Living Shorelines in SF Bay

Restoring Habitat and Building Capacity to Adapt to Rising Seas

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State of California
Coastal Conservancy

A Legacy of Shoreline Hardening

14% of U.S. shoreline is hardened

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

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

Hard Infrastructure

Necessary in certain locations

Impacts to shorelines, wetlands and submerged habitats

Nature-Based Infrastructure

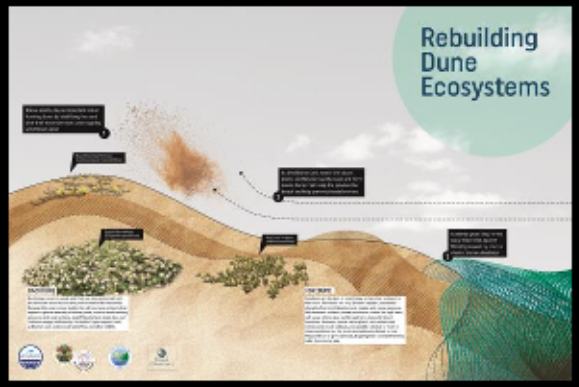
Biological and Physical Benefits

Habitat Connectivity

Climate Adaptation

Implementing New Approaches

- Advance Nature-based Adaptation and Design Guidance
- Build Regional Capacity through Knowledge Transfer
- Pilot Multi-Objective Designs in Different Settings
- Encourage Local Labor and Involvement



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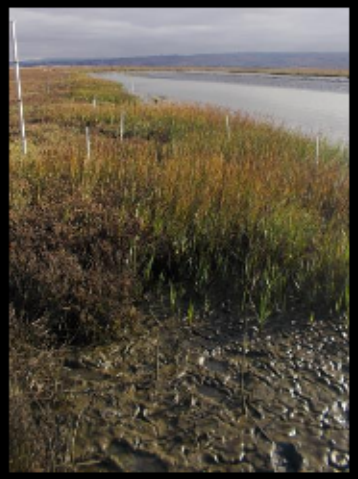
Living Shorelines

- Shoreline protection via restoration design
- Suite of techniques/habitat types
- Minimize coastal erosion
- Maintain coastal processes
- Natural habitat for plants, wildlife, and people




