



# WORKING WITH WATER: Toward nature-based adaptation

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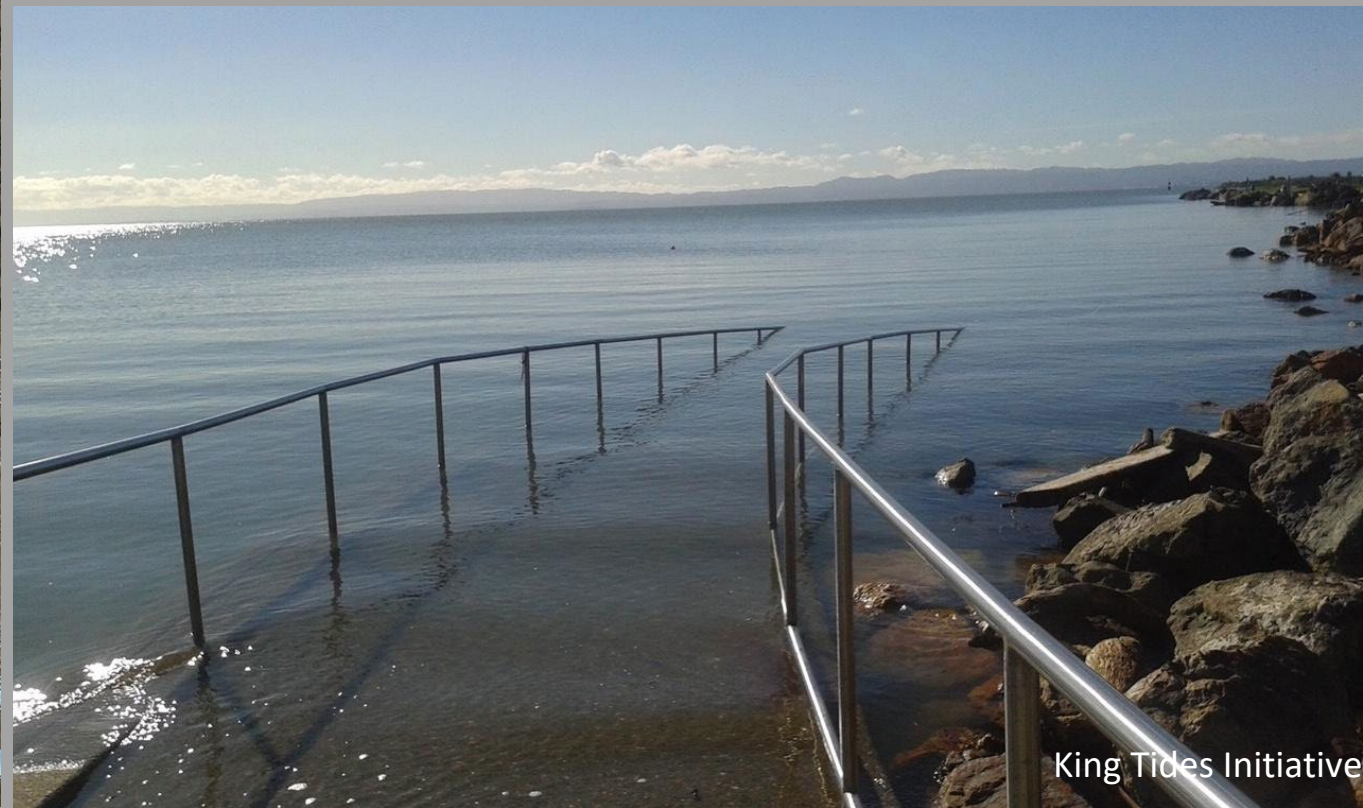
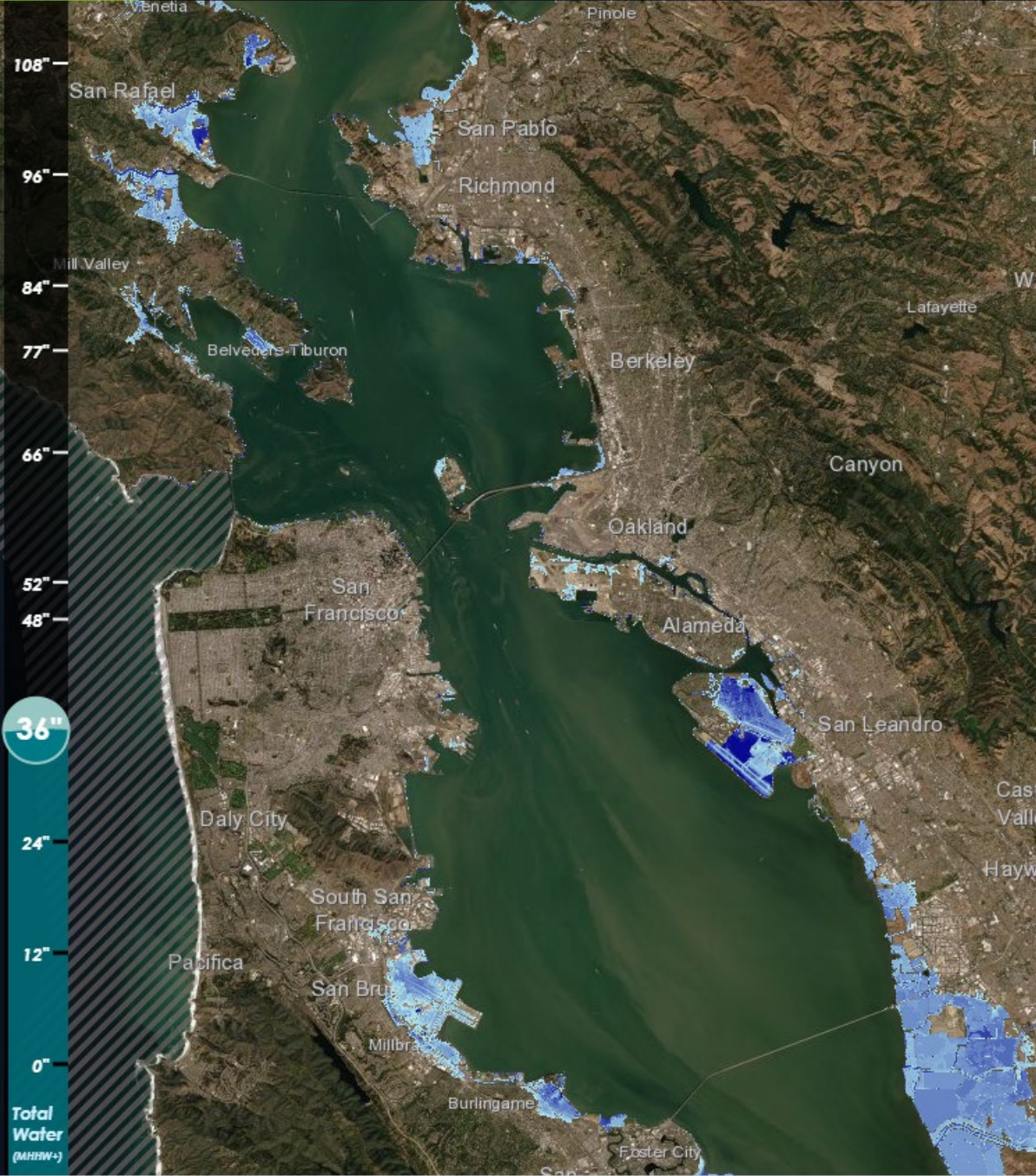


