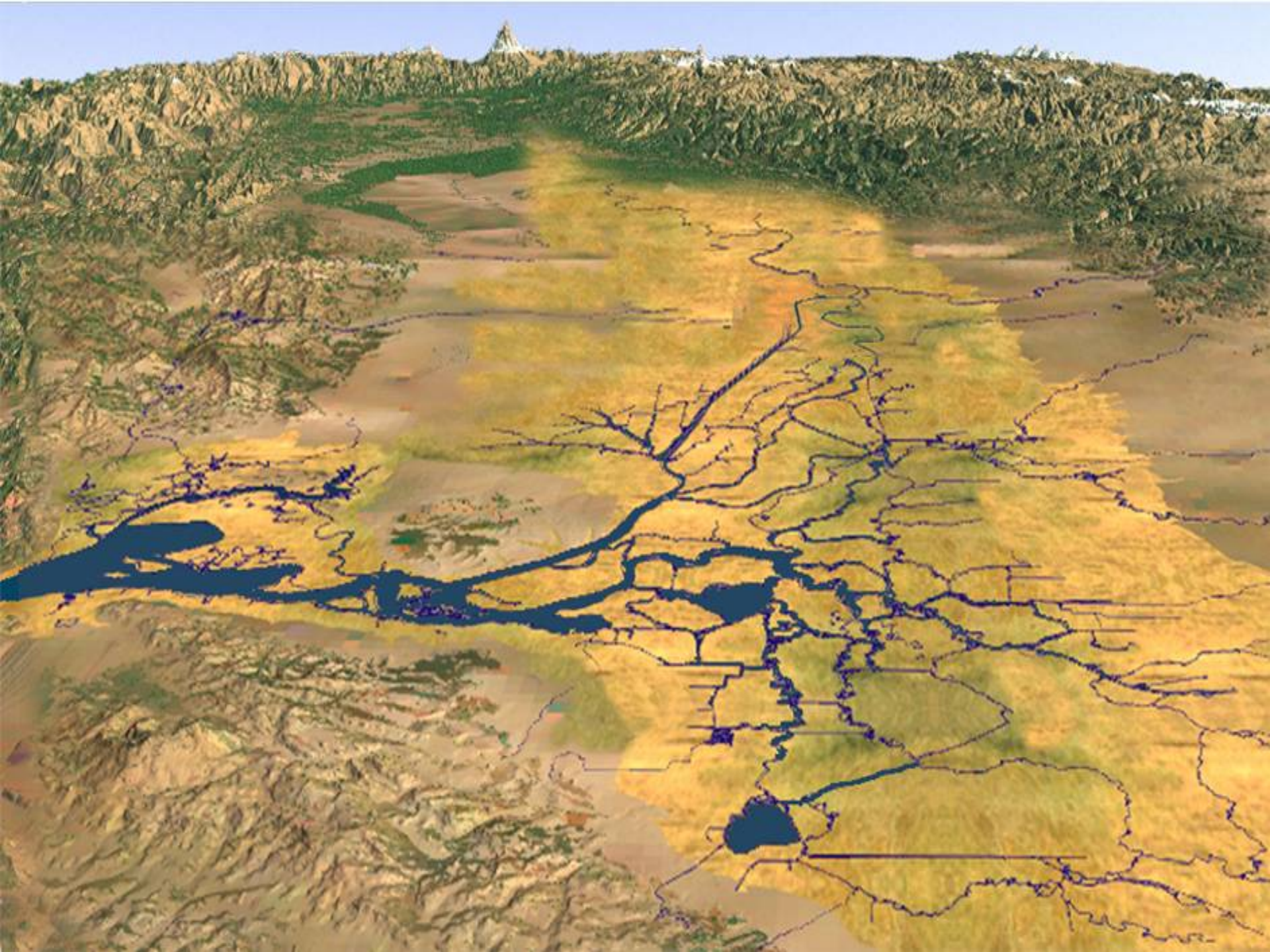


# California's Bay-Delta



- **Highly Altered**
- **Non-sustainable**
- **Rigid**

April 9, 2015

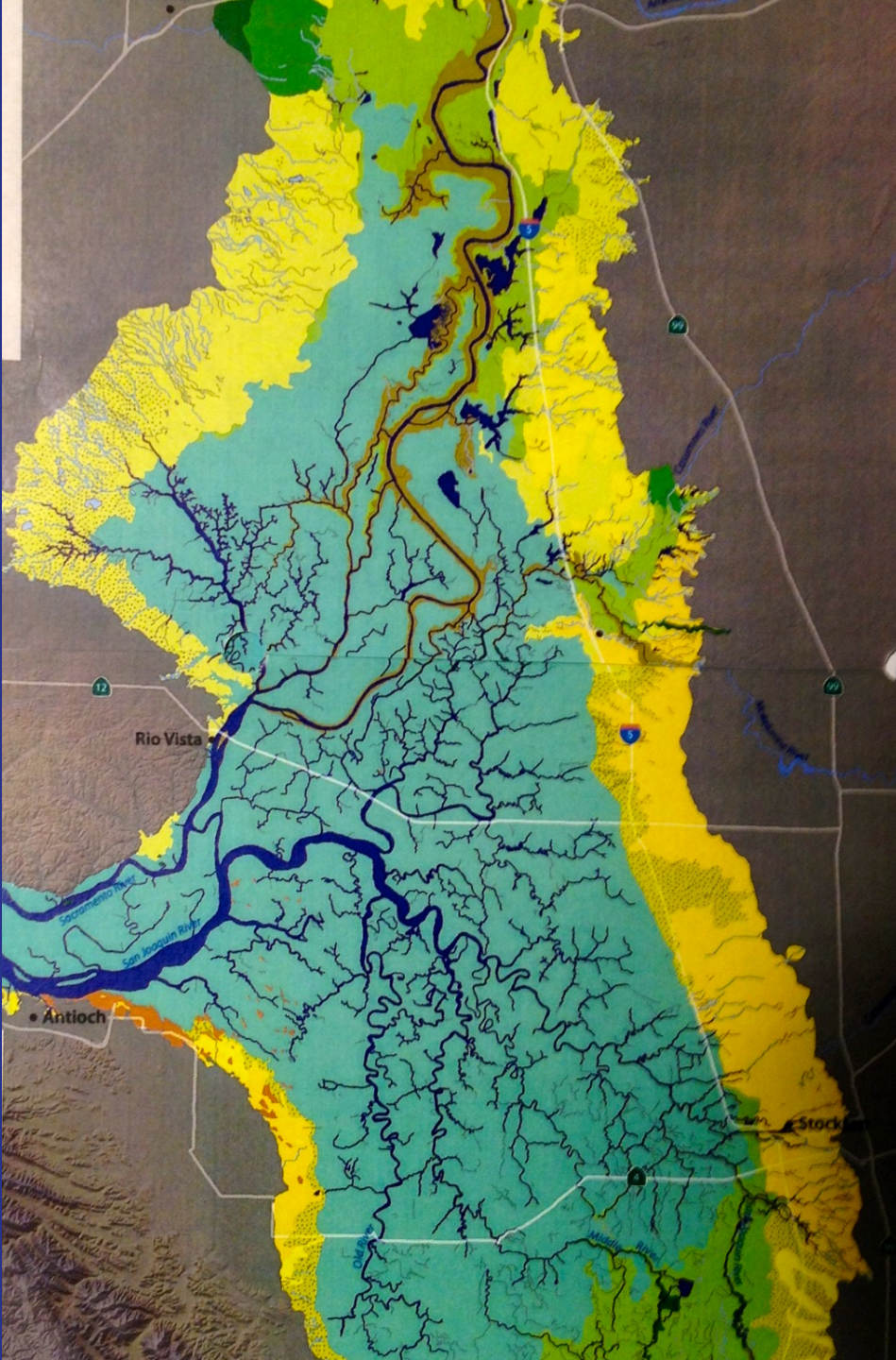








18.0 ka







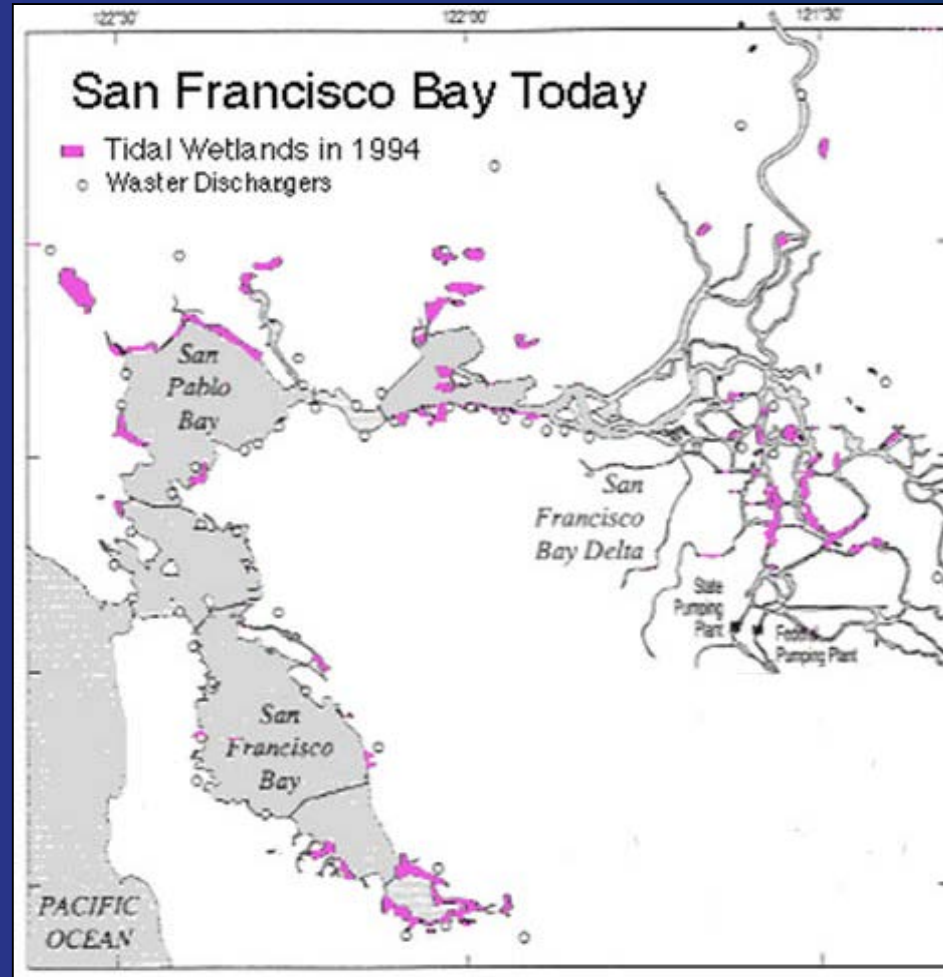
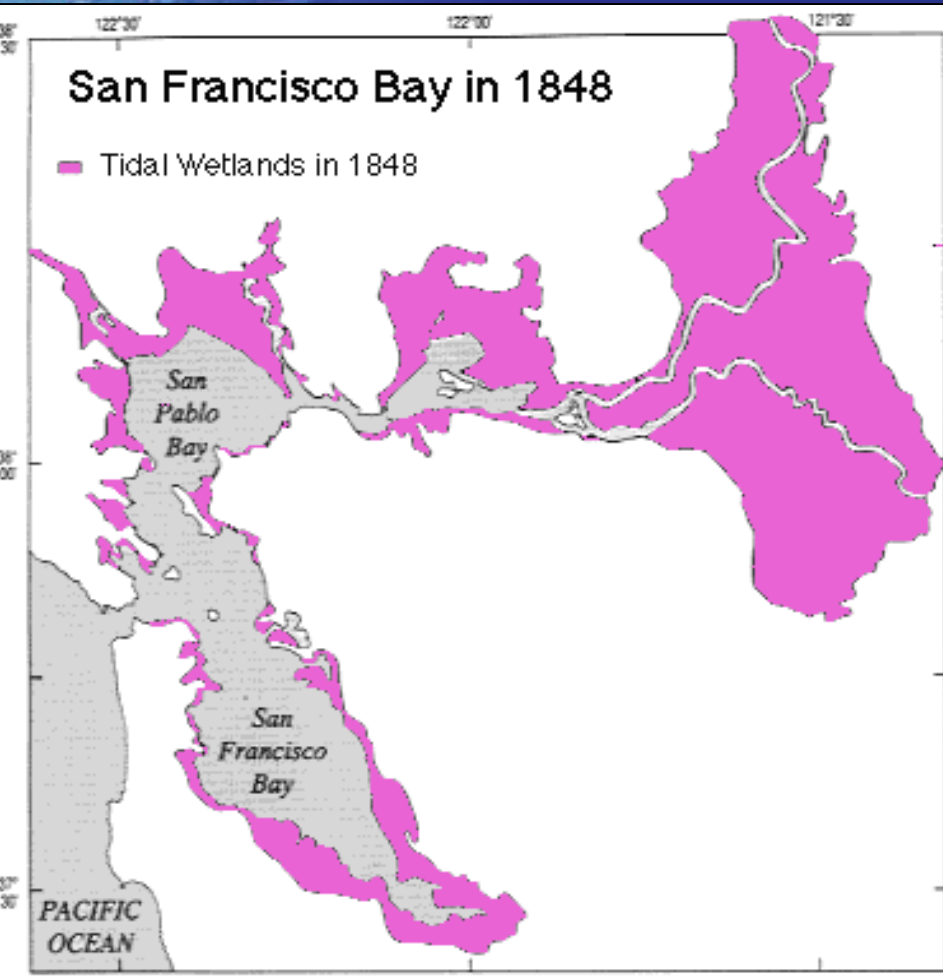