Submerged Aquatic Vegetation


Rock Habitats


Macroalgal Beds

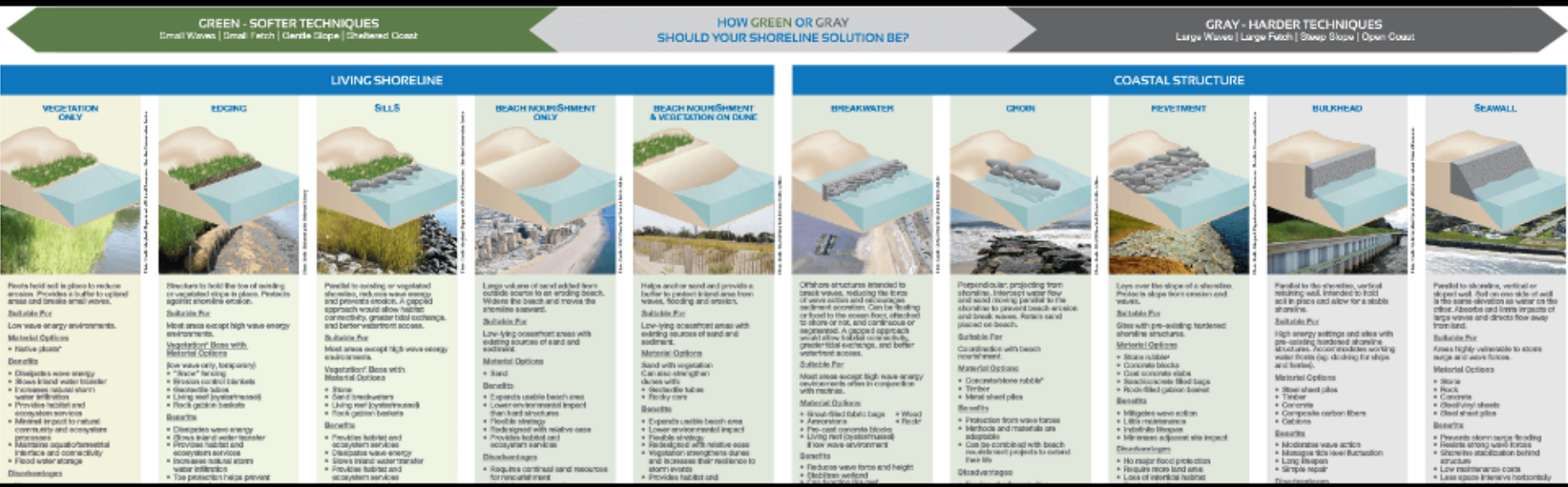

Soft substrate: sand


Artificial Structures


Shellfish Beds

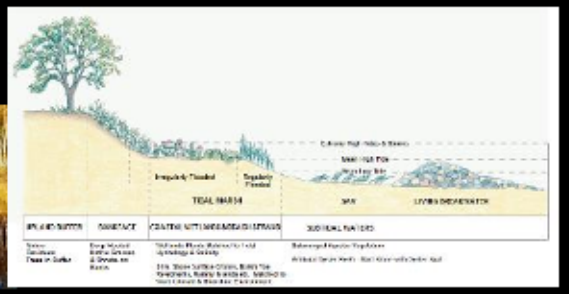

Soft Substrate:Mud/ shell mix

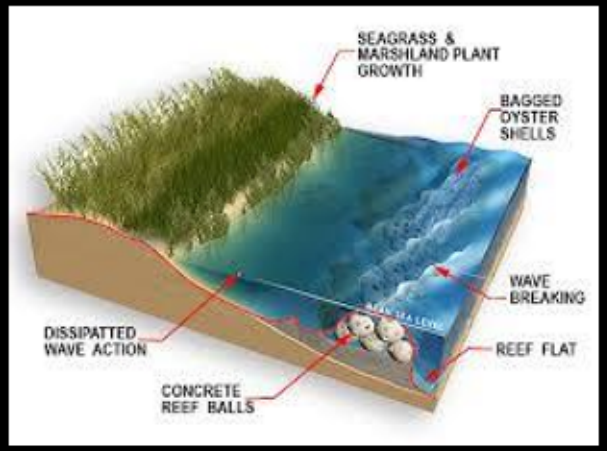
Green-Grey Spectrum for Living Shorelines



East, Gulf, Pacific NW Projects

- private shorelines
- short linear length
- stone sills, oyster breakwaters, dunes, plantings





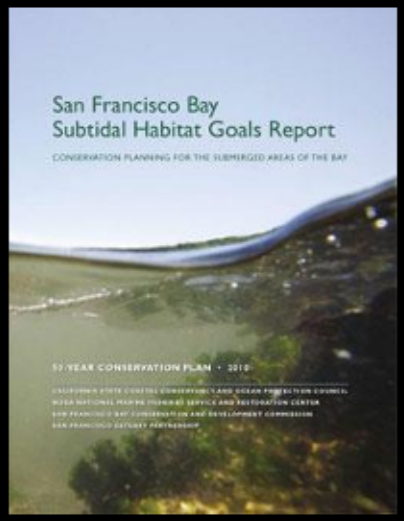
Maryland Living Shorelines Protection Act of 2008

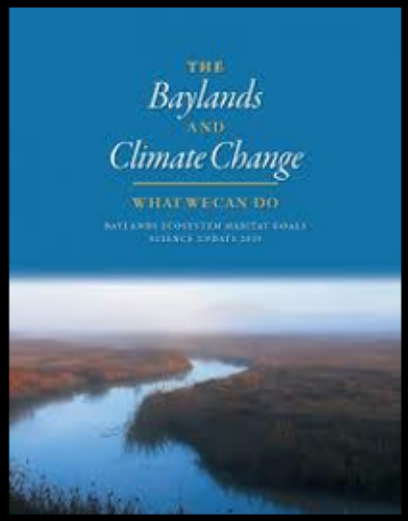
New York Waterfront Alliance Waterfront Edge Design Guidance

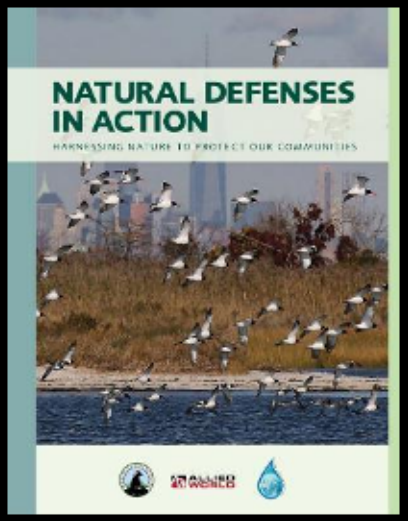
States - programmatic permits

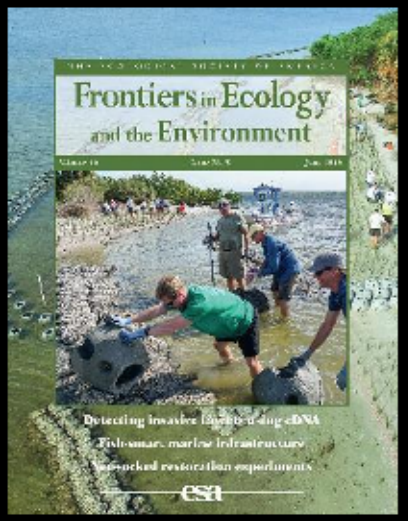
- North Carolina
- Alabama
- Mississippi
- Maryland
- Delaware
- New Jersey

USACE Nationwide Permits 27, 54- Living Shorelines; Engineering with Nature
FWS Programmatic Biological Opinions, Section 6 Streamlined Permits
NMFS Programmatic Biological Opinions, Restoration Center NEPA
SWRCB General Order on Aquatic Restoration 401 cert- ***Riparian, Estuarine, Coastal***
CDFW Cutting Green Tape Initiative and Permit Program ***& potential CEQA exemption***
BCDC Beneficial BayFill for Habitat Amendment ***& Adapting to Rising Tides Joint Platform***