Bay Nature: Mill Valley, CA



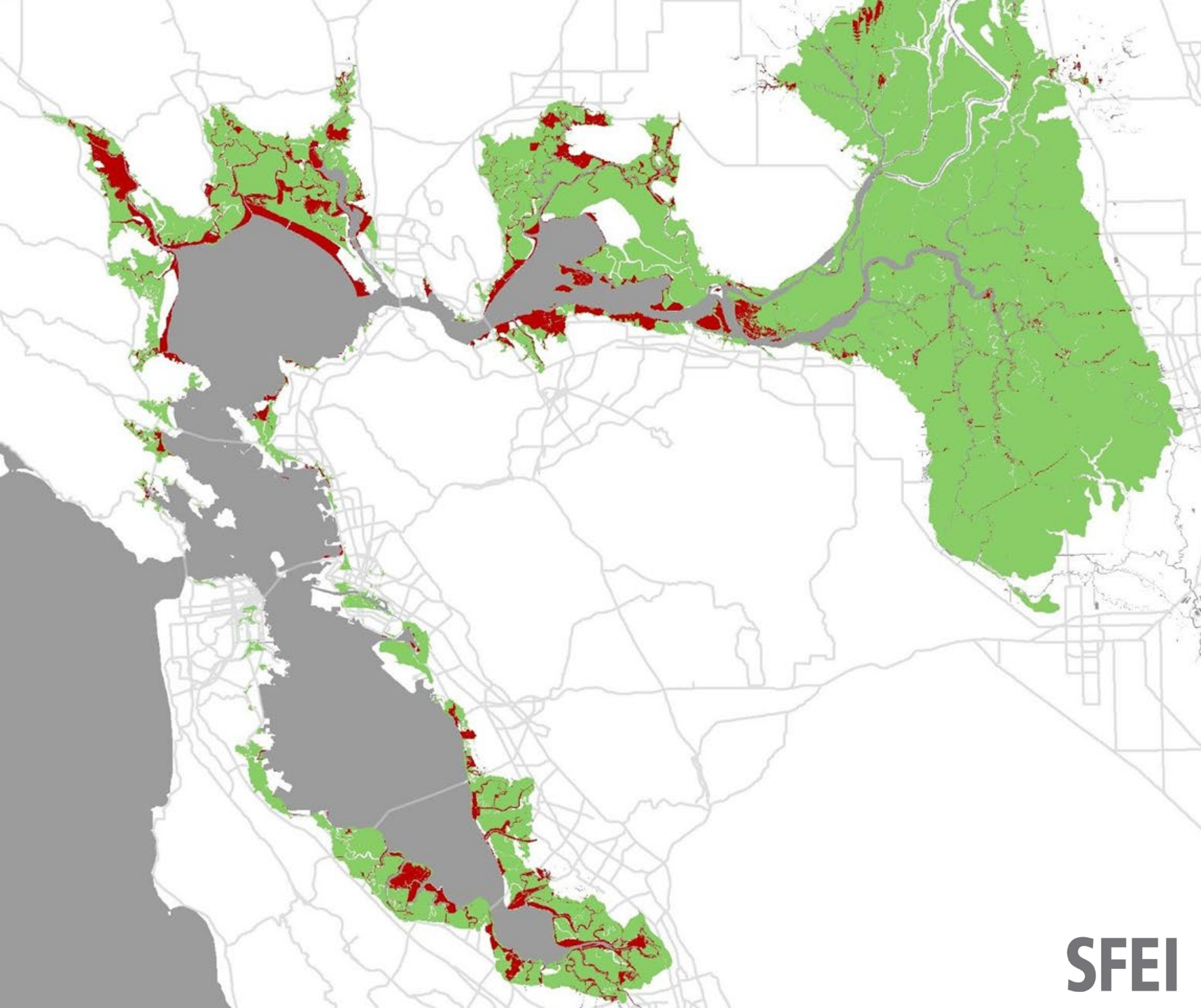






ART Bay Area Shoreline Flood Explorer



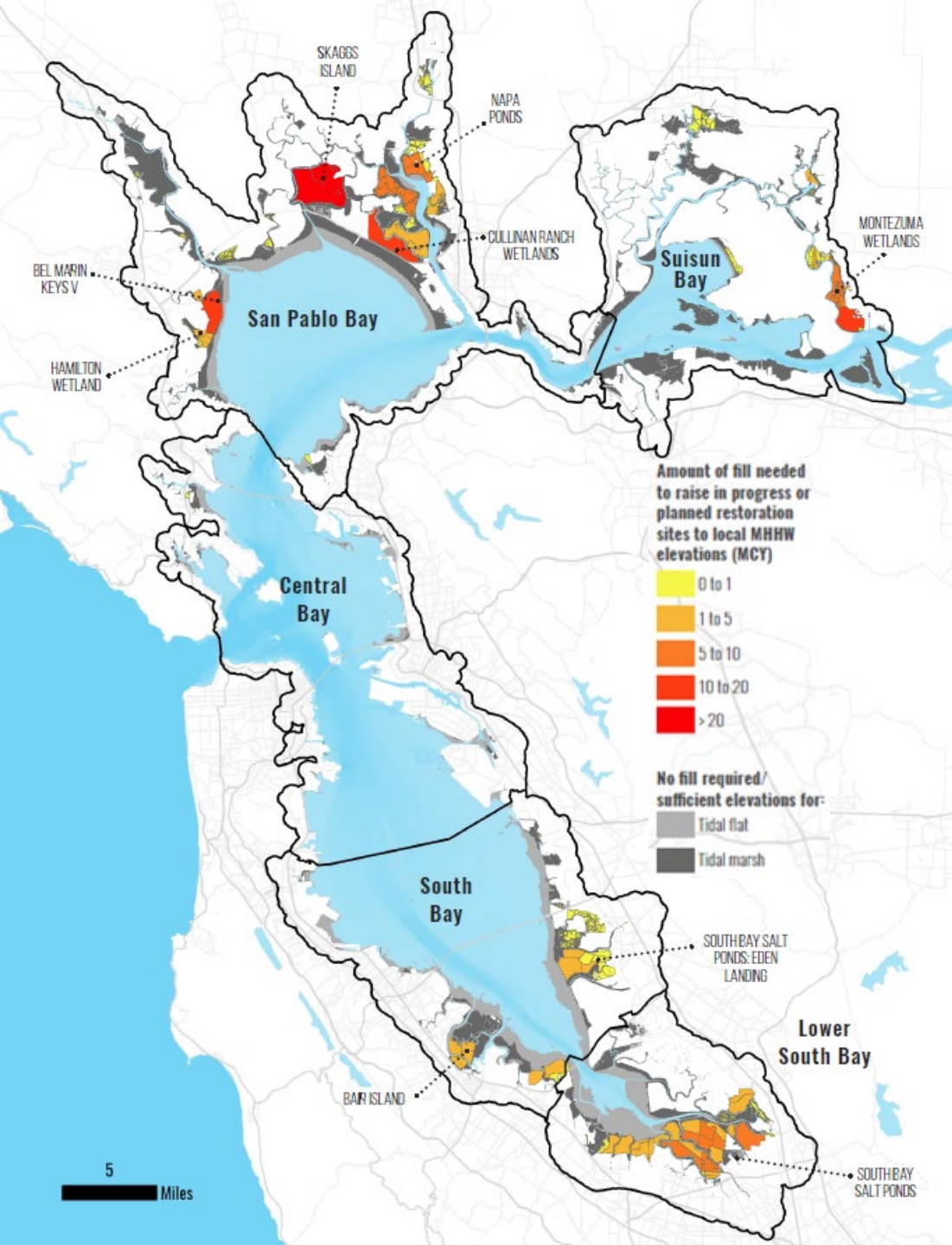


ISSUE 1:

# History matters

We built on top of the Baylands and in floodplains and **now these areas are sinking and flooding.**

**SFEI**



## Amount of fill needed to raise sites to MHHW elevations

(millions of cubic yards)



SFEI and SPUR 2019, Dusterhoff et al. 2021

## ISSUE 2: Lands below sea level

Some areas subsided so badly and are **protected by fragile levees.**





ISSUE 3:  
**Lots of  
cooks in  
the kitchen**

Many jurisdictions  
have generally  
pursued **Flood Risk  
Management.**

**Flooding**  
will not stop at  
city boundaries.



**We have a choice to make**







# ENGINEERING WITH NATURE (EWN)



An engineering philosophy that uses natural and engineering processes to deliver economic, environmental, and social benefits, including:

- Flood, coastal storm, and erosion risk mitigation
- Ecosystem restoration
- Equitable outcomes for EJ communities
- Recreation
- Climate resilience

Nature-based solutions referred to as Natural and Nature-based Features (NNBF) in EWN context.





