

# RESILIENT SILICON VALLEY

*Increasing Landscape Resilience through Interdisciplinary Science  
and Multi-Sector Collaboration*



**Bay-Delta Science  
Conference**

**11/17/16**

**SFEI**

**AQUATIC  
SCIENCE  
CENTER**

SAN FRANCISCO ESTUARY INSTITUTE & THE AQUATIC SCIENCE CENTER

An aerial photograph showing a dense grid of small, rectangular plots, likely orchards, in San Jose. The plots are arranged in a regular pattern, with some larger, irregular plots interspersed. The overall appearance is that of a well-organized agricultural landscape. A road or path runs diagonally across the lower portion of the image. The year 1939 is printed in the top right corner.

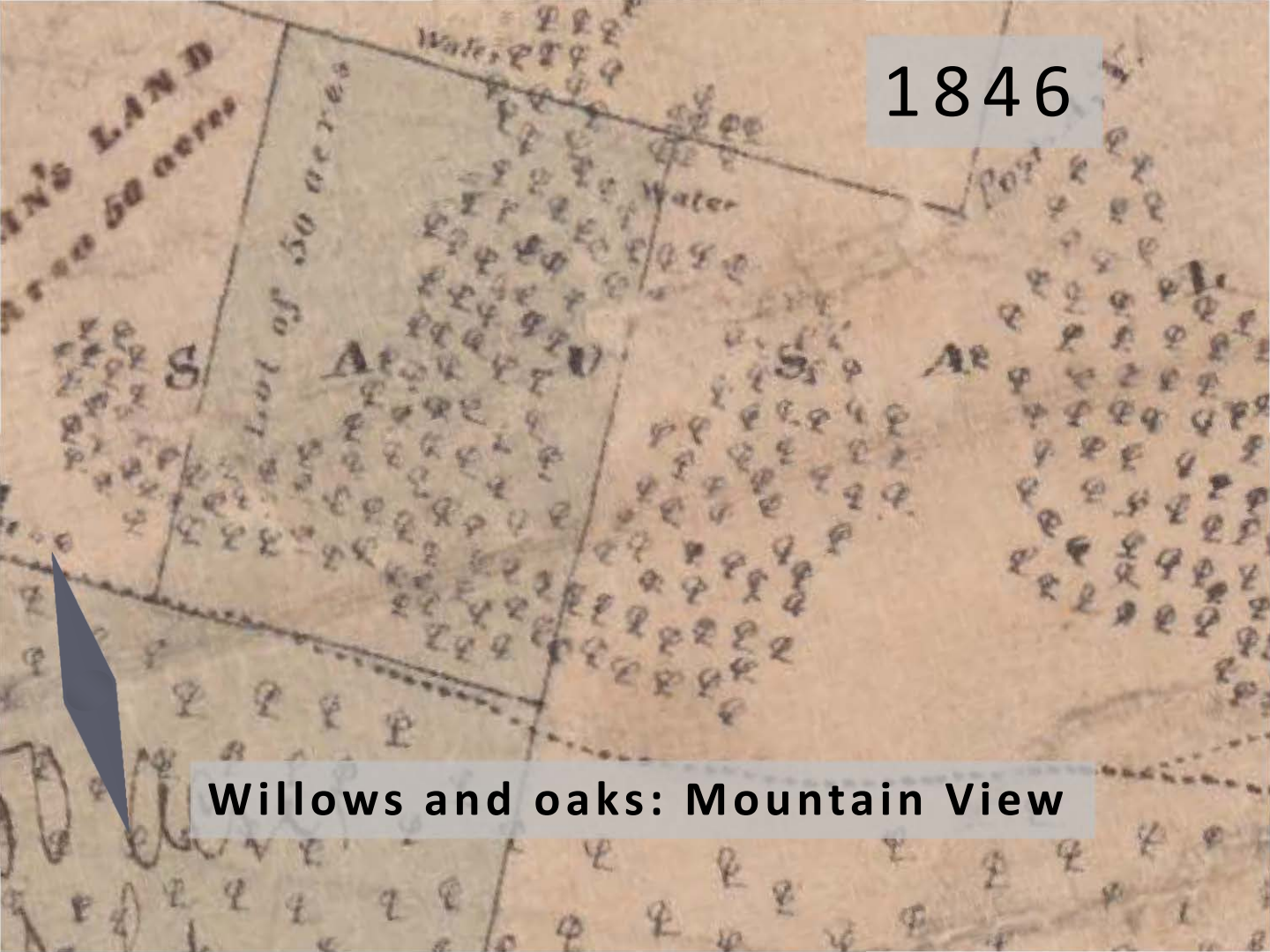
1939

orchards: San Jose

2005

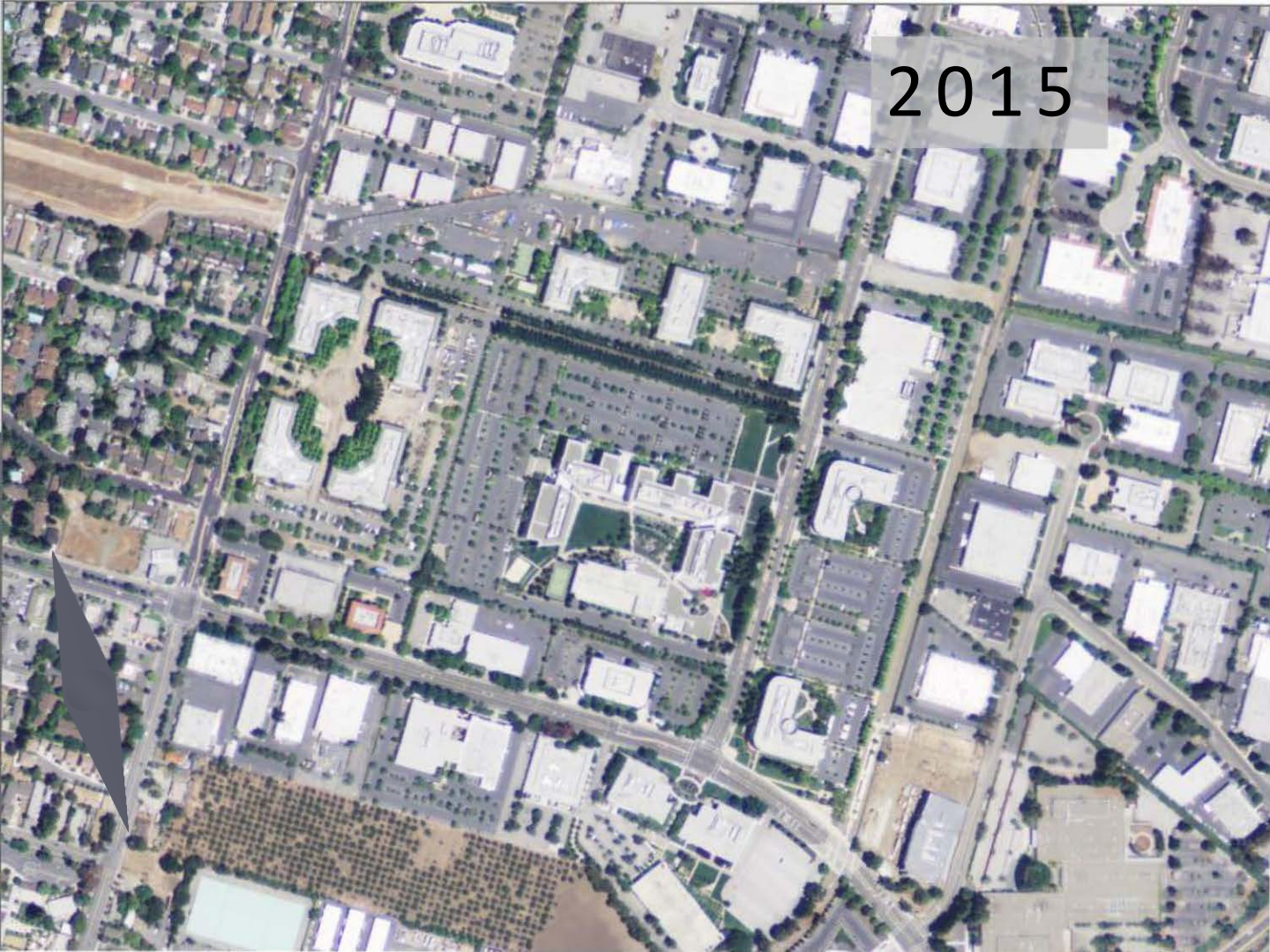


1846



**Willows and oaks: Mountain View**

2015



1904

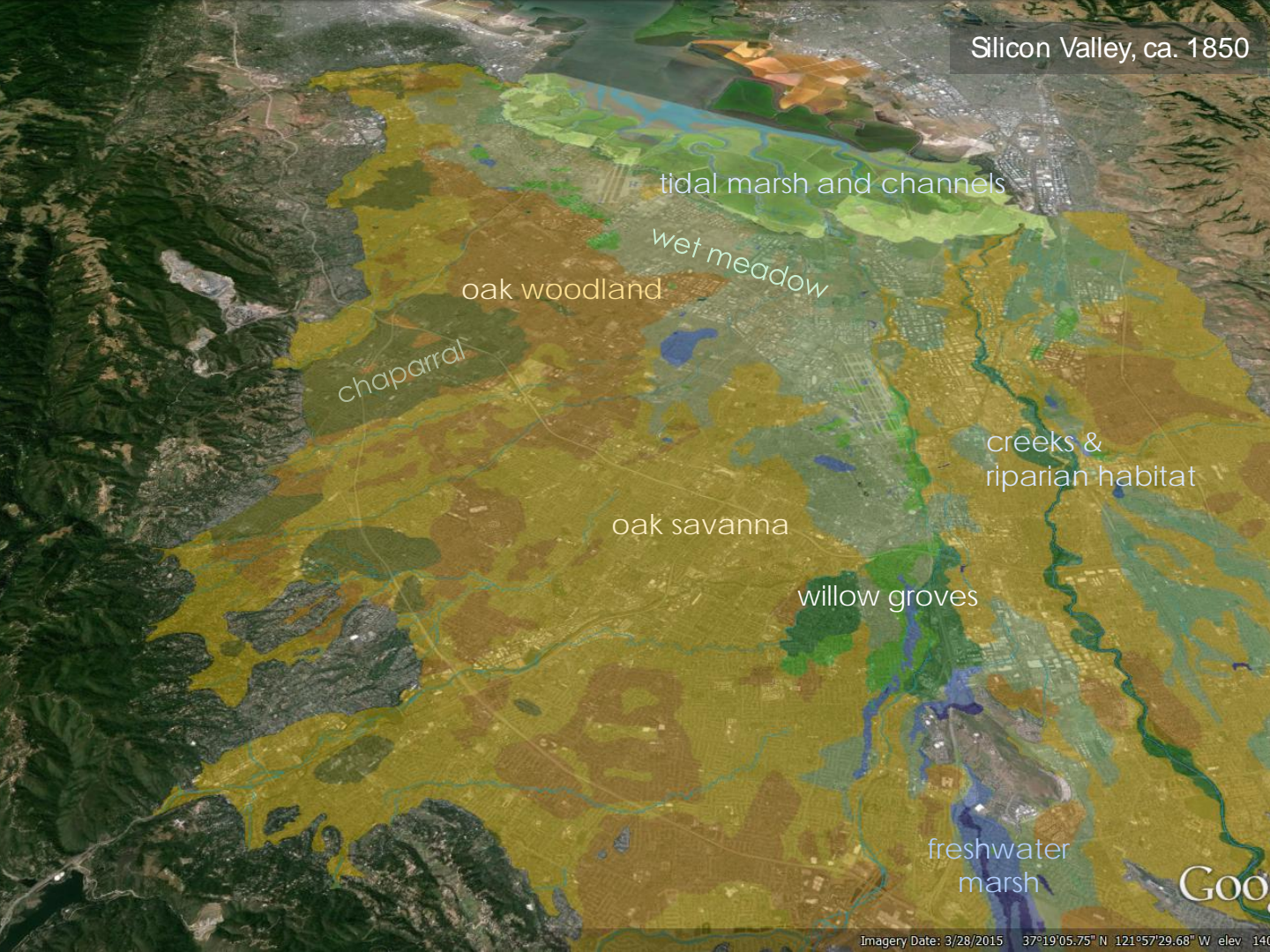


Oak savanna: Palo Alto

1904 (Palo Alto Hist. Soc.)  
Smith and Elliott 1976

2016





tidal marsh and channels

wet meadow

oak woodland

chaparral

oak savanna

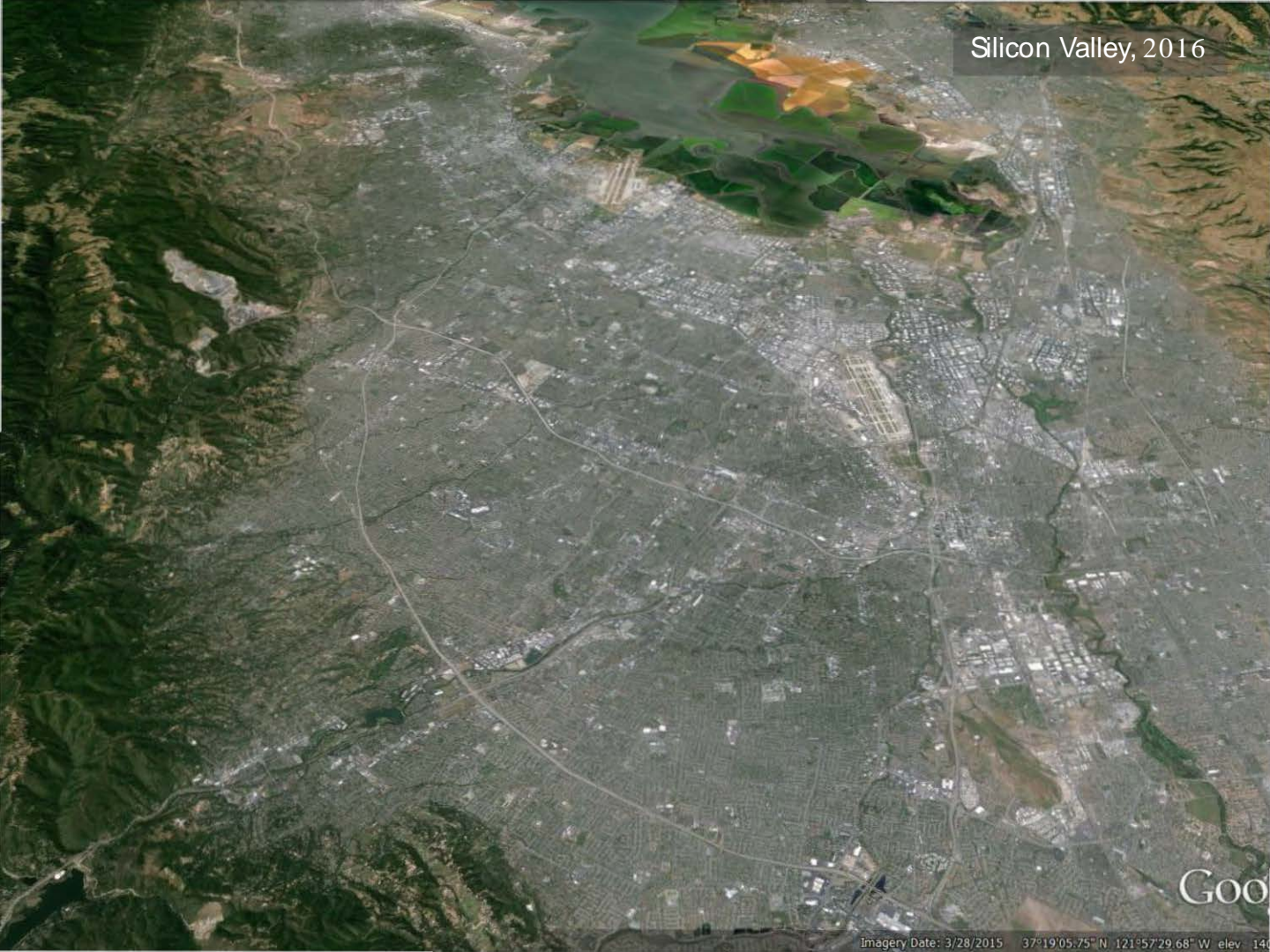
willow groves