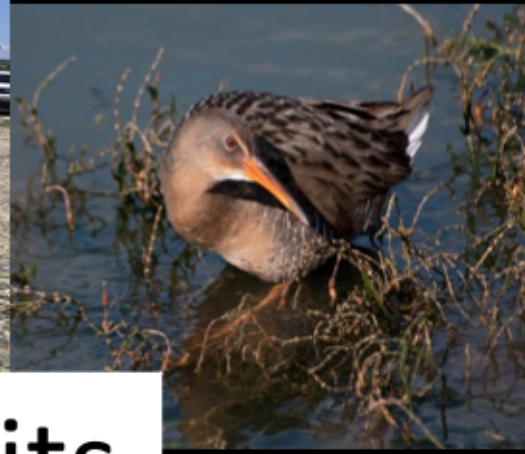












Multiple Co-Benefits

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






Threading the Needle

Innovation and Feasibility

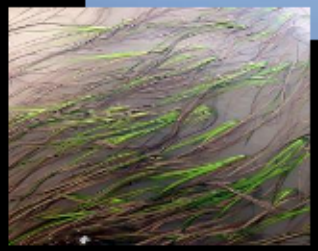
Barriers to Innovation:

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

Importance of Feasibility:

- Habitat and species
- Pilot projects – test
- Develop Best Management Practices
- Document success before scaling up
- Monitor long-term benefits and impacts

One Size Does Not Fit All



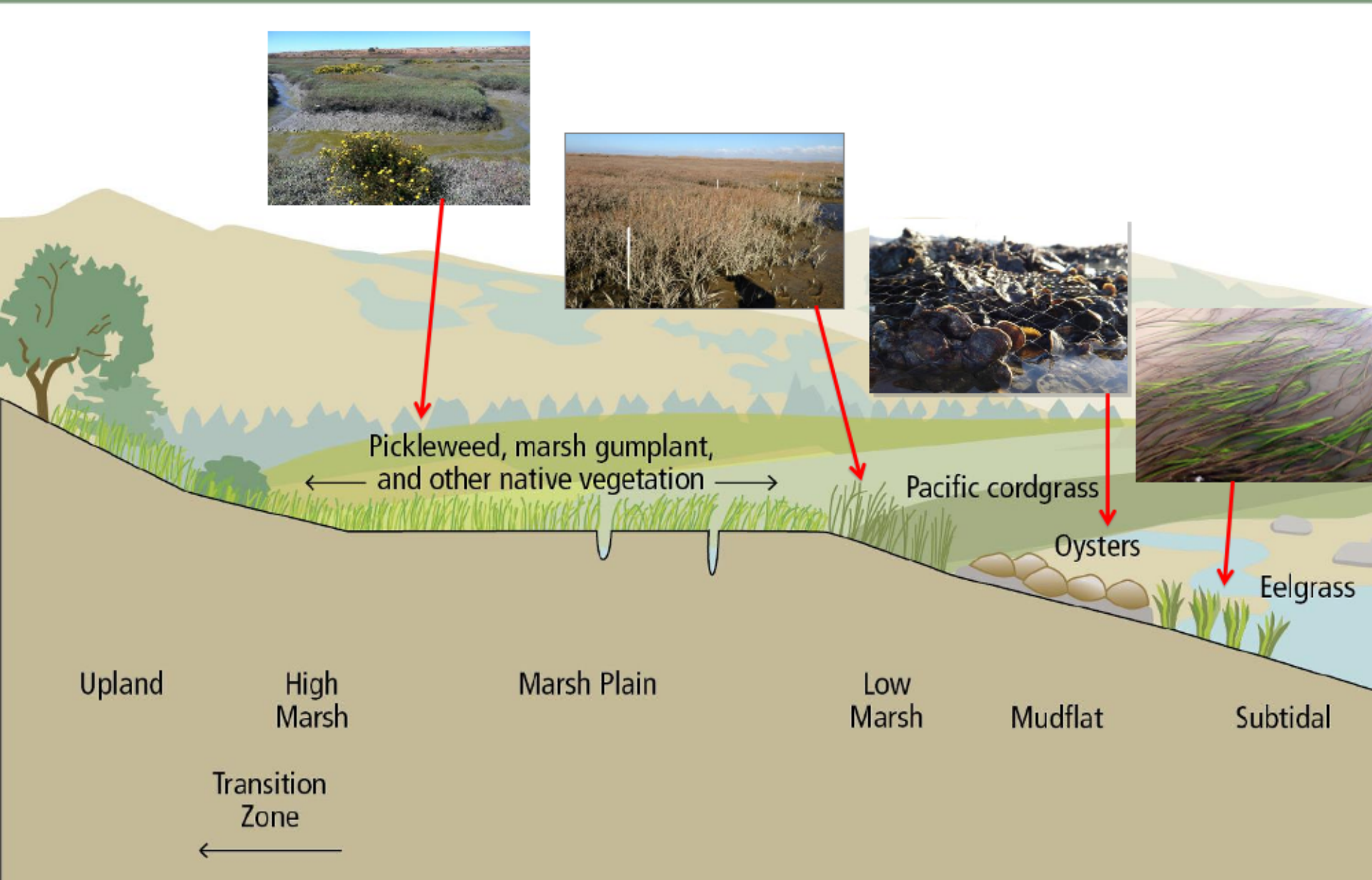
Design for specific conditions

- Substrate/ soil
- Shoreline type/slope
- Wave exposure
- Adjacent infrastructure