# GUIDING PRINCIPLES FOR EWN PROVING GROUNDS

- **Adapting to climate change** will require us to manage landscapes differently than we have in the past
- If we **work with nature rather than fight against it**, we will likely be more successful in enhancing resilience for **species, habitats, and humans.**
- **Collaboration** across agencies, communities, and sectors will be increasingly important for **equitable adaptation.**





# PROVING GROUND NETWORK



## Proving Grounds

Implement. Document. Share.

EWN Proving Grounds are USACE districts and divisions committed to the broad integration of EWN principles and practices into all business lines in the form of constructed projects. Proving grounds are places where innovative ideas are tested on the ground, throughout USACE missions. They document processes, project milestones, and lessons learned in the implementation of EWN measures so others can learn from their experience.



[Mobile District](#)



[San Francisco District](#)



[St. Louis District](#)



# San Francisco District 20-Year Strategic Plan





**Gray**

**Nature-Based and Green-Gray Solutions**

**Green**

Conventional  
Engineering

Green Gray

Hybrid

Prompted  
Recovery

Natural

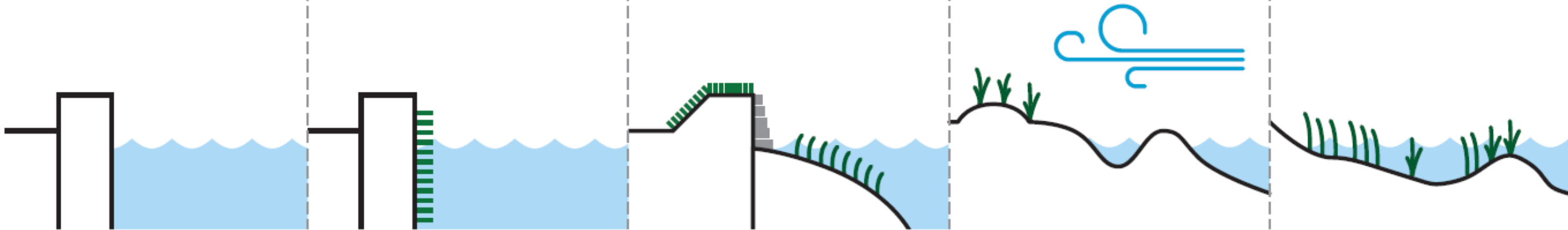
Project or scheme  
constructed with  
little or no ecological  
consideration

Gray infrastructure  
that intrinsically  
incorporates green  
habitat elements by  
design or retrofitting

Traditional  
engineering fronted  
by a created  
“natural” feature;  
e.g., salt marsh in  
front of sheet piling

Scheme initiated by  
human input that is  
then dependent on  
natural process; e.g.,  
dune restoration,  
sand motor

Naturally occurring  
habitat; e.g.,  
mangrove, salt  
marsh, dunes,  
shingle, rocky shore



It's always a spectrum





# EWN + COASTAL STORM RISK MANAGEMENT



## San Francisco Waterfront Flood Study

- SF Port-led **EWN working group** to integrate nature-based features equitably across the project area
- **Drawing on experience** in Australia, Seattle, New York, and other steep urban shorelines
- Successfully included **3 miles of NBS** into Recommended Plan





# THERE ARE POSSIBILITIES EVEN IN SMALL AND CONSTRAINED ENVIRONMENTS



Source: Pathways Institute, CMG

Wave Runup Reduction with Hybrid Green-Grey Measures



# NATURAL AND NATURE-BASED FEATURES (NNBFS)

Included in EIS Report

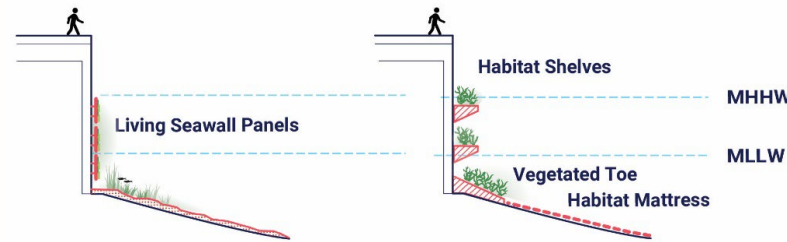
Key Benefits:

- Habitat
- Wave Energy Dissipation
- Erosion Mitigation
- Inland Flood Risk Mitigation

