Living Shorelines

National and California Project Examples

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State of California
Coastal Conservancy

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A Legacy of Shoreline Hardening

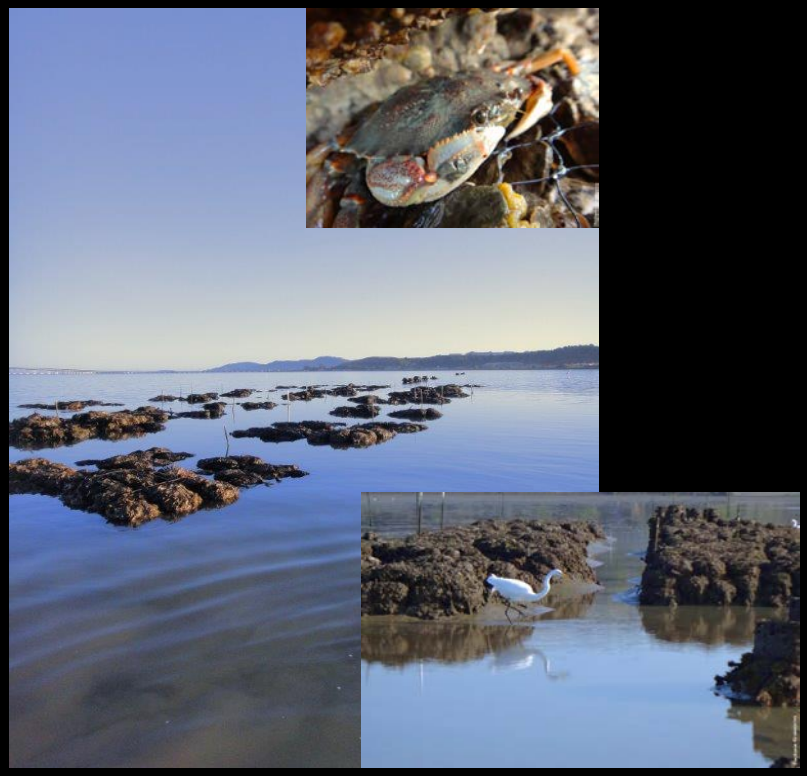
14% of U.S. shoreline is hardened

Up to 50%+ of San Francisco Bay

Gittman et al. 2015 *Frontiers in Ecology and the Environment*

Hard Infrastructure
Impacts to Shorelines and Wetlands

- Dredging, fill, structures
- Loss of habitat values and species
- Impacts, erosion, high cost
- SLR: seawalls, groins, levees



Nature-Based Infrastructure
Potential Benefits

- Biologically dynamic borders
- Species support and connectivity
- Shoreline protection
- Climate adaptation and habitat resilience
- Cost effective, sustainability

What are the ecological consequences of shoreline hardening?



