Historical Ecological Analysis and Its Application to Regional HCP/NCCPs

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San Francisco Estuary Institute

Habitat Conservation Planning from Tahoe to the Bay: 10th Annual Workshop

November 15, 2012

SFEI ASC

San Francisco Estuary Institute
Aquatic Science Center

- SFEI formed in 1993
- Towards a **comprehensive, coordinated Regional Monitoring and Research Strategy** to assess the chemical, physical and biological health of the Estuary
- BOD represents agencies, NGOs, industry
- 50 staff
- Administer a **Joint Powers Authority** of the state: the Aquatic Science Center (ASC)
- 3 programs: Clean Water, EDIT, and Resilient Landscapes

- → *Impartial environmental science synthesis for the region*

The challenge of understanding habitat loss

HCP/NCCPs generally initiated because of habitat loss (and other stressors)

But that doesn't mean that the changes are well-documented or well understood

- **What was the historical distribution of target habitat types?**
- **What processes controlled their distribution? What made them resilient, adaptive?**
- **How have they changed?**
- **What is possible now?**

Historical Ecology helps answer these questions

- Habitat patterns, connectivity, and spatial relationships
- Change analysis: what is left, how much has changed where
- Conceptual models of functional, resilient landscapes
- New restoration strategies
- Better agreement on problems and priorities
- More specific, well supported targets and metrics
- Lower risk and cost

Historical Ecology helps answer these questions

"Where was habitat historically, and how did that distribution differ from today? What were the geomorphic processes that created the habitat, and how do those processes differ today?" **Collins and Montgomery 2001**

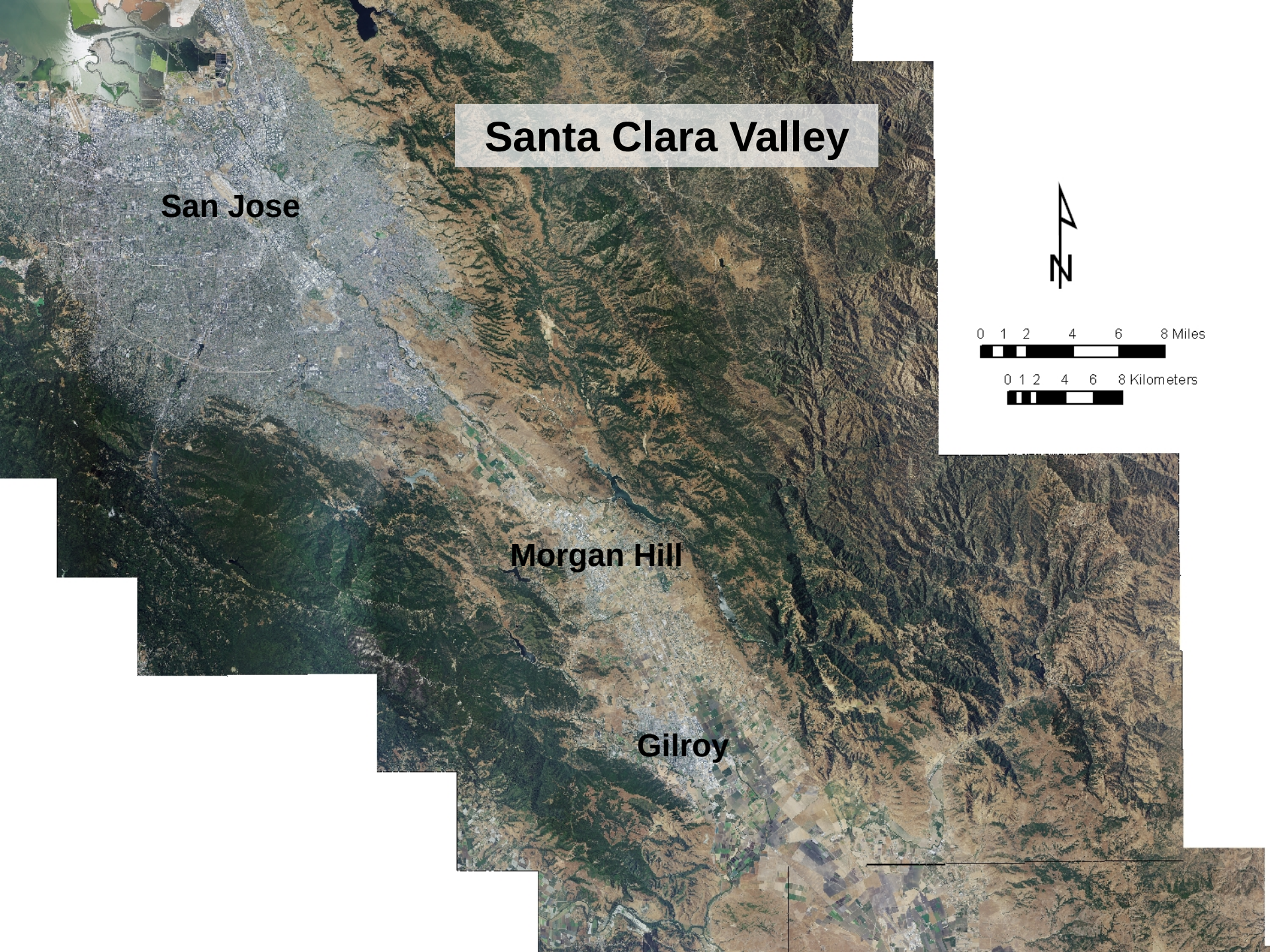
Use HE to identify "landscape components" as "building blocks for restoration" **Verhoeven et al. 2008**

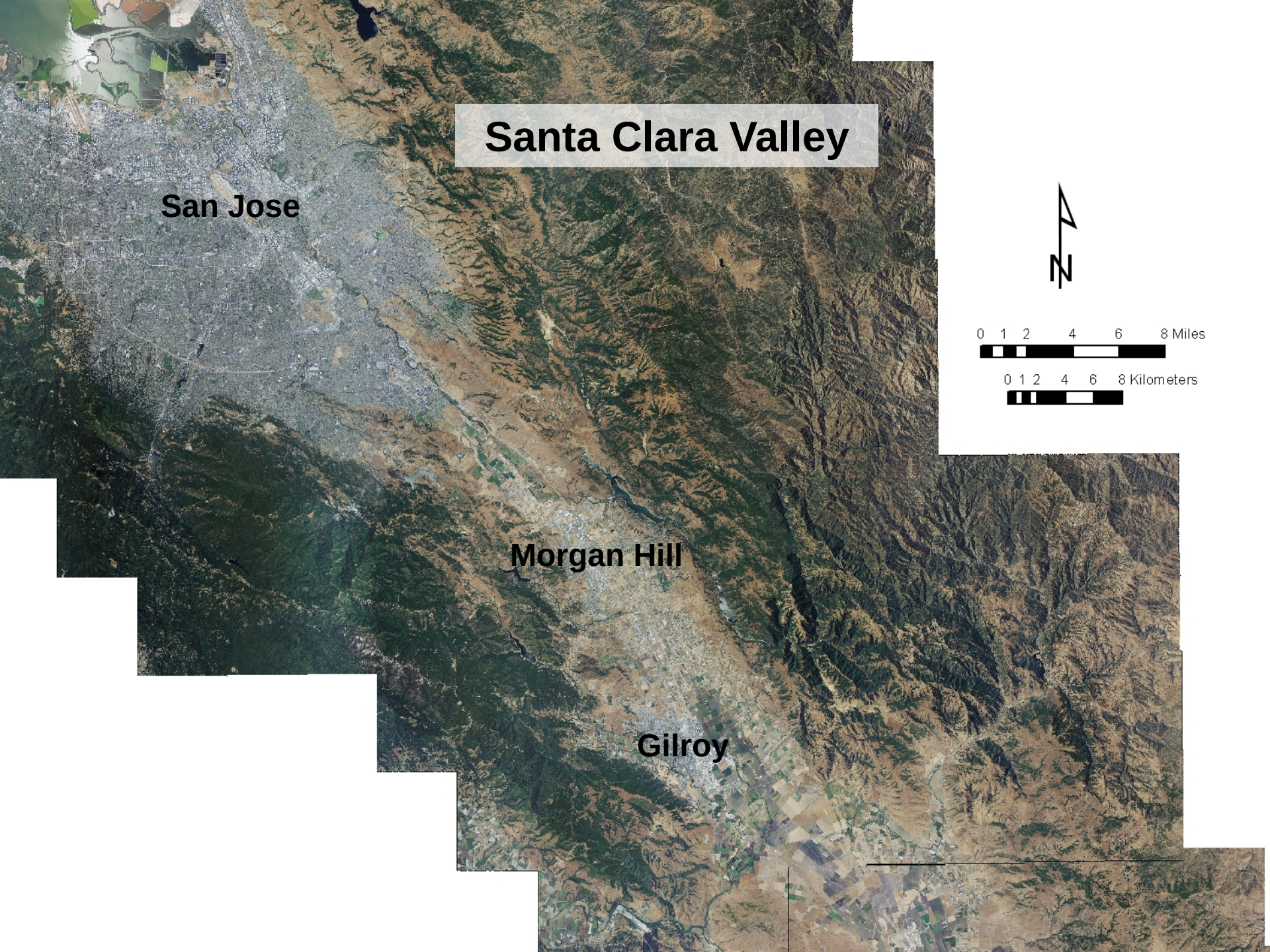
"Historical understanding" necessary to distinguish "historical," "hybrid," and "novel" ecosystems– and associated restoration trajectories. **Hobbs et al. 2009**

Use HE "to operationally define concepts like "ecological integrity" and "resilience"…" **Safford et al. 2012**

