

San Francisco Baylands Transition Zones:

Patterns of transformation, migration and resilience



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Overview

- Sea level rise is happening.
- Assessments and decisions are being made.
- Where around the Bay should we prioritizing our efforts?
- How will our Baylands adapt?





UPLAND

Creek

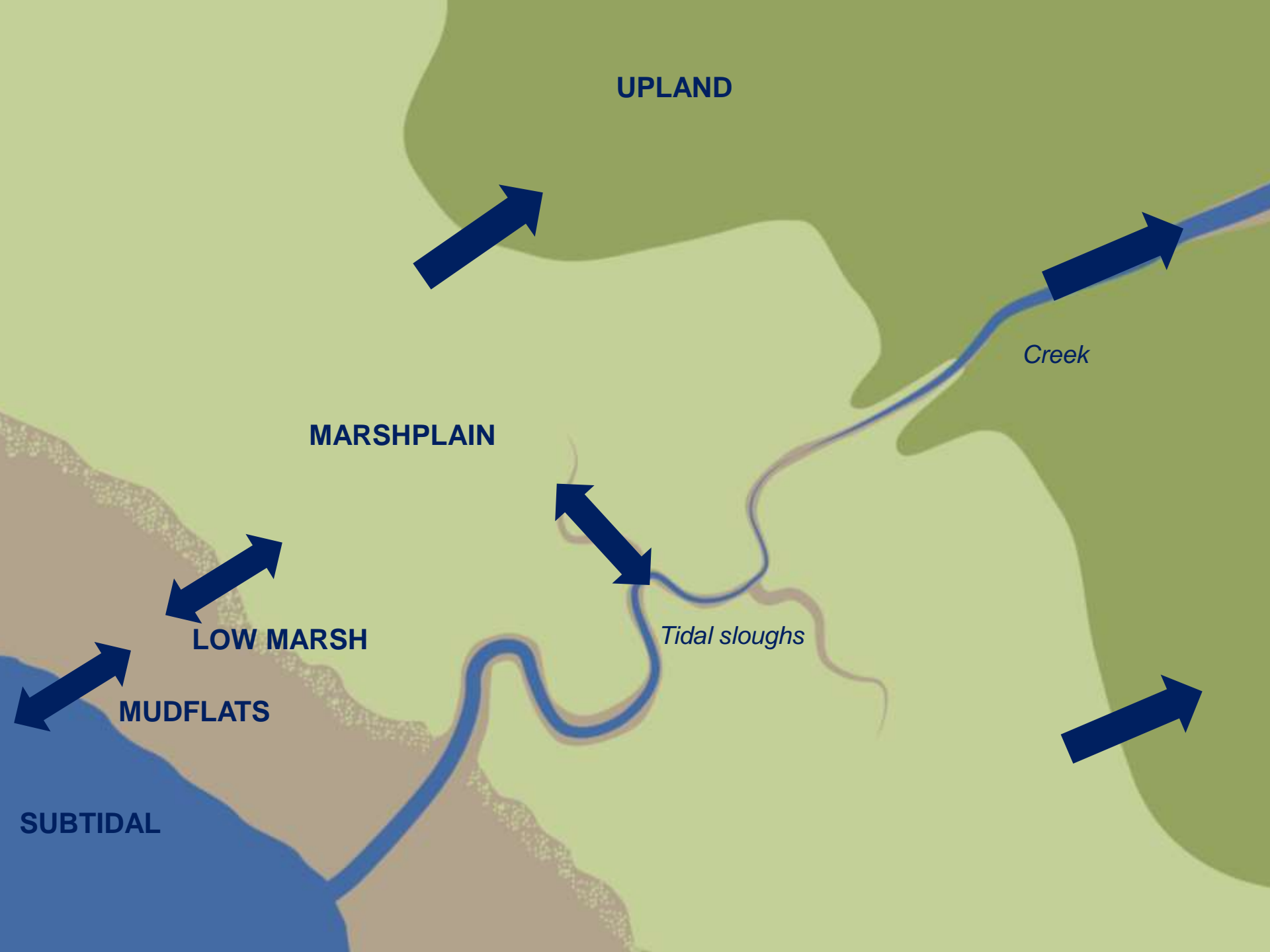
MARSHPLAIN

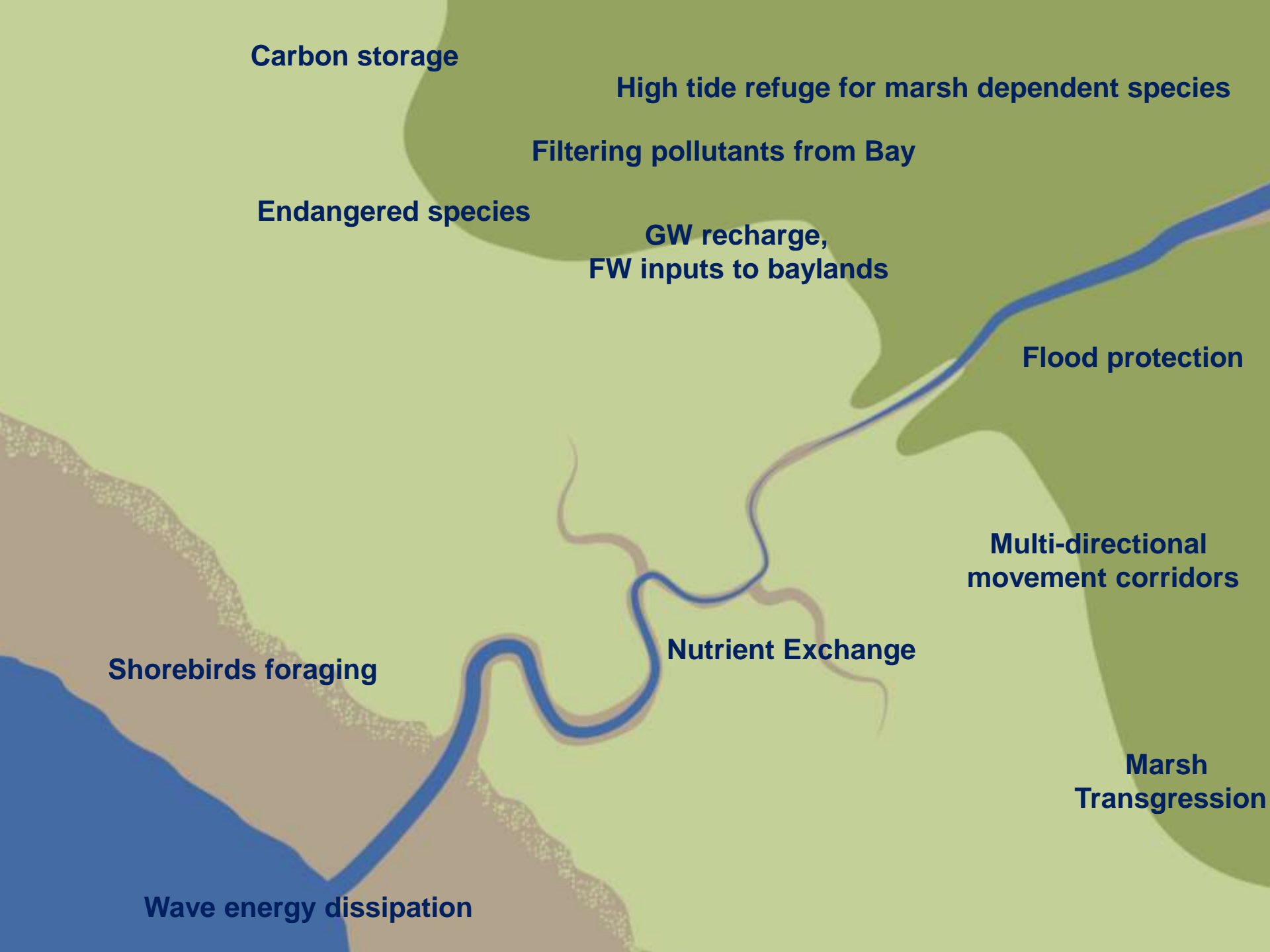
Tidal sloughs

LOW MARSH

MUDFLATS

SUBTIDAL







Bayland Goals Update Regional Recommendations

1 Restore estuary-watershed connections.

2 Design complexity and connectivity into the Baylands landscape.

3 Restore and conserve complete tidal wetlands systems.

4 Restore Baylands to full tidal action prior to 2030.

5 Plan for the Baylands to migrate.

6 Actively recover, conserve, and monitor wildlife populations.

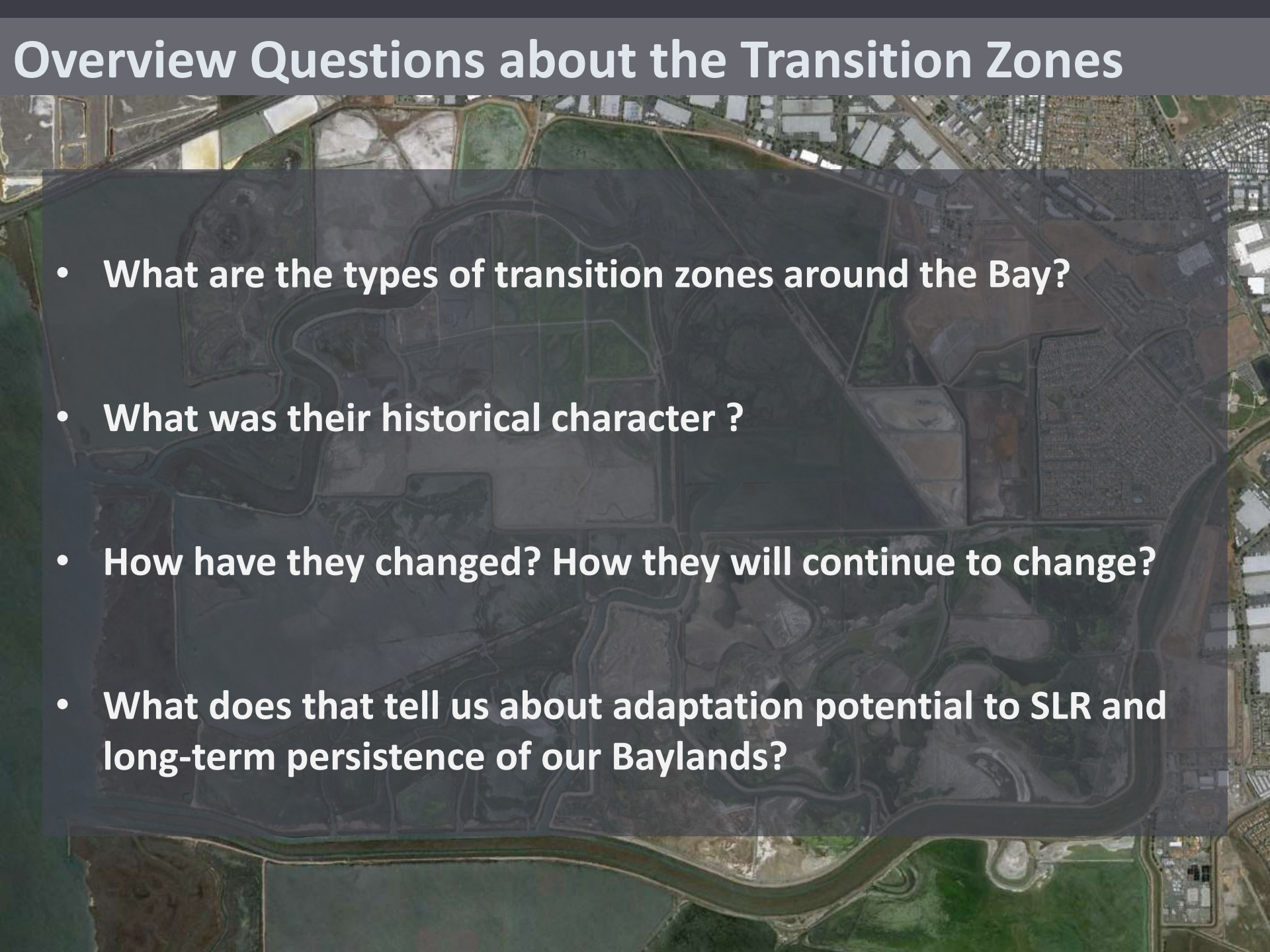
7 Develop and implement a comprehensive regional sediment management plan.

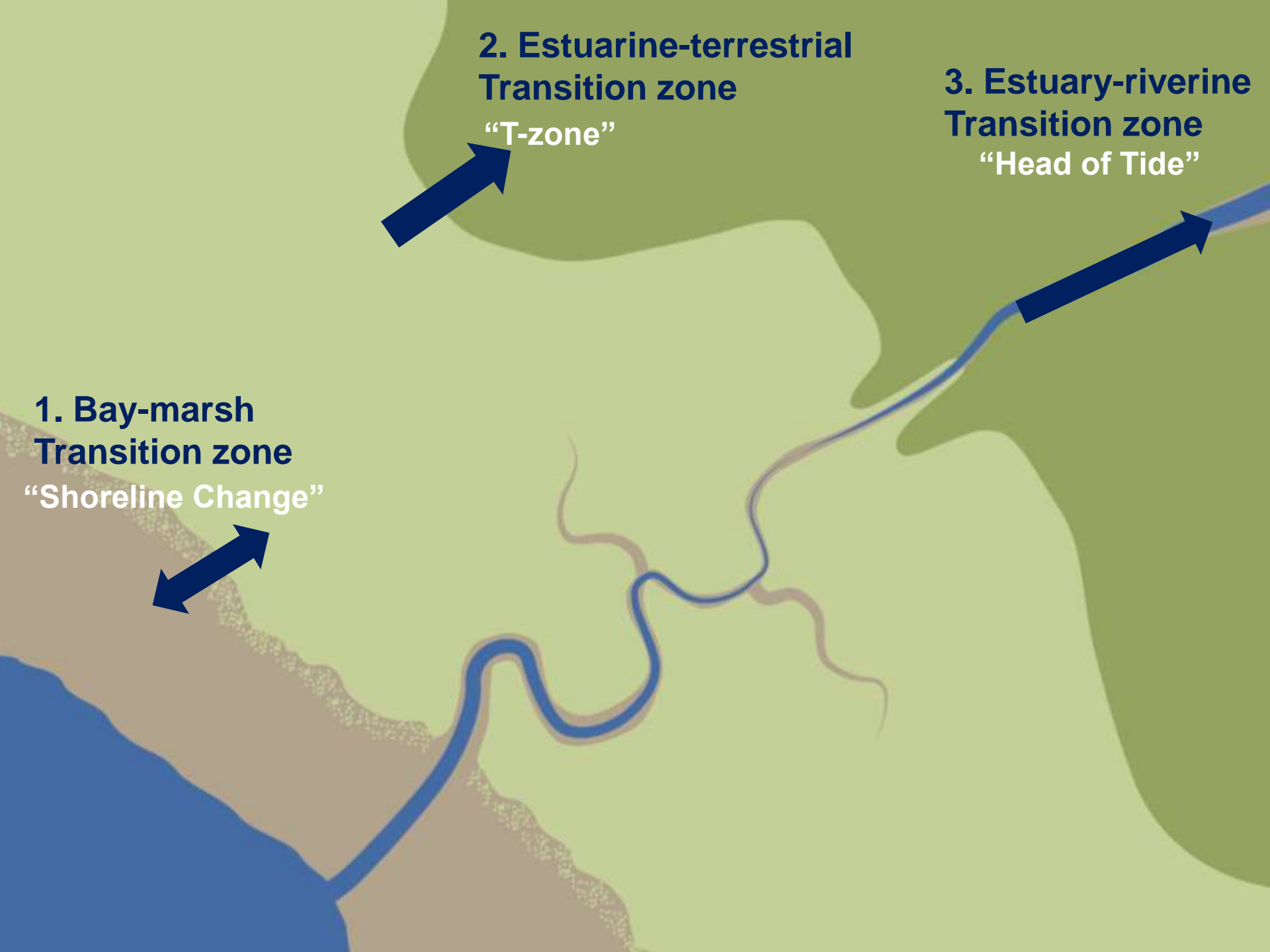
8 Invest in planning, policy, research and monitoring.

9 Develop a regional transition zone assessment program.

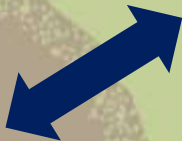
10 Improve carbon management.

Overview Questions about the Transition Zones

- 
- What are the types of transition zones around the Bay?