creeks &  
riparian habitat

freshwater  
marsh



Silicon Valley, 2016



Go

***Current challenges call for re-integrating natural processes***

- **ecological function and resilience**  
->steelhead, SAW, oak savanna, marshes, riparian birds...
- **shoreline adaptation**
- **sediment management**
- **groundwater recharge**
- **drought tolerant urban forest**
- **low water use landscaping**

1 We can make our landscapes more resilient.  
*(Design amplifies or dampen climate change impacts)*

2 Integrated approaches are the great challenge  
but also the best hope.  
*(very complex: sediment, flood, water, stormwater, land-use)*

3 A systematic framework can help.  
*(but we need strong links to impact decisions)*



# RESILIENT SILICON VALLEY



- **Project of SFEI**
- **Steering Committee: SCVWD, SCVOSA, Google**
- **Build science-based tools to guide investments in SCV ecosystem health and resilience**
- **Initial funding Google; next phase EPA, POST, others**

# 1 Landscape Resilience Framework

## LANDSCAPE RESILIENCE FRAMEWORK

Operationalizing ecological resilience at the landscape scale

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### 2 PROCESSES

## PROCESSES create and sustain landscapes in a dynamic way

**What is it?** Physical, biological, and chemical drivers, events, and processes shape landscapes at a variety of spatial and temporal scales. They contribute to the movement of materials in the landscape, help create and maintain habitats and habitat heterogeneity, and spatially organize ecological functions and communities.

#### What are the key elements?

**SYSTEMS CONTEXT:** Large-scale forces such as climate and land use

**DISTURBANCE REGIMES:** Erupted but unpredictable events, such as fires, floods, and droughts, that reset and create new habitats at certain frequencies and magnitudes

**HABITAT-SUSTAINING PROCESSES:** Dynamic physical processes, such as the transport of water and sediment, that sustain habitats

#### How does it contribute to resilience?

Processes drive such as precipitation, gradient erosion, wind, and waves to determine which ecological functions are able to occur and whether species will be able to adapt to environmental change in a particular place.