Historical Ecology use in HCPs

- East Contra Costa County
- Santa Clara Valley
- Alameda Creek
- Bay Delta


Santa Clara Valley
San Jose
Morgan Hill
Gilroy
N
0 1 2 4 6 8 Miles
0 1 2 4 6 8 Kilometers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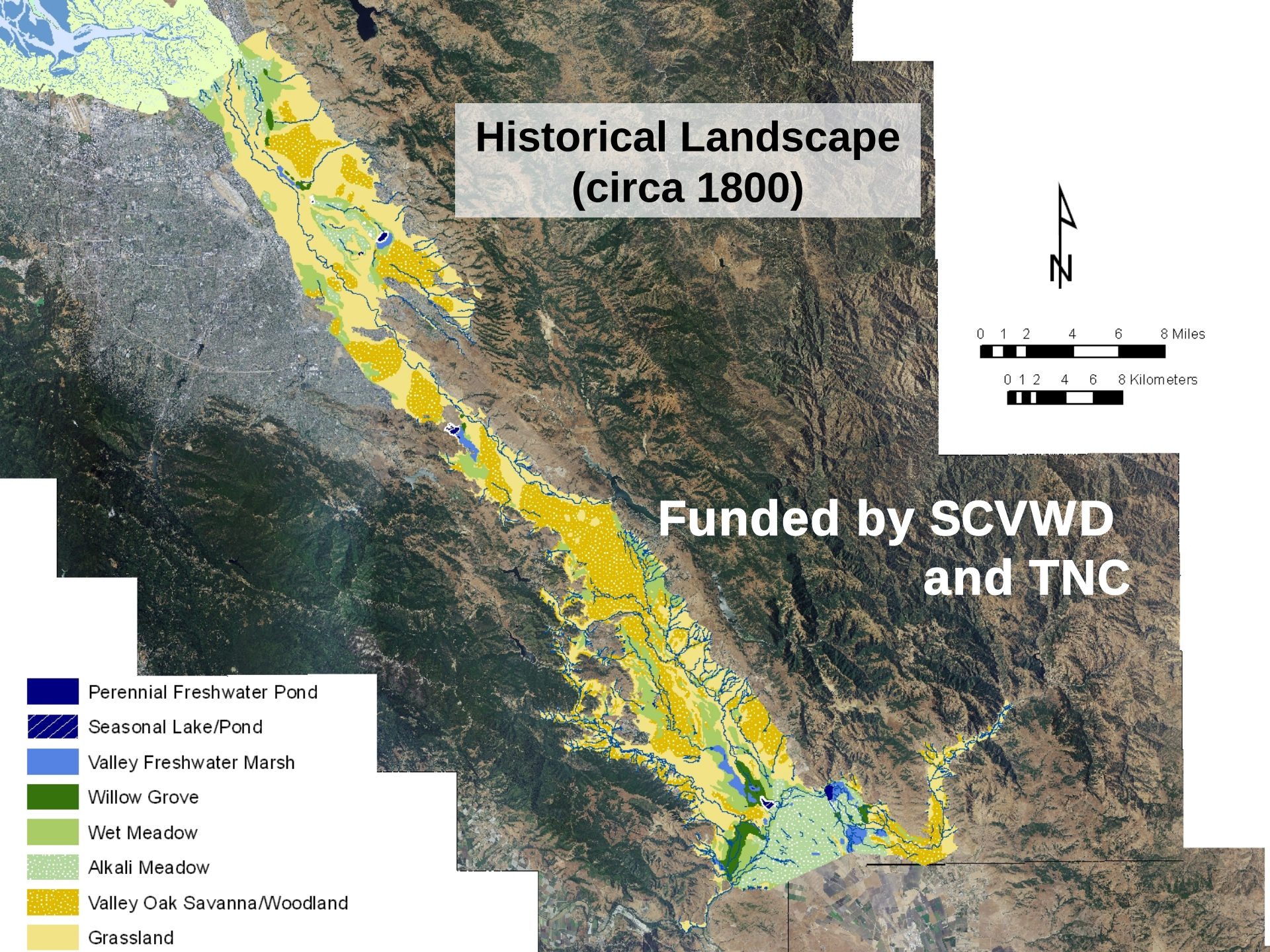
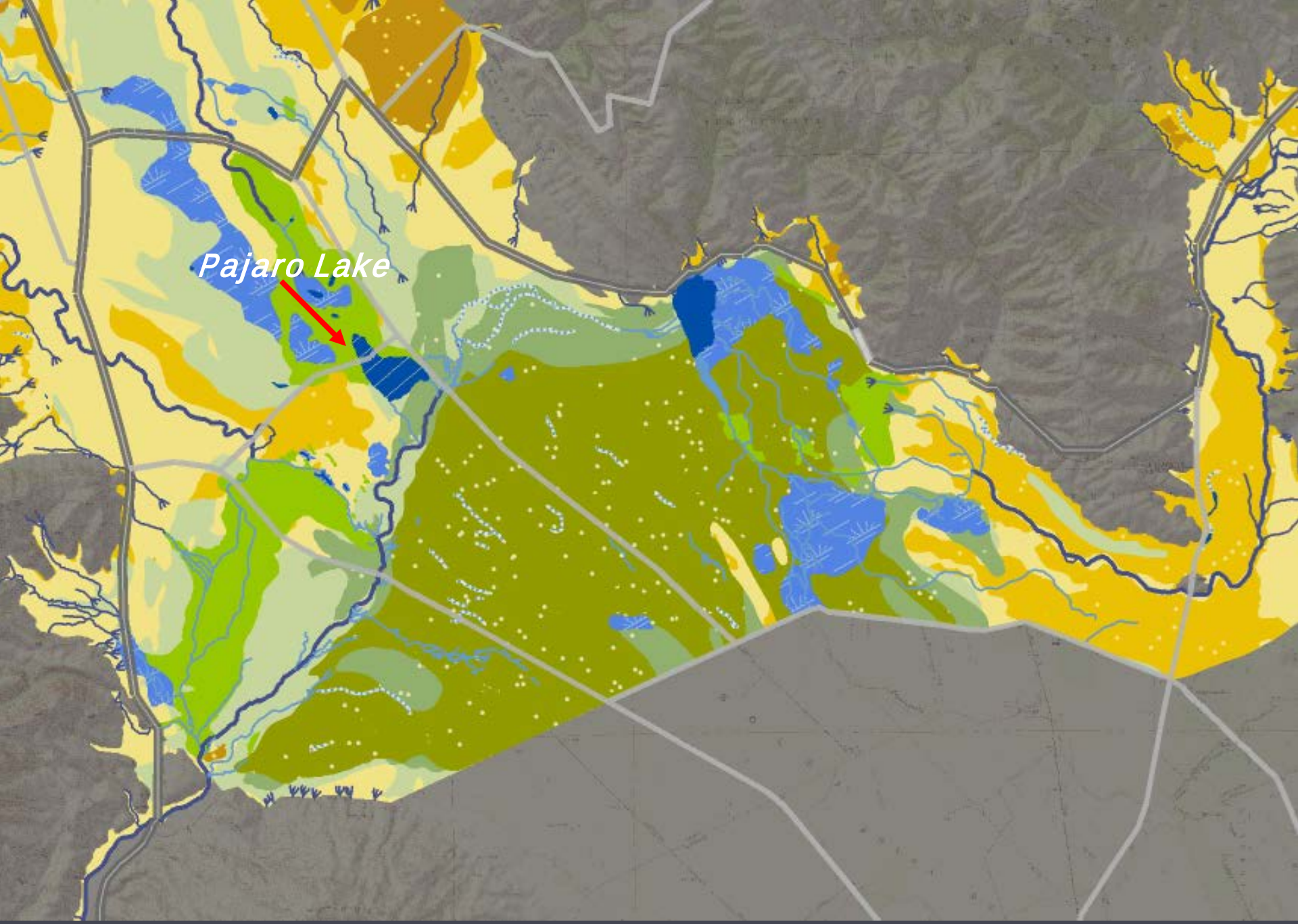
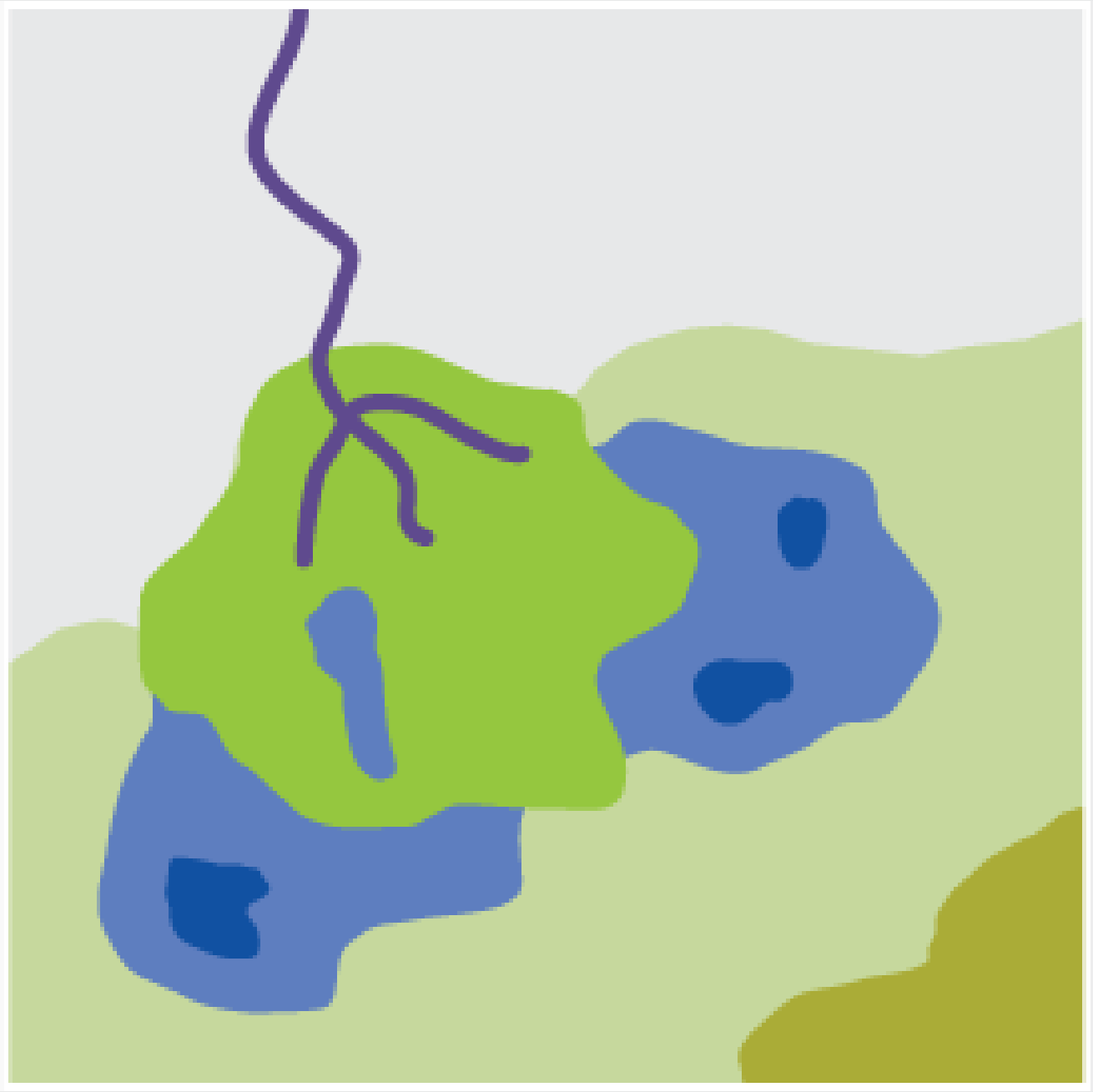

Historical Landscape
(circa 1800)
N
0 1 2 4 6 8 Miles
0 1 2 4 6 8 Kilometers
Funded by SCVWD
and TNC
Perennial Freshwater Pond
Seasonal Lake/Pond
Valley Freshwater Marsh
Willow Grove
Wet Meadow
Alkali Meadow
Valley Oak Savanna/Woodland
Grassland