Local support

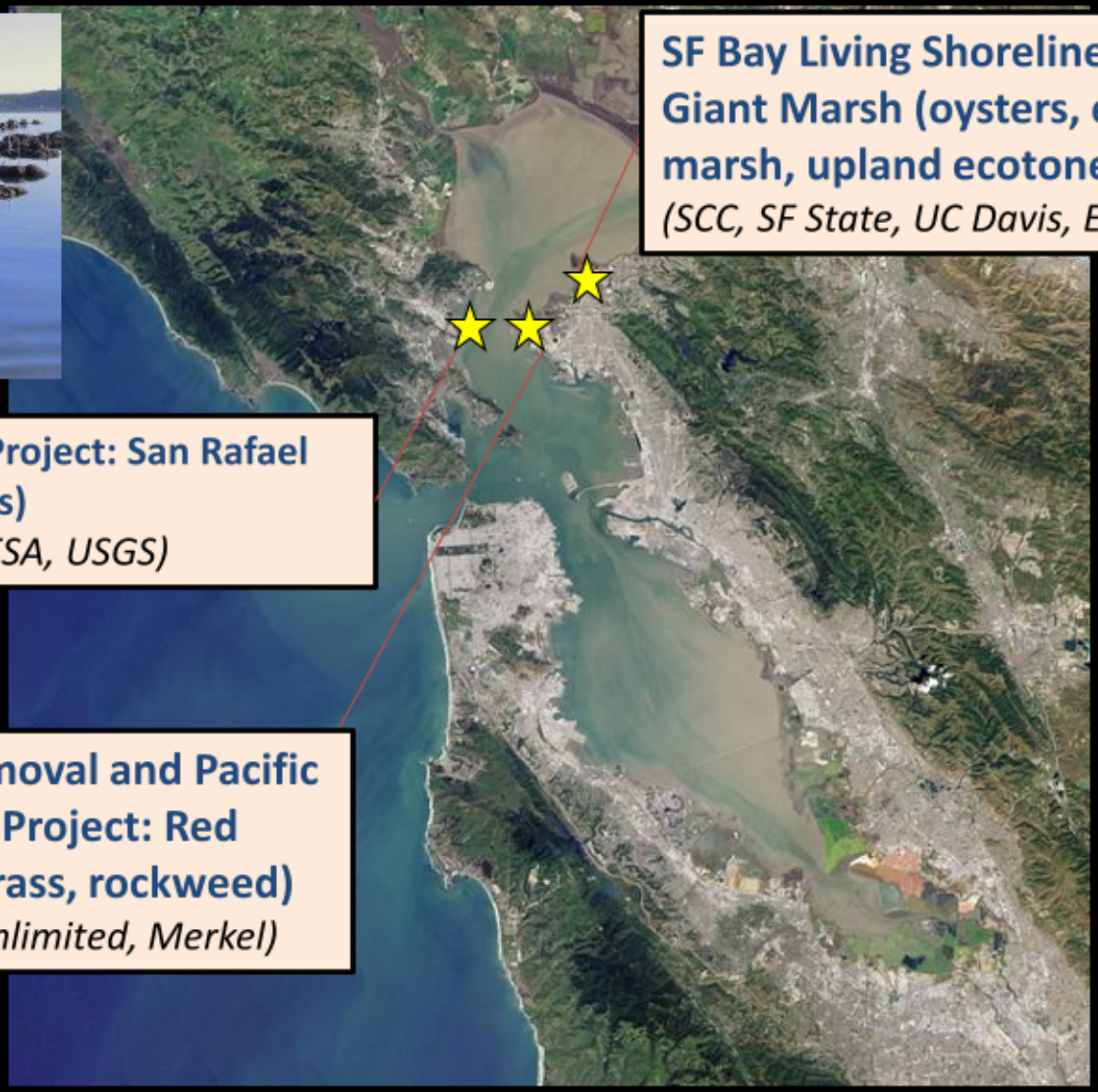
- Government willingness
- Community engagement

Restore COMPLETE SYSTEMS



Pilot Projects in San Francisco Bay

(Oyster Reefs, Eelgrass Beds, Tidal Marsh, Upland Ecotone)



SF Bay Living Shorelines Project: Giant Marsh (oysters, eelgrass, tidal marsh, upland ecotone)
(SCC, SF State, UC Davis, ESA, USGS, OEI)

SF Bay Living Shorelines Project: San Rafael (Olympia oysters, eelgrass)
(SCC, SF State, UC Davis, ESA, USGS)

SF Bay Creosote Removal and Pacific Herring Restoration Project: Red Rocks (oysters, eelgrass, rockweed)
(SCC, AECOM, Ducks Unlimited, Merkel)