**Disturbance:** Processes create corridors, heterogeneity

in habitats, and habitats and support ecological variability in habitats. They also drive disturbance such as wind and sediment.

A species being able to migrate to a new habitat as part of disturbance regimes, such as wildfires or floods, also has the potential to be determined that must be managed by depending on their magnitude, frequency, and context.

#### EXAMPLES

from Resilient Silicon Valley vision

- Disturbance regimes can be patterns in stressors
- Disturbance regimes are managed to areas where the absence of disturbance, especially fire, habitat habitat diversity (e.g., through fire-retarding and sediment control) both increasing or decreasing
- Sediment transport to tidal wetlands often has to be managed to avoid the potential for sedimentation

# 2 Silicon Valley vision (regional + local pilot)

## VISION for a resilient Silicon Valley landscape

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## STREAMS and riparian habitat

Stream networks within Silicon Valley form the backbone of transportation and support a variety of local and regional habitats, including potential or extant natural resources, riparian forest, riparian wetlands, and parks.

#### KEY ECOLOGICAL FUNCTIONS INCLUDE:

- providing habitat and cover for resident freshwater fish, amphibians, and riparian birds
- providing riparian habitat for native and non-native plants, animals, and insects
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#### PRIMARY STRESSORS INCLUDE:

- Increased temperature
- Increased turbidity/frequency
- Increased flow variability
- Increased precipitation
- Increased flooding
- Increased sediment
- Increased riparian habitat fragmentation
- Increased riparian habitat fragmentation
- Increased riparian habitat fragmentation

## An ecologically resilient Silicon Valley includes...

- **Stream flows** with naturalistic magnitude, timing, and duration to support habitat diversity, transport sediment, and maintain natural flows for fish and other aquatic and riparian organisms
- **Heterogeneity in surface flow**, including perennial, intermittent, and ephemeral reaches, instream and riparian habitat complexity and diversity, providing groundwater recharge, and delivering sediment and woody debris to creeks and baylands
- **Flows that can generate** a variety of riparian, wetland, and other native riparian species in appropriate locations. Flows that can establish and other fish, riparian vegetation, spawning, nesting and out-migration
- **Increased sediment transport and delivery** from upper watersheds to stream, floodplains, and baylands
  - Sufficient coarse sediment (gravel, cobbles and boulders) to creeks to sustain aquatic habitat (e.g., to support steelhead reproduction) and avoid accumulation of excessive fine sediment
  - Sufficient fine sediment to baylands to support tidal marsh disturbance
- **Establishment of sufficient width and connection** to channel to promote groundwater recharge, support riparian habitat, provide natural and flood flow variability and accommodate extreme flooding, using sea walls, and geomorphic alteration (including geomorphic responses to climate change and subsidence)

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# LANDSCAPE RESILIENCE FRAMEWORK

Operationalizing ecological  
resilience at the landscape scale

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A•S•C





# VISION

for a resilient  
Silicon Valley  
landscape

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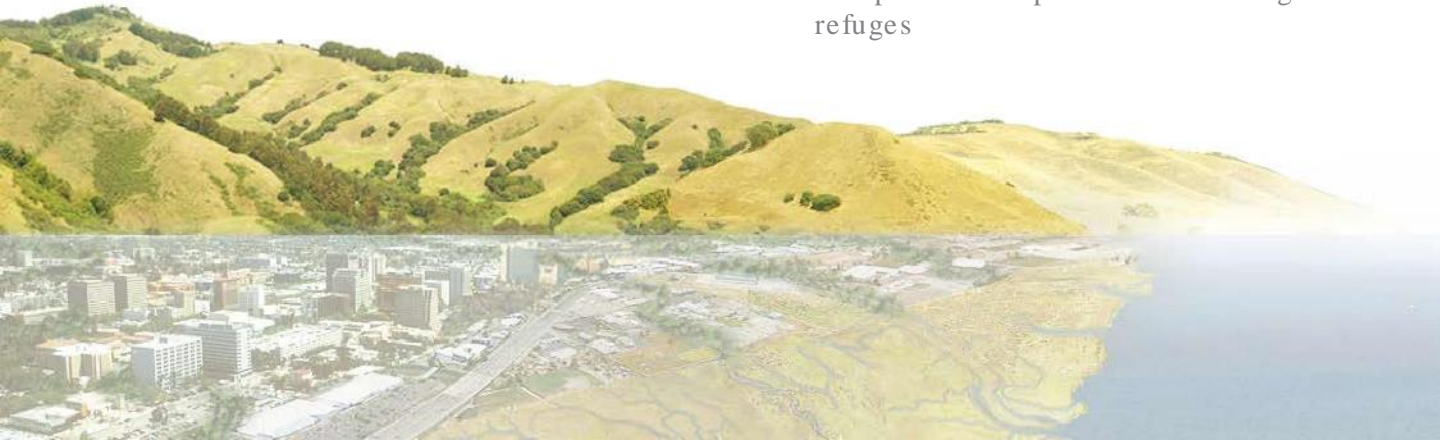




# Hills

## An ecologically resilient Silicon Valley includes...

- Redundancy, Scale** • **Multiple large areas** of protected open space
- Connectivity** • **Connectivity between ranges** for large mammal movement
- Connectivity, Scale** • **Connectivity up and down ranges** for habitat shifts
- Setting, Scale** • **Drought-tolerant vegetation** that could serve as future seed sources
- Setting, Complexity/Diversity** • **Microtopography and microclimates** that provide temperature and drought refuges



# Valley

## An ecologically resilient Silicon Valley includes...

### Setting, Process, Complexity/Diversity

- A diversity of **wetland habitats** where supported by appropriate soils, topography, and groundwater levels

### Setting, Scale, People

- **Native landscaping** that includes species likely to tolerate heat and drought stresses

### People

- **Buffers** between wildlands and developed areas

### Connectivity, Scale, People

- **Coordinated planting efforts** across parks, backyards, greenways, medians, office parks, etc. to provide habitat and permeability



## An ecologically resilient Silicon Valley includes...

### Connectivity

- **Connectivity between bayland and upland habitats** for wildlife movement around Bay perimeter

### Process, Scale

- **Sufficient sediment** from local watersheds to support tidal marsh persistence