Pajaro Lake

1850



1939

2008

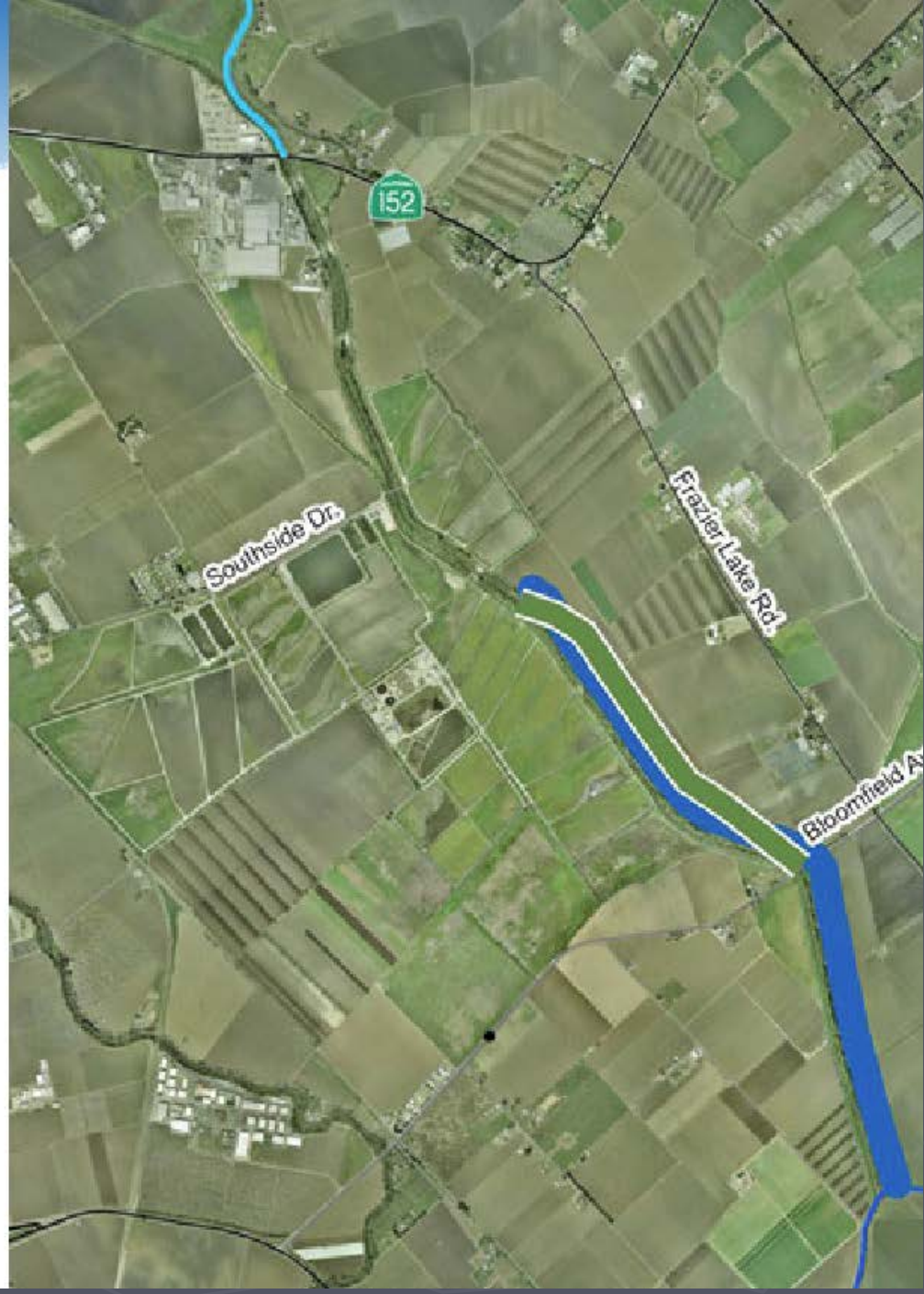
conceptual restoration model

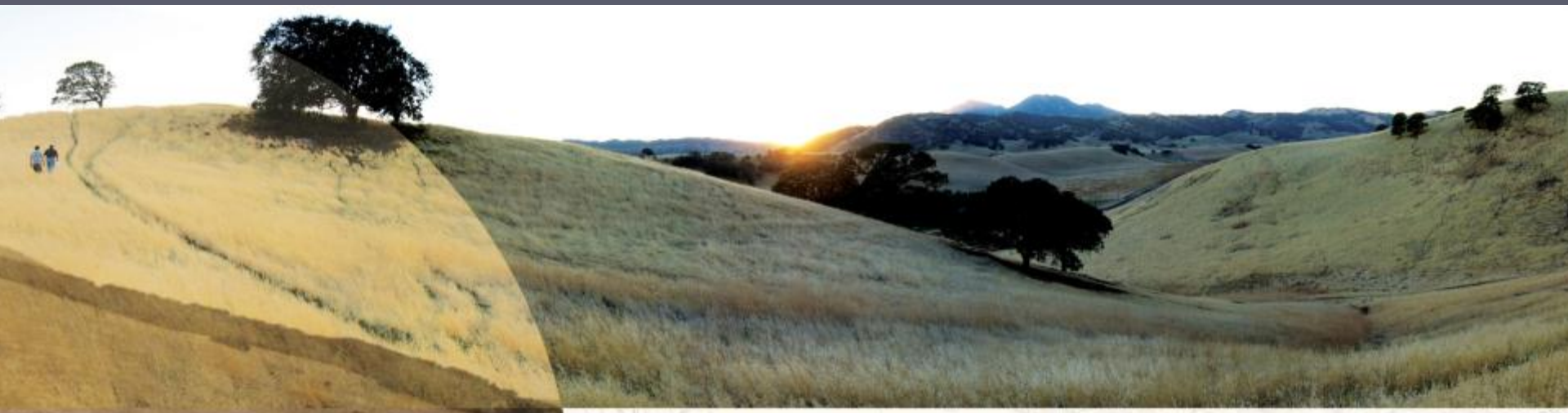
Alternative F

4 Levee Removal

6 Setback Levee

9 New Bridge/Box Culvert

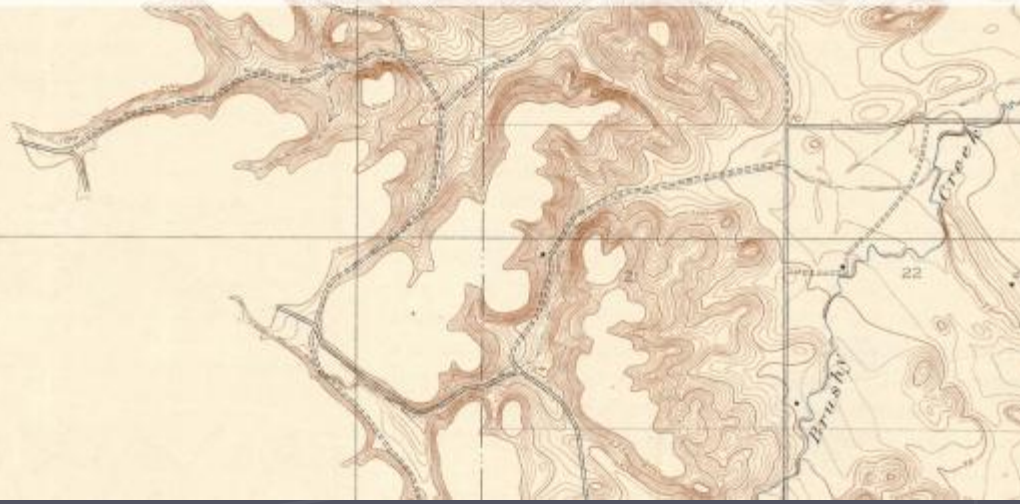


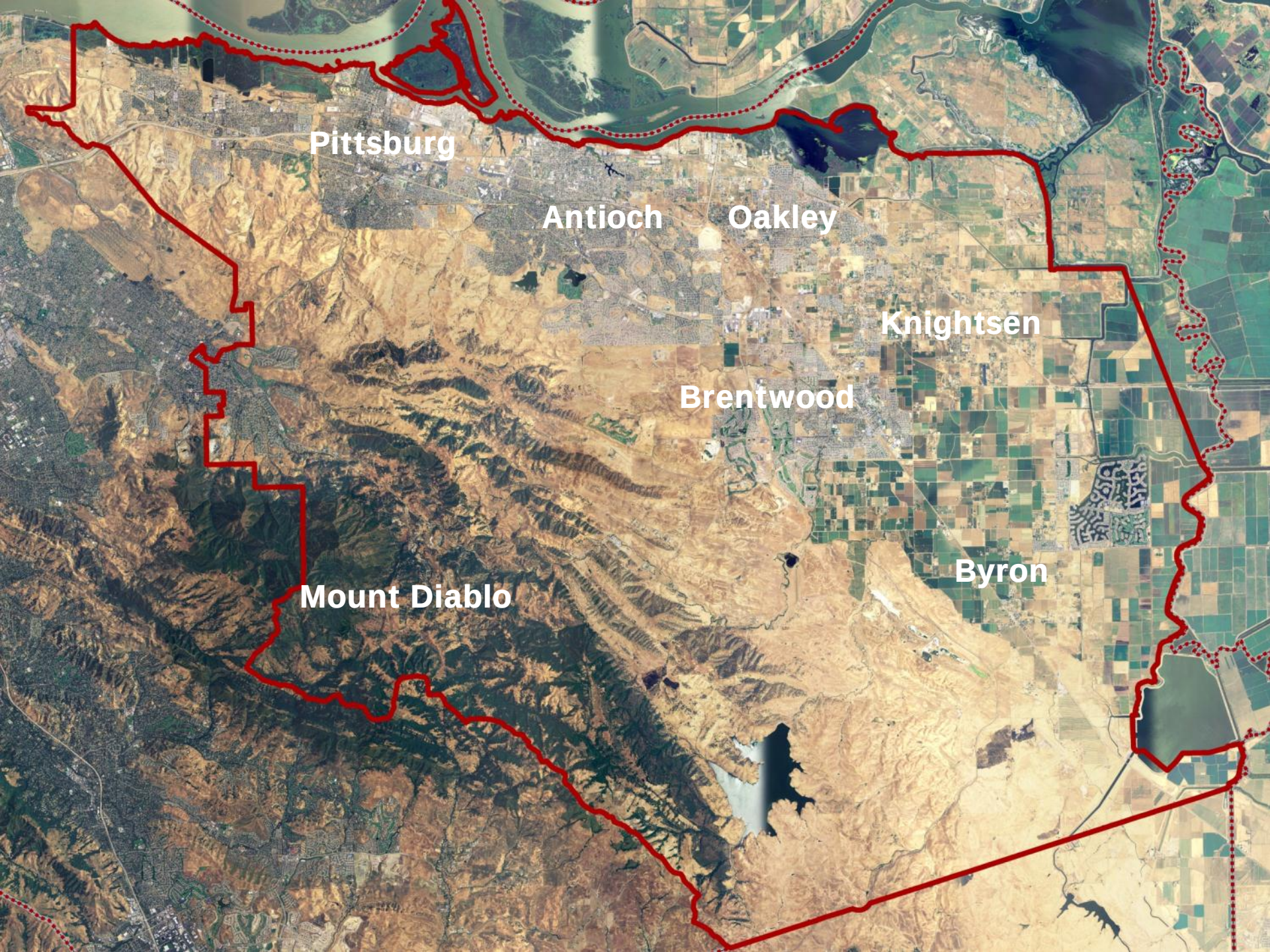


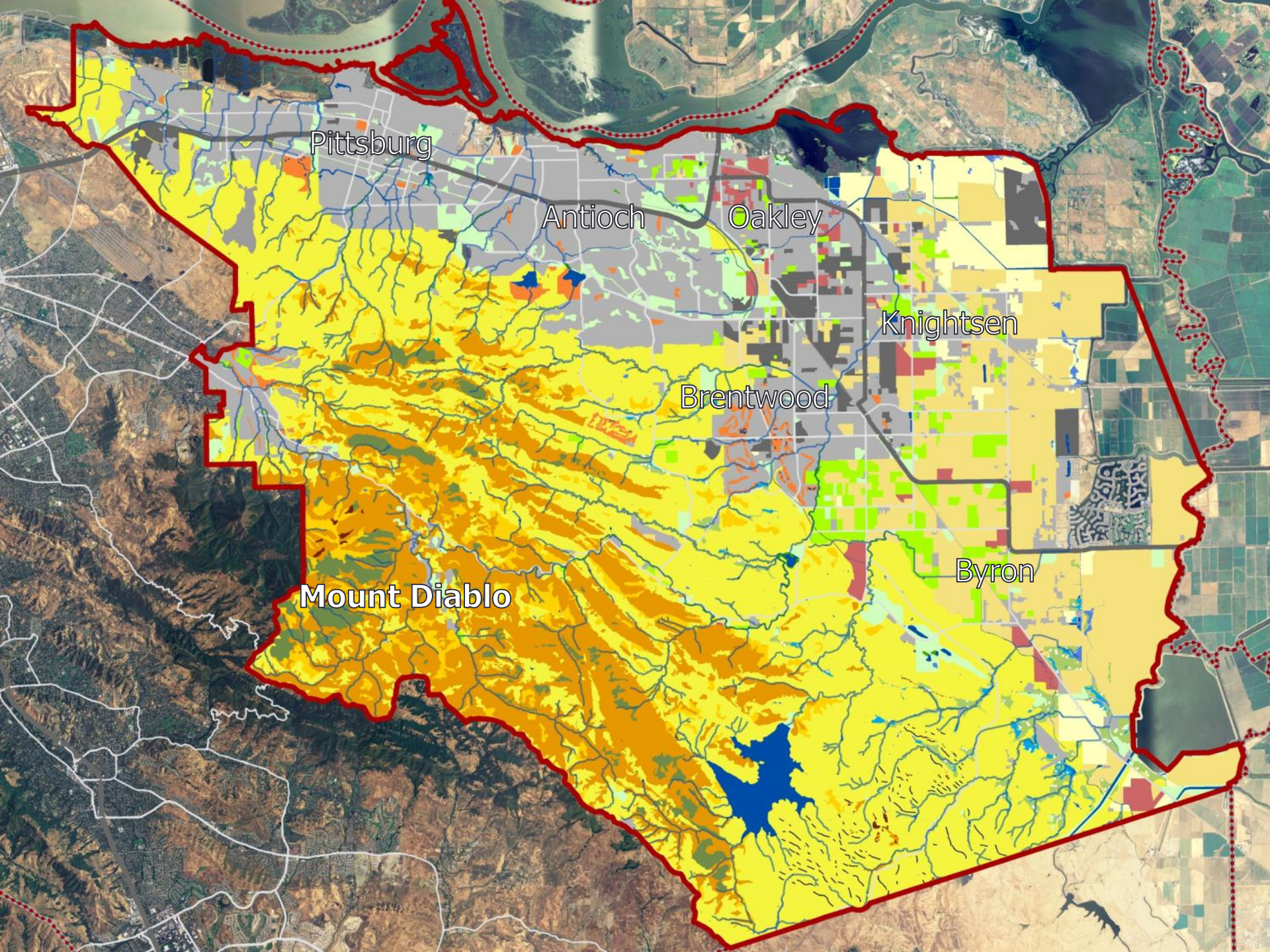
EAST CONTRA COSTA COUNTY HISTORICAL ECOLOGY STUDY