Nature's Architects

Native Olympia Oysters and Eelgrass

- Food source for other invertebrates, birds, fish
- Reproductive and physical structure

Creosote Pilings and Pacific herring

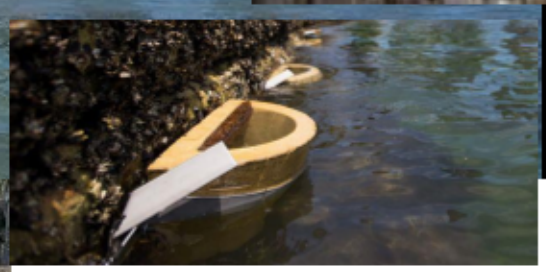
- More than 33,000 derelict pilings
- Toxic compounds and marine debris

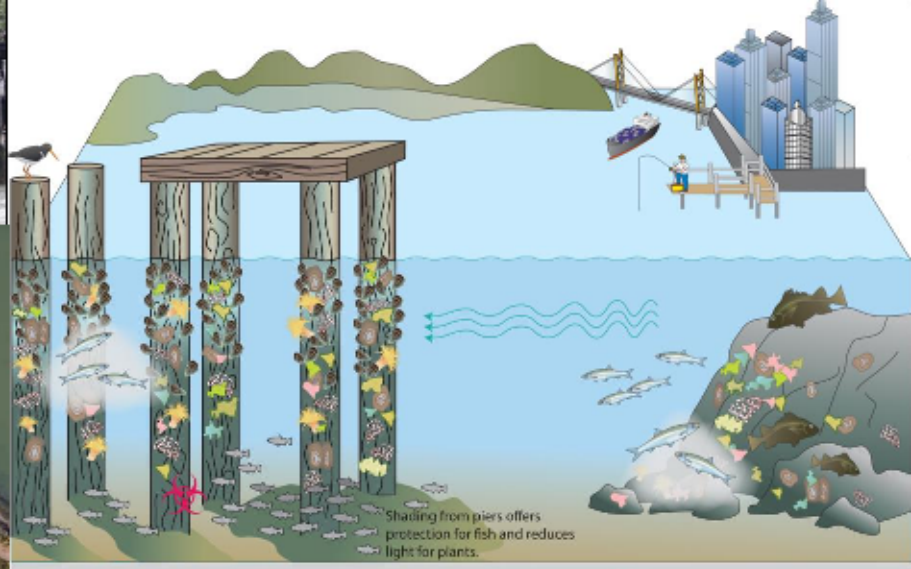
Pacific cordgrass and Marsh gumplant

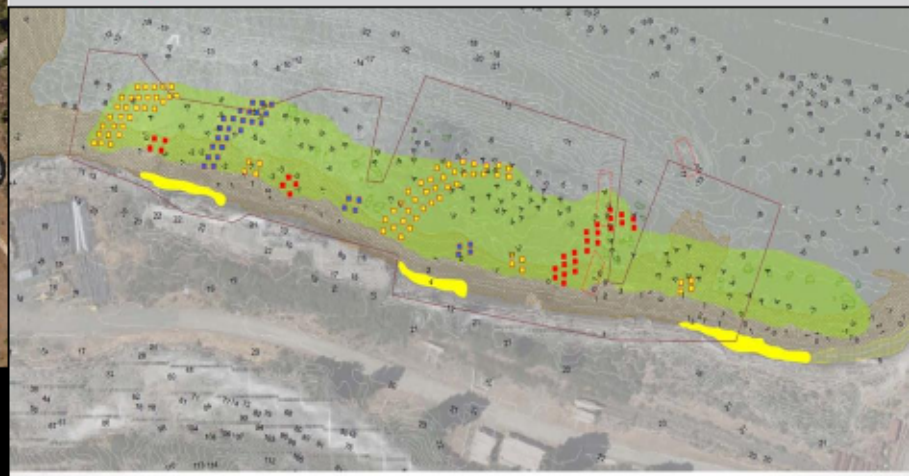
- Builds habitat, traps sediments
- Food chain- seed and detrital food resources

Living Seawalls- vertical methods

Global Harbour Project
City of Seattle Seawall
City of Miami Seawall
City of San Diego Breakwaters







- Pacific herring substrate
- Eelgrass Beds- main focus
- Oyster Reefs- protection
- Rockweed- experimental

- **Oyster treatments in multiple rows of 3**
- **Eelgrass plantings opportunistically throughout**
- **Fucus on shoreline**
- **Oriented to dampen wave and wake energy from vessels**

Site Specific Considerations

Existing Uses and Community Input

Parcel Ownership

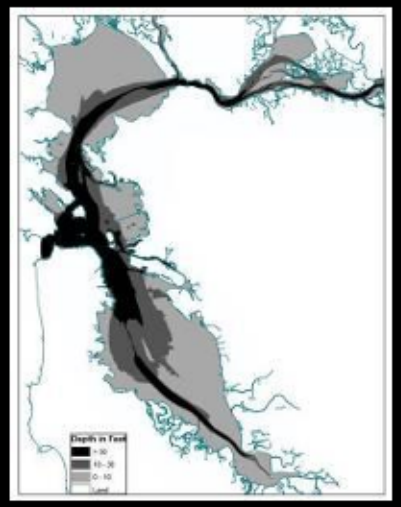
Bathymetry
- Depths for Habitat Restoration
- Depths for Access