## COARSE BEACH



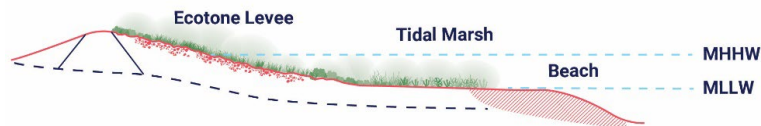
## LIVING SEAWALL



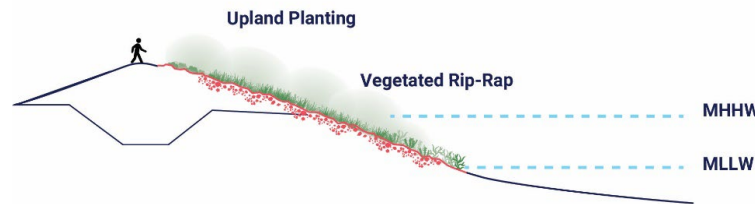
## WETLAND CREATION



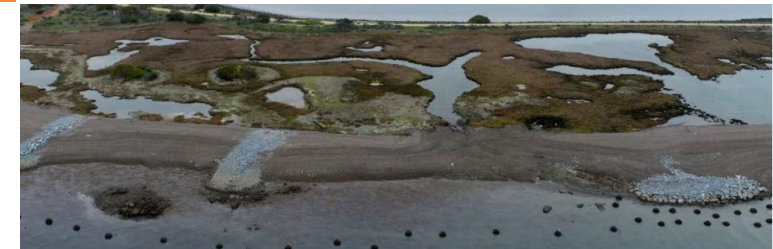
## ECOTONE LEVEE



## EMBANKMENT SHORELINE



## ENHANCE EXISTING WETLANDS



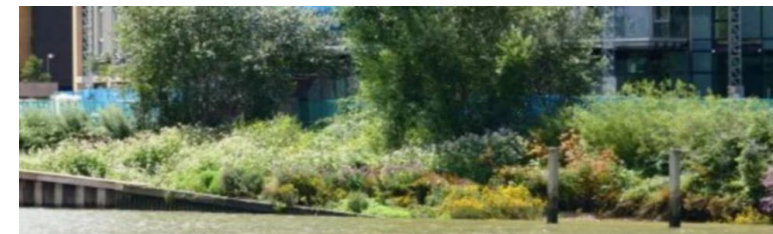
## ECOLOGICAL ARMORING



## NATURALIZED SHORELINE



## CREEK ENHANCEMENTS



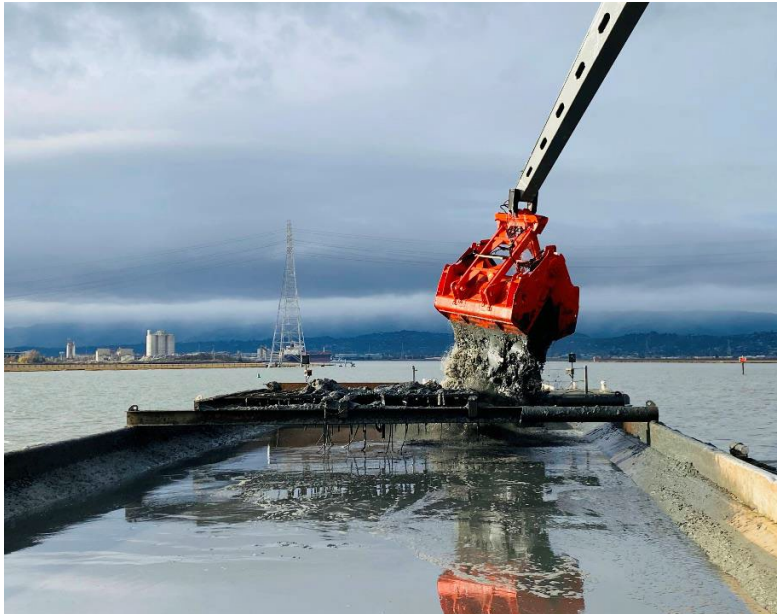




# EWN + NAVIGATION O&M AND BENEFICIAL USE



## Successfully implemented 1122 Shallow Water Strategic Placement Pilot Project



- 90K CY Dredged Material placed offshore of eroding marsh in **December 2023**
- Monitoring impacts, **fate** and **transport** of **sediment** through 2024