NOVEMBER 2011

SAN FRANCISCO ESTUARY INSTITUTE




Pittsburg
Antioch
Oakley
Knightsen
Brentwood
Byron
Mount Diablo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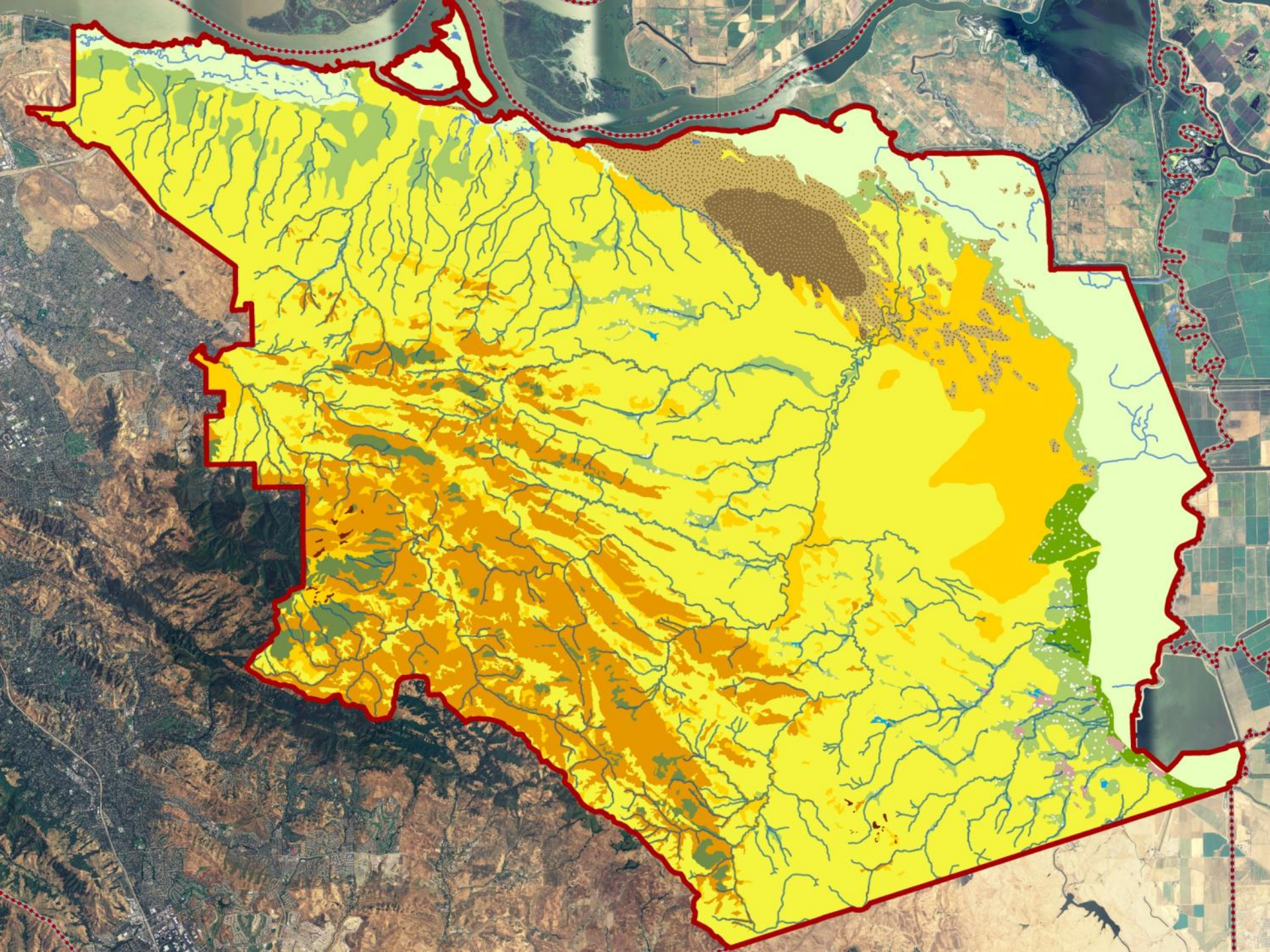
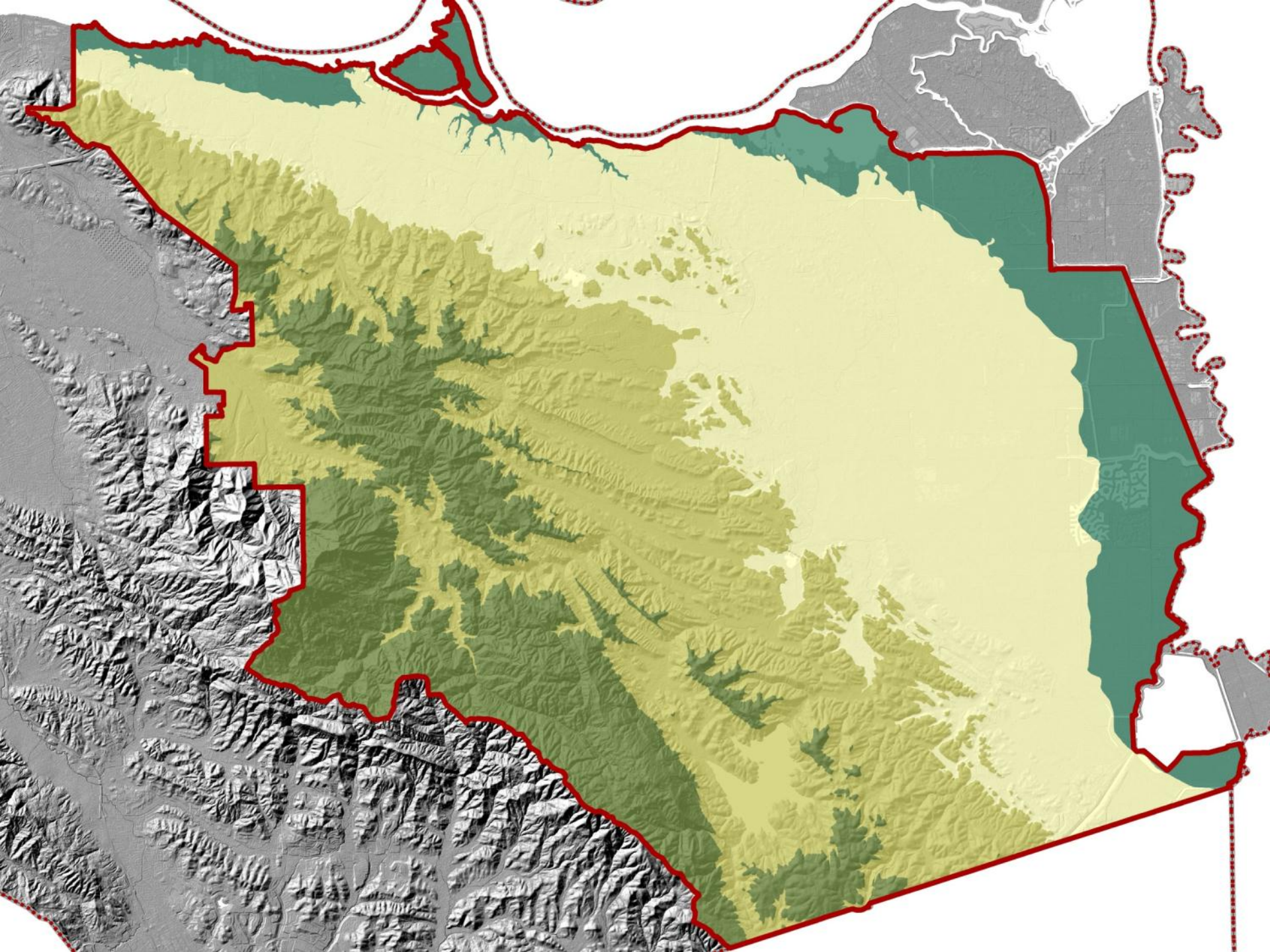
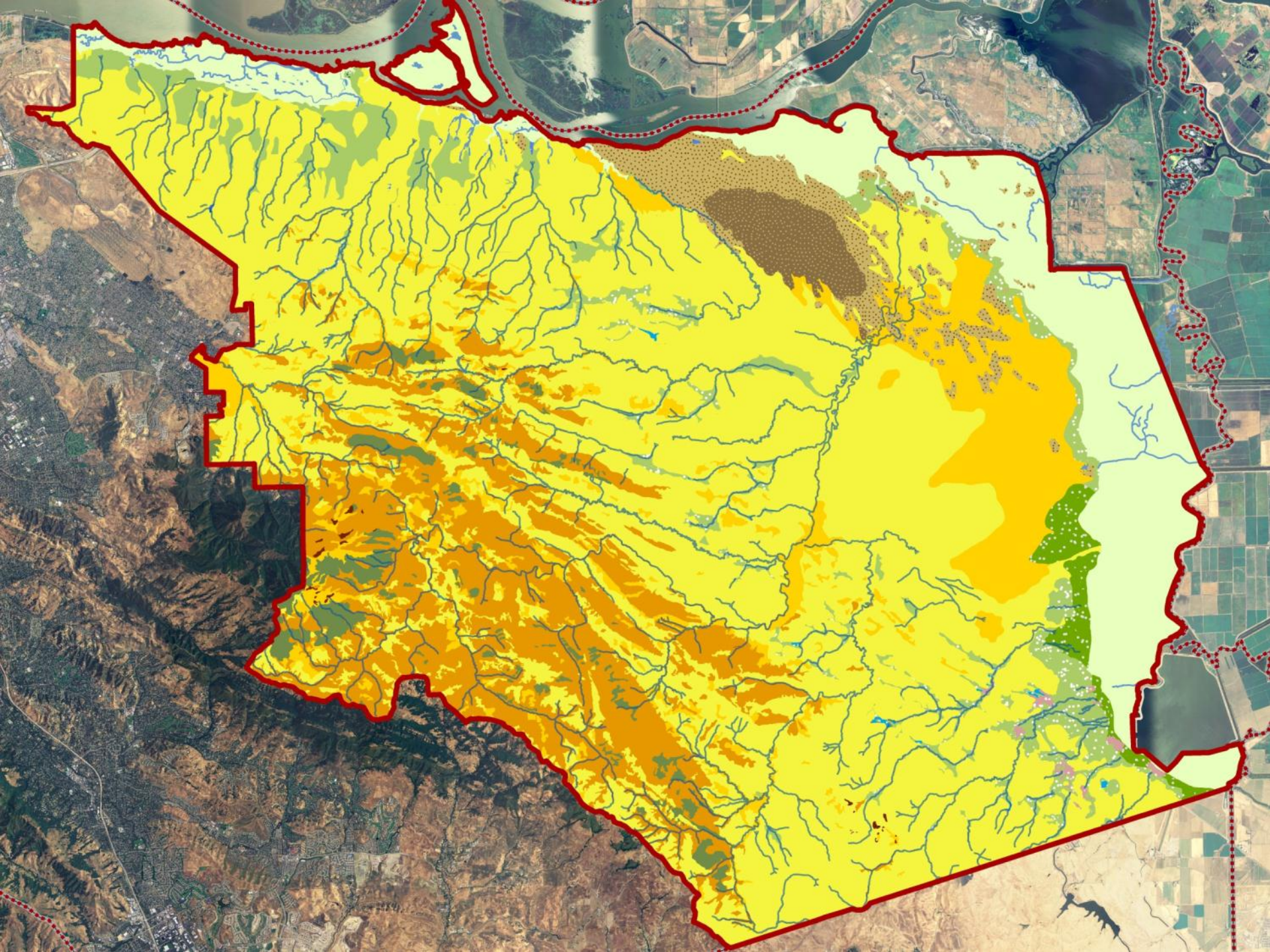
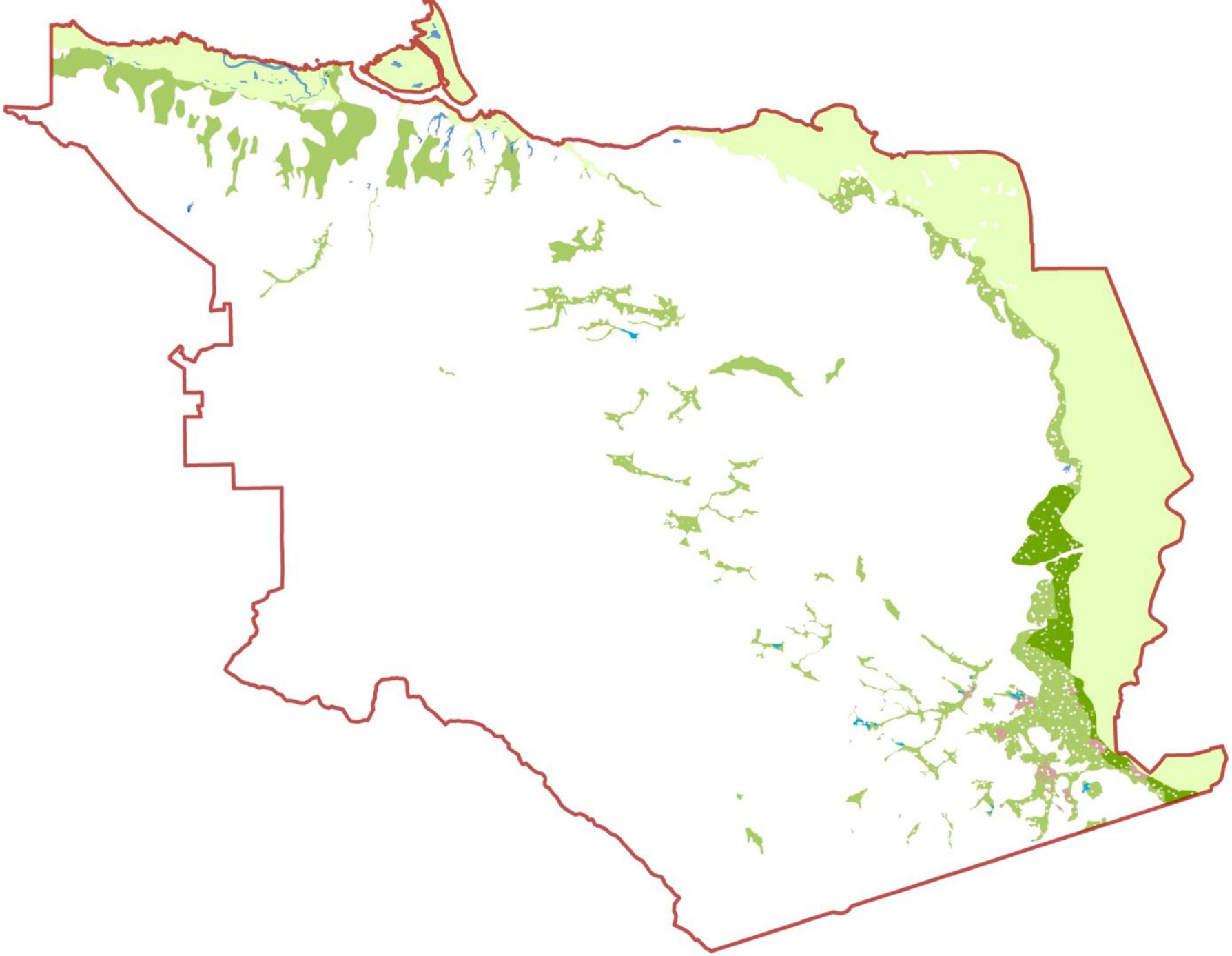
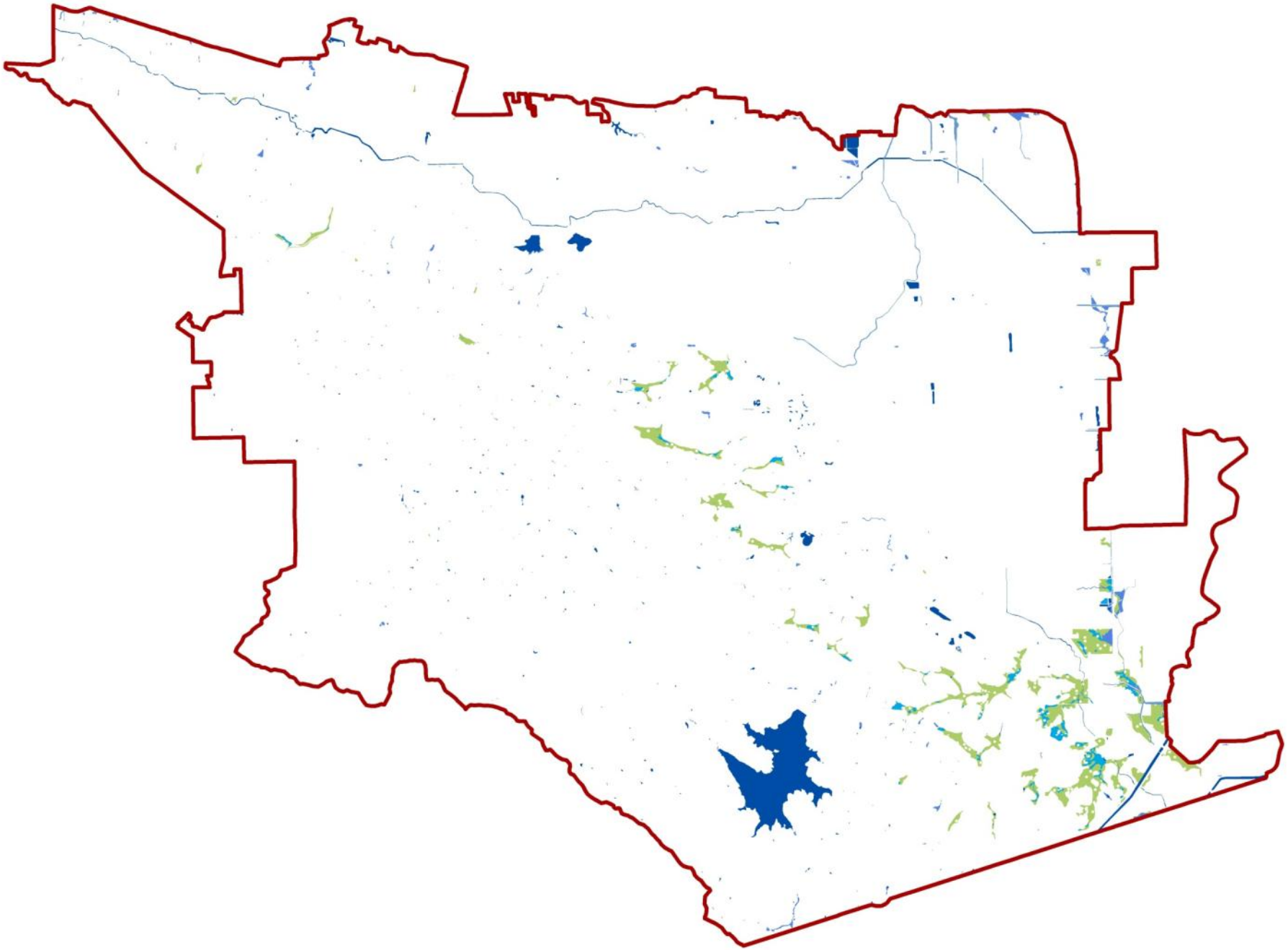