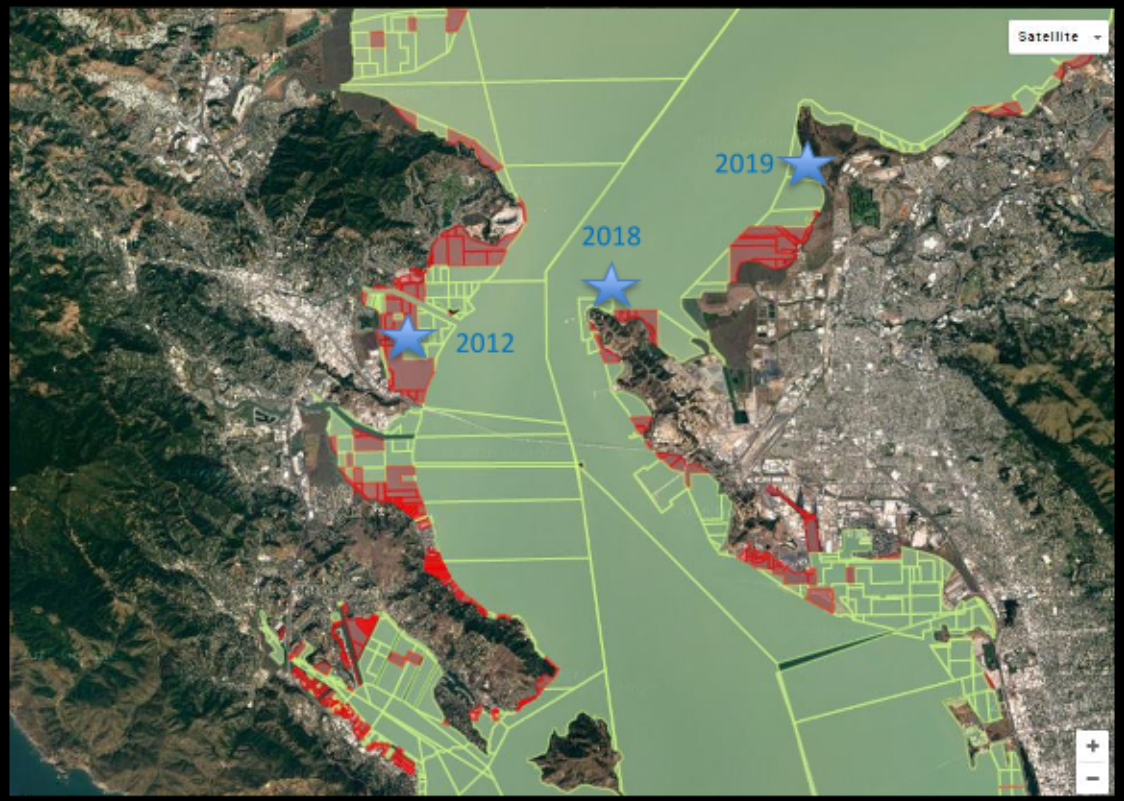
Orientation to Wind/Waves

Existing Species and Habitats

Sea Level Rise Modeling

Physical Space Required





Issues to Consider Thoughtfully

Beneficial Fill Justification

Materials

Construction Methods and Timing

Avoidance of Species Impacts

Native Pacific Cordgrass

Spartina foliosa

Why is Invasive Spartina a Problem?

Degrades Habitat and Reduces Biodiversity
Dominates mudflats and impacts shorebirds
Endangers native Pacific cordgrass
Reduces flood control capacity
Creates mosquito breeding areas
Causes failed tidal marsh restoration

2011-2021 Native Spartina/Ecotone Revegetation

Planted 500,000+ seedlings at 40+ sites

Constructed 82 high tide refuge islands at 18 sites –
MLK Shoreline, Hayward Shoreline, others

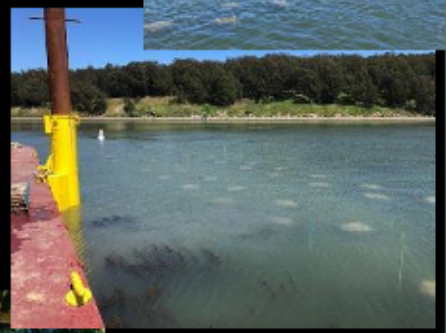
Winter 2021-22:

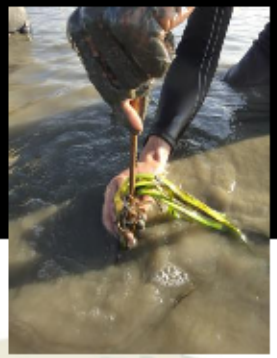
- 10 islands constructed Dumbarton Marsh and Bair Island
- 25,000 seedlings were installed at 10 sites
- Linked revegetation with Living Shorelines approach