*Pilot projects are great **and** we need to do them more than once!*

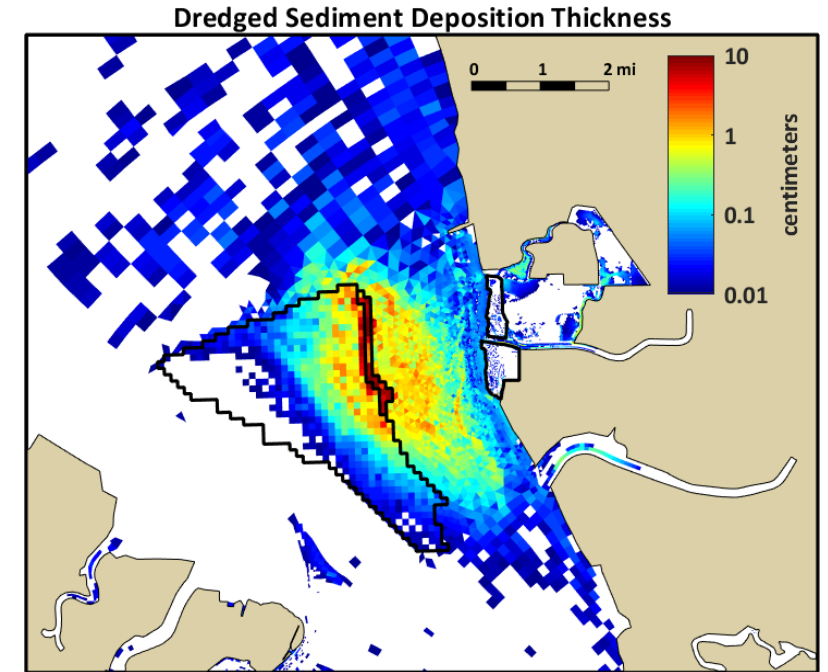


# SECTION 1122 SHALLOW WATER PLACEMENT

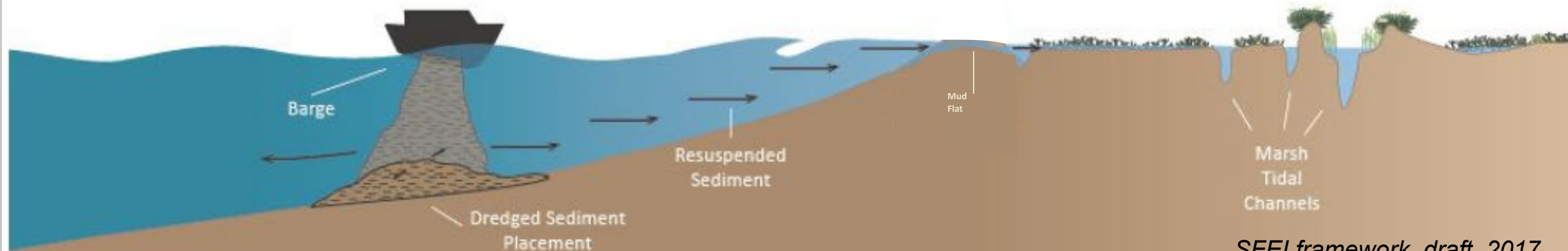


- Using natural transport processes to move material onshore
- Creates resilience for mudflats and marshes
- Innovative, cost-effective, moves towards regional goals
- Monitoring impacts and effectiveness

