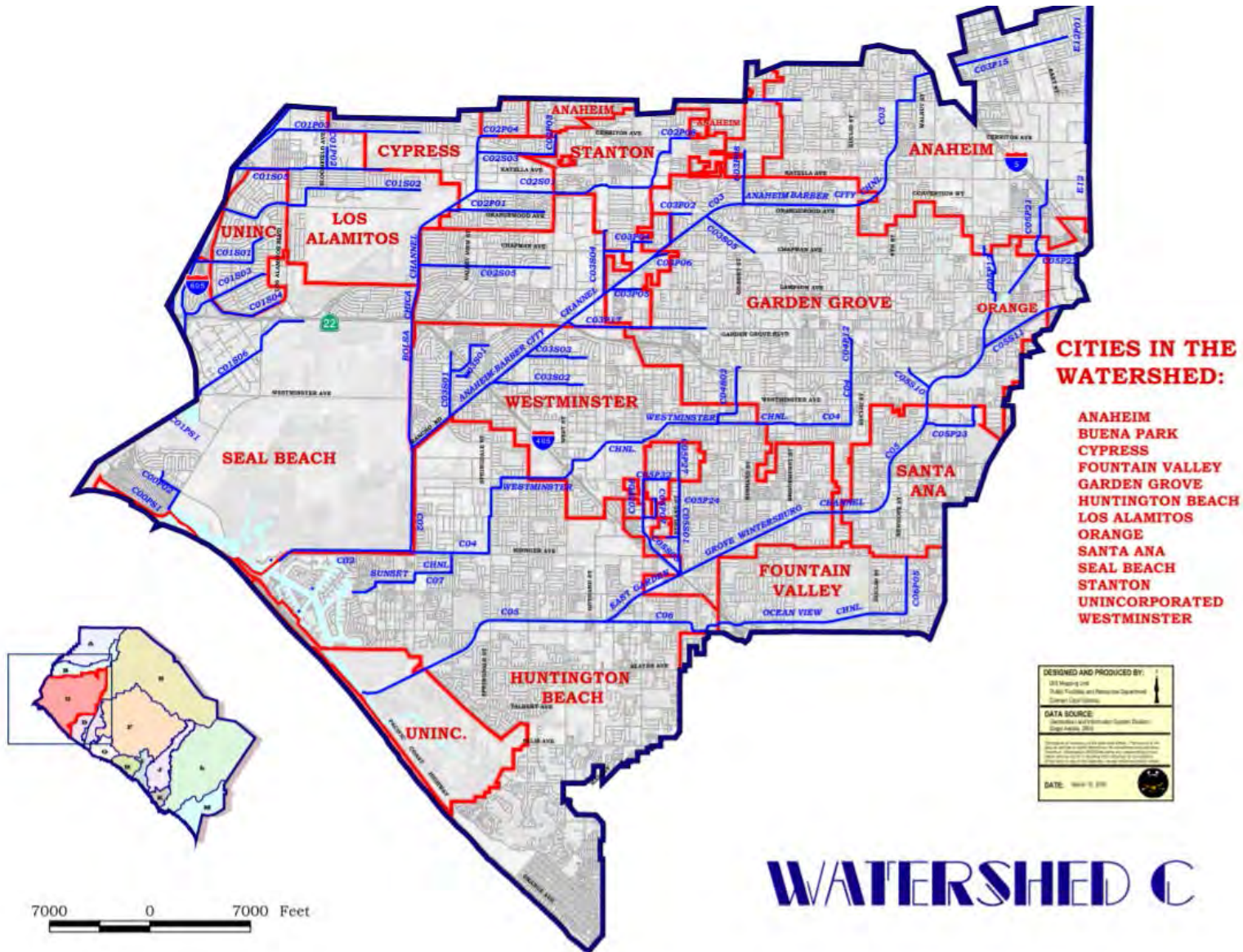
UC DAVIS STREAM WATER SUSTAINABILITY INDICATORS – GEOMORPHIC CONDITIONS



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ORANGE COUNTY: WESTMINSTER—EAST GARDEN GROVE



WESTMINSTER—EAST GARDEN GROVE SCENARIO

Pre-Development: Coastal Plain with areas of poor drainage

Initial Settlement and Agricultural Development: Drainage Districts established to improve drainage, support irrigation. Drainage/irrigation canals constructed, extensive agriculture