# Past – Present - Future

*THE BAY DELTA: PAST, PRESENT, AND FUTURE*



# Fish evolved to vastly different landscape







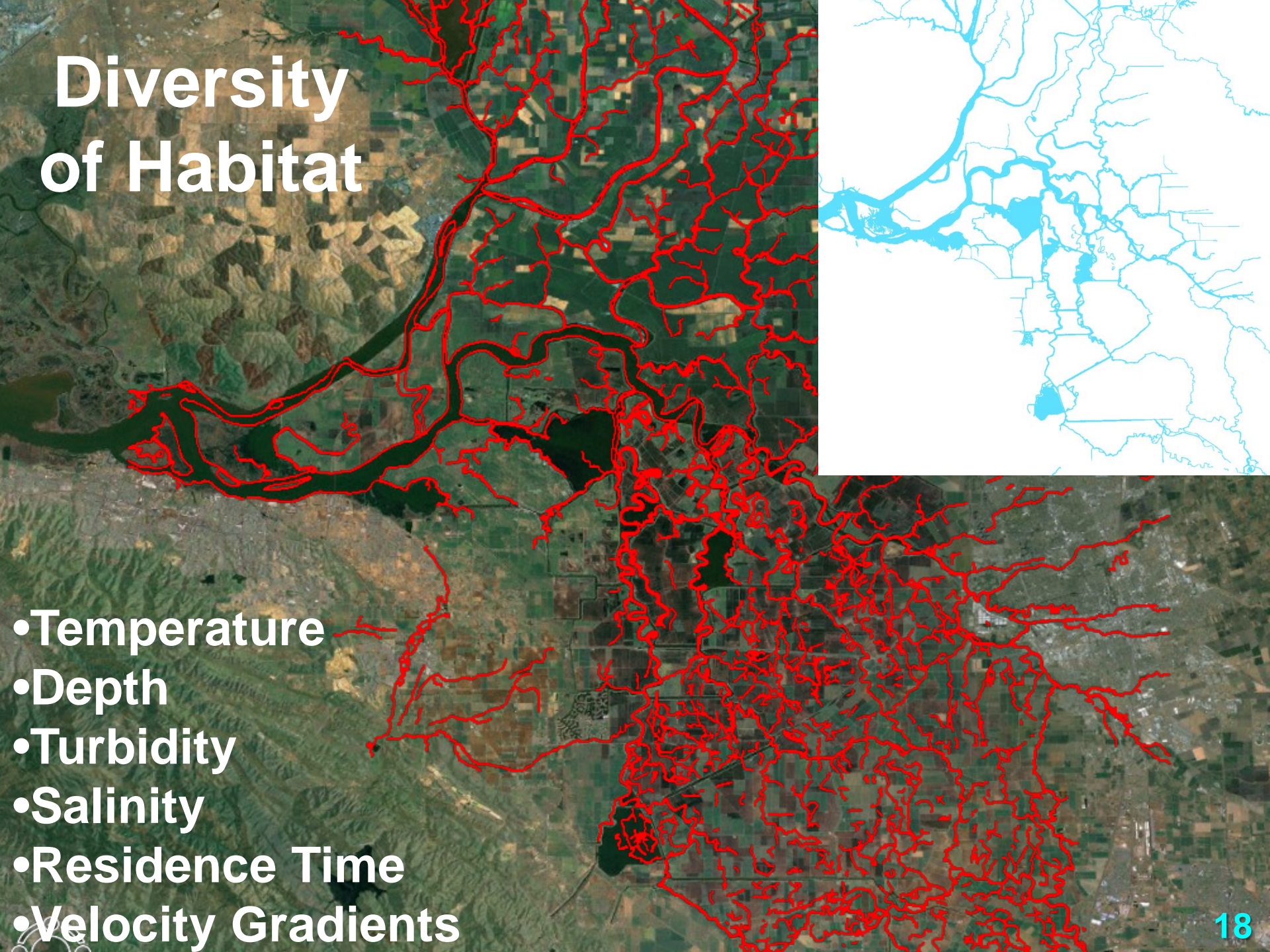


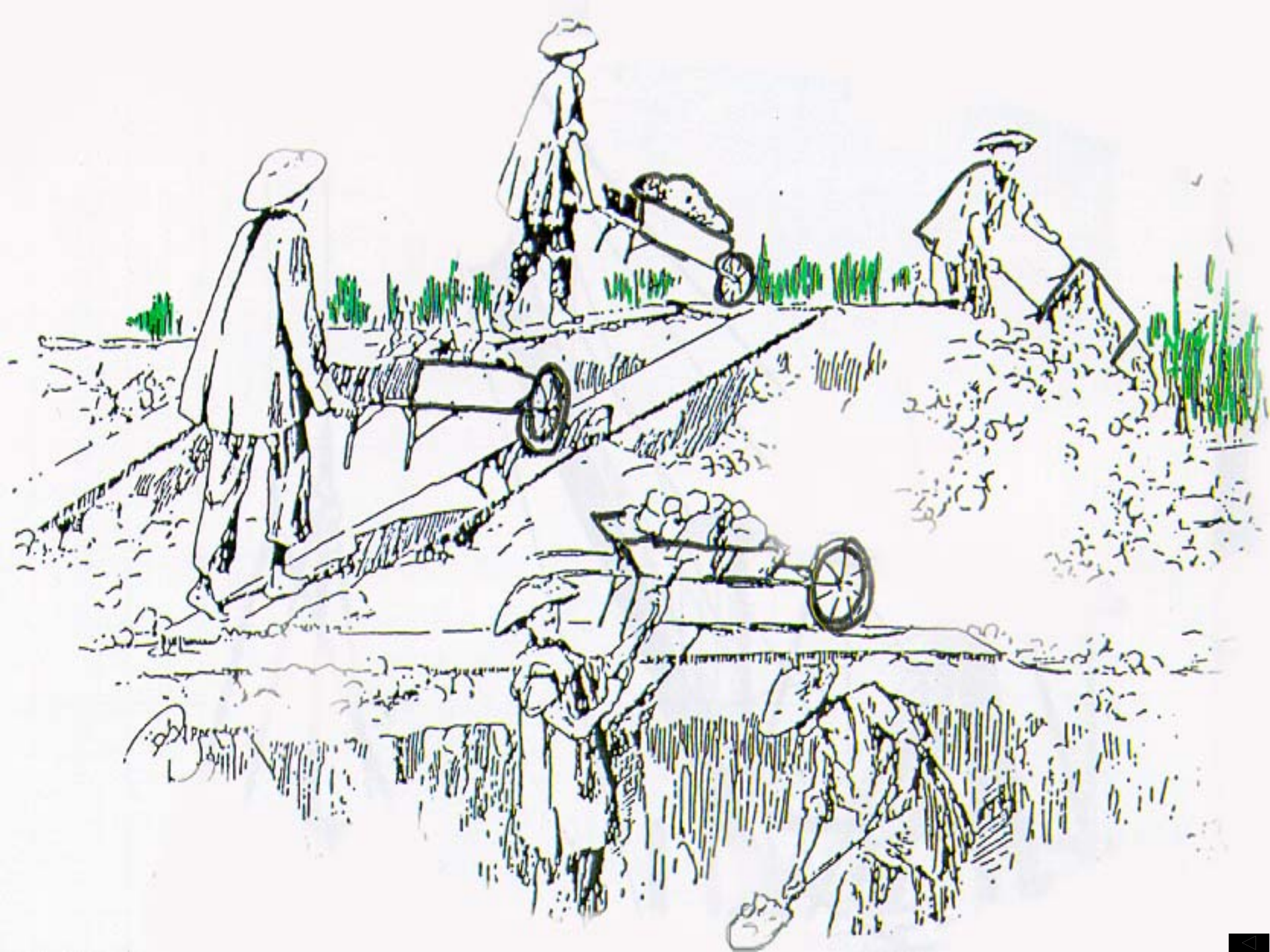




# Diversity of Habitat

- Temperature
- Depth
- Turbidity
- Salinity
- Residence Time
- Velocity Gradients