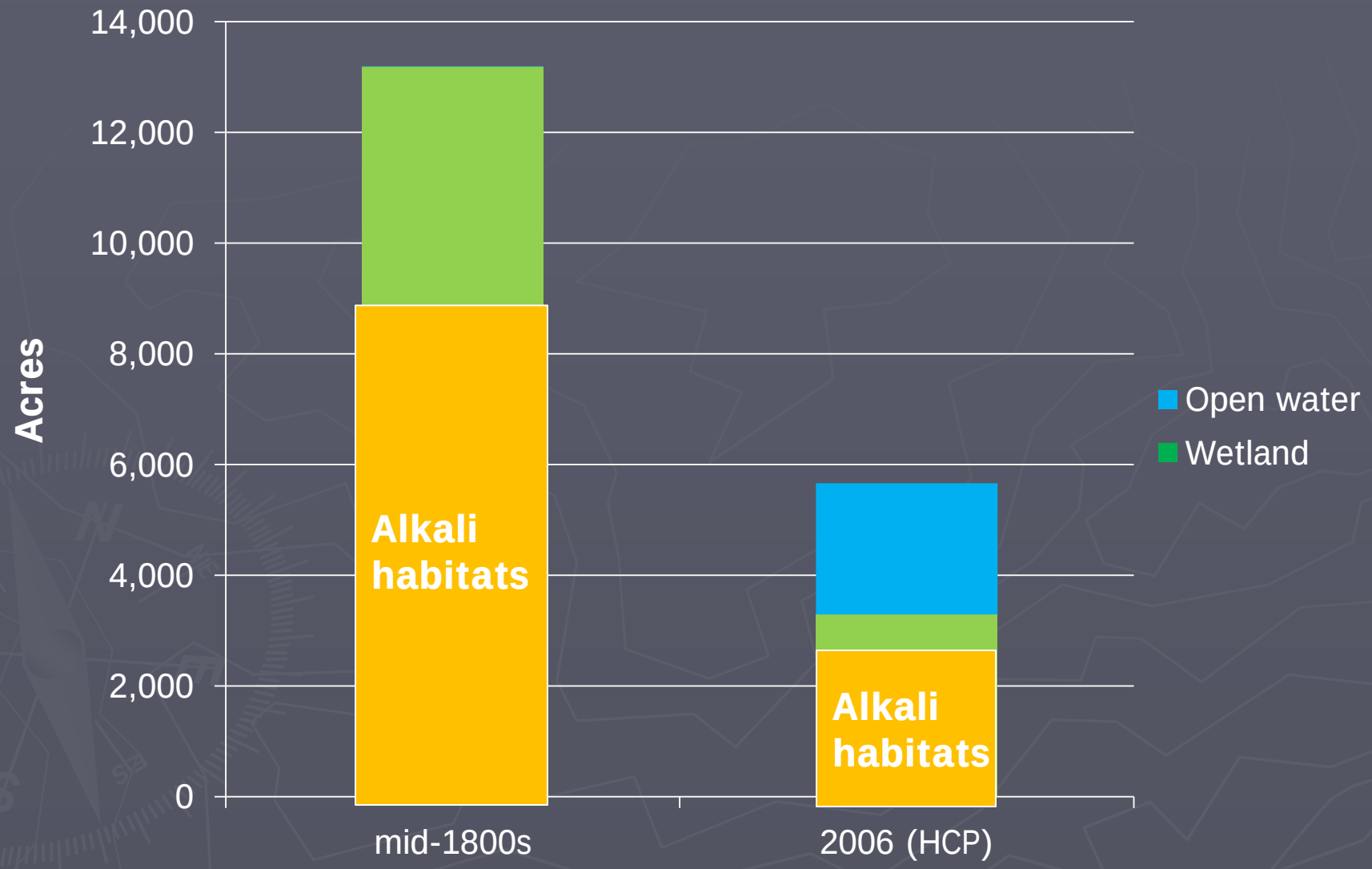


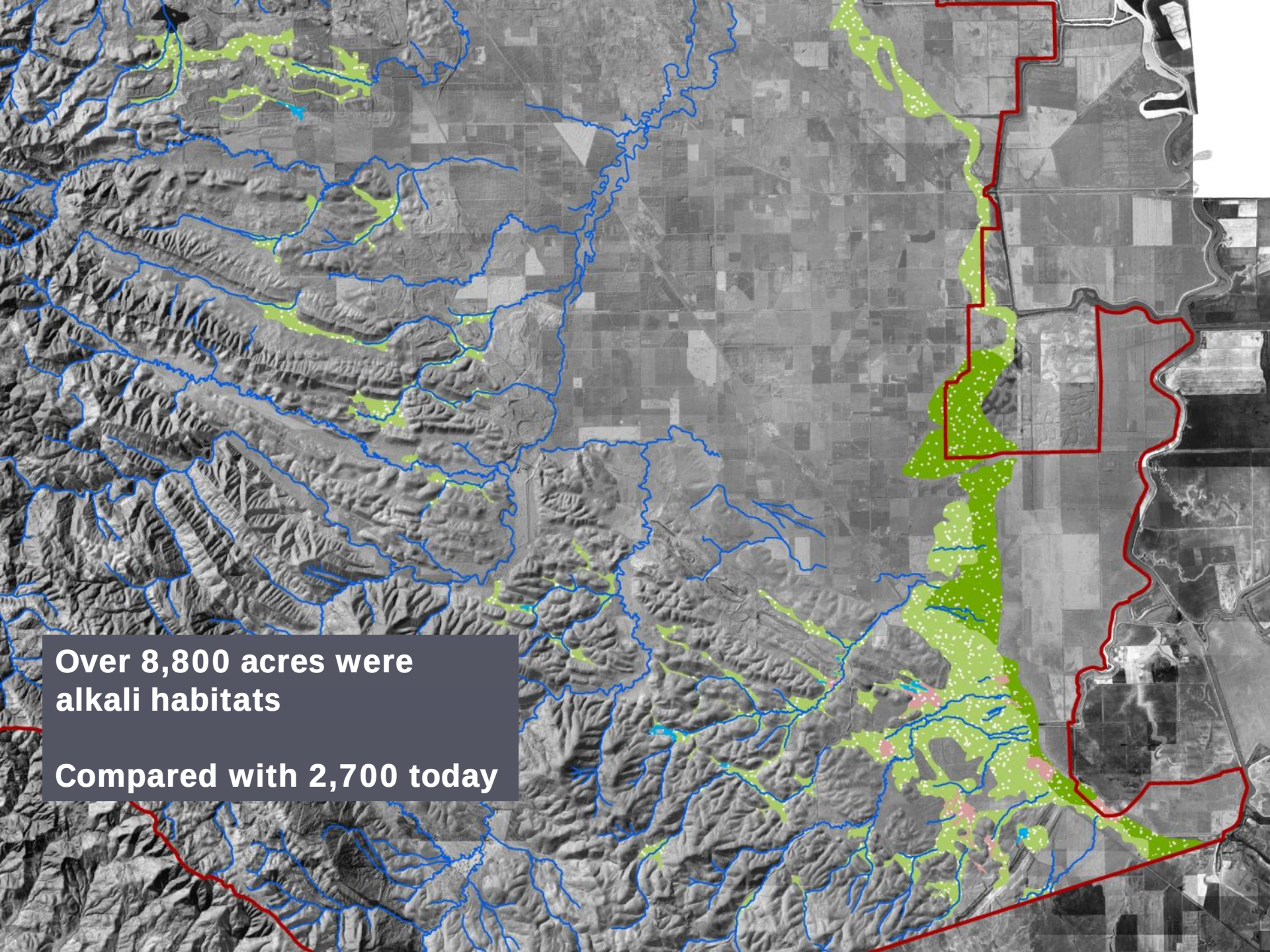




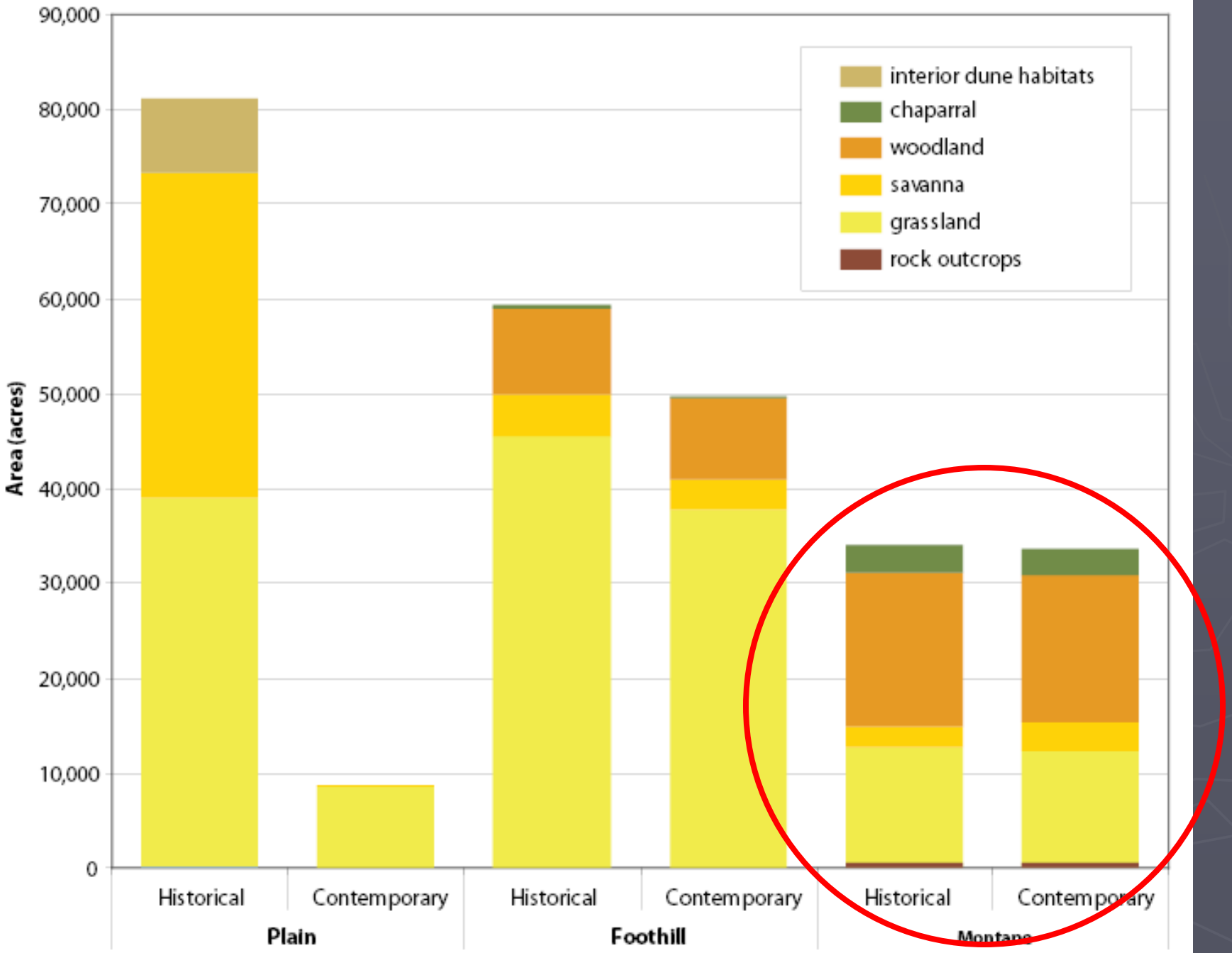


Wetlands (excluding tidal marsh)