Urbanization and Residential Development: Flood control Districts expand existing drainage ditches, typical flood protection at 25-year recurrence interval

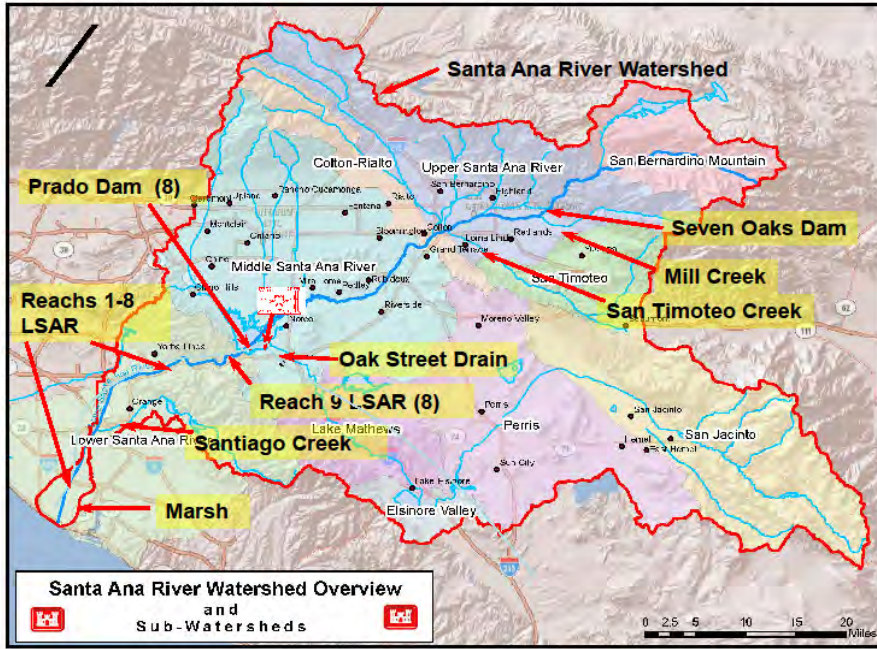
Ongoing system upgrades: improve flood protection with fully engineered channels, goal: 100-year recurrence interval