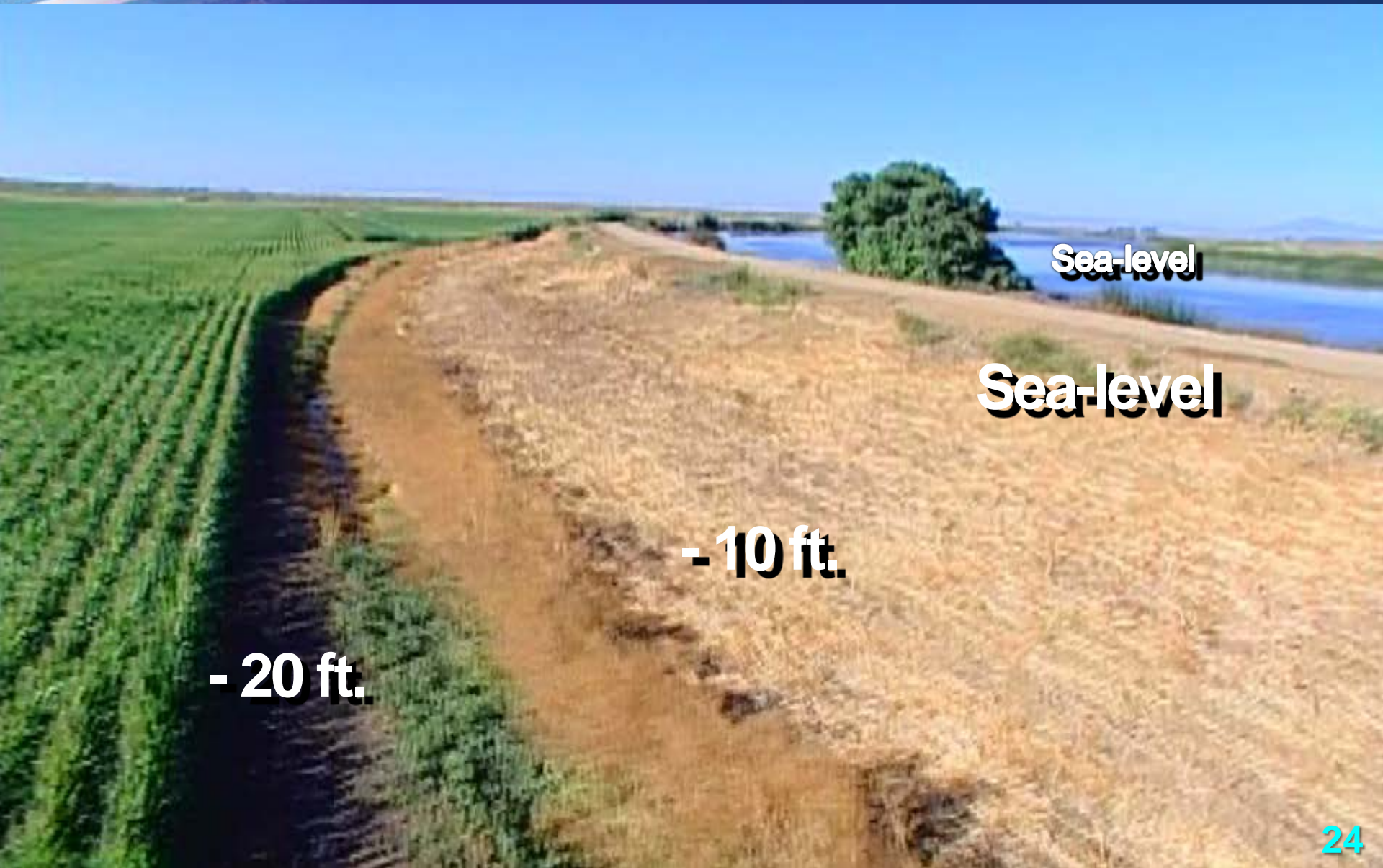






# Critical Levee Characteristics

Loose Dredged Fill & Must Function 24/7/365



Sea-level

Sea-level

- 10 ft.

- 20 ft.