 - What was their historical character ?
 - How have they changed? How they will continue to change?
 - What does that tell us about adaptation potential to SLR and long-term persistence of our Baylands?



**1. Bay-marsh
Transition zone**



Tidal Marshes c.1855



Tidal Marshes c.2009



Recent shoreline change

2010

0 50 100 Meters

San Pablo Bay

The main image is an aerial photograph of a coastal area. A white line is drawn along the shoreline, with the year '2010' written above it. A scale bar at the bottom left indicates distances of 0, 50, and 100 meters. An inset map in the bottom right corner shows the location of the study area within San Pablo Bay, with a red box highlighting the specific area of interest.

Recent shoreline change

2010

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San Pablo Bay

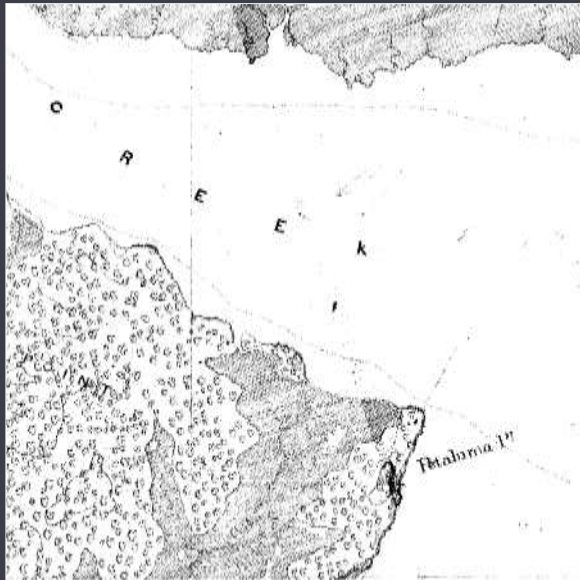
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[illegible]

Why does the shoreline position matter?

- **First line of shoreline protection**
- **Increasing concern about marsh erosion due to sediment deficit**
- **Need to understand where marshes are eroding and where they are expanding (prograding)**
- **Where marshes can persist or migrate with rising sea level? (looking at lateral movement and vertical)**