Giant Marsh Living Shorelines Project – Point Pinole

Oysters, Eelgrass, Rockweed, Pacific Cordgrass, CA Seablite, Upland Ecotone

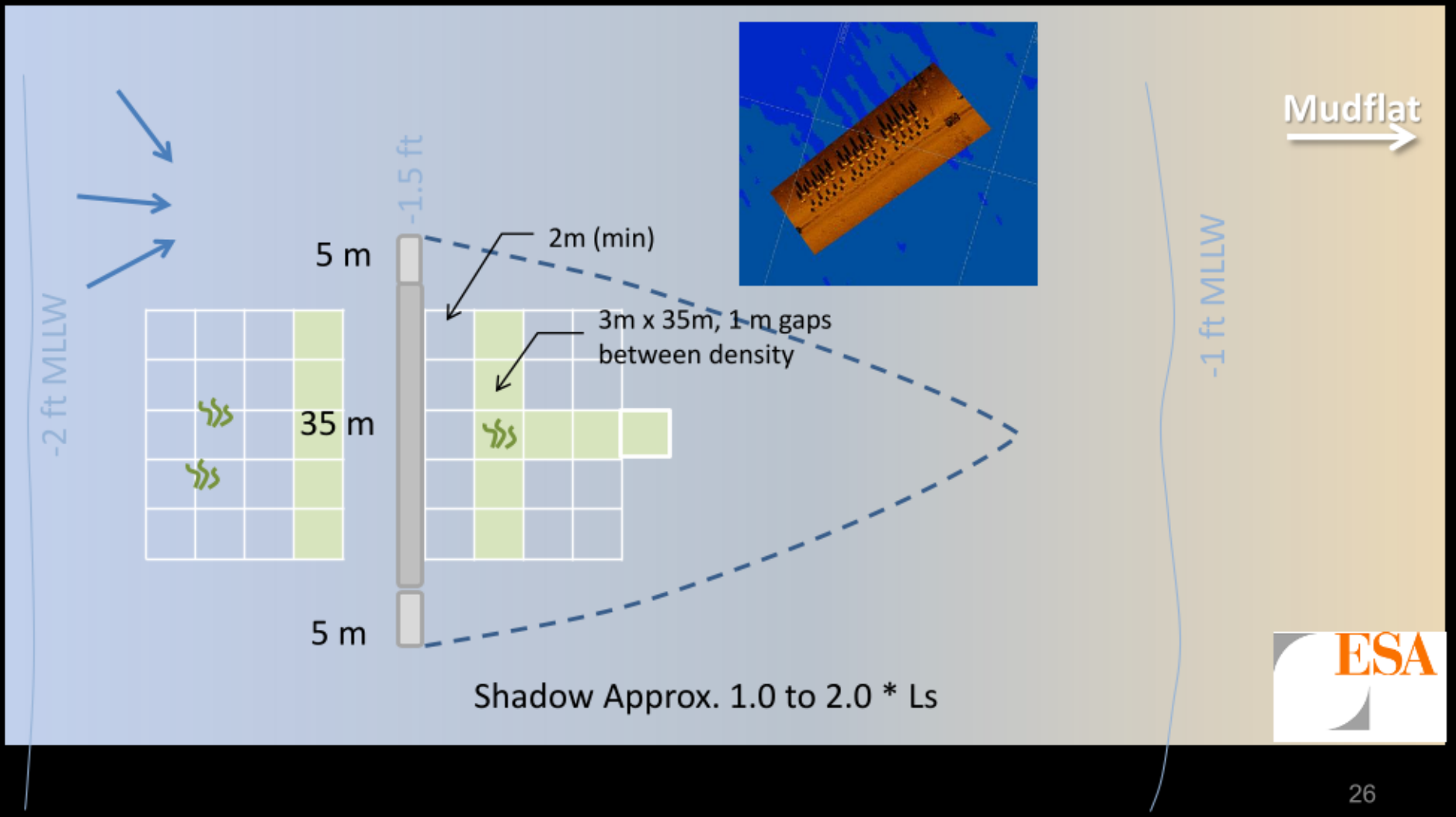
- Tidal marsh habitat
- Endangered Species
- High Marsh/ Ecotone
- High Tide Refugia





Wave modeling to inform design

Quantify wave shadow/area of oyster reef effect
Eelgrass offshore and inshore of oyster reefs
Cordgrass plantings with and without oyster reef protection