# Island Flooding

**PPIC - 90% probability half islands flood next 50 years**

**High Risk Zone**

Sacramento

**Flooded  
since 1960**

Bay  
Area

Stockton

**162 Delta levee breaches have occurred in past  
century**



**Modern  
Delta very  
different for  
fish**

**Delta historically  
both bigger &  
smaller**



Potato Slough looking east

Delta was  
narrower  
and longer



Potato Slough looking east

# Key Delta Levee Risks

## Sea Level Rise



## Seismic Risk Bay Area Faults



PRE-1850 DELTA

**Subsidence**

PRESENT CONDITIONS

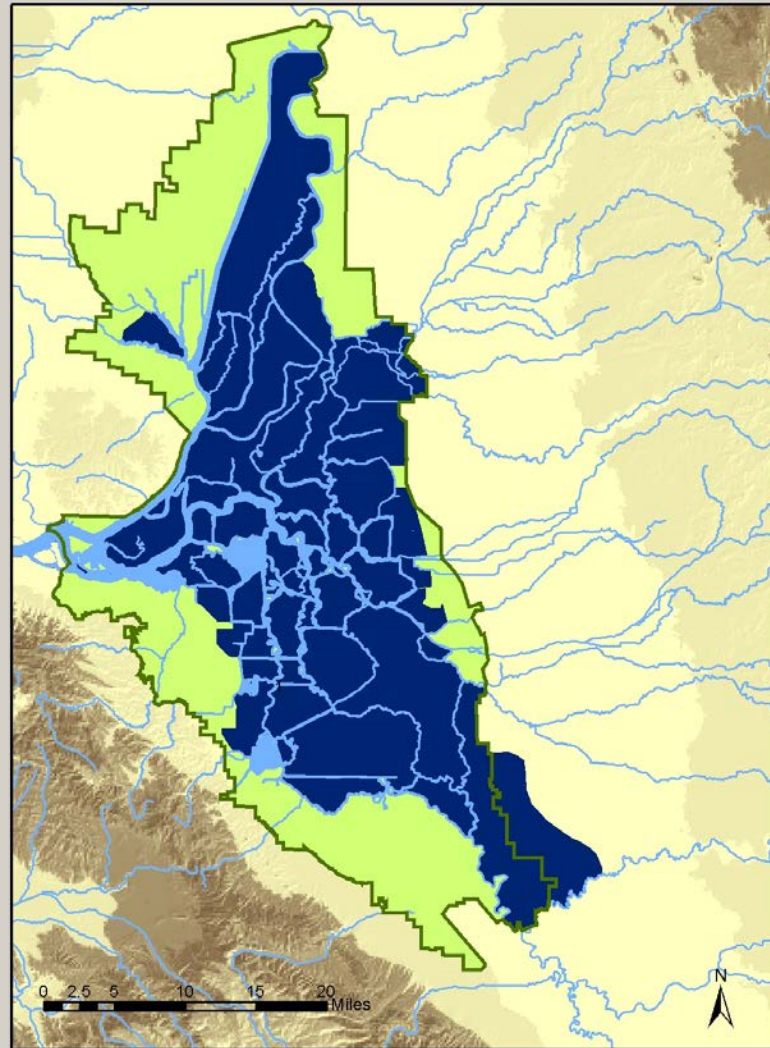
Subsidence





# 48" of Sea Level Rise

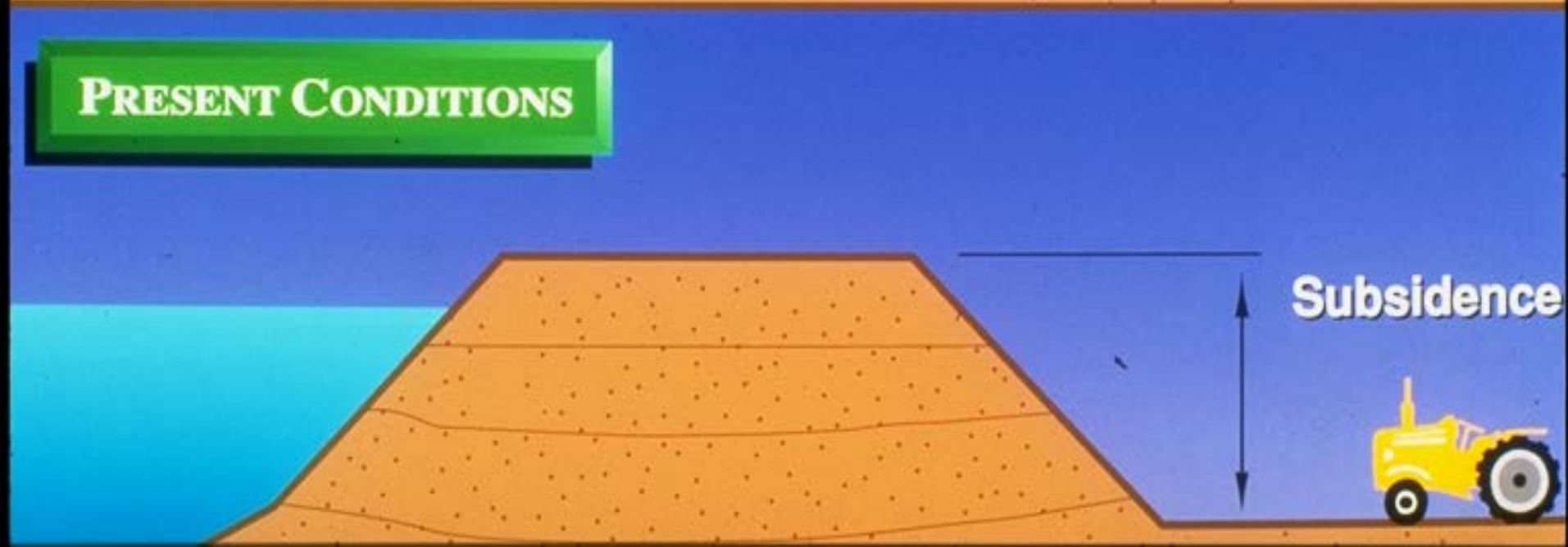
## Areas most at risk



## PRE-1850 DELTA



## PRESENT CONDITIONS





# Microbial Decomposition

Plant  
Matter

1.7 Tons/ac.

Carbon  
Dioxide

4.9 Tons/ac.

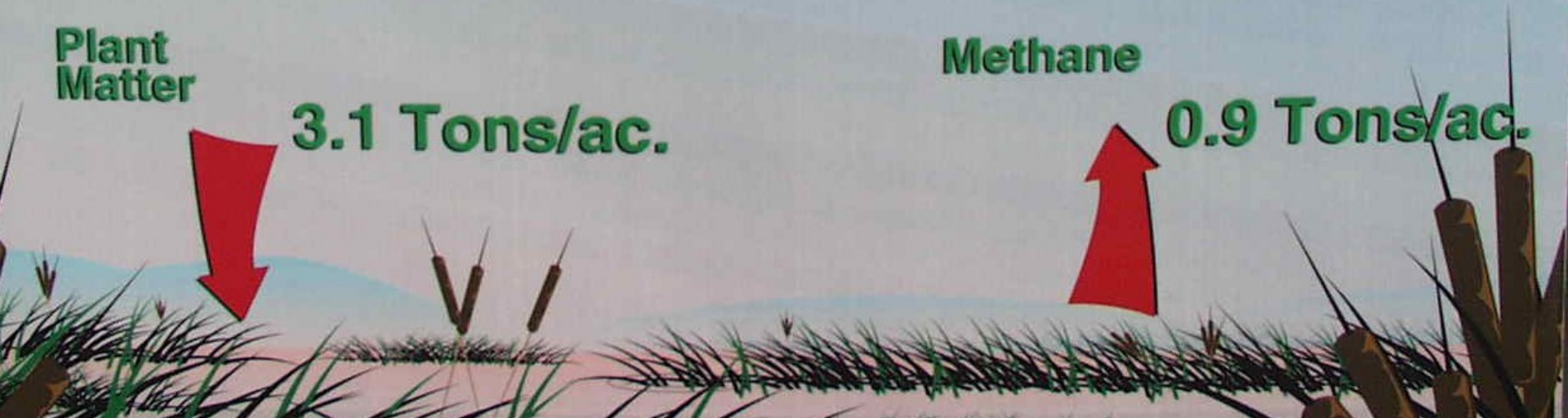


Plant  
Matter

3.1 Tons/ac.

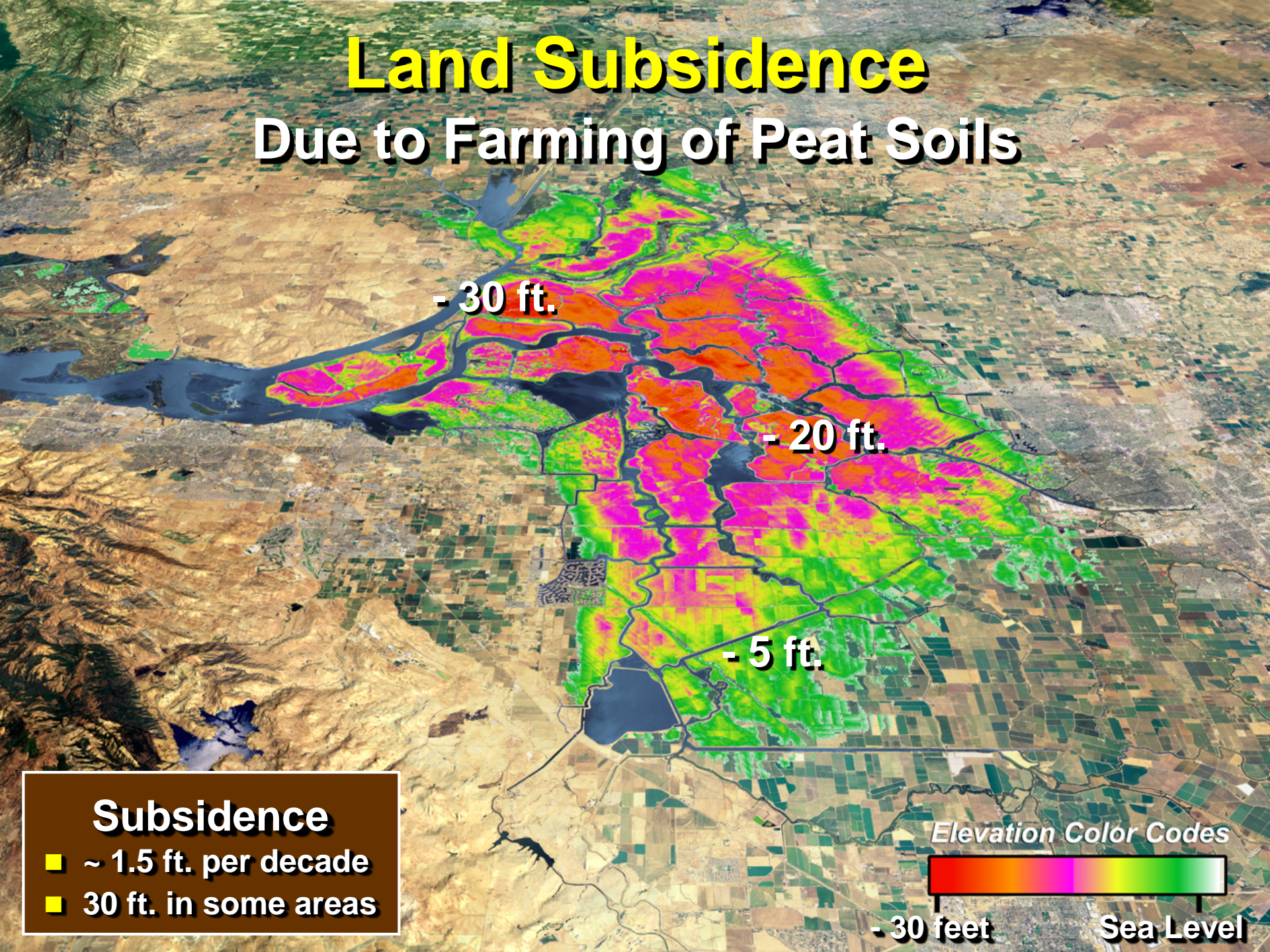
Methane

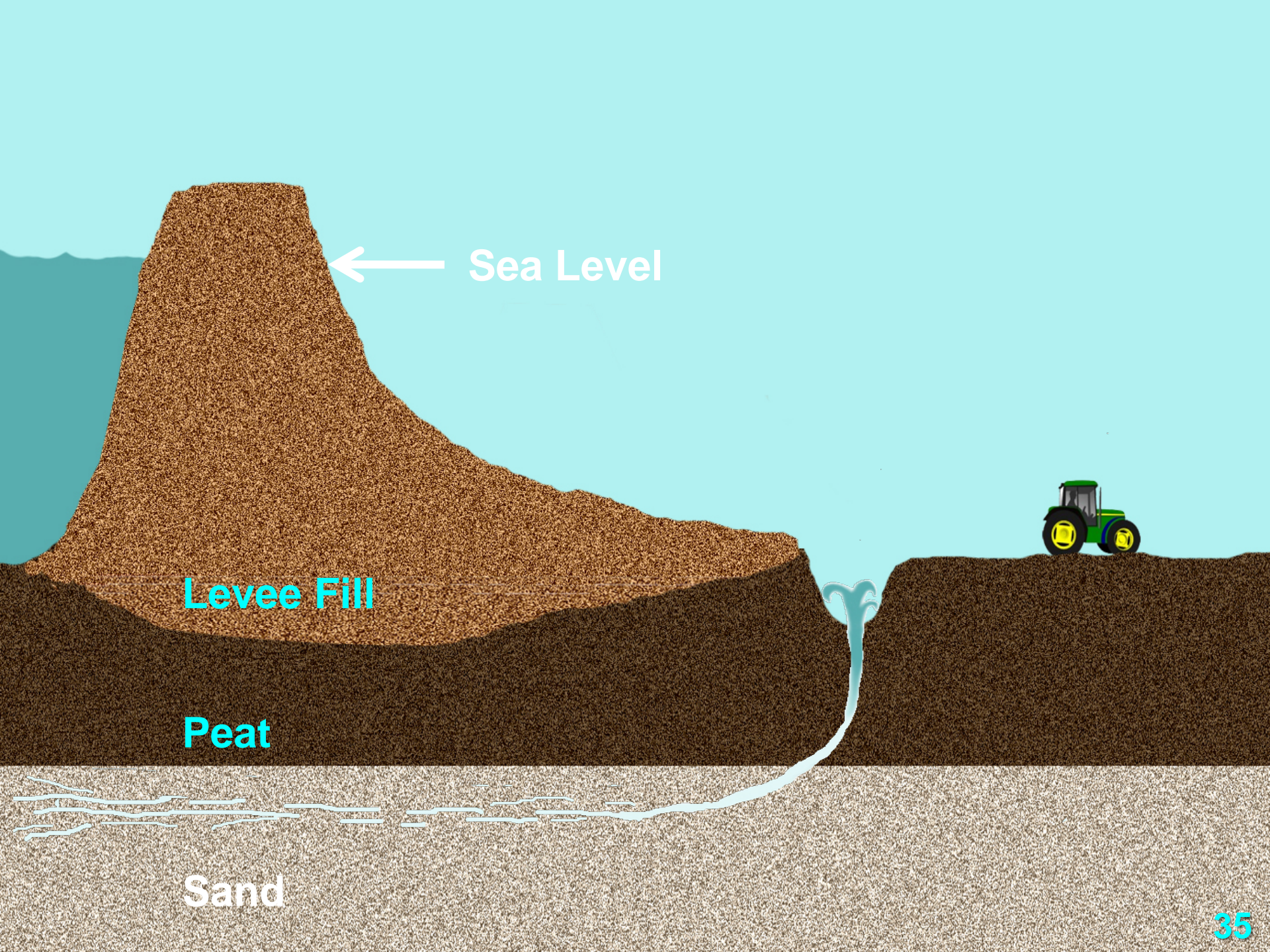
0.9 Tons/ac.