Mapping methods



1854



1993



2009/10

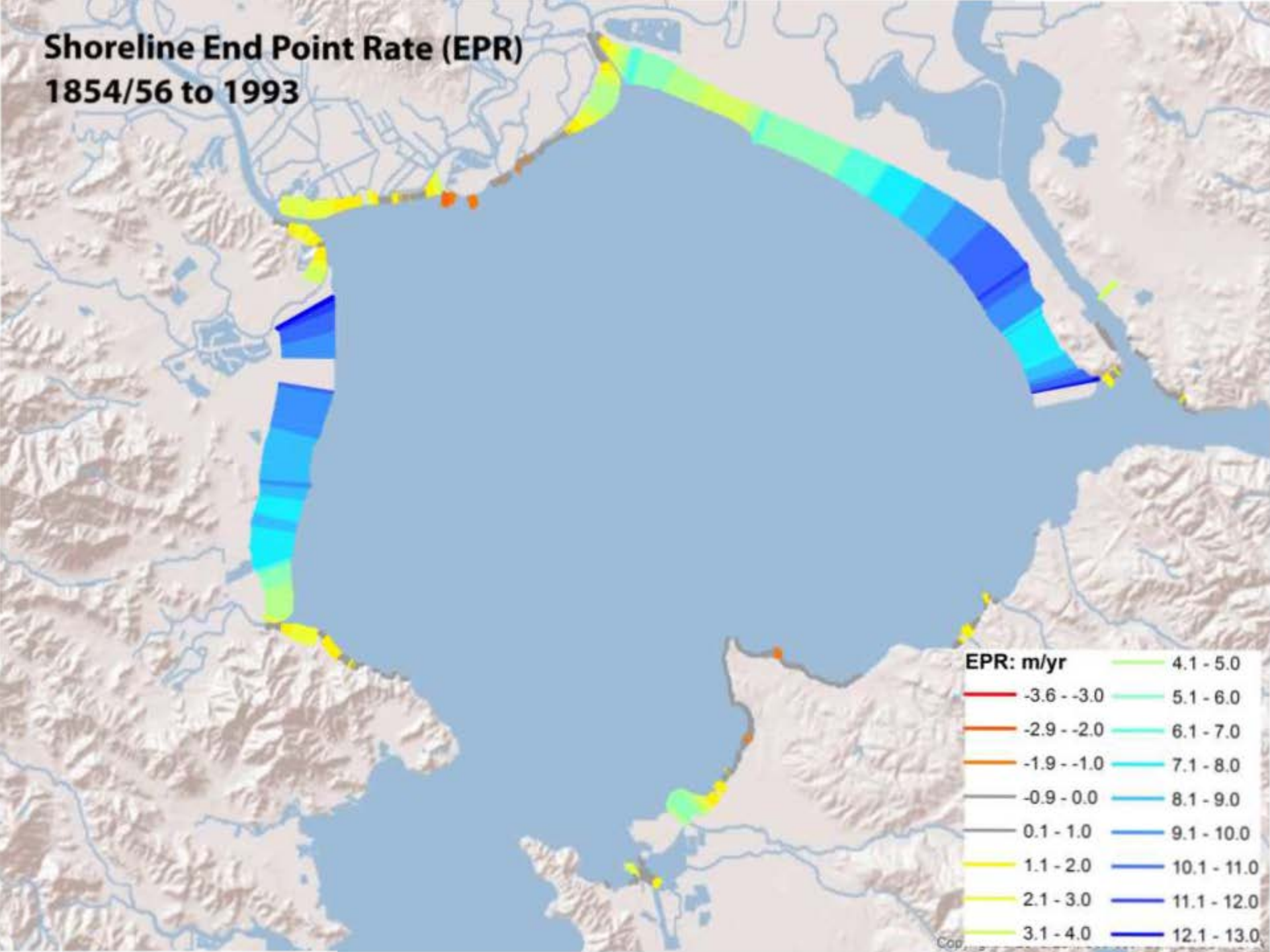
Long term

Short term

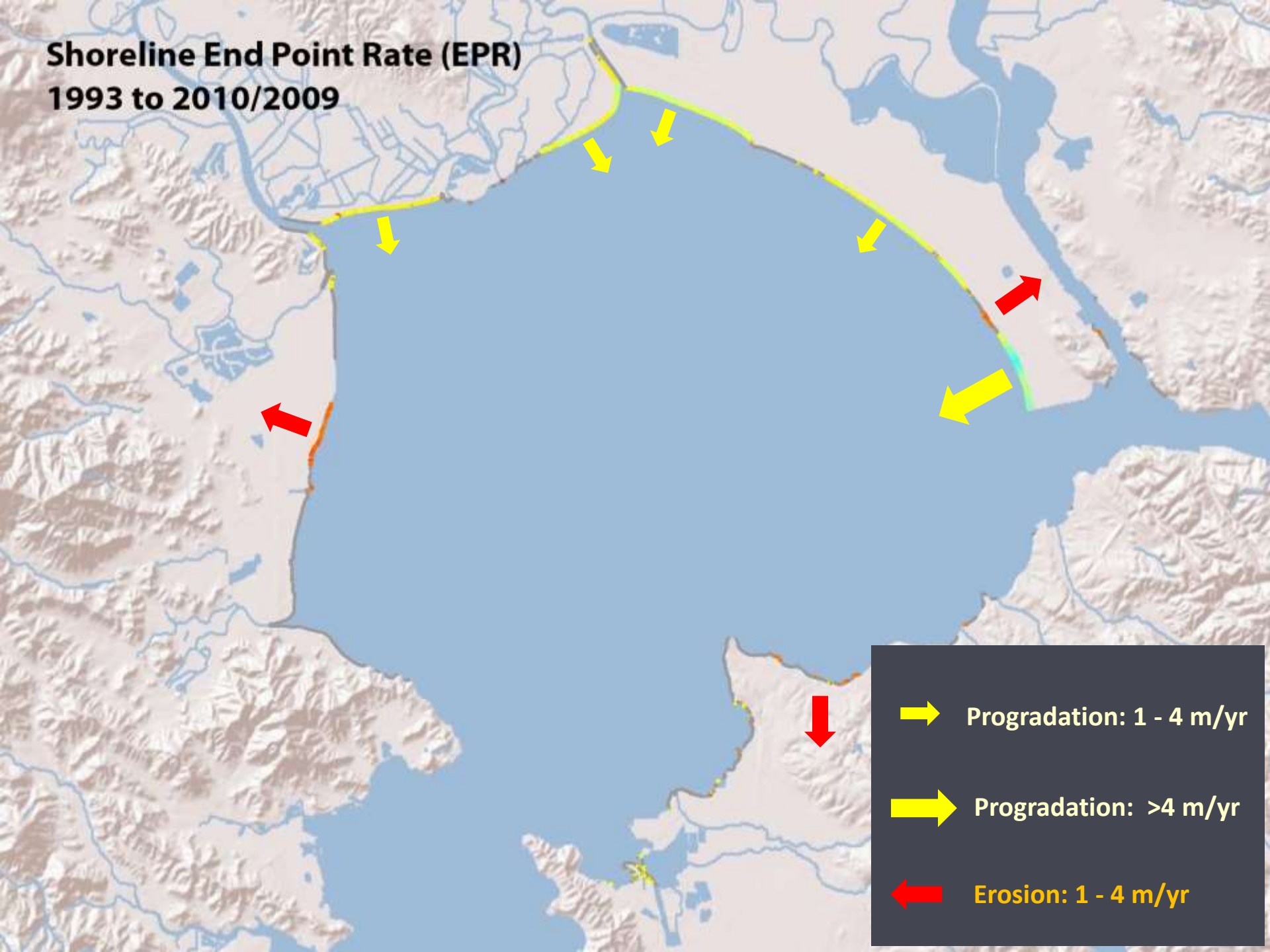
Field validation



Shoreline End Point Rate (EPR) 1854/56 to 1993



**Shoreline End Point Rate (EPR)
1993 to 2010/2009**

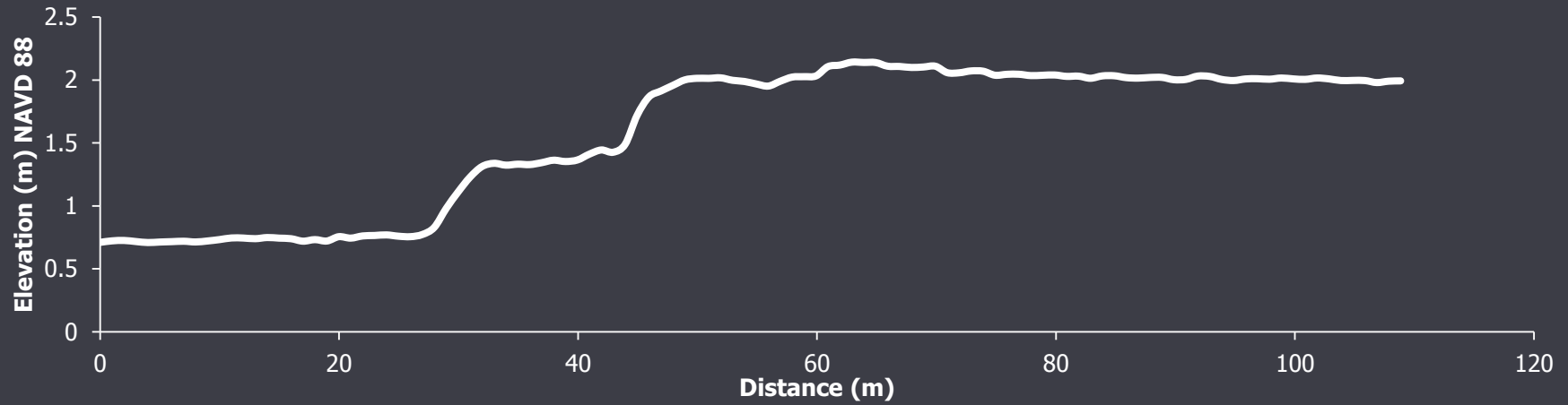


Yellow arrow Progradation: 1 - 4 m/yr

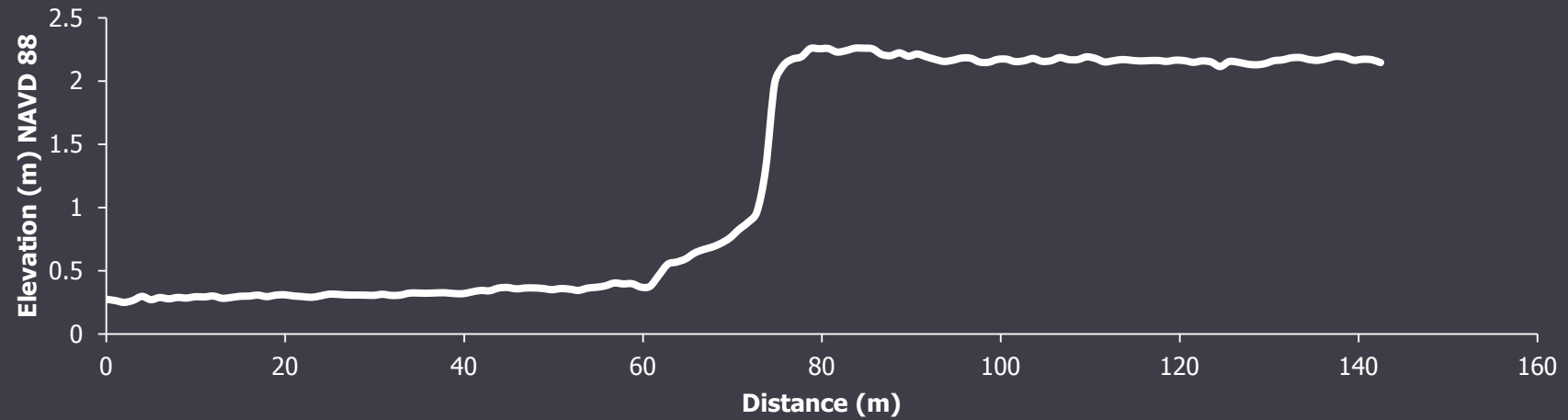
Thick yellow arrow Progradation: >4 m/yr