*Let the water do the work  
Mimic natural processes*



Shallow-Water Placement



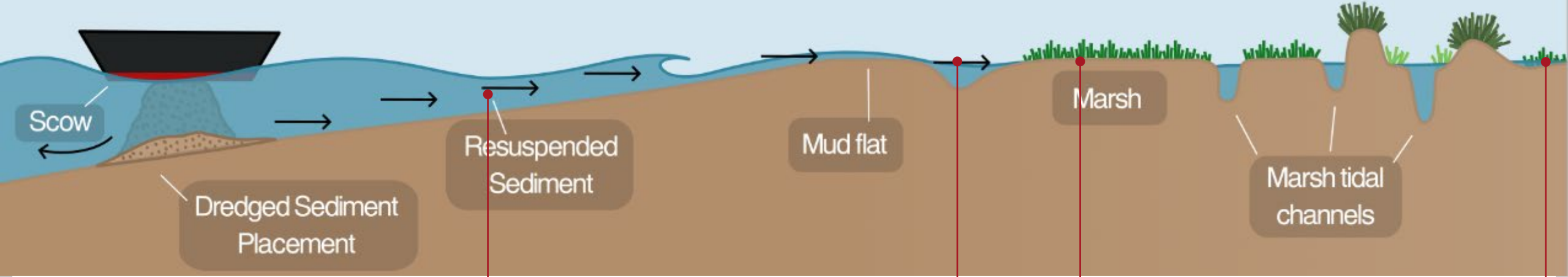




# MIMICKING/BOOSTING SEDIMENT TRANSPORT PROCESSES



## Shallow-Water Placement



*Wave and current resuspension*

*Daily tides transport via channels*

*Extreme water level transport across marsh*

*Trapping and blocking by vegetation*



# MIMICKING/BOOSTING SEDIMENT TRANSPORT PROCESSES



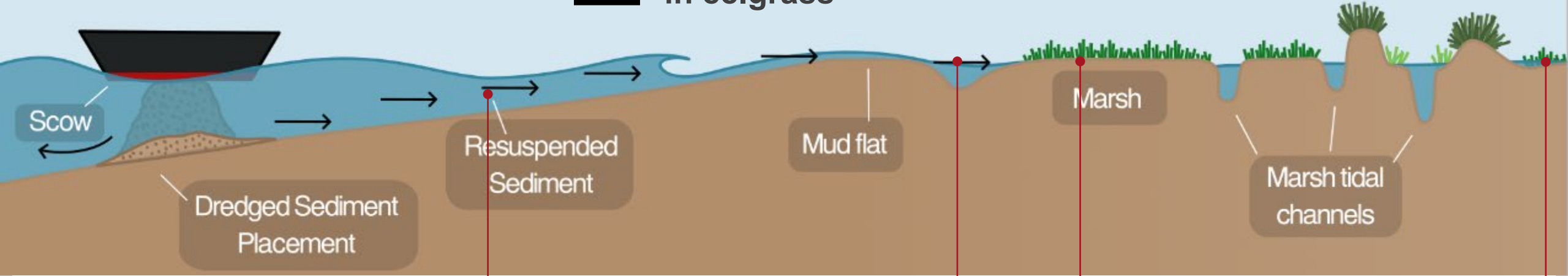
## Shallow-Water Placement



200% increase in eelgrass



Slowly feeding the marsh



Mounds are eroding



Benthos are recovering

*Wave and current resuspension*

*Daily tides transport via channels*

*Extreme water level transport across marsh*

*Trapping and blocking by vegetation*



# MANY TOOLS IN THE BENEFICIAL USE TOOLBOX

## Remove obstructions

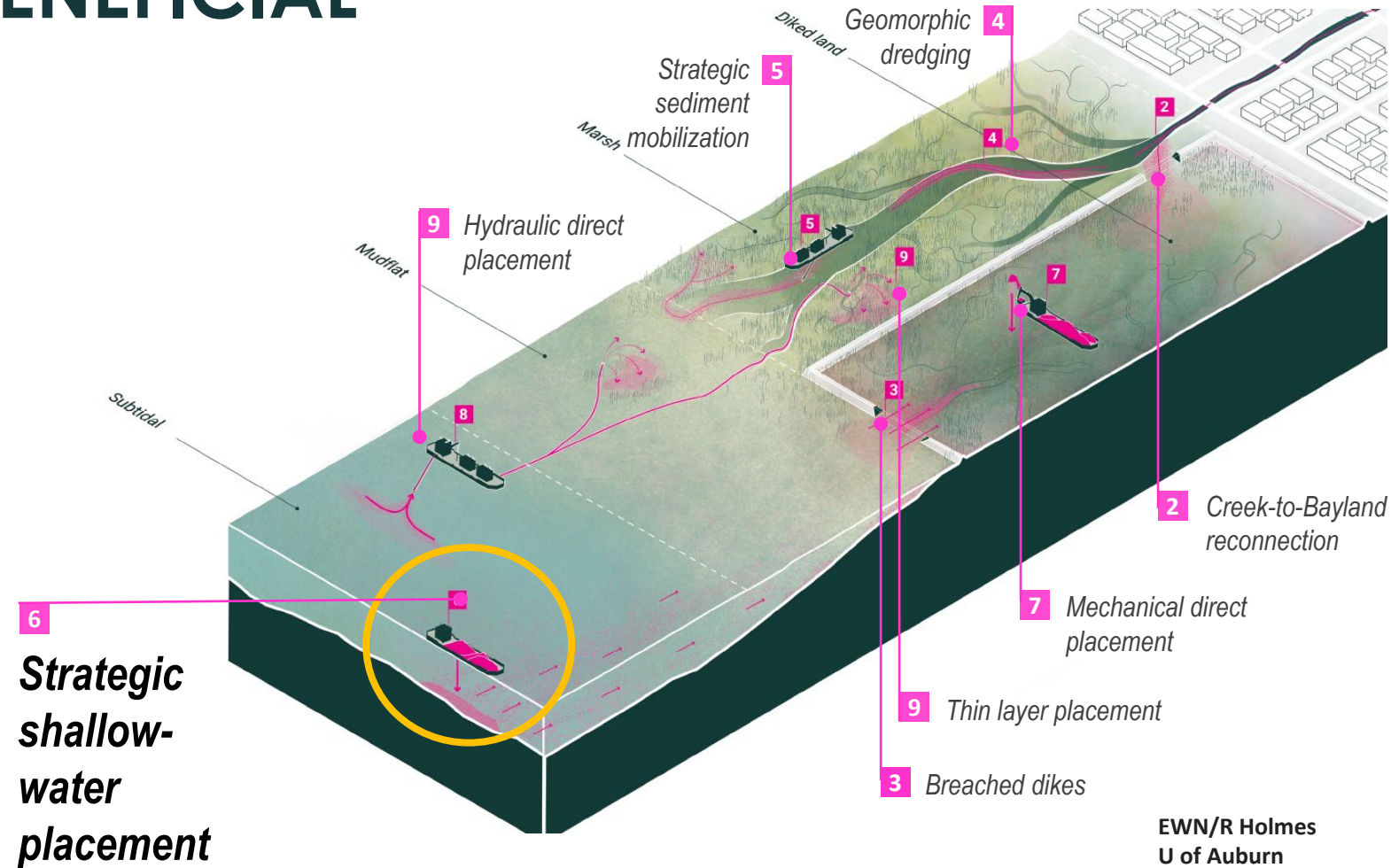
- Reservoir management
- Reconnect Creeks to Baylands
- Mechanical breaches