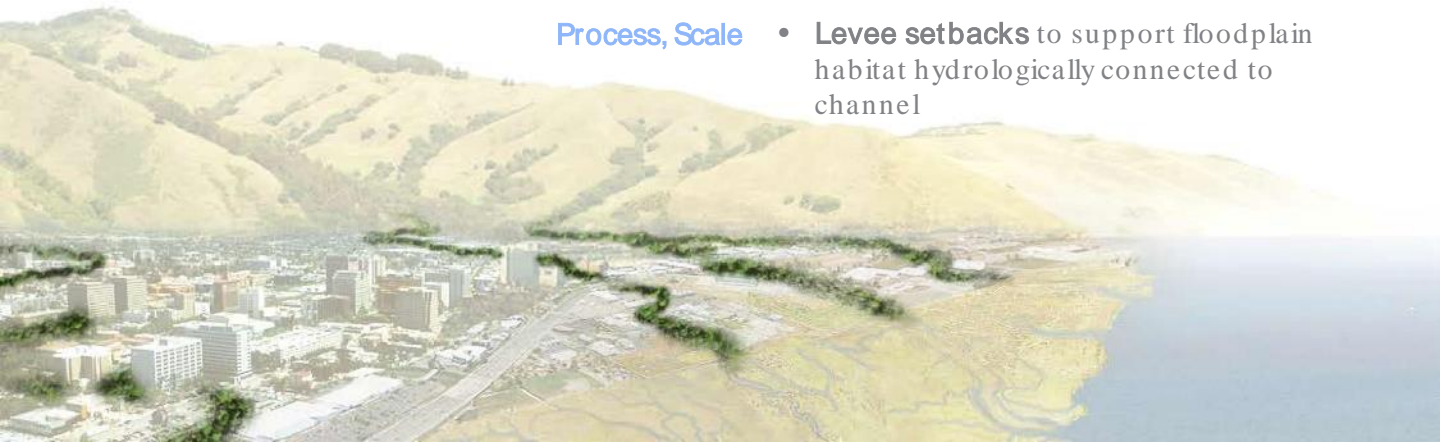
### Complexity/Diversity

- **Channel and marsh plain complexity** to support diverse species

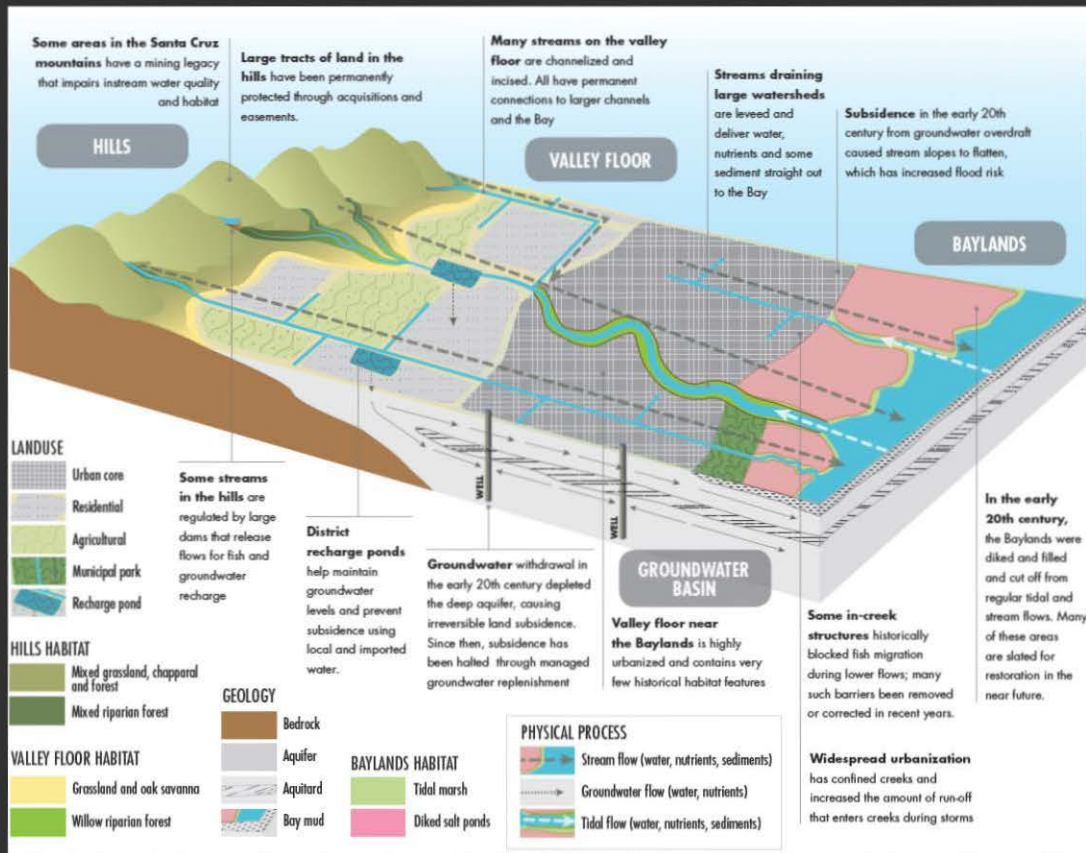


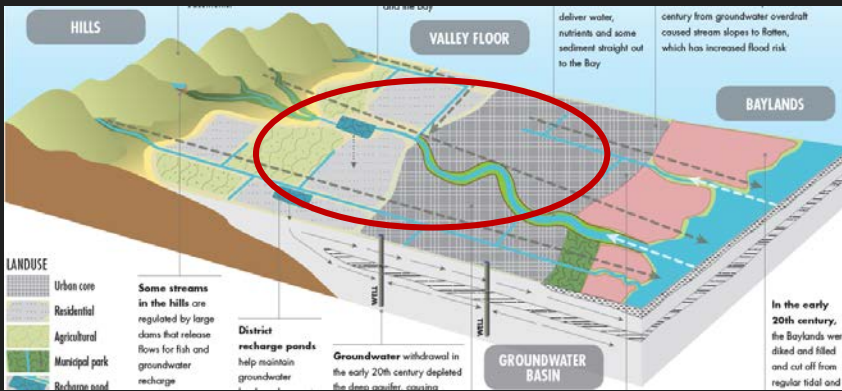
## An ecologically resilient Silicon Valley includes...