# Land Subsidence

## Due to Farming of Peat Soils





Sea Level

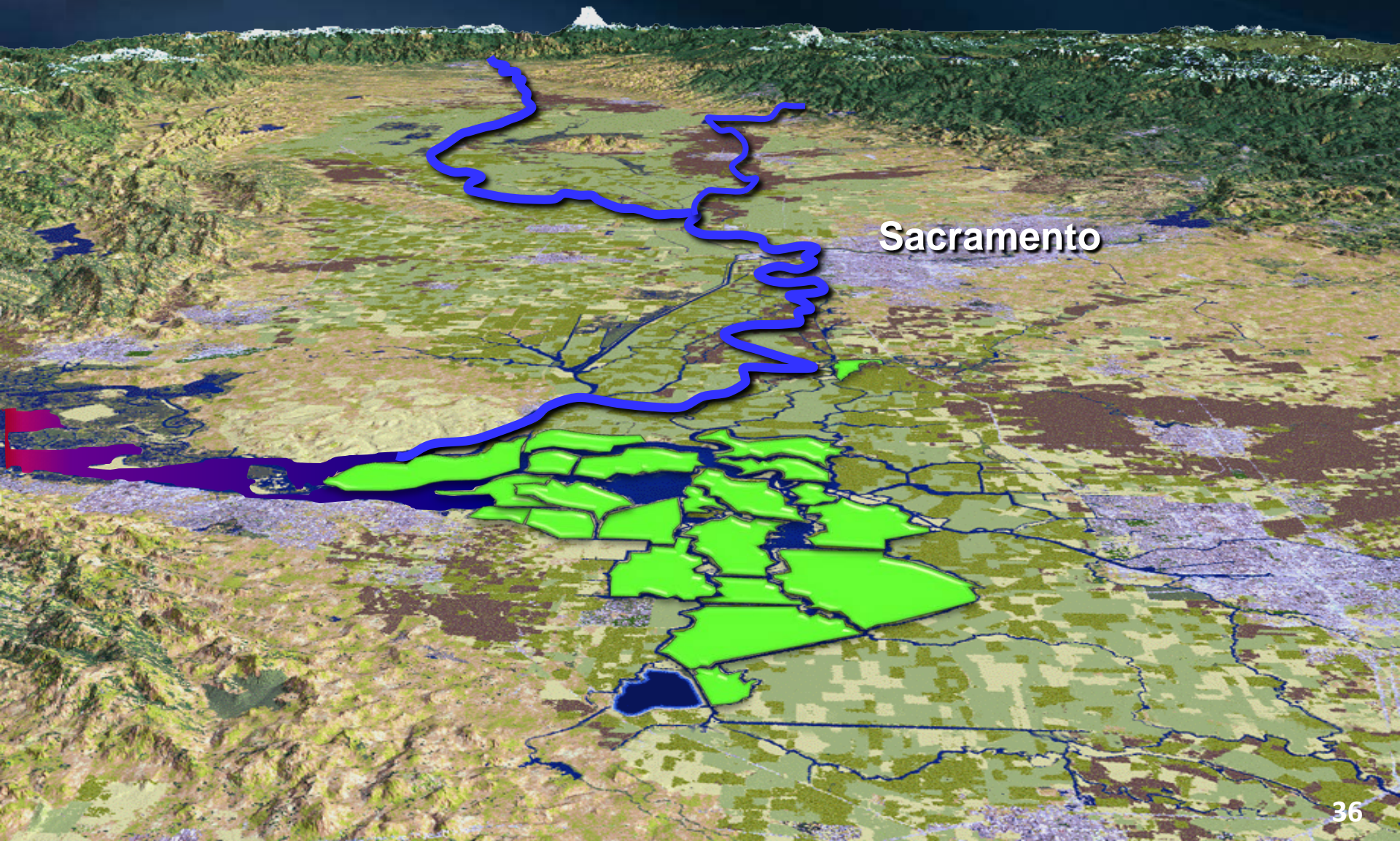
Levee Fill

Peat

Sand

# Island Seepage Analysis

## Under Artesian Conditions



# Seismic Vulnerability



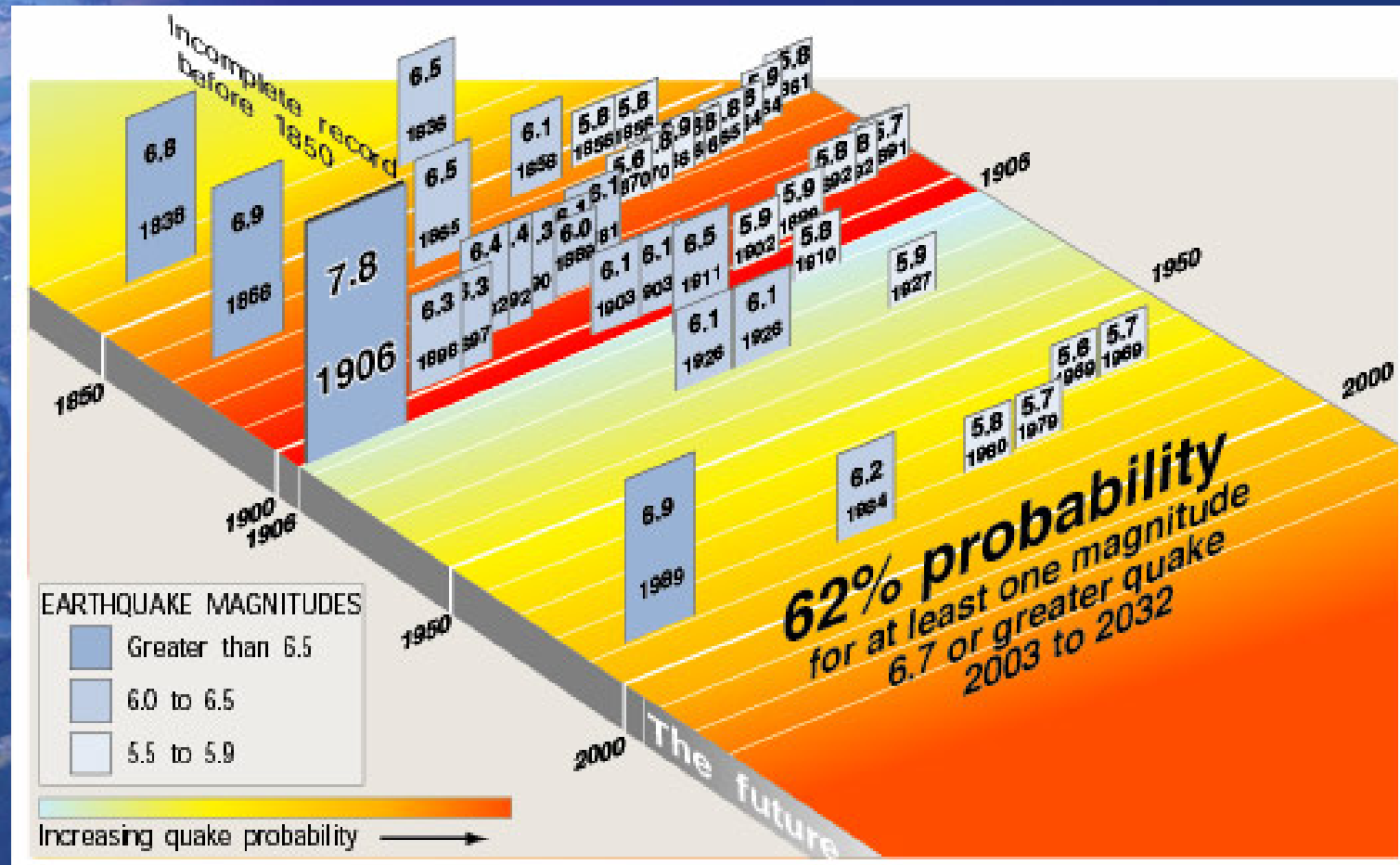
Bay-Delta Region Major Faults

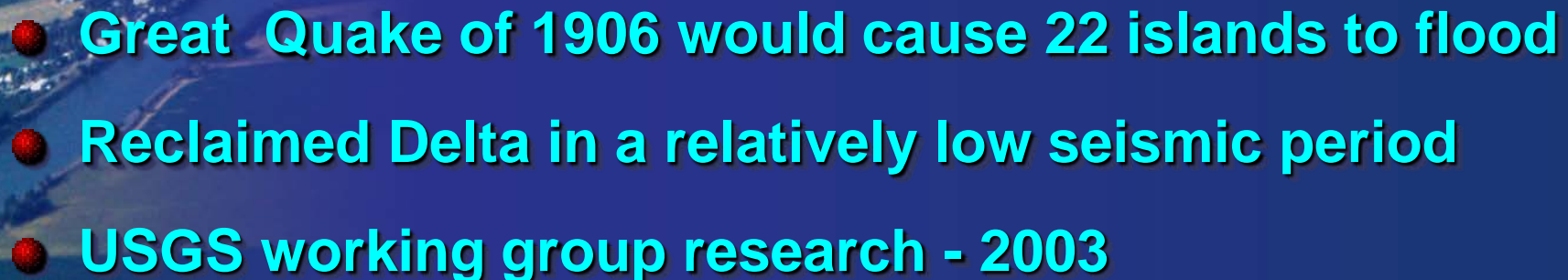
## Past Seismic Events in the Bay-Delta Region

The chart displays seismic activity in the Bay-Delta region from 1850 to 2000. The x-axis represents time, with major ticks at 1850, 1900, 1906, 1950, and 2000. The y-axis represents earthquake magnitude. A legend indicates three magnitude categories: Greater than 6.5 (dark blue), 6.0 to 6.5 (medium blue), and 5.5 to 5.9 (light blue). A color gradient at the bottom indicates increasing quake probability from green to red. A large text overlay states: "62% probability for at least one magnitude 6.7 or greater quake 2003 to 2032". The chart also includes a label "The future" pointing towards the right side of the plot.