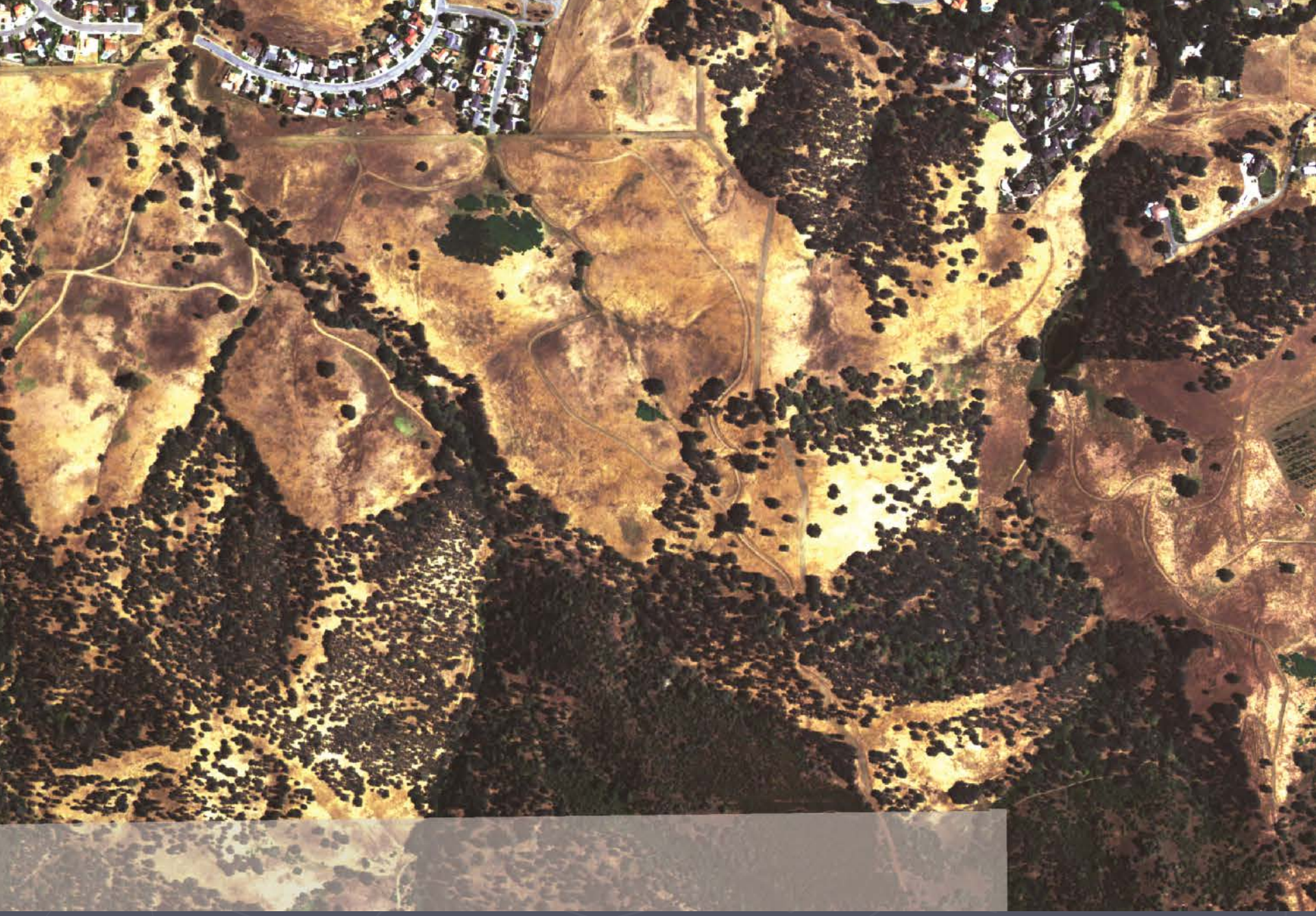


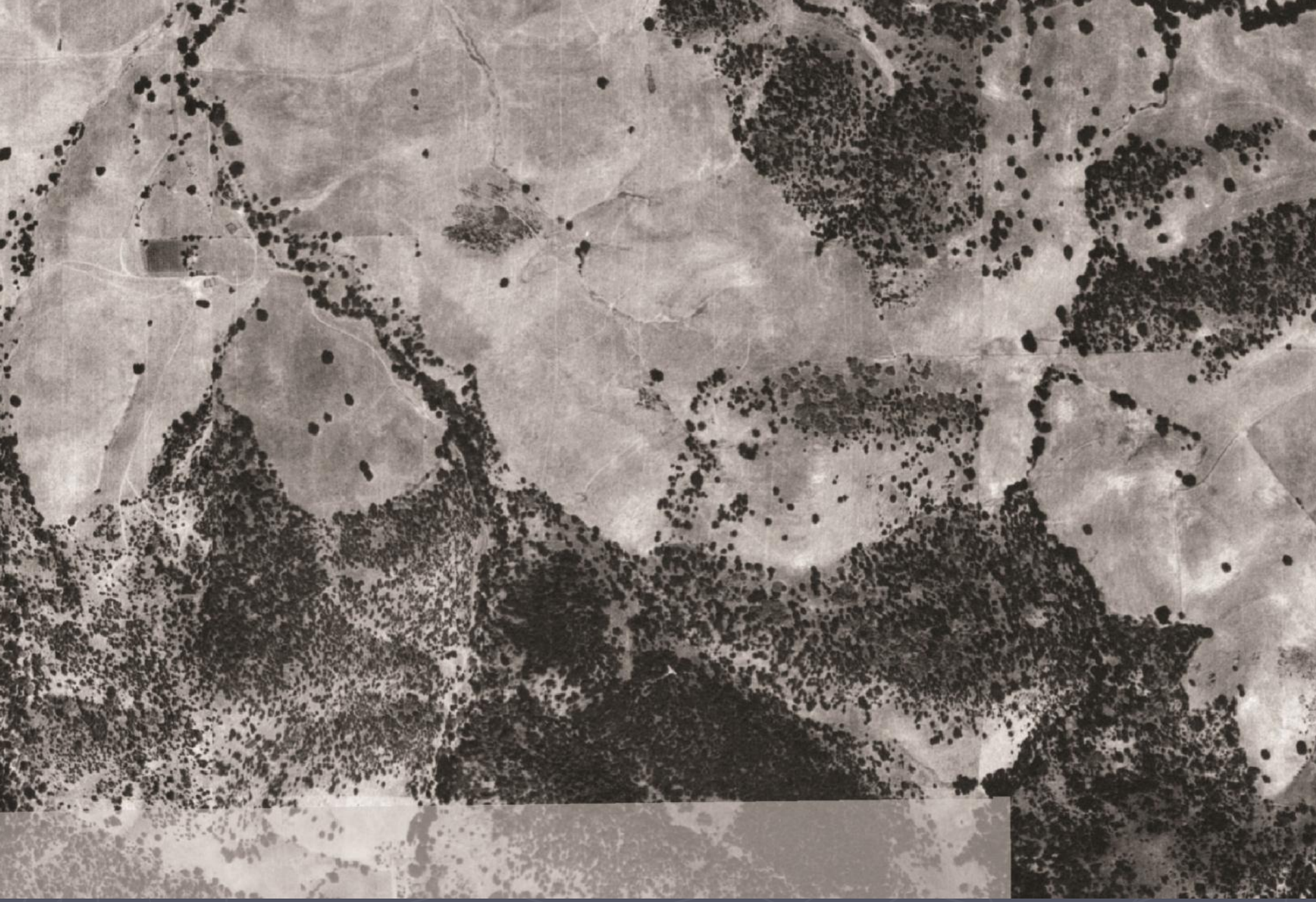

Over 8,800 acres were alkali habitats
Compared with 2,700 today

Abigail Fateman


90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Area (acres)
interior dune habitats
chaparral
woodland
savanna
grassland
rock outcrops
Historical
Contemporary
Historical
Contemporary
Historical
Contemporary
Plain
Foothill

1939 - 2005





In cooperation with:

Contra Costa Watershed Forum

East Contra Costa County Habitat Conservancy

Funded by:

California State Coastal Conservancy

Contra Costa County

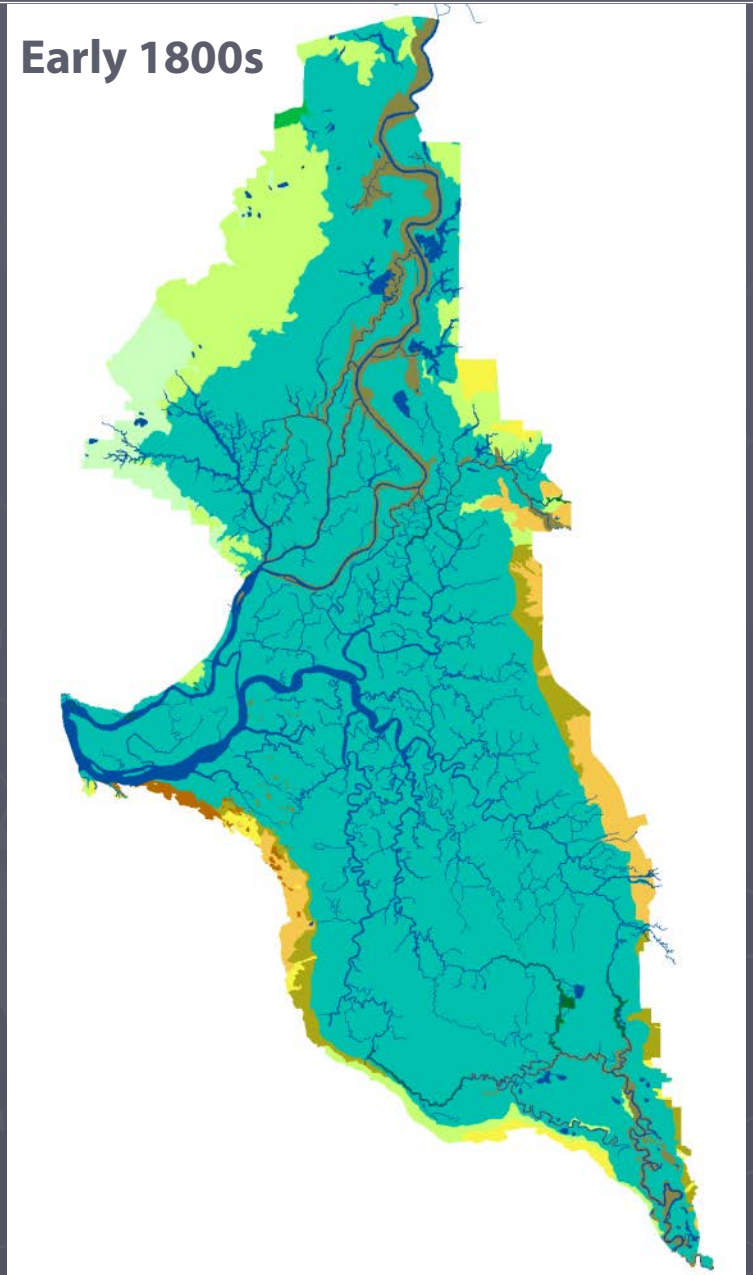
Department of Conservation and Development

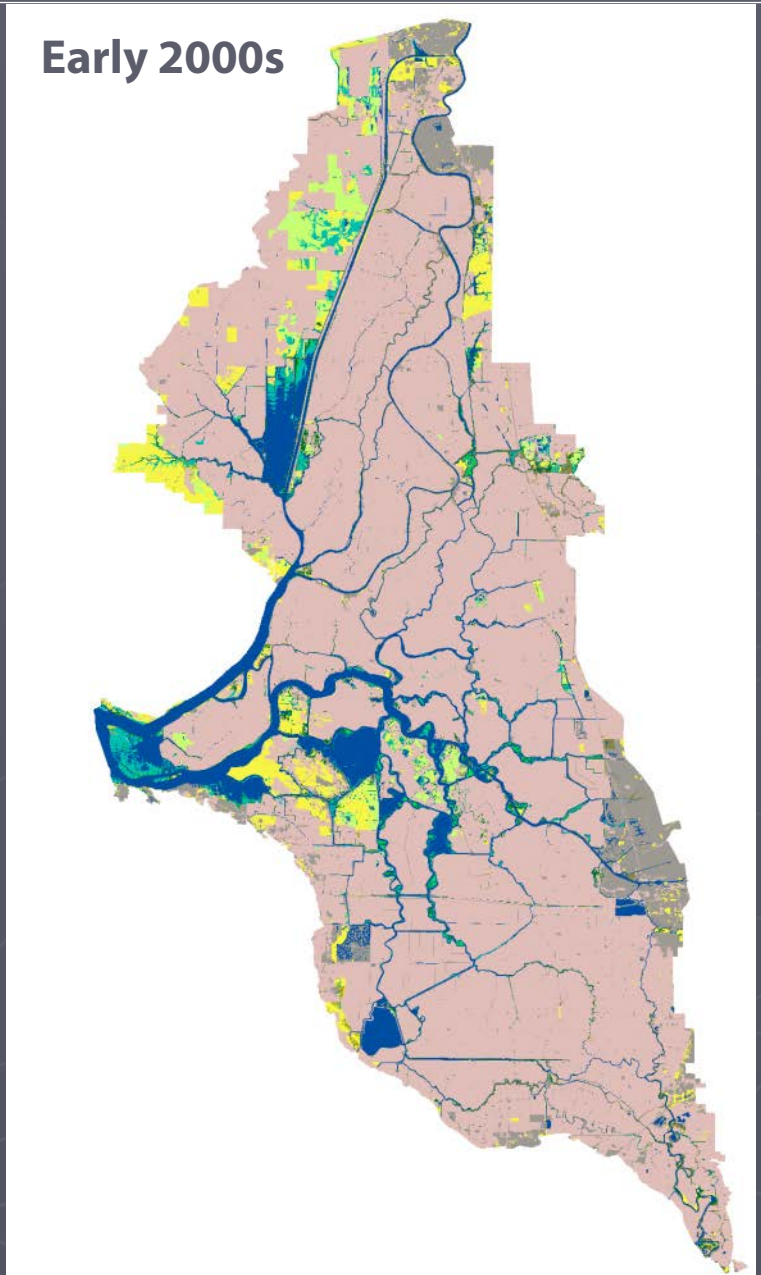
Contra Costa Flood Control

and Water Conservation District

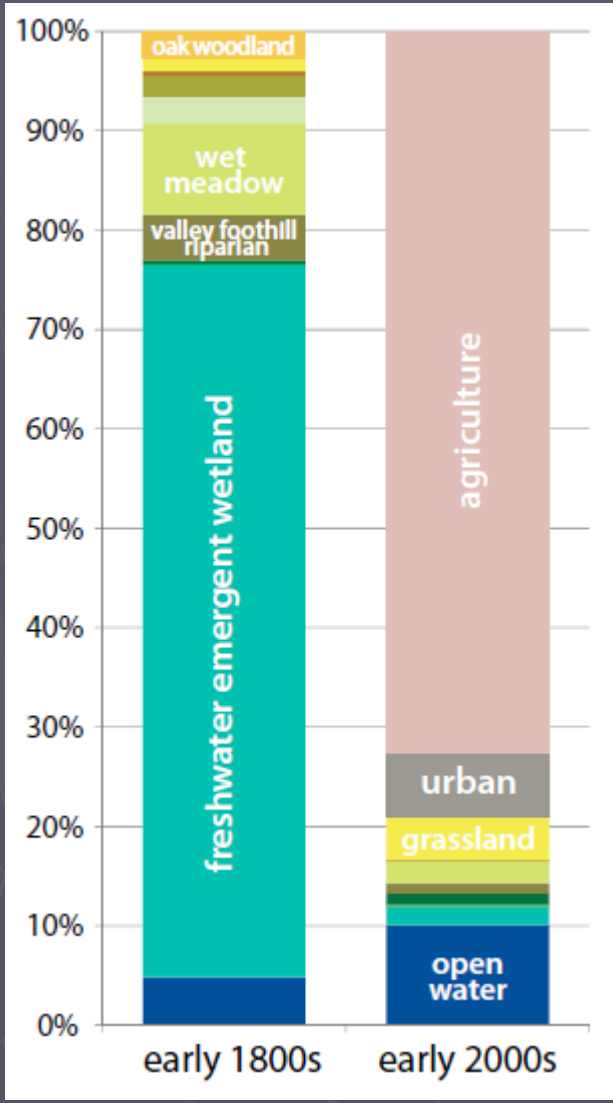
California Department of Fish and Game

Land cover change



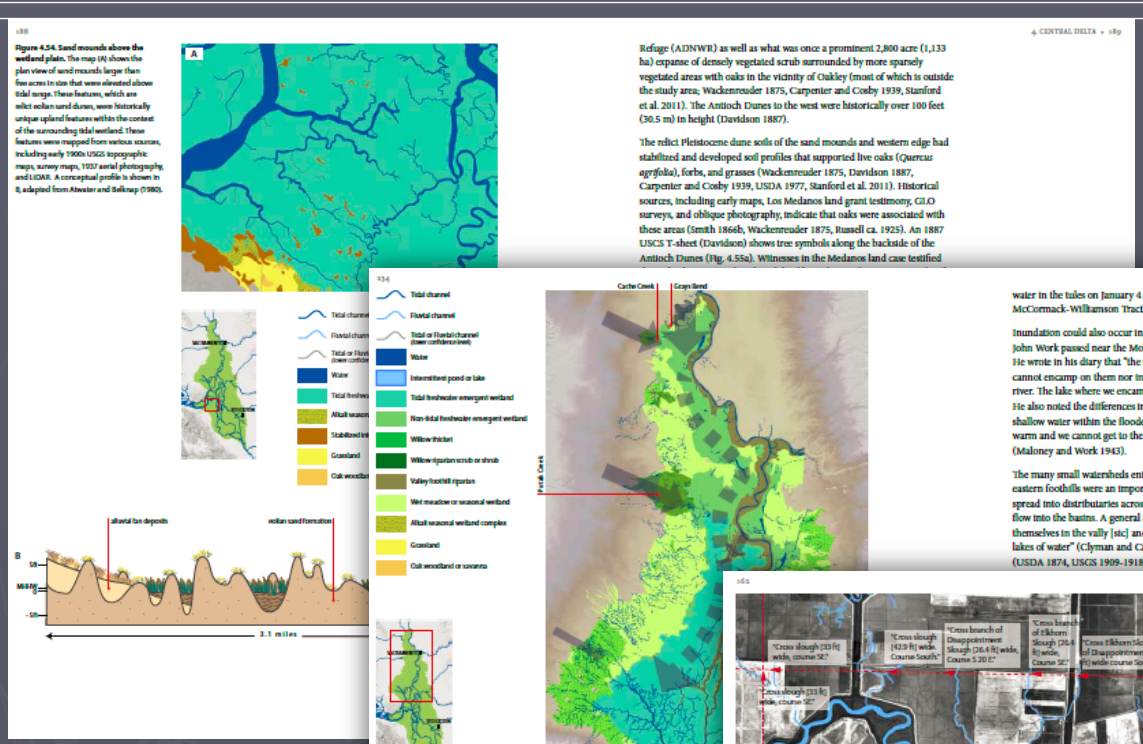


Land cover change



- 3% of historical freshwater wetlands remain
- Ratio of open water to freshwater wetland
  - Historically: 7:100
  - Today: 556:100
- Open water now in central Delta instead of as lakes within wetlands upstream
- 81% loss of small tidal channels
- Few true “remnants”
- Highly fragmented natural habitats

Landscape pattern and process



Refuge (ADNWR) as well as what was once a prominent 2,800 acre (1,133 ha) expanse of densely vegetated scrub surrounded by more sparsely vegetated areas with oaks in the vicinity of Oakley (most of which is outside the study area; Wackenreuder 1875, Carpenter and Cosby 1939, Stanford et al. 2011). The Antioch Dunes to the west were historically over 100 feet (30.5 m) in height (Davidson 1887).