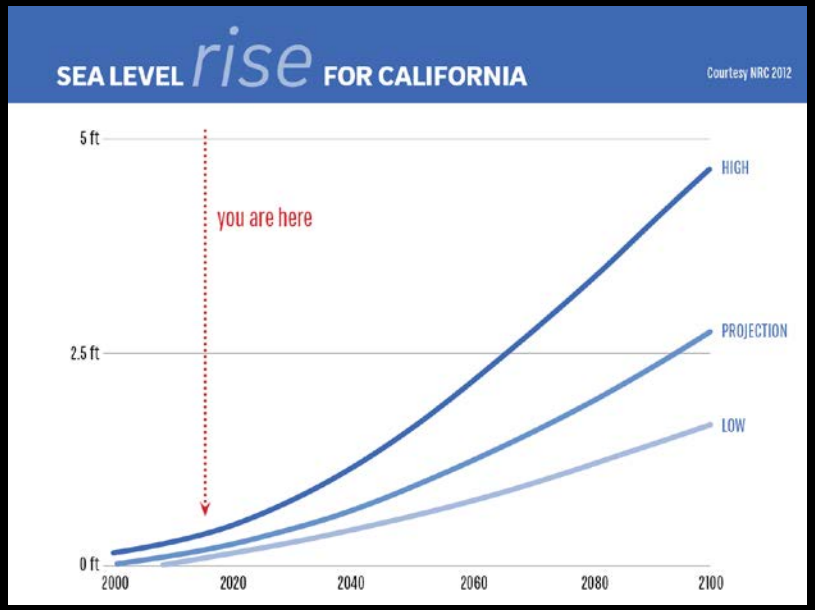
Affected flora and fauna

- Benthic invertebrates (e.g., Seitz et al. 2006)
- Shore birds (e.g., Dugan et al. 2006, 2008)):
- Fish (Peterson et al. 2000, Gittman et al. 2016, Seitz et al. 2006)

Shoreline access and uses

At Risk In California:

- 1.4M SLR – 480,000 people
- Property valued at $1B
- Habitats and Species





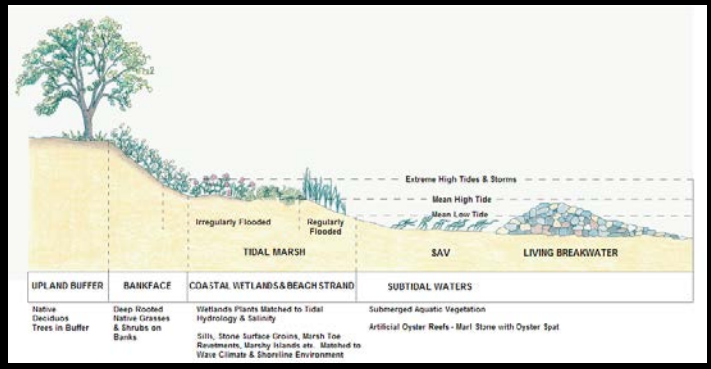
Living Shorelines

Living Shorelines can include any shoreline management system that is designed to protect or restore natural shoreline ecosystems through the use of natural elements and, if appropriate, manmade elements.

Any elements used must not interrupt the natural water/land continuum to the detriment of natural shoreline ecosystems.

East and Gulf Coast Projects

- protection of private shorelines
- short linear length, high intertidal
- lack of monitoring data
- originally not climate adaptation