- Connectivity, Complexity/Diversity** • **Surface flow heterogeneity** to support a range of species and as a barrier to spread of invasives
- Process** • **Flows** that cue the germination of native trees and steelhead migration, spawning, and rearing
- Process** • **Sediment delivery** from upper watersheds to channel, floodplain, and baylands
- Connectivity** • **Continuous riparian corridors** for wildlife movement from hills to bay
- Process, Scale** • **Levee setbacks** to support floodplain habitat hydrologically connected to channel



# Resilience Strategies

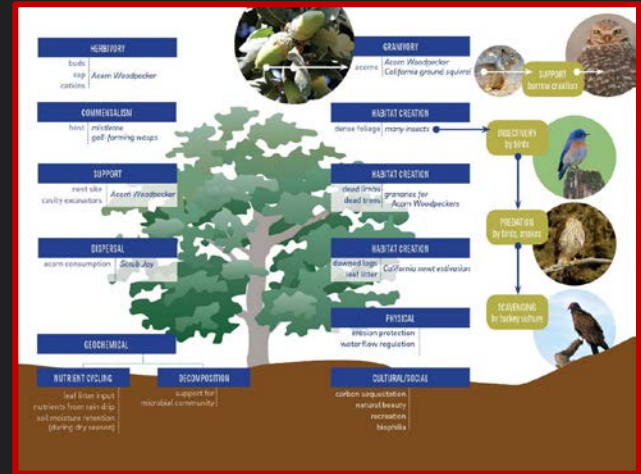


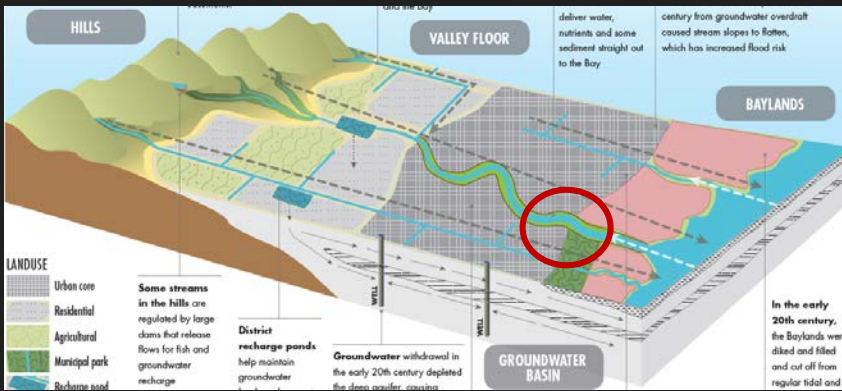


- Canopy
- Google



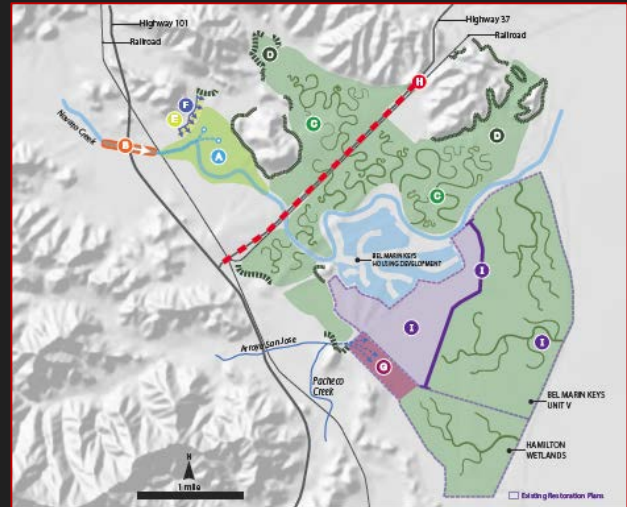
# Re-Oaking

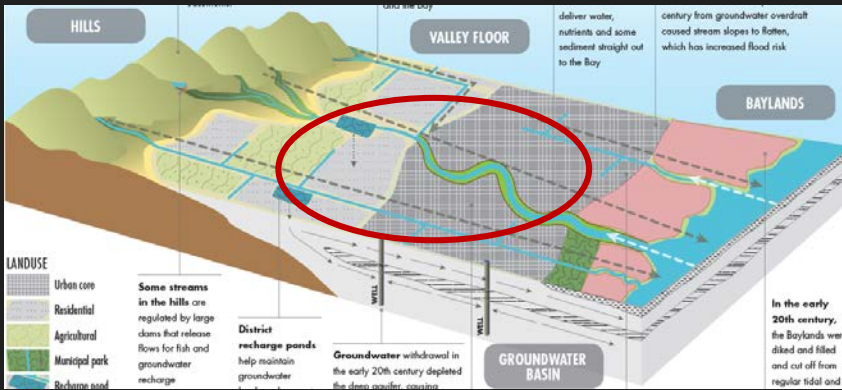




# Flood Control 2.0

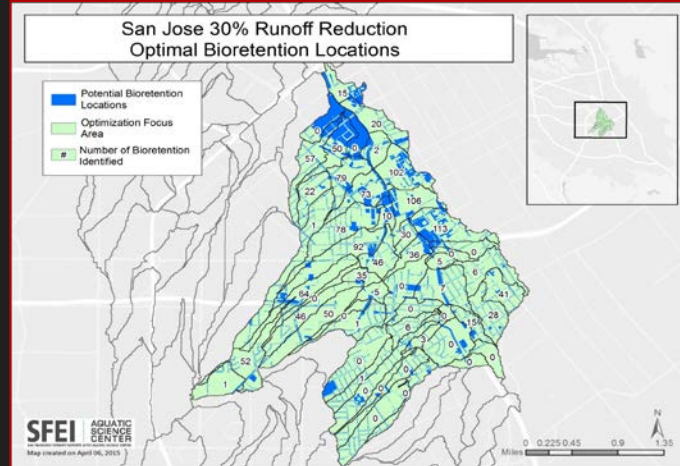
- SCVWD





# GreenPlan-IT

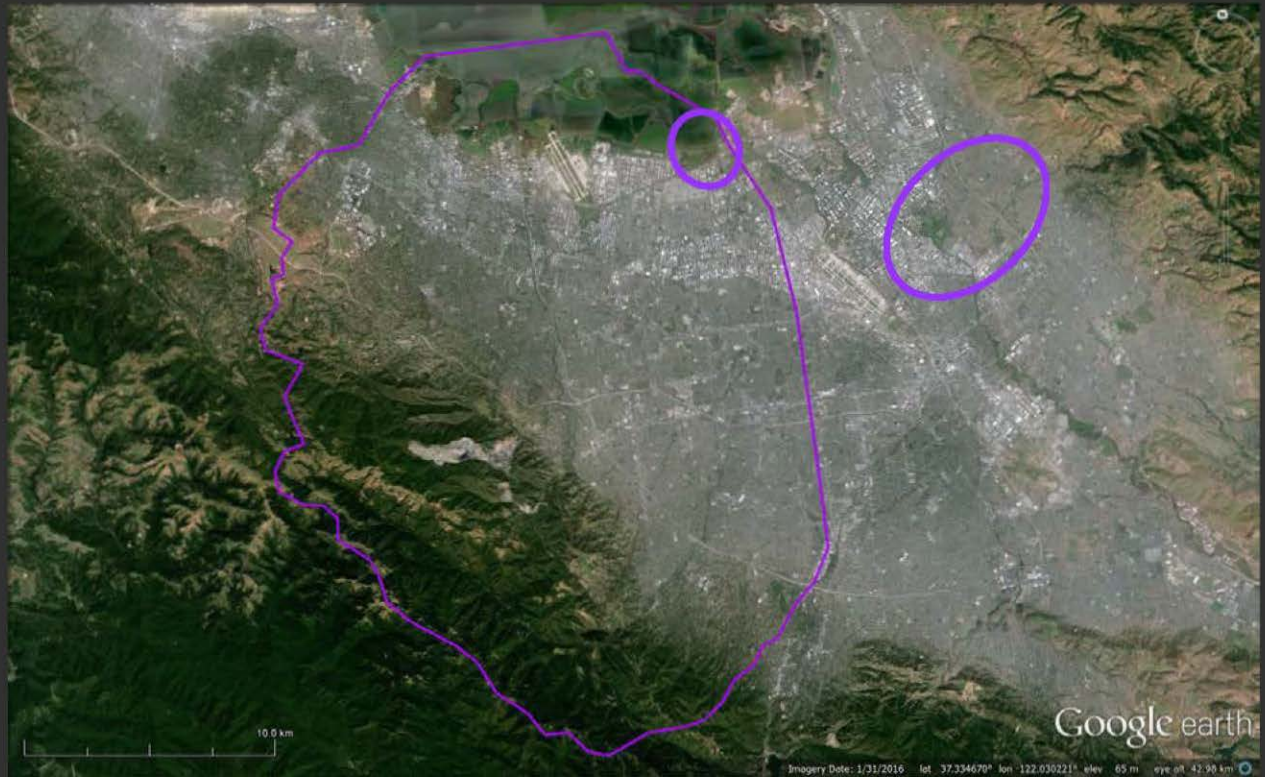