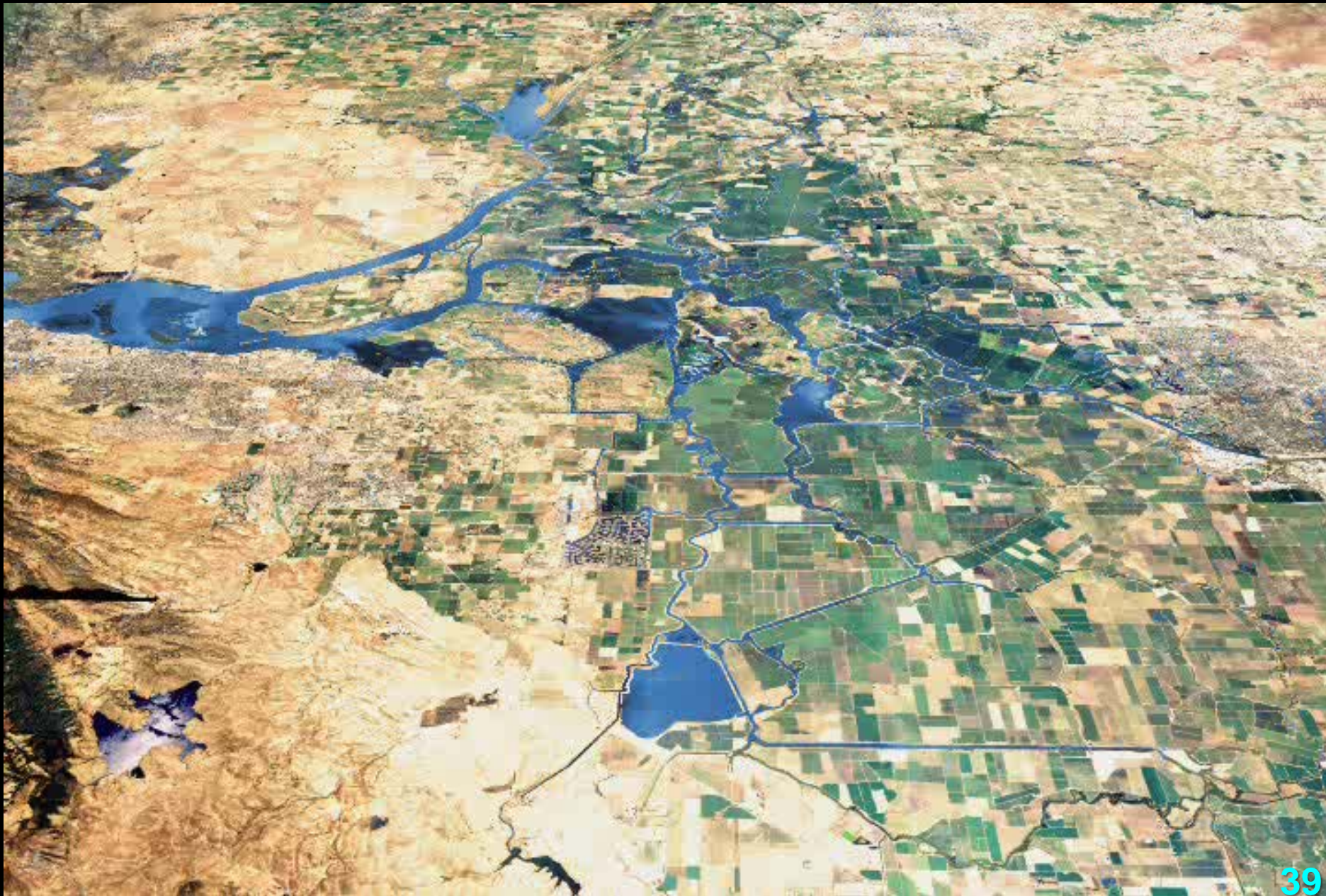
Year	Magnitude
1838	6.8
1866	6.9
1906	7.8
1906	6.5
1906	6.3
1906	6.1
1906	6.0
1906	5.9
1906	5.8
1906	5.7
1906	5.6
1906	5.5
1906	5.4
1906	5.3
1906	5.2
1906	5.1
1906	5.0
1906	4.9
1906	4.8
1906	4.7
1906	4.6
1906	4.5
1906	4.4
1906	4.3
1906	4.2
1906	4.1
1906	4.0
1906	3.9
1906	3.8
1906	3.7
1906	3.6
1906	3.5
1906	3.4
1906	3.3
1906	3.2
1906	3.1
1906	3.0
1906	2.9
1906	2.8
1906	2.7
1906	2.6
1906	2.5
1906	2.4
1906	2.3
1906	2.2
1906	2.1
1906	2.0
1906	1.9
1906	1.8
1906	1.7
1906	1.6
1906	1.5
1906	1.4
1906	1.3
1906	1.2
1906	1.1
1906	1.0
1906	0.9
1906	0.8
1906	0.7
1906	0.6
1906	0.5
1906	0.4
1906	0.3
1906	0.2
1906	0.1
1906	0.0
1906	-0.1
1906	-0.2
1906	-0.3
1906	-0.4
1906	-0.5
1906	-0.6
1906	-0.7
1906	-0.8
1906	-0.9
1906	-1.0
1906	-1.1
1906	-1.2
1906	-1.3
1906	-1.4
1906	-1.5
1906	-1.6
1906	-1.7
1906	-1.8
1906	-1.9
1906	-2.0
1906	-2.1
1906	-2.2
1906	-2.3
1906	-2.4
1906	-2.5
1906	-2.6
1906	-2.7
1906	-2.8
1906	-2.9
1906	-3.0
1906	-3.1
1906	-3.2
1906	-3.3
1906	-3.4
1906	-3.5
1906	-3.6
1906	-3.7
1906	-3.8
1906	-3.9
1906	-4.0
1906	-4.1
1906	-4.2
1906	-4.3
1906	-4.4
1906	-4.5
1906	-4.6
1906	-4.7
1906	-4.8
1906	-4.9
1906	-5.0
1906	-5.1
1906	-5.2
1906	-5.3
1906	-5.4
1906	-5.5
1906	-5.6
1906	-5.7
1906	-5.8
1906	-5.9
1906	-6.0
1906	-6.1
1906	-6.2
1906	-6.3
1906	-6.4
1906	-6.5
1906	-6.6
1906	-6.7
1906	-6.8
1906	-6.9
1906	-7.0
1906	-7.1
1906	-7.2
1906	-7.3
1906	-7.4
1906	-7.5
1906	-7.6
1906	-7.7
1906	-7.8
1906	-7.9
1906	-8.0
1906	-8.1
1906	-8.2
1906	-8.3
1906	-8.4
1906	-8.5
1906	-8.6
1906	-8.7
1906	-8.8
1906	-8.9
1906	-9.0
1906	-9.1
1906	-9.2
1906	-9.3
1906	-9.4
1906	-9.5
1906	-9.6
1906	-9.7
1906	-9.8
1906	-9.9
1906	-10.0

- Great Quake of 1906 would cause 22 islands to flood
- Reclaimed Delta in a relatively low seismic period
- USGS working group research - 2003



- 
- An aerial photograph of a coastal region, likely the Sacramento-San Joaquin River Delta. A long, narrow land strip, possibly a levee or a reclaimed area, extends from the left side of the frame into a large body of water. The water is a deep blue, and the land strip is a lighter, brownish-green color. The background shows more land and water, with some distant structures visible on the horizon.
- Great Quake of 1906 would cause 22 islands to flood
  - Reclaimed Delta in a relatively low seismic period
  - USGS working group research - 2003