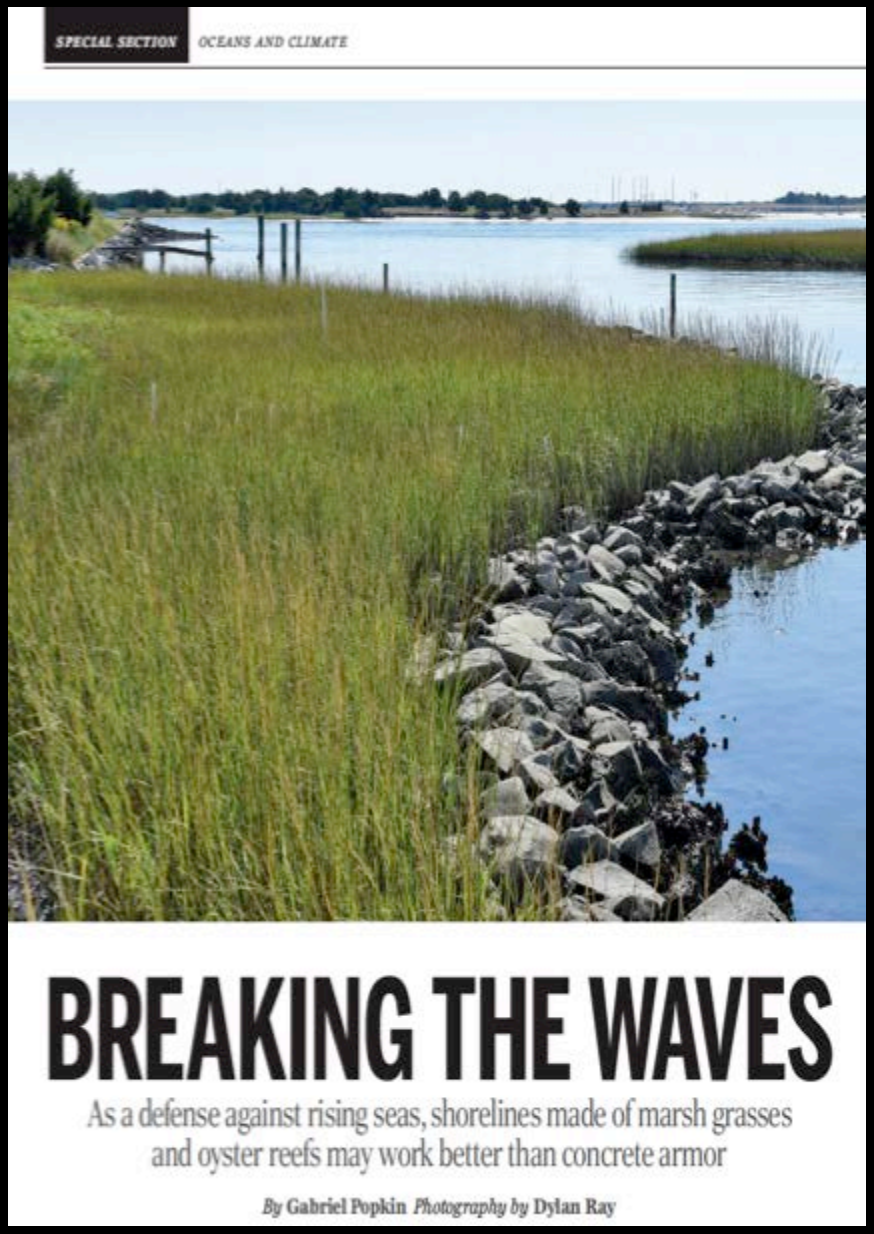


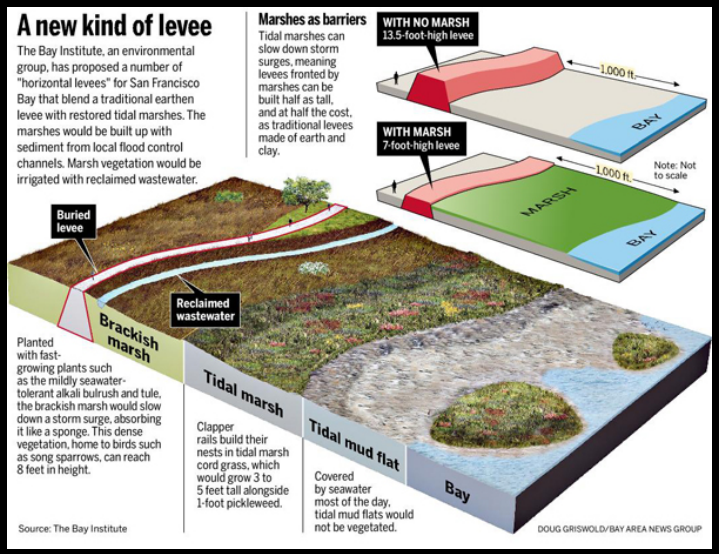
Maryland Living Shorelines Protection Act of 2008