## Assist natural processes

- Strategic shallow water placement
- Strategic pulse dredging in tidal channels

## Replace natural processes

- Mechanical placement (direct)
- Hydraulic placement



EWN/R Holmes  
U of Auburn



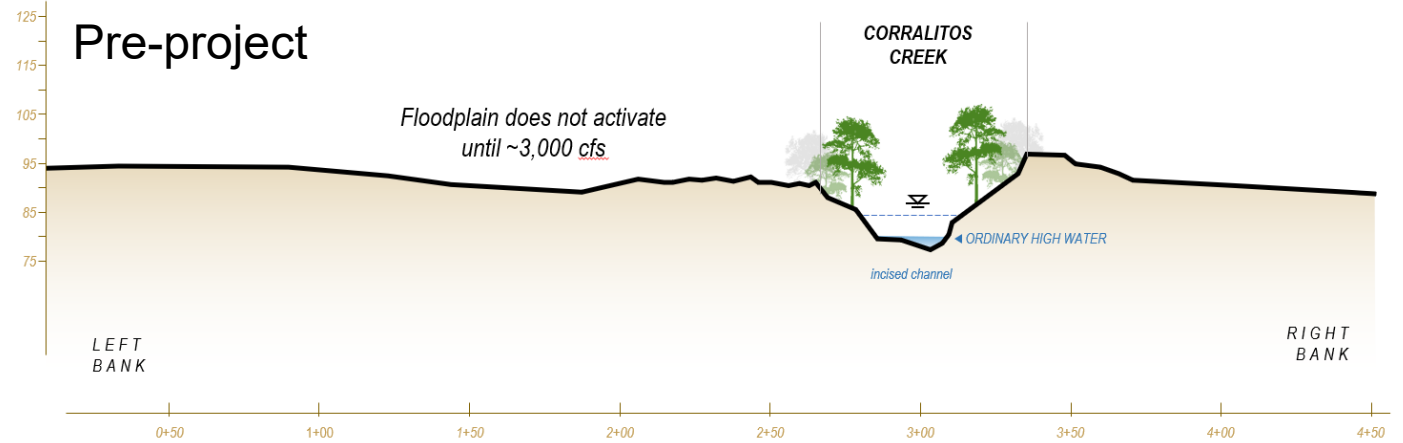


# EWN + FLOOD RISK MANAGEMENT STUDIES



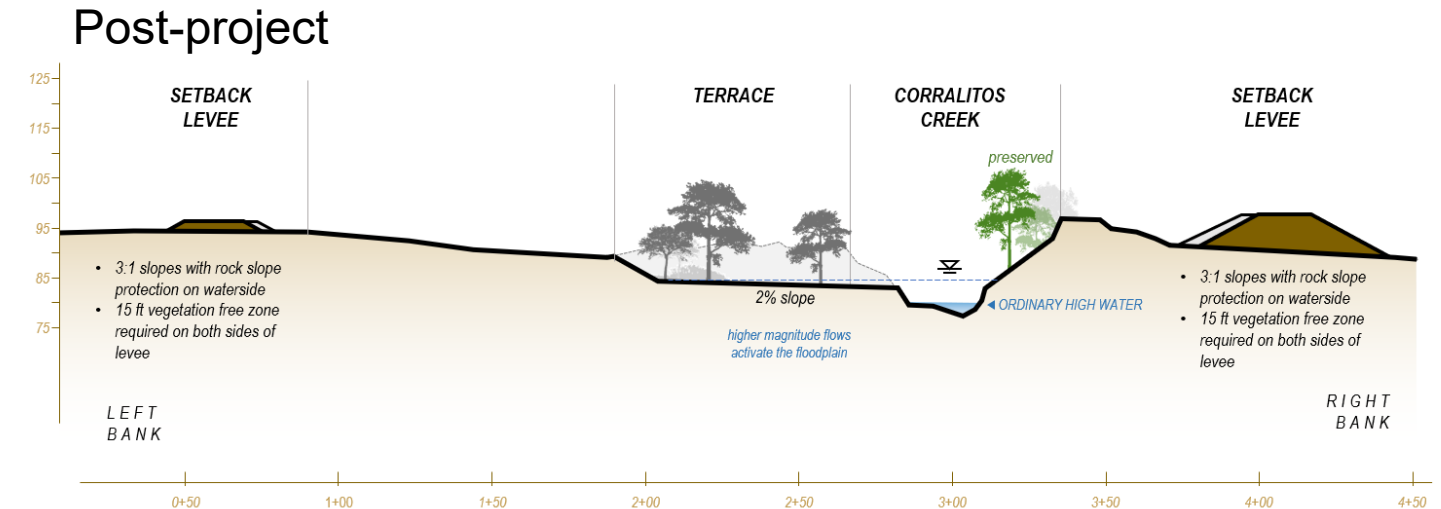
## UPPER GUADALUPE RIVER FRM PROJECT

- Replace bypass flood control channel with a **floodplain bench**
- Integrate multiple benefits for endangered **salmonids**
- **Lower flood stage** and velocities



## PAJARO RIVER FRM PROJECT

- Setback levees + floodplain bench
- Using borrow material to **decrease cost of levee**, increase riparian corridor, **groundwater recharge**
- Partnering with CBOs/**youth training program** to revegetate







# FINAL THOUGHTS

- **We need to use as much dredged material as possible to create these nature-based features along the shoreline**
- **Need to be open to pilot projects, hybrid solutions, other ways to soften the shoreline and adapt**
- **Collaboration between agencies, the public, local knowledge and communities is critical**



# THANK YOU

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