The relict Pleistocene dune soils of the sand mounds and western edge had stabilized and developed soil profiles that supported live oaks (*Quercus agrifolia*), forbs, and grasses (Wackenreuder 1875, Davidson 1887, Carpenter and Cosby 1939, USDA 1977, Stanford et al. 2011). Historical sources, including early maps, Los Medanos land grant testimony, GLO surveys, and oblique photography, indicate that oaks were associated with these areas (Smith 1866b, Wackenreuder 1875, Russell ca. 1925). An 1887 USCS T-sheet (Davidson) shows tree symbols along the backside of the Antioch Dunes (Fig. 4.55a). Witnesses in the Medanos land case testified

water in the tules on January 4 along his survey line in the middle of the McCormack-Williamson Tract, which became deeper southward.

Inundation could also occur in the early summer. On June 13, 1833, trapper John Work passed near the Mokelumne River (Maloney and Work 1943). He wrote in his diary that "the river had overflowed its banks so that we cannot encamp on them nor indeed except in some places approach the river. The lake where we encamped yesterday continues on to the river." He also noted the differences in water temperature, complaining that the shallow water within the flooded basin he was traveling along was "very warm and we cannot get to the river where it might be a little colder" (Maloney and Work 1943).

The many small watersheds entering the valley from the Coast Ranges and eastern foothills were an important annual source of water. These streams spread into distributaries across their alluvial fans, discharging all of their flow into the basins. A general account describes that the streams "loose themselves in the vally [sic] and spreading in all directions form extensive lakes of water" (Clyman and Camp 1928[1848]). Though dry in the summer (USDA 1874, USGS 1909–1918, Moerenhout [1849]1935), these small

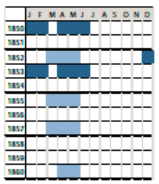


Figure 5.19. Periods of overflow. This graphic shows the months in selected years from 1850 and 1860 when the region near Snodgrass Slough was overflowed. This information was summarized from recollections of Josiah B. Greene, who testified before the Swamp Land Committee

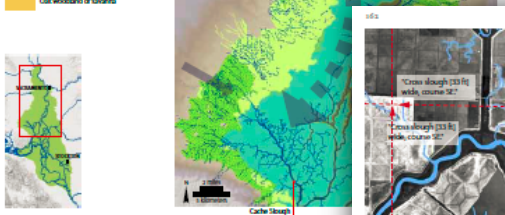


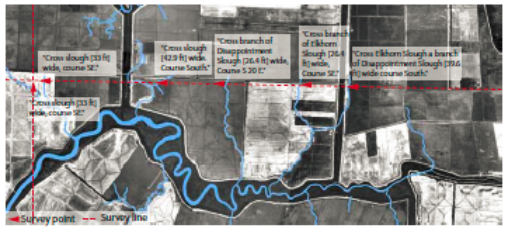
Figure 3.18. The pattern of flood flows is illustrated

fill blue arrows indicate direct inputs from river and

near Gray's Bend; Putah Creek). The dashed blue arro

from north to south that moved as a broad sheet thr

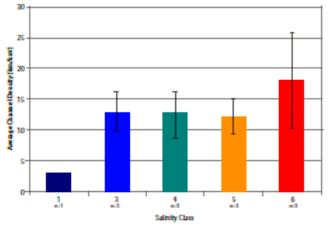
mouth of Cache Slough.



Survey point — Survey line

Figure 4.31. The frequency and size of blind tidal channels branching from Disappointment Slough are found in a rare GLO survey that extends within the wetland margin. It should be noted that this survey was conducted in 1878, during a period of extensive levee construction in the Delta. Though records indicate that these tracts of land were not officially reclaimed until the early 1900s, it is likely that some activity was already underway at the time of this survey. (Benson 1878-9; USDA 1937-1939)

Figure 4.32. Channel density by salinity class. The freshest salinity class has significantly lower density than the other classes. There are relatively similar densities across the middle salinity classes. (reprinted with permission from Collins and Grossinger 2004)



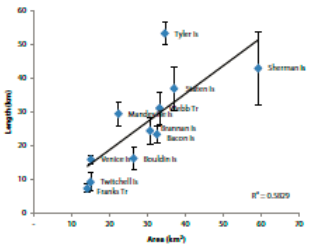


Figure 4.33. Relationship between island area and mapped channel length. Mapped historical blind tidal channels were summed for each of the major central Delta islands. Those that were bounded by substantial natural levees for the majority of their perimeter (such as Roberts, Union, and Grand Islands) were excluded. Error bars are derived from the miles of channel mapped that are of "medium" or "low" interpretation certainty, that is, those channels that do not have many lines of evidence supporting them.

tolerances of marsh vegetation (in freshwater conditions, tule is able to grow at elevations below MLLW and would therefore occupy small and shallow channels; Atwater et al. 1979).

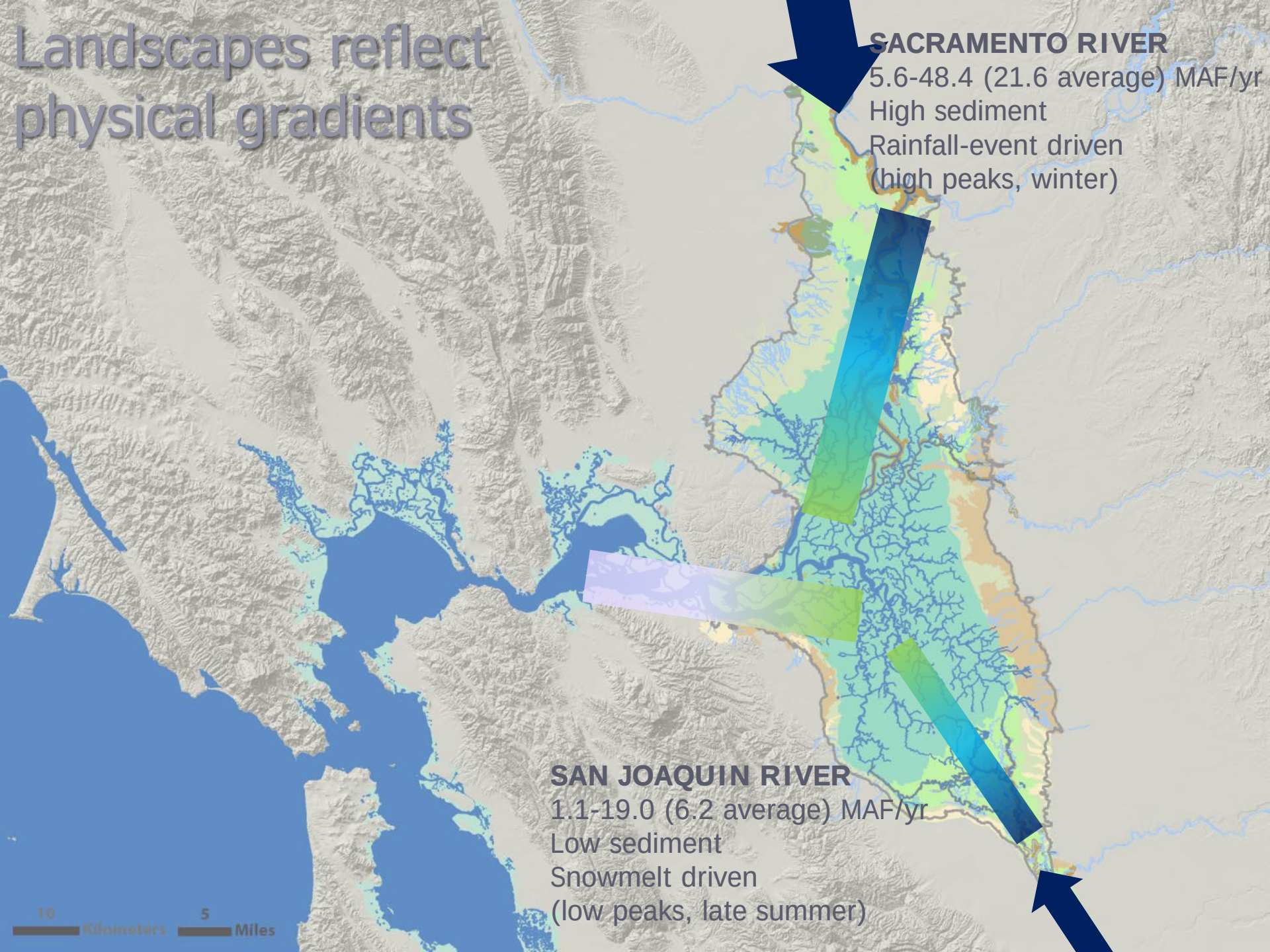
A complicating factor for estimating channel density is the uncertainty associated with the level of detail shown in Delta mapping sources. Unlike the San Francisco Bay, there is no single comprehensive and detailed data source for historical networks comparable to the U.S. Coast Survey (USCS) T-sheets. To calibrate the level of detail in the mapping from this study with the level of detail found in other sources, we made several comparisons to what similar sources showed in the San Francisco Bay. We compared USGS 7.5-minute topographic maps against USCS T-sheets in Suisun Bay and found that the T-sheets usually mapped one channel order more than the topographic maps (i.e., a 3rd order T-sheet channel was shown as a 2nd or 1st order USGS channel). Since most mapping sources we used were closer to USGS scales, one conclusion could be that the mapping does not show the lowest order channels. However, by comparing historical channel density as shown by USGS maps of similar vintages in the brackish Napa River marshlands (Grossinger 2012) and remnant Delta marshes, we found consistently lower densities in the Delta, which supports the conclusion that channel densities were, in fact, lower in the Delta historically than in more brackish and saline marshes downstream.

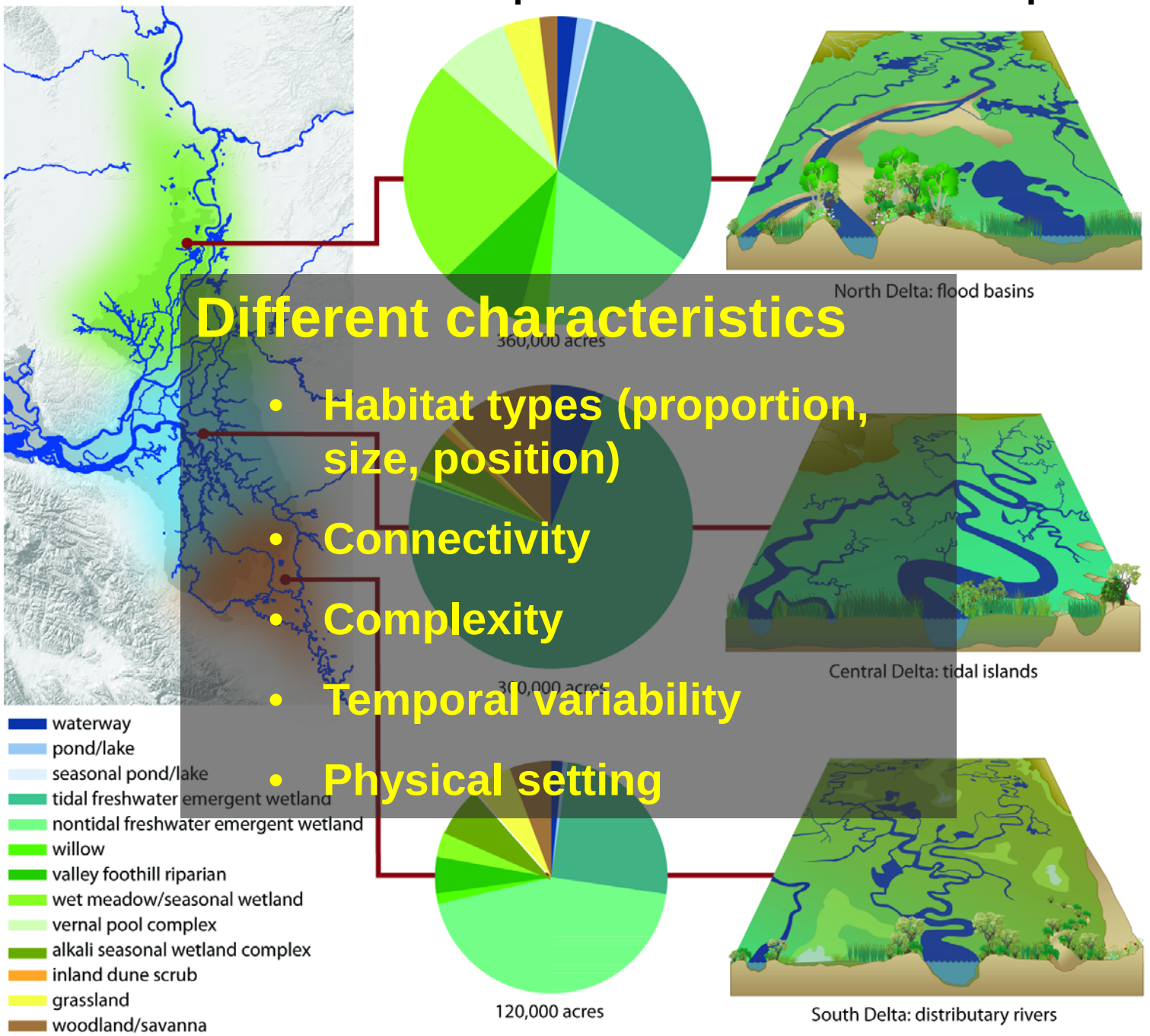
To further evaluate this relationship using other data, we compared early aerial photography of wetlands in the Delta, Napa, and Alameda at the same scale using imagery from other historical ecology studies (Grossinger 2012, Stanford et al. forthcoming). Signatures of dense networks of narrow sloughs are visible in the reclaimed Napa and Alameda marshes, while fewer comparatively wide and less sinuous channel signatures are seen in