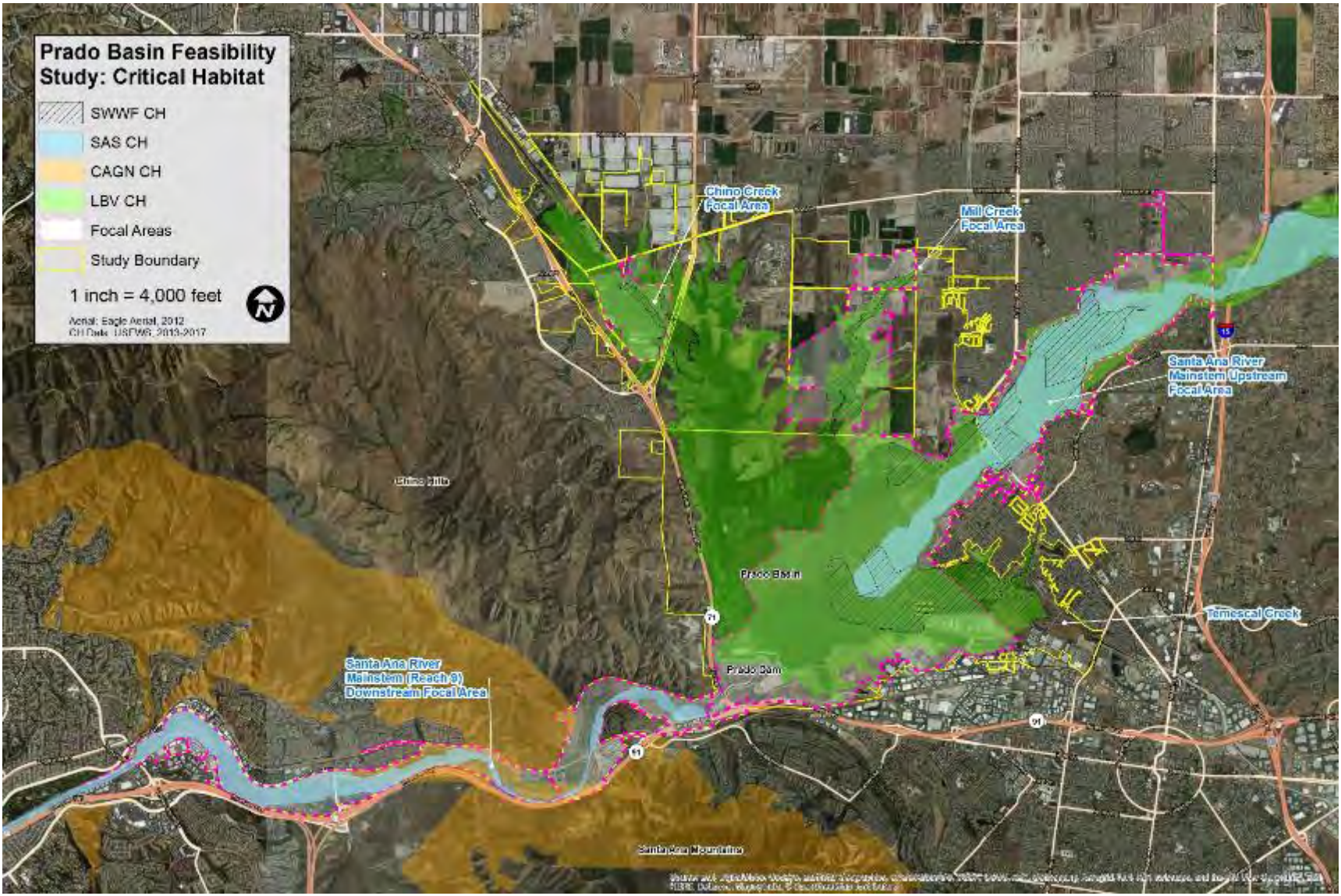


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Santa Ana River Projects





RESOURCE SIGNIFICANCE: Threatened and Endangered Species Critical Habitats





Problem: Incised Channels

- Sediment starved flows scour streambeds and streambanks
- Steep sides degrade habitat by reducing the area available for native vegetation and by reducing connectivity
- Incised channel lowers water table beneath the floodplain and reduces floodplain wetlands



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Problem: Upstream Sedimentation



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Problem: Non Native & Highly Invasive Arundo Donax

- Displaces native vegetation
- Consumes 9-25 acre-feet of water/acre/year (2-4 times more than native vegetation)