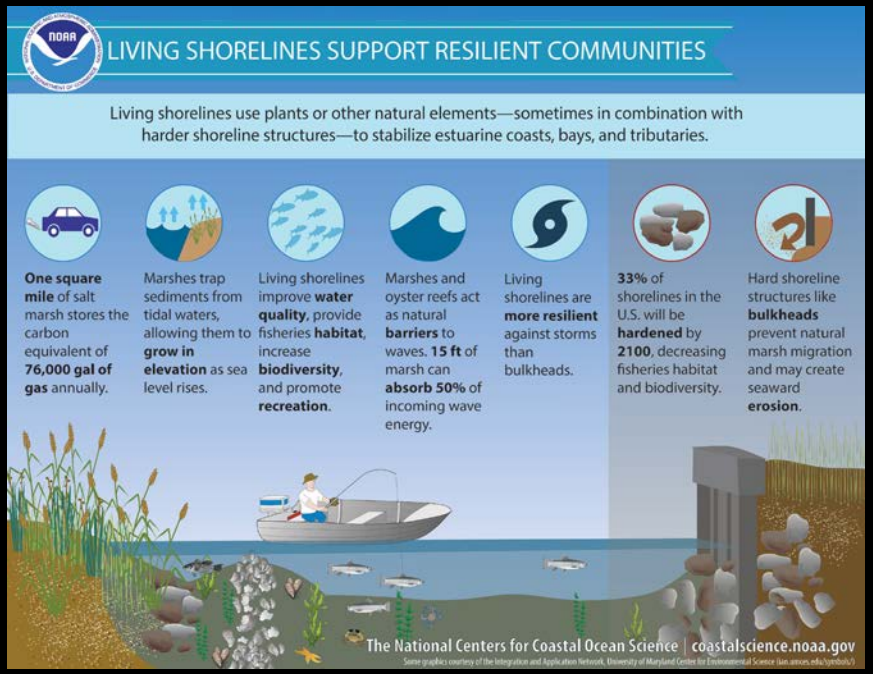
States - programmatic permits

- Virginia
- North/ South Carolina
- Alabama
- Mississippi
- Maryland

Recent Innovation & Popularization of Living Shorelines







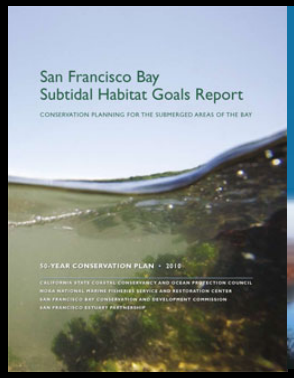
ACOE Nationwide Permit 54- Living Shorelines

Policy Support in California

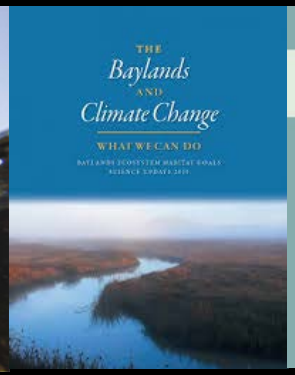
Exec Order B-30-15- ***Prioritize natural infrastructure solutions***

SB 246: ***Integrated Climate Adaptation and Resiliency Program***

- Safeguarding CA Plan
- 4th Climate Assessment
- CA Coastal Commission
- CA Coastal Conservancy
- CA Ocean Protection Council
- SF Bay BCDC
- Counties: Marin, San Mateo



Subtidal Goals 2010
www.sfbaysubtidal.org



Baylands Goals 2015
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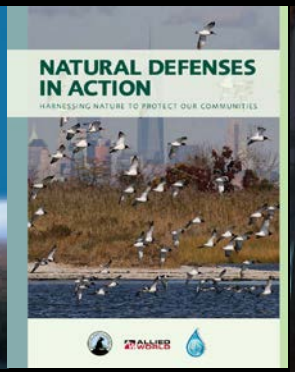
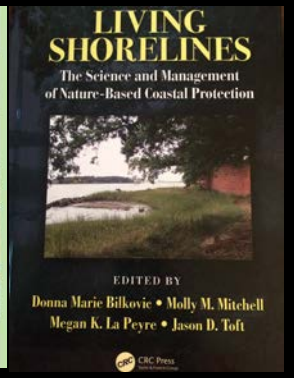