Key points

- Multiple landscapes
  - Habitat mosaics arranged in distinct patterns
  - Expressed across broad physical gradients

Landscapes reflect physical gradients



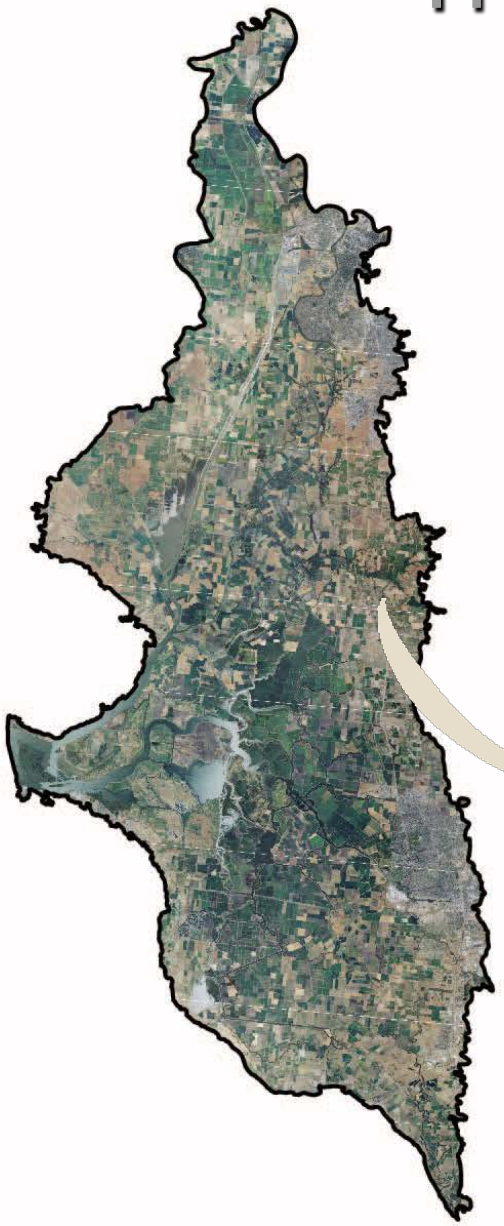


Different characteristics

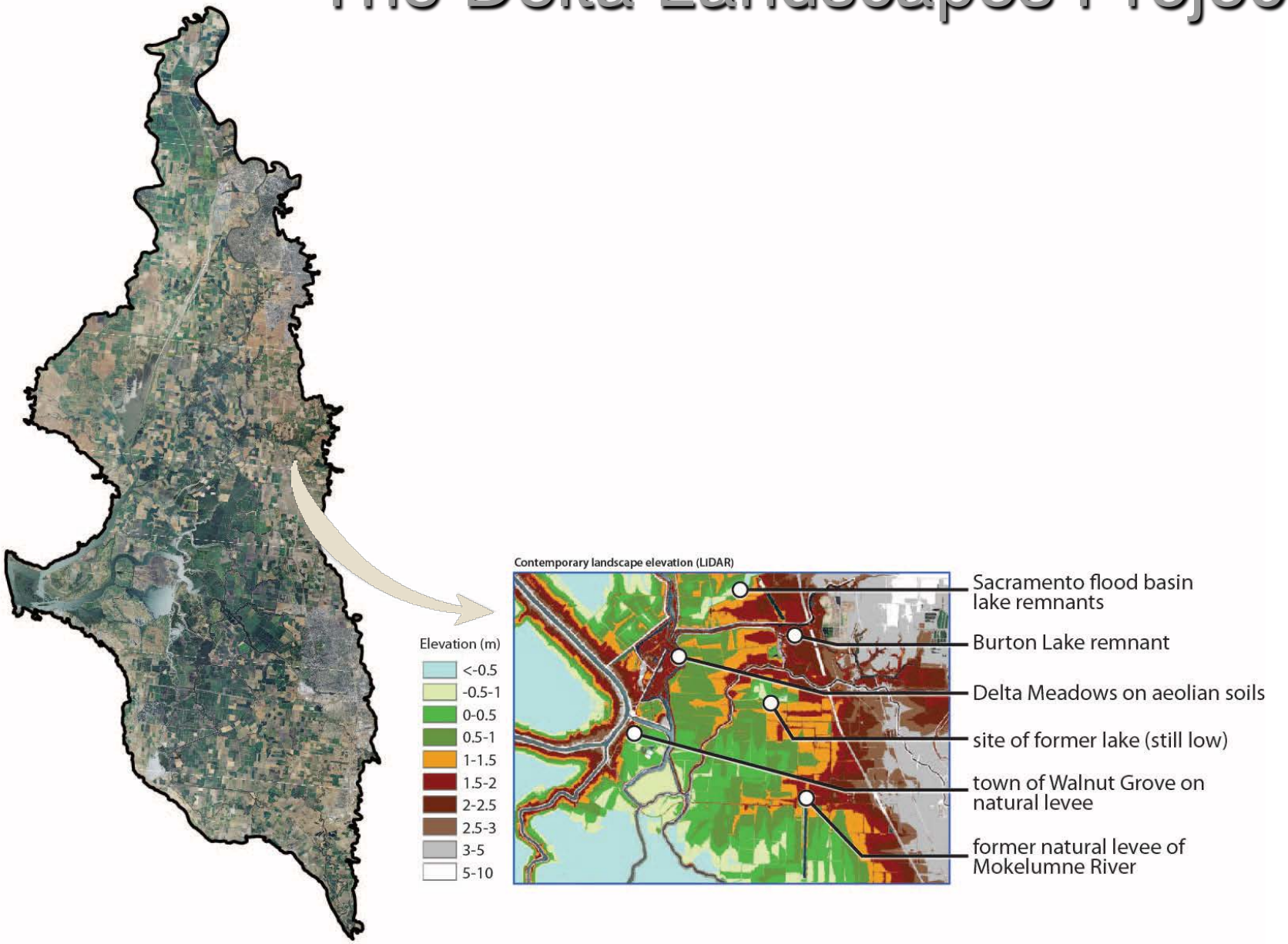
- Habitat types (proportion, size, position)
- Connectivity
- Complexity
- Temporal variability
- Physical setting

The Delta Landscapes Project

The Delta Landscapes Project



The Delta Landscapes Project



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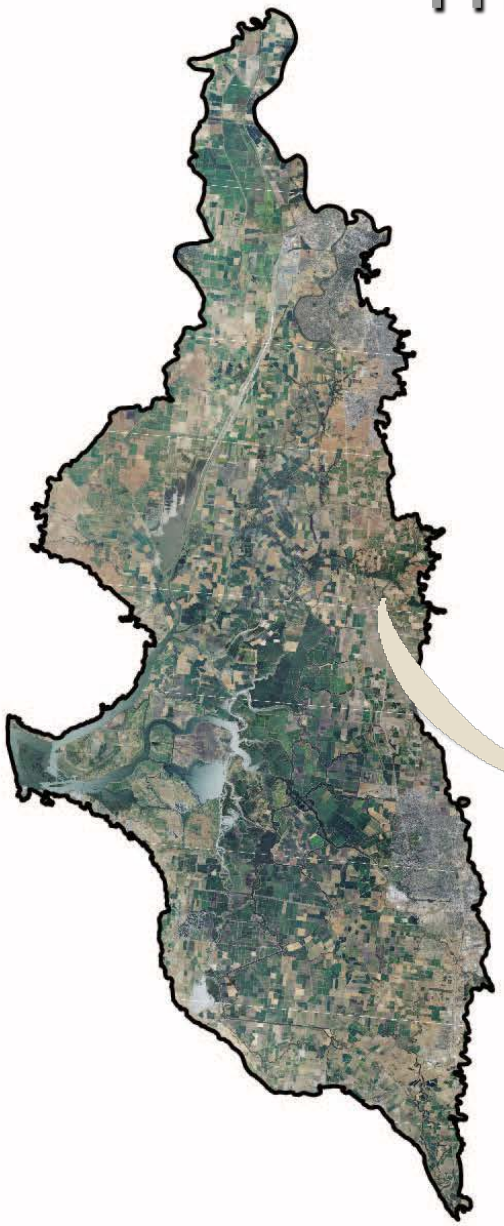
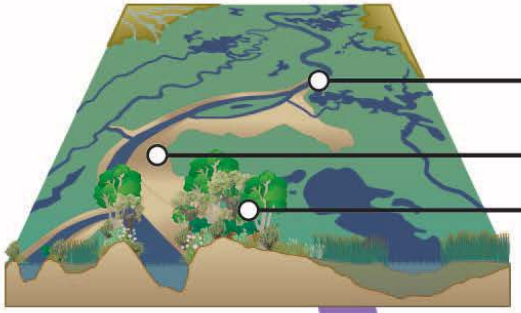




minimum fluvial inundation of {*XX weeks*} in summer

natural levees {*XX m*} high

riparian forest {*XX m*} wide

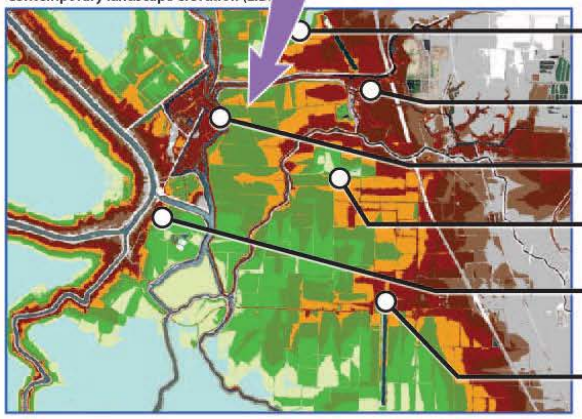
?

could a functional landscape unit be supported here?

Contemporary landscape elevation (LiD

Elevation (m)

- <-0.5
- -0.5-1
- 0-0.5
- 0.5-1
- 1-1.5
- 1.5-2
- 2-2.5
- 2.5-3
- 3-5
- 5-10



Sacramento flood basin lake remnants

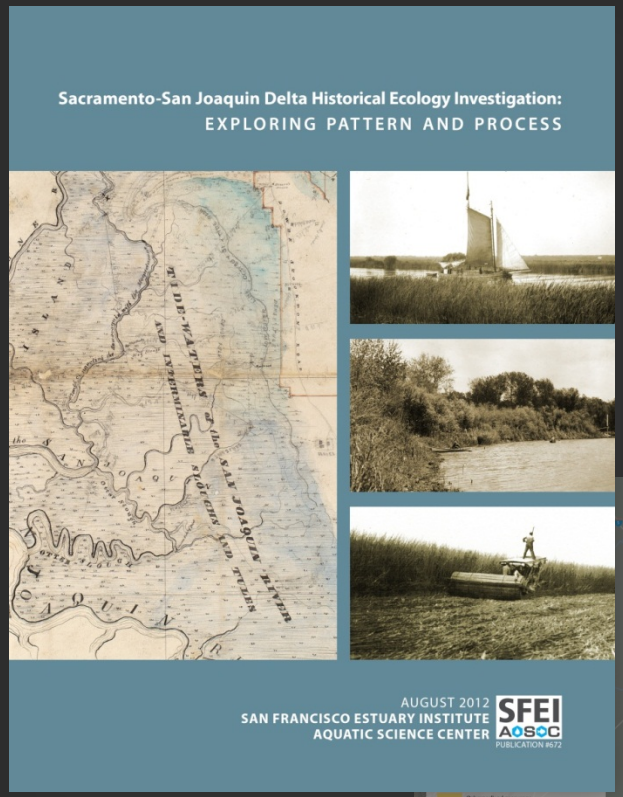
Burton Lake remnant

Delta Meadows on aeolian soils

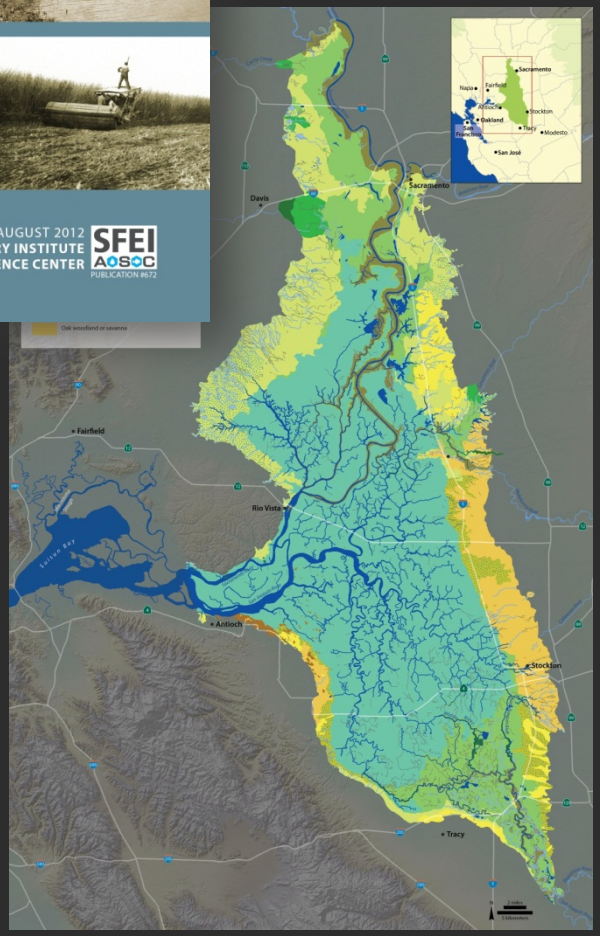
site of former lake (still low)

town of Walnut Grove on natural levee

former natural levee of Mokelumne River



Sacramento-San Joaquin Delta Historical Ecology Investigation: Exploring Pattern and Process



- Funded by Ecosystem Restoration Program (CDFG, NOAA, US FWS)
- Final Report/GIS Available: www.sfei.org/DeltaHEStudy
- Collaboration with KQED QUEST and Stanford's Bill Lane Center for the American West: science.kqed.org/quest/delta-map/

THANK YOU

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