- City of San Jose
- City of Sunnyvale
- SCVWD







# Local Visions (varying scales)



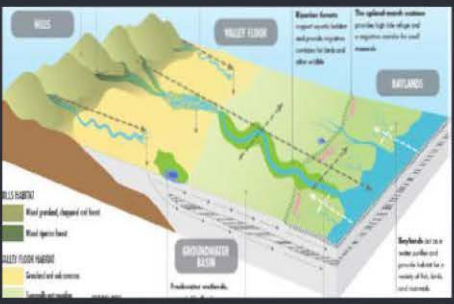


# Next Steps

- Translating with partners into Visions and Plans
- Local demo projects
- More integration and collaborations –RSV
- Encouragement/facilitation for staff to integrate



# How do we create the healthy, resilient Silicon Valley of the future?





California Native Plant Society, SCV Chapter  
Canopy  
City of East Palo Alto  
City of Sunnyvale  
Committee for Green Foothills  
Environmental Protection Agency  
Grassroots Ecology  
Peninsula Open Space Trust  
San Francisco Estuary Partnership  
San Francisco Public Utilities Commission  
Santa Clara Valley Audubon Society  
SF Bay Regional Water Quality Control Board  
Sierra Club, Loma Prieta Chapter  
South Bay Salt Pond Restoration Project  
State Coastal Conservancy