NWF 2016
www.nwf.org



Bilkovic et al 2017
www.crcpress.com

CA Living Shorelines

soft shorelines green infrastructure nature-based adaptation etc

Multiple Habitat Types in Designs

Intertidal and subtidal connectivity

Offshore, nearshore, and onshore treatments

Estuaries and Outer Coast

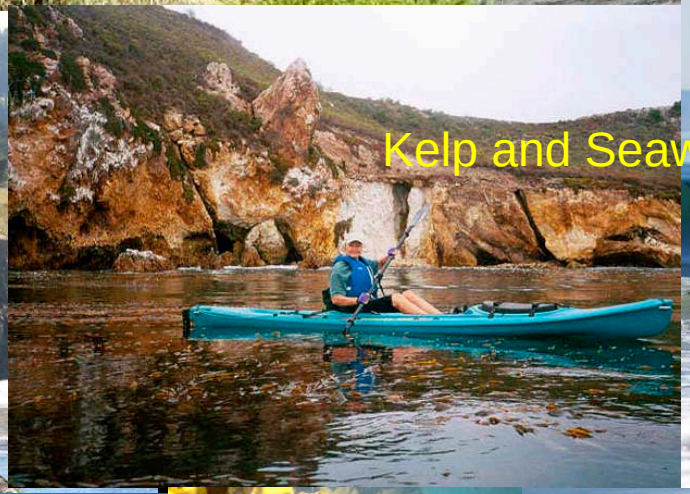
Climate Adaptation

Landscape Scale Approach


Coastal Scrub


Coastal Bluffs


Headlands


Kelp and Seaweed Beds

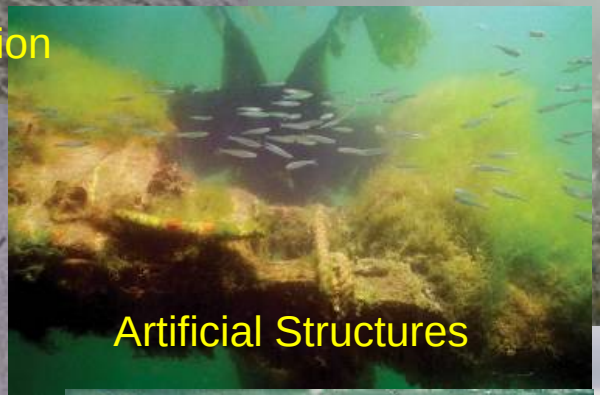

Coastal Dunes


Beaches


Tidal wetlands


Submerged Aquatic Vegetation


Soft and coarse substrate:
Sand, gravel beaches


Artificial Structures

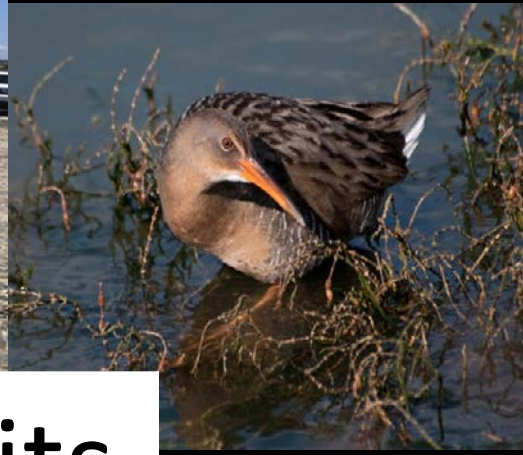

Rock Habitats


Macroalgal Beds


Shellfish Beds


Soft Substrate: Mud/ shell mix

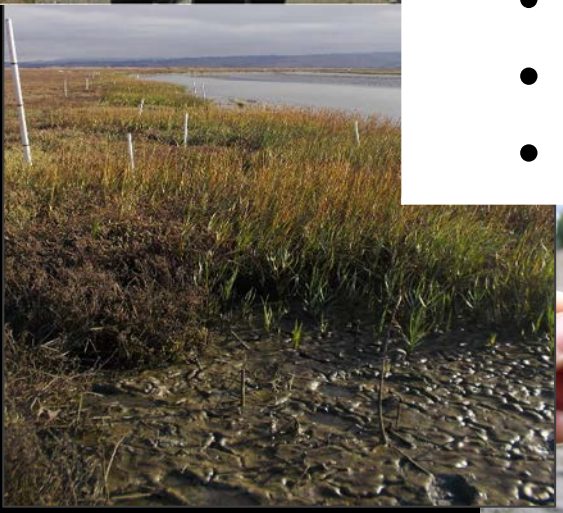




Multiple Co-Benefits

- Create Fish and Wildlife Habitat
- Attenuate Wave Energy
- Accrete Sediment
- Reduce Erosion
- Can Provide Outdoor Recreation
- May Sequester Carbon
- May Buffer Ocean Acidification