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54°F



11/30/2012 09:43AM CAM2

PROBLEM: NON-NATIVE WILDLIFE

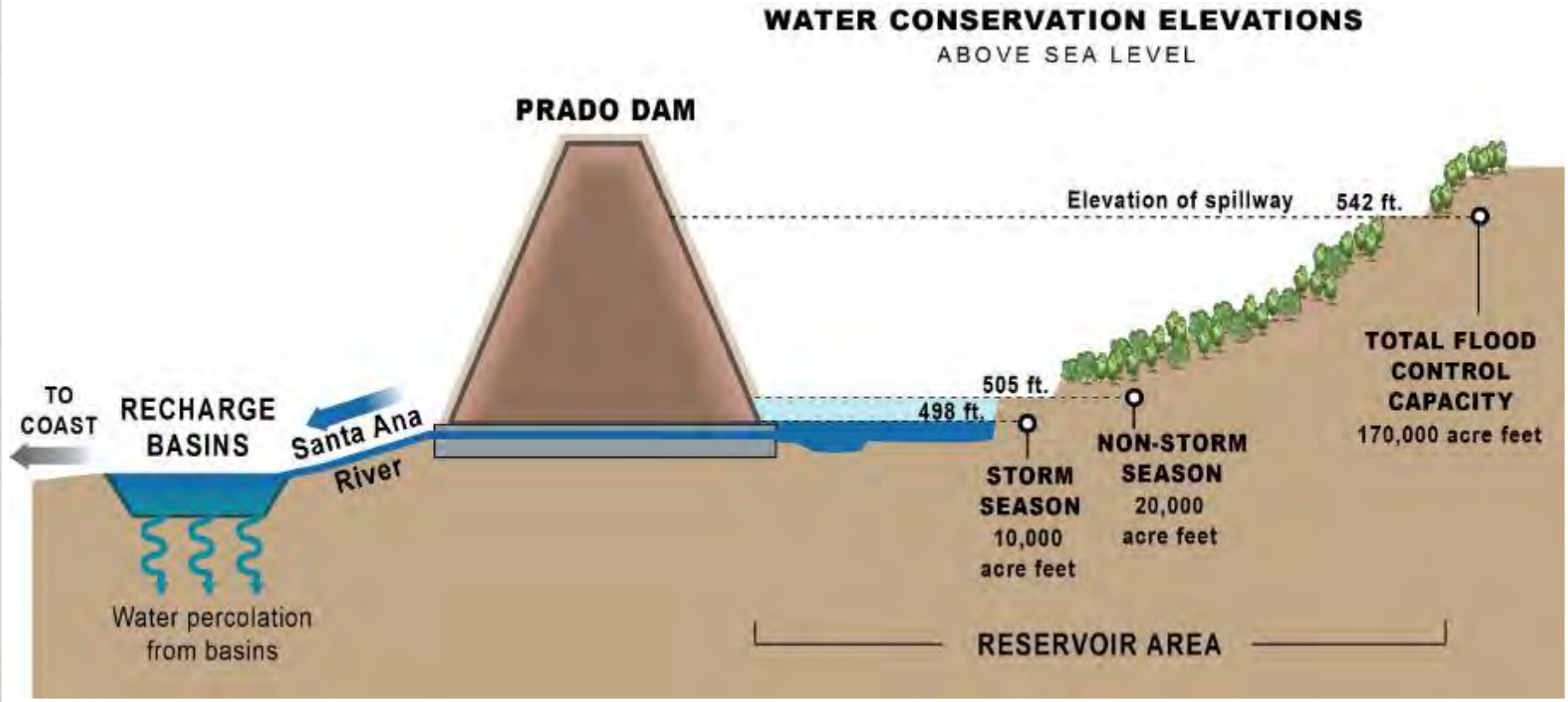
**FERAL PIGS, COWBIRDS,
CRAWDADS, TURTLES**



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PRADO DAM OPERATIONS AND WATER CONSERVATION



PRADO BASIN RESTORATION TECHNIQUES

- Sediment Management – upstream removal and downstream re-entrainment
- Invasive Vegetation Management
- Invasive Animal Control
- In-stream habitat features – rock groins for mimicking natural flow conditions and habitat
- Channel restoration – channel diversion, bank features and reconnection to floodplain



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CHANGING WATERWAYS – SUMMARY

- California's climate is inherently conducive to flooding and droughts
- Water supplies are dependent on large-scale long-distance transfers
- Development has incrementally addressed flood risks
- California's terrain means flooding has additional impacts beyond inundation (bank failure, landslides)
- Restoration opportunities do exist
- Greatest limitations on restoration and adaptation are posed by extensive development



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