Red arrow Erosion: 1 - 4 m/yr

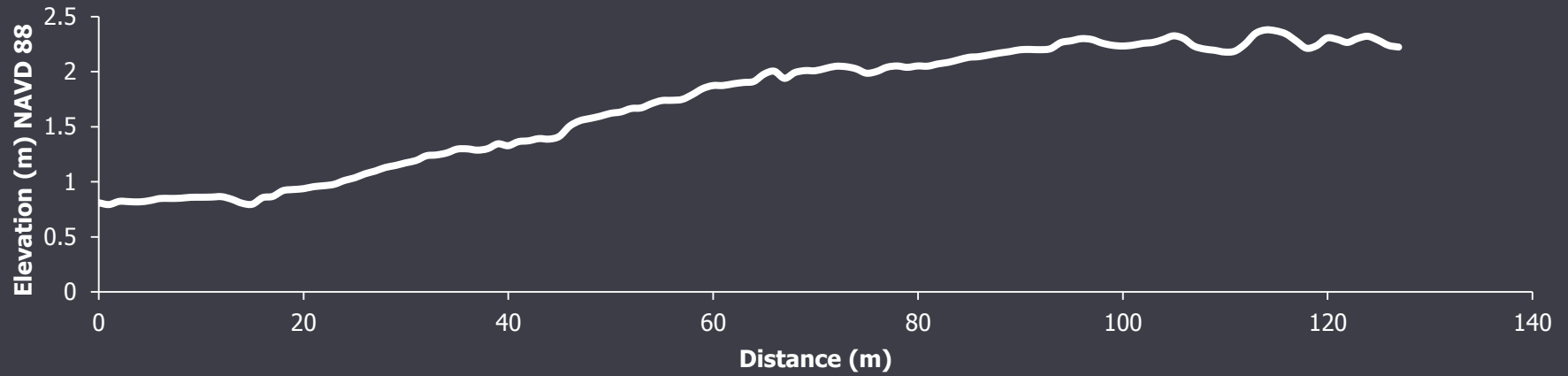
Typologies: Double bench



Typologies: Bluffs



Typologies: Ramps



Bay Marsh transition zone typologies





- 1855 shoreline
- 1855 Beach
- 2010 shoreline

Eroding marsh shoreline
1993-2010

Marsh showing no change 1993-2010
Narrow beach



Aramburu Island, Richardson Bay, Marin County



Pre-project
shoreline erosion:

2.9 ft/yr



Post-project
shoreline
stabilization:

- Oystercatcher breeding 2014
- Western snowy plover 2014

2. Estuarine-terrestrial Transition zone

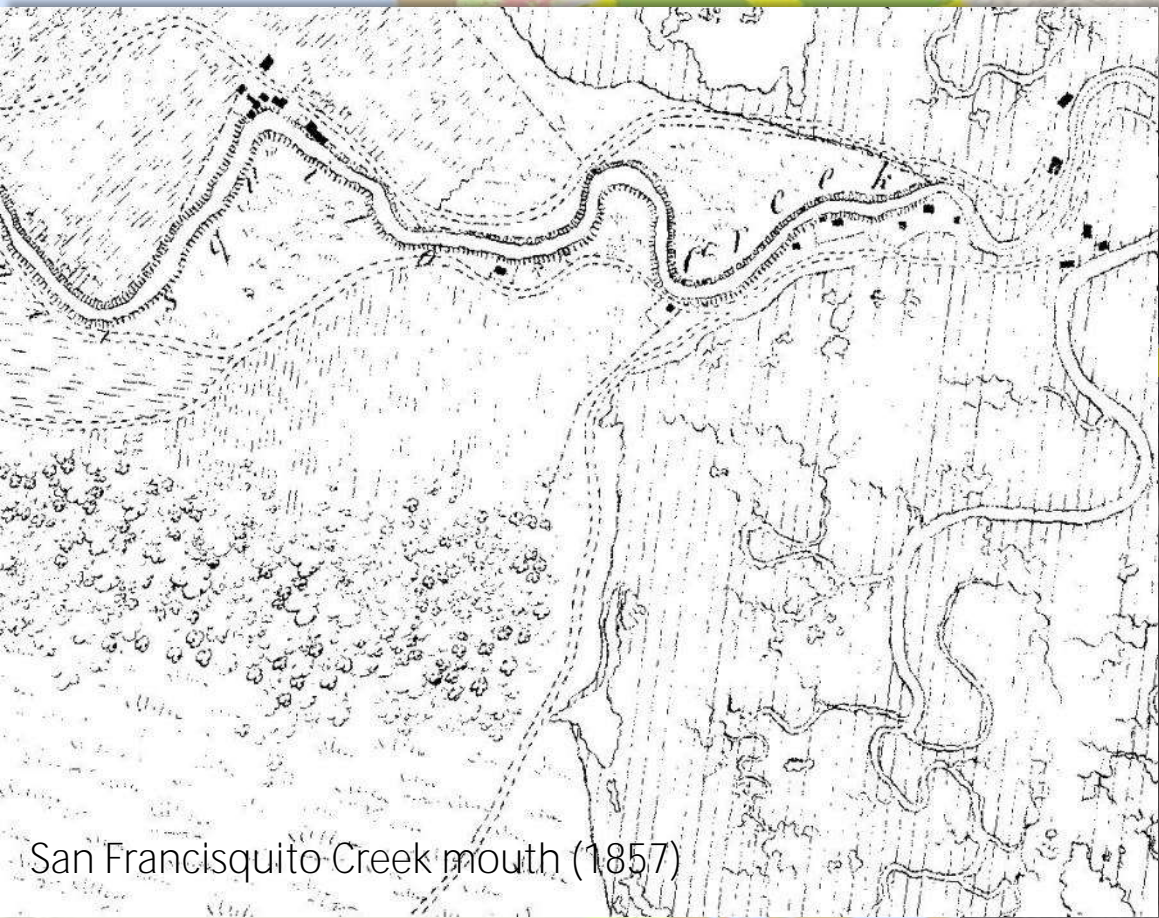
“T-zone”



Why does the T-zone matter?

- Critical zone for marsh transgression
- Largely missing part of the tidal marsh landscape (<99%)
- Major ongoing efforts considering T-zone restoration
- Little information about what T-zones looked like historically

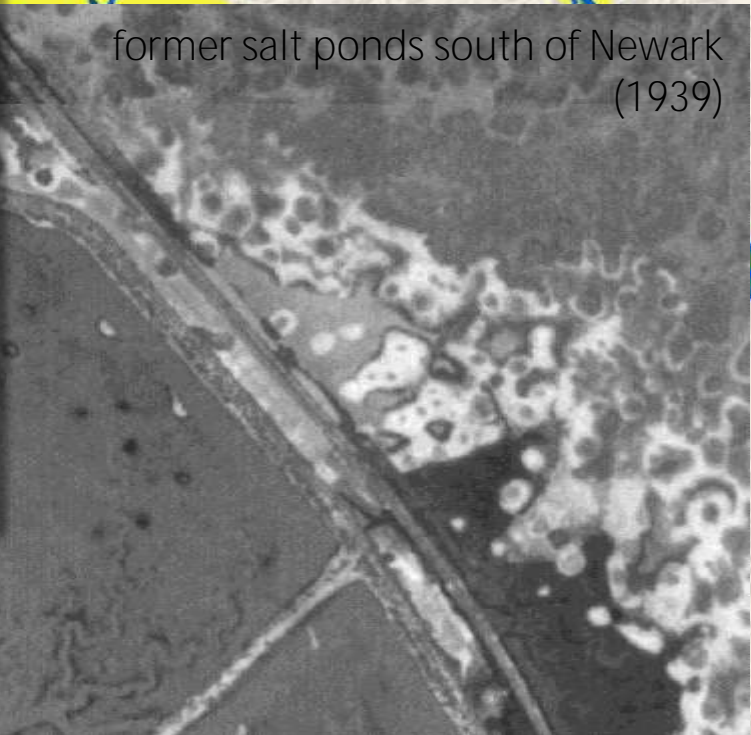
What estuarine and terrestrial habitat types comprised the South Bay T-zone?