CA Living Shoreline Examples

(Oysters, Eelgrass, Beaches, Dunes, Tidal Marsh)

Humboldt Bay Coastal Dunes and Living Shorelines *(City of Arcata, SCC)*

SF Bay Living Shorelines Project *(SCC, SF State, UC Davis, ESA, USGS)*

Terminal Four Wharf Removal *(SCC, City of Richmond, Ducks Unlimited, others)*

Ora Loma Demonstration Project *(Ora Loma Sanitary District, SFEP, Save SF Bay)*

Arambaru Island Restoration Project, Bay Beaches *(Richardson Bay Audubon, SFSU, Marin County, others)*

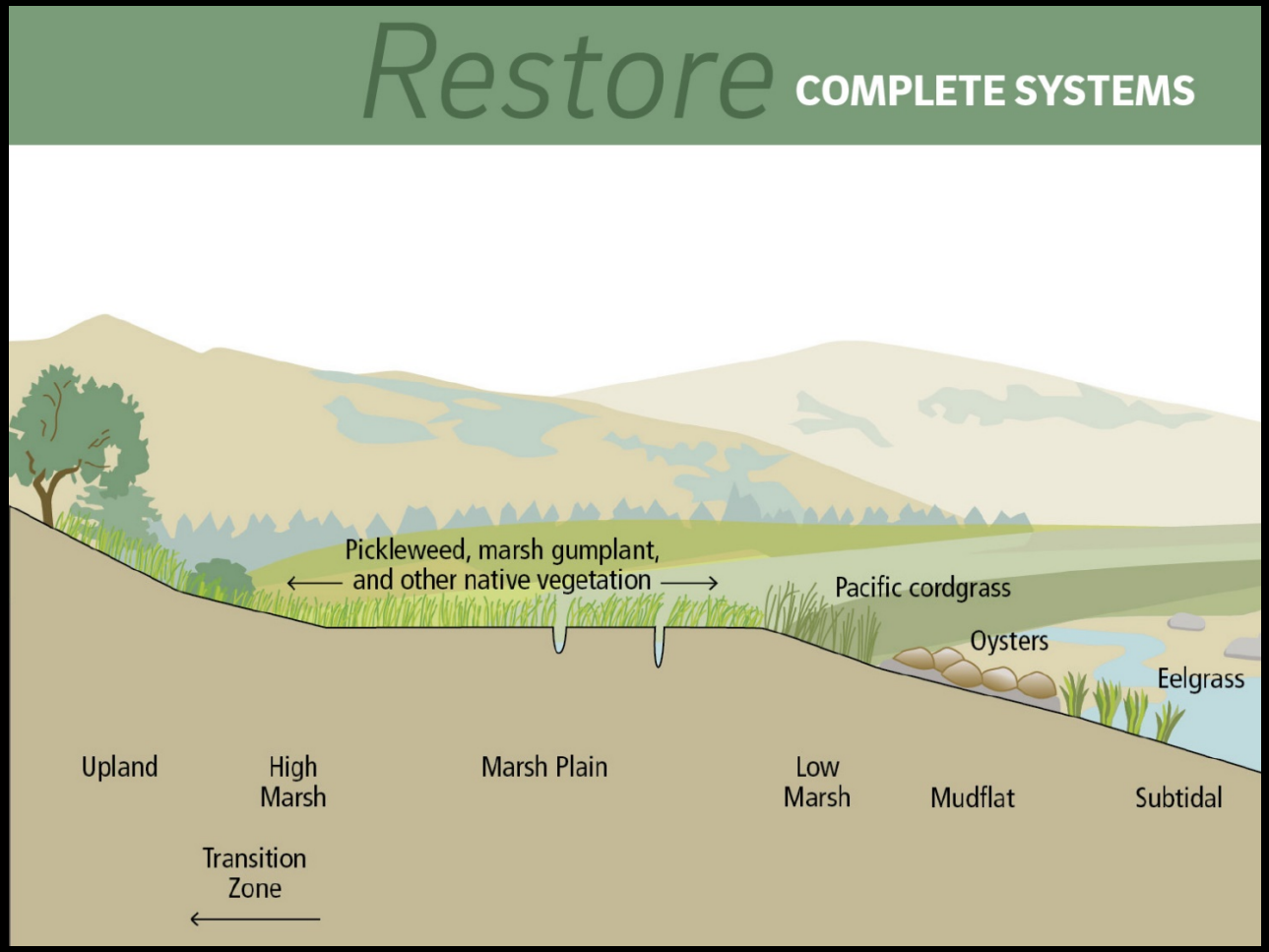
Hamilton Wetlands Restoration Project *(SCC, ACOE, others)*