# 8 Days in the Delta after an Earthquake

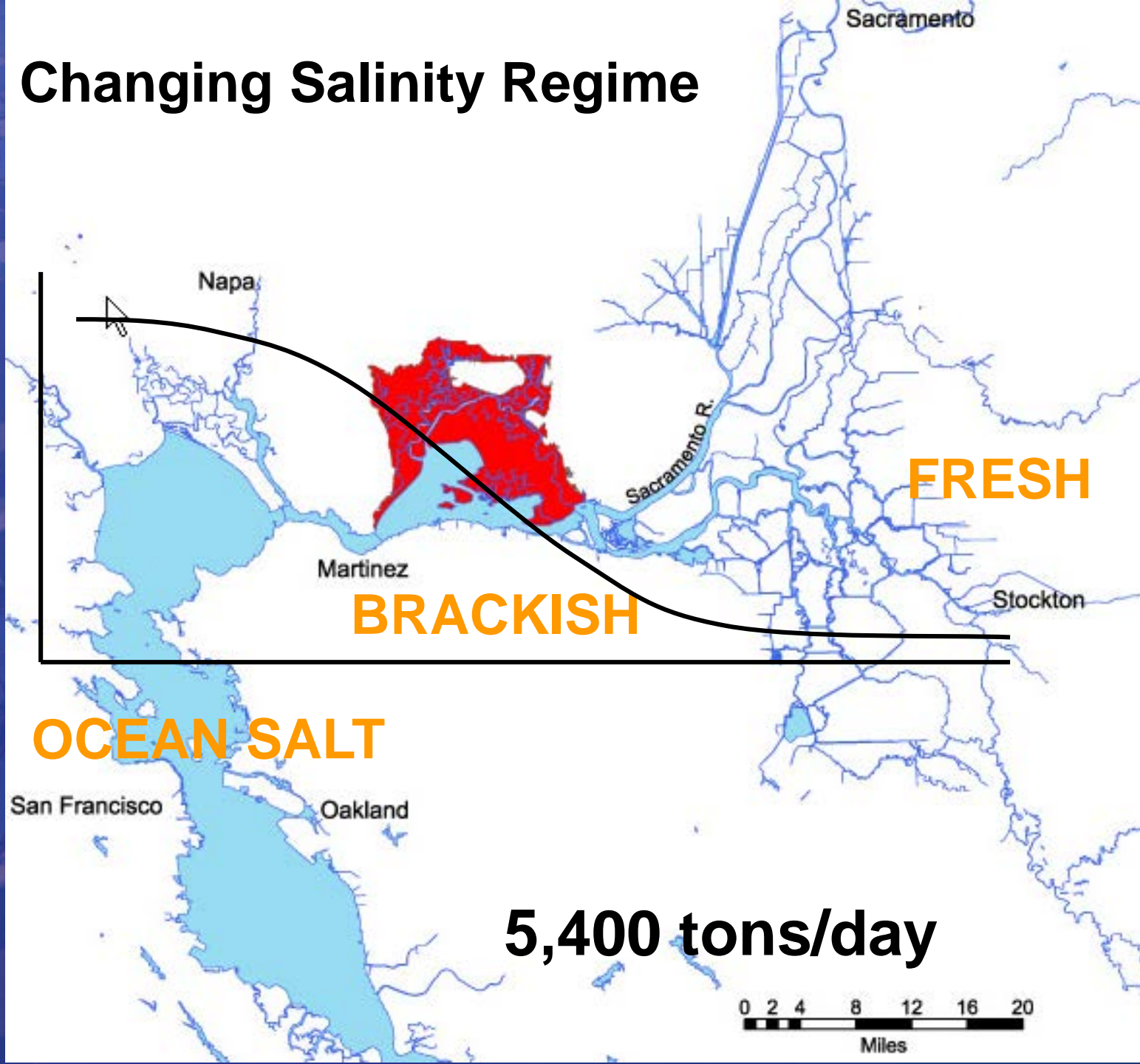


# Changing Salinity Regime

35 ppt

Salinity

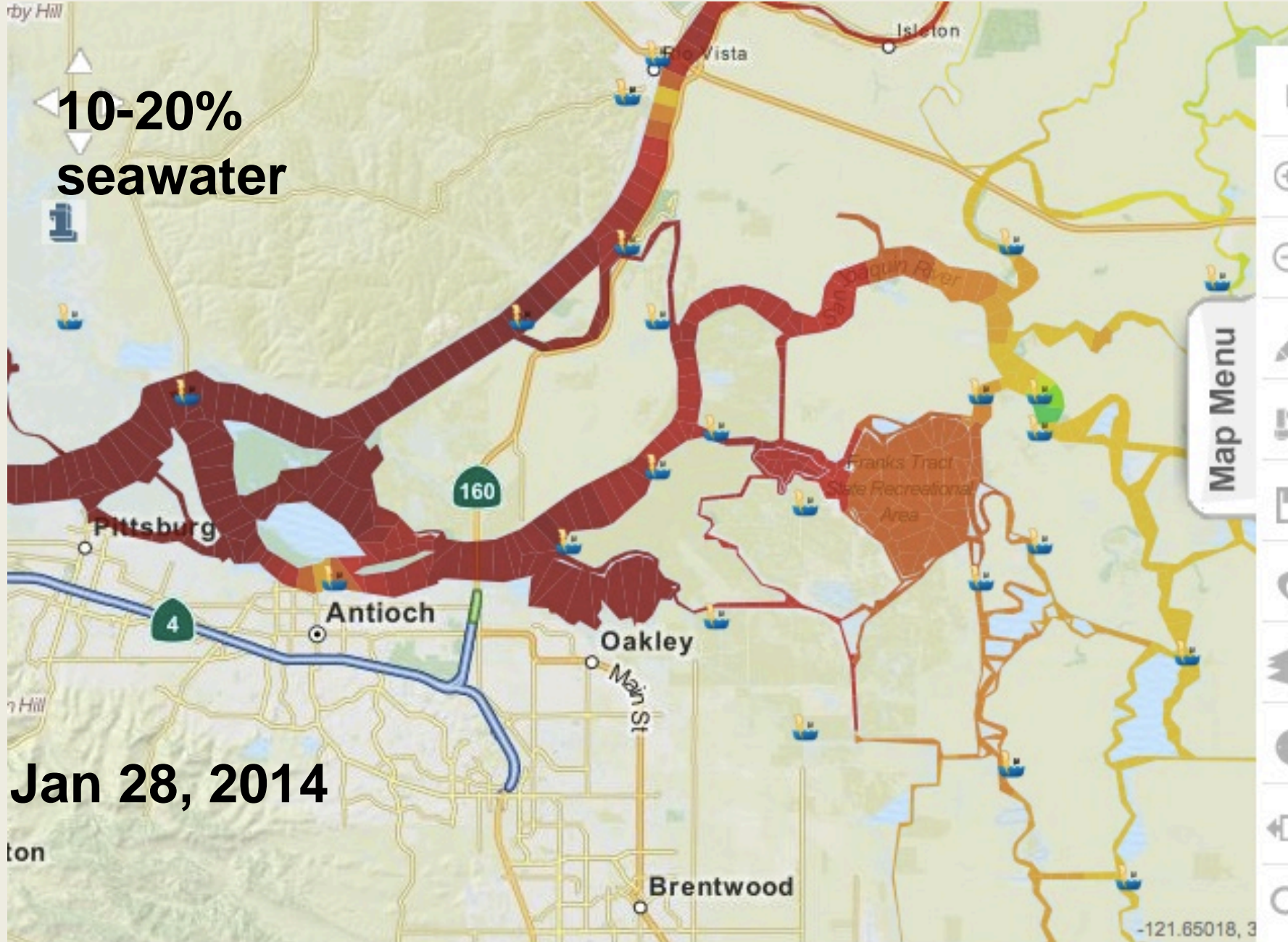
0 ppt



5,400 tons/day

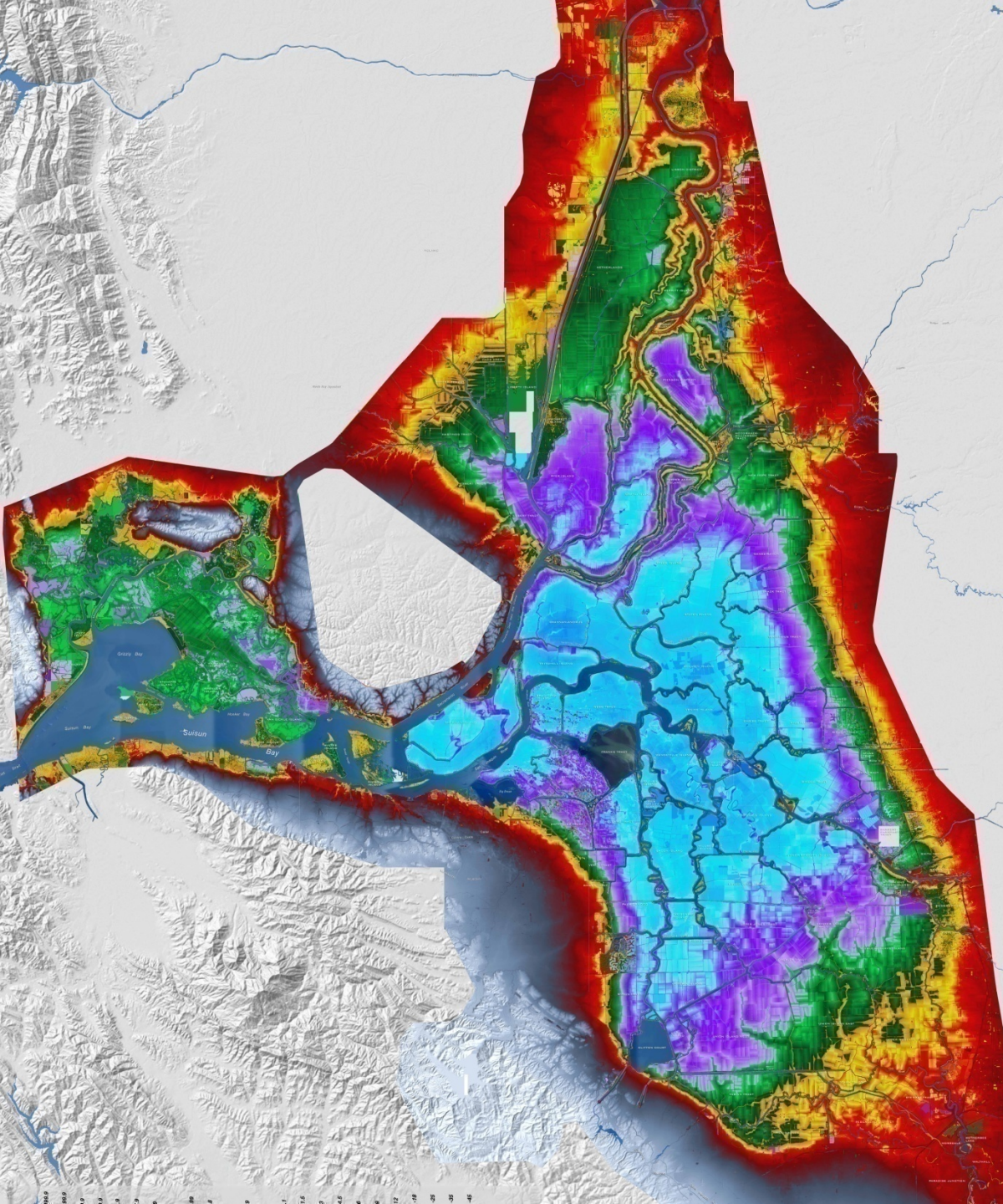


10-20%  
seawater



Jan 28, 2014

0.4 1.9 2.7 3.7 5.2 7.2 10 13.9 19.3 26.8 37.3 51.8 72 100 138.9 193.1 268.3 372.8 517.9 719.7 1000 1389.1 1930.2 2682.3 3727.5 5179.7 196



**12' +  
supratidal  
intertidal**

**0' to -6'  
(Subsidence reversal)**

**-6' to -30'**



1992

**Naturally restored tidal wetlands - Little Holland**

G  
R  
O  
W  
T  
H



Daphnia



Slow it down!

Spread it out!

Grow them up!



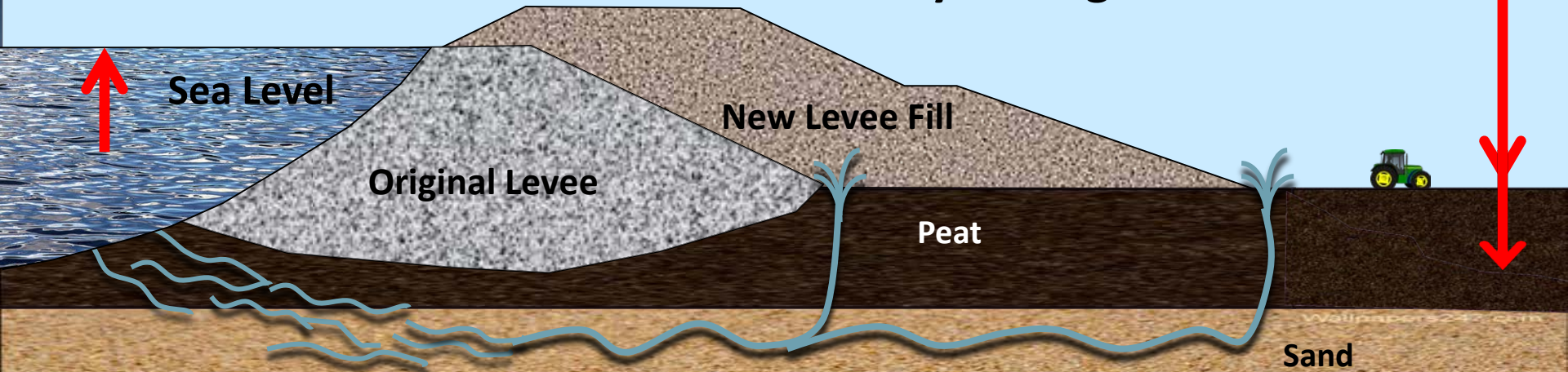
# Summary

A photograph of a sunset over a body of water. The sun is a bright, glowing orb just above the horizon, casting a long, horizontal band of light across the sky. The sky is filled with soft, horizontal clouds. In the foreground, there are dark, silhouetted trees and branches. The water is calm and reflects the light from the sun.