San Francisco Creek mouth (1857)



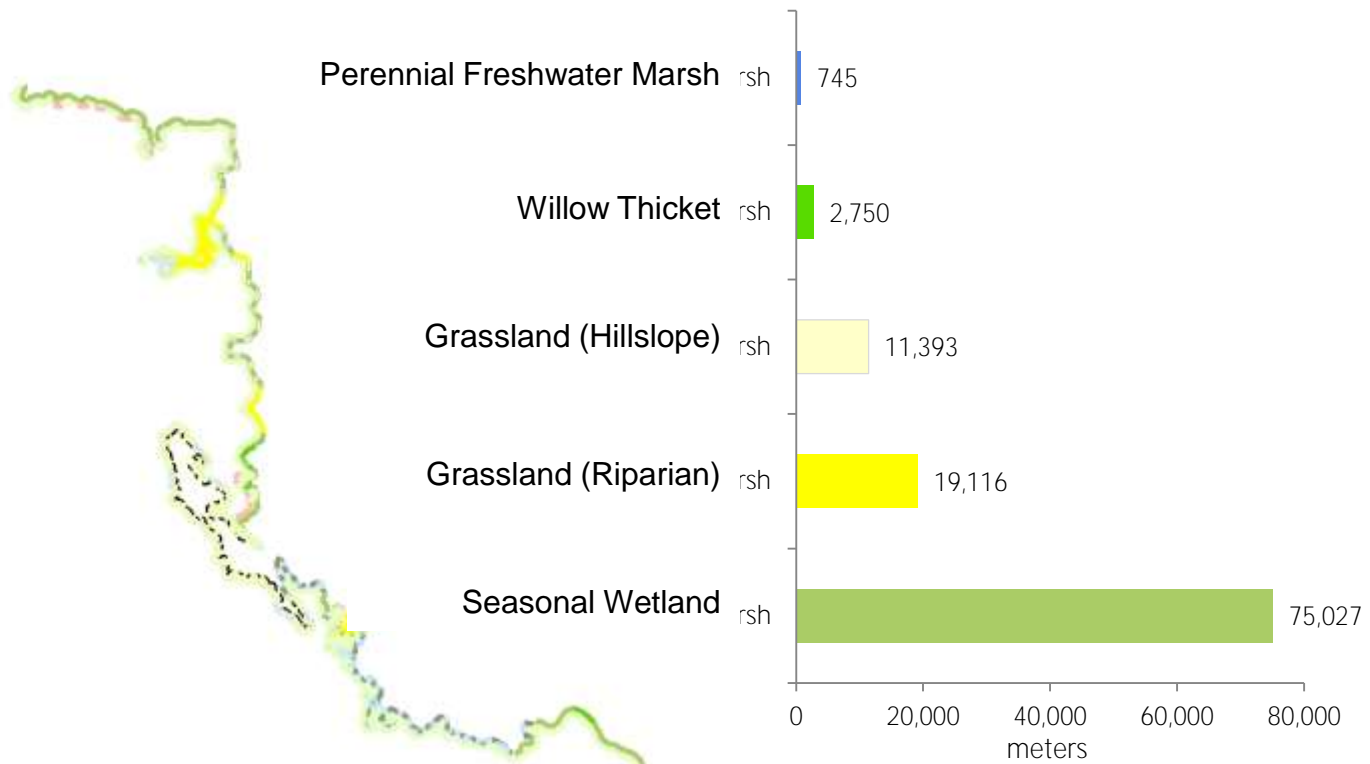
Coyote Hills (1916)



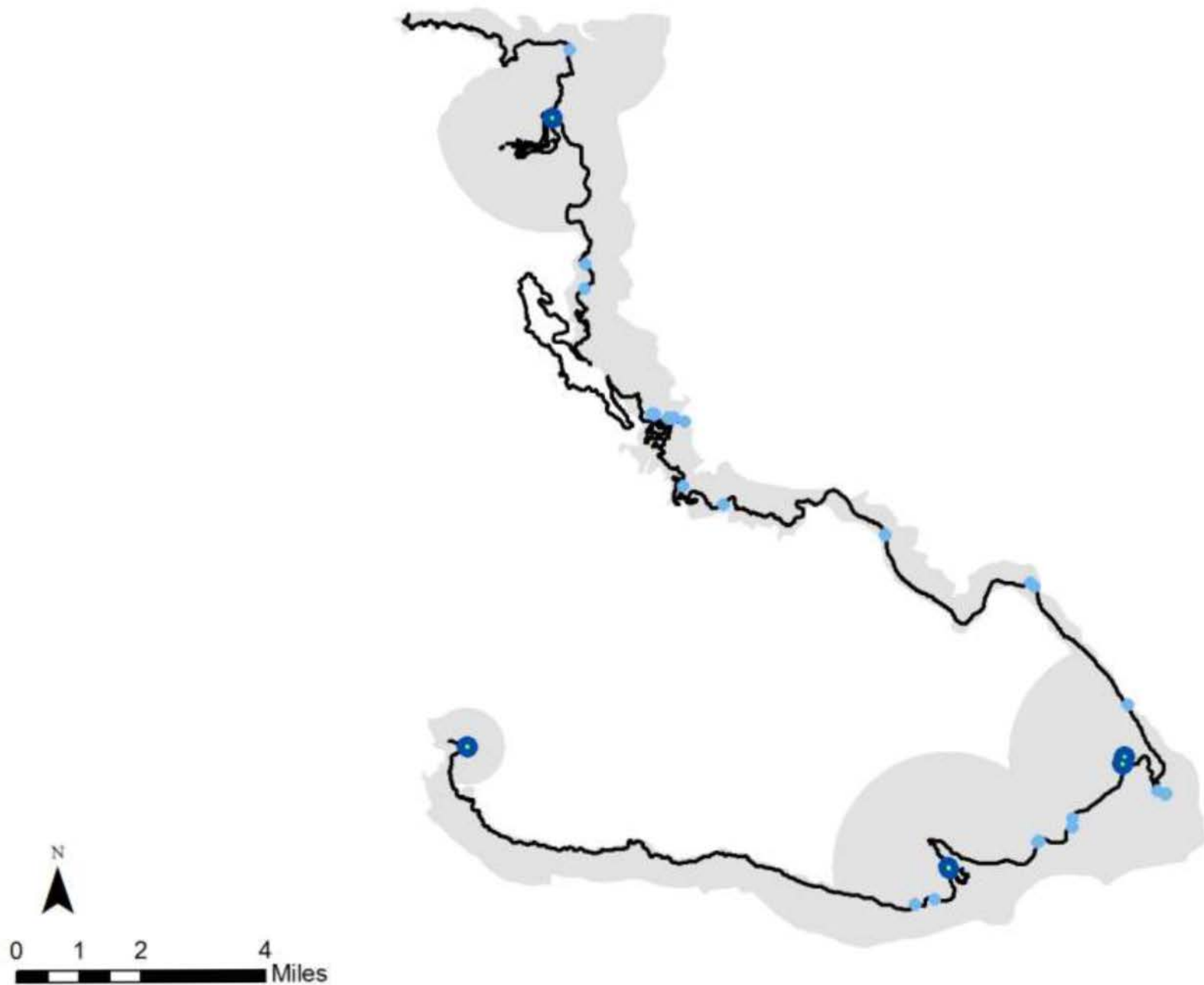
former salt ponds south of Newark (1939)



South Bay, ca. 1850

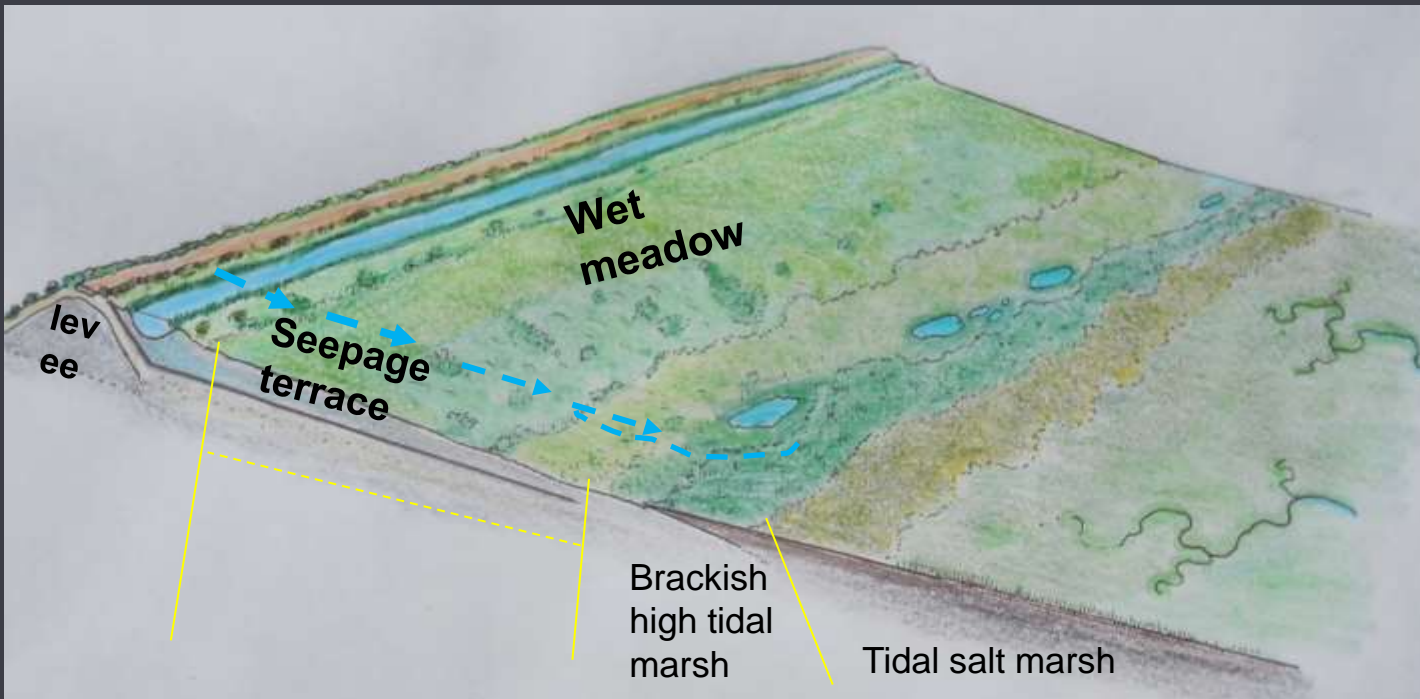


How broad was the estuarine-terrestrial T-zone across the South Bay?