## THANK YOU

Audrey Davenport,  
Google Ecology  
Program

Norma Camacho,  
Sarah Duckler, Brian  
Mendenhall, Afshin  
Rouhani, SCWWD

Andrea MacKenzie,  
SCVOSA

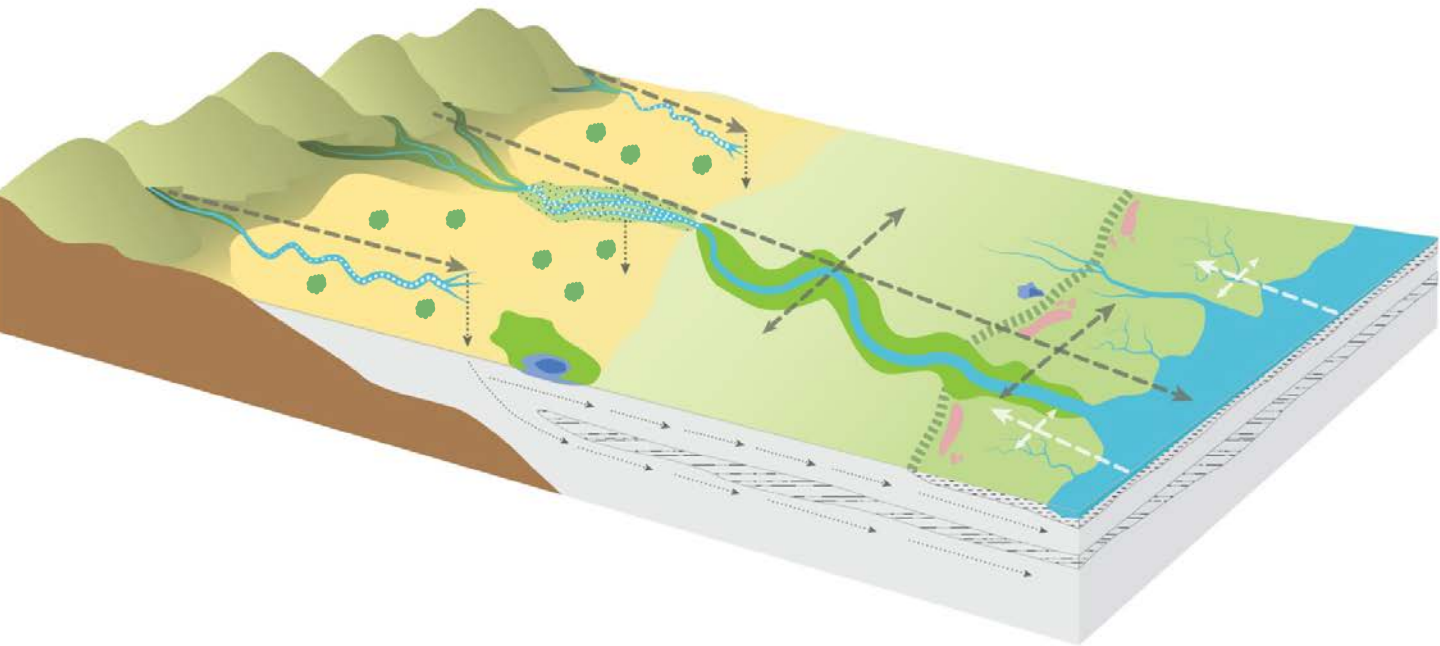
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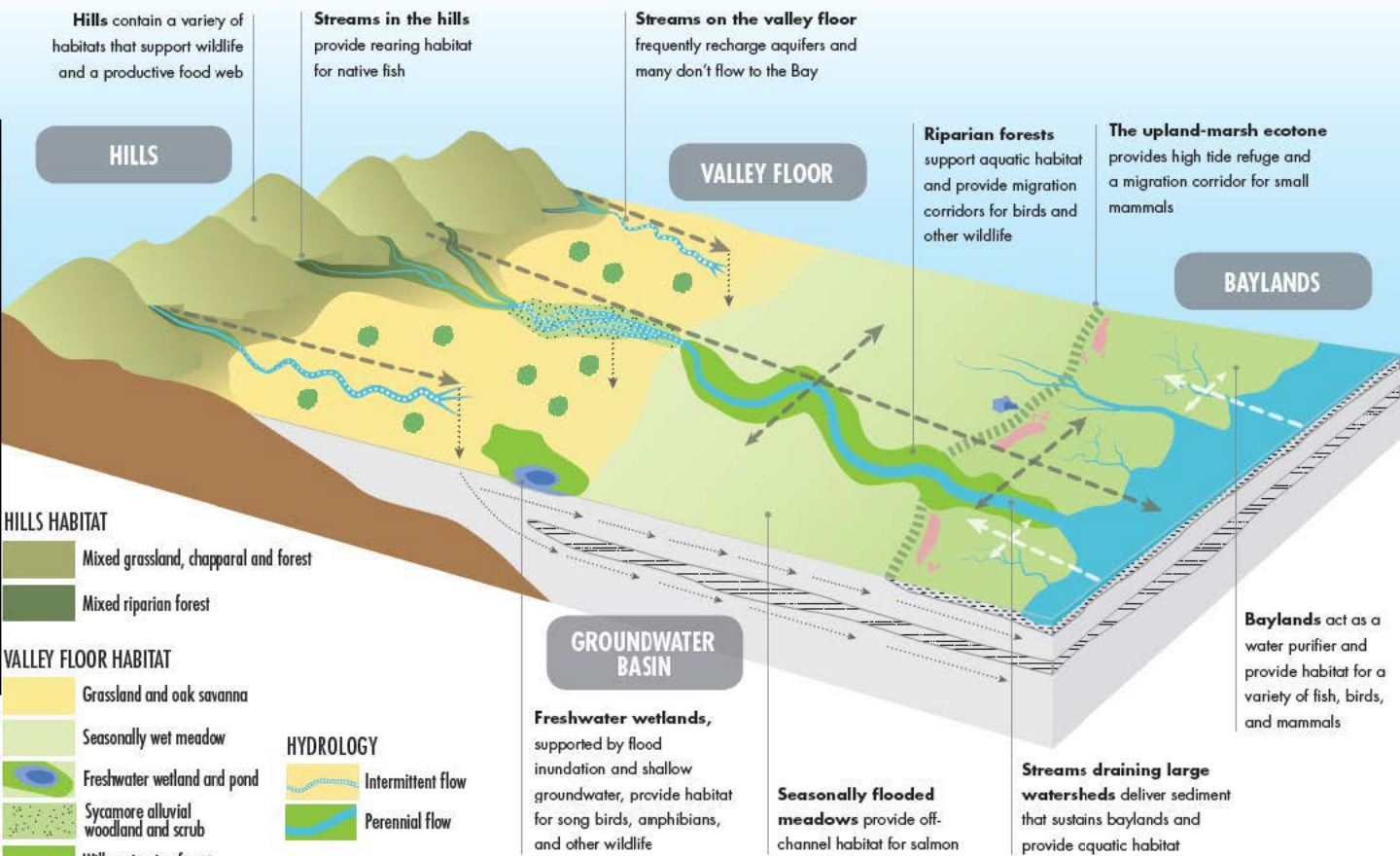
**Letitia Grenier**  
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# One Water – Watershed Conceptual Model (courtesy SCVWD)



**Historical Landscape  
(1850s)**



**HILLS HABITAT**

- Mixed grassland, chaparral and forest
- Mixed riparian forest

**VALLEY FLOOR HABITAT**

- Grassland and oak savanna
- Seasonally wet meadow
- Freshwater wetland and pond
- Sycamore alluvial woodland and scrub
- Willow riparian forest

**BAYLANDS HABITAT**

- Tidal marsh
- Salt pannes
- Upland-marsh ecotone

**HYDROLOGY**

- Intermittent flow
- Perennial flow

**GEOLOGY**

- Bedrock
- Aquifer
- Aquitard
- Bay mud

**PHYSICAL PROCESS**

- Stream flow (water, nutrients, sediments)
- Groundwater flow (water, nutrients)
- Tidal flow (water, nutrients, sediments)