Tiscornia Marsh *(Marin Audubon Society, SF Bay NERR, ESA, City of San Rafael)*

Cardiff Dunes Living Shorelines *(SCC, City of Cardiff, OPC, others)*

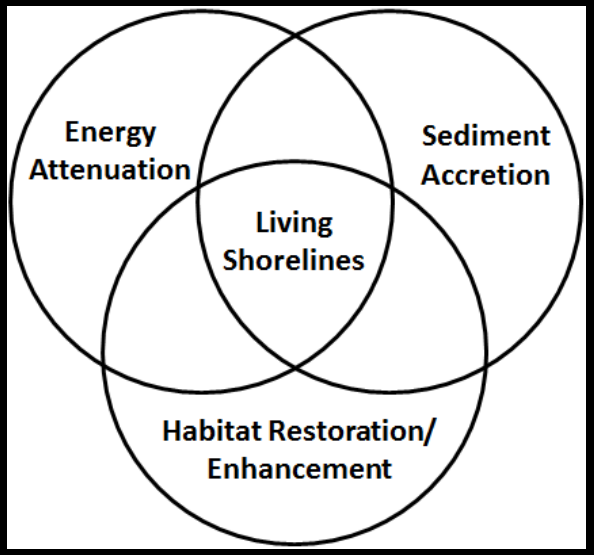
Baylands Goals Regional Climate Adaptation Recommendations

1. Restore estuary-watershed connections
2. Design complexity and connectivity
3. Complete tidal wetlands systems
4. Plan for migration
5. Actively recover wildlife
6. Invest in planning and research



Using Nature's Architects

Habitat forming species



Native Olympia Oysters and Eelgrass

Creosote Piling Removal for Pacific herring

Tidal marsh and upland ecotones

Site Specific Considerations

Existing Uses

Parcel Ownership

Bathymetry

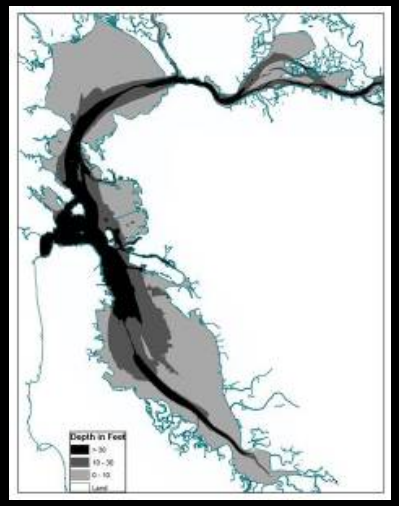
- **Depths for Habitat Restoration**
- **Depths for Access**