Horizontal Levee: Prototype seepage levee

- Constructed urban-edge ecotone, multi-purpose wetland
- Water quality treatment, subsurface discharge
- Sea level rise accommodation space, high tide refuge
- Brackish back-marsh ecotone – high native species diversity



Broad sloping platform
for estuarine
transgression (30:1 or >)

Freshwater seepage buffers
high marsh hypersalinity
during droughts

Example at Eden Landing (STB)



Summer 2011

Courtesy of Donna Ball (STB)

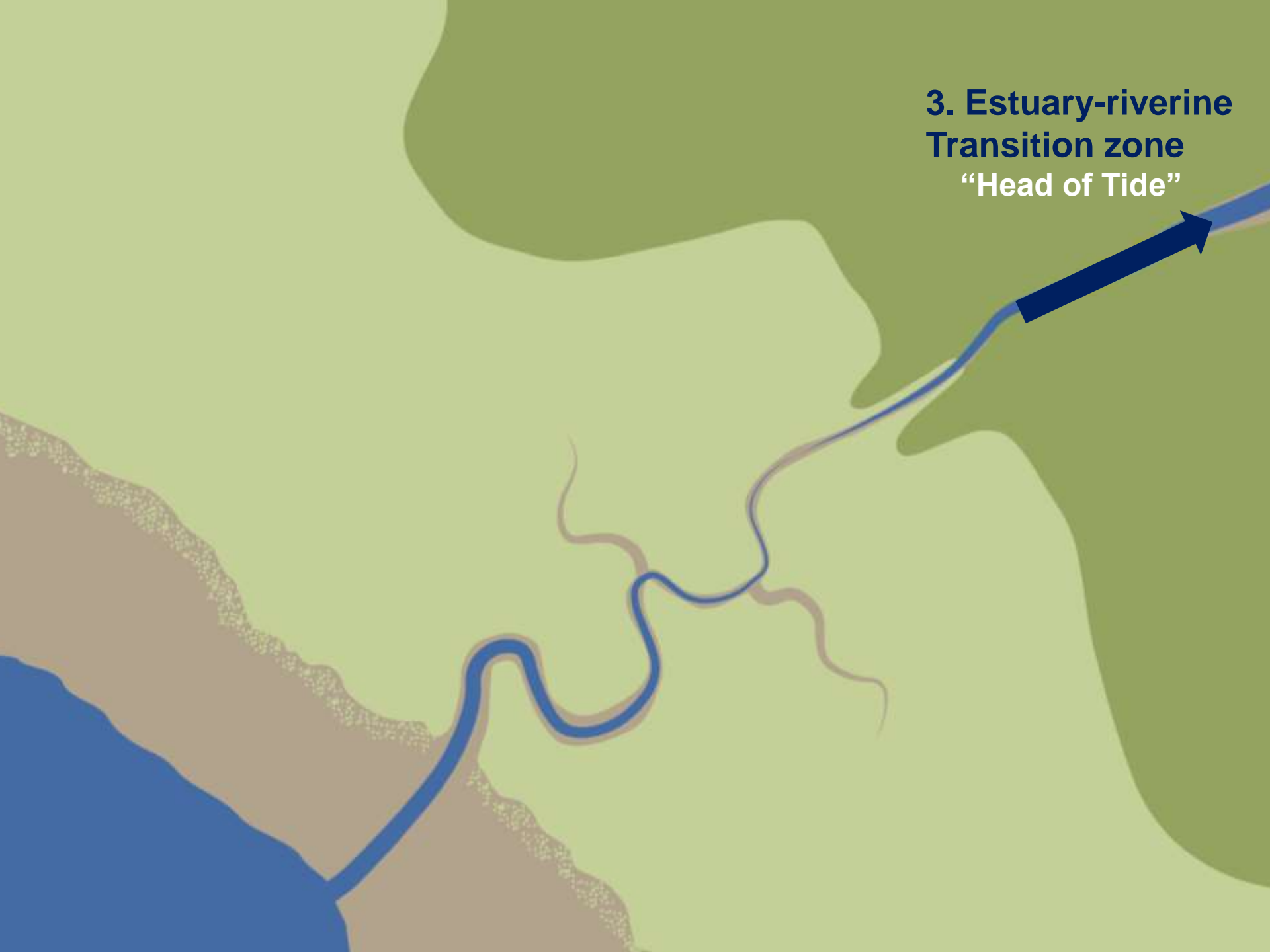
Example at Eden Landing (STB)



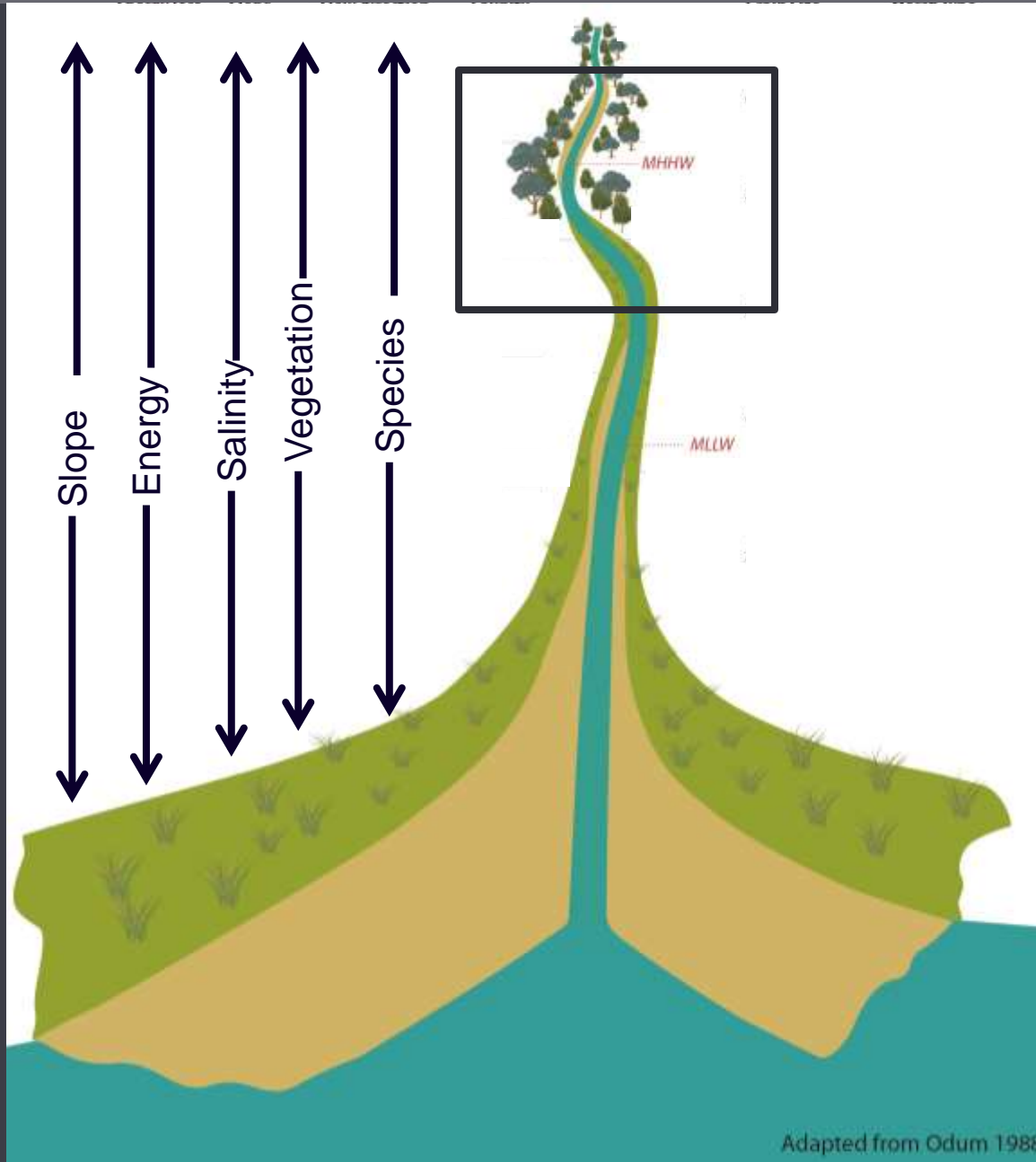
Summer 2013

Courtesy of Donna Ball (STB)

**3. Estuary-riverine
Transition zone**
“Head of Tide”



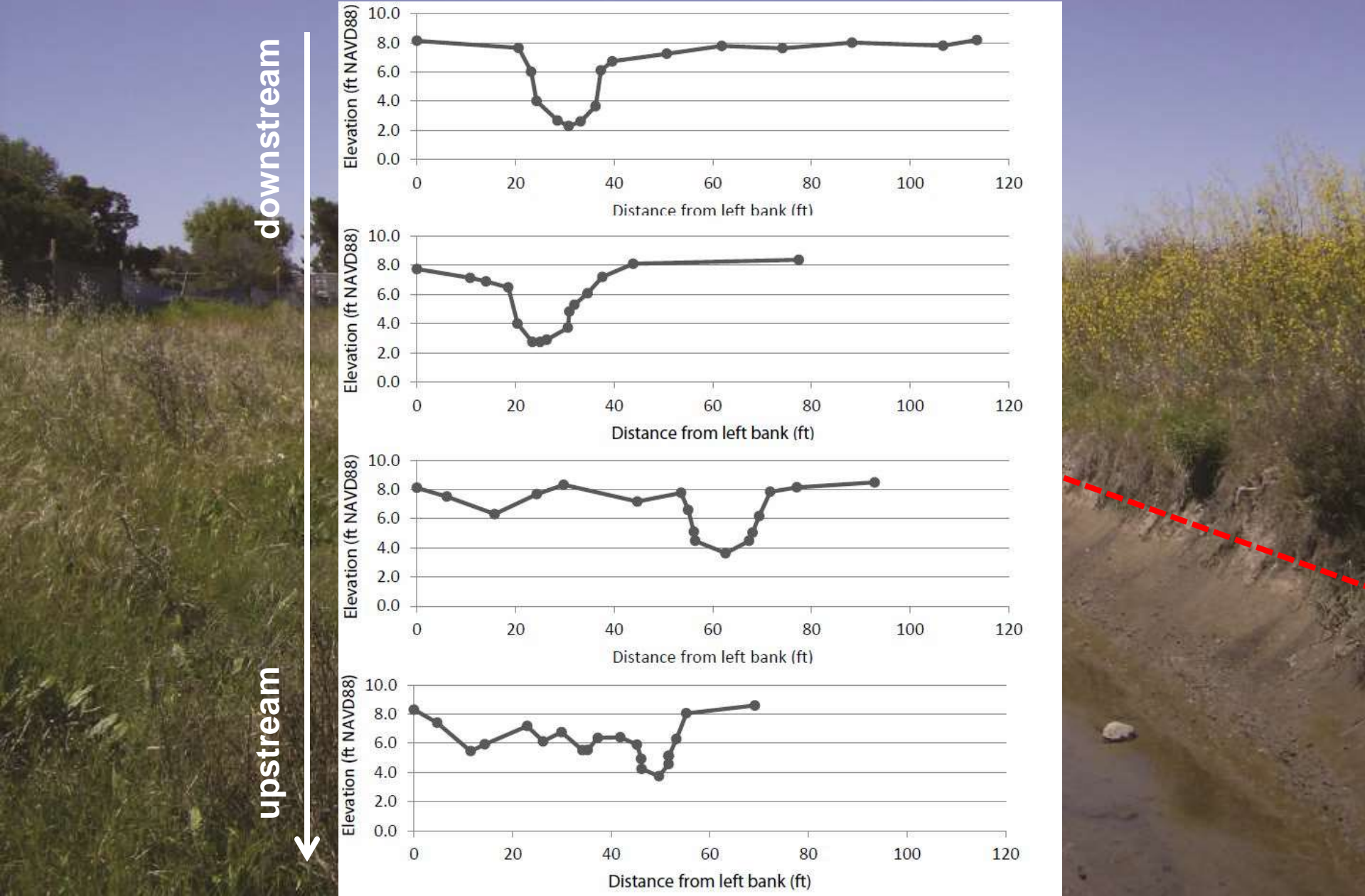
Head of Tide pilot study



Why does Head of Tide Matter?