Curt Schmutte

# Continued reliance upon levees doesn't work!

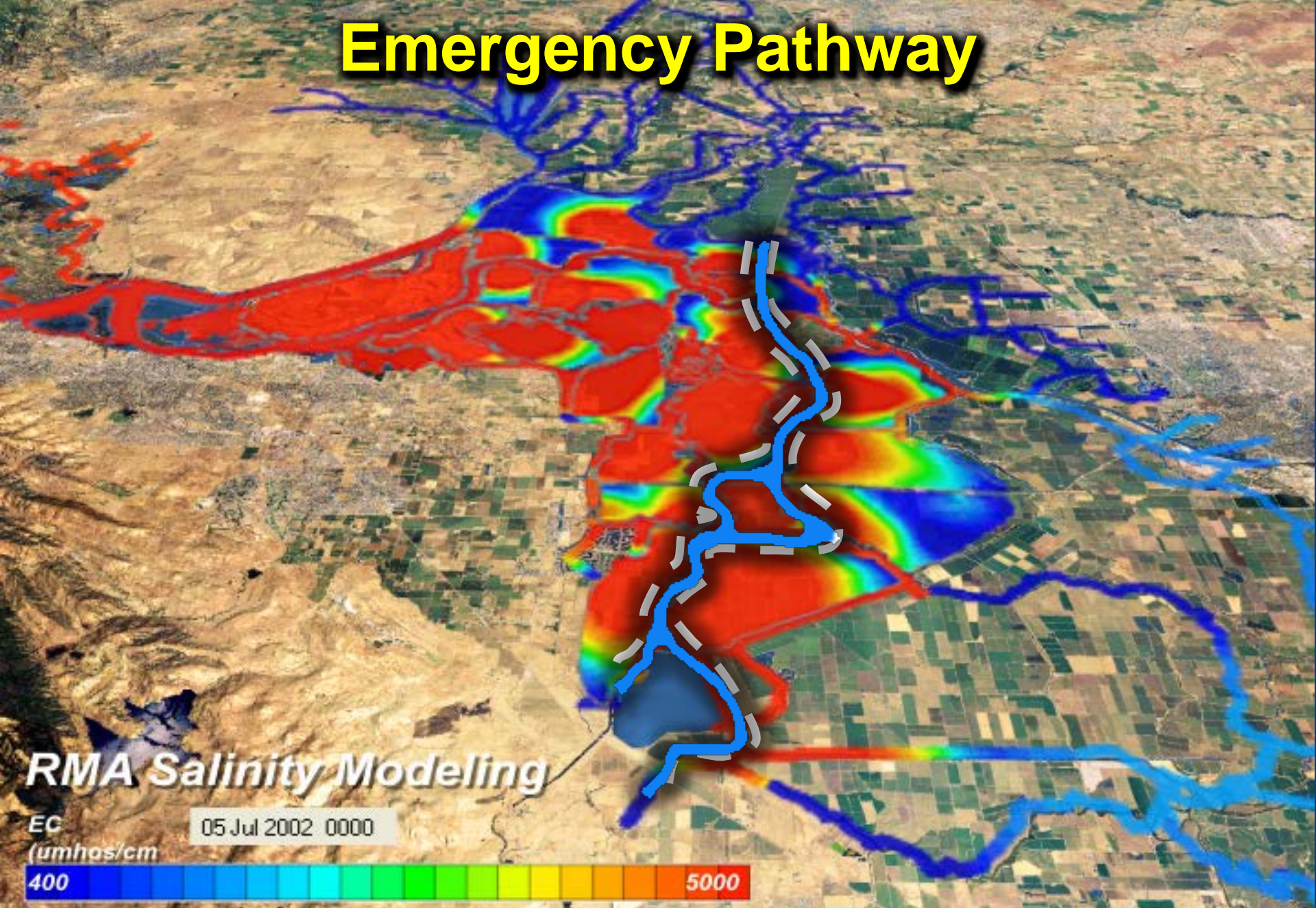
- 1) 34 economically unsustainable
- 2) Seismic risks – comparatively greater
- 3) Sea level rise - salinity intrusion
- 4) Subsidence impacts
- 5) Ecosystem – e.g. Liberty Is
  - Reduces restoration
  - Salinity mixing



## Peat Farming Perpetuates

- Organic loading – THM's
  - CO<sup>2</sup> Emissions
  - Subsidence
- Larger "gulp"
  - Increases forces & costs
  - Increases artesian conditions

# Emergency Pathway



**50** Estimated export resumption within 6-months

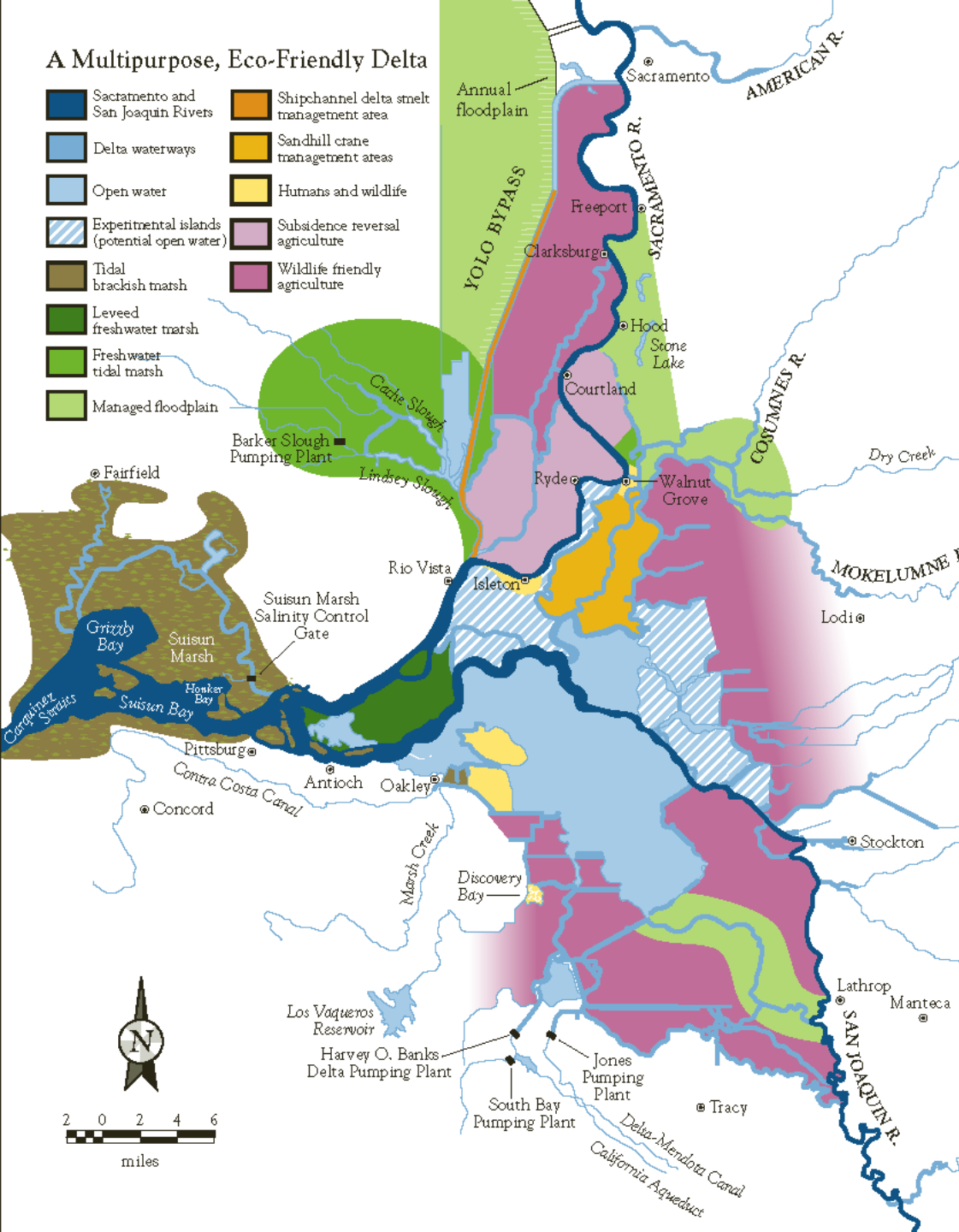
An aerial photograph of a river delta, likely the Sacramento-San Joaquin River Delta. The image shows a complex network of waterways (rivers and canals) branching out from a larger body of water on the left. The land is divided into numerous rectangular parcels, some of which are green (possibly agricultural or forested) and others are brown/tan (possibly bare or irrigated). The background shows a rugged, hilly landscape with some buildings and infrastructure. The text "Plan Form dictate uses" is overlaid in yellow at the top.

**Plan Form dictate uses**

**Proactive  
or  
Reactive**

## A Multipurpose, Eco-Friendly Delta

- |   |   |
|---|---|
| Sacramento and San Joaquin Rivers           | Shipchannel delta snelt management area |
| Delta waterways                             | Sandhill crane management areas         |
| Open water                                  | Humans and wildlife                     |
| Experimental islands (potential open water) | Subsidence reversal agriculture         |
| Tidal brackish marsh                        | Wildlife friendly agriculture           |
| Leveed freshwater marsh                     |   |
| Freshwater tidal marsh                      |   |
| Managed floodplain                          |   |



PPIC

Sustainable  
Delta