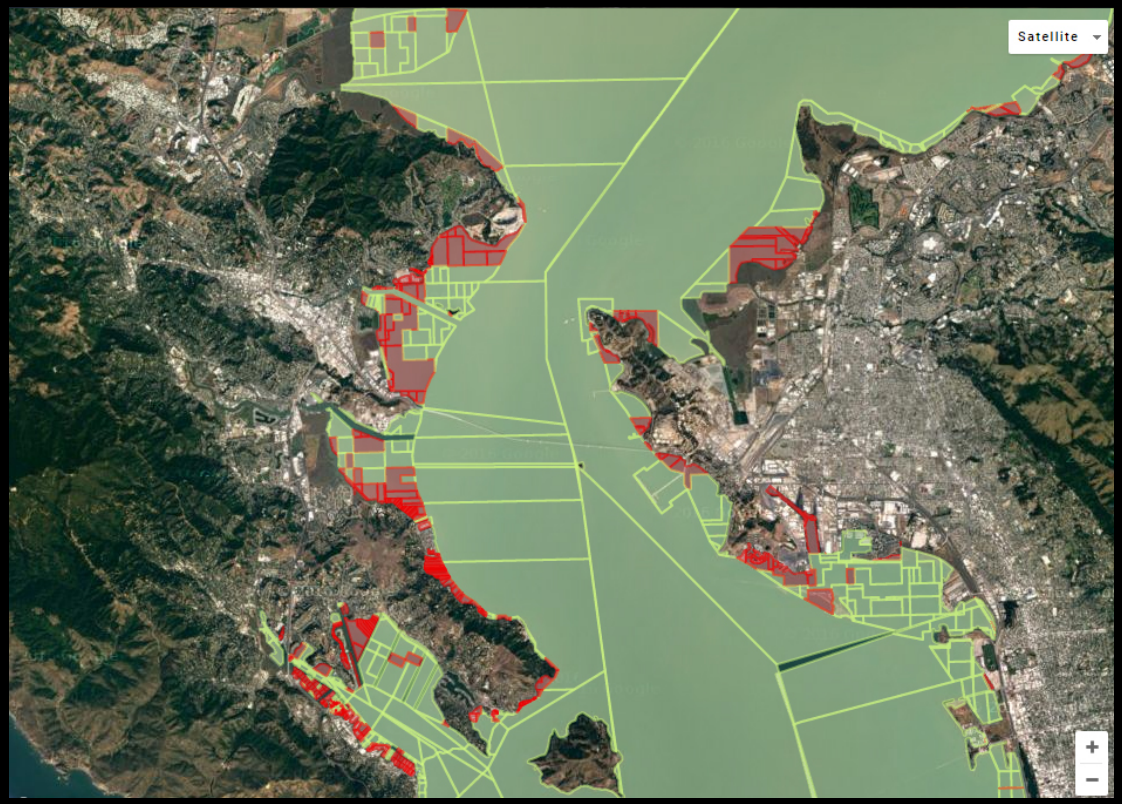
Orientation to Wind/Waves

Existing Species and Habitats

Sea Level Rise Modeling

Physical Space Required





Issues to Consider Thoughtfully

Regulatory Framework

Army Corps of Engineers:
Nationwide 27, Nationwide 54

USFWS/ National Marine Fisheries Service:
Endangered Species/ Essential Fish Habitat

SF BCDC:
Minor Permit, Major Permit

CA Department of Fish and Wildlife:
State-listed species consultation

State Water Resources Control Board:
Section 401 Clean Water Certification

State Lands Commission:
Lease Agreement if SLC owns land

Local Permits:
City Council
Regional landowner permits

Considerations and Challenges

- Lack of data/ constructed projects
- Beneficial Fill Justification
- Species Protection Windows
- Suitable Materials- Green to Grey
- Construction Methods/ Timing
- Sequential permits
- Long timeframes
- Cost – concept development

California needs demonstration projects

- Efficacy of natural habitats as shoreline protection
- Green-grey infrastructure
- Biological performance
- Public education
- Horizontal & vertical methods

One Size Does Not Fit All

- **Small and Large Scale**
  - **both needed!**
- **Permitting**
- **Design for specific conditions**
  - **Substrate/soil**
  - **Wave energy**
  - **Adjacent infrastructure**
- **Local support**
  - **Government willingness**
  - **Community engagement**

Threading the Needle

Innovation and Feasibility

Barriers to Innovation:

- Science and data gaps
- Institutional Inertia
- Lack of broader context
- Lack of an advocate

Importance of Feasibility:

- Habitat and species
- Pilot projects – test
- Document success before scaling up
- Monitoring of long-term benefits and impacts

Thank You

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