- Sea level rise may cause HOT zone to move upstream (or compress) causing flooding, jeopardizing resources, habitat.
- There is no regional map of the existing HOT zones.
- No regional sense of where the zone is likely to migrate with sea level rise.

Indicators of Head of Tide

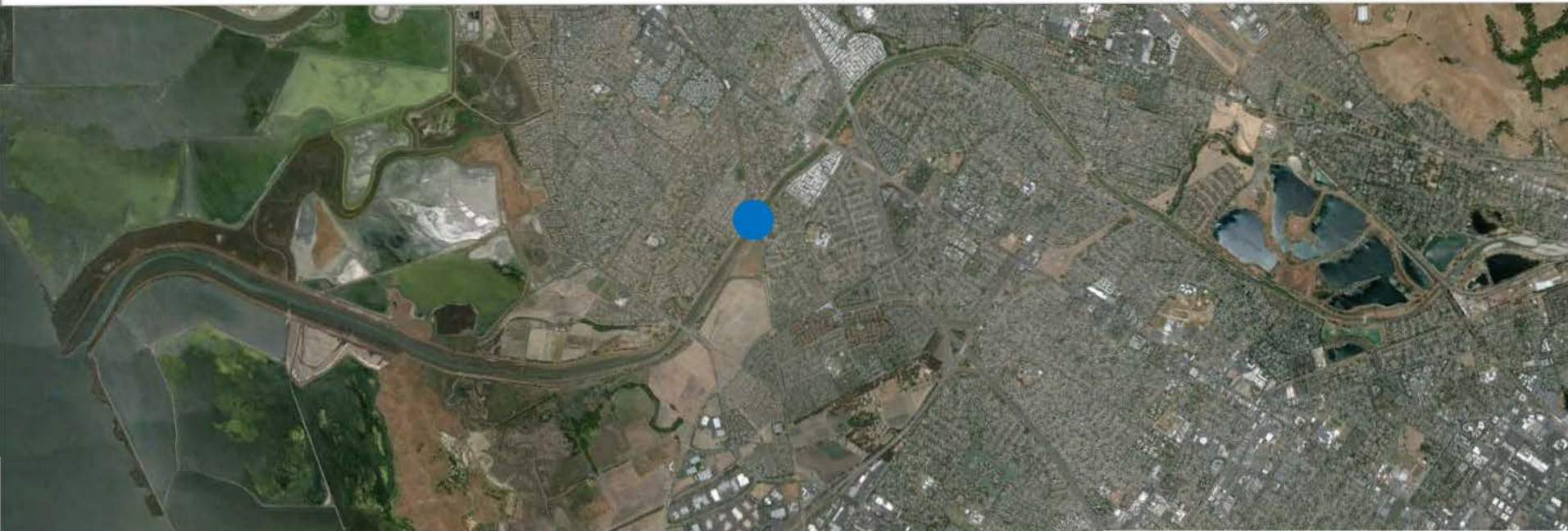
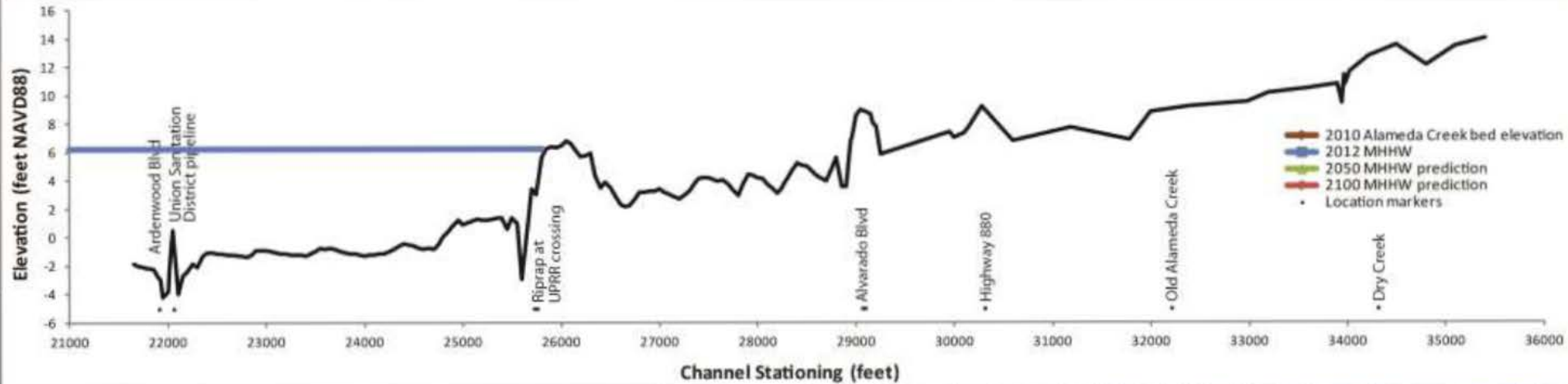


Indicators of Head of Tide



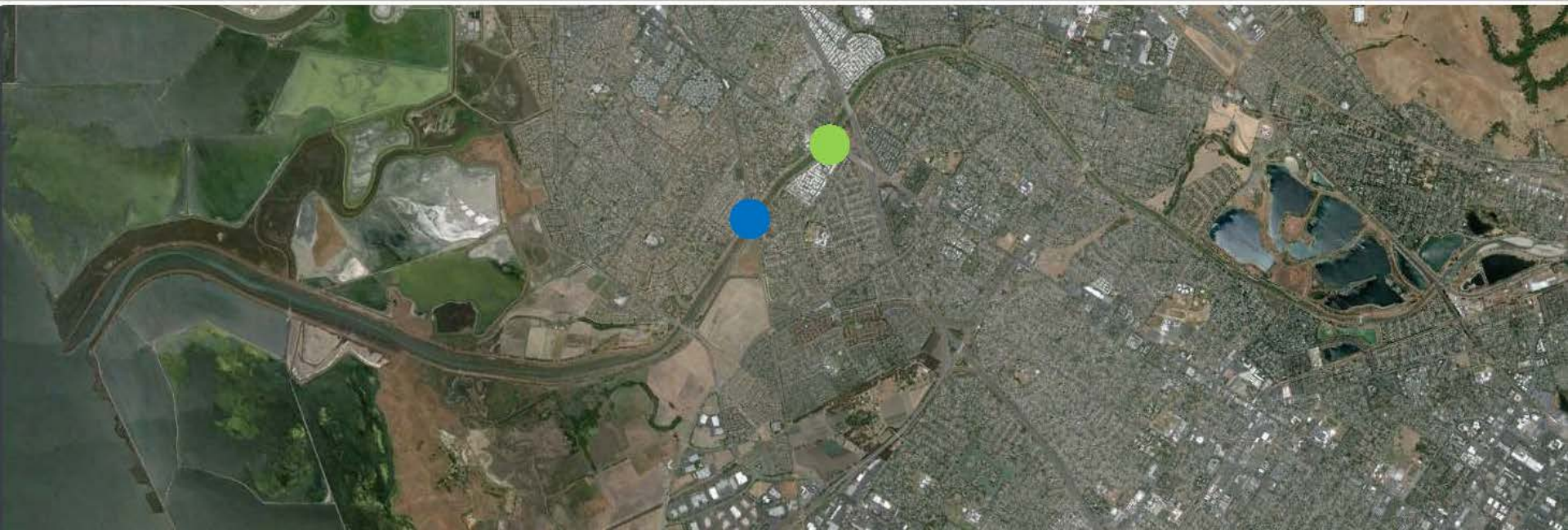
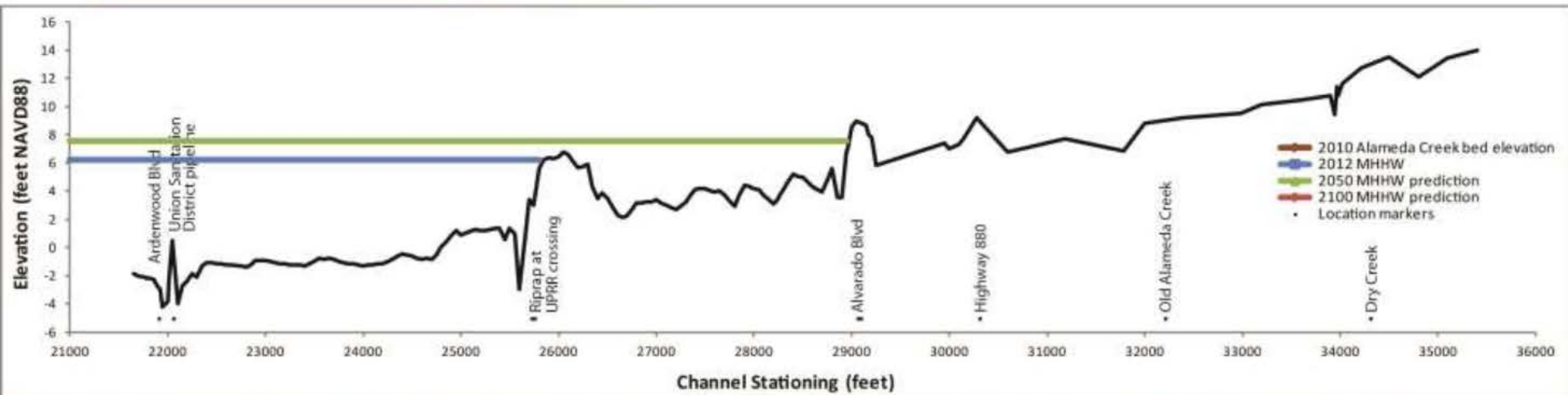
HOT migration with sea level rise