Green Jobs and Job Training







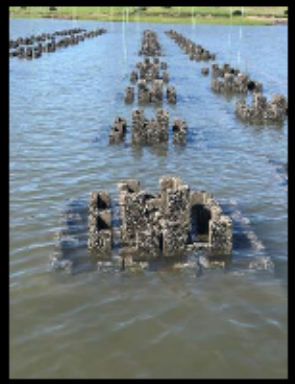


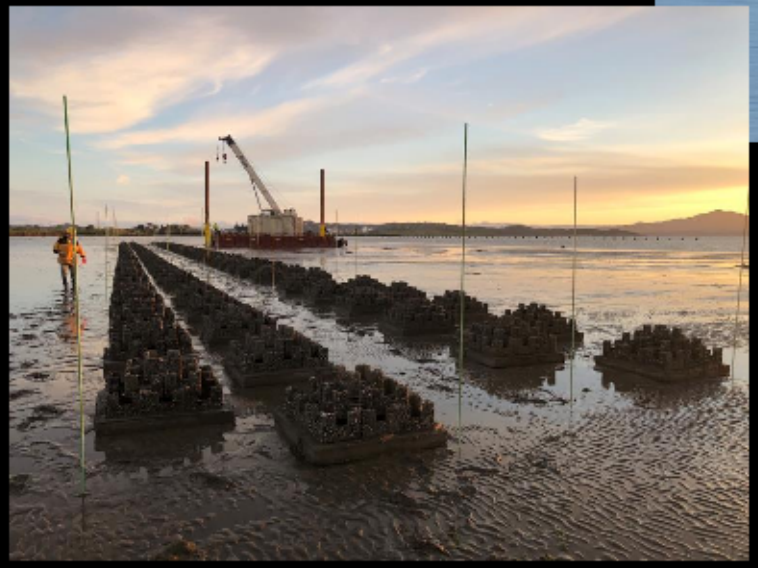
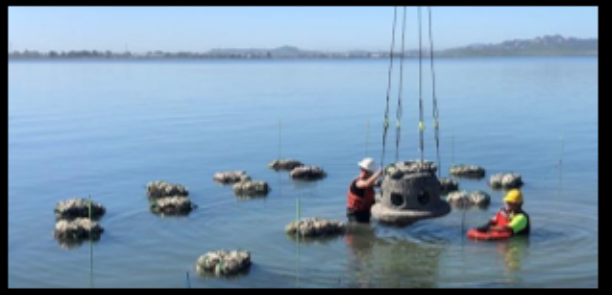
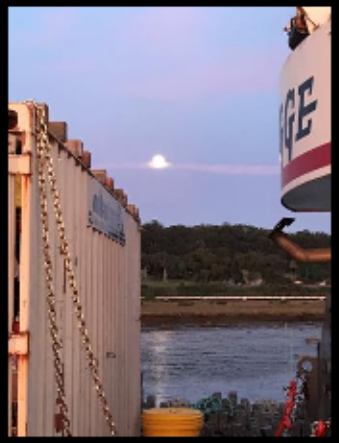




Local Contractors and Equipment








Permitting Multi-Habitat Projects





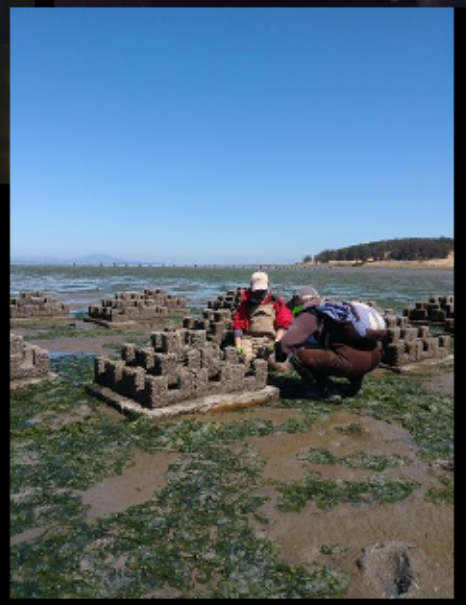







Monitoring is Critical to Building Proof of Concept

- Eelgrass, Oyster, Revegetation success
- Invertebrates- benthic and on reefs
- Fish- traps, seining, acoustic imaging
- Birds- shorebirds and waterfowl
- Physical-
  - bathymetry
  - sediment accretion and erosion
  - reef elements
  - water quality
  - wave attenuation



Habitat and Benefits to Birds, Fish, Wildlife

Physical Shoreline Benefits

Reduce Wave Energy ~30%

Sedimentation, reductions in erosion

Collaborative Partnerships

Communities, Technology, and Science

Regionally Advancing Living Shorelines

Goals:

COLLABORATE

DESIGN ACROSS OLU'S

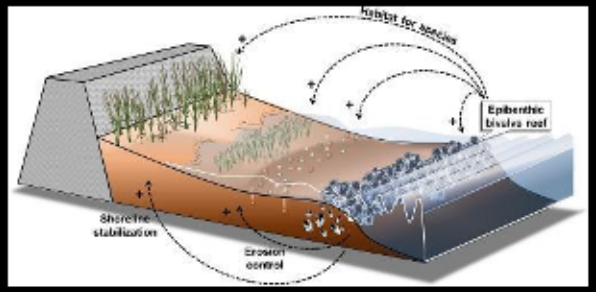
SCALE UP AND BUILD ADAPTATION FASTER

TRANSFER AND SHARE KNOWLEDGE

Tasks:

- Pilot Site and Baseline Data Collection
- Regional Design/Constructability Guidance
- Living Shorelines Collaborative
- Develop 30-60% Designs at 10 sites
- Programmatic Permit Approach
- Local Engagement/ Workforce Trainings

Designing for the Future



Allow for habitat connectivity- above and below
Use nature-based and hybrid approaches
Experiment and Innovate
Encourage local labor and involvement
Coordinate with adjacent landowners

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