Current zone of tidal influence



2050 zone of tidal influence

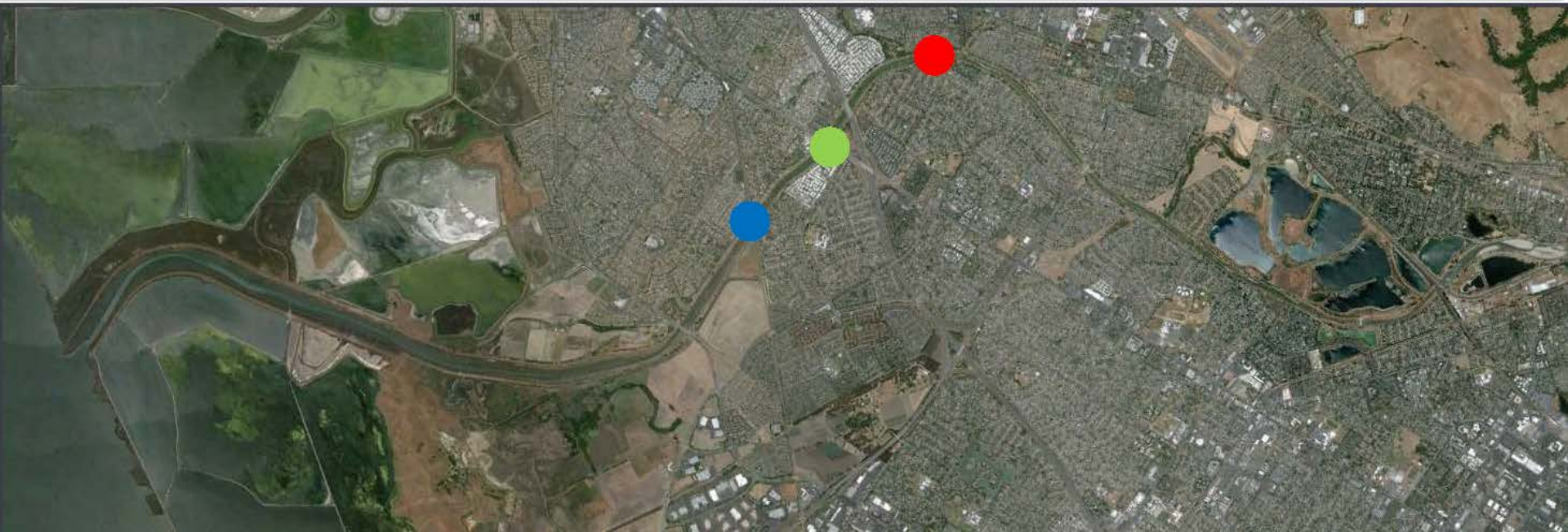
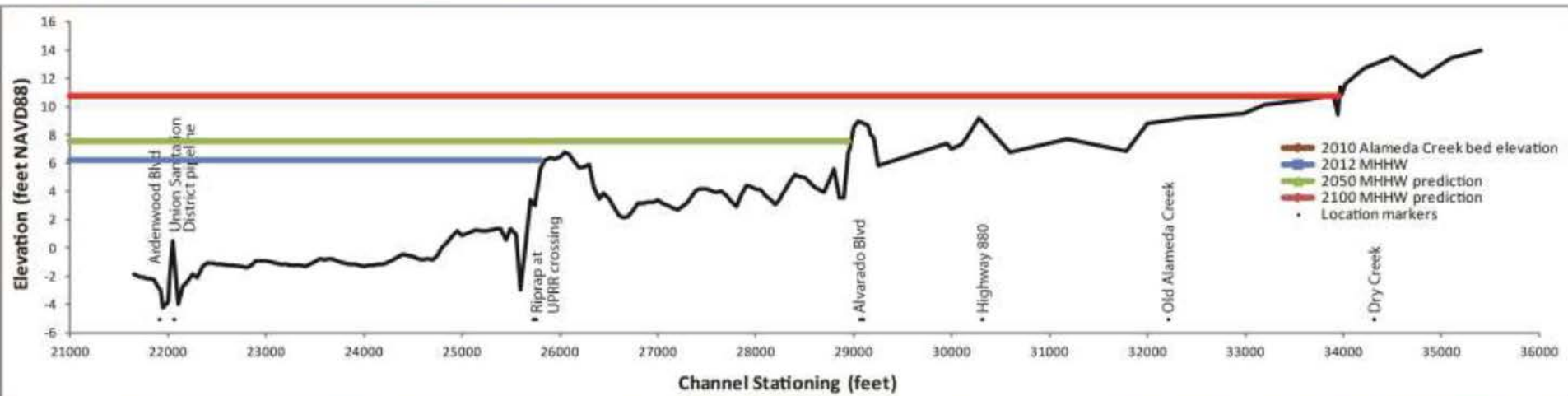
Current zone of tidal influence

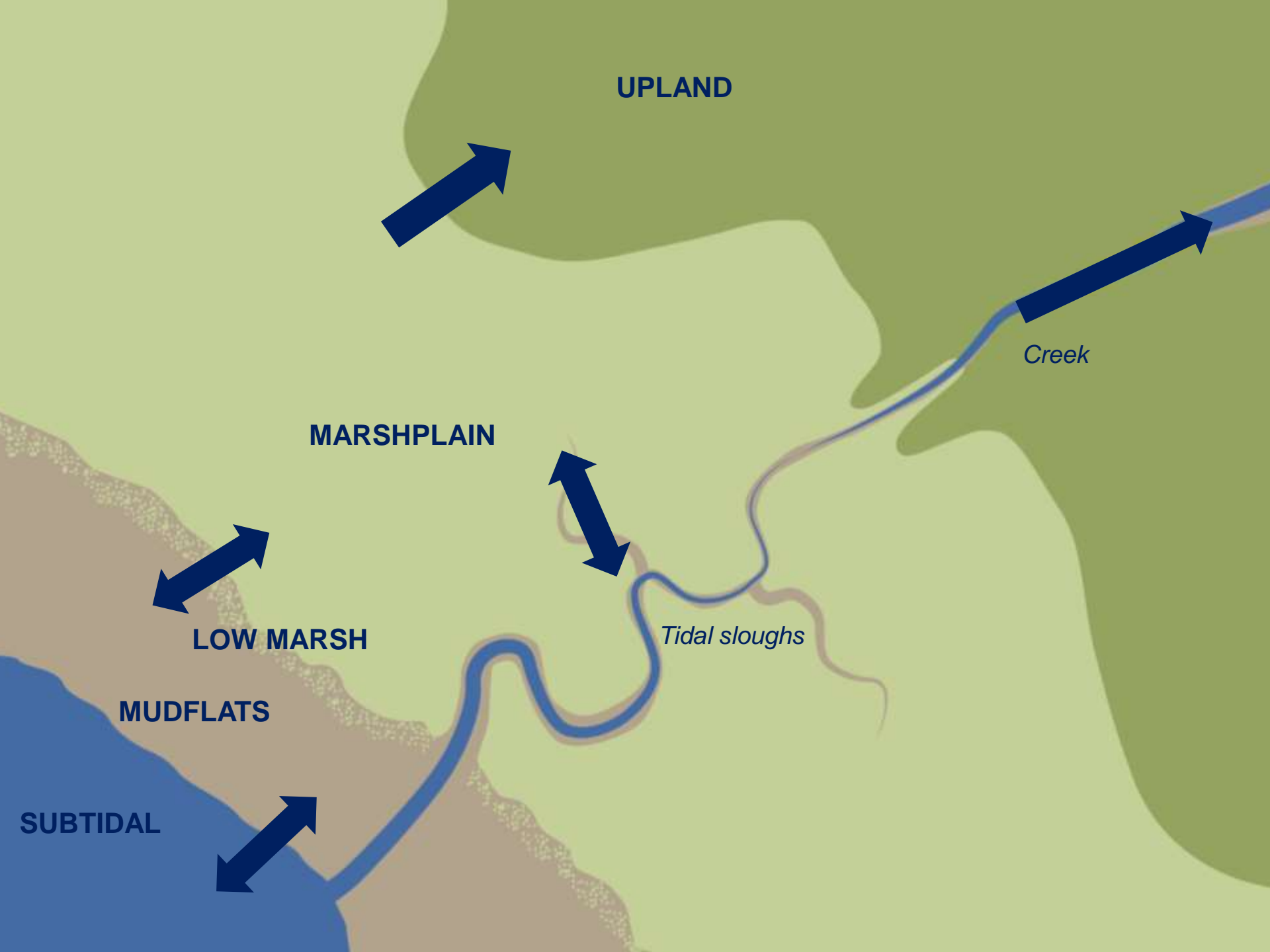


2100 zone of tidal influence

2050 zone of tidal influence

Current zone of tidal influence





Implications

- **Heterogeneous and dynamic Bay-Marsh Transition zone → Opportunities for strategic beach and marsh restoration**
- **Diverse upland T-zone historically → opportunities for multi-benefit backmarsh restoration**
- **Head of Tide varies with gradient and setting → Likely to migrate inland or compress**
- **No “one-size-fits-all” for management/restoration of transition zones**
- **Baylands and the transitions between them need to be assessed, prioritized and managed as a whole**

Thank you!

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Funders: SFEP, EPA E-2100, BCDC-CIAP, USFWS